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ARIZONA DEPARTMENT OF MINES AND MINERAL RESOURCES AZMILS DATA

PRIMARY NAME: SAN MANUEL COPPER MINE

ALTERNATE NAMES:
APEX LEAD VANADIUM MNG. CORP.
QUARELLI GROUP
MAGMA COPPER CO. PROP.
BHP COPPER SAN MANUEL MINE

PINAL COUNTY MILS NUMBER: 577A

LOCATION: TOWNSHIP 8 S RANGE 16 E SECTION 34 QUARTER NE
LATITUDE: N 32DEG 41MIN 46SEC LONGITUDE: W 110DEG 41MIN 21SEC
TOPO MAP NAME: MAMMOTH - 7.5 MIN

CURRENT STATUS: PRODUCER

COMMODITY:
COPPER SULFIDE
COPPER OXIDE
MOLYBDENUM
GOLD
SILVER
TITANIUM RUTILE

BIBLIOGRAPHY:
ADMMR SAN MANUEL COPPER MINE FILE
ADMMR ST. ANTHONY MIN. AND DEV. CO FILE
CREASEY, S. "GEOL. OF SAN MANUEL AREA" P 471
CHAPMAN, T.L. "SAN MANUEL COPPER DPSTS" USBM RI 4108; 1947
MYRICK, D.F. "RAILROADS OF AZ." VOL. II, P726
ADMMR "U" FILE
PANEK, L.A. - USBM RI 9049
DAVIS, E.G. "POTENTIAL FOR RECOVERY OF RUTILE AND OTHER BYPRODUCTS FROM WESTERN COPPER TAILINGS" USBM RI 9158

ARIZONA DEPARTMENT OF MINERAL RESOURCES
Mineral Building, Fairgrounds
Phoenix, Arizona

1. Information from: Personal Visit

   Address:

2. Mine: San Manuel 3. No. of Claims - Patented

   Unpatented

4. Location: (Mine) Red Hill

5. Sec 34 Tp 8S Range 16E 6. Mining District Old Hat

7. Owner: Magma Copper Co.

8. Address: Box "M" San Manuel

9. Operating Co.: Same

10. Address:

11. President: W. P. Goss 12. Gen. Mgr.: John Wise

13. Principal Metals: Copper 14. No. Employed: See Active Mine List

15. Mill, Type & Capacity:

16. Present Operations: (a) Down ☐ (b) Assessment work ☐ (c) Exploration ☐
    (d) Production ☒ (e) Rate 40,000 tpd.

17. New Work Planned: Work in the two new shafts is continuing.
    All so work on the smelter, mill and refinery additions.

18. Miscl. Notes: John Wise, announced the promotion of E.K. Staley to Mine Manager.
    L. C. Acton# Mine supt, and several others.

    See San Manuel Miner Vol. 16 No. 17 Thursday April 30 1970

Date: 4-30-70 H W Lum.
(Signature) (Field Engineer)

ARIZONA DEPARTMENT OF MINERAL RESOURCES
Mineral Building, Fairgrounds
Phoenix, Arizona

1. Information from: High Steele + personal visit
   Address: San Manuel
2. Mine: San Manuel
3. No. of Claims - Patented ?
   Unpatented
4. Location: Near old town of Tiger
5. Sec 34 - 35 Tp T 8 S Range 16 E
6. Mining District
7. Owner: Magma Copper Co
8. Address: San Manuel
9. Operating Co.: Same
10. Address:
11. President:
12. Gen. Mgr.:
13. Principal Metals: Cu Mo
14. No. Employed:
15. Mill, Type & Capacity:
16. Present Operations: (a) Down ☐ (b) Assessment work ☐ (c) Exploration ☐
    (d) Production ☒ (e) Rate 40,000 tpd.
17. New Work Planned: Sinking Two new shafts near present muck shaft. New Stack for smelter additions to be built.
18. Miscl. Notes:

Date: 4-24-69

(Signature)

(Field Engineer)

ARIZONA DEPARTMENT OF MINERAL RESOURCES
Mineral Building, Fairgrounds
Phoenix, Arizona

1. Information from: Hugh Steele & Frank Hoagland. & visit

   Address: Drawer M San Manuel

2. Mine: San Manuel 3. No. of Claims - Patented ?

   Unpatented

4. Location:

5. Sec # Tp 8&9S Range 16E 6. Mining District Old Hat, Tiger, San Manuel Mammoth.

7. Owner: San Manuel Copper Corp. 80% owned by Newmont.

8. Address: Drawer "M"

9. Operating Co.: San Manuel

10. Address: Drawer "M" San Manuel

11. President: W. Goss 12. Gen. Mgr.: John F. Wise

13. Principal Metals: Cu Copper 14. No. Employed: 2017

15. Mill, Type & Capacity:

16. Present Operations: (a) Down ☐ (b) Assessment work ☐ (c) Exploration ☐
    (d) Production ☒ (e) Rate 41,000 tpd.

17. New Work Planned: 41,000
    CEMENTATION Co. has about 200 men employed sinking two new shafts.

18. Miscl. Notes:

Date: 1-30-69

(Signature) (Field Engineer)

DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
FIELD ENGINEERS REPORT

Mine Magma Limestone Quarry (San Manuel Division) Date May 18, 1961

District San Pedro District, Pinal Co. Engineer Lewis A. Smith

Subject: Quarry Visit

Location: NW¼ Sec. 8, T. 7 S., R. 16 E. (2 miles southwest of Feldman).

The quarry now has three benches about 40 feet high, the longest of which is about 500 feet, and the shortest or top bench is 200 feet. The limestone is of Carboniferous age and outcrops in a narrow belt which trends N 45°W. The belt is about 2 miles long and about 1/4 mile wide. It is underlain by the Apache formation which in turn overlies granite and schist. The region is known as the Block Hills because it is largely composed of several block faults. The entire borders of the block are Gila Conglomerate or later gravel and lake deposits. A diabasic sill splits the Apache Formation block into two relatively narrow bands. The Apache locally is underlain by schist at 2 miles west of the quarry. The sediments dip roughly to the NE.

The quarry is situated in the southeast tip of the Carboniferous band. Expansion of the pit is being developed to the northwest. A good haulage road connects the quarry with Highway 77 or the San Manuel Arizona R.R.

Preliminary Report on the evaluation and extraction of the values from the old Tiger mill tailings at Mammoth, Ariz.

It is estimated that the old dump contains 200,000 tons arrived at by boring and assaying the cores of 38 auger holes on 100 foot grids. The overall average is as follows:

Metal present	Assays % or ounces		Assay values contained in dollars & cents per ton
Lead	0.83	@ 14¢ per pound	$ 2.32
Molybdenum	0.15	@ $1.30 "	3.90
Copper	0.15	@ 26¢ "	0.78
Tungsten	0.03	@ $1.00 "	0.60
Gold	0.04	@ $35.00 per oz.	1.40
Silver	0.03	@ $.90 " "	0.27
TOTAL VALUE			$ 9.27

Proven recovery 77.98 per cent on the Molybdenum and Lead in the mill by gravity and flotation. Proven total recovery in the mill and the chemical plant on all values listed 58.33 per cent.

Estimate of costs on tonnage basis:

Handling of mill feeds	$ 0.25
Water development & maintenance for mill	0.10
Power for complete milling plant	0.10
Flotation maintenance labor included	0.25
Flotation reagents	0.46
Gravity concentration labor included	0.25
Tailings disposal	0.10
Erection of mill to treat 250 tons per day	0.15
Insurance and supervision	0.10
	$ 1.76
Added ten percent for unknowns	0.18
TOTAL ESTIMATED MILLING COST PER TON	$ 1.94

Chemical treatment per ton of mill heads; this includes plant erection, labor, operating costs, and a profit if it is desired to keep it a separate business $ 2.00
TOTAL ESTIMATED COST OF EXTRACTION $ 3.94 per ton

Proven recovery of total values of 58.33%	$ 5.41
Estimated cost of recovery	3.94
ESTIMATED PROFIT PER TON OF FEEDS OR HEADS	$ 1.47

From all indications from experiments and figures of no importance here I am more than confident that a total overall recovery of values contained can be raised to exceed 85 per cent. As the case usually is in practice, experience is gained and the first estimate is exceedingly low. Also I am confident that these cost estimates will prove to be somewhat lower when operation is actually entered into, as cuts can be applied in many ways that are not considered in an estimate of this nature.

Figuring on the basis of an 85 per cent recovery, the total recoverable value is $7.78. Deducting operating cost of $3.94, the net profit is increased to $3.84; and I am confident that costs can be lessened to increase the net profit to exceed $4.00 per ton.

Respectfully presented this 2nd day of October, 1957.

signed
CharlesWalter
Chemical & Metallurgical Consultant
Lordsburg, New Mexico

A. J. Marcatte
Box 52
Klondyke Arizona

THE STORY OF SAN MANUEL *

The San Manuel Copper Corporation holdings are located in southeast Pinal County, Arizona, about 45 miles northeast of Tucson. The concentrator, smelter, administration building, and other plant facilities are located some seven miles southeast of the mine area at the new town of San Manuel.

HISTORY

The district was prospected prior to the Civil War, but there was little or no production until 1881. Until the advent of the San Manuel mine, the chief producers were the Mammoth and Mohawk mines, located a mile farther north. Gold, lead, zinc, and some vanadium and molybdenum were the main recoverable metals at these properties.

In the San Manuel group there are claims located in 1906 that have been held continuously to the present time, and at least two exploratory churn drill holes were drilled in or near the ore zone in 1917. The copper content indicated by these holes was not sufficient to encourage further exploration at that time.

In 1942, through the efforts of the owners, James M. Douglas, R. B. Giffin, Victor Erickson, and Henry W. Nichols, all of Superior, Arizona, the Reconstruction Finance Corporation and War Production Board authorized the United States Geological Survey to investigate the property. The Survey confirmed the owners' original conception of the probable existence of important copper mineralization, and by its recommendation the Bureau of Mines was authorized to put down a limited number of churn drill holes. This test drilling started in November, 1943, and was continued by the Bureau until February, 1945, when seventeen holes had been drilled for a total of 15,844 feet.

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* The information in this story was obtained from the brochure published by the San Manuel Copper Corporation.

Magma Copper Company obtained an option from the owners in 1944 to buy the property. On September 17, 1944, Magma exercised its purchase option, and purchased additional adjoining claims held by the Apex Load Vanadium Mining Corporation and the Quarelli family, and located additional claims. In December of that same year, Magma commenced exploration by churn drilling.

The San Manuel Copper Corporation was incorporated in August, 1945, and all of the property acquired by Magma Copper Company in the district was deeded to San Manuel.

Exploratory churn drilling was essentially completed in early 1948. A total of 205,536 feet of drilling was done to prove an ore reserve of 367,624,000 tons of sulphide ore, averaging 0.785% copper. There is an additional 111,876,000 tons of oxidized ore averaging 0.717% copper, or a total reserve of 479,500,000 tons averaging 0.769% copper.

Underground exploration and development was started in March, 1948, and has progressed continuously. Up to the present time there have been five shafts sunk and over 20 miles of drifting completed to prepare the first lift for production.

On July 10, 1952, Reconstruction Finance Corporation authorized a loan of $94,000,000 to San Manuel for mine development and plant construction.

In the early part of 1953, Utah Construction Company and The Stearns-Roger Manufacturing Company (a Joint Venture) was awarded a contract for the design and construction of the entire surface plant, including the concentrator, smelter, railroads, and auxiliaries. Principal sub-contractors were San Xavier Rock and Sand Company, which furnished the concrete, Newbery Electric Corporation, which installed the electric control and transmission system and Custodis Construction Company, which erected the stack.

The concentrator was completed in September, 1955, and trial runs on stockpiled ore and mine development ore were started. By the end of 1955, Plant

construction was completed except for minor cleanup work and smelting of copper concentrate was started January 8, 1956. January 23, 1956, the Mine was in production with the first stope undercut completed.

To provide adequate permanent housing facilities for the construction period, as well as the future productive life of the mine, an agreement was made with the Del E. Webb Construction Company and M. O. W. Homes, Inc., under which they were to finance and build a town suitable for the accommodation of San Manuel's employees.

Active construction was started in mid-1953, and by late 1954 the town of San Manuel was completed to its present status of 1,000 homes, shopping facilities, and hospital.

Magma Copper Company acquired the town early in 1955.

SAN MANUEL OREBODY AND METHOD OF MINING

The San Manuel orebody is part of a mass of mineralized rock, chiefly a granitic appearing monzonite and a similar, though finer textured monzonite porphry. This large zone of mineralization is covered for the most part by conglomerate, a younger rock containing no copper. The orebody, or portion of the general mineralized mass containing appreciable copper sulphide minerals in addition to iron sulphides, covers an area over one mile long by one-half mile wide. The known depth of ore extends about 2,600 feet below the surface. The control as to size and shape of the orebody is an arbitrary cutoff based on copper content of the mineralized rock. Therefore, that portion considered economically feasible to mine appears in the more northerly portion as a tabular mass up to 400 feet thick with its long dimension bearing northeast and lying at an angle of 55° from horizontal to the southeast. This attitude persists down dip for about 2,400 feet where it flattens and then rolls upward to form a cross-sectional fishhook shape. Within this part of the orebody there is a pronounced

thickening, and it is the upper one-third of this southeast portion, starting some 1,100 feet below the surface, that was selected for initial mining operations. Of this 1,100 foot thickness from the first mining level to the surface, there is an average of about 430 feet of ore and 670 feet of waste over-burden.

The thickness of the overburden and shape and size of the orebody combine to make open pit mining impractical. For these reasons the underground block caving method of mining was selected. The monzonite in which the ore occurs is well fractured, caves readily and crushes to a size that is easy to transport.

The area to be mined has been divided into panels 210 feet wide, separated by 35-foot pillars. The blocks or stopes within each panel vary in length from 175 feet to 270 feet.

Block caving entails the undercutting or removal of a horizontal slice of ore of sufficient area (stope block) so that the unbroken ore above will not support itself, but will cave and slough into the undercut. As the broken ore is drawn off, thereby removing support from the ore above, caving progresses upward. As drawing continues, caving extends to the surface, the overburden or waste rock following the ore down. When the waste rock reaches the undercut horizon, drawing is stopped and the stope block is finished.

The underground track for the haulage system is 36 inch gauge with 70-pound rail through the panels. On the main lines between the mining area and the hoisting shaft, 90-pound rail is used to accomodate the heavy traffic and higher speeds. The ore cars in this haulage system have a capacity of about 12.5 tons, and each train is made up of 15 to 18 cars, pulled by a 23-ton, 250HP trolley locomotive.

At the two ore hoisting shafts on the 1,475 haulage level the trains pass through a rotary tripple which dumps three cars at a time into a 1,500 ton pocket or underground storage bin adjacent to the shaft.

The bottom-dump ore-skips, which hold 18 tons of ore, are hoisted to the surface and discharged into a 5,000-ton surface storage bin for transportation to the Plant.

Oxidized ore for smelter silica flux requirements is being mined by a small open pit operation on the orebody outcrop. Limestone and high grade silica for metallurgical use is mined from quarry sites along the San Manuel Arizona Railroad about 17 miles north of the Plant. These products are hauled to the flux crushing plant by rail in 50-ton bottom-dump cars.

THE SAN MANUEL MILL

Ore transportation from the Mine to the Plant is by rail shuttle service in 100-ton capacity bottom-dump railroad cars. The 35 to 40-car train is pulled by a 1,600 HP, 125-ton diesel electric locomotive. The seven mile ore transportation track is standard gauge, 132-pound rail, and was constructed with liberal curves and no grades.

A 10,000-ton coarse ore receiving bin feeds two seven-foot standard Symons cone crushers at the rate of 1,000 tons per hour to each crusher. The crushed ore from the two primary crushers is conveyed and distributed to four secondary seven-foot Symons cone crushers, each preceded by mechanical screens to by-pass the undersize material.

The final product from the crushing plant, all less than one inch in diameter, is conveyed by belt conveyor to discharge on the 54-inch belt conveyor, carrying the crushed ore at the rate of 2,000 tons per hour up to the 45,000-ton capacity fine ore bin in the concentrator.

The ore is drawn from underneath the fine ore bins by belt conveyors onto a gathering conveyor which feeds each rod mill at the rate of 4,000 tons per day. A weightometer both registers and controls tonnage to the rod-mills. Water is first added at the rod mill feed to start the wet grinding.

The concentrator is divided into eight sections and each section consists of one 10-foot by 13-foot rod mill and two 10-foot by 10-foot ball mills; each ball mill operates in closed circuit with a 16-foot by 35-foot drag classifier in which the ore ground to the specified size overflows to the flotation section.

The wet grinding bay is serviced by a 175-ton crane, which is capable of taking out a fully charged rod or ball mill for repairs. A 10-ton crane serves for lighter, faster service.

The classifier overflow goes to distribution boxes where, with reagents added, it is distributed to 48-inch rougher flotation cells. There is a total of 480 of these mechanical flotation machines. The concentrate is floated from the surface, and the tailings are piped by gravity to the tailings thickeners where approximately 12,000 g.p.m. of reclaimed overflow water is returned to the mill. The thickened underflow is piped to the tailings pond.

The concentrate is pumped from the rougher flotation cells through cone classifiers in closed circuit with four 8-foot by 12-foot regrind ball mills. The reground concentrate is distributed to 144 48-inch cleaner flotation cells. The tailings from this regrind section are returned to the mill circuit, and the final copper concentrate, averaging about 28% copper, is pumped to the molybdenum thickener with the thickened concentrate going to the molybdenum plant.

Molybdenum is recovered from the concentrate through another series of flotation cells, after which the concentrate is pumped into a final thickener, then filtered, dried, and conveyed by belt conveyor to the concentrate bins.

THE SAN MANUEL SMELTER

The copper concentrate, amounting to approximately 750 tons per day, averages about 28% copper. The concentrate is drawn from the storage bins in the smelter building by conveyor belts and is fed to the 32-foot by 100-foot reverberatory furnace through hoppers located along each sidewall of the furnace. The concentrate

is smelted in the furnace at a temperature of approximately 2700°F, using natural gas for fuel.

All gases from the reverberatory furnace and the converters pass through an electric precipitator prior to entering the 500-foot high stack. Practically all the small particles of solid matter are removed from the smoke. This dust has a high copper content and is returned to the reverberatory furnace.

When the charge is smelted the furnace wall is tapped for slag which is allowed to run into railroad car slag pots of 200-cubic foot capacity. The slag pots are then hauled to the slag dump. After the slag is skimmed off, the matte, which is chiefly copper, sulphur and iron, is tapped into 200-cubic foot ladles and poured into the 13-foot by 30-foot Pierce-Smith type converters. There are three converters in the smelter, and two 60-ton overhead cranes handle the ladles.

After the matte has been poured into the converters, a flux with a high silica content is added. This flux, with the iron, forms a slag which is skimmed off and returned to the reverberatory furnace. The molten copper is transferred by ladle into the holding furnace.

In the holding furnace the oxygen is burned off by the burning of wooden poles. The copper is poured into anode moulds located on a 34-foot diameter casting wheel. The finished anode slabs, weighing 700 pounds each, are cooled in water in a bosh tank. The anodes are then removed by overhead crane and stacked on the storage floor where they are later inspected and loaded on flat cars for shipment to the electrolytic refinery.

MISCELLANEOUS FACILITIES

The flux plant is between the smelter and concentrator buildings and includes receiving bins and crushers for handling limestone and silica flux. A lime kiln for calcining limestone and a slaker have been built to provide metallurgical lime for the concentrator.

Other Plant facilities include a machine shop with locomotive service and repair pit, carpenter and auto shops, warehouse, time office and change house.

The San Manuel Arizona Railroad Company operates 30 miles of standard gauge railroad from the Plant to connect with the Southern Pacific at Hayden. Current timber and other operating supplies are being brought in. All of the anode copper is transported by rail.

REPORT OF FIRST YEAR'S OPERATIONS (1956) *

5,496,328 tons of sulphide ore assaying 0.77 percent copper were produced and milled at the San Manuel Mine during the year. In addition 43,253 tons of oxide ore assaying 0.7 percent copper were mined from the surface pit for smelter flux. 17,523 tons of limestone and 11,179 tons of silica were quarried for smelter and concentrator requirements.

Net Metal Production (1956):

Copper	Molybdenum Sulphide	Silver	Gold
78,152,140 lbs.	591,970 lbs.	136,074 ozs.	9,719 ozs.

There are presently approximately 2,200 employees at San Manuel. To reach full production, which is planned for the middle of 1957, about 150 additional employees will be needed. Considerable development work has been done and must continue to be done to prepare the ore body for orderly and continuous long term mining operations. Such development work now planned for the second level will require substantial expenditures over the next six years and these deferred or prepaid development costs will be written off as the ore so developed is mined in future years.

San Manuel's total capital expenditures to the end of 1956, including railroad, but excluding the townsite, were $102,589,445, being $1,150,847 for property, $27,701,948 for deferred development and $73,736,650 for plant. Of this total, $88,587,000 were expended on the production "Project" which commenced January 1, 1952 and has now been substantially completed.

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* From 1956 Annual Report.

San Manuel, under its original $94,000,000 Government loan authorization obtained in 1952 to carry on its production "project", to date has borrowed $70,754,137. It also has borrowed from Magma Copper Company $27,595,000. The Government, by agreement with San Manuel, has extended to May 10, 1957 the time within which a final disbursement of loan funds may be made and has reduced to $6,000,000 the maximum amount which hereafter may be disbursed under the loan authorization.

The guiding genius of this tremendous undertaking has been Wesley P. Goss, the president of the Company, and in his 1956 annual report to the stockholders he gives special commendation to the operating staff for their "notable accomplishment in attaining a rate of mine production in excess of 580,000 tons of ore per month within nine months after undercutting the first stope and starting production in January, 1956. This is an achievement believed never before equalled in the history of underground mining".

The "Story of San Manuel" has been a prime example of the conversion of a mountain of worthless rock into indestructible copper metal.

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EXPLORATION AND DEVELOPMENT OF THE SAN MANUEL ORE BODY*

By Wesley P. Goss, Gen. Mgr.
Magma Copper Co.
Superior, Arizona

The early history of the San Manuel mine, the principal geologic features of the deposit, the methods of drilling and sampling, and some of the results of the drilling and sampling have been ably described in previous reports, namely Bureau of Mines Report of Investigations 4108; a paper entitled "San Manuel Prospect" by H. J. Steele and G. R. Rubly given before the Arizona Section, A.I.M.E. at Tucson, Arizona, October, 1946; and a talk given by Philip Kraft at a meeting of the New York Section, A.I.M.E. in March, 1948.

The San Manuel property is in the Old Hat mining district about 45 miles north of Tucson, Arizona. The town of Mammoth about 3 miles further north is one of the oldest towns in Arizona and has been the center of mining activity off and on for over 75 years. The old stage road from Tucson to Globe, as well as the present State highway 77, crosses the property over the ore body.

A prominent hill of monzonite, stained red with iron oxide, attracted early prospectors to the property but shallow prospecting and two churn drill holes put down in 1915 failed to discover anything of economic interest. Most of the area surrounding the red hill is covered with a layer of conglomerate. Two small outcrops of copper silicate stained monzonite lie at the base of the hill. The largest of these outcrops covers less than two acres in a triangular shaped patch.

J. M. Douglas, R. B. Giffin, V. Erickson and H. W. Nichols were owners of a group of claims covering the San Manuel property. In 1942 they applied to the R.F.C. for a development loan and the U.S.G.S. was requested to examine the property, which they did. The Survey recommended that the United States Bureau of Mines test the ground and early in 1943 the Bureau decided to put down some churn drill holes in the outcrop and through the surrounding conglomerate to determine the value and extent of the copper mineralization. I believe that Dr. B. S. Butler of the United States Geological Survey who was then head of the Department of Geology at the University of Arizona, was instrumental in convincing the Bureau that an important and valuable body of copper ore might exist under the conglomerate cover.

The U.S.G.S. mapped the area and the Bureau of Mines drilled a few shallow holes starting in November, 1943. A coordinate grid system was laid out on 200-foot centers to conform to the estimated axis of the ore body. The preliminary drilling showed that the ore body did extend under the conglomerate and that it continued in depth beyond 350 feet which was the deepest hole drilled. The Bureau secured additional funds and continued drilling.

The Magma Copper Company became interested in the property and upon the recommendation of Dr. John Gustafson, who was engaged in geological work for the

* Presented at the 1948 Metal Mining Convention, Western Division, The American Mining Congress, San Francisco, California, September 20-23.

Magma Copper Company at the time, Magma secured an option to purchase the property in August, 1944. Magma also took options on some adjacent claims and located other claims on surrounding open ground. In September, 1945, Magma exercised its option and formed the San Manuel Copper Corporation to carry on exploration and development of the property.

The Bureau of Mines Engineers decided before they started exploration that churn drilling was the most practical method of obtaining samples in this area. They did not think diamond drills would core unless a large diameter core such as 3 inches or more was cut. This would have been very expensive sampling. When we took over the property our engineers agreed with the Bureau that diamond drilling was impractical so churn drilling was continued. Later on one of our neighbors, who was drilling in search of an extension of our ore body, introduced diamond drills. Our observation of their drilling convinced us that churn drilling was better suited for sampling this particular formation. Core samples would have been very desirable to have so we attempted to cut core with a rotary rig brought in from California. It was a good rig and was operated by an efficient crew. The hole was put down 1000 feet before coring was started. The hole was continued to 1650 feet with core cutting bits but less than 10% core was recovered. The hole was 9" in diameter and the core 3 5/8" in diameter. The ore is interlaced with numerous fractures in all directions. The core broke on these fracture planes while in the core barrel and then it was ground to powder by the rotation of the drill and little or nothing remained in the barrel. After this attempt we gave up trying to obtain a core.

Drilling started in the shallower part of the ore body where only a few holes were drilled deeper than 1500 feet. Most of these holes were collared with an 8-inch bit and finished with a 6-inch bit. Both the conglomerate and the monzonite proved to be tight, compact rock so that casing was seldom needed. When drilling was extended over an area where the over-burden and ore was deeper only a few holes were less than 2000 feet and several were over 2700 feet with the deepest 2850 feet. These deeper holes were started with 12¼-inch diameter bits and casing was generally necessary. Most of the casing was recovered for re-use and I believe the loss did not average quite 10%.

We made no attempt to specify the type of drilling rig or equipment to be used. We described the work to be done and the contractors brought in whatever machine they had suitable for the job. Six different models of Bucyrus-Erie machines were used at various times. The Bucyrus-36-L and the latest model Bucyrus 28-L were the most satisfactory rigs tried, especially on holes over 1500 feet deep. Four different models of Fort Worth Spudders were also used; they were the Super D, Model F, Jumbo H, and Super J. The Fort Worth machines did well on deep holes but they were heavy and cumbersome to move, they took more time than the Bucyrus machines to set up, and required a larger site on which to work. Gasoline, diesel oil and butane were used as fuel depending on the engine. The water table lay from 300 to 700 feet below the surface so the contractors had to haul the water needed for drilling until they had reached the ground water. They used tank trucks and obtained the water from the Mammoth-St. Anthony mine about a mile from our drilling area. No living quarters were provided for the drillers by the company. They took care of themselves and families. Some stayed in the town of Oracle about nine miles away but most of them lived in trailers close to their work.

The coordinate system for drilling started by the Bureau of Mines was adopted and extended. At first we drilled on centers 200 feet apart along the supposed strike or long axis and on 400 foot centers across the short axis. As the body began to take shape and we realized to some extent its area we drilled on

400 foot centers in both directions. The Bureau of Mines drilled 17 holes having a total of 15,844 feet; San Manuel deepened several of these holes and put down 88 new holes drilling 180,092 feet in total.

Samples were taken every 20 feet while drilling in conglomerate except where copper minerals were visible in the sludge and 5 foot samples were taken. After the hole penetrated the monzonite below the conglomerate samples were taken every 5 feet until the hole was finished. Drilling was continued in each hole for a considerable distance, in material assaying less than .4% copper, below the projected bottom of the ore body, before the hole was abandoned. Where the information from adjacent holes permitted us to make a reasonable estimate of the depth to the bottom of the ore we seldom drilled over 120 feet in low grade below the estimated bottom position. Where we were not reasonably sure of the thickness of the ore body we occasionally drilled up to 500 feet in low grade material below the last assay of .5% or better.

Samples were taken every 5 feet from the bottom of the conglomerate to the bottom of the hole. After a five-foot run the operator was required to bail the hole until it was clean. All of the material bailed was run through a series of splitters and the cut taken for sampling was drawn off in a 5 gallon milk can. A portion of the reject was taken from each run to provide material for classifying the rock and for panning a concentrate. The entire contents of the milk can containing 15 to 20 pounds of solids were dried on a steam table. All of the water was evaporated and no attempt was made to settle and decant before drying. After drying the sample was quartered and one of the quarters was pulverized for assay pulps. The three quarters were bagged separately and stored for future reference. Each sample representing 5 feet of hole was assayed separately. When a hole was completed composite samples, representing about 100 feet of drilling, were made up covering the entire ore column in each hole. These composites were assayed in our laboratory and spot checks made with assays run by outside custom assayers. Finally a composite was made for the total sulphide column in each hole and each of these composites was assayed by ourselves and an independent custom assayer. The average of the 5 foot samples checked with the composite samples within a few hundredths of one percent copper. I don't believe there was over .02 percent copper difference between the average of the 5 foot samples, our composite assays, and the custom assays, for the entire ore body and many individual holes checked exactly.

One of the characteristics of the San Manuel Ore body is the uniform distribution of copper values throughout the body in both horizontal and vertical direction. The percentage of copper in each ore column cut by the large majority of holes is very close to the percentage of copper in the entire ore body. In an individual hole the top of the ore body is usually marked by a change in copper content from .3% or less to .8% copper in a single 5 foot run. The succeeding samples would seldom assay over .9% or below .7% copper until the bottom was reached. The bottom would be marked by an immediate drop from .8% copper to say .4% in the next sample and within a few more runs the assays would be below .3% copper. Below this it was not unusual to have several hundred feet of .25% copper before the grade fell to .1% or less. In general the footwall material was pyritic with chalcopyrite giving way to pyrite and very little change in the total sulphide content.

The size, shape and extent of the ore body was established by systematic drilling. From the beginning numerous theories were advanced regarding the trend and location of the values beyond completed holes. Very little weight was given to these theories in practice for we followed the ore along the coordinate system as

long as it persisted in a given direction. The full extent of the ore body is not yet known because, having developed 460,000,000 tons, we stopped drilling. A series of holes along the southwest perimeter of the drilling show good columns of ore. The best of these has a column 1780 feet thick averaging better than .7% copper; the bottom 500 feet of this column assayed .9% copper. We have no idea as to how far the ore body extends beyond these holes.

The ore body we have outlined is covered with several hundred feet of Gila conglomerate for the greater part. Most of the tonnage is so far below the surface and covered with so much over-burden that stripping and open cut mining is out of the question. The structure of the monzonite we have been able to observe on the surface and the experience obtained in drilling leads us to believe that the ore will cave readily and that block caving will prove to be the most economical method of mining. We plan to adopt that method.

The drilling and sampling we have done has provided us with proof of a definite tonnage of ore, the metal content thereof, and the partial boundaries of the ore body. We still need adequate representative samples for metallurgical testing so we will be able to design a reduction and concentration plant. We need accurate knowledge of the physical characteristics of the rock in place, and broken, in order to plan development and extraction methods and to estimate mining costs. To get this information we have started a program of underground exploration. Two shafts will be sunk--one 7' by 26½' outside of steel, with four compartments, will be 2140 feet deep and the other 7' by 20' outside of timber, with three compartments, will be 1960 feet deep. About 14,000 feet of drifting and crosscutting is planned on two levels.

The prelininary exploration program has been laid out so that the openings may be used for development or extraction when production is started. In order to obtain the information we desire as quickly as possible we would have preferred to locate the first shaft near the center of the ore body. If we thought that a conventional timbered shaft with three compartments four or five feet in cross section could be sunk 2000 feet deep near the center of the ore body that would have been our first shaft, even though it would eventually be lost. We anticipate that a large quantity of water will be encountered in the ore body. Our neighbor, the St. Anthony Mining and Development Company, a few thousand feet north of us is pumping over 2000 gallons per minute from their 1050 foot level. They pumped over 3000 G.P.M. for many months after opening this level and the water came from a single 6' x 8' face. We may have a comparable amount of water in our shaft and if this proves true a large shaft section will be necessary to accommodate the pumping equipment. In addition, expensive stationary pumps with sumps and accessory equipment will be required. We didn't think it wise to locate such an expensive shaft in a position where it will be destroyed by mining operations. Consequently, a site was chosen in the footwall of the ore body outside of the line of subsidence and about midway between the extremities of the body. Due consideration was given to faults, surface topography, and accessibility in choosing the site. The yard and surface plant have been arranged so that a twin shaft may be located close by. Two shafts will be needed to hoist the anticipated production of 25,000 to 30,000 tons per day. The first shaft has been started and is being sunk as a permanent shaft which will be capable of handling up to 15,000 tons of ore per day when provided with suitable skips and hoisting equipment. Steel sets, with concrete outside the steel where needed, will be used for lining.

The second shaft will be sunk in the ore body and will be started soon. This will be a timbered three-compartment shaft which will eventually be lost. If we are fortunate and do not encounter excessive water we will be into the ore and

obtaining needed information in a short time. If the water is excessive we will delay sinking this shaft until the large footwall shaft is down and the ground around the second shaft is dewatered. This second shaft is located in the part of the ore body which will probably be mined first. It will be used for access to exploratory levels in the immediate area and later will be used to service the development work required to prepare the body for extraction.

The surface plant required for the sinking and exploration program is rapidly nearing completion. We have constructed a power plant containing three G. E. 1000 K.W. generators driven by Cooper-Bessemer gas diesel engines, and two C.P. air compressors; one of 1600 and one of 1800 cubic feet per minute capacity. Natural gas is supplied at 500 lbs. pressure through 20 miles of 4-inch pipe which was installed recently by the El Paso Natural Gas Company to serve our property. A machine shop, steel shop, hoist house, warehouse, change room, and office are either finished or nearly so. We have constructed twenty-one 3, 4, and 5-room dwellings, two 24-bed dormitories and a mess hall.

Some months ago we had Fairchild Aerial Surveys photograph the property and prepare a topographic map of the area. They did an excellent job and we now have contour maps on a scale of 200 feet to the inch with 10 foot contour intervals covering our entire group of claims. These maps will provide the base for laying out plans for plant, townsite, transportation system, tailings disposal and other surface construction. We are presently planning for production at a rate of 25,000 tons per day. A concentrating plant will be built as near to the ore body as property and topographic limitations will allow. It must of course be outside the ultimate limit of subsidence. A smelter may or may not be built depending upon economic considerations. There are already several copper smelters operating in Arizona, for instance the A. S. and R. Smelter at Hayden is twenty-five miles down the San Pedro river from our property. Magma Copper Company, who controls San Manuel, has a smelter at Superior about seventy-five miles north of San Manuel. The transportation of concentrates plus the charge for smelting will have to be compared with the amortization of the cost of a new smelter plus the cost of smelting, before a decision is made.

Where the plant and townsite will be located has not been decided nor will it be decided for some time. We anticipate 1000 to 1200 men will be employed and according to the experience in southwest mining camps that will mean a new town of 5 to 6 thousand population will come into being. During the next two years we will be making plans for the mine and permanent plant, but many details will have to wait until the information from underground is obtained.

The ore body is low grade and deeply situated; on the other hand the tonnage is large and the ore column is thick. We have a virgin, untouched deposit whose size, shape and location have been accurately determined for our planning engineers information. The best practices and most efficient devices developed in caving operations to date can be adopted. The combined and accumulated knowledge of many mines having years of experience will be drawn upon in laying out our plans for exploitation.

It is too soon for an exposition on our plans for exploitation of the ore body as these plans are in a very early and formative stage and they consist mainly of detached ideas rather than a consolidated program.

We expect to be able to develop caving blocks or panels 700 feet long, 160 feet wide and 600 feet high where the thickness of the ore will allow. Few blocks of this height have been caved and drawn before. The plans for development

will be made flexible so that the height of the block can be reduced or increased if early experience indicates a change desirable. The opportunity is present for making this the most efficient block caving operation in existence.

We have given considerable thought to the possibility of raising the ore to the surface by means of long, inclined conveyor belts in series, rather than by conventional vertical hoisting. This is quite practical from an engineering point of view. Modern conveyor belt systems afford a cheap method of transportation. The inclined conveyor could be pointed in the direction of the surface plant and thus greatly reduce the length of surface transportation which will be required to reach the reduction plant if vertical hoisting is adopted. The decision on this point will of course be one of overall economy and flexibility. Our present conclusions are that belt life would be too short and the consequent maintenance cost too high for a conveyor to compete with hoisting. However, great strides are being made by belt manufacturers for this type of service and before we must commit outselves the picture may change. In this connection the permanent footwall shaft now being sunk has been so designed that it can be used as an ore hoisting shaft or if we do not hoist ore it can be used either as a supply shaft or as a ventilation shaft, both of which will eventually be required.

I mentioned the fact that we expected to find considerable water in the ore body. The footwall shaft was located in an area which is unbroken by known faults and which a careful geological study indicated was the least likely to encounter a large flow of water while sinking. We hope this will prove to be true but we are providing for a disappointment. When the top of the ground water table is reached a pump station and sump will be cut on the 820 foot level. Two 700 G.P.M. centrifugal pumps will be installed immediately and provision made for additional pumps if they are required. Sinking pumps with a combined capacity of 600 G.P.M. have been provided and more may be installed if necessary. Air driven, large capacity, low head sump pumps will be used in the bottom. They will discharge into a steel tank hanging in the shaft. Motor driven centrifugal pumps will relay the water from this tank to the sump above. The platform holding the centrifugal pumps is under and an integral part of the hanging tank. When the head capacity of the hanging pumps has been reached booster pumps will be installed in series in the discharge pipe line. Two 8-inch pump lines will be carried down the shaft.

Even though we are fortunate enough to finish sinking without encountering more water than we can handle easily, a large sump and pump station will be immediately installed on the bottom level before we crosscut to the ore body. We think it inevitable that a large flow of water will be encountered in the ore body so water doors will be installed and long holes will be carried ahead of the face of the crosscut towards the ore body.

If we run into an excessive quantity of water, say 1,500 to 3,000 G.P.M. in sinking, we will probably sink one or more churn drill holes outside the shaft and install deepwell pumps to lower the water table below the sinking operations.

Many phases of this operation have been discussed very briefly and incompletely. I am sure that the experience gained in bringing the property into production will provide subjects for reports which will be of interest and value to the mining industry. It is often said the geologist can make an accurate picture of the ore body after it has been mined out. We will be able to tell how to exploit the San Manuel ore body after we have done it and our mistakes are behind us.

---oOo---

NAME OF MINE: SAN MANUEL
OWNER:

COUNTY: Pinal
DISTRICT:
METALS: Cu

OPERATOR AND ADDRESS		MINE STATUS	
Date:	(Magma Copper Co.)	Date:	
1/45	Wesley P. Goss, Superior	1/45	Drilling

MEMO:

The San Manuel ore body near Tiger, Arizona, now being developed by the Magma Copper Co., is one of the largest low-grade copper ore bodies in the known world.

Some 400,000,000 tons of copper ore of about 8/10th of 1% copper per ton have been proven by drilling.

About 80 lode claims have lately been PATENTED. Many of such (most of them in fact) are without any surface discovery of mineral; are, in fact, all in the formation known as Gila conglomerate. It is assumed patent issued on basis of drill-hole discovery.

Consequently, the examiner, did not know of his own knowledge that the claim had a discovery. There isn't any outcrop. He had to take someone else's word for underground conditions.

Contrast this with conditions where there are visible surface outcrops containing minerals, or proven indications of minerals by reason of character of the outcrop.

SAN MANUEL MINE, MILL & SMELTER PINAL COUNTY

KAP WR 12/6/85: While on the December 5, 1985 Forest Service Field trip, we visited the San Manuel Mine operated by Magma Copper Company. Initial stripping of overburden and construction of benches has begun for the oxide heap leaching operation. At least for a while waste rock can be merely pushed into the deeper caved portion above the block caving areas. Acid soluble copper runs about 1.0% and the approximately 4,000,000 tons is sufficient to operate for about 10 years. The in situ leaching experiments are continuing. The in situ project could extend the solvent extraction electrowinning part of the oxide project for an additional 10 years. They are considering establishing a separate company to run the oxide leaching operation so it will not be burdened with corporate overhead or have to carry any of the high costs of the underground mine. No decision has yet been made regarding building a flash furnace to replace the current reverberatory furnace at the San Manual Smelter. Such a replacement will have to be made if the smelter is to meet the 1988 air quality standards. Preliminary engineering for such a furnace replacement is continuing. If a flash smelter is constructed they will have to find additional sources of concentrates, but cannot afford to operate the San Manuel mine at a higher production rate due to the cost of continued development ahead of mining.

KAP WR 1/29/88: Prepared a field trip lecture for the AIME field trip to the San Manuel Copper Mine (file) Pinal County and accompanied the tour of 21 poeple to the mine. The mine tour consisted of a review of mining methods on the 2615 level. Additional details of the tour and the San Manuel Mine operation are included in a separate report.

NJN WR 2/19/88: John Jones, a consulting engineer who visited a few weeks ago regarding a new air sparge flotation unit, reported that as a result of my suggestions they will be installing such a unit in the moly circuit of the San Manuel Mine (file) Pinal County to increase their recovery.

SAN MANUEL MINE, MILL & SMELTER PINAL COUNTY

MG WR 4/13/84: With John Jett, visited Mr. Lloyd Thomas, Chief-Planning Dept., at San Manuel mine (Pinal Co). Presently the mine production rate is about 54,000 tpd. Production may be dropping slowly since attrition is reducing the workforce. No development of the adjacent Kalamazoo deposit has been done for over one year. Mr. Thomas and his engineers are considering various means (in-situ leaching, open-pit mining, etc) to recover copper from the untouched oxide-copper mineralization capping the San Manuel sulfide deposit.

NJN WR 12/14/84: It was reported at the AIME State Conference that Magma Copper Co's San Manuel (f) deposit has in-situ copper oxide reserves of 175 million tons grading .34% acid soluable copper. In addition they have oxide reserves available for open pit mining from the block cave area.

NJN WR 3/29/85: Changes should be made to the copper reserve reference listings for Magma Copper Company's San Manuel (f) Mine according to Paydirt Arizona edition March, 1985, p. 5. The article on the proposed operations listed open pit reserves of 55 million tons averaging .47% acid soluable copper with a 2-1 stripping ratio. In-situ copper oxide reserves are 175 million tons grading .43% acid soluable copper.

CJH WR 6/28/85: Eddie Martin, Asst. State Mine Inspector reported on a visit to Magma San Manuel's new acid leach solvent extraction/electrowinning project. Prime contractor is Bechtel, Inc. of San Francisco, California and the sub-contractor for excavation is Granite Corp., Tucson. The target date for project completion is June 1, 1986. Attached map may be placed in San Manuel Mine, Pinal County file.

SAN MANUEL MINE, MILL & SMELTER PINAL COUNTY

Directory of Mining - August 1971 - 2600 men.

San Manuel construction works is proceeding to completion. GWI QR 9/71

San Manuel Copper Co. construction is nearing completion. They announced that their acid plant would produce 2000 tons of acid a day with no market in sight. GWI 4 ¼ '72

Called to verify Dick Moore's assertion that San Manuel mine had little water in it. I told him (Gerry Wright, Tucson City Water Dept.) that the perched water table had been pumped dry and the mine presently made a very small amount of water from very small water fissures. VBD WR 3/19/75

San Manuel mill is now re-running slag from its smelter. They have been taking about 3000 tons per day (one shift) for some time. The slag carries about 1.5% Cu. Recently production has been increased to 9000 tons per day (three shifts at 3,000 tons). VBD WR 3/8/76

Gerry Scott, Southwest Salt Company, said that San Manuel was taking 300 tons/month. GW WR 11/26/76

In order to meet air quality controls the San Manuel Smelter has had to make many slow downs. Total emissions are controlled by a combination of producing sulfuric acid from converter sulfur and a closed loop "capacity reduction" approach to reverbatory furnace sulfer. Many furnaces have been shut down with a resultant approximately 25,000 ton backlog of concentrate. A new method is under evaluation. KP WR 6-14-77.

KAP WR 4/23/82: Discussed anode refinery slimes from San Manuel (Magma Copper) with Charles Tillar of Newmont in Tucson. Bob Languth reported he heard a rumor that the slimes were for sale. Mr. Tillar said they were contracted for the next three years.

NJN WR 9/17/82: From Frank Harris, Public Relations Officer with Magma Copper Company the following information was received. The current operating level at the Superior Mine is at 4,682 foot level and the deepest workings there are at 4,873 feet. At San Manuel the 2,675 foot level is presently being mined while the shaft shared with the Kalamazoo goes to 4,200 feet.

SAN MANUEL MINE PINAL COUNTY

Visited San Manuel, interview with John Wise, Mgr. He said they were pretty busy with shaft sinking, etc. He said they were doing some drilling on the Copper Creek property but were not going to push it. FTJ WR 7-25-69

Fine progress is being made at the 2 new shafts (3C and 5?) of the San Manuel mine. One shaft is approaching a 2,000 ft. depth with the other close behind. Strong rumors abound that in San Manuel now plans to double their present 44,000 tpd production and that a new shaft, 3-D is being planned. The 4 shafts, 3-A, 3-B, 3-C, and possible 3-D will be ore hoisting shafts. JHS QR 8-1969

Active Mine List Oct. 1969 - 2200 men - John F. Wise, Gen. Mgr.

The Magma Copper Company is continuing expansion work at the San Manuel mine. Another smelter stack has been started. Sinking of the two new shafts at the mine is continuing. GWI QR 2-27-70

Shaft sinking continuing at San Manuel as well as construction work at the mill and smelter. GWI QR 4-1-70

Active Mine List May 1970 - 2400 men - J.F. Wise, Gen. Mgr.

Expansion work at San Manuel continues on schedule. GWI QR 6-30-70

Expansion work at San Manuel continues unabated. GWI QR 10-1-70

Active Mine List Oct. 1970 - 2400 men - J.F. Wise, Gen. Mgr.

Expansion work at San Manuel continues. GWI QR 12-31-70

Mine visit - San Manuel mine office. GWI WR 2-1-71

San Manuel activity is well reported in the Journals. To the North, West & South various companies are looking. Construction work on the expansion at San Manuel continues full force. GWI QR 4-1-71

San Manuel HQ on 3/15. They had 2627 employees. GWI WR 5-4-71

Construction work at San Manuel is proceeding as scheduled. GWI QR 6-30-71

Mine visit - San Manuel Mine. (Hugh Steele) GWI WR 9/20/71

SAN MANUEL MINE, MILL & SMELTER PINAL COUNTY

At San Manuel, Arizona, Magma Copper Co. plans to double the capacity of the smelter serving its large underground copper mine and erect a second smokestack, which will be 550 feet high. The enlarged plant will handle the increased production of concentrate resulting from the $100 million expansion program under way at the San Manuel mine as well as at the Magma mine at Superior, Arizona. Upon the completion of the San Manuel smelter early in 1971, the smelter at the Superior mine is expected to be closed. Taken from Skillings Mining Review 1-25-69

Active Mine List April 1969 - 2017 men - John F. Wise, Gen. Mgr.

The Magma Copper Co. is sinking two shafts at the San Manuel mine. These are close to the present hoisting shafts. The smelter capacity is to be increased with a new stack to be added. GWI QR 3-1969

SAN MANUEL MINE, MILL & SMELTER PINAL COUNTY

San Manuel Copper Corporation is scheduled to start mining "Arizona State Lease" ore at its San Manuel mine in Pinal County this summer. San Manuel's mining schedule calls for some production from State Leases for the next five years with continual production, of course, from its own claims. Taken from Mining World - Jyly 1961 - p. 41

F. H. Buchella, Gen. Mgr., San Manuel Copper Corp., Box M, San Manuel, Arizona.
2358 men working Feb. 1962

On April 30, 1962, San Manuel Copper Corporation, wholly-owned subsidiary of Magma Copper Co., transferred all its property and assets to Magma Copper Co. and was dissolved as a separate corporation. Magma assumed all debts and liabilities of the subsidiary, and is continuing its business and operations as the Magma Copper Company, San Manuel Division. Taken from Mining World - July 1962 - p. 43

Mr. Dave Lowell at his office, 5215 North Oracle Rd, informed that Quintana was still drilling at San Manuel, but tight security guard would not allow visitors. Morris Enright is now exploration geologist for San Manuel. GWI WR 1-2-66

Mr. John F. Wise replaces Mr. F. H. Buchella as Gen. Mgr. at San Manuel. Mr. Buchella is Vice President. (San Manuel Miner 6-29-67)

Active Mine List Nov. 1967 - 2062 men
Active Mine List April 1968 - 2062 men
Active Mine List Oct. 1968 - 1970 men

Two mine shafts will be sunk by Cementation Co. of America, Inc. at the San Manuel, Arizona Division of Magma Copper Co. The shafts are part of plans to increase underground production of ore at San Manuel from 40,000 to 60,000 tpd. Both will be circular and concrete-lined, with one serving as a main production and exhaust ventilating shaft and the other as a service and intake ventilation shaft. The former is to be 22 feet in diameter and 2861 feet deep. The latter shaft will be 25 feet in diameter and 3620 feet deep. Mining Congress Journal Dec. 1968

SAN MANUEL MINE, MILL & SMELTER PINAL COUNTY

Information from Mine Inspector's Office - August 15, 1957

San Manuel - Old Hat District - Pinal County 6-8-57

600,000 tons - 5 shafts - 1336 men

San Manuel Copper Co.

San Manuel Lime Pit - 2000 tons - 7 men 6-8-57 Lime & silica

San Manuel Copper Corporation:

Government floor price purchase options on San Manuel Copper Corporation's copper output continue under the DMPA contract negotiated in 1952, and are expected to remain in effect until the third quarter of 1960. In 1958, the company's copper was sold to the government at the "put" price of 27.05¢ per pound until October, when the market price rose above the contract price and so was then sold on the open market. With further operation of the contract's escalation clause, the "put" price has increased to 27.68¢ per pound, but no copper will be delivered to the government as long as it can be sold on the open market at or above the contract price. Last year San Manuel produced 11,486,300 tons of ore assaying 0.716 percent sulphide copper. Pounds of copper recovered per ton of ore mined averaged 13.01 in 1958, compared with 13.57 in 1957. San Manuel's metal production for 1958 was 149,401,672 pounds copper, 1,872,450 pounds molybdenum sulphide, 16,868 ounces gold, and 253,858 ounces silver. Metal production in 1957 was 119,797,769 pounds copper, 1,452,080 pounds molybdenum sulphide, 13,578 ounces gold, and 200,301 ounces silver.
Taken from Mining World - June, 1959 - p. 74

San Manuel Copper Corp.

Magma Copper Company has renegotiated terms of indebtedness of its subsidiary firm, San Manuel Copper Corp., with the U.S. Treasury Department. San Manuel had been authorized to borrow $94,000,000 to develop the San Manuel copper property in Arizona. Quarterly payments ($1,550,000) of the principal were to start in 1959. Actually, however, San Manuel only borrowed $76,771,000, so the quarterly payments now will be only $1,250,000, or a total of $5,000,000 during 1959.
Taken from Mining World - Feb. 1959

SAN MANUEL MINE, MILL & SMELTER
Box M
San Manuel, Arizona

Magma Copper Co. (file) IC 8673
Mohawk Mine (file) Pinal
Mohawk Ext. Mine (file)
St. Anthony Mining & Dev. (file)
Kalamazoo Project (file)
MAPS UPSTAIRS IN FLAT COPPER STORAGE AREA (look under copper) - Top Drawer -
(4 different folders)
ABM Bull. 180, p. 121, 133, 134, 137, 138, 143, 144, 390, 394 415

USGS P.P. 256, p. 42
" " 610, p. 43

RI 6216 - 1963
" 6955 - 1967

Pay Dirt 7/24/72

E/MJ, July, 1949
" June, 1957, p. 40
" March, 1964, p. 129
" December, 1965, p. 104
" August, 1968, p. 13 (expansion)
" June, 1972, p. 262
" September, 1972, p. 188
" January, 1973, p. 64, 74
" February, 1973, p. 118, 129
" April, 1973, p. 43, 45
" November, 1973, p. 201
" December, 1973, p. 117
" January, 1974, p. 128
" Aug., 1974, p. 98 (personnel) p. 39 (expansion)
" September, 1974, p. 231 (expansion)
" March, 1975, p. 26 (new air quality control system) p. 237 (personnel)
" May, 1975, p. 58 (loop monitoring system)

Mineralogy of Arizona p. 16, 17, 22

Mineralogical Record, Arizona IV - Volume 14, Number two, Pgs. 72-82

San Manuel Copper Mine file

ABSTRACTED FROM ADMMR ACTIVE MINES DIRECTORY, 1992 Pinal

MAGMA COPPER COMPANY

Corporate Headquarters
7400 N. Oracle Rd, Tucson, AZ 85704- Phone 575-5600
President and CEO J. Burgess Winter
San Manuel Mine T8S R16E Sec 34, 35
P.O. Box M, San Manuel, AZ 85631 - Phone 385-3100 - Employees: 2151 - Underground copper-molybdenum mine - 62,000 TPD concentrator - Open pit oxide mine - In-situ leaching - Heap Leaching - Solvent extraction-electrowinning plant.
General Manager Francisco E. Durazo
Manager Sulfide Mining Hendrick W. Seamey, Jr.
Manager Oxide Mining, Leaching & SX-EW Douglas R. McGregor
Superintendent Concentrator Gerald R. Brunskill

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General Manager ..... Harry C. Smith
Manager Sulfide Mining ..... Francisco E. Durazo
Manager Oxide Mining, Leaching & SX-EW ..... Douglas R. McGregor
Superintendent Concentrator ..... Gerald R. Burnskill
Manager Maintenance ..... Wendell F. Pauling

ABSTRACTED FROM ADMMR ACTIVE MINES DIRECTORY, 1990

MAGMA COPPER COMPANY

Corporate Headquarters
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President and CEO ..... J. Burgess Winter
San Manuel Mining Division T8S R16E Sec 34, 35
P.O. Box M, San Manuel, AZ 85631 - Phone 385-3100 - Employees: 2151 - Underground copper-molybdenum mine - 62,000 TPD concentrator - Open pit oxide mine - In-situ leaching - Heap Leaching - Solvent Extraction-electrowinning plant.
General Manager ..... Harry C. Smith
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Manager Oxide Mining, Leaching & SX-EW ..... Douglas R. McGregor
Superintendent Concentrator ..... Gerald R. Burnskill
Manager Maintenance ..... Wendell F. Pauling

ABSTRACTED FROM ADMMR ACTIVE MINES DIRECTORY, 1992

Pinal County

MAGMA COPPER COMPANY

Corporate Headquarters
7400 N. Oracle Rd, Tucson, AZ 85704- Phone 575-5600
President and CEO J. Burgess Winter
Magma Metals Company
San Manuel Smelter T9S R17E Sec 32
P.O. Box M, San Manuel, AZ 85631 - Phone 385-3100 - Employees: 1217 - 1,000,000 TPY flash smelter - 3000 TPY acid plant - 300,000 TPY electrolytic refinery - 180,000 TPY continuous cast rod plant.
President John F. Champagne
Vice President/General Manager Operations Tom L. Jordan
Vice President Marketing & Sales Brian Disbury
Manager Smelting J. D. McCain
Manager Refinery/Rod Casting Ralph Juvera

ABSTRACTED FROM ADMMR ACTIVE MINES DIRECTORY, 1991

MAGMA COPPER COMPANY

Corporate Headquarters
7400 N. Oracle Rd, Tucson, AZ 85704- Phone 575-5600
President and CEO ..... J. Burgess Winter
San Manuel Smelting Division T9S R17E Sec 32
P.O. Box M, San Manuel, AZ 85631 - Phone 385-3100 - Employees: 1217 - 800,000 TPY flash smelter - 2000 TPY acid plant - 300,000 TPY electrolytic refinery - 180,000 TPY continuous cast rod plant.
General Manager ..... Tom L. Jordan
Manager Smelting ..... J. D. McCain
Manager Refinery/Rod Casting ..... Ralph Juvera

ABSTRACTED FROM ADMMR ACTIVE MINES DIRECTORY, 1990

MAGMA COPPER COMPANY

Corporate Headquarters
7400 N. Oracle Rd, Tucson, AZ 85704- Phone 575-5600
President and CEO ..... J. Burgess Winter
San Manuel Smelting Division T9S R17E Sec 32
P.O. Box M, San Manuel, AZ 85631 - Phone 385-3100 - Employees: 1217 - 800,000 TPY flash smelter - 2000 TPY acid plant - 300,000 TPY electrolytic refinery - 180,000 TPY continuous cast rod plant.
General Manager ..... Tom L. Jordan
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ABSTRACTED FROM ADMMR ACTIVE MINES DIRECTORY, 1989

MAGMA COPPER COMPANY

Corporate Responsibilities
P.O. Box M, San Manuel 85631 - Phone 385-3100

Chairman of the Board (New York) ..... Donald J. Donahue
President ..... Burgis Winter
Vice President Mining Operations .....W. Glenn Martin
Vice President Planning & Development ..... Brad Mills
Controller ..... Bob Lemons
Treasurer ..... Bill Diggin
Corporate Director Personnel ..... Marsh Campbell
Corporate Director Environmental Affairs ..... Eldon Helmer
Public Relations Officer ..... Frank R. Harris
Manager, Rod Production ..... Lee Browne
Land Manager ..... Alex Acosta

San Manuel Mine T8S R16E Secs. 34 & 35
San Manuel Concentrator, Smelter etc. T9S R17E Sec. 32
P.O. Box M, San Manuel 85631 - Phone 385-3100 - Employees 3800 - Underground copper-molybdenum mine - In situ leaching - Open pit oxide copper mine - Heap leaching - Solvent extraction-electrowinning plant - 62,000 TPD concentrator - 800,000 TPY smelter with 2,000 TPD acid plant - Electrolytic refinery and rod plant.

Vice President & General Manager ..... T.E. Hearon
Manager, Mining ..... H.W. Seaney
General Plant Superintendent ..... Kay D. Parks
Director, Metallurgical Labs ..... S.K. Young
Manager, Engineering & Technical Services ..... J.R. Tinnin
Manager, Purchasing ..... Fred Hays

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Vice President Mining Operations .....W. Glenn Martin
Vice President Projects & Plant ..... Tom E. Hearon
Vice President Corporate Planning ..... John W. Goss
Controller ..... Bob Lemons
Treasurer ..... Bill Diggin
Corporate Director Personnel ..... Marsh Campbell
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Manager, Engineering & Technical Services ..... J.R. Tinnin
Manager, Purchasing ..... Fred Hays

SAN MANUEL

Mining World, December, 1958, p. 58
" " December, 1960, p. 35
" " February, 1963, p 32

Metal Mining & Processing, March, 1964, p. 14
" " " April, 1965, p. 27, 41

World Mining Catalog, Survey & Directory, 1964, p. 163
" " October, 1965, p. 79
" " August, 1968, p. 52

Mining Congress Journal, February, 1965, p. 58
" " " September, 1965, p. 15
" " " September, 1968, p. 11
" " " July, 1972, p. 5
" " " February, 1973, p. 24
" " " November, 1973, p. 21
" " " February, 1974, p. 7
" " " Aug., 1974, p. 5 (expansion)
" " " September, 1974, p. 5 (expansion)
" " " January, 1975, p. 6 (prod. cutback)

Mining Engineering, November, 1965, p. 70
" " June, 1967, p. 66
" " November, 1972, p. 22, 62
" " February, 1973, p. 119
" " October, 1973, p. 70
" " January, 1974, p. 47, 49
" " Aug., 1974, p. 6 (doubling capacity)
" " September, 1974, p. 16 (expansion)
" " October, 1974, p. 6 (expansion)
" " January, 1975, p. 10, 52 (cut back prod.) (personnel)
" " March, 1975, p. 16 (emission control system inaugurated)
" " October, 1975, p. 21

SAN MANUEL MINE

Skillings Mining Review, March 19, 1966, p. 15
" " " June 18, 1966, p. 22
" " " July 9, 1966, p. 18
" " " June 3, 1967, p. 9
" " " October 7, 1972, p. 12
" " " December 16, 1972, p. 23
" " " December 30, 1972, p. 21
" " " January 6, 1973, p. 12
" " " June 16, 1973, p. 23
" " " September 29, 1973, p. 21
" " " October 6, 1973, p. 22
" " " November 17, 1973, p. 21
" " " December 29, 1973, p. 21
" " " December 22, 1973, p. 19
" " " January 5, 1974, p. 17
" " " February 9, 1974, p. 18
" " " March 2, 1974, p. 1, 6
" " " April 27, 1974, p. 9
" " " May 18, 1974, p. 26

Skil. Mng. Rev., June 15, 1974, p. 8
" " " July 20, 1974, p. 23 (doubling cu rod cap.)
" " " July 27, 1974, p. 21 (personnel)
" " " Aug. 10, 1974, p. 6 (expansion)
" " " Nov. 16, 1974, p. 18 (personnel)
" " " Jan. 4, 1975, p. 10 (sampling)
" " " February 8, 1975, p. 21
" " " June 28, 1975, p. 4 (gen. info.)

Metals Week, November 12, 1973, p. 2
" " May 27, 1974, p. 6
" " July 1, 1974, p. 2
Metals Week, June 28, 1974, p. 525
" " July 5, 1974, p. 13

Contractor & Engineer, November, 1973, p. 27, 34

Mining Annual Review, July, 1973, p. 19, 295
" " " 1974, p. 305 (gen. info.)

Mining Magazine, November, 1973, p. 453
" " August, 1974, p. 127 (doubling capacity)
" " September, 1974, p. 225 (increase output)

Mining Journal, February 1, 1974, p. 72
" " Aug. 16, 1974, p. 143 (increase capacity)
" " December 6, 1974, p. 492 (cutback production)
" " Dec. 13, 1974, p. 510 (cutbacks)

California Mining Journal, Sept., 1974, p. 25
" " " February, 1975, p. 24 (cuts prod.)
" " " March, 1975, p. 22 (cutback)

Mng. Journal, 2/7/75, p. 107
" " (prod. cutback)
" " 1/24/75, p. 57 (output prod.)
" 3/14/75, p. 191 (respite from emission standards)

SAN MANUEL MINE, MILL & SMELTER PINAL COUNTY

1969

John S. Wise - Vice President & General Manager
W. H. Burt - Assistant General Manager
D. J. Buckwalter - Assistant General Manager
Wesley P. Goss - President

Arizona Department of Mines and Mineral Resources

INFORMATION FROM MINE CARDS IN MUSEUM

ARIZONA

PINAL COUNTY

SAN MANUEL MINE

mils # 577A

3. AKA's

San Manuel Copper Mine fields

MM-9488	Monzonite
MM-9499	Monzonite
MM-9490	Chalcocite
MM-9491	Chalcopyrite
MM-9492	Cuprite
MM-9493	Carnotite
MM-9494	Calcite
MM-9495	Chrysocolla
MMK801	Chrysocolla
MMO 470	Artifact

Abstract from SME Annual Meeting 2002

Seguin, J.M., 2002, The benefits of interdisciplinary team work at the San Manuel mine, Arizona

The San Manuel mine has been in production since early 1956. Between 1985 and 1995 the open pit oxide operation produced 580 million pounds of cathode copper. Today in-situ mining within the original open pit is the sole mining method. In 1987 BHP commissioned an interdisciplinary team to perform a feasibility study which evaluated resumption of open pit mining at a level necessary to provide value to the entire San Manuel operation. The foundation of this study was the mineral resource model that stands as the most comprehensive evaluation of the San Manuel ore body to date.

Notes from talk on February 27, 2002 taken by Keith R. Long, Economist, Geologist, USGS – Tucson

The San Manuel mine was placed on care-and-maintenance in June, 1999. On January 15, 2002, BHP-Billeton announced the official closure of the San Manuel mine. A proposal to resume mining the oxide ore pit was not taken up due to low copper prices and the commitment of company development funding to the Escondida Phase IV expansion in Chile.

From January, 1956 to June, 1999, more than 700 million tons of sulfide ore was mine, mostly underground. Oxide ore mining began in 1977 with an in situ leach operation which continues to this day. Open-pit mining of oxide ore from 1985 to 1995 yielded 580 million pounds of cathode copper. Open-pit operations were limited by proximity to the underground mine. Oxide ore mined was leached at a 242 acre facility north of the pit. Since the pit was closed in February, 1995, all oxide copper has been mined by in situ leach. Since then, 23 million pounds of copper have been recovered by this method. Current operations include 6 million pounds of copper per year from residual leach of underground workings.

In January, 1997, a reserve inventory identified 3 billion pounds of copper in oxide ores along with considerable additional resources. The San Manuel Oxide Open Pit Project conducted drill exploration from February, 1997 to July, 1997. To January, 1998, $9 million was spent on exploring oxide reserves. A new pit was designed, based on data from 1,974 drill holes. Besides waste and a block-caved zone, the proposed pit includes an oxide zone of mainly chrysocolla with grades up to more than 0.8 percent copper, irregular peripheral pods of high-grade chalcocite, and a sulfide zone consisting of chalcopyrite. Resources at various cut-off grades are:

Cut-off Grade percent total copper	Resource billion pounds copper
0.0	19
0.2	14
0.5	5

Note that, of the 14 billion pounds of copper at a 0.2 percent total copper cut-off grade, only 3 billion pounds is in oxide copper ore.

Alternative open-pits were designed at assumed prices of $0.80, $0.90, and $1.00 per pound for copper. No pit design was economic at $0.65 per pound copper. The project would have a 14-year life with a peak production of 100 million pounds per year cathode copper.

BHP also examined other projects, including expansion of in situ leach operations, in-pit heap leaching, mining shaft pillars, and rubblizing ore in pit.

Date Printed: 01/28/98

ARIZONA DEPARTMENT OF MINES AND MINERAL RESOURCES

INFORMATION SUMMARY

Information from: Field Visit by Ken Phillips,

Company: Nyal Niemuth, and H. Mason Coggin

Address:
City, State ZIP:
Phone:

MINE: San Manuel

ADMMR Mine File: San Manuel Copper Mine
County: Pinal
AzMILS Number: 577A

SUMMARY

Together with State Legislators, Officials of the State Mine Inspector's Office and Nyal Niemuth, Mason Coggin, and Eric Nordhausen toured the 2615 level of the San Manuel Copper Mine, the San Manuel Open Pit Oxide Mine, the San Manuel SX-EW plant and the San Manuel production shafts hoist house. Applicable Pinal AZMILS numbers are 577A and 744

The following are some notes from the visit:

1. BHP is the worlds largest non government producer of copper
2. BHP produces 11 % of the world's copper.
3. BHP controls 40 % of the world's copper concentrate.
4. The San Manuel Mine is north America's largest underground mine.
5. Current average sulfide ore grade of the two ore bodies is 0.611 % Cu.
6. Current average oxide ore grade is 0.589 % Cu.
7. Current mine cash cost of production for the combined sulfide and oxide ores is $0.91 per pound of copper.
8. Current San Manuel employment is 2300.
9. BHP's Arizona operations spend $616,000,000 on supplies, power, etc. in Arizona which is 75-80 % of their expenditures.
10. The expenditures are divided as follows:

San Manuel Operations	$243,000,000
Corporate Operations	70,000,000
Pinto Valley Operations	132,000,000
Superior Operations	16,000,000
Smelter, refinery, rod plant	156,000,000

11. Current San Manuel production is 20,000,000 pounds of copper per month.
12. Plan 23,500,000 pounds of copper per month by May 1998 by increasing oxide and Kalamazoo production.
13. Ton of ore per day is planned at 60,000 by May 1998.
14. Costs are targeted to be $0.78 per pound by May 1998. First quarter 1998, $0.88; second quarter 1998, $0.91; third quarter 1998,

$0.84; and fourth quarter 1998, $0.78 for a 1998 average of $0.85.

15. The Arizona Industrial Commission's "8 hour law" limits the total amount of time a worker can work underground to 8 hours portal-to-portal (or collar-to-collar) in 24 hours. Underground transportation time to the work face, set up time, lunch time, etc.

Date Printed: 01/28/98

ARIZONA DEPARTMENT OF MINES AND MINERAL RESOURCES

INFORMATION SUMMARY

limits the actual underground working time to between 4.5 and 5 hours. BHP claims that both management and labor desire to have the law changed to allow 10 hour days.

If such a work day/week were allowed there would no additional cost to the company and the workers, a majority of whom drive over one hour each way to and from work, would not get any increase in pay. the workers would have one less round trip commute per week. However, the average production per hour would increase. The current union contract allows such a change if the law can be changed. There is some question as to if the union business office is in favor of a change that would allow the same number of workers to produce more and thus eliminate the need to hire more workers.

In 1991 the company and the union signed a 15 year labor agreement guaranteeing no strikes, but agreeing to re-negotiate in 1997. That agreement was just signed. Wages went from $13.66 to 16.54 per hour. Cost of labor went from 23.94 to 28.16 per pound of copper. The agreement provides for 10.5 hour per day underground and 12 hour per day surface work schedules.

A 2/3 vote of workers is needed to change the schedule if the statute is changed. If the vote approves a change, it can be changed back to the old schedule by a worker vote after 6 months.

During the same trip the San Manuel open pit mine (currently an in-situ leach injection well field) and the solvent extraction and electrowinning plant were toured. When open pit mining operations stopped in February of 1995, 93,000,000 tons of oxide ore had been mined. The San Manuel pit now has 1,000 injection wells on the eastern portion of the deposit. The resultant pregnant leach solution is recovered in old underground workings.

When the open pit operation started it was decided production cost would not exceed $0.50 per pound of copper produced and there would be no recapitalizion of the truck and shovel fleet.

There is current consideration to restart the open pit but if done it will impact the underground portion of the mine. Currently they are determining what modifications to their aquifer protection permit and environmental impact statement would be required to start oxide ore production again. They could reopen the pit in 3 years. Open pit resources could be as much as 200,000,000 tons at 0.5% total copper and 0.41% acid soluble copper.

The plant is running at 50 percent capacity on leach solution from the insitu leaching operations under the south and east side of the idle open pit. The SX-EW plant has produced over 600 million pounds of copper at a guaranteed purity of 99.999%. Even insitu leaching is currently limited so as to protect portions of the underground operation.

Ken A. Phillips, Chief Engineer Date: November 17, 1997

AR ONA DEPARTMENT OF MINER. RESOURCES
Mineral Building, Fairgrounds
Phoenix, Arizona

1. Information from: Personal Visit

   Address:

2. Mine: San Manuel 3. No. of Claims - Patented

   Unpatented

4. Location: (Mine) Red Hill

5. Sec 34 Tp 8S Range 16E 6. Mining District Old Hat

7. Owner: Magma Copper Co.

8. Address: Box "M" San Manuel

9. Operating Co.: Same

10. Address:

11. President: W. P. Goss 12. Gen. Mgr.: John Wise

13. Principal Metals: Copper 14. No. Employed: See Active Mine List

15. Mill, Type & Capacity:

16. Present Operations: (a) Down ☐ (b) Assessment work ☐ (c) Exploration ☐
    (d) Production ☒ (e) Rate 40,000 tpd.

17. New Work Planned: Work in the two new shafts is continuing.
    All so work on the smelter, mill and refinery additions.

18. Miscl. Notes: John Wise, announced the promotion of E.K. Staley to Mine Manager.
    L. C. Acton# Mine supt, and several others.
    See San Manuel Miner Vol. 16 No. 17 Thursday April 30 1970

Date: 4-30-70 (Signature) (Field Engineer)

AR ONA DEPARTMENT OF MINER. RESOURCES
Mineral Building, Fairgrounds
Phoenix, Arizona

1. Information from: Hugh Steele + personal visit
   Address: San Manuel
2. Mine: San Manuel 3. No. of Claims - Patented ?
   Unpatented
4. Location: Near old town of Tiger
5. Sec 34-35 Tp T8S Range 16E 6. Mining District
7. Owner: Magma Copper Co
8. Address: San Manuel
9. Operating Co.: Same
10. Address:
11. President: 12. Gen. Mgr.:
13. Principal Metals: Cu Mo 14. No. Employed:
15. Mill, Type & Capacity:
16. Present Operations: (a) Down ☐ (b) Assessment work ☐ (c) Exploration ☐
    (d) Production ☒ (e) Rate 40,000 tpd.
17. New Work Planned: Sinking two new shafts near present muck shaft. New Stack for smelter additions to be built.
18. Miscl. Notes:

Date: 4-24-69

(Signature) (Field Engineer)

A ONA DEPARTMENT OF MINER RESOURCES
Mineral Building, Fairgrounds
Phoenix, Arizona

1. Information from: Hugh Steele & Frank Hoagland. & visit

   Address: Drawer M San Manuel

2. Mine: San Manuel 3. No. of Claims - Patented ?

   Unpatented

4. Location:

5. Sec # Tp 8&9S Range 16E 6. Mining District Old Hat, Tiger, San Manuel Mammoth.

7. Owner: San Manuel Copper Corp. 80% owned by Newmont.

8. Address: Drawer "M"

9. Operating Co.: San Manuel

10. Address: Drawer "M" San Manuel

11. President: W. Goss 12. Gen. Mgr.: John F. Wise

13. Principal Metals: Cu Copper 14. No. Employed: 2017

15. Mill, Type & Capacity:

16. Present Operations: (a) Down ☐ (b) Assessment work ☐ (c) Exploration ☐
    (d) Production ☒ (e) Rate 41,000 tpd.
    41,000

17. New Work Planned: CEMENTATION Co. has about 200 men employed sinking two new shafts.

18. Miscl. Notes:

Date: 1-30-69

(Signature) (Field Engineer)

DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
FIELD ENGINEERS REPORT

Mine Magma Limestone Quarry (San Manuel Division) Date May 18, 1961

District San Pedro District, Pinal Co. Engineer Lewis A. Smith

Subject: Quarry Visit

Location: NW¼ Sec. 8, T. 7 S., R. 16 E. (2 miles southwest of Feldman).

The quarry now has three benches about 40 feet high, the longest of which is about 500 feet, and the shortest or top bench is 200 feet. The limestone is of Carboniferous age and outcrops in a narrow belt which trends N 45°W. The belt is about 2 miles long and about 1/4 mile wide. It is underlain by the Apache formation which in turn overlies granite and schist. The region is known as the Block Hills because it is largely composed of several block faults. The entire borders of the block are Gila Conglomerate or later gravel and lake deposits. A diabasic sill splits the Apache Formation block into two relatively narrow bands. The Apache locally is underlain by schist at 2 miles west of the quarry. The sediments dip roughly to the NE.

The quarry is situated in the southeast tip of the Carboniferous band. Expansion of the pit is being developed to the northwest. A good haulage road connects the quarry with Highway 77 or the San Manuel Arizona R.R.

Preliminary Report on the evaluation and extraction of the values from the old Tiger mill tailings at Mammoth, Ariz.

It is estimated that the old dump contains 200,000 tons arrived at by boring and assaying the cores of 38 auger holes on 100 foot grids. The overall average is as follows:

Metal present	Assays % or ounces		Assay values contained in dollars & cents per ton
Lead	0.83	@ 14¢ per pound	$ 2.32
Molybdenum	0.15	@ $1.30 "	3.90
Copper	0.15	@ 26¢ "	0.78
Tungsten	0.03	@ $1.00 "	0.60
Gold	0.04	@ $35.00 per oz.	1.40
Silver	0.03	@ $.90 " "	0.27
TOTAL VALUE			$ 9.27

Proven recovery 77.98 per cent on the Molybdenum and Lead in the mill by gravity and flotation. Proven total recovery in the mill and the chemical plant on all values listed 58.33 per cent.

Estimate of costs on tonnage basis:

Handling of mill feeds	$ 0.25
Water development & maintenance for mill	0.10
Power for complete milling plant	0.10
Flotation maintenance labor included	0.25
Flotation reagents	0.46
Gravity concentration labor included	0.25
Tailings disposal	0.10
Erection of mill to treat 250 tons per day	0.15
Insurance and supervision	0.10
	$ 1.76
Added ten percent for unknowns	0.18
TOTAL ESTIMATED MILLING COST PER TON	$ 1.94

Chemical treatment per ton of mill heads; this includes plant erection, labor, operating costs, and a profit if it is desired to keep it a separate business ---------- $ 2.00
TOTAL ESTIMATED COST OF EXTRACTION ---------- $ 3.94 per ton

Proven recovery of total values of 58.33%	$ 5.41
Estimated cost of recovery	3.94
ESTIMATED PROFIT PER TON OF FEEDS OR HEADS	$ 1.47

From all indications from experiments and figures of no importance here I am more than confident that a total overall recovery of values contained can be raised to exceed 85 per cent. As the case usually is in practice, experience is gained and the first estimate is exceedingly low. Also I am confident that these cost estimates will prove to be somewhat lower when operation is actually entered into, as cuts can be applied in many ways that are not considered in an estimate of this nature.

Figuring on the basis of an 85 per cent recovery, the total recoverable value is $7.78. Deducting operating cost of $3.94, the net profit is increased to $3.84; and I am confident that costs can be lessened to increase the net profit to exceed $4.00 per ton.

Respectfully presented this 2nd day of October, 1957.

signed
CharlesWalter
Chemical & Metallurgical Consultant
Lordsburg, New Mexico

A.J. Marcotte
Box 52
Klondyke Arizona

THE SAN MANUEL OXIDE PROJECT

The Open Pit Mine

The San Manuel Open Pit Mine is a medium-size operation currently scheduled to produce approximately 19,000 tons per day of copper ore and 33,000 tons per day of waste over an eight year period. The 4,400-ft. long by 2,400-ft. wide by 1100-ft. deep open pit contains approximately 154,000,000 tons of material, of which an estimated 55,000,000 tons is oxide copper ore averaging 0.375 acid soluble copper and 3,000,000 tons is sulfide copper ore averaging 1.16 total copper. The stripping ratio is 1.7 to 1 or 1.7 tons of waste mined per one ton of copper ore mined.

The predominant oxide copper mineral is chrysocolla, which is processed on the leach dumps, utilizing a weak sulfuric acid solution to recover the copper. The common sulfide minerals are chalcocite and chalcopyrite, which are to be processed in the sulfide mill and smelter.

The open pit is partially within the large subsidence area that has resulted from the past 34 years of block caving. This close proximity to the subsidence zone has provided many unique conditions of the open pit, a few advantages which have resulted in significant cost savings, and some disadvantages which challenge mining operations. These include:

- The subsidence zone is a favorable location to dump a portion of the waste material, allowing shorter truck haulage distances over the life of the project.

- The underground dewatering system has dewatered the open pit, which permits dry material blasting techniques to be utilized. Dewatered pit slopes will also enhance slope stability due to the reduced water pore pressures within the rock.

- Within an adjacent to the subsidence zone the rock formations have been fractured and displaced, reducing the inherent competency of the rock. Depending upon the rock type, this results in favorable or unfavorable blasting and mining conditions, and also adversely affects slope stability.

Adequate fragmentation is accomplished by drilling 35-ft. deep, 9-7/8-in. diameter blast holes with three truck-mounted Ingersoll-Rand T5BH rotary drills. The spacing of the blast holes and the amount of explosives used is determined from the specific conditions of the material being blasted. The blast holes are charged with an average of 350 pounds of ANFO, a mixture of ammonium nitrate prills and fuel oil, which is an explosive, and detonated with 1-lb. primers in a delayed multiple row blast.

The blast hole cuttings are sampled and assayed for copper content to segregate the material as oxide ore, sulfide ore, or waste.

The loading equipment utilized in the open pit consists of two P&H 1200 hydraulic excavators equipped with a 13-cu.yd. dipper and three Caterpillar 992C wheel loaders equipped with a 12-cu.yd. bucket. These can load the haul trucks in less than four minutes.

The haulage truck fleet consists of 14 Unit Rig M100 Lectra Haul trucks with 1,050 hp diesel engines, electric drive dual wheel motors, and a rated capacity of 100 tons. They operate on roads that are a minimum 60 ft. wide and at a maximum grade of 10%. The oxide ore is hauled to the leach dump just north of the open pit; the sulfide ore will be hauled to a railroad siding near the underground mine production shafts west of the open pit where it will be added to the sulfide ore from underground and processed in the mill and smelter. The waste is hauled to various waste dumps within and adjacent to the subsidence area.

All surface mining equipment is maintained and repaired in a truck shop north of the open pit. All preventive maintenance is scheduled utilizing a computer which keeps track of the various equipment and component operating hours. The truck shop also contains offices for supervisors and engineers.

The Leach Dumps

Approximately 116 acres were initially prepared for oxide ore dump leaching. This area will increase to over 200 acres to accomodate the estimated 55,000,000 tons of oxide ore contained within the current open pit design.

The 116 acre area was grubbed, stripped, and graded to take advantage of the natural drainage for channeling the copper-rich or pregnant leach solution (PLS) toward a 5,000,000-gallon capacity collection pond. A 60 mill (0.060 in.) thick high density polyethylene (HDPE) liner was installed over the entire 116 acre area, creating an impermeable surface which prevents the loss of any PLS to the surrounding environment. The liner is covered with an 18-in. thick layer of select fill which protects it from the initial leach dump construction.

The typical leach dump has a surface area of 125,000 sq.ft. and a minimum thickness of 15 ft. To finish dump construction the dump surface is leveled and cross-ripped to a maximum depth of 7 ft., enhancing dump surface permeability. A network of distribution pipes and wobbler sprinklers are installed on the dump surface, allowing the application of a weak sulfuric acid solution, called raffinate, to the leach dump surface at a maximum rate of 0.8 gallons per minute per 100 sq.ft. of leach dump surface area. Dumps remain under leach as long as possible to maximize recovery.

As a raffinate percolates downward through the leach dump, it dissolves copper from the oxide ore and emerges from the bottom of the dump as PLS (pregnant leach solution) and drains into the PLS collection pond where it is pumped to a 10,000,000-gallon capacity plant feed pond located west of the solvent extraction and electrowinning (SX-EW) plant.

The PLS is drained from the plant feed pond and processed in the solvent extraction plant where the copper is removed from the PLS. This now copper-barren solution, or raffinate, flows into the 10,000,000-gallon raffinate pond east of the SX-EW plant. Sulfuric acid is added to the raffinate as may be required and then pumped back into the leach dump surface where the leach solution cycle begins again.

Solvent Extraction

The purpose of solvent extraction is to extract copper from a pregnant leach solution into an organic liquid. Copper is then stripped from the organic liquid to form a purified rich electrolyte for electrowinning.

The process consists of two phases, extraction and stripping and takes place in the mixer-settler trains in front of the EW building.

In the extraction phase (in the mixing chambers of the trains) the pregnant leach solution is mixed with organic liquid, a mixture of copper extractant in a high grade kerosene.

In the settling chambers, the organic liquid phase, now enriched with copper, naturally separates and floats to the top of the aqueous phase which is now barren of copper and is discharged to a 10,000,000 gallon raffinate pond to be recycled to the leach dumps.

The copper rich organic liquid is then "stripped" of its copper by a strong solution of sulfuric acid and copper sulfate.

In this stripping phase the copper ions move away from their organic liquid host and enter the sulfate electrolyte to be used in electrowinning.

The four mixer-settler solvent extraction trains each have two stages of extraction and one of stripping and each operates at approximately 4,000 gallons per minute flow-through of the pregnant leach solution.

Electrowinning

Electrowinning is the electrochemical process in which copper is taken from the electrolyte and plated onto a cathode.

It is similar to electrolytic refining at San Manuel with the primary difference in the anode material which is copper in refining and inert lead in electrowinning.

In refining, the copper anode dissolves into the electrolyte and deposits onto the cathode at the same time.

In electrowinning, the anode cannot dissolve so the source of copper is the electrolyte itself. As the copper is drawn from the electrolyte, free oxygen is released creating a mist which at San Manuel is suppressed by a layer of polypropylene beads.

Electricity for both processes is direct current throughout the electrolytic cells.

The electrowinning building has 188 cells of concrete sides and douglas fir bottoms lined with polyvinyl chloride.

Dimensions of the cells are 20', 3" long by 4', 2" wide by 4', 6" deep.

Each cell is fitted with 61 permanent lead anodes at the positive pole of the electrical circuits, and 60 stainless steel cathode mother blanks at the negative pole of the circuit.

Electrolyte from the solvent extraction settling chambers circulates through the cells at 42 gallons per minute. When the electric current is applied, the copper is plated on both surfaces of the cathode mother blank.

The copper plates out evenly onto the surfaces of the mother blank at the rate of 14½ pounds per day and, at the end of seven days, the two 100 pound cathodes are mechanically stripped from the mother blank, washed of residual electrolyte and stacked for transport to the San Manuel rod plant.

The mother blanks are recharged into the cells to start another 7 day electrowinning cycle.

Electrowinning operations are controlled from a glass enclosed central control room overlooking the cells and mechanical stripper.

All SX-EW functions are instrumented at the control room for monitoring and operational control by technicians.

The solvent extraction trains and electrowinning cell building (SX-EW) are designed to produce 50,000 tons per year of cathode copper.

In-situ Leaching

The SX-EW plant is also designed to accommodate the production of pregnant leach solution from in-situ leaching of additional soluble ores beneath the limits of the open pit and above depleted underground mine areas.

Approximately 175,000,000 tons of ore below the open pit may be available for leaching in-place (in-situ) by injecting leach solutions into the area and collecting them on the 2375' level of the underground mine.

This area which was formerly part of the underground mine has been rubblized and broken by the action of the subsidence.

Highest Purity Copper

Magma copper is sold primarily in the form of continuous cast rod, 5/16" in diameter, which is the standard feed stock in the copper wire and communications cable industry.

Modern, high speed wire drawing as well as cable winding and bundling machinery requires copper rod of the highest purity to eliminate breakage during wire drawing operations and to enhance productivity and overall produce quality.

The oxide project's solvent extraction-electrowinning provides the highest purity copper because trace elements are not introduced into the system in any of its processes.

Even so, every electrowon cathode is subjected to a strict quality control analysis to assure that appropriate standards are maintained for purity.

SAN MANUEL MINE (f)
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BHP Billiton

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NEWS RELEASE 10/27/2003 10:53:48 AM GMT

BHP Billiton to Initiate Closure of San Manuel Plantsite

(PRESSI.COM 10/27/2003) BHP Billiton today announced the transition of its BHP Copper Inc. idled San Manuel smelting and refining facilities from care and maintenance status to permanent closure. The facilities were placed into care and maintenance in May 1999 and have been idle since that time.

BHP Billiton has explored a number of options for the facilities, however none have led to a viable economic outcome. This announcement marks the end of 50 years of mining and smelting activity in San Manuel, Arizona.

The transition to full closure will not result in a significant reduction in manpower, since the current workforce is less than 40. The remaining workforce will focus on safety and environmental issues related to the closure.

President, BHP Copper Inc., Ben Wichers, said that transitioning of the plant site to closure would enable the company to implement a comprehensive approach to both the mine site, closed in January, 2002, and the plant site.

â œThe companyâ ™s continuing commitment to the protection of the environment and safety will be central to the closure process for these historic sites," Mr Wichers said.

The decommissioning and reclamation of the sites will be completed over the next five to seven years in cooperation with the appropriate regulatory agencies.

â œWe recognize the impact this will have on the community and we are committed to continuing to work with the people who are affected," Mr Wichers said.

Over the period of 50 years, the San Manuel smelter and mine have undergone major changes. The San Manuel facilities were first established in the 1940â ™s. In 1952, Magma Copper Company constructed the mine, plant, railroads and started developing the community of San Manuel. By 1972, the mine was processing more than 60,000 tons of ore per day. By the 1990â ™s, the operation included an open pit, solvent extraction-electrowinning operation, an in-situ leaching process, underground sulfide mine, concentrator, smelter, refinery and rod plant. In May 1999, a decision was made to curtail all operations at San Manuel due to low copper prices.

For more information contact:
Jeff Parker, San Manuel, Manager of Environmental and External

AFFAIRS. TEL. 1+520 385-3581

Mine: San Manuel
County: Pinal
ADMMR File: San Manuel Copper Mine

Engineer: Ken A. Phillips
Date: February 4, 1988

Subject: **San Manuel Mine Tour, January 29, 1988**

Prepared a field trip lecture for the AIME field trip to the San Manuel Mine and accompanied the tour to the mine. The mine tour consisted of a review of mining methods on the 2615 level which is the grizzly or transfer level beneath the sulfide ore body currently being mined by block caving methods. Mine production methods are being changed from using laborers to tap chutes (actually draw points) and load pockets to using LHDs to tram ore from larger draw points to a single larger grizzly pocket in each panel. The primary cost savings comes from a significantly reduced amount of development work required before a panel can be brought into production. The reduction in development work is planned to save over $40,000,000 in the live of the Kalamazoo. The new method has not been in operation long enough to determine if daily production efficiency is also improved. Ground support on the 2615 is handled by a combination resin and/or fast setting cement grouted 8 foot rock bolts, shotcrete and monolithic concrete. Under ground employment is about 1200. Ventilation for the entire mine is 1.3 million cubic feet per minute. Current production rate is 45,000 tons of sulfide ore per day. The underground mine is designed for a capacity of 65,000 tons hoisted per day. The record production was 71,000 ton in a single day. The mine holds the world record for the most all time ore hoisted of over 1/2 billion tons.

Inauguration of Air Quality System at San Manuel, Arizona
January 25, 1975

Comments by P. Malozemoff, Chairman of Newmont Mining Corporation

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The inauguration today of Magma's air quality maintenance system is an important milestone in the history of Magma and its parent company, Newmont Mining Corporation, and for the community of San Manuel and the State of Arizona. This new system represents an investment of more than $40 million and countless thousand man-hours. I think it is a testament to Magma's and Newmont's commitment to reasonable and effective air quality control. And I stress reasonable air quality control.

Reason often has to struggle to prevail; the effort to establish reasonable air quality standards has been no exception. A brief look at the history of the developments which culminated in the construction of this facility illustrates what I mean.

When the Arizona Board of Health first adopted regulations governing air quality, it followed the lead of the Federal Environmental Protection Agency, or E.P.A. as it is universally known, and chose a standard requiring a 90 percent reduction in the emissions of sulfur dioxide from smelters. This simplistic approach to control focused on emissions and overlooked that air quality at ground level is what humans and plants are affected by. Costs and availability of technology to meet these standards were not fully appreciated and were hardly considered.

While we viewed the State's initial standards as ill-considered, we decided to study all available and practicable technology that might readily attain such a strict requirement. The best approach at the time seemed to be the use of a flash furnace developed by a Finnish company. After an extensive engineering study by an American contractor, in cooperation with Finnish experts, the estimated cost of adapting this system to our smelter proved astronomical--$88 million--and other alternatives had to be considered. It is significant to note that this figure is several times the original cost of the entire San Manuel smelter when it was built in the 1950's, even if reduced in terms of 1950 dollars.

It soon became obvious that the cost to comply with a 90% emission limitation by any other practicable method was also prohibitively costly for the San Manuel smelter. Magma had to ask itself a fundamental question: Was the 90% emission limitation necessary to achieve an acceptable clean air level? In other words, did it have any logical relation to what was needed to protect the health and welfare of the prople of Arizona? The answer seemed to be "No", and the Board of Health was petitioned, by all the smelter operators, to hold hearings on the issues.

Extensive evidentiary hearings were held in December 1971, and May 1972, at which the copper industry made a full presentation of scientific, technical, and economic data on the issues. The Board of Health took note of all this information. It concluded that the early emission standard was indeed unduly onerous, and could impose unreasonable financial strain on some companies.

Most important of all, such standard was not necessary for the attainment of acceptably clean air. Based on all the facts before it, and with advice from its staff and outside experts, it adopted a new control strategy, one that endorsed a balanced application of continuous and intermittent emission control systems with ambient air standards that still provided ample margins for the protection of the public health and welfare. Thereafter the Board carried the same sound strategy into an implementation plan for meeting the largely comparable Federal ambient standards.

Even though the State's newly adopted ambient standards were more stringent than E.P.A.'s, the E.P.A. rejected the Arizona implementation plan. The E.P.A. issued a proposed substitute plan for Arizona which called for the capture of 94.6 percent of sulfur emissions in the case of San Manuel by 1977. These proposed regulations were, and still are, based on wholly inaccurate and erroneous data. More importantly, they are premised on a wrong view of the Clean Air Act, designed to strip from Arizona and vest in the E.P.A. control over existing sources in this State, in clear violation of the Clean Air Act. Before I comment further on this vital matter of continuing and urgent concern, let me complete the history of events.

Throughout this period, Dr. Kossuth, the Administrator, and members of the Board of Health were willing in open session to listen to reason; and all points of view were represented at these sessions. Also, because we were confident that common

sense and reason would ultimately prevail with the E.P.A. as well, we proceeded to construct the system being dedicated today. It should enable Magma to meet present State and Federal ambient air standards for sulfur dioxide. The sulfuric acid plant, which is the heart of the system, removes sulfur dioxide from converter gases. As a further control measure, eight monitoring stations have been established in the San Manuel area that measure the SO_2 content of the air and transmit their readings to the smelter. A computer evaluates these data and signals a rising trend line in time to allow curtailment in smelter operations to prevent excessive SO_2 emissions. This is what is called the intermittent control system, or I.C.S. for short.

The sulfuric acid plant, which is one of the largest, most reliable facilities of its kind, has the capacity to produce 2,000 tons per day. Most of this acid will be sold under long-term contracts. However, facilities are available to neutralize any unsold acid.

Further work is progressing on removal of particulates from the reverberatory furnace gas. One electrostatic precipitator has been installed, and two more will be completed by the third quarter of 1975.

I wish I could say to you that all is well now, having provided facilities to meet the State and Federal ambient air standards. But I can't. Even though we have spent more than $40 million to improve air quality, we are uncertain what the

Federal authorities intend to force upon the State of Arizona as an implementation plan, whether it can be met or how much it will cost us to meet it.

We believe the philosophy underlying the State of Arizona's control strategy and regulations for the attainment of national ambient air quality standards is basically sound and in accordance with Congressional intent to let the States regulate existing sources.

Right now it would appear that the E.P.A. dogmatically contends that the Clean Air Act forbids the use of intermittent control system except on a temporary E.P.A.-sanctioned basis.

The E.P.A.'s positive control approach compared to the presently adequate combination of the intermittent control system and acid plants will cause a profligate waste of extra money and energy. The adverse effects of this policy will not be confined to the copper smelting industry. Throughout the nation, the E.P.A.'s rigid opposition to intermittent control systems will require an estimated $5.5 billion or more of capital expenditures by the electric utility industry for flue gas scrubbers that are not needed to attain applicable air quality standards. This is at a time when capital resources for needed productive investment to curb inflation are under severe strains. Operation of these systems will consume a significant fraction of the generating capacity of the plants on which they are installed.

The E.P.A.'s regulations for new and modified sources would be even more severe. For example, the E.P.A. has proposed that new and modified smelters be provided with double absorption facility to convert 99.5 percent of sulfur rather than the

average of 95 percent of a standard plant. Because availability of the more elaborate double absorption plant is lower, on an annual basis only a very small reduction in sulfur dioxide emission is likely with it. Yet the double absorption system sould consume over 50 percent more electrical power and over 2,000 percent more fuel oil.

I think the size of our present investment in the acid plant facility and auxiliaries is testimony to our good will and desire to eliminate undesirable emissions to whatever degree is necessary to protect the health and welfare of the citizens of the State. Every piece of pollution control equipment costs money, and we consider these costs reasonable when they truly protect public health and welfare. We view these as unreasonable when they do not serve that end.

We strongly oppose the E.P.A.'s present position against the intermittent control system. We hope that the Department of Health Services and other responsible State offices continue to defend the State's control strategy, just as they have defended their own planning with respect to transportation regulations against the E.P.A.'s arbitrary and unrealistic proposals.

Judging by E.P.A.'s actions in other states, in Nevada and Utah in particular, where extensive hearings and litigation are in course, there is a real danger of interference from Washington not only with the implementation of the State plans but with the very health and growth of the industry. The industry and the people of the State should be alert to the threat of this

interference, as it will affect the well-being not only of the copper industry, which is so important to the State, but of the people of the State if the industry is crippled.

#

FOR IMMEDIATE RELEASE

January 25, 1975

SAN MANUEL, ARIZONA, JANUARY 25, 1975 -- The State of Arizona should defend itself against the interference of the Federal Environmental Protection Agency in the establishment and enforcement of ambient air quality standards, Plato Malozemoff, Chairman of the Board and Chief Executive Officer of Newmont Mining Corporation, said today at the inauguration of an air quality maintenance system at its wholly-owned subsidiary, Magma Copper Company.

"Judging by E.P.A.'s actions in other states, in Nevada and Utah, in particular," Mr. Malozemoff said, "there is a real danger of interference from Washington not only with the implementation of State plans but with the very health and growth of the copper industry."

Mr. Malozemoff called on the Department of Health Services and other responsible offices to "continue to defend the State's control strategy, just as they have defended their own planning with respect to transportation regulations against E.P.A.'s arbitrary and unrealistic proposals."

The Newmont executive said that the E.P.A.'s insistence on positive control causes a "profligate waste of extra money and energy."

The new air quality system at San Manuel, which cost about $40 million, is designed to enable Magma to meet present State and Federal ambient air standards for sulfur dioxide. The sulfuric acid

...more...

NEWS FROM MAGMA
MAGMA COPPER COMPANY
Subsidiary of Newmont Mining Corporation
P. O. Box M, San Manuel, Arizona 85631
Public Relations Officer—Frank Harris (602) 385-2201/385-2153

plant, which is the heart of the system, removes sulfur dioxide from converter gases. As a further control measure, eight monitoring stations have been established in the San Manuel area that measure the sulfur dioxide content of the air and transmit their readings to the smelter. A computer compiles these data and signals any rising trend line in time to allow curtailment in smelter operations to prevent excessive sulfur dioxide emissions. The San Manuel air quality system is called the "intermittent control system."

Mr. Malozemoff noted that despite the Company's efforts to improve air quality, "we are uncertain what the Federal authorities intend to force upon the State of Arizona as an implementation plan, whether it can be met and how much it will cost to meet it."

"We believe the philosophy underlying the State of Arizona's control strategy and regulations for the attainment of national ambient air quality standards is basically sound and in accordance with the Congressional intent to let states regulate existing sources," Mr. Malozemoff said.

"Right now it would appear that E.P.A. dogmatically contends that the Clean Air Act forbids the use of the intermittent control system except as a temporary E.P.A.-sanctioned basis," Mr. Malozemoff added.

# # # #

FOR IMMEDIATE RELEASE

January 25, 1975

Magma Copper Company, Arizona subsidiary of Newmont Mining Corporation, inaugurated the air quality maintenance system for its San Manuel smelter today in special ceremonies attended by representatives of federal, state and county government, businessmen, and the Boards of Directors of Newmont and Magma.

The air quality system, which began start-up operations on September 14, 1974, includes a sulfuric acid plant for control of sulfur dioxide gases, electrostatic precipitators for the control of particulates, and an air monitoring system to continuously measure ambient air quality.

Wayne H. Burt, president of Magma, said that "while some work remains toward the completion of the precipitators, the smelter should be in substantial compliance" with Arizona clean air standards for sulfur dioxide by March 5, 1975 the deadline imposed by the State Air Pollution Hearing Board.

But, he said that E.P.A. imposed regulations for particulate controls could be met only partially by March 5 because of delays caused by late changes in E.P.A. standards and delays associated with a construction workers' strike and deliveries of critical materials.

Burt said that one unit of the new electrostatic precipitator was operating now and that the entire system would be completed and on line in the third quarter of 1975.

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Regulations require Magma to exercise positive control over approximately 60% of the sulfur dioxide and approximately 99% of the particulates. The new system is designed to control up to 70% of the sulfur dioxide and to meet the particulate control standards.

The $40 million project was funded in part by $30 million in municipal-type bonds of the Pinal County Industrial Development Authority, the first of many similar issues authorized by the State Legislature to assist in air pollution control projects.

The $30 million Pinal County bonds were guaranteed by Magma and were used in the construction of the Sulfuric Acid Plant.

Other project items included smelter modifications and gas handling system, acid handling and shipping facilities, acid neutralization plant and limestone quarry, and the air monitoring network.

Magma will sell all of the acid it is able to market but must provide for neutralization and discarding of any surplus which cannot be beneficially used or sold.

For neutralization, the acid is mixed with crushed limestone to form a neutral gypsum slurry which is mixed with concentrator tailings. The process consumes a ton of limestone and a ton of water for each ton of acid and costs as much as the production of the acid itself.

Magma has long term contracts for most of the acid with the Anamax-Twin Butte Company for leaching low grade copper ores and has been making acid deliveries since September to fertilizer, mining, and industrial customers throughout the Southwest.

Current production from the San Manuel sulfuric acid plant is 1,600 tons per day of commercial quality acid. The plant has the capacity to produce up to 2,000 tons per day.

...more...

The air monitoring system which began operations in September 1972, continuously measures weather conditions and sulfur dioxide concentrations from eight stations within the area influenced by the San Manuel Smelter.

Burt said the monitoring system insures that ambient air quality standards around San Manuel are being met and serves to alert the smelter if it is necessary to curtail operations maintain control over emissions necessary to insure meeting the standards at all times.

# # # #

FOR IMMEDIATE RELEASE

January 25, 1975

MAGMA HAS COMPREHENSIVE AIR QUALITY MAINTENANCE PROGRAM

Both direct emission controls and air pollution monitoring figure prominently in Magma Copper Company's comprehensive program for maintaining air quality around its San Manuel, Arizona, copper smelter.

Magma, Newmont Mining Corporation's major subsidiary and the leading Arizona producer of cathode and continuous cast 5/16" redraw rod, has invested $40 million in a sulfuric acid plant, smelter modifications, acid neutralizing facilities, and a supplemental control system based on extensive air monitoring.

The program which began start-up operations on Sept. 14, 1974 is the culmination of long study and planning which grew out of Magma's and Newmont's determination to identify and control air quality problems in the area of influence of the smelter which is designed to treat up to one million tons of copper concentrates per year.

Arizona's air pollution control regulations require Magma to exercise "direct emission control" over 59.6% of the sulfur dioxide produced in smelter operations.

The state also permits the use of a supplemental control system and intermittent production curtailments to insure that ambient air standards are not exceeded.

MAGMA COPPER COMPANY
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Magma's sulfuric acid plant was designed to keep emissions well within that standard and has additional capacity to handle any planned increase in smelter production rates.

The acid plant will control and treat approximately 96% of the SO_2 generated by the smelter converters and will be capable of producing up to 2,000 tons per day of acid.

The weaker reverberatory furnace gases will be cleaned of 99% of particulate matter in new electrostatic precipitators before entering the stack. These gases contain less than 2% sulfur dioxide. Thus, overall sulfur dioxide control, averaged between the converters and the furnaces, will be 70%, well within the 60% required by the state.

Current acid production is approximately 1,600 tons per day. Present market conditions provide an outlet for most of the acid, but any excess must be neutralized in a limestone slurry to produce gypsum for on-line disposal with concentrate tailings.

Even before acid plant construction began, Magma's air monitoring system went into operation with two stations in September of 1972 and with six additional stations added later.

The network of eight stations was installed at points of highest SO_2 concentrations predicted by diffusion modeling techniques based on extensive field study of the area meteorology and the smelter emission characteristics.

Newmont and Magma engineers selected continuous coulometric SO_2 monitors and low threshold weather sensors, and erected air-conditioned metal buildings in the remote locations.

...more...

Every three minutes the SO_2 concentration and weather information, converted to digital data, is sent by high frequency radio to a central data processing unit which both stores and prints-out the information for immediate use by Management.

Up to now, the monitoring system has reported that violations of air standards have occurred less than 3% of the total time at the points of highest SO_2 concentrations in the area.

Magma believes that small margin will be eliminated when the acid plant is in full operation but, even so, plans to go one step further and will begin predictions of SO_2 concentrations which could result from unusual weather or operating conditions.

Computer programs provide the capability to anticipate conditions which could contribute to SO_2 concentrations above ambient air standards.

Magma is able to predict the concentrations and base operation schedules on continuously updated data, if necessary, for supplementary emission control.

The San Manuel supplemental control system is a refinement of those successfully in use in Rotterdam and Pittsburgh and has received high praise from Arizona's air pollution control officials.

The system is supervised by two full-time meteorologists who have installed an additional network of 45 sulfation plates to monitor long-term SO_2 concentrations in a wide area beyond the perimeter of the permanent stations.

Daily teletype weather reports from the U.S. Weather Service, together with local monitored data, gives day-to-day forecasts of weather and pollution potential.

# # # #

While Magma officials believe that they have achieved the best possible control over smelter emissions, they also believe that other problems remain and can best be solved with similar thorough planning, research, and a positive approach.

# # # #

MAGMA COPPER COMPANY'S SULFURIC ACID PLANT

SAN MANUEL, ARIZONA

PROCESS DESCRIPTION

Type of Plant:	Two-train, single absorption, sulfuric acid plant.
Approx. Normal Operating Production:	1,600 tons per day
Approx. Peak Capacity Production:	2,480 tons per day
Manpower:	30 employees
Product Acid:	Clear, commercial grade sulfuric acid with a minimum concentration of 93% and maximum of 98%. Normal product will be 93.6% commercial strength.
Storage Capacity:	20,000 tons of sulfuric acid at railroad loading site.
Efficiency:	98% conversion of sulfur in smelter converter discharge gases.
Feed Gases:	Waste gases including Sulfur Dioxide produced by copper smelter converting process.
Basic Process:	Sulfur dioxide gas from the smelter converters is cleaned, cooled, and chemically converted into sulfur trioxide which is absorbed into a sulfuric acid solution. Five basic processes are:

1. Collection and movement of hot sulfur dioxide gases from operating smelter converters to acid plant.

2. Cleaning, cooling, and drying of gases.

3. Conversion of sulfur dioxide to sulfur trioxide.

4. Absorption of sulfur trioxide into acid.

5. Storage, shipment or neutralization of acid production.

1. Collection of Gases

Converters are equipped with water-cooled hoods which close during the blowing cycles to entrap sulfur dioxide, limit fugitive emissions, restrict ambient air from diluting the gas, and direct the gases into high velocity flues. The flues are pipes through which the gases are carried by large fans and deliver the gases, cooling by about 50% as they flow, to electrostatic precipitator where large particles and dust are entrapped and returned to the smelter furnaces because of their metallic content.

2. Cleaning of Gases

Gases flow from precipitator to Humidifying Tower where they flow upward through a spray of weak acid (scrubbing). Gas, now at maximum of 700°F begins to cool as water evaporates from the weak acid.

Major cooling is brought about in the Cooling Tower through which

the gases are now moved. Cooling is also achieved by acid evaporation but acid is now kept at a cool temperature by discarding its heat to carbon tube heat exchangers (which use circulating water).

Dust, metallic fumes, and trace acids and other gases are removed and "floated" away in both the Humidifying and Cooling processes. Liquids and solids flow to a sump for neutralization and/or recovery of any metallic values.

Continuous cleaning of gases occur as they are drawn through three parallel banks of two electrostatic precipitators which remove the remaining traces of acid mist and any solids.

In the precipitators the gas, passing up charged tubes, receives an electrical charge and the charged particles are attracted to and deposited upon an electrically grounded collecting cable. The acid mist washes down the solids and the effluent is used as make-up acid for the previous cooling and humidifying processes.

Leaving the precipitators, the gas is split into two identical trains, or systems, for further processing, the first stage of which is drying.

3. Conversion to Sulfur Trioxide

The process gas flows through the Drying Tower and across a large surface volume flow of a strong (93%) sulfuric acid. The natural drying action of the acid removes the water vapor from the gas. Any acid mist remaining in the gas is eliminated by mist eliminators.

From the Drying Tower, gas enters the Main Compressors. The gas

passes through three heat exchangers for heating up to the 750°F temperature necessary for the main chemical converting reaction to take place.

The gas makes four consecutive passes through the Converting Tower where, in the presence of a vanadium pentoxide catalyst, 99% of the sulfur dioxide is converted to sulfur trioxide (SO_3). Each pass generates heat requiring the gas to be cooled before each subsequent cycle, and additional conversion of SO_2 to SO_3.

Temperature limits in the Converter are critical to maintain an efficient process and are controlled by the cooling heat exchangers and a Preheater. Additional heat may be required for start-up and a low-strength sulfur dioxide gas conversion.

4. Absorption into Sulfuric Acid

Having been converted to sulfur trioxide, the process gas passes to the Absorbing Tower where it is absorbed into a flowing high strength (98-99%) sulfuric acid (H_2SO_4).

Any gaseous materials remaining after absorption are passed through a mist eliminator before exiting to the atmosphere through one of the two acid plant stacks.

Strong acid circulating systems for drying and absorption are separate but interconnected for control of strength and temperature.

Gas flows are maintained by two operating (and one standby) centrifugal air compressors, each with a capacity of 135,000 cubic feet per minute and driven by 6,000 HP motors.

5. Neutralization or Storage of Acid

Product acid or acid waste is neutralized by mixing with a crushed limestone slurry, producing an inert gypsum ($Ca\ SO_4\ 2H_2O$) also in the form of a slurry. This flows to the concentrator tailing disposal system, mixes into the tailings, and is carried to the impoundments as an integral part of the tailings. All tailings water is recovered and pumped back to the mill where it is clarified and recycled at the rate of 28,000 gallons per minute.

Acid may also be stored for long periods in steel tanks if it is of sufficient strength inasmuch as pure sulfuric acid is non-corrossive to steel.

# # # #

January 1, 1975

NEWS FROM MAGMA
MAGMA COPPER COMPANY
Subsidiary of Newmont Mining Corporation
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Public Relations Officer—Frank Harris (602) 385-2201/385-2153

ENVIRONMENTAL AIR MONITORING SYSTEM

MAGMA COPPER COMPANY

SAN MANUEL, ARIZONA

Purpose

-- To supplement the direct air pollution controls imposed on the San Manuel Copper Smelter and

-- To insure maintenance of Arizona ambient air quality standards in the area influenced by the smelter, by

-- Continuously monitoring levels of sulfur dioxide, and

-- Continuously monitoring changing weather conditions.

Started

September 1, 1972 with two stations

January 10, 1973 with seven stations reporting

Stations

Permanent buildings containing sulfur dioxide analyzers, thermometers, wind sensors, analog to digital converters, and radio transmitters. Equipped with air conditioning and radar intrusion alarms.

Reliability

All instruments and equipment meet or exceed specifications of the Environmental Protection Agency. Equipment used by EPA itself as well as other public agencies in five other states notably in the Pittsburgh-Allegheny County area and in Rotterdam, Holland.

Locations	Air Distance From Smelter
San Manuel	1.2 miles
Mammoth	7.3 miles
Oracle	8.2 miles
San Manuel Mine	6.5 miles
San Manuel Golf Club	1.9 miles
Redington	15.6 miles
Peppersauce Wash	3.6 miles
Mobile station	Variable

Operation

Instruments continuously measure environmental data, transmit it every three minutes by radio to IBM System 7 computer at Magma Copper Company in San Manuel. Assisted by a DSC-Meta 4 computer, the data is both printed-out for immediate information and is stored for future reference.

Display Map

In addition to the data print-out, display maps located in top management offices contain lights, representing each station, which blink when air standards are exceeded.

Site Selection

Made by Stanford Research Institute, Menlo Park, Calif. based on extensive study of area meteorology and smelter emission characteristics. Mathematical model calculations of plume behavior were made for 16 different directions at 40 different distances under 1,440 different combinations of weather conditions. Other model configurations considered frequency of occurrence and changing smelter

Operational conditions. Site locations were based on:

1. Areas of highest population concentrations.
2. Areas subject to highest concentrations of SO_2 or long-term concentrations of SO_2.
3. Areas for obtaining best data for continuing scientific investigation.

Results

Stanford Research Institute accurately predicted points of greatest concentration of Sulfur Dioxide for locating monitoring stations. Highest concentration has proven to be at the San Manuel Golf Club location, about two miles northwest of the smelter. Since monitoring began there over two years ago, and prior to startup of the acid plant, the Golf Club station reported a violation frequency of the State primary ambient air standard for an overall 2.9% of the total time in operation. (i.e. out of a two year period the State's most rigid air standard was violated only 2.9% of the time at the point of highest concentrations of sulfur dioxide in the area of influence of the San Manuel smelter.)

The point of lowest pollution was predicted to be Redington where the monitor has recorded a violation frequency of 0.1% of the State's primary standard. The Mammoth monitor also has recorded a frequency of 0.1% violations. The Oracle monitor has recorded a frequency of 0.2%. The San Manuel monitor, closest to the smelter, has experienced a 2.4% frequency. These monitoring results show that air pollution from the smelter is highly local and is predictable.

System Checks

One check of system accuracy is network of 45 sulfation plates located in well exposed locations both at monitoring sites and in a wide area several miles beyond the perimeter of the permanent monitoring stations. Plates are changed monthly and SO_2 values compared to monitoring results. Plates are particularly useful for indicating long term concentrations and may be used to locate future additional monitoring sites.

Meteorology

The Magma staff meteorologist interprets data from the environmental air monitoring system and gives day-to-day forecasts of weather and pollution potential. He receives U.S. Weather Service teletype data which, together with monitoring system weather data, is a base upon which a mathematical model can be constructed and, utilizing computer technology, can give reliable predictions of potential air pollution episodes. These predictions will enable smelter management to curtail or reschedule emission producing operations to avoid any violations of air standards which may occur in spite of direct controls imposed on the smelter.

Closed Loops and Intermittent Controls

While it will not be used as the primary emission control system for the San Manuel smelter, the Magma environmental air monitoring system is a good example of the "Closed Loop" or "Supplemental Control System."

A "Closed Loop" system relates actual air quality to the level of smelter operations and maintains a given level of air quality by controlling smelter operations to permit only those emissions which will not compromise that standard.

Equipment & Instruments

Phillips	Coulometric Sulphur Dioxide Analyzers	
Climet	Wind and Temperature Sensors	
Motorola	Two-Way High Frequency Radios	
	Computers	
IBM	(a) System 7	Data Collection
DSC	(b) Meta 4	Data Processing

NEWS FROM MAGMA
MAGMA COPPER COMPANY
Subsidiary of Newmont Mining Corporation
P. O. Box M, San Manuel, Arizona 85631
Public Relations Officer—Frank Harris (602) 385-2201/385-2153

Jan. 1, 1975

REMARKS OF PLATO MALOZEMOFF
CHAIRMAN AND PRESIDENT, NEWMONT MINING CORP.

DEDICATION OF NEW ELECTROLYTIC COPPER REFINERY
SAN MANUEL, ARIZONA

JANUARY 29, 1972

Governor Williams, honored guests, and friends. Your presence here today at the dedication of this new refinery of Magma Copper Company is, I assure you, a source of great pleasure and pride to all the men and women of Magma and of Newmont and the contractors who had a part in designing and building this facility. It is a project of great significance, not only to Magma and Newmont Mining Corporation, but to the State of Arizona and its citizens as well.

It is almost exactly three years ago this month that we started investigating the advisability of having a refinery. The problem was complex, not only economically and commercially but technologically as well. Various sites were studied with respect to geographical distribution of demand and corresponding freight rates. All of us involved wanted to build the most advanced refinery possible, and other recent refineries were studied in detail. Teams of engineers visited refineries in various parts of the country and abroad. I, myself, headed up such a team in Japan. No stone was left unturned in getting the best in equipment, in design, in the choice of men of expertise who did the work and who will operate this refinery. We are proud to show you today the result of these intensive and varied efforts.

Although the name of Newmont Mining Corporation has been heard frequently in Arizona only in the last few years, our connection with the Arizona mining industry began back in 1910 when Colonel William Boyce Thompson, the founder of Newmont, incorporated Magma Copper Company to operate a small mine, the Silver Queen, at Superior, Arizona, that he had purchased for $130,000 on the recommendation of his geologist, Henry Krumb, who thought that it might make a copper mine. From that rather unimpressive beginning, the Silver Queen grew into the Magma Mine, which is today, after all these years, undergoing an expansion that will double its capacity and greatly improve its productivity.

Of course, the outstanding achievement of Magma Copper Company is the enterprise at San Manuel that you see all around you. From its early beginnings of a few holes drilled by the U. S. Bureau of Mines in 1944 and 1945, there followed acquisition of the prospect by Magma and a comprehensive exploration program, and, in due course, the development of the entire San Manuel project.

Today, 61 years after Colonel Thompson incorporated Magma, the company is in the front rank of copper producers in the United States. With the completion of this refinery, Magma is now one of the very few copper producers with integrated production facilities at one location, complete from mine through semi-fabrication.

Obviously this growth is of tremendous significance both to Magma and to the parent company, Newmont. What has it meant to Arizona? Since that first investment of $130,000

made by Colonel Thompson at Superior, Magma Copper has invested approximately $370 million in property, mining development, plant and equipment and townsite.

More significant to the citizens of Arizona are the figures for Magma's expenditures for wages and for state and local taxes. Since 1910 through 1971, Magma has paid state and local taxes amounting to a total of $58 million, and has paid in salaries and wages to its employees in Arizona the total of $530 million. When you remember that Magma, after our expansion program is completed, will be producing only about 20 per cent of Arizona's copper, you gain an idea of what the copper industry means to this state.

Although the growth from humble beginnings in 1910 to what you see around you today has been truly impressive, I dare say it will not stop at this point. We do not regard this refinery as the final step in Magma's development. I cannot now give you a specific outline of plans for the future, but I can assure you that we do have the future very much in mind. A potential for further growth does exist, if a means can be found to bring it to fruition.

This refinery will add some 275 jobs to Magma's payroll at San Manuel, which in turn has required the addition of a corresponding number of residences to the community. In turn, this adds substantially to the payroll in the tri-community area, and the influx of new funds should be noticeable in Tucson as well.

To Magma, the refinery means that by doing the refining job ourselves instead of paying others to do it, we

achieve certain economies in production, and we avoid having to ship our copper back east for refining and back west again for sale. Therefore, we are able to provide better service to our customers, and it is quite possible that this circumstance may encourage other industries to come to Arizona to take advantage of this improved service, as some already have.

Actually, the trend in the copper industry whereby more and more copper fabricators were moving westward was one of the things that encouraged us to build our refinery here. We were not the first to observe this trend. The continuous-cast rod mill of Inspiration Consolidated Copper Company at Miami preceded ours. Although our refinery and casting plant is quite a bit larger than Inspiration's, we salute their enterprise, and acknowledge their generosity in providing us with information on their experience with their new facility.

As to the future, in designing this refinery provision was made for a 50 per cent expansion if the raw material can be supplied in sufficient quantity. Whether or not this can be done is still open to question, but we have sufficient confidence in the State of Arizona and in the basic health of the copper mining industry to believe that it can, and will, be done.

Some extreme critics of our industry have suggested that the end of copper mining is in sight, and that Arizona can look forward to not much more than a legacy of ghost towns and abandoned smelters. I hope while you are here

you will have an opportunity to drive through San Manuel and see for yourselves the kind of community that our people have built here. Long before the ore bodies we are now working have become exhausted, I hope that our present management and those managements who will follow, will have found other ore bodies, other productive means, other resources that will fit together with those facilities you see here today to insure that there will be no ghosts in the foreseeable future of San Manuel. That this is not an empty hope is testified to by the exploration efforts our geologists have been making across the San Pedro Valley at Copper Creek, where we have had some indication of success.

Before closing, I should like to comment on the problem of air pollution. First, let me say that Magma is committed to clean up our smelter emissions to whatever degree it may be necessary to protect the health and welfare of the citizens of Arizona. Second, Newmont and Magma have a commitment to our shareholders, our employees, and to the general public of all of the United States to remain strong and productive companies, able to contribute effectively to the national economy, dependent as it is on adequate supplies of copper at reasonable cost. These two commitments are obligations that we must reconcile and must discharge faithfully. We have earnestly devoted our energies to this end, and we will continue to do so with every means reasonably available to us.

Thank you, Governor Williams, for meeting with us here today, and my thanks also to each and every one of our guests here today for joining us on this happy occasion. I also want to express the appreciation and pride that Newmont and Magma managements and Boards of Directors feel in the accomplishment, dedication and skills of all employees present who have worked hard and have brought about the successful completion of the refinery we are dedicating here.

# # # #

Recently the State Board of Health of Arizona decided not to base Arizona's air quality program on the Federal ambient air standards. Strong evidence exists, and was presented to the Board, that the Federal standards are more than ample to protect health and welfare in Arizona, and to maintain the air quality we all wish to have. We are convinced, and are willing to demonstrate, that we can meet the Federal standards without excessive economic hardship to ourselves or to Arizona's economy. To meet the present Arizona's standards will cause such hardship and will damage the state's economy, and would have serious and lasting effects on the U.S. strategic political and economic position with respect to copper, an indispensable metal in our civilization. I am sure no one wishes this to occur. This has been recognized by the Federal Government and the Environmental Protective Agency has urged the states to avoid such consequences. I hope that further deliberation will bring about in Arizona a recognition of this fact, and that appropriate action will result.

MAGMA DEDICATES ELECTROLYTIC COPPER REFINERY AT SAN MANUEL

SAN MANUEL, ARIZONA, Jan. 29, 1972 -- The Arizona copper industry entered a new dimension in world copper markets with the dedication here today of a new electrolytic copper refinery which will produce 200,000 tons per year of pure copper for direct sale to fabricators.

The Board of Directors of Newmont Mining Corporation, and its president and chairman Plato Malozemoff, were in San Manuel to dedicate the refinery and to host leading Arizona government leaders, including Governor Jack Williams, and also representatives of Arizona business, as well as copper buyers from throughout the United States.

Magma Copper Company, a subsidiary of Newmont Mining Corporation, will produce and market continuous cast 5/16-inch copper redraw rod, full plate cathode copper, and sheared cathode plate under its own brand name, MAGMA.

The new refinery and rod-casting plant, among the four largest in the nation, makes Magma a fully, vertically integrated copper production company from mining through smelting, refining, casting, marketing, and shipping.

Wayne H. Burt, president of Magma, said the electrolytic refinery project was the culmination of a three-year expansion and

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NEWS FROM SAN MANUEL AND SUPERIOR

MAGMA COPPER COMPANY
P. O. Box M, San Manuel, Arizona 85631
Public Relations Officer — Frank Harris (602) 385-2201 / 385-2153

modernization program of Magma's properties at San Manuel and Superior, which has resulted in local capital investments of more than $250 million.

Burt said that by increasing mine output, centralizing smelting at San Manuel, installing a broader program of quality control, and providing on-site electrolytic refining, Magma could produce a higher quality copper more efficiently and provide greater stability for continued long-term operations in Arizona.

Built at a cost of $34 million, the refinery and rod casting plant utilize mechanization and automation for efficient mass production as well as a safer work place for employees.

The plant has a controlled environment which not only provides clean and comfortable working areas, but also controls against corrosion and contamination in production processes.

All materials used in the plant are recycled and there is no waste or discard and no emissions into air, water, or land.

When in full production, the operation requires 275 trained employees. Magma's current San Manuel work force is approximately 3,200.

The electrolytic copper refining process involves the exchange of metallic copper ions through an electrolytic solution from the smelter anode onto a pure copper starting sheet core. The copper deposit builds up into a 330 pound cathode while impurities and trace elements dissolve or sink to the bottom of the refining cell.

One anode, weighing 785 pounds, produces two cathodes in a 28-day cycle and the remaining anode is returned to the smelter

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for reprocessing. The sludge of impurities is processed for economic mineral values and the electrolyte is purified and recycled.

The cathodes are washed and bundled for shipment to fabricators, or melted and cast into continuous rod. Approximately 50% of the cathode production will be cast into rod.

The refining process takes the purity of copper from 99.6% in the anode to 99.96% in the cathode. This high purity is essential to meet the requirements of electrical conductivity and fabrication of industrial products.

Magma continuous cast rod is produced with a Southwire casting system beginning with molten cathode copper fed to an 8-foot-diameter casting wheel which continuously casts a 5-square-inch bar. The bar is fed to a 12-stand rolling mill which rolls and shapes it into alternate oval and round shapes, progressively smaller down to 5/16 inch in diameter.

Operating at speeds as high as 4,000 feet per minute, the system casts, rolls, pickles, waxes, and winds the rod into coils up to 16,000 pounds depending upon customer requirements.

Before shipment, all Magma copper is subjected to rigorous inspection and strict physical and metallurgical tests to insure consistent high quality. X-ray spectography, emission spectography, gas chromatography, and atomic absorption analysis are utilized for metallurgical quality and process control throughout Magma operations.

# # # #

MAGMA'S EXPANSION IS NEAR COMPLETION

The major, multi-project expansion program undertaken in 1968 by Magma Copper Company is nearing completion with some phases already in operation and other well underway.

Magma planned the expansion of its operations at San Manuel and Superior for greater tonnage and better efficiency. Subsequent decisions were made to provide for electrolytic refining and continuous rod casting.

Recent estimates show that expansion of production and processing facilities together with underground development is costing approximately $250,000,000.

Goals are for a 50% expansion of San Manuel mine production up to 62,000 tons per day, a 100% expansion of Magma-Superior mine production up to 3,300 tons per day, a 100% expansion in the San Manuel smelter to handle the total throughput, and the electrolytic refining capacity of 200,000 tons per year.

Since the 47-year-old Superior smelter was shut down in July, 1971, the Superior concentrates are shipped by rail approximately 75 miles to San Manuel via the two Magma short-lines and their connecting carrier.

Superior's current production of 1,500 tons of ore per day is being increased to 3,300 tons per day by 1974 with the completion of a 22-foot diameter circular concrete shaft to a depth of 4,800 feet

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NEWS FROM SAN MANUEL AND SUPERIOR

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and extensive underground development, together with modernization and expansion of the concentrator.

For practical purposes, the Superior project will result in a brand new mining operation with new underground and surface facilities and the abandonment of portions of the 61-year-old Magma mine which are now maintained mostly for access and supply.

At the San Manuel Mine, which started-up in 1956, production has already begun to increase from 40,000 tons per day to 60,000 tons per day with the completion of a third ore hoisting shaft, 2,860 feet in depth, concreted and 22 feet in diameter.

Two additional new shafts are under construction: a fourth production shaft is scheduled to be completed to a depth of 3,713 feet in 1973, and a service shaft will be sunk to 3,776 feet by summer, 1972.

To handle the current 50% increase in ore production at San Manuel, Magma has installed additional primary crushers, more railroad haulage equipment, and three new concentrator sections with expanded flotation capacity, water recovery systems, and concentrate treatment and handling facilities.

Smelter expansion at San Manuel is likewise geared to the increased throughput and by 1974 will have capacity for treating approximately 700,000 tons of concentrate per year. Combined copper production for Magma will increase from 114,000 tons per year to an estimated 184,000 tons per year.

Already in operation in the smelter are two additional 15' x 35' Pierce-Smith converters, new anode casting wheel, 550 ft. stack, second electrostatic precipitator and new flue system.

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With the expansion and new refinery projects, Magma has reorganized its metallurgical department and has installed fully-equipped laboratories to maintain positive process and quality control in all phases of operations.

Magma also produces approximately 4,200 tons per year of molybdenum concentrate with relatively high rhenium content and small amounts of silver and gold.

At San Manuel, Magma has reserves of approximately one billion tons of ore averaging .75% copper. The block caving method is used for mining. Some 2,000 draw points are maintained on two major levels to support current production.

Magma employs approximately 4,000 with an annual payroll of more than $36 million.

Current reserves of the older Magma mine at Superior amount to 10,200,000 tons of bedded limestone replacement deposits averaging 5.7% copper. Discovery of this reserve in 1965 permitted the rejuvenation of this historic mine which was founded in 1910 by William Boyce Thompson.

Magma is under the leadership of Wesley P. Goss, Chairman of the Board; Wayne H. Burt, President; John S. Wise, Vice President and General Manager of the San Manuel Division; Curt R. Sundeen, Manager of the Superior Division.

Prime contractors in the expansion program have included Stearns-Roger Corporation, Bechtel Corporation, Arthur G. McKee Company, and Cementation Company of North America.

# # # #

San Manuel Smelter

Concentrates are brought into the smelter by conveyor belt. They are fed through the roof to the sidewalls of the reverberatory furnace and melted down by natural gas burners which use preheated air for combustion. The furnace is operated 24 hours a day on a continuous basis. Temperatures in the furnace range from about 2750° F at the burner end to approximately 2450° F at the opposite end. This melting of concentrates results in two products--matte and slag. These products separate; the heavier, matte, contains copper sulfide and iron sulfide, while the lighter, slag, contains the rock residues from the mined ore that were retained during concentration in the mill.

The separation of the matte and slag into two distinct layers allows them to be conveniently removed from the furnace. The matte is removed through a tap-hole located on the side at the bottom of the furnace. At its temperature of about 2100° F, it readily flows from the furnace into ladles. It is then moved to the converter aisle for transfer into the converter by a 60-ton overhead crane. The slag is removed to a slag car through a skim-hole located on the side but higher than the tap-hole. A train of four slag cars is pulled by a 25-ton diesel-electric engine to the slag dump where the slag is poured over the side.

The converter into which the matte is poured is a horizontal cylindrical vessel of steel lined with basic refractories (bricks and mortar) to a thickness of about 18 inches. A row of air pipes (tuyeres) is arranged along the back of the converter. These tuyeres conduct large volumes of air at 15 lbs. per square inch pressure, to the bath of matte in the vessel. This air oxidizes the iron in the matte so it can be removed. Mine ore containing silica is added to the blowing matte in order to form a silica slag. This silica slag gathers in the

oxidized iron for removal. This slag is returned, by ladle, to the furnace because it contains about 2% copper. The copper is removed and the remainder is finally disposed of with the reverberatory slag.

A batch of blister copper is made in the converter by adding ladles of matte from time to time and removing the slag as it is formed. The iron loses its sulfur and is oxidized and slagged off while the copper portion retains its sulfur. This cycle of adding matte and removing oxidized iron by slagging slowly builds up a supply of copper sulfide in the converter. When a sufficient volume of copper sulfide has accumulated, it is blown to the finish without further additions of fluxing ore (mine ore) and without the formation of any additional slag. The slagging portion of the charge requires about 8 hours and the finish blow requires about $2\frac{1}{2}$ hours. The product of the converter is blister copper which is about 98% pure copper.

The blister copper is removed from the converter by ladle and placed in an anode vessel--a furnace similar in construction to the converter but with only two tuyeres. Here the copper is oxidized further by blowing with compressed air. The resulting slag is removed to the converter. This small amount of slag contains most of the impurities to be found in the copper which is now saturated with copper oxide. The charge is then reduced by poling with hydrogen gas to remove the oxygen. From this vessel, the copper is cast into anodes that will be electrolytically refined in El Paso or New York. The anode copper is 99.8% pure copper.

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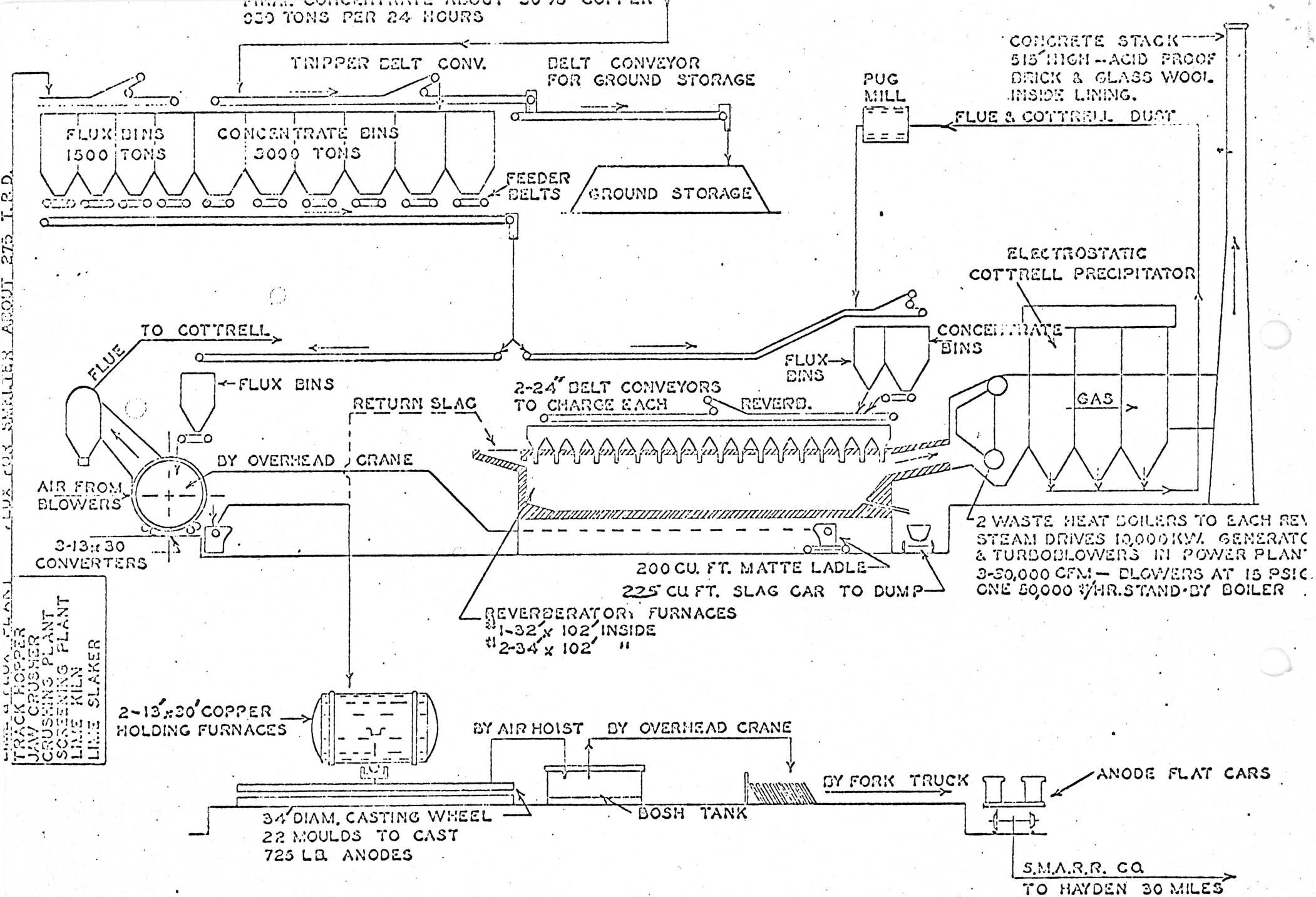


MAGMA COPPER COMPANY
SMELTER
SAN MANUEL DIV.

APRIL 10 1967

San Manuel file

August 24, 1976

Mr. G. W. Dopson
Mill Superintendent
Magma Copper Company
San Manuel Division
San Manuel, Arizona 85631

Dear Mr. Dopson:

Enclosed is a memorandum report describing the results of our studies to recover rutile from San Manuel tailings. Recently we have obtained grades of over 40 percent TiO_2 at essentially the same recoveries reported. It is likely that the investigation will be extended for another year, in which event, we may require additional sample. We will inform you when our authorizations are confirmed.

We would appreciate any comments that you or any of your staff may have concerning this work.

Sincerely yours,

Martin H. Stanczyk

Martin H. Stanczyk
Research Director

ENCLOSURE

cc:
G. V. Sullivan
T. O. Llewellyn
J. C. Arundale, L.O.--Arizona
file
day file

AUG 2 8 1976

United States Department of the Interior

BUREAU OF MINES

TUSCALOOSA METALLURGY RESEARCH LABORATORY
P. O. BOX L
UNIVERSITY, ALABAMA 35486

June 7, 1976

Memorandum

To: G. V. Sullivan, Research Supervisor, Tuscaloosa Metallurgy Research Laboratory

From: Metallurgist, Tuscaloosa Metallurgy Research Laboratory

Subject: Beneficiation of Magma Copper Tailings

INTRODUCTION

A sample of porphyry copper tailings was obtained from Magma Copper Company, San Manuel Division, Pinal County, Arizona. Beneficiation studies were conducted under Authorization No. 9365, Component 2-A, Titanium and Zirconium Minerals from Low Grade Sources and Wastes. This particular sample was obtained for study because a U.S.G.S publication had reported that a significant quantity of rutile was contained in the San Manuel ore.

DESCRIPTION OF THE SAMPLE

The sample was collected by the company from the mill tailings discharge and was thickened to about 65 percent solids prior to shipment to Tuscaloosa. Representative samples were obtained for testing as follows: as-received material was diluted to about 50 percent solids; the resultant slurry agitated until it was essentially homogeneous; individual and large samples were taken by siphon while the slurry was being agitated.

Particle size distribution and chemical analysis of the sample are presented in table 1. The data show that almost half of the TiO_2 content reported in the minus 400-mesh fraction.

Mineralogical analysis of sized fractions of the material revealed that the principal constituents were feldspar, quartz, pyrite, calcite, and biotite; lesser amounts of titanium-bearing minerals--mainly rutile; some muscovite and chlorite; and minor amounts of zircon, chalcopyrite and molybdenite. Microscopic examination showed that in the plus

200-mesh fractions about 80 percent of the rutile was locked. In the minus 200-mesh fractions better than 70 percent of the rutile was liberated.

Further characterization studies of the sample included heavy liquid analysis. A representative sample was ground to pass a 200-mesh sieve and classified into a minus 200-mesh plus 10-micrometer fraction and a minus 10-micrometer fraction (slimes). The minus 200-mesh plus 10-micrometer portion was treated by heavy liquid at a specific gravity of 3.3 to obtain a concentration of the titanium-bearing minerals. Results of heavy liquid separation are shown in table 2.

The heavy liquid separation demonstrated that by grinding the material to minus 200-mesh 70.1 percent of the total TiO_2 content can be considered as liberated and of that amount 16.9 percent is present in the minus 10-micrometer fraction. This indicates that about 53 percent of the total TiO_2 is potentially recoverable material. It should also be noted that grinding the sample to pass 325-mesh did not result in any increased liberation of the titania. The locked titania is so closely associated with other minerals and is so finely crystalline that it cannot be adequately liberated even by an extremely fine grind.

BENEFICIATION STUDIES

Beneficiation techniques considered for concentrating the titanium-bearing minerals in the San Manuel copper tailings were gravity, magnetic separation and flotation. The characterization studies showed that the material had to be ground to minus 200-mesh to achieve a significant degree of liberation. This fine particle size would limit the effectiveness of conventional gravity or magnetic separation methods; therefore, the major effort in this investigation was directed toward flotation.

GRAVITY CONCENTRATION

Although the fine particle size of rutile liberation would hamper gravity concentration, several techniques were investigated to determine if a low grade concentrate at high titania recovery could be made. Techniques studied were spirals and several types of tables. In addition to testing the response of the as-received sample, some test samples were ground through 200 and 400 mesh to liberate more of the rutile. Only 35 percent TiO_2 recovery was obtained in the spiral concentrate, which ranged from 0.96 to 1.2 percent TiO_2. The spiral tailings product contained 0.5 percent TiO_2. Table concentrating tests

were conducted using a regular table deck, a slime deck, and a Bartles-Mozley slime concentrating table. For all three types, the table concentrate contained 1.8 to 3.9 percent TiO_2 and recovered only 23 to 42 percent of the TiO_2. The TiO_2 content of the table tailings could not be lowered below 0.5 percent TiO_2.

MAGNETIC SEPARATION

Magnetic separation tests were made primarily with wet-type separators. Tests were made on as-received, minus 200- and minus 400-mesh material in both matrix-type and high gradient, high intensity magnetic separators. The highest grade concentrate obtained was 2.5 percent TiO_2 and titania recoveries never exceeded 40 percent.

FLOTATION

Preliminary flotation tests were made to recover rutile. A 250-gram MS type batch flotation cell was used in these tests. The material was screened on a 200-mesh sieve and the oversize stage ground to pass 200-mesh. The original plus 200-mesh fraction represented 47.4 weight percent of the total sample. The total minus 200-mesh material was deslimed by decantation at 10 micrometers (Stoke's diameter). Next, a residual rougher sulfide concentrate, mainly pyrite, was floated at a pH of 8.5 using a xanthate as a collector together with a frother. The sulfide rougher tailings were filtered, repulped and conditioned with 0.5 pounds per ton of HF as a selectivity assisting agent, and 20 pounds per ton of sulfuric acid, to adjust the pH to 2.5. A rougher rutile concentrate was floated using 1.0 pound per ton of petroleum sulfonate as a collector. The rougher rutile concentrate was cleaned four times. Each cleaning stage required about 0.3 pounds per ton of sulfuric acid to maintain the pulp pH at 2.5. Results of a representative test of this preliminary flotation investigation is presented in table 3.

The data, in table 3, showed that the final rutile cleaner concentrate analyzed 20.0 percent TiO_2 with a recovery of 26.3 of the total and 49.3 percent of the recoverable TiO_2.

Reaction of the sulfuric acid with the carbonate minerals present in the sample resulted in an excessive acid consumption and considerable variation of the pulp pH during flotation. Therefore, flotation tests were made in which the carbonates were floated in an alkaline circuit prior to rutile flotation. The carbonates were floated using sodium oleate (0.5 pounds per ton of ore) as a collector and dextrin (0.4 pounds per ton of ore) for depression of rutile. After removing

the carbonates, the sulfuric acid to adjust the pH to 2.5 was reduced to about 5.0 pounds per ton of ore. The rougher rutile concentrate was cleaned three times. Results of a representative test in which the carbonates were removed prior to rutile flotation are summarized in table 4, and a corresponding reagent schedule is shown in table 5. In this test, the sulfide and carbonate rougher concentrates were each cleaned once and the cleaner tailing of each products was added to the subsequent flotation feed. The preliminary flotation tests showed that the sulfide concentrate retained 6.9 percent of the total TiO_2 (see table 3). This time, after a cleaner step, the retained TiO_2 was reduced to 1.5 percent of the total.

The data in table 4 showed that flotation of rutile after the sulfides and carbonates had been removed a rutile concentrate grading 25.2 percent TiO_2 could be produced. The process recovered 37.5 percent of the total and 70.4 percent of the recoverable TiO_2.

During all the previous series of flotation tests in the rutile circuit the pulp density for the first cleaning stages varied from 4 to 8 percent solids and dropped to less than 3 percent for the final cleaning step.

An additional series of tests was conducted using a 2000-gram flotation cell for all rougher flotation operations and the cleaning stages were performed in a 250-gram flotation cell. Under these conditons a pulp density of 20 percent solids in the last (second) rutile cleaning step was obtained. All other test variables, such as particle size, conditioning and flotation time, pulp temperature and pH, and amount of reagents remained the same as in previous tests series. Results of a representative test of this series is presented in table 6, and table 7 shows the reagents and operating conditions for rutile flotation.

The data in table 6 demonstrated that the higher pulp density in the cleaning stages, as would be expected, achieved a higher grade and recovery of the rutile. Another important factor was that the rougher concentrate only had to be cleaned twice to obtain a concentrate grade of 34.9 percent TiO_2. Titania recovery also increased to 48.7 percent of the total and 91.4 percent of the recoverable.

Memo to G. V. Sullivan Subj: Beneficiation of Magma Copper Tailings

CONCLUSIONS AND RECOMMENDATIONS

Characterization studies of San Manuel copper mill tailings showed the material to contain 0.75 TiO_2 with rutile being the most abundant titania mineral. Mineralogical examination showed that grinding to pass 200-mesh would liberate about 70 percent of the TiO_2 with another 15 percent of the TiO_2 being lost in the minus 10 micrometer slimes; thus establishing a "recoverable TiO_2" of 50 - 55 percent of the total. Although this limit appears to be low, recovery of 40 percent of the TiO_2 at a marketable grade from this single operation would furnish 20 - 25 percent of the total domestic rutile consumption.

Beneficiation studies showed that gravity and high-intensity magnetic separation would not produce either an appreciably upgraded or a waste product.

Flotation studies showed that flotation of the sulfides and carbonates prior to rutile flotation in an acid circuit with a petroleum sulfonate collector provided the best results. As the scale of testing was increased the grade and recovery of rutile increased. Concentrates of 34.9 percent TiO_2 with titania recoveries of 91 percent of the recoverable and 49 percent of the total.

It is recommended that these studies be continued to determine to what extent the TiO_2 concentrate grade can be increased without drastically lowering recoveries. Then a preliminary cost evaluation should be made to determine the approximate cost of producing a ton of contained titania. If the results of the cost evaluation are favorable, the studies should be continued on a continuous mini-plant scale. Concurrently, a survey of other tailings should be undertaken to determine others that may be potential titania resources.

Thomas O. Llewellyn

Attachments

TABLE 1. - Particle size and chemical analysis of San Manuel tailing

Size fraction, mesh	Weight, percent	Analysis, percent				Distribution, percent			
		TiO_2	Cu	Fe	S	TiO_2	Cu	Fe	S
Minus 35 plus 48	2.5	0.56	0.25	1.3	0.3	1.8	6.3	1.5	0.6
Plus 65	11.3	.48	.16	1.0	.3	7.1	18.9	5.4	2.8
Plus 100	13.2	.55	.12	1.0	.3	9.6	16.8	6.4	3.3
Plus 150	8.1	.65	.10	1.5	.7	7.0	8.4	5.9	4.8
Plus 200	12.3	.74	.08	2.2	1.5	11.9	10.5	13.2	15.4
Plus 270	5.2	.94	.08	2.9	3.5	6.4	4.2	7.3	15.3
Plus 400	8.2	.96	.07	2.6	1.7	10.4	6.3	10.3	11.7
Minus 400	39.2	.89	.07	2.6	1.4	45.8	28.4	50.0	46.1
Composite	100.0	.76	.10	2.0	1.2	100.0	100.0	100.0	100.0
Head	-	.75	.14	2.2	1.2	-	-	-	-

TABLE 2. - Heavy liquid separation of sample

Fraction	Weight, percent	Analysis, percent TiO_2	Distribution, percent, TiO_2
Minus 200-mesh plus 10 μm:			
float at sp. gr. 3.3	71.5	0.32	29.9
sink at sp. gr. 3.3	2.5	16.10	53.2
Minus 10 μm (slimes)	26.0	0.49	16.9
Composite	100.0	0.76	100.0

TABLE 3. - Sulfide and rutile flotation (250-gram charge)

Product	Weight, percent	Analysis, percent TiO_2	Distribution, percent, TiO_2
Rutile cleaner concentrate	1.0	20.0	[1]26.3
Sulfides rougher concentrate	7.5	0.7	6.9
Combined cleaning tailings	20.1	1.4	37.7
Rutile rougher tailings	45.3	0.2	11.9
Minus 10 μm (slimes)	26.1	0.5	17.2
Composite	100.0	0.76	100.0

[1] Represents 49.3 percent of "recoverable" TiO_2.

TABLE 4. - Sulfide, carbonate, and rutile flotation (250-gram charge)

Product	Weight, percent	Analysis, percent TiO_2	Distribution percent, TiO_2
Rutile cleaner concentrate	1.1	25.2	[1]37.5
Sulfide cleaner concentrate	2.8	0.4	1.5
Carbonate cleaner concentrate	6.0	1.1	8.9
Combined rutile cleaner tails	8.4	1.3	14.8
Rutile rougher tails	53.7	0.2	14.5
Minus 10 μm (slimes)	28.0	0.6	22.8
Composite	100.0	0.74	100.0

[1] Represents 70.4 percent of the "recoverable" TiO_2.

TABLE 5. - Reagents schedule for sulfides, carbonates and rutile flotation (250-gram charge)

	Flotation										
	Sulfides			Carbonates			Rutile				
									Cleaner		
Operating conditions	Cond.	Rougher	Cleaner	Cond.	Rougher	Cleaner	Cond.	Rougher	1	2	3
Reagents, pounds per ton of ore:											
Xanthate	0.10	-	-	-	-	-	-	-	-	-	-
Dowfroth	0.16	-	-	-	-	-	-	-	-	-	-
Dextrin	-	-	-	0.4	-	-	-	-	-	-	-
Sodium carbonate	-	-	-	0.5	-	-	-	-	-	-	-
Sodium oleate	-	-	-	0.5	-	-	-	-	-	-	-
Hydrofluoric acid	-	-	-	-	-	-	0.5	-	-	-	-
Sulfuric acid	-	-	-	-	-	-	5.0	-	0.3	0.2	0.2
Petroleum sulfonate	-	-	-	-	-	-	1.0	-	-	-	-
Conditioning time--minutes	4	-	-	5	-	-	8	-	-	-	-
Flotation time--minutes	-	4	3	-	6.0	4.0	-	7	5	5	5
Pulp pH	8.5	8.5	8.5	9.0	9.0	9.1	2.5	2.5	2.5	2.5	2.5
Pulp temperature--° C	24	24	24	24	24	24	25	25	24	24	24

TABLE 6. - Sulfides, carbonates and rutile flotation using 2000 gram charge

Product	Weight, percent	Analysis, percent TiO_2	Distribution, percent, TiO_2
Rutile cleaner concentrate	1.1	34.9	[1]48.7
Sulfide cleaner concentrate	1.9	0.3	0.8
Carbonate cleaner concentrate	4.8	0.5	3.0
Rutile cleaner tails No. 1	2.2	0.7	1.9
Rutile cleaner tails No. 2	.8	2.1	2.1
Rutile rougher tails	64.2	0.3	24.5
Minus 10 μm (slimes)	25.0	0.6	19.0
Composite	100.0	0.79	100.0

[1] Represents 91.4 percent of the "recoverable" TiO_2.

TABLE 7. - Reagent schedule for rutile flotation for a 2000 gram charge

Operating conditions	Rutile			
	Conditioner	Rougher	Cleaner No. 1	Cleaner No. 2
Reagents, pounds per ton of ore:				
Hydrofluoric acid	0.5	-	-	-
Sulfuric acid	5.0	-	0.2	0.1
Petroleum sulfonate	-	1.0	-	-
Conditioning time--minutes	6	-	-	-
Flotation time--minutes	-	8.0	5	5
Pulp pH	2.6	2.5	2.5	2.5
Pulp temperature--° C	25	26.0	27	27

NEWSPAPER CLIPPING - September 29, 1953 - A Tucson Newspaper

GENERAL MANAGER ESTIMATES -

SAN MANUEL PROJECT TO HIRE 1,850

WHEN IT'S IN FULL OPERATION

By- E. C. Rutherford

When the San Manuel mine, mill and smelter go into full operation, they will employ 1,850 men, with a payroll of $830,000 a month or $10,000,000 a year. Wesley P. Goss, Vice-president and general manager of the Magma Copper company, said yesterday in a talk at the initial breakfast forum of the Chamber of Commerce.

The forum, a new venture sponsored by the young men's division of the chamber, drew a crowd of 260 for breakfast in the Pioneer hotel ballroom. Goss gave a comprehensive description of the San Manuel project and answered numerous questions. It is hoped to have the mine in production by 1956.

The ore body being developed is located on the Old Hat mining district of Pinal county about seven miles east of Oracle and seven miles south of Mammoth. Magma Copper owns about 5,000 acres of ore land, and the development is taking place in four sections, 34 and 35 in township 8 south, range 16 east, and sections 2 and 3 in township 9. The company also owns 20,000 acres of desert land being developed as townsite and plant area and for the deposit of tailings.

EMPLOYS 500 NOW

The company is now employing about 500 men at the mine, and the contractors building the town and plant are using 250, Foundations for the first thousand homes are being poured, and some of the walls are up. The company has contracted for 1,000 homes and can get an additional 1,000 when needed. By the last of October there will be essential business developments on the site, Goss said.

Two main shafts for the mine have been sunk, one to a depth of 1,643 feet and the other approximately 2,000 feet. About 23,000 feet of driftings have been developed. Goss said that water was encountered at 700 feet, and that pumps are now bringing from the mine 2,500 gallons per minute.

The San Manuel project has been made possible by the development of new scientific techniques in mining. Back in 1915 mining in this area was abandoned because it was not profitable. Goss said that, once the company fulfills its contracts for delivery to the government, which will take about five years, it will be on a competitive basis and can produce copper cheaply enough for the market. The demand is expected to be constant, as this country is at present producing only 60 to 70 per cent of the copper it needs.

The new town of San Manuel, Goss said, is expected to have a population of 7,000, but planning is sufficient for a city of 10,000. The initial homes in the community will be rentals, but there will be opportunity for residents to purchase and own their homes. Commercial enterprise in the community will be competitive, and there will be no company-owned stores, Goss said. The water supply for San Manuel is being developed along the San Pedro river, where there is an extensive artesian basin. Wells drilled to a depth of 1,200 feet have developed good water with strong pressure.

Among the numerous construction jobs is the laying of 40 miles of railroad track. The company will have seven miles of line from the mine to the plant, and another 300 miles to connect the plant with the Southern Pacific. Plans now contemplate the laying of this line along the San Pedro valley to Hayden.

There will be four shafts to the mine, two of them to be used for hoisting ore. Production plans call for mining 3,500 tons of ore per day for a six-day week. The smelter will have a production capacity of 200 tons of copper per day for a seven-day week.

The San Manuel project has already brought a sizable office payroll to the Tucson community. The Stearns-Rogers Construction company and the Utah Construction company, handling the engineering and construction for the San Manuel plant, have opened two offices, with 30 to 40 people working from each one.

The administration and purchasing office is at 4885 East Speedway. The office for engineering and design is at 1037 North Park Avenue.

NEWSPAPER CLIPPING - A TUCSON NEWSPAPER - September 29, 1953

'DEPRESSION PROOF'

GOSS OUTLINES SAN MANUEL

By - Clifton Abbott

sley

[redacted]

DEPARTMENT OF MINERAL RESOURCES

REPORT TO OPA ON ACTIVE MINING PROJECT

Date: 6/11/45

Name of Mine: Boyer drilling

Owner or Operator: R H Wininger

Address: 2619 Grant Rd Tucson

Mine Location: Old Hat mining dist

Filing Information

File System:

File No.:

This chart to be used for gallons of gasoline required per month.

PRESENT OPERATIONS: (check X)

Production ; Development ; Financing ; Sale of mine ;

Experimental (sampling) ; Owner's occasional trip ;

Other (specify): Drilling of mining property

PRODUCTION: Past and Future.

	Tons
Approx. tons last 3 months	
Approx. present rate per 3 months	
Anticipated rate next 3 months	
If in distant future check (X) here	

EQUIPMENT OPERATED:

Type	Quantity or Horse Power	Miles or Hours Per Month	Gallons Required Per ~~Month~~ Qtr
Personal Cars	List of		
Light or Service Trucks	equipment		
Ore Hauling Trucks	as attached		
Compressors	application		
Other Mine or Mill Eqpt.			1200 per qtr

PRODUCT PRODUCED OR CONTEMPLATED: Name metals or minerals.

Copper

REMARKS:

This gasoline is to be used on the Mammoth (San Manuel) drilling job

ARIZONA DEPARTMENT OF MINERAL RESOURCES

By George A. Ballam

DEPARTMENT OF MINERAL RESOURCES

OD2

REPORT TO OPA ON
ACTIVE MINING PROJECT

Date 7/4/45

Name of Mine Red Hill - San Manuel

Owner or Operator R. H. Weninger

Address 4449 Oracle Rd, Tucson

Mine Location Tiger

Filing Information

File System

File No.

This chart to be used for gallons of gasoline required per month.

PRESENT OPERATIONS: (check X)

Production ; Development ; Financing ; Sale of mine ;

Experimental (sampling) ; Owner's occasional trip ;

Other (specify) Drilling

PRODUCTION: Past and Future.

	Tons
Approx. tons last 3 months	
Approx. present rate per 3 months	
Anticipated rate next 3 months	
If in distant future check (X) here	

EQUIPMENT OPERATED:

Type	Quantity or Horse Power	Miles or Hours Per Month	Gallons Required Per Month
Personal Cars			
Fleet Light or Service Trucks	F281137 R7		500 gal/qtr
Ore Hauling Trucks			
Compressors			
Other Mine or Mill Eqpt.			

PRODUCT PRODUCED OR CONTEMPLATED: Name metals or minerals.

Copper

REMARKS: Mr Weninger has 4 trucks (fleet no. above) engaged in drilling and hauling supplies for the San Manuel project. This is critical and application recommended for approval

ARIZONA DEPARTMENT OF MINERAL RESOURCES

By George A. Ballam

PUBLIC HEARING

SENATOR ULM FILES CHARGES AGAINST MAGMA

John Scott Ulm, Arizona State Senator and TV newscaster, recently filed charges against Magma Copper Co., for putting concern for production ahead of the safety of its employees.

The whole affair is shaping up into a battle between the Company and Mine Inspector Verne McCutchan on one side and the Unions along with Senator Ulm on the other side.

The Unity Council, consisting of all the different Unions at Magma is issuing this leaflet in order to make the Unions' position clear to the membership and to the Company.

Wild-Cat STRIKE OVER SAFETY

The safety issue came to a head, a few weeks ago, when more than 150 employees of Magma took part in a wild-cat strike because the Company fired a man who refused, on grounds of safety, to cut into an electrical junction box unless the power was cut off.

There is something deeper here than just the technical question of whether the procedure proposed by the Company in this instance was or was not safe.

The refusal of a good worker to perform that particular job and the strike that followed his dismissal, constitute a resounding vote of NO CONFIDENCE in the Company and it's safety practices in general.

WE DON'T TRUST YOU

These men are in effect saying to the Company: "we don't care how many experts you use to tell us that this job is safe-we don't trust you! We have seen too many of your short cuts, tricks and just plain petty policies. We know by our own every day experience that you DO put concern for production and profit ahead of concern for our safety and health."

THE "RANK AND FILE" BRINGS A VISITOR

As a result of the strike, some of the men, too long frustrated by the Company's unyielding policies, contacted Senator John scott Ulm. One of the men, a Rank and File leader, proposed that Ulm make an inspection tour of the Smelter in order to learn first hand about some of the conditions that are causing concern. The Senator accepted, then got a visitor's pass in his own name, without the Company noticing that they were about to receive an influential outsider into their inner-sanctum of fumes; otherwise known as the Smelter.

Ulm, inspected the Smelter for three hours, while some of the management watched from behind posts. This was an inspection that was really an inspection...and most important was the fact that the Company was'nt given advance warning, so that it might hide it's sins.

The Company was caught with it's pants down. Senator Ulm filed a seven page report with the so called Mine inspector, detailing many safety violations and questionable practices at the Smelter.

EVEN CHARLIE McCARTHY WOULD MAKE A BETTER MINE INSPECTOR

Senator Ulm, along with the Mine "Inspector", Verne McCutchan, revisited the Smelter a week later. The "Inspector" made sure the Company was warned of the visit. The Company, accustomed to the methods of their "Inspector", did its stuff. Production was cut and the place was all spruced up, just waiting for the admiring glances of the "Inspector". Sure enough, the "Inspector was true to his cause; he complimented warmly and generously, what he called Magma's fine job regarding the safety of its employees.

Then, in a gesture, making even Charlie McCarthy, the wooden dummy look like a true independent...and with the Company's well oiled ventriloquist lips scarcely moving...the "Inspector" swinging around on his strings, charged the Senator with illegal entry into the Smelter. Criminal charges might be pressed, said the Company, thru its puppet.

Of course, this duet between the puppet and the puppeteer is a big sham and the Company is'nt fooling anyone except people like mine inspectors,who make a living by getting "fooled".

THERE WILL BE A PUBLIC HEARING THAT IS REALLY GOING TO BE A HEARING

The Unity Council, consisting of Local 937 USWA and Locals of IBEW, IAM&AW, BOILERMAKERS, UTU, RAILROAD and TEAMSTERS, along with Senator Ulm and others is holding a Public Hearing into the charges against Magma. This is in order to give all workers at Magma, a chance to present their views on questions regarding safety and other matters of concern.

Special attention will also be directed at Magma's hospital facility, which Senator Ulm branded a disgrace to medicine.

Brothers, this is our chance to make some changes. Remember, that the Company, like a vampire,thrives in darkness. Let's put on the lights!
The Hearing will take place on Monday, June 25, 6pm at the Union Hall,Oracle.

From L 8789

The Sacaton discovery gave credence to the geologists' assumption of a northeast-southwest trending lineament. Following this lead, two other substantial finds on the same trend were made about 30 miles southwest of Sacaton. One, by El Paso Natural Gas Co., is known as the Lakeside property; the other, by Newmont Mining Corp., is named for the nearby Vekol Hills. Both are on the Papago Indian Reservation.

SAN MANUEL COPPER DEPOSIT, ARIZONA

Red Hill, which led to the discovery of the San Manuel copper deposit, is an iron-stained rocky knob that stands above the flat gravel surface of the Arizona desert some 45 miles northeast of Tucson (fig. 8). Because of the iron discoloration, the hill reputedly was prospected prior to the Civil War, and the first claims officially were staked in the 1870's. By 1873, interest had shifted about a mile to the north, to a group of mineralized veins around which the Mammoth or Old Hat mining camp was developed. Production at Mammoth started in 1881 and continued intermittently until 1947. Little attention was paid to Red Hill, although additional claims were staked in 1906. Between 1915 and 1917, two cable tool prospect holes were drilled just southeast of Red Hill where some green copper stains were noted on a small outcrop of rock. Prophetically, they were drilled at the instigation of William Boyce Thompson, who was associated with the newly organized Magma Copper Co. The holes penetrated pyritized rock and yielded assays of 0.8 percent copper, about half the value that was considered ore at the time.

Serious prospecting in the Red Hill area started in 1925, when Anselmo Laguna of nearby Superior staked the original San Manuel Nos. 1-5 claims. James M. Douglas, owner of a saloon in Superior, purchased a one-third interest in the Laguna claims in June 1926, and another one-third interest in August 1939. Douglas and R. Burns Giffin, a garage owner and car dealer from Superior, acquired the remaining one-third interest. Another story relates that Laguna, on his deathbed, willed his remaining share of the San Manuel claims to Douglas for his kindness during Anselmo's final illness. In any event, by 1940, Douglas, Giffin, and Victor Erickson, who had just acquired a one-fourth interest in the claims, held title to the San Manuel Group. They offered the property to Magma Copper Co. for $50,000, but after a Magma field engineer examined the property, the offer was declined.

In 1942, at the request of the partners, Henry W. Nichols, an assayer for Magma, examined their property, located some new claims for the owners, prepared a report on the property, and again tried unsuccessfully to interest Magma. For his services, he received a one-fourth interest in the partnership. In October, Nichols submitted an application to the Reconstruction Finance Corp. (RFC) for a $20,000 exploration loan, using his report as supporting evidence of the merit of the area. Although the RFC declined the immediate loan, the application came to the attention of other Government agencies interested in developing copper resources to meet the demands of World War II. Through the persistence of Nichols, the RFC ultimately requested that the U.S. Geological Survey examine the prospect. N. P. Peterson and B. S. Butler of the Geological Survey mapped and sampled the property in mid-March. Butler thought that the pyritized rocks of Red Hill were part of a halo of pyritic

mineralization, which often surrounds copper deposits in Arizona. He postulated that the main ore body might lie out under the gravels, which all but engulf Red Hill. Butler's enthusiasm encouraged the U.S. Bureau of Mines to clean out some old prospects and to sample the working faces. In 1943, after drawing up an agreement with the partners, the Bureau started a churn drilling program to consist of five 300-foot holes. These test holes all revealed low-grade copper oxide ore beneath the gravel and conglomerate. After receiving additional funds for the project, in the spring of 1944 the Bureau carried out some deeper drilling and encountered sulfide ore at 685 feet.

It was at this point that John Gustafson, geologist for the Magma mine at Superior, first heard of Red Hill and the drilling program of the Bureau of Mines. On his own initiative, he visited the San Manuel property and was impressed by its potential. He reported his findings to Magma's New York office, and received permission to try to acquire an option on the property from the four partners. At first Nichols was reluctant to deal with Magma, who had rebuffed him on several previous occasions. Finally, however, Gustafson and Nichols worked out a preliminary agreement, and by the end of August, a formal option agreement was signed by Magma Copper and the partners. Under the option, the vendors would get a 5-percent interest in the San Manuel Copper Corp.

With the partner's claims as a nucleus, Magma staked additional claims over the eastern and southern extensions of the ore body. To the north, valid claims were held by Sam Houghton, a local mining engineer, and by members of the Quarelli family, who owned a saloon in nearby Winkleman. The latter had optioned their claims to Houghton. After protracted negotiations, Gustafson and Houghton reached an oral agreement in the early hours of the morning at a bar in Oracle. Under the agreement, Magma was to acquire the best of Houghton's claims and an option on the Quarelli claims. Gustafson promptly wrote out the essence of their agreement and submitted it to a lawyer to rewrite in final legal form. Three days later, Gustafson received a shock when he came back to Houghton with an agreement ready for signatures. According to Ramsay (p. 162):

> Houghton greeted him by handing him a letter from the Chief geologist of International Smelting and Refining, an Anaconda subsidiary, saying that his company agreed to conclude the purchase of Houghton's property on terms that had been proposed previously. To Gustafson's great relief, Houghton stuck by his agreement and signed the papers Gustafson had prepared.

Subsequently, Anaconda acquired the remainder of Houghton's holdings, and it was several years before Anaconda and Magma reached an accord on how to mine the Anaconda interest.

With a viable group of claims under its control, Magma embarked on a protracted drilling program extending from December 1944 to February 1948. Eighty-eight cable tool holes totaling 172,692 feet were drilled; the deepest was 2,755 feet. Anaconda drilled 18 holes on its adjacent claims, and the Bureau of Mines drilled 17 holes totaling 15,839 feet. Their deepest penetration was 1,990 feet below the surface.

In 1948, as a result of all drilling, an ore body 3,000 feet long, 400 to 800 feet wide, and 500 to 700 feet thick was outlined. Distance to the top of the ore body averaged 670 feet; at its deepest point it was 1,900 feet below the desert floor. Magma was now ready to proceed with development of a large-scale underground mine and all necessary adjuncts.

In accordance with a section of the original agreement with the partners, San Manuel Copper Corp. was formed as a subsidiary of Magma in late 1945. By the end of 1946, Magma owned 458,941 shares and Houghton and the early partners owned 56,059 shares in the new company. In 1950, in order to make San Manuel a wholly owned subsidiary, Magma exchanged for the partners' shares 20,000 shares of Magma stock, then worth about $25 a share, or half a million dollars, for their faith in the Red Hill prospect! By 1956, those same shares would be worth $2.5 million.

Sinking of the first shaft was started in March 1948, and it was completed in January 1952 (fig. 15). By this time it was evident that more than

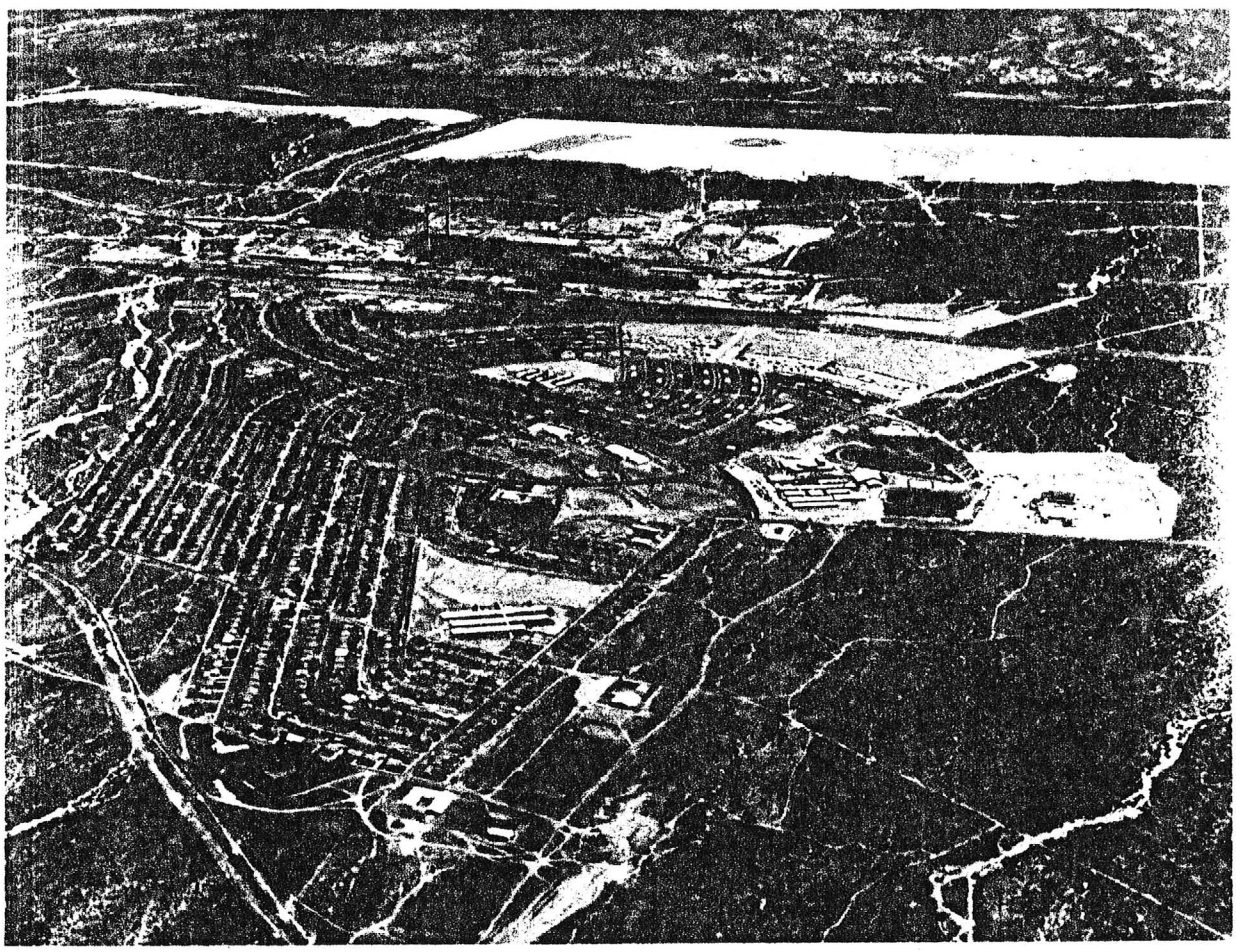


FIGURE 15. - Surface plant, mill, smelter, refinery, casting plant, and townsite at San Manuel copper mine, Pinal County, Ariz.

(Courtesy, Magma Copper Co., Newmont Mining Corp.)

$100 million would be needed to put the mine into production. To obtain such financing for a small company like Magma challenged the ingenuity of A. J. McNab, president and guiding genius of both San Manuel and Magma. The financing is a story in itself; the Federal Reconstruction Finance Corp. (RFC) supplied the bulk of the money at 5 percent interest and supported its investment by agreeing to purchase copper from the company at a specified floor price if it could not be sold at a higher price on the open market. RFC's conditions were as follows: (1) All the Magma Copper property was pledged as a mortgage, (2) Magma was to raise and invest $8 million in addition to the $10 million already spent before drawing on RFC funds, and (3) Magma was to find other financing for a town of 1,000 dwellings as well as attendant utilities, services, and schools. Magma met these conditions to the letter. The venture was so successful that Magma soon obtained private financing for $80 million and repaid the RFC in full.

Major underground development started in January 1953, and the first block of ore was undercut in January 1956. During this development period, Magma also planned and constructed a 30,000-ton-per-day mill, a smelter, a 30-mile branch railroad from Hayden, Ariz., and the completely new town of San Manuel. By December 31, 1956, total capital expenditure at San Manuel, including the railroad but excluding the townsite, was $102,589,445. The first copper anode was poured at the smelter in early 1956, and the operation reached its scheduled output of 33,000 tons of ore per day in October 1957.

Bibliography

In addition to notes in trade journals, the following sources have been freely drawn upon.

1. Burgin, L. B. Time Required in Developing Selected Arizona Copper Mines. BuMines IC 8702, 1976, 144 pp.

2. Joralemon, I. B. Copper. Howell-North Books, Berkeley, Calif., 1973, pp. 337-340.

3. Ramsay, R. H. Men and Mines of Newmont. Octagon Press, New York, 1973, pp. 157-177.

VIBURNUM TREND LEAD-ZINC DEPOSITS, MISSOURI

French voyageurs paddling along the Meramec River in southeastern Missouri in search of furs reported good showings of lead ore as early as 1700. By 1725 surface mining was started at Mine La Motte under French auspices. This was probably one of two lead-mining areas within the limits of the Louisiana Purchase at the time President Jefferson bought that vast territory from Napoleon's government in 1803. Successive discoveries of shallow lead and zinc ore continued to expand the known productive area and to increase the number of modest sized mining operations in the region. The St. Joseph Lead Co. (St. Joe) was formed in New York in 1864 to develop lead-mining properties in St. Francois County, Mo. They started by purchasing the La Grave mine, which was iwthin the limits of the present-day town of Bonne Terre. Gradually, St. Joe acquired other properties, and by 1933 it was the dominant operator in the entire district.

Florida Mining & Materials Corp. will invest $68 million this year to double cement production capacity to 1.2 million tons per year at its Brooksville plant, 30 miles north of Tampa.

COBALT

Sozacom, the Zairian marketing agency of GECAMINES, reportedly lowered its world list price of cobalt for electrolytic broken cathodes from $17.26 per pound to $12.50 per pound effective February 1. The price reduction brings the producer price in line with current spot market prices, which were consistently well below the producer price throughout 1981.

COPPER

It is estimated that domestic copper mine production was curtailed from 12% to 15% in early 1982 by shortened work schedules and closed-down mines. The average producer's price for delivered wirebar copper was 78.8 cents per pound in February, compared with 78.6 cents in January and 80.3 cents in December.

In Pima County, Arizona, the copper industry experienced the following:

- As of February 1, Cyprus Pima Mining Co. announced a 43% reduction in copper and molybdenum production for a minimum of 3 months. The company put over 700 employees on a 4-day work week and has plans to lay off 175 workers.

- Magma Copper Co. scheduled a cutback at its San Manuel smelter from 40 hours to 35 hours per week because of the reduction in the amount of copper concentrate being received from other mining companies. About 360 smelter workers will lose an average of $50 per week.

- Anamax Mining Co. reportedly has requested a freeze on cost-of-living pay increases until the price of copper rises significantly. The company employs 1,300 people at its Twin Buttes mine.

Michigan White Pine Copper, a division of Copper Range co., announced on February 8, that mine production would be cut back affecting 125 hourly employees. Construction of the firm's new refinery complex is continuing.

GOLD

Standard Metals Corp., which operates the Sunnyside mine near Silverton, Colorado, announced a reduction in its workforce from 300 to 125 effective March 1. The mine is Colorado's largest producer of gold, producing about 1,000 tons of ore per day, and the sixth largest primary producer of gold in the United States. Silver, lead, zinc, and copper are also produced at the mine.

IRON ORE

The first price increase for Lake Superior pellets in 13 months was announced by Hanna Mining Co., effective February 15, raising the price 9% to 88 cents per long ton unit of iron contained, delivered rail-of-vessel at lower lake

SAN MANUEL (+) PINAL

BHP

Metals
BHP Copper

November 18, 1999

Mr. Paul Torres
Compliance Engineer
Arizona Department of Environmental Quality
3033 North Central Avenue T5109B
Phoenix, Arizona 85012-2809

RECENT AIR ISSUES

Dear Mr. Torres:

During your recent site visit you requested an update on our plans to control the dust from the San Manuel tailings that has occurred as a result of BHP's placing mining operations on "care and maintenance." After thoroughly reviewing a number of alternatives we have chosen to use a magnesium chloride surfactant. The deciding factor for the use of surfactant is that it can be applied with an aircraft across the tailings dams to control the dust. This alternative required the least amount of time to complete when compared to the other alternatives. In addition, this method of dust control has been used effectively at the Cyprus Sierrita tailings facility.

Western Sealcoating Inc. of Murrieata, California has been contracted to deliver and apply "*Dust Off*" magnesium chloride to approximately 2,800 acres of tailings. *Dust Off* is a moderately concentrated brine solution, is produced from natural seawater and is composed primarily of magnesium, chloride and water. This application will include all the tailings dams at San Manuel with the exception of Number 1 and 2 dam which were capped in 1990 to control dust (see attachment).

Western Sealcoating will be mobilizing the week of November 29th and commence application on the tailings during the first week of December. It is BHP's goal to complete the application before December 25th. Western Sealcoating estimates 20 days to complete the application, depending on weather conditions. The cost of the project is estimated to be $700,000.

In addition I will be contacting a number of stakeholders in the Tri-community the week of November 21st to set up dates for a series of town meetings to discuss BHP's plans.

BHP Copper Inc. P.O. Box M San Manuel Arizona 85631
Telephone (520) 385-3100 Facsimile (520) 385-3299
BHP Copper is a Business Group of The Broken Hill Proprietary Company Limited

BHP will keep you apprised of changes and update you accordingly. Please feel free to contact me if you have any questions or concerns at 520-385-3581.

Regards,

Jeff J. Parker
Manager Environmental Affairs, San Manuel

CC: Harry Clark, Representative
Phil Howard, Arizona State Mine Inspectors Office
Galileo Gutierrez, ADEQ
John Perry, BHP
Ken Driggs, BHP
Art Verdugo, BHP
Charles Taylor, BHP
Doug Sawyer, Arizona Department of Mines and Minerals
Sue Diaz, ADEQ
Dr. Diane Lemley, Mammoth Elementary
Don Gabrielson, Pinal County

TAKEN FROM REPORT OF THE GOVERNOR OF ARIZONA 1893 pp 28-29

Among the notably successful mines of the main belt may be named the Mammoth, of Pinal County, which has been returning large dividends to its English stockholders; the recently worked Mammoth of the Superstition Mountains, in Maricopa County, one of the most promising properties yet discovered; a large number of rich and easily worked deposits in the northern counties of Mohave, Yavapai, and Coconino; the Congress, Crowned King, Gladiator, Model, Roach, and other mines yielding rich sulphides which can be very profitably concentrated. In Maricopa County the Vulture, Union, Yarnell, and Phoenix mines are representative of a class of valuable gold-producers with a pyritous product. Cochise County has a number of mines which yield notable quantities of gold in ores which have heretofore been marketed for their silver contents.

PINAL COUNTY 1899

The silver mines of Pinal County, being largely low-grade propositions, the output of the white metal has been next to nithing for the past year, the present price being so low that they can not be worked at a profit. The Silver King is an exception, and work has been recently started up on this property, which has in times past paid over $2,000,000 in dividends to its stockholders. In gold mining, however, there has been considerable activity at Mammoth, Goldfield, Ripsey, and other points, and the bullion output of gold for the year has been about $250,000. With the new machinery that is being put in this will easily be doubled the coming year. The principal mines of the county are the Silver King, and Reymert (both silver and each with 20-stamp mills), the Reward (copper), and the following gold mines:

	Stamps
Mammoth, at Mammoth	50
Mammoth, at Goldfield	20
Mohawk, at Mammoth	50
Bulldog, at Goldfield	10
Reksom, at Mineral Creek	5
Mammon, south of Casa Grande	20
Victoria, south of Casa Grande	10
Southern Belle at Catalinas	20
Norman, at Ripsey	20

MAMMOTH MINE 1896

This property, which as been a large producer has been idle most of the year owing, it is said, to a change of ownership. Considerable amounts of high-grade lead ore have been shipped from the mine. It is now reported that satisfactory results have been obtained in experiments with the cyanide process. This process will shortly be introduced there.

MAGMA

MAGMA COPPER COMPANY
SAN MANUEL DIVISION

MAGMA VISITORS:

MSHA HAZARD TRAINING REQUIRES THAT AS A "MINER VISITOR," EACH INDIVIDUAL MUST HAVE SOME SPECIAL INSTRUCTION BEFORE THEY CAN ENTER THE PROPERTY. MAGMA WILL REQUIRE THAT THE FOLLOWING BE RECOGNIZED:

1. *TRAFFIC HAZARDS:*

   (a) *YIELD TO ORE HAUL TRUCKS*
   (b) *WATCH OUT FOR MOBILE CRANES, FORK LIFT TRUCKS, CARRY LIFTS, ROAD GRADERS, WATER TRUCKS AND OTHER COMPANY VEHICLES.*

2. *PARK IN DESIGNATED AREAS:*

3. *ROAD HAZARDS:*

   (a) *BEWARE OF RAILROAD CROSSINGS*
   (b) *STOP AND LOOK - BOTH WAYS*
   (c) *OBEY ALL ROADWAY MARKERS, 15 MPH IN CONGESTED AREAS, 25 MPH ON GENERAL ROADWAYS*
   (d) *AVOID PROHIBITED AREAS Example: CAVE AREA (Surface) SEALED AREAS (Underground)*
   (e) *BEWARE OF PAVED AND DIRT ROADWAYS - WET OR DRY*
   (f) *BEWARE OF ROAD CROSSINGS*

4. *BEWARE OF BLASTING IN #3 AREA, PRODUCTION ORE BINS. WHEN SIREN IS SOUNDING, "STAY CLEAR," BLASTING IS IN PROGRESS.*

5. *SHOP HAZARDS:*

   (a) *BEWARE OF ARC WELDING FLASHES*
   (b) *BEWARE OF GRINDING WHEEL ACTIVITIES AND HOT SPARKS*
   (c) *WATCH OUT FOR OVERHEAD CRANE LOADS*
   (d) *WALK ON DESIGNATED WALK AISLES*

6. *UNDERGROUND:*

   (a) *BEWARE OF "HOT" TROLLEY WIRE OVERHEAD*
   (b) *DO NOT CLOSE ELECTRICAL SWITCHES WITHOUT AUTHORITY*
   (c) *TAG OUT AND LOCK OUT ELECTRICAL EQUIPMENT AS ACTIVITIES REQUIRE*

7. *CHECK IN AND OUT:*

   (a) *"BRASS IN" WHEN GOING UNDERGROUND*
   (b) *"SIGN IN" OR "CHECK IN" ON UNDERGROUND PRODUCTION LEVELS.*
   (c) *"SIGN OUT" OR "CHECK OUT" WHEN LEAVING OR CLEARING AT LUNCH TIME*
   (d) *"BRASS OUT" WHEN ARRIVING ON THE SURFACE*

8. *SAFETY RULES:*

   (a) *DRIVE THE POSTED SPEED LIMITS*
   (b) *WEAR HARD HAT WHEN NOT IN VEHICLE*
   (c) *WEAR APPROVED SAFETY GLASSES*
   (d) *WEAR APPROVED HARD TOED FOOTWEAR (Underground)*
   (e) *SAFETY BELT*
   (f) *SAFETY LANYARD*
   (g) *METATARSAL FOOTWEAR*
   (h) *DUST RESPIRATOR (Occasionally)*
   (i) *HEARING PROTECTION MUST BE WORN IN DESIGNATED AREAS WHEN TIME SPENT IS OVER 1 HOUR (MAGMA HEARING CONSERVATION PROGRAM).*

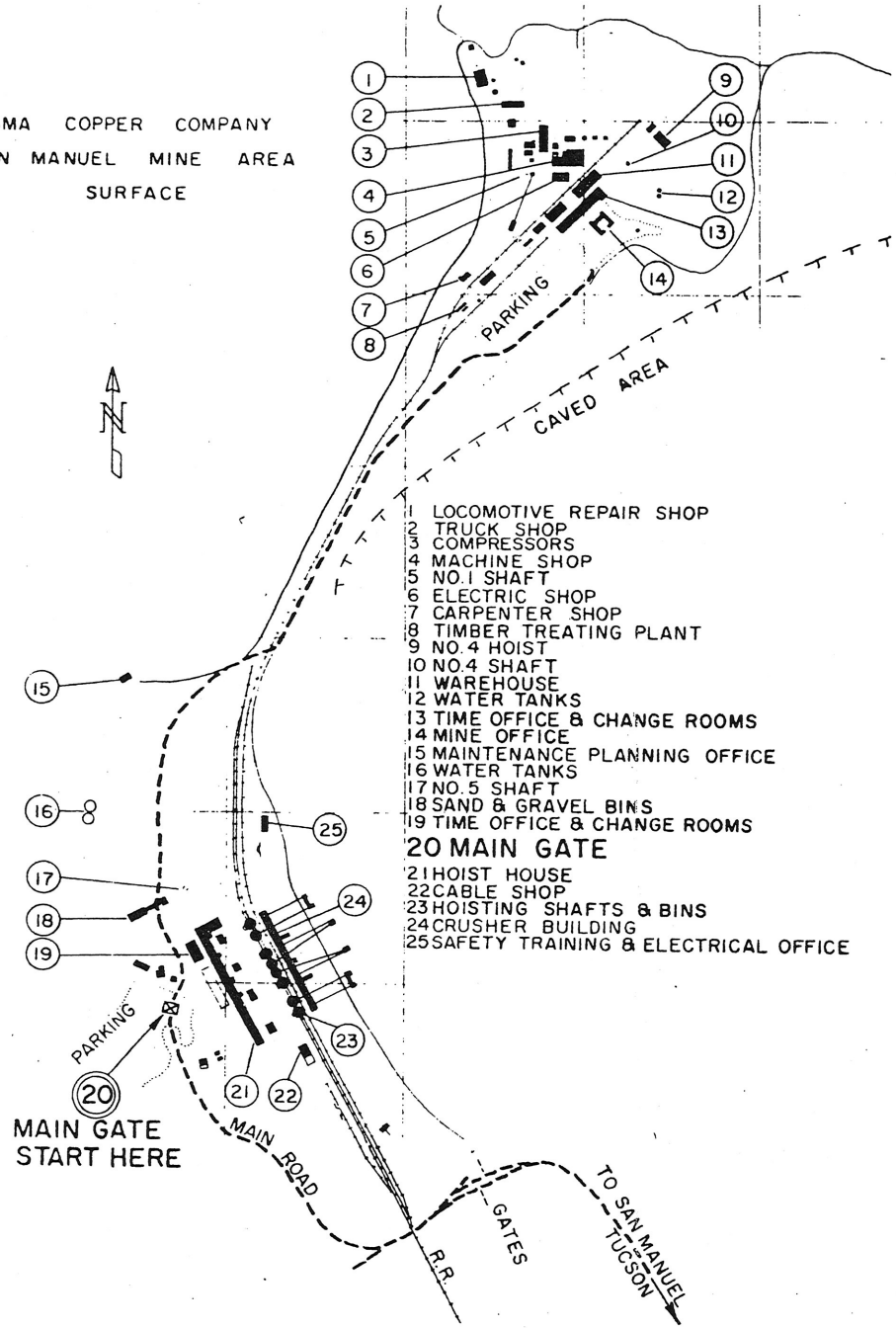
9. *HEALTH AND SAFETY STANDARDS AND SAFE WORK PROCEDURES:*

   (a) *MINERS WILL BE INSTRUCTED BY EXPERIENCED MINERS IN HEALTH AND SAFETY STANDARDS AND SAFE WORK PROCEDURES AS THEY BECOME RELEVANT TO THE MINERS ACTIVITIES AT THE MINE.*

10. *EMERGENCY AND EVACUATION, SELF RESCUER AND RESPIRATOR TRAINING:*

    (a) *IS GIVEN BY EITHER THE MINE INSTRUCTION DEPARTMENT OR THE MINE SAFETY & INDUSTRIAL HYGIENE DEPARTMENT, AS APPLICABLE. (EVERY PERSON GOING UNDERGROUND MUST BE ACCOMPANIED BY AN EXPERIENCED MINER).*

MAGMA COPPER COMPANY
SAN MANUEL MINE AREA
SURFACE



I have received Hazard Training for

Mine area

Telephone Numbers

Mine Safety Office – 471, 500
Security Office – 420
First Aid or Fire – 440

FORM SMD–2792A

MAGMA

MAGMA COPPER COMPANY
SAN MANUEL DIVISION
SAN MANUEL, ARIZONA

SAN MANUEL (A) FINAL

MAGMA COPPER COMPANY
SAN MANUEL MINING DIVISION SUMMARY

JANUARY 1991

ACTUAL	PLAN	% OF PLAN	(000'S)	YEAR TO DATE ACTUAL	PLAN	% OF PLAN
			PRODUCTION			
			COPPER (LBS)			
16,516	14,846	111.2	ELECTROLYTIC (IN CONCENTRATE)	16,516	14,846	111.2
4,775	5,226	91.4	OPEN PIT (SXEW CATHODE)	4,775	5,226	91.4
1,991	1,778	112.0	IN-SITU (SXEW CATHODE)	1,991	1,778	112.0
23,282	21,850	106.6	SUBTOTAL OF COPPER (LBS)	23,282	21,850	106.6
386	284	135.9	REFINERY LEACHATE	386	284	135.9
0	0		PURCHASED COPPER	0		
336	247	136.0	MOLYBDENUM (LBS)	336	247	136.0
			REVENUE			
25,572	24,963	102.4	COPPER	25,572	24,963	102.4
44	24	183.3	OTHER	44	24	183.3
25,616	24,987	102.5	SUBTOTAL	25,616	24,987	102.5
			COSTS (NET OF BY-PRODUCTS)			
14,456	14,008	103.2	ELECTROLYTIC	14,456	14,008	103.2
1,389	1,498	92.7	IN-SITU	1,389	1,498	92.7
2,704	3,358	80.5	OPEN PIT	2,704	3,358	80.5
	0		OTHER		0	
18,549	18,864	98.3	SUBTOTAL	18,549	18,864	98.3
7,067	6,123	115.4	OPERATING CASH FLOW	7,067	6,123	115.4
1,581	1,752	90.2	D, D, & A	1,581	1,752	90.2
5,486	4,372	125.5	OPERATING INCOME	5,486	4,372	125.5
			CAPITAL EXPENDITURES			
86	371		ELECTROLYTIC	86	371	
660	2,237		OPEN PIT	660	2,237	
29	616		IN-SITU	29	616	
0	37		OTHER	0	37	
775	3,261		TOTAL CAPITAL EXPENDITURES	775	3,261	
18,549	18,864	98.3	CASH COSTS	18,549	18,864	98.3
20,130	20,616	97.6	DIVISION PROFIT & LOSS COSTS	20,130	20,616	97.6

MAGMA COPPER COMPANY
SAN MANUEL MINING DIVISION SUMMARY

JANUARY 1991

ACTUAL	PLAN	% OF PLAN	(000'S)	YEAR TO DATE ACTUAL	PLAN	% OF PLAN
COSTS (NET OF BY-PRODUCTS)						
0.875	0.944	92.7	ELECTROLYTIC	0.875	0.944	92.7
0.698	0.843	82.8	IN-SITU	0.698	0.843	82.8
0.566	0.643	88.1	OPEN PIT	0.566	0.643	88.1
0.000	0.000		OTHER	0.000	0.000	
0.797	0.863	92.3	SUBTOTAL	0.797	0.863	92.3
DIVISION EMPLOYMENT						
			MANPOWER			
1,873	1,912	98.0	HOURLY	1,873	1,912	98.0
309	319	96.9	SALARY	309	319	96.9
2,182	2,231	97.8	TOTAL	2,182	2,231	97.8
			TURNOVER			
7.1			ABSENTEEISM	7.1		
5.8			OVERTIME	5.8		
1.64	3.8		SAFETY INCIDENT RATE	1.64	3.8	
11			2nd STEP GRIEVANCES	11		
DIVISION PRODUCTIVITY						
509			SALABLE LBS. PER MANSHIFT WORKED	509		

MAGMA COPPER COMPANY
THE MANUEL MINING DIVISION

PRODUCTION SUMMARY
1991 BUSINESS PLAN

JANUARY, 1991

MONTH				YEAR-TO-DATE		
BUDGET	ACTUAL	% VAR	SAN MANUEL MINING DIVISION	BUDGET	ACTUAL	% VAR
21,848,773	23,281,817	106.6	Lbs Salable Copper	21,848,773	23,281,817	106.6
			UNDERGROUND SULFIDE MINE			
1,320,000	1,441,677	109.2	Tons Hoisted	1,320,000	1,441,677	109.2
44,000	48,056	109.2	Tons per Day	44,000	48,056	109.2
0.668	0.676	101.2	% Total Copper	0.668	0.676	101.2
0.026	0.020	76.2	% Oxide Copper	0.026	0.020	76.2
0.642	0.656	102.2	% Net Sulfide Copper	0.642	0.656	102.2
0.022	0.026	115.9	% MoS_2	0.022	0.026	115.9
14,844,773	16,515,530	111.3	Lbs Salable Copper	14,844,773	16,515,530	111.3
0	0	0	Lbs Open Pit Salable Copper	0	0	0
			CONCENTRATOR OPERATION			
			SULFIDE ORE			
			(Mine Ore only)			
87.23	88.83	101.8	% Total Copper Recovery	87.23	88.83	101.8
90.69	91.82	101.2	% Sulfide Copper Recovery	90.69	91.82	101.2
71.00	77.11	108.6	% MoS_2 Recovery (o/a)	71.00	77.11	108.6
26,074	28,862	110.7	Dry Tons Copper Concentrate	26,074	28,862	110.7
29.50	29.65	100.5	% Copper in Concentrate	29.50	29.65	100.5
7,692	8,557	111.2	Tons Copper in Concentrate	7,692	8,557	111.2
224.1	301.5	134.5	Tons Molybdenum Concentrate	224.1	301.5	134.5
123.7	168.0	135.8	Total Tons Molybdenum	123.7	168.0	135.8
			SLAG			
59,985	68,917	115.0	Dry Tons Milled	59,985	68,917	115.0
5.0	4.579	91.6	% Total Copper in Slag	5.0	4.579	91.6
91.20	95.73	105.0	% Total Copper Recovery	91.20	95.73	105.0
7,198	8,721	121.2	Dry Tons Copper Concentrate	7,198	8,721	121.2
38.0	34.64	91.2	% Copper in Concentrate	38.0	34.64	91.2
2,735	3,021	110.5	Tons Copper in Concentrate	2,735	3,021	110.5

MAGMA COPPER COMPANY
THE MANUEL MINING DIVISION

OXIDE MINE OPERATIONS
PRODUCTION SUMMARY

JANUARY, 1991

MONTH				YEAR-TO-DATE		
BUDGET	ACTUAL	% VAR	OPEN PIT	BUDGET	ACTUAL	% VAR
0	0	0	Tons Sulfide Ore	0	0	0
1,055,000	1,056,114	100.1	Tons Oxide Ore	1,055,000	1,056,114	100.1
1,444,000	1,386,440	96.0	Tons Waste	1,444,000	1,386,440	96.0
2,499,000	2,442,554	97.7	Tons Total Material Mined	2,499,0000	2,442,554	97.7
0	0	0	% Total Copper in Sulfide	0	0	0
0.551	0.637	115.6	% Total Copper in Oxide	0.551	0.637	115.6
0.315	0.452	143.5	% ASol Copper in Oxide	0.315	0.452	143.5
			IN-SITU OPERATIONS			
3,340	2,617	78.4	Injection Flow Rate (gpm)	3,340	2,617	78.4
2,150	2,466	114.7	PLS Flow Rate (gpm)	2,150	2,466	114.7
2.107	2.190	103.9	PLS Tenor (g/l)	2.107	2.190	103.9
44	0	0.0	New Injection Well	44	0	0.0
139	127	91.4	Active Injection Wells	139	127	91.4
33	8	24.2	Terminated Injection Wells	33	8	24.2
-	0	-	New Production Wells	-	0	-
18	25	138.9	Active Production Wells	18	25	138.9
-	7	-	Terminated Production Wells	-	7	-
			SX-EW PLANT			
5,226,000	4,774,969	91.4	Open Pit Copper Pounds	5,226,000	4,774,969	91.4
1,778,000	1,991,318	112.0	In-Situ Copper Pounds	1,778,000	1,991,318	112.0
284,000	386,464	135.9	Leachate Copper Pounds	284,000	386,464	135.9
7,288,000	7,152,711	98.1	Total Copper Pounds	7,288,000	7,152,711	98.1
93.0	93.3	100.3	Amp Efficiency	93.0	93.3	100.3

6219 E 22ND STREET
TUCSON, AZ 85711

STATE TAX APPEALS BOARD DECISIONS ON MAJOR CENTRALLY ASSESSED TAXPAYERS' APPEALS

Taxpayer	1978 State Valuation	Taxpayer Asked	Board Decision	Change From 1977
Anaconda Co. & AMAX, Inc.	$ 58,000,000	$ 25,000,000	$ 45,000,000	Down 25 per cent
Cyprus Bagdad Copper	76,000,000	43,000,000	57,000,000	Down 9.6 per cent
Hecla; El Paso Nat. Gas	24,000,000	12,157,001	14,250,000	Down 61 per cent
Nevada Power Co.	72,000,000	67,700,000	67,700,000	Up 5 per cent
Arizona Public Service	1,150,000,000	1,015,000,000	1,100,000,000	Up 20 per cent
Salt River Project	800,000,000	661,000,000	708,000,000	Up 38 per cent
Cholla 4 Const. Co.	28,900,000	23,400,000	23,400,000	(New this year)
Public Service Co. of N.M.	16,000,000	13,849,200	16,000,000	Up 333 per cent
El Paso Electric Co.	21,687,000	18,355,932	21,687,000	Up 300 per cent
El Paso Natural Gas Co.	215,000,000	195,140,000	200,000,000	Down 6 per cent
Continental Telephone	19,400,000	15,650,000	16,241,000	Down 12 per cent
San Manuel Ariz. RR	2,300,000	1,750,000	1,499,160	Down 31 per cent

NEWMONT MINING CORPORATION
200 PARK AVENUE
NEW YORK, NEW YORK 10166
(212) 953-6900

GORDON R. PARKER
CHAIRMAN, PRESIDENT AND
CHIEF EXECUTIVE OFFICER

RECEIVED
OCT 08 1986
DEPT. OF MINES &
MINERAL RESOURCES

September 30, 1986

To the Shareholders of Newmont Mining Corporation:

I believe it is important for you to have the enclosed press release made yesterday after extended consideration of its several subjects by our Board of Directors. The release announces the recapitalization of Magma Copper Company, a plan to finance and retrofit Magma's Arizona smelter and the intent to expand its associated refinery. The release also states our expectation, once the financing of that plan is assured, to dividend 80 percent of Magma's common stock to our shareholders. Each of those subjects merits further explanation, which I propose to furnish by this letter.

As noted in our two most recent Annual Reports to Shareholders, Magma's smelter at San Manuel, Arizona, has long been obligated under federal and Arizona air quality laws to change its production methods by January 1, 1988. The capital cost to do so is currently estimated at approximately $130 million. Pretax losses at Magma, aggregating $301 million since 1980, and amounting to $44.5 million in the first eight months of 1986, had deterred its Board of Directors from any such investment and had discouraged Newmont's Board from freely shouldering the burden of financing that capital project. Efforts at legislative and regulatory relief have all proved unavailing. A final decision on the future of Magma's smelter could no longer be delayed, given that a nine-month hiatus in smelter availability was already unavoidable and would grow concurrently with each further postponement.

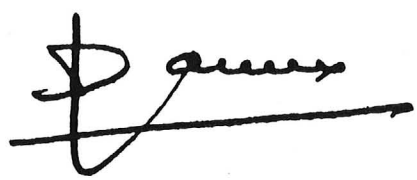
Newmont has completed an intensive and extensive study of Magma's and Pinto Valley's operating prospects in the light of the depressed outlook for the copper market. The result of this study was an operating plan which exploits sulfide and oxide copper resources at Magma and Pinto Valley and provides for the co-termination of copper production at both properties in approximately 1997. The study further concluded that if Magma were combined with Pinto Valley and were freed from a large part of its debt to Newmont, it could with reasonable confidence undertake the smelter alteration, expect to repay third party borrowings made for or during the period of construction, and generate substantial additional cash to reward the holders of its equity. Accordingly, Newmont's Board of Directors approved a contribution to Magma's capital of Pinto Valley and all but $200 million of such intercompany debt as of October 1, 1986, with the conversion of the remainder to a new series of Magma nonvoting preferred stock. Such preferred stock would carry an eight percent dividend, cumulative if earned, with the right to an additional 20 percent participation in Magma's distributions to common stockholders.

With such a recapitalization available to it, Magma's Board of Directors determined to proceed with the final engineering and the reconstruction of its smelter, the completion date for which is estimated to be October 1988. Magma has started discussions to arrange the needed loans, retaining the services of Chemical Bank as financial adviser. Initial indications are that fixed rate funds to sustain Magma on an independent basis from October 1, 1986, can be borrowed from a variety of sources, consistent with Magma's long-term mining and operating plans.

This brings us to the reasons for the contemplated dividend declaration, and to what we intend it to mean. Newmont's Board of Directors and management have long held and often stated a belief that domestic copper markets could not expect a "quick turnaround" in prices, and that our new corporate investments should be directed to other metals and resource opportunities. Gold and energy have consequently received the preponderance of Newmont's exploration and development funds in recent years. I confidently expect that this constrained view of rewards from domestic copper is widely shared by our institutional and individual stockholders, and importantly also by investment advisers and commentators. The absolute size of our copper interests and the time and attention naturally given to any beleaguered segment of one's business, have contributed to hiding our other and principal earning assets from the clear view of many potential investors. By contrast, it is easily calculated that Magma's earning potential is substantial at higher but, to many observers, attainable copper prices. Magma's actual and projected costs are moving down, as its deliberate cost reduction steps take effect, and as its previously reported oxide projects mature in operation and under test alike. The new smelter should lower treatment costs appreciably as well. I do believe that across the remaining life of its San Manuel mine Magma could amply reward all of its investors. For that major reason, our Board of Directors has been reluctant just to seek a buyer for Magma in the currently depressed market for copper equities. Instead, the Board has determined that the distribution of 80 percent of the stock of a combined Magma and Pinto Valley as a dividend to our shareholders would provide the best means of preserving the shareholders' upside copper opportunity while clarifying that our new commitments will be elsewhere. A further five percent of Magma's outstanding stock would be placed under an incentive plan or surrendered to the discretion of its Board of Directors, for the benefit of Magma's new and independent management team. Newmont would thus retain an ultimate 15 percent interest in Magma's common stock as well as a substantial preferred stockholding.

Newmont shareholders can expect to receive a complete prospectus on Magma in advance of any actual dividend. You will also be advised of significant progress by Magma in smelter-related financing, which as I have noted is our Board of Directors' precondition to declaring a dividend of Magma shares.

I hope to have anticipated in the press release and in this letter your most important questions, and will respond to additional points as events allow us to add meaningful investment information.



Gordon R. Parker
Chairman, President and Chief Executive Officer

SAN MANUEL ~~MAGMA~~ GEN FILE

FOR IMMEDIATE RELEASE

NEWMONT NEWS RELEASE

NEWMONT MINING CORPORATION, 200 PARK AVENUE, NEW YORK, N.Y. 10166

NEW YORK, September 29, 1986--Gordon R. Parker, Chairman, President and Chief Executive Officer of Newmont, announced today that Newmont had adopted a plan to recapitalize its wholly-owned subsidiary, Magma Copper Company, by contributing to its capital the stock of another 100-percent-owned subsidiary, Pinto Valley Copper Corporation, and all but $200 million of intercompany debt. This restructuring will allow Magma to raise the funds needed for a major retrofit and expansion of its Arizona smelter and expansion of its refinery, and for an anticipated in-situ oxide ore leaching project. He also announced that under the plan 80 percent of Magma's common stock would be distributed as a special dividend to Newmont shareholders after Magma has arranged the smelter-related financing. Mr. Parker expressed the hope that the precondition of such financing could be sufficiently advanced by year-end to permit registration, listing on the NASDAQ for trading over the counter, and distribution of Magma shares by late January 1987.

Mr. Parker stated that recently completed engineering and economic studies of Newmont's Arizona copper resources have justified Magma's investing the required $130 million in a 3,000-ton-per-day smelter, so as to comply by late 1988 with federal and state air quality laws that are effective January 1 of that year. Magma's refinery would be expanded to treat the output of the enlarged smelter, at a further capital cost of approximately $20 million. He noted that the capacity of the new smelter and the refinery expansion were predicated, in part, on a long-term toll treatment contract recently concluded with Cyprus Minerals Company covering a minimum of 300,000 tons of Cyprus concentrates per year.

The recapitalization of Magma also involves the exchange by Newmont of its remaining $200 million Magma debt (out of approximately $350 million) for a Magma preferred stock that would be nonvoting and subordinated, would have a dividend of eight percent cumulative if earned and would also have a participation of 20 percent in Magma's future dividends to common stockholders. The preferred stock would be exchangeable at Magma's option for an eight percent fixed interest subordinated note with similar participation rights. Additionally, Pinto Valley, which was acquired by Newmont in 1983 at a cost of $75 million, will immediately become a Magma subsidiary.

Magma's Board of Directors, accepting the recapitalization offer from Newmont, has determined to proceed with the reconstruction of its smelter and has initiated steps to arrange the needed financing. Magma has retained Chemical Bank as its financial advisor. Initial indications are that fixed rate funds to sustain Magma on an independent basis from October

(more)

1, 1986, can be obtained from a variety of sources consistent with Magma's long-term operating cash flow projections.

Newmont noted that it has long stated its belief that its domestic copper operations could not expect a "quick turnaround," and that new discretionary investments by the company should be directed to other opportunities. Newmont said its gold and energy businesses have consequently received the preponderance of both exploration and development funding in recent years.

Magma's future earning potential, Newmont added, is quite substantial at readily foreseeable copper prices primarily due to existing and potential oxide leaching projects, significant anticipated improvements in the cost structure of its underground mine and the economies of a larger smelter.

Magma produces some 100,000 tons per year of refined copper from its underground sulfide mine. Pinto Valley, currently operating near a breakeven level, annually produces 70,000 from open-pit sulfide mining and 12,000 tons from leaching/electrowinning of oxide ore.

Magma's new $70 million open-pit oxide ore mine and solvent extraction/electrowinning facility at San Manuel were producing at a rate approaching capacity of 25,000 tons per year. Costs at the plant, opened in May 1986, are about half the costs of current production from underground mining. Production of another 50,000 tons of electrowon copper, from additional oxide reserves at even lower costs, currently is under a large-scale feasibility test whose results will be available in 1987.

Labor cost reductions achieved in July 1986 are expected to lower the 1987 cash costs of Magma's underground sulfide mine production by approximately nine cents a pound of copper. A new underground mining plan should further reduce cash costs by approximately 15 cents a pound by 1989, and the new smelter should reduce cash costs of all smelter copper a further four cents a pound--with all reductions measured from an expected 1986 average cash cost of approximately 82 cents a pound before interest charges. The 1986 level is unusually high due to development work undertaken during the year to expand future production. As Magma will operate at reduced levels in 1988 awaiting the availability of the new smelter, costs in that year are expected to be high.

Newmont said it would enter a service agreement with an independently managed Magma for three years to provide a transition period in which Magma can acquire key skills now provided by Newmont personnel.

Newmont Mining Corporation is a leading worldwide natural resource company engaged in the exploration for, and operation and management of precious and nonferrous metal mining and hydrocarbon energy properties.

# # #

FOR IMMEDIATE RELEASE
July 26, 1988

SAN MANUEL, ARIZONA -- Magma Copper Company (NASDAQ-MGCP) announced today a second quarter, 1988 net income of $11.7 million or $0.31 per common share. Net income for the second quarter, 1987, which contained a pension settlement gain of $9.8 million, was $7.5 million.

Total revenue for the second quarter of 1988 was $136.2 million, compared to $97.8 million for the same period in 1987. Copper sales, including rod conversion premiums, contributed $116.3 million or 85% of total revenue for the second quarter of 1988, compared to $82.5 million or 84% of total revenue for the second quarter of 1987.

Net income for the first six months of 1988 was $28.5 million, or $0.33 per common share after accounting for preferred dividends of $16 million in the first quarter. During the same period in 1987, net income was $1.7 million. Total revenue for the first six months of 1988 was $269.1 million, compared to $199.2 million for the same period in 1987.

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NEWS FROM MAGMA
MAGMA COPPER COMPANY
P.O. Box M, San Manuel, Arizona 85631
Public Relations Officer—Frank Harris (602) 385-3256/385-2153
Investor Relations Officer—Alan Oshiki (602) 385-3145

Magma sold 114.4 million pounds of refined copper during the second quarter, compared to 114.1 million pounds in the second quarter of 1987. The average revenue per pound of copper sold during the second quarter of 1988, including rod conversion premiums, was $1.017. During the same period in 1987 the average revenue per pound of copper sold was $0.723.

The production cost per pound of copper during the quarter was higher than the comparable period in 1987 due primarily to price related bonuses payable to employees and other costs linked to copper prices.

Refined copper production during the second quarter of 1988 was 106.4 million pounds, excluding third party tolling.

After an extensive test of a mechanized production system in two underground panels of the San Manuel orebody, the Company has concluded that it will limit mechanized production to these areas because of ground support and ore recovery problems. As a result, conventional block caving methods will be used in the remaining undeveloped areas of the San Manuel mine.

Start-up of the Company's new flash furnace at the San Manuel smelter began on schedule July 7 and has progressed smoothly, according to plan, with only minor

more---

technical delays. The retrofitted smelter is expected to operate at its fully rated capacity of 3,000 tons per day of concentrates by October 1, when a three month commissioning period will end. By that time, costs for sulfide copper smelting should decrease significantly.

Magma operates mines near San Manuel and Miami, Arizona; a smelter, refinery, and rod plant in San Manuel and a rod plant in Chicago.

MAGMA COPPER COMPANY
Summary of Consolidated Income
(In Thousands Except Per Share Amounts)
(Unaudited)

	Three Months Ended June 30,		Six Months Ended June 30,	
	1988	1987	1988	1987
Revenue	$136,213	$97,827	$269,059	$199,244
Net Income	11,745	7,467	28,524	1,684
Preferred Stock Dividends	---	(7,467)	(16,000)	(1,684)
Net Income Available For Common Stock	11,745	---	12,524	---
Net Income Per Common Share	$0.31	---	$0.33	---
Average Number of Common Shares Outstanding	38,114	38,091	38,106	38,091

# # #

MAGMA COPPER COMPANY
Consolidated Balance Sheet
(in thousands)

ASSETS	June 30, 1988 (unaudited)	December 31, 1987
Current Assets:		
Cash and short-term investments	$ 1,529	$ 9,148
Accounts receivable	54,523	51,447
Inventories:		
Metals	68,201	71,947
Materials and supplies	26,807	24,640
Prepaid expenses	5,034	16,658
Total Current Assets	156,094	173,840
Property, Plant and Mine Development, (net):		
Mining claims and land	30,628	30,705
Equipment and buildings	470,716	425,766
Deferred mine development	157,419	136,655
Net property, plant and mine development	658,763	593,126
Funds Held by Trustee	---	906
Other assets	12,082	10,202
	$826,939	$778,074
LIABILITIES AND STOCKHOLDERS' EQUITY		
Current Liabilities:		
Accounts payable	$ 19,483	$ 23,160
Accrued liabilities	46,810	48,399
Due to Newmont Mining Corporation	351	1,336
Income taxes payable	96	---
Total Current Liabilities	66,740	72,895
Accrued Pension, Retirement and Facility Abandonment Costs	27,750	28,855
Deferred Income Taxes	465	---
Long Term Debt	244,182	218,182
Series A Convertible, Exchangeable Preferred Stock	200,000	200,000
Stockholders' Equity:		
Class B Common Stock	381	381
Capital in Excess of Par Value	331,490	327,381
Retained Earnings (Deficit)	(39,923)	(68,447)
Unearned Stock Grant Compensation	(4,146)	(1,173)
	$826,939	$778,074

MAGMA COPPER COMPANY
AND CONSOLIDATED SUBSIDIARIES
STATEMENT OF OPERATIONS
(in thousands except per share amounts)
(unaudited)

	Three Months Ended June 30		Six Months Ended June 30	
	1988	1987	1988	1987
Sales	$136,213	$ 97,827	$269,059	$199,244
Cost of sales:				
Cost of products sold	(110,780)	(85,647)	(212,996)	(180,276)
Depreciation, depletion and amortization	(5,562)	(5,804)	(10,904)	(11,444)
General and administrative	(4,147)	(3,907)	(8,599)	(7,502)
Marketing and delivery	(3,606)	(4,548)	(7,253)	(7,601)
Income (loss) from operations	12,118	(2,079)	29,307	(7,579)
Interest expense	(53)	(288)	(72)	(571)
Pension settlement gain	---	9,834	---	9,834
Income before income taxes and extra-ordinary credit	12,065	7,467	29,235	1,684
Provision for income taxes	(5,439)	(2,893)	(12,080)	(2,893)
Income (loss) before extraordinary credit	6,626	4,574	17,155	(1,209)
Extraordinary credit - utilization of net operating loss carryforward	5,119	2,893	11,369	2,893
Net income	$ 11,745	$ 7,467	$ 28,524	$ 1,684
Preferred stock dividends	$ ---	$ (7,467)	$(16,000)	$ (1,684)
Net income available for common stock	$ 11,745	$ ---	$ 12,524	$ ---
Earnings Per Share:				
Income (loss) before extraordinary credit and preferred stock dividends	$ .17	$ .12	$ .45	$(.04)
Extraordinary credit - utilization of net operating loss carryforward	.14	.08	.30	.08
Preferred stock dividends	---	(.20)	(.42)	(.04)
Earnings Per Share of Common Stock	$ .31	$ ---	$ .33	$ ---
Average common shares outstanding	38,114	38,091	38,106	38,091

MAGMA COPPER COMPANY
Consolidated Statement of Cash Flows
(in thousands)
(unaudited)

	Six Months Ended June 30, 1988	1987
Net income	$28,524	$ 1,684
Adjustments to reconcile net income to net cash provided by operating activities:		
Depreciation, depletion and amortization	10,904	11,444
Gain on sale of assets	(2,893)	---
Other	1,070	---
Pension settlement gain	---	(9,834)
Change in assets and liabilities:		
(Increase) decrease in:		
Accounts receivable	(3,076)	(4,783)
Inventories	1,579	12,383
Prepaid expenses	11,624	(4,746)
Increase (decrease) in:		
Accounts payable and accrued expenses	(5,266)	7,666
Due to Newmont Mining Corporation	(985)	14
Income taxes payable	96	---
Accrued pension and facility abandonment costs	(1,105)	65
Deferred income taxes	465	---
Total adjustments	12,413	12,209
Net cash provided by operating activities	40,937	13,893
Cash flows from investing activities:		
Proceeds from sale of assets	4,089	---
Capital expenditures	(77,723)	(46,486)
Other	(1,828)	(4,633)
Proceeds from pension settlement net of excise tax	---	18,653
Net cash used in investing activities	(75,462)	(32,466)
Cash flows from financing activities:		
Drawdown of IDA loans held by trustee	906	4,714
Increase in long-term debt	26,000	53,000
Newmont short-term borrowing	---	11,116
Repayment of Newmont short-term borrowing	---	(29,757)
Net cash provided by financing activities	26,906	39,073
Net increase (decrease) in cash	(7,619)	20,500
Cash at the beginning of the period	9,148	235
Cash at the end of the period	$ 1,529	$20,735

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ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

Rose Mofford, Governor
Ronald Miller, Acting Director

NOTICE OF INTENT TO ISSUE A GROUNDWATER QUALITY PROTECTION PERMIT(S)

Pursuant to Arizona Administrative Code, Title 9, Chapter 20, Article 2, the Director of the Arizona Department of Environmental Quality intends to issue a Groundwater Quality Protection Permit(s) to the following applicant(s), subject to certain special and general conditions.

Public Notice No. 122-88AZGW — On or about January 16, 1989
Magma Copper Company
San Manuel Mine — File
P.O. Box M
San Manuel, Arizona 85631
Groundwater Quality Protection Permit No. G-0058-11

The permittee shall be authorized to operate a nondischarge hydrometallurgical precious metal recovery facility utilizing the sulfuric acid (H_2SO_4) solution/heap leaching method. The facility is located directly northeast of San Manuel, Arizona in Pinal County, Township 8 South, 9 South, Range 16 East, Section 2, 3, 26, 27, 34, 35 over groundwaters of Lower San Pedro Basin. The proposed Groundwater Quality Protection Permit shall regulate the containment of leach solution to be used in the operation of the heap leach facility. The heap pad shall be constructed with a flexible geomembrane liner system over a prepared subgrade to form an impermeable boundry between leaching operations and land surface. The pregnant leach solution (PLS) pond, solvent extraction - electrowinning (SX-EW) plant feed pond, and raffinate pond are constructed with flexible geomembrane liner over a prepared subgrade to form an impermeable boundry between solution operations and land surface. Directly adjacent to leaching operations vadose monitoring shall be required by eight (8) observation wells emplaced en echelon to moniter any potential liner leakage. The facility shall monitor leach solution daily in the form of a water balance record and monitor vadose observation wells weekly for liner leakage.

The facility shall be protected from runoff associated with a 100-year/24-hour storm water event. The facility processing site is fenced to provide restricted access. Mine dewatering has produced depth to groundwater in excess of 650 feet.

The permit and related material are available for public review Monday through Friday, 8:00 a.m. to 5:00 p.m. at Arizona Department of Environmental Quality, Water Permits Unit, 2005 North Central Avenue, Phoenix, Arizona 85004.

Persons may submit comments or request a public hearing on the proposed action, in writing, to ADEQ at the above address within thirty (30) days from the date of this notice. Public hearing request must include the reason for such request.

The Department of Environmental Quality is An Equal Opportunity Affirmative Action Employer

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

Rose Mofford, Governor
Randolph Wood, Director

JOINT NOTICE OF PROPOSED ACTION

by the

U. S. Environmental Protection Agency
Region 9 (W-5-1)
215 Fremont Street
San Francisco, CA 94105

Telephone: (415) 974-8105

On Application for National Pollutant Discharge Elimination System (NPDES) Permit to Discharge Pollutants to Waters of the United States

State of Arizona
Arizona Department of Environmental Quality
2005 North Central Avenue-Room 300
Phoenix, AZ 85004

Telephone: (602) 257-2270

On Application for Certification for Compliance with Applicable Effluent Limitations and Appropriate Requirements of the State of Arizona

The Environmental Protection Agency (EPA), Region 9, San Francisco, California, and the Arizona Department of Environmental Quality (ADEQ) are jointly issuing the following notice of proposed action under the Clean Water Act (CWA).

The Environmental Protection Agency, Region 9, San Francisco, California, has received a complete application for a National Pollutant Discharge Elimination System (NPDES) permit and has prepared tentative determinations regarding the permit.

On the basis of preliminary review of the requirements of the Clean Water Act, as amended, the implementing regulations, the Regional Administrator, Region 9 Environmental Protection Agency, proposes to issue an NPDES permit to discharge to the following applicant, subject to certain effluent limitations and special conditions.

Public Notice No. 2-89-AZ March 6, 1989

Magma Copper Company
P. O. Box M
San Manual, Arizona 85631
NPDES Permit No. AZ0023191

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DEPT OF MINES & MINERAL RESOURCES

The applicant operates the San Manuel Mine, located near San Manuel in Pinal County. The discharge consists of process water and storm water run-off. There are two (2) discharge points. Discharge point No. 001, at latitude 32° 41' 25" N, longitude 110° 41' 45" W, is to an unnamed wash tributary to Tucson Wash, tributary to the San Pedro River. Discharge point 002, at latitude 32° 41' 53" N, longitude 110° 40' 14" W, is to an unnamed wash tributary to Mammoth Wash, tributary to the San Pedro River. The San Pedro River has protected uses of Aquatic and Wildlife, Incidental Human Contact and Agriculture Livestock Watering. The proposed permit contains effluent limits for Total Suspended Solids, Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Selenium, Silver, Zinc, Cyanide, Phenolics, Sulfides and pH. The proposed permit will expire five (5) years after it becomes effective.

The State of Arizona is considering a request to certify the discharge described above, pursuant to Section 401 of the Clean Water Act. The certification will set forth any limitations and monitoring requirements necessary to assure compliance with water quality standards under Section 303, area-wide waste treatment management plans under Section 208(e), effluent limitations under Sections 301 and 302, standards of performance under Section 306, or prohibitions, effluent standards or pretreatment standards under Section 307 of the CWA, and any other appropriate requirement of State law.

The State may certify a draft permit and specify conditions which are more stringent than those in the original draft permit, where the State finds such conditions necessary to meet the requirements of the CWA. For each more stringent condition, the certifying State agency shall cite the CWA or State law references upon which that condition is based. Review of appeals of limitations and conditions attributable to State certification shall be made through the applicable procedures of the State.

The Administrative Record, which includes the application, draft permit conditions and other relevant documents, is available for public review Monday through Friday from 9:00 a.m. to 4:00 p.m. at the EPA address below. A copy of the draft permit and other pertinent documents may be obtained by calling or writing to the addresses below.

Persons wishing to comment upon or object to the proposed determinations or request a public hearing pursuant to 40 CFR 124.12 should submit their comments or request in writing within 30 days from the date of this notice, either in person or by mail to:

U. S. Environmental Protection Agency
Region 9 (W-5-1)
Attn: Andrew Lincoff
215 Fremont Street
San Francisco, CA 94105

Telephone: (415) 974-8284

State of Arizona
Arizona Department of Environmental Quality
Attn: Wayne H. Palsma - Room 300
2005 North Central Avenue
Phoenix, AZ 85004

Telephone: (602) 257-2270

All comments or objections submitted within 30 days from the date of this notice will be considered in the formulation of the final determinations regarding the application. If the response to this notice indicates a significant degree of public desire for a public hearing, the Regional Administrator shall hold one in accordance with 40 CFR 124.12. A public

notice of such hearing will be issued at least 30 days prior to the hearing. A request for a public hearing shall be in writing and shall state the nature of the issues proposed to be raised in the hearing.

The permit will become effective 33 days following the date of mailing by the EPA of the final permit. If no comments request a change in the draft permit, the permit will become effective 3 days from the date of mailing.

A request for an evidentiary hearing may be submitted to the Permits Record Coordinator, (W-5-1), within 33 days following the mailing of the final determination, in accordance with 40 CFR 124.74. If granted, applicable provisions of the permit will be stayed pending the hearing.

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

DEPARTMENT OF MINERAL RESOURCES

REPORT TO OPA ON ACTIVE MINING PROJECT

Date 6/11/45

Name of Mine Okum drilling

Owner or Operator K H Wenniger

Address 249 Cactus Rd Tucson

Mine Location Old Hat mining dist

Filing Information

File System

File No.

This chart to be used for gallons of gasoline required per month.

PRESENT OPERATIONS: (check X)

Production ; Development ; Financing ; Sale of mine ;

Experimental (sampling) ; Owner's occasional trip ;

Other (specify) Drilling of mining property

PRODUCTION: **Past and Future.** **Tons**

Approx. tons last 3 months	
Approx. present rate per 3 months	
Anticipated rate next 3 months	
If in distant future check (X) here	

EQUIPMENT OPERATED:

Type	Quantity or Horse Power	Miles or Hours Per Month	Gallons Required Per Month 9/Hr
Personal Cars	List of equipment as attached applicable		
Light or Service Trucks			
Ore Hauling Trucks			
Compressors			
Other Mine or Mill Eqpt.			

PRODUCT PRODUCED OR CONTEMPLATED: Name metals or minerals. 9200 per yr

Copper

REMARKS:

This gasoline is to be used on the Mammoth (San Manuel) drilling job

ARIZONA DEPARTMENT OF MINERAL RESOURCES

By George A Callaway

DEPARTMENT OF MINERAL RESOURCES

REPORT TO OPA ON ACTIVE MINING PROJECT

Date 5/4/45

Name of Mine Red Hill - San Manuel

Owner or Operator R. H. Wenneger

Address 3649 Oracle Rd, Tucson

Mine Location Ajo

Filing Information

File System .....

File No. .....

This chart to be used for gallons of gasoline required per month.

PRESENT OPERATIONS: (check X)

Production .....; Development .....; Financing .....; Sale of mine .....;

Experimental (sampling) .....; Owner's occasional trip .....;

Other (specify) Drilling

PRODUCTION: Past and Future.

	Tons
Approx. tons last 3 months	
Approx. present rate per 3 months	
Anticipated rate next 3 months	
If in distant future check (X) here	

EQUIPMENT OPERATED:

Type	Quantity or Horse Power	Miles or Hours Per Month	Gallons Required Per Month
Personal Cars			
Light or Service Trucks	Ford F28113TRJ		50 gal/light
Ore Hauling Trucks			
Compressors			
Other Mine or Mill Eqpt.			

PRODUCT PRODUCED OR CONTEMPLATED: Name metals or minerals. Copper

REMARKS: Mr Wenneger has 4 trucks (Ford No. above) engaged in hauling and handling supplies for the San Manuel Project. This is critical and application Recommended for approval

ARIZONA DEPARTMENT OF MINERAL RESOURCES

By George A Callaway