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03/20/90

ARIZONA DEPARTMENT OF MINES AND MINERAL RESOURCES FILE DATA

PRIMARY NAME: MAMMOTH

ALTERNATE NAMES:

TIGER  
ST. ANTHONY

PINAL COUNTY MILS NUMBER: 570D

LOCATION: TOWNSHIP 8 S RANGE 16 E SECTION 26 QUARTER SW  
LATITUDE: N 32DEG 42MIN 22SEC LONGITUDE: W 110DEG 41MIN 03SEC  
TOPO MAP NAME: MAMMOTH - 7.5 MIN

CURRENT STATUS: PAST PRODUCER

COMMODITY:

GOLD  
LEAD  
COPPER  
ZINC  
VANADIUM  
MOLYBDENUM  
STONE CALC MARL  
FLUORINE FLUORSPAR

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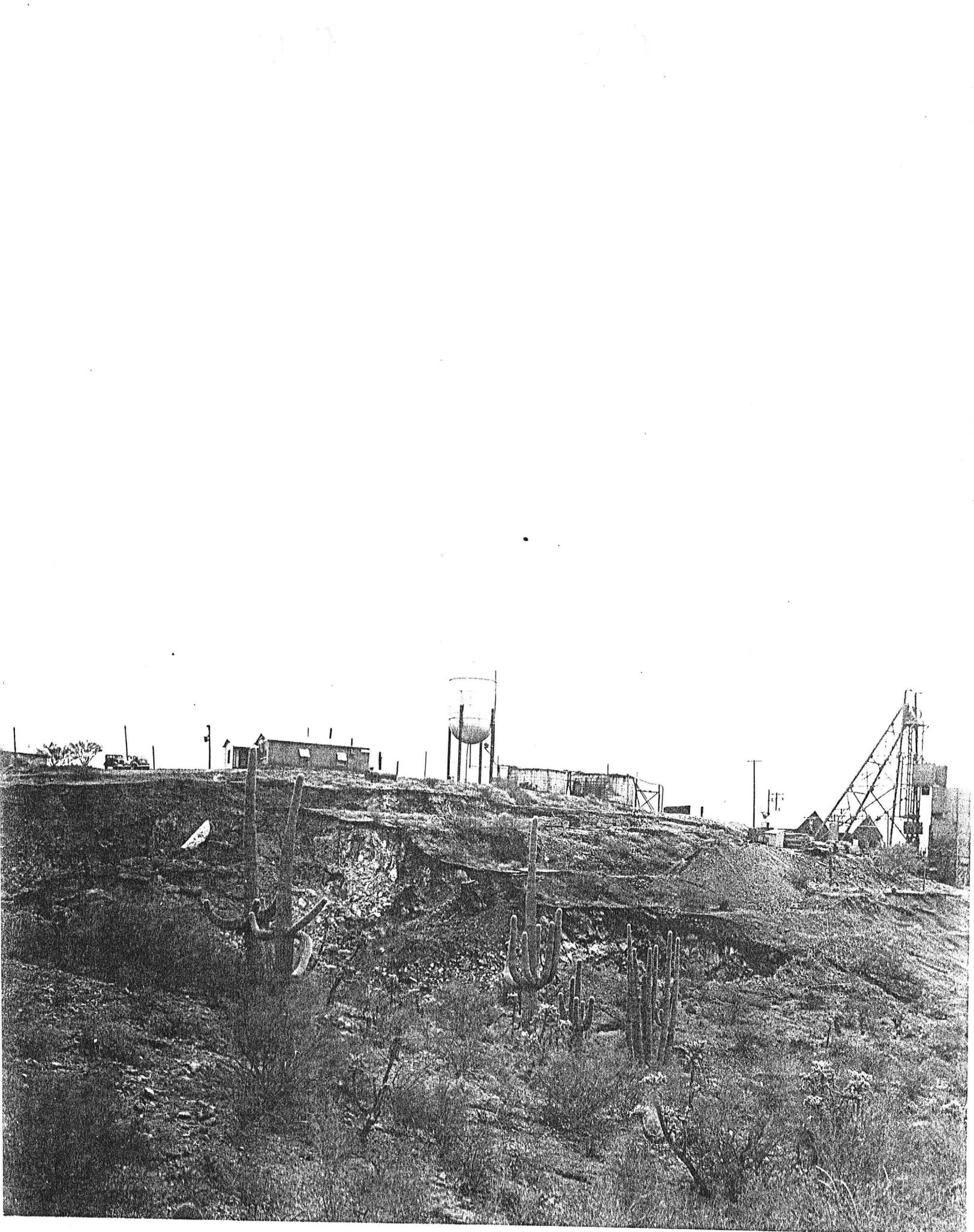
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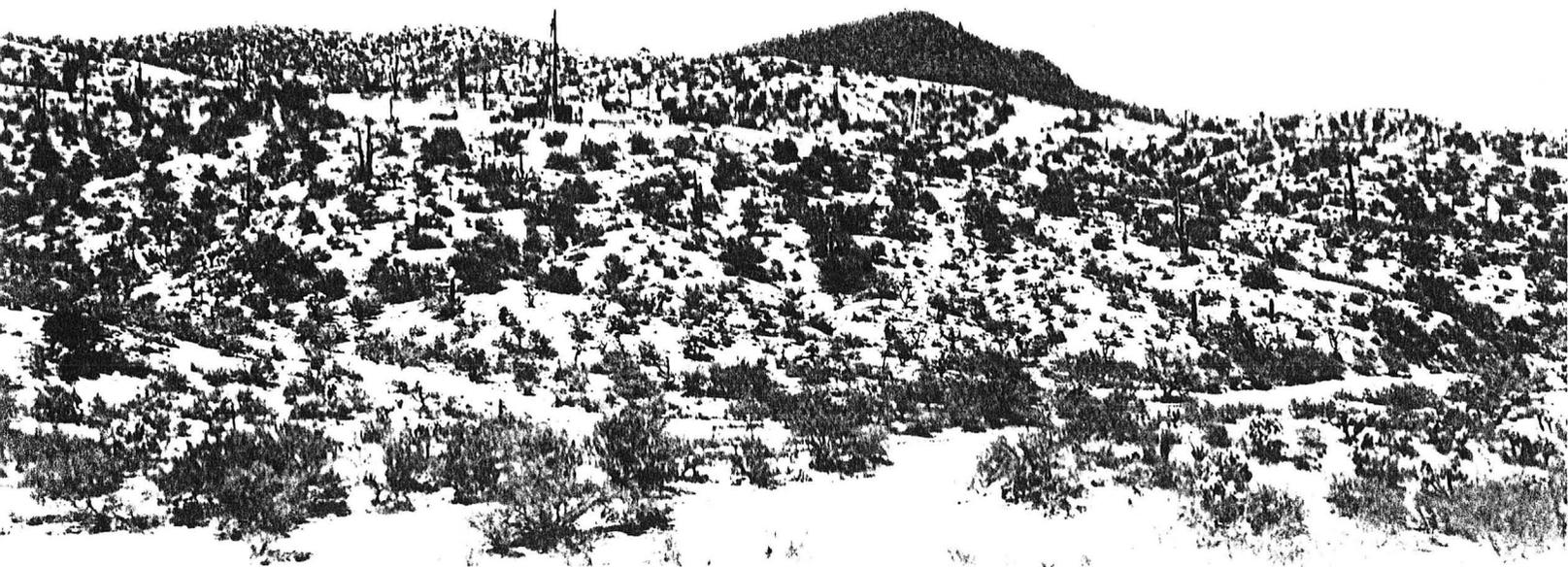
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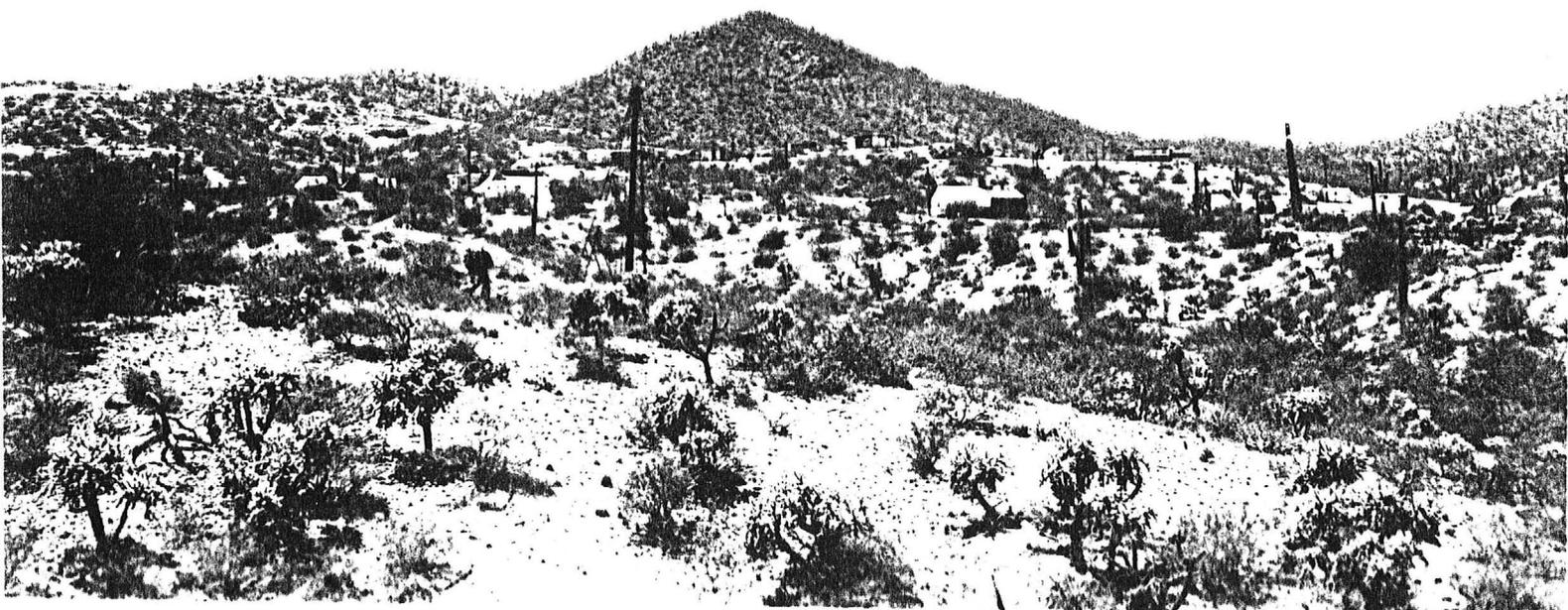
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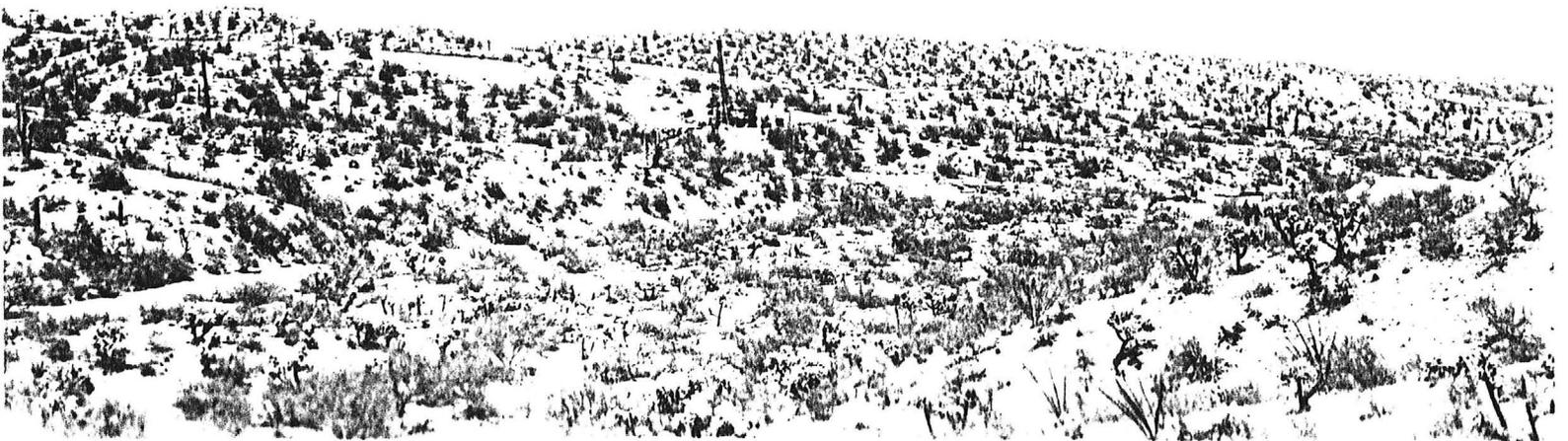
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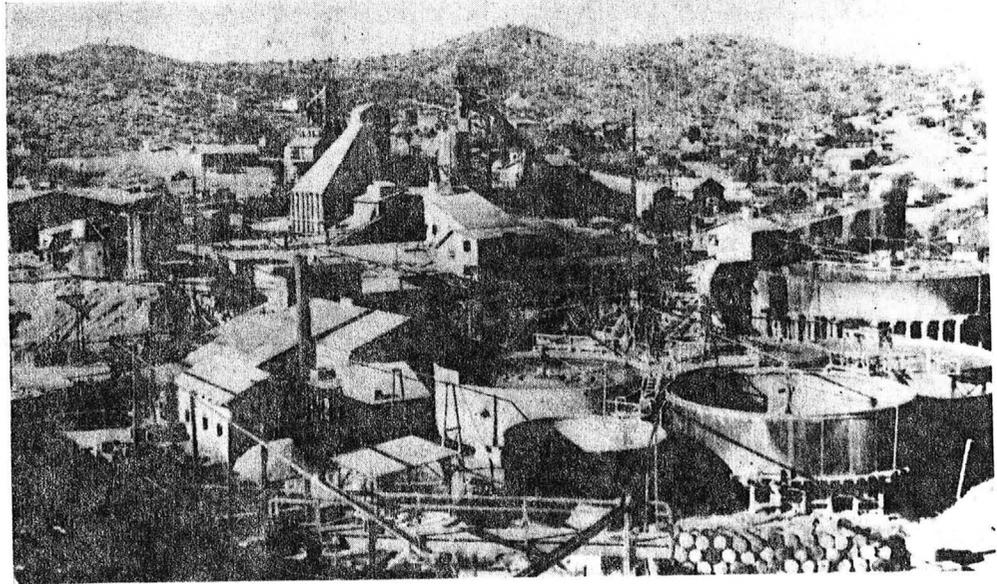
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# UNUSUAL METALLURGY -

*Mining World*

Rear view of the Mammoth St. Anthony mill, showing the cyanide tanks and precipitation plant in the foreground. Center buildings house the sulphide and oxide treatment plants, with the crusher building and Mohawk shaft headframe behind. Wood tower at right is the terminus of the aerial tram connecting with the Mammoth shaft.



## Mammoth - St. Anthony Ltd. - ARIZONA

*A mine known to contain 58 different minerals—seven of which are being recovered in commercial quantities; where oxide ores are both tabled and floated; where a smelter unlike any other is making lead bullion from oxide concentrates, providing a slag from which valuable vanadium and molybdenum are recovered.*

PROBABLY the most interesting metallurgical plant in the southwest today is that of Mammoth-St. Anthony Ltd., in the town of Tiger, Pinal County, Arizona. Seven refined and semi-refined products are shipped and payment is received for seven metals including gold, silver, lead, zinc, vanadium, molybdenum and copper.

John A. Richards is general manager of the operation; other members of the staff include: H. J. Nickolds, mill and smelter superintendent; Richard Eddy, mine foreman; James McGavock, master mechanic; E. A. Mills, chemist; and E. B. Daggett, engineer.

The mine produces both sulphide and oxide ores in which 58 different

minerals have been identified at various times. This condition makes Mammoth a specimen collector's paradise but a mill operator's headache. In separating the values of these complex ores many deviations from standard practice are necessary, as well as the development of special methods of treatment. For example, both tabling and flotation are used in concentrating the oxide ores, a procedure that is being conducted successfully in only a few other places in the world. The company's smelter,

unlike any other, is making a lead bullion from the oxide concentrates; and a water soluble slag is obtained by using soda ash for fluxing instead of the usual limestone. Finally, the slag is crushed, dissolved in water and valuable vanadium and molybdenum salts are removed by evaporation and crystallization.

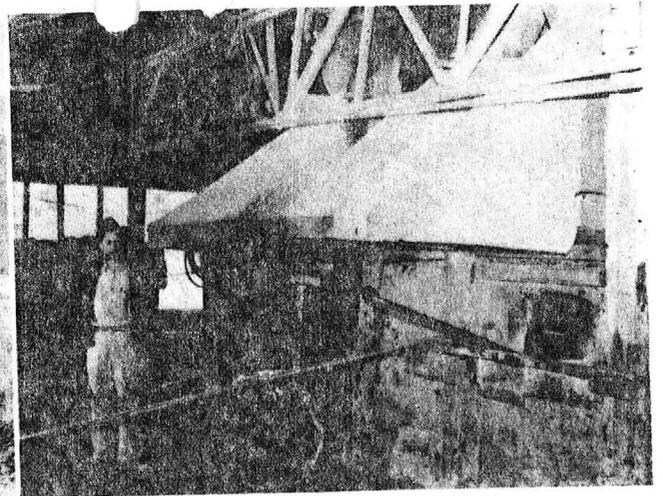
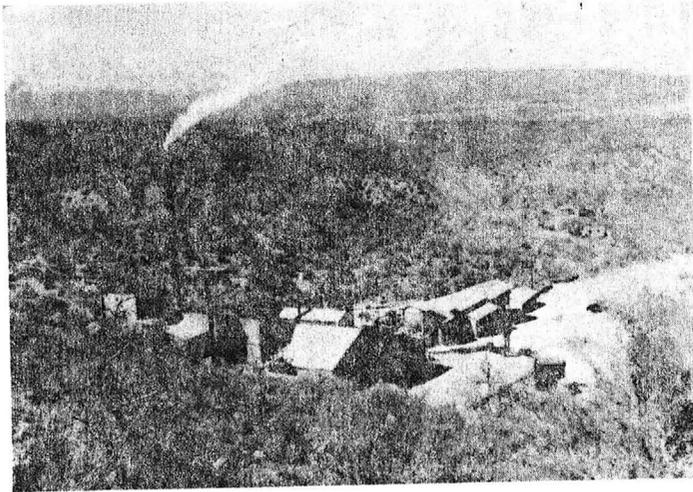
### Sulphide Ore Treatment -

Sulphide ores are mined between the 700' and 900' levels of the Collins vein, loaded into Allison end dump ore cars and trammed 2500' by Mancha Little Trammers to the Mohawk shaft for hoisting. The values are in galena and sphalerite occurring in a gangue of rhyolite and dark quartz glistening with flakes of specularite. It is practically free from oxidation and is treated separately from the oxidized ore in the sulphide mill.

From the coarse ore bin the ore is fed by a pan feeder to a No. 4 McCulley gyratory crusher which reduces it to minus 5". A 24" conveyor belt raises it to a ½"-mesh Allis-Chalmers vibrating screen, and the oversize is reduced to minus ½" in a 4' Symons shorthead cone crusher. The screen undersize and the crushed product join and are carried by another 24" conveyor, over a Merrick "Weightometer," to the 100-ton fine ore storage bin. At the head of this conveyor, a Vezin sampler removes about 2 percent of the flow. This



John A. Richards, general manager of Mammoth St. Anthony Ltd.



sample is immediately split through riffles, taking about .5 percent for further crushing and assaying.

Because of the hardness of the rhyolite gangue, two-stage grinding is employed. Material from the fine ore bin is fed by an 18" conveyor to a 6 by 4½' Marcy grate discharge ball mill operating in closed circuit with a 4½ by 18' Dorr duplex classifier. The mill is driven at 24 rpm. by direct gear drive from a 100-hp. Westinghouse synchronous motor. It is lined with manganese steel liners and charged with 2 and 2½" cast iron balls. Grinding is so difficult that 3½ lbs. of balls are required for each ton of ore, and the liners are good for only 13,000 tons.

The ball mill discharge to a 12 by 18" Denver duplex mineral jig which produces a finished high grade lead concentrate. The concentrate is blended with the product of lead flotation for shipment to the smelter. The jig overflow passes to the classifier.

The 30-mesh classifier overflow goes by gravity to the Dorr 6 by 20' duplex classifier of the secondary grinding circuit. This operates in closed circuit with another 6 by 4½' ball mill which is V-belt driven at 25 rpm. by a 105-hp. G. E. variable speed motor. This mill has cast iron liners and is charged with 2" cast iron balls. The 3½ lbs. consumption mentioned above includes that in this secondary stage. The classifier overflow at minus 65-mesh is pumped by a 2" Wilfley pump to a 6 by 6' conditioning tank. Cresylic acid is added as required by a cup and wheel liquid reagent feeder, and the pulp enters the flotation circuit at 22 percent solids.

Difficulty has been experienced in obtaining a clean lead concentrate because the zinc is very difficult to depress. Tests have been conducted by the American Cyanamid Ore Dressing Laboratory, the Denver Equipment Company and the Arizona Bureau of mines as well as by the laboratory at Mammoth-St. Anthony. In these tests grinding as fine as

Left—Smelter and salt plant buildings where table and flotation concentrates from the oxide plant are smelted into 100-lb. lead-silver-gold ingots. Slag is crushed and leached, and vanadium and molybdenum salts recovered by evaporation. Right—Joseph Fulton, smelter and salt plant shift foreman, stands beside the reverberatory furnace which, despite its worn appearance, effects an excellent recovery.

minus 325-mesh was tried with no improvement in the final result. All agreed that a large portion of the sphalerite was very difficult to depress in the presence of as little as .05 lbs. per ton of ethyl xanthate, aerofloat, or thio carbanalid. Some of the reagents used in trying to depress the zinc were sodium cyanide, aurocyanide, zinc sulphate, sodium sulphate and zinc hydro sulphite. These were also tried in varying combinations without success. It was found that even in ½ percent cyanide solution, .05 lbs. of Z-3 (ethyl xanthate) would produce lead concentrate containing 20 percent zinc. The best results were obtained by varying the collectors rather than trying to depress the zinc.

The sulphide flotation circuit consists of twenty 18" Denver "Sub A" cells with rubber linings and impellers that are divided into two sections, nine cells for lead and 11 for zinc. The lead section consists of three roughers, two cleaners and four middling cells. Flow from the conditioner enters the second cell. Rougher froth from No. 3, 4 and 5 cells goes to the first cell. The froth from the first and second cell is the cleaned concentrate which is elevated by a 2" Wilfley pump to a 10' Dorr thickener.

Tailings from the first 5 cells, which are low in lead and high in zinc, enter the sixth cell where more

collector is added. Froth from cells 7, 8 and 9 goes to No. 6 which produces a zinc-lead middling which is returned to the primary ball mill. Tailings from this 4-cell section are a low grade zinc material which flows to a 6 by 6' conditioner.

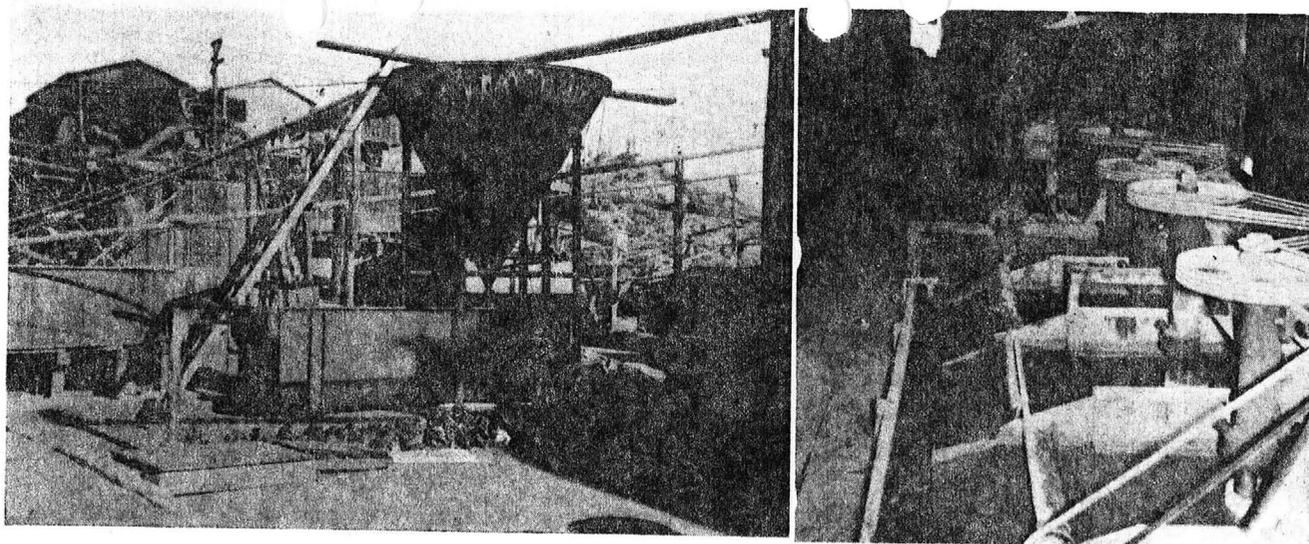
At this point, a saturated solution of copper sulphate is added at the rate of .75 lbs. per ton of dry ore, and dry lime at 3.0 lbs. per ton of ore. This flows to the fourth cell of the 11-cell zinc separation section. Froth from rougher cells 4, 5, 6, 7 and 8 passes to No. 3, while that from the scavenger cells 9, 10 and 11 enters No. 5 cell. Froth from 3 and 4 is cleaned in cells 1 and 2 which pro-



H. J. Nickolds, mill and smelter superintendent, under whose direction much of the metallurgical technique has been developed.

duce the final cleaned concentrate to be pumped to the thickener.

The product of both thickeners is elevated to a 4-disk 6' American type Oliver filter where two disks handle the zinc and two the lead.



Both concentrates are trucked to the railhead at Winkleman where the lead is shipped to the AS&R smelter at El Paso and the zinc to the same company's smelter at Amarillo, Texas.

Sulphide flotation heads average  $7\frac{1}{2}$  percent lead and  $7\frac{1}{2}$  percent zinc and contain 0.8 percent copper,  $1\frac{1}{4}$  oz. of silver and a trace of gold.

The lead concentrate runs from 55 to 60 percent lead, about 4 percent copper, 5 ounces of silver and 0.1 ounces of gold. It has a moisture content of about 10 percent.

The zinc concentrate runs from 45 to 50 percent zinc, 2 to 5 percent lead, 2 percent copper and has 10 percent moisture content. The reason copper is found in the zinc is that in the ore it appears as fine encrustations peppered with chalcopyrite and is very difficult to separate.

At the present time the plant recovers from 85 to 90 percent of the lead as a lead concentrate and 75 to 80 percent of the zinc as a zinc concentrate.

### Oxide Circuit —

The major portion of Mammoth-St. Anthony ores are oxides and although the oxide mill can handle 400 tons daily, shortage of labor has reduced oxide ore production to about 150 tons daily. The oxides are mined from the Mammoth vein and above the 700' level of the Collins vein. Ore is hoisted by skip at the Mammoth shaft to a 500-ton steel ore bin and carried by a 1200' aerial tram to storage bins near the crusher.

It is the oxidized veins that the wide variety of minerals is found. Gold averages about 0.19 ounces per ton. Other minerals of commercial value are cerussite (lead carbonate), wulfenite (lead molybdate) and vanadinite (lead vanadate). There is also a trace of copper which is not recovered.

Crushing and sampling are identical to that given the sulphides with

Left—Cone thickener and tank filter which remove water from iron-lead-gold concentrate taken from magnetic separator. Solids are mucked out and sun dried on the concrete apron, later sprayed with oil and roasted to remove sulphur. Right—Denver No. 24 Sub-A flotation cells in the oxide mill. The thin froth is typical of oxide flotation.

the same equipment being used, the ball mill feed being diverted to a separate 400-ton ore bin.

The first stage of grinding is handled by a 5 by 10' converted Marcy rod mill in closed circuit with a 6-mesh stationery Leahy screen. The ball mill is driven at 21 rpm. by a 150-hp. Westinghouse motor with a V to flat drive, is lined with manganese steel liners and is charged with 4" cast iron balls. This primary grinding requires 1.42 lbs. of balls per ton of ore.

Ore from storage is carried by a short 18" conveyor belt to a sump where it joins the ball mill discharge, and the combined products are elevated by wet bucket elevator to the Leahy screen. The screen oversize returns to the mill for further grinding while the undersize enters a 5-spigot St. Joseph hydraulic classifier. Each spigot discharges onto one of six 5 by 12' concentrating tables. Three of the tables are Diester Plat-O units and the other three are Wilfleys. Tabling is used in the flow sheet to avoid overgrinding and consequent slime losses of the soft wulfenite and vanadinite. The slimes enter a 5' Allen cone thickener, the overflow being raised by a 2" Wilfley pump to the oxide flotation feed thickener while the underflow passes to the last table.

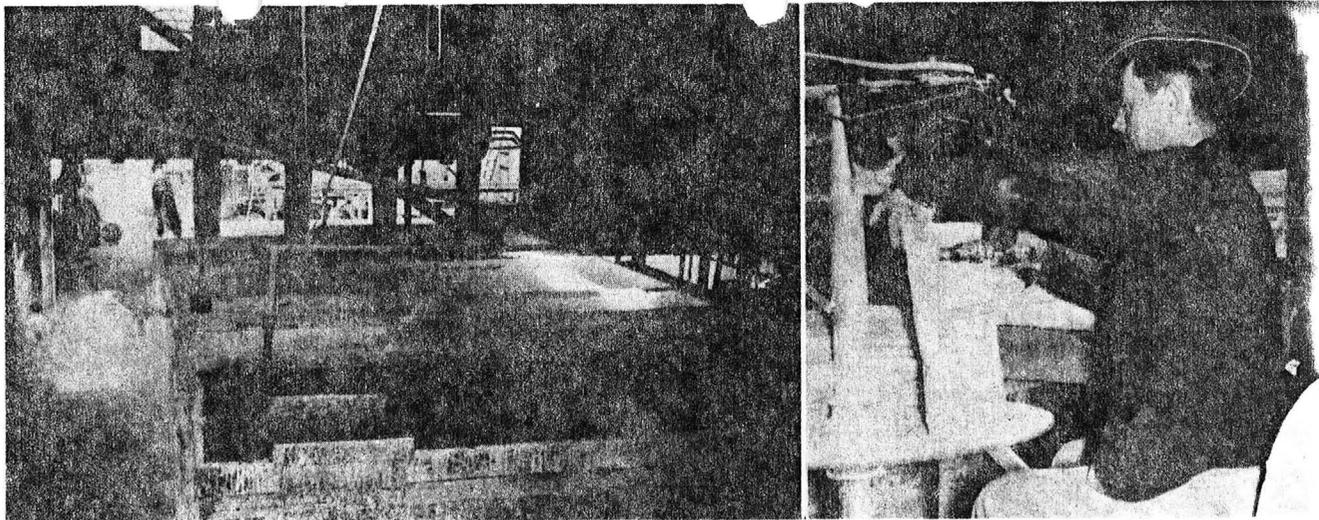
The table concentrates are dried

in a rabble arm drier and trucked to the company's own smelter. Middlings from all tables flow to the No. 5 table. The table concentrate contains about 35 to 40 percent lead, 8 percent molybdenum trioxide, 2 percent vanadium pentoxide, 2 oz. gold and 2 oz. silver.

Table tailings are taken via a 3" Wilfley pump to a 6 by 20' Dorr duplex classifier operating in closed circuit with a  $64\frac{1}{2}$  Marcy ball mill lined manganese steel liners and charged with 2 and  $2\frac{1}{2}$ " cast iron balls. The mill is V-belt driven at 24 rpm. by a 100-hp. Allis-Chalmers motor. The regrinding requires 1 lb. of balls per ton of ore, and one set of liners will last about a year. The classifier overflow, running 25 percent plus 65-mesh, is elevated by a 3" Wilfley pump to join the cone thickener fines in the oxide flotation feed thickener. As an alkalinity regulator, 1.5 lb. of soda ash per ton of ore is fed to the regrind mill. This provides a pH of 9 in the circuit.

The flotation section consists of 22 Denver "Sub A" cells and one large and two small conditioning tanks. These are divided into two units. In the first unit, comprising six 42" roughers cells and four 18" cleaners, all molybdenum and vanadium that floats readily and practically all of the gold are recovered. The second unit is composed of eight 42" roughers and four 18" cleaners, and it makes a concentrate high in lead and molybdenum values. The first unit is required in order to recover the gold before adding sodium sulphate which is a gold depressant. The addition of this reagent is necessary to sulphadize and aid the flotability of the molybdenum, vanadium and lead minerals. The concentrate of both flotation units join ahead of filtering.

Before entering the circuit, all oxide flotation feed is thickened to 40 percent solids. This unusually high percentage has been found necessary because of the low grade of the ore, and serves to stabilize the froth. Even then the froth in the cells is



flat and watery looking, having none of the tough, elastic appearance of bubbles common to sulphide flotation recovery.

The feed is pumped by a Dorr diaphragm pump from the thickener to a 4 by 6' conditioning tank where ethyl xanthate, amyl xanthate and aerofloat 25 or 31 is added as required. The conditioned product enters the first cell of the gold rougher unit, the froth from the first three roughers going to the second cell of the cleaners while that from the last three rougher cells returns to the conditioner at the head of the circuit. In the 4-cell cleaner, froth from the last two cells goes to No. 2, froth from No. 2 goes to No. 1 and the product of the first cell is the final concentrate. Tailings from the cleaner cells return to the first conditioner and tailings from the roughers flow to the second 4 by 6' conditioner.

The sulphadizing agent, sodium sulphide, at .25 lbs. per ton is added at the small conditioner and the flow enters an 8 by 8' conditioner where copper sulphate in saturated solution is added as required by a cup and wheel reagent feeder. Additional quantities of aerofloat; ethyl xanthate and amyl xanthate enter at this point.

The feed now enters the first cell of the 8-cell, lead-molybdenum rougher; the froth from these cells goes directly to the second of the four cleaner units. The flow in the cleaning circuit follows the same course as that in the gold cleaners, with the concentrate from the first cell joining that from the gold unit and the tailings returning to the second small conditioning tank. Tailings from the roughers are pumped by a 2" Wilfley pump to a 20 by 6' Dorr duplex classifier with a 15' bowl for removing slimes.

These slimes are 95 percent minus 200-mesh and contain a gold value of only .015 oz. They go to waste. However, the sands run 22 percent minus 200-mesh and contain .05 oz. of gold which is recovered by leaching. This cyanidation follows standard

Pans in which heat from the smelter flues effects evaporation of salt bearing solutions and where molybdenum and vanadium products are dried before shipment. Right—Joseph Fulton, smelter foreman, sews a sack of calcium molybdate. The product shipped contains about 50% molybdenum trioxide.

practice with two floods of strong solution, two of barren solution and two of wash. Final recovery is made in a Merrill-Crowe precipitation unit.

The combined flotation concentrate, without thickening, is pumped by a 2" Wilfley pump to a Stearns magnetic separator which removes an iron concentrate assaying 20 oz. of gold, 10 percent lead and 50 percent iron. This product flows by gravity to a cone thickener and a tank filter. It is mucked by hand onto a concrete floor where it is sun dried and roasted by oil flame to remove the sulphur. Shipment is made in steel drums to the American Smelting & Refining Company's El Paso smelter where the values are recovered and payment is made for the iron for fluxing purposes. This product, magnetite and flake iron containing gold, cannot be treated in the comparatively low heat of the smelter at Mammoth-St. Anthony.

The tailings from the Stearns magnetic separator go by gravity to a 10' thickener and thence to a 6' Oliver drum filter. The cake is semi-dried by the sun and trucked to the company smelter.

In this complex oxide flow sheet conditions vary considerably, and reagent requirements vary accordingly. In both the oxide and sulphide flotation departments it is necessary to constantly check and examine the condition of each cell. False floors have been built near the top of the

flotation machines so that mill operators will be high enough to have easy access to them for taking samples and making adjustments. Reagents and height of weirs are often changed every few hours.

Throughout the entire process samples are constantly checked. Steps to effect an adequate recovery are so exacting and ores vary so much that assay samples are taken hourly at some places and at least at every point in each batch run at others. Determinations in the laboratory will average nearly 150 per day.

### Smelting Practice—

The smelter is a reverberatory type furnace built of brick with three side doors for tending and removing slag. It is oil fired from the front and molten metal is drawn off near the bottom on the opposite end. Long brick flues convey the smoke and excess heat to a tall metal stack.

The unique feature of the furnace is its unusual hearth. The original hearth failed during early phases of the operation, allowing a run off of bullion. This left a cavity some 12' deep which was filled to the original floor level, with the furnace still hot by adding large blocks of rhyolite rock, silica sand and molten slag which were melted down together. This filling was done in stages, with periods of cooling allowed for settling and freezing the mass in layers. To build the hearth above the original floor level, a high silica, lead bearing slag was used. Instead of forming a solid hearth, the material remains semi-fluid allowing the molten metal to percolate down to the solid material. The charge is dumped in from above onto a bath of molten slag. The metal melts down forming pockets in the semi-fluid hearth, and these pockets are tapped by inserting a long rod and blowing air in through the draw hole on the end of the furnace.

At capacity operation the furnace receives the following charge at 15 minute intervals:



Esmael Contreras pours a 100-lb. lead ingot. This bar will contain a small amount of silver and gold which is recovered in the final refining process at the IS&R East Chicago plant.

Table Concentrate .....	500 lbs.
Oxide Flotation Concentrate .....	400 lbs.
Soda Ash .....	300 lbs.
Coke .....	26 lbs.

Soda ash is used in place of the usual limestone flux so that the slag will be water soluble and permit the recovery of the molybdenum and vanadium values. Oil refinery sludge is used for heating and recovery is made at 2,000° F.

The bullion is poured into 100 lb. bars of combined lead, gold and silver and shipped to the International Smelting & Refining Company at East Chicago, Indiana, for further refining.

A matte is also recovered from the smelter operation. This matte is actually a combination of a true matte and the dross off the pouring. It contains lead, copper, gold and silver in proportions that vary widely from time to time. It is shipped to the lead smelter at El Paso.

The hearth construction and operating technique were developed locally and this small, low heat, lead furnace is recovering nearly 100 percent of the gold and from 82 to 85 percent of the lead.

**Salt Plant —**

It is from the smelter slag that the recovery of molybdenum and vanadium is made. The slag, containing 25 percent molybdenum trioxide and 5 percent vanadium pentoxide, is drawn off in 500-lb. pots and after cooling is broken through a 3" grizzly. It is hauled by incline skip to a small jaw crusher which reduces it to about 1/2" and then discharged to a 3 by 6' rod mill for reduction to a practical grind. The product is not classified or screened to size, but is ground until it is fine enough to obtain speed and efficiency in leach-

ing. The ground product passes over a trommel screen and a Hartz jig which removes the flake lead which is valuable in building up the false hearth in the furnace. The balance flows into one of four 6 by 6' Denver leaching tanks.

The recovery in the salt plant is strictly a batch process with 7000 lbs. of slag being treated at a time.

In the leach tank, the slag is agitated mechanically in water. The pregnant solution is passed through a basket filter with the residue going to waste. Part of the solution is evaporated by waste heat from a heat exchanger in the furnace flues, and the balance goes to storage tanks. The dry salt contains 30 percent MoO<sub>3</sub>, 10 percent V<sub>2</sub>O<sub>5</sub> and 60 percent silicates.

Formerly, all of the solution was evaporated and the combined salt was shipped to Austria for final separation. After the war stopped these shipments, it was sent for treatments to the Molybdenum Corporation of America in Washington, Pennsylvania; but because of limited capacity there, large reserves were piled up at Mammoth. The present treating method was developed at the operation to separate the molybdenum and vanadium at the plant and thus make the two products available for the war effort.

The recovery is accomplished as follows: A saturated solution is built up in an agitating tank by mixing the combined evaporated salts with the pregnant solution. As the solution dissolves the salt, a saturation point of vanadium is reached and vanadium is precipitated out as sodium vanadate and recovered in a basket type filter.

The filtrate passes to an air agitated tank where calcium chloride is added. This causes the molybdenum to be precipitated in the form of calcium molybdate and it is recovered on a second filter.

The vanadium product is shipped for the manufacture of vanadic acid and the molybdenum product is sacked for shipment direct to the steel mills for alloying purposes. Molybdenum content of each batch is determined by analysis and sacks are weighed to contain the equivalent of 3 lbs. of metallic molybdenum. Both salts are completely dried in the waste heat exchanger on the furnace flues before shipment.

Although the operation is working with very complex ores and has been forced to resort to many unorthodox practices to recover sufficient values to economically justify its existence, the following table indicates that a very creditable recovery is being made by each process. The figures are approximate percentages recovered from the total heads entering each department.

**SULPHIDE MILL**

Lead in Lead Concentrate.....	85 to 90%
Zinc in Zinc Concentrate.....	75 to 80%
Lead in Zinc Concentrate.....	5 to 10%

**OXIDE MILL**

Lead .....	75%
Molybdenum .....	70%
Vanadium .....	40%
Gold .....	95%



James McGavock, master mechanic, and E. A. Mills, chemist, in the fire assay room of the laboratory.

**SMELTER**

Lead .....	85%
Molybdenum & Vanadium	
(In sol. from slag) .....	85%
Gold & Silver (in bullion) .....	95-100%

**SALT PLANT**

Molybdenum .....	85-95%
Vanadium .....	75%

Electric power at Mammoth-St. Anthony is supplied by the U. S. Indian Irrigation Service's San Carlos dam on the Gila River. Water is furnished in abundance by the mine. In fact, removing water from the mine is a major operational problem. Tailings are dammed behind the mill on the property.

## Tiger Mine Hit By Big Blaze

TUCSON, Sept. 4—(AP)—A destructive fire was raging tonight through the shafts and buildings of the Tiger Mine, at Tiger, owned by the Mammoth St. Anthony Company, which produces lead, molybdenum, gold and vanadium. The timbering in one shaft caught fire at 3.30 p. m. and spread quickly, it was reported by Mrs. Nola Bourne, operator of the Tiger boarding house.

O. V. Graham, of Tucson, who returned tonight from Tiger, said timbering in the shafts burned out and the fire extended to the powder room, machine shops and ore dumps, and tonight was threatening to spread to the mill. Later reports indicated the blaze also was threatening the timbers in the underground workings.

# Minerals of the Tiger Mining Camp Area

By Jessie Hardman  
Mineral Research Society

## History

Tiger is in the San Pedro Valley of southern Arizona, about 40 miles north-east of Tucson. The first gold claims in the district were filed in 1879 by Frank Shultz on the Collins vein, followed by the Mohawk claim in 1881, and the Mammoth and Mars claims in 1882. Several owners followed Shultz operating these mines, and a total of 3,510,835 in gold was mined prior to 1914. This was the only metal recovered.

Because of the need of molybdenum during the first World War, the mines and tailings were reworked to recover wulfenite. After the war, the price of molybdenum decreased and the mines became inactive for 14 years.

With the increase in the price of gold in 1933, a third period of production

started. During the second World War, vanadium production became important. While the mines were operating, there was so much water present that pumps had to run constantly. There was enough water for the local water supply. When the mines closed in 1952, the pumps stopped and the mines became flooded.

## Geology

Geologically, the area is very complex. The original area consisted of a series of low eroded hills composed of Oracle granite. Thick deposits of alluvium which accumulated in the valleys became consolidated into a quartz arkose. This granite and arkose subsequently were intruded by dikes of rhyolite and breccia.

Heavy basaltic flows incorporated the coarse sand and conglomerate. These flows were interrupted by periodic erosion. Smaller basaltic bodies were intruded along the faults and the borders of the rhyolitic intrusions.

Mineralization took place along several main faults. The Mammoth fault, which contains the principal ore shoots, is continuous through the Mammoth-Mohawk Mines. The relative vertical displacement amounts to several hundred feet. Fault movement started with the first rhyolitic intrusions and continued at intervals during the period of mineralization. There was one main branch of this fault which was very productive in the Mohawk Mine.

The Dream vein fault is parallel to the Mammoth vein and follows the contact between the granite and rhyolite.

Mineralization of the Collins vein followed several parallel fractures. This was the most highly mineralized and oxidized area of the fault system, and the finest mineral specimens came from this area.

Mineralization occurred in several stages due to periodic movement along the faults. There were two distinct breaks in the types of mineral deposited. During the first three stages there was

very little difference in the vein minerals from one stage to the next. They consisted of quartz, adularia, specularite, and some sulfides. Characteristics of these minerals varied due to different conditions which existed in each stage. Minerals deposited during the fourth stage are completely different from the minerals of the first three stages. They were mainly molybdenum, vanadium, and manganese minerals. Fifth stage minerals consisted of carbonates, sulfates, silicates, and secondary sulfides. Cerussite was the principal mineral of this stage.

Seventy-four species have been reported from Tiger:

Adularia	Leadhillite
Albite	Lepidocrocite
Anglesite	Limonite
Atacamite	Linarite
Aurichalcite	Maagnetite
Azurite	Malachite
Barite	Matlockite
Beudantite	Melanotekite
Biotite	Microcline
Boleite	Mimetite
Bornite	Minium
Brochantite	Mottramite
Bromyrite	Murdochite
Calcite	Muscovite
Caledonite	Oligoclase
Cerargyrite	Olivenite
Cerussite	Paralaurionite
Chalcocite	Penfieldite
Chalcopyrite	Phosgenite
Chlorite	Psilomelane
Chrysocolla	Pyrite
Covellite	Pyrolusite
Crocoite	Quartz
Descloizite	Sericite
Dioptase	Serpentine
Diaboloite	Silver
Epidote	Smithsonite
Fornacite	Sphalerite
Fluorite	Sulfur
Galena	Tenorite
Goethite	Vanadinite
Gold	Viridite
Gypsum	Wad
Hematite	Wherryite
Hemimorphite	Willemite
Hydrocerussite	Wulfenite
Kaolinite	Wurtzite

Note: Ecdemite is listed by Peterson as one of the minerals found in this mining area, but all so-called ecdemite specimens that have been tested have turned out to be mimetite. (Personal communication with Richard Bideaux, 1963.)

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## GOLD NUGGETS

Jefferson Gulch, Blackfoot City,  
Powell County, Montana

Since our first offering of gold nuggets some two years ago, the demand has always exceeded the supply, particularly for the larger nuggets. Our Montana collector has finally obtained a supply of those larger nuggets and we are pleased to present them ranging in size from 1/4" to over 1".

These nuggets have ideal form and are all endowed with that soft velvety luster so characteristic of high quality gold. 1/4x1/4" \$2.50, 3/8x1/2" \$5.00, \$6.50, \$7.50, 3/8x3/8" \$8.50, \$10.00, \$12.50, \$15.00.

## ALBITE variety MOONSTONE India.

Sodium aluminum silicate. Transparent to translucent green to gray cleavages of gem-quality. These specimens all exhibit a beautiful rose-colored fluorescence. 1" to 1x1" \$50, \$75, \$100. 1x1 1/2" \$2.00, \$2.50. 1 1/2x2" \$3.50.

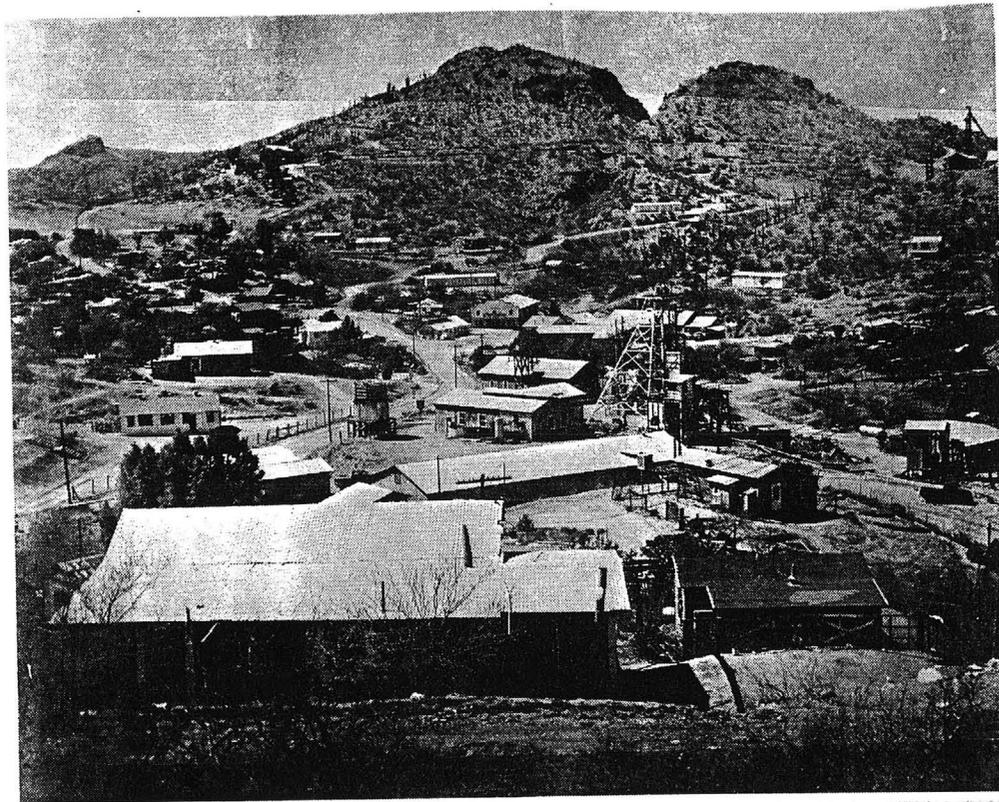
ALUNITE Beregszasz, Hungary. Basic hydrous sulphate of aluminum and potassium. Transparent to white rhombohedral crystals in cavities in massive alunite. These specimens were obtained from a well known Dana locality. Select MICROMOUNT specimens. 1/2" to 1" \$50, \$1.00.

BIXBYITE San Luis Potosi, Mexico. Iron manganese oxide with minor Ti. Brilliant black metallic single crystals and crystal clusters from a new discovery. All crystals are suitable for MICROMOUNTS. Average 1/4" size \$2.50. Select crystals all of which clearly show the rare diploidal crystal face along with the cube and the octahedron, in addition to vicinal faces. 1/4" to 3/8" \$3.50.

ERICAITE Thuringia, East Germany. Fluorine analogue of boracite. Laverder to maroon tetrahedral or pseudo-tetrahedral xls. MICRO study. 1/16" to 1/8" \$2.00, \$2.50.

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## Tiger And The Mammoth-St. Anthony District

Tiger died that San Manuel might live.

It's an old story around mining operations that development of a big open pit mine to process the large mass of low-grade ore surrounding a high-grade core often brings an end to a community that served the earlier miners.

Predecessor to the San Manuel Mine was the long lived and productive group of claims and mines in the area of Mammoth and Red Hill.

Frank Schultz opened a mine there as early as 1881 and designated the area The Old Hat District. As miners began to establish shacks around the mine, he opened a store there in 1889. On July 27, 1896 a post office was established for Schultz, Arizona.

The St. Anthony mine, operated by the St. Anthony Mining and Development Company, Ltd., had a long and varied history of development and production. The camp actually was developed as three different mines—the Mammoth, Collins, and Mohawk-New Years—which were consolidated in 1934 by St. Anthony.

Other early claims were located in 1879 and mining was continued intermittently by several companies, mostly on the Mammoth vein, until 1901 when the workings on their vein caved from the 750 level to the surface. This early mining was done

entirely for gold; production from the Mammoth and Collins mines through 1901 was over 150,000 ounces of gold valued at more than \$3,000,000.

The camp was largely inactive from 1901 until 1915 when the wartime demand for molybdenum and vanadium resulted in re-opening the mines for a short period. In 1919 prices fell and the mines closed again.

During the 1930's a young mining engineer, Sam Houghton, arrived on the scene to attempt to bring the mines and camp back to life. He had just graduated from Princeton University and with a gesture of true alumni spirit promptly rechristened the place, Tiger, after the Princeton Tiger football team.

Increase in the price of gold in 1933 caused renewed activity and production of gold-vanadium-molybdenum ores began in 1934 from the oxidized part of the veins.

	Gold Ounces	Silver Ounces	Copper Tons
1881-1912	170,000	-----	-----
1916-1919	10,450	-----	-----
1934-1947	216,751	983,918	1,728
1948-1954*	9,213	545,809	1,876
	Lead Tons	Zinc Tons	MoO <sub>3</sub> Pounds
1881-1912	-----	-----	-----
1916-1919	-----	-----	447,876
1934-1947	37,365	24,136	5,866,946
1948-1954*	26,328	20,563	-----
			V <sub>2</sub> O <sub>5</sub> Pounds
			2,540,842

\*Negligible production in 1953 and 1954.

Mining of this ore continued into 1943 when, stimulated by high prices and the need for base metals, the management developed sulphide ore bodies below the 650-level on the Collins vein. All lead and zinc production following 1944 was from the sulphide vein where galena and sphalerite were the chief ore minerals.

The post office was re-established as Tiger on March 15, 1939 and operated until November 26, 1954, during which period an estimated 1,800 persons lived in the community.

With the purchase of the claims by Magma and subsequent development of the area for block caving, the town was evacuated by the end of June, 1954 and demolished to make way for the San Manuel mine.

The former mine itself, along with some of its works and outbuildings is located about one mile north of the San Manuel mine office and is guarded by a resident caretaker.

The production of the Mammoth Mining Camp may be summarized as follows:

This specimen now catalogued in the ADMR Museum (see K number)

L-4

MINE SPECIMEN FOR DEPARTMENT OF LIBRARY AND ARCHIVES

K085

(Do not write  
in this space)

Ore \_\_\_\_\_

Cabinet \_\_\_\_\_

No. \_\_\_\_\_

(Wrap each specimen separately, or place it in a substantial bag, by itself, with a number attached, identical with the number on this card.)

Specimen No. 12, collected by Newton Wolcott  
Field Engineer

Name of ore Lead molybdate

Minerals contained Wulfenite

Gangue \_\_\_\_\_

Depth at which taken Not known

Approximate mineral content (in terms of average per ton) Pure crystalline

wulfenite.

Name of mine or claim Not known

Group \_\_\_\_\_

District Old Hat Mining District

Location (distance and direction by highway from what town) 3 Mi. SW of Mammoth

Owner of property Mammoth-St. Anthony Ltd.

Operator Mammoth-St. Anthony Ltd.

Mine active or inactive Active

If inactive, when operated \_\_\_\_\_

Specimen presented by Jacob Judesh

Date Sept. 29, 1939.

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

See Arizona Bureau of Mines Bulletin No. 144

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

13.0 x 8.0 x 6.0 cm

1-4-40

K085

216

MAMMOTH-ST. ANTHONY MINING CO.

Cu, Pb

Pinal

11 - 4

T 8 S R 16 E

John A. Richards, Mgr., Tiger

'43

**St. Anthony mine**, one of the oldest operations in the state, shut down in the face of falling prices and because of operational difficulties. The operator said the shutdown may be permanent because ore is playing out and the shaft is so deep that water must be pumped at the rate of 5,000 gpm. The mine originally was worked for gold.  
E.M.J. 12/1952

★Tiger operations of St. Anthony Mining and Development Co. were to be discontinued because of declining metal markets and ore depletion. About 100 workers were affected.  
ENGIN. + MINING JNL-1-53 - VOL 154 No. 1

★Magma Copper Corp. has purchased properties of the St. Anthony Mining Development Co., Ltd., adjacent to Magma's new San Manuel copper mine in southeastern Pinal County. St. Anthony lead and zinc operations were closed in November because of price decline and rising water at the 125-ft. level. The St. Anthony property is adjacent to the new \$114-million Magma copper project. W. P. Goss, Magma manager, said the company has no plans at present to reopen the St. Anthony development which was acquired for 10,000 shares of Magma common stock. In nearly 70 years of operation, the St. Anthony mine produced \$40-million worth of ore. 4/53  
E.M.J.

St. Anthony Property  
Sold to Magma Copper

Properties of the St. Anthony Mining and Development Company at Tiger, Arizona, have been sold to Magma Copper Company of Superior for 10,000 shares of Magma's capital stock. The St. Anthony lead and zinc mine was shut down last December because of the depressed market for lead and zinc and because of the excessive flow of water encountered at the 1,125-foot level.

Magma has no plans to reopen and operate the mine. The main objective in the purchase was to acquire St. Anthony's housing, dispensary with equipment, schoolhouse, store, office, warehouse and miscellaneous buildings which will be used by Magma's subsidiary, the San Manuel Copper Corporation, until the company's own townsite can be erected. The St. Anthony mill was sold to other interests and is being dismantled.

At the Magma mine proper, development of ore in the Far East area continues to confirm important orebodies. Between the 2,700- and 3,000-foot levels, for example, 259,000 tons of ore assaying 7.8 percent copper, 1.4 ounces of silver, and 0.046 ounces of gold per ton have been proven. In addition, 30,864 tons of ore assaying 4.96 percent copper were shipped to the mill from this area.

APRIL 1953 *Min World*

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# Magma expects cost cuts to pay off

By Guy Webster  
The Arizona Republic

6/18/88

TUCSON — Major cost-cutting projects that were begun last year, including a new smelter furnace due to start up Friday, will begin to show "tangible results in the second half this year," Magma Copper Co. shareholders were told Tuesday.

Company Chairman Donald J. Donahue also said the current quarter will be profitable because of high copper prices, even before the benefits of lowered production costs begin.

Changes at a smelter in San Manuel were

required by a consent agreement with federal and state environmental agencies for air-pollution control and will reduce smelting costs as well as emissions. The agreement forbids operation of Magma's old smelter furnaces after Nov. 1.

The changes, costing less than the \$133 million budgeted for them, will be completed ahead of schedule, said John R. Parry, Magma president.

The new furnace is scheduled to begin extracting copper from concentrated ore in early July after a gradual heat up beginning this week, he said.

However, another investment in low-cost production at San Manuel, the leaching of copper from underground ore without removing the ore from the ground, is six to 12 months behind a 1987 schedule that projected 62,000 tons of annual copper output by 1990.

The company's first-quarter profits of \$16.8 million after full-year losses of \$41 million in 1987 stemmed from copper prices that averaged \$1.09 per pound on the New York Commodity Exchange.

Second-quarter earnings will not have to — See MAGMA, page C8

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## Magma expects cost cutting to pay off in second quarter

— MAGMA, from page C1

cover any preferred-stock dividends, which pulled \$16 million out of the first-quarter profits and paid it to Magma's former parent company, Newmont Mining Corp. Newmont spun off Magma in March 1987 but retained the preferred stock and 15 percent of common stock. The preferred dividends are payable annually.

Magma missed tens of millions of dollars in potential income from high copper prices in the second half of 1987 by locking into advance-sale prices when the price rise was just getting started at midyear.

"This program nullified a splendid opportunity," Donahue told shareholders.

The company has been able to benefit from prices remaining high this year after writing off a \$25 million reserve fund in December to buy

out of most remaining advance-price commitments.

The program of cost-reduction investments began last year, with \$277 million budgeted over three years. It includes the smelter retrofit and expansion of solvent extraction and electrowinning facilities used for processing leached copper.

The lower costs expected from the rebuilt smelter have a secondary benefit: The estimate of usable copper ore at Pinto Valley has been increased by more than 40 percent because the cheaper processing will make lower-grade ore economically minable, Parry said.

Promising results so far from a joint venture with Cyprus Minerals Co. for gold exploration on Magma properties probably will lead to active gold mining at San Manuel after this year, he said.

MAMMOTH (#)  
FINAL

MAMMOTH (F)

COLLINS PROPERTY (F)

MOHAWK (F)

# Cyprus and Magma working on gold venture in old Tiger area

By Karen Walenga  
Staff Reporter

Magma Copper Company and Cyprus Minerals Company are teaming up for a gold exploration project at a portion of Magma's San Manuel property in southern Arizona.

Magma and Cyprus have agreed in principle to form a joint venture whereby Cyprus would conduct exploration for gold on a portion of Magma's old Tiger Mine townsite property near Mammoth, Magma announced in February.

The exploration site is not far from Magma's openpit oxide copper mine at San Manuel.

"Under the proposed arrangements, Cyprus would have the right to earn a 50 percent interest in the property covered by the joint venture by undertaking certain exploration activities," Magma said. "Cyprus would be the operator of the mine if one were built."

According to the joint venture agreement, which has yet to be signed, the gold exploration program could last up to four years, said Gail Abercrombie, adviser of public and government relations for Cyprus at the company's headquarters in Colorado.

Magma pointed out that the joint venture's exploration area was the site of several mines in the Old Hat Mining District, which supported the communities of Tiger and Mammoth.

Drilling began in January along the Mammoth-Mohawk vein, a gold producer that was mined from the 1880s through the 1940s.

Cyprus currently is continuing with the drilling, and will proceed next to metallurgical testing, Abercrombie told PAY DIRT March 3rd.

Although any decision will depend on the

exploration results, Cyprus initially envisions development of a small openpit gold mine, Abercrombie said. It is possible that the exploration also might find underground potential, she added.

Explaining some of the reasons for formation of the joint venture, Abercrombie pointed out that Cyprus is "looking to expand our gold production."

Arizona is "a good mining state," and permitting for a gold operation—should one be developed—likely will be easier at a property like San Manuel that currently is in operation, she noted.

In addition, Cyprus already has staff members in Arizona and producing copper and gold operations in the state. Plus, Magma geologists will be working together with Cyprus personnel.

Therefore, the joint venture exploration project "fits together as a nice package," Abercrombie said.

Cyprus is "willing to put up the money to explore," she also pointed out, noting that it hasn't been too long since Magma was spun off by Newmont Mining Corporation as an independent company and Magma currently is concentrating on its core copper business.

## More than 100-year history

The history of the community of Tiger and the Mammoth-St. Anthony District, as reported by PAY DIRT in January 1972, dates back to the early 1880s.

And, the ultimate demise of the community of Tiger is a familiar story for many mining operations: one where development of a big openpit mine to process the large mass of low-grade ore surrounding a high-grade core brings an end to a community that served the earlier miners.

Predecessor to the San Manuel mine was the long-lived and productive group of claims and mines in the area of Mammoth and Red Hill.

Frank Schultz opened a mine there as early as 1881 and designated the area The Old Hat District. As miners began to establish shacks around the mine, he opened a store in 1889. On July 27, 1896, a post office was established for Schultz, Arizona.

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Anthony Mining and Development Company Ltd., had a long and varied history of development and production. The camp actually was developed as three different mines—the Mammoth, Collins, and Mohawk-New Years—which were consolidated in 1934 by St. Anthony.

Other early claims were located in 1879 and mining was continued intermittently by several companies, mostly on the Mammoth vein, until 1901 when the workings on the vein caved from the 750 level to the surface.

This early mining was done entirely for gold; production from the Mammoth and Collins mines through 1901 was more than 150,000 ounces of gold valued at more than \$3 million.

The camp was largely inactive from 1901 until 1915 when the wartime demand for molybdenum and vanadium resulted in reopening the mines for a short period. In 1919, prices fell and the mines closed again.

## Place is renamed Tiger

During the 1930s, a young mining engineer, Sam Houghton, arrived on the scene to attempt to bring the mines and camp back to life. He had just graduated from Princeton University and, with a gesture of true alumni spirit, promptly rechristened the place Tiger, after the Princeton Tiger football team.

An increased price for gold in 1933 caused renewed activity, and production of gold-vanadium-molybdenum ores began in 1934 from the oxidized part of the veins.

Mining of this ore continued into 1943 when, stimulated by high prices and the need for base metals, the management developed sulphide orebodies below the 650-level on the Collins vein. All lead and zinc production following 1944 was from the sulphide vein where galena and sphalerite were the chief ore minerals.

The post office was re-established as Tiger on March 15, 1939 and operated until November 26, 1954. During that period, an estimated 1,800 persons lived in the community.

With the purchase of the claims by Magma and subsequent development of the area for block caving, the town was evacuated by the end of June 1954 and demolished to make way for the San Manuel mine.

## Of Mines And Men

### Helton named inventory manager at PD's Hidalgo copper smelter

Ivan H. Helton has been promoted to inventory management supervisor at Phelps Dodge Corporation's Hidalgo smelter in southwestern New Mexico.

Helton, a native of New Mexico, attended both the New Mexico Institute of Mining and Technology and Western New Mexico University before entering the Army, where he spent 22 years, including three tours of duty in Germany and one in Vietnam.

Following his 1982 retirement as a first sergeant, Helton returned to Western New Mexico University in Silver City and earned a BS in geology and an MBA.

He joined Phelps Dodge in January 1987 at the Hidalgo smelter as senior buyer, the position he was holding when named supervisor.

The production of the Mammoth Mining Camp may be summarized as follows:

	Gold Ounces	Silver Ounces	Copper Tons
1881-1912	170,000	-----	-----
1916-1919	10,450	-----	-----
1934-1947	216,751	983,918	1,728
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1916-1919	-----	-----	447,876
1934-1947	37,365	24,136	5,866,946
1948-1954*	26,328	20,563	-----

\*Negligible production in 1953 and 1954.

an  
MS

GG Dispatch 2/10/88

# Firms Mine for Gold in Pinal

SAN MANUEL (AP) — Magma Copper Co. has reached an agreement in principle with Cyprus Minerals Co. to form a joint venture under which Cyprus would explore for gold on a portion of Magma's San Manuel property about 40 miles northeast of Tucson, company officials announced.

Drilling began last month along the Mammoth-Mohawk vein which produced gold and was mined from the 1880s through the 1940s, Magma said in a news release Tuesday.

The area under exploration was the site of several mines in the Old Hat mining district, which supported the communities of Tiger and Mammoth in southern Pinal

County, the company said.

Under the proposed agreement, Cyprus would have the right to earn a 50 percent interest in the property covered by the joint venture by undertaking certain exploration activities, the announcement said.

Magma Copper Co. is the second-largest copper producer in the United States, operating mines in San Manuel and Miami and a smelter, refinery and rod plant in San Manuel, as well as a rod plant in Chicago.

Cyprus Minerals Co., headquartered in Englewood, Colo., is a major producer of coal, copper, molybdenum, gold and industrial metals.



USGS-MR05, DDS 20

RECNO M050189  
 REC\_TYPE S  
 USER\_FIE  
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 REP\_DATE 83 04  
 FIL\_LINK CIMRI IMS  
 REP PETERSON, JOCELYN A.  
 REP\_AFF USGS  
 SYN TIGER, COLLINS, MOHAWK, NEW YEARS, MAMMOTH,  
 ST. ANTHONY,  
MAMMOTH MINE, TIGER MINE TAILINGS, MAMMOTH  
 TAILINGS  
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 COUNTY PINAL  
 STATE\_CODE AZ  
 CTRY\_CODE US  
 PHYS 12  
 BASIN AND RANGE  
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 LAND\_ST 01  
 ELEV 3200  
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 UTM\_N 3618560  
 UTM\_E 529620  
 UTM\_Z +12  
 ACC ACC  
 TOWNSHIP 008S  
 RANGE 016E  
 SECTION 26  
 SECT\_FRACT SW/4  
 MERIDIAN GILA AND SALT RIVER  
 POSITION 50 MI NNE OF TUCSON, 21 MI S OF WINKLEMAN, NEAR  
 TIGER, 3 MI  
 SW OF MAMMOTH.  
 LOCATION ON E SLOPE OF BLACK HILLS, GOOD ACCESS BY ROAD.  
 ; INFO FROM  
 LAND.ST :(1979)  
 SITE MAMMOTH - ST. ANTHONY MINE  
 LAT 32.7061  
 LONG -110.6839  
 CTRY\_NAME UNITED STATES  
 COMMOD AU PB ZN V SIL AG CU MO F BA

W

ORE\_MAT WULFENITE, SILVER, GALENA, SPHALERITE,  
CHALCOPYRITE,  
VANADINITE, DESCLOIZITE, COVELLITE, MALACHITE,  
AZURITE, CHRYSOCOLLA, CERUSSITE, ANGLSITE,  
SMITHSONITE, HEMIMORPHITE, WILLEMITE, DIOPTASE,  
LINARITE, BROCHANTITE, DIABOLEITE, VANADINITE,  
GOLD, MOTTRAMITE

COM\_USE SILICA FLUX

GAD MILL CONC IN 1938 CONTAINED 0.4 - 0.5% W03.

TUNGSTEN IS

CONTAINED IN WULFENITE AND VANADINITE; TYPICAL  
ORE ASSAYS 7.16% PB, 10.14% ZN, 0 .011 OZ/T AU,  
1.53 OZ/T AG, 0.74% CU, 0.6% MG, 7.5% FE, AND  
47.5% SI02

MAJOR AU PB ZN V  
MINOR SIL AG CU MO

CLH\_USE 94/08/17

TRACE F BA W

PROD S

LOC\_STRUCT MAMMOTH FAULT SPLITS ORE BODY

INTO 2 SEGMENTS STATUS 6

DISC FRANK SCHULTZ

YR\_DISC 1879

NAT\_DISC B

YRFST\_PROD 1881

OWNER MAGMA COPPER CO. (1988)

OPER CYPRUS MINERALS CO. (1988)

EXPL\_COM MINE CLOSED IN 1952. ST. ANTHONY ORIGINALLY  
DEVELOPED AS 3

MINES. CYPRUS EXPLORING PROPERTY AS POTENTIAL  
LARGE GOLD PRODUCER AND WILL BE OPERATOR IN  
EXCHANGE FOR A 50% INTEREST IN THE PROPERTY.

DEP\_TYPE VEIN

DEP\_FORM TABULAR

D\_T\_U FT

DEPTH\_BOT 1000

D\_B\_U FT

MAX\_THICK 20

M\_T\_U FT

DEP\_SIZE S

STRIKE NW

DIP STEEPLY NE & SW, NW

DDESC\_COM TWO MAJOR VEINS, THE MAMMOTH AND THE COLLINS.  
MO-V MINERALIZATION POSTDATES PB-CU-ZN  
MINERALIZATION. DEPOSITS OCCUR WHERE TERTIARY  
RHYOLITE INTRUDES PRECAMBRIAN QUARTZ MONZONITE.

QUAD250 TUCSON  
 DEPTH\_WK 1000  
 D\_W\_U FT  
 DWORK\_COM OLD UNDERGROUND WORKINGS ARE NOW INACCESSIBLE.  
 MIN\_AGE TERT POST 22 MY  
 NORÉ\_MINS CHLORITE, SPECULARITE, AMETHYST, QUARTZ,  
 FLUORITE, BARITE, CALCITE, PYRITE, CLAYS,  
 EPIDOTE, TOURMALIN E  
 ORE\_CNTL WNW SHEAR ZONES, PARTICULARLY WHERE SHEARING AND  
 BRECCIATION  
 ARE INTENSE  
 TECT\_SET BASIN AND RANGE  
 REG\_STRUCT BLOCK FAULTING TRENDING NNW  
 ALTER OXIDIZED TO 900 FT, SLIGHT TO COMPLETE  
 SILICIFICATION, SOME  
 CHLORI TIZATION, SERICITIZATION, CLAY A LTERATION  
 CONC FISSURE FILLING,  
 REPLACEMENT  
 HRU\_AGE PREC 1420-1450  
 MY  
 HRU\_NAME ORACCLE GRANITE  
 CONT\_CODE NA  
 GEN\_COM THIS REPORT REPRESENTS A MERGER OF ORIGINAL  
 RECORDS D000829  
 AND M0 50189 WITH RECORD D000829 OF JAN WILT IN  
 MOLYBDENUM FILE, CONTACT PERS ON T.G. THEODORE,  
 USGS. ; INFO.SRC : 1 PUB LIT  
 REF PETERSON, 1938, ABM BULL 144.|WILSON ET AL, 1934,  
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 137.|CREASEY, 1965, USGS PP 471.|CREASEY, 1950,  
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 STRATEGIC AND CRITICAL MINERALS IN ARIZONA:  
 UNITED STATES BUREAU OF MINES SPECIAL  
 PUBLICATION, 334 P.  
 CONT\_NAME NORTH AMERICA  
 STATE\_NAME ARIZONA  
 WORK\_TYPE S  
 CP\_ITEM ORE|CU|PB|ZN|AG|AU|MO|V205  
 CP\_ACC ACC|ACC|ACC|ACC|ACC|ACC|ACC|ACC

CP\_AMT 4091.|11647.|214007.|143153.|3016.|563.667|4210.  
 |254 1.  
 CP\_U TONS|LBS|LBS|LBS|OZ|OZ|LBS|LBS  
 CP\_YEAR 1930-1978|1930-1978|1930-1978|1930-1978|1930-  
 1978|1  
 930-1978|1930-1978|1930-1978  
 CP\_GRADE |||||  
 AP\_COM PROD FIGURES IN TABLE ARE FROM MAMMOTH MINE. \$3  
 MILLION OF  
 GOLD PRODUCED 1886-1918 (ELSING & HEINEMAN,  
 1936). TAILINGS WERE MINED FOR SILICA FLUX AND  
 SHIPPED TO ASARCO'S SMELTER AT HAYDEN; ROCK FROM  
 THE OPEN PIT HAS BEEN SHIPPED AS FLUX TO MAGNA'S  
 SAN MANUEL SMELTER.  
 RPR\_ITEM ORE  
 RPR\_ACC EST  
 RPR\_AMT 10000.  
 RPR\_U ST  
 RPR\_YEAR 1987  
 RPR\_GRADE 0.04 TOZ AU/ST  
 RPR\_SOURCE SAWYER AND  
 OTHERS, 1992. UPD\_DATE  
 91 09  
 UPDATER CARBONARO,  
 MARGUERITE M.  
 COMMOD\_TYP B  
 QUAD24 MAMMOTH  
 DATE\_ISSUE 95/5/18  
 UPD\_AFF USGS  
 MODEL POLYMETALLIC VEINS  
 MODEL\_NUM 22C  
 PROF\_ID 100  
 PROF\_LOC 100  
 PF\_COMMOD 100  
 PROF\_EXPL 100  
 PFDESC\_DEP 75  
 PFDESC\_WRK 100  
 PROF\_GEOL 85  
 PROF\_REF 100  
 PPROD\_RESV 40  
 PROF\_ALL 88  
 HR\_AGE\_MV PREC 1420 - 1450 MY HR\_TYPE\_MV  
 QUARTZ MONZONITE HR\_NUMBER 1  
 AR\_AGE\_MV TERT 22.3 MY  
 AR\_TYPE\_MV RHYOLITE PLUGS AND DIKES,  
 INTRUSIVE BRECCIAS OREBODY\_NB 1

DEP_CODE	11000
HUC	15050203

MAMMOTH - ST. ANTHONY MINING CO.

PINAL COUNTY  
MAMMOTH DISTRICT  
T8S R16E Sec 26 SW

AKA: Tiger

See also: Collins (card), Mohawk (file), Mammoth-Tiger Extension Mining Corp., (file)  
Mammoth Tailings Dump (file)

Book V-VII, A. L. Flagg. Vanadium Reports

ABM Bull. 137, p.171  
ABM Bull. 145, p. 124-127  
ABM Bull. 144, p. 43, 54-58  
ABM Bull. 180, p. 353, 166, 236, 295  
ABM Bull. 156, p. 63

USBM Bull. 111, p. 46

USGS P.P. 471, p. 30 (Mammoth Mines)

Arizona Mining Journal Issue of Oct, 1917, p. 23 Jan. 1918, p. 10

Minerology of Arizona 6, 17, 21

The Mineralogical Record, May - June, 1980 (Included in file)

Maps - Upstairs in the ABM rolled map boxes - Maps include underground maps of the Mohawk area and the Collins, Tornado Veins. See also Mammoth Mines in the ABM boxes.

IC 8236 p. 87

Arizona Department of Mines and Mineral Resources

INFORMATION FROM MINE CARDS IN MUSEUM

ARIZONA Card # 1  
 PINAL COUNTY  
 MAMMOTH MINING DIST. 121  
 Tiger area  
Mammoth-St. Anthony Mine

*MILS # 5700*  
*2-APR-6*  
*Mammoth mine file*

MM 267 Concentrate, Wulfenite  
 268 Concentrate, Wulfenite-  
 Vanadinite  
 296 Diatomaceous Earth  
 437 Cerussite & Wulfenite  
 928 Diopside & Mimetite  
 1171 Diopside  
 1201 Alteration of Galena  
 1304 Cerussite  
 2570 Selenite  
 6038 Wulfenite crystals  
 7119 Wulfenite  
 7456 Quartz var. Amethyst  
 7457 Quartz var. Amethyst  
 8367 Cerussite  
 8800 Wulfenite  
 8701 Wulfenite  
 8702 Cerussite  
 8703 Cerussite  
 8704 Cerussite  
 8776 Cerussite  
 8777 Cerussite

ARIZONA , Card # 2  
 PINAL COUNTY  
 MAMMOTH MINING DIST. 121  
 Tiger area  
Mammoth-St. Anthony Mine

*MILS # 5700*

MM 8778 Cerussite  
 8779 Cerussite  
 8780 Cerussite  
 8781 Cerussite  
 8782 Cerussite  
 9772 Wulfenite  
 9773 Smithsonite  
 9774 Smithsonite  
 9775 Azurite  
 9776 Malachite  
 9777 Cerussite  
 9778 Cerussite  
 9779 Cerussite  
 9780 Cerussite  
 9781 Malachite & Cerussite  
 9782 Azurite  
 9783 Rosasite  
 9784 Malachite, Anglesite  
 9785 Covellite, Malachite  
 9786 Malachite  
 9787 Sauconite  
 9813 Wulfenite

Arizona Department of Mines and Mineral Resources

INFORMATION FROM MINE CARDS IN MUSEUM

ARIZONA

Card # 3

MMK 085 WULFENITE

PINAL COUNTY

MAMMOTH MINING DIST. 121

~~MMK 640 Quartz var Amethyst~~

Tiger area

~~MMK 641 Quartz var Amethyst~~

Mammoth-St. Anthony Mine

MILS # 570 0

Arizona Department of Mines and Mineral Resources

INFORMATION FROM MINE CARDS IN MUSEUM

ARIZONA  
PINAL COUNTY  
MAMMOTH DISTRICT # 121  
TIGER AREA  
TIGER MINE

Card # 1  
MM K802 Calcite xls  
M-168 Azurite

MILLS # 570 D  
2-ARIZ  
MAMMOTH # 121

Placed to file  
by  
R.A. DAEM  
May 24, 06

# Mammoth Gold Mining Co.

CHAS. R. FLETCHER, General Agent.  
GEO. LITTLE, Superintendent.  
A. F. FLETCHER, Treasurer.

Mines: Black Hills, near Oracle, Pinal County.

Tucson, Arizona,

Dec. 2

1885

His Excellency O. M. J. - Governor of Arizona: -  
Dear Sir

I respectfully request from you protection for this mining camp, from Indian. The situation is as follows: -  
Last February we purchased mines here, built a 30 stamp (capacity 50) gold mill, since Aug. 3 have run steady, and are today the largest gold producer in Arizona except the "Vulture" camp. In July Gen. G. Forsythe of Ft. Lowell loaned us 20 Sharp's rifles and 2600 rounds of ammunition as we are on the San Pedro, exactly in line of the Indian raid of 3 years or so ago. - He was not justified by law to loan rifles but used common sense and should be responsible for me, his friend. -  
The new ordinance officer has advised me to return these weapons etc. and I have done so. - I understand that

# Michigan Gold Milling Co.

CHAS. R. FLETCHER, General Agent.  
ANDREW WALLACE, Superintendent.  
A. F. FLETCHER, Treasurer.

Mill on San Pedro, opposite Oracle.

Tucson, Arizona, ..... 188.....

<sup>n</sup>  
The Governor must make the requisition  
for arms and issue them. —  
This being the case I respectfully  
represent the 15000 \$ spent here  
must be protected, and beg you  
to act for us promptly, as I  
beg that Indians are heading  
this way through the Aravaipa Canon.  
An Indian scout has just brought  
this news and warned the settlers  
below us on the river. — We shall  
not stand on the defensive if the  
come here, provided the law allows  
aggression. — Our mines are 3 miles  
from the mill, isolated, and although  
50-60 men are employed here, they  
have only a few arms. —

If possible please issue 20  
rifles and 2000 cartridges to us.  
I <sup>will</sup> gladly furnish bonds as  
you may wish, and refer

3

You to W. Henderson Banker Tucson; Mr. Franklin E. Tucson; and Ex-Governor Smith can tell you of us. —

But references are of small account in an emergency, which I know you will perceive requires action. —

Very respectfully  
 Wm. H. G. May, Co.  
 Michigan St. Wm. H. G.  
 for C. R. Fletcher  
 Genl Mgr. —

It is suggested that the Governor telegraph Ft Lowell to issue 20 rifles & 2000 cartridges (as possibly the numerous cases consigned to the Gov. of Arizona are still at S. P. RR depot, Tucson) to C. R. Fletcher agt. upon bonds endorsed by two well known Tucson citizens. —

MAMMOTH MINE

PINAL COUNTY

NJN WR 4/8/88: John Dowis (card) reported that through discussion with Magma Copper Company, it appears that Cyprus Minerals' immediate target in the Tiger area (Mammoth (file), Mohawk (file) Collins (file) Pinal County is the open pit gold potential of the vein systems. Underground potential, though not the primary target may be considered if drilling reveals it to be warranted.

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NJN WR 6/17/88: Cyprus Minerals wants to have 3 drilling contractors working at the Mammoth (file) Pinal County. There is currently one, but they are seeking bids for two additional contracts.

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RH

MAMMOTH - ST. ANTHONY MINING CO.

PINAL COUNTY  
MAMMOTH DISTRICT

KAP WR 3/21/75: Bill Hunt, a mineral collector, called to tell us that mineral collecting would be allowed on the old Tiger Dumps for one last day, Sunday, March 23. The Tiger Mine dumps are part of the old Mammoth-St. Anthony Mine, now part of Magma's San Manuel operation.

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KAP WR 1/11/85: The Tiger Mine, Pinal County gold-silver-silica flux mining operation of McFarland & Hullinger was the 22nd largest lead producer in 1983 according to the "Lead" chapter in 1983 Minerals Yearbook, Volume 1 - Metals and Minerals published by the U.S. Bureau of Mines.

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KAP QR 12/27/85: The Tiger Mine (file), Pinal County, is listed as the 22nd largest lead producer in 1984 in Table 6, of the 1984 chapter entitled "Lead" in the U.S. Bureau of Mines Minerals Yearbook for that year. The operator is listed as McFarland & Hullinger. The source of the lead is listed as gold-silver tailings.

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NJN WR 11/27/87: Gary McFarland is the new general manager of McFarland & Hullingers operation in Tucson. McFarland & Hullinger just finished mining and crushing 110,000 tons at St. Anthony Development Company (file) Pinal County for use as flux at the Magma smelter. They are trying to get a similar contact to produce at the Camp Grant Quarry (San Manuel Limestone Quarry - file) Pinal County.

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RRB WR 12/11/87: Earnie Downs and Stan Dodd, Cyprus, report that Cyprus and Magma are joint venturing at the Mammoth-St. Anthony (file) in Pinal County. They are determining if there is sufficient ore left to be profitable and were looking for any stope maps that might be available from the 1945 era. They will be at motel in Tucson through December (297-8111, Rm 277). Colorado contact is Jim Matlock (303) 740-5000.

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MG WR 1/9/88: Received unconfirmed report that Cyprus Minerals is interested in acquiring the Mammoth property (file) Pinal County from Magma Copper Co.

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## ARIZONA DEPARTMENT OF MINES AND MINERAL RESOURCES

VERBAL INFORMATION SUMMARY

1. Mine file: MAMMOTH
2. Mine name if different from above:
3. County: Pinal
4. Information from: Bud Hillemeier  
Company: Fischer Watt Gold Inc.  
Address: 114 Tucker  
Kingman, AZ  
Phone: 753-1622
5. Summary of information received, comments, etc.:

Mr. Hillemeier reports that resource numbers being discussed by Cyprus now are 2 million tons of .08 oz/ton Au available by open pit. Apparently drilling will continue as Cyprus would require a larger resource before capitalizing an operation here as milling would be required for a high recovery of the gold.

Date: October 12, 1988

Nyal J. Niemuth, Mining Engineer

NET RETURN - PER TON ORE MILLED

MARKET: Pb 15¢  
Zn 15¢

*Table C*

ASSAYS		% RECOVERY		RECOVERABLE ASSAYS		METALS RECOVERED		NET RETURN			TONS ORE MILLED PER MONTH			
%Pb	%Zn	%Pb	%Zn	%Pb	%Zn	Lbs. Pb	Lbs. Zn.	Pb	Zn	Combined	6500	7000	7500	8000
2.50	3.50	78.40	57.50	1.96	2.01	39.2	40.2	\$ 4.53	\$ 2.96	\$ 7.49	\$ 48,685	\$ 52,430	\$ 56,175	\$ 59,920
2.75	3.75	79.20	58.75	2.18	2.20	43.6	44.0	5.04	3.24	8.28	53,820	57,960	62,100	66,240
3.00	4.00	80.00	60.00	2.40	2.40	48.0	48.0	5.55	3.53	9.08	59,020	63,560	68,100	72,640
3.25	4.25	80.80	61.25	2.63	2.60	52.6	52.0	6.08	3.83	9.91	64,415	69,370	74,325	79,280
3.50	4.50	81.60	62.50	2.86	2.81	57.2	56.2	6.61	4.14	10.75	69,875	75,250	80,625	86,000
3.75	4.75	82.40	63.75	3.09	3.03	61.8	60.6	7.14	4.46	11.60	75,400	81,200	87,000	92,800
4.00	5.00	83.20	65.00	3.33	3.25	66.6	65.0	7.70	4.78	12.48	81,120	87,360	93,600	99,840
4.25	5.25	84.00	66.25	3.57	3.48	71.4	69.6	8.25	5.12	13.37	86,905	93,590	100,275	106,960
4.50	5.50	84.80	67.50	3.82	3.71	76.4	74.2	8.83	5.46	14.29	92,885	100,030	107,175	114,320
4.75	5.75	85.60	68.75	4.07	3.95	81.4	79.0	9.41	5.81	15.22	98,930	106,540	114,150	121,760
5.00	6.00	86.40	70.00	4.32	4.20	86.4	84.0	9.99	6.18	16.17	105,105	113,190	121,275	129,360

NET RETURN - PER TON ORE MILLED

MARKET: Pb 16¢  
Zn 16¢

*Schedule*

ASSAYS		RECOVERY		RECOVERABLE ASSAYS		METALS RECOVERED		NET RETURN			TONS OF ORE - MILLED PER MONTH			
%Pb	%Zn	%Pb	%Zn	%Pb	%Zn	Lbs. Pb	Lb. Zn	Pb	Zn	Combined	6500	7000	7500	8000
2.50	3.50	78.40	57.50	1.96	2.01	39.2	40.2	\$ 4.87	\$ 3.26	\$ 8.13	\$ 52,845	\$ 56,910	\$ 60,975	\$ 65,040
2.75	3.75	79.20	58.75	2.18	2.20	43.6	44.0	5.42	3.57	8.99	58,435	62,930	67,425	71,920
3.00	4.00	80.00	60.00	2.40	2.40	48.0	48.0	5.97	3.89	9.86	64,090	69,070	73,590	78,880
3.25	4.25	80.80	61.25	2.63	2.60	52.6	52.0	6.54	4.22	10.76	69,940	75,320	80,700	86,080
3.50	4.50	81.60	62.50	2.86	2.81	57.2	56.2	7.11	4.56	11.67	75,855	81,690	87,525	93,360
3.75	4.75	82.40	63.75	3.09	3.03	61.8	60.6	7.68	4.91	12.59	81,835	88,130	94,425	100,720
4.00	5.00	83.20	65.00	3.33	3.25	66.6	65.0	8.28	5.27	13.55	88,075	94,850	101,625	108,400
4.25	5.25	84.00	66.25	3.57	3.48	71.4	69.6	8.88	5.64	14.52	94,380	101,640	108,900	116,160
4.50	5.50	84.80	67.50	3.82	3.71	76.4	74.2	9.50	6.02	15.52	100,880	108,640	116,400	124,160
4.75	5.75	85.60	68.75	4.07	3.95	81.4	79.0	10.12	6.41	16.53	107,445	115,710	123,975	132,240
5.00	6.00	86.40	70.00	4.32	4.20	86.4	84.0	10.74	6.81	17.55	114,075	122,850	131,625	140,400

ORE RESERVES & VALUE as of June 30<sup>th</sup> 1952

MAMMOTH ST ANTHONY I. E

My Block Number	Company	Stope Number	Dimensions of Block	Tons Sulphide Unbroken	Tons Sulphide Broken	Tons Oxide Broken	Assay Average		See Exhibit for details		Mill Recovery		Lbs Metal Recoverable		Smelter Value Per Ton	Operating Costs	Net Value Per Ton	Probable Profit	Probable Loss	Remarks
							Pb	Zn	Pb	Zn	Pb	Zn	Pb	Zn						
A	904W		100 x 22 x 8		975		2.40	3.84	78	40	37.4	45.9	4.68	3.32	8.00	16.34	(R) 8.34			
A	904W		140 x 45 x 7	3670			2.37	5.03	78	45	37.0	65.4	4.62	4.80	9.42	17.34	(R) 7.92			
A	800		140 x 40 x 7	3230																
B	86N		80 x 30 x 10	2000			6.26	6.49	87	71	103.0	92.0	12.45	6.77	19.22	17.34	1.88	3760		
			80 x 20 x 8		710		"	"	"	"	"	"	"	"	"	16.34	288	2200		
C	96N		80 x 40 x 7	1870			2.33	4.73	77	44	36.0	60.3	4.54	4.44	8.98	17.34	(R) 8.36		15600	
			45 x 20 x 7		350		"	"	"	"	"	"	"	"	"	16.34	(R) 7.36	2570		
D	115		110 x 35 x 7	2250			2.47	5.44	78	17	38.6	73.0	4.77	5.40	10.10	17.34	(R) 7.24		16300	
			140 x 50 x 7		2710		"	"	"	"	"	"	"	"	"	16.34	(R) 6.24		16900	
E	116		50 x 55 x 6	1365			2.89	4.15	80	61	46.3	50.7	5.75	3.73	9.48	17.34	(R) 7.86		10920	
					500		"	"	"	"	"	"	"	"	"	16.34	(R) 6.86		3420	
F	117		30 x 55 x 8	1100			9.66	9.10	90	72	172.5	130.0	21.65	9.68	31.33	17.34	14.00	15400		
					900		"	"	"	"	"	"	"	"	"	16.34	1500	13500		
G	111M		90 x 80 x 8	4800			6.66	7.15	88	71	118.0	100.0	12.50	7.37	19.87	17.34	2.53	12180		
H	1191B		75 x 80 x 7	3500																
	1191C		120 x 80 x 5	4000																
J	703					7320	3.00	6.10	80	70	48.0	86.0	5.97	6.30	12.27	17.34	(R) 5.07		17700	(Assay Pb 3.1 Au .007 Net Comm. .10)
K	96W		90 x 30 x 8		1200															
			65 x 70 x 7		1775		4.30	5.74	84	9	72.0	79.0	9.00	5.80	14.80	16.34	(R) 1.54		4570	
L	91A		Unmeasurable		2600		2.55	3.70	79	3	40.3	46.6	4.98	3.20	8.18	16.34	(R) 8.16		21200	(Tonnage by deduction Abandoned as too low.)
	701																			

Density Factors  
 Sulphide Unbroken 120 cuft per ton  
 Sulphide Broken 18.0 " " "  
 Oxide Broken 20.0 " " "

Metal Prices (as of 7/1/52)  
 Lead 16.04  
 Zinc 15.04

Compiled July, 1952  
 Chester Hanning

## SAMPLING BY CHAS. H. DUNNING

ST. ANTHONY MINING AND DEVELOPMENT COMPANY, LTD.  
TIGER, ARIZONA

JUNE, 1952

Sample Number	Stope Number	Location	Type of Sample	Height Above Track	% Pb	% Zn
31051	115	Over South Manway	4' cut across back	43' below 1025	3.75	7.80
31052	115	20' North of South Manway	11' cut across back	40' below 1025	3.00	5.95
31053	115	40' North of South Manway	4' cut across back	40' below 1025	0.10	0.10
31054	115	60' North of South Manway	4' cut across back	40' below 1025	0.10	6.10
31055	115	80' North of South Manway	4' cut across back	35' below 1025	4.25	7.68
31056	115	At raise to 1025 level	4' cut across back	35' below 1025	4.00	8.90
31067	115	Chutes 1, 2, 3	Grab Sample	-	2.75	6.22
31068	115	Chutes 4, 5, 6	Grab Sample		2.00	4.55
31069	115	Chutes 7, 8, 9	Grab Sample		0.75	1.45
31070	115	Chutes 10, 11, 12	Grab Sample		2.00	2.45
31071	115	Chutes 13, 14, 15	Grab Sample		0.10	1.95
31072	115	Chutes 16, 17, 18	Grab Sample		0.10	1.25
31073	115	Chutes 19, 20, 21	Grab Sample		0.10	0.10
31057	116	10' South of 106 Winze	5-1/2' cut across back	55' below 1025	1.25	1.25
31058	116	30' South of 106 Winze	5-1/2' cut across back	55' below 1025	3.00	3.90
31062	116	Chutes 1, 2, 3	Grab Sample		3.25	3.45
31063	116	Chutes 4, 5	Grab Sample		1.70	5.30
31059	117	South Edge of Manway	6-1/2' cut across back	45'	6.00	6.90
31060	117	20' South of Manway	11-1/2' cut across back	50'	4.00	7.35
31061	117	South End	10-1/2' cut across back	50'	8.10	5.40
31064	117	Chutes 1, 2, 3	Grab Sample		13.50	6.40
31065	117	Chutes 4, 5, 6	Grab Sample		8.50	9.70
31066	117	Chutes 7, 8, 9	Grab Sample		4.75	9.40
31074	Mohawk 111	North End	7' cut across back	116'	11.50	7.10
31075	Mohawk 111	Muck pile in center - 18' long, 9' wide, 6' high	Grab Sample	21'	4.50	4.20
31076	Mohawk 111	South End	10' cut across back	16'	3.00	10.35
✓ 31077	11 A.N. Drift		6' cut across face		2.00	0.50
31078	1191 B	Muck pile - taking down back - 20' long, 9' wide, 10' high	Grab Sample	16'	2.50	5.50

SAMPLING BY CHAS. H. DUNNING - Continued  
 St. Anthony Mining & Development Co., Ltd.

Sample Number	Stope Number	Location	Type of Sample	Height Above Track	% Pb	% Zn
31079	86 N.	10' North of South Manway	5-1/2' cut across back	34'	1.90	7.00
31080	86 N.	30' North of South Manway	5-1/2' cut across back	37'	6.60	4.10
31081	86 N.	50' North of South Manway	11' cut across back	45'	3.25	7.25
31082	86 N.	70' North of South Manway	16' cut across back	50'	9.25	9.30
31083	86 N.	Over North Manway	10' cut across back	50'	4.50	12.00
31084	86 N.	Chutes 1, 2, 3	Grab Sample		3.00	4.90
31085	86 N.	Chutes 4, 5, 6	Grab Sample		10.25	5.10
31086	86 N.	Chutes 7, 8	Grab Sample		7.50	9.25
31087	86 N.	Chutes 9, 10	Grab Sample		6.00	8.40
31088	86 N.	Chutes 11, 12, 13 in footwall drift	Grab Sample		5.85	10.10
31089	96 W.	2 chutes on 800 level	grab sample		2.10	3.95
31093	96 W.	Chutes 1, 2, 3	Grab Sample		1.35	5.05
31094	96 W.	Chutes 4, 5, 6	Grab Sample		4.90	6.30
31095	96 W.	Chutes 7, 8, 9	Grab Sample		11.50	9.40
31096	96 W.	Chutes 10, 11, 12	Grab Sample		2.60	4.40
31090	96 N.	North end	6.5' cut across back	34'	2.00	5.90
31091	96 N.	10' south of North Manway	7.5' cut across back	36'	2.50	5.85
31092	96 N.	South end	6' cut across back	40'	2.00	4.45
31097	96 N.	Chutes 1, 2, 3	Grab Sample		1.00	3.50
31098	96 N.	Chutes 4, 5, 6	Grab Sample		3.00	3.85
31099	96 N.	Chutes 7, 8, 9	Grab Sample		1.90	3.40
31101	904 W.	Over North Manway	5' cut across back	40'	0.70	3.90
31102	904 W.	20' South of North Manway	4-1/2' cut across back	40'	2.25	8.14
31103	904 W.	40' South of North Manway	11' cut across back	45'	6.25	6.24
31104	904 W.	60' South of North Manway	6-1/2' cut across back	50'	2.75	5.00
31105	904 W.	80' South of North Manway	8-1/2' cut across back	44'	1.75	4.80
31106	904 W.	10' North of South Manway	4-1/2' cut across back	40'	1.75	4.10
31107	904 W.	10' South of South Manway	5' cut across back	20'	0.10	3.75
31108	904 W.	Chutes 1, 2, 3	Grab Sample		1.75	4.80
31109	904 W.	Chutes 4, 5, 6	Grab Sample		0.10	3.00
31110	904 W.	Chutes 7, 8, 9	Grab Sample		4.25	5.40
31111	904 W.	Chutes 10, 11, 12	Grab Sample		1.00	4.00
31112	904 W.	Chutes 13, 14	Grab Sample		2.50	4.15

SAMPLING BY CHAS. H. DUNNING - Continued  
St. Anthony Mining & Development Co., Ltd.

<u>Sample Number</u>	<u>Stope Number</u>	<u>Location</u>	<u>Type of Sample</u>	<u>Height Above Track</u>	<u>%Pb</u>	<u>% Zn</u>
31113	91 A.	Chutes 1, 2, 3	Grab Sample		0.75	0.40
31114	91 A.	Chutes 4, 5, 6	Grab Sample		1.25	3.36
31115	91 A.	Chutes 7, 8, 9	Grab Sample		2.00	7.40
31116	91 A.	Chutes 10, 11, 12	Grab Sample		4.50	3.94

ASSAYERS  
CHEMISTS

# HAWLEY & HAWLEY

W. E. HAWLEY, MANAGER  
DOUGLAS, ARIZONA  
537 TWELFTH STREET  
Box 1060

SHIPPERS REPRESENTATIVES  
BULLION BUYERS  
ORE BUYERS

EL PASO, TEXAS  
Box 4

St. Anthony Mining & Development Co.

WE HEREBY CERTIFY THAT THE FOLLOWING RESULTS WERE OBTAINED FROM SAMPLES OF

OFFICE NO.	MARKED	GOLD OZS.	SILVER OZS.	LEAD PER.CENT	COPPER PER CENT	ZINC PER CENT	IRON PER CENT
254673	Sample : 31102			2.8		8.4	
	31103			6.8		6.2	
	31104			2.9		4.5	
	31105			2.0		4.2	
	31106			0.9		4.2	
	31107			0.2		3.1	
	31108			2.0		4.5	
	31109			1.4		3.3	
	31110			4.8		5.3	
	31111			1.4		3.7	
	31112			2.4		2.4	
	31113			2.1		3.1	
	31114			1.0		2.8	
	31115			2.1		4.3	
	31116			5.0		4.6	

Note : Sample No. 31100 was missing  
Copies : 2 - Chas H. Dunning  
2 - St Anthony

METAL QUOTATIONS:

GOLD \$35.00 PER OZ. COPPER \_\_\_\_\_ C PER LB. CHARGES: \$ 178.75  
SILVER \_\_\_\_\_ PER OZ. \_\_\_\_\_ PER LB. DATE 7/30/52

HAWLEY & HAWLEY  
PER *H. Dunning*

ASSAYERS  
CHEMISTS

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Box 1060

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OFFICE NO.	MARKED	GOLD OZS.	SILVER OZS.	LEAD PER CENT	COPPER PER CENT	ZINC PER CENT	IRON PER CENT	Zn Test	Pb Mine	Zn Mine
254623	Sample : 31051			4.8		8.5	5.05	9.10	3.75	7.80
	31052			4.1		6.8			3.00	5.95
	31053			0.8		1.4	4.0	1.10	.10	.10
	31054			1.7		6.5			.10	6.10
	31055			4.7		8.0			4.25	7.68
	31056			4.5		9.3			4.00	8.90
	31057			1.7		3.5			1.25	1.25
	31058			4.1		4.3	4.20	4.50	3.00	3.90
	31059			6.6		6.5			6.00	6.90
	31060			4.6		7.5			4.00	7.35
	31061			8.9		5.0			8.10	5.40
	31062			3.7		3.1			3.25	3.45
	31063			2.0		5.7	2.00	5.20	1.70	5.30
	31064			14.0		6.4			13.50	6.40
	31065			9.2		10.3			8.50	9.70
	31066			5.0		9.8			4.75	9.40
	31067			3.0		6.6			2.75	6.22
	31068			2.3		5.0	2.10	5.60	2.00	4.55
	31069			1.4		2.3			.75	1.48
	31070			2.3		2.3			2.00	2.45
	31071			1.1		2.2			.10	1.95
	31072			0.9		1.3			.10	1.25
	31073			0.5		0.5	.20	1.10	.10	.10
	31074			12.4		7.2			11.50	7.10
	31075			4.8		4.7			4.50	4.20

METAL QUOTATIONS:

1.00 PER OZ. COPPER \_\_\_\_\_ C PER LB. CHARGES: \$ \_\_\_\_\_

PER OZ. \_\_\_\_\_ PER LB. DATE 7/30/52

HAWLEY & HAWLEY  
PER *[Signature]* ASSAYER.

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CHEMISTS

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ORE BUYERS

EL PASO, TEXAS  
Box 4

WE HEREBY CERTIFY THAT THE FOLLOWING RESULTS WERE OBTAINED FROM SAMPLES OF St. Anthony Mining & Development Co.

OFFICE NO.	MARKED	GOLD OZS.	SILVER OZS.	LEAD PER CENT	COPPER PER CENT	ZINC PER CENT	Pb		Mise	
							IRON PER CENT	Test	Pb	Zn
254648	Sample : 31076			2.8		10.2			3.00	10.35
	31077			1.9		2.8			2.00	.50
	31078			3.0		6.1	4.70	6.50	2.50	5.50
	31079			1.9		6.9			1.90	7.00
	31080			6.5		3.8			6.60	4.10
	31081			3.3		6.8			3.25	7.25
	31082			11.1		8.6			9.25	9.30
	31083			4.7		11.8	7.0	11.50	4.50	12.0
	31084			3.1		4.5			3.00	4.90
	31085			10.9		4.9			10.25	5.10
	31086			8.2		8.9			7.50	9.25
	31087			6.7		8.6			6.00	8.40
	31088			6.2		10.1	6.39	10.50	5.35	10.10
	31089			2.7		4.4			2.10	3.95
	31090			2.3		6.1			2.00	5.90
	31091			2.9		5.3			2.50	5.85
	31092			2.1		4.9			2.00	4.45
	31093			1.5		4.9	1.95	5.70	1.35	5.05
	31094			3.3		6.1			4.90	6.30
	31095			11.2		9.0			11.50	9.40
	31096			2.7		4.3			2.60	4.40
	31097			1.2		3.5			1.00	3.50
	31098			3.1		4.6	3.70	5.20	3.00	3.85
	31099			2.4		4.0			1.90	3.40
	31101			1.0		4.6			.70	3.90

METAL QUOTATIONS:

GOLD \$35.00 PER OZ. COPPER \_\_\_\_\_ C PER LB. CHARGES: \$ \_\_\_\_\_

SILVER \_\_\_\_\_ PER OZ. \_\_\_\_\_ PER LB. DATE 7/30/52

HAWLEY & HAWLEY  
  
 PER \_\_\_\_\_ ASSAYER.

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CHEMISTS

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OFFICE NO.	MARKED	GOLD OZS.	SILVER OZS.	LEAD PER CENT	COPPER PER CENT	ZINC PER CENT	IRON PER CENT	Mine		
								Pb	Zn	
254673	Sample : 31102			2.8		8.4	7.10	6.50	2.25	8.14
	31103			6.8		6.2			6.25	6.24
	31104			2.9		4.5			2.75	5.00
	31105			2.0		4.2			1.75	4.80
	31106			0.9		4.2			1.75	4.10
	31107			0.2		3.1			.10	3.75
	31108			2.0		4.5	2.80	4.75	1.75	4.80
	31109			1.4		3.3			.10	3.00
	31110			4.8		5.3			4.25	5.40
	31111			1.4		3.7			1.00	4.00
	31112			2.4		2.4			2.50	4.10
	31113			2.1		3.1	1.00	3.70	.75	4.40
	31114			1.0		2.8			1.25	3.36
	31115			2.1		4.3			2.00	7.40
	31116			5.0		4.6	6.10	4.50	4.50	3.94

Note : Sample No. 31100 was missing  
Copies : 2 - Chas H. Dunning  
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HAWLEY & HAWLEY  
PER *[Signature]* ASSAYER.

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CHEMISTS

# AWLEY & HAWLEY

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254648	Sample : 31076			2.8		10.2	
	31077			1.9		2.8	
	31078			3.0		6.1	
	31079			1.9		6.9	
	31080			6.5		3.8	
	31081			3.3		6.8	
	31082			11.1		8.6	
	31083			4.7		11.8	
	31084			3.1		4.5	
	31085			10.9		4.9	
	31086			8.2		8.9	
	31087			6.7		8.6	
	31088			6.2		10.1	
	31089			2.7		4.4	
	31090			2.3		6.1	
	31091			2.9		5.3	
	31092			2.1		4.9	
	31093			1.5		4.9	
	31094			3.3		6.1	
	31095			11.2		9.0	
	31096			2.7		4.3	
	31097			1.2		3.5	
	31098			3.1		4.6	
	31099			2.4		4.0	
	31101			1.0		4.6	

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SILVER \_\_\_\_\_ PER OZ. \_\_\_\_\_ PER LB. DATE 7/30/52

HAWLEY & HAWLEY  
PER *H. Hawley* ASSAYER.

ASSAYERS  
CHEMISTS

EL PASO, TEXAS  
Box 4

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ORE BUYERS

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OFFICE NO.	M A R K E D	GOLD OZS.	SILVER OZS.	LEAD PER CENT	COPPER PER CENT	ZINC PER CENT	IRON PER CENT			
254623	Sample :			4.8		8.5				
	31051			4.1		6.8				
	31052			0.8		1.4				
	31053			1.7		6.5				
	31054			4.7		8.0				
	31055			4.5		9.3				
	31056			1.7		3.5				
	31057			4.1		4.3				
	31058			6.6		6.5				
	31059			4.6		7.5				
	31060			8.9		5.0				
	31061			3.7		3.1				
	31062			2.0		5.7				
	31063			14.0		6.4				
	31064			9.2		10.3				
	31065			5.0		9.8				
	31066			3.0		6.6				
	31067			2.3		5.0				
	31068			1.4		2.3				
	31069			2.3		2.3				
31070			1.1		2.2					
31071			0.9		1.3					
31072			0.5		0.5					
31073			12.4		7.2					
31074			4.8		4.7					
31075										

METAL QUOTATIONS:

GOLD \$35.00 PER OZ. COPPER \_\_\_\_\_ C PER LB. CHARGES: \$.

SILVER \_\_\_\_\_ PER OZ. \_\_\_\_\_ PER LB. DATE 7/30/52

HAWLEY & HAWLEY  
PER *[Signature]* ASSAYER.

June 27, 1952

Mr. Thad W. Moore, Chairman  
Mr. Warren Peterson, Member  
Mr. George Hillier, Member  
State Tax Commission  
Capitol Building  
Phoenix, Arizona

Gentlemen:

I am appearing before you today in behalf of St. Anthony Mining & Development Company, Ltd., to make a verbal presentation regarding the value of our property for taxation purposes. In addition, for your records, we are addressing this letter to you.

Our mine is now operating at a loss. In May of this year the net loss was \$39,608.66, which offset profits made during the first four months and resulted in a net loss of \$2,858.92 for the first five months of the year.

The grade of the ore produced during the first twenty-four days of June reached an all-time low of 2.55% lead and 3.77% zinc. The metal market has declined to 15 cents per pound for lead and 16 cents per pound for zinc. We have cut expenditures wherever possible in an attempt to minimize our losses. We have reduced our workweek from 6 to 5½ days and, in addition, we have been forced to lay off 24 men. Despite these curtailments we estimate that our loss in June will be approximately \$35,000.

A careful study of all of our existing mine workings shows that our remaining ore reserves are less than 40,000 tons or about five months supply. Even if the grade of ore increases 50%, we will be lucky if we break even on this remaining tonnage.

You may well ask why we continue to operate under these conditions. Mining requires courage and one must be an optimist to stay in the business. There is always the possibility of finding more ore in some unexplored area. Metal prices may go to higher levels. In addition, our mine has a severe water problem. Shut-down expenses would be very heavy if we kept the mine dewatered. If we allowed it to flood I fear a reopening would be so expensive as to be impractical.

In addition, at least 90% of the approximate 1,200 people in Tiger and Mammoth are either directly or indirectly dependent upon our operations for their livelihood. The great majority of our workers have been with us for almost ten years and we feel a real obligation to these people.

We intend to continue operating as long as we can keep our losses within reasonable bounds, and we will hope to find more ore and have better metal prices. In this situation we do not think it would be reasonable to take the position that our plant and equipment should be assessed at only its salvage value. Such a position would imply a shut-down and as I have stated, we hope that will not happen. We do, however, urge that you recognize the fact that our mine as such has no value and that therefore our assessed valuation should be limited to that placed on our plant and equipment by the Pinal County Assessor, namely \$155,098.00.

Should you wish any further information we will be happy to furnish it and we take this opportunity to invite you to have our property and records examined by any engineer of your choosing, before fixing our 1952 valuation.

Very truly yours,

St. Anthony Mining & Development Co., Ltd.

By \_\_\_\_\_  
Vice President & General Manager

JAR:pk

MEMORANDUM

June 9, 1952

TO: Mr. John A. Richards, Vice Pres. & Gen. Mgr.

FROM: Ernest E. Sturrock, Engineer

SUBJECT: MINING OPERATIONS DURING MAY, 1952

ORE PRODUCTION - SULPHIDE

PLACE	<u>FOR MAY, 1952</u>		<u>YEAR TO DATE</u>	
	TONS	EST.GRADE	TONS	EST.GRADE
		\$PB		\$Zn
81 Stope	678	7	3922	8
82 N. Stope	1091	3	3353	4
86 N. Stope	54	3	686	6
90 J. Stope	206	1	991	4
90 1/2 W. Stope	309	3	856	2
91 A. Stope	1693	2	3464	4
92 Winze	144	1	654	3
94 A. Back	14	6	112	9
95 Stope	73	4	8247	5
95 S. Stope	279	2	324	2
96 W. Stope	238	4	1860	6
96 N. Stope	270	2	469	2
1025 F. S. Raise	48	2	246	4
115 Stope	445	3	2828	2
116 Stope	367	4	704	5
117 Stope	144	5	718	5
111 Mohawk Stope	441	5	441	6
111 Mohawk Drift	78	5	365	6
11 A. N. Drift	446	2	989	6
1125 N. Drift	517	1	517	1
1191 Raise	68	6	68	10
80 1/2 S. Drift			401	8
84 W. Back			38	2
86 W. Stope			2862	5
90 G. Stope			965	6
903 Drift			68	1
907 Raise			202	4
91 B. N. Sill			99	2
96 N. Drift			217	1
1025 F. Crosscut			12	1
1025 B. Stope			663	6
11 A. S. Drift			421	3
1125 S. Drift			541	4
115 S. Raise			68	2
<b>Totals</b>	<b>7603</b>	<b>3.07</b>	<b>38,371</b>	<b>4.97</b>

No oxide ore was milled during the month of May.

DEVELOPMENT AND PROSPECTING

92 WINZE:

Advance for Month: 0.0'  
Year to Date: 74.5'

The station cuts have been taken and mucked up. Several drift rounds have been taken to the north and south of the winze to give blasting clearance for the station timber. The drift muck is now being cleaned up and then the station timbers will be placed shortly.

1025 F. S. RAISE:

Advance for Month: 21.0'  
Year to Date: 73.0'

The raise was advanced for 13 feet vertical and 8 feet on an incline to the north during the month. The raise was on a rhyolite-granite contact and was inclined to the north so that the entire raise would be in granite to facilitate drilling. Several feet of good ore is visible in the raise.

1091 MOHAWK CROSSCUT:

Advance for Month: 77.0'  
Year to Date: 95.5'

Crosscutting is continuing on a S. 55 E. bearing. The ground is considerably broken up due to the Mammoth Fault. On reaching firm ground the crosscut will be turned right to prospect for the 111 Mohawk vein.

111 MOHAWK SOUTH DRIFT:

Advance for Month: 32.5'  
Year to Date: 115.5'

The drift was driven 32.5 ft. into the fault that terminated the ore and drifting was halted temporarily to permit long hole drilling for the offset segment of the vein.

11 A. NORTH DRIFT:

Advance for Month: 131.5'  
Year to Date: 397.5'

The drift was driven to N. 351 W. 340 on a N. 80 W. bearing. At this point the ore disclosed by Long Hole No. 172 was intersected. The ore was followed on a N. 55 W. bearing to N. 408 W. 410. The ore turned to a N. 70 W. bearing and was followed to N. 425 W. 453. Drifting was temporarily halted to permit driving the 1191 raise to intersect the 1091 winze for ventilation. The average of 36 muck samples ran 1.81% Pb; 6.01% Zn in the section of 11 A north drift described above.

1125 NORTH DRIFT:

Advance for Month: 134.5'  
Year to Date: 143.0'

Drifting was resumed in this heading the early part of the month. The vein zone was followed to N. 115 W. 363 at which point a N. 20 W. fault was intersected that terminated the vein. The drift was turned to a N. 80 W. bearing to locate the offset segment of the vein. The vein zone was found at N. 125 W. 400 and drifting is continuing on the vein structure. No values have been encountered to date.

111 MOHAWK N.W. CROSSCUT:

Advanced for Month: 72.5'  
Year to Date: 72.5'

A crosscut was started at N. 109 E. 378 on the 1125 level to prospect for the projection of the Mohawk vein on the 1125 level horizon. The crosscut is being driven on a N. 15 W. bearing to intersect the projection at N. 236 E. 334, and 71 feet remain to be driven to reach this point.

1191 B. RAISE:

Advance for Month: 36.5'  
Year to Date: 36.5'

This raise was driven from the 11 A. North Drift, 1125 level, from N. 417 W. 441 to intersect the bottom of 1091 B. winze. The entire raise is in ore and the average of 8 muck samples ran 6.15% Pb - 9.88% Zn.

1125 - 92 WINZE N. DRIFT:

Advance for Month: 18.5'  
Year to Date: 18.5'

The 1125 drift from 92 winze was driven 18.5 feet north to give blasting clearance before installing the station timber

1125 - 92 WINZE S. DRIFT:

Advance for Month: 8.5'  
Year to Date: 8.5'

The 1125 drift from 92 winze was driven 8.5 feet south to give blasting clearance before installing the station timber. The face of the drift is in a 4 foot vein structure assaying 5% combined lead-zinc.

TOTAL DEVELOPMENT FOR MONTH:

MAY, 1952

Drifts and Crosscuts

475.0'

Raises and Winzes

37.5'

Total

532.5'

Development Expense for the Month:

\$1.62 per ton

Development Expense for Year to Date:

\$1.61 " "

SUMMARY OF DEVELOPMENT AND PROSPECTING

<u>PLACE</u>	<u>A D V A N C E</u>	
	<u>MAY, 1952</u>	<u>YEAR TO DATE</u>
1025 F. S. Raise	21.0'	73.0'
1091 Mohawk Crosscut	77.0'	95.5'
111 Mohawk S. Drift	32.5'	115.5'
11 A. North Drift	131.5'	397.5'
1125 North Drift	134.5'	143.0'
111 Mohawk N.W. Crosscut	72.5'	72.5'
1191 B. Raise	36.5'	36.5'
1125-92 Winze N. Drift	18.5'	18.5'
1125-92 Winze S. Drift	8.5'	8.5'
804 South Drift		74.0'
804 N.E. Crosscut		27.0'
804 N. F.W. Drift		9.0'
805 S. W. Crosscut		34.0'
86 A. South Drift		56.0'
86 A. Footwall Drift		68.5'
92 Winze		74.5'
903 South Drift		106.0'
907 Raise		71.0'
96 North Drift		63.0'
1025 F. Crosscut		17.0'
1125 South Drift		195.5'
1125 North Crosscut		155.0'
11 A. South Drift		158.0'
11 A. N. E. Crosscut		44.5'
1125 Mohawk Crosscut		139.5'
115 South Raise		22.5'
<b>Totals</b>	<b>532.5'</b>	<b>2,275.5'</b>

STOPE PREPARATION

96 N. STOPE:

The stope has been placed in production.

116 STOPE:

The stope has been placed in production.

117 STOPE:

The stope has been placed in production.

95 S. STOPE:

The timbering has been completed and one cut taken.

111 MOHAWK STOPE:

Two cuts have been taken and mucked up. The stope is ready for timbering.

## LONG HOLE DRILLING

Long Hole No. 184 was drilled 116 feet on a N. 52 E. bearing at a plus 16 degrees on the 1025 level from N. 007 W. 087. The hole prospected the area south of the Mammoth fault from the intersection of the Collins vein with the fault. No values were encountered.

Long Hole No. 185 was drilled 44 ft. on a N. 18 E. bearing at a plus 18 degrees on the 1125 level from the Mohawk 11 crosscut at N. 148 E. 931. Bad ground conditions forced drilling to be halted. No values were encountered.

Long Hole #186 was drilled 32 ft. on a N. 10 E. bearing on the 1125 level from the 111 Mohawk South drift at N. 175 E. 105. This hole was drilled to prospect for the offset segment of the 111 vein. Bad ground conditions forced drilling to be halted. No values were encountered.

Long Hole #187 was drilled 32 ft. on a N. 26 E. bearing from the same location as Hole 186. Bad ground conditions forced drilling to be halted. No values were encountered.

Long Hole #188 was drilled 100 ft. on a N. 57 E. bearing from the same location as hole No. 186. No values were encountered in the hole.

STOPPE SAMPLING

<u>STOPPE</u>	<u>SAMPLE NO.</u>	<u>SPB</u>	<u>ASH</u>	<u>LOCATION</u>
703	893	4.35	5.50	35' below 800 level
	975	2.25	2.00	21' below 800 level
95 South	897	0.10	2.00	11' above track, T.D.B. south end
	928	0.10	3.00	15' " " " north "
96 W.	911	3.00	3.00	4' below 800 level-South half
	912	1.85	2.50	7' below " " -North half
96 W.	989	5.50	3.55	7' above 800 level-South half
	992	2.50	2.50	22' above track
90 1/2 W.	913	1.75	3.50	20' above track-North third
	990	2.50	3.25	28' above track-Center third
115	991	1.00	3.50	24' above track-North third
	916	0.10	3.75	52' above track-South third
	917	2.00	0.40	56' above track-Center third
	918	0.10	0.10	60' above track-North third
	994	4.00	5.50	57' above track-South third
	995	1.75	2.00	61' Above track-Center third
	996	0.10	0.10	65' above track-North third
116	997	4.50	6.25	24' above track
111 Mohawk		4.42	5.65	Average of 13 samples, T.D.B.

ORE RESERVES - SULPHIDE

JUNE 1, 1952

MAY 1, 1952

<u>STOPE</u>	<u>IN PLACE</u>	<u>BROKEN</u>	<u>TOTAL</u>	<u>IN PLACE</u>	<u>BROKEN</u>	<u>TOTAL</u>
81	-	-	-	-	500	500
90 1/2 W.	5500	300	5800	5800	-	5800
82 N.	-	-	-	-	1900	1900
86 N.	1500	600	2100	1500	600	2100
90 J.	-	-	-	-	700	700
91 A.	-	5500	5500	-	7200	7200
95	-	-	-	-	1500	1500
96 W	<i>9000</i> 100	3000	3100	300	2700	3100
115	2200	2600	4800	3600	1500	5300
116	1800	700	2500	2800	-	2800
117	1400	700	2100	1400	-	1400
111 Mohawk	1100	-	1100	1600	-	1600
<b>Totals</b>	<b>13,600</b>	<b>13,400</b>	<b>27,000</b>	<b>17,300</b>	<b>16,600</b>	<b>33,900</b>

\* 1400 tons of broken ore in 95 Stope carried in the reserves of May 1, 1952 have been dropped from the reserve due to an over-estimation of the stope content.

ORE RESERVES - OXIDE

JUNE 1, 1952

MAY 1, 1952

<u>STOPE</u>	<u>IN PLACE</u>	<u>BROKEN</u>	<u>TOTAL</u>	<u>IN PLACE</u>	<u>BROKEN</u>	<u>TOTAL</u>
701	<i>9000</i> 500	3300	3800	500	3300	3800
703	-	7400	7400	400	7000	7400
<b>Totals</b>	<b>500</b>	<b>10,700</b>	<b>11,200</b>	<b>900</b>	<b>10,300</b>	<b>11,200</b>

### PUMPING

During the month of May water was pumped from the mine at an average rate of 2334 gallons per minute.

At the end of the month the water table measured at churn drill hole No. 3 was 2139.9 feet elevation compared to 2140.2 feet elevation at the end of April. This indicates that the water table was lowered 0.3 feet during the month of May.

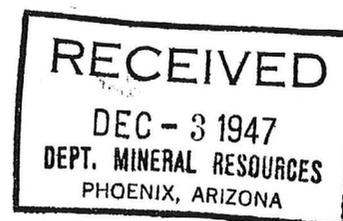
### PERSONNEL

The total payroll as of May 15, 1952 was 194 compared to 210 on April 15, 1952.

The Mine Department, including shift bosses, worked a total of 3507 manshifts, which produced 2.17 tons per manshift compared to 2.41 tons per manshift in April.

## ST. ANTHONY MINING AND DEVELOPMENT CO., LTD.

TIGER, ARIZONA  
December 1, 1947



Mr. Charles H. Dunning,  
Department of Mineral Resources,  
Mineral Building, Fairgrounds,  
Phoenix, Arizona.

Dear Sir:

Your recent undated circular letter has been referred to me for reply and I give you herewith the following information.

1. Production prior to veto of Allen Bill:

	<u>Copper</u>	<u>Lead</u>	<u>Zinc</u>
April, 1947	39,480	865,044	737,993
May, 1947	44,172	866,351	762,391
June, 1947	43,630	862,199	748,411

2. Production subsequent to veto of Allen Bill:

July, 1947	42,403	834,549	715,844
August, 1947	43,987	778,058	636,529
September, 1947	37,501	797,061	648,802

3. We anticipate that our production during the next few months will closely approximate that of previous months.

4. We are unable to make an estimate of production if some incentive plan were placed in effect due to the fact that the stress of heavy war time production left our mine in need of much development work. Production cannot be increased appreciably until our development program is farther advanced.

I trust that the foregoing may be helpful to you.

Yours very truly,

ST. ANTHONY MINING AND DEVELOPMENT COMPANY, LTD.

*B. W. Roebuck*  
B. W. Roebuck - Chief Clerk

BWR:jpp

COPY

FORM C. O. 23

UNITED STATES SMELTING REFINING  
AND MINING COMPANY

SALT LAKE CITY, UTAH

For Mr. Brough

Mammoth-St. Anthony

Superior, Arizona  
August 10, 1949

Mr. A. G. Kirkland  
Manager of Western Mines  
U.S. Smelting Refining & Mining Co.  
Salt Lake City 13, Utah

St. Anthony Mining and Development Co., Tiger, Arizona  
Ray Consolidated Copper Company, Hayden, Arizona

Dear Sir:

Visits were made this day at the St. Anthony and Hayden mills.

The mill of the St. Anthony Mining and Development Company, Ltd., is probably the only one of its kind in the southwest. Sulphide lead-zinc and oxidized lead ore is milled simultaneously in parallel grinding and processing sections. About 100 tons of oxide and 350 to 400 tons of sulphide ore are milled per operating day. The operating schedule is now 11 days on and 3 off. Wage rates are about 10¢ per hour less than was ours. They work Tuesday through Friday, with one day at overtime.

Sulphide ore heads carry low values in Au, Ag and Cu, with 4 to 5 percent lead and 5 to 6 percent zinc. Oxide heads carry about 0.03 oz Au, 0.50 oz Ag, 3 to 3.5 percent lead and 4 percent zinc, most of the latter being oxidized and non-recoverable.

Successful operation of these sections is entirely dependant upon segregation of ores underground. This had not been done on the day of my visit and the sulphide circuit was in rough condition.

I will not go into detail on the two operations as Mr. Givens, Mill Superintendent, supplied me with a flowsheet showing the separate circuits and I have a published account of the oxide operation. A fair amount of the galena is in massive form so feed to the sulphide circuit is passed over vibrating screens

decked with 6 mesh cloth, these screens closing the primary grinding circuit. Screen undersize is roughly sized in a launder spits and sent to 3 Deister tables which take off a finished lead concentrate. This product assays close to .04 Au, 5.5 Ag, .50 Cu, 67% Pb and 4.5% Zn. Table tails and mids are ground in the secondary mill for flotation.

Cleaning and recleaning of lead and zinc concentrate is practiced. Flotation lead concentrate assays close to 67% Pb and 6% Zn. A considerable amount of slow floating galena carries over into the zinc concentrate so this product is also tabled, the lead streak being cut for return to the classifier. Final zinc concentrate assays 54 to 55% zinc.

Processing of lead oxides is by flotation alone. While cerussite is the principle economic mineral, galena, wulfenite, vanadinite and anglesite are present in varying, but important amounts. Recovery of lead in this circuit has averaged close to 90% on 3% lead heads while recovery of Au and Ag has been close to 85%. Oxidized Zn is no problem; but sulphide Zn wrecks the operation. The sulphide responds to promoters for lead. If zinc depressants are added they destroy the effect of lead promoters. Vanadinite and wulfenite are prominent in the concentrate. Mr. Givens is not sure about the anglesite content.

The plant is an old one, as is most of the equipment except the Denver cells. From the standpoint of arrangement there is little to imitate. Tailing disposal methods are quite similar to ours up to the change we made last spring. Disposal cost is comparable to ours. Other costs are unknown.

#### Kennecott Copper at Hayden

Ore is delivered to this mill after being crushed to 3/4" at the mine. Four 9' x 12' rod mills are now installed, each taking 2800 to 3000 tons per day

of this 3/4" feed and reducing it to practically all through 8 mesh with about 10% circulating load, the latter being obtained with a locally designed tramp oversize trap. Rod mill product is reduced to 70% minus 200 mesh in two stage ball milling and classification.

The mill is notable for the absence of fine crushing and screening equipment such as is found in so many mills and which was in this one at an earlier date. The change to fine crushing with rod mills resulted in a 7.5% reduction in costs back in the thirties. Reasons other than sticky feed induced the change.

The economic mineral is preponderantly chalcocite, accompanied by some pyrite. A little milk of lime is added to the rod mills, but most is added to the third stage grind where the heaviest concentration of pyrite is formed. Locally made "Raconite", a butyl xanthate is the only promoter. Roughing is done in callow type cells while Fags are used for cleaning and recleaning.

Seven men and a foreman constitute a shift operating crew, including the filter plant. Tailing is laundered, unthickened, to the high point of the disposal area and diverted alternately to very large divisions of river bottom land. Rims are pushed up by a dozer after a division has been filled and allowed to dry. There is no return of water and none is skimmed, the areas being so large that it evaporates. Cost of disposal is negligible.

- - -

F. V. Brough

PVB:ab

Typed at SLC  
from pencil copy  
August 15, 1949

cc: Mr. Mulock (2)  
Mr. Brough

August 4th, 1958.

To: St Anthony Mining and Development Co.,  
Tiger, Ariz.

Appraisal Report on Mammoth St Anthony Mine.

Persuant to the request of your Mr. Richards I have made an independant examination of your Mammoth St. Anthony Mine with view to establishing a valuation thereof as of July 1st, 1958, based on the ore at that time proven, developed or semi-developed.

This examination was made during the last week of June. All stopes and ore exposures were inspected and 75 samples taken under my supervision to determine the value of each block of ore.

Attached herewith are the following exhibits:  
(A) Tabulation showing each block of ore correlated with company stope numbers; the measurements of the block and calculated tonnage; the average assay thereof; the extraction and recoverable pounds of metal per ton; the net smelter value per ton; and the net value of the block.  
(B) A tabulated list of each individual sample assay segregated into the various blocks, showing how the averages used in "A" were obtained.  
(C) and (CI) A company furnished tabulation showing the various metallurgical extractions on the various grades of ore, and the net smelter value of the resultant pounds of metal extracted. In this regard it should be born in mind that metallurgical extraction is not a constant percentage, but varies with the grade or metal content. The higher the metal content the higher the percentage extraction - in fact there is a tendency for the tailings value to remain quite uniform in spite of variations in the head value. Also in regard to the net value per pound the smelter contract imposes a different value per pound for each difference in grade. These complicated factors have all been taken into consideration and the results as tabulated in exhibit "A" worked out as meticulously as practice.

In addition to these factors there are variations due to the market price of lead and zinc as shown on Exhibits "C" and "C1", and as the price of lead on June 30th was 16¢ and zinc 15¢, these prices were used in all computations. (Exhibit D). Assayers certificate, showing all 75 assays.

It should be added that the values of the small amounts of gold and silver does not show directly but is included in the valuations of lead.

Maps showing outline of the blocks or stopes are available but are not herewith attached.

While separate samples were taken of the broken and unbroken ore in the stopes they have been lumped together to make a stope average. Segregation of the two items would hardly make an iota of difference in the final picture and would further complicate the details. In the case of 904W however a separation was made because there were a large number of samples, but it still made very little difference.

In establishing a net valuation such as this it is a moot question whether one should take the broad aspect of costs applicable to a going concern, or should base costs as they would apply only to a salvage operation. Certain ordinary and continuing operating cost could be eliminated if it were decided to grab what ore was feasible and abandon the mine for good. In this instance I have tried to use common sense and have made no departure from experienced average costs except that I have allowed a cost of \$1.00 per ton less in computing the value of the ore already broken in stopes.

One wonders why blocks of ground showing a negative value should be included at all. Possibly some of them will be abandoned unless metal prices improve. It is a problem of managerial efficiency to supply the mill with maximum daily tonnage to minimize heavy overhead expenses such as keeping the mine unwatered. This could not be done by selecting only the high grade spots or stopes. Furthermore miners must have an intrinsic optimism or they would not be miners, and there is always hope that a low grade spot may become better, or that the market will turn more favorable.

I have made no attempt to value this mine as a prospect. There are no doubt prospective possibilities. Enough, I hope, to encourage the ownership to keep digging in spite of recent operating losses. But the general prospective picture is not very good. The value of the ore has been declining down to the present bottom level at 1100 feet. Most possibilities for commercial ore above that level have been exhausted. And the water problem that will be encountered in exploration below that level will require courage indeed, especially in the face of the declining values and heavy foreign importations of lead and zinc.

The overall net ore value as worked out in exhibit "A" shows a negative result, and in spite of your most excellent management it seems exceedingly doubtful if this can be transposed into any profit at all under present metal prices and operating cost conditions.

Therefore I can give no value to the mine except as a very speculative prospect.

Respectfully Submitted,

August 4, 1952.

*Charles H. Dunning*

ST. ANTHONY MINING AND DEVELOPMENT CO., LTD.

TIGER, ARIZONA

TELEPHONES  
MINE OFFICE - TIGER 2  
PURCHASING AGENT - TIGER 1

July 2, 1952

Mr. Charles H. Dunning,  
1635 W. Earll Drive,  
Phoenix, Arizona

Dear Charlie:

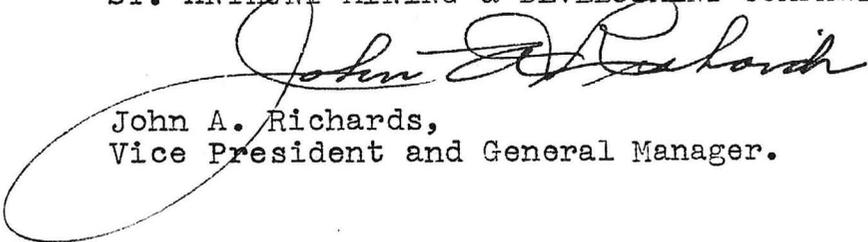
I am enclosing the typed list of the samples you had taken so that you can complete your report.

Both Mr. Guynn and I feel quite certain that as a result of our appearance before the Tax Commission they will make a rather substantial cut in our valuation. If that is the case, I doubt that we will take them into court.

Therefore, it seems to me that you might well limit your report at this time to merely an estimate of tonnage and grade. We can always bring it up to date as to costs and recoveries later.

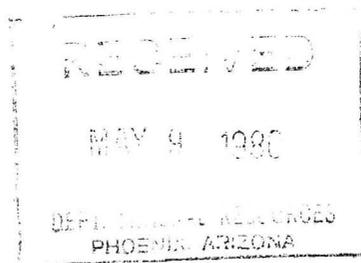
Sincerely,

ST. ANTHONY MINING & DEVELOPMENT COMPANY, LTD.



John A. Richards,  
Vice President and General Manager.

JAR: jp  
enc.



May 8, 1980

*Mammoth Mine file  
(St. Anthony)  
(Tiger)*

Mr. John T. Kummer  
Division of Ferrous Metals  
U. S. Bureau of Mines  
Washington, D. C. 20202

Dear John,

I enjoyed talking with you the other day and I certainly appreciate the information on byproduct molybdenum.

I was able to get some production figures on the Mammoth and Copper Creek properties. There were several individual mines in the Mammoth Area (Pinal County Arizona) that were consolidated by 1938. The molybdenum at Mammoth is contained in the mineral wulfenite. The first reference is Davis, Hubert W., 1950, Molybdenum: Minerals Yearbook 1948, U. S. Bureau of Mines, p. 815-826.

1898 ...approximately 12 short tons of wulfenite assaying 90%  $PbMoO_4$  were shipped from the Mammoth mine....

1903 ...795-short tons of wulfenite concentrates (estimated to contain 10% Mo) produced at the Mammoth mine....

1904-06 ...about 15 tons Mo(?)annually (mostly from Mammoth mine?)....

1907-13 ...none....

1914- ...1,297 pounds Mo produced in Arizona (where?), New Mexico, and Washington....

On p. 816, Davis references his figures to footnotes. My next reference is Creasey, S. C., 1950, Geology of the St. Anthony (Mammoth) Area, Pinal County, Arizona: in Arizona Zinc and Lead Deposits, Pt. 1, Arizona Bureau of Mines Bulletin 156, p. 63-84.

<u>YEAR</u>	<u>NAME</u>	<u>MoO<sub>3</sub> (lbs)</u>
1916-19	Mammoth-Collins	447,876
<u>1934</u>	Mohawk-New Year	70,546
1935	Mammoth-Collins <sup>1</sup>	49,869
<u>1935</u>	Mohawk-New Year	93,649
1936	Mammoth-Collins	109,915
<u>1936</u>	Mohawk-New Year	137,889
1937	Mammoth	245,042
1938	Mammoth-St Anthony	840,900

1939	Mammoth-St Anthony	820,169
1940	Mammoth-StaAnthony	946,300
1941	"	890,000
1942	"	624,144
1943	"	743,025
1944	"	295,488
1945-present	"	Probably None

Concerning the Copper Creek Area, my main source was Kuhn, Truman, H., 1941, Pipe Deposits of the Copper Creek Area, Arizona: Econ. Geology, Vol. 36, p. 512-538.

1933-38 ...6,946,782 pounds of MoS<sub>2</sub> from the Childs-Aldwinckle mine.

Hope this information helps you. Thanks again for the byproduct data.

Sincerely,

*Michael N. Grealey*  
MICHAEL N. GREALEY,  
Field Engineer

MNG:mcr

(MAMMOTH (+) COLLINS (+) MOHAWK (+))

MB Kay

FOR IMMEDIATE RELEASE  
February 9, 1988

SAN MANUEL, ARIZONA, February 9, 1988, Magma Copper Company (NASDAQ-MGCP) has entered into an agreement in principle with Cyprus Minerals Company to form a joint venture under which Cyprus would conduct exploration for gold on a portion of Magma's San Manuel property located about 40 miles northeast of Tucson, Arizona.

Drilling began last month for exploration along the Mammoth-Mohawk vein which produced gold and was mined from the 1880's through the 1940's.

The area under exploration was the site of several mines in the Old Hat Mining District which supported the communities of Tiger and Mammoth, Arizona.

Under the proposed arrangements, Cyprus would have the right to earn a 50% interest in the property covered by the joint venture by undertaking certain exploration activities.

Cyprus also would be the operator of the mine if one were built.

Magma Copper Company is the second largest copper producer in the U.S. and operates mines in San Manuel and Miami, Arizona, and a smelter, refinery and rod plant in San Manuel as well as a rod plant in Chicago.

Cyprus Minerals Company, headquartered in Englewood, Colorado, is a major producer of coal, copper, molybdenum, gold and industrial minerals.

# # #

NEWS FROM **MAGMA**

**MAGMA COPPER COMPANY**  
P. O. Box M, San Manuel, Arizona 85631  
Public Relations Officer—Frank Harris (602) 385-3256/385-2153

RECEIVED  
FEB 10 1988  
DEPT. OF MINES & MINERAL RESOURCES

Taylor



S. I. AN 1121 (A)

STATE MINE INSPECTOR Office of State Mine Inspector

MAR 07 1985

705 West Wing, Capitol Building  
Phoenix, Arizona 85007  
602-255-5971

NOTICE TO ARIZONA STATE MINE INSPECTOR

In compliance with Arizona Revised Statute Section 27-303\*, we are submitting this written notice to the Arizona State Mine Inspector (705 West Wing, Capitol Building, Phoenix, Arizona 85007) of our intent to start stop (please circle one) a mining operation.

COMPANY NAME A. J. Gilbert Construction Co.

CHIEF OFFICER A. J. Gilbert, Jr.

COMPANY ADDRESS 6741 N. Thornydale, Suite 121, Tucson, AZ 85741

COMPANY TELEPHONE NUMBER 742-2976

MINE OR PLANT NAME Magma - Tiger Mine

MINE OR PLANT LOCATION (including county and nearest town, as well as directions for locating by vehicle)

San Manuel, Pinal County, Arizona, 1 mile west of Magma Mine Main Gate, off Arizona State Route 77. Ask for directions at mine gate.

TYPE OF OPERATION Crushing PRINCIPAL PRODUCT Silica

STARTING DATE March 1 CLOSING DATE June 28, 1985

DURATION OF OPERATION 4 months

PERSON SENDING THIS NOTICE A. J. Gilbert, III

TITLE OF PERSON SENDING THIS NOTICE Vice President

DATE NOTICE SENT TO STATE MINE INSPECTOR March 6, 1985

\*A.R.S. Section 27-303 NOTIFICATION TO INSPECTOR OF BEGINNING OR SUSPENDING OPERATIONS: When mining operations are commenced in any mine or when operations therein are permanently suspended, the operator shall give written notice to the inspector at his office prior to commencement or suspension of operations.

Taylor

# Office of State Mine Inspector

705 West Wing, Capitol Building  
Phoenix, Arizona 85007  
602-255-5971

STATE MINE INSPECTOR  
AUG 5 1985

## NOTICE TO ARIZONA STATE MINE INSPECTOR

In compliance with Arizona Revised Statute Section 27-303\* we are submitting this written notice to the Arizona State Mine Inspector (705 West Wing, Capitol Building, Phoenix, Arizona 85007) of our intent to start stop (please circle one) a mining operation.

COMPANY NAME A. J. Gilbert Construction Company

CHIEF OFFICER A. J. Gilbert, Jr.

COMPANY ADDRESS 6741 N. Thornydale, Suite 121, Tucson, AZ 85741

COMPANY TELEPHONE NUMBER 742-2976

MINE OR PLANT NAME Tiger Mine- Magma

MINE OR PLANT LOCATION (including county and nearest town, as well as directions for locating by vehicle)

San Manuel, Pinal County, Arizona, 1 mile west of Magma Mine Main Gate, off Arizona State Route 77. Ask for directions at mine gate.

TYPE OF OPERATION Crushing PRINCIPAL PRODUCT Silica

STARTING DATE March 1, 1985 CLOSING DATE July 3, 1985

DURATION OF OPERATION 4 months

PERSON SENDING THIS NOTICE A. J. Gilbert Construction

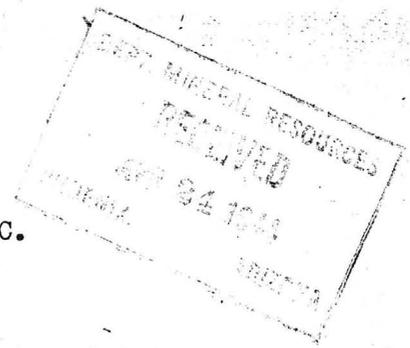
TITLE OF PERSON SENDING THIS NOTICE Vice President

DATE NOTICE SENT TO STATE MINE INSPECTOR July 31, 1985

**RECEIVED**  
SEP 16 1985  
DEPT. OF MINERAL RESOURCES

A.R.S. Section 27-303 NOTIFICATION TO INSPECTOR OF BEGINNING OR SUSPENDING OPERATIONS: When mining operations are commenced in any mine or when operations therein are permanently suspended, the operator shall give written notice to the inspector at his office prior to commencement or suspension of operations.

Washington, D.C.  
April 21, 1944



SUBJECT: Mammoth St, Anthony; Minerals Classification List re labor

Mammoth is on the Minerals Classification list as a II-B mine, which is not a bad place on the list at all. You will find the definition of these classifications in a prior memo of mine.

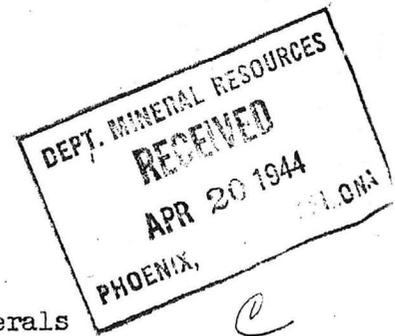
However, I have asked that the case be reviewed with the idea of boosting it into a higher bracket for at least a couple of months. This will depend entirely upon their zinc production, and how badly the Zinc boys want the metal.

I have been promised a review in May, which is the next issue of the priority list.

W. C. Broadgate

Washington, D.C.  
April 17, 1944

SUBJECT: Mammoth St. Anthony labor priority

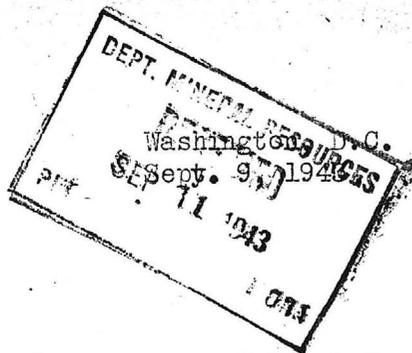


I am beginning to understand why this mine is not on the Minerals Classification List.

Apparently it produces only small quantities of anything but lead and zinc which, as you know, are in sufficient supply according to WPB.

I am going to make a few more inquiries, but it looks bad for any lead or zinc producer to get an advance in its labor status.

Bill Broadgate



SUBJECT: Labor, Mammoth-St. Anthony

I have nothing from Howard Young on this as yet, although I reported that the Zinc Division feels that under the Labor Production Division rule the production per man is too low to change the position on the list, Class II-C.

However, Col. Moulton called me today and stated that the USES had furnished Rush Sill with a letter saying that they could supply 125 men for the Old Reliable at a week's notice. Obviously, if they can do this (which we doubt) they should first supply Mammoth, or any property on the list, as Old Reliable is not on the list at all.

Moulton asked me if there were any small coppers in the same position as Mammoth, where USES should have been furnishing labor if they have so much laying around.

I didn't have any particular cases except Mammoth.

Bill Broadgate

Washington, D.C.  
Sept. 1, 1943

SUBJECT: St. Anthony Mining & Development Co.

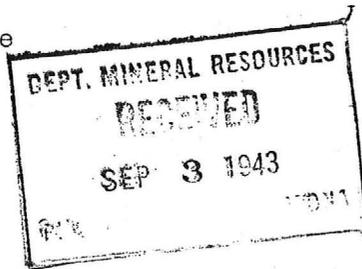
I can scarcely understand this situation as this mine in the priority lists is in Class II-C-Zinc.

Class II Mines, listed within metals, by mines, are essential mines to which referrals may be made of applicants for employment who do not accept employment in Class I mines whether for reasons of working conditions, location of domicile, climactic conditions, or other reasons. Certificates of separation are to be denied to employees of these mines except in unusual cases wherein the transfer desired is to a Class I mine.

This should put them in a relatively secure position.

I am taking the matter up with Howard Young.... mentioned it to him this afternoon..... also the substance of Willis memo of Aug. 30th.

Bill Broadgate



## FERROSILICON

American Alloys Inc.	Ferrosilicon plant, Mason County, WV.	American Alloys tapped its first heat of ferrosilicon at the old Foote Mineral Co., Graham plant in February. The plant, which was purchased by American Alloys at the end of 1987, has been idle for over 2 yr. A second and third furnace are nearly ready to produce and are expected to come on line some time before fall. Until that time, all production has been contracted for sale.
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## GOLD

Coeur-Thunder Mountain, Inc.	Marble Creek, ID.	Permission is being sought from the U.S. Forest Service to operate an open pit, cyanide leach gold mine in Marble Creek, ID. Mine life is anticipated at 3 yr with employment at 120. It is estimated that a total of 700,000 tr oz of gold would be recovered.
------------------------------	-------------------	---

Crown Resources Corp.	Ferry County, WA.	The company will spend \$9.5 million this year on exploration and development work on two gold mines. Work includes completion of a 3,600-ft decline and continued exploration of the Kettle property, plus continued drilling and initial development at the Key project.
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Goldstake Explorations (SD), Inc.	Whitewood Creek, Lawrence County, SD.	Goldstake Explorations has been acquiring leases and evaluating gold resources of tailings deposits near the Homestake Mine. The company proposes to process about 5 million st of tailings using gravity concentration and leaching. The area of the leases is listed as an Environmental Protection Agency Superfund Site because of arsenic concentrations of about 0.025% remaining from past gold recovery operations.
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Magma Copper Co.	San Manuel, AZ.	An agreement in principle has been made for a joint venture with Cyprus Minerals Co. to explore for gold on Magma Copper's property 35 mi northeast of San Manuel, AZ. In January, Cyprus Minerals began drilling along the Mammoth-Mohawk vein near the abandoned Tiger mining camp. Mines located in the Mammoth (Old Hat) mining district produced approximately 397,000 tr oz of gold from the 1880's through 1940's. By undertaking certain exploration activities, Cyprus Minerals would have the right to earn a 50% interest in the property and operate the mine if built.
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*Mammoth in AZ*

Placer Dome Inc.	Golden Sunlight Mine, Whitehall, MT.	Open pit production has been expanded, with the addition of 25 new jobs and a capital investment of \$4.5 million. New plans call for two more stages of development, which will extend the mine life to the year 2005.
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St. Joe Gold Corp.	Richmond Hill-Turnaround Deposit, Lawrence County, SD.	A mining permit has been received from the South Dakota State Board of Minerals and Environment to begin open pit mining. The deposit has reserves of 3.9 million st, grading 0.055 tr oz/st of gold and 0.23 tr oz/st of silver.
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## INDIUM

Indium Corp. of America.	Utica, NY.	The company announced plans to build a new indium refinery that will boost its indium output by more than 1 million tr oz/yr. The new indium refinery in Utica, which should be fully operational by 1990, is being built to meet an expected rise in worldwide demand for the metal.
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## IRON AND STEEL

Arkansas Steel Co.	Helena, AR.	The company is being organized to build an electric furnace steel mill with a production capacity of 650,000 st/yr of 700,000 st/yr of slab. Long-term supply contracts and equity interest are being offered to steel companies that currently have insufficient supplies of slab for their rolling mills.
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Bethlehem Steel Corp.	Burns Harbor, IN.	Bethlehem announced in February that it will begin construction later this year on a state-of-the-art vacuum degassing facility that will give it the capability to produce an all new family of ultralow-carbon sheet and plate steels. The multimillion-dollar plant is expected to be in operation in late 1989. Bethlehem produces about 5.3 million st/yr of steel and employs about 6,000 persons.
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Phoenix Steel Co.	Claymont, DE.	Bankrupt Phoenix Steel has agreed to sell the shutdown steel plate plant to Wai Hing & Co., a Hong Kong trading company, for \$13.5 million. Wai Hing will spend \$6 million to \$7 million reconditioning and upgrading the 500,000-st/yr plant before reopening it in October.
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## IRON ORE

LTV Steel Mining Co.	Hoyt Lakes, St. Louis County, MN.	LTV's 1,170 union workers ratified a new 25-mo contract on February 26 that cut wages and benefits by \$2.19/h. In addition to the base pay cut, Sunday premium pay was reduced from 1-1/2 to 1-1/4 regular pay, quarterly cost-of-living adjustments were abolished, and shift differential was reduced by 10¢ to 15¢/h.
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