NEW CORNELIA (F) PIMA

NEWS RELEASE

phelps dodge Corporation 2600 N. Central Avenue, Phoenix, AZ 85004-3014 • (602) 234-8100

For Immediate Release
Contact: Thomas M. Foster
(602) 234-8139

PHELPS DODGE TO REOPEN AJO MINE

Phoenix, Arizona – May 7, 1997 – Phelps Dodge Corporation today announced plans to resume production at its historic Ajo copper mining operation in southern Arizona.

Construction of a $238 million modernization of the facility is scheduled to begin in early 1998, pending completion of environmental permitting, with commercial production beginning as soon as late 1999. When operating at full capacity, Ajo will add 135 million pounds of copper to the company's annual production and will employ 400 people from the Ajo and Gila Bend areas. Ajo also is expected to yield an estimated 25,000 ounces of gold annually as a byproduct of copper production.

"Modern mining technology allows us to cost-effectively resume production of copper at Ajo – an important step toward reaching our goal to increase Phelps Dodge Mining Company's annual copper production to 2.2 billion pounds by 2002," said Douglas C. Yearley, chairman, president and CEO of Phelps Dodge Corporation. "In addition, the resumption of mining will provide important benefits to the local economy."

-more-

PHELPS DODGE TO REOPEN AJO MINE **2-2-2-2**

An open pit and much of the needed infrastructure already exist at the operation. Preparations for reopening the mine will include construction of a new $166 million concentrator facility. An additional $72 million will be spent on infrastructure upgrades including mining equipment.

The concentrator will process 38,000 tons of ore daily and will include a new semi-autogenous (SAG) mill. Concentrate produced from Ajo will be smelted at Phelps Dodge Mining Company's Hidalgo smelter in Playas, New Mexico.

Phelps Dodge Corporation is among the world's largest producer of copper. The company operates mines and manufacturing facilities and employs more than 16,000 people in 26 countries.

###

Ajo Well Team

NEW CORNELIA (?) TECHNIQUE

Curtis Taylor, Guide
Apr. 16, 1987

NOTES ON SINKING OF SHAFT AT WELL NO. 1

In the spring of 1913, it was decided by the management of the Calumet and Arizona Mining Company to do drilling for water, which would be needed for treatment of the New Cornelia ores at Ajo.

A survey by geologists, drill experts and others was made, and the location of the first well was made about six and three-quarter miles north of the Ajo Camp, in the Child's Valley near a large arroyo. This arroyo drains the country for thirty miles to the south and east. This fact was the deciding factor for locating at this place.

Later, two other wells were drilled. Well #2 about four miles north of camp near the road to Well #1. Water was struck at a depth of_____feet, but not any great quanity. Well #3 was then drilled about seven miles west of Well #1, near the same wash. This well proved up water at about 464 feet.

Well #1 is a churn drill hole 1,348 feet deep. The water strata was encountered at 645 feet from the surface and continued to 664 feet, making a total thickness of 19 feet. No more water was encountered after this strata was passed.

The water strata was tested in March and April, 1914, by an air lift pumping system for seventeen days at an average capacity of 197 gallons per minute. The water level was measured after the test and it was found that it hadn't lowered at all. This information gave the management enough confidence in the water developed to warrant the expenditure for the sinking of a shaft, which would be used to make a greater capacity test (or more severe test) of the water held in the strata, also this shaft with station is to be equipped with pumps of such capacity as will be necessary for delivering water to the Ajo Camp.

TYPE OF SHAFT

The shaft is of the vertical two compartment wooden lined type. The hoisting compartment is 4'-6" X 5' inside dimensions. The second compartment is 5' X 6' inside dimensions, this accomodated the ladderway, 3 ft. wide and the 8" water column and the electric cables. Outside dimensions of shaft are 12'-6" X 6'-4". Timbers used in framing are 8 X 8's for wall plate, and plate, studdle and dividers. 2 X 12's are used for lagging. Sets are placed on 6' centers.

Total board feet in shaft timbers, lagging, sollars, ladders and guides,_____ board feet.

TOP BEARERS

The top set of bearers are two, 24" X 24" X 30' pine timbers laid parallel to and flush with inside surface of the end plate. The bearers are built into the end construction in the usual manner.

SINKING WITH HAND WINDLASS

With bearers in place the first set was built up and the windlass stands placed on top of the set which is now the collar of the shaft 9'4" above the natural surface of the ground. Sinking from this collar was begun on April 26, 1914 with four windlass men and two muckers, (these laborers were Papago Indians), two windlass stands, and four buckets of 15 cu. ft. capacity each. With this equipment, the shaft was sunk to a depth of 112'-6", at which depth we began using the gas hoist. Average advance per day in sinking to 112'-6" was 4.6 ft.

SINKING WITH GASOLINE HOIST

The hoisting plant was put into readiness while sinking with hand windlass was in progress. The plant consisted of 22 H.P. Fairbanks Morse gas hoist with 18" X 22" drum and 3/4" cable. The head frame is of a simple wooden type, framed out of 12 X 12 and 10 X 12 timbers, vertical, height 32'6" above collar of shaft. Sinking with this equipment began May 21, from the 112'-6" level. Advance per day in the cemented clay formation was 5.24 feet and 2.76 feet in the lava.

FORMATIONS

Formations encountered while sinking were cemented clay from surface to a depth of 173 feet and lava from 173 to 663'-6", the bottom of the sump.

The cemented clay and sand was hard and dry with boulders of varying sizes embedded in it. It was drilled with hand drills and blasted.

The lava was of varying densities and color, usually red or black. The red lava constituted the principle rock. It was quite soft and full of blow holes which caused some trouble to the drills.

The black lava was hard, found in seams or bands of varying thicknesses from one foot to fifteen feet. These hard seams of lava lay about parallel, dipping from southeast to northwest at an angle from 25 to 45 degrees.

PUMP STATIONS

As soon as the shaft was completed to a depth of 651 feet, which was three feet below water level, a 7' X 7-1/2' X 8 station was cut in the south side, opposite ladder and pipe compartment, 1'-3" above the water. This station accommodates a 25 gallon electric driven pump with 2" discharge line. The suction was placed in the sump. The pump supplies water for the boilers at the power plant and domestic use.

On the north side, the large station, outside dimensions 21' X 43' X 15' was cut in the record time of 26 days. This station accommodates a 500 gallon Nordberg electric pump as a permanent installation.

NORDBERG PUMP

This pump is second handed, being shipped from Bisbee where it had been used in the Oliver shaft. It was originally designed to pump 500 gallons per minute against a head of 1800 feet. The laying of the foundation and installation began about January 12, 1915, and finished March 12, which is also the date on which work for deepening the sump began.

The pump suction was made of short lengths which were connected with flanges. The suction was disconnected at the top flange before blasting and hoisted out of the sump with block and tackle.

The pump was running continually for two shifts, three o'clock and eleven o'clock every day holding the water to a level 15 feet above the bottom of sump discharging at the rate of 160 gallons per minute at the beginning of operations and gaining continuously until 400 gallons per minute were being discharged over a weir to hold the water at about 1.5 feet above the bottom of the sump. The pump at the time was lifting water 16 feet, temperature 102 degrees F. The pump gave some trouble in the beginning and until the valve seats were changed from the brass ring to fiber. Due to these fiber valve seats can be attributed the 16 ft. lift of the pump.

DEEPENING THE SUMP

With the pump operating as stated above, drilling, blasting and mucking continued for a few hours each shift in 1.5 or 2 feet of water or as long as the pump could hold the water down to such a level that men could work.

The water at the beginning of operations came up through one small hole in the west side of sump. This later developed into a crevice the full width of the shaft. A smaller crevice developed in the east side which discharged but little water and finally disappeared. The large crevice continued on down and was apparently supplying 400 gallons per minute at the point where the sinking had to be stopped due to the fact that the capacity of the pump had been reached under these working conditions. The bottom of the sump is now 16'-6" below the floor of the station of 663'-6" from collar of shaft.

TESTS

As it was found impossible to make the sump any deeper with the present installation, orders to shut down were given and to make a 48 hour test of the water developed.

The pump was started on the test at 11 o'clock P.M., April 21, and continued without stop till 11:00 P.M. April 23. The discharge was measured with a rectangular weir, length 20 inches, which was built in a wooden launder 30 ft. long, into which the discharge pipe from the sump emptied.

The average discharge over the wier for the period of 48 hours was 400 gallons per minute. In addition to the 400 gallons, the boilers were using from 20 to 25 gallons per minute. In the wier there was considerable velocity at the point where the hook gauge was located. The additional disharge, due to velocity head, figured back from the average discharge over the weir, was about ten gallons per minute which makes the amount of water developed in teh sump to date, 430 to 435 gallons per minute.

Following is a statement of total cost to March 1st, 1915.

Total Cost of Shaft	656'-6"	$ 48,305.36
Total Cost of Station	21 X 43 X 15'	3,433.92
Total Cost of Drift	78'	439.17
	Total	$ 52,178.45

Large Worthington Pumps shut down in 1953.

Joe

New corp P to (P) 85814200

STATE MINE INSPECTOR

SEP 25 1985

September 20, 1985

Office of State Mine Inspection
705 West Wing, Capitol Tower
Phoenix, Arizona

Attention Joe Ramirez Deputy Mine Inspector

Recently my brother and I formed Arizona Stone and Mining Company.
The purpose of the company is to remove and haul decorative rock.
Currently we are removing rock from Phelps Dodge Corporation and our equipment consists of a 1979 - 931 CAT crawler loader, a 1972 5-ton dodge truck, and a 1968 Mack 10 ton truck. Please contact Larry E. Fry or Freeman Fry for inspection of equipment.

Larry E. Fry
844 jefferson
Ajo, Ariz. 85321

Freeman Fry
P.O. Box 305
Ajo, Arizona 85321

Sincerely yours,

Freeman Fry
Larry E. Fry
Larry Fry

lef

Joe

PI NEW CORNELIA (AJO) SMELTER (P)
85/8/33000

STATE MINE INSPECTOR

JUL 24 1985

1003770

MINERALS RESEARCH & RECOVERY
OF ARIZONA, INC.

4600 EAST SPEEDWAY, SUITE #60
TUCSON, ARIZONA 85712
TELEPHONE: (602) 323-3279
TELEX 165-550 (MRR TUC)

July 23, 1985

RECEIVED
AUG 26 1985
DEPT. OF MINES &
MINERAL RESOURCES

Mr. James H. McCutchan
State Mine Inspector
705 Capital Tower
Phoenix, AZ 85007

Dear Sir:

This is to advise MR&R is commencing a minerals processing operation adjacent to the copper slag pile on P.D.'s property in Ajo, AZ.

For the past couple of months we have been setting up and conducting essentially R&D activity, but we now have our first commercial order for material.

We do no actual mining, and we do not disturb any natural, pre-existing terrain or outcrop. We excavate the above surface copper slag on the P.D. slag dump. Following this we have a small crushing and wet screening operation.

We were recently visited by Mr. Joseph R. Ramirez, Deputy Mine Inspector, and are in the process of correcting certain deficiencies that were pointed out to us.

Sincerely,

Don E. Byron

Don E. Byron, President

MINERALS RESEARCH & RECOVERY OF AZ, INC.

DEB/af

NEWS RELEASE

phelps dodge Corporation Western General Offices, Office of the General Manager
Phelps Dodge Tower, 2600 N. Central Avenue, Phoenix, AZ 85004-3015 • (602) 234-8100

March 27, 1985
For immediate release
Contact: M. P. Scanlon
(602) 234-8113

Phelps Dodge Corporation's New Cornelia copper smelter at Ajo, Arizona will be shut down on April 4, 1985 for an indefinite period. Approximately 235 employees will be affected, of whom about 35 will retire or be transferred to other Phelps Dodge locations and the remainder will be laid off.

In announcing the shutdown, Leonard R. Judd, Phelps Dodge's senior vice president in charge of its western mining operations, said "The Ajo employees put forth an outstanding effort to make the smelter a viable operation, but the inherent handicaps of operating a small smelter located a long distance from the sources of concentrates were just too great to be overcome." Under these circumstances, the Company could not justify spending $5 million for particulate control equipment required to permit the smelter to operate beyond December 31, 1985.

The Ajo mine and concentrator were shut down in August 1984. When and if copper prices improve sufficiently to justify resuming production from the mine and concentrator, it is likely that the smelter would be restarted also. The plant will be shut down in a manner that will facilitate reopening. In the meantime, some of the concentrates that otherwise would have been smelted at Ajo will be smelted at Phelps Dodge's other smelters and the remainder will be sold or smelted on toll here and possibly abroad. Because of a general shortage of concentrates caused by the prolonged depression in copper prices, both domestic and foreign smelters have recently been offering to smelt concentrates on terms that are favorable to concentrate producers like Phelps Dodge.

###

NEWS RELEASE

phelps dodge Corporation Western General Offices, Office of the General Manager
Phelps Dodge Tower, 2600 N. Central Avenue, Phoenix, AZ 85004-3015 • (602) 234-8100

FOR IMMEDIATE RELEASE

Contact: M. P. Scanlon
Phoenix, Arizona
(602) 234-8100

NEW YORK, August 6, 1984 - Phelps Dodge Corporation announced today that it will suspend copper production from its New Cornelia Branch mine and concentrator at Ajo, Arizona effective Sunday, August 12. The smelter at Ajo will continue to operate, treating material from Phelps Dodge's other mines at Morenci, Arizona and Tyrone, New Mexico.

The company said that it was hopeful that the price of copper would improve sufficiently in the coming months to permit an early resumption of operations. Nevertheless, it appears certain that the shutdown will last for at least three months, the company said. Normal production from the Ajo mine and concentrator is approximately 40,000 tons of copper per year.

About 500 employees will be laid off as a result of the suspension. Phelps Dodge is considering a number of measures to cushion the impact of the shutdown on the laid-off employees and their families, including offering jobs at other Phelps Dodge locations to some of the employees affected.

In announcing the production curtailment, George B. Munroe, chairman of the company, said: "The outstanding efforts of the Ajo work force to increase efficiencies have been insufficient to overcome the effects of today's disastrous copper prices."

"Those prices are a direct result of overproduction by foreign copper producers," Munroe continued, "primarily those owned or controlled by foreign governments, which continue to export excess copper to the United States to be sold at distress-sale prices."

Many of the foreign mines and plants that are turning out this excess copper have been financed by the World Bank and other multilateral lending agencies funded in large part by the United States. "The bitter irony," Munroe said, "is that much of the money that enables these foreign producers to cause Ajo employees to lose work has been provided by American taxpayers, including the very people affected. American workers, American investors and American towns and states will continue to be victimized until something is done to curb these destructive production and lending policies."

STATE NEWS

ALABAMA

Alcoa Plans Modification of Alumina Facility. - Aluminum Company of America (Alcoa) plans an $18 million modification of its alumina facility at Mobile. This will be in addition to the 4-year, $60 million modernization and expansion project that was begun in early 1979. Part of the $18 million modification would be used to increase the metal grade alumina capacity from 2,200 tons to 2,500 tons per day by the third quarter of 1981. The modification also provides for the installation of an alumina grinding facility that will increase capacity for producing alumina chemicals and chemical products, as well as provide packaging, warehousing, and loading facilities.

ALASKA

Gold Mining in Chandalar Area. - Gold lode and placer mining operations were scheduled to start by late May on properties of Little Squaw Gold Mining Co. in the Chandalar area 200 miles north of Fairbanks. The operations are to be conducted by Jan-Drew Holdings Ltd. of Edmonton on claims leased from Little Squaw by Chandalar Development Associates.

ARIZONA

New Cornelia Molybdenum Recovery Plant. - Phelps Dodge Corp. is constructing a molybdenum recovery plant at the New Cornelia copper mine at Ajo, 108 miles southwest of Phoenix. The $2.9 million plant is to be in operation by the end of the year and is expected to recover about 800 pounds of molybdenum sulfide per day from copper concentrates that assay close to 0.4% molybdenum sulfide.

ARKANSAS

Arkansas River Tonnage Increases. - Tonnage on the Arkansas River Navigation System was up 26% to 2.4 million tons in the first quarter of 1980, and was up 4.5% over the record tonnage of 1978, according to the Army Corps of Engineers. Mineral commodities accounted for much of the increase with bauxite, coal, iron and steel, and chemical fertilizer shipments all up over 50%. The river system extends from the Mississippi River, through Arkansas, and into Oklahoma and Kansas.

COLORADO

Division of Mines Reduced. - The State Legislature has reduced the State Division of Mines staff from 21 to 6 in recognition of the fact that State mine safety inspections have been taken over largely by the U.S. Mine Safety and Health Administration.

A. T. BARR, Mgr.
New Cornelia Branch
Phelps Dodge Corp.
Ajo, Arizona

NEW CORNELIA PIMA COUNTY

New Cornelia uses about 20,000 tons of 85-90% silica flux and 5,000 tons of + 90% silica for patching (slurry) per year. Their prices are $4.00 to $4.50 silica credit plus accessory values.

LAS
Conf. Report 9-2-58

SHOVEL MAINTENANCE PRACTICES

AT

THE NEW CORNELIA MINE

by

J. A. Littrell, Assistant Pit Mechanical Foreman

PHELPS DODGE CORPORATION
New Cornelia Branch, Ajo, Arizona

AIME
ARIZONA SECTION ANNUAL MEETING
Tucson, Arizona
December 7, 1964

(Not For Publication)

SHOVEL MAINTENANCE PRACTICES AT THE NEW CORNELIA MINE

The Shovel Repair Department at the New Cornelia Mine has the responsibility of maintaining a sufficient number of shovels in operating condition to provide 22 shovel shifts per day in the production of approximately 90,000 tons of ore and waste. There are 14 shovels in service in the open pit mine. These machines vary in capacity from six to nine cubic yards and include five different models. Eight of the shovels are equipped with 6-cubic-yard dippers, three with 7-cubic-yard dippers, and three with 9-cubic-yard dippers. The ages of the shovels in the Ajo pit range from one to twenty-nine years. The oldest shovel now in operation has a production record of over 47,000,000 tons of material mined. Many different loading conditions are encountered at Ajo, ranging from the rough digging in fanglomerate stripping areas to relatively good digging in some parts of the ore body. The age of the shovels, the number of different types of machines, and the difficult digging conditions have had an important bearing on the development of the present Shovel Maintenance Program at Ajo. Discussion of this Maintenance Program can best be handled by describing the organization of the Shovel Repair Department, the selection and training of Shovel Repair Personnel, Shovel Lubrication procedures, and Maintenance Techniques.

Organization of the Shovel Repair Department

The Shovel Repair Department is under the general supervision of the Pit Mechanical Foreman and his Assistant. The scope of the work includes erection of new machines, major overhaul of old machines, current modifications, experimental testing of shovel components, and routine shovel repair jobs. Shovel repair crews performing routine repair work on the shovels in the field are under the direct supervision of the Shovel Repair Foreman.

Each shovel repair field crew is composed of four men; one repair mechanic sub-boss, one shovel repairman, and two helpers. Three such crews are currently in the field, two assigned to day shift, and one to afternoon shift. Repair crews are not assigned to the night shift. When necessary, the afternoon shift repair crew is worked overtime to provide enough shovels to operate as determined by the Shift Foreman. An attempt is made to complete essential shovel repair work on day shift for the following reasons:

(1) The work can be more closely supervised.

(2) Some jobs are more safely done during daylight hours.

(3) Shop work and hoist crews are more readily available on day shift.

(4) Less shovels are worked on day shift to accommodate blasting operations, track maintenance, and normal repair work.

Since the New Cornelia Mine is a rail haulage operation, access

roads to the shovels are occasionally rough; sometimes amounting to little more than the path a shovel has made. With this in mind, the shovel repair crews are provided with heavy duty 2-1/2-ton trucks which are rugged enough to negotiate this type road. The trucks are equipped with special beds to provide storage space for the tools and equipment needed for the large variety of repair jobs which the field crews perform.

In addition to the three field repair crews, a three-man shop crew is scheduled to work on day shift only. This crew is made up of a Shovel Repairman and two helpers. The duties of the shop crew consist mainly of cleaning and overhauling shovel parts as they come in from the field. Other duties include unloading, assembling and storing new and rebuilt shovel parts and maintaining an adequate inventory of the bolts, shafts, pins and other items necessary in day to day repair operations. The services of a machinist, blacksmith and welders are available to aid this crew in completing their repair and assembly work.

The Mine Electrical Department maintains the electrical components on the shovels and is responsible for lubricating all motor and generator bearings on a regularly scheduled program. This department is headed by an Electrician Gang Boss. Two journeymen electricians and two helpers are available to perform the necessary repair work. These men are also responsible for regularly scheduled electrical inspections of the shovels. When possible, routine electrical maintenance is planned at a time when the shovel is down for mechanical repairs. A shift electrician

is assigned to each shift and, along with his other duties, performs minor repairs as necessary to keep the shovels operating.

A two-man Shovel Repair Service Crew is scheduled to work on day shift and is assigned the task of maintaining an adequate supply of lubricants and cleaning materials on each shovel. This crew is provided with a track gang car and trailer for transportation on their regular visits to the shovels. Each morning a list of the shovels scheduled for servicing that day is presented to the Shift Foreman who determines the order in which the shovels will be serviced to interfere least with shovel-loading operations. Five shovels are normally serviced every day. The Service Crew furnishes a supply of bolts, pins, trip cables, tools and other operating supplies needed on the shovels. In addition, this crew maintains the air and grease systems, changes dipper teeth and performs a monthly lubrication of the anti-friction bearings on the shovels.

Selection and Training of Repair Department Personnel

All men assigned to do shovel repair work must have passed a mechanical aptitude test administered by the Employment Office. New men enter the department as second-class helpers and are normally assigned the job of steam cleaning shovel parts. This work familiarizes the man with the various shovel components and introduces him to the type of work done by the shovel repair crews. In this job the new man can be closely supervised by the shop foreman and given special safety training that applies more directly to the new type work he is doing. New men are provided

a code of safe practice covering shovel repair work in considerable detail. Before a man is given a permanent job in the shovel repair department, he must satisfy his foreman that he is familiar with the safe practices outlined in the code. Helpers receive further training by being assigned to the field repair crews. As their seniority and experience qualifies them, they may advance to Shovel Repairman and Repair Mechanic Sub-boss. All members of the repair crews receive additional training in monthly safety meetings and code reviews.

New men entering the shovel operating department also receive their initial training as helpers in the shovel repair operation and are taught how to make the many minor repairs to the shovel for which they will later be responsible as shovel oilers. Experience has shown that this training in the repair crews results in more capable and efficient shovel operating crews. New oilers are also given instructions by Repair Department personnel. The Shovel Repair Foreman takes the new oiler to each type machine and explains in detail the complete oiling procedure. During this period, the man becomes acquainted with all lubrication points on each of the various types of machines, the amount and type of lubricant needed at each point and the frequency of application. After the Shovel Repair Foreman has completed his instructions, the new man works with an experienced oiler for a period usually lasting five days; one day on each different type machine. The shovel operator also acts as instructor until his oiler is thoroughly

acquainted with the proper lubrication procedures.

Shovel Lubrication

The shovels are lubricated twice each shift at approximately four-hour intervals by the shovel oiler using a manually-operated grease gun. In order to help insure that all points are properly lubricated, an oiler's report is provided. On this form is listed each lubrication point, the type of lubricant to be applied, and the proper interval between applications for each type machine. The report also provides a place for the oiler to list defective grease fittings and oil lines. This report is filled out in duplicate and one copy is turned in to the Shovel Repair Department at the end of the shift and the other copy must be left on the shovel for the guidance of the oiler on the following shift. This report is especially beneficial to new oilers who use it as a guide to make sure they do not miss any lubrication point.

Centralized automatic lubrication systems have been designed and are being installed on all the shovels in an effort to improve the shovel lubrication. To date, installations are being made on six shovels, and it is anticipated that the installation of automatic lubrication systems will be completed on the remaining shovels in 1965. The centralized automatic lubrication system provides clean lubricant in measured amounts to each bearing on the machine at the desired time interval. A properly designed automatic lubrication system eliminates faulty application and waste. The system at the New Cornelia Open Pit Mine is designed as four separate

units, as follows:

(1) A grease system for the boom and upper deck.

(2) A grease system for the lower frame.

(3) An oil spray system for the open gears.

(4) A grease system for the circle rollers.

The boom and deck system is a combination pneumatic-electric system and is actuated by a control panel which can be set for the desired volume of lubricant. At a pre-set time interval, this control panel energizes an air solenoid to start the lubrication cycle. Lubricant is fed into the system through a flow meter which measures the volume of lubricant on a piston displacement basis. This flow meter is equipped with a micro-switch which supplies the necessary shut-off information to the panel. Upon delivery of the desired volume of lubricant, the micro-switch turns off the system and the panel resets itself for the next cycle. Lubricant is distributed to the individual bearings through feeder blocks of various sizes depending on the size of the bearing. Individual metering pistons in each feeder assembly work in series to insure that each bearing accepts its accurately measured share of lubricant. If any bearing fails to accept grease, a central warning signal notifies the shovel operator of a malfunction in the system.

The rotation of the upper car body in relation to the lower frame led to the design of the lower frame grease system as a separate, all electric unit. Control of the system is identical with the boom and upper

deck system. The supply lines were shielded with heavy duty angle iron at all exposed points in order to prevent rock damage and reduce maintenance costs.

The oil spray system supplies lubricant to the open gears, the point sheaves, hoist cables and the top of the dipper handles. This unit is controlled by a simple timing clock which energizes the system to provide a pre-determined spraying period every hour.

The existing design of circle roller lubrication requires a manual application through a grease fitting. This method is being replaced with a mechanical pump which is cam operated and discharges a small amount of lubricant into the system on each stroke of the cam. This pump requires an integral reservoir and is equipped with a battery-powered low level warning device. The entire unit is mounted on the inside of the circle gear and is attached directly to the circle roller bands. The pump operates when the shovel swings and can be adjusted to provide the proper amount of lubricant to the circle rollers.

The installation of the automatic lubrication system on the shovels will result in longer bearing life, lower maintenance costs, increased shovel availability, and more efficient overall shovel operation.

Maintenance Techniques

In order to have an effective maintenance program, certain basic procedures must be followed. These procedures include the following items:

(1) Equipment inspection.

(2) Reporting of defects.

(3) Scheduling of repair work.

(4) Record keeping.

The maintenance program actually begins with the daily inspections given the shovels by the operating crews. When a shovel crew arrives at a shovel at the beginning of the shift, they must give the shovel a brief but thorough inspection. Special attention is given to the condition of the boom assembly, the crawler frames, the boom heel sockets, the rotating deck machinery and the amount and condition of the tools and supplies on the shovel. Each operator is provided with a report card on which he notes the results of the above inspection. He also records any defects which may develop during the shift and which cannot be corrected by the shovel crew. This card is turned in at the end of the shift for the guidance of the Shift Foreman and the Shovel Repair Department.

The shovels are also given a complete and thorough inspection daily by the Shovel Repair Foreman. It is this very important daily examination which gives the Shovel Repair Foreman his detailed knowledge of the shovels, and allows shovel repairs to be effectively scheduled. This routine inspection reveals many defective parts which can be repaired or replaced before they fail in service. The results of this inspection are entered on a chart which is located in the Pit Mechanical Foreman's office. This record gives an up to the minute picture of the condition of all major shovel components, including the right and left crawler frames, the boom,

the upper car body, the lower car body, the hoist drum assembly and the gantry frame. Items which need immediate attention are marked in red and are scheduled for repair as soon as possible. Other items which are not so critical are scheduled for repair at a time that will least interfere with mining operations.

Each month the shovels are given a safety inspection by the unit safety secretary of the Shovel Loading Department. Many minor defects are found and reported by this inspection. The type of defects discovered by this inspection are in the nature of broken or bent hand rails and damaged guards. To date this year, 189 such defects have been reported and corrected.

Each year a survey of all the shovels is made to determine which major components should be replaced in the coming year. The results of this survey are brought to the attention of the Operating Department which uses this information as a basis for coordinating major repair jobs with mining plans.

An indispensable tool in maintenance work is the keeping of records. The variety in shovel models requires that a diverse inventory of shovel parts be kept on hand. For example, two different size dipper teeth, three different size dippers, four different size dipper handles, and five different size hoist cables. Detailed performance data is maintained on many shovel components in order that an estimate of the life and tonnage performance of these components can be made. This estimate,

based on the record, assists in judging the size and extent of the inventory which must be kept on hand in order to have an effective maintenance program. Records are also maintained on many items to determine which ones have the best operating characteristics. In this manner various parts of different manufacture are tested and compared to determine which ones perform best.

Electric shovels are the heart of the modern open pit mine. Without these giant machines, open pit mines, as we know them today, would not exist. Radical changes in shovel design have been made in the last 30 years, incorporating new features made necessary by demands on the mining industry. Electric shovels have become much larger in size and more sophisticated in controls. These improvements have created increasingly complex maintenance problems. The Maintenance Department, through experiments with new materials, and the use of new tools and labor techniques, is continually striving to solve these problems in order to increase shovel availability and reduce maintenance costs.

THE ARIZONA COPPER CO. (Ajo) **Report of the Governor** Pima Co. 1877

The present plan of the Arizona Copper Company consists of four smelting furnaces, having a capacity of 400 tons per day; one sulphuric acid plant, capacity 8 tons per day; one siliceous ore concentrating plant, capacity 180 tons per day, and one sulphide ore concentrating plant with a capacity of 150 tons per day. The output of this company five years ago was equal to about 6,000,000 pounds of copper per year; in 1895 it had almost doubled, amounting to 11,500,000 pounds, and last year topped all of its previous records by producing 13,000,000 pounds. At this time over half the output is made from concentrating and leaching ores. The original owners could not treat anything less than 20 per cent ore. Today ores as low as 3 per cent in copper are treated with profit. With the assistance of the Bessemer plant, now being put in position, a slightly larger output may be expected. The mines, however, are not being strained by immense daily outputs, the owners, like the owners of other Arizona copper mines, preferring that the mines should be treated as permanent and enduring enterprises, to the end that time may be given for development of the large undeveloped territories tributary to them.

1899 The Arizona Copper Co. (Ajo)

The Ajo mine was located in November, 1854, by a party of Americans from California. The organization was known as the Arizona Copper Mining and Trading Company. Maj. Robert Allen, U.S.A. deputy quartermaster-general of the Department of the Pacific, was the president of the corporation, and J. Downer Wilson, of San Francisco, was secretary and treasurer.

At that date the present boundary line between Sonora, Mexico, and the territory of the United States had not been determined, and its position was not ascertained until the following year, 1855.

As soon as the region began to be occupied by citizens of the United States and work commenced on the Ajo mines, these mines were claimed by several wealthy residents of Sonora as being within Mexican territory. In the month of March, 1855, a Mexican company of cavalry was sent from the district of Altar and from Ures, the capital of Sonora at that time, to dispossess the Americans, to capture them, and take them to Ures as prisoners. But the miners refused to go and defended their position. With only 9 men against 110 dragoons and vaqueros, the mine was successfully held and the Mexicans were dispersed. For six months after this nothing was done beyond mere prospecting, but in the fall of the year 1855 the boundary line had been run, and it was found that the Ajo mining camp was at least 40 miles inside of the boundary on the U.S. side. Edward E. Dunbar, one of the pioneer residents of San Francisco, was then made the superintendent of the property and work was resumed in a formal manner. The mining locations, of which there were 17 made in that year, all had some work done on them. In the meantime 10 tons of selected ore had been taken from Shaft No. 1. This ore consisted of red oxide of copper. It was shipped to Swansea and was sold for a little less than $400 per ton. There were several hundred tons of sulphurets of copper extracted from the different workings. The principal portions were in a limestone formation, but the richest ores were all found near where the first work was done and were in porphyry.

"The company attempted to transport the ore to San Francisco and thence around Cape Horn to Europe, but the costs were so great that their plan of transportation had to be abondoned. For the first year, on every pound of ore transported from the mine by way of Yuma to San Francisco the freight alone amounted to 9 cents. A reverberatory furnace was built at a cost of over $30,000, and not as much as 100 pounds of copper was ever produced in it. Finally, after several years of great expenditure, the company ceased operations. The property was left in charge of a keeper shose claim for services amounted to $5,000, and the property was sold at sheriff's sale."

PREPRINT NO. 59A079

SOCIETY OF MINING ENGINEERS
of AIME
29 WEST 39TH STREET NEW YORK 18, N.Y.

DRILLING METHODS AND EQUIPMENT AT NEW CORNELIA OPEN PIT MINE

John E. O'Neill
Assistant Mine Superintendent

Phelps Dodge Corporation
New Cornelia Branch
Ajo, Arizona

This paper is to be presented at the Annual Meeting of the American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., San Francisco, February 15 to 19, 1959.

DRILLING METHODS AND EQUIPMENT AT NEW CORNELIA OPEN PIT MINE

by: John E. O'Neill 59A079
Assistant Mine Superintendent
New Cornelia Branch
Phelps Dodge Corporation

INTRODUCTION

Description of Operation: The New Cornelia Open Pit Mine of Phelps Dodge Corporation is located at Ajo, Arizona. Large scale open pit mining operations were started at Ajo in 1917, and during the past 42 years 216,000,000 tons of copper ore and 210,000,000 tons of waste rock have been mined. The current daily rate of production is 31,000 tons of ore and 46,500 tons of waste.

The pit is roughly elliptical in shape, extending 5,100 feet from north to south and 4,600 feet from east to west, and covering an area of 388 areas. The depth below the average rim elevation is 640 feet. At present, there are 14 active mining levels, each designated by its sea level, elevation. The bottom level is at an elevation of 1220 feet, and the top-most active level is at 1693 feet.

Material to be mined is broken by blasting large diameter blast holes to a free face on 33 or 40-foot banks. The width of the mining benches varies from a minimum of 80 feet up to several hundred feet. Full-revolving electric shovels, equipped with either 6, 7 or 9-cubic yard dippers, are used to load the material into 30-cubic yard side dump, standard-gauge railroad cars, each car holding approximately 63 tons. Haulage over ruling three percent grades, adverse to the loads, averages 4 miles to the crushers and 3-3/4 miles to the waste dumps. Seven-car trains are hauled by 125-ton locomotives or 1800 h.p. trolley-electric locomotives equipped with Diesel auxiliary power for operation over non-electrified tracks. Train haulage is supplemented by some truck haulage with the use of 25-ton capacity, single rear axle, dump trucks.

Geology and Structure: The New Cornelia ore body is a disseminated copper deposit occurring almost wholly in quartz monzonite porphyry, but to a lesser extent in diorite, a border facies of the monzonite, and also in rhyolite which encloses part of the intrusive stock. The ore body in the south portion of the pit is overlain by a tough, blocky sedimentary deposit called fanglomerate, that presents a drilling problem separate from that of the ore body. Present mining operations are conducted, therefore, within a range of different rock types; and it is these rock formations with their variable physical characteristics which have led to the development of the drilling techniques used at Ajo.

In the porphyry areas, the monzonite and diorite are brittle and have numerous shatter cracks. The rhyolite is similar to hard monzonite and is somewhat more abrasive and harder to break. Good fragmentation of the material is achieved in these formations as long as a powder factor commensurate with the hardness of the rock is used. While all the material is considered hard, there is a wide variation in drill-ability between the different formations as well as between different phases of the same formation. For comparison of drilling and blasting results, the material is classified as hard, medium, and soft. The designation of the different hardness areas is influenced mainly by drill efficiencies in the respective areas. Currently, approximately two-thirds of all tonnage mined is from these formations, and the remaining one-third is removed from the fanglomerate formation in the mine.

STORY OF NEW CORNELIA

For the last five years the New Cornelia mine at Ajo has been producing copper at the rate of over one hundred and thirty million pounds, annually, and has been second only to Morenci among the Arizona copper producing companies. Ajo is situated in low mountains in extremely arid desert country. By road it is 42 miles south of Gila Bend and 132 miles west of Tucson.

History *

It is claimed that the first mining of copper by Americans in Arizona was done at Ajo in 1854. The first shipment of ore, consisting of native copper and cuprite (an oxide of copper containing, when pure, 88.8% copper) came from what is now the Eastern end of the New Cornelia workings. It was hauled in ox-carts(1) to San Diego, 400 miles across the desert; later shipments were made only as far as Yuma; whence they were shipped to Swansea, Wales, for smelting.

The mine at Ajo, known successively as the Cornelia(2) and the New Cornelia, passed through the usual vicissitudes of fortune until in later days improved mining and metallurgical methods, preceded by diamond-drilling, created conditions favorable to the large scale exploitation of low-grade ore. Several companies and several distinguished engineers failed to bring the enterprise to fruition until, in 1911, on the initiative of John C. Greenway and the recommendation of Ira Joralemon the Cornelia mine passed into the possession of the Calumet and Arizona Mining Company. Greenway, aided by Louis D. Ricketts, as consulting engineer, made a complete success of the

---

* The story of Ajo has been recorded by Rickard in "A History of American Mining", by Parsons in "The Porphyry Coppers", by Joralemon in "Romantic Copper", and in U.S. Bureau of Mines Bulletin #405.

(1) Tom Childs says mules and horses were used.

(2) Named in 1900 for John Boddie's wife.

venture. As the oxidized material had to be removed before the sulphide ore could be mined, they started a series of experiments in 1912 to determine whether such such oxidized material could be beneficiated profitably by some simple leaching process. The tests were made by James Potter and Henry Tobelmann, and after a one-ton plant and a 40-ton plant were operated, a 5,000-ton plant was built in 1917 and proved completely successful. Two years later, in 1919, an experimental mill was built to test the treatment of the sulphide ore by flotation. Then came the erection of a flotation plant of 5,000-tons capacity, designed by H. Kenyon Burch. This plant started in 1924. By later remodelling, the tonnage has been stepped up to 29,000 daily capacity. These large-scale operations would have been impracticable if an ample supply of water had not been obtained. This was accomplished by sinking a two-compartment shaft 650 feet deep at a place six miles distant, where the water-table of the region was tapped originally by two pumps, with a combined capacity of 1,500 gallons per minute, and ultimately by five pumps with a combined capacity of 5,550 gallons per minute delivered to the reservoir at the mine against a total head of 1,375 feet. Without an adequate supply of drinking water for the large force of men employed and without plenty of water for metallurgical purposes, the New Cornelia enterprise would have been impossible. The finding, pumping, and distribution of this ample supply of water are not the least of the many engineering features that characterize this successful undertaking in the southwestern desert.

In July 1917, the New Cornelia Company acquired the property of its neighbor, the Ajo Consolidated Company. The Ajo property had been purchased in 1912 from the Randall Ore Reduction Co. by Briggs and Gaskill for James Phillips, Jr. Diamond drilling was started in 1913 by E. J. Longyear & Co., and in due course 12,845,026 tons of 2 percent ore was proved. When the New Cornelia acquired

the property the assured tonnage had increased to 21,000,000 tons of 1½ percent ore. The diamond drilling on the consolidated property was continued until 59,000,000 tons of 1½ percent ore had been proved. In November 1918 the New Cornelia paid its first dividend. In 1929 it was merged with the Calumet & Arizona, and in 1931 it became the New Cornelia Branch of the Phelps Dodge Corporation. The leaching plant was abandoned in 1930 after treating 16,812,324 tons of 1.355 percent ore, from which about 345,000,000 pounds of copper had been recovered. The New Cornelia Copper Co. from 1918 to the time of its absorption by the Calumet & Arizona in 1929 paid $18,630,000 in dividends. Operations were suspended early in April 1932 until July 1, 1934. In July, 1950, an eight million dollar smelter at Ajo began to treat the New Cornelia concentrates which had hitherto been shipped to Douglas.

Geology and Ore Body *

The ore body occurs almost wholly in monzonite porphry which has intruded into volcanic lavas and tuffs. Some of the volcanic rocks are also considerably mineralized. The ore body is crudely elliptical in shape, about 3,600 feet long by 2,500 feet across. The average thickness is 425 feet, and the maximum about 1,000 feet. The primary ore consists chiefly of chalcopyrite, with bornite and a little pyrite, and these minerals are distributed both in veinlets and in grains scattered through the altered monzonite.

The ore body was oxidized to a surprisingly level plane near the present water table, at an altitude of about 1,800 feet. Except for local variations of as much as 50 feet, the transition from sulphide to the oxidized zone was about as sharp as could be mined by steam shovel. The depth of oxidized ore ranged from 20 to 190 feet, with an average of about 55 feet. The minerals of the oxidized ore were malachite with a little azurite and cuprite. A little

---

* Described in Arizona Bureau of Mines Bulletin #145, pp 87-89. Also Bureau of Mines Information Circular 6666 written by Geo. Ingham and A. T. Barr.

chalcocite occurs close beneath the bottom of the oxidized zone.

The fact that in most of the ore body the tenor of ore was essentially the same in oxidized and subjacent sulphide ore seems to show that there was little migration of copper during weathering but that the sulphides were oxidized in place. In this respect the Ajo ore body differs from the other great disseminated deposits of the Southwest, in each of which supergene chalcocite enrichment was essential to the production of commercial ore.

Mining, Leaching and Concentration

The deposit is mined by open-cut method, with power shovels operating on benches at vertical intervals of 40 feet. Inasmuch as the oxidized part of the ore body was practically as productive as the sulphide part, there was no stripping problem of the sort confronting most of the disseminated deposits of the southwest. To January, 1931, less than 7,000,000 tons of waste had been moved in the mining of 32,400,000 tons of ore, a ratio of 0.21 tons of waste to 1 ton of ore. Much of this waste occurred within the ore body and was not overburden. As the depth of the pit increased, however, a larger proportion of waste had to be moved in order to maintain a safe angle of slope.

Doubt as to the possibility of successfully treating the oxidized overburden had helped discourage J. Parke Channing and Seeley W. Mudd when they were considering separate parts of the property in 1909 and 1910. Dr. Ricketts has stated the essence of the problem that faced him and Greenway in the following short paragraph:

> "Greenway drilled the great ore deposit in 200-foot squares and about 50,000,000 tons of sulphide ore containing about 30 lbs. of copper on a 20-lb minimum were developed. This ore was capped with some 10,000,000 tons of granitic material containing the same amount of copper in the form of malachite and chrysocolla. There was no known method of treating such lean oxidized material. The steam shovel was best adapted to mining the sulphide ore, but even so it was estimated that it would cost, with interest, $5,000,000 or $6,000,000 to remove the overburden and throw it away. If, however, a process for treating this oxidized overburden profitably on a large scale could be devised, a large liability would be converted into a much larger asset."

It was easy to dissolve a substantial proportion of the copper contained in a few grams of ore with dilute sulphuric acid in a test-tube; and that the copper could be precipitated on scrap iron or by electrolysis was equally certain. But it took a great deal of painstaking experiment and research to prove that a commercial process for handling 5,000 tons of ore per day would be a success. This work, which continued from 1912 until 1916, finally developed a design for a large-scale plant, which accomplished what it was designed to do from the very start. Virtually no changes in equipment nor modification in procedure were found necessary. For example, during the first full year of operation, the leaching plant at Ajo averaged 5,000 tons per day with a recovery of 81 percent of the total copper content of the ore and 84% of the soluble copper.

The sequence of events from the standpoint of ore treatment, has been just the reverse of that at Inspiration, in that at Ajo the leaching plant has finally given way to a concentrator instead of largely displacing a concentrator.

This concentrator, for treating the sulphide ore, originally had a capacity of 5,000 tons per day, and was put in operation during 1924. For six years both leaching plant and concentrator were operated. During 1928 and 1929 three additional units were constructed, essentially duplicating the five older units except that the rod mills used to crush the ore were longer. Balls replaced the rods in 1934, and in 1935 all mills were speeded up. This change, in conjunction with additions to the intermediate crushing plant, increased the capacity from 8,000 tons per day to 16,000 tons. It is now capable of handling 29,000 tons. The plant has kept up to date in its equipment, and continues to be among the leading concentrators in the country.

Well designed feeders and conveyor-belt systems for moving the ore from one machine to another; electric cranes to facilitate the repair of equipment, and a modern installation of dust-collecting equipment are features of the plant. The gyratory crusher, which eats up chunks of ore as big as can pass through the

dipper, weighs more than 40 tons. A crane large enough to lift this machine is necessary to permit rapid repair work. Individual electric motors for the operation of each piece of equipment is a feature, as is also the use of machinery and devices for the automatic control of operations to the end that the requirements for labor are minimized. Entirely aside from the town itself, from the power plant, the leaching plant and various shops and auxiliaries, the concentrator and crushing plant represent an investment of almost seven million dollars. The new smelter at Ajo, constructed at a cost of over eight million dollars, began operations in 1950 and resulted in the saving of many hundreds of thousands of dollars annually in freight charges.

The New Cornelia enterprise has produced 3,156,000,000 pounds of copper from 200,146,000 tons of ore, up to January 1, 1957. This production, together with gold and silver values, had a gross value of 625 millions of dollars. As stated before, New Cornelia paid its first dividend in 1918, and from that time to the time of its absorption by Calumet & Arizona Mining Company in 1929, the company had paid $18,630,000 in dividends and had produced 620,000,000 pounds of copper. Its subsequent earnings have not been published separately from the total earnings of the Calumet & Arizona, and the Phelps Dodge Corporation, but based upon the early dividends, which averaged three cents per pound of copper produced, it may be conservatively estimated that the mine has earned $94,000,000 in dividends from 1918 to 1956 inclusive. In addition, it has ploughed back many more millions of dollars for additions to, and improvements of plant equipment. The company has about 1,400 employees on its payroll. It has built about 800 homes for its employees, and the taxes which the company has paid, have provided an excellent school system for the children of the community. The company also maintains a first class hospital for the community. Ajo is an unincorporated town with a population of slightly under 7,000 persons, and the livelihood of all these

(Ol Loss File)

May 1979 KJ

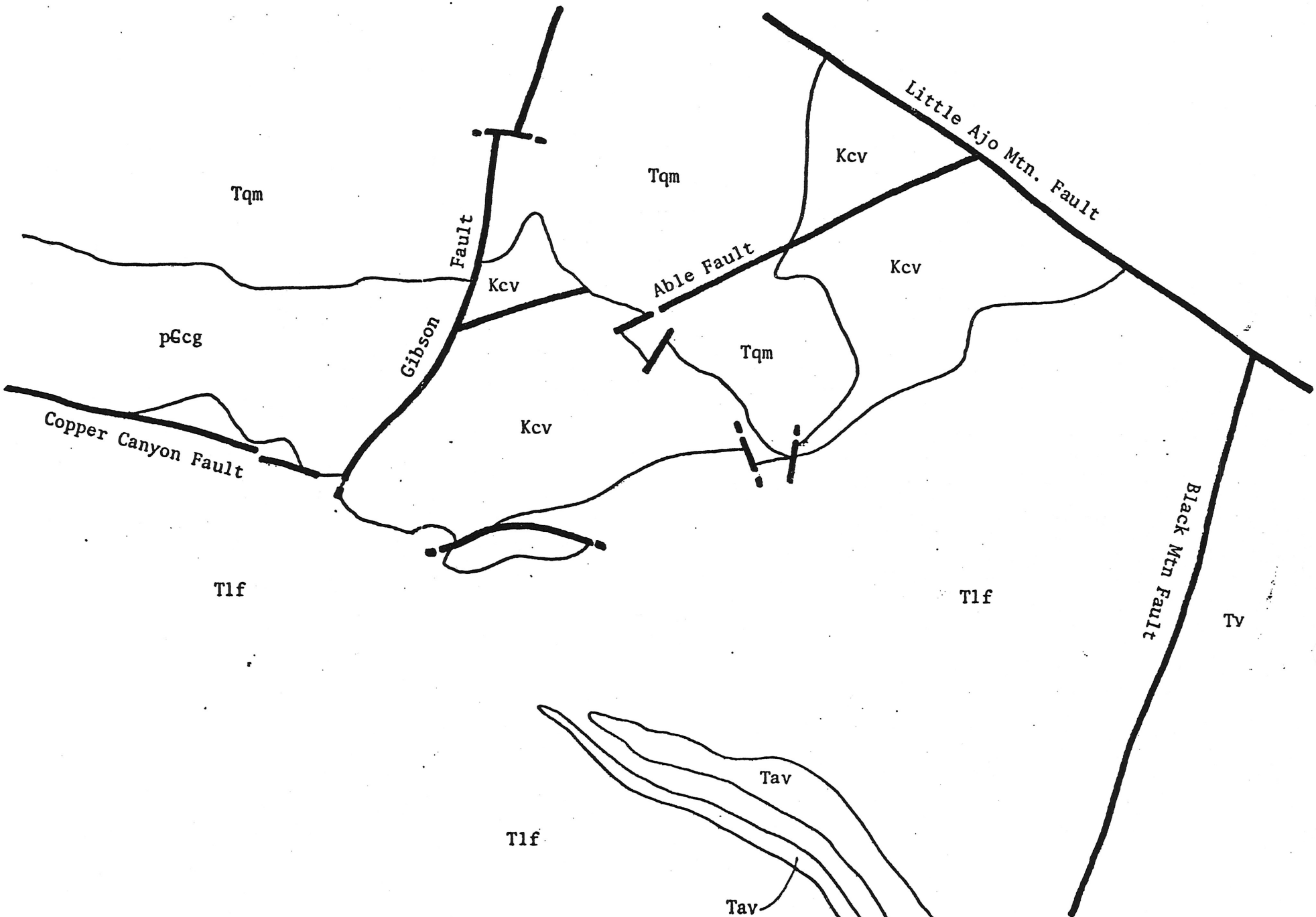
GEOLOGY OF THE NEW CORNELIA MINE
AJO, ARIZONA

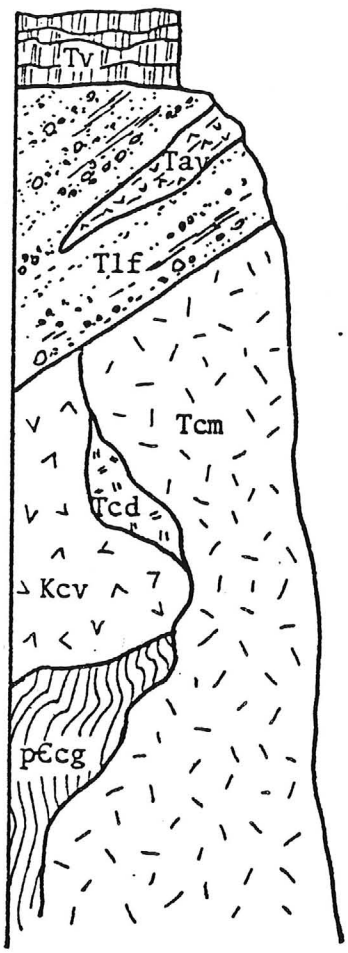
The New Cornelia Mine is one of Arizona's larger porphyry copper depoits. It differs from many of the others by having had negligible overburden covering the original ore body, very little secondary enrichment and two different types of ores. The original ore body was exposed at the surface as rich carbonate ore, mainly malachite. It was underlain by the primary sulfide ore body of chalcopyrite and bornite. A very thin enriched zone of chalcocite lies between the two, but is not a significant ore zone. Both the carbonate and the sulfide ores required the perfection of metalurgical techniques before they could be mined.

Mineralization accompanied the laramide intrusion of the Cornelia stock into pre-Cambrian gneiss and Cretaceous Concentrator volcanics. The stock is mainly composed of quartz monzonite and quartz diorite in the vicinity of the mine. Mineralization occured as quartz-sulfide veins and as disseminated sulfides. The most important veins are quartz-anhydrite-feldspar-chalcopyrite-bornite, quartz-chalcopyrite-bornite and quartz-chalcopyrite-bornite-molybdenite. Veins range in size from a few inches to hairline cracks. Many of the smaller veinlets form a stockwork. Mineralization is usually confined to the intrusive rocks and a small part of the Concentrator volcanics.

Most all rocks exposed in the mine area show the effects of one or more types of alteration. Pervasive deuteric-propylitic alteration is often accompanied by phyllic and or potassic alteration which are largely vein controlled.

Complex faulting and basin and range tilting followed mineralization. The ore body was severed from the main stock, exposed to erosion and oxidation and then buried to be exposed again.


Tqm
Tqm
Kcv
Little Ajo Mtn. Fault
Gibson Fault
Kcv
Able Fault
Kcv
pGcg
Tqm
Copper Canyon Fault
Kcv
Tlf
Tlf
Black Mtn Fault
Tv
Tav
Tlf
Tav



Tv - late Tertiary flows and flow breccias of andesite, latite and basalt, unconformably overlies Tav and Tlf

Tav - Ajo volcanics, intercalated with and overlying Tlf, andesitic flows and tuffs

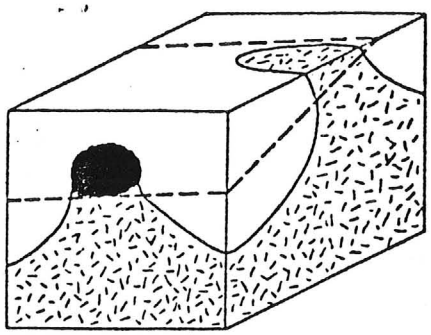
Tlf - Locomotive fanglomerate, early to mid-tertiary boulder conglomerate to arkose and shales, monolithic breccias, unconformably overlies Kcv and Tqm

Tqm - Cornelia quartz monzonite, about 62 million years, the Cornelia stock contains rock types ranging from granite thru tonalite and diorite, quartz monzonite(Tcm) and quartz diorite(Tcd) dominate in the orebody, intrudes Kcv and pCcg

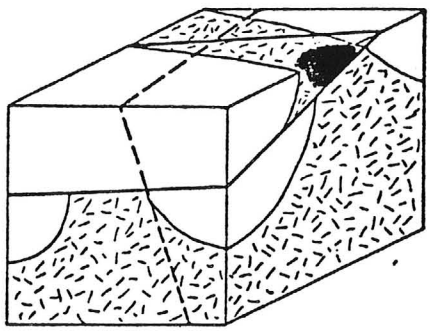
Kcv - cretaceous Concentrator volcanics, metamorphosed andesite, dacite and rhyolite flows, tuffs and breccias, unconformably overlies pCcg

pЄcg - pre-cambrian Cardigan gneiss, quartz-feldspar-mica gneiss, basement rock

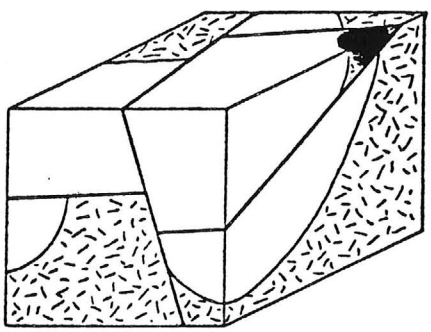
GEOLOGIC UNITS FOUND IN THE NEW CORNELIA MINE AREA



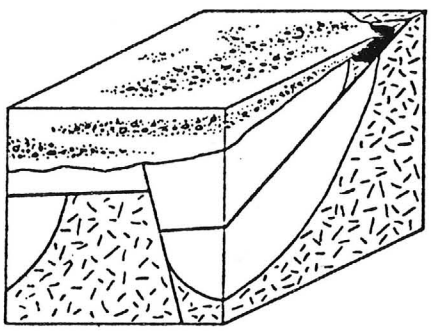
1. Laramide intrusion of Tqm into older rocks accompanied by copper mineralization, dashed line is Able fault.



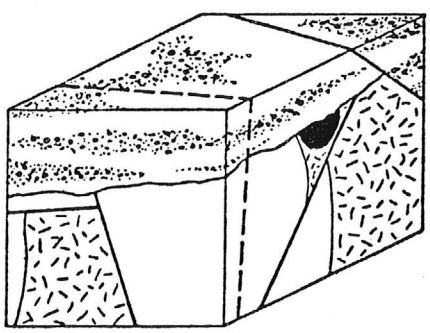
2. Able fault thrusts orebody 5-10,000 feet to the northeast, dashed line is Gibson fault.



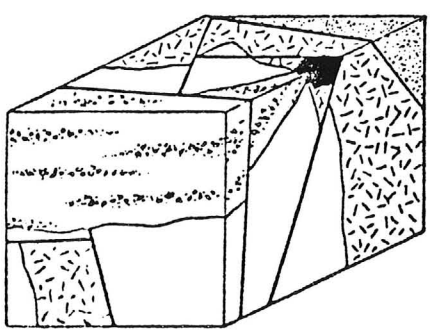
3. Gibson fault drops east side down about 3000 feet, the orebody is partially oxidized and eroded, a secondary enrichment blanket of chalcocite forms.



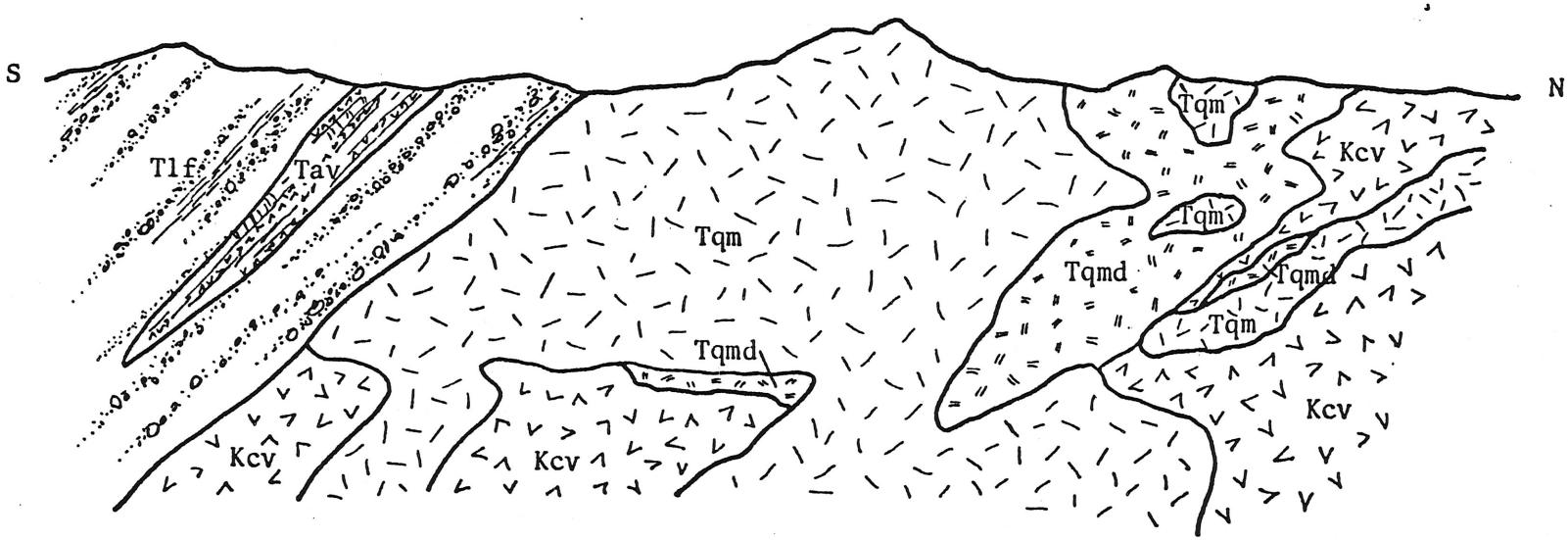
4. Locomotive fanglomerate is deposited and the oxidation and erosion of the orebody is halted.



5. Block tilting, 45° S-SW, Little Ajo Mountain fault drops north margin of Little Ajo Mountains, dashed line is Copper Canyon fault.



6. Copper Canyon fault drops south side down, erosion removes much of the fanglomerate, present conditions are reached.



GENERALIZED N-S CROSS-SECTION THRU THE NEW CORNELIA OREBODY

Tlf - Locomotive fanglomerate

Tav - Ajo Volcanics

Tqm - Cornelia quartz monzonite

Tqmd - " " diorite

Kcv - Concentrator volcanics