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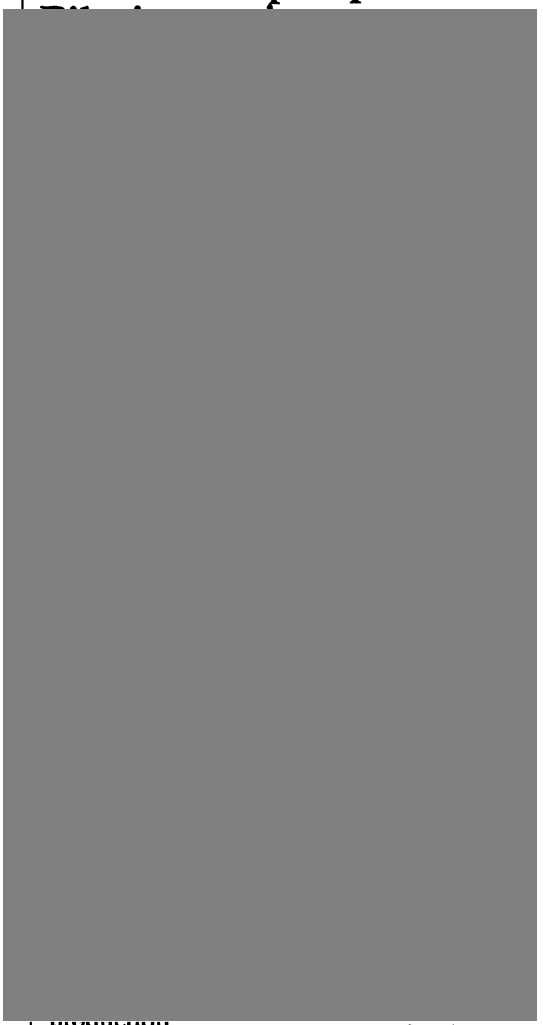
Mohave

Mohave steps up



Northern Miner, May 1, 1988

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INFORMATION CIRCULAR

DEPARTMENT OF THE INTERIOR - BUREAU OF MINES

MINING AND MILLING METHODS AT THE PILGRIM MINE, CHLORIDE, ARIZ.[1]

By Earl F. Hastings[2]

CONTENTS

	Page		Page
Introduction	1	Milling methods	8
Acknowledgments	2	General	8
History	2	Breaking and crushing	9
Geology	2	Grinding	9
Mine-surface equipment	4	Flotation	10
Prospecting and exploration	4	Concentrate treatment	11
Mining methods	5	Tailings disposal	12
Development	5	Sampling	13
Costs	6	Metallurgical data	13
Stoping	6	Milling costs	14
Costs	8	Power	14
		Water	15
		Assaying	16
		General costs	16

INTRODUCTION

The Pilgrim mine, operated by the Pioneer Gold Mining Co., is 9-1/2 miles west of Chloride in the Pilgrim mining district on the eastern slope of the Black Mountains, or River Range, Mohave County, Ariz. In March 1937, 100 tons of gold ore per day were being mined and milled at the property by a total force of 54 men.

Climatic conditions allow year-round operations. Due to present activity in the county there is an ample supply of labor for the requirements of the mine.

The Pilgrim is the only producing property within a radius of 6 miles; recently, however, the South Pilgrim Mining Co. has launched a development campaign on claims that adjoin the Pioneer Co. property to the south.

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[1] The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is used: "Reprinted from U. S. Bureau of Mines Information Circular 6945."

[2] Manager, Pioneer Gold Mining Co., and one of the consulting engineers, U. S. Bureau of Mines.

Zvb

Production from the Pilgrim mine was 26,000 dry tons in 1935 and 29,304 dry tons in 1936. Working time in 1936 was 19,381 man-shifts in 350 days.

ACKNOWLEDGMENTS

Acknowledgment is made to M. C. Richardson, mine superintendent, T. N. Slaughter, mill superintendent, and B. E. Charles, geologist, for their assistance in gathering special information requested by the writer.

HISTORY

The Pilgrim mine was located in 1903 by Dempsey and O'Dea; by 1907 the main shaft had been sunk to a depth of 360 feet, a small amount of drifting and crosscutting done, and a few tons of high-grade ore shipped. From 1907 to 1928 the mine was idle except for a little spasmodic development work. In 1928 M. C. Richardson, the present mine superintendent, took a lease and bond on the property and mined and milled a small tonnage of high grade ore. In 1933 the Pioneer Gold Mining Co., controlled by B. A. Laselle of Los Angeles, took a lease and bond on the property and developed it until 1934, when a flotation mill was built. Until November 1935 operations were irregular, owing to mechanical difficulties in the mill and power house. The installation of a new Diesel plant and complete revision of the mill flow-sheet solved both the mechanical and metallurgical troubles.

GEOLOGY

The River Range extends in a general north and south direction along the Colorado River for about 100 miles. Scattered mineralized areas containing commercial ore occur along its whole length, the most notable being the Oatman, Katherine, Pilgrim, and Klondyke districts.

Rocks in the vicinity of the Pilgrim mine consist of uptilted blocks of closely related volcanic flows and tuffs that dip toward the east at angles ranging from 10 to 20°. This series of flows and ash is intruded at irregular intervals by rhyolitic and basic dikes.

The veins so far developed follow a well-defined shear zone that runs along the center lines of the Mayflower, Pilgrim, and Plymouthrock claims; the strike is north 30 west and the dip 30° to the west. The hanging wall of the shear zone is a well-defined and persistent streak of red gouge that ranges in thickness from a few inches to 4 feet; beyond this efficient dam no mineralization has been found other than drag within the gouge itself. Soft rhyolitic flows and latite predominate behind the red wall. (Fig. 1.)

The foot wall of the shear zone is not well-defined. Roughly, it is andesite but has been influenced by a series of north-striking, steep-dipping, minor shear zones that cut through the foot wall and, in some places, filter on through to the hanging wall. These minor faults, at the intersection on acute angles with the major fault, show noticeable enrichment along the foot wall; and where filtration to the hanging wall occurs, a large, low-grade ore body is found from wall to wall. The foot wall is complicated further by rhyolite intrusions.

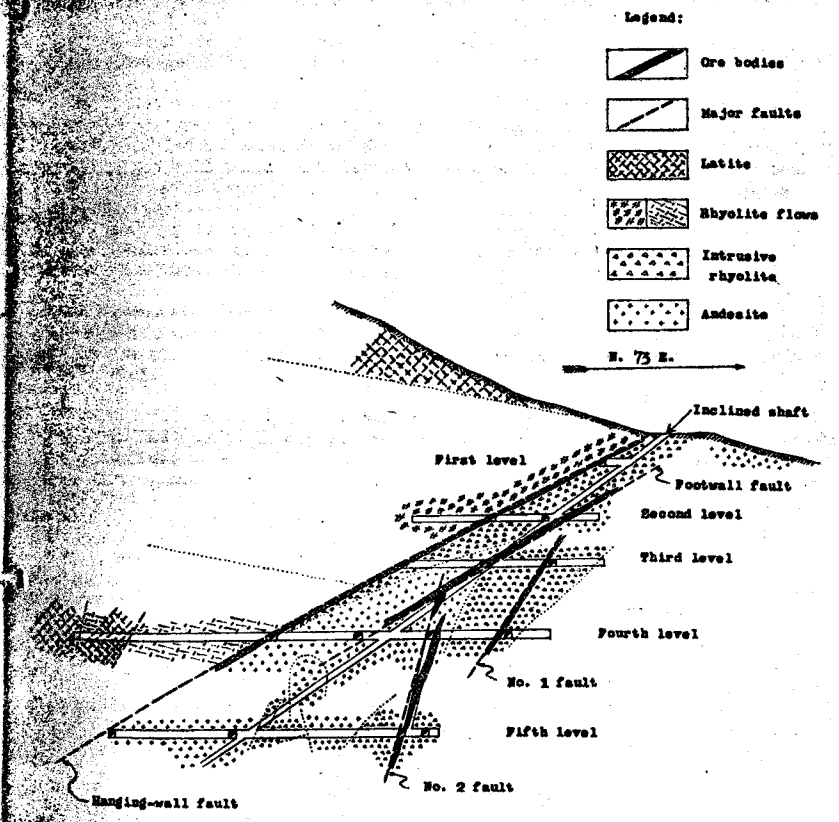

Figure 1.- Typical vertical cross-section at main shaft, Pilgrim mine, showing relation of ore bodies to structure. Scale, 1 inch equals 100 feet.

[illegible] north-striking, steeper-dipping minor shear zones are credited with [illegible] the main shear zone. Five of these feeders, as they are called, [illegible] traced on the surface, and two developed by drifting underground, [illegible] a series of rich quartz stringers with barren andesite or rhyolite [illegible] making a width in all of 4 to 22 feet. The quartz stringers range [illegible] less than 1 inch to 24 inches in width and contain up to 1,000 ounces [illegible] per ton. Ore broken from stoping these stringers over an 8-foot [illegible] has averaged 1.75 ounces gold.

[illegible] vein material between walls is a breccia and fragments of the underlying [illegible]. The distance between walls varies with depth but averages about 60 [illegible] Commercial ore bodies 3 to 18 feet in width are found along each wall. [illegible], the wall rocks have little influence on ore deposition other than [illegible] their structural capacities as host rocks. At the present mining horizon [illegible] deposits are found more in the rhyolites than in the andesites, [illegible] the capacity of the latter to support open fissures or solution [illegible]. Andesites in the Oatman district are much harder than those so [illegible] encountered here and are structurally suitable as host rocks for commercial ore bodies. It is expected that with more depth this will be true [illegible] the Pilgrim, also, as the andesites in both localities are similar in [illegible] respects. At the Pilgrim, however, about 1,800 feet of flows and [illegible] must be penetrated before the geological horizon of the Oatman district [illegible] be reached.

Gold and silver are the only commercial metals found in the district, [illegible] occur in the approximate ratio of 1 ounce of gold to 1 ounce of silver. [illegible] gold is free; some of it is slightly tarnished. Small quantities of [illegible], pyrite, chalcopyrite, tetrahedrite, sphalerite, and marmatite can [illegible] identified by microscopic examination. Quartz is the predominating gangue [illegible].

Three definite types of ore and variations of each are encountered in [illegible] mine; their occurrence is not limited to any given locality, and they do [illegible] always occur singly:

1. Quartz-rhyolite breccia, in which the quartz is of either the fourth [illegible] fifth stage,[1] being either waxy yellow, in the fourth stage, or waxy green, [illegible] the fifth stage, with primary values predominating but with secondary [illegible] values in the cleavages of both quartz and rhyolite.

2. Quartz-rhyolite breccia, in which the quartz is of the fifth stage [illegible] only and has primary values of very fine gold disseminated throughout the [illegible] quartz. No secondary values are found. The fifth-stage mineralization, which [illegible] the richest, predominates in the breccia.

[1] Five stages of quartz have been identified by Ransome in the Oatman-Kingman district.
Ransome, F. L., Geology of the Oatman Gold District, Arizona. A preliminary Report: U. S. Geol. Survey Bull. 743, 1923, 58 pp.

3. Calcite-quartz breccia, with variations of calcite replaced by quartz and spar.

MINE--SURFACE EQUIPMENT

The mine has a complete surface plant. All equipment is in excellent mechanical condition and is well-housed.

The hoist is a single-drum Denver Engineering Co. unit, gear-driven by a 75-horsepower electric motor; it hoists a 1-1/2 ton skip at a speed of 450 feet per minute. The skip has sealed Hyatt bearings and an automatic dump.

Compressed air is supplied by an Ingersoll-Rand Imperial type 10, two-stage compressor with a capacity of 677 cubic feet per minute. A 104-horsepower motor supplies power through a short-center, endless leather belt. A second unit, consisting of a 325-cubic foot, electrically driven Chicago Pneumatic compressor, which is housed in the hoist house, is available in emergency. A 350-cubic foot Chicago Pneumatic N-50 compressor driven by an oil engine, which was purchased before enough electrical power was available, is in the power house. It is connected with the main air lines in readiness for an emergency.

The blacksmith shop is 70 feet south of the main shaft. It is equipped with an Ingersoll-Rand tool sharpener, punch, oil furnace, and usual shop equipment. Approximately 200 crossbits are sharpened per day. Steel and tools are transported from the shaft collar to the shop on a small flat car with a minimum of time and effort.

A spacious change house equipped with hot and cold showers is 50 feet north of the shaft. Other buildings include a framing shed, warehouse, engineering office, and general office.

An electric-bell system is used in the shaft. The magnetic coil and control for the system, which was built by the plant electrician, are in the hoist room. This system is interesting in that it makes use of Ford starter buttons for push buttons on the levels. The starter buttons, as purchased, are dismantled and reassembled with heavier insulation to accommodate 110 volts. A three-wire transmission line of No. 12 rubber-covered wire is strung down the shaft; it serves both the station-lighting and signal systems. This unit is simple, cheap, and effective.

PROSPECTING AND EXPLORATION

Detailed geological maps recently completed do not permit orderly interpretation. Geological study indicates that ore deposition, structural conditions or faulting are not systematic. Reliance cannot be placed upon projection of ore bodies or faults from one level to the next because of intervening local movements. More often than not successive vertical cross-sections at 50- or 100-foot intervals do not appear to be sections of the same mine.

[illegible] condition seriously complicates prospecting; the direction of each [illegible] round in a heading is governed by the geological evidence disclosed [illegible] previous one. Wherever possible the policy of "follow the ore" is adhered to. In general, prospecting is confined to the major fault zones along [illegible] which a drift is run; then at intervals diamond-drill holes are used as [illegible]. The diamond drill is used solely for locating quartz, and little [illegible] attention is paid to the assay of the core of sludge. A small drill [illegible] a 3/4-inch core is used; all work is done on a contract basis at a [illegible] of $1.65 per foot.

MINING METHODS

Development

The mine is developed by numerous pits and shafts along the 4,500 feet of [illegible] exposure. The main shaft is in the center of the Pilgrim claim, and [illegible] drifts have been run into the end line claims to both the north and [illegible]. This shaft has been sunk to a depth of 575 feet on an incline of 37°; it starts at the hanging wall on the surface but, having an inclination steeper [illegible] the vein, cuts the foot wall near the third level. Stations have been cut [illegible]-, 150-, 263-, 354-, and 500-foot levels, with drifts along one or both [illegible] on each level.

The main shear zone as well as a few of the minor ones have been exposed [illegible] feet of shafts, 950 feet of raises, 1,875 feet of crosscuts, 5,100 feet [illegible] drifts, and 360 feet of winzes. All these workings are connected with the [illegible] shaft. In addition, a 100-foot shaft with a 25-foot crosscut was sunk [illegible] develop an indicated ore body on the Water Witch claim about 1,500 feet [illegible] of the main shaft. Drillings from a 6-inch water well assayed 1 [illegible] of gold to the ton. Crosscutting to this vein was in progress when all [illegible] was recessed awaiting a new power installation. It has not yet [illegible] resumed.

All drifts and crosscuts are 5 feet by 7 feet in section. Ingersoll-[illegible] 1-74 and Chicago Pneumatic No. 5 drifters are used for drilling. The [illegible] of holes per round ranges from 9 to 15, depending upon the ground. An average advance of 4.2 feet is made per round. A miner and helper are employed in each heading; they do the shoveling, tramming, drilling, and [illegible]. When timbering is necessary these men are assisted by the shift [illegible] occasionally it is necessary to miss a drilling shift to permit [illegible] the timber.

Winzes generally are sunk in the better ore and usually pay their own [illegible]; the dimensions vary with the width of the ore in which they are being [illegible].

At least two and usually three development headings are in progress per [illegible]. A crew of five miners and six muckers is employed for this purpose.

Costs

Drifting costs average $5.20 per foot and winzes $12.20 per foot. Expenditures for development are limited to approximately $1 for labor and supplies per ton of ore milled. The development cost per ton of ore milled is as follows:

Labor and supervision	$0.680
Supplies	.314
Power	.086
Assaying	.030
Development cost per ton of ore milled	1.11

Powder consumption is 0.32 pound per ton of ore milled, and lumber consumption is 2.6 board feet per ton of ore milled; these items are included in supplies of the above tabulation.

Stoping

The open-stope method of mining is used exclusively. However, owing to the various types of ore bodies, variations in dip of ore, thickness and hardness of the ore, as well as condition of walls, it has been found impossible to apply the same detailed methods in any but a few instances.

The hanging-wall vein is very flat (32°) and is composed of hard vein material or a breccia, upon which rests a mechanical clay under extreme pressure. The rock behind and above the clay or red gouge is soft. The problem, then, is to break hard or brecciated vein material from under a soft, flat, hanging wall with a minimum of dilution. This is accomplished best by raising through the ore between levels in two or more places. The number of raises depends upon the length of the ore body; usually in development of an ore body there is a raise every 60 feet. Both sides of the raise are then slabbed down with jackhammers, retreating from a common center. Slabbing at the top of the raise progresses faster and is graduated downward, giving a V-shaped opening. (Fig. 2.) The slabbing holes seldom are more than 2 feet from the face, although the holes usually are 4 feet deep. This type of drilling has three distinct advantages under the circumstances; first, it propels the ore downward toward the chute on the level below; second, it opens very little ground unsupported by timber; third, the downward hole has a tendency to undercut. In carrying a flat back stope the charge in an upward hole would tend to dislodge the hanging-wall gouge and dilute the ore. Rills and benches are avoided in these flat stopes, as slushing and mucking are accomplished better if the progressing face is straight.

In short, this method makes for cleaner ore, allows retreat in two directions from a common center with protected working faces, and minimizes slushing and mucking of ore.

The back is supported by 8- by 8-inch stulls cut to fit and with umbrella headboards when needed. The timbering is carried to within 4 feet of the face. The slabbing holes are blasted lightly with only one or two sticks of

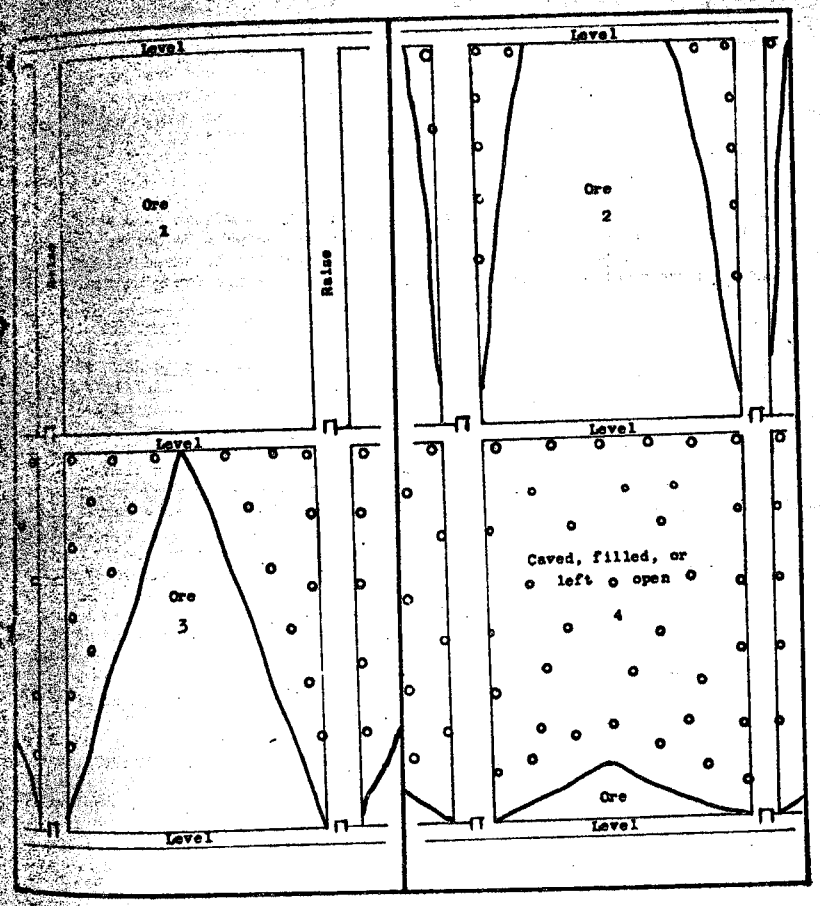

Figure 2.- Ideal progression of stoping on hanging-wall vein. Variable with extent of ore. Timbering at random.

hence the timber seldom is broken or loosened. The stulls afford protection for enough time to retreat; within a few weeks the headboards fall down over the ends of the stulls, and the red gouge, having been exposed to the air, begins to slough. The mined-out stopes, except at the working faces, are soon, practically if not wholly, filled by the hanging wall and the loosened material behind it.

Broken ore is conveyed to loading chutes either by slusher hoists or by scrapers. If by the latter, shaker chutes of 12-inch split fan pipe are commonly used.

An underhand stoping method is used in steeper-dipping zones. Stoping starts at the top of a raise and is carried downward in a series of benches. The triangular banks of ore left between raises near the lower level are blasted down on shoveling sheets on the floor of the drift and shoveled into cars.

Where there is commercial ore from the foot wall to the hanging wall extra care must be exercised in mining because of the vertical shearing of the vein material. This shearing produces vertical slabs of ore that weigh 75 to 150 tons each. The slabs are well-shattered and have been loosely cemented; when dropped they break easily. Each slab must be let down singly so that only a little ground will be opened at a time. The foot-wall ore proper is first mined, thereby undercutting the slabs; then a flat back stope is carried upward and the exposed slab, constituting the working face, is well-broken. Three short holes are drilled in the exposed slab and loaded with 1/3 to 1/2 stick of powder -- just enough to jar it. The braces are loosened and the shots fired, which drops the ore. Wedges, blocking, and long stulls are adjustment for immediate timbering of the hanging wall, and short, temporary braces are placed to support the newly exposed slab of ore. The broken ore is removed and the procedure repeated. So far this type of deposition has been encountered only in the narrower parts of the main shear zone where the distance from wall to wall averages from 12 to 20 feet. The rock behind the red-gouge hanging wall is harder in the vicinity of these stopes, and little trouble is encountered in keeping the stope open while mining is in progress, if it is properly timbered. When all ore has been removed the long stulls are removed gradually, and the stope is filled with waste from development headings, thereby saving the timber and eliminating the hoisting of waste.

In instances where the bottom of a drift is in ore that is known not to be continuous to the level below, the underhand stoping method for mining small ore bodies is employed. If the ore is not continuous downward, owing to a pitching fault, which is often the case, an underhand stope is started at the intersection of the drift and the fault and is worked downward and in the direction of the rake. Slabbing holes are drilled with jackhammers along the progressing face, as in other stoping, and the method of timbering is identical with that first described. Ore is removed from the stope either by an air slusher or by laying track and lowering the regular mine cars into the stope by means of a small air hoist.

1/7/85

Orogrande Mine - very thick file - if interested, should look over, tons lots of old repts, many by Colvocoresses
prep. now held by McFarland & Hullinger & Global Energy
Mr. J.D. Ingram, V.P. Global Energy Ltd
6005 S. Palomino Rd., Tucson, AZ (602) 883-7556
- says drilled lots of holes, 150-200' deep
- thesis at CSU by Mary Post
- ore assoc. w/ MnOx, FeOx

rept. of Carlton Bray, Texas, 9/15/32
635,000 Tons @ $3,175,000 to 300' level
add 340,000 tons @ 1,700,000 to 400' level
ore bodies on Copperhead and Frenchman's claim

Pilgrim Mine - not too much - engineers rept by AZ Bur., Elgin Holt, 5/8/41 - some old repts.

Clementine Prop. - owned by United Mining - Carl Tripalin and Robert Hicks - Phoenix Area
- property is in center of Sec. 10, NE of White Peak Mine
- file has lots of press crap on Copper Lake
- Copper Lake rept in Ann rept.
Proven. 1,110,272 + .052 Au
Probable 5,520,000 + .055
Possible 17,700,000 + .050
no geology, etc in file

Papago - only Tenney's published account

Story Mine - Per U.S.F.S., 7/31/85 - TG and Freeport planning exploration drilling on claims at Story Mine. Planning to use helicopter rig.