06/06/88

ARIZONA DEPARTMENT OF MINES AND MINERAL RESOURCES FILE DATA

PRIMARY NAME: HARTMAN GROUP

ALTERNATE NAMES:

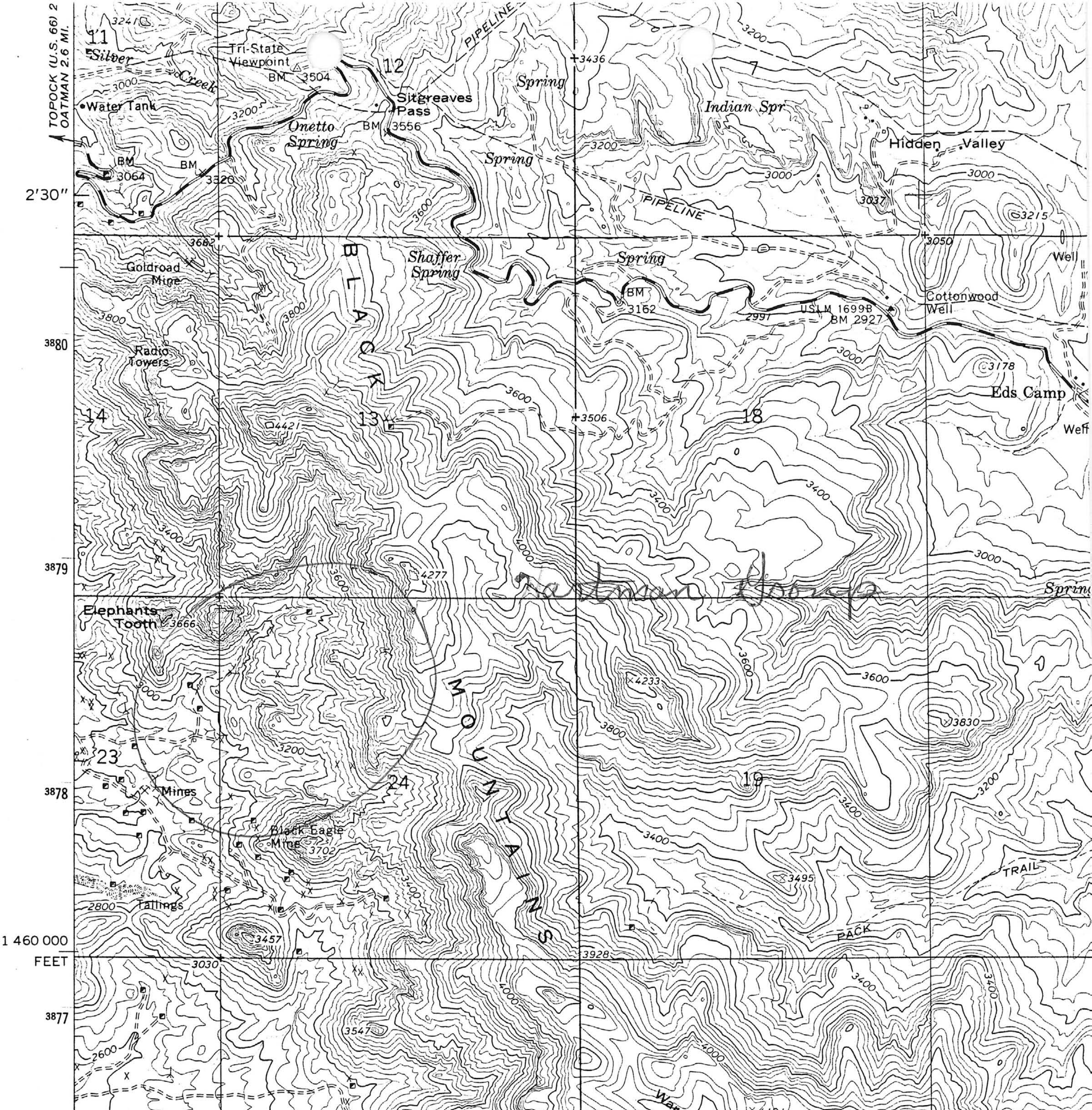
MOHAVE COUNTY MILS NUMBER: 35E

LOCATION: TOWNSHIP 19 N RANGE 20 W SECTION 24 QUARTER NW
LATITUDE: N 35DEG 01MIN 21SEC LONGITUDE: W 114DEG 22MIN 01SEC
TOPO MAP NAME: MOUNT NUTT - 7.5 MIN

CURRENT STATUS: DEVEL DEPOSIT

COMMODITY:
GOLD LODE

BIBLIOGRAPHY:
SEE ADMMR OATMAN GOLD MIN & MILL CO. FILE
ADMMR HARTMAN GROUP FILE
ADMMR UNITED EASTERN FILE, HAFF & COLWELL MAP
WEED'S MINES HANDBOOK, VOL. XVI, P. 329, 405; 1925
ADMMR MOHAVE CUSTOM MILL PROJECT



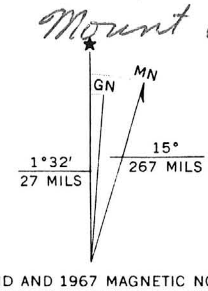
Mapped, edited, and published by the Geological Survey

Control by USGS and USC&GS

Topography by photogrammetric methods from aerial photographs taken 1965. Field checked 1967

Polyconic projection. 1927 North American datum
10,000-foot grid based on Arizona coordinate system, west zone
1000-meter Universal Transverse Mercator grid ticks, zone 11, shown in blue

Mount Nutt 7.5



UTM GRID AND 1967 MAGNETIC NORTH
DECLINATION AT CENTER OF SHEET

1000

Hartman group (?)
Mohave Co.
c. 1930's

FLOATING AND TABLING AN OXIDIZED GOLD ORE

HARTMAN MINING & MILLING CO.

Cactus, Arizona.

By Paris V. Brough, Mill Foreman.

The ore, in general, is a highly oxidized, gold bearing quartz. Some residual iron sulfide occurs, generally in ore from the 400' and 500' levels, either in dense quartz or as unoxidized ores, in massive iron oxide. This sulfide is valuable for its gold content.

Run of mine ore is dumped on a rail grizzly, set to six-inch spacing over the coarse ore bin, the large pieces then being broken with a hammer. The bin discharges to an 18" rubber conveyor belt, traveling at the rate of 30' per minute, and set at a slope of 18 degrees. Waste is picked off this belt. The picking belt discharges to a tapered bar grizzly with 1" spacing and set at an angle of 37 degrees, the undersize dropping to mill ore bin. The oversize discharges to a short, steel-plate sorting table, set at a slope of 2" per foot, and discharging manually into the jaw of a 7 x 11 Blake type crusher making 280 RPM and discharging to mill bin below. Waste from both picking points passes, by gravity, to a car, and is tallied and trammed to the waste dump.

RH

The mill ore bin has a flat bottom, and has a capacity of 54 tons. At present, tonnage of ore delivered to the mill is estimated from the car tally.

Ore is drawn from the bin bottom through a steel hopper, equipped with an adjustable gate, to a ratchet-driven 12" rubber conveyor belt, the ratchet being adjustable. This belt discharges into the ball mill scoop box. The ball mill, manufactured by the Maine Machine Works, of Los Angeles, California, is a scoop-feed, cylindrical, overflow-type mill, the inside dimensions of shell being 4'4" in diameter by 5' in length, and is mounted on roller bearing trunnions. Four-inch cast iron balls are used as grinding media.

The mill has a tendency to discharge small balls, which are discarded rather than have them circulate. This leads to a high ball consumption, but can be remedied by placing a reverse screw in the discharge throat, and an alteration in design of the mill end liners.

Closed circuit grinding is practiced, with a 36" by 16' Dorr simplex classifier, set at a slope of 2-3/4" per foot. The overflow contains 32% to 36% solids, giving a grind with about 1-1/2% on 60 mesh, and 68% through 200 mesh. Rake speed is 24 strokes per minute and the circulating load is held at the full raking capacity of the drag, at this speed. The mill grinds an average of close to 1-1/2 tons per hour, at 28 RPM. Greater mill speed is prohibited for lack of power.

More recent milling practice has demonstrated the fact that ores of different type can best be treated by varying the character of grind. The practice, mentioned earlier in these notes, consisted in operation of the ball mill with high solids, giving maximum tonnage rate, with classifier overflow solids at 32 to 36% and grind as mentioned. This system produces a maximum amount of -200 mesh material, and is evidently best suited to the ore carrying little free gold and iron oxide, the value being principally in sulfide form.

The practice best suited to the highly oxidized ore involves a small sacrifice in tonnage rate and no doubt a slightly higher consumption of grinding media. The mill is operated with lower solids and higher circulating load, with classifier overflow near 40% solids. This gives a more granular grind, particularly in the finer sizes, and produces a higher grade of concentrate, with lower tailing, on this class of ore. The benefit is probably derived from a combination of two factors. These are: higher solids to flotation and the fact that a higher percentage of gold bearing oxide minerals are discharged over the classifier weir in coarse enough condition for recovery on the table. This system requires closer attention to the mill circuit, on the part of the operator.

Pulp conditioning and numerous other tactics were tried, but this is the only method that we have found to be effective in improving the metallurgy. High solids to flotation, with dry mill grinding, made no improvement. The oversize probably carried locked values. A thickener ahead of flotation might alter the theory and permit dry mill grinding if a high percentage of fines is not the interfering element.

The mine has seldom furnished full day runs on any one class of feed, it being usually a mixture from several sources, so advantage can not be taken of these findings, until such time as the mine is able to deliver at least full day runs of the different classes. In order to maintain good practice in this mill, with one operator on a shift, it is necessary that highly skilled men be employed.

A hopper-bottomed steel tank is mounted on a deck above the classifier. This is provided for the purpose of storing the classifier sand load when it becomes necessary to shut down. The grinding out period is thereby shortened, and the circulating load is quickly restored when starting up. A long, tapered wooden plug, operated from the top, in conjunction with a water jet in the hopper discharge, makes the sand load self-dumping, once it is started. The sand flows by gravity, through a vertical. pipe, to the classifier.

The hopper is provided with an overflow which discharges to the flotation machine, by gravity. The fines are therefore subjected to regular treatment while the mill circuit is being cleaned out. The latter procedure is accomplished by opening the classifier drain cock, which is connected to the classifier overflow pipe, and discharges to the Wilfley pump sump. The pump normally discharges to flotation, but by closing a valve, this discharge is sent to the hopper above the classifier. When cleaning out the classifier, a four-mesh screen is placed in the sump, to keep stray rocks and iron from passing into the pump.

The classifier overflow discharges to the pump sump, by gravity, and is elevated to the first cell of a four-cell, Groch Engineering Company flotation machine. Finished concentrate is removed from the first cell, the other three producing a middling which flows by gravity to the pump sump, where it joins the stream of original feed, and is returned to the first cell. The flotation machine recovers free gold and pyrite, with some barren gangue, as there is not enough mineral present to crowd back all of this material. Shallow froth columes are carried, particularly on middling cells.

Flotation tailing, without being sized, flows by gravity to a standard Deister Plat-O sand table, riffled for fine sand treatment, operating at 260 strokes per minute. That portion of the iron oxide which has not been too finely ground, is recovered on the table, as a concentrate low in grade, when compared with that from flotation. No provision has been made for re-treating table middling, so it is cut to concentrate, as a protection against tailing loss and for dilution of the high-grade flotation product. Little recovery is made by the table, but it serves a useful purpose, by furnishing a granular mixture for the filter. The product is fast filtering when table concentrate is in excess.

Concentrates from the two machines discharge, by gravity, to an eight-foot steel cone, equipped with a revolving mechanism to prevent packing. Once a day the accumulated concentrate is drawn from the cone and filtered on a four-foot single-disk American type filter, the cake carrying about 15% moisture. The combined concentrate is sampled for assay on the filter sectors, and for moisture, by core sampling the sacked material, just before weighing. This method has checked with smelter returns very closely.

Table tailing flows, by gravity, to a 7' x18' Dorr Thickener, the underflow of which passes to waste, through a No. 3 Domestic diaphragm pump. The clear overflow joins that from the concentrate cone and is returned to the mill tank by a 1" centrifugal pump. About 50% of the water is recovered for re-use. The small amount of filtrate from concentrate de-watering is also wasted, through a barometric seal situated some distance from the mill, due to surface contour.

A limited amount of preliminary test work was conducted on a sample of ore taken from the 500' level. This work was misleading, as was soon demonstrated when the mill went into operation. To date, most of the mill feed has come from the upper levels. It contains highly kaolinized gangue and oxidized vein minerals, with metallic gold. These oxide minerals require fine grinding in order to free the gold. The density is high enough to insure a selective grind. Early operations indicated that the slime was adsorbing upon the free gold and sulfide surfaces to the exclusion of the flotation reagents, the free gold as well as sulfide was generally detected by panning the tailing. Standard frothing reagents, in very small amounts, produced large volumes of non-flocculated froth, low in grade. Sodium compounds were ordered and tried out, in the order of their arrival. Sodium sulfide had already been tried, with no benefit. A conditioner for this brick red slime was evidently needed.

Some improvement was noted with caustic soda and sodium silicate. Soda ash finally arrived and the rate of addition was increased daily. Some flocculation of the froth was observed with 1.5 pounds per ton ore, with an improvement in recovery and ratio, and the red slime was well dispersed. At the rate of 2.0 pounds, more improvement was apparent, and an over-flocculated condition was obtained with 2.5 to 3.0 pounds per ton. Experience has since shown that the quantity of soda ash required varies in proportion to the amount of upper or lower level ore in the mill feed. It will vary from 1.5 to 2.5 pounds per ton ore, the higher rate being necessary when most of the ore is from the upper levels, especially if much decomposed wall rock is present.

Soda ash is added dry to the ball mill feed belt. American Cyanamid Reagent No. 208 is also introduced with the feed, as a 10% solution, at the rate of 0.05 to 0.07 pounds per ton ore. Potassium Amyl Xanthate, 10% solution, 0.07 pounds per ton, is divided in about equal parts and added to the classifier overflow and No. 3 flotation cell. A very small quantity of Aerofloat No. 15 is introduced in the Wilfley pump sump, to suit frothing conditions. Excessive froth, with normal aerofloat feed, indicates too low soda ash, and vice-versa.

Proper pH control of the mill circuit is essential, and soda ash additions conform to this requirement. To obtain a proper froth condition, the flotation circuit must have a [illegible] of [illegible]. The mill water is derived from two sources, one being the mine, with a pH of 8.0, and the other being a drilled well, with a pH of 7.7. An analysis of these waters has not been made, but additions of Na_2CO_3 indicate that this alkalinity is derived from lime or magnesia.

Additions of soda ash to the mill circuit so thoroughly disperse the slime that it will remain in suspension for days. To overcome this effect, dilute sulphuric acid is added to the table tailing launder, at the rate of about 0.50 pounds acid per ton of ore. This lowers the pH of the water in the tail thickener to about 7.9, at which point the slime is flocculated and a good settling rate is obtained, with clear overflow. This overflow, being returned to the mill tank, maintains the mill water at that point. Make-up water for the plant is added as sprays and table wash only, these points being beyond the critical flotation circuit.

No free gold or sulfide has been observed in the tailing since the plant was placed on a soda ash circuit. Screen analyses and other evidence point to the fact that most of the loss in tailing is in the finer particles of iron oxide, not recovered on the table, but always evident in the tailing. Some attempts were made to float this fine mineral, with Oleic Acid. The degree of flotability of iron oxide, as compared with that of gold and pyrite, is far down the scale, and with a set-up proper for the latter minerals, iron oxide was noted in small amount, in the froth from No. 4 cell.

A second stage of flotation, or separate treatment of sand and slime, by table and vanner, following flotation, would no doubt make a higher recovery of this mineral, but the tailing loss at this small plant does not justify such equipment, in view of the fact that future operation will increase the proportion of the more suitable ore.

Indicated recovery, based on the flotation feed sample averages about 80% on upper level ore and close to 90% when most of the feed is from a deeper source, this sample having averaged about $8.00 to date. A higher recovery should be made on ore of a higher grade. Some gold accumulates in the ball mill and classifier circuit, and when this is cleaned up, the average recovery will be increased. As this has not been done to date, there is no means of making this estimate.

No increase in recovery has resulted from lowering the ratio of concentration on the flotation machine, so the current practice is to produce high-grade concentrate from this machine and dilute with table product. Some reagent consumption may be high, but this will be checked as operations continue.

The ball mill feed is sampled occasionally, but is apparently so erratic that no calculations are based upon it. The ratio of concentration varies from 54 to 60 into 1 on lower level ore, to 75 to 85 into 1 on upper level feed, it being calculated on the basis of assays of flotation feed, final tailing and filtered concentrate. Milled tonnage is estimated by averaging the weight of one-minute cuts off the end of the ball mill feed belt, with correction for moisture.

HORSEPOWER REQUIREMENTS

CRUSHER MOTOR - 10 HP. Drives 14" conveyor belt and the crusher. Tight and loose pulley starting.

BALL MILL FEED BELT - 1/2 HP

CLASSIFIER MOTOR - 2 HP

BALL MILL MOTOR - 35 HP

WILFLEY PUMP, 2" SIZE - 5 HP motor, direct connected.

FLOTATION MACHINE - Two 5 HP motors, each driving two impellors through texrope drive.

DEISTER PLAT-O TABLE, 260 STROKES PER MINUTE - 1-1/2 HP through texrope drive.

CONE MECHANISM AND FILTER DRIVE - 1/2 HP motor.

VACUUM PUMP AND LOW PRESSURE BLOWER - 5 HP motor.

TAILING THICKENER AND DIAPHRAGM PUMP - 1-1/2 HP motor.

RECLAIMED-WATER PUMP, with 40' head, 1" centrifugal pump, direct connected. - 1 HP motor. 2 HP motor is needed.