

Progress Report on Testing of
Sample from Geddes-Bertstrand Mine

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by

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Background

On June 6, 1978 Mr. Egil Livgard brought to this laboratory about 400 pounds of ore samples from the Geddes-Bertstrand mine, sometimes called the Stockton-Getty mine, located in Secret Canyon south of Eureka, Nevada. The combined sample was taken from a substantial tonnage of material in the deposit, and it was expected to be more representative than samples from the mine tested here previously for Richard L. Gerish and reported on August 6, 1975.

In the previous work a sample averaging 7.85 oz of silver per ton was placed in a plastic pail with a wooden filter bottom and leached with cyanide solution applied at the center of the cone shaped top of the ore in the pail. In a few days nearly 30 percent of the silver had been extracted, but because the solutions from the ore were black and smelled of pitch, the test was discontinued. A bottle test on pulverized ore showed 60 percent extraction after 24 hours.

Objectives of work to be done on the present sample were to make a more thorough column leach test on uncrushed ore, to avoid using wood that might color the solutions, and to experiment with ways of increasing the recovery of silver, if a satisfactory recovery was not obtained by straight cyanidation.

Sample Preparation

The sample arrived in a number of plastic bags. These were emptied into a pile on the floor, and the ore was mixed and sampled following the scheme outlined in Figure 1. The sample had pieces up to about 4 inches across, and it was said to be about the same size as the ore would break into during mining. The sample was divided and half of it was set aside for use in a column leach. The rest of the sample was alternately crushed and divided in order to obtain a Head Sample for analysis; all rejects were saved separately as shown in Figure 1.

Head Analyses

Not only was it considered important to know the precious metal contents of the ore, but also various other metals that might effect the cyanidation. Thus besides fire and other assays for gold and silver as discussed later, wet analyses of the Head Sample using atomic absorption were made for the metals listed in Table I. All are quite low and should not interfere with cyanidation.

Table I
Wet Analyses of Head Sample

Element	Notes on Method	Concentration	
		%	ppm
Copper	Nitric Acid	0.019	190
Lead	Nitric Acid	0.53	5300
Zinc	Nitric Acid	0.885	8850
Mercury	Aqua Regia	<0.005	<50
Arsenic	Pyrosulfate fusion	0.0084	84
Antimony	Pyrosulfate fusion	0.1655	1655
Bismuth	Pyrosulfate fusion	0.00007	0.70
Manganese	HF/HCl/HNO ₃	0.027	270

The first fire assay on the Head Sample showed 4.46 oz silver and 0.04 oz gold per ton. However, a later fire assay of the same sample showed 6.12 oz silver and only 0.01 oz gold. Separate analyses by different analysts using atomic absorption on one-gram samples showed 4.87 and 5.25 oz silver respectively. Later similar parallel analyses by the same analyst run at the same time showed 4.90 and 5.19 oz, while a single analysis by atomic absorption on a ten gram sample showed only 4.35 oz silver per ton. Thus it appears that either the sample pulp must be spotty or the analyses are of low precision. Perhaps all that can be said at this time is that the Head Sample has about five ounces of silver per ton.

Column Leach

The first one half of the ore set aside by cone and quartering, estimated to weigh about 200 pounds, was loaded into a plastic leach vessel about 10½ inches in diameter and 38 inches high. The column was provided with a filter bottom made of plastic and screen-sized sand. Solutions were applied to the top of the ore by a mechanical distributor with 28 ports from which wires directed drops of liquid to points uniformly distributed over the surface. Feed solutions were made up in a 19.5 liter bottle and pumped to a head tank feeding the distributor. Solutions draining from the bottom were collected in plastic pails. Before starting leaching, the ore was wetted and the distributor checked out by the application of four liters of water.

To start with, leach solution was made up from water, sodium cyanide, and soda ash. Later solutions were made by reusing barren solutions from which dissolved silver had been removed. The free cyanide strength of leach solutions was kept about 0.1%, while sodium carbonate rather than lime was used for protective alkalinity, as in the previous work. Free cyanide was determined by titration with silver nitrate, and protective

alkalinity, expressed as CaO equivalent, by titration with acid to a phenolphthalein endpoint. Sometimes pH measurements were also used, especially on pregnant drain solutions showing little color with phenolphthalein.

Drain solutions came through the ore perfectly clear, but red colored. Tests showed that there was no ferrocyanide, which commonly makes cyanide solutions yellowish in color. Further tests all indicated that the coloring matter is organic, and since there was no wood or other leachable organic material added to it, it is clear that the color comes from something in the ore. Perhaps this would not be present in ore from deeper within the deposit. However, this red coloring matter did not seem to interfere with the cyanidation process.

In order to simulate the actual operation of a heap leach, the Pregnant Solution that drained from the ore column was treated to remove dissolved silver, and then reused in making up leaching solutions. Silver in the first three batches of Pregnant Solution was precipitated by adding sodium sulfide solution, and then recovered by filtration of the solids followed by smelting as in fire assaying.

An attempt was made to develop a field method for determining the amount of sulfide to be added. The most straightforward and perhaps best method tried was to titrate a sample of the pregnant solution with dilute sodium sulfide. Alum and a polyacrilimide flocculating agent were added to help coagulate and clear the solution of precipitated silver sulfide. The endpoint was approached by adding the sulfide dropwise to a thin layer of reasonably clear solution illuminated from beneath by a fluorescent light. As long as a cloud of precipitate could be seen a few seconds after addition of a drop, the endpoint had not been reached. Best results were obtained

by using a moderate excess of sodium sulfide over that indicated by the titration.

Silver in the fourth and subsequent batches, however, did not precipitate upon the addition of sodium sulfide solution as that in the first three had. It is thought that the reason for this different behavior was the presence of too much free cyanide in the Pregnant Solution. As an alternative to sulfide precipitation of its silver, the Pregnant Solution 4 was pumped slowly through a series of three flasks in each of which there was activated carbon. This effectively removed silver from the solution, but the problem remained of recovering it from the charcoal. An additional column of carbon was added to the series when Pregnant Solution 5 was treated.

Samples from each Pregnant Solution that drained from the column and the corresponding Barren Solution remaining after silver removal were analysed by atomic absorption. From these values and the volume of pregnant solution the quantity of silver recovered during each leach cycle was calculated.

Results

Partial data and results from the column leach are presented in Table II. Values for percentage recovery of silver cannot be presented at this time because of uncertainty about the assay of the Head Sample and the fact that the exact weight of ore in the column is unknown. However, it is likely that the column originally contained about 15 grams of silver, and based on this estimate about 56 percent of it has been recovered by passage of solution through the ore amounting to about 80 percent of the weight of ore. More exact values will be possible later when the test is finished and the ore is dried and weighed.

Additional Work

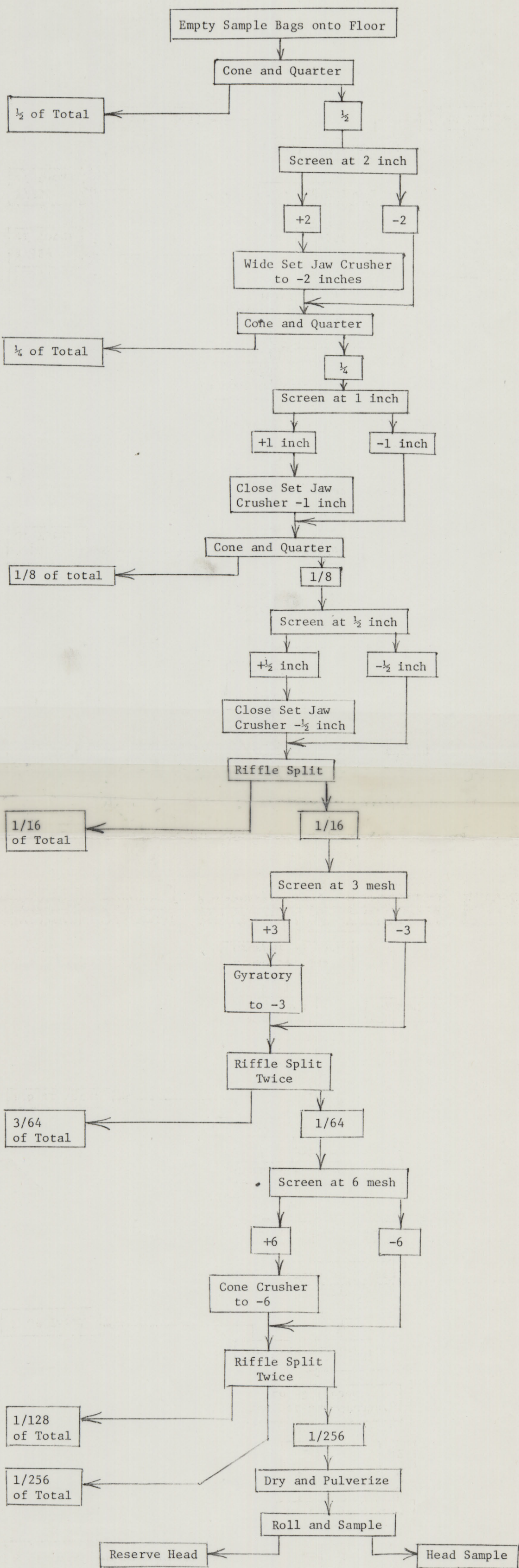
Data in Table II lead to an expectation that the concentration and recovery of silver in future drainage from the column will decrease to very low values. It is recommended that research with solutions containing reducing agents based on sulfur dioxide or related compounds be continued in an effort to increase the recovery of silver from this ore.

Table II
Partial Results of Column Leaching

Solution	No.	Vol, l.	Ag by AA, ppm	Wt Ag, g.
Pregnant	1	11.8	172	1.6874
Barren	1	—	29	
Pregnant	2	12.16	268	2.8272
Barren	2	—	35.5	
Pregnant	3	9.455	107	0.9879
Barren	3	—	2.52	
Pregnant	4	18.11	119	2.1439
Barren	4	—	0.62	
Pregnant	5	18.85	42.6	0.7568
Barren	5	—	2.45	

Figure 1

Flowsheet for Sample Preparation



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