CONTACT INFORMATION
Mining Records Curator
Arizona Geological Survey
416 W. Congress St., Suite 100
Tucson, Arizona 85701
602-771-1601
http://www.azgs.az.gov
inquiries@azgs.az.gov

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Volume 3 ; Book 3 0042

# TOMBSTONE

## Mining District

Cochise County

ARIZONA

James A. Briscoe Exploration Proposal
July 15, 1978

Consultants in:
• base & precious metals • uranium
• coal • geothermal • environment
• remote sensing • color aerial photography
• interpretation-image processing
Worldwide Mobilization
James A. Briscoe, Principal
Registered Professional
Geologist

# Southwestern Exploration Associates

~~6783 Camino Principal~~
~~Tucson, Arizona 85715~~
~~(602) 885-2319~~

New Address:
4500 E. Speedway, Suite 14
Tucson, Arizona 85712
(602) 795-6097

July 15, 1978

Mr. Dwight E. Lee
FAMCO
120 Sylvan Ave.
Inglewood Cliffs, New Jersey 07632

Dear Dwight,

Transmitted with this letter is a copy of my exploration proposal called the Central Arizona Project. Please consider this a draft copy and give me your input on it. I believe it is the best approach to this type of exploration venture, but there is certainly some flexibility possible for the program. Please feel free to give me your candid opinions.

During our meeting on the 30th, you brought up two major points:

1. What is the ultimate potential for investors in this program - why should they be interested in a mineral exploration program, and/or what amount of money could it eventually bring them?

2. Why are the odds any better for Southwestern Exploration Associates than any other group?

I do not have as precise an answer to the first question as I would like; but, as I explained during our telephone conversation Friday, July 15, I am having our librarian thoroughly research available data and I will be able to give you a rather precise answer by mid-September, when I return from the field.

While I will briefly discuss both of these questions in this short letter, I would like to take the second question first; "Why should Southwestern Exploration Associates have better odds than other exploration groups?"

The factors which I believe give Southwestern Exploration Associates a competitive advantage over other exploration teams can be briefly summarized by the following four factors:

+Organization
+Advanced Techniques
+Motivation
+Expertise

Taken sequentially and given more detail, these factors are:

1. Organization - As an exploration consulting firm, Southwestern Exploration Associates has <u>all</u> components of a fully-integrated exploration team. In fact, though not comparable in numbers, I believe that we have more components of a complete exploration group than any other entity, except possibly some of the largest oil companies that have been involved in mineral exploration. For

certain, we have more capabilities than any other exploration team headquartered in the Southwest. The components of this exploration team are carefully managed and organized to form a mutually reinforcing, integrated effort--something that is lacking in every other exploration group with which I am familiar. The various components include:

A. A Professional Geological Staff

B. An Aerial Photography Division specializing in the most-advanced and highest-quality color aerial photography available for mineral exploration purposes.

C. A Literature Research Group, including a registered librarian and accredidation as an industrial library, tying in with the national interlibrary loan system.

D. A Land Status Research Department

E. A Drafting and Scientific Illustration Department

F. An Environmental Services Division

G. Computer Services, with a staff operating 24 hours a day using the most-advanced computer word processing equipment.

H. Business Services, including a bookkeeper and secretarial staff.

2. We have made an effort to use the most-advancd exploration techniques available which are directly applicable and cost effective. In many cases, much of the advanced hardware and technology we are using are off-the-shelf items that are available at relatively low costs. They are being used by other industries but have not been used by a mineral exploration firm. We are using available technology and techniques in imaginative and, we believe, unique ways. These include:

   A. Color Aerial Photography - S.E.A. Photography Division has developed an inexpensive, proprietary, highly-effective, red sensitive photography that is available, to our knowledge, through no other contractors.

   B. Data Collection and Processing - We use:

      1. Miniature dictating units to dictate field observations and data recordation for transcription on our DEC Computer-Word Processor in a data retrievable format.

      2. 35 mm photography and microfilm camera to record field observations and printed data, as well as drill core and sample data.

C. We have extensive Literature Research capabilities supported by our registered librarian with data filing and retrieval based on our DEC Computer System.

3. Motivation - We have a young, aggressive, imaginative staff of personnel who are motivated by a program where they retain a portion of the earnings of the business. This is an incentive program based on personal production and creativeness.

4. Expertise - The expertise of our staff is at least equal to competitive groups. When combined with the first three parameters of organization, advanced technology, and motivation, the result is application of expertise that is strongly superior to most, if not all, other competitive exploration teams.

Going back to the first question, what is the ultimate potential for investors in this program; why should they be interested in a minerals exploration program; and/or, what amount of money could it eventually bring them?

The simplistic answer to this question would be merely a recitation of past success stories and what the return on investment was. However, I believe that the mineral industry and opportunities for profit from discovery of mineral resources is in a

great state of flux, and recent historical parameters might not be projected accurately into the future. I think it is also axiomatic to successful investing that great opportunities for potential investment are recognized very early by only a few who take advantage of the potential, and, by the time all investors are aware of the opportunity, the profit potential has peaked out with most of the Johnny-come-lately's getting in on the last part of the peak or even on the downhill side. I will very briefly try and outline those changes which I feel are important and, of course, would be happy to go into further detail on them at your request.

During the last three-quarters of a century, most nonferrous base metal mining and much of the precious metal mining in the United States has been controlled by a very few major companies. Controlling most of the mining were the American Smelting and Refining Company and the Kennecott Mining Company. Both of these companies were founded and are still in good part controlled by the Guggenheim family. Also controlling a large share of the mining industry were the Phelps Dodge Corporation, the Anaconda Company, and, to a lesser extent, the Cyprus Mining Company, the Newmont (Magma) Mining Company, and the Homestake Mining Company. Except for some gold mining during the depression years, and uranium mining during the uranium boom of the '50's, these few companies controlled most of the mining and metallurgical expertise, as well as most of the big, well-known mines. As is so often the case in this situation, these companies have become complacent and lethargic and have thus succumbed to more competition in the last ten years. Almost ringing a death knell on their control has been the blow dealt to them by the environmental regulations promulgated within the last 5-to-10 years. These companies have had to lay out in the range of one

billion dollars for pollution control abatement. This combined with sinking copper prices has left them financially moribund, and they will probably remain so until eased by increasing copper prices. In the meanwhile, they have very little resources left to take advantage of the very strong market for molybdenum, silver, gold, geothermal resources, and, particularly, uranium. The fuel situation triggered by the Arab Oil Embargo of 1974 also has a great impact on this changing picture. Happily for the mining explorationists, the price of uranium has increased from approximately $6 per pound three years ago to current price of $42 per pound. Because most of the cost in nuclear power generation is in capital for plant construction and very little in fuel consumption, it is calculated that this price could again increase by a factor of $3 to $120 per pound before having any significant impact on the cost of nuclear power generation. At the price of $120 per pound, uranium would be worth about $8.57 per troy ounce or almost double the price of silver today. With the traditional old line mining companies pretty much out of the exploration picture (though certainly not entirely), other companies are rushing in to fill the vacuum and partake in the profits. These companies include the major oil companies, many of the major power-producing companies (this list grows daily and includes the Tennessee Valley Authority and Consolidated Edison of New York), nuclear power plant fabricators (notably Westinghouse, whose story is too long to get involved in here but has some strong importance to the general investment picture), and a variety of smaller mining and investment companies. In spite of all this exploration activity, reserves are not growing nearly as fast as demand, causing continued upward pressure on price. Many of the power companies are absolutely frantic (as is Westinghouse

for well-publicized reasons) to get their hands on long-term stable supplies of uranium. I might also point out that this is an international situation with German, Canadian, French and probably Japanese companies partaking in the exploration melee in the western USA, as well as other parts of the world. I have personally received correspondence from represenatives from power companies saying that they will joint venture any property that has potential for uranium reserves, with anyone, anywhere, anytime, anyplace, under any circumstances. Thus an eager, extremely competitive, buyer's market exists for uranium deposits. Though less frantic, this same situation exists for molybdenum, gold, silver, and geothermal resources.

The approach taken by Southwestern Exploration Associates in all of our exploration programs is to explore for all of these commodities, as well as keeping an eye out for good porphyry copper, lead, or zinc deposits. It costs no more to explore for any of the above-mentioned commodities since they occur in the same environment - it simply requires alertness, and a knowledge of potential buyers. In addition to the required technical expertise, we are both alert and in constant contact with such buyers. I believe that world consumption of these commodities and economic factors influencing them will continue to keep an upward pressure on their price. I conclude, therefore, that this is a prime time for qualified investors to fund aggressive, carefully thought out, efficient exploration for these commodities.

I think that is certainly enough of my commentary on the general situation and I hope that I haven't bored you. Certainly of equal significance is what has happened in the recent past. You are probably aware of the fortunes made by the Guggenheim family in precious metals and copper in the western United States and Mexico during the early 1900's, the fortune made by the Hearst family on the Homestake Gold Mine in Lead, South Dakota, and, possibly, the fortunes made by Col. William Boyce Thompson, founder of Newmont Mining Company, which was for many years his private investment entity. However, I think even more interesting would be recent success stories. I will try to review very briefly five success stories within the last 25 years in the discovery of copper, molybedunum, and gold. Unfortunately, I don't have the details on the original investments for these, but I will try to obtain those that are missing by all of previously mentioned mid-September dates. These are as follows:

J. David Lowell - Discovery of the offset portion of the San Manuel ore body near Tucson, Arizona - the so-called Kalamazoo discovery. This discovery for Quintana Minerals Corporation cost approximately one million dollars and was sold to the Magma Copper Company, the operator of the San Manuel Mine. Lowell discovered some 600 million tons of copper ore, averaging approximately 14 pounds copper per ton or 8,400,000,000 pounds of copper. If we assume a reasonable price of copper at $1 a pound - this deposit obviously has a gross metal value of $8,400,000,000. As is acknowledged widely by Quintana personnel, they sold too soon for too low a price. Their sale price to Magma was $27 million on their 1 million original investment; or a 27 fold return. But this only comes to $0.00321 per pound contained copper.

The Carlin Gold Mine in northeastern Nevada near Elko - discovered in the early '60's by the Newmont Mining Corporation. By 1963, Newmont had invested some $350,000 in the project and, at that time, were assured of having a viable ore body. At the current price of gold at $185 per ounce, the value of the reserves known in 1963 (these I believe have been substantially increased since that time) would be worth some $655,000,000 gross metal value or about 935 times the original investment, if we can assume that investment in today's dollars would equal $700,000 rather than the original $350,000 in 1963 dollars.

Mount Emmons, Colorado Molybdenum Deposit - purchased by American Metals Climax (AMAX) from U. S. Energy Coroporation and Crested Butte Silver Corporation, equal owners of the Mount Emmons claims. The purchase price was approximately $26,000,000 with a 5% net smelter returns royalty. At present the gross metal value of the presently known ore reserves (which could increase in the future) at current prices are worth approximately three billion dollars. The 5% net smelter royalty will, over the life of the mine, yield to U. S. Energy and Crested Butte Silver, some $150,000,000. This was had for an investment of approximately one million dollars on the part of U. S. Energy and Crested Butte Silver.

INEXCO Oil of Houston, Texas - founded by Mr. Erving Wolfe in 1968. INEXCO will be selling their Canadian uranium properties to the Saskatchewan Mining Development Corporation (a Canadian state-owned mining group) for 158.5 million dollars. Original investment unknown.

Charles Steen - the so-called Uranium Baron - sold his Mi Vida Mine in Utah in the early '50's, which at that time had a net worth of approximately 100 million dollars. Original investment - hard to be exact, but Steen, a graduate geologist, lived in abject poverty for some years while prospecting and before striking the Mi Vida Mine.

Hope the above is of some help, and more details will follow in mid-September.

James A. Briscoe/ewd

James A. Briscoe

JAB/mp

1599

# EVALUATION

# HEWLETT MANAGEMENT

R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
Sparks, Nevada 89431

## FINANCIAL ANALYSIS

Major variables that relate to the economics of deposits such as Getchell are as follows:

1. Metallurgical Process
2. Economic Tonnage & Grade
3. Capital Investment for each process
4. PerCent Recovery for each process
5. Operating Costs per ton ore for each process
6. Pre-Treatment and Induced Percolation costs.

A subtle variable inter-action exists between "Economic Ore Reserves-Break-Even Cut-Off Grade-Stripping Ratio". This relationship must be further quantified with basic testing of pre-treatment reagents and precious metal solvents, as well as the application of "Induced Percolation Substances".

In order to present the economics of milling vs. heap leaching, an analysis was made for carbonaceous ore deposits that should cover the range of tonnages at Getchell. A gold head of 0.15 Au(t.oz./ton ore) was used because it is common at Carlin, Cortez-Gold Acres, Jerritt Canyon, and Merker, Utah.

Basic assumptions and ranges of the various parameters are:

1. Heap Leaching vs. Milling(Conventional CCD)
2. Tonnage range of 1 to 10 million; 0.15 Au Heads
3. Capital Investment:
   A. Heap Leaching; ½ to 5 million based on prod. rate
   B. Milling; 15 to 40 million based on production rate
4. PerCent Recovery
   A. Heap Leaching = 75 %
   B. Milling = 95 %
5. Operating Cost/ton ore
   A. Heap Leaching; $ 5/ton ore
   B. Milling; $ 9-10/ton ore
6. Pre-Treatment & IPS costs- under $0.50/ton ore.

The following page presents the capital investment-operating costs per tonnage-production rate for a stripping ratio of 5.5:1(W/O).

# HEWLETT MANAGEMENT

R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
Sparks, Nevada 89431

The Present Worth of the cash flow was computed using the following assumptions:

1. Present Worth of the cash flow is computed for this illustration for Utah International using the Net Operating Profit Before Tax-because;

   A. NOPBT "balances" Corporate Tax Structures by not including taxes, depreciation, depletion, etc., and affords a fair-basis of comparison of milling vs. heap leaching

   B. Utah Internationals Corporate "Economic Critera" is unknown

   C. Utah Internationals method of financial analysis is unknown.

2. Interest Rate of 10% - present worth factor.

3. Present Worth Equation;

$$PW = \frac{(1+i)^n - 1}{i(1+i)^n}$$

where; $i$ = interest rate
$n$ = mine life

This basic equation was modified for a defered period(mine pre-production period) and nonuniform annual income.

The following figure presents the results. Notice that for any tonnage, that the present worth is from over 2 to 5 time for heap leaching vs. milling. Also, the capital investment is much less for heap leaching and therefore heap leaching minimizes the risk.

# HEWLETT MANAGEMENT

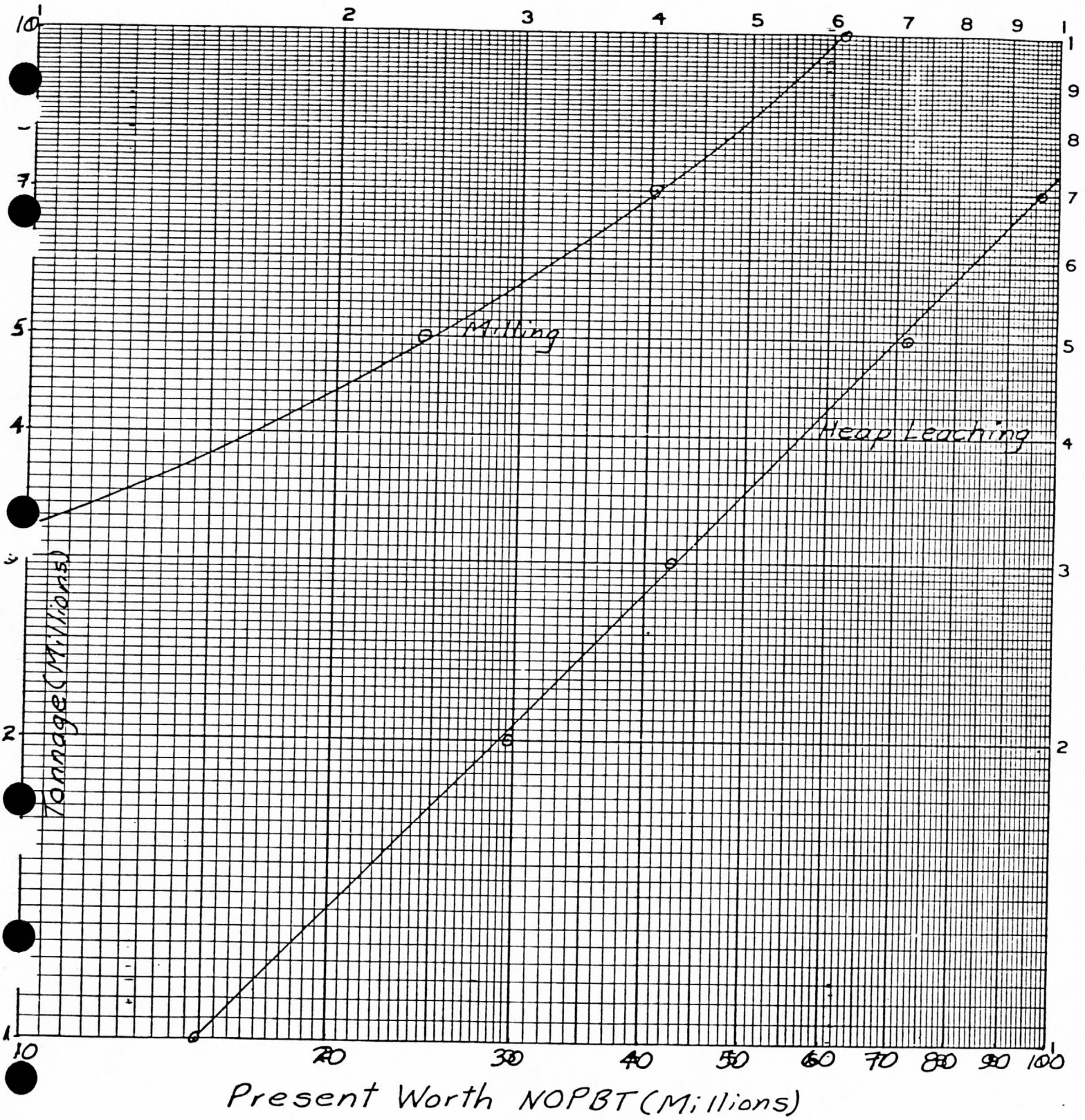
R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
Sparks, Nevada 89431

## GETCHELL
## Capital Investment and Operating Costs

| Deposit Tonnage | Production Rate (TPD Ore) | Capital Investment | Operating Cost (SR=5.5:1;/ton ore) |
|---|---|---|---|
| Heap Leaching: ********** | | | |
| 200,000 | 12,500 TPD | $ 500,000 | $ 5.00/ton ore |
| 500,000 | 12,500 | 600,000 | 5.00 |
| 1,000,000 | 12,500 | 700,000 | 5.00 |
| 2,000,000 | 12,500 | 1,150,000 | 5.00 |
| 3,000,000 | 12,500 | 1,300,000 | 5.00 |
| 5,000,000 | 12,500 | 2,200,000 | 5.00 |
| 7,000,000 | 12,500 | 3,150,000 | 5.00 |
| 10,000,000 | 12,500 | 5,000,000 | 5.00 |
| Milling: ******** | | | |
| 1,000,000 | 1,000 TPD | $ 20,000,000 | $9.25 |
| 2,000,000 | 1,500 | 26,000,000 | 9.50 |
| 3,000,000 | 2,200 | 30,000,000 | 9.75 |
| 5,000,000 | 2,500 | 35,000,000 | 10.00 |
| 7,000,000 | 2,750 | 37,500,000 | 10.00 |
| 10,000,000 | 3,000 | 40,000,000 | 10.00 |

Comparison of Milling vs. Heap Leaching
Carbonaceous Ores; Heads .15 Au; SR = 5.5:1 (w/o)



# HEWLETT MANAGEMENT

R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
Sparks, Nevada 89431

Further assumptions were made in order to analyze the comparative interactions of milling vs. heap leaching for the following variables:

A. Ore Tonnage = 9 million
B. Carbonaceous Ore Grade = 0.123 Au Heads
C. Production Rate:
   1. Milling; 3,000 TPD
   2. Heap Leaching; 12,500 TPD
D. PerCent Recovery:
   1. Milling; 95 %
   2. Heap Leaching; 75 %
E. Operating Costs:
   1. Milling; $ 8.67/ton ore
   2. Heap Leaching; $ 4.57/ton ore
F. Capital Investment:
   1. Milling; $ 30,000,000
   2. Heap Leaching; $ 5,000,000
G. Gold Price: $ 200/t.oz.
H. Present Worth Interest Rate: 10 %
I. Pre-Production Period:
   1. Milling; 18 months
   2. Heap Leaching; 6 months

The effect of various stripping ratios on the present worth of the cash flow can be examined for a specific stripping ratio by subtracting 50¢/ton waste for each ton of waste. The present computations are based on 5.5:1, which is $3.25/ton ore. Therefore, a stripping ratio of 3.5:1 would result in a heap-leaching cost per ton of ore of $4.00.

Using the above, the following was computed:

A. Present Worth of NOPBT vs. Capital Investment
B. Present Worth of NOPBT vs. PerCent Recovery
C. Present Worth of NOPBT vs. Operating Cost/ton ore.

The following three figures present the results.

# HEWLETT MANAGEMENT

R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
Sparks, Nevada 89431

The Present Worth was computed for a range of capital investments for both milling and heap leaching. The following graph presents the results. Notice the following:

1. As the Capital Investment for milling increases from $ 30 million, the present worth rapidly approaches zero; the discounted rate of return becomes very low after a capital investment of $ 40 million(milling).

2. The Capital Investment for heap leaching does not greatly effect the present worth; from an investment of $ 1 million to $ 20 million(the total range), the present worth only decreases from $ 97.73 to $ 78.73 million(a change of $ 19 million).

3. Notice that an important relationship exists between the rate of change of the Capital Investment-Present Worth relationship for both the milling and heap leaching case; the rate of change is as follows:

$$\text{Rate of Change:} \quad \frac{\text{Present Worth NOPBT}}{\text{Capital Investment}} = \frac{\$\ 1 \text{ decrease PW}}{\$\ 1 \text{ increase CI}}$$

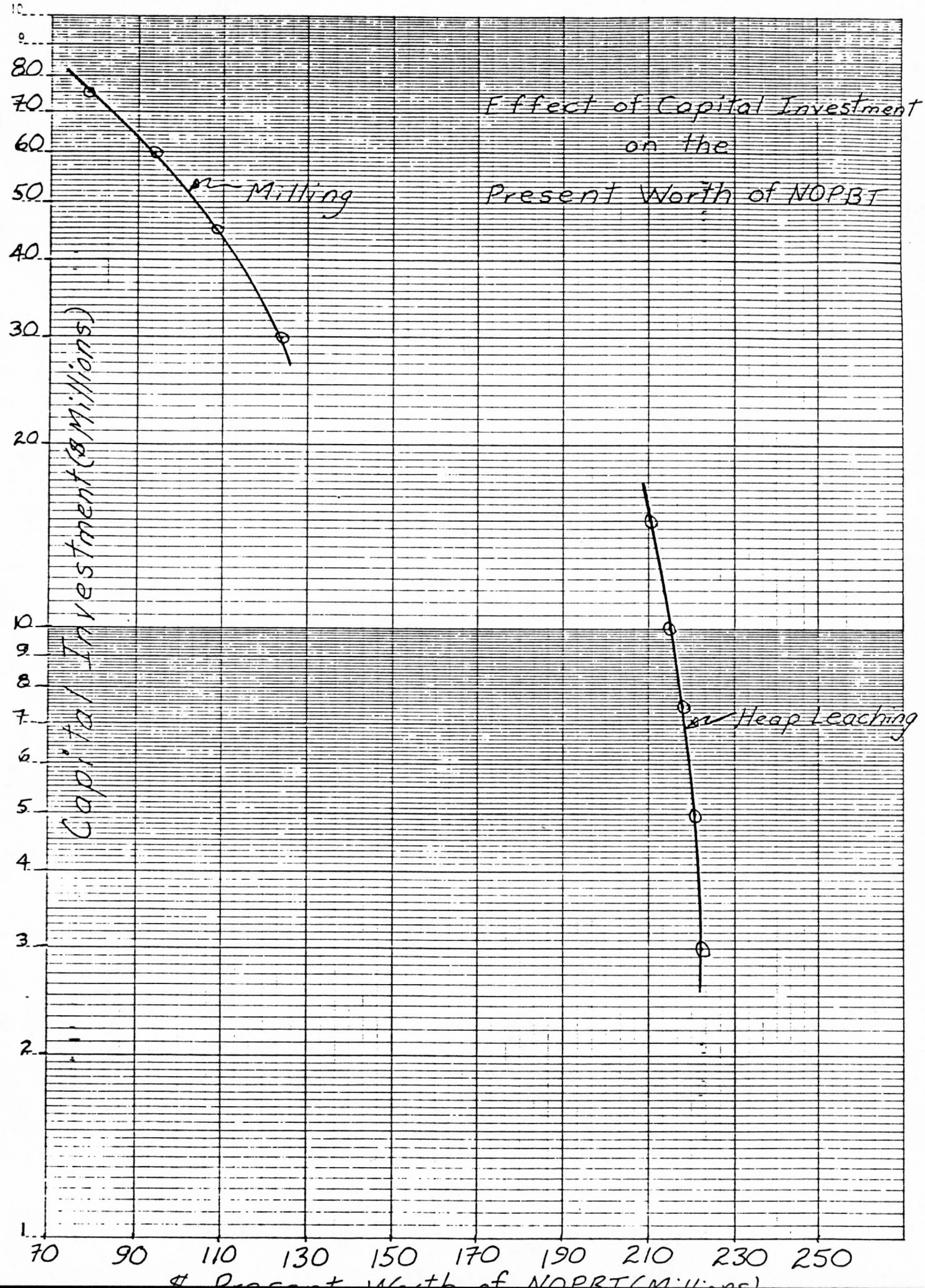
The present worth of the NOPBT was computed for various percent recoveries for milling and heap leaching. The basic fact presented in the following plot is as follows:

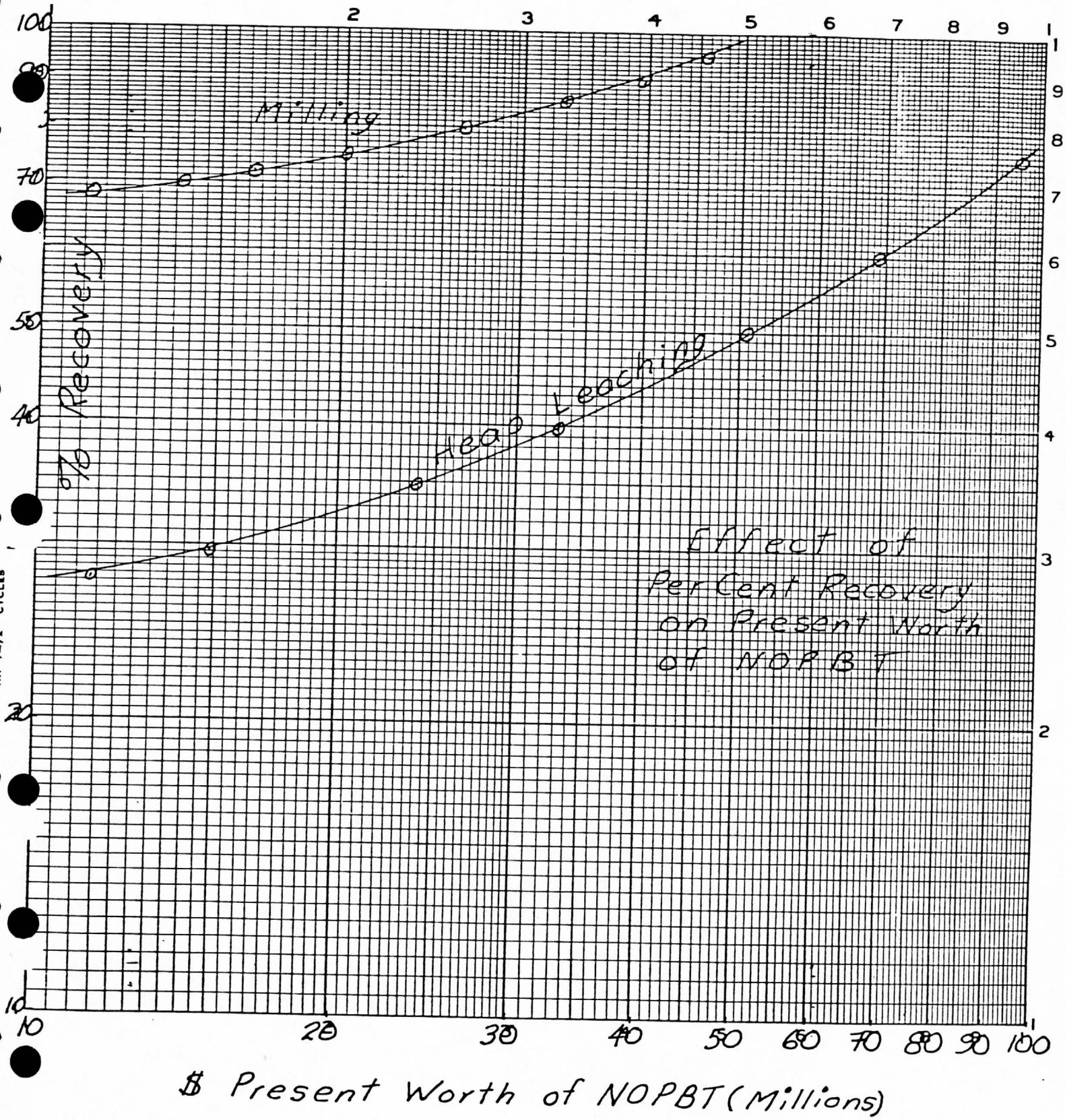
1. Milling requires double the percent recovery to obtain the same present worth as heap leaching; heap leaching will obtain the same present worth of the cash flow as milling at one-half the recovery.

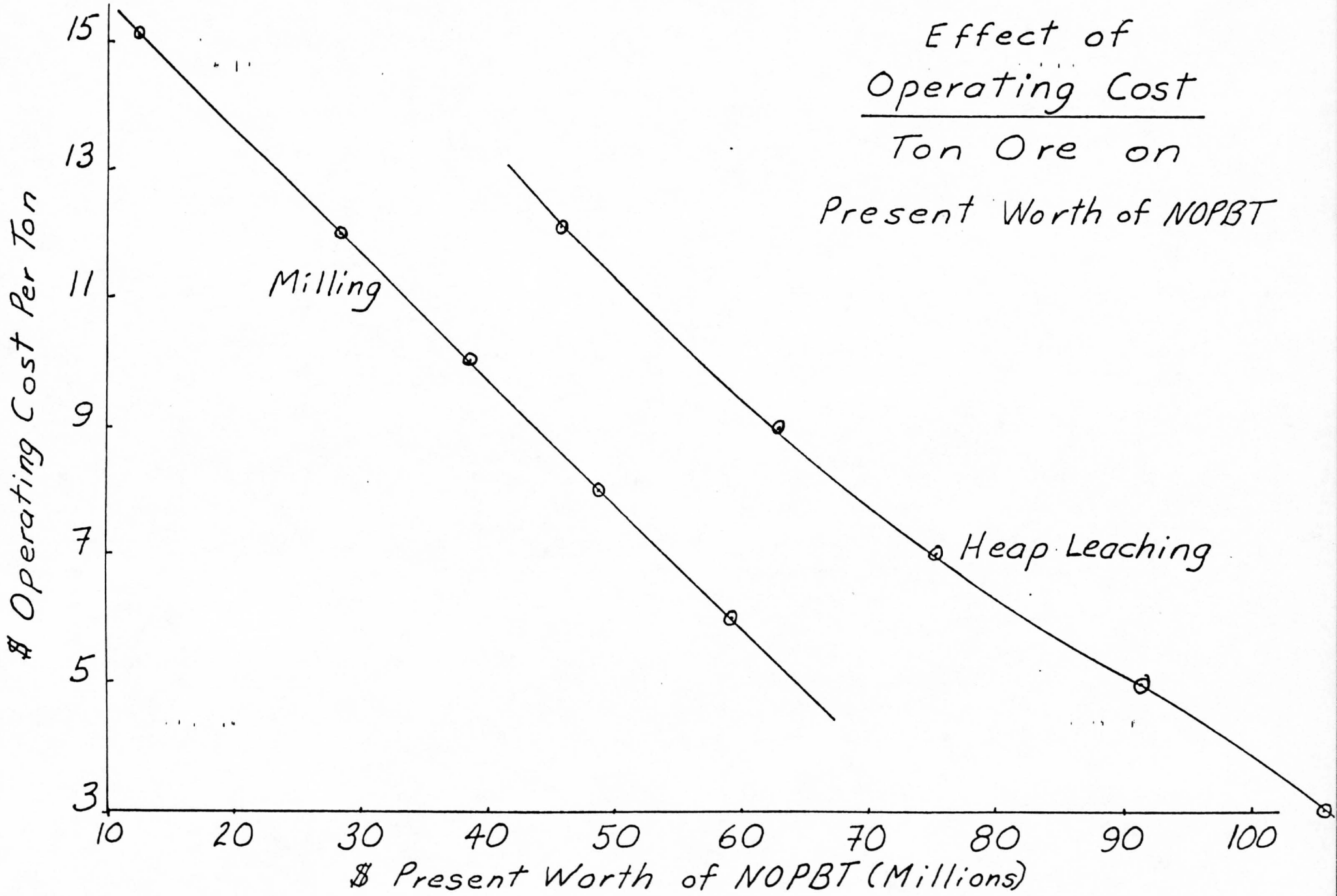
The present worth of the NOPBT was computed for various operating costs for milling and heap leaching. Following are the results:

1. For the same operating cost per ton of ore, heap leaching produces an average $ 21.5 million present worth greater than milling.

2. For realistic operating costs, the present worth for heap leaching is about 2½ times that of milling.


Effect of Capital Investment on the Present Worth of NOPBT
Milling
Heap Leaching
Capital Investment ($ Millions)
# Present Worth of NOPBT (Millions)
10
9
80
70
60
50
40
30
20
10
9
8
7
6
5
4
3
2
1
70
90
110
130
150
170
190
210
230
250


Milling
Heap Leaching
% Recovery
Effect of Per Cent Recovery on Present Worth of NOPBT
$ Present Worth of NOPBT (Millions)
10
20
30
40
50
60
70
80
90
100


Effect of
Operating Cost
Ton Ore on
Present Worth of NOPBT
Milling
Heap Leaching
$ Operating Cost Per Ton
15
13
11
9
7
5
3
10
20
30
40
50
60
70
80
90
100
$ Present Worth of NOPBT (Millions)

# HEWLETT MANAGEMENT

R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
Sparks, Nevada 89431

## GETCHELL PARAMETERS

### Geology

The eastern part of the District is underlain by shale, slate, and limestone of the Preble Formation(Cambrian) and by limestone, shale, and conglomerate(Pennsylvania and Permian). The higher central part of the District is occupied by a stock of granodiorite(Cretaceous).

The major ore deposits are sheetlike masses irregularly distributed in veins along various fault branches near the surface but that coalesce at depth along the main fault. The veins consist of sheared and mineralized sedimentary rock which is cut by quartz and calcite veinlets and which contains a soft carbonaceous gumbo. Most of the gold is in the gumbo. Gangue, in addition to gumbo, consists of small amounts of barite, chabazite, gypsum, and fluorite. Pyrite, pyrrhotite, arsenopyrite, marcasite, orpiment, realgar, stibnite, ilsemannite, cinnabar, magnetite, gold, and scheelite are the major ore minerals. Gold occurs as minute particles associated with magnetite and carbonaceous material in the gumbo and also as submicroscopic particles in pyrite and marcasite. The richer gold accumulations are characterized by realgar.

### Mineralogical Chemistry

Following are the solvents for the various minerals at Getchell:

| Mineral Name | Chemical Equation | Mineral Solubility |
|---|---|---|
| Gangue; ****** | | |
| Barite | $BaSO_4$ | $H_2SO_4$- 3 % HCℓ |
| Chabazite | $CaAℓ_2Si_4O_{12}$ | Zeolite-Weak acid |
| Gypsum | $CaSO_4 \cdot 2H_2O$ | Acids, $Na_2S_2O_3$, & $NH_4$ salts |
| Fluorite | $CaF_2$ | $NH_4$ salts, acids |
| Ore; *** | | |
| Pyrite | $FeS_2$ | $HNO_3$ |
| Pyrrhotite | $Fe_{n-1}S_n$ -n=5-16 | Acids |
| Arsenopyrite | FeAsS | HCℓ, $HNO_3$, $NH_4OH$ |
| Marcasite | $FeS_2$ | $HNO_3$ |
| Orpiment | $As_2S_3$ | Alkali & Alkali Carbonates |
| Realgar | AsS | $K_2S$, $NaHCO_3$ |
| Stibnite | $Sb_2S_3$ | Alkali, $NH_4HS$, $K_2S$, & HCℓ |
| Cinnabar | HgS | $Na_2S$, aqua regia, & $HNO_3$ |
| Magnetite | $Fe^{II}Fe_3^{III}O_4$ | Acids |
| Scheelite | $CaWO_4$ | $NH_4Cℓ$ |

# HEWLETT MANAGEMENT

R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
Sparks, Nevada 89431

## Metallurgical Processes

Conventional cyanide milling methods have been applied over the last ten years to "Heap leaching" techniques that have resulted in lower operating costs, lower capital investments, and much higher production rates. Mining Companies such as Newmont and Placer Development have pioneered these "heap leaching" innovations on ore very similar to the carbonaceous and oxide gold ores found at Utah International's Getchell deposit.

A review of the similarities of conventional milling and heap leaching follows:

### Gold Metallurgical Comparison of Unit Operations

| Milling | Heap Leaching |
|---|---|
| ******* | ********** |
| Crushing Grinding | Crush |
| Pre-Treatment | Add IPS / Pre-Treatment |
| Materials Handling in Mill | Heap Ore on Pad |
| Agitation Leaching with CN | Spray with CN |
| Liquid-Solid Separation (CounterCurrent Decanation) | Collect Effluent in Preg Pond |
| Tailing's Disposal Pond / Recover Precious Metal Values in Plant | Recover Precious Metal Values in Plant |

# HEWLETT MANAGEMENT

R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
Sparks, Nevada 89431

Both Carlin(Newmont) and Cortez(Placer) had conventional cyanide mills and separate heap leaching operations. Carlin ran their heap-leach effluent into their mill solutions and Cortez had separate recovery facilities(carbon adsorption). Both used zinc precipitaion in their CCD plants.

Production Rate

It was assumed that for heap leaching, a constant daily rate of 12,500 tons per day of ore would be heaped on the pad. For a range of tonnages, it was assumed that the production rate would not change because on a one-shift basis, 12,500 TPD is 250,000 tons per month on a 20 day month. I firmly believe that for smaller tonnages, a high production rate is the most feasible due to the cash flow requirements with respect to the operation economics. Also, if the equipment is going to be on a lease-purchase basis, it is more economical to have a higher production rate on a unit cost basis(see discussion in the operating cost-heap leaching section). Alternatively, if the mining and hauling is contracted, lower unit costs will result on a higher production rate.

For milling, lower production rates were required due to the relationship of capital investment vs. production rate; it is the production rate for milling that determines the capital investment.

Stripping Ratio

Due to a lack of information, a stripping ratio similar to Carlins operation was used- 5.5:1.

Capital Investment(Milling)

Placer has recently determined that the replacement cost of their 2200 TPD CCD-plant at Cortez would be about $24 million. For start-up utilization of their existing plant, it would cost $18 million.

PLACER has historically been able to take Becktel's estimates for plant costs and build it themselves for 1/3 less(Cortez, Marcopper, and Cordero).

Taking PLACER's replacement capital estimate of $24 million for a 2200 TPD plant, this would be $32.73 million for a 3000 TPD CCD plant.

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R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
Sparks, Nevada 89431

A very recent estimate for another property for a 3000 TPD CCD plant was $34 million. If it could be built for 1/3 less by very careful engineering and use of "very small contractors", the cost would be $21.82 million.

It is obvious that the decision to build a conventional CCD mill would have to be justified by a great deal of test work-engineering, etc.. Therefore, the delays for the justification phase would be at least one-half year. Then, the lapse time due to plant construction(pre-production period) would be about 18 months.

For purposes of this analysis, I have assumed only a delay for pre-production construction(18 months). Also, I have not included the cost of money(interest) in the financial analysis. However, effects of such items as interest are accounted for in the parametric analysis; the capital investment is varied from 20 to 70 million dollars to account for all combinations of capital investment estimates.

It was shown that the present worth of the cash flow for milling is very sensitive to capital investment.

Note that an overall capital investment estimate contains two components; the mill cost plus the mining equipment and the mine-plant facility. I am assuming that in addition to the mill construction costs, the only other two capital components are the working capital and the mine-plant facility; the mining equipment will be on a lease-purchase basis. Otherwise the capital investment would be increased by $5 million, as explained in the section on operating costs.

Capital Investment(Heap Leaching)

A break-down of the capital investment for heap leaching for the case of a 10,000,000 ton deposit. Lower capital investments(for smaller deposits) would be in proportion. Notice that the same lease-purchase basis is assumed for the heavy equipment, not making a capital investment neccessary. These cost categories and the capital investment is very realistic-in fact they can be cut quite a bit due to the use of the highest costs I have observed in such heap-leaching operations as Tombstone, Cripple Creek, Nelson, Goldfield, Round Moutain, Carlin, Cortez, and Packard(near Lovelock). For all but Round Mtn., Carlin, and Cortez, the "start-up costs" were close to one-half million dollars(including working capital). Therefore, my capital cost estimates are very easy to accomplish, and in probably all cases(various tonnages), cut them up to one-half.

# HEWLETT MANAGEMENT

R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
Sparks, Nevada 89431

Following are the general cost distribution for heap leaching:

| General Category | |
|---|---|
| Engineering | $ 54,900 |
| Water Survey | 22,000 |
| Well | 27,000 |
| Water Line | 140,000 |
| Pad | 110,000 |
| Ponds | 44,000 |
| Fencing | 22,000 |
| Roads | 54,000 |
| Housing | 54,000 |
| Freight | 150,000 |
| Spray-Leaching System, Crushing, & Metal Recovery Plant | 720,000 |
| Generators/Power | 160,000 |
| Pre-Production Mining | 550,000 |
| Management-Overhead | 130,000 |
| Ancillary | 2,762,100 |
| | $ 5,000,000 |

Note:- This is for a very large heap-leaching operation; in the tonnage range of 10,000,000. This is why such items as ancillary are very high; maintenance of a large fleet of trucks with a high stripping requirement(5.5:1).

# HEWLETT MANAGEMENT

R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
Sparks, Nevada 89431

## Operating Costs (Mining)

The stripping ratio for the Getchell deposit is unknown. One of the necessary next steps is to design a sequence of open pits in order to quantify the sequential stripping ratios, tonnages, grades and the consequential financial analysis based on metallurgical testing to determine the economic cut-off grades.

Because the stripping ratio is presently unknown, a number of combinations of stripping ratios was used to compute various truck requirements for an assumed cycle time as follows:

Number of Trucks (35-ton)

| Stripping Ratio | Milling (3000 TPD) Cycle Time = ½ hour | Heap Leaching (12,500 TPD) Cycle Time = ¼ hour | |
|---|---|---|---|
| 0 | 5 | 11 | |
| 1:1 | 11 | 22 | |
| 2:1 | 16 | 33 | |
| 3:1 | 21 | 44 | |
| 4:1 | 26 | 55 | |
| 5:1 | 32 | 66 | |
| 5.5:1 | 35 | 73 | ...Newmont (Carlin) |
| Truck Fleet Cost | $ 4.375 Million | $ 9.124 Million | |

However, the total capital investment is not required because the trucks would be purchased on a "lease-purchase" plan, as shown on the following page.

It is obvious that the cycle time potentially can be cut from ½ and ¼ of an hour for milling and heap leaching respectively, and that it would be more economically feasible for long hauls to use larger trucks which would reduce the unit operating costs per ton of ore hauled. (I used 35-ton trucks in this example because they are a good compromise for moderate hauls without excessive road building, maintenance, etc..

# HEWLETT MANAGEMENT

what would be the cost of the equipment

B. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
Sparks, Nevada 89431

The equipment lease-purchase payments are presented below:-

| Equipment | MILLING Number | MILLING Monthly Payments | HEAP LEACHING Number | HEAP LEACHING Monthly Payments |
|---|---|---|---|---|
| Cat. 769B 35-ton trucks | 35 | $ 192,000 | 73 | $ 401,500 |
| Cat. 988 6-yd. loaders | 6 | 34,500 | 12 | 69,000 |
| Cat. D8K tractor-dozer | 2 | 14,600 | 2 | 14,600 |
| Cat 977 loader | | | 1 | 3,000 |
| Blade | 1 | 1,000 | 1 | 1,000 |
| Water Truck | 1 | 1,000 | 1 | 1,000 |
| Pick-ups | 3 | 1,000 | 5 | 2,000 |
| | | $ 244,600 | | $ 492,100 |
| Monthly; | | | | |
| Cost/ton ore | | $ 2.72 | | $ 1.97 |
| Cost/ton material | | .42 | | .30 |

Notice that this lease-purchase agreement would have an "ownership payout" of 22 months. Then the ownership costs of the equipment would be considerably less, even with replacement of some of the units.

If more than one shift is considered, the following would result:

| Equipment | One-Shift | Two-Shift | Three-Shift |
|---|---|---|---|
| Trucks | $ 401,500 | $ 325,600 | $ 290,400 |
| Loaders | 69,000 | 55,200 | 50,600 |
| Dozer(s) | 14,600 | 11,680 | 11,680 |
| | 485 | 392,080 | 352,080 |
| Monthly cost; | | | |
| Per ton Ore | $ 1.97 | $ 1.60 | $ 1.44 |
| Per ton Material | .30 | .25 | .22 |

# HEWLETT MANAGEMENT

R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
Sparks, Nevada 89431

## Operating Costs (Milling)

PLACER's recent operating costs and those used for estimating their Cortez start-up operating costs per ton of ore are:

| Cost Item | 2200 TPD* | 3000 TPD |
|---|---|---|
| Milling | $ 2.00 | $ 2.75 |
| Admin. & Overhead | 2.00 | 2.25 |
| Ore Haulage | .50 | .50 |
| Ore Rehandling, Stock Pile, & Plant Services | .50 | .50 |
| | $ 5.00 | $ 6.00 |

*Cortez plant start-up estimate (1978).

The Cortez estimate (1978) for ore and waste moved is 50¢/ton. Notice that this is slightly more than the lease-purchase payments which yield a depreciation-investment situation. 2.00 US 1.97 [illegible]

Therefore, the total operating cost for milling is as follows:

| Stripping Ratio | Operating Cost |
|---|---|
| 0 | $ 6.00 |
| 1:1 | 6.50 |
| 2:1 | 7.00 |
| 3:1 | 7.50 |
| 4:1 | 8.00 |
| 5:1 | 8.50 |
| 5.5:1 | 8.75 |
| 6:1 | 9.00 |
| 7:1 | 9.50 |
| 8:1 | 10.00 |
| 9:1 | 10.50 |
| 10:1 | 11.00 |

In order to relate the operating costs per ton ore to yhe numerous cost factors as yet unquantified, especially stripping ratio, the operating costs have been ranged from $ 6.00 to $ 15 per ton of ore.

# HEWLETT MANAGEMENT

R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
Sparks, Nevada 89431

## Operating Costs (Heap Leaching)

The distribution of direct costs at Carlin (1974) for their heap leach operation on a basis of 10,000 tons ore per month:

| Category | Operation | Repair | Total | Est. Cost |
|---|---|---|---|---|
| Crushing | 14.9 % | 10.8 % | 25.7 % | 15 ¢/ton |
| Loading & hauling | 21.4 | 18.0 | 39.4 | 24 |
| Leaching | 14.9 | 12.1 | 27.0 | 16 |
| Plant | 4.3 | 1.0 | 5.3 | 3 |
| Refining | 2.2 | .4 | 2.6 | 2 |
| | | | 100.0 | 60 ¢/ton |

A very careful analysis of heap leaching operating costs was made from the operating summaries of six heap-leaching operations. The summary results applied to the Getchell deposit are (SR=5.5:1):

| Category | Operating Cost/ton ore |
|---|---|
| Crushing | $ 0.25 |
| Mining; | |
| Sample Preparation | 0.18 |
| Drilling | .37 |
| Blasting | .31 |
| Loading | .49 |
| Haulage | 1.41 |
| Dozing | .49 |
| Leaching | .15 |
| Plant | .40 |
| Admin. & Overhead | .25 |
| Shipping & Refining | .16 |
| Pre-Treatment | .54 |
| | $ 5.00 |

3.25

Notice that the mining cost is $3.25, which is related to the stripping ratio (5.5:1), or 50¢/ton ore as stated previously.

# HEWLETT MANAGEMENT

R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
Sparks, Nevada 89431

## Crushing

Newmont crushed their ore for heap leaching to 3/4 inch. Their consists are presented below:

| Screen Size | Weight % | Gold Assay | % Au Distribution |
|---|---|---|---|
| -3/4 in. + 1/2 inch | 34.2 % | 0.11 t.oz. | 23.5 % |
| -1/2 in. + 1/4 inch | 29.5 | .09 | 16.6 |
| -1/4 in. + 6 mesh | 9.4 | .12 | 7.1 |
| - 6 mesh + 20 mesh | 8.7 | .13 | 7.1 |
| -20 mesh + 200 mesh | 7.4 | .40 | 18.6 |
| -200 mesh | 10.8 | .40 | 27.1 |
| | 100.0 | | 100.0 |

The recovery obtained by heap leaching the above ore was 65.7 %. The recovery was not higher due to poor percolation resulting from the fines and values tied-up in the coarse. A new development that solves the problem is the use of "Induced Percolation Substances". This allows a recovery of over 85 % crushing finer than 3/4 inch if it is necessary from an economic point-of-view.

Analysis of other projects where the relationship of degree of crushing vs. percent recovery are as follows:

| Degree of Crushing: | As Mined | -2 inch | -3/4 inch | -1/2 inch |
|---|---|---|---|---|
| PerCent Recovery | 50 % | 60 % | 73 % | 83.6 % |
| Capital Investment | - | $ 1/4 MM | $ 1/2 MM | $ 3/4 MM |
| Unit Cost(Crushing)/ton ore | | 7 ¢ | 15 ¢ | 25 ¢ |
| Au Value(.15 Heads) | $ 15/ton | $ 18/ton | $ 21.9/ton | $ 40.32 |
| Inc. Au Value/$1 Crushing | | $ 42.86 | $ 46.0 | $ 40.32 |

The above analysis(which is a summary of numerous studies) indicates that crushing beyond approximately 3/4 inch yield a less-than-optimum situation, but it still may be economic but not optimum. Use of "Induced Percolation Substances" would allow at least a 75 % recovery. However, percent recoveries from 30-75 % were used to determine the effect of recovery on the present worht of the cash flow.

# HEWLETT MANAGEMENT

R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
Sparks, Nevada 89431

## Break Even Cut-Off Grade

After mining, the decision to be made is whether it would pay to process (heap leach) or if the material should go to a wate dump. This is to say that for the case of milling, it would pay to heap leach the low grade. Following are the break even cut-off grades:

| MILLING | | | HEAP LEACHING | |
|---|---|---|---|---|
| 2200 TPD | 3000 TPD | | No Crushing | Crushing |
| $ 5.00 | $ 6.00 | Post Mining .....Cost..... | $ 1.50 | $ 1.75 |
| .026 | .032 | Break Even ...Cut-Off Grade... (Heads) | .015 | .012 |

It would be very interesting to know what the ore reserves would be for cut-off grades of .010, .015, .020, .025, .030, and .035.

I believe that would add many millions of tons to the leachable ore reserve, which would add both life and cash flow to the property. This would greatly reduce the stripping ratio, and consequently the unit costs per ton ore, which further effects the break even cut-off grade.

TM First Proposal

pltf's EXH #1
Briseno Depo
Aug 28 '80
RL

TOMBSTONE PROJECT

Southwestern
Exploration
Associates, Inc.

4500 E. SPEEDWAY, SUITE 14, TUCSON, ARIZONA 85712 (602) 795-6097

# TOMBSTONE PRECIOUS METAL PROCESSING

One million tons of gold and silver ore has been "heaped" into a large pile 1500 feet long, 400 feet wide, and 100 feet high. Processing of the ore was incomplete in the past. Crushing and chemical pre-treatment of the ore has been proven to liberate the gold and silver values.

Samples taken in February show a combined gold and silver value of $23 per ton of ore. This confirms previous sampling of the ore taken before it was heaped, when precious metal prices were 1/3 of today's prices. Existing leaching facilities on the property make the chemical processing of the ore very feasible and economic.

The cash flow from the processing of the ore would pay back a $200,000 capital investment in from 4 to 6 months, assigning 50% of the net operating profit to retiring the capital investment. However, the project would be structured in capital investment increments of $50,000 because the expected required capital investment is under $100,000. Following are the profits participating interest and return for various required investment increments:

| Required Investment Increment | Profits Participating Interest | Expected Return |
|---|---|---|
| Under $100,000 | 15% | $1,500,000 |
| $100,000-$150,000 | 20% | 2,000,000 |
| $150,000-$200,000 | 25% | 2,500,000 |

One important feature of this investment is that the lease provides for taking "product in kind", which allows the investor to hold certificates of ownership of gold and silver issued by the refinery. Also, bullion can be owned and stored. Because of possession of bullion in some form, the time of sale and quantity sold is determined by the owner, and the "taxable event" occurs at the time of the sale.

# TOMBSTONE EQUIPMENT

Required for re-processing the dumps would be the following:

Jaw and roll or cone crusher.

Grizzly for course at jaw feed.

One half (½) inch screen for re-cycle through roll/cone.

Conveyor belts.

Dozer.

Front-end loader.

Infrequently, a blade & water truck (pad construction).

We will pay the insurance and performance bond. Premiums - (2,000,000 liability & $150,000).

Following are the profits interest and expected profit returns:

| Case | Profits Interest | Expected Profit Return | |
|---|---|---|---|
| | | Total | Per Ton |
| Contractor pays operating costs for 60 days. | 15% | $1,500,000 | $1.50 |
| Contractor pays operating costs for 30 days. | 12% | $1,200,000 | $1.20 |
| S.E.A. Hydromet pays cost plus 10% from start. | 10% | $1,000,000 | $1.00 |

# TOMBSTONE SERVICES

Services required for the Tombstone heap re-processing include but are not limited to:

1. Supervision and labor for metallurgical testing, equipment and pipe installation, and leaching personnel.
2. Use of laboratory equipment, such as, crushing & pulverizing equipment, wet-lab facilities and atomic adsorption analysis for gold or silver.

For the above, the following profits interest would be earned and the resulting expected profit return from the heap re-processing.

| Actual Cost of Services and Equipment Rental | Profits Participating Interest | Expected Return |
|---|---|---|
| $0 - 25,000 | 2½% | $250,000 |
| 25,000 - 50,000 | 5% | 500,000 |
| 50,000 - 75,000 | 7½% | 750,000 |
| 75,000 - 100,000 | 10% | 1,000,000 |

# TOMBSTONE HEAP

Following are recent samples taken from the heap, grouped by screen size and mineral:

| Ore Type | Troy Oz./Ton Au | Troy Oz./Ton Ag | Value* Au | Value* Ag | Total Value |
|---|---|---|---|---|---|
| Clay | .041 | .26 | $10.25 | $1.95 | $12.20 |
| Fines | .086 | .29 | 21.38 | 2.18 | 23.56 |
| Large | .038 | .53 | 9.38 | 3.94 | 13.32 |
| Manganese | .155 | 1.44 | 38.75 | 10.80 | 49.55 |

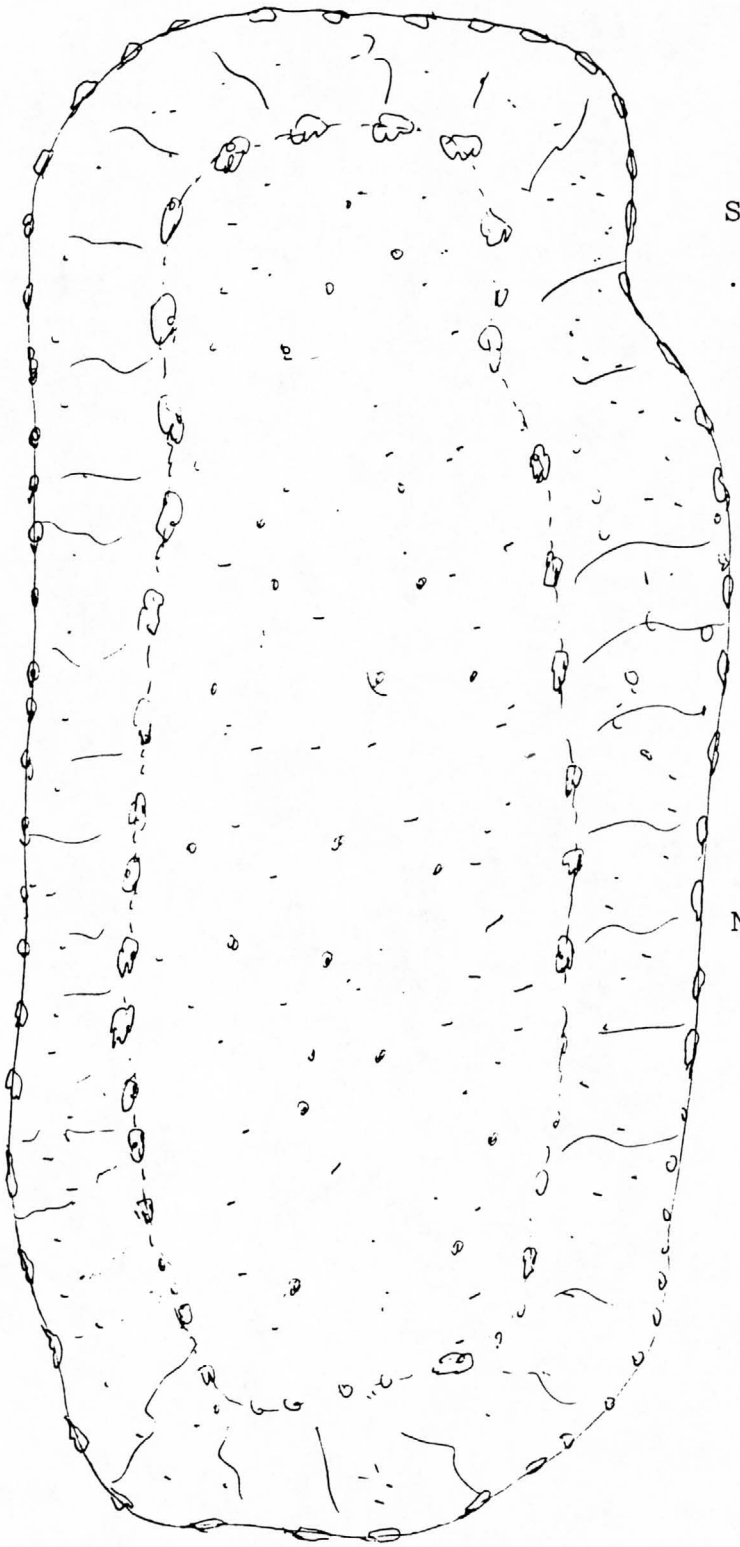
The above were weighted by their respective weight percent age (15%,25%,40% & 20%) and the average value ($250 Au & $7.50 Ag*) is $22.95. Assuming a 65% recovery, the resulting ore value would be $15.00. The operating costs will be under $5.00 per ton ore, yielding a net operating profit before taxes of $10.00 per ton ore.

SOUTHEAST CLAY
.021 Au/.12 Ag

SOUTHWEST CLAY
.060 Au/.36 Ag

SOUTH FINES
.120 Au/.42 Ag

SOUTH LARGE
.042 Au/
.57 Ag



SOUTH MANGANESE

.150 Au/1.89 Ag

TOMBSTONE "HEAP"
**********
Assays of ore types
and sizes.....

NORTH MANGANESE

East .177 Au/1.98 Ag

West .138 Au/.45 Ag

NORTH CLAY
.042 Au/.30 Ag

NORTH FINES
.051 Au/.15 Ag

NORTH LARGE
.033 Au/.48 Ag

Plf's EXH #2
Brisco Depo
Aug 28 '80
RL

I

Tombstone Dump Leach

II

Tombstone Open-Pit and Underground

February 20, 1979

Prepared for:
Southwestern Exploration Associates

## TOMBSTONE DUMP LEACH

Summary..... 1
Introduction..... 2
Location and Access..... 2
Legal Description..... 2
Description of the Dumps..... 3
Productive History of the Dumps..... 3
Recommendations..... 4
Costs..... 5

## TOMBSTONE OPEN-PIT AND UNDERGROUND

Summary..... 6
Introduction..... 7
Location and Access..... 8
Legal Description..... 8
Regional Geology..... 8
Geology of the Property..... 9
Production History of the Property..... 10
Recommendations..... 11
Costs..... 12

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4500 E. Speedway, Suite 14
Tucson, Arizona 85712
(602) 795-6097

James A. Briscoe, President
Registered Professional
Geologist

**Southwestern Exploration Associates, Inc.**

Feb 20, 1979

# TOMBSTONE DUMP LEACH

## SUMMARY

Southwestern Exploration Associates, Hydrometallurgy has acquired a lease from Tombstone Development Company of all their mining properties in the Tombstone Mining District. These mining properties consist of 88 patented and 18 unpatented mining claims located in Sections 11, 12, 13, 14, 15, and 23, Township 20S, Range 22E, Cochise County, Arizona, U.S.A.

1971 Minerals of New York City, New York operated a heap leach on the property for over three years. They economically recovered gold and silver from waste dumps located on the property. Austral Oil Company of New York City, New York sampled and conducted metallurgical testing on the dump material prior to 1971 Minerals operation.

Examination of dump assays, recovery reported by the refinery, and a study of 1971 Mineral's recovery methods directs us to recommend processing of 1,000,000 tons of dump materials utilizing advanced metallurgical heap-leaching technology. Significiant gold and silver values exist in all of the dump material. Completed work totals $177,600. Costs are verified as of February 20, 1979.

## INTRODUCTION

This report was prepared at the request of Southwestern Exploration Associates. The writer has inspected all available information, public, state, and private (see attached report). This information consists of drill logs, trench assays, metallurgical testing of the dump ore, and check assays made by the writer on a large number of dump samples.

## LOCATION AND ACCESS

The property held for discussion in this report is located 75 miles southeast of Tucson, Arizona, U.S.A. It is just south of the town of Tombstone Arizona in the County of Cochise.

Access is excellent throughout the area. Numerous roads connect through the property.

## LEGAL DESCRIPTION

TOMBSTONE DEVELOPMENT LEASE
Sections 11, 12, 13, 14, 15, and 23, Township 20S,
Range 22E, Cochise County, Arizona, U.S.A.
(2194 acres)

## DESCRIPTION OF THE DUMPS

The dumps were formed during the mining of the District during the late 1800's through 1924. At that time, this material was not economic to process by milling (see page 10 of attached report).

The dump ore consists of limestones, shales, quartzites, and siltstones that are chemically basic. The gold is mainly native with some near surface oxide minerals. The silver minerals are largely chlorides.

## PRODUCTIVE HISTORY OF THE DUMPS

The dumps have been measured to contain 1,000,000 tons of material that averaged .037 troy ounces gold and 2.26 ounces silver per ton of material. This amounts to 33,679 troy ounces of gold and 2,057,151 troy ounces of silver.

1971 Minerals recovered 13,472 troy ounces gold and 720,003 troy ounces of silver. This results in a precious metal inventory remaining in the dumps of 20,207 troy ounces gold and 1,337,148 troy ounces silver. At present precious metal prices, the gross value is over $12 million U.S. Dollars. Refer to attached report showing details of the dump sampling and precious metal values.

| | Total before '71 | '71 Min. | Total assumed value after mining at '71 | Theoretical $ value left at current prices |
|---|---|---|---|---|
| Gold | (100%) 33,679 | (40%) 13,472 | = (60%) 20,207 x 200 | = $4,041 |
| Silver | (100%) 2,057,151 | (35%) 720,003 | = (65%) 1,337,148 x $6 | = 8,022 |
| | | | | $12,063 |
| | | | | at current prices |
| | | | 250 | = 5,[illegible] |
| | | | 8 | [illegible] |
| | | | | $15,748 |

Metallurgical testing by various laboratories produced recoveries of from 50 to 75%. The ore must be crushed and pre-treated to induce percolation and then heap leached. Leaching would be conducted on an existing leach pad on the property. Also, numerous facilities exist on the property that would enable production shortly after the project is initiated.

A very careful analysis of the operating costs incurred by 1971 Minerals showed a total processing cost of slightly over $2.00 per ton treated. A detailed cost analysis made of six other precious metal heap leaching operations show that the costs of further processing of the Tombstone dumps would be about $2.50 per ton treated. The dumps represent a gross value of $11.40 per ton and, using a minimum metallurgical recovery of 50%, the recovered value is $5.70 per ton, or a net operation profit of $3.25 per ton. This represents a net operating profit of $3,250,000 (see pages 12 and 13 of attached report).

RECOMMENDATIONS

It is recommended that processing of the dumps proceed at once, starting with minor metallurgical testing to determine the most profitable dump areas for fast recovery.

min '71 processing cost of $2/ton
Further processing of ore $2.50/ton
total costs 4 [illegible] + = $5.00/ton

| Gross value | Au | Ag |
|---|---|---|
| | 15 mm | 12 mm |
| 50% to 75% (50% → | 7.5 | 6.0 |
| → cos'ts | | 5.0 |
| | $2.50 | $1.00 |

Jim give us estimate of # 3

By utilizing recently developed heap-leaching technology, at least 50% of the remaining values can be recovered. The costs of precious metal recovery will be very low, resulting in a significant cash flow.

COSTS-

The $177,600 represents the following turn-key complete work to get the property to the point of producing enough gold and silver to support the on-going production.

| | | |
|---|---|---|
| 1. | Property research and title clearance | $ 5,000 |
| 2. | Leases, claims, and property consolidation | 10,000 |
| 3. | S.E.A., Inc. test work and tonnage verification of: | |
| | a. Heap ore | |
| | b. Gob ore | |
| | c. Open-pit ore | 10,000 |
| 4. | Heap leaching and gob evaluation and testing: | |
| | a. Plant monitoring equipment | |
| | b. PVC pipe and leaching supplies | |
| | c. Recovery plant | |
| | d. Pumps | |
| | e. Chemicals for leaching | |
| | f. Crushing equipment | |
| | g. Dozing and blade work | |
| | h. Power | |
| | i. Water | 152,600 |
| | TOTAL | $177,600 |

# TOMBSTONE OPEN-PIT

## SUMMARY

Southwestern Exploration Associates, Hydrometallurgy has acquired a lease from Tombstone Development Company of all their mining properties in the Tombstone Mining District. These mining properties consist of 88 patented and 18 unpatented mining claims located in Sections 11, 12, 13, 14, 15, and 23, Township 20S, Range 22E, Cochise County, Arizona, U.S.A.

Austral Cil Company of New York City, New York sampled and conducted metallurgical testing on the dump material and did extensive geophysical work that led to the discovery of open pit ore. Nemont and Phelps Dodge have done major surface drilling and underground exploration during the 1950's. The data generated cost over $3,000,000 at a time when precious metal prices were very low compared to the present.

Open pit exploration should begin at once to develop ore for heap leaching on existing leach facilities on the property.

Completed work totals $150,000

What will be the cost to evaluate.

## INTRODUCTION

This report was prepared at the request of Southwestern Exploration Associates, Tucson, Arizona. The writer has inspected all available information, public, state and private (see attached report).

This information consists of core and rotary surface drilling conducted by Newmont Mining Company in 1953-57, underground maps of structure and core drilling, assay sheets from the drilling, surface sampling by Duval Mining Company, surface sampling and rotary drilling by 1971 Minerals. Also, data from surface drilling by Phelps Dodge has been studied, as well as their geological maps and cross-sections showing underground working and the extent of the mined ore bodies. Numerous reports of the early mining was helpful to evaluate underground areas that are not accessible at this time.

The writer has spent considerable time underground and examining the surface outcrops and has done extensive sampling on the property.

## LOCATION AND ACCESS

The property held for discussion in this report is located 75 miles southeast of Tucson, Arizona, U.S.A. It lies just south of the town of Tombstone, Arizona in the County of Cochise.

Numerous roads provide good access to all areas of the property. Most underground workings are accessible, but some work will be required in more remote workings.

## LEGAL DESCRIPTION

TOMBSTONE DEVELOPMENT LEASE
Sections 11, 12, 13, 14, 15, and 23, Township 20S
Range 22E, Cochise County, Arizona, U.S.A.
(2194 acres)

## REGIONAL GEOLOGY

Quartz porphry intrusions cut sedimentary units comprising limestones, shales, sandstones, and quartzites that were previously folded and faulted by tectonic activity. Mineralizing fluids migrated into the sediments along faults, fissures, and other structures and deposited precious and other minerals along the structures or along contacts and in the limestone as manto deposits (see page 5 of attached report and "Regional Section").

## GEOLOGY OF THE PROPERTY

The geology of each of the geological targets for open-pit and underground ore bodies are shown in detail in the attached report (see page 6 and the "Deposits Section"). Anticlinal structures were the largest single producer and most of these mineralized structures are very close to the surface; many of the bonanza ore bodies outcropped on the surface and were followed in depth.

All of the old mines have gob that is of economical grade, as well as disseminated mineralization that is economic at the present precious metal prices.

In addition to the open-pit ore bodies, mining could not progess much below 500 feet below the surface due to numerous problems of pumping the water in the early 1900's (see page 5 of the attached report). Very high-grade ore bodies exist at the water table, and it has been proven in over 10 of the 23 mines that good ore-grade continuity exists below the 500 foot level (see page 7 and "Exploration Section" of attached report). Gold values range from 1 to 5 ounces on the lower mine levels. Refer to enclosed maps showing the mine workings above and below the water table (see Exploration Section" of attached report).

1636X .133 gold X 250 = $54 MM
20.67 silver X 7 $236 MM

## PRODUCTION HISTORY OF THE PROPERTY

From 1879 to 1936, 1,635,639 tons of ore were mined that averaged .133 troy ounces gold and 20.67 troy ounces silver. The present value of this production is over $225 million U.S. Dollars. The attached report contains the detailed production by mine and for the District (see pages 3 & 4).

A detailed study of drill-hole results, geological mapping and surface and underground sampling results in the following open-pit projection (see pages 14 through 17 of attached report).

| Mine Area | Tonnage Previously Mined | Last Grade Mined | | Economic Tonnage Projection | |
|---|---|---|---|---|---|
| | | Au | Ag | Gob | Ore |
| Contention Dike | 500,000 | .207 | 15.22 | 500,000 | 1,150,000 |
| Tranquillity | 200,000 | .307 | 23.25 | 100,000 | 250,000 |
| Lucky Cuss | 100,000 | .056 | 16.92 | 70,000 | 126,000 |
| Emerald | 100,000 | .010 | 8.00 | 70,000 | 126,000 |
| Bunker Hill | 50,000 | .035 | 15.45 | 40,000 | 72,000 |
| Tombstone Extension | 70,000 | .071 | 11.88 | 15,000 | 60,000 |

It has been estimated by the writer that the total potential net operating profit from open-pit mining of all mine areas is $18,821,000 from the gob and $133,480,000 from open-pit ore. (See details in attached report).

Extending the known ore bodies at depth, below 500 feet, produces a large tonnage of high-grade ore. (See maps appended to this report). The writer estimates a potential net operating profit from underground mining of over $100,000,000.00 U.S. Dollars.

RECOMMENDATIONS

It is recommended that drilling and surface sampling be initiated on the following properties to prove their potential and for open-pit development.

1. Contention Dike
2. Tranquillity Area
3. Lucky Cuss Area
4. Emerald Area
5. Bunker Hill Area
6. Tombstone Extension Area

Open-pit mining with heap leaching for precious metal recovery can be initiated shortly after the initial development sampling and drilling.

Underground evaluation and development will be concurrent with open pit development.

## REFERENCES


1. Enfield Bell
   Vice President
   Freeport Exploration Company
   Reno, Nevada

2. Hugh Matheson
   Placer Development
   Vancouver, B.C.
   Canada

3. Ralph Van Arsdale
   Occidental Petroleum Company
   Hawthorne, Nevada


## MEMBERSHIP

1. Sigma Xi, National Honor Scientific Society
2. Colorado School of Mines Alumni Association
3. Mining and Metallurgical Society of America
4. American Institute of Mining, Metallurgical and Petroleum Engineers
5. Canadian Institute of Mining and Metallurgy
6. American Mining Congress

COSTS

The 150,000.00 U.S. Dollars represents the following turn-key complete work to sample and drill the property sufficiently to develop open-pit ore to initiate precious metal recovery by facilities on the property.

1. Geological mapping
2. Surface trench sampling
3. Geochemical sampling
4. Rotary drilling
5. Underground sampling
6. Open-pit development drilling

DATED AT TUCSON, ARIZONA, U.S.A., this 20th day of February, 1979.

Richard F. Hewlett

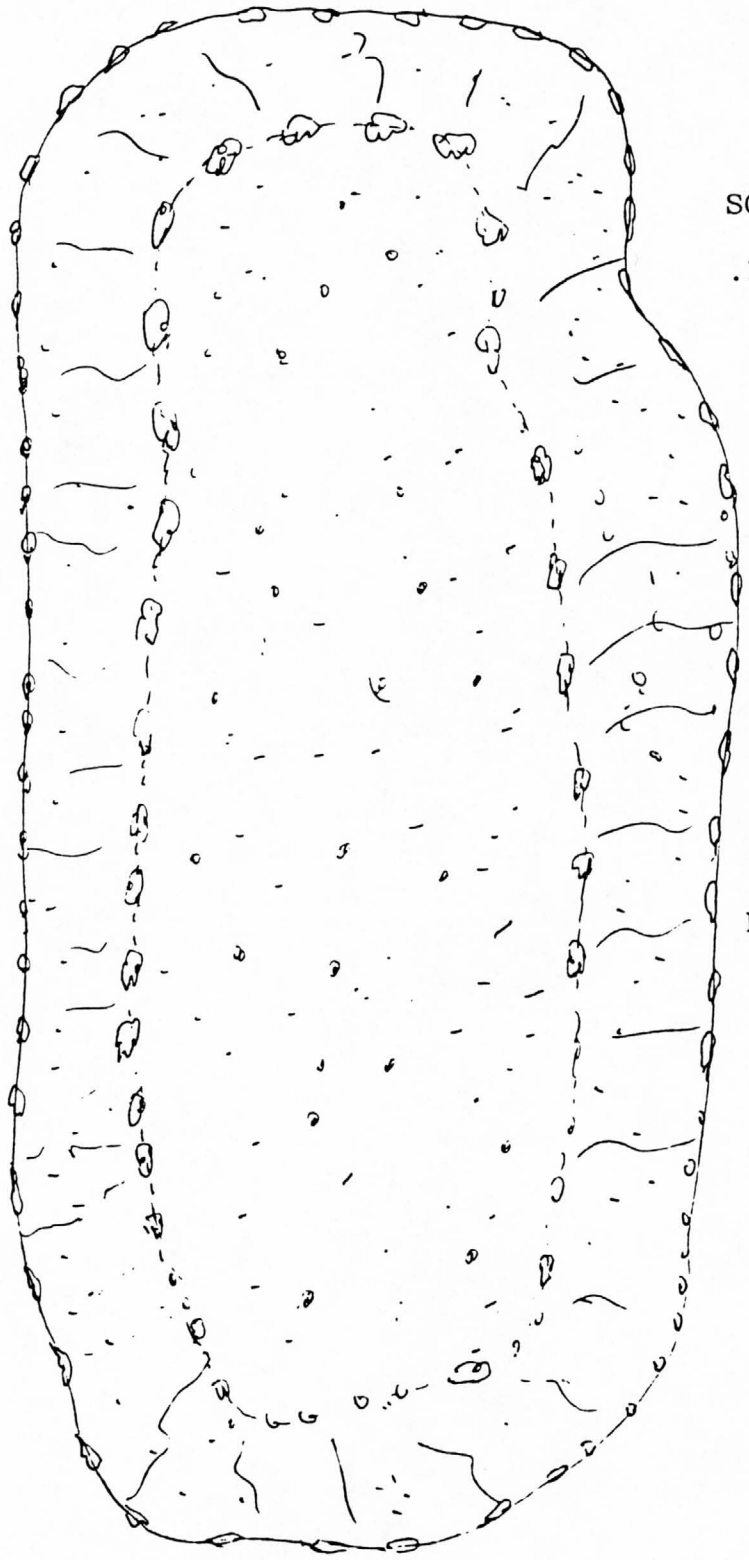
Richard F. Hewlett
Chemical & Mining Engineer
State of Arizona

SOUTHEAST CLAY
.021 Au/.12 Ag

SOUTHWEST CLAY
.060 Au/.36 Ag

SOUTH FINES
.120 Au/.42 Ag

SOUTH LARGE
.042 Au/
.57 Ag



SOUTH MANGANESE

.150 Au/1.89 Ag

TOMBSTONE "HEAP"
**********
Assays of ore types
and sizes.....

NORTH MANGANESE

East .177 Au/1.98 Ag

West .138 Au/.45 Ag

NORTH CLAY
.042 Au/.30 Ag

NORTH FINES
.051 Au/.15 Ag

NORTH LARGE
.033 Au/.48 Ag

# TOMBSTONE PRECIOUS METAL PROCESSING

One million tons of gold and silver ore has been "heaped" into a large pile 1500 feet long, 400 feet wide, and 100 feet high. Processing of the ore was incomplete in the past. Crushing and chemical pre-treatment of the ore has been proven to liberate the gold and silver values.

Samples taken in February show a combined gold and silver value of $23 per ton of ore. This confirms previous sampling of the ore taken before it was heaped, when precious metal prices were 1/3 of today's prices. Existing leaching facilities on the property make the chemical processing of the ore very feasible and economic.

The cash flow from the processing of the ore would pay back a $200,000 capital investment in from 4 to 6 months, assigning 50% of the net operating profit to retiring the capital investment. However, the project would be structured in capital investment increments of $50,000 because the expected required capital investment is under $100,000. Following are the profits participating interest and return for various required investment increments:

| Required Investment Increment | Profits Participating Interest | Expected Return |
|---|---|---|
| Under $100,000 | 15% | $1,500,000 |
| $100,000-$150,000 | 20% | 2,000,000 |
| $150,000-$200,000 | 25% | 2,500,000 |

One important feature of this investment is that the lease provides for taking "product in kind", which allows the investor to hold certificates of ownership of gold and silver issued by the refinery. Also, bullion can be owned and stored. Because of possession of bullion in some form, the time of sale and quantity sold is determined by the owner, and the "taxable event" occurs at the time of the sale.

# TOMBSTONE EQUIPMENT

Required for re-processing the dumps would be the following:

Jaw and roll or cone crusher.

Grizzly for course at jaw feed.

One half (½) inch screen for re-cycle through roll/cone.

Conveyor belts.

Dozer.

Front-end loader.

Infrequently, a blade & water truck (pad construction).

We will pay the insurance and performance bond. Premiums - (2,000,000 liability & $150,000).

Following are the profits interest and expected profit returns:

| Case | Profits Interest | Expected Profit Return | |
|---|---|---|---|
| | | Total | Per Ton |
| Contractor pays operating costs for 60 days. | 15% | $1,500,000 | $1.50 |
| Contractor pays operating costs for 30 days. | 12% | $1,200,000 | $1.20 |
| S.E.A. Hydromet pays cost plus 10% from start. | 10% | $1,000,000 | $1.00 |

# TOMBSTONE SERVICES

Services required for the Tombstone heap re-processing include but are not limited to:

1. Supervision and labor for metallurgical testing, equipment and pipe installation, and leaching personnel.
2. Use of laboratory equipment, such as, crushing & pulverizing equipment, wet-lab facilities and atomic adsorption analysis for gold or silver.

For the above, the following profits interest would be earned and the resulting expected profit return from the heap re-processing.

| Actual Cost of Services and Equipment Rental | Profits Participating Interest | Expected Return |
|---|---|---|
| $0 - 25,000 | 2½% | $250,000 |
| 25,000 - 50,000 | 5% | 500,000 |
| 50,000 - 75,000 | 7½% | 750,000 |
| 75,000 - 100,000 | 10% | 1,000,000 |

# TOMBSTONE HEAP

Following are recent samples taken from the heap, grouped by screen size and mineral:

au $250 ag $7.50

| Ore Type | Troy Oz./Ton Au | Troy Oz./Ton Ag | Value* Au | Value* Ag | Total Value |
|---|---|---|---|---|---|
| Clay | .041 | .26 | $10.25 | $1.95 | $12.20 |
| Fines | .086 | .29 | 21.38 | 2.18 | 23.56 |
| Large | .038 | .53 | 9.38 | 3.94 | 13.32 |
| Manganese | .155 | 1.44 | 38.75 | 10.80 | 49.55 |
| | .0732 | .6015 | | | |

The above were weighted by their respective weight percent age (15%,25%,40% & 20%) and the average value ($250 Au & $7.50 Ag*) is $22.95. Assuming a 65% recovery, the resulting ore value would be $15.00. The operating costs will be under $5.00 per ton ore, yielding a net operating profit before taxes of $10.00 per ton ore.

200 5.00

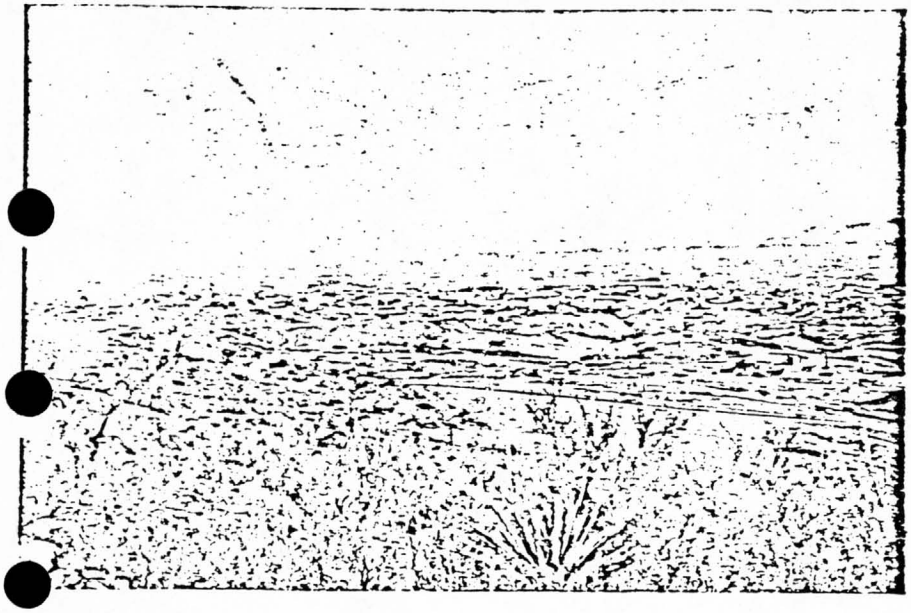
Gold 200/oz Silver 6.00/oz

| | | | | |
|---|---|---|---|---|
| Clay | 8.20 | 1.56 | = 9.76 | = 1.46 |
| Fines | 17.20 | 1.74 | = 18.94 | = 4.74 |
| Large | 7.60 | 3.18 | = [illegible] | = [illegible] |
| Manganese | 31.00 | 8.64 | = 39.64 | = 5.93 |
| | | | | 18,441 |
| | | | | 9.22 |

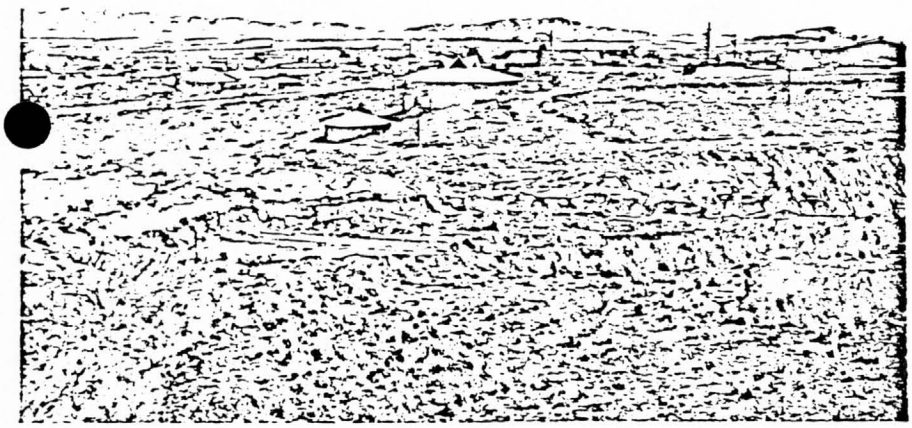
recovery % [illegible]%

[illegible]

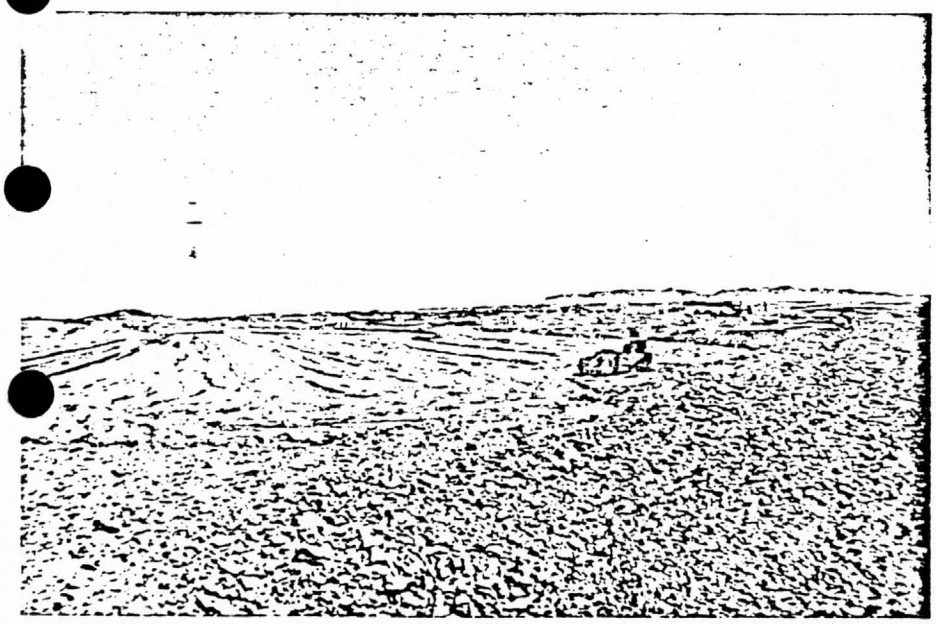
$4,000 m = [illegible]



Heap leaching site south of the town of TOMBSTONE; notice the town in the middle background. Photo taken from Contention Mine area.



Tailings site; Girard tailings. Tombstone is just north. Hatcher home in far right.



Pad site; tailings are being layed down with the blade leveling into lifts of about 3 inches and then the leveled tailings are watered for obtaining the maximum compacted density. This impermeable pad was approved by the Bureau of Mines and used for about five years without problem.

# HEWLETT MANAGEMENT

R. F. HEWLETT
PHONE (702)359-1069

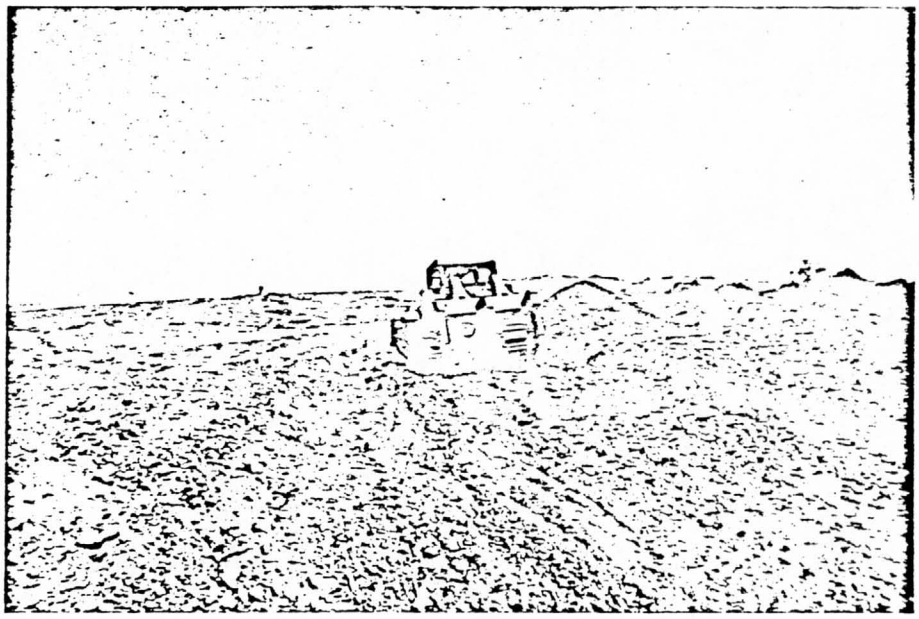


2602 Monte Verde Way
Sparks, Nevada 89431

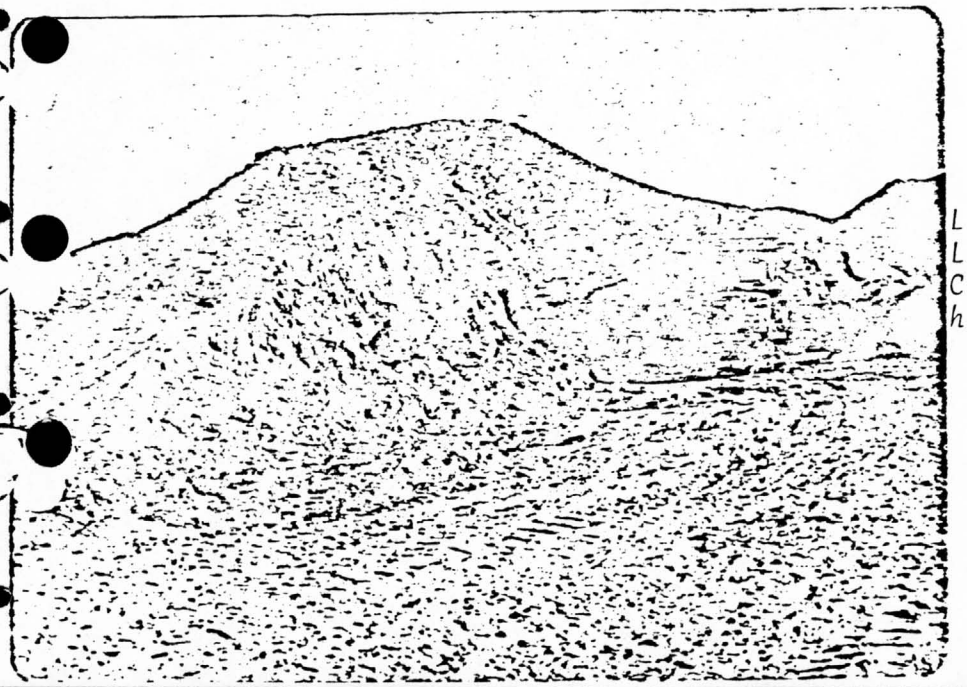
Having determined the feasibility of heap-leaching the Tombstone dumps, a site was selected south of town that was not in view of the town, but still close enough for power and city water (see photos on opposite page).

Tailings from the old Girard mill were used for pad material, as well as tailings from the West Side area. As is mentioned on the opposite page(last photo), the pad is still in good condition.

Following are the sequential development of the heap leaching operation.



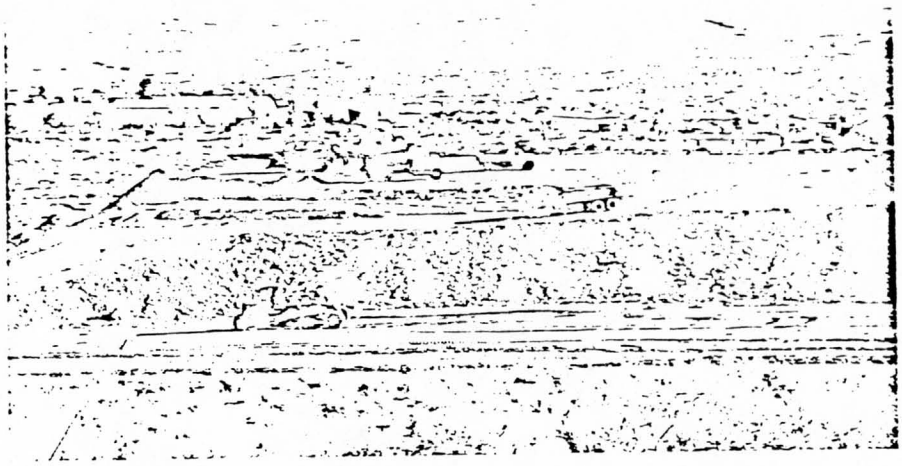
Dozer pushing and ripping on the Contention dump. This facilitates the loading operation.



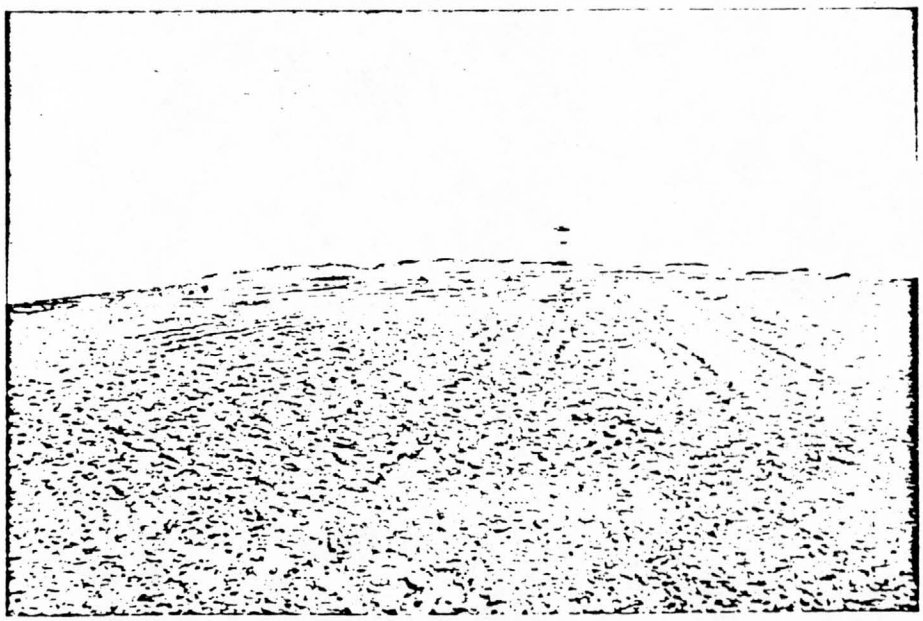
Loading at the Boss dump; Loader is a Cat 988 and Cat 35-ton trucks for haulage.

Early loading of the heap from the Contention dump. Notice in the following photos that the heap will become 100 feet high.

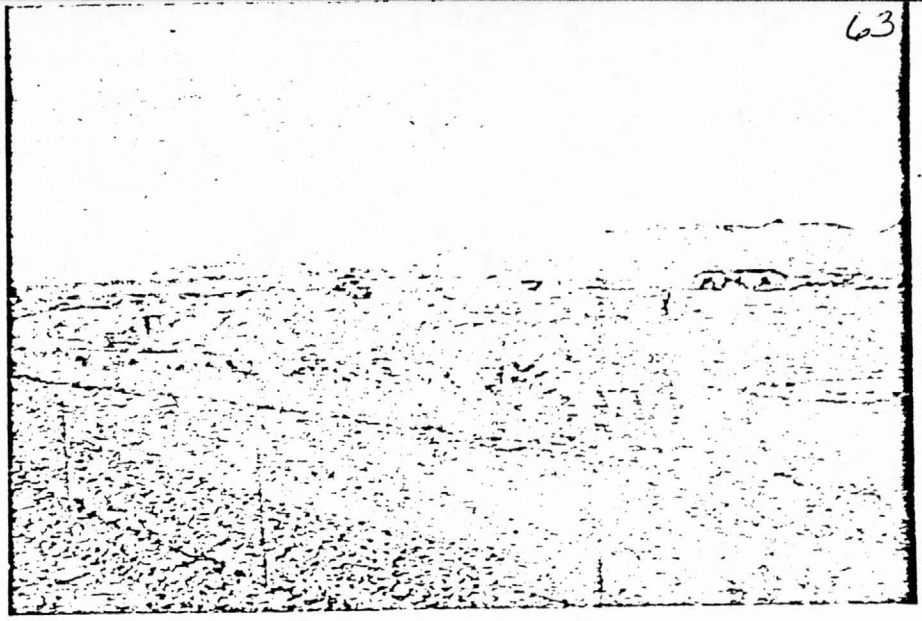
First lift on the north end of the heap; above is the south end. Notice that the first lift is about 25-feet high. The grader is preparing additional pad area.



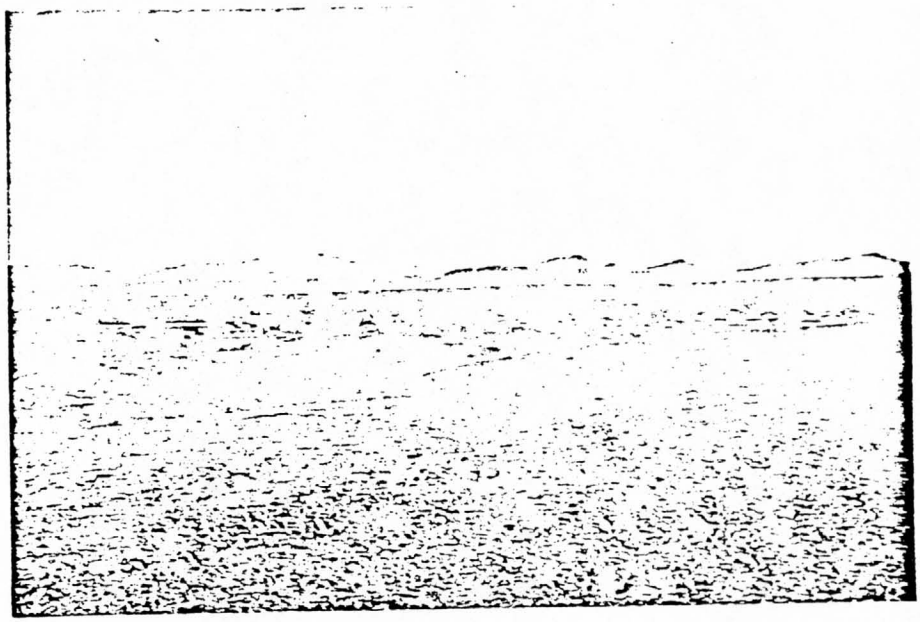
Top of leveled heap looking north. Notice that the north end is being leached. Then the spray lines will be moved to the south end and new ore will then be heaped on the north end; so goes the leaching cycle.



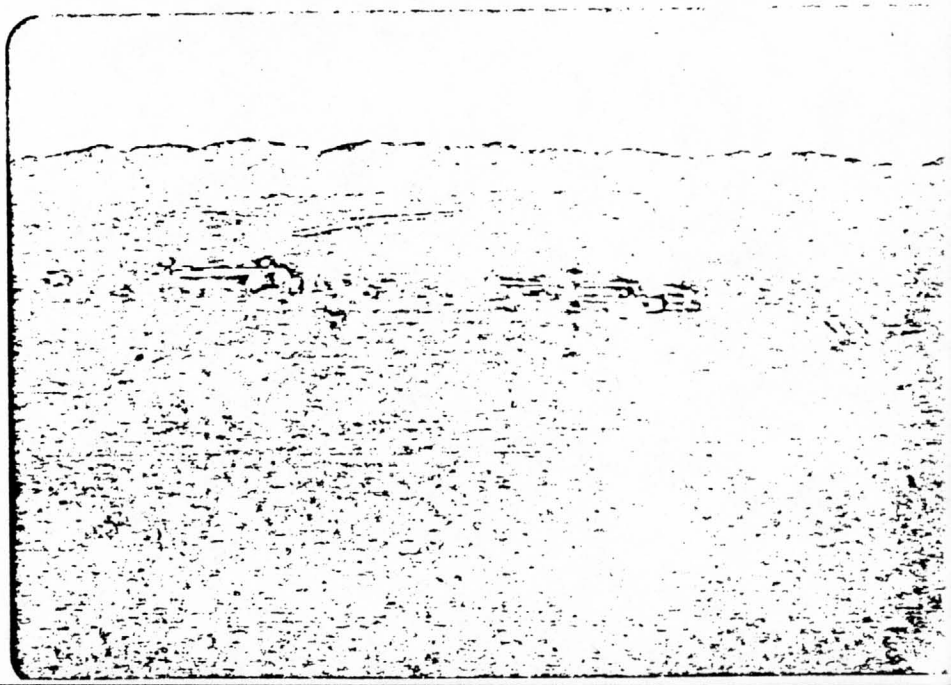
First lift increment being prepared for leaching. Notice beyond and right of the pick-up are the heaps of ore dumped by the trucks.

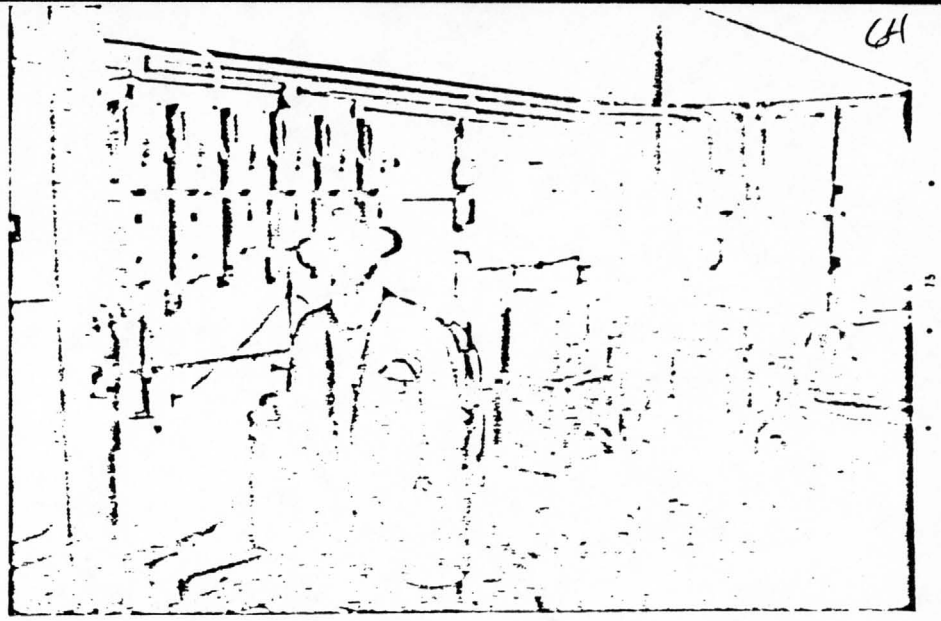


South area being leached while the ore is being heaped on the north end. Contention dump site in foreground.



Completion of second lift on the north end.

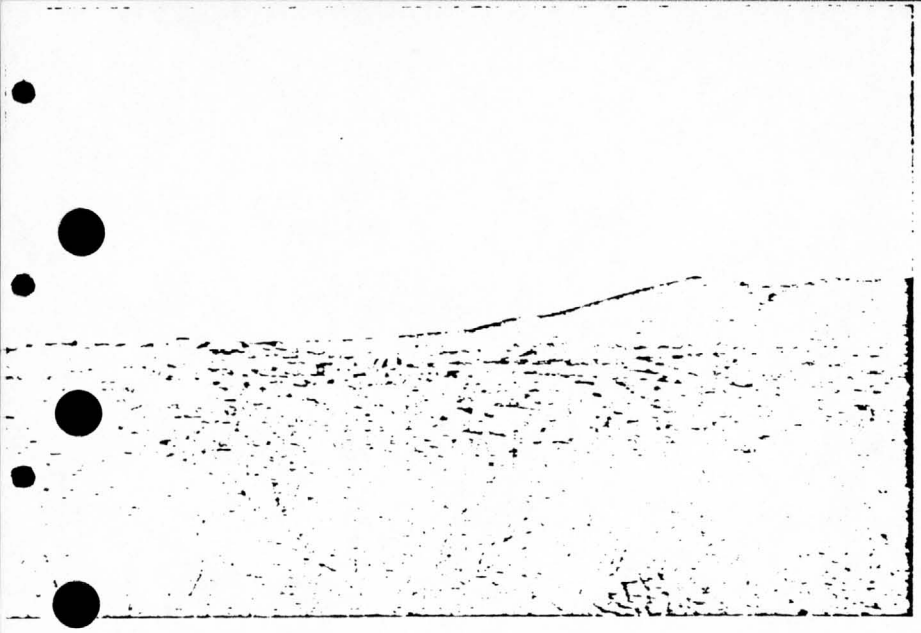




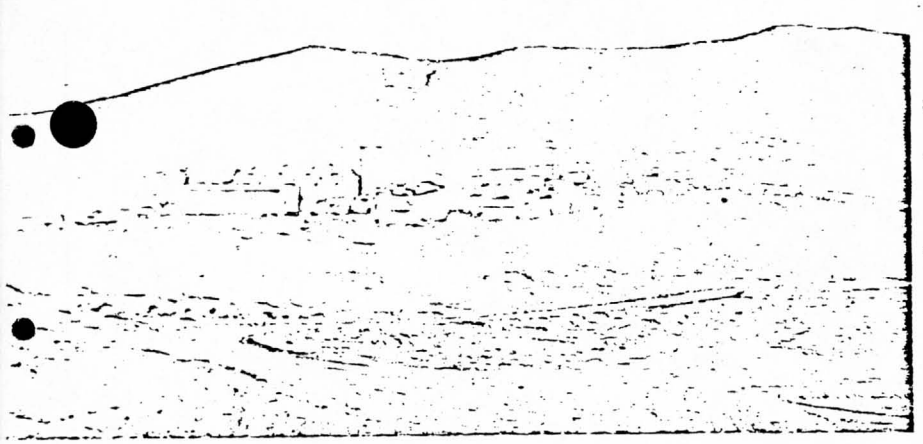
Chief metallurgist; 71 Minerals leach plant. Plant was a Merrill-Crowe zinc precipitation precious metal recovery system.

Leach plant; Schriver presses on right are for clarification and the yellow presses are for the precious metal precipitates. Each press held about $100,000 worth of gold-silver precips.

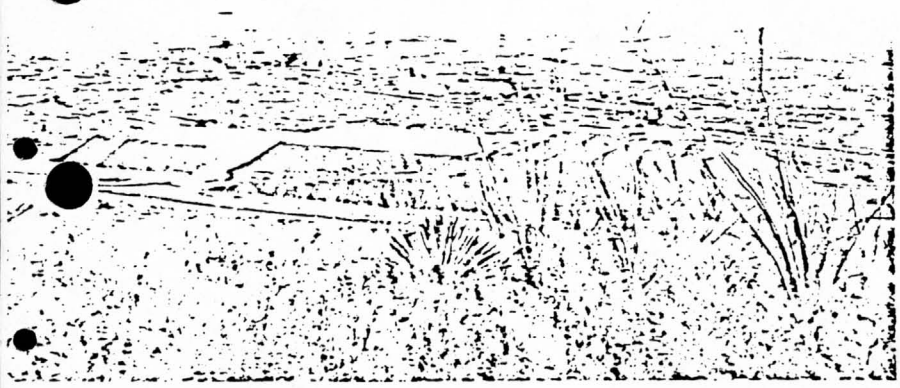
Precious metal precip press clean-up. Black color is unused zinc. Precip's are sealed in the black cyanide barrel's and shipped to the refinery.



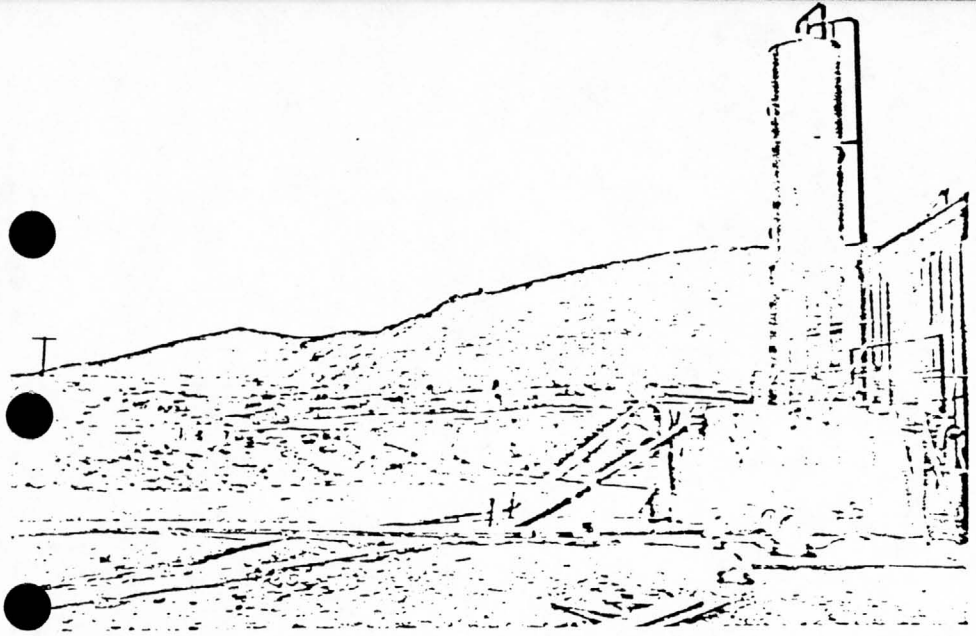
Leach plant and heap; early stage phase of the leaching operation. Photo taken from Empire dump area; looking over Tranquility mine area. Contention mine to the far right-center.



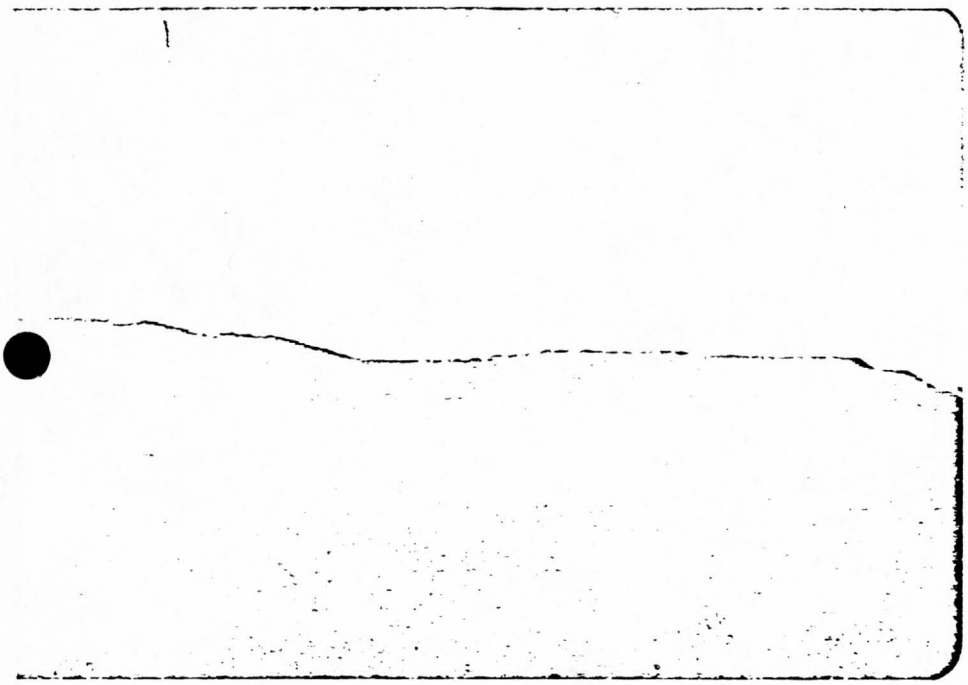
Leach plant and heap after completion of second lift on the north side. Photo taken from Tranquility dump and mine area.



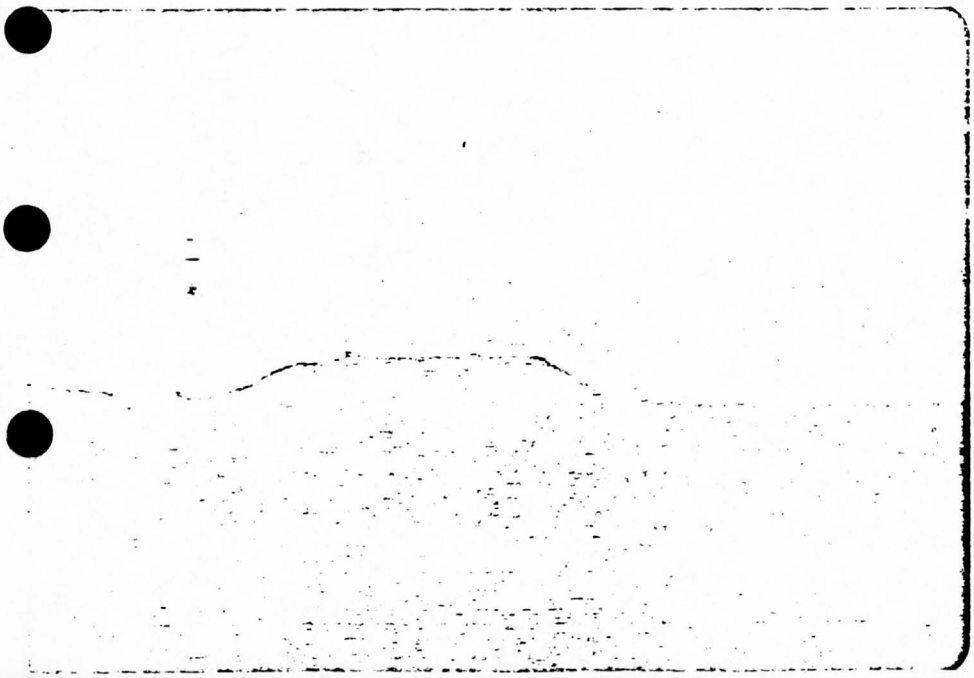
Spraying of third lift on the far south end; area on north being loaded with ore-"heaped". White crust on middle section is dryed caustic and soluble calcite ppt.



Present heap at Tombstone; The heap is about 100 feet high. Compare this photo with previous when 25-50 feet high. Hauling new ore to the heap was stopped over two years ago. Production continued by secondary recovery methods.



Final stages of leaching heap; south end was Emerald and Bunker Hill ore. Notice that the south end is becoming saturated.



Present heap viewed from the south. Notice dozer on top pushing ore and ripping to increase percolation.

HEWLETT MANAGEMENT

R. F. HEWLETT
PHONE (702)359-1069



2602 Monte Verde Way
Sparks, Nevada 89431

## FUTURE POTENTIAL

Tombstone represents three potential economic assets:

1. Heap; for re-processing.
2. Open-pit and underground ore.
3. Water; for possible sale to Tucson and locally for irrigation.

These will be discussed, but the water potential was mentioned in the section called WATER TABLE. Little can be added concerning the water potential without further discussions with the City of Tucson.

### Heap Re-Processing

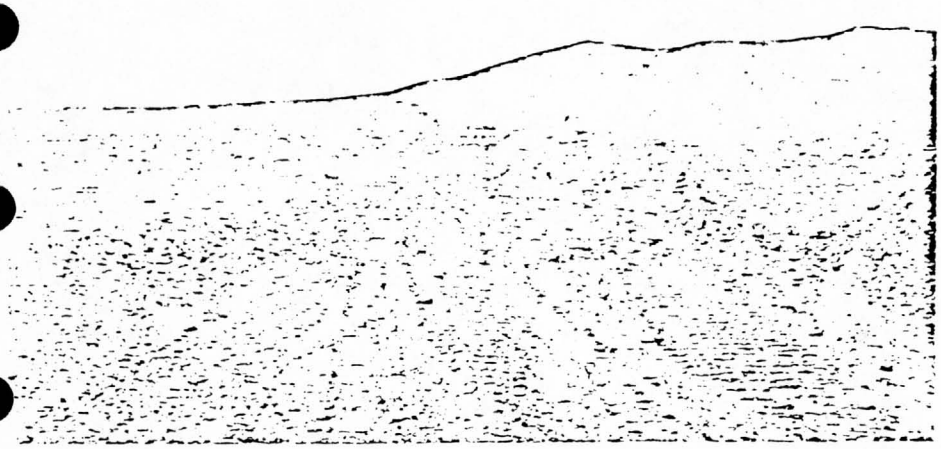
Gross value of the heap is known by the dump samples taken and the samples taken from the heap during truck-dumping and the heap leveling. Also, samples were taken after an area was leached to estimate percent recovery. In all, good sampling was done as an important phase of production monitoring.

The gross amounts and values in the heap are:

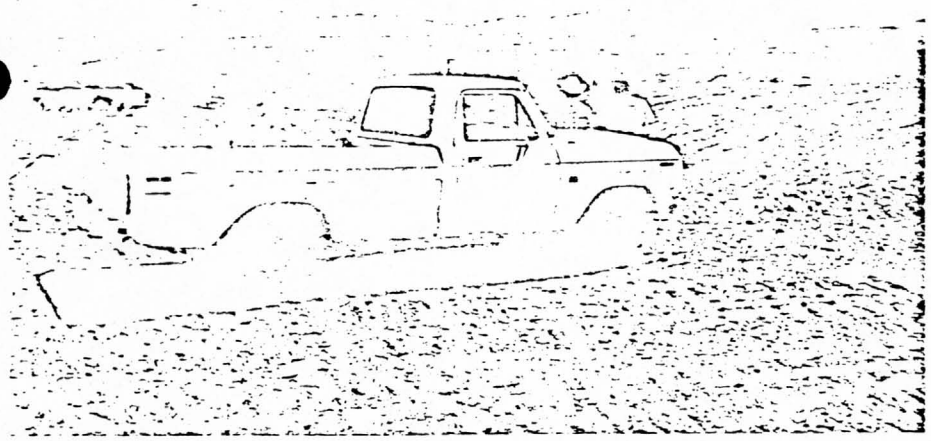
| Precious Metal | Troy Oz. | Present $ Value |
|---|---|---|
| Gold | 33,679 | $ 6,735,806 |
| Silver | 2,057,151 | $ 11,314,333 |

From the refinery receipts and the computed recoveries:

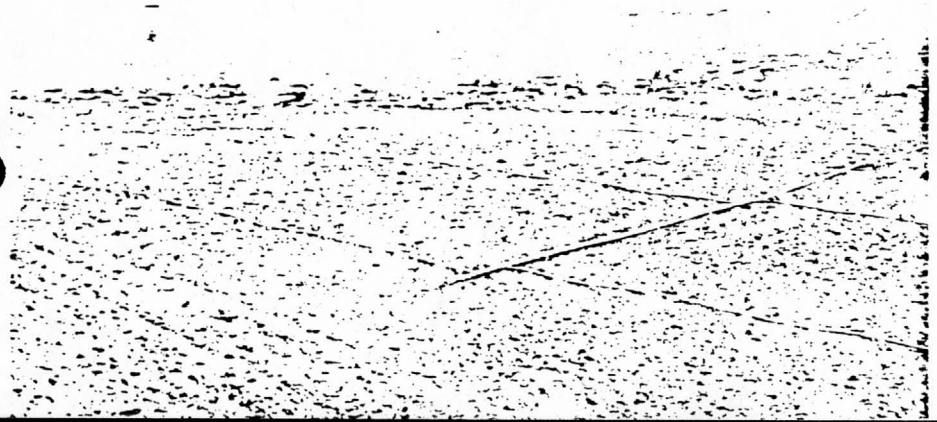
| | Quantity Remaining in Heap | |
|---|---|---|
| Precious Metal | Troy Ounces | Present $ Value |
| Gold | 20,207 | $ 4,041,483 |
| Silver | 1,337,148 | $ 7,354,316 |
| | | $ 11,395,799 |



Recent dozer activity; pushing and ripping increases percolation. Clay and fines cause channeling and blinding in the heap, reducing the recovery to about 35-40 percent.



Area east(behind) pick-up was dozed down 15 feet and ripped, producing additional values in the preg which lasted for 6 monthes; the heap represents a real asset that simple re-working can produce a significant cash flow.



Above area being leached. Notice the caustic crust which indicates this section of the heap has de-watered for about two weeks.

# HEWLETT MANAGEMENT

R. F. HEWLETT
PHONE (702)359-1069



2602 Monte Verde Way
Sparks, Nevada 89431

A financial analysis of the Tombstone heap follows:

Gross Value Remaining in Heap; $ 11.40/ton(for 1 mm tons)

Minimum recovery with crushing and "IPS" treatment; 50 %

Minimum recoverable value; $ 5.70/ton.....

Processing Costs; Operating Cost/Ton

| | |
|---|---|
| Crushing | $ 0.25 |
| Dozing | .50 |
| Leaching | .50 |
| "IPS" | .50 |
| Plant | .30 |
| Admin.&Overhead | .25 |
| Shipping&Refining | .15 |
| | $ 2.45..... |

Minimum net profit;

| | |
|---|---|
| Gross Value | $ 5.70/ton |
| Operating Cost | 2.45/ton |
| Net Operating Profit | $ 3.25/ton |
| Net Operating Profit from Re-Processing Heap | $ 3,250,000 ..... |

Required Capital Investment = $ 200,000

# HEWLETT MANAGEMENT

R. F. HEWLETT
PHONE (702)359-1069



2602 Monte Verde Way
Sparks, Nevada 89431

## Open Pit Potential

At the present prices of precious metals and by utilizing new innovations in heap-leaching technology, relatively small open pit tonnages are required to be developed to produce a very significant cash flow.

It has been observed in the underground workings that at least the same tonnage(in the form of gob)is still underground as was hoisted to the surface and placed in the "waste dumps". In most(if not all) cases, the gob is higher-grade than the waste dumps;Goodenough gob averaged .15 Au and 10 ounces Ag. Old miners tell me that the gob is the lower-grade material(ore) that was expected to be milled at a later date. The waste was assumed to be to to low grade to ever be processed. Because it was economic to process the "waste dumps", it will be shown that if we assume to discover the same gob tonnage as was dumped on the surface("waste dumps") that an open pit operation would make money if no additional ore would be discovered. That really reduces the risk.

Following are the assumptions and factual data used to make ore reserve estimates:

| Deposit Name | Last Production | | Waste Dump | | | Gob Assumed | | |
|---|---|---|---|---|---|---|---|---|
| | Au | Ag | Tons (X1000) | Au | Ag | Tons (X1000) | Au | Ag |
| Contention "Dike" | .207 | 15.22 | 381 | .051 | 1.75 | 500 | .050 | 2.10 |
| Tranquillity Skip-Ag Thd. | .307 | 23.25 | 61 | .051 | 1.99 | 100 | .058 | 1.92 |
| Lucky Cuss-Old Guard | .056 | 16.92 | 66.4 | .036 | 3.23 | 70 | .039 | 3.50 |
| Emerald | .010 | 8.00 | 70 | .015 | 3.61 | 70 | .015 | 3.50 |
| Bunker Hill | .035 | 15.45 | 38 | .021 | 3.39 | 40 | .021 | 3.40 |
| Tombstone Extension | .071 | 11.88 | 6 | .031 | 6.50 | 15 | .025 | 5.00 |

HEWLETT MANAGEMENT

R. F. HEWLETT
PHONE (702)359-1069



2602 Monte Verde Way
Sparks, Nevada 89431

Present open-pit mining and heap-leaching costs have been used for the computation of gross value, net operating profit before tax(NOPBT), and total open-pit mining cost. Costs used are:

Ore operating cost/ton = $2.25
Waste haulage/ton = .50

For example, for a stripping ratio of 5.5:1 = $5.00/ton ore.

Preliminary open pits were designed for the six open-pit targets previously defined as having good potential. Criteria used were:

A. $45^{o}$ pit slopes
B. 50-foot minimum width at bottom bench
C. Pit depth does not exceed ore body width.

The above criteria allows comparison of the various "target" ore bodies on an equitable basis.

After an analysis of the underground maps and personal knowledge, the following resulted from the "mineable open-pit-ore-reserves":

| Deposit Name | Pit Total Tonnage | % Ore Tonnage | Ore Value/Ton |
|---|---|---|---|
| Contention Dike | 9,100,000 | 12.6 % | $ 80.00 |
| Tranq-Ag Thread | 4,220,000 | 5.9 % | 80.00 |
| Lucky Cuss | 1,580,000 | 8.0 % | 68.00 |
| Emerald | 1,340,000 | 9.4 % | 36.94 |
| Bunker Hill | 1,150,000 | 6.3 % | 65.00 |
| Tomb. Extension | 650,000 | 9.2 % | 58.00 |

Notice that the dumps had an ore value of $ 20.96/ton and that the past ore production had an ore value of $ 150.62/ton. The estimated ore values above from underground samples falls about half way between the previously mined ore and the dump values.

R. F. HEWLETT
PHONE (702)359-1069



2602 Monte Verde Way
Sparks, Nevada 89431

As will be presented on the following page, with a realistic projection of deposit ore reserves, a very significant cash flow results. Howvever, it is very interesting to evaluate the individual "target deposits" from the following minimum risk point-of-view:

A. For the designed pits, it is assumed that no ore will be discovered or developed.

B. For the designed pits, it is assumed that only gob exists; the gob has been observed and sampled.

Using the previously mentioned open-pit mining costs, the net operating cost before taxes was computed mining only gob. Also, the "break-even" gob tonnage was computed to relate to the minimum gob tonnage required to develop and not loose any money. It is easy to relate to this approach, because it is quickly seen that relatively small tonnages are required to break even. For example, tonnages smaller than the "waste dump" tonnages are required. Following are these computations:

OPEN PIT RISK ANALYSIS
(Only Gob-No Ore)

| Deposit Name | Total OP Mining Cost-Gob & Waste | Gross Value Gob | NOPBT Gob-MM | Break Even Gob Tonnage |
|---|---|---|---|---|
| Contention | $ 5,425,000 | $ 11,300,000 | $ 5.875 | 240,044 |
| Tranq.-Ag Th. | 2,285,000 | 2,312,000 | .027 | 98,832 |
| Lucky Cuss | 912,500 | 2,016,000 | 1.104 | 31,684 |
| Emerald | 792,500 | 1,680,000 | .888 | 33,021 |
| Bunker Hill | 645,000 | 984,000 | .339 | 26,220 |
| Tomb. Extens. | 328,750 | 525,000 | .196 | 9,393 |

Following are the computed economics for the projected ore and the gob within each designed open pit.

# HEWLETT MANAGEMENT

R. F. HEWLETT
PHONE (702)359-1069



2602 Monte Verde Way
Sparks, Nevada 89431

## OPEN PIT POTENTIAL

| Deposit Name | Open Pit Dimensions | | | Estimated Ore Reserves | | | | Economics | |
|---|---|---|---|---|---|---|---|---|---|
| | Length | Width | Depth | Type | Au | Ag | Tons | Gross Value | Net Op. Profit |
| "Contention Dike"- Grand Central- Contention- Tranquillity | 2,000' | 350' | 300' | Ore | .100 | 10.0 | 1.15MM | $92.MM | |
| | | | | Gob | .050 | 2.10 | .50MM | 11.3 | $95.93MM |
| Tranquillity- Skip Shaft- Silver Thread | 900' | 300' | 300' | Ore | .100 | 10.0 | .250MM | $20.MM | |
| | | | | Gob | .058 | 1.92 | .100MM | 2.312 | $19.59MM |
| Lucky Cuss- Old Guard | 700' | 200' | 200' | Ore | .040 | 10.0 | .126MM | $8.6MM | |
| | | | | Gob | .039 | 3.50 | .070MM | 2.0 | $ 9.451MM |
| Emerald | 600' | 250' | 200' | Ore | .005 | 6.0 | .126MM | $4.7MM | |
| | | | | Gob | .015 | 3.5 | .070MM | 1.7 | $ 5.321MM |
| Bunker Hill | 500' | 200' | 200' | Ore | .025 | 10. | .072MM | $4.7MM | |
| | | | | Gob | .021 | 3.4 | .040MM | .984 | $ 4.893MM |
| Tombstone Extension | 300' | 250' | 200' | Ore | .050 | 8. | .060MM | $3.48MM | |
| | | | | Gob | .025 | 5. | .015MM | .525 | $ 3.55MM |

Gob = 18,22

HEWLETT MANAGEMENT

R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
Sparks, Nevada 89431

REGIONAL PATTERNS

A regional distribution of ore minerals was studied by analyzing the assay values from all of the dumps in the District. The results are shown in the following maps. The trend-surfaces show the following:

1. Gold is not widely distributed and it is the highest along the Empire-Contention-Grand Central trend.

2. Zinc is related to the gold mineralization. The zinc forms a halo around the gold high(where there is a zinc low) and the highest grade zinc is to the south and east of the gold high.

3. Silver exhibits a regional pattern similar to that of lead and copper. The silver high is shifted from the gold high in the eastern part of the District to a more central location around the Lucky Cuss and Emerald mines.

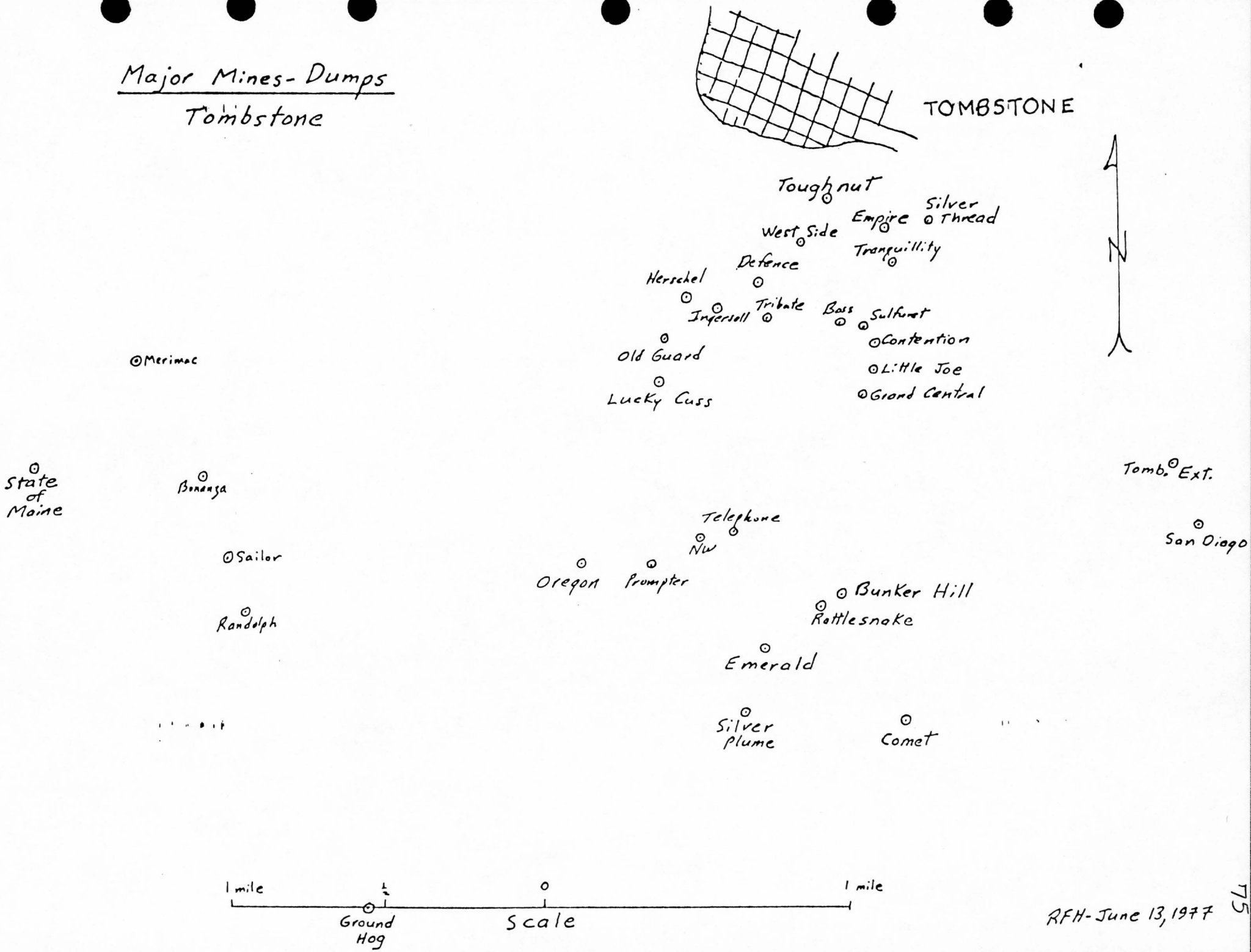
4. Lead exhibits a regional pattern with high-grade veins in the south-west portion of the District.

5. Copper is also widely distributed, with very high-grade copper having been mined in the Emerald(Central area). The copper trend to the southwest is in the breccia pipe area by the Charleston Lead Mine.

Topo maps with claim-group locations are presented following the regional distribution maps. The third map shows the location of some drill holes in the area.

# Major Mines - Dumps

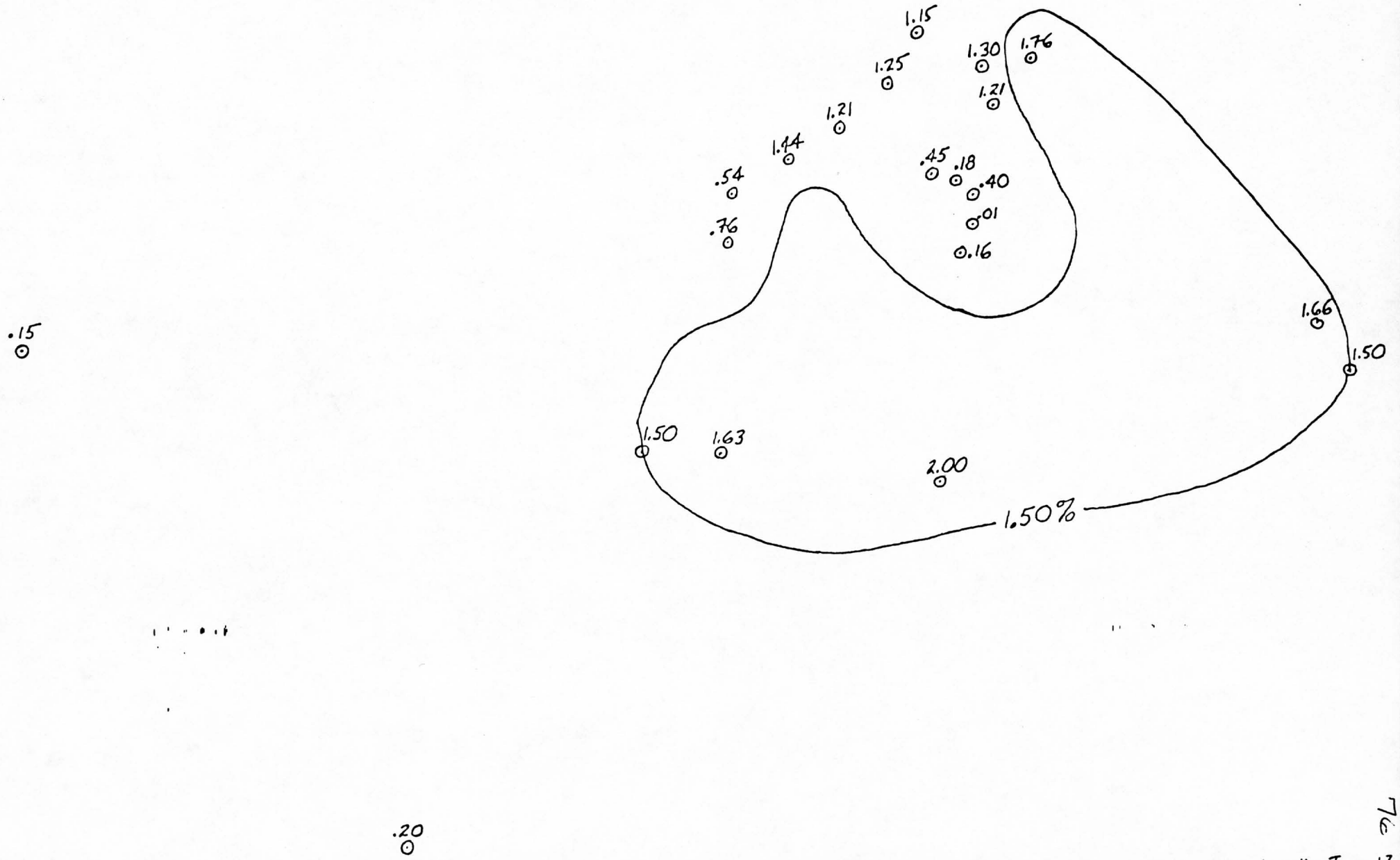
## Tombstone




RFH-June 13, 1977

TOMBSTONE DUMP ASSAYS

Zinc (%/ton)

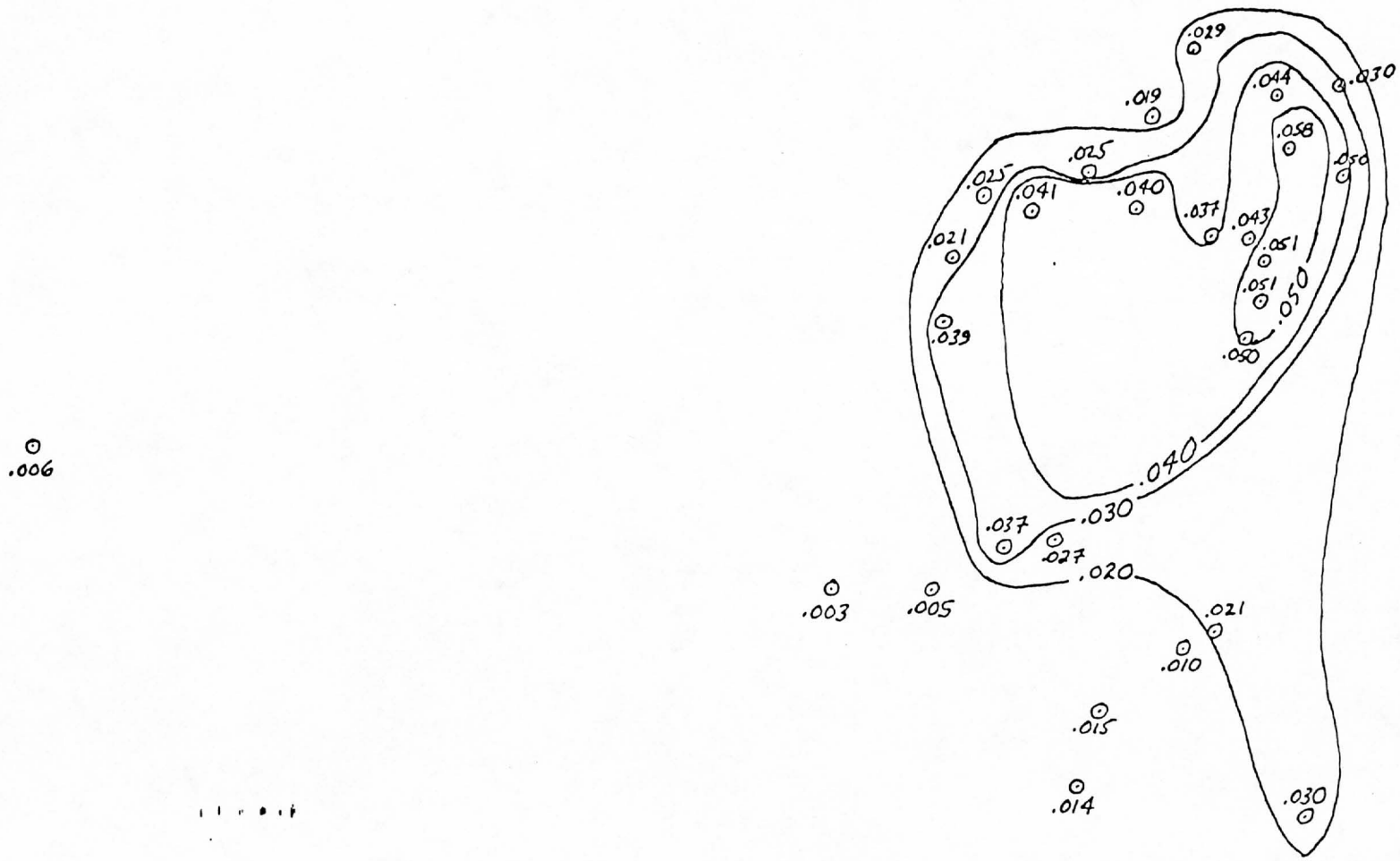



RF Hewlett - June 13,

76

TOMBSTONE DUMP ASSAYS

Gold (T.oz/ton)

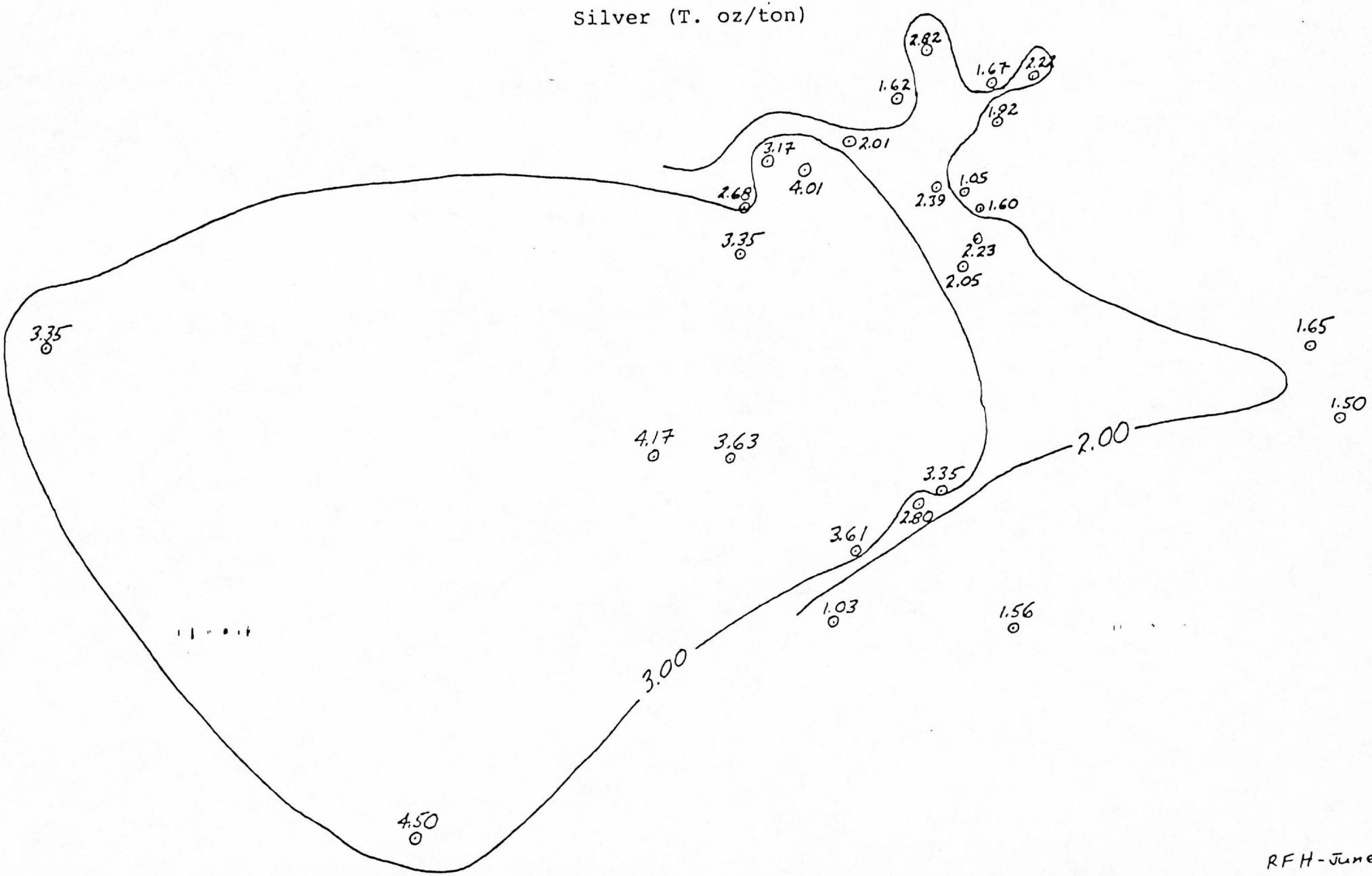



RFH - June 13, 1977

77

TOMBSTONE DUMP ASSAYS

Silver (T. oz/ton)

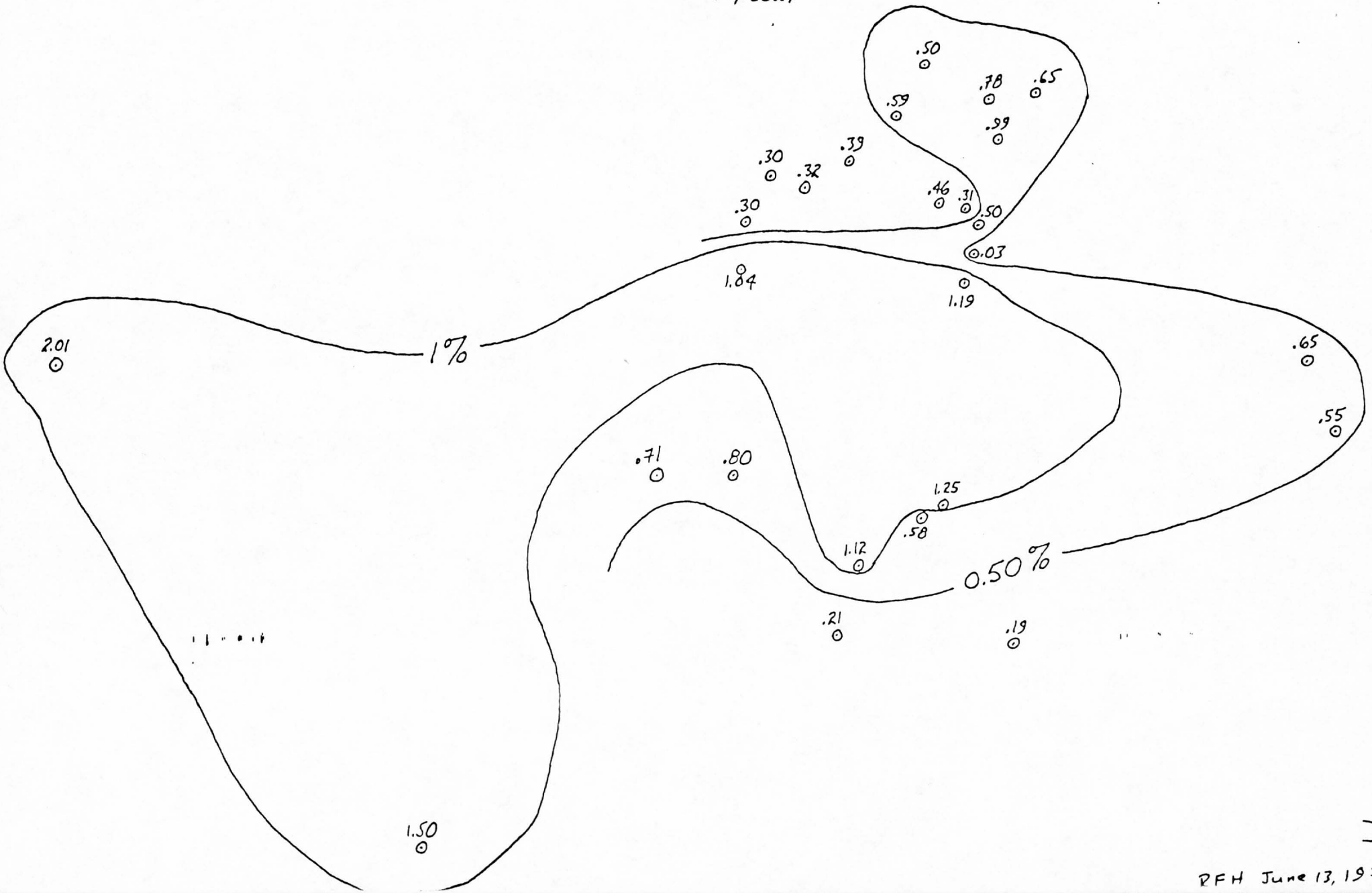



RFH-June 13

78

# TOMBSTONE DUMP ASSAYS

Lead (%/ton)

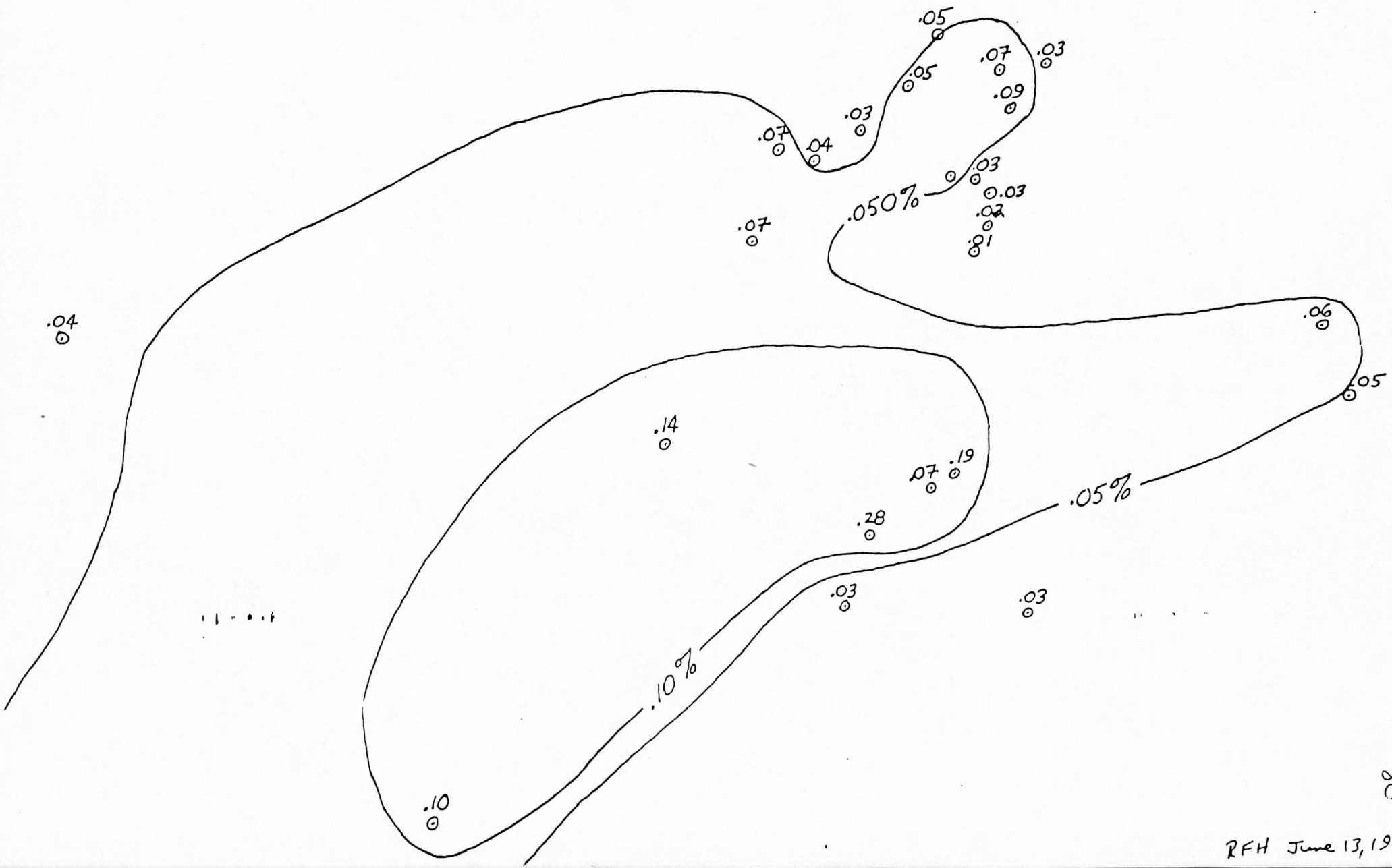





RFH June 13, 1977

TOMBSTONE DUMP ASSAYS

Copper (%/ton)




RFH June 13, 197

# HEWLETT MANAGEMENT

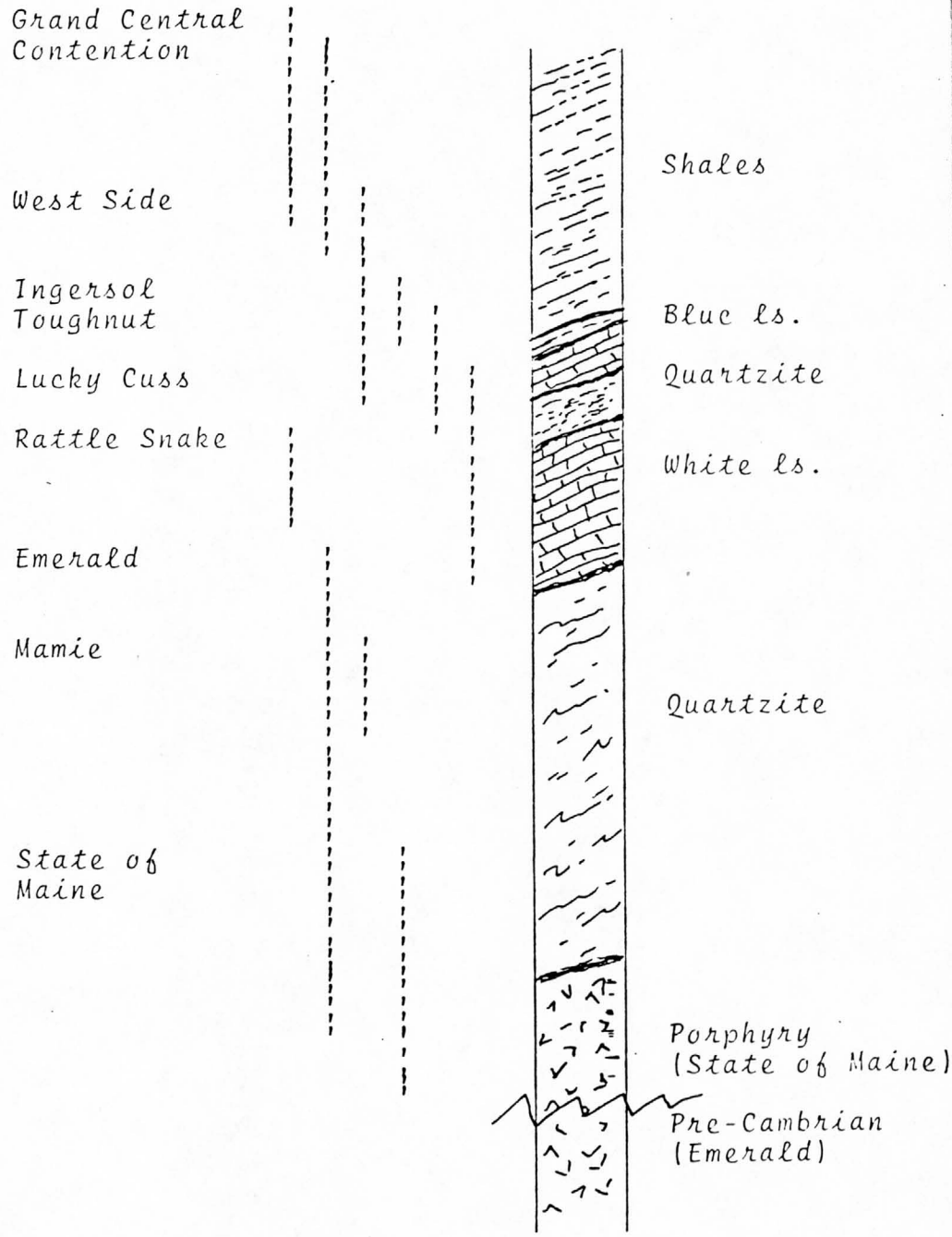
R. F. HEWLETT
PHONE (702)359-1069

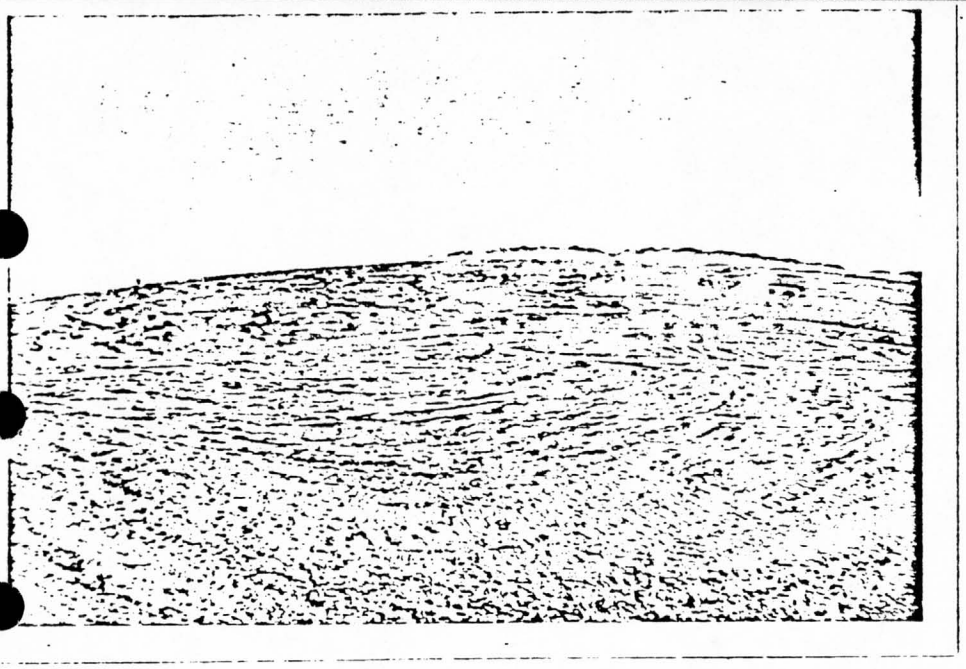
2602 Monte Verde Way
Sparks, Nevada 89431

## DEPOSIT DESCRIPTIONS

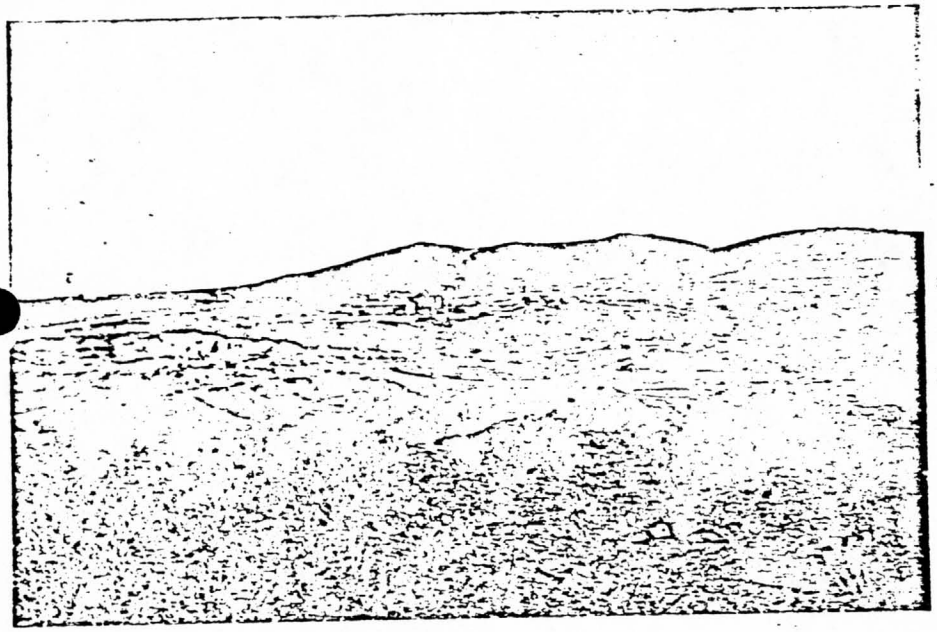
Broad-geological environments present in the Tombstone District are the Contention-Toughnut Series in the Eastern part of the District(just south of town), the Manganiferous Limestone Group in the Central part of the District, and the Emerald Series in the Southwest part of the District(south of the Manganiferous Group).

The comparative geological position of various mines is shown....

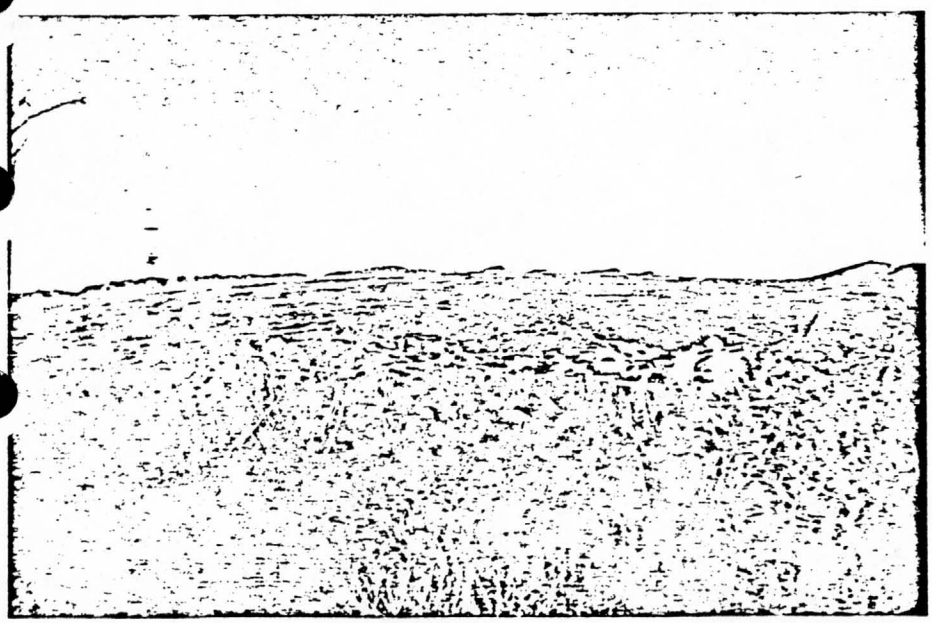




Contention-Toughnut Series area; West Side-Vizina on far left, Toughnut-Empire in center, and Contentment under heap in far right. Viewed from Contention dump area-dump removed.



Empire-Tranquillity area; looking over Tranquillity. Contention at far right and Spip shaft near blue pick-up. Viewed from the Empire mine area.



Contention dike area; Notice "line" of caved workings along the dike. This is an open-pit target, as well as underground. Very good values exist all along this structure. Also, very high-grade underground samples are found along this structure.

# HEWLETT MANAGEMENT

R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
Sparks, Nevada 89431

The previous comparison of the location of the workings of the various mines in the geologic column shows that ore-grade mineralization transverses a large vertical interval. Underground workings have been extensively sampled, and based on deep drill holes, the vertical extent of ore-grade mineralization exceeds 3,000 feet.

## Contention-Toughnut Series

This sequence of limestones, shales, quartzites, and other sedimentary members are Bisbee and Naco formations(see Geology in the Appendix). A stratigraphic section is on the following page. The mines in this series are in the eastern portion of the District. Mines included in this series are the Vizina, Toughnut, and Silver Thread on the north, the Empire, Tranqility, and West Side in the central portion of the series, and the Contention and Grand Central on the far south portion of the series.

Structural features in this series are dikes, veins, and fissures cutting limestone and other beds. Localization of the mineralization is at contacts of the vertical structures(that are "feeders") with sediments such as limestones, shales, and quartzites and "manto" type replacement along anticlinal structures. Drag folds on the upper-flanks of anticlines are the most important ore producer, especially on the lower limbs from intersecting vertical structures.

The main lines of flexure are:

1. Anticline through Defence, Intervenor, West Side, Sulphuret, Flora Morrison, and into the Contention. Approximate direction N. 68° W.

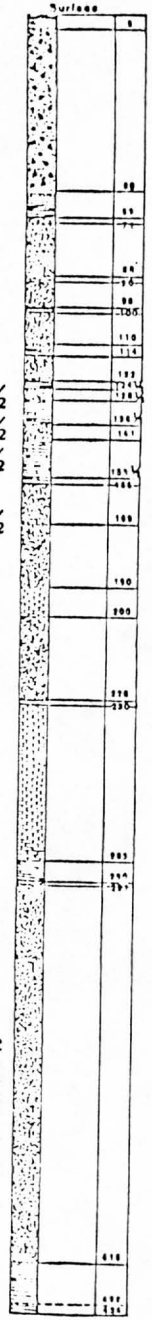
2. Anticline through Toughnut, Girard, towards the Tranquillity, Head Center, and Contentment. Approximate direction N. 68° W.

3. Anticline through Goodenough into Hawkeye and Little Wonder. The major axis of this blanket, if prolonged, would pass through the Empire and Silver Thread to the North Point claim. Approximate direction N. 70° W.

4. Vizina through the corner of Goodenough and Gilded Age and the western end of the Way Up. Direction of N. 77° W.

| Formation. | Thickness. | Total Depth |
|---|---|---|
| 1. Soil and "cement"—Caliche.. | 5 | 5 |
| 2. Detrital, Clay with loose rock of limestone and quartzite. | 55 | 60 |
| 3. Shale, loose and broken..... | 9 | 69 |
| 4. Blue Limestone..... | 2 | 71 |
| 5. Broken Shale and Quartzite... | 17 | 88 |
| 6. Blue Limestone..... | 2 | 90 |
| 7. Grey Quartz, iron stained and broken..... | 8 | 98 |
| 8. Black Shale, broken..... | 2 | 100 |
| 9. White Quartz, iron stained... | 10 | 110 |
| 10. Black Shale, broken..... | 4 | 114 |
| 11. Grey Quartz, iron stained, broken..... | 8 | 122 |
| 12. Black Shale..... | 2½ | 124½ |
| 13. Quartzite, Grey..... | 4 | 128½ |
| 14. Black Shale..... | 8 | 136½ |
| 15. Quartzite, Grey..... | 4½ | 141 |
| 16. Black Shale..... | 12½ | 153½ |
| 17. Shale with calcareous seams.. | 2½ | |
| 18. Quartzite, brown stained..... | 13 | 169 |
| 19. Quartzite, hard blue, with pyrites at bottom..... | 21 | 190 |
| 20. Blue Limestone..... | 10 | 200 |
| 21. Hard Quartzite, iron stained. | 28 | 228 |
| 22. Black Siliceous Shale..... | 2 | 230 |
| 23. Blue Limestone..... | 53 | 283 |
| 24. Black flinty quartz, limestone and quartzite (assay 3.2 oz. silver)..... | 7 | 290 |
| 25. Blue Limestone..... | 1 | 291 |
| 26. Quartzite, Novaculite..... | 125 | 416 |
| 27. White Limestone..... | — | — |
| Water-level ..... | | 432 |
| Bottom of Hole..... | | 436 |

FIG.




The so-called quartzites of this part of the Section are very fine in grain without the usual granular structure, and may be properly called novaculites, or hone-stones. This is true especially of the lower bed, 125 feet in thickness. It is a white, compact, dense rock, breaking with a conchoidal fracture and without visible grains.

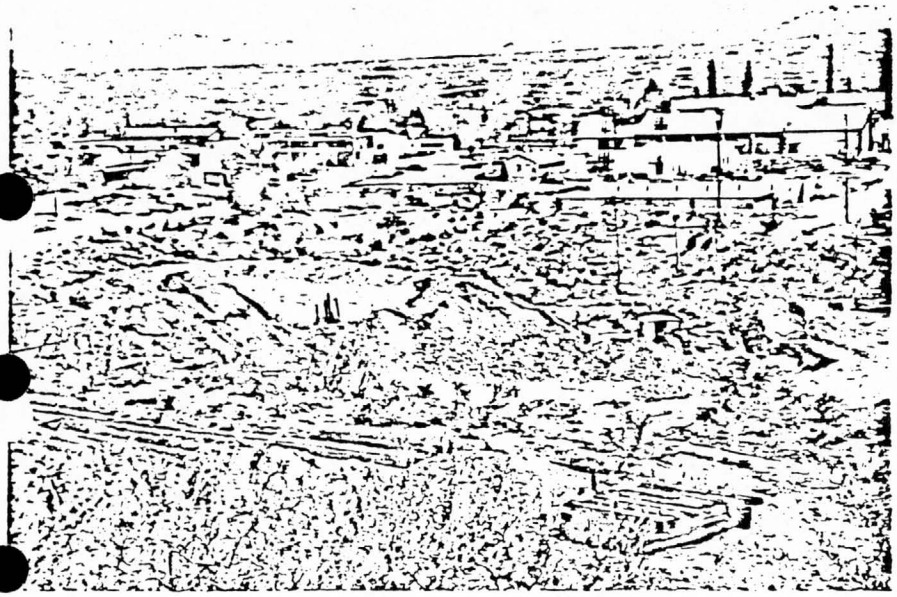
HEWLETT MANAGEMENT

R. F. HEWLETT
PHONE (702)359-1069

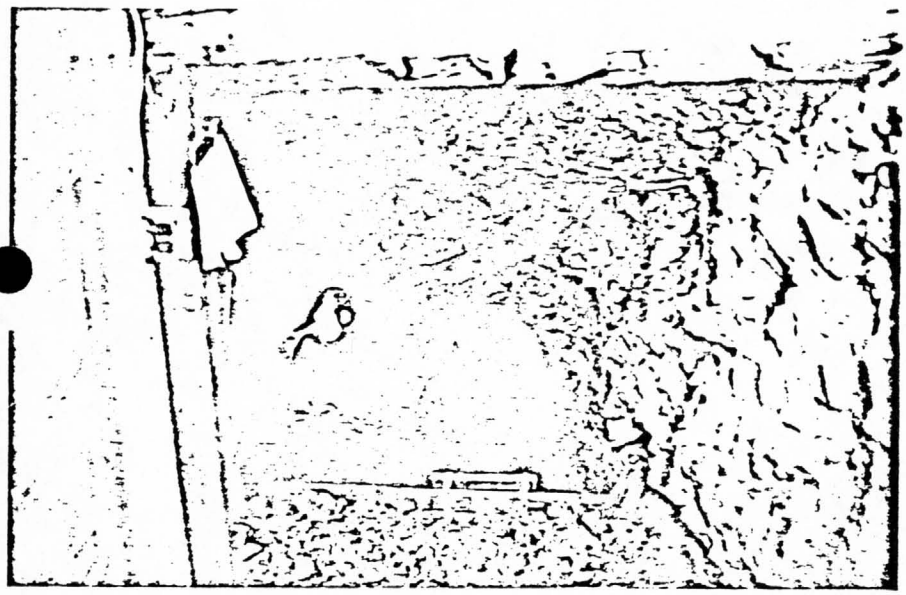
2602 Monte Verde Way
Sparks, Nevada 89431

VIZINA: The Vizina mine was one of the closest to the town; the mine is south of the Nellie Cashman(in the south part of town). The Vizina roll is shown in the following plate. Notice that on the other side of the Tribute dike that the ore follows the Bisbee-Naco contact, with the main host being the Novaculite member.

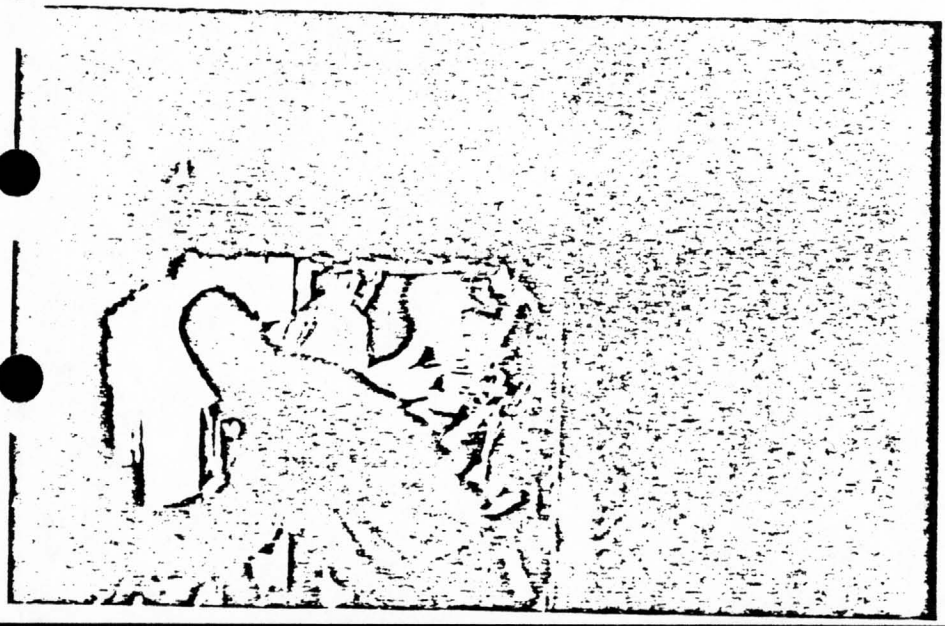
Vizina mine and dumps in center left, with an open-stope just beyond near the buildings. Covered-shaft is the Girard, which the author had re-timbered to the 400 level. Metal building between Girard and town is the Goodenough Incline with the Toughnut Incline to the left-near the small dumps.



Toughnut-Goodenough area; Toughnut east-dump lobe area. Goodenough Incline by small metal building in right cneter. Foreground covered shaft is Girard.



Incline portal; Incline is in very good shape-notice the lights down the decline. Gob starts at the surface.



Underground collection station for leach system. Station is on the 400 level of the Goodenough. From here, all of the mines are interconnected; there are 200 miles of workings.

# HEWLETT MANAGEMENT

R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
Sparks, Nevada 89431

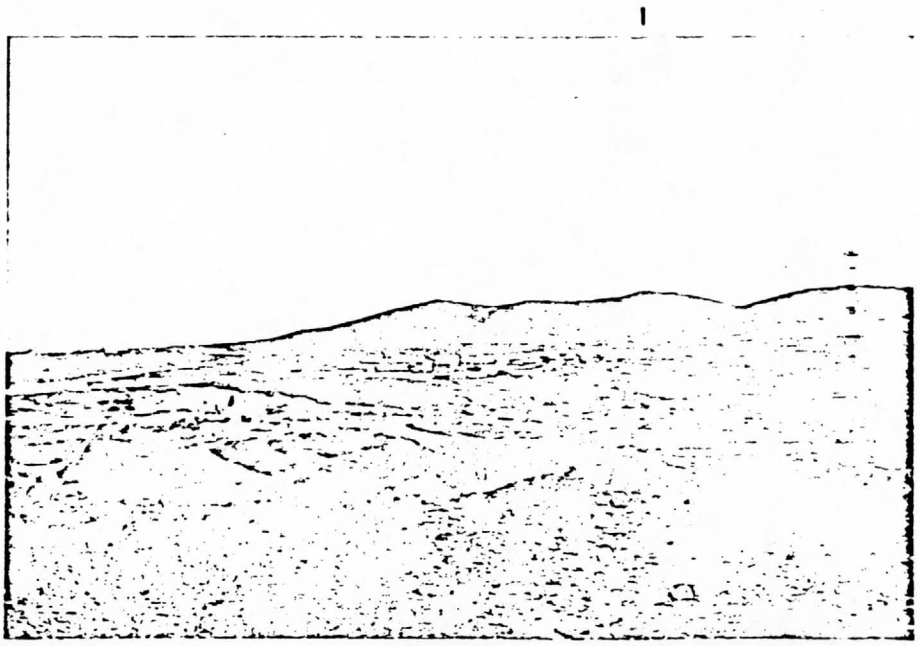
TOUGHNUT-GOODENOUGH-EMPIRE-TRANQUILLITY: The Goodenough Incline is the best access to the Tombstone underground workings in the District. The Incline is on a 45° dip down to the 300 level. There a cross-cut goes back toward the Toughnut and a decline goes to the 400 level. From there, access is to the Empire, West Side, Tranquillity, Silver Thread and the Silver Belt and Way Up which are under the town. The author and others have spent considerable time in these workings, sampling and mapping, and in situ leaching.

The Goodenough Incline was sank in a very-well mineralized blue limestone that was about 20 feet thick. Gob remaining in the Incline averages 10 ounces Ag and .10 ounces Au per ton.

Stopes with gob and un-mined commercial ore form a continuous sequences of workings. From the Goodenough and Toughnut Inclines (both with ore and gob) follows at the 400 level the China stope, the Gallery, Babe's stope, the Girard Stope, West Side stopes, etc.. The workings are in good shape; they were approved and checked by the Bureau of Mines at regular intervals. The only places where the air is bad is where sulfides are oxidizing, such as under the town on the 400 level (Silver Belt).

Following are maps presenting the ore control; anticlinal structures intersected by vertical structures which serve as "feeders". Following are these structures:

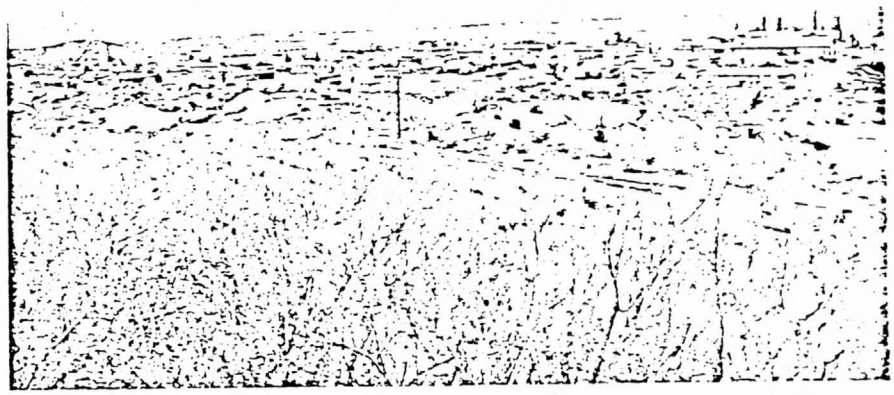
| Anticlinal Structure | Vertical Structure |
|---|---|
| Goodenough roll | West Side Fissure |
| Quarry roll | Sulphuret Dike(s) |
| Holderness roll | "409" Fissure |
| | Empire Dike |



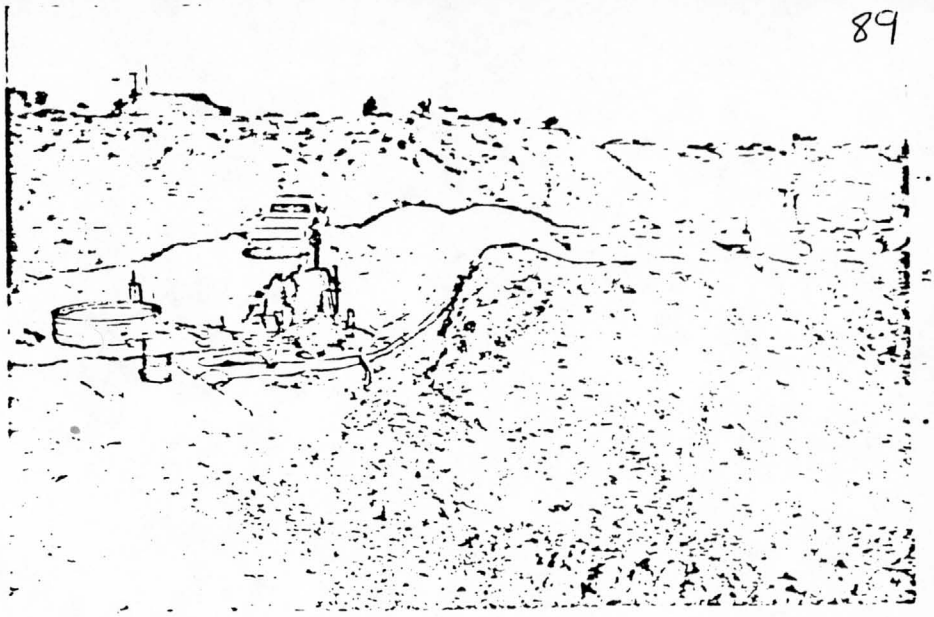
Toughnut dump;
Early phase of hauling the dump to the heap. Toughnut Incline is beyond the pole to the far left.

Photo on the facing page is the early testing-sampling of the Toughnut dumps.

Toughnut dump area;
Most of the dump has been hauled to the heap. Workings can be traced on the surface from the Goodenough Incline (small building) to the Toughnut Incline (left of pole) and near small dumps. Blue limestone outcrop's in this area.



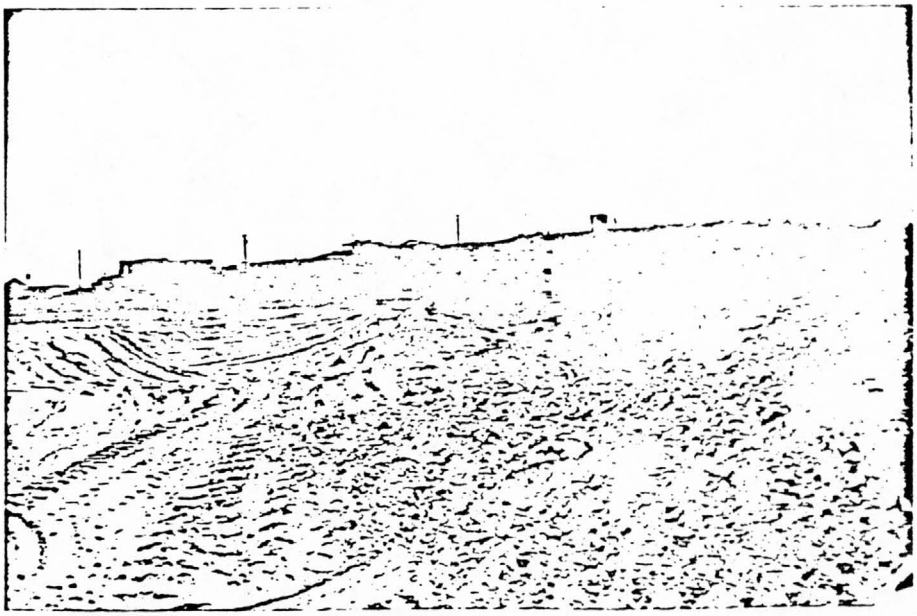
Toughnut-Goodenough-Empire area from the Contention mine, looking over the Tranquillity mine area.



Drilling near Skip Shaft looking at Empire dump before it was hauled to the heap. Red building is where the core is stored.

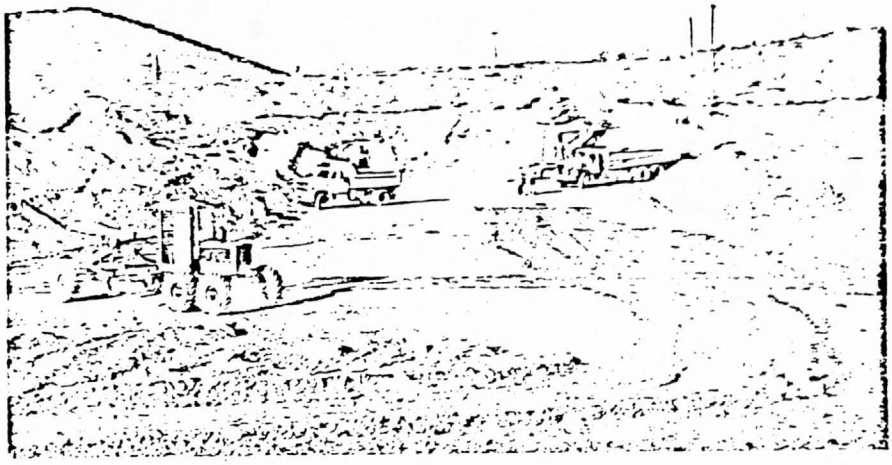
Back-hoe trench on opposite page is on Empire dump.

Empire dumps on right and the Tranquillity and Contention areas moving left. Viewed from the Silver Thread looking west. High-grade sulfides on Silver Thread dump; copper-lead-zinc.

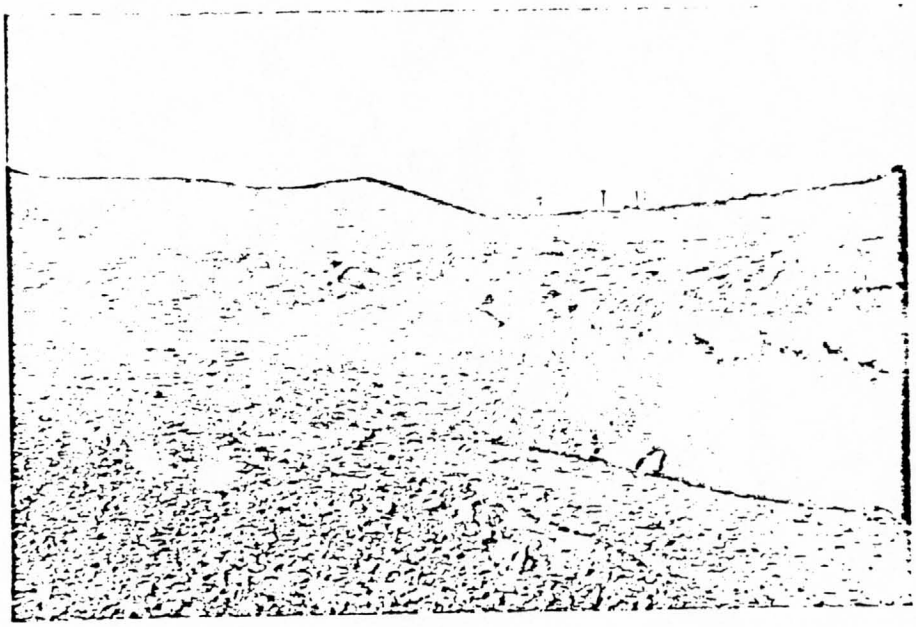


Empire dump area after removal to the heap. Area ready for exploration. Structures are now exposed.

Tranquillity area; Loading dump ore for haulage to the heap. Shaft is to the left-in bushy area over grader.

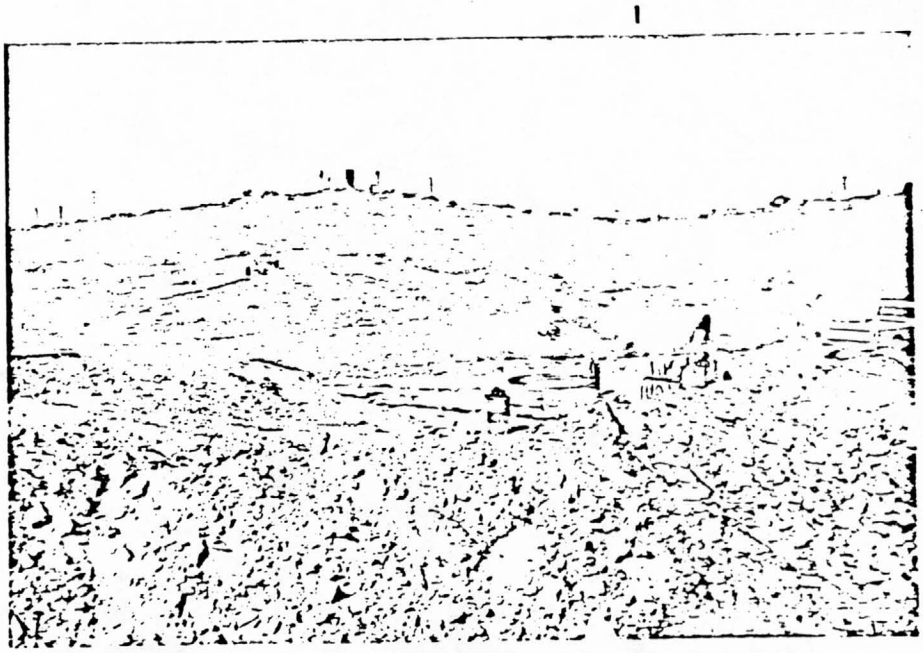


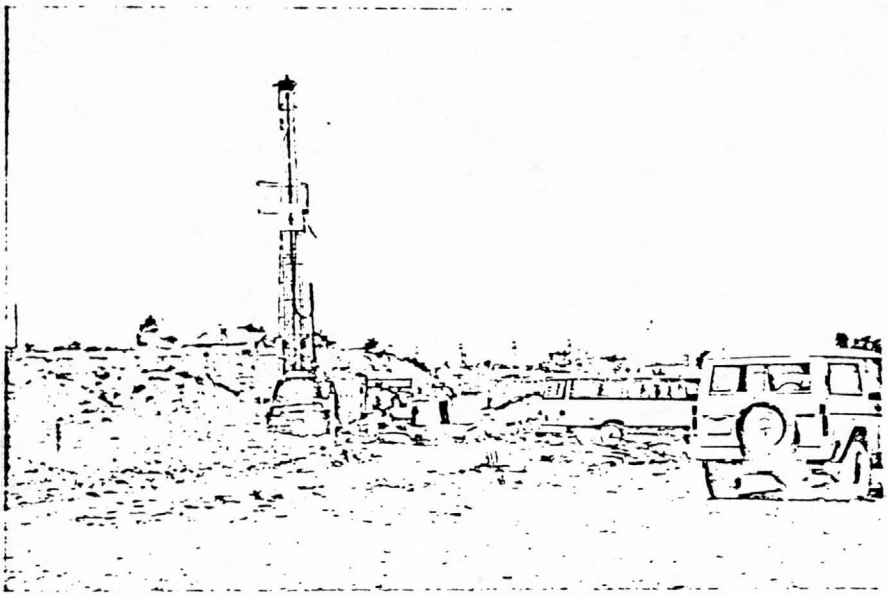
Late stage of dump hau;age to the heap. Skip Shaft in near foreground by the brush. Workings are accessable and they are very high grade;gold values from .10 to .85 t. ounces. Silver runs over 10 ounces.



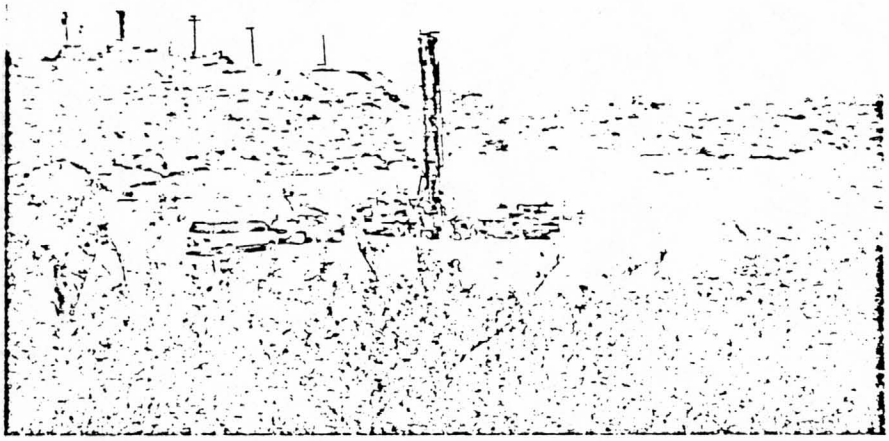
Final phase of dump clean-up;ready for sampling-mapping-drilling.

Skip Shaft area; good surface samples with continuity with depth.

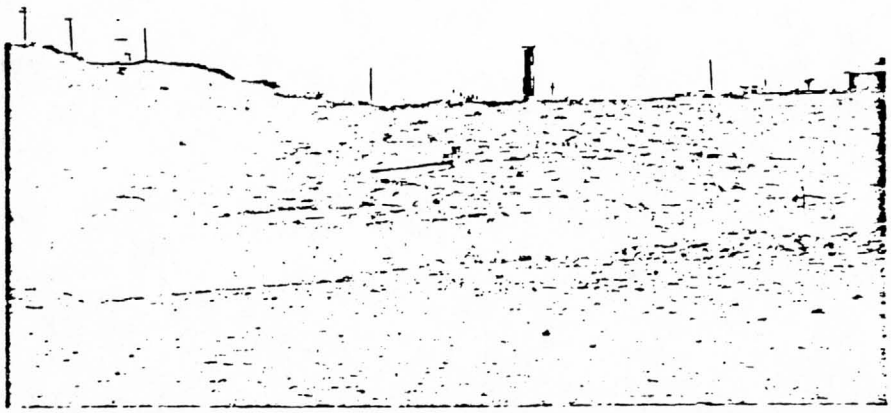




Reverse-Circulation drilling near Skip Shaft. Empire dump in the background.



Drilling near Tranquillity Shaft area. Drilling was shallow and much was in overburden. Results are in Appendix. Gold and silver values were encouraging.



Tranquillity fault area; further drilling should follow surface mapping and sampling.

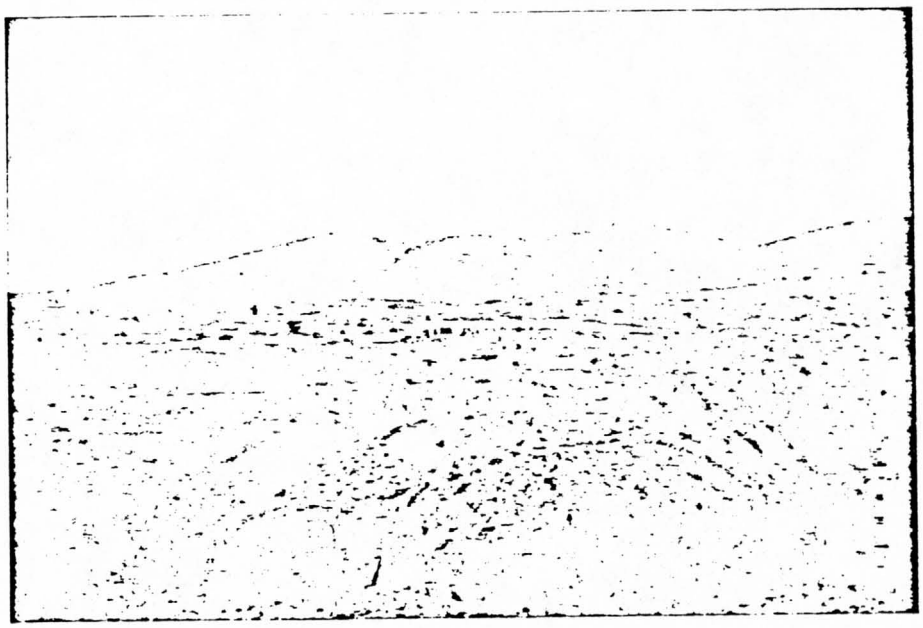
# HEWLETT MANAGEMENT

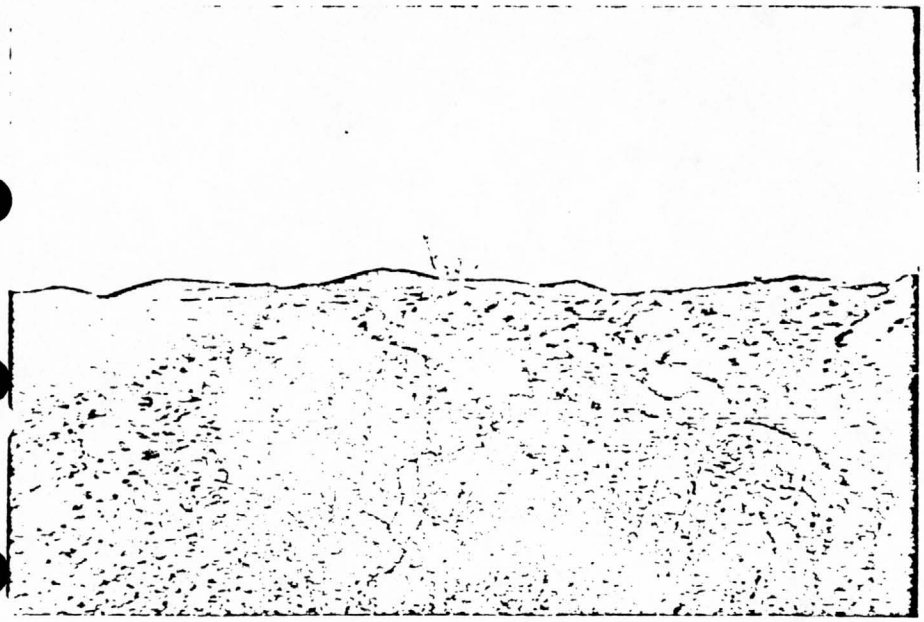
R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
Sparks, Nevada 89431

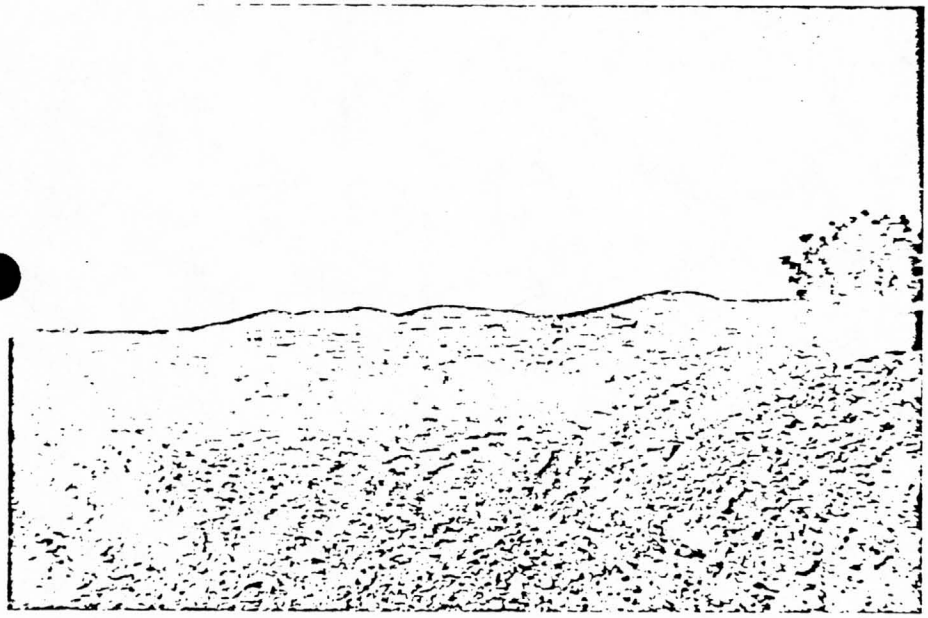
SKIP SHAFT-SILVER THREAD: The Skip Shaft area deserves much sampling and mapping, followed by drilling. Very encouraging results have been obtained in the past. The following plate shows the vast extent of the near-surface stopes;an excellant open-pit target. This"Tombstone Triangle" area deserves careful study due to the abundant structure;Empire dike, Skip Shaft fissure, and the Tranquillity fault zone intersect favorable limestone anticlinal structures.

Underground near and east(towards the Silver Thread) of the Empire shaft, the structures exhibit red hematite which is indicative of high-grade gold ores. The author has followed this structure for over one-half mile. Sulfides increase north and east of the Empire. The Silver Thread had zinc so high that it is stock piled in a dump because it could not be treated. The high-grade zinc ores were found south of the Silver Thread shaft about 200 feet. Lead-zinc vertical zoning is shown through the mine. Stopes on the 700-800 foot level were 8-28 feet wide and very high grade. The Silver Thread mine shows a definite zone of deposition or ore column which with other mines is in excess of 3,000 feet in depth.

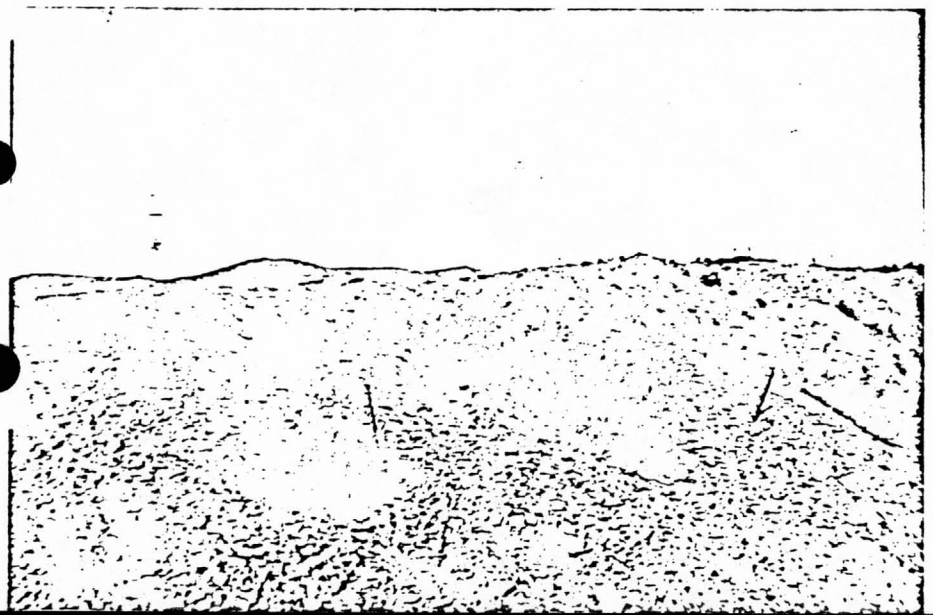




Silver Thread mine and dump area looking west toward Contention area. This is a target area for additional drilling.



Silver Tread looking at Contention and Grand Central area. Structures connect these mines with the Silver Thread. This area has higher base metal content, especially zinc. Dumps of zinc and other sulfides are scattere in this area.



Silver Thread sulfide dumps. A faulted-off-block of this ore body probably exists east. Notice the state claims we leased on topo-claim maps in regional patterns section. Drilling proved an intrusive(feeder) and sulfides with precious metal conten, starting on the surface.

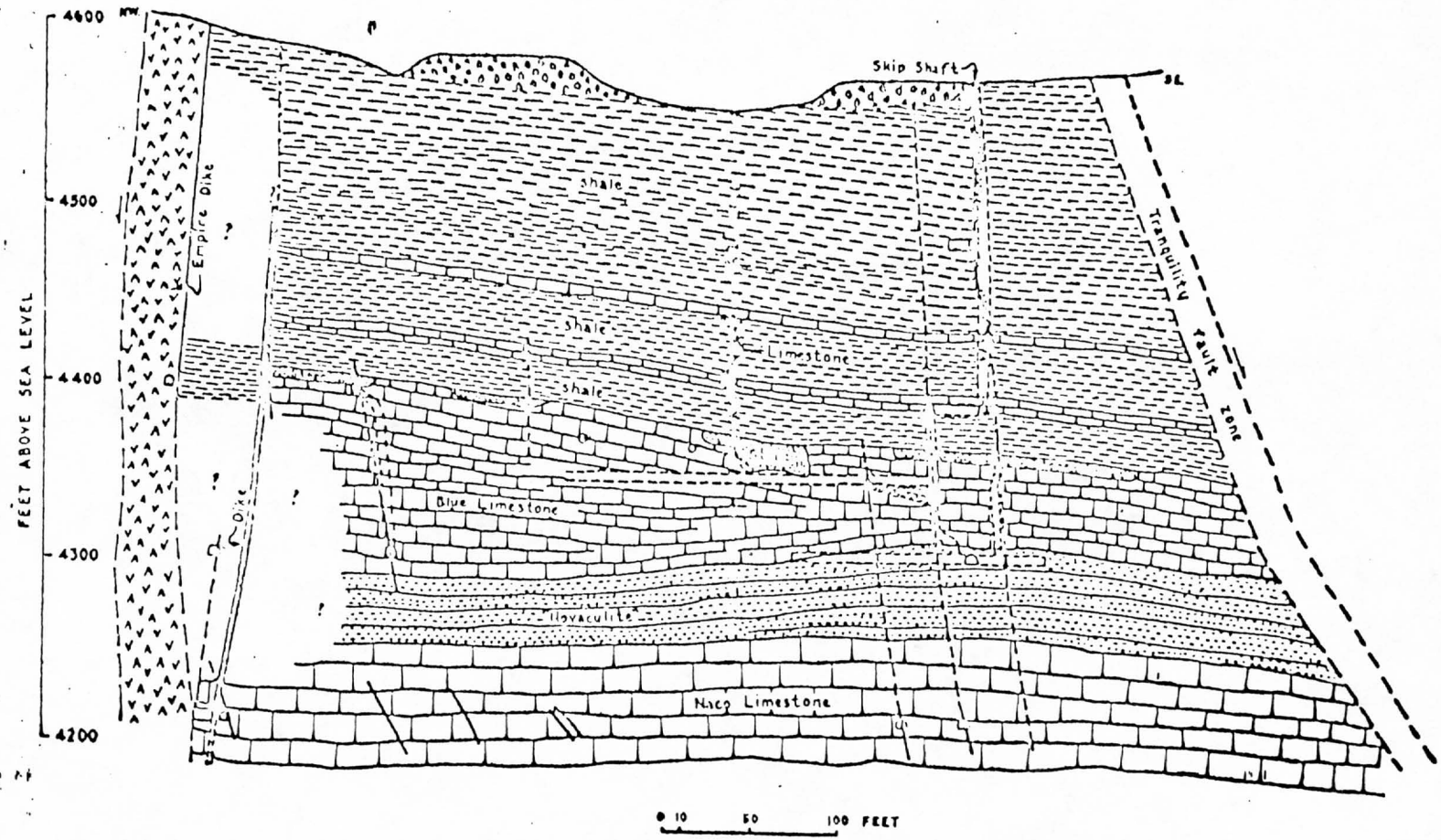



Plate XVII.—Longitudinal section near axis of Macia roll, looking northeast.

# HEWLETT MANAGEMENT

R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
Sparks, Nevada 89431

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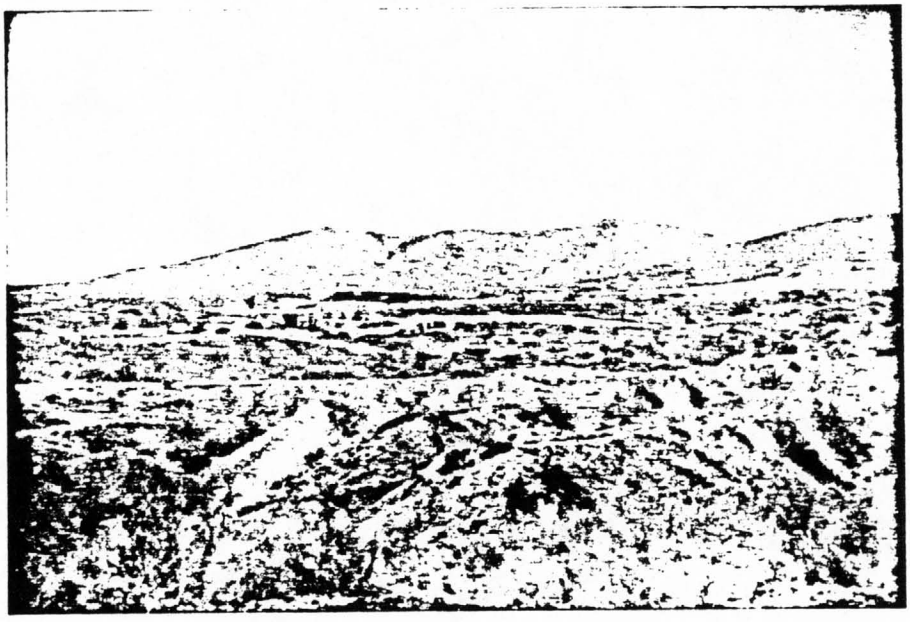


# HEWLETT MANAGEMENT

R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
Sparks, Nevada 89431

WEST SIDE: The high-grade silver ores of the old Camp were discovered on the Toughnut and the West Side fissure was found intersecting limestone beds on the Toughnut claim. The fissure was followed westerly(in ore) and the rich mine known as the West Side was discovered. Obviously, this was the westerly most mine in the District(now a drift connects the West Side and the Lucky Cuss-about one mile west of the West Side). The West Side fissure was followed from the anticline at the West Side mine easterly to another anticline in the Way Up claim(see following plate). In parts of its course, it is barely more than a "crevice". Notice that Shaft 3 reaches the water table in a continuous column of ore(called a chimney by local miners). The host are shales and limestones. In Shaft #1 the host is a quartzite and some white limestone.

The author has observed the West Side fissure(and the West Side workings) on the 300,400, and 500 level(water level). These are accessable from the Goodenough Incline, or one can climb down the ladders in the West Side or the Girard shafts because they have recently been re-timbered and approved by the Bureau of Mines. Also, the drift(400 level) from the Goodenough Incline was worked on and approved by the Bureau of Mines. Also, Newmont used the West Side for hoisting when they were conducting underground exploration and drilling in the District.

The ore left in the stopes, gob, and backfilling all represents a good sized tonnage. It has been found that as much "ore" was left in the mines as was hoisted. The grade is only about half of what was hoisted, but that is ore today(about 10 ounces Ag and .10 Au). Samples taken in the West Side workings would average the 10/.10, as do most of the other mines. This was the cut-off when silver was about $1/troy ounce. Actually, silver was used as the cut-off mineral;gold was considered a credit-just as at Virginia City(Comstock).

North South

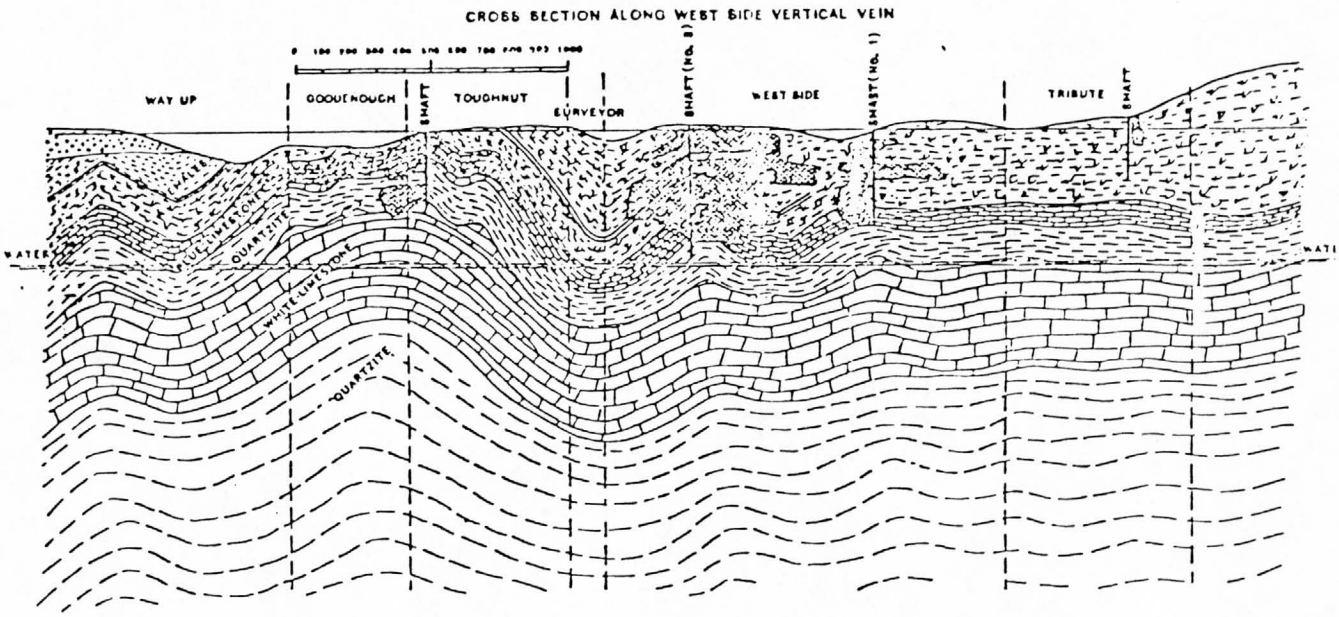
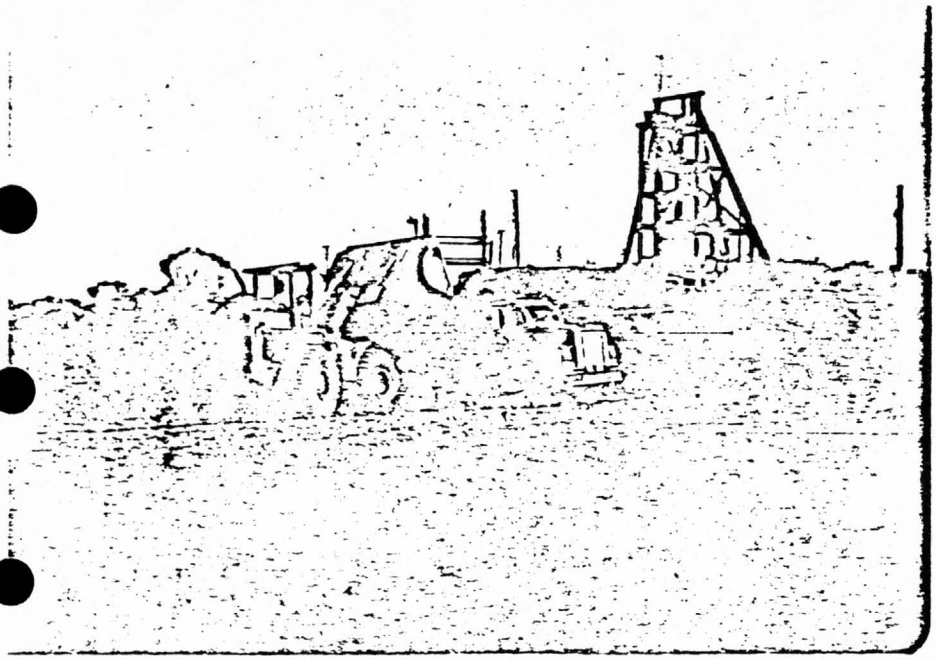



FIG. 15. *Cross-section of the Anticlines and Synclines Crossing the West Side Vertical Vein.*

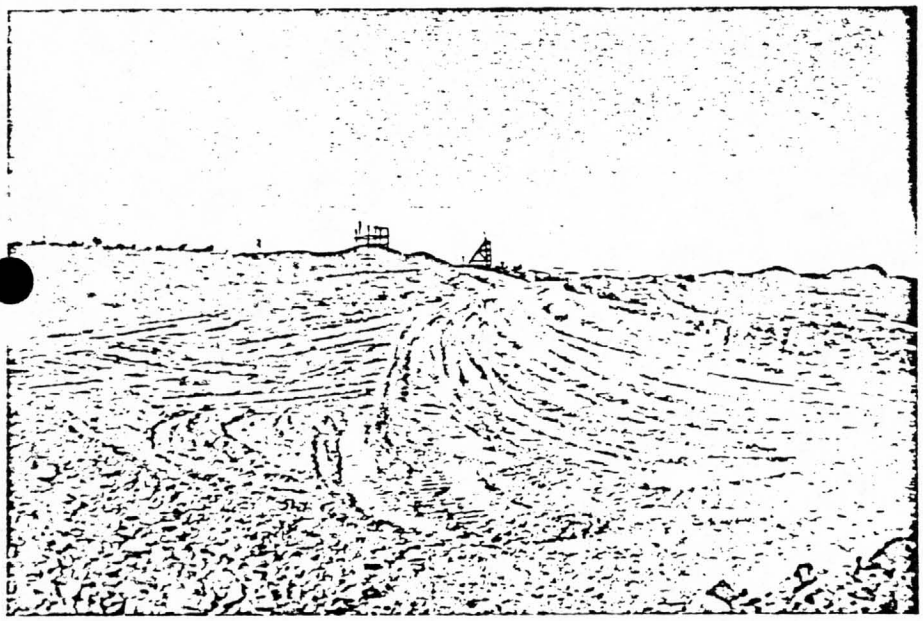
Above is the plate showing the West Side fissure from north(left) to south(right). North would be in the City limits of Tombstone. The shading indicates stoped-out ore. Notice the numerous areas that are unexplored, such as between the West Side and the Tribute. To date, no exploration has been conducted in that area;the drift from the West Side to the Lucky Cuss passes through this area. Also, good-grade ore still exists at shallow depths in the Goodenough and Toughnut areas.

The page facing this shows a photo of the area in 1880. Notice the Girard mill on the hill(center), the Sulphuret dump near right, the Flora Morrison shaft in near forerground, the West Side on the ridge down(SW) from the Girard(between the observer and the court house) and the Boss mine between the obserber and the West Side. The Tribute would be to the far left-off the photo a short distance. The Toughnut dumps are seen over the hill between the West Side and the Girard mill.

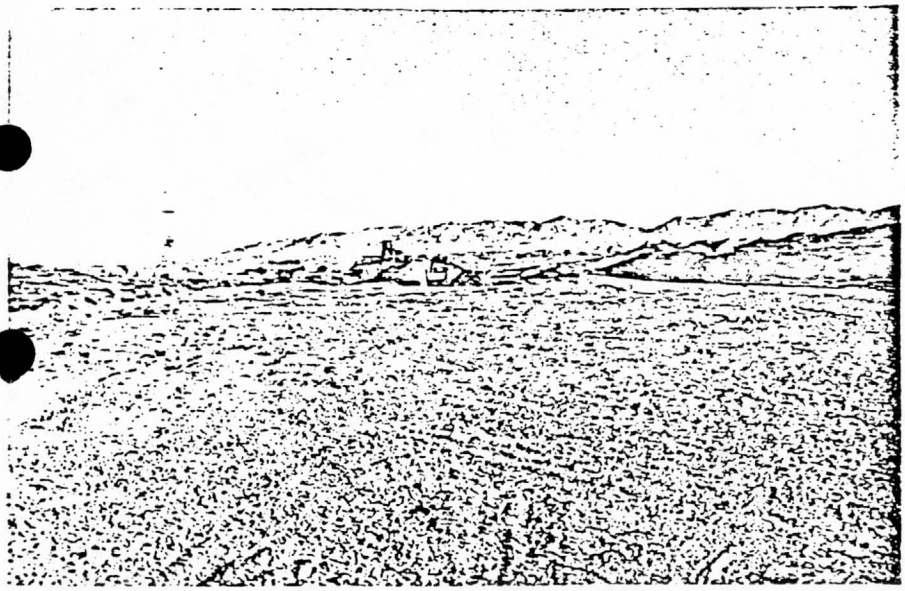
It is obvious from all early photos that all empasis was for the high-grade ores underground;no mining was done by open pit.



Initial stage of hauling West Side dump to the heap. Headframe is in good shape, as are the lagging and ladders.



Most of West Side dump has been hauled to the heap. No exploration has been done in this area after the removal of the dump. Notice in the plate that the shaft was sunk in ore.



Large area for mapping, sampling, and drilling. West Side fissure can be traced on the surface. Outcrops indicate heap-leach grade ore.

# HEWLETT MANAGEMENT

R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
Sparks, Nevada 89431

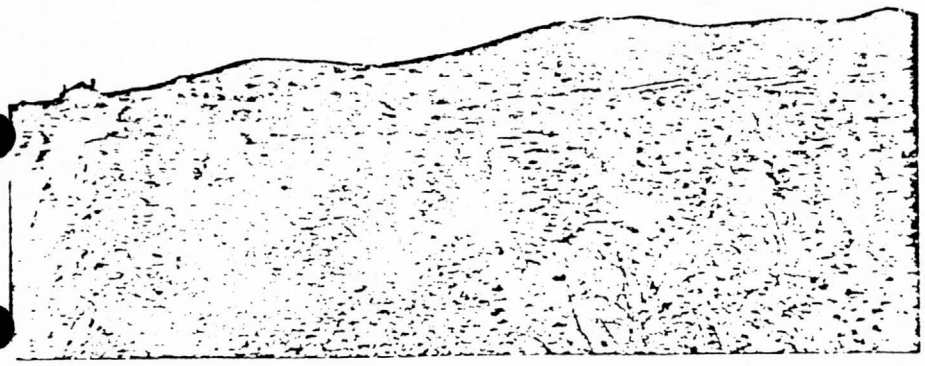
CONTENTION: Along the Contention-Grand Central lode there were over 20 miles of workings in 1902(William P. Blake-Tombstone and its Mines). How many more miles were added since that time is unknown. This quantification relating to the ore mined, or what the ore justified, is very important in considering both open-pit and underground targets at present precious metal prices. Also, the Contention is interconnected to the other mines.

The porphyry dike of the Contention and Grand Central mines extends not only through these mines but beyond through the Head Center into the Tranquillity and through the Empire mine. It is the leading vein or lode of the District. The dike is a crystalline igneous rock which has broken through and disrupted all the stratified beds in its path. However, it is closely connected with siliceous layers and impregnations and with the deposites of gold and silver found in the quartz alongside the dikes and also in the dike;hence the term lode.

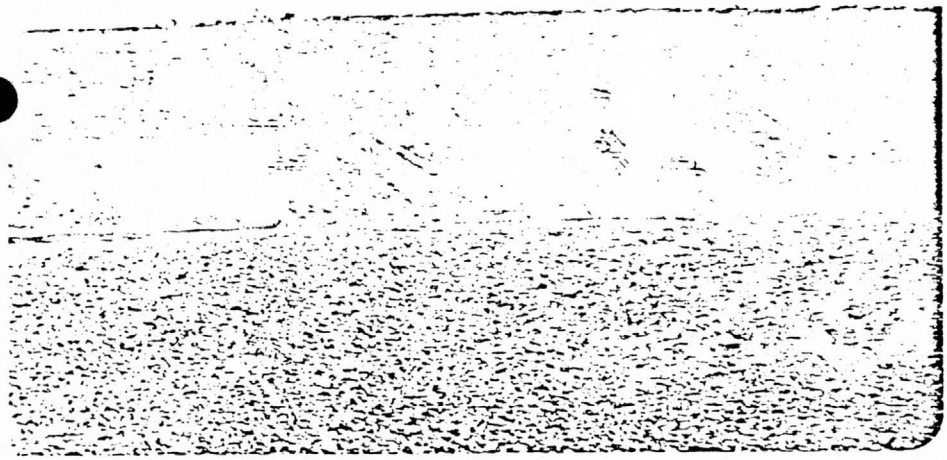
The Contention dike is dislocated by faulting which gives the semblance of two or more parallel dikes. For example, on the 207-foot level of the Contention(equivalent to the first level of the Head Center) the fault has dislocated the shales, limestones, and quartzites with a detectable throw-about 50 feet. On the 258-foot level from the South Shaft to the Flora Morrison it appears that three dikes exist parallel to each other, but it is a result of faulting. Here, the chief faulting plane trends north 25° to 30° west and dips to the northeast. It is marked by a heavy(thick) belt of crushed material of a bright red color. The distance of the throw is less than 250 feet. The dip of the strata is 45° to the east.

The thickness of the Contention dike is variable. In the Contention mine workings it is about 68 feet thick. Further north about 500 feet it is only two feet thick for a short distance(which could be a fault intersection) and then 400 feet further north it suddenly expands on both sides of a mass of shale.

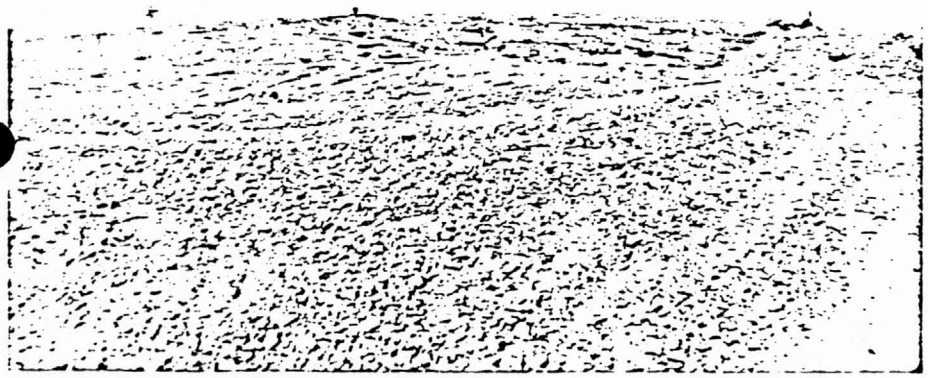
In addition to the Contention dike, the Tranquillity fault, the Sulphuret dike, and numerous other faults intersect or originate in this area. This is why most of the workings are in the Contention mine area(see large plate of all workings). This area would make a very good open pit, due to its location and the near-surface ore. A great deal of sampling has been done in this area with very good results(see sample-assay map).



Contention mine area; Contention dumps shown to the right of the old assay office. Sulphuret shaft is seen between the two; road shown goes to the Lucky Cuss-haul road built for dump haulage to the heap.



Loading at the Contention; This area should be mapped sampled, and drilled. This area is the intersect of numerous structures.



Contention dump removed; Pump Shaft on far right. Sulphuret Shaft by assay building, and West Side and Boss left-center. This is the potential open-pit area.

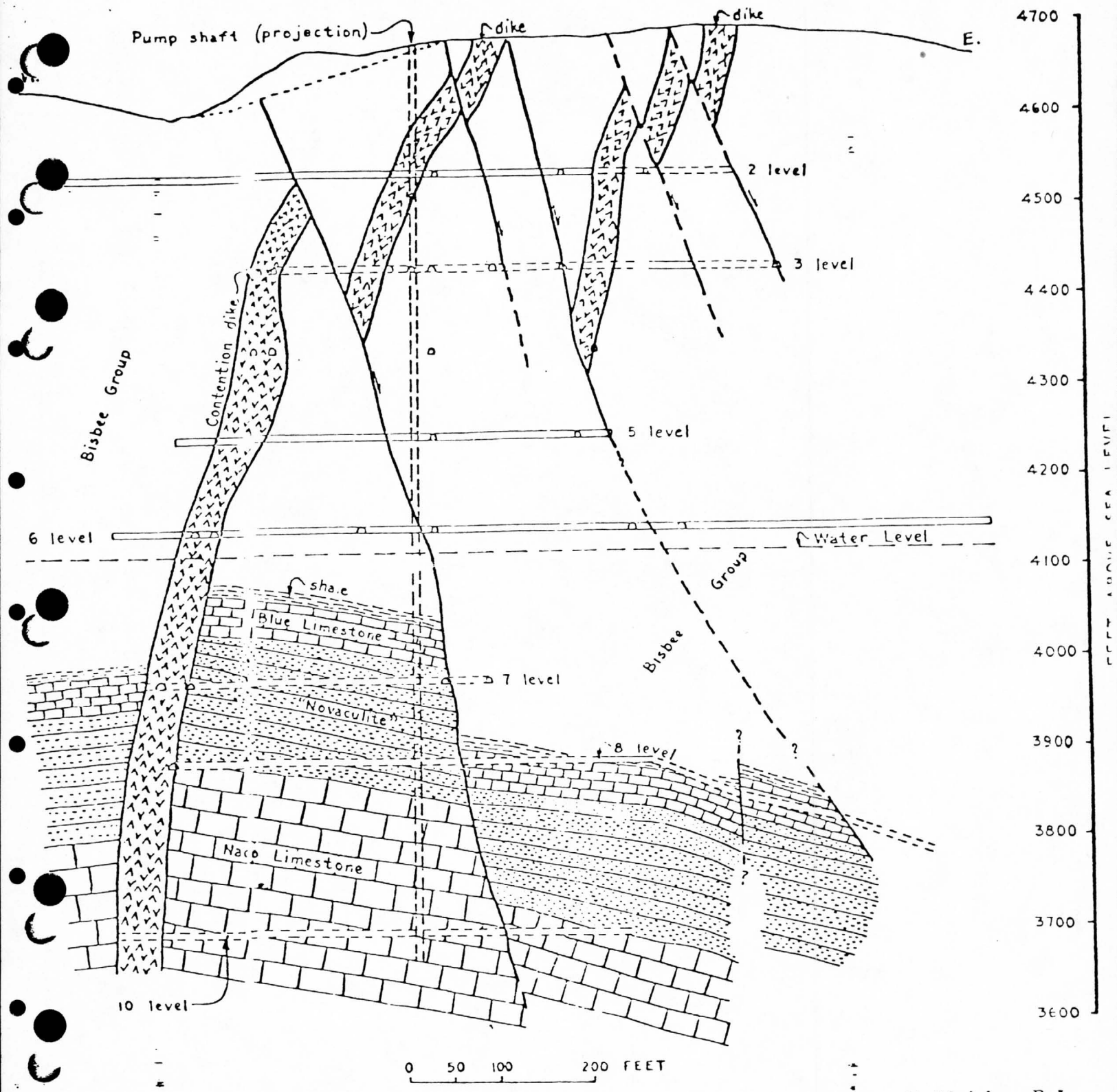
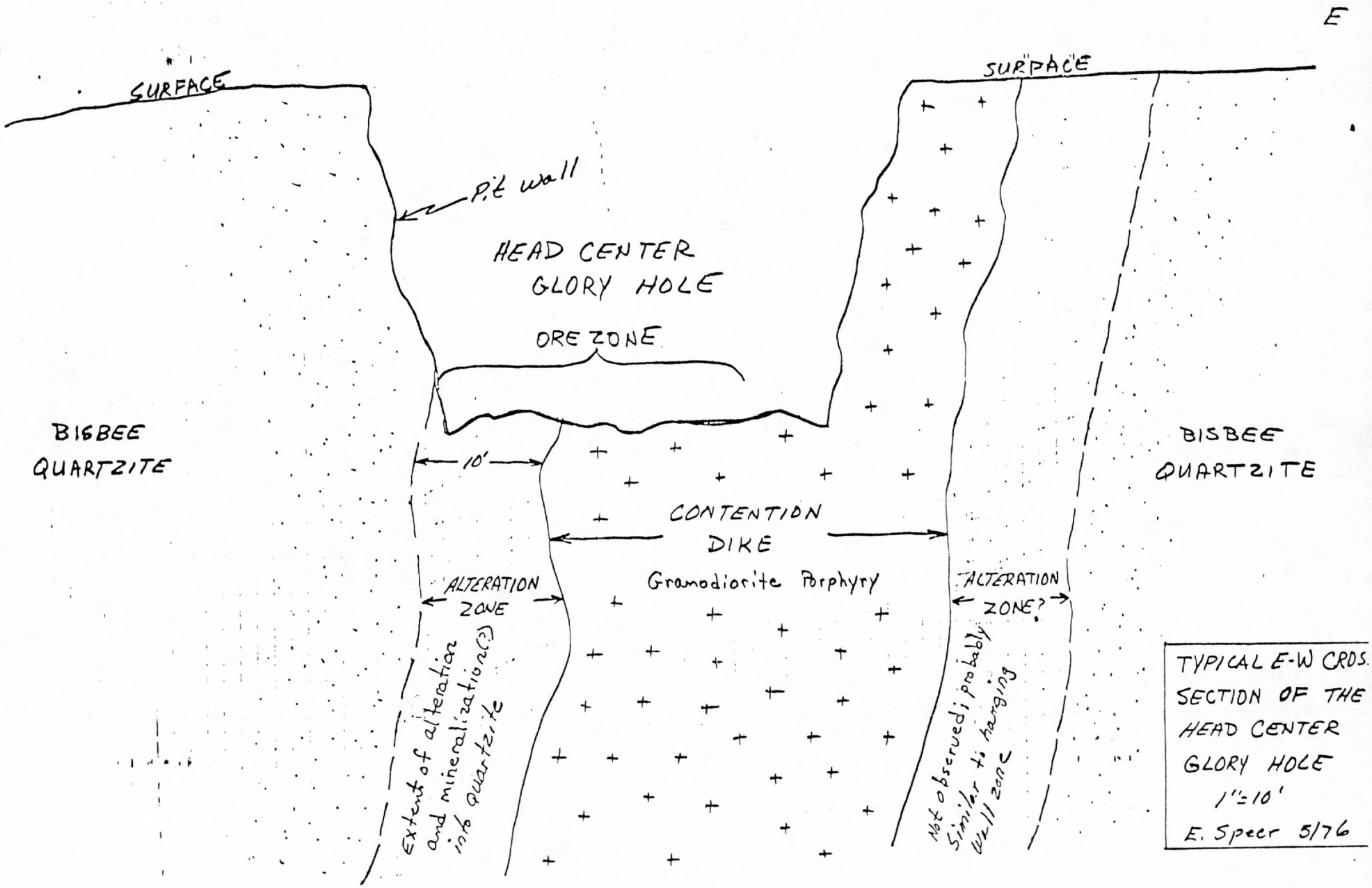



Plate VIII.—Generalized cross section through Contention dike at Pump shaft, looking north. (Modified from F. L. Ransome.)




TOMBSTONE COCHISE CO., AZ

# HEWLETT MANAGEMENT

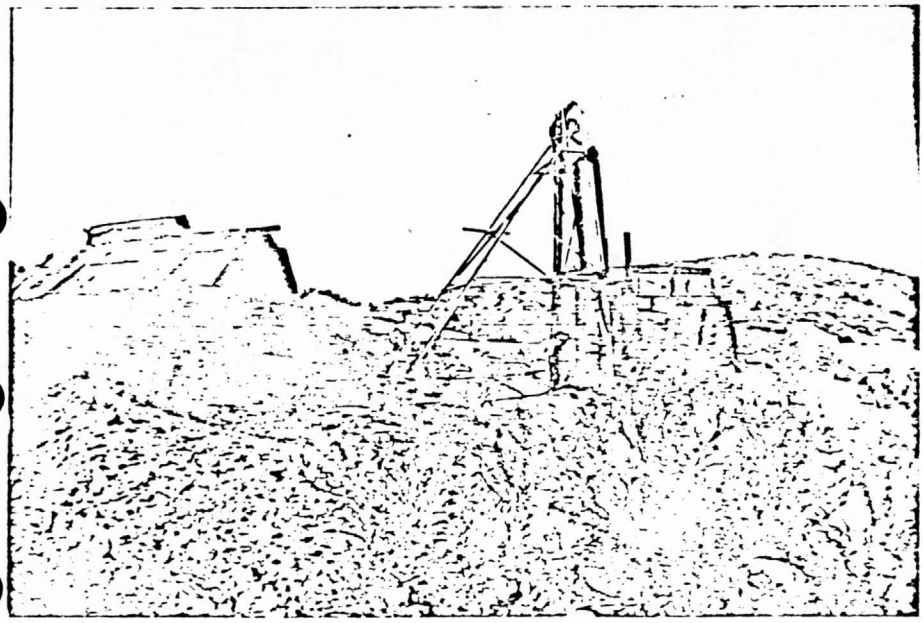
R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
Sparks, Nevada 89431

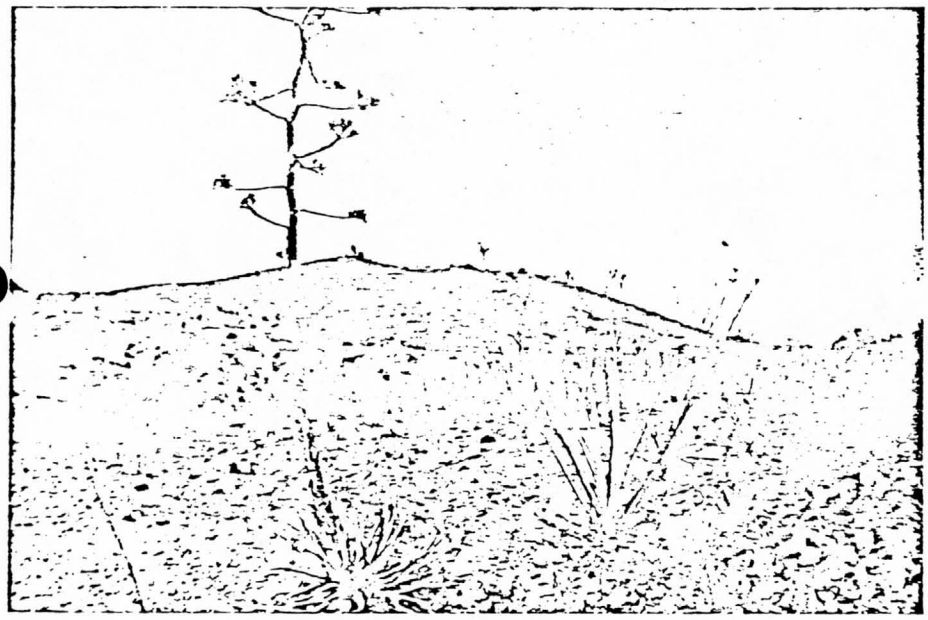
The Contention dike is highly crystalline in some areas, but in most portions it consists chiefly of a feldspathic base in which the feldspar crystals are obscure. It passes into a felsite which in the decay portions of the dike, it looks like partly decayed shales or quartzites. Most of the dike is penetrated by quartz and remant pyrite cube cavities are present in the oxidized-upper portion. In general, the dike looks like a spongy mass of porphyry or quartz. Much of the ore close to the dike(in the sediments) has been crushed by injection of the dike. This ore has a highly-colored red color which is hematite and an indicator of "pay ore". On the 600-foot level, the dike is a smooth(slickensides) and where it is the brilliant hematite red exists, so does ore-bearing ground below. The fissure containing the Contention dike was opened a second time and a parallel intrusion of diabase formed. This diabase is in close association with the high-grade ore(bottom of Sulphuret shaft, third level of the Head Center, etc.). On the 309-foot level of the Contention there were "scales" of gold in the diabase, as well as horn silver.

The Contention mine exhibits the largest tonnage of high-grade ore in the District. For example, samples taken on the 600-foot level (just abovr the water) ran 47.07 ounces Ag and 2.31 ounces gold. Some select ores ran 98 ounces silver and 3.20 ounces gold. However, along the Contention dike in the Tranquillity mine ore averaging 2.4 ounces gold, 98 ounces silver, and 14 % lead was shipped directly to the smetlers.

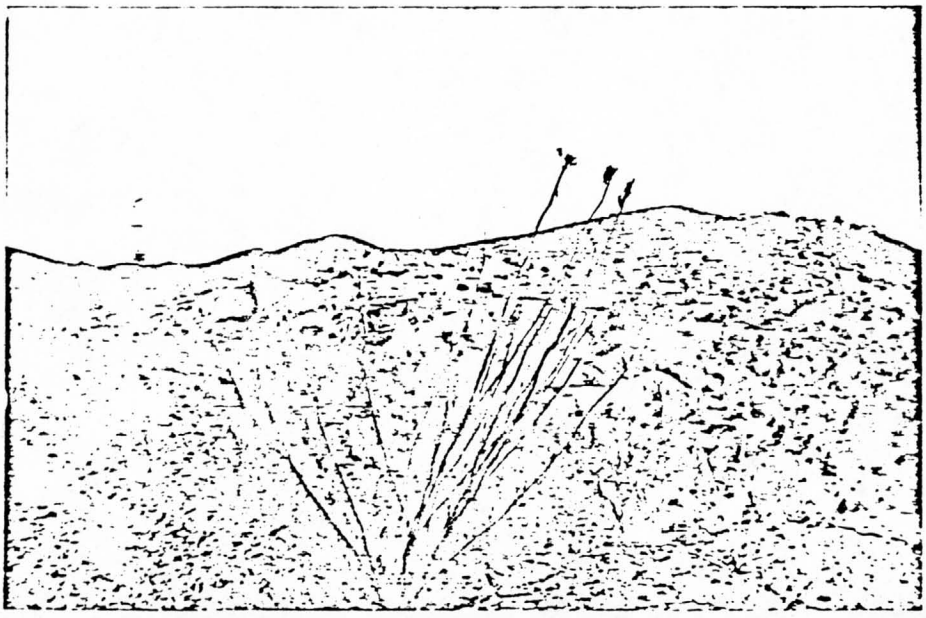
The ore is continuous from the surface down below the water in all mines, but it has been proven in the Contention;the ore bodies have been traced through the workings from the surface to below the water table. During pumping(de-watering) by the pumps in the Pump Shaft, the Contention vein was sunk-on(winze) and for 100 feet (total depth of the winze) the ore ran 5 ounces gold. In general, all winze's sunk below the past water table(during de-watering) averaged 2.5 ounces gold and 20 ounces silver. In all workings in the mines in the east part of the District, the gold increases at depth.



Little Joe shaft; sampled underground with good results. Notice the Contention dike cave in background-red color. Indiana-shaft across the fault on hill in right center.



Grand Central left (dumps) and Little Joe headframe taken from Indiana side of fault (looking west). Open pit potential here is very good.



Contention dike-south; Little Joe and Grand Central areas. Good values found throughout the structural zone over 300 feet wide.

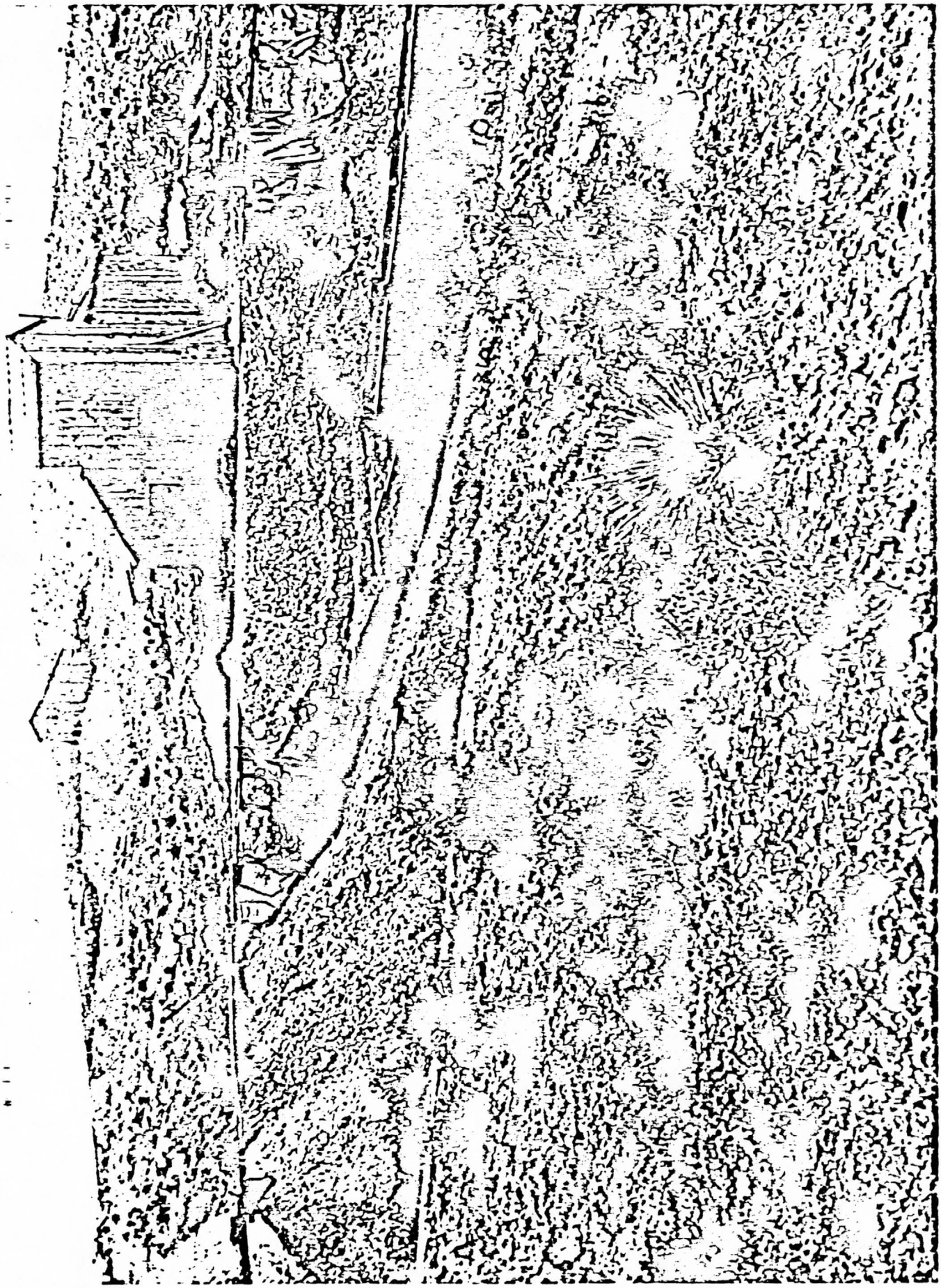
# HEWLETT MANAGEMENT

R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
Sparks, Nevada 89431

GRAND CENTRAL-LITTLE JOE-INDIANA: The Grand Central and other mines are along the Contention dike, or its southerly extension. The largest ore bodies exist in the northern part of the Grand Central and they are continuous below the water table. The three ore shoots in the Grand Central mine are all very good grade. One is the extension of the south Contention ore body, while the other two are more central and trend to the southwest.

Samples taken underground in the Grand Central, Little Joe, and Indiana mines show very good values in both gold and silver. Samples taken along the 65-foot level in the Little Joe averaged ½ ounce gold and 20 ounces silver. Surface samples also show open-pit grade throughout this area(see assay maps). The Indiana shaft has been sampled for about 200 feet and it also shows good open-pit values. Drilling in the area produced and average of .08 gold and 7 ounces silver.



# HEWLETT MANAGEMENT

R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
Sparks, Nevada 89431

Manganiferous Limestone Group

These ore bodies are characterized by a series of thickly bedded massive limestones containing manganese ores and manganiferous silver. These ore bodies lie in the western and southern portion of the District. Mines included in this group are the Lucky Cuss, Luck Sure, Wedge, Sunset, Knoxville(Stonewall), Anchor, and the Grand Dipper. The limestone that crops out around the Lucky Cuss is Naco, with the Schieffelin granodiorite to the west and north. The limestone strikes N. 8° W., and dips 72° W. Further south the strike and dip change, curving toward the Emerald series. The north-south trending manganiferous limestones have a mineralized width of 1700 feet.

Ore bodies of this type exhibit a series of "pipe-like" structurally controlled ore bodies locally called "chimneys". The chimneys pitch eastwardly at an angle of about 45°. Manganese sulphide was found in a body of the Lucky Cuss mine;the mineral species Alabandite was found in some of the manganese kidney ore bodies. The silver came in with the manganese sulphide as tetrahedrite.

LUCKY CUSS MINE: Surface ores ran from 30 to 50 ounces silver per ton. The ore was high grade gold-silver-lead and continued below the water table. Also, much manganese oxide was mined and shipped.

The Lucky Cuss, Old Guard, and Herschel are along the strike of this limestone mass. Notice on the follwoing plate that some of the ore bodies were in the fault zone and the others in massive limestone. The author has entered the Lucky Cuss from a long drift starting in the Old Guard. The area is ideal for an open pit. The outcrops' are open pit grade;the area should have more sampling and drilling. Notice that the ore bodies all came to the surface(following plate), which provide surface ore that was below the cut-off during the mule-train days.

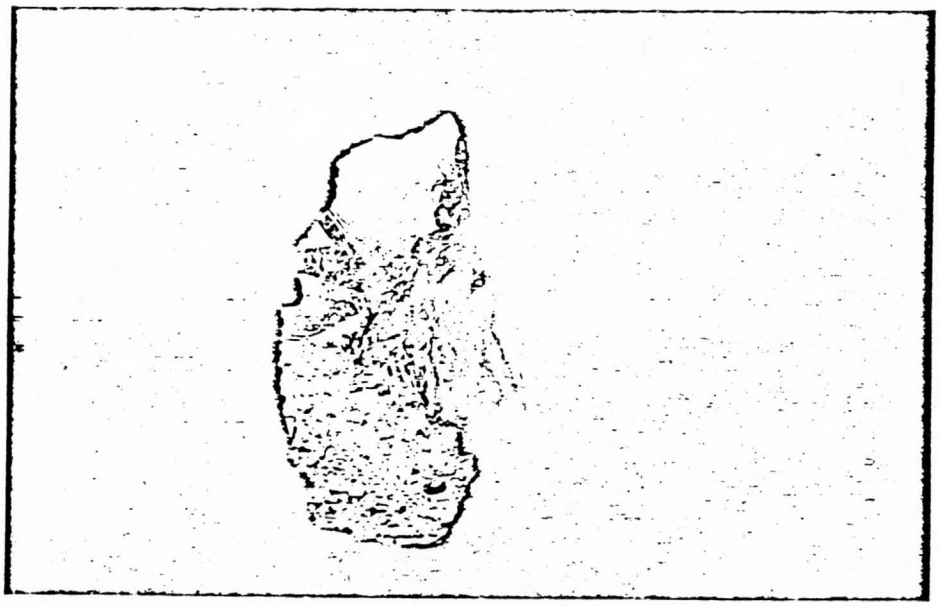
On the facing page is a photo of the old Lucky Cuss workings in about 1884, looking easterly. The upper shaft was later to be the largest workings and dump. The lower shaft and dumps did not develop much further. To the right and up hill is the Luck Sure. The Old Guard and Herschel is to the left over the ridge.

On the back of this page is a more recent photo of the Lucky Cuss dump and the Luck Sure on the side of the hill. Facing that photo is an 1880 photo of the Luck Sure.

Vertical photo showing dip at the Prompter; dip is to the south. The structure can be traced across the hill to the Oregon mine. Good values exist between the two mines in the structure. Gob would be at the lower workings (from 200 to 500 foot level) due to steep dip of the structure.

Numerous ore/stope exposures exist near the portal and east along the structure.

Oregon end of the long drift connecting the Oregon and Prompter mines. There are numerous workings that come to the surface and that provide access to the undergound stopes.



# HEWLETT MANAGEMENT

R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
Sparks, Nevada 89431

## Emerald Series

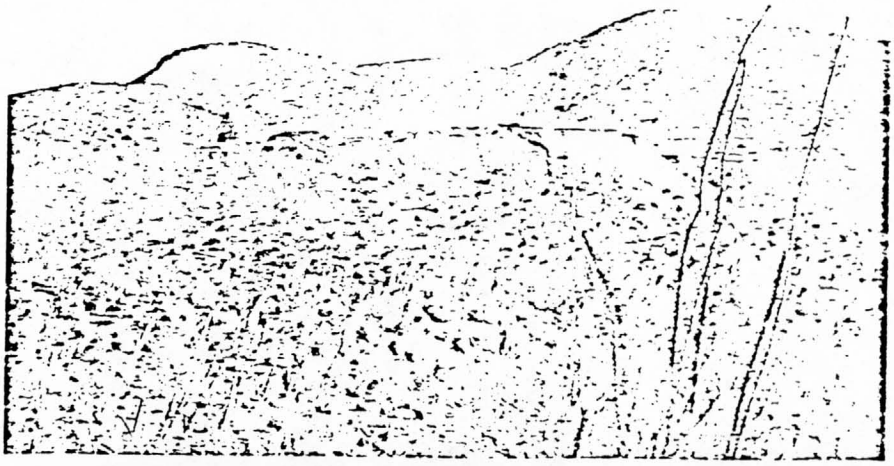
South of the Lucky Cuss are a series of beds of limestone, shales, and quartzites the crop out with extreme regularity and dip eastward at an angle of 30°, striking north-south. The upper members consist chiefly of massive limestone which forms the massive hill to the south of the Emerald mine. The limestones rest on argillaceous limestones with many shaly partings forming sharply defined linear croppings. Then under a bed of shales there is a foudation of regularly bedded clean quartzite of vitreous even grain that is limonite stained and over 400 feet thick. Two east-west structures separate the Emerald from the Lucky Cuss type ore bodies. The Bunker Hill mine is possibly dislocated by the structure; the Bunker Hill is in the Naco as are the Lucky Cuss type ore bodies.

EMERALD: The Emerald is the lowest in the Geological Column in the District, as follows;

| | |
|---|---|
| Escabrosa ls. | Carboniferous |
| Martin ls. | Devonian |
| Abrigo ls. | Cambrian |
| Bolsa qtz. | Cambrian |
| Pinal Schist | Pre-Cambrian |

In addition to manganiferous silver ores and gold, base metals were found. At the pre-Cambrian contact, chalcocite was mined and shipped that ran 40 % copper. Also, the vein was recently sampled and mapped and at the water table would run about $200 per ton. The north-south structure was examined by the team of Spear and Walker who report hugh stopes and interconnected workings. Surface samples indicate ore-grade vein walls over a large strike distance.

Emerald dump with headframe. Good area for open-pit exploration.



# HEWLETT MANAGEMENT

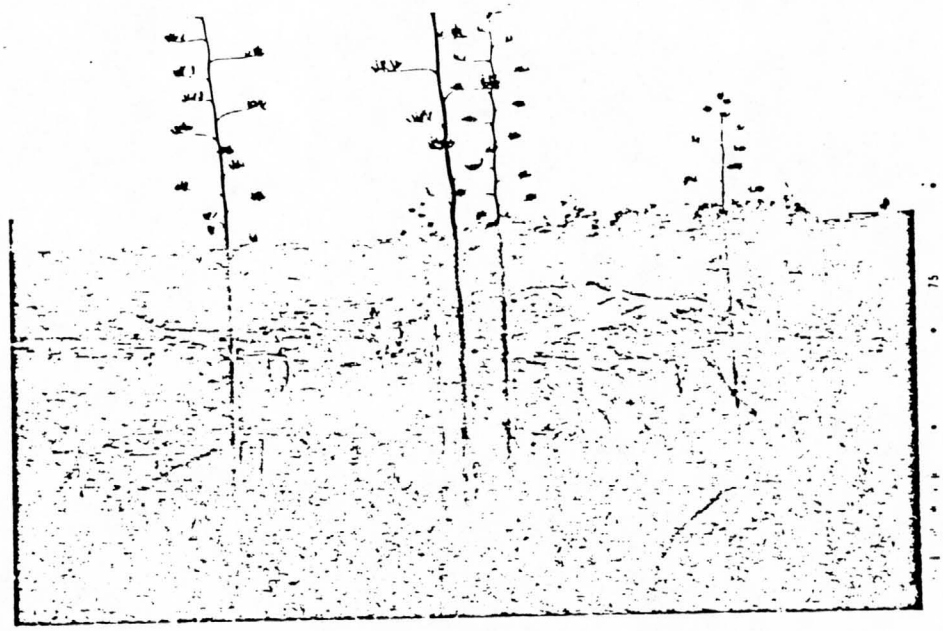
R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
Sparks, Nevada 89431

## Tombstone Extension

This area is possibly faulted-off from the main District. The ore bodies are very much like the main District ore bodies, starting in Bisbee on the surface. The following plate shows in section the ore bodies which are in the upper Bisbee. The main mines were the Tombstone Extension, Carper, and the San Diego. Most of the lead or contained .071 ounces gold per ton. The Tombstone Extension Mine was the largest producer of lead in Arizona in 1932-1933.

Exploration conducted by the author determined that an intrusive outcrops in this area. The Teriary intrusive caused a large belt of alteration and was moderately mineralized at the surface. At a depth of 200 feet(maximum depth of hole) the grade was up to .06 Au and 5 ounces Ag. About 600 feet east of the alteration center is a breccia pipe. This area deserves more exploration. About 20 shallow drill-holes have been drilled and interesting precious metals and base metals were discovered.



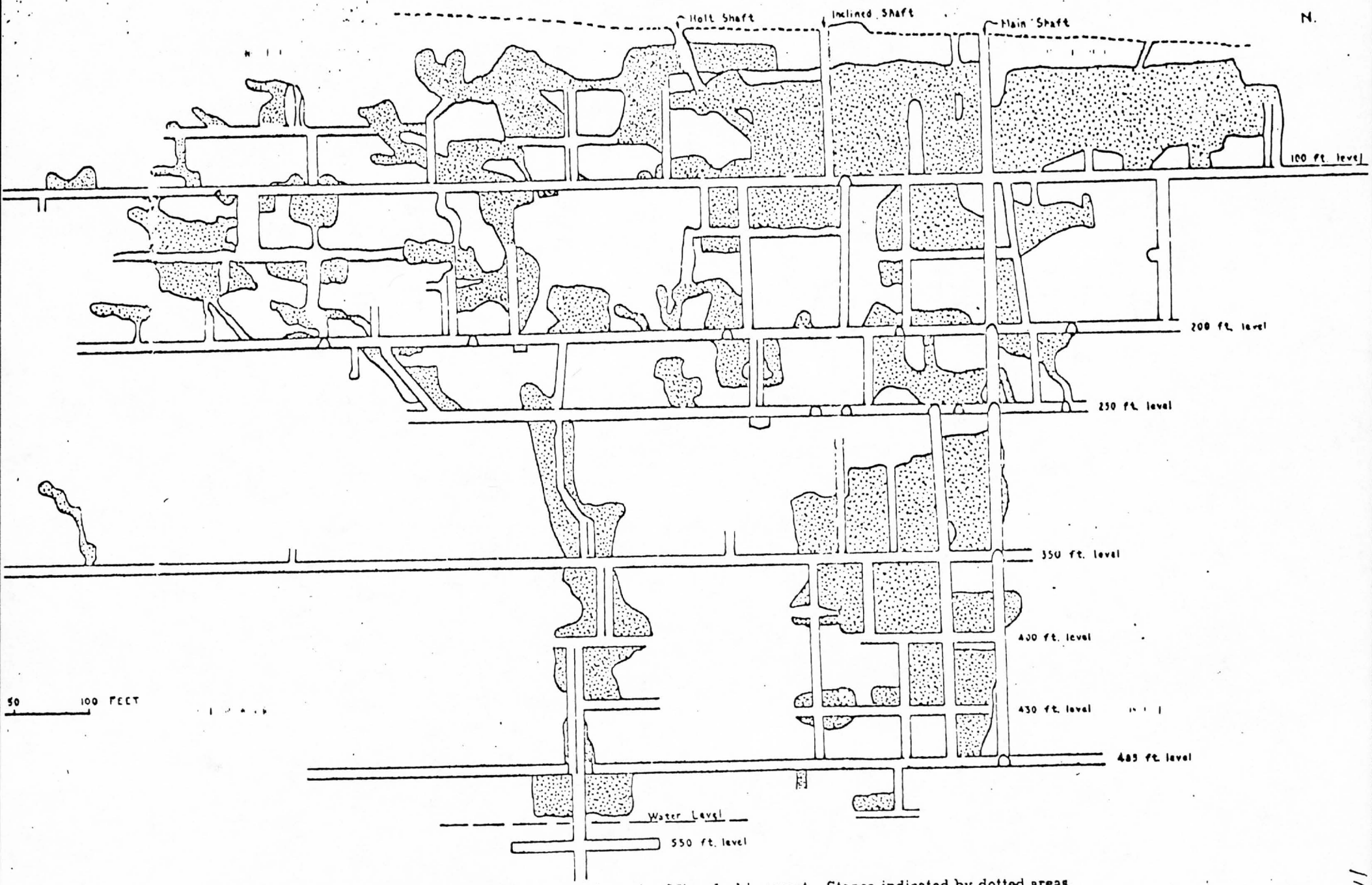



Plate X.—Longitudinal section of Tombstone Extension Mine, looking west. Stopes indicated by dotted areas.

# HEWLETT MANAGEMENT

R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
Sparks, Nevada 89431

## EXPLORATION

Both underground and open pit exploration will be considered for the Tombstone District. However, there are more open pit targets than underground from an economic point-of-view.

The underground workings are generally in good shape. Because of this, the following approach is suggested:

1. Compilation of all data; determination of targets from roll and structural intersections.

2. Sample these areas underground-with whatever mapping is necessary.

3. Surface drilling using reverse circulation of determined targets.

4. Drifting along any high-grade intercepts.

### Open Pit

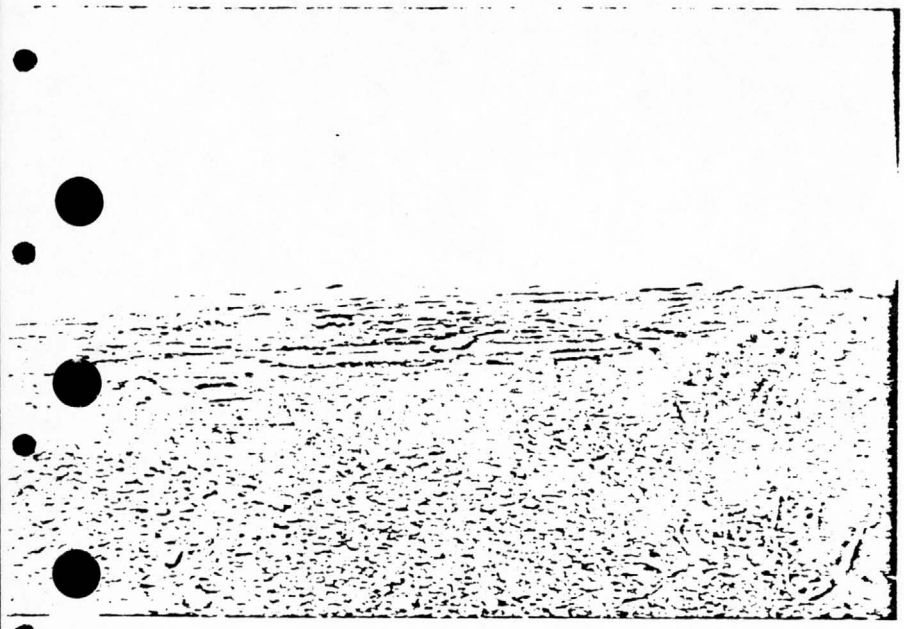
Considerable surface sampling has been done in the District. Also, extensive underground mapping and sampling has been done for many years. Based on these data and knowldge of the underground workings, the following open-pit targets exist in decreasing order of priority:

1. Contention dike structure
2. Silver Thread-Skip Shaft area
3. Lucky Cuss-Old Guard-Herschel area
4. Emerald area
5. Bunker Hill-Rattlesnake area
6. Tombstone Extension area.

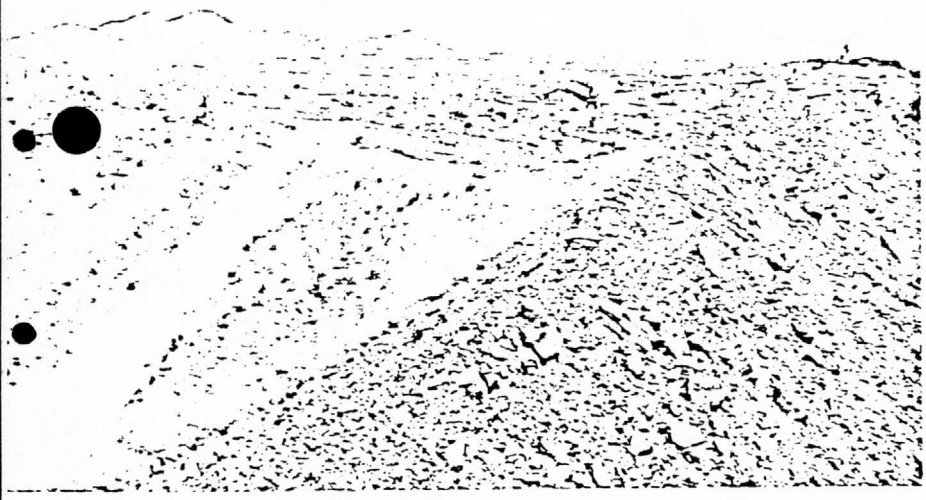
### Underground

Underground mining is a very costly operation. Considering the economics and the past production of various mines, structure, extent of workings, grade of past production and present knowledge of ore extent, there is only one target-the Contention Dike. Therefore, it will be discussed along with the open pit consideration; the underground evaluation would be an extension of open pit evaluation.

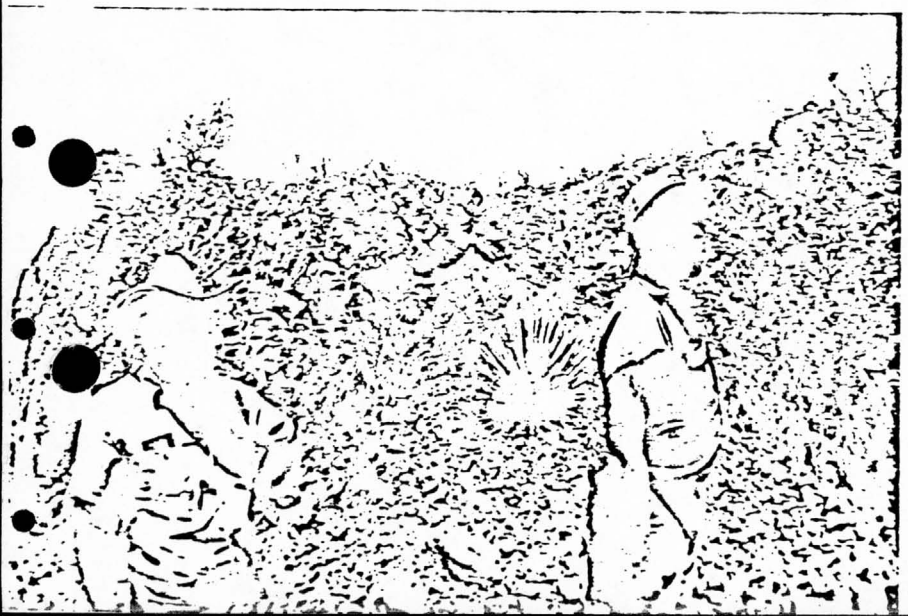
The Contention is the only underground target that could potentially stand-on-its-own. However, the Lucky Cuss could justify an underground operation in combination with open-pit mining.



Contention dike area; viewed from ridge separating cave area from dike and faults. Breccia dikes in area.



Contention Shaft area; beyond hill with roads. Viewed from heap.



Contention Cave area; Outcrop showing red hematite-good gold values in this area.

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R. F. HEWLETT
PHONE (702)359-1069

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CONTENTION DIKE: This structure is rated as the best open pit and underground possibility in the District. As was mentioned, it will be discussed from the point of view that the underground mining would be an extension of open pit mining, from an evaluation standpoint.

Consider first the three maps showing the surface sampling in the Empire-Tranquillity-Contention-Grand Central zone(Duval, Homestake/Doherty, and Hewlett). Results of these samplings are:

| Open-Pit Target Area | Average Grade Au oz | Average Grade Ag oz |
|---|---|---|
| Contention Shaft | .066 | 1.75 |
| Contention Cave | .145 | 3.53 |
| Grand Central | .058 | 3.12 |
| Tranquillity | .063 | 1.66 |
| Skip Shaft | .207 | 2.02 |

This zone is an obvious open-pit target, and it is also an underground target due to two basic facts, which are:

1. Continuity exists at depth and the gold values increase at depth.

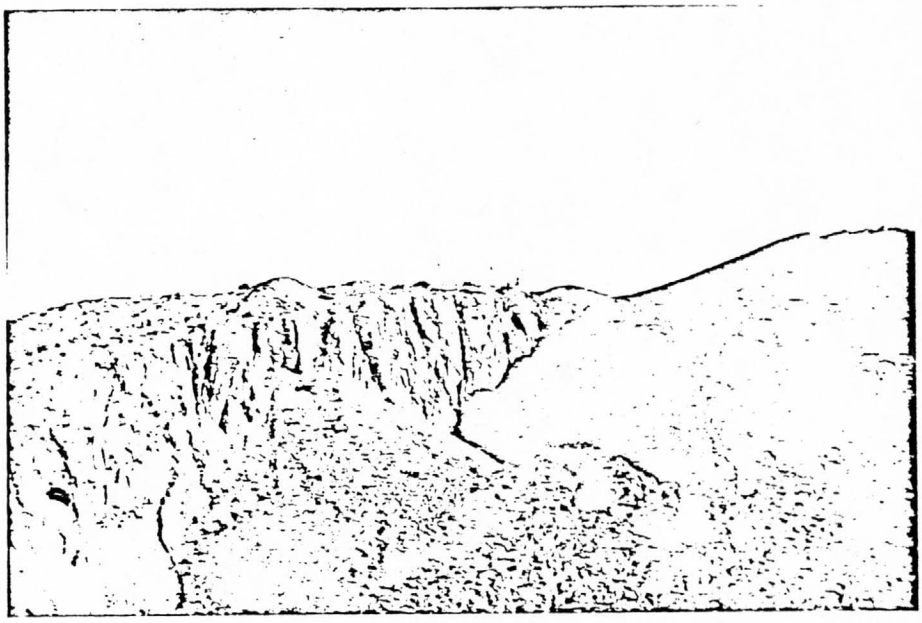
2. Water level curtailed mining very far below the water table due to previous pumping problems(see special maps showing the workings above and below the water).

Contention Cave area; Dike was mined and the ore was followed to the surface.- Viewed from between the Contention-left and the Grand Central-right out of picture. Flora Morrison is to far left-lower.

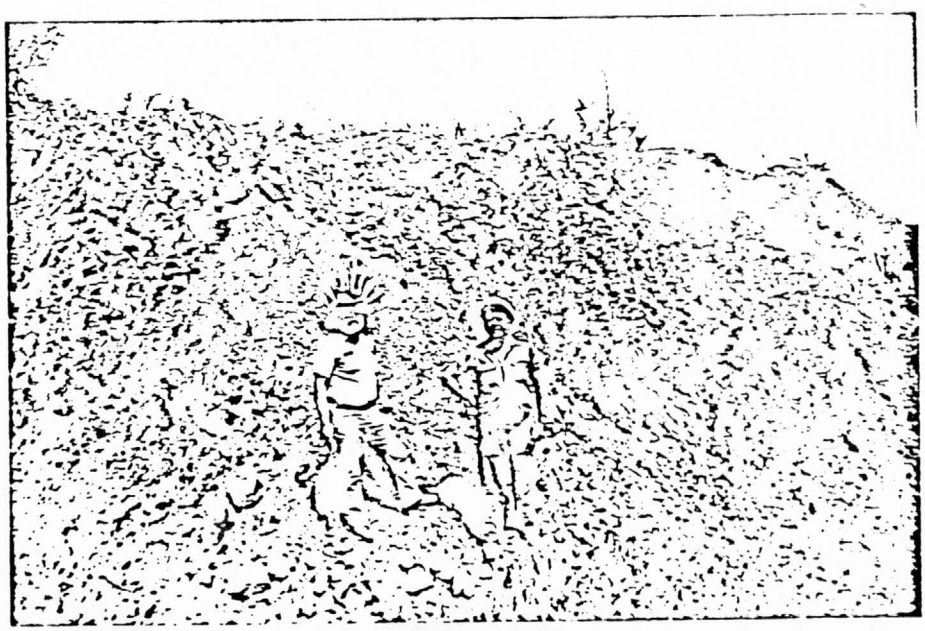
Contention; north end of caved area is separated by a silicious ridge that is mineralized. Notice other caved area on the other side if the road. This caved area is shown on sample maps.

Contention; numerous breccia zones (dikes/pipes). Little Joe headframe far right. This area averaged .145 Au & 3.53 Ag. Vein on south side runs over 1 ounce Au & 30 oz. Ag

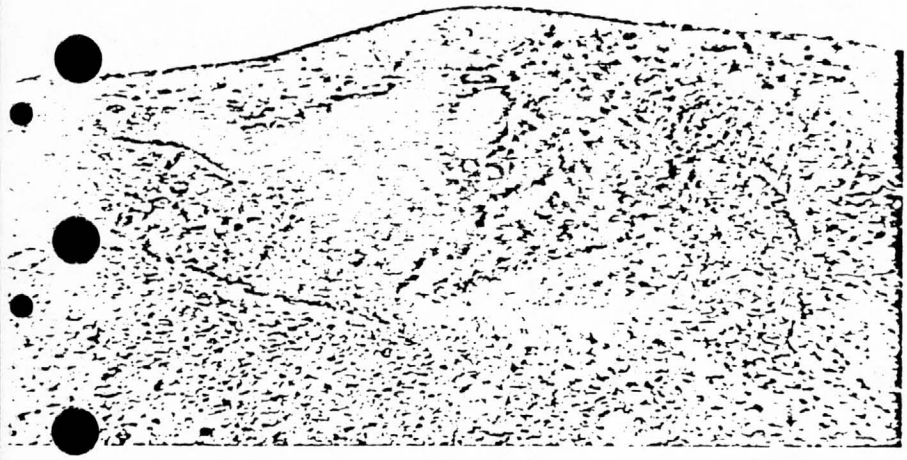
North end of the
Contention Cave;
Notice the alteration.



South end of caved area;
Back-hoe trenches found
many high-grade veins.

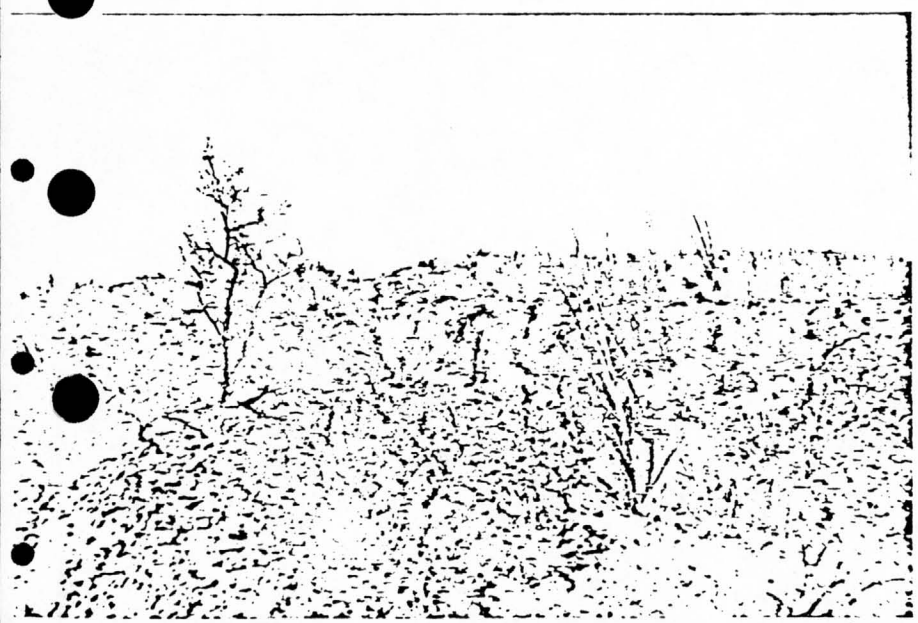


Walls of dike;
Notice the red
hematite-indicative
of gold values.



Contention Incline; Part of the structure in the Contention area. This is a north-east extension of the caved area along the Contention dike-close to the heap. Called the Little Contention; had high-grade gold in dumps. Structure carries good values.

Contention cave area; North end. Contention Incline over the ridge. This structure trends into Incline area(above) and under the heap to the Contentment Shaft.



Indiana Shaft area; behind observer a short distance. Red altered area is railroad cut that extends about 700 feet. Samples taken along cut averaged .03 Au, which is a good indication of better ore at depth. Most areas have better gold values at 15 feet. Cut is close the caved area(looking NNE).

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R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
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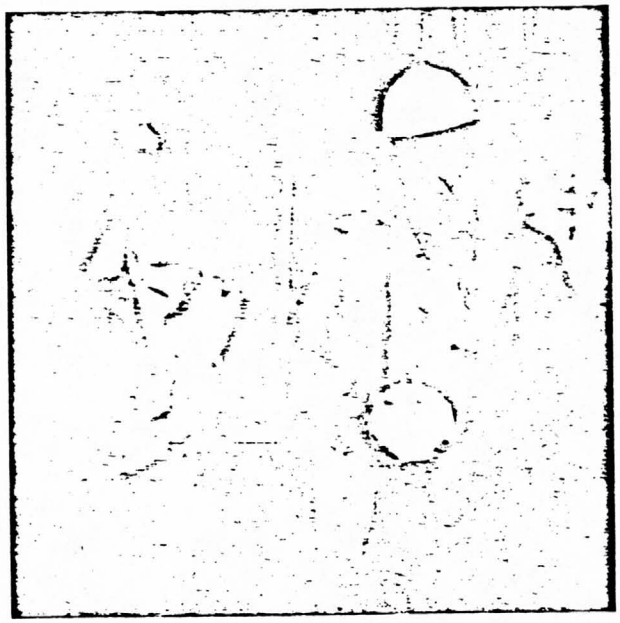
Below is a summary of the relationship of gold to depth:

| | Grand Central | Contention | Sulphuret | West Side | Toughnut Goodenough | Lucky Cuss |
|---|---|---|---|---|---|---|
| Surface | | | | 1/3 | Little | Tr |
| Water Level | 5 oz. | 5 oz. | 1 oz. | 2/3 oz. | 1½ oz. | 1 1/3 oz. |
| Below | | | | | | 2 ½ oz. |

The above makes the obvious point that the gold increases with depth and that the south end of the Contention dike deserves the most serious exploration for both open pit and underground.



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R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
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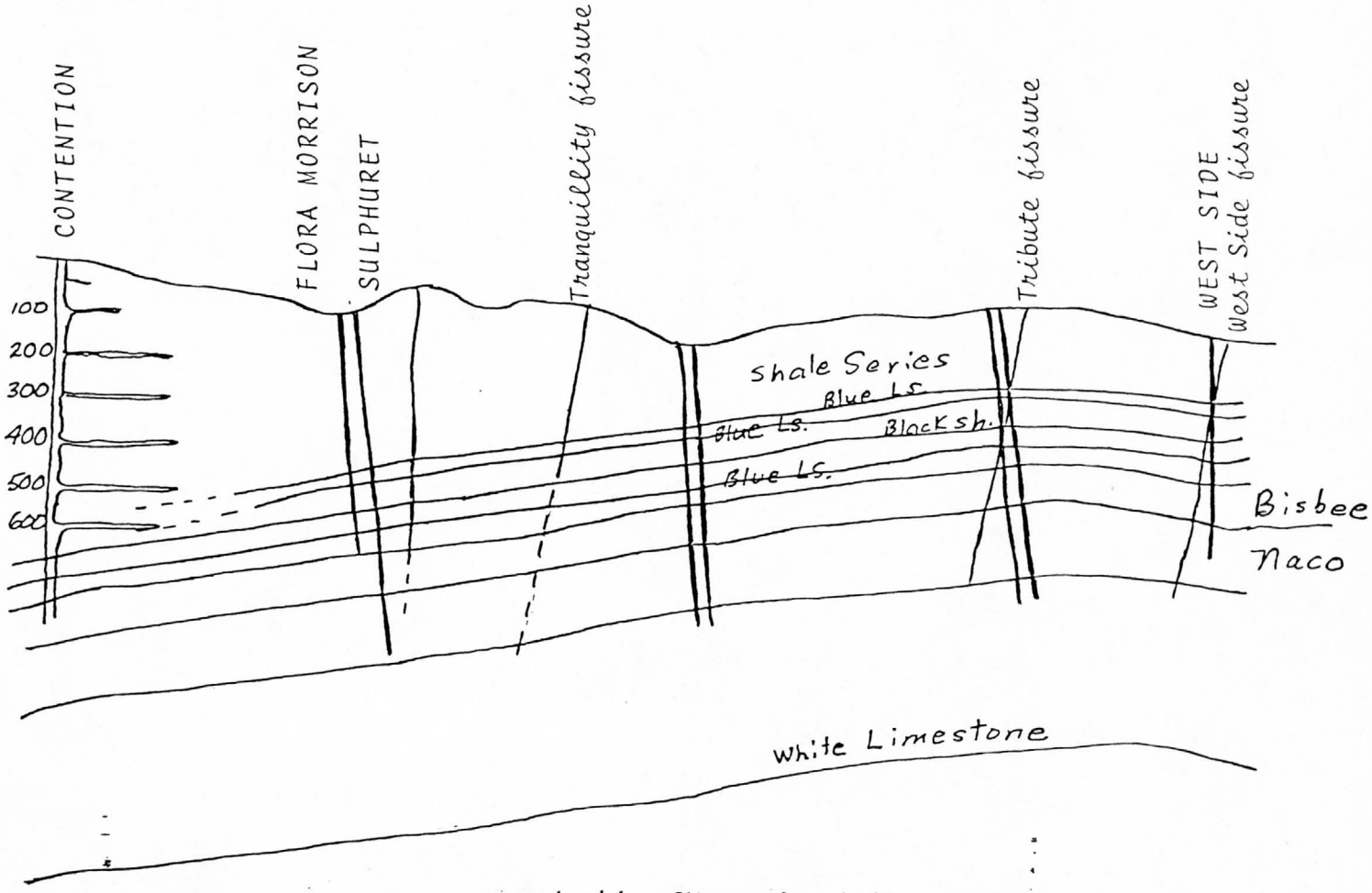
The West Side anticline is shown below, presenting the concept that at depth in the Contention mine exists high-grade ore bodies that are high-grade accumulations of the Bonanza ores found in the anticline near the surface (West Side, Tribute, Tranquillity, etc.). The ore bodies would be the highest grade near the intersection of the "ore-producing" horizons in the blanket ore zones and the Contention dike. Numerous examples of this fact have been found in isolated winze's, cross-cuts, and other lower workings. However, due to the fact that little mining was done during the de-watering period (see map showing workings below the water table), no concerted effort was made to mine these high-grade ores.




Looking SW: scale; 1 in. = 400 ft.

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R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
Sparks, Nevada 89431

## HEAP LEACHING ACTIVITIES

### GENERAL

1. Legal Agreements

2. Cadestral Survey
   - A. Patented claims
   - B. Lode claims

3. Claim Staking
   - A. Lode
   - B. Mill site

4. Environmental Survey
   - A. Local-State-Federal Regulations
   - B. Obtain Permits
   - C. Design & Install Monitor System

5. Water
   - A. Location Selection-Ownership
   - B. Drilling
     1. Draw-down tests
     2. Reaming & casing
   - C. Pump Installation
   - D. Generator or Electric Power
   - E. Pipe Installation
   - F. State Use Permit
   - G. Water Testing
     1. pH
     2. Anions & Cations
     3. Major Elements (Mass Spec)
   - H. Water Treatment
     1. Filters
     2. Point-settling
     3. Polymers
     4. pH

6. Power
   - A. Source-Availability Decision
   - B. Installation

7. Ancillary
   - A. Office Buildings
   - B. Laboratory
   - C. Shops-Maintanence
   - D, Fencing
   - E. Housing

# HEWLETT MANAGEMENT

R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
Sparks, Nevada 89431

## HEAP LEACHING ACTIVITIES

### EVALUATION

1. Review of Available Data
   - A. Past Production History
   - B. Geology
   - C. Previous Sampling
   - D. Previous Metallurgical Testing

2. Geology
   - A. Mapping
     1. Lithology
     2. Alteration
     3. Structure
     4. Geochemistry
   - B. Ore Occurence
     1. Host Rocks
     2. Gangue
   - C. Ore Mineralogy

3. Topographic Mapping
   - A. Photographs (aerial)
   - B. 5-foot Contour Map(s)

4. Sampling
   - A. Dumps & Tailings
     1. Grab/channel
     2. Back-hoe trenches
     3. Dozer cuts
   - B. Surface Mineralization
     1. Soil
     2. Outcrop
        - a. Rock chip
        - b. Channel
        - c. Drilling
          1. Rotary
          2. Diamond

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R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
Sparks, Nevada 89431

## HEAP LEACHING ACTIVITIES

5. Assaying
   A. Fire
   B. Atomic Adsorption

6. Preliminary Metallurgical Tests
   A. pH determinations
      1. "Leaching" water
      2. Ore; host & gangue

   B. Solvent Analysis
      1. Acid
      2. Basic

   C. Leaching Efficiency-Recovery
      1. Head Assay-Fire Assay
      2. Noble Metals Leached
         a. Cyanide
         b. Aqua Regia
         c. Other Solvents

   D. Solvent Economic Analysis
      1. Solvent Recoveries
      2. Estimated Costs
         a. Reagents
         b. Solvents
         c. Buffers

7. Mining Layout & Design
   A. Dumps
      1. Tonnage for sections of dump
      2. Heads & Recoverable Grades for sections
      3. Estimated Production Costs
      4. Break-Even Economic Cut-Off Grades
      5. Economic Ore Reserves

   B. Open-Pit Ore
      1. Bench Height
      2. Bench Reference Elevation(s)
      3. Production Rate & Costs
      4. Economic Break-Even Cut-Off Grades
      5. Economic Mineable Ore Reserves

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R. F. HEWLETT
PHONE (702)359-1069

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## HEAP LEACHING ACTIVITIES

### METALLURGICAL TESTING

1. Preliminary Sampling
   - A. Bulk Samples
     1. Ore(host rock types)
     2. Gangue
   - B. Leaching Water Source

2. Pre-Treatment
   - A. Carbonaceous-Kerogen
     1. pH change
     2. Noble Metal Solvents
     3. Carbon bond-Noble Metal exchange
   - B. Partially Oxidized Sulfides
   - C. Base Metals; Copper, Zinc, Iron, etc.
   - D. Tellurides
   - E. Refractory Minerals
   - F. Complex Sulfides

3. Solvent Selection
   - A. Types
     1. Toxic
     2. Non-Toxic
     3. Acid pH
     4. Basic pH
     5. Dual Range pH
     6. Combinations
     7. Oxidants
   - B. Gold-Silver Solvents
     1. Acid phase
        - a. Sodium thiosulfate($Na_2S_2O_3 \cdot 5H_2O$
        - b. Ferric chloride($FeCl_3$)
        - c. Sodium hypochlorite($NaOCl$)
        - d. Sodium chloride-Sulfuric acid systems
        - e. Acids($HCl$, $HNO_3$, $H_2SO_4$, Oxalic, Aqua Regia, etc.)
        - f. Thiourea($NH_2CSNH_2$)
     2. Basic phase
        - a. Cyanide
        - b. Sodium thiosulfate
        - c. Chlorine-sodium chloride

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R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
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## HEAP LEACHING ACTIVITIES

C. Economic Analysis
  1. Noble Metal dissolution rate per solvent
  2. Optimum solvent concentration
  3. Solvent costs
  4. Optimum solvent economics
    a. Solvent selections
    b. Concentrations

4. Induced Perculation
  A. Open-Pit ore
    1. Physical-size analysis
    2. Chemical-fines aggregation
  B. Dumps
    1. Physical-size analysis
    2. Chemical-fines aggregation/clay mineral lattice
  C. Tailings
    1. Physical-size analysis
    2. Chemical-clay and fine particle agglomeration

5. Leaching Tests (Barrel Tests)
  A. Recovery-percentage
    1. Solvent(s)
    2. Effect of crushing
  B. Leaching rate
  C. Reagent consumption

6. Process Economics
  A. Noble Metal Recovery(%)
  B. Noble Metals Recovered per Ton
  C. Solvent Cost per Ton

7. Metal Recovery
  A. Zinc electromotive replacement
    1. Deaeration
    2. No deaeration
  B. Powdered iron electromotive replacement
  C. Carbon adsorption
  D. Ion-exchange resins
  E. Precipitation by pH change
  F. Selective silver precipitation with sodium sulfide
  G. Reduction of gold with ferrous sulfate/ppt.
  H. Precipitation of silver with HCl

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R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
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## HEAP LEACHING ACTIVITIES

### DESIGN

1. Site Survey & Design
   - A. Pads
   - B. Ponds
   - C. Plant
   - D. Roads

2. Pad
   - A. Surface area & slope
   - B. Pad drainage spacing & network
   - C. Drainage ditch layout
   - D. Construction material selection
     1. Compaction & permeability testing
        - a. Tailings
        - b. Clay-kaolinite, volcanic tuff, etc.
        - c. Desert soil
     2. Artificial membranes

3. Heap Design
   - A. Optimum lift increment
   - B. Shape and configurations of heaps
   - C. Heap geometry-tonnage-spray relationships
   - D. Spray design
     1. Ore tonnage
     2. Spray spacing and configuration
     3. Spray rate
     4. Tons treated/spray
     5. GPM/spray
     6. GPM/100 $ft^2$

4. Spray Cycle
   - A. Saturation
   - B. Spray rate
     1. Initial
        - a. Clay/high % fines
        - b. Non-clay & low % fines
     2. Post-saturation & final
   - C. Optimum leach period
   - D. De-water period

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R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
Sparks, Nevada 89431

## HEAP LEACHING ACTIVITIES

5. Ponds
   A. Settling Tests
      1. Settled volume
      2. Corrected $H_2O$
      3. Weight percent solids
      4. Volume percent solids
      5. Settled solution density

   B. Settling Rate
      1. Terminal velocity
      2. Un-hindered settling velocity
      3. Settling velocity vs. pond height
      4. Flow rate in pond
      5. Mean width of pond
      6. Free-settling velocity of smallest particle that will settle
      7. Overflow particles

   C. Parameters
      1. Slope
      2. Topography
      3. Shape
      4. Length
      5. Heigth
      6. Fluid area(right angles to settling force)
      7. Dimension-volume-gallons

   D. Types of Ponds
      1. Sand ditch
      2. Pregnant solution
      3. Precipitation/barren
      4. Spray
      5. Acid
      6. Basic
      7. Acid settling-copper, ferric gels, clay minerals, etc.

   E. Layout of Pond Systems

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R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
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## HEAP LEACHING ACTIVITIES

6. Plant
   A. Design
      1. Solvents
         a. Pre-Treatment
         b. Leaching

   B. Equipment Selection
      1. Filters
      2. Pumps
      3. Plumbing
      4. Metal recovery system(s)

7. Plumbing Layout & Design
   A. Plant capacity
   B. Pipe selection(type)
   C. Pipe diameter selection
      1. Viscosity & density
      2. Pressure drop
      3. Mass flow rate
      4. Liquid flow rate
      5. Length of flow

8. Pump Selection
   A. Suction lift
   B. Vertical lift(head)
   C. Suction & discharge pipe size
   D. Pipe size
   E. Line distance
   F. Desired PSI & discharge GPM
   G. Type
   H. HP, Head, RPM, etc.

9. Reagent Storage & Mixing
   A. Cyanide
   B. Caustic-Lime
   C. Water treatment(flocculation/polymers)
   D. Other solvents/reagents

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R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
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## HEAP LEACHING ACTIVITIES

### PRE-PRODUCTION

1. Construction
   - A. Haulage roads
   - B. Pads (including berms)
   - C. Ponds (including dykes)
   - D. Installation
     1. Liners
        - a. Ditch
        - b. Pond
        - c. Pad
     2. Plumbing
        - a. Preg-plant pipe
        - b. Plant
        - c. Plant-precip pipe
        - d. Precip-spray pond pipe
        - e. Spray manifold & pipe lines
        - f. Make-up tanks
     3. Wiring
        - a. Pump motors
        - b. Plant
        - c. Well-generator (?)
     4. Tanks
        - a. "Fresh" make-up water
        - b. Make-up solutions
          1. Reagent
          2. Solvent

2. Plant
   - A. Equipment purchase
   - B. Plant construction
   - C. Installation on-site
   - D. Testing; de-bug

3. Laboratory
   - A. Atomic adsorption
   - B. Titrations
   - C. Solvent analysis
   - D. Leaching tests
   - E. Metal recovery tests
   - F. Process monitoring

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R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
Sparks, Nevada 89431

## HEAP LEACHING ACTIVITIES

### PRODUCTION

1. Mining
   - A. Grade control
   - B. Drilling & blasting(open pit)
   - C. Loading(open pit, dumps, & tailings)
   - D. Haulage

2. Heap
   - A. Ore "heaping"
     - 1. Leveling to specified heigth
     - 2. Ripping

3. Leaching
   - A. Solution balance
   - B. Spray rate
   - C. Heap "weep" monitor
   - D. Pregnant Monitor
     - 1. Effluent
     - 2. Pond
   - E. Spray Monitor
     - 1. Spray manifold
     - 2. Spray pond

4. Plant
   - A. Monitor of preg & barren
   - B. pH control & monitor
   - C. Solvent/reagent make-up; Pre-treatment
   - D. Oxygen control
   - E. Anti-scaling reagents
   - F. Surface tension control
   - G. Moniote for EPA
     - 1. Well(s)
     - 2. Groundwater
   - H. Titrations
     - 1. Cyanide("free")
     - 2. Lime &/or caustic
     - 3. Other solvents
   - I. Procedure
     - 1. Start-up of plant
     - 2. Shut-down of plant
     - 3. Cleaning
     - 4. Pumps, etc.
   - J. Mill operators monitor & reports

5. Metal Recovery
   - A. Elution/stripping
   - B. Melting/refining

6. Sales

RESUME

JAMES A. BRISCOE
Registered Professional Geologist
Arizona and California
President
Southwestern Exploration Associates, Inc.

## Education

| | | |
|---|---|---|
| Geology, M.S. | University of Arizona | 1967 |
| Geology, B.S. | University of Arizona | 1964 |

## Professional History

| | |
|---|---|
| 1978-Present | Southwestern Exploration Associates, Inc. |
| 1973-1978 | Southwestern Exploration Associates |
| 1970-1973 | Sierra Mineral Management |
| 1969-1970 | Geodata Systems Inc. |
| 1965-1969 | American Smelting & Refining Co. |
| 1964 Summer | American Metals Climax |
| 1962 Summer | American Smelting & Refining Co. Mission Mine |
| 1961 Summer | U.S. Park Service |
| 1960 Summer | U.S. Park Service |

## Professional Experience

1973-Present — Southwestern Exploration Associates (Incorporated, June 29, 1978)

Since founding Southwestern Exploration Associates, Mr. Briscoe has been involved in all aspects of the business, both technical and managerial. Technical work has included regional exploration planning and execution for base and precious metal deposits, including uranium, detailed prospect examination and ore reserve calculations, and drill supervision. During this period he worked with S.E.A. Photography Director Dana M. Slaymaker in designing and implementing unique color aerial photographic techniques and procedures. From a business standpoint, Mr. Briscoe has been involved in all aspects of management and customer relations, including general management, product design and sales, and customer and employee relations. Numerous detailed, confidential geologic and mining reports have been prepared for major clients including: Chase Manhattan Bank, U.S. Borax, Texas Gas Exploration Corp., Felmont Oil Co., Cities Service Minerals, Phelps Dodge, The Cotter Corporation, and Newmont Mining, Incorporated.

1970-1973 — Sierra Mineral Management

As Vice President and Chief Geologist, Mr. Briscoe worked on a variety of base and precious metal exploration projects. He played a key role in the discovery and development of the McDermitt Mercury Ore Body of the Opalite Mining District on the Nevada/Oregon border.

This ore body is presently in production and operated as a joint venture between Placer Amex and the successor company to Sierra Mineral Management. This large open pit mercury mine is the largest mercury producer in North America.

1969--1970 Geodata Systems Inc.

As Chief Geologist, managing an exploration budget of over one million dollars a year, Mr. Briscoe designed regional exploration programs for base and precious metal deposits; designed, supervised and implemented research in lineament tectonic studies which resulted in original and specific exploration guides; designed and implemented a color aerial photographic system; hired and trained geologic personnel; participated in customer and investor relations, property acquisition and negotiations, and many other facets involved in the business.

1965--1969 American Smelting & Refining Co.

Assigned as pit geologist, Silver Bell Unit, Arizona, Mr. Briscoe was responsible for detailed mapping of open pit copper mines and logging exploratory diamond drill core. After one year, he was promoted to Resident-Exploration Geologist in charge of exploratory diamond drilling project, Silver Bell. Other duties included training geologists from ASARCO's Mexican subsidiary in the techniques of geologic mapping of mineral deposits and interpretation of leached porphyry copper capping. After this second year, he was again promoted to Exploration Geologist working out of the Tucson office on assignments in Arizona and Utah. During the ensuing year, he became part of a two-man field office in California generating and pursuing their own projects in precious and base metal exploration. During this period, much valuable experience was gained in disseminated precious metal occurrence of the Calico District and Carlin types. Extensive work was also performed on the gold mineralization of the Mother Lode region.

During Mr. Briscoe's numerous field trips, he has examined most of the major underground and open pit copper and molybdenum mines in the Arizona-New Mexico-Mexico area, including recent major discoveries. Additionally, he has examined specialty metal (rare earth, tungsten, mercury and sulfur) deposits in the California-Nevada area.

1964--Summer American Metals Climax

During summer vacation from college, Mr. Briscoe was an Assistant Geologist in molybdenum exploration for American Metals Climax.

1962--Summer American Smelting & Refining Co.

This summer was spent as a laborer and explosives worker at ASARCO"s Mission Mine Unit near Tucson, Arizona.

1961 & 1960--Summers U.S. Park Service

These summers were spent maintaining trails and as a fire lookout.

Professional Affiliations

American Institute of Mining,Metallurgical and Petroleum Engineers
American Society of Photogrammetry
Arizona Geological Society
Society of the Sigma Xi, Sigma Gamma Epsilon
Society of Mining Engineers of A.I.M.E.
New Mexico Geological Society

SOUTHWESTERN EXPLORATION ASSOCIATES, INC.

## PROFESSIONAL SERVICES

### Minerals Exploration

| | | | | |
|---|---|---|---|---|
| James A. Briscoe | President; Registered Professional Geologist (Arizona & California) | M.S. Geology | University of Arizona | 1967 |
| | | B.S. Geology | University of Arizona | 1964 |
| W. Edward Speer | Program Manager, Senior Geologist | M.S. Geology | University of Arizona | 1977 |
| | | B.S. Geology | University of Arizona | 1969 |

### Literature Research

| | | | | |
|---|---|---|---|---|
| Michael C. Baumann | Manager, Literature Research; Geologist (Registered Professional Geologist in training, Arizona) | M.S. Geological Engineering | University of Arizona (course work complete, thesis in progress) | |
| | | B.S. Geology | University of Arizona | 1973 |
| Susan N. Craft | Certified Librarian | M.S. Library Science | State University of New York at Buffalo | 1977 |
| | | B.A. American History | State University of New York at Buffalo | 1974 |
| Audrey C. Garven | Assistant Geologist | M.S. Geology | University of Regina Saskatchewan, Canada | 1976 |
| | | B.S. Geology | University of Southern California | 1975 |
| Bruce M. Prior | Assistant Geologist | B.S. Geology | University of Arizona | 1978 |
| John M. Jurasin | Assistant Geologist | B.A. Geology | Rutgers University | 1977 |
| Philip J. Tuley | Computer Specialist | Metallurgical Engineering | Univeristy of Arizona student (work co-op program) | 1980 |

### Land Status Research

| | | | | |
|---|---|---|---|---|
| Thomas E. Waldrip, Jr. | Manager, Land Status Research; Manager, Drilling Division; Geologist | M.S. program in Agriculture | University of Arizona | |
| | | B.S. Geology | University of Arizona | 1973 |
| Clark D. Green | Assistant Geologist | B.S. Geology | University of Arizona | 1978 |

SOUTHWESTERN EXPLORATION ASSOCIATES, INC.

## TECHNICAL SERVICES

### Drafting & Scientific Illustration

| | | | | |
|---|---|---|---|---|
| Susan Angelon | Manager, Drafting & Scientific Illustration | A.S. Management/Marketing | Pima Community College | 1975-Present |
| | Senior Draftsperson & Scientific Illustrator | B.A. Political Science/Geography<br>A.S. Photography | University of Arizona<br>Endicott College | 1967<br>1958 |
| Susan Bancroft | Draftsperson, Scientific Illustrator | B.F.A. Studio Art | University of Arizona | 1978 |
| Jan L. McDonald | Draftsperson, Scientific Illustrator | 2-year course Scientific Illustration<br>4-year course Graphic Design | University of Arizona | 1977 |
| Jill Slaymaker | Assistant Geologic Draftsperson | M.A. Anthropology, Museum Work<br>B.A. Art History & Art Technique | University of Arizona<br>Mills College | 1972<br>1969 |

### Business Services

| | | | | |
|---|---|---|---|---|
| Christine M. Dodson | Manager, Business Services<br>Administrative Secretary | A.A.S. Secretarial Sciences | Pace University Westchester | 1972 |
| Mahina Drees | Administrative Secretary | B.A. Secondary Education<br>1 year Graduate School | Antioch College<br>San Francisco State | 1965<br>1966 |
| Marilyn Pfautsch | DEC Computer Operator | 2 years Nursing | University of Arizona | 1970-1972 |
| Susan J. Ouderkirk | DEC Computer Operator | IBM Magnetic Card Training Course (IBM) | Sahuaro High School | 1971 |
| Jane Talley | Senior Bookkeeper | Accounting Major | University of Arizona | 1971-1972 |
| Judy M. Urias | Junior Bookkeeper | Commercial Business Course | Millvale High School | 1969 |

S.E.A. PHOTOGRAPHY, INC.

| | | | | |
|---|---|---|---|---|
| Dana M. Slaymaker | Vice President & General Manager; Aerial Photographer | Scientific Illustration | Linda Vista School of Fine Arts<br>University of Arizona<br>The Haverford School | 1969-1973<br>1965-1969<br>1961-1965 |
| Robbin D. Brown | Lab Manager | Image Interpretor, Remote Sensing Specialist, Cartographic Aid, Photo Lab Specialist | U.S. Army | 1971-1977 |
| Mark S. Thaler | Lab Assistant | B.A. Archeology w/ Special Courses in Geology & Photography | University of New Mexico | 1976 |
| Barry F. Zak | Lab Assistant | B.S. Design w/ major in Photography | Illinois Institute of Technology | 1977 |

## ASSOCIATES

| | | | | |
|---|---|---|---|---|
| Kenyon Richard | Independent Consultant; Senior Consulting Associate, Southwestern Exploration Associates, Inc. | Retired Chief Geologist ASARCO; World recognized expert on porphyry copper deposits | | |
| | | B.S. Geological Engineering | Mackay School of Mines University of Nevada | 1937 |
| Eugene V. Ciancanelli | Registered Professional Geologist, California; Geothermal & Mining Consultant Independent Consultant; Associate of Southwestern Exploration Associates, Inc. | M.S. Geology | University of Arizona | 1965 |
| | | B.S. Geology | University of Arizona | 1963 |
| | | Graduate Work | Oregon State University | 1965-1966 |
| Norman E. Dausinger, Jr. | Hydrologist; Independent Consultant; Consulting Associate, Southwestern Exploration Associates, Inc. | Geological Engineering (honorary degree) | University of Arizona | 1971 |
| | | Law | University of Arizona | 1959 |
| | | Geology | University of Arizona | 1956-1957 |
| | | Electronics | Radar Electronics School | 1954-1955 |
| | | B.S. Geological Engineering | University of Arizona | 1954 |

139

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James A. Briscoe, President
Registered Professional
Geologist

# Southwestern Exploration Associates, Inc.

## Partial List of Clients

Anaconda Company
AMAX
Arizona State Land Department
Bock River Boat Shop
Bureau of Land Management
Chase Manhattan Bank
Cities Service Minerals Corporation
Compania Minera Zapata
Continental Oil Company
Cooper Aerial Surveys, Inc.
Cotter Corporation
Exxon Minerals Company
Felmont Oil Company
Freeport Exploration
Fugro Photogrammetrics, Inc.
GEOMET, Inc.
Gulf Resources
Hewitt and Associates
Lucky Mc Uranium Corporation
(subsidiary of Westinghouse)
Mission Mortuary
Murray, Nelson and Turner Associates
Newmont Exploration Ltd.
Occidental Minerals Corporation

Phelps Dodge Corporation
Power Resources Corporation
Republic Geothermal, Inc.
Ross Investigation Service
San Diego Gas & Electric Company
SAGE Associates
71 Minerals, Ltd.
Sierra Mineral Management
Smoky Valley Mining Company
Southwest Properties, Inc.
Tenneco Oil Company
Texas Gas Exploration Corporation
Texasgulf Western
Tierra and Associates
Tim Fuller Photography
Tucson Museum of Art
University of Arizona
  College of Agriculture
  College of Mines
  Environmental Research Lab
  Office of Arid Land Studies
U.S. Air Force
U.S. Borax and Chemical Company

# HEWLETT MANAGEMENT

R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
Sparks, Nevada 89431

## RESUME

### EDUCATION

1957 - B.S. in Chemical Engineering; Iowa State University
1960 - M.S. in Mining Engineering; University of Arizona
1967 - Course work and Dissertation completed for a D. Sc. in Mining Engineering and a Ph.D. in Geological Engineering while on the teaching faculty at the University of Arizona and the Colorado School of Mines.

### EXPERIENCE

1978 to date: Consultant; Precious Metal Heap Leaching, Property Valuation & Acquisition

1970-1977: General Partner and Officer;
- A. Sierra Mineral Management-McDerrmott Mine (Open-Pit Mercury Mine)
- B. 1971 Minerals-Tombstone, Arizona(Gold-Silver Heap-Leach Operation)
- C. Nelson, Nevada(Gold-Silver Heap Leach)
- D. Cripple Creek, Colorado(Gold Heap Leach)
- E. Goldfield, Nevada(Gold-Silver Heap Leach)

1968-1970: Mine Finance; Consultant on Acquisition and Mine Valuation(Zurich, London, Rome, Johannesburg, Paris, Belem(Brazil), and New York)

1963-1967: Chairman of the Board; COMPUTEC RESEARCH, GFI COMPUTER INDUSTRIES, COMPUTERIZED NATURAL RESOURCES, & R.F. HEWLETT & ASSOCIATES; Computer Application Companies

1957-1963: Bear Creek/Kennecott; Statistical Engineer. Developed computer applications for ore reserve computations, design of underground and open-pit mines, exploration drilling patterns, financial evaluation of exploration projects, production scheduling, and process optimization for copper smelting.

Yuba Mining Company; Exploration, mine examination, and design for open-pit gold & silver deposits in Idaho.

Utah Construction; Mine Engineer for underground mining of oil shale in Colorado(Union Oil).

Kaiser Aluminum; Bauxite exploration, mine examination, fluorspar deposit valuation, engineering, and plant process in Jamaica, Panama, Brazil, and U.S.A.

# HEWLETT MANAGEMENT

R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
Sparks, Nevada 89431

## CONSULTING EXPERIENCE BY COMPANY

American Metal Climax
American Potash & Chem Corp
American Smelting & Refining
Anaconda Company
Banner Mining Company
Behre-Dolbear
Cerro De Pasco
Cities Service
Compania Minera De Cananea
Duval Corporation
El Paso Natural Gas
Ethyl Corporation
Granby Mining Company
Granisle Mines
G.T. Bator & Associates
Hanna Mining Company
Irish Base Metals
Kaiser Aluminum & Chem Corp
Kennecott Copper Corp
Kingdom of Saudi Arabia
Miami Copper
Minera Bayovar
Molybdenum Corp of America
Noranda Mines
Occidental Petroleum (Minerals)
Placer Development
P.L.A.N.T.
Quintana Minerals
Revere Copper & Brass
Superior Oil Company
Swindell-Dressler
Texas Gulf Sulphur
Transvaal Consolidated Goldfields
Trans World Airlines

## CONSULTING EXPERIENCE BY COMMODITY

### GOLD

Virginia Mine (Transvaal)
Loraine (Transvaal-Africa)
Cripple Creek (Colorado)
Goldfield (Nevada)
Thunder Mtn. (Idaho)
Nelson (Nevada)
Congress (Arizona)
Elkhorn (Montana)
Mojave (California)
Chloride (Arizona)
Virginia City (Nevada)
Oro del Rey (Utah)
Merker (Utah)
Central City (Colorado)
Wickenburg (Arizona)
Crown King (Arizona)
Oatman (Arizona)

### SILVER

Packard Mine (Nevada)
Tonopah (Nevada)
Calico (California)
Candelaria (Nevada)
Ojos Calientes (Mexico)
Zacatecas (Mexico)
Tombstone (Arizona)
Silver Plumb (Colorado)
Eureaka-Ely (Nevada)
Rey Mart (Arizona)
La Colorada (Mexico)
Leadville (Colorado)
Searchlight (Nevada)
Prescott (Arizona)
Yucca (Arizona)
Pierce-Gleason (Arizona)
Reville (Nevada)

# HEWLETT MANAGEMENT

R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
Sparks, Nevada 89431

COPPER-MOLY-Au

Safford, Arizona(KCC)
Tanama, Puerto Rico(KCC)
Lights Creek, Calif. (AMEX)
Nevada Divison(KCC)
Diamond H(Miami Copper)
San Xavier North(ASARCO)
Ray Mines, Arizona(KCC)
Granisle, B.C. (Granby)
Michiquillay, Peru(ASARCO)
Jabal Sayid, Saudi Arabia
Ruby Creek, Alaska(KCC)
Kalamazoo, Ariz. (Quintana)
Silver Bell, Ariz. (ASARCO)
White Mesa, Ariz. (ASARCO)
Canaea, Mexico(Anaconda)
Cajo Abaho, Puerto Rico(AMAX)
Copper Creek, Ariz. (OXY)
Lampa, Peru(ASARCO)
Galore Creek, B.C. (KCC)
Lakeshore, Ariz. (El Paso)
Marcopper, Philippines
Castle Dome, Cities Service
Newman, B.C. (Noranda)
Christmas, Arizona
San Manuel, Arizona
Twin Buttes, Ariz. (Anaconda)

NICKEL-COPPER

Ragland Nickle(Quebec)
Pikwe, Africa

SULPHUR

Benguet, Philippines

URANIUM

Homestake-Sapin, New Mexico

BRINES & SOLID PHASE

Trona, California

COPPER-ZINC-LEAD-Ag

Timmins, Ontario(Texas Gulf)
Cerro De Pasco, Peru

COPPER-MOLY

Sierrita, Arizona(Bear Creek)
Brenda, B.C., Canada

MOLYBDENUM

Climax, Colorado(Am. Metals Climax)
York Hardy, B.C. (ASARCO)
Questa, New Mexico(MOLY CORP)
Endako, B.C. (PLACER)
Hall, Nevada(Anaconda)
Alice Arm, B.C. (KCC)

LEAD-ZINC-Ag

Northgate, Ireland
Salem, Missouri(KCC)
Viburnum, Mo. (ASARCO)
Terre Monte, Portugal

COPPER-IRON

Craigmont, B.C. (PLACER)
Boss-Bixby, Mo. (Am. Pb-Zn)

PHOSPHATE

Florida
Tunesia
Sechura Desert, Peru

IRON

Colima, Mexico

# HEWLETT MANAGEMENT

R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
Sparks, Nevada 89431

PUBLICATIONS

1. 1970 - "Comparison of the Triangular, Polygonal, and a Statistical Method of Computing Grade and Tonnage of Ore for the Silver Bell Oxide Porphyry Copper Deposit."

2. 1969 - "Case Histories of Exploration Drilling and Ore Reserve Estimation", Geological and Mining Society of British Columbia, Vancouver, B. C.

3. 1968 - "Case Histories of Automated Ore Reserve Estimates", Annual Meeting of the AIME, N. Y. (In Collaboration with Dr. A. Banfield of Behre Dolbear).

4. 1968 - "New Techniques in Prospecting for Coal", American Mining Congress, Annual Meeting of the Coal Division, Pittsburg, Penn.

5. 1965 - "Open Pit Mine Design Utilizing a Digital Computer", Annual Meeting of the American Institute of Mining, Metallurgical and Petroleum Enginners, Inc., Chicago, Illinois.

6. 1965 - "Design of Drill-Hole Grid Spacing for Evaluating Low-Grade Copper Deposits", Report of Investigation, U. S. Bureau of Mines.

7. 1964 - "Future Computerization in the Mineral Industry", International Symposium on Applications of Statistics, Operations Research, and Computers in the Mineral Industry, Colorado School of Mines.

8. 1964 - "Empirical Models of a Copper Reverberatory Furnace", International Symposium of Statistics, Operations Research, and Computers in the Mineral Industry, Colorado School of Mines.

9. 1964 - "Dynamic Problems in Mining", International Symposium in Computers and Computer Applications, University of Arizona.

10. 1964 - "Application of Simulation in Evaluating Low Grade Mineral Deposits", Bureau of Mines, Report of Investigation Number 6501, 63 pages.

11. 1964 - "Polynomial Surface Fitting Using Surface Data from an Underground Copper Deposit", U. S. Bureau of Mines, Report of Investigations Number 6522, 27 pages.

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R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
Sparks, Nevada 89431

12. 1964 - "Simulating Mineral Deposits Utilizing Monte Carlo Techniques and Mathematical Methods", U. S. Bureau of Mines, Report of Investigation Number 6493, 27 pages.

13. 1963 - "Computer Methods in Evaluation, Development, and Operations of an Ore Deposit", Annual Meeting of the American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., Dallas, Texas.

14. 1963 - "Pit Design Utilizing a Digital Computer", Symposium of Operations Research, Stanford University.

15. 1963 - "A Basic Computer Program for Computing Grade and Tonnage of Ore Using Statistical and Polygonal Methods", U. S. Bureau of Mines, Report of Investigation Number 6292.

16. 1963 - "Computing Ore Reserves by the Triangular Method Using a Medium Sized Digital Computer", U. S. Bureau of Mines Report of Investigation Number 6176, 30 pages.

17. 1962 - "A Survey of the Techniques and Applications of Computers in Resolving Operating Problems", American Mining Congress, San Francisco Annual Meeting.

18. 1962 - "Computing Ore Reserves by the Polygonal Method Using a Medium Sized Digital Computer", U. S. Bureau of Mines, Report of Investigation Number 5952, 31 pages.

19. 1962 - "Mineral Deposit Evaluation Using Mathemantical Models and a Digital Computer", University of Arizona Symposium on Computer Applications, vol. 1, section K, pages 1-55.

20. 1962 - "Use of High-Speed Data Reduction and Processing in the Mineral Industry", U. S. Bureau of Mines, I. C. 8099, 82 p.

21. 1962 - "Formulating Computer Problems", University of Arizona Symposium on Computer Applications, v. 1, section D, pp. 1-37.

22. 1961 - "Calculating Ore Reserves Using a Digital Computer", MINING ENGINEERING, v. 13, 1.1, pp. 37-42.

23. 1961 - "Small Mines Can Make Wide Use of Computer", MINING WORLD, v. 23, n. 7, pp. 38-40.

24. 1961 - "Computer Calculates Best Method to Develop High-Angle Escalante Vein", MINING WORLD, v. 23, n. 10, pp. 31-35.

25. 1960 - "A Comparison of Various Methods of Calculating Ore Reserves Using a Digital Computer", U. of Arizona Symposium.

PRE-TREATMENT

# HEWLETT MANAGEMENT

R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
Sparks, Nevada 89431

## PRE-TREATMENT

Pre-Treatment has come to mean anything done to an ore prior to cyanidation. However, it may not be required or desireable to use cyanide; there are many draw-backs of cyanidation.

The following illustration summarizes the most common problem ore-types, mineralogy, etc.. It is self explanatory.

### Carbonaceous Ores

The second illustration identifies common carbonaceous material types. This is important because the solvent selection depends upon the type of carbon, due to different carbon absorptive response.

The degradation of organic substances buried in fine-grained sedimentary rocks depends upon the depth of burial and the Geothermal Gradiant. This temperature-time relationship is also effected by the exhaustion of availabel oxygen, lowering the $E_h$ of the sediment. The oxidation reaction takes place faster than the decarboxylation of this organic matter, making oxidation a better choice of pre-treatment than chemical break-down. Total dehydrogenation of organic(carbon-bond) substances results in graphite. Other substances produced are fats, carbohydrates, proteins, and amino acids.

The problem basic to the leaching of carbonaceous ores is that when cyanide is used, the gold-cyanide complex($Au(CN)_2^-$) is absorbed by the carbon components of the ore. Most tests run on carbonaceous ores show that only about 30% of the gold can be extracted by using a cyanide leach(using pulverized ore). Because of the poor recovery due to carbon adsorption, milling with only cyanide is not economic.

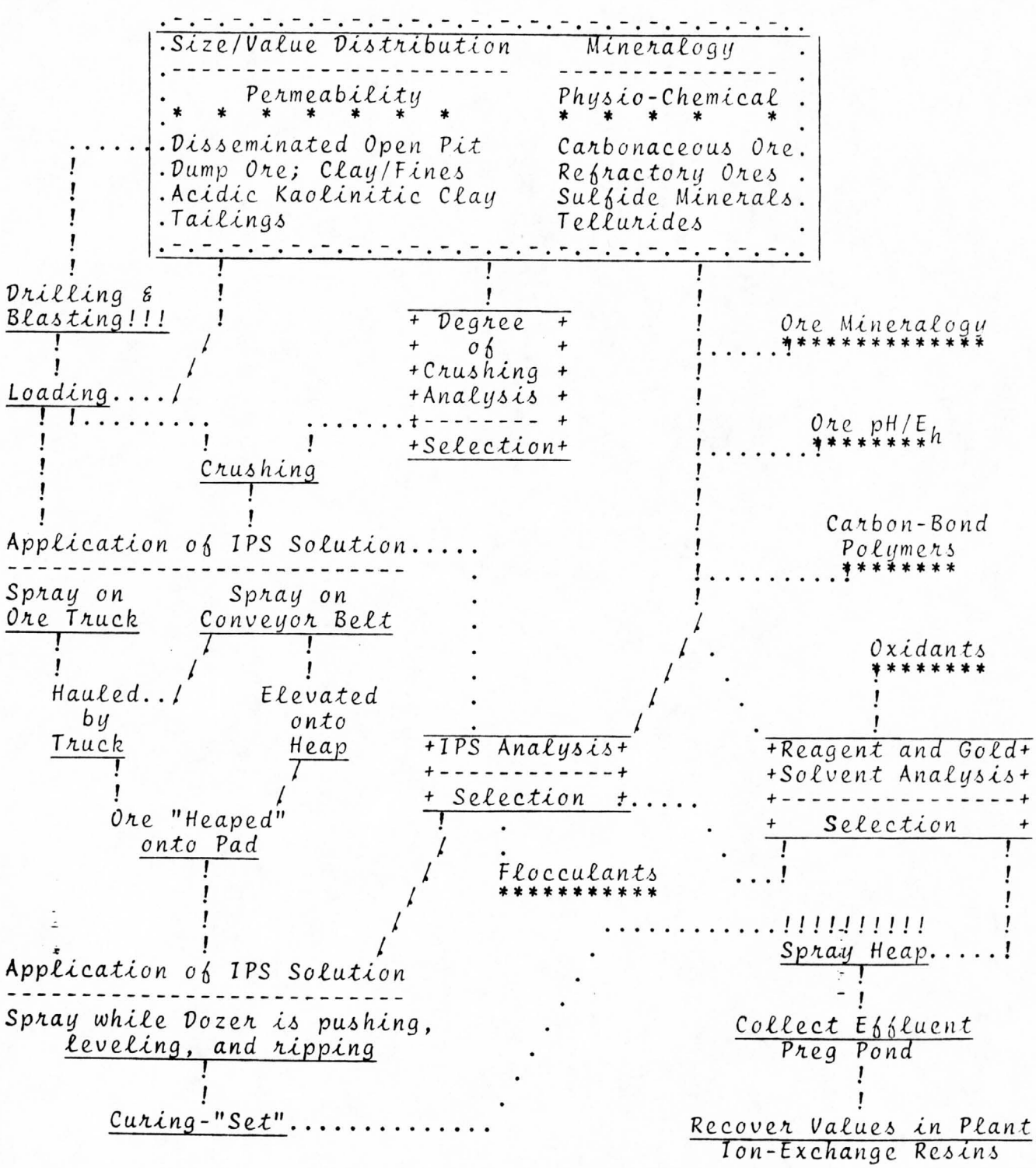
Newmont has applied a technique developed by the U.S. Bureau of Mines at their Carlin gold mine. They use sodium hypochlrite as an oxidant followed by cyanidation of the gold-chloride complex. I have used hypochlorite for the past two years, and it is clearly a pre-treatment reagent that is effective on various carbonaceous ores. However, other solvents used with hypochlrite are much more effective than the cyanide follow-up, which requires a more expensive solvent cost and metal recovery system. In fact, the use of salt(NaCl) as a source of chlorine was used for gold leaching before the development of cyanide(pre-1900). Also, the use of salt as a pre-treatment for roasting was very common.

# HEWLETT MANAGEMENT

R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
Sparks, Nevada 89431

## PRE-TREATMENT of Various Problem Precious Metal Ores for HEAP LEACHING

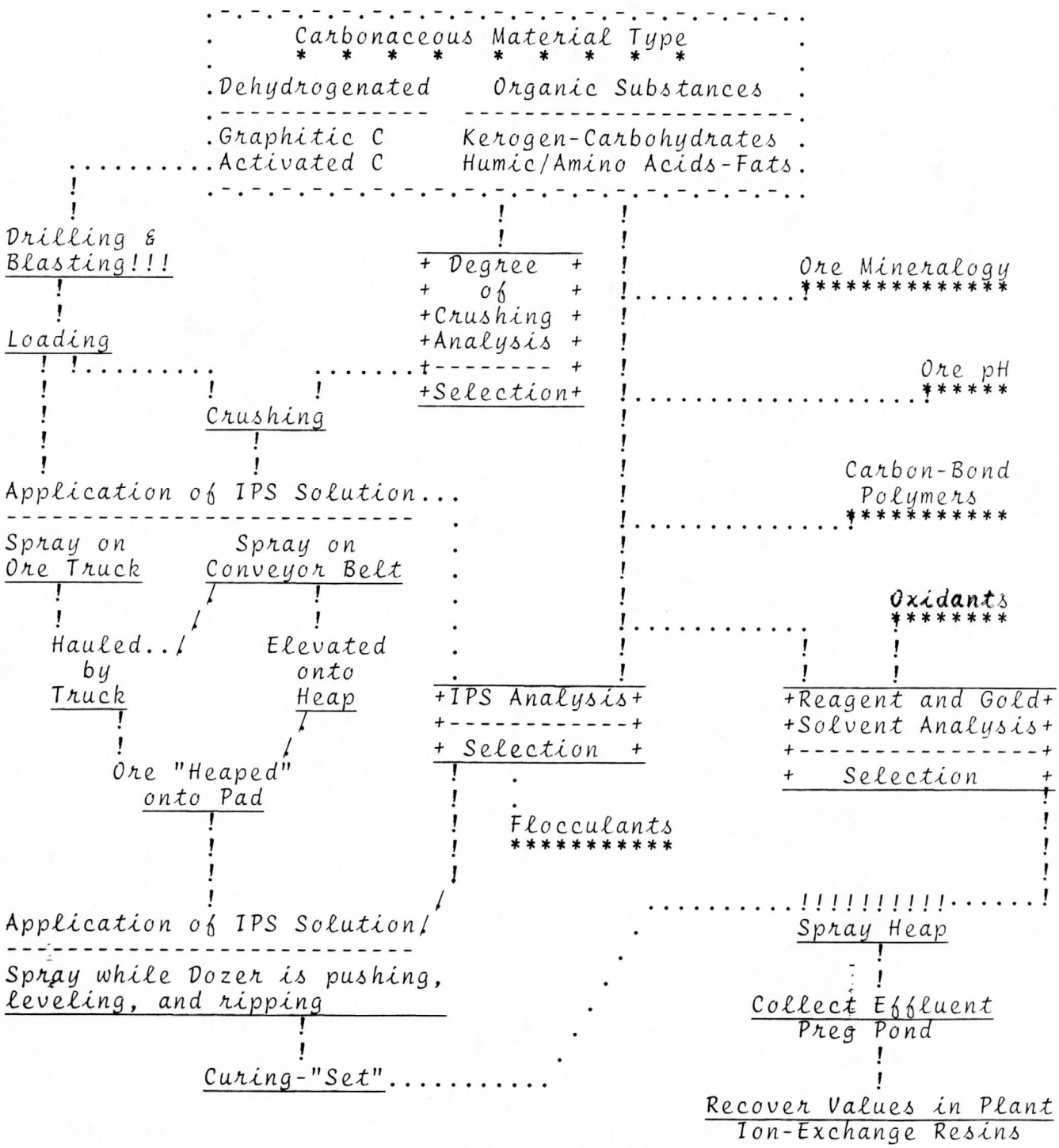


# HEWLETT MANAGEMENT

R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
Sparks, Nevada 89431

## PRE-TREATMENT of CARBONACEOUS ORES for HEAP LEACHING



# HEWLETT MANAGEMENT

R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
Sparks, Nevada 89431

There are three common ways to add hypochlorite to an ore for pre-treatment, which are:

1. Add sodium hypochlorite directly in solution
2. Add liquid chlorine directly
3. Add hypochlorite by in situ generation.

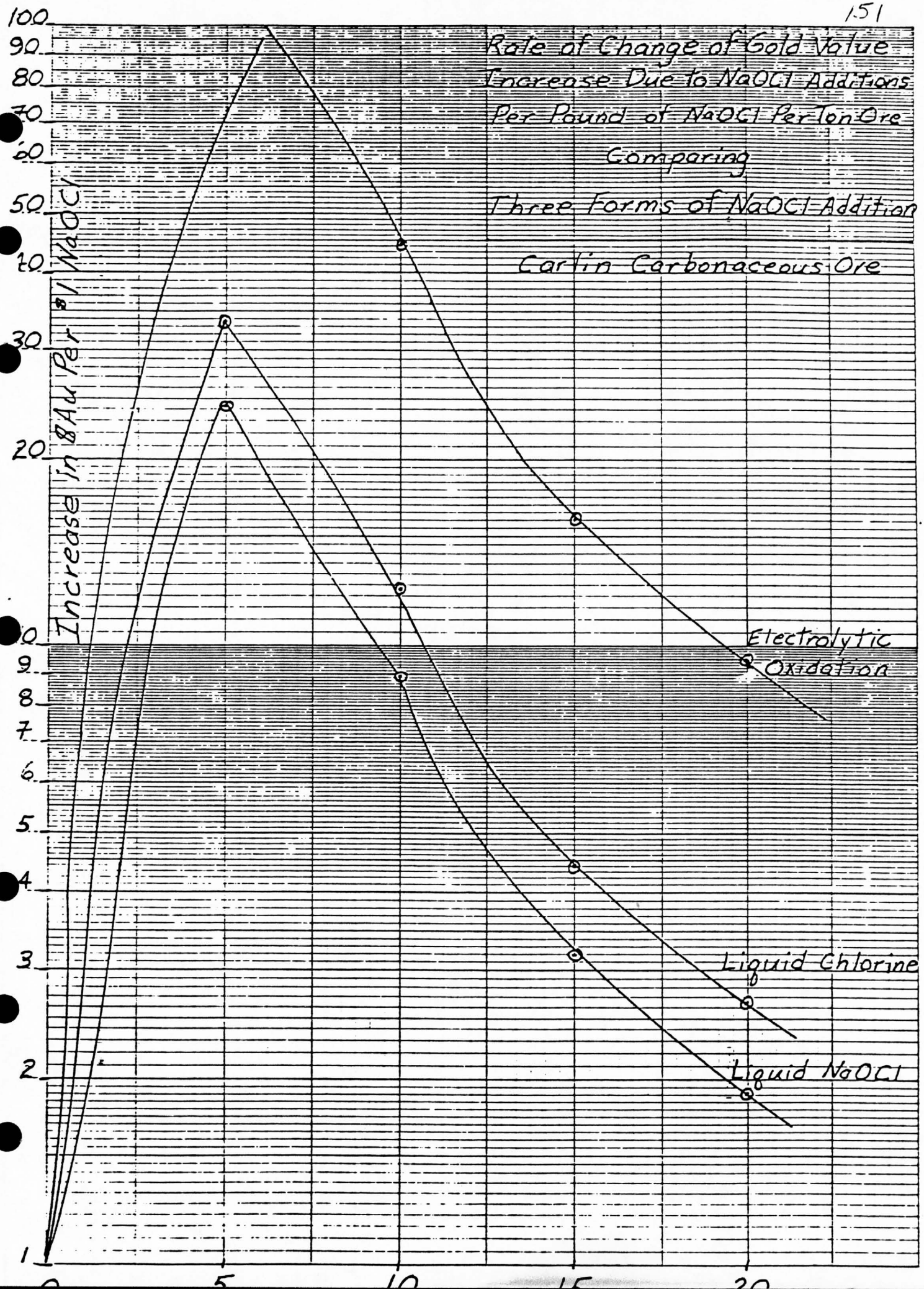
The following figure presents the increase in gold value due to hypochlorite pre-treatment for Carlin carbonaceous ores. Note that in addition to showing the response of the ore to pre-treatment, that I have compared the economics of the three methods of adding (or generating) hypochlorite.

The application of hypochlorite is sensitive to pH, as is illustrated by the following two figures. Notice that for the Carlin ore, the amount of lime added is as important as the amount of hypoch;orite. The Carlin carbonaceous ores have been analysed as follows:

| Ore Category | Ore Type | Organic Carbon | Au, t.oz./ton |
|---|---|---|---|
| I | Carbonaceous | .60 % | .40 Au/ton |
| II | Carbonaceous | .45 % | .19 |
| III | Carbonaceous | .42 % | .33 |
| IV | Mixed-Oxidized | .06 % | .20 |

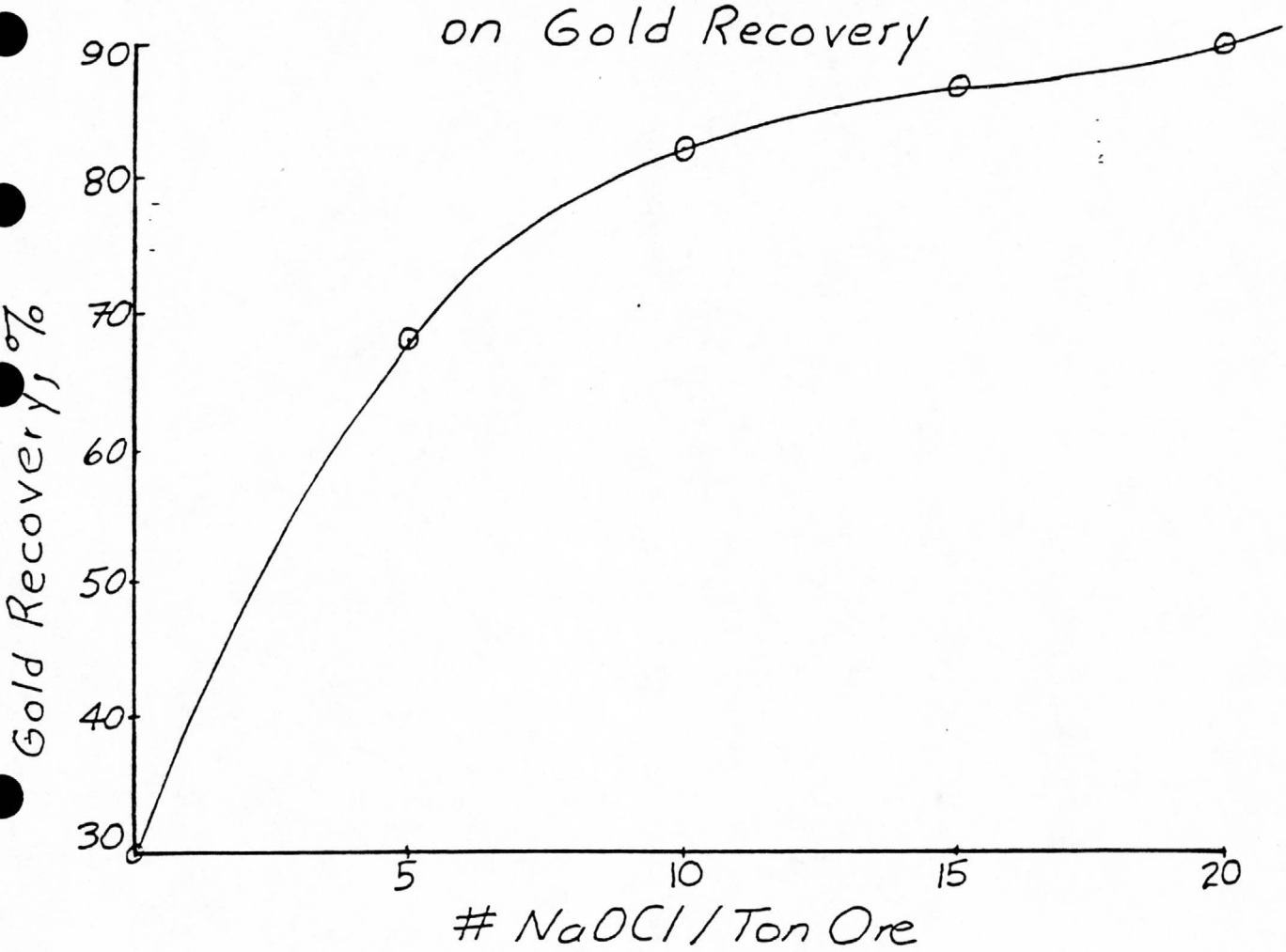
These all respond differently to hypochlorite, but all with positive results. Testing is the only way to quantify the response of any pre-treatment reagent/solvent.

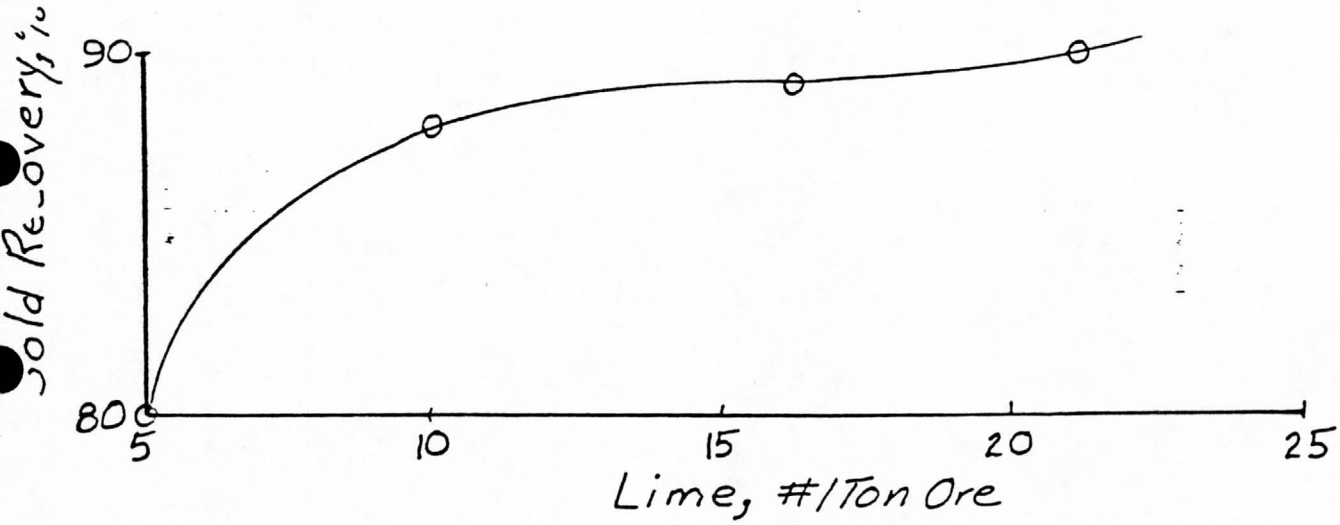
Notice that in the last illustration that the response of two Carlin ore types is presented. It is obvious that the type III would have a better response because hypochlorite is a much stronger oxidant in more acid pH ranges; under a pH of 7 the oxidation potential of hypochlorite is much greater and chlorine is released which is a good solvent for gold. The only restriction for carbonaceous ores is that they usually are in limestone, which cosume acid. Also, notice that the Carlin ore type I has a natural buffered pH at 9; hypochlorite response is stopped at a pH of 9 due to the liberation of hydroxyl ions on fine grinding.

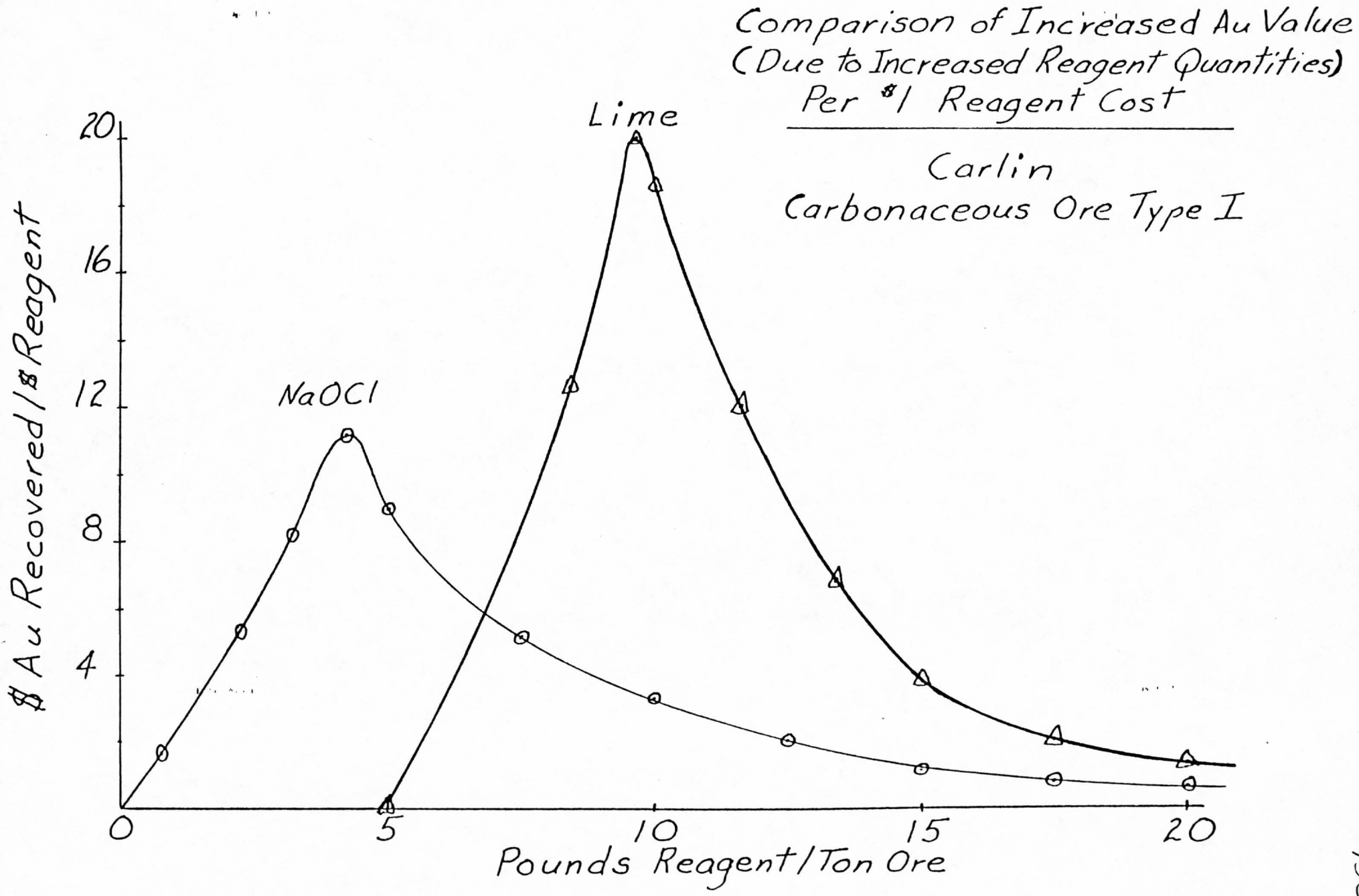

Rate of Change of Gold Value
Increase Due to NaOCl Additions
Per Pound of NaOCl Per Ton Ore
Comparing
Three Forms of NaOCl Addition
Carlin Carbonaceous Ore
Increase in $Au Per # NaOCl
100
90
80
70
60
50
40
30
20
10
9
8
7
6
5
4
3
2
1
0
5
10
15
20
Electrolytic Oxidation
Liquid Chlorine
Liquid NaOCl

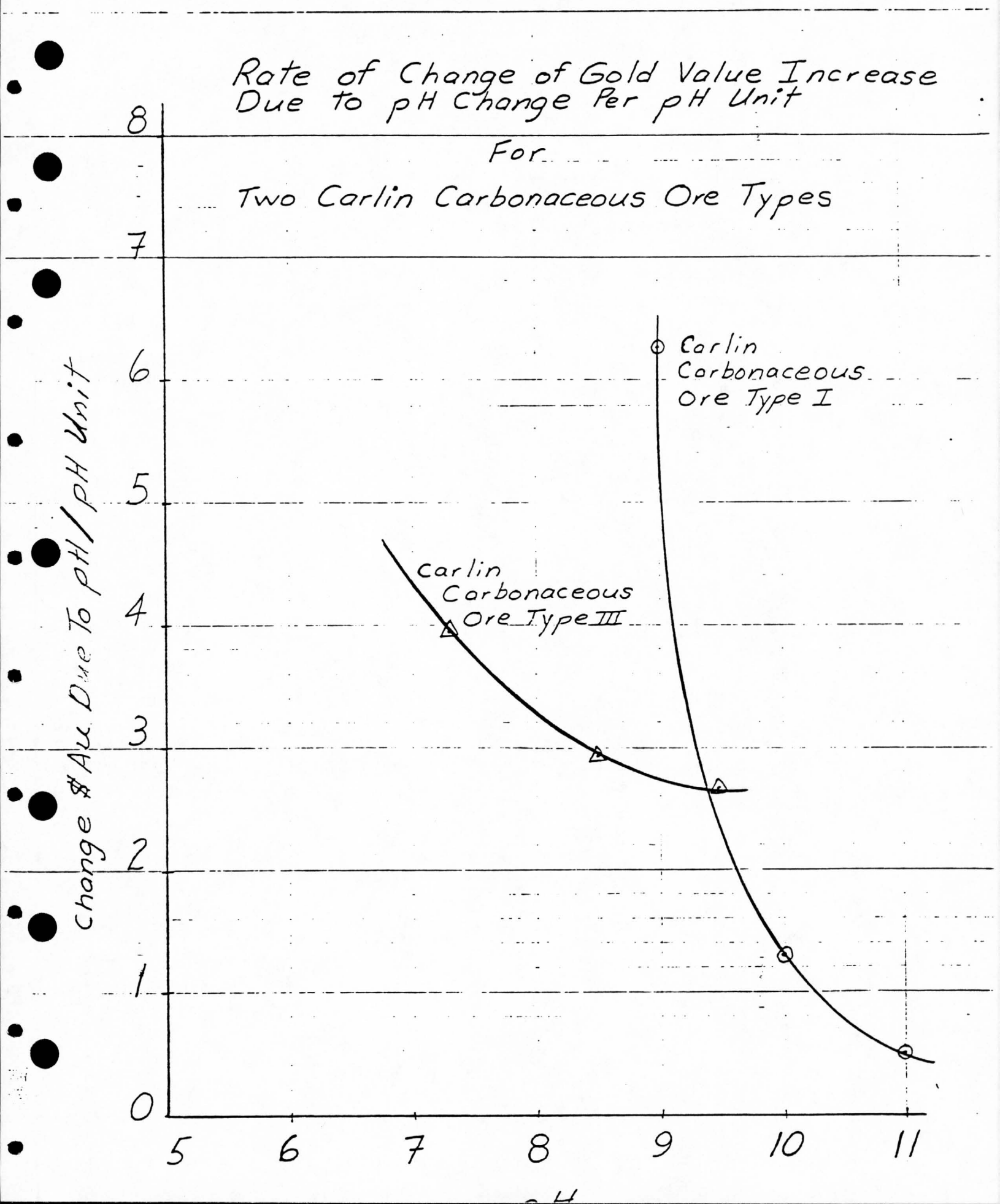
# Carbonaceous Ore

## Effect of Quantity of NaOCl & Lime on Gold Recovery




Comparison of Increased Au Value
(Due to Increased Reagent Quantities)
Per $1 Reagent Cost
Carlin
Carbonaceous Ore Type I
Lime
NaOCl
$ Au Recovered / $ Reagent
20
16
12
8
4
0
5
10
15
20
Pounds Reagent / Ton Ore


Rate of Change of Gold Value Increase
Due to pH Change Per pH Unit
For
Two Carlin Carbonaceous Ore Types
Carlin
Carbonaceous
Ore Type I
Carlin
Carbonaceous
Ore Type III
Change $ Au Due To pH / pH Unit
0
1
2
3
4
5
6
7
8
5
6
7
8
9
10
11

# HEWLETT MANAGEMENT

R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
Sparks, Nevada 89431

## Effective Pre-Treatment for Carbonaceous Ores

| Ore Type | Pre-Treatment | % Au Extracted |
|---|---|---|
| Carlin I | Sodium hypochlorite(NaOCl)-liquid | 90 % |
| Carlin I | Sodium hypochlorite(NaOCl)-liquid | 92 % |
| Carlin II | NaCl-NaOCl generation(Electrolytic Ox.) | 95 % |
| Carlin II | NaCl-NaOCl generation(Electrolytic Ox.) | 96 % |
| Carlin III | Liquid chlorine | 79 % |
| Carlin III | Liquid chlorine | 94 % |
| Utah-Kerogen | Ammonia($NH_3$) | 92 % |
| Open-Pit | Sodium hypochlorite(NaOCl) | 95 % |
| " | $NaOCl/Na_2CO_3/NaOH$; oxidant & strong bases | 95 % |
| " | $H_2SO_4$ -- NaOH; Sulphuric acid-neutralized | 83 % |
| " | Potassium PerManganate($KMnO_4$) | 89 % |
| " | Ferric Chloride($FeCl_3$) | 93 % |
| " | Sodium Bromate($NaBrO_3$) | 90 % |
| Utah-Tails | Ammonium hydroxide($NH_4OH$) | 91 % |
| Activated | Sodium hypochlorite(NaOCl) | 21 % |
| Carbon | Ferric chloride($FeCl_3$) | 87 % |
| " | NaCl-NaOCl-HCl system | 95 % |
| Nevada-Graphitic | Ferric chloride($FeCl_3$) | 79 % |
| Carbon | NaCl-NaOCl system | 89 % |
| " | NaCl-HCl system | 92 % |
| " | Thiourea($NH_2CSNH_2$) | 99 % |
| " | Sodium thiosulfate($Na_2S_3O_2 \cdot 5H_2O$) | 85 % |
| Nevada-Activated | Ferric chloride($FeCl_3$) | 80 % |
| Carbon | NaCl-NaOCl system | 85 % |
| " | $Na_2S_3O_2 \cdot 5H_2O$ | 79 % |
| " | Thiourea($NH_2CSNH_2$) | 99 % |
| " | Halide complex(NaCl, NaOCl, Bromine) | 95 % |
| " | Sodium Bromate($NaBrO_3$) | 85 % |

# HEWLETT MANAGEMENT

R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
Sparks, Nevada 89431

## Gold Dissolution Rates
## (Milligrams Gold Dissolved Per Hour)

Equal quantities of gold foil were weighed and allowed to dissolve in various solvents to determine the dissolution rates. After the time to dissolve was observed, the quantity of gold dissolved was checked by titration. Therefore, the rate of dissolution was computed (milligrams Au/Hour), and the dissolution rate cost(milligrams Au/ $ 1 Solvent Cost per ton solution). These results are presented to illustrate:

1. The dissolution rate of cyanide is very slow compared to other halide solvent systems.
2. The relative cost of cyanide compared to halide systems is much higher(for cyanide).
3. Halide system solvents are economic for pre-treatment applications to carbonaceous ores.

Basic to the above is the concept that aurous chloride is insoluble in water but is soluble in sodium chloride. This is based on the following:

A. The initial reaction between chlorine & gold is;

$$2\ Au + Cl_2 = 2\ AuCl$$

B. The rate of solution of the gold is controlled by the rate at which the insoluble aurous chloride film is removed from the surface by the following;

$$AuCl + Cl_2 + Cl^- = AuCl_4$$

and $$AuCl + Cl^- = AuCl_2^-$$

C. The aurous chloride ion is later oxidized to the auric state, but in dilute chlorine solutions this is not the rate-controlling reaction.

# HEWLETT MANAGEMENT

R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
Sparks, Nevada 89431

## Sodium Cyanide

This standard leach solvent produces the following dissolution rates:

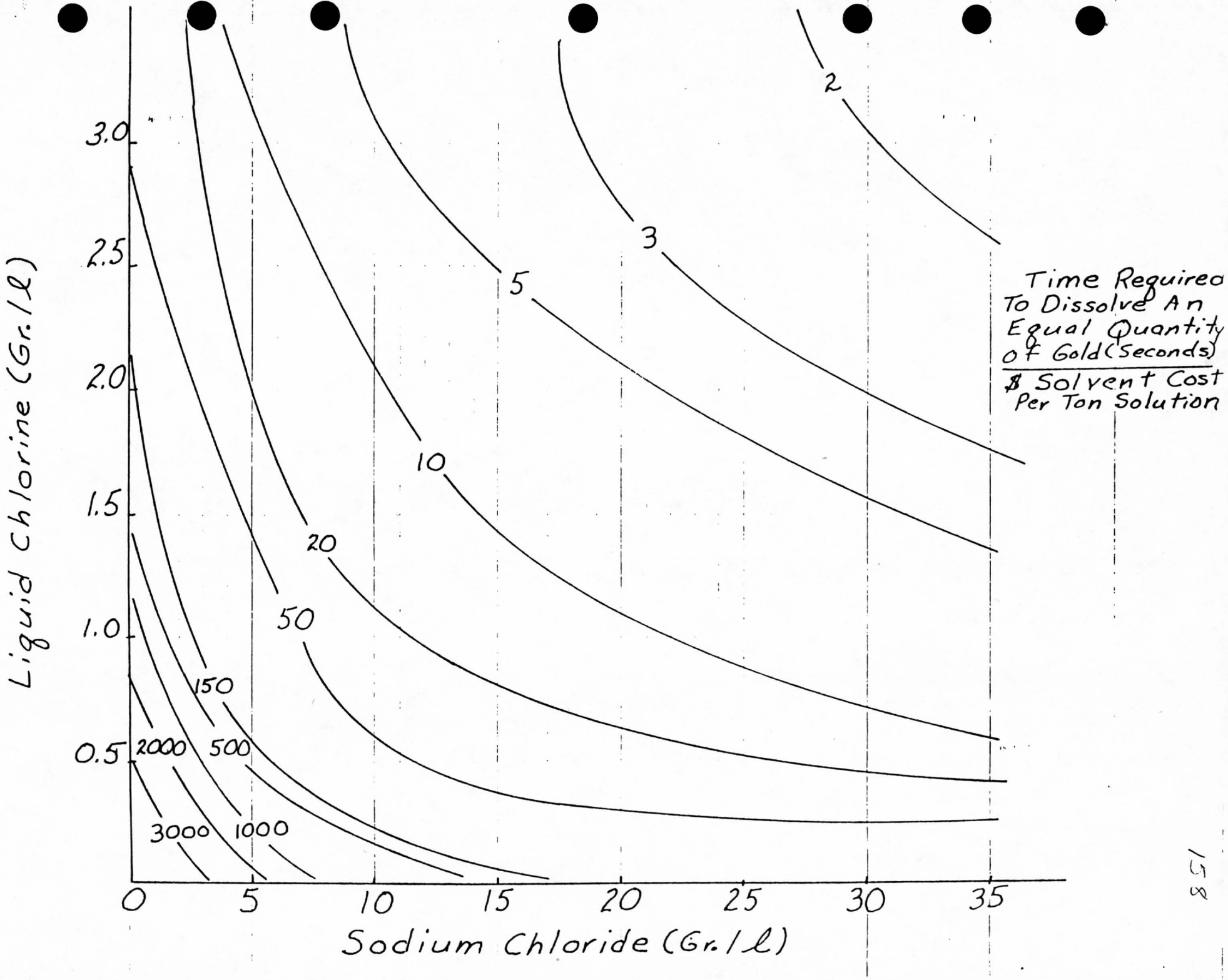
| Solvent Concentration; # / ton solution | Milligrams Au Dissolved Per Hour |
|---|---|
| 5 | 2.4 |
| 1 | 3.0 |
| .2 | .36 |

## Sodium Chloride-Chlorine System

A standard-brine-solution was prepared using 58.86 pounds of salt(NaCl) per ton solution. This provides an excess chlorine ion. Into this standard brine solution was added various amounts of liquid chlorine. Following are the Au dissolution rates:

| Solvent Concentration; # / ton solution | Milligrams Au Dissolved Per Hour |
|---|---|
| .118 | .18 |
| .236 | 7.2 |
| 2.36 | 108. |

Additional tests were made with brine solutions and liquid chlorine because of the application of chlorine to make hypochlorite for carbonaceous ores. An equal amount of gold foil was dissolved in various combinations of concentrations of chlorine and salt. The time to dissolve the gold was divided by the cost of the solvent (per ton solution) to yield a time-of-dissolution vs. cost relationship that allows direct comparison because of the standardization of all of the variables. The plot of these data are presented in the following illustration.


Time Required To Dissolve An Equal Quantity of Gold (Seconds)
$ Solvent Cost Per Ton Solution
2
3
5
10
20
50
150
500
1000
2000
3000
Liquid Chlorine (Gr./ℓ)
3.0
2.5
2.0
1.5
1.0
0.5
0
5
10
15
20
25
30
35
Sodium Chloride (Gr./ℓ)

# HEWLETT MANAGEMENT

R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
Sparks, Nevada 89431

## Sodium Chloride-Chlorine-$H_2SO_4$ System

The same standrad-brine-solution was used with 58.86 pounds of salt(NaCl) per ton of solution. Into this solution was added various amounts of liquid chlorine and sulphuric acid. Following are the Au dissolution rates:

| Solvent Concentrations; # / ton solution | | Milligrams Au Dissolved Per Hour |
|---|---|---|
| $Cl_2$ | $H_2SO_4$ | |
| .118 | 5. | 7.8 |
| .118 | 14. | 8.4 |
| .236 | 5. | 16.2 |
| 2.36 | 14. | 108.6 |

## Chlorine Solution

Two different liquid chlorine solutions were prepared with the following results:

| Solvent Concentration; # / ton solution | Milligrams Au Dissolved Per Hour |
|---|---|
| .874 | 3.6 |
| 4.0 | 20.4 |

# HEWLETT MANAGEMENT

R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
Sparks, Nevada 89431

## Chlorine-$H_2SO_4$ System

Various sulphuric acid concentrations were added to chlorine solutions, with the following results:

| Solvent Concentration; # / ton solution | | Milligrams Au Dissolved Per Hour |
|---|---|---|
| $Cl_2$ | $H_2SO_4$ | |
| .874 | 1.6 | 9. |
| .874 | 16. | 21.8 |
| .874 | 20. | 37.2 |

## Chlorine Solutions

Various solvents were mixed with chlorine solutions, with the following results:

| Solvent Concentration; # / ton solution | | Milligrams Au Dissolved Per Hour |
|---|---|---|
| $Cl_2$ | Other | |
| 4. | 1. $Br_2$ | 19.2 |
| 4. | 4. $CaCl_2$ | 40.8 |
| 4. | 16. $HCl$ | 225.6 |
| 4. | 40. $Na_2SO_4$ | 19.8 |
| 4. | 40. NaF | 21. |

# HEWLETT MANAGEMENT

R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
Sparks, Nevada 89431

## Bromine Solutions

Various solvents were dissolved in bromine solutions with the following results:

| Solvent Concentration; # / ton solution | | Milligrams Au Dissolved Per Hour |
|---|---|---|
| $Br_2$ | Other | |
| 1. | 4. $Cl_2$ | 19.2 |
| 60. | - | 110.4 |
| 60. | 40. NaCl | 960. |
| 60. | 50. KBr | 2220. |

# HEWLETT MANAGEMENT

R. F. HEWLETT
PHONE (702)359-1069

2602 Monte Verde Way
Sparks, Nevada 89431

## Analysis of Various Gold Solvents

| Rank | Solvent Concentration; #/ton soln. Reagent A | Reagent B | Reagent C | Dissolution Rate; Mg. Au/Hr. | Dissolution Mg. Au Per $ 1 Solvent(s) |
|---|---|---|---|---|---|
| 1 | 60. $Br_2$ | 50. KBr | | 2220. | 94.9 |
| 2 | 4. $Cl_2$ | 16. HCl | | 225.6 | 74.2 |
| 3 | 60. $Br_2$ | 40. NaCl | | 960. | 60. |
| 4 | 4. $Cl_2$ | 4. $CaCl_2$ | | 40.8 | 60. |
| 5 | 4. $Cl_2$ | | | 20.4 | 51. |
| 6 | 2.36 $Cl_2$ | 58.86 NaCl | | 108. | 41.7 |
| 7 | .874 $Cl_2$ | | | 3.6 | 40. |
| 8 | 4. $Cl_2$ | 1. $Br_2$ | | 19.2 | 30. |
| 9 | .874 $Cl_2$ | 1. $H_2SO_4$ | | 9. | 22.5 |
| 10 | 2.36 $Cl_2$ | 14. $H_2SO_4$ | 58.86 NaCl | 108.6 | 15.7 |
| 11 | 60. $Br_2$ | | | 110.4 | 7.7 |
| 12 | .874 $Cl_2$ | 16. $H_2SO_4$ | | 31.8 | 6.3 |
| 13 | .874 $Cl_2$ | 20. $H_2SO_4$ | | 37.2 | 6.3 |
| 14 | 1. NaCN | | | 3. | 4.8 |
| 15 | .236 $Cl_2$ | 5. $H_2SO_4$ | 58.86 NaCl | 16.2 | 4.1 |
| 16 | 4. $Cl_2$ | 40. NaF | | 21. | 2.8 |
| 17 | .118 $Cl_2$ | 5. $H_2SO_4$ | 58.86 NaCl | 7.8 | 2.0 |
| 18 | 5. NaCN | | | 2.4 | 1.9 |
| 19 | 4. $Cl_2$ | 40. $Na_2SO_4$ | | 19.8 | 1.5 |
| 20 | .118 $Cl_2$ | 14. $H_2SO_4$ | 58.86 NaCl | 8.4 | 1.3 |
| 21 | .2 NaCN | | | .36 | 1.3 |
| 22 | .118 $Cl_2$ | 58.86 NaCl | | .18 | .1 |

From 4/13/79

Report

# TOMBSTONE HEAP

Following are recent samples taken from the heap, grouped by screen size and mineral:

| Ore Type | Troy Oz./Ton Au | Troy Oz./Ton Ag | Value* Au | Value* Ag | Total Value |
|---|---|---|---|---|---|
| Clay | .041 | .26 | $10.25 | $1.95 | $12.20 |
| Fines | .086 | .29 | 21.38 | 2.18 | 23.56 |
| Large | .038 | .53 | 9.38 | 3.94 | 13.32 |
| Manganese | .155 | 1.44 | 38.75 | 10.80 | 49.55 |

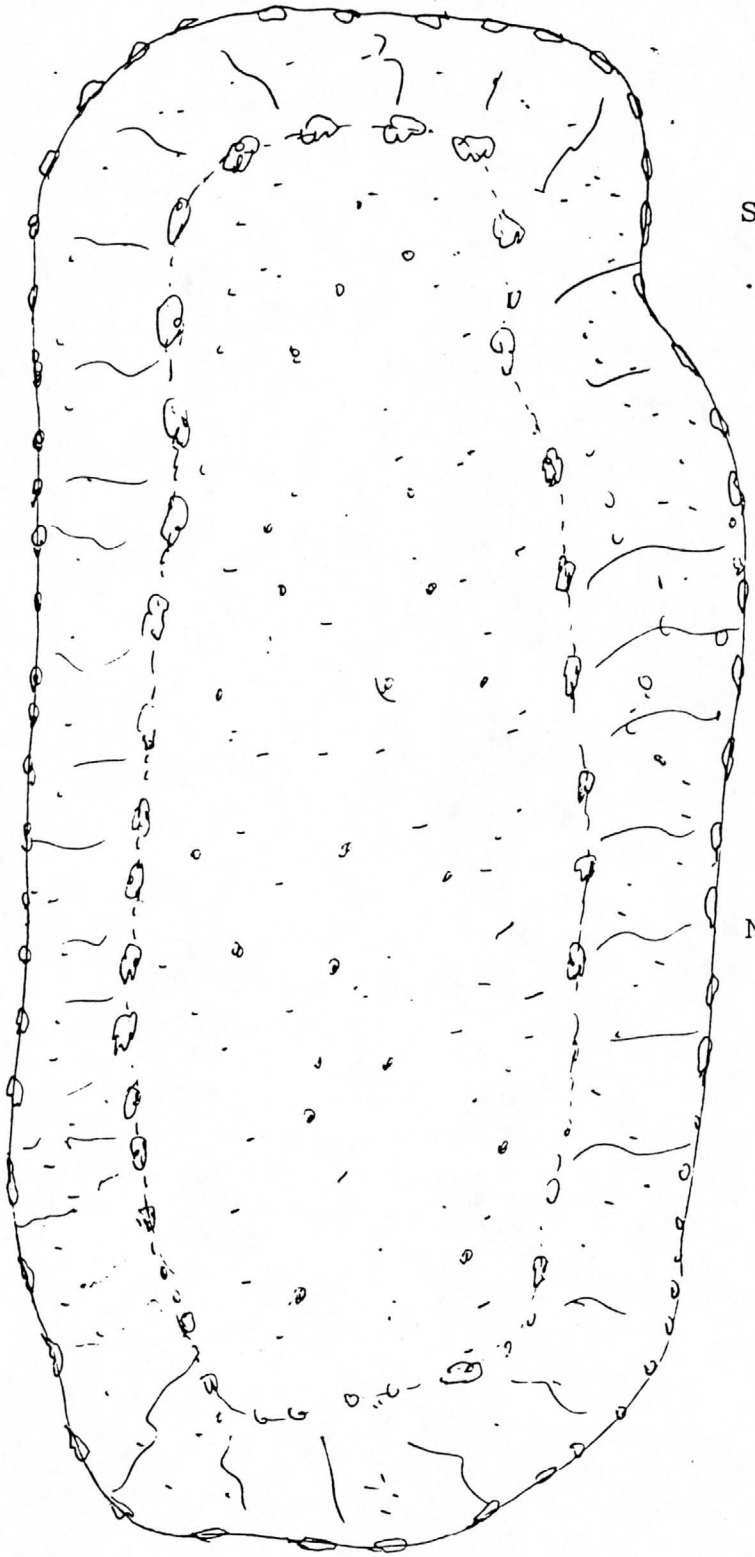
The above were weighted by their respective weight percent age (15%,25%,40% & 20%) and the average value ($250 Au & $7.50 Ag*) is $22.95. Assuming a 65% recovery, the resulting ore value would be $15.00. The operating costs will be under $5.00 per ton ore, yielding a net operating profit before taxes of $10.00 per ton ore.

SOUTHEAST CLAY
.021 Au/.12 Ag

SOUTHWEST CLAY
.060 Au/.36 Ag

SOUTH FINES
.120 Au/.42 Ag

SOUTH LARGE
.042 Au/
.57 Ag



SOUTH MANGANESE

.150 Au/1.89 Ag

TOMBSTONE "HEAP"
**********
Assays of ore types
and sizes.....

NORTH MANGANESE

East .177 Au/1.98 Ag

West .138 Au/.45 Ag

NORTH CLAY
.042 Au/.30 Ag

NORTH FINES
.051 Au/.15 Ag

NORTH LARGE
.033 Au/.48 Ag

# TOMBSTONE

Sampling Summary
March 12, 1979

| Location | Ore Type | Troy Oz./ton ore | | Gross Value |
|---|---|---|---|---|
| | | Gold | Silver | ($250/$7.5) |
| Heap | Coarse | .038 | .53 | $ 13.48 |
| " | Clay | .041 | .26 | 12.20 |
| " | Fines | .086 | .29 | 23.56 |
| " | Manganese | .155 | 1.44 | 49.55 |
| North Ramp | Contention | .138 | 1.31 | 44.33 |
| Emerald Dump | Fines/coarse | .127 | 2.72 | 52.15 |
| Contention | Tailings | .050 | .63 | 17.23 |
| Sh-t | Carbonaceous | .234 | 1.56 | 70.20 |
| Contention Dike-Cave Open-Pit Area | Altered Dike/ Limestone- No Manganese | .158 | 1.94 | 36.00 |

# TOMBSTONE

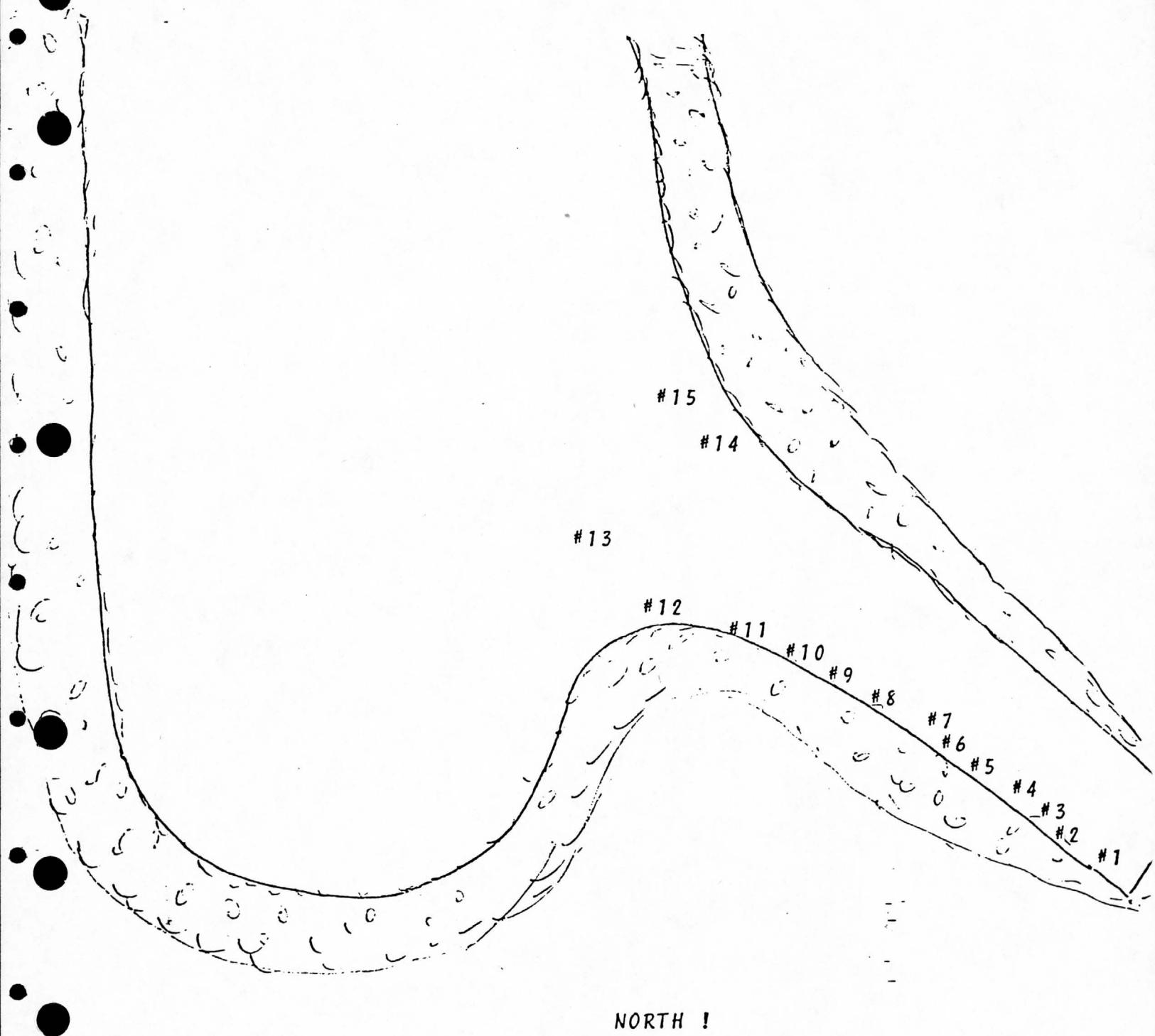
North Ramp Sampling:
(Tom Schloss et. al.)

(C. Escapule Lab Results);

| Sample Number | Troy Oz./ton soln. | | Troy Oz./ton ore | |
|---|---|---|---|---|
| | Gold | Silver | Gold | Silver |
| NR- 1 | .043 | .31 | .129 | .93 |
| NR- 2 | .040 | .38 | .120 | 1.14 |
| NR- 3 | .063 | 1.80 | .189 | 5.40 |
| NR- 4 | .039 | .24 | .117 | .72 |
| NR- 5 | .043 | .41 | .129 | 1.23 |
| NR- 6 | .104 | .58 | .312 | 1.74 |
| NR- 7 | .037 | .29 | .111 | .87 |
| NR- 9 | .039 | .41 | .117 | 1.23 |
| NR-10 | .034 | .20 | .102 | .60 |
| NR-11 | .034 | .29 | .102 | .87 |
| NR-12 | .040 | .29 | .120 | .87 |
| NR-13 | .052 | .46 | .156 | 1.38 |
| NR-14 | .039 | .20 | .117 | .60 |
| NR-15 | .037 | .25 | .111 | .75 |
| | | Ave. | .138 | 1.31 |

# TOMBSTONE

## North Ramp Sample Map:



TOMBSTONE

Open Pit Samples
Contention Dike

Identifying letter on next page

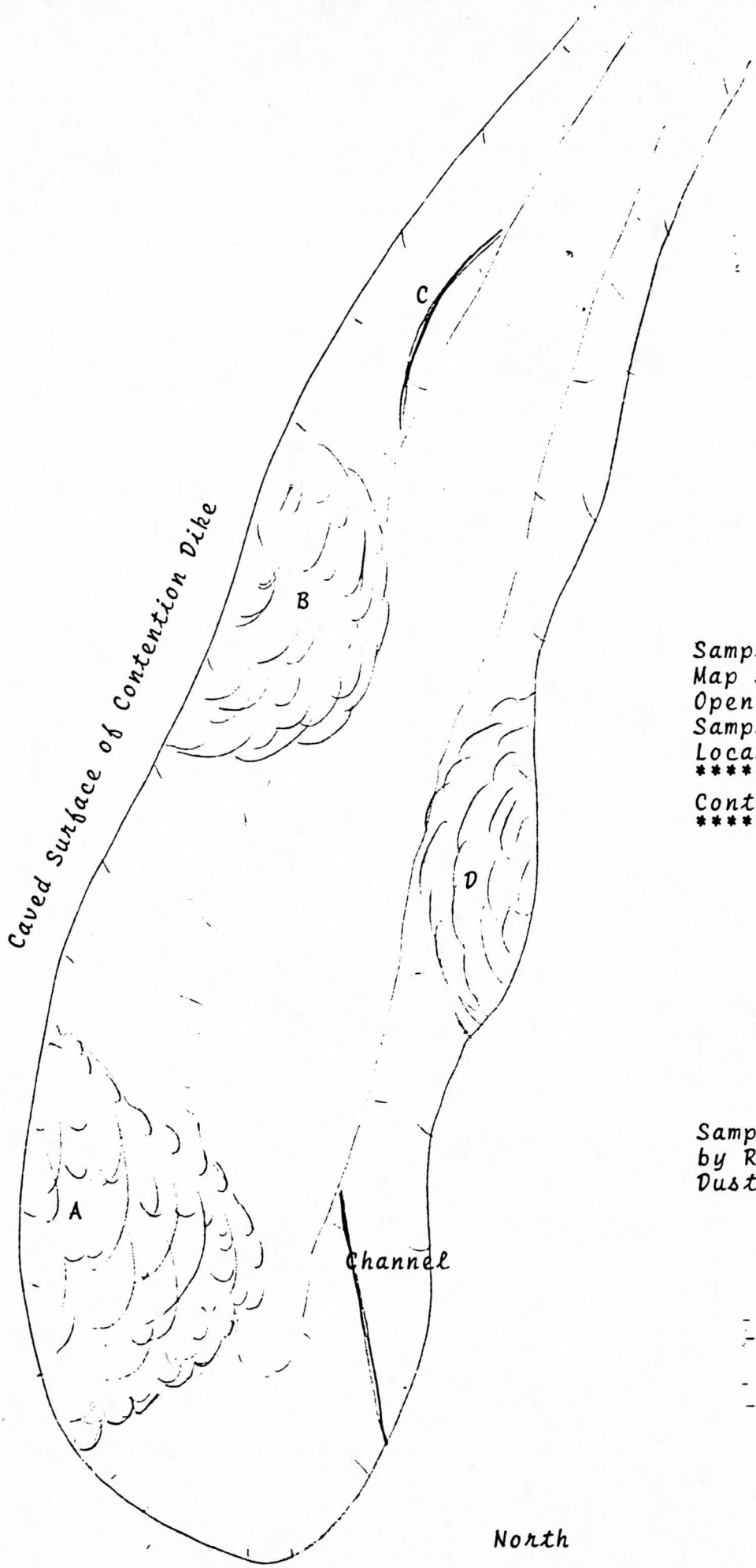
Summary of Contention Dike Open-Pit Samples:

| Sample Identification | T.Oz./ton ore | | Gross Value/ton ore |
|---|---|---|---|
| | Gold | Silver | ($250/$7.50) |
| Channel Coarse | .126 | .39 | $ 34.43 |
| A-Fines/coarse/mixed | .130 | 1.32 | 42.40 |
| B-Fines/coarse/mixed | .135 | 2.88 | 55.35 |
| C-Coarse | .105 | .48 | 29.85 |
| D-Fines/Coarse | .158 | 1.94 | 54.05 |
| Ave. | .158 | 1.94 | $ 36.00 ..... |

# TOMBSTONE

Open Pit Samples
Contention Dike

| Sample Identification | T.Oz./ton soln. | | T.Oz./ton ore | | Gross Value Ton Ore ($250/$7.5) |
|---|---|---|---|---|---|
| | Gold | Silver | Gold | Silver | |
| Channel Sample along Contention Dike | .042 | .13 | .126 | .39 | $ 34.43 |
| A- Fines | .060 | .70 | .180 | 2.10 | 60.75 |
| A- Mixed(mine run) | .035 | .25 | .105 | .75 | 31.88 |
| A- Coarse | .035 | .37 | .105 | 1.11 | 34.58 |
| B- Fines | .055 | 2.03 | .165 | 6.09 | 86.93 |
| B- Mixed(mine run) | .040 | .35 | .120 | 1.05 | 37.88 |
| B- Coarse | .040 | .50 | .120 | 1.50 | 41.25 |
| C- Coarse(Channel) | .035 | .16 | .105 | .48 | 29.85 |
| D- Fines | .050 | .96 | .150 | 2.88 | 59.10 |
| D- Coarse | .055 | .33 | .165 | .99 | 48.68 |




Sample Location
Map Showing
Open-Pit
Sample
Locations
*********

Contention Dike
**********

Sampled March 11, 1979
by RF Hewlett and
Dusty Escapule.....

# TOMBSTONE

Special Samples:
(Tom Schloss et. al.)

(C. Escapule Lab Results);

| Sample Number | Troy Oz./ton soln. | | Troy Oz./ton ore | |
|---|---|---|---|---|
| | Gold | Silver | Gold | Silver |
| Emerald Dump; | | | | |
| Fines | .037 | 2.14 | .111 | 6.42 |
| Coarse | .060 | .38 | .180 | 1.14 |
| High Ag | .026 | .70 | .078 | 2.10 |
| Hot H | .046 | .40 | .138 | 1.20 |
| | | | .127 | 2.72 |
| Contention Tailings; | | | | |
| East | .010 | .21 | .030 | .63 |
| Middle | .017 | .28 | .051 | .84 |
| West | .023 | .14 | .069 | .42 |
| | | | .050 | .63 |
| Sh-t | .078 | .52 | .234 | 1.56 |

# TOMBSTONE

## Special Samples

CYANIDE vs. ACID LEACH:

To estimate the effectiveness of cyanide as a leaching solvent without pre-treatment, samples taken from the same location were leached with cyanide and aqua regia to determine the relative recoveries. It is known that aqua regia will dissolve all of the gold and some of the silver, making aqua regia a good estimator of total value(heads). For gold, aqua regia is more precise than fire assays, and with the use of an atomic absorption machine, is much faster. Following are the results:

| | CYANIDE | | AQUA REGIA | | PerCent CYANIDE RECOVERY |
|---|---|---|---|---|---|
| | T.Oz./ton soln. | | T.Oz./ton soln. | | |
| Ore Type | Gold | Silver | Gold | Silver | Gold |
| Sh-t | .020 | .27 | .070 | .42 | 29 % |
| Emerald Fines | .005 | .24 | .045 | .21 | 11 % |
| Contention Tails | .020 | .21 | .047 | .08 | 43 % |
| North Ramp-6- | .025 | 2.85 | .082 | .52 | 30 % |

The above cyanide-aqua regia comparison confirms Ralph VanArsdale's statement concerning the recovery of only 10% of the values from the manganifeous ore left in the Emerald dump and what was hauled to the heap and leached.

## '71 MINERALS CYANIDE LEACH TESTS

Notice that the projected recoveries were low(under 50%) for a cyanide leach. Realize further that cyanide was used to determine the dump grade, which does not reflect to true total grade.

December 23, 1974

Memo to: R. J. Hewlett

From: R. M. Darrah

Subject: Tombstone Metallurgical Test Results

The results for the second series of cyanide leaching test to evaluate heap leaching are as follows:

| Test | Dump | Gold Leached, oz/ton 1 day | Gold Leached, oz/ton 2 days | Silver Leached, oz/ton 1 day | Silver Leached, oz/ton 2 days |
|---|---|---|---|---|---|
| 10 | Tranquility | .016 | .023 | .35 | .45 |
| 11 | Empire | .015 | .022 | .23 | .32 |
| 12 | Toughnut | .008 | .010 | .26 | .32 |
| 13 | Contention 1 | .024 | .032 | .52 | .70 |
| 14 | Little Joe | .006 | .008 | .34 | .53 |
| 15 | West Side | .013 | .018 | .44 | .60 |
| 16 | Grand Central | .007 | .010 | .59 | .76 |
| 17 | Lucky Cuss | .018 | .024 | .51 | .73 |
| 18 | Emerald | .004 | .005 | .44 | .57 |
| 19 | Contention | .020 | .033 | .83 | 1.18 |
| | Average | .013 | .018 | .46 | .62 |

Using $4.50 per troy oz. for silver, and $185 per troy oz. for gold, the total leached values in $/ton for 2 days leaching are as follows:

| | | | |
|---|---|---|---|
| Tranquility..... | 6.30 | West Side..... | 6.11 |
| Empire..... | 5.43 | Grand Central.. | 5.31 |
| Toughnut..... | 3.20 | Lucky Cuss..... | 7.75 |
| Contention 1 ... | 8.80 | Emerald..... | 3.53 |
| Little Joe..... | 3.92 | Contention 2 .. | 11.35 |

The total silver recovery for 2 days is $2.77 per ton and gold recovery is $3.40 per ton, for a total gold and silver average of $6.17/ton.

Cyanide consumption in 2 days has been about one pound per ton with the exception of Contention 1 and Lucky Cuss, which have used about two pounds per ton. Lime consumption for two days is about 1.5 pounds per ton.

The above results are extremely encouraging in regards to the economics and viability of heap leaching.

A recommendation to proceed with the initial 50,000 ton production test will be made when tests 10 - 19 are completed. This will be around Jan. 3, 1975.

Robert M. Darrah
Consulting metallurgist

cc: Jim Kennedy
File (2)

# Projected Gold and Silver Production From Heap Leaching the Tombstone Dumps

December 30, 1974

| Dump | Estimated Tons | U. S. Dollars/short ton Recovery 1/ | Net Profit 2/ | $Profit 3/ |
|---|---|---|---|---|
| Contention 1 | 100,000 | 7.00 | 4.00 | 400,000 |
| Lucky Cuss | 55,000 | 5.90 | 2.90 | 159,500 |
| Contention 2 | 20,000 | 10.58 | 7.58 | 151,600 |
| Tranquility | 50,000 | 5.39 | 2.39 | 119,500 |
| Grand Central | 50,000 | 4.61 | 1.61 | 80,500 |
| Empire | 40,000 | 4.32 | 1.32 | 52,800 |
| West-Side | 10,000 | 5.41 | 2.41 | 24,100 |
| Totals/Aver. | 325,000 | | | 988,000 |

1/ Based on $4.50/troy oz. silver, $185/troy oz. gold

2/ For $3.00/ton net operating cost

3/ Tonnage x net profit/short ton

# Mining and Leaching Sequence, Tombstone Waste Dumps

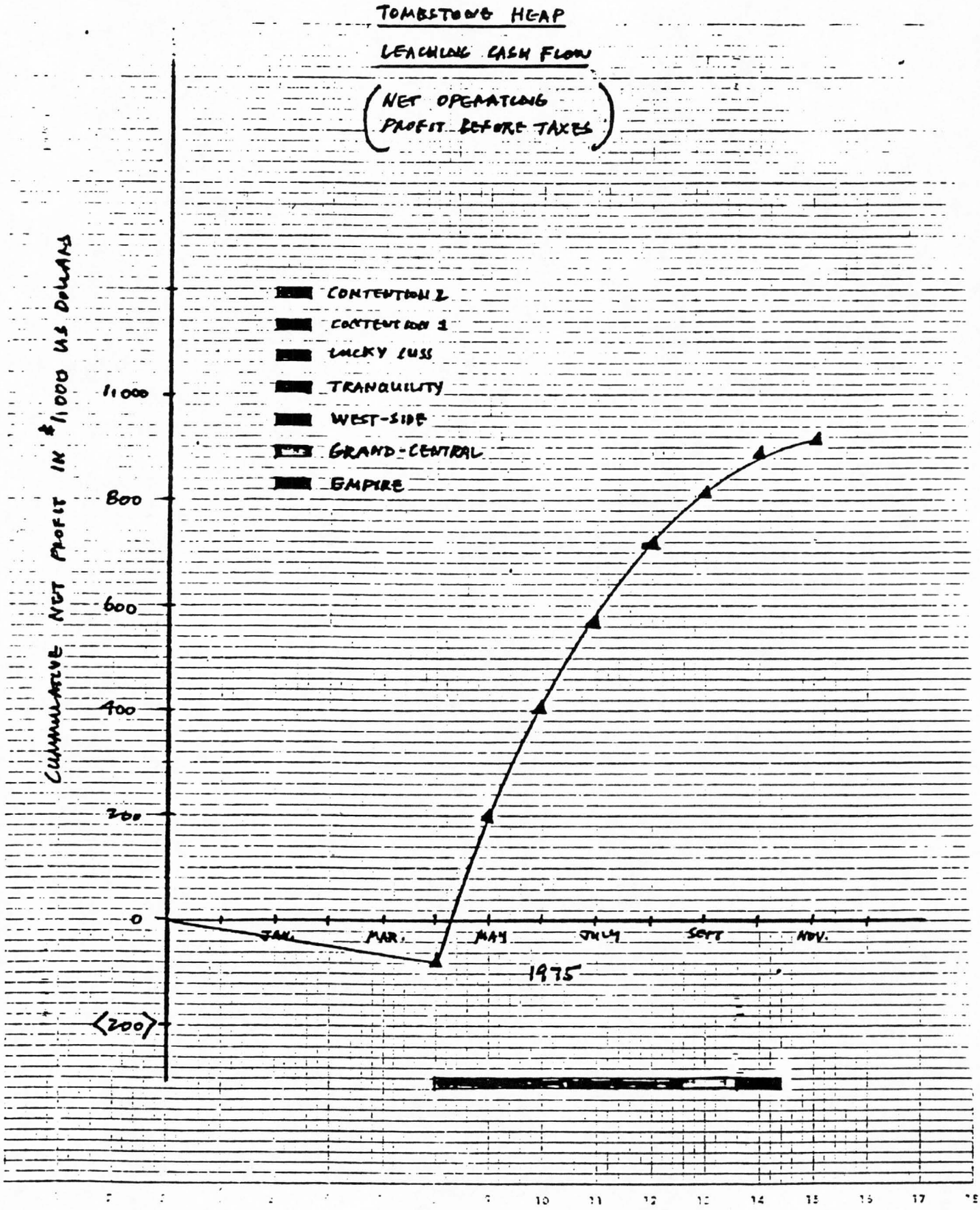
| Leach Period | Tonnage | Dump | Production, $ | Net Profit $ |
|---|---|---|---|---|
| April 1975 | 20,000 | Contention 2 | 211,600 | 151,600 |
| April 1975 | 30,000 | Contention 1 | 210,000 | 120,000 |
| May 1975 | 50,000 | Contention 1 | 350,000 | 200,000 |
| June 1975 | 20,000 | Contention 1 | 140,000 | 80,000 |
| June 1975 | 30,000 | Lucky Cuss | 177,000 | 87,000 |
| July 1975 | 25,000 | Lucky Cuss | 147,500 | 72,500 |
| July 1975 | 30,000 | Tranquility | 161,700 | 71,700 |
| Aug. 1975 | 20,000 | Tranquility | 107,800 | 47,800 |
| Aug. 1975 | 10,000 | West Side | 54,100 | 24,100 |
| Aug. 1975 | 20,000 | Grand Central | 92,200 | 32,200 |
| Sept. 1975 | 30,000 | Grand Central | 138,300 | 48,300 |
| Sept. 1975 | 20,000 | Empire | 86,400 | 26,400 |
| Oct. 1975 | 30,000 | Empire | 86,400 | 26,400 |
| Totals | 325,000 | | 1,963,000 | 987,800 |

| Month | Production $ | Net Profit $ | Cum. Net Profit $ |
|---|---|---|---|
| April 1975 | 421,600 | 271,600 | 271,600 |
| May 1975 | 350,000 | 200,000 | 471,600 |
| June 1975 | 317,000 | 167,000 | 638,600 |
| July 1975 | 309,200 | 144,200 | 782,800 |
| Aug. 1975 | 254,100 | 104,100 | 886,900 |
| Sept. 1975 | 224,700 | 74,700 | 961,600 |
| Oct. 1975 | 86,400 | 26,400 | 988,000 |

# Summary of Cyanide Leach Tests

| Test | Dump | Metal leached, Mg. Silver | Metal leached, Mg. Gold | Metal leached tr oz/ton ore Silver | Metal leached tr oz/ton ore Gold |
|---|---|---|---|---|---|
| 10 | Tranquility | 1449 | 78 | 0.37 | 0.0200 |
| 11 | Empire | 1061 | 65 | 0.27 | 0.0167 |
| 12 | Toughnut | 962 | 27 | 0.25 | 0.0070 |
| 13 | Contention 1 | 2155 | 95 | 0.55 | 0.0244 |
| 14 | Little Joe | 1711 | 30 | 0.44 | 0.0077 |
| 15 | West Side | 2217 | 60 | 0.57 | 0.0154 |
| 16 | Grand Central | 2345 | 40 | 0.60 | 0.0103 |
| 17 | Lucky Cuss | 2192 | 71 | 0.56 | 0.0182 |
| 18 | Emerald | 1831 | 18 | 0.47 | 0.0046 |
| 19 | Contention 2 | 4419 | 115 | 1.14 | 0.0295 |
| | Average | | | 0.52 | 0.0154 |

| | |
|---|---|
| Sample size, pounds..... | 250 |
| Leaching time, days..... | 2.0 |
| Washing time, days..... | 5.0 |
| Average cyanide consumption, lbs/ton... | 1.0 |
| Average lime consumption, lbs/ton..... | 1.5 |
| Water usage, tons water/tons ore..... | 0.6 |
| Application rate, tons water/day/ton ore | 0.1 |
| Extrapolated leach time in days for production head, 50,000 tons/month mining rate, 200 gpm sprayrate..... | 22 |


TOMBSTONE HEAP
LEACHING CASH FLOW
(NET OPERATING PROFIT BEFORE TAXES)
CONTENTION 2
CONTENTION 1
LUCKY LUSS
TRANQUILITY
WEST-SIDE
GRAND-CENTRAL
EMPIRE
CUMULATIVE NET PROFIT IN $1,000 US DOLLARS
1,000
800
600
400
200
0
(200)
JAN.
MAR.
MAY
JULY
SEPT
NOV.
1975

Barrel Tests 1-8 - Calc. recovery in 3 days

| Test # | Pump | (1) Channel oz/ton Ag | (1) Channel oz/ton Au | (2) Calc. Recovery oz/ton Ag | (2) Calc. Recovery oz/ton Au | (3) Calc. % Recovered Ag | (3) Calc. % Recovered Au | (4) Calc. days for 100% R Ag | (4) Calc. days for 100% R Au |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Tranquility | 1.6 | .05 | .227 | .0062 | 14.3 | 12.7 | 273 | 428 |
| 2 | Empire | 1.4 | .04 | .129 | .0062 | 9.1 | 15.9 | 184 | 328 |
| 3 | Tunghnut | 2.8 | .03 | .124 | .0031 | 4.4 | 11.5 | 270 | 22 |
| 4 | Contention | 1.5 | .04 | .399 | .0134 | 27.5 | 31.9 | 33 | 13 |
| 5 | Little Joe | 2.2 | .05 | .184 | .0020 | 8.2 | 3.9 | 45 | +∞ |
| 6 | West-side | 1.6 | .02 | .332 | .0052 | 20.5 | 27.4 | 64 | 15 |
| 7 | Grand Central | 1.4 | .03 | .770 | .0041 | 53.5 | 13.7 | 6 | -∞ |
| 8 | Lucky Cuss | 3.4 | .04 | .504 | .0102 | 15 | 26.2 | 61 | 35 |

(1) Calc. grade using RJH % Recovery & Calc. oz/ton recovered
i.e. grade Ag = oz/ton Ag recovered ÷ % Recovery Ag
" Au " Au " ÷ % " Au

(2) From test data, but may be low due to Ag & Au ppt' onto carbon, zinc dust, pipe & nails.

(3) Calc. by RJH 12/16

(4) Calc. by RJH 12/16 using first order equation

183 (0501) 1-

BECHTEL

TOMBSTONE HEAP LEACH TESTS 12/21/74 AMJ

SAMPLE WEIGHT: 250 LBS.
1 TROY OZ/SHORT TON = 3892 MG/250 LBS.

| TEST | DUMP | NaCN #/TON | MG. LEACHED (17 HRS) SILVER | MG. LEACHED (17 HRS) GOLD | OZ/TON ORE SILVER | OZ/TON ORE GOLD | $/TON ORE 1/ SILVER | $/TON ORE 1/ GOLD |
|---|---|---|---|---|---|---|---|---|
| 10 | TRANQUILITY | 0.07 | 1350.1 | 61.8 | .347 | .0159 | 1.56 | 2.94 |
| 11 | EMPIRE | 0.34 | 895.0 | 58.8 | .230 | .0151 | 1.04 | 2.79 |
| 12 | TOUGHNUT | 0.70 | 992.5 | 30.2 | .255 | .0078 | 1.15 | 1.44 |
| 13 | CONTENTION 1 | 0.68 | 2039.3 | 92.2 | .524 | .0237 | 2.35 | 4.38 |
| 14 | LITTLE JOE | 0.38 | 1509.1 | 24.1 | .388 | .0062 | 1.74 | 1.15 |
| 15 | WEST-SIDE | 0.46 | 1726.0 | 51.2 | .443 | .0132 | 2.00 | 2.44 |
| 16 | GRAND CENTRAL | 0.08 | 2289.2 | 28.0 | .588 | .0072 | 2.65 | 1.33 |
| 17 | LUCKY CUSS | 0.57 | 1976.1 | 68.6 | .508 | .0176 | 2.28 | 3.26 |
| 18 | EMERALD | 0.80 | 1694.4 | 14.3 | .435 | .0037 | 1.96 | .68 |
| 19 | CONTENTION 2 | 0.32 | 3218.7 | 76.0 | .827 | .0195 | 3.72 | 3.61 |
| | AVERAGE | 0.44 | — | — | .455 | .0130 | 2.05 | 2.40 |

1/ BASED ON $4.50/TROY OZ. AG & $185/TR. OZ. AU

HEFLIN

# HEFLIN STEEL SUPPLY CO.

## HEFLIN - HARRINGTON

INDUSTRIAL PLASTICS INC.

STEEL 252-8941

1111 WEST MARICOPA FRWY.
P. O. BOX 1249
PHOENIX, ARIZONA 85001

PLASTICS 252-7616

| # | Doré | AU | AG |
|---|---|---|---|
| 1 # Bar 20 1-9-75 | 17.22 | .39 | 17.33 |
| 2 21 | 8.1 | .19 | 7.91 |
| 3 22 | 17.50 | .18 | 17.32 |
| 4 23 | 37.32 | .05 | 37.27 |
| 5 24 | 5.75 | .19 | 5.56 |
| 6 25 | 41.8 | .02 | 41.78 |
| 7 26 | 23.08 | 1.1 | 21.98 |
| 8 27 | 4.83 | .97 | 3.86 |
| 9 28 | 23.31 | .36 | 22.95 |
| 10 29 | 22.34 | .83 | 21.51 |
| 11 Bar 24 1-8-75 24 | 2.12 | | 49.10 |
| 12 25 Gel Gold | 49.12 | .020 | |
| 13 26 | 28.03 | | |
| 14 27 | 6.24 | | |
| 15 28 | 27.97 | | |
| 16 29 | 28.15 | | |

1-9-75

Head Assay

| Dump | Silver oz/ton G.S. | Silver oz/ton B.T. | Gold oz/ton C.S. | Gold oz/ton B.T |
|---|---|---|---|---|
| Tranquility | 1.6 | 1.2 | .05 | .03 |
| Empire | 1.4 | 2.4 | .04 | .04 |
| Tonsemal | 2.8 | 1.1 | .03 | .02 |
| Continental 1 | 1.5 | 1.1 | .04 | .03 |
| Little Joe | 2.2 | 1.4 | .05 | .02 |
| West-side | 1.6 | 3.7 | .02 | .04 |
| Grand Central | 1.4 | 1.3 | .03 | .04 |
| Lucky Cuss | 3.4 | 3.1 | .04 | .05 |
| ~~Continental 2~~ | | ~~1.6~~ | | ~~.03~~ |
| Aver. | 2.0 | 1.9 | .044 | .034 |

C.S. Channel sample

BT Bunsel test, Calc. head from Solid + Stream.

tests 60-69

183

# CERTIFICATE OF ANALYSIS

Your Sample (S) Were Assayed With The Following Results

184

| Description | Gold Ounces Per. Ton | Silver Ounces Per. Ton | % Lead | % Copper | % Zinc | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Re Test #30 | .078 | 2.143 | | Silver Thread | | | | | | | | | |
| " #31 | .002 | .485 | | Contact | | | | | | | | | |
| " #32 | .017 | .761 | | Prompter | | | | | | | | | |
| " #33 | .034 | 5.105 | | Hershel | | | | | | | | | |
| " #34 | 0.111 | 16.881 | | Bob Ingersoll | | | | | | #35 - Tribute | | | |
| #37 | .013 | 2.659 | | Visina | | | | | | 36 - Sulphuret | | | |
| " #38 | .015 | 4.706 | | Defense | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |

15 JAN 75
DATE

CHARGES

CHEMIST

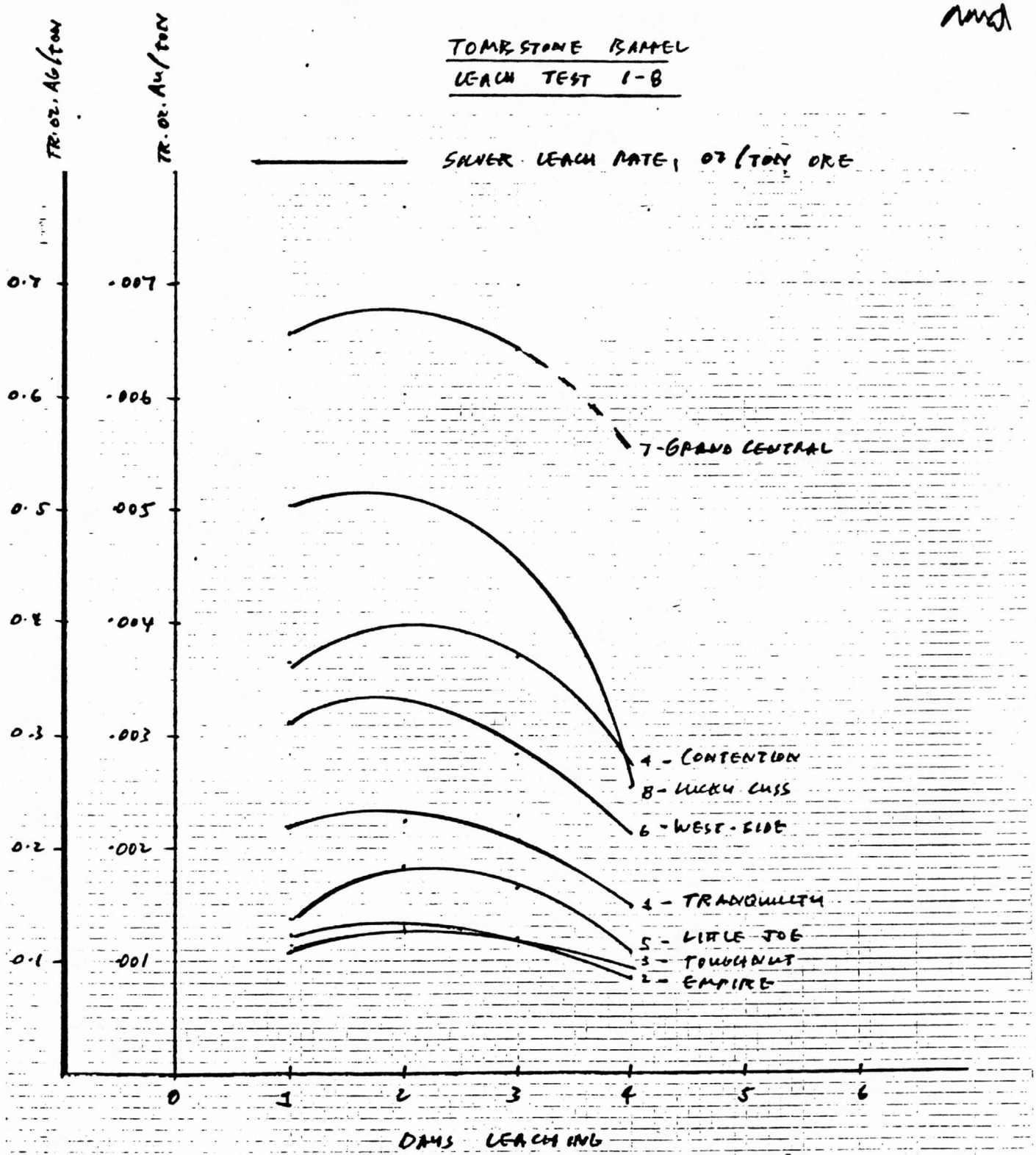
| Doré | AU | AG |
|---|---|---|
| 20: 17.63 | .40 | 17.23 |
| 21: 11.13 | .25 | 10.28 |
| 22: 23.42 | .15 | 22.27 |
| 23: 46.02 | .06 | 45.96 |
| 24: 6.24 | .19 | 6.05 |
| 25: 45.96 | .02 | 45.34 |
| 26: 28.06 | 1.28 | 26.78 |
| 27: 5.81 | 1.13 | 4.68 |
| 28: 28.12 | .43 | 27.69 |
| 29: 26.12 | .90 | 25.22 |

1-8-75

185

12/18/34

TOMBSTONE BARREL
LEACH TEST 1-B



186

FIG. 5

TOMBSTONE BARREL TESTS 10-19

BASED ON $4.50/oz. AG, $185/oz. AU

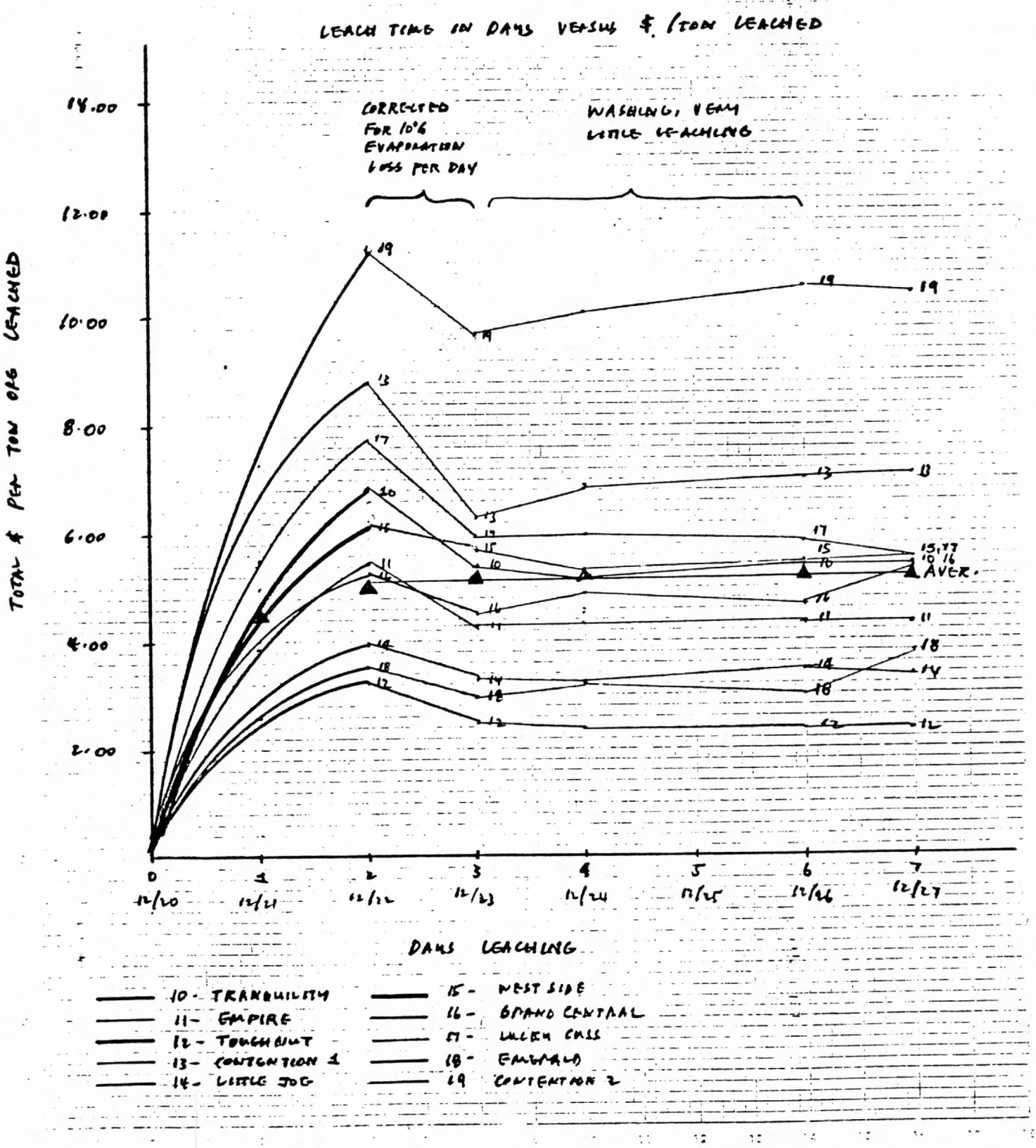
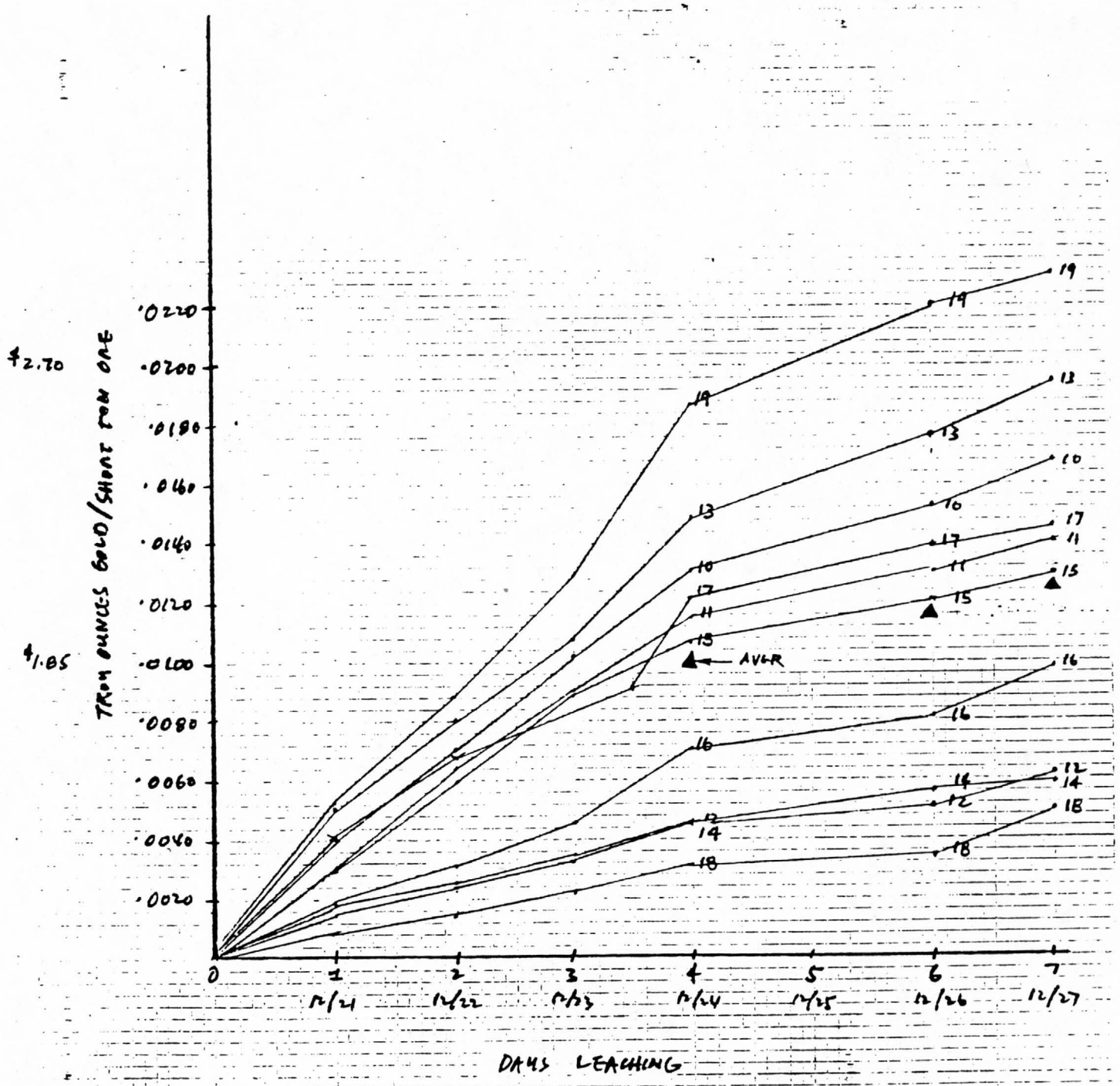


FIG. 1

TOMBSTONE BARREL TESTS 10-19

GOLD LEACHED[1/] IN TROY OUNCES/SHORT TON

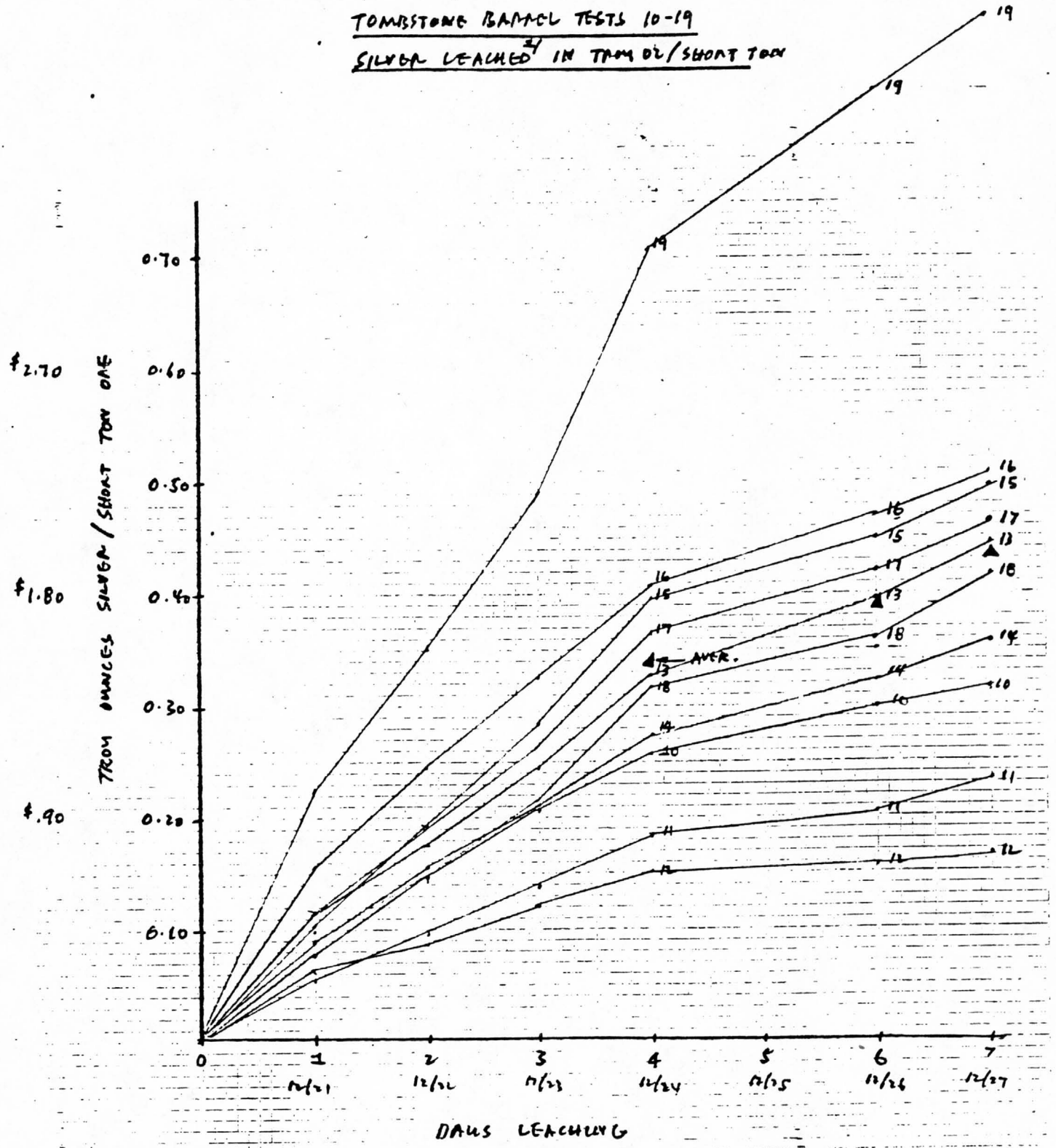



1/ FOR GOLD REMOVED ONLY, SEE FIG-3, FOR GOLD IN TEST PLUS GOLD REMOVED, i.e. TOTAL GOLD LEACHED.

FIG. 2

TOMBSTONE BARREL TESTS 10-19

SILVER LEACHED 1/ IN TROY OZ/SHORT TON




1/ FOR SILVER REMOVED ONLY, SEE FIG. 4 FOR SILVER IN TEST PLUS SILVER REMOVED, I.E. TOTAL SILVER LEACHED.

Barrel Tests: Summary of Reagents Consumption and Au & Ag Recovery

189

| Test No. | Sample | Days Leaching | Reagents Consumption Lime/Ton | Reagents Consumption NaCN/Ton | Recovery, Au oz/Ton | Recovery, Au $/Ton | Recovery, Ag oz/Ton | Recovery, Ag $/Ton | Total $/Ton |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | |
| 2 | | | | | | | | | |
| 3 | | | | | | | | | |
| 4 | | | | | | | | | |
| 5 | | | | | | | | | |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |
| 8 | | | | | | | | | |
| 9 | | | | | | | | | |
| 10 | Tranquility | 7 | 1.53 | 1.504 | .0177 | 3.27 | .332 | 1.33 | 4.60 |
| 11 | Empire | 7 | 1.35 | 1.488 | .0150 | 2.78 | .243 | .97 | 3.75 |
| 12 | Toughnut | 7 | 1.88 | 1.544 | .0066 | 1.22 | .231 | .92 | 2.14 |
| 13 | Contention 1 | 7 | 1.53 | 2.359 | .0212 | 3.92 | .490 | 1.96 | 5.88 |
| 14 | Little Joe | 7 | 1.70 | 1.504 | .0062 | 1.15 | .386 | 1.54 | 2.69 |
| 15 | West Side | 7 | 1.21 | 1.496 | .0135 | 2.50 | .513 | 2.05 | 4.55 |
| 16 | Grand Central | 7 | 1.53 | 1.504 | .0103 | 1.90 | .537 | 2.15 | 4.05 |
| 17 | Lucky Cuss | 7 | 1.70 | 1.512 | .0156 | 2.89 | .499 | 2.00 | 4.89 |
| 18 | Emerald | 7 | 1.70 | 2.576 | .0054 | 1.00 | .454 | 1.82 | 2.82 |
| 19 | Contention 2 | 7 | 1.00 | 1.504 | .0247 | 4.57 | .977 | 3.91 | 8.48 |
| 20 | Toughnut | 1 | | | .0090 | .00 | .39 | | |
| 21 | Little Joe | 1 | | | .0050 | | .21 | | |
| 22 | Emerald | 1 | | | .0030 | | .48 | | |
| 23 | Bunker Hill | 1 | | | .0015 | | 1.21 | | |
| 24 | Comet | 1 | | | .0038 | | .12 | | |
| 25 | St. of Maine | 1 | | | *.0362 | | .81 | | |
| 26 | Boss | 1 | | | .0227 | | .10 | | |
| 27 | Flora Mou. | 1 | | | .0082 | | .51 | | |
| 28 | Old Guard | 1 | | | .0265 | | .76 | | |
| 29 | Contention 2 | 1 | | | .0191 | | .69 | | |

Computations based on:
54 % available CaO
$185/oz Au, $4/oz Ag

For tests 10-19, lime consumption ≃ lime added, no titration data available

# Barrel Tests: Summary of Reagents Consumption and Au & Ag Recovery



| Test No. | Sample | Days Leaching | Reagents Cons. lb CaO/ton ore | Reagents Cons. lb NaCN/ton ore | Recovery Au oz/T ore | Recovery Au $/T ore | Recovery Ag oz/T ore | Recovery Ag $/T ore | Total $/T ore |
|---|---|---|---|---|---|---|---|---|---|
| 30 | Silver Thread | 6 | 2.53 | .976 | .0136 | 2.52 | .351 | 1.40 | 3.92 |
| 31 | Contact | 6 | 1.08 | 1.08 | .0006 | 0.11 | .057 | 0.23 | 0.34 |
| 32 | Prompter | 6 | 3.05 | .997 | .0020 | 0.37 | .092 | 0.37 | 0.74 |
| 33 | Hershel | 6 | 3.27 | 1.40 | .0050 | 0.92 | .627 | 2.51 | 3.43 |
| 34 | Bob Ingersol | 6 | 3.01 | 1.35 | .0124 | 2.29 | 2.141 | 8.56 | 10.85 |
| 35 | Tribute | 5 | 3.86 | .944 | .0033 | 0.61 | .046 | 0.18 | 0.79 |
| 36 | Sulpheret | 5 | 3.99 | .976 | .0058 | 1.07 | .026 | 0.10 | 1.17 |
| 37 | Visina | 6 | 3.05 | .992 | .0013 | 0.24 | .847 | 3.39 | 3.63 |
| 38 | Defense | 6 | 2.52 | 1.496 | .0017 | 0.31 | .650 | 2.60 | 2.91 |
| 39 | Tombstone Ext. | 5 | 2.02 | .984 | nil | 0 | .009 | 0.04 | 0.04 |
| 40 | Grand Dipper | 5 | 2.70 | .808 | .0056 | 1.04 | .141 | 0.56 | 1.60 |
| 41 | Telephone | 5 | 2.71 | .832 | .0002 | 0.04 | .207 | 0.83 | 0.87 |
| 42 | Silver Plume | 5 | 2.95 | .936 | .0024 | 0.44 | .261 | 1.04 | 1.48 |
| 43 | Oregon | 5 | 2.86 | .998 | .0004 | 0.07 | .092 | 0.37 | 0.44 |
| 44 | State of Maine | 5 | 2.91 | .978 | .0002 | 0.04 | .886 | 3.54 | 3.58 |
| 45 | State of Maine underground | 5 | 1.94 | .952 | nil | 0 | 1.676 | 6.70 | 6.70 |
| 46 | Tranquility | 6 | 2.90 | .968 | .0128 | 2.37 | .178 | 0.71 | 3.08 |
| 47 | Tranquility | 6 | 2.97 | .968 | .0119 | 2.20 | .184 | 0.74 | 2.94 |
| 48 | Contention | 6 | 3.99 | .984 | .0152 | 2.81 | .368 | 1.47 | 4.28 |
| 49 | Contention | 6 | 3.94 | .984 | .0150 | 2.78 | .380 | 1.52 | 4.30 |
| 50 | Lucky Cuss | 6 | 3.01 | .992 | .0135 | 2.50 | .453 | 1.81 | 4.31 |
| 51 | Lucky Cuss | 6 | 2.99 | 1.03 | .0155 | 2.87 | .463 | 1.85 | 4.72 |
| 52 | Toughnut | 5 | 3.94 | .976 | .0053 | 0.98 | .244 | 0.98 | 1.96 |
| 53 | Toughnut | 5 | 3.94 | .904 | .0054 | 1.00 | .212 | 0.85 | 1.85 |
| 54 | Tombstone Ext. | 5 | 2.93 | .960 | .0022 | 0.41 | .123 | 0.49 | 0.90 |
| 55 | Comet | 5 | 2.97 | .976 | .0027 | 0.50 | .101 | 0.40 | 0.90 |

Computations based on:
54% available CaO
$185/oz Au; $4/oz Ag

| Test No. | SAMPLE | Days Leaching | Reagent Consumption | | | Au Recovery | | Ag Recovery | | Total $/Ton |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | lb lime per Ton | lb cyanide per ton | lb NaCN per Ton | oz/Ton | $/Ton | oz/Ton | $/Ton | |
| 56 | Contention 1 | 8 | 4.52 | 0 | 1.40 | .0098 | 1.81 | .159 | .64 | 2.45 |
| 57 | Contention 1 | 8 | 0 | 2.10 | 1.42 | .0073 | 1.35 | .104 | .42 | 1.77 |
| 58 | Contention 2 | 8 | 3.58 | 0 | 1.38 | .0190 | 3.52 | .588 | 2.35 | 5.87 |
| 59 | Contention 2 | 8 | 0 | 1.04 | 1.40 | .0195 | 3.61 | .573 | 2.29 | 5.90 |

TEST 10

TOMBSTONE HEAP LEACH

METALLURGICAL TESTS

Dump Location TRANQUILITY

Sample Weight, Lbs. 250

Total Days Leaching _____

December, 1974

Conducted by: _____

Approved by: _____

| Date Day | Date Month/Yr | GMS CaO Added | GMS NaCN Added | cc Water Added | cc Water Removed | Reagent Consumption Lime #/Ton Ore | Reagent Consumption NaCN #/Ton Ore | Solution Assays Silver Oz/Ton | Solution Assays Gold Oz/Ton | MG. Gold Leached | MG. Silver Leached | oz % rock Gold Recov. | % Silver Recov. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 19 | DEC-74 | 56.8 | ~~0~~ | 20,000 | ~~0~~ | 1.0 | | | | | | | |
| 20 | DEC-74 | 30.0 | 56.8 | 2,000 | 0 | | | | | | | | |
| 21 | DEC-74 | 0 | 0 | 5000 | 5,000 | | .874 | 1.792 | .082 | 14.04 | 306.8 | .0036 | .079 |
| 22 | DEC-74 | 0 | 0 | 5,000 | 5,000 | | .096 / .970 | 1.562 | .083 | 14.21 | 267.5 | .0036 / .0072 | .069 / .148 |
| 23 | DEC-74 | 0 | 0 | 7,000 | 5,000 | | .037 / .957 | 1.360 | .072 | 12.33 | 232.8 | .0031 / .0103 | .060 / .208 |
| 24 | DEC-74 | 0 | 30.0 | 10,000 | 7,242 | | .008 / .960 | .807 | .044 | 10.91 | 200.1 | .0028 / .0131 | .051 / .259 |
| 26 | DEC-74 | 0 | 0 | 10,000 | 7,752 | | .416 / 1.376 | .567 | .035 | 9.29 | 150.6 | .0024 / .0154 | .038 / .297 |
| 27 | DEC-74 | 0 | 0 | 10,000 | 7,600 | | .088 / 1.464 | .327 | .021 | 5.46 | 85.1 | .0014 / .0168 | .021 / .318 |
| 28 | DEC-74 | 0 | 0 | 0 | 8,680 | | .040 / 1.504 | .186 | .012 | 3.567 | 55.29 | .0009 / .0177 | .014 / .332 |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| Total Ave. | | 86.8 | 86.8 | 69,000 | 46,474 | | | | | | | | |

1 / 2

1 - Daily
2 - Cumulative

192

TEST 11

TOMBSTONE HEAP LEACH

METALLURGICAL TESTS

Dump Location EMPIRE

Sample Weight, Lbs. 250

Total Days Leaching

December, 1974

Conducted by:

Approved by:

| Date Day | Date Month/Yr | GMS CaO Added | GMS NaCN Added | cc Water Added | cc Water Removed | Reagent Consumption Lime #/Ton Ore | Reagent Consumption NaCN #/Ton Ore | Solution Assays Silver Oz/Ton | Solution Assays Gold Oz/Ton | MG. Gold Leached | MG. Silver Leached | % Gold Recov. | % Silver Recov. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9 | DEC. 74 | 56.8 | Ø | 20,000 | Ø | | | | | | | | |
| 0 | DEC. 74 | 10.Ø | 56.8 | 4000 | Ø | | | | | | | | |
| 21 | DEC. 74 | Ø | Ø | 5000 | 5000 | | .854 | 1.182 | .078 | 13.356 | 203.42 | .0034 | .052 |
| 22 | DEC. 74 | Ø | Ø | 5,000 | 4,500 | | .080 / .936 | 1.130 | .073 | 11.25 | 174.14 | .0029 / .0063 | .047 / .097 |
| 23 | DEC. 74 | Ø | Ø | 7,000 | 5,000 | | .024 / .960 | .944 | .059 | 10.10 | 161.64 | .0026 / .0089 | .042 / .139 |
| 24 | DEC. 74 | 10.Ø | 30.Ø | 10,000 | 7,242 | | .008 / .968 | .662 | .041 | 10.17 | 164.2 | .0026 / .0115 | .042 / .181 |
| 26 | DEC. 74 | Ø | Ø | 10,000 | 7,092 | | .384 / 1.352 | .474 | .028 | 6.80 | 115.1 | .0017 / .0132 | .029 / .210 |
| 27 | DEC. 74 | Ø | Ø | 10,000 | 7,400 | | .117 / 1.464 | .330 | .018 | 4.56 | 83.63 | .0011 / .0143 | .021 / .231 |
| 28 | DEC. 74 | Ø | Ø | Ø | 8,350 | | .024 / 1.488 | .166 | .010 | 2.860 | 47.47 | .0007 / .0150 | .012 / .243 |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| Total Ave. | | 76.8 | 86.8 | 69,000 | 44,784 | | | | | | | | |

1 / 2

1 - Daily
2 - Cumulative

193

TEST 12

TOMBSTONE HEAP LEACH

METALLURGICAL TESTS

Dump Location TOUGHNUT

Sample Weight, Lbs. 250

Total Days Leaching

December, 1974

Conducted by:

Approved by:

| Date Day | Date Month/Yr | GMS CaO Added | GMS NaCN Added | cc Water Added | cc Water Removed | Reagent Consumption Lime #/Ton Ore | Reagent Consumption NaCN #/Ton Ore | Solution Assays Silver Oz/Ton | Solution Assays Gold Oz/Ton | MG. Gold Leached | MG. Silver Leached | % Gold Recov. | % Silver Recov. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 19 | DEC-74 | 56.8 | Ø | 20,000 | Ø | | | | | | | | |
| 20 | DEC-74 | 30.Ø | 56.8 | 1,000 | Ø | | | | | | | | |
| 21 | DEC-74 | Ø | Ø | 5,000 | 4800 | | .934 | 1.58 | .042 | 6.90 | 236.30 | .0018 | .061 |
| 22 | DEC-74 | 10.Ø | Ø | 5,000 | 2,600 | | .048 / .976 | 1.127 | .033 | 2.938 | 100.3 | .0008 / .0026 | .025 / .087 |
| 23 | DEC-74 | Ø | Ø | 7,000 | 4,000 | | - / .976 | .956 | .028 | 3.836 | 130.9 | .0010 / .0036 | .034 / .121 |
| 24 | DEC-74 | 10.Ø | 30.Ø | 10,000 | 6,942 | | - / .976 | .689 | .020 | 4.755 | 163.8 | .0012 / .0048 | .042 / .163 |
| 26 | DEC-74 | Ø | Ø | 10,000 | 6,702 | | .480 / 1.416 | .511 | .014 | 3.213 | 117.3 | .0008 / .0036 | .030 / .193 |
| 27 | DEC-74 | Ø | Ø | 10,000 | 7,240 | | .120 / 1.536 | .346 | .010 | 2.49 | 85.78 | .0006 / .0062 | .022 / .215 |
| 28 | DEC-74 | Ø | Ø | Ø | 8,390 | | .008 / 1.544 | .213 | .005 | 1.437 | 61.20 | .0004 / .0066 | .016 / .231 |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| Total Ave. | | 106.8 | 86.8 | 68,000 | 40,874 | | | | | | | | |

| 1 | 2 |
|---|---|

1 - Daily
2 - Cumulative

1C4

TEST 13

TOMBSTONE HEAP LEACH

METALLURGICAL TESTS

Dump Location CONTENTION 1

Sample Weight, Lbs. 250

Total Days Leaching

December, 1974

Conducted by:

Approved by:

| Date Day | Date Month/Yr | GMS CaO Added | GMS NaCN Added | cc Water Added | cc Water Removed | Reagent Consumption Lime #/Ton Ore | Reagent Consumption NaCN #/Ton Ore | Solution Assays Silver Oz/Ton | Solution Assays Gold Oz/Ton | MG. Gold Leached | MG. Silver Leached | % Gold Recov. | % Silver Recov. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 19 | DEC. 74 | 56.8 | ~~0~~ | 20,000 | ~~0~~ | | | | | | | | |
| 20 | DEC-74 | 30.0 | 56.8 | 3,000 | ~~0~~ | | | | | | | | |
| 21 | DEC-74 | 0 | 0 | 5,000 | 4000 | | .944 | 2.59 | .117 | 20.034 | 443.32 | .0031 | .114 |
| 22 | DEC-74 | 0 | 30.0 | 5,000 | 3,000 | | .032 / .976 | 2.3085 | .099 | 10.17 | 237.17 | .0026 / .0071 | .060 / .175 |
| 23 | DEC-74 | 0 | 30.0 | 7,000 | 4,000 | | .488 / 1.464 | 1.929 | .084 | 11.51 | 264.2 | .0029 / .0107 | .067 / .243 |
| 24 | DEC-74 | 0 | 20.0 | 10,000 | 5,942 | | .437 / 1.896 | 1.622 | .0715 | 14.55 | 330.1 | .0037 / .0144 | .085 / .328 |
| 26 | DEC-74 | 0 | 0 | 10,000 | 6,952 | | .304 / 2.200 | 1.172 | .051 | 12.14 | 279.0 | .0031 / .0175 | .072 / .400 |
| 27 | DEC.-74 | 0 | 0 | 10,000 | 6,580 | | .175 / 2.375 | .852 | .035 | 7.88 | 193.11 | .002 / .0195 | .049 / .449 |
| 28 | DEC-74 | 0 | 0 | 0 | 8,960 | | .034 / 2.359 | .518 | .021 | 6.444 | 158.9 | .0017 / .0212 | .041 / .490 |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| Total Ave. | | 86.8 | 136.8 | 70,000 | 39.634 | | | | | | | | |

| 1 / 2 |
|---|

1 - Daily
2 - Cumulative

195

TEST 14

TOMBSTONE HEAP LEACH

METALLURGICAL TESTS

Dump Location LITTLE JOE

Sample Weight, Lbs. #250

Total Days Leaching _____

December, 1974

Conducted by: _____

Approved by: _____

| Date Day | Date Month/Yr | GMS CaO Added | GMS NaCN Added | cc Water Added | cc Water Removed | Reagent Consumption Lime #/Ton Ore | Reagent Consumption NaCN #/Ton Ore | Solution Assays Silver Oz/Ton | Solution Assays Gold Oz/Ton | MG. Gold Leached | MG. Silver Leached | % Gold Recov. | % Silver Recov. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 19 | DEC. 74 | 56.8 | Ø | 20,000 | Ø | | | | | | | | |
| 20 | DEC-74 | 30.Ø | 56.8 | 2,000 | Ø | | | | | | | | |
| 21 | DEC-74 | Ø | Ø | 5,000 | 5800 | | .776 | 2.003 | .032 | 5.479 | 342.98 | .0014 | .085 |
| 22 | DEC-74 | Ø | Ø | 5,000 | 4,000 | | .160 / .936 | 1.843 | .029 | 3.973 | 252.47 | .0010 / .0024 | .065 / .153 |
| 23 | DEC-74 | Ø | Ø | 7,000 | 4,000 | | .032 / .968 | 1.659 | .028 | 3.836 | 227.3 | .0009 / .0034 | .058 / .211 |
| 24 | DEC-74 | 10.Ø | 30.Ø | 10,000 | 5,642 | | – / .968 | 1.235 | .019 | 3.671 | 238.6 | .0009 / .0043 | .061 / .272 |
| 26 | DEC-74 | Ø | Ø | 10,000 | 6,752 | | .368 / 1.336 | .873 | .015 | 3.468 | 201.9 | .0009 / .0052 | .051 / .323 |
| 27 | DEC-74 | Ø | Ø | 10,000 | 6,610 | | .144 / 1.480 | .588 | .010 | 2.264 | 133.1 | .0006 / .0058 | .038 / .357 |
| 28 | DEC-74 | Ø | Ø | Ø | 8,660 | | .024 / 1.504 | .377 | .005 | 1.483 | 111.8 | .0004 / .0062 | .029 / .386 |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| Total Ave. | | 96.8 | 86.8 | 69,000 | 40,864 | | | | | | | | |

1 / 2

1 - Daily
2 - Cumulative

196

Test = 36.08 / 250 lbs.

Test # 15

TOMBSTONE HEAP LEACH

METALLURGICAL TESTS

Dump Location WEST SIDE

Sample Weight, Lbs. 250

Total Days Leaching _____

December, 1974

Conducted by: _____

Approved by: _____

| Date Day | Date Month/Yr | GMS CaO Added | GMS NaCN Added | cc Water Added | cc Water Removed | Reagent Consumption Lime #/Ton Ore | Reagent Consumption NaCN #/Ton Ore | Solution Assays Silver Oz/Ton | Solution Assays Gold Oz/Ton | MG. Gold Leached | MG. Silver Leached | % Gold Recov. | % Silver Recov. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 19 | DEC. 74 | 56.8 | Ø | 20,000 | Ø | 1.0 / 1.0 | ~~0~~ / 0 | | | | | | |
| 20 | DEC. 74 | Ø | 56.8 | 4,000 | Ø | 0 / 1.0 | 1.0 / 1.0 | | | | | | |
| 21 | DEC-74 | Ø | Ø | 5,000 | 5000 | 0 / 1.0 | .880 / ~~1.0~~ | ↑ | ↑ | ↑ | ↑ | | |
| 22 | DEC-74 | Ø | Ø | 5,000 | 5,000 | 0 / 1.0 | .02 / .936 | 2.29 | .068 | 11.64 | 392.29 | .003 | .101 |
| 23 | DEC-74 | Ø | Ø | 7,000 | 5,000 | 0 / 1.0 | .024 / .960 | 2.088 | .065 | 11.13 | 357.5 | .0028 / .0059 | .0919 / .193 |
| | | | | | | | | 2.054 | .064 | 10.96 | 351.7 | .0028 / .0087 | .090 / .283 |
| 24 | DEC-74 | 15.Ø | 30.Ø | 10,000 | 7,842 | | — / .960 | 1.665 | .025 | 6.71 | 447.2 | .0017 / .0104 | .115 / .398 |
| 26 | DEC-74 | Ø | Ø | 10,000 | 6,902 | | .416 / 1.376 | .892 | .026 | 6.15 | 210.8 | .0016 / .0120 | .054 / .452 |
| 27 | DEC-74 | Ø | Ø | 10,000 | 7,650 | | .096 / 1.472 | .585 | .015 | 3.93 | 153. | .0010 / .0130 | .039 / .491 |
| 28 | DEC-74 | Ø | Ø | Ø | 8,850 | | .024 / 1.496 | .280 | .007 | 2.122 | 84.86 | .0005 / .0135 | .022 / .513 |
| | | | | | | | | | | | | | |
| Total Ave. | | 71.8 | 86.8 | 69,000 | 46,444 | | | | | | | | |

1 / 2

1 - Daily
2 - Cumulative

TE. # 16

TOMBSTONE HEAP LEACH

METALLURGICAL TESTS

Dump Location GRAND CENTRAL

Sample Weight, Lbs. 250

Total Days Leaching _____

December, 1974

Conducted by: _____

Approved by: _____

| Date Day | Date Month/Yr | GMS CaO Added | GMS NaCN Added | cc Water Added | cc Water Removed | Reagent Consumption Lime #/Ton Ore | Reagent Consumption NaCN #/Ton Ore | Solution Assays Silver Oz/Ton | Solution Assays Gold Oz/Ton | MG. Gold Leached | MG. Silver Leached | % Gold Recov. | % Silver Recov. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 19 | DEC. 74 | 56.8 | Ø | 18,500 | Ø | 1.0 / 1.0 | 0 / 0 | | | | | | |
| 20 | DEC-74 | 30.Ø | 56.8 | 1,000 | Ø | .53 / 1.53 | 1.0 / 0 | | | | | | |
| 21 | DEC-74 | Ø | Ø | 5,000 | 5000 | | .824 | 3.428 | .042 | 7.19 | 586.98 | .0018 | .1508 |
| 22 | DEC-74 | Ø | Ø | 5,000 | 3,800 | | .104 / .928 | 2.819 | .040 | 5.205 | 366.9 | .0013 / .0031 | .094 / .245 |
| 23 | DEC-74 | Ø | Ø | 7,000 | 4,000 | | .032 / .960 | 2.359 | .035 | 4.794 | 323.2 | .0012 / .0043 | .083 / .328 |
| 24 | DEC-74 | Ø | 30.Ø | 10,000 | 6,798 | | .960 | 1.316 | .042 | 9.778 | 305.8 | .0023 / .0068 | .079 / .407 |
| 26 | DEC-74 | Ø | Ø | 10,000 | 6,762 | | .424 / 1.384 | 1.022 | .017 | 3.937 | 236.7 | .0010 / .0078 | .061 / .468 |
| 27 | DEC-74 | Ø | Ø | 10,000 | 6,470 | | .104 / 1.488 | .693 | .035 | 7.76 | 153.6 | .0020 / .0098 | .0395 / .507 |
| 28 | DEC-74 | Ø | Ø | Ø | 8,900 | | .016 / 1.504 | .387 | .006 | 1.829 | 117.9 | .0005 / .0103 | .030 / .537 |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| Total Ave. | | 86.8 | 86.8 | 66.5 | 41,930 | | | | | | | | |

1 / 2

1 - Daily
2 - Cumulative

198

TEST # 17

TOMBSTONE HEAP LEACH

METALLURGICAL TESTS

Dump Location LUCKY CUSS

Sample Weight, Lbs. 250

Total Days Leaching _____

December, 1974

Conducted by: _____

Approved by: _____

| Date Day | Date Month/Yr | GMS CaO Added | GMS NaCN Added | cc Water Added | cc Water Removed | Reagent Consumption Lime #/Ton Ore | Reagent Consumption NaCN #/Ton Ore | Solution Assays Silver Oz/Ton | Solution Assays Gold Oz/Ton | MG. Gold Leached | MG. Silver Leached | % Gold Recov. | % Silver Recov. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 19 | DEC. 74 | 56.8 | Ø | 20,000 | Ø | | | PRE-CONDITIONED | | | | | |
| 20 | DEC-74 | 30.Ø | 56.8 | 2,000 | Ø | | | PRE-CONDITIONED | | | | | |
| 21 | DEC-74 | Ø | Ø | 5000 | 5000 | | .972 | 2.623 | .091 | 15.58 | 449.14 | .0040 | .115 |
| 22 | DEC-74 | Ø | Ø | 5,000 | 3,250 | | .052 / .968 | 2.578 | .085 | 9.461 | 286.9 | .0024 / .0064 | .074 / .189 |
| 23 | DEC-74 | Ø | Ø | 7,000 | 4000 | | .068 / .976 | 2.114 | .075 | 10.27 | 289.6 | .0026 / .0090 | .074 / .263 |
| 24 | DEC-74 | 10.Ø | 30.Ø | 10,000 | 6,848 | | — / .976 | 1.483 | .052 | 12.20 | 347.8 | .0031 / .0121 | .089 / .352 |
| 26 | DEC-74 | Ø | Ø | 10,000 | 6,412 | | .424 / 1.060 | 1.117 | .034 | 7.47 | 245.3 | .0019 / .0140 | .063 / .415 |
| 27 | DEC-74 | Ø | Ø | 10,000 | 6,940 | | .048 / 1.088 | .789 | .008 | 1.90 | 188 | .0005 / .0145 | .048 / .463 |
| 28 | DEC-74 | Ø | Ø | Ø | 8,650 | | .024 / 1.017 | .479 | .014 | 4.147 | 141.9 | .0011 / .0156 | .036 / .499 |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| Total Ave. | | 96.8 | 86.8 | 69,000 | 41.300 | | | | | | | | |

| 1 / 2 |
|---|

1 - Daily
2 - Cumulative

TES. # 18

TOMBSTONE HEAP LEACH

METALLURGICAL TESTS

Dump Location EMERALD

Sample Weight, Lbs. 250

Total Days Leaching _____

December, 1974

Conducted by: _____

Approved by: _____

| Date Day | Date Month/Yr | GMS CaO Added | GMS NaCN Added | cc Water Added | cc Water Removed | Reagent Consumption Lime #/Ton Ore | Reagent Consumption NaCN #/Ton Ore | Solution Assays Silver Oz/Ton | Solution Assays Gold Oz/Ton | MG. Gold Leached | MG. Silver Leached | % Gold Recov. | % Silver Recov. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 19 | DEC. 74 | 56.8 | Ø | 20,000 | Ø | | | | | | | | |
| 20 | DEC-74 | 30.Ø | 56.8 | 4000 | Ø | | | | | | | | |
| 21 | DEC-74 | Ø | Ø | 5,000 | 5000 | | .98/2 | 2.249 | .019 | 3.25 | 385.1 | .0008 | .099 |
| 22 | DEC-74 | 10.Ø | 30.Ø | 5,000 | 2,606 | | .040 / .992 | 2.003 | .018 | 1.603 | 178.3 | .0004 / .0012 | .046 / .145 |
| 23 | DEC-74 | Ø | 30.Ø | 7,000 | 4,000 | | .488 / 1.880 | 1.927 | .019 | 2.603 | 263.9 | .0007 / .0019 | .068 / .213 |
| 24 | DEC-74 | Ø | 20.Ø | 10,000 | 7,648 | | .336 / 1.816 | 1.533 | .013 | 3.405 | 401.5 | .0009 / .0028 | .103 / .316 |
| 26 | DEC-74 | Ø | Ø | 10,000 | 6,902 | | .488 / 1.304 | .803 | .009 | 2.127 | 189.8 | .0005 / .0033 | .049 / .365 |
| 27 | DEC-74 | Ø | Ø | 10,000 | 8,250 | | .032 / 2.336 | .727 | .024 | 6.781 | 205.4 | .0017 / .0050 | .052 / .418 |
| 28 | DEC-74 | Ø | Ø | Ø | 8,580 | | .024 / 2.576 | .483 | .025 | 1.469 | 141.9 | .0004 / .0054 | .036 / .454 |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| Total Ave. | | 96.8 | 136.8 | 69,000 | 43.186 | | | | | | | | |

1 / 2

1 - Daily
2 - Cumulative

TEST #9 1.85 1.9

TOMBSTONE HEAP LEACH

METALLURGICAL TESTS

Dump Location CONTENTION #II

Sample Weight, Lbs. 250

Total Days Leaching _____

December, 1974

Conducted by: _____

Approved by: _____

| Date Day | Date Month/Yr | GMS CaO Added | GMS NaCN Added | cc Water Added | cc Water Removed | Reagent Consumption Lime #/Ton Ore | Reagent Consumption NaCN #/Ton Ore | Solution Assays Silver Oz/Ton | Solution Assays Gold Oz/Ton | MG. Gold Leached | MG. Silver Leached | % Gold Recov. | % Silver Recov. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 19 | DEC. 74 | 56.8 | Ø | 18200 | Ø | | | | | | | | |
| 20 | DEC. 74 | Ø | 56.8 | Ø | Ø | | | | | | | | |
| 21 | DEC. 74 | Ø | Ø | 5000 | 5000 | | .836 | 5.164 | .122 | 20.89 | 884.24 | .0053 | .227 |
| 22 | DEC-74 | Ø | Ø | 5,000 | 3,000 | | .120 / .936 | 4.6485 | .1325 | 13.613 | 477.58 | .0034 / .0088 | .123 / .350 |
| 23 | DEC-74 | Ø | Ø | 7,000 | 4,000 | | .018 / .944 | 3.980 | .113 | 15.48 | 545.2 | .0040 / .0128 | .140 / .490 |
| 24 | DEC-74 | Ø | 30.Ø | 10,000 | 8,848 | | — / .944 | 2.812 | .074 | 22.42 | 852.1 | .0058 / .0186 | .219 / .709 |
| 26 | DEC-74 | Ø | Ø | 10,000 | 7,512 | | .452 / 1.400 | 2.153 | .056 | 14.41 | 553.88 | .0037 / .0223 | .142 / .851 |
| 27 | DEC. 74 | Ø | Ø | 10,000 | 6,390 | | .088 / 1.488 | 1.198 | .012 | 2.63 | 262.2 | .0007 / .0230 | .067 / .918 |
| 28 | DEC-74 | Ø | Ø | Ø | 8,990 | | .016 / 1.504 | .749 | .021 | 6.465 | 230.6 | .0017 / .0247 | .059 / .977 |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| Total Ave. | | 56.8 | 86.8 | 65.200 | 43,940 | | | | | | | | |

1 / 2

1 - Daily
2 - Cumulative

BECHTEL

# Barrel Test 10-19 Assayed Screen Analysis, Tailings

| | | +1½ | +1" | +½ | +¼ | -¼ | Calc. Tailing | oz/ton leached | Calc. head | % Recovery |
|---|---|---|---|---|---|---|---|---|---|---|
| CONTEMPTION 1 | | | | | | | | | | |
| | wt % | 6 | 4 | 13 | 17 | 60 | | | | |
| | Au | <.005 | <.005 | <.005 | <.005 | <.005 | <.005 | .0244 | <.0244 | 83 |
| Test 13 | Ag | 0.72 | 2.76 | 0.62 | 0.78 | 1.16 | 1.063 | .550 | 1.613 | 34 |
| | wt x Au | — | — | — | — | — | — | | | |
| | wt x Ag | .0432 | 0.1104 | .0806 | .1326 | .696 | 1.063 | | | |
| | % Au | 4 | 10 | .8 | 13 | 65 | 100 | | | |
| | % Ag | 6 | 4 | 13 | 17 | 60 | 100 | | | |
| CONTEMPTION 2 | | | | | | | | | | |
| | wt % | 8 | 4 | 18 | 28 | 42 | | | | |
| | Au | <.005 | <.005 | <.005 | <.005 | <.005 | <.005 | 0.0245 | <.031 | 95 |
| Test 19 | Ag | .80 | .82 | 1.54 | 4.58 | 0.92 | 2.043 | 1.140 | 3.183 | 36 |
| | wt x Au | — | — | — | — | — | — | | | |
| | wt x Ag | .064 | .0328 | .2772 | 1.2824 | .3864 | 2.043 | | | |
| | % Au | 8 | 4 | 18 | 28 | 42 | 100 | | | |
| | % Ag | 3 | 2 | 13 | 63 | 19 | 100 | | | |
| TRANQUILITY | | | | | | | | | | |
| | wt % | 19 | 9 | 20 | 19 | 33 | | | | |
| | Au | <.005 | <.005 | <.005 | <.005 | <.005 | <.005 | 0.020 | .025 | 80 |
| Test 10 | Ag | .68 | .60 | .56 | 1.50 | 0.74 | .8244 | 0.370 | 1.1944 | 31 |
| | wt x Au | — | — | — | — | — | | | | |
| | wt x Ag | .1292 | .054 | .112 | .285 | 0.2442 | .8244 | | | |
| | % Au | 19 | 9 | 20 | 19 | 33 | 100 | | | |
| | % Ag | 16 | 7 | 13 | 34 | 30 | 100 | | | |
| Grand Central | | | | | | | | | | |
| | wt % | 18 | 5 | 17 | 17 | 43 | | | | |
| 7 | Au | <.005 | <.005 | <.005 | .15 * | <.005 | .0297 | .0103 | .0400 | 25 |
| 16 | Ag | .30 | .30 | 1.54 | .35 * | .60 | .649 | 0.60 | 1.245 | 48 |
| | wt x Au | | | | | | | | | |
| | wt x Ag | | | | | | | | | |
| | % Au | | | | | | | | | |
| | % Ag | | | | | | | | | |

BECHTEL

# Barrel Tests 10-19, Crushed Tailing

| | | + 1½" | + 1" | + ½ | + ¼ | - ¼ | Calc. tailing | oz/ton leached | Calc. head | % Recovery |
|---|---|---|---|---|---|---|---|---|---|---|
| **Little Joe** | | | | | | | | | | |
| | wt% | 11.0 | 5.0 | 15 | 18 | 51 | | | | |
| | Au | <.005* | <.005 | <.005 | <.005 | .030* | .0179 | .0077 | .0256 | 30 |
| Test 14 | Ag | 2.88* | .50 | .54 | .150 | .30* | .603 | 0.44 | 1.043 | 42 |
| | wt x Au | .0006 | .0003 | .0008 | .0009 | .0153 | .0179 | | | |
| | wt x Ag | .317 | .025 | .081 | .027 | .153 | .603 | | | |
| | % Au | 3 | 2 | 4 | 5 | 85 | 100 | | | |
| | % Ag | 53 | 4 | 13 | 4 | 25 | 100 | | | |
| **West Side** | | | | | | | | | | |
| | wt% | 23 | .9 | 22 | 17 | 29 | | | | |
| Test 15 | Au | <.005 | <.005 | .056* | <.005* | <.005 | .0164 | .0134 | .0318 | 48 |
| | Ag | 1.02 | .82 | 1.14* | 12.48* | 1.32 | 3.06 | 0.57 | 3.63 | 16 |
| | wt x Au | .0012 | .0005 | .0123 | .0009 | .0015 | .0164 | | | |
| | wt x Ag | .235 | .074 | .251 | 2.120 | .383 | 3.063 | | | |
| | % Au | 7 | 3 | 75 | 5 | 9 | 100 | | | |
| | % Ag | 8 | 2 | 8 | 69 | 13 | 100 | | | |
| **Lucky Cuss** | | | | | | | | | | |
| | wt% | 15 | 6 | 18 | 17 | 44 | | | | |
| | Au | <.005 | <.005 | <.005 | <.005 | <.005* | <.0057 | .0182 | .0233 | 78 |
| Test 16 | Ag | 1.18 | 1.34 | 1.50 | 2.12 | 3.62* | 2.480 | 0.56 | 3.04 | 18 |
| | wt x Au | .0008 | .0003 | .0009 | .0009 | .0022 | .0051 | | | |
| | wt x Ag | .177 | .080 | .270 | .360 | 1.593 | 2.480 | | | |
| | % Au | 15 | 6 | 18 | 17 | 44 | | | | |
| | % Ag | 7 | 3 | 11 | 15 | 64 | | | | |

* Avg. of duplicate assay

BECHTEL

# Barrel Tests 10-19, Tailings

| | | +1 1/2 | +1" | +1/2" | +1/4 | -1/4 | Calc. Tailing | Orfton Leached | Calc. Head | % Recovery |
|---|---|---|---|---|---|---|---|---|---|---|
| **Emerald** | | | | | | | | | | |
| Test 10 | wt% | 11 | 6 | 16 | 19 | 48 | | | | |
| | Au | .005 | .005 | <.005 | .01 | .005 | .0060 | .0046 | .0106 | 43 |
| | Ag | 1.70 | 3.91 | 1.21 | 2.45 | 2.10 | 2.09 | .47 | 2.56 | 18 |
| | wt x Au | .0006 | .0003 | .0008 | .0019 | .0024 | .0060 | | | |
| | wt x Ag | .187 | .235 | .194 | .466 | 1.008 | 2.09 | | | |
| | % Au | 10 | 5 | 13 | 32 | 40 | | | | |
| | % Ag | 9 | 11 | 9 | 22 | 48 | | | | |
| **Empire** | | | | | | | | | | |
| TEST 11 | wt% | 13 | 5 | 16 | 18 | 48 | | | | |
| | Au | <.005 | <.005 | <.005 | .040 | .035 | .0258 | .0167 | .0425 | 61 |
| | Ag | 1.50 | 2.04 | 0.78 | 3.12 | 2.45 | 2.160 | .27 | 2.43 | 11 |
| | wt x Au | .0007 | .0003 | .0008 | .0032 | .0168 | .0258 | | | |
| | wt x Ag | .195 | .102 | .125 | .562 | 1.176 | 2.160 | | | |
| | % Au | 3 | 1 | 3 | 28 | 65 | 100 | | | |
| | % Ag | 9 | 5 | 6 | 26 | 54 | 100 | | | |
| **Toughnut** | | | | | | | | | | |
| Test 12 | wt% | 11.0 | 5.0 | 17.0 | 18.0 | 49 | | | | |
| | Au | <.007 | <.005 | <.005 | <.005 | .010 | .0076 | .0070 | .0146 | 48 |
| | Ag | 1.42 | 1.16 | .70 | .54 | .79 | .818 | 0.25 | 1.068 | 23 |
| | wt x Au | .0006 | .0003 | .0009 | .0009 | .0049 | .0076 | | | |
| | wt x Ag | .156 | .058 | .119 | .097 | .387 | .818 | | | |
| | % Au | 8 | 4 | 12 | 12 | 64 | 100 | | | |
| | % Ag | 19 | 7 | 15 | 12 | 47 | 100 | | | |

BECHTEL

205 1/7/75 183 1050111

BARREL TESTS, 20-29
250# each

Started: 11:00 am 1/6/75

1/7/74

| TEST | DUMP | ASSAY, SOLUTION Au | Ag | % in test | Mb. leached in 1 day Au | Ag | oz/ton in 1 day Au | Ag | % ton Au | Ag |
|---|---|---|---|---|---|---|---|---|---|---|
| 20 | Tonopah | .57 | 24.53 | 14 | 35.1 | 1512 | .0090 | .39 | 1.67 | 1.75 |
| 21 | Little Joe | .38 | 17.86 | 15 | 19.52 | 917 | .0050 | .24 | .93 | 1.06 |
| 22 | Emerald | .18 | 28.62 | 19 | 11.71 | 1862 | .0030 | .48 | .56 | 2.15 |
| 23 | Bunker Hill | .08 | 64.00 | 22 | 6.03 | 4822 | .0015 | 1.24 | .29 | 5.58 |
| 24 | Comet | .23 | 7.29 | 19 | 14.97 | 474 | .0038 | .12 | .71 | .55 |
| 25 | St. of Maine | 1.87 | 43.32 | 22 | 140.9 | 3264 | .0362 | .84 | 6.70 | 3.7 |
| 26 | Boss | 1.52 | 6.88 | 17 | 88.5 | 401 | .0227 | .10 | 4.21 | .46 |
| 27 | Flora Mow. | 0.52 | 34.37 | 18 | 32.1 | 2119 | .0082 | .54 | 1.52 | 2.45 |
| 28 | Old Guard | 1.31 | 37.54 | 23 | 103.2 | 2957 | .0265 | .76 | 4.90 | 3.42 |
| 29 | Cont. 2 | 1.36 | 49.12 | 16 | 74.5 | 2692 | .0191 | .69 | 3.54 | 3.1 |

Salt .002 Actual

#30

TOMBSTONE HEAP LEACH

METALLURGICAL TESTS

Dump Location Silver Thread

Sample Weight, Lbs. _____

Total Days Leaching _____

December, 1974

Conducted by: _____

Approved by: _____

| Date Day | Date Month/Yr | GMS CaO Added | GMS NaCN Added | cc Water Added | cc Water Removed | Reagent Consumption Lime #/Ton Ore | Reagent Consumption NaCN #/Ton Ore | Solution Assays Silver Oz/Ton | Solution Assays Gold Oz/Ton | MG. Gold Leached | MG. Silver Leached | % Gold Recov. | % Silver Recov. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 13 | 1-75 | 113.5 | 0 | 15,000 | 0 | | .816 / .816 | | | | | | |
| 14 | 1-75 | 0 | 56.75 | 2000 | 0 | | .104 / .920 | | | | | | |
| 15 | 1-75 | 0 | 0 | 6000 | 5000 | 1.78 | .040 / .960 | 2.143 | .078 | 13.3562 | 366.95 | .0034 | .094 |
| 16 | 1-75 | 0 | 0 | 6000 | 5,000 | .13 / 1.91 | .008 / .968 | 2.150 | .083 | 14.2123 | 368.15 | .0036 / .0070 | .095 / .189 |
| 17 | 1-75 | 30.0 | 0 | 6000 | 5,000 | — / 1.91 | .008 / .976 | 1.653 | .068 | 11.6438 | 283.05 | .0030 / .0066 | .073 / .262 |
| 18 | 1-75 | 0 | 0 | 6000 | 4800 | .57 / 2.46 | ↓ | .978 | .044 | 6.4795 | 144.02 | .0017 / .0084 | .037 / .299 |
| 19 | 1-75 | 0 | 0 | 4,000 | 4,550 | .07 / 2.53 | ↓ | .791 | .031 | 4.8305 | 123.26 | .0012 / .0096 | .032 / .331 |
| 20 | 1-75 | 0 | 0 | | 4220 | | | .565 | .019 | 2.7459 | 81.654 | .0007 / .0103 | .021 / .352 |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| Total Ave. | | 143.50 | 56.75 | 45,000 | 28,070 | 2.86 | 0.36 | | | 53.3680 | 1367.08 | .0134 | .351 |

3.33 lb/T.N

1 / 2

1 - Daily
2 - Cumulative

@ 54% mill time

206

#31

TOMBSTONE HEAP LEACH

METALLURGICAL TESTS

Dump Location Contact

Sample Weight, Lbs. _____

Total Days Leaching _____

December, 1974

Conducted by: _____

Approved by: _____

| Date Day | Date Month/Yr | GMS CaO Added | GMS NaCN Added | cc Water Added | cc Water Removed | Reagent Consumption Lime #/Ton Ore | Reagent Consumption NaCN #/Ton Ore | Solution Assays Silver Oz/Ton | Solution Assays Gold Oz/Ton | MG. Gold Leached | MG. Silver Leached | % Gold Recov. | % Silver Recov. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 13 | 1-75 | 113.5 | Ø | 10,000 | Ø | | | | | | | | |
| 14 | 1-75 | Ø | 56.75 | 2000 | Ø | | | | | | | | |
| 15 | 1-75 | Ø | Ø | 5000 | 2000 | 1.76 | .824 / .824 | .485 | .020 | 0.1369 | 33.219 | Nil | .008 |
| 16 | 1-75 | Ø | Ø | 5000 | 3200 | .03 / 1.79 | .140 / .964 | .539 | .010 | 0.1096 | 59.068 | Nil | .015 / .023 |
| 17 | 1-75 | Ø | Ø | 5000 | 3800 | .05 / 1.88 | .076 / 1.02 | .431 | .010 | 1.3014 | 56.09 | .0004 / .0004 | .014 / .037 |
| 18 | 1-75 | Ø | Ø | 5000 | 3500 | .06 / 1.94 | .048 / 1.07 | .294 | .005 | 0.5993 | 35.24 | .0002 / .0006 | .009 / .046 |
| 19 | 1-75 | Ø | Ø | 4,000 | 3260 | .03 / 1.97 | .016 / 1.08 | .215 | TR | Nil | 27.685 | Nil / .0006 | .007 / .053 |
| 20 | 1-75 | — | — | — | 3450 | | | .141 | TR | Nil | 16.659 | Nil / .0006 | .004 / .057 |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| Total Ave. | | | | | | | | | | 2.1478 | 207.96 | | |

1 / 2

1 - Daily
2 - Cumulative

207

# 32

TOMBSTONE HEAP LEACH

METALLURGICAL TESTS

Dump Location Prompter

Sample Weight, Lbs. _____

Total Days Leaching _____

December, 1974

Conducted by: _____

Approved by: _____

| Date Day | Date Month/Yr | GMS CaO Added | GMS NaCN Added | cc Water Added | cc Water Removed | Reagent Consumption Lime #/Ton Ore | Reagent Consumption NaCN #/Ton Ore | Solution Assays Silver Oz/Ton | Solution Assays Gold Oz/Ton | MG. Gold Leached | MG. Silver Leached | % Gold Recov. | % Silver Recov. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 13 | 1-75 | 113.5 | ø | 13,500 | ø | | .952 / .952 | | | | | | |
| 14 | 1-75 | ø | 56.75 | 2000 | ø | | .024 / .976 | | | | | | |
| 15 | 1-75 | ø | ø | 5000 | 2500 | 1.98 | .008 / .984 | .761 | .017 | 1.4555 | 65.154 | .0004 | .017 |
| 16 | 1-75 | 30.0 | ø | 5000 | 3000 | .01 / 1.99 | .008 / .992 | .740 | .017 | 1.7466 | 76.027 | .0004 / .0008 | .020 / .027 |
| 17 | 1-75 | 30.0 | ø | 5000 | 4000 | .53 / 2.52 | | .658 | .014 | 1.9178 | 90.137 | .0005 / .0013 | .023 / .060 |
| 18 | 1-75 | ø | ø | 5000 | 2600 | .46 / 2.98 | | .442 | .009 | 0.8014 | 39.356 | .0002 / .0015 | .010 / .070 |
| 19 | 1-75 | ø | ø | 4,000 | 3,490 | .07 / 3.05 | .008 / .992 | .402 | .010 | 1.1952 | 48.047 | .0003 / .0018 | .012 / .082 |
| 20 | 1-75 | — | — | — | 3750 | | | .309 | .006 | 0.7705 | 39.683 | .0002 / .0020 | .010 / .092 |
| | | 173.5 | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| Total Ave. | | | | | | | | | | 7.8870 | 358.40 | | |

| 1 / 2 |
|---|

1 - Daily
2 - Cumulative

208

# 33

TOMBSTONE HEAP LEACH

METALLURGICAL TESTS

Dump Location Hershel ~~Stop Ore~~

Sample Weight, Lbs. _____

Total Days Leaching _____

Conducted by: _____

December, 1974

Approved by: _____

| Date Day | Date Month/Yr | GMS CaO Added | GMS NaCN Added | cc Water Added | cc Water Removed | Reagent Consumption Lime #/Ton Ore | Reagent Consumption NaCN #/Ton Ore | Solution Assays Silver Oz/Ton | Solution Assays Gold Oz/Ton | MG. Gold Leached | MG. Silver Leached | % Gold Recov. | % Silver Recov. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 13 | 1-75 | 113.5 | 0 | 15,000 | 0 | | .896 / .846 | | | | | | |
| 14 | 1-75 | 56.75 | 56.75 | 2,000 | 0 | | .048 / .944 | | | | | | |
| 15 | 1-75 | 0 | 0 | 5000 | 3000 | .289 | .024 / .968 | 5.105 | .034 | 3.4932 | 524.486 | .0009 | .133 |
| 16 | 1-75 | 0 | 0 | 5000 | 2900 | .07 / 2.44 | .016 / .984 | 4.994 | .047 | 4.6678 | 495.979 | .0012 / .0021 | .127 / .260 |
| 17 | 1-75 | 0 | 0 | 5000 | 3900 | .03 / 2.47 | .416 / 1.40 | 4.170 | .038 | 5.0753 | 556.952 | .0013 / .0034 | .143 / .403 |
| 18 | 1-75 | 30.0 | 30.0 | 5000 | 2800 | .03 / 3.00 | | 2.845 | .025 | 2.3973 | 272.808 | .0006 / .0040 | .070 / .473 |
| 19 | 1-75 | 0 | 0 | 4,000 | 3170 | .27 / 3.27 | | 2.819 | .027 | 2.9312 | 306.035 | .0007 / .0047 | .079 / .552 |
| 20 | 1-75 | — | — | — | 3770 | | | 2.270 | .012 | 1.5493 | 293.079 | .0003 / .0050 | .075 / .627 |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| Total Ave. | | 200.25 | 86.75 | | | | | | | 20.1141 | 449.357 | 0052 | 624 |

| 1 / 2 |
|---|

1 - Daily
2 - Cumulative

204

# 34

TOMBSTONE HEAP LEACH

METALLURGICAL TESTS

Dump Location Bob. Ingersol

Sample Weight, Lbs. _____

Total Days Leaching _____

December, 1974

Conducted by: _____

Approved by: _____

| Date Day | Date Month/Yr | GMS CaO Added | GMS NaCN Added | cc Water Added | cc Water Removed | Reagent Consumption Lime #/Ton Ore | Reagent Consumption NaCN #/Ton Ore | Solution Assays Silver Oz/Ton | Solution Assays Gold Oz/Ton | MG. Gold Leached | MG. Silver Leached | % Gold Recov. | % Silver Recov. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 13 | 1-75 | 113.5 | 0 | 14,500 | 0 | | | | | | | | |
| 14 | 1-75 | 56.75 | 56.75 | 2,000 | 0 | | | | | | | | |
| 15 | 1-75 | 0 | 0 | 6000 | 4600 | 2.96 | .936 / .936 | 16.881 | .111 | 17.4863 | 2659.336 | .0045 | .643 |
| 16 | 1-75 | 30.0 | 0 | 4000 | 3100 | .03 / 2.99 | .040 / .976 | 13.057 | .086 | 9.1301 | 1386.188 | .0023 / .0068 | .356 / 1.039 |
| 17 | 1-75 | 30.0 | 0 | 6000 | 3900 | .53 / 3.57 | 0 / .976 | 11.827 | .030 | 4.0068 | 1579.634 | .0010 / .0078 | .406 / 1.445 |
| 18 | 1-75 | 0 | 30.0 | 5000 | 3800 | .46 / 3.98 | .008 / .984 | 7.834 | .052 | 6.7671 | 1019.495 | .0017 / .0095 | .262 / 1.707 |
| 19 | 1-75 | 0 | 0 | 4000 | 3550 | .03 / 4.01 | .368 / 1.352 | 7.603 | .050 | 6.0788 | 924.337 | .0016 / .0111 | .237 / 1.944 |
| 20 | 1-75 | | | | 3760 | | | 5.956 | .038 | 4.8932 | 766.937 | .0013 / .0124 | .197 / 2.141 |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| Total Ave. | | 230.75 | | | | | | | | 48.3673 | 8335.425 | | 2.142 |

1 / 2

1 - Daily
2 - Cumulative

210

#35 Tribute

TOMBSTONE HEAP LEACH

METALLURGICAL TESTS

Dump Location ~~Sabbat~~

Conducted by: _____

Sample Weight, Lbs. _____

December, 1974

Approved by: _____

Total Days Leaching _____

| Date Day | Date Month/Yr | GMS CaO Added | GMS NaCN Added | cc Water Added | cc Water Removed | Reagent Consumption Lime #/Ton Ore | Reagent Consumption NaCN #/Ton Ore | Solution Assays Silver Oz/Ton | Solution Assays Gold Oz/Ton | MG. Gold Leached | MG. Silver Leached | % Gold Recov. | % Silver Recov. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 13 | 1-75 | 113.5 | Ø | 15,000 | Ø | | | | | | | | |
| 14 | 1-75 | 56.75 | Ø | 2,000 | Ø | | | | | | | | |
| 15 | 1-75 | 56.75 | 56.75 | 2,000 | Ø | | | | | | | | |
| 16 | 1-75 | Ø | Ø | 5000 | 4350 | 3.70 | .742 | .322 | .030 | 4.469 | 47.969 | .0011 | .012 |
| 17 | 1-75 | Ø | Ø | 6000 | 3800 | .06 / 3.76 | .012 / .864 | .325 | .027 | 3.5137 | 42.2945 | .0009 / .0020 | .011 / .023 |
| 18 | 1-75 | Ø | Ø | 5000 | 4050 | .04 / 3.80 | .040 / .904 | .268 | .018 | 2.4966 | 37.171 | .0006 / .0026 | .009 / .032 |
| 19 | 1-75 | Ø | Ø | 4000 | 3250 | .06 / 3.86 | .040 / .944 | .242 | .015 | 1.9264 | 31.721 | .0005 / .0031 | .008 / .040 |
| 20 | 1-75 | — | — | — | 3350 | | | .207 | .009 | 1.0325 | 23.748 | .0002 / .0033 | .006 / .046 |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| Total Ave. | | 127.0 | | | | | | | | 13.4382 | 182.903 | .0033 | .047 |

| 1 / 2 |
|---|

1 - Daily
2 - Cumulative

#36

TOMBSTONE HEAP LEACH

METALLURGICAL TESTS

Dump Location Sulphuret

Sample Weight, Lbs. _____

Total Days Leaching _____

December, 1974

Conducted by: _____

Approved by: _____

| Date Day | Date Month/Yr | GMS CaO Added | GMS NaCN Added | cc Water Added | cc Water Removed | Reagent Consumption Lime #/Ton Ore | Reagent Consumption NaCN #/Ton Ore | Solution Assays Silver Oz/Ton | Solution Assays Gold Oz/Ton | MG. Gold Leached | MG. Silver Leached | % Gold Recov. | % Silver Recov. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 13 | 1-75 | 113.5 | 0 | 15,000 | 0 | | | | | | | | |
| 14 | 1-75 | 56.75 | 0 | 3,000 | 0 | | | | | | | | |
| 15 | 1-75 | 56.75 | 56.75 | 2,000 | 0 | | | | | | | | |
| 16 | 1-75 | 0 | 0 | 5000 | 2,000 | 3.89 | .896 | .227 | .056 | 3.8356 | 15.548 | .0010 | .004 |
| 17 | 1-75 | 0 | 0 | 6000 | 4100 | – / 3.89 | 0 / .896 | .217 | .055 | 7.7226 | 30.4691 | .0020 / .0030 | .008 / .012 |
| 18 | 1-75 | 0 | 0 | 5000 | 3850 | .06 / 3.95 | .048 / .944 | .153 | .036 | 4.7466 | 20.173 | .0012 / .0042 | .005 / .017 |
| 19 | 1-75 | 0 | 0 | 4000 | 3680 | .04 / 3.99 | .032 / .976 | .142 | .033 | 4.1589 | 17.896 | .0010 / .0052 | .005 / .022 |
| 20 | 1-75 | — | — | — | 3600 | | | .111 | .021 | 2.5890 | 13.685 | .0006 / .0058 | .004 / .026 |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| Total Ave. | | | | | | | | | | 23.0527 | 97.771 | .0059 | .025 |

1 / 2

1 - Daily
2 - Cumulative

212

#37

# TOMBSTONE HEAP LEACH

## METALLURGICAL TESTS

Dump Location Visina

Sample Weight, Lbs. _____

Total Days Leaching _____

December, 1974

Conducted by: _____

Approved by: _____

| Date Day | Date Month/Yr | GMS CaO Added | GMS NaCN Added | cc Water Added | cc Water Removed | Reagent Consumption Lime #/Ton Ore | Reagent Consumption NaCN #/Ton Ore | Solution Assays Silver Oz/Ton | Solution Assays Gold Oz/Ton | MG. Gold Leached | MG. Silver Leached | % Gold Recov. | % Silver Recov. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 13 | 1-75 | 113.5 | 0 | 15,000 | 0 | | | | | | | | |
| 14 | 1-75 | 0 | 56.75 | 2,000 | 0 | | | | | | | | |
| 15 | 1-75 | 0 | 0 | 5,000 | 3500 | 1.85 | .904 / .904 | 7.659 | .013 | 1.5582 | 918.03 | .0004 | .236 |
| 16 | 1-75 | 30.0 | 0 | 5000 | 2350 | .13 / 1.98 | .064 / .968 | 6.524 | .011 | 0.8853 | 525.05 | .0002 / .0006 | .135 / .371 |
| 17 | 1-75 | 30.0 | 0 | 6000 | 4700 | .52 / 2.50 | — / .968 | 5.233 | .009 | 1.4486 | 842.298 | .0004 / .0010 | .216 / .587 |
| 18 | 1-75 | 0 | 0 | 5000 | 2900 | .40 / 2.90 | .024 / .992 | 3.475 | .006 | 0.5959 | 345.120 | .0001 / .0011 | .088 / .676 |
| 19 | 1-75 | 0 | 0 | 4000 | 3350 | .15 / 3.05 | — / .992 | 2.802 | .004 | 0.4589 | 321.422 | .0001 / .0012 | .083 / .759 |
| 20 | 1-75 | — | — | — | 4672 | | | 2.142 | .002 | 0.3200 | 342.72 | .0001 / .0013 | .088 / .847 |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| Total Ave. | | | | | | | | | | 5.2669 | 3294.68 | .0014 | |

1 / 2

1 - Daily
2 - Cumulative

# 38

TOMBSTONE HEAP LEACH

METALLURGICAL TESTS

Dump Location Defense

Sample Weight, Lbs. _____

Total Days Leaching _____

December, 1974

Conducted by: _____

Approved by: _____

| Date Day | Date Month/Yr | GMS CaO Added | GMS NaCN Added | cc Water Added | cc Water Removed | Reagent Consumption Lime #/Ton Ore | Reagent Consumption NaCN #/Ton Ore | Solution Assays Silver Oz/Ton | Solution Assays Gold Oz/Ton | MG. Gold Leached | MG. Silver Leached | % Gold Recov. | % Silver Recov. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 13 | 1-75 | 113.5 | 0 | 13,000 | 0 | | | | | | | | |
| 14 | 1-75 | 0 | 56.75 | 2,000 | 0 | | | | | | | | |
| 15 | 1-75 | 0 | 0 | 6,000 | 5,000 | 1.79 | .808 | 4.706 | .015 | 2.5685 | 805.82 | .0006 | .207 |
| 16 | 1-75 | 30.0 | 30.0 | 5000 | 4350 | .45 / 1.94 | .120 / .928 | 3.917 | .012 | 1.7877 | 583.53 | .0004 / .0010 | .150 / .357 |
| 17 | 1-75 | 0 | 0 | 6000 | 4350 | .40 / 2.34 | .360 / 1.288 | 3.207 | .011 | 1.6387 | 477.76 | .0004 / .0014 | .123 / .480 |
| 18 | 1-75 | 0 | 0 | 5000 | 4500 | .12 / 2.46 | .112 / 1.40 | 1.959 | .006 | 0.9247 | 301.90 | .0002 / .0016 | .078 / .558 |
| 19 | 1-75 | 0 | 0 | 4000 | 4,000 | .06 / 2.52 | .096 / 1.496 | 1.511 | .004 | 0.5479 | 206.986 | .0001 / .0017 | .053 / .611 |
| 20 | 1-75 | — | — | — | 4042 | | | 1.105 | .001 | 0.1384 | 152.959 | Nil / .0017 | .039 / .650 |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| Total Ave. | | | | | | | | | | 7.6059 | 2528.915 | .0020 | .650 |

1 / 2

1 - Daily
2 - Cumulative

214

#39 Tomb. Extension

TOMBSTONE HEAP LEACH

METALLURGICAL TESTS

Dump Location Tombstone Extension

Sample Weight, Lbs. 250 Dry

Total Days Leaching _____

December, 1974

Conducted by: _____

Approved by: _____

| Date Day | Date Month/Yr | GMS CaO Added | GMS NaCN Added | cc Water Added | cc Water Removed | Reagent Consumption Lime #/Ton Ore | Reagent Consumption NaCN #/Ton Ore | Solution Assays Silver Oz/Ton | Solution Assays Gold Oz/Ton | MG. Gold Leached | MG. Silver Leached | % Gold Recov. | % Silver Recov. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 | 1-75 | 113.5 | Ø | 29,000 | Ø | | | | | | | | |
| 21 | 1-75 | Ø | 1400 Nacs 56.75 | 10,000 | Ø | | | | | | | | |
| 22 | 1-75 | Ø | Ø | Ø | 3670 | | – | .062 | TR | Nil | 7.792 | Nil | .002 |
| 3 | 1-75 | Ø | Ø | 3000 | 2590 | 1.76 | .848 / .848 | .118 | .001 | .0887 | 10.466 | Nil | .003 / .005 |
| 4 | 1-75 | Ø | Ø | 3000 | 3270 | .24 / 2.00 | .136 / .984 | .048 | .001 | .1120 | 5.735 | Nil | .001 / .006 |
| 25 | 1-75 | Ø | Ø | 7700 | 1760 | | | .074 | .001 | .0602 | 4.460 | Nil | .001 / .007 |
| 26 | 1-75 | — | — | — | 2900 | | | .092 | .001 | .0993 | 9.137 | Nil | .002 / .009 |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| Total Ave. | | | | | | | | | | .3602 | 37.590 | nil | .010 |

1 / 2

1 - Daily
2 - Cumulative

215

#40 Ground Dump

# TOMBSTONE HEAP LEACH
## METALLURGICAL TESTS

Dump Location _____

Sample Weight, Lbs. 250 Dry

Total Days Leaching _____

December, 1974

Conducted by: _____

Approved by: _____

| Date Day | Date Month/Yr | GMS CaO Added | GMS NaCN Added | cc Water Added | cc Water Removed | Reagent Consumption: Lime #/Ton Ore | Reagent Consumption: NaCN #/Ton Ore | Solution Assays: Silver Oz/Ton | Solution Assays: Gold Oz/Ton | MG. Gold Leached | MG. Silver Leached | % Gold Recov. | % Silver Recov. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1-75 | 113.5 | ø | 15,000 | ø | | | | | | | | |
| 1 | 1-75 | 56.75 | 1400 56.75 | ø | ø | | | | | | | | |
| 2 | 1-75 | ø | ø | 7000 | 6760 | | – | .693 | .034 | 7.8712 | 160.434 | .0020 | .041 |
| 3 | 1-75 | ø | ø | 6000 | 5790 | 2.67 / 2.67 | .688 / .688 | .705 | .026 | 5.1555 | 139.793 | .0013 / .0033 | .036 / .077 |
| 4 | 1-75 | ø | ø | 5,000 | 9730 | .03 / 2.70 | .120 / .808 | .507 | .017 | 5.6647 | 168.942 | .0014 / .0047 | .043 / .120 |
| 5 | 1-75 | ø | ø | 6000 | 3840 | | | .345 | .014 | 1.8411 | 45.370 | .0005 / .0052 | .011 / .131 |
| 6 | 1-75 | — | — | — | 5500 | | | .211 | .008 | 1.5069 | 39.743 | .0004 / .0056 | .010 / .141 |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| Total Ave. | | | | | | | | | | 22.0394 | 554.282 | .0057 | .142 |

1 / 2

1 - Daily
2 - Cumulative

216

#41 Tombstone

# TOMBSTONE HEAP LEACH

## METALLURGICAL TESTS

Dump Location _____

Sample Weight, Lbs. 250 Dry

Total Days Leaching _____

December, 1974

Conducted by: _____

Approved by: _____

| Date Day | Date Month/Yr | GMS CaO Added | GMS NaCN Added | cc Water Added | cc Water Removed | Reagent Consumption: Lime #/Ton Ore | Reagent Consumption: NaCN #/Ton Ore | Solution Assays: Silver Oz/Ton | Solution Assays: Gold Oz/Ton | MG. Gold Leached | MG. Silver Leached | % Gold Recov. | % Silver Recov. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1-75 | 113.5 | ~~0~~ | 15,000 | ~~0~~ | | | | | | | | |
| 1 | 1-75 | 56.75 | 1400 56.75 | ~~0~~ | ~~0~~ | | | | | | | | |
| 2 | 1-75 | ~~0~~ | ~~0~~ | 6000 | 3440 | ~~.04~~ — | .816 .816 | 1.527 | .002 | 0.2356 | 179.893 | .00006 | .046 |
| 3 | 1-75 | ~~0~~ | ~~0~~ | 5000 | 5,000 | 2.68 | .016 .833 | 1.142 | .001 | 0.1712 | 195.548 | .00004 .0001 | .050 .096 |
| 4 | 1-75 | ~~0~~ | ~~0~~ | 5.000 | 8000 | .03 2.71 | — .871 | .911 | .001 | 0.2740 | 249.589 | .00007 .00017 | .064 .160 |
| 25 | 1-75 | ~~0~~ | ~~0~~ | 6000 | 3950 | | | .725 | .001 | 0.1353 | 98.074 | .00003 .0002 | .025 .185 |
| 26 | 1-75 | — | — | — | 4850 | | | .509 | TR | — | 84.543 | Nil .0002 | .022 .207 |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| Total Ave. | | | | | | | | | | .8161 | 807.647 | .0002 | .208 |

1 - Daily
2 - Cumulative

217

# 42 Silver Plume

TOMBSTONE HEAP LEACH

METALLURGICAL TESTS

Dump Location _____

Sample Weight, Lbs. 250 Dry

Total Days Leaching _____

December, 1974

Conducted by: _____

Approved by: _____

| Date Day | Date Month/Yr | GMS CaO Added | GMS NaCN Added | cc Water Added | cc Water Removed | Reagent Consumption Lime #/Ton Ore | Reagent Consumption NaCN #/Ton Ore | Solution Assays Silver Oz/Ton | Solution Assays Gold Oz/Ton | MG. Gold Leached | MG. Silver Leached | % Gold Recov. | % Silver Recov. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 | 1-75 | 113.5 | Ø | 16,000 | Ø | | | | | | | | |
| 21 | 1-75 | 56.75 | 56.75 | 3,000 | Ø | | | | | | | | |
| 22 | 1-75 | Ø | Ø | 6000 | 5150 | – / – | – / – | 1.393 | .016 | 2.8219 | 245.683 | .0007 | .063 |
| 23 | 1-75 | Ø | Ø | 6,000 | 5700 | 2.9v / 2.9v | 90# / 90# | 1.223 | .010 | 1.9521 | 238.736 | .0005 / .0012 | .061 / .124 |
| 24 | 1-75 | 30 | Ø | 5.000 | 9700 | .03 / v.95 | .03v / .136 | 1.064 | .010 | 3.3219 | 353.452 | .0008 / .0020 | .091 / .215 |
| 25 | 1-75 | Ø | Ø | 6000 | 3310 | | | .770 | .008 | 0.9068 | 87.284 | .0002 / .0022 | .022 / .237 |
| 26 | 1-75 | — | — | — | 4200 | | | .655 | .006 | 0.8630 | 94.212 | .0002 / .0024 | .024 / .261 |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| Total Ave. | | | | | | | | | | 9.8657 | 1019.367 | 0025 | .262 |

1 / 2

1 - Daily
2 - Cumulative

#43 OREGON

TOMBSTONE HEAP LEACH

METALLURGICAL TESTS

Dump Location _____

Sample Weight, Lbs. 250 Dry

Total Days Leaching _____

December, 1974

Conducted by: _____

Approved by: _____

| Date Day | Date Month/Yr | GMS CaO Added | GMS NaCN Added | cc Water Added | cc Water Removed | Reagent Consumption: Lime #/Ton Ore | Reagent Consumption: NaCN #/Ton Ore | Solution Assays: Silver Oz/Ton | Solution Assays: Gold Oz/Ton | MG. Gold Leached | MG. Silver Leached | % Gold Recov. | % Silver Recov. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 | 1-75 | 113.5 | -0- | 15,000 | -0- | | | | | | | | |
| 21 | 1-75 | 56.75 | 1400 56.75 | -0- | -0- | | | | | | | | |
| 22 | 1-75 | -0- | -0- | 6000 | 3200 | — | .970 / .970 | .503 | .003 | 0.3288 | 55.123 | .0001 | .014 |
| 23 | 1-75 | ∅ | ∅ | 7000 | 6946 | 2.70 | — / .970 | .449 | .003 | 0.7136 | 106.807 | .0002 / .0003 | .027 / .041 |
| 24 | 1-75 | ∅ | ∅ | 5000 | 11860 | .16 / 2.86 | .008 / .978 | .330 | .001 | 0.4062 | 134.034 | .0001 / .0004 | .034 / .075 |
| 25 | 1-75 | -0- | -0- | 6000 | 4150 | | | .249 | Tr | Nil | 35.389 | Nil / .0004 | .009 / .084 |
| 26 | 1-75 | — | — | — | 4856 | | | .197 | .001 | 0.1661 | 32.721 | Nil / .0004 | .008 / .092 |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| Total Ave. | | | | | | | | | | 1.6147 | 364.074 | / | .094 |

| 1 / 2 |
|---|

1 - Daily
2 - Cumulative

319

#44 State of Maine Re Run

TOMBSTONE HEAP LEACH

METALLURGICAL TESTS

Dump Location _____

Sample Weight, Lbs. 250 Dry

Total Days Leaching _____

December, 1974

Conducted by: _____

Approved by: _____

| Date Day | Date Month/Yr | GMS CaO Added | GMS NaCN Added | cc Water Added | cc Water Removed | Reagent Consumption Lime #/Ton Ore | Reagent Consumption NaCN #/Ton Ore | Solution Assays Silver Oz/Ton | Solution Assays Gold Oz/Ton | MG. Gold Leached | MG. Silver Leached | % Gold Recov. | % Silver Recov. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 | 1-75 | 113.5 | Ø | 16,000 | Ø | | | | | | | | |
| 21 | 1-75 | 56.75 | 1400 56.75 | 7,000 | Ø | | | | | | | | |
| 22 | 1-75 | Ø | Ø | 7000 | 7150 | 2.52 | .577 | 4.096 | .001 | 0.2449 | 1002.959 | .0001 | .258 |
| 23 | 1-75 | Ø | Ø | 8000 | 5,800 | .10 / 2.66 | .786 / .577 | 3.710 | .001 | 0.1986 | 736.918 | .0001 / .0002 | .189 / .447 |
| 24 | 1-75 | Ø | Ø | 5000 | 7680 | .75 / 2.91 | .056 / .928 | 3.1695 | .0005 | 0.1315 | 833.622 | Nil / .0002 | .214 / .661 |
| 25 | 1-75 | Ø | Ø | 14,000 | 3480 | | | 2.236 | Tr | Nil | 266.482 | Nil / .0002 | .068 / .729 |
| 26 | 1-75 | — | — | — | 12,600 | | | 1.412 | Tr | Nil | 609.288 | Nil / .0002 | .157 / .886 |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| Total Ave. | | | | | | | | | | .5750 | 3449.269 | .0001 | / |

1 / 2

1 - Daily
2 - Cumulative

220

#45 State Mine under ground

TOMBSTONE HEAP LEACH

METALLURGICAL TESTS

Dump Location _____

Sample Weight, Lbs. 250 Dry

Total Days Leaching _____

December, 1974

Conducted by: _____

Approved by: _____

| Date Day | Date Month/Yr | GMS CaO Added | GMS NaCN Added | cc Water Added | cc Water Removed | Reagent Consumption Lime #/Ton Ore | Reagent Consumption NaCN #/Ton Ore | Solution Assays Silver Oz/Ton | Solution Assays Gold Oz/Ton | MG. Gold Leached | MG. Silver Leached | % Gold Recov. | % Silver Recov. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 | 1-75 | 113.5 | ø | 21,000 | ø | | | | | | | | |
| 21 | 1-75 | ø | 1400 56.75 | 8,000 | ø | | | | | | | | |
| 22 | 1-75 | ø | ø | 8000 | 8460 | 1.90 | .872 | 7.474 | TR | Nil | 2165.412 | Nil | .556 |
| 23 | 1-75 | ø | ø | 8000 | 7300 | .03 / 1.93 | .072 / .944 | 6.3715 | .0005 | 0.1250 | 1592.875 | Nil | .409 / .965 |
| 24 | 1-75 | 30 | ø | 5000 | 12210 | .01 / 1.94 | .008 / .956 | 3.392 | TR | Nil | 1476.449 | Nil | .379 / 1.344 |
| 25 | 1-75 | ø | ø | 15,000 | 3820 | | | 3.598 | TR | Nil | 470.70 | Nil | .121 / 1.465 |
| 26 | 1-75 | — | — | — | 11,000 | | | 2.181 | TR | Nil | 821.610 | Nil | .211 / 1.676 |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| Total Ave. | | | | | | | | | | .1250 | 6527.045 | nil | 1.677 |

1 / 2

1 - Daily
2 - Cumulative

46

TOMBSTONE HEAP LEACH

METALLURGICAL TESTS

Dump Location Tranquility

Sample Weight, Lbs. 250 Dry

Total Days Leaching _____

December, 1974

Conducted by: _____

Approved by: _____

| Date | | GMS CaO Added | GMS NaCN Added | cc Water Added | cc Water Removed | Reagent Consumption | | Solution Assays | | MG. Gold Leached | MG. Silver Leached | % Gold Recov. | % Silver Recov. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Lime #/Ton Ore | NaCN #/Ton Ore | Silver Oz/Ton | Gold Oz/Ton | | | | |
| 29 | 1-75 | 113.5 | Ø | 16,000 | Ø | | | | | | | | |
| 30 | 1-75 | 56.75 | 56.75 | 1000 | Ø | | | | | | | | |
| 1 | 1-75 | Ø | Ø | 7000 | 5260 | 2.61 | .720 | 1.527 | .089 | 16.8319 | 275.07 | .0041 | .070 |
| 1 | 2-75 | Ø | Ø | 6000 | 5772 | .10 / 2.71 | .136 / .856 | .949 | .068 | 13.4416 | 187.59 | .0035 / .0076 | .050 / .120 |
| 2 | 2-75 | Ø | Ø | 6000 | 5210 | .14 / 2.89 | .088 / .944 | .559 | .043 | 7.6722 | 99.382 | .0020 / .0096 | .026 / .146 |
| 3 | 2-75 | Ø | Ø | 7000 | 4675 | .01 / 2.90 | .004 / .968 | .376 | .032 | 5.1233 | 60.1986 | .0013 / .0109 | .015 / .161 |
| 4 | 2-75 | Ø | Ø | 6000 | 10,270 | — / 2.90 | — / .968 | .148 | .015 | 5.2757 | 52.054 | .0014 / .0123 | .013 / .174 |
| 5 | 2-75 | Ø | Ø | Ø | 5410 | | | .104 | .012 | 2.2232 | 19.268 | .0005 / .0128 | .004 / .178 |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| Total Ave. | | | | | | | | | | 49.7679 | 693.563 | ✓ | ✓ |

1 / 2

1 - Daily
2 - Cumulative

222

47

TOMBSTONE HEAP LEACH

METALLURGICAL TESTS

Dump Location Tranquility

Sample Weight, Lbs. 250 DRY

Total Days Leaching _____

December, 1974

Conducted by: _____

Approved by: _____

| Date Day | Date Month/Yr | GMS CaO Added | GMS NaCN Added | cc Water Added | cc Water Removed | Reagent Consumption Lime #/Ton Ore | Reagent Consumption NaCN #/Ton Ore | Solution Assays Silver Oz/Ton | Solution Assays Gold Oz/Ton | MG. Gold Leached | MG. Silver Leached | % Gold Recov. | % Silver Recov. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 29 | 1-75 | 113.5 | Ø | 15,000 | 1000 | | | | | | | | |
| 30 | 1-75 | 56.75 | 56.75 | 1000 | Ø | | | | | | | | |
| 31 | 1-75 | Ø | Ø | 6000 | 4800 | 2.65 | .736 | 1.671 | .1020 | 16.7671 | 274.685 | .0043 | .071 |
| 1 | 2-75 | Ø | Ø | 6000 | 5100 | .13 / 2.78 | .120 / .856 | 1.108 | .074 | 12.9247 | 193.521 | .0033 / .0076 | .050 / .121 |
| 2 | 2-75 | Ø | Ø | 5000 | 4,400 | .10 / 2.81 | .072 / .928 | .663 | .045 | 6.7808 | 99.904 | .0017 / .0093 | .026 / .147 |
| 3 | 2-75 | Ø | Ø | 5000 | 4310 | .06 / 2.91 | .032 / .960 | .462 | .033 | 4.8709 | 68.192 | .0015 / .0106 | .02 / .167 |
| 4 | 2-75 | Ø | Ø | 5000 | 3850 | .03 / 2.97 | .008 / .968 | .282 | .022 | 2.9007 | 37.182 | .0007 / .0113 | .010 / .177 |
| 5 | 2-75 | Ø | Ø | Ø | 4000 | | | .195 | .018 | 2.4657 | 26.7123 | .0006 / .0119 | .007 / .184 |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| Total Ave. | | | | | | | | | | 46.7099 | 700.1963 | .0120 | .180 |

1 / 2

1 - Daily
2 - Cumulative

223

48

TOMBSTONE HEAP LEACH

METALLURGICAL TESTS

Dump Location Contention

Sample Weight, Lbs. 250 Dry

Total Days Leaching _____

December, 1974

Conducted by: _____

Approved by: _____

| Date Day | Date Month/Yr | GMS CaO Added | GMS NaCN Added | cc Water Added | cc Water Removed | Reagent Consumption Lime #/Ton Ore | Reagent Consumption NaCN #/Ton Ore | Solution Assays Silver Oz/Ton | Solution Assays Gold Oz/Ton | MG. Gold Leached | MG. Silver Leached | % Gold Recov. | % Silver Recov. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 29 | 1-75 | 113.5 | Ø | 21,000 | Ø | | | | | | | | |
| 30 | 1-75 | 56.75 | 56.75 | 4,000 | Ø | | | | | | | | |
| 31 | 1-75 | Ø | Ø | 11,000 | 9760 | – / – | .008 | 1.961 | .071 | 23.7315 | 655.458 | .0061 | .168 |
| 1 | 2-75 | Ø | Ø | 9000 | 8220 | 2.67 | .018 / .896 | 1.143 | .050 | 14.0753 | 321.762 | .0036 / .0097 | .083 / .251 |
| 2 | 2-75 | 56.75 | Ø | 6000 | 5850 | .33 / 3.00 | .080 / .976 | .882 | .040 | 8.0136 | 176.202 | .0021 / .0118 | .045 / .296 |
| 3 | 2-75 | Ø | Ø | 5000 | 5000 | .98 / 3.98 | – / .976 | .231 | .035 | 5.9932 | 125.171 | .0015 / .0133 | .032 / .328 |
| 4 | 2-75 | Ø | Ø | 6000 | 4100 | .01 / 3.99 | .008 / .984 | .569 | .028 | 3.9315 | 79.894 | .0010 / .0143 | .021 / .349 |
| 5 | 2-75 | Ø | Ø | – | 5000 | | | .439 | .022 | 3.7671 | 75.171 | .0009 / .0152 | .019 / .368 |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| Total Ave. | | | | | | | | | | 59.5177 | 1434.158 | .0153 | / |

1 / 2

1 - Daily
2 - Cumulative

224

49

TOMBSTONE HEAP LEACH

METALLURGICAL TESTS

Dump Location Contention

Sample Weight, Lbs. 250 Dry

Total Days Leaching _____

December, 1974

Conducted by: _____

Approved by: _____

| Date Day | Date Month/Yr | GMS CaO Added | GMS NaCN Added | cc Water Added | cc Water Removed | Reagent Consumption Lime #/Ton Ore | Reagent Consumption NaCN #/Ton Ore | Solution Assays Silver Oz/Ton | Solution Assays Gold Oz/Ton | MG. Gold Leached | MG. Silver Leached | % Gold Recov. | % Silver Recov. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 29 | 1-75 | 113.5 | ø | 21,000 | ø | | | | | | | | |
| 30 | 1-75 | 56.75 | 56.75 | 2,000 | ø | | | | | | | | |
| 31 | 1-75 | ø | ø | 8000 | 6550 | 2.47 | .872 | 2.013 | .076 | 17.0479 | 451.546 | .0044 | .116 |
| 1 | 2-75 | ø | ø | 8000 | 7150 | .42 / 2.89 | .056 / .928 | 1.610 | .065 | 15.9161 | 394.229 | .0041 / .0085 | .101 / .217 |
| 2 | 2-75 | 56.75 | ø | 6000 | 6250 | .10 / 2.99 | .054 / .984 | 1.195 | .047 | 10.0599 | 255.779 | .0026 / .0123 | .066 / .283 |
| 3 | 2-75 | ø | ø | 6000 | 5170 | .94 / 3.93 | - / .984 | 1.007 | .041 | 7.2592 | 178.294 | .0019 / .0130 | .046 / .329 |
| 4 | 2-75 | ø | ø | 6000 | 4580 | .01 / 3.94 | - / .984 | .729 | .029 | 4.5486 | 114.343 | .0011 / .0141 | .029 / .358 |
| 5 | 2-75 | ø | ø | - | 4220 | | | .585 | .023 | 3.3723 | 84.544 | .0008 / .0150 | .022 / .380 |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| Total Ave. | | | | | | | | | | 58.1640 | 1478.735 | .0149 | |

1 / 2

1 - Daily
2 - Cumulative

325

50

# TOMBSTONE HEAP LEACH

## METALLURGICAL TESTS

Dump Location: Lucky Cuss

Sample Weight, Lbs.: 250 Dry

Total Days Leaching: _____

December, 1974

Conducted by: _____

Approved by: _____

| Date Day | Date Month/Yr | GMS CaO Added | GMS NaCN Added | cc Water Added | cc Water Removed | Reagent Consumption: Lime #/Ton Ore | Reagent Consumption: NaCN #/Ton Ore | Solution Assays: Silver Oz/Ton | Solution Assays: Gold Oz/Ton | MG. Gold Leached | MG. Silver Leached | % Gold Recov. | % Silver Recov. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 29 | 1-75 | 113.5 | ø | 17,000 | ø | | | | | | | | |
| 30 | 1-75 | 56.75 | 56.75 | 2,000 | ø | | | | | | | | |
| 31 | 1-75 | ø | ø | 6,000 | 4400 | 2.73 | .840 | 3.368 | 0.101 | 15.2192 | 507.507 | .0039 | .130 |
| 1 | 2-75 | ø | ø | 6000 | 4470 | .21 / 2.94 | .11 / .95 | 2.687 | .082 | 12.5527 | 411.332 | .0032 / .0071 | .106 / .236 |
| 2 | 2-75 | ø | ø | 6000 | 4250 | .01 / 2.95 | .008 / .960 | 1.960 | .058 | 8.4417 | 285.273 | .0026 / .0092 | .073 / .309 |
| 3 | 2-75 | ø | ø | 6000 | 5530 | .06 / 3.01 | .03 / .99 | 1.553 | .047 | 8.9010 | 294.113 | .0023 / .0115 | .076 / .385 |
| 4 | 2-75 | ø | ø | 6000 | 4710 | — / 3.01 | — / .99 | 1.023 | .030 | 4.8390 | 165.011 | .0012 / .0127 | .042 / .427 |
| 5 | 2-75 | ø | ø | — | 4350 | | | .022 | .023 | 3.4263 | 100.830 | .0008 / .0135 | .026 / .453 |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| Total Ave. | | | | | | | | | | 53.3799 | 1764.066 | .0137 | 1 |

1 / 2

1 - Daily
2 - Cumulative

226

51

TOMBSTONE HEAP LEACH

METALLURGICAL TESTS

Dump Location Lucky Cuss

Sample Weight, Lbs. 250 Dry

Total Days Leaching _____

December, 1974

Conducted by: _____

Approved by: _____

| Date Day | Date Month/Yr | GMS CaO Added | GMS NaCN Added | cc Water Added | cc Water Removed | Reagent Consumption Lime #/Ton Ore | Reagent Consumption NaCN #/Ton Ore | Solution Assays Silver Oz/Ton | Solution Assays Gold Oz/Ton | MG. Gold Leached | MG. Silver Leached | % Gold Recov. | % Silver Recov. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 29 | 1-75 | 113.5 | 0 | 17,000 | 0 | | | | | | | | |
| 30 | 1-75 | 56.75 | 56.75 | 1,000 | 0 | | | | | | | | |
| 31 | 1-75 | 0 | 0 | 10,000 | 8620 | 2.86 | .776 | 2.205 | .073 | 21.5500 | 650.928 | .0055 | .167 |
| 1 | 2-75 | 0 | 0 | 10,000 | 9050 | .06 / 2.86 | .144 / .920 | 1.548 | .052 | 16.1164 | 479.774 | .0041 / .0096 | .123 / .290 |
| 2 | 2-75 | 0 | 0 | 6000 | 8350 | .01 / 2.87 | – / .920 | 1.093 | .035 | 10.0085 | 312.553 | .0026 / .0122 | .090 / .380 |
| 3 | 2-75 | 0 | 0 | 6000 | 4400 | .114 / 2.99 | .114 / 1.03 | .946 | .031 | 4.6712 | 142.548 | .0014 / .0134 | .037 / .407 |
| 4 | 2-75 | 0 | 0 | 6000 | 6360 | – / 2.99 | – / 1.03 | .610 | .021 | 4.5740 | 132.863 | .0012 / .0146 | .034 / .441 |
| 5 | 2-75 | 0 | 0 | – | 5250 | | | .431 | .013 | 3.3476 | 84.821 | .0009 / .0155 | .022 / .463 |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| Total Ave. | | | | | | | | | | 60.1677 | 1803.533 | / | / |

1 / 2

1 - Daily
2 - Cumulative

LCC