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This is a section
out of the
4/1/93 Business
Plan.

RESUME

JOHN O. RUD

933 E. Waballa Ln.
Phoenix, Arizona
85024
(602) 581-9140

1992

RESUME

JOHN O. RUD
GEOLOGIST, M. SC.

PERSONAL DATA

Date of Birth:	November 23, 1938
Marital Status	Divorced
Health	Good

EDUCATION

1970 - Bachelor of Science (Geology)
University of Oregon
1971 - Master of Science (Geology)
University of Oregon

EXPERIENCE

General Partner and Manager of Southwest Color Supply

Located a source of red iron oxide to be used as a color pigment in the paint and concrete industry. Designed and constructed the processing facility. Southwest Color Supply is presently mining, processing, and selling a red iron oxide pigment

Geological Consultant

Completed reserve studies and pit design for Sunwalker Development Inc. on the Cherokee Rock Quarry. Quarry presently under production producing decorative rock aggregate.

Geological Consultant

Economic evaluation of the San Francisco Volcanic Field to determine its potential as a source of lightweight aggregate.

Geological Consultant

Completed a underground evaluation of the Bearup Mine. Glenwood, New Mexico. Presently supervising rehab of underground workings.

Geological Consultant

Completed Geological evaluations on 40 gold mines in Yavapai and Maricopa Counties for a Canadian firm to determine the economic potential of placing the Redtail Mill into a custom milling facility.

Geological Consultant

Ron Lewis Construction. Located and evaluated rock formations in northern Gila County for utilization as road base material. Quarry presently in production for AB & MA road base on Arizona state highway 260 road improvement projects.

1989 - 1990

Leased the RedTail gravity/flotation/cyanide mill near Congress AZ. Currently processing gold ores from the George Washington mine, Clementine mine and Pikes Peak mine. Mill is operating as a custom milling facility.

Formed a Public Company, (HIGHLAND RESOURCES INC. Director, Sec. Tres) Highland Resources Inc. leases the George Washington Gold mine near Wickenburg, Arizona. Raised initial funding to place the mine into production. Gold ore is being transported to the RedTail flotation/cyanide mill for processing.

1987-1988

Geological Consultant for a private company.

Located and assisted in the development of a 30 to 50 ton-per-day gold mine near Congress, Arizona. Consulted on the design, location of equipment and construction of the 150 TPD RedTail flotation/cyanide mill.

1987 - 1988

Geological Consultant for Real Estate Firm.

Conducted geological evaluation and detail feasibility studies on granite property near Apache Junction. Property is presently in production selling granite for landscaping purposes.

Conducted geological evaluation on a Gila River sand deposit. Property sold for development.

1986-1987

Geological Consultant for a private company.

Conducted evaluations on placer gold property near Congress, Arizona.

Leased agitation cyanide equipment to conduct tests on the gold potential of the mines in the Congress Area. Conducted extensive studies on the economic potential of magnetite, iron oxides, specularite, vermiculite, and perlite for industrial use. Developed pilot mill for initial processing of the above minerals.

Consulted on construction of processing plant for the iron oxide material. Plant is on standby waiting results from weathering tests being conducted by paint and roof tile manufacturers.

Geological Consultant for private company to develop the Crater sulphur-gypsum deposit near Big Pine, California. Market studies completed for foreign and domestic markets. Crater mine is in production.

1981-1985

Director and Vice President of exploration

A public corporation with holdings in a lead-silver mine in Yuma, County, Arizona and Cattle feeding operations in Iowa. The Lead-Silver mine has been developed to the 300 ft. level is on a standby status due to low silver prices. Extensive cyanide leach tests were completed. Leach pads installed and operated for the recovery of silver and gold.

1977 to 1983

Geological Consultant

Project included the geological evaluation of the Butterfield Placer deposit near Yuma, Arizona.

Geological evaluation of the Castle Dome mining district near Yuma, Arizona. Negotiated the purchase of all mining claims in the district. Retained all personnel for the development of the Hull Mine. Hull mine was developed to the 300 level and placed into production at 150 tons-per-day and operated at full capacity until the severe drop in silver prices in 1983.

Purchased and rehabilitated a 75 TPD portable gravity mill which was leased out to numerous mining companies for bulk sampling. Mill sold to local mining company and is presently operating in Mexico. Designed and supervised heap leach operation near Corborca, Mexico for a Canadian public company.

Consulted and supervised the Brick Mine decline development near Arivaca, Arizona for a public company listed on the Vancouver Exchange.

Geological Evaluation of the Little Jessie Mine near Humbolt, Arizona. Supervised rehabilitation of underground workings. Leased portable gravity mill for bulk sampling of dumps.

Geological evaluation of the open pit gold mine in Valley County, Idaho. Project was financed and placed into a production status.

Geological evaluation of the George Washington mine near Wickenburg, Arizona. Mine placed in production.

Geological evaluations of the fluorspar deposits in the Tonto Basin area of Arizona.

Initiated a fluorspar dump reclamation program. Purchased trucks and transported material for processing at the Tonto Fluorspar Mill. Acid grade fluorspar was sold to Allied Chemical.

1976-1977

Geological Consultant

Conducted geological evaluations in the Central City area, Colorado.

Geological evaluations of Uranium deposits near Green River, Utah.

Consulted and supervised the development of the Quito Mine, shipped gold-copper ore to the Central City Mill, at Central City, Colorado.

Consulted on the rehabilitation of the Black Hawk flotation mill near Idaho Springs, Colorado.

Purchased and shipped the Lamartine mine dumps to the Central City flotation mill.

1973 - 1976

Geological Consultant

Geological evaluation of limestone deposits for sources of agricultural lime and decorative stone. Open two quarries near Medford, Oregon, and sold agricultural and decorative products. Operation was sold to major producer of agricultural products.

Geological evaluation of pumice deposit near Mt. Shasta California. Mine was open and material sold to the northern California block manufacturers. U.S. Government initiated action and purchased mine claims which were included in a new wilderness area.

Leased several mine dumps in central Nevada and conducted heap leaching operations.

Consultant for Pacific Power & Light Co. Supervised drilling program on the Spring Creek Coal project near Decker, Montana.

1971 - 1973

Geological Consultant

Consultant for numerous public companies trading on the Vancouver and Calgary exchanges. Extensive geological evaluations, geochemical, and geophysical surveys completed in the Highland Valley area near Kamloops, B.C.

1961 - 1967

Underground Miner

Worked as a underground miner in numerous mines and diversion tunnels for dam construction in Washington, Idaho, and Montana area.

**METALLURGICAL TESTING FOR THE
PRECIOUS METALS CONTENT WITHIN
THE PYROCLASTIC MATERIALS LOCATED
IN THE NORTHERN ARIZONA VOLCANIC FIELDS**

For

MARIAH-GUILD MARK INDUSTRIES JOINT VENTURE
Phoenix, Arizona

by

John O. Rud
Geologist, M.Sc.
February 12, 1992

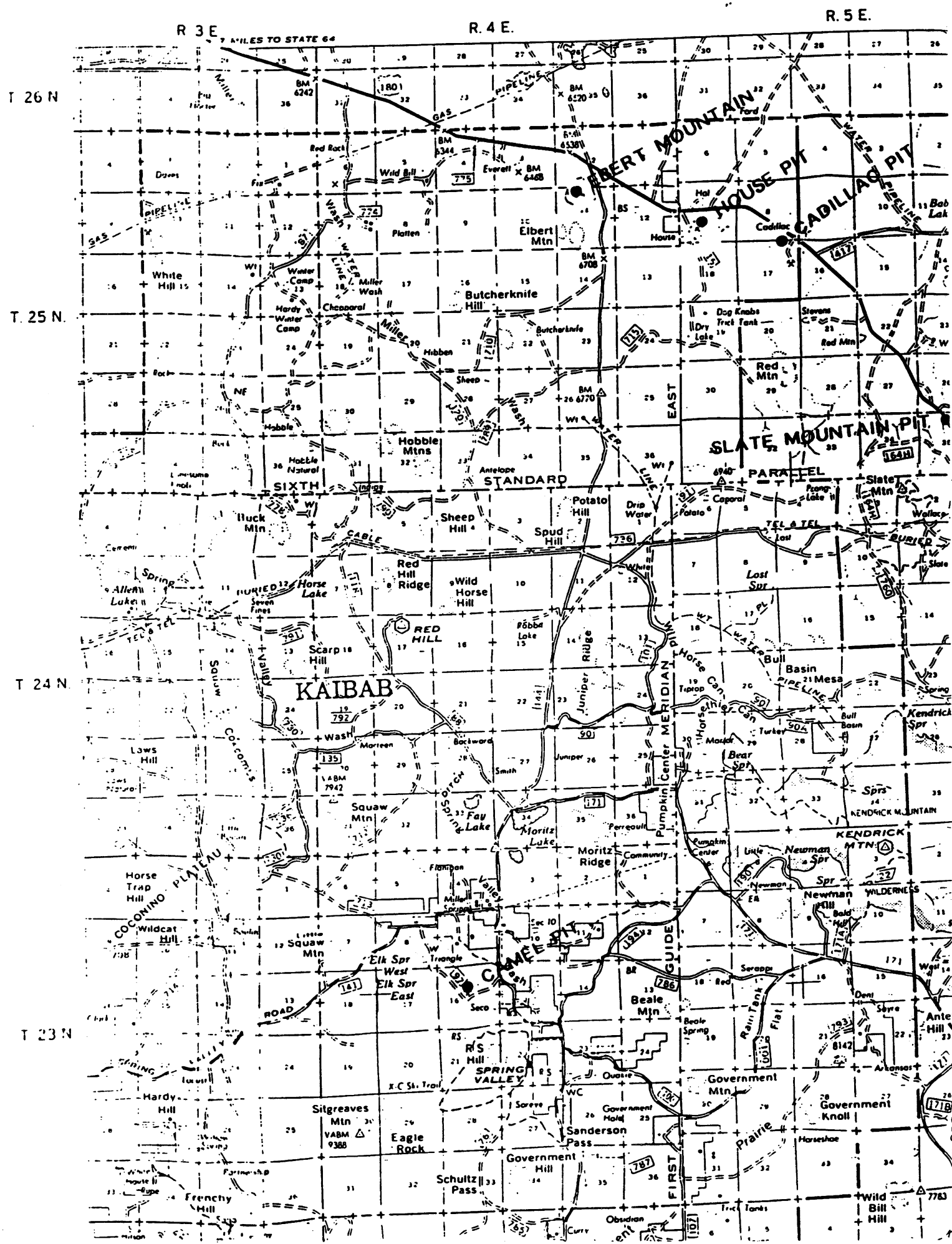
CONCENTRATION AND EXTRACTION OF PRECIOUS METALS FROM VOLCANIC MATERIAL

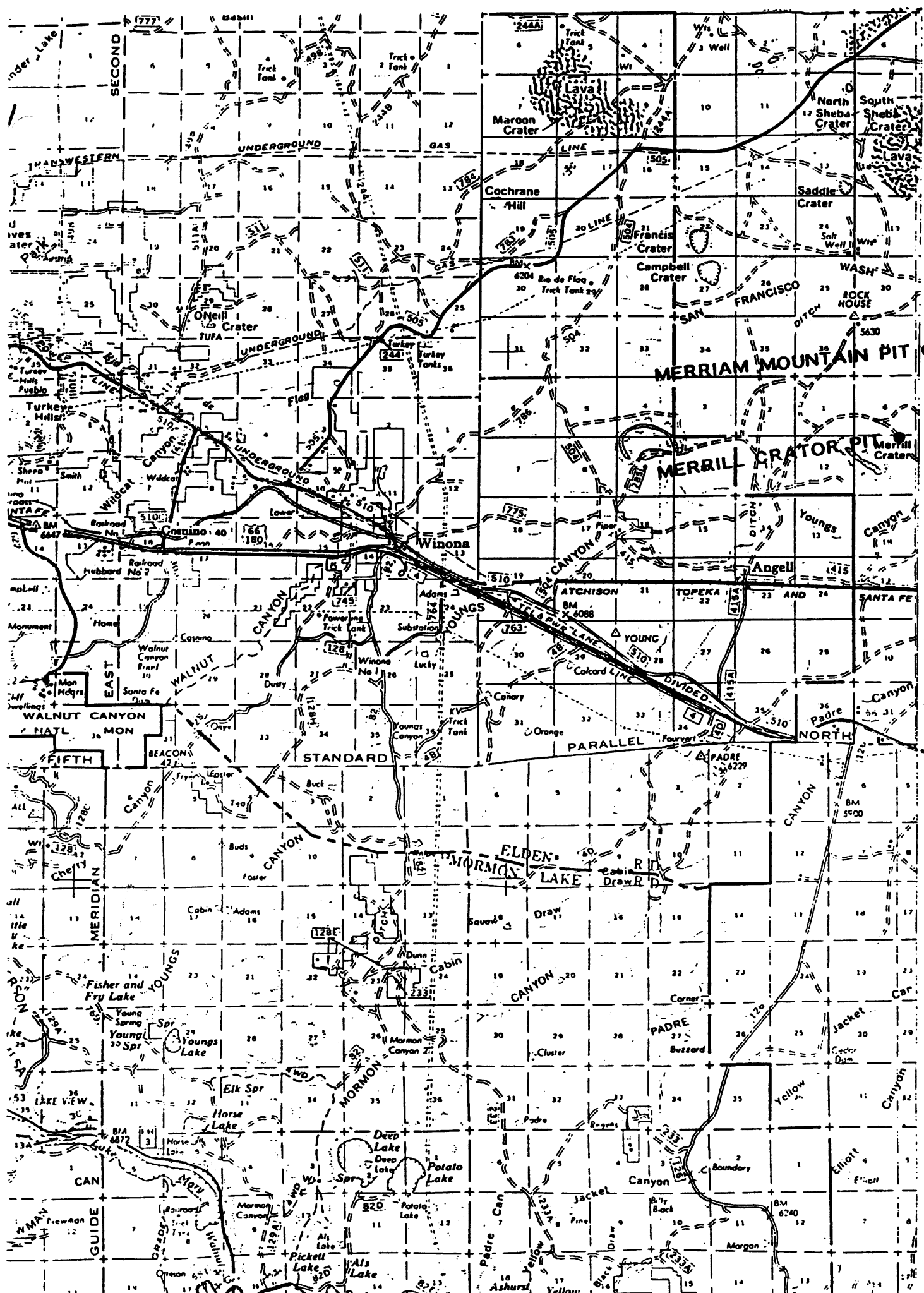
SAMPLING PROGRAM

A program to sample and evaluate various cinder cones for Mariah International and Guildmark Industries Joint Venture was undertaken during November, 1991. A total of 7 cones was sampled in the Coconino and Kaibab National Forest Service area. The samples ranged in size from 150 to 3,400 pounds each and were taken in a manner to be representative of the material exposed in the existing quarries. The pyroclastic deposits sampled are listed below. (See location maps)

Camel Pit	Township 23 North, Range 4 East, Section 16
Ebert Mountain	Township 25 North, Range 4 East, Section 11
Cadillac Pit	Township 25 North, Range 5 East, Section 17
House Pit	Township 25 North, Range 5 East, Section 7
Slate Mountain	Township 25 North, Range 5 East, Section 35
Merriam Mountain	Township 23 North, Range 10 East, Section 24
Merrill Mountain	Township 21 North, Range 11 East, Section 7

The samples were then transported to a facility owned by Sunwalker Development Inc., which is located on Castle Hot Spring Road near Wickenburg, Arizona. The facility is equipped with Allis Chalmers 1518 Vibratory ball mill, a micro gold concentrating table, drying ovens, Rotap screen system, fire assay lab, and related equipment required to process the volcanic material.





T. 22 N.

T. 21 N.

T. 20 N.

PRIOR TESTING

A report, "**ANALYSIS OF CINDER CONE MATERIALS**" by Professor Baki Yarar, Department of Metallurgical Engineering, Colorado School of Mines, Golden Colorado, dated September 1, 1987 states "**Results of AA (atomic absorption spectrophotometry) analyses of all products are shown in Exhibits 1, 2, 3, and 4. Brief examination of the data indicates that all samples contain gold. Quarry A (House pit) contains the highest average of gold (7.7 ppm = 7.7 grams/m.t.) whereas Quarry D (Slate Mountain) contains the lowest average of gold (3.9 ppm = 3.9 grams/m.t.)**"

The Summary of Observations and Conclusions state:

1. We have collected 42 samples of material from the locations shown on the accompanying maps.
2. We studied these samples by SEM, EDX, fire assay and AA analysis.
3. We found that all samples contain gold and silver in the concentration range.....ppm = (g/t) to ppm = (g/t)
4. While panning of the original material does not show gold flakes, table concentrates invariably show gold and silver bearing flakes in the heavy fraction, which also contains sulphides of Fe, Cu, Zn, and Pb.

A report, **CONCENTRATION AND EXTRACTION OF VALUE ELEMENTS OF THE MERRIL AND MERRIAM PROPERTIES OF WMR BY FLOTATION** by B. Yarar, Ph.D. Professor of Metallurgical Engineering, Colorado School of Mines, Golden, Colorado, dated July 1, 1987

states that a 17 metric tons sample was removed from the Merriam Crator. AA analysis indicated the sample averaged .0651 oz/ton gold and .0075 oz/ton silver.

The report also states in the Conclusion and Recommendations, that:

1. All our experimental findings are based on a 17 metric ton sample taken from the Merriam property of WMR.
2. We found that this sample contains native gold, silver and copper as well as sulfide minerals such as FeS₂, PbS and ZnS.
3. These materials are highly disseminated in the matrix and are much lower grade than conventional complex-sulfide-gold-silver ore bodies. We stress that our studies did not aim at the discovery of any ore-body nor do we know if an ore-body exists in the area sampled. Therefore all economic calculations, or extrapolations to other regions of the area we sampled, need to be documented independently of our work.
4. The fact that the values in the sample, we studied are highly unconventional in grade and mode of occurrence notwithstanding, we found that a gravity pre-concentration produces a higher grade material.
5. We found that table concentrates can be ground and subjected to froth flotation, which gives concentrates assaying up to 84.28 grams of gold plus silver per ton of flotation concentrate.

6. **Grinding of table concentrates to about 80%-150 mesh gives acceptable liberation.**
7. **The Bond work index for 150 mesh grind of this material is 44.5 which indicates a very hard ore, requiring about 36 to 44 kWh per metric ton to be able to grind to liberation size.**
8. **We find that desliming is essential for a successful flotation-concentration of the value components by conventional flotation reagents.**
9. **We also found that a low pH and a frother which can withstand low pH pulps are favorable for obtaining high-grade flotation concentrates.**
10. **Our leaching studies indicated that a conventional cyanide tank leaching leads to the passage of up to 20% of gold and silver into solution; if, the head ore is used, while 95% of gold and 85% of silver solubilization occurs when roasted table concentrates are subjected to leaching by cyanide.**
11. **Our studies also indicates that higher leaching efficiencies are achieved if the material leached is finely ground i.e., 100%-200 mesh, roasted and then leached by cyanide.**
12. **Our smelting experiments indicates that flotation concentrates can be smelted, giving a dore product containing 92.67% Au and 7.33% Ag; after, they have been roasted at 900°C.**

13. We recommend that if any plant based on our findings is contemplated by the sponsors, it should first aim at demonstrating the process at pilot size and not as a profit-making installation.
14. We also recommend that any economic calculations on the part of the sponsors require a knowledge of the size and average grades of the ore-body by appropriate geological and engineering methods.
15. We visualize a potential recovery process for which economics have not been worked out, as given in Exhibit 54.

CONCENTRATION PROCEDURE

Previous testing has indicated that the cinder material must be ground to a 80 percent passing -325 mesh to achieve 96%+ liberation. (Liberation means the separation of the mineral constituents of a rock)

To achieve the necessary grind the material was hand fed into a Allis Chalmers model 1518 vibratory mill at a 1,000 pounds per hour rate. The oversize material was then screened off and re-ground in the mill until 100% of the material passed a 200 mesh screen.

Screen analysis was then conducted on the material with the following results.

PRODUCT PARTICLE SIZE ANALYSIS
(Cumulative Passing)

<u>(Tyler) Mesh</u>	<u>Weight %</u>
100	100.0
200	100.0
250	95.5
325	80.2
400	60.9

Two head ore samples were then taken from each deposit and submitted to Alpine Assay of Twin Falls, Idaho for fire assay. The material was then hand fed onto two types of micro gold concentrating tables to compare recovery and concentrating efficiencies. The feed rate was approximately 500 lbs per hour with the heavy concentrate removed on a 10 minute interval.

TESTING RESULTS

TEST 1

A 540 pound of sample was removed from the Camel pit, ground in the AC vibratory mill, and sampled for fire assay. The material averaged .767 oz/ton gold and 1.43 oz/ton silver. The high gold content may be due to a nugget effect or a layer of material that has concentrated the gold over a long period of time. Continuing sampling of the Camel Pit to determine its average gold content is strongly recommended.

The ground material was then fed onto a micro gold table which produced 10 pounds of concentrates. (approximately 50 to 1 concentration ratio)
The concentrate was then smelted in a electric furnace utilizing a siliceous flux formulation from the **Manual of Fire Assaying and Determination of Noble Metals** (U.S.G.S. Publ. No 1445 (1977)) The process produced 4.5 grams (.145 troy ounces) of Dore which indicates a recovery rate of approximately 70% was achieved on this test.

TEST 2

A 500 pound sample from the Ebert Mountain pit was ground in the AC vibratory mill and sampled for fire assay. The results indicated a gold content of .104 oz/ton and silver content of 1.135 oz/ton. The material was concentrated on a micro gold table producing 7.8 pounds of heavy concentrate. (Concentration ratio of 70 to 1) The concentrate was then smelted into a Dore bead that weighted .5 grams or .016 troy ounces. A recovery rate of 62% was realized on this test run.

TEST 3

A composite sample of 3,400 pounds was removed from the Merrill Crator and processed and sampled by the above procedure. The head ore assayed .228 oz/ton gold and 2.38 oz/ton silver. The tabling of the material produced 52 pounds of concentrate that was reduced to 14 pounds by additional concentration by tabling. The concentrate was then smelted and produced a 9 gram (.289 troy ounce) Dore bead. A 73% recovery was achieved by controlling the feed rate and using a head tank to control the water pressure to the table.

CERTIFICATE OF ASSAY

Date Assayed: _____

Alpine Assay

MATHE GOLD MINE
1000 East Avenue
Denver, CO 80202

ATTN: Mr. M. J. [illegible]

CHARGES

DESCRIPTION	FINO	CU	UN	CU	UN	AG
25.5 Grams						
9 Grams						
4.5 Grams						
8.5 Grams						



8.5 Grams

Dore Beads Produced During Test Program

The remaining samples from the various pits were then ground and sampled for fire assay with the following results:

<u>Deposit</u>	<u>Average gold content</u>	<u>Average silver content</u>
Cadillac Pit	.030 oz/ton gold	.07 oz/ton silver
Merriam Crator	.171 oz/ton gold	.07 oz/ton silver
Slate Mountain Pit	.088 oz/ton gold	1.04 oz/ton silver
House Pit	.095 oz/ton gold	1.17 oz/ton silver

The material was then used to determine optimum feed rates and concentrate removal times to maximize recovery and feed rates. The material was processed 4 times and then smelted to produce a 25.5 gram (.819 troy ounce) Dore product. The objective of this test was to determine optimum pilot mill size to be constructed and general processing data for future testing.

CONCLUSIONS and RECOMMENDATIONS

1. The completed testing program corroborates the data presented in the two Colorado School of Mines reports by Professor Yazar, Namely, that the pyroclastic material contains precious metals; the precious metals can be concentrated by gravity methods; the concentrates can be smelted into dore by standard flux formulations.
2. The testing program indicates a 60% to 70% range of recovery was achieved. Recommendations are hereby made to test and evaluate different micro-gold concentrators to determine if the recovery rate can be increased to the 80% range.

3. The results from the gravity concentrating process indicates a significant portion of the gold remains in the Tails. Recommendations are hereby made to determine if a Carbon-in-Pulp cyanide system can recover this gold and if it would be economically feasible to install this type of process in the milling circuit.
4. The metallurgical evaluation completed by the Colorado School of Mines indicates that the flotation process can increase the concentration ratio of the milling process substantially. Recommendations are hereby made to determine the economic feasibility of utilizing this process in the final mill circuit to increase the concentration ratio thereby, producing a high grade gold product which would be shipped to established gold refiners.
5. Strong recommendations are hereby made to construct a 50 tons-per-day pilot mill to determine the optimum milling circuit for the processing of this pyroclastic material. The pilot mill process would establish the overall grade of the selected cinder cones by bulk testing, determine the optimum concentration circuit with the highest percentage of precious metal recovery, and determine the economic feasibility of constructing a concentrating facility with a capacity exceeding 1,000 tons-per-day.

Respectfully submitted,

John O. Rud
Geologist, M.Sc.
February 12, 1992

PROGRESS REPORT

TEST PROGRAM

During April, 1992 the Merrill Crator was bulk sampled by removing 10 ton truck loads of material from four separate areas which included the vent area and the northern side of the crator. Approximately 150 tons of material was stockpiled in an area accessible to highway tractor-trailer trucks with one 21 ton truck load transported to Phoenix for the initial testing program.

The testing program consisted of grinding the material in a 15 inch by 18 inch Allis Chalmers Vibratory Mill. Classification of the material was completed by utilizing a 2 inch Krebs hydrocone. The minus 250 mesh undersized material was then fed to a micro gold table developed by Advance Mining Company. Feed rates varied from 500 to 1500 pounds per hour.

The testing program encountered several difficulties which affected the recovery of gold present in the material. Namely, the first portion of the test was conducted with no classification of the grinding mill, therefore, the total liberation of the gold was not attained. With the installation of the Krebs Hydrocone the grinding became more efficient and higher liberation was achieved. Blockage of the hydrocone also occurred on numerous occasions. The principal reason for the blockage was the presence of fibrous material from vegetation. This problem was solved by screening the material before it was discharged into the mill sump.

Upon solving the above problems a 10 ton test run was completed. Head, tails, and concentrate samples were taken in 15 minute intervals. The samples were compiled and submitted for analysis to Alpine Assay. Results

indicate that the head ore averaged .264 oz/ton gold with the tails containing .118 oz/ton gold. The concentrate averaged 1.336 oz/ton gold and .56 oz/ton silver which was upgraded by hand feeding onto the micro table for reconcentration. This resulted in the concentrate containing 11.820 oz/ton gold and 1.17 oz/ton silver. The recovery rate achieved during this test run was approximately 55 percent.

A short one ton test was also completed to determine if the recovery rate could be increased by grinding the ore finer and slowing the feed rate to the table to 200 pounds per hour. The hand selected head ore contained .544 oz/ton gold and .32 oz/ton silver. The material was then discharged to the table at a very slow rate with samples of the tails taken on a 1 hour interval. Analysis of the tail indicated a gold content of .006 oz/ton. The results indicate the recovery rate increased into the high 90's percentile. This also indicated gravity concentration of this type of material may not be economically feasible due to the fine particle size of the gold which creates a very slow rate of feed onto concentrating table to attain acceptable recovery rates.

A decision was then made to submit a sample of this material to the Diester Concentrating Company testing facility located in Tucson Arizona for column flotation testing. Approximately, 100 pounds of hand selected material with visible sulphide mineralization was compiled and transported to the Tucson testing facility. Diester Concentrator Company personnel divided the material into two portions and completed two test runs on their 3 inch column flotation test cell. Test one indicated a head ore gold content of 2.18 oz/ton gold and .80 oz/ton silver. The tail assay indicated a gold content of .104 oz/ton gold and .05 oz/ton silver. The flotation concentrate produced contained 184.63 oz/ton gold and 30.0 oz/ton silver. The second column test indicated a head assay of 2.44 oz/ton gold and .75 oz/ton silver. The tail

sample contained .378 oz/ton gold and .25 oz/ton silver. The flotation concentrate contained 270.36 oz/ton gold and 48.5 oz/ton silver.

CONCLUSIONS

The preliminary results from the column flotation tests indicate additional column flotation work should continue. The column flotation method of concentration indicates a very high grade concentrate can be produced with a recovery rate in the high 80 per cent range. The small particle size of the gold contained in this material appears to be advantageous in increasing the recovery rate during the concentration process.

Therefore, recommendations are hereby made to continue the testing program by renting a column flotation test cell and completing sufficient flotation tests to determine the overall recovery rates, average grade of the material removed during the bulk sampling program and economic aspects of operating a column flotation concentrating facility.

Respectfully submitted,

John O. Rud
Geologist, M.Sc.

John O. Rud

Geological Consultant

**BULK SAMPLING AND COLUMN FLOTATION
OF THE
MERRILL CRATOR VOLCANICLASTIC DEPOSIT**

for

***Mariah International Inc.
Phoenix, Arizona***

by

**John O. Rud
Geologist, M.Sc.**

November 23, 1992

TABLE OF CONTENTS

	<u>page</u>
Introduction	1
Location	1
Access	2
Geology	2
Flotation	3
Column Flotation	4
Flotation Reagents	5
Bulk Test Procedure	6
Test Results	7
Conclusions	10
 Map 1	

BULK SAMPLING OF THE MERRILL CRATER by COLUMN FLOTATION

INTRODUCTION

During September, 1992 Mariah International Inc. initiated and completed a bulk sampling program on the Merrill Crator. The material was removed from the crator along the access road and a trench located within the vent area of the cone. The material was fed into a vibratory ball mill, ground, and concentrated by column flotation.

The objectives of the program was to determine the average grade of gold occurring in this area of the cone and the percentage of gold recovery that could be attained by utilizing column flotation.

LOCATION

The Merrill Crator is located 22 miles east of Flagstaff, Arizona within Township 21 North, Range 11 East, Sections 7 & 12. The Crator can be easily observed when traveling east from Flagstaff, Arizona and is considered to be one of the larger deposits of volcanoclastic material in the San Franciscan volcanic field.

ACCESS

Access to the Merrill Crator is provided by traveling east on Interstate 40 to the Winona Interchange, then 6 miles east on the north frontage road (formerly the Route 66 highway) to the Angell railroad crossing, then north to the east base of the crator.

GEOLOGY

The Merrill cinder cone is within the Merriam Age strata which is approximately 50,000 years old. The composition of the cinders consists of aphanitic alkali olivine basalt. Phenocrysts of hypersthene, clinopyroxene, plagioclase, and olivine a few millimeters in size, are surrounded by a very fine groundmass of highly oxidized material.

Cummings (Cummings, D., 1972, Mafic and Ultramafic Inclusion, Crator 160, San Francisco Volcanic Field, Arizona, U.S. Geol. Survey Prof. Paper 800B,) conducted an extensive study of the Crator 160 cinder cone. Although, Crator 160 is older than the Merriam Crator it occurs within the same volcanic event and therefore, will have the same compositional and textural features because of the similar geologic conditions.

Cummings states: "The cinders are aphanitic to porphyritic vesicular olivine basalt. They are characteristically reddish brown (hematite stained) on weathered surfaces and dark gray on fresh surfaces. Most cinders are rounded and show some evidence of aerodynamic shaping. The cinders and cinder beds are generally welded, so they were probably partly molten

when deposited. The bombs overlying the plagonite tuff range in size from 0.3 to 1.5 m. Many are almond shaped, and some of the larger bombs are broken."

Cummings also states " Opaque minerals include chromite, magnetite, and ilmenite. ---Hematite, an alteration product, surrounds grains of magnetite, ilmenite, and augite. -----Crator 160 has abnormally high concentration of Ba, Sr, Rb, Ni, and Cr; high concentrations of Cu, Zr, and V; and low concentration of Y, compared with median concentrations of tholeiites and basalts. High concentrations of Ni, Cr, V, and Cu are characteristic of mafic rocks; high concentrations of Ba, Sr, Rb, and Zr, felsic rocks.

The high concentrations of Ba, Sr, Rb, and Zr may indicate contamination from basement granites and other felsic rocks. If the magma incorporated basement material, then assimilation must have been considerable in order to approach (or even exceed, as for Ba and Sr) the element abundances in granite."

FLOTATION

Froth flotation is considered to be the most widely used method for ore beneficiation. In ore beneficiation, flotation is a process in which valuable minerals are separated from worthless material or other valuable minerals by inducing them to gather in and on the surface of a froth layer. Sulphide and non-sulfide minerals as well as native metals are recovered by froth flotation.

This process is based on the ability of certain chemicals to modify the surface properties of the minerals. Other chemicals are used to generate the froth and still others are used to adjust the pH. Certain chemicals are capable of depressing the flotation of minerals that are either to be recovered at a later time or are not to be recovered.

The process of froth flotation entails crushing and grinding the ore to a fine size. This fine grinding separates the individual mineral particles from the waste rock and other mineral particles. The grinding is normally done in water with the resultant slurry call the "pulp". The pulp is processed in the column or conventional flotation cells which agitates the mixture and introduces air as small bubbles.

The ability of a mineral to float depends upon its surface properties. Chemical modification of these properties enables the mineral particles to attach to an air bubble in the column flotation cell. The air bubble and mineral particle rise through the pulp to the surface of the froth or foam that is present on the column flotation cell. Even though the air bubbles often break at this point, the mineral remains of the surface of the froth. The mineral is physically separate from the remaining pulp material and is removed for further processing.

COLUMN FLOTATION

Based on pilot concentration tests conducted by Deister Concentrator Co., Inc. test facility located in Tucson, Arizona a column flotation method of gold

recovery was selected. Column flotation advantages over conventional flotation include:

- Improved grade/recovery relationships.
- Superior process control through improved instrumentation.
- Lower capital costs.
- Lower operating costs.

The flotation column main characteristic is its ability to eliminate gangue entrainment in the concentrate. This is accomplished by introducing the feed one third down the column and is distributed evenly. The slurry then travels down the column counter-currently to a rising stream of bubbles which are produced in a sparging device. Particles which collide and attach to the bubbles are carried up the column, eventually reaching the interface between the pulp or collection zone and the froth zone. The froth zone is primarily gas with solids and liquid in the lamella between the bubbles. Washwater, which is added at the top of the column, filter down through this bed and washes the froth of entrained particles.

FLOTATION REAGENTS

A 200 pound sample was submitted to Deister Concentration Co., Inc., laboratory in Tucson for the initial column flotation testing. It was determined during this pilot test Kerley Mining Inc. KI 444 frother and KI 1 Sodium Isopropyl Xanthate collector would be suitable for this ore.

FROTHERS are liquids that produce the froth or foam on which the flotation process depends. The froth resembles soap suds and provides the physical

separation between the minerals floated and the pulp containing the waste. The froth must be strong enough to support the weight of the mineral floated and yet not be tenacious and non-flowing. It should have the tendency to break down when removed from the column flotation cell. The frother should not enhance the flotation of unwanted material.

COLLECTORS are chemicals which attaches to the mineral surface and produce a hydrophobic (water fearing) surface. While certain minerals are naturally hydrophobic and do not require a collector, recovery is often improved when a collector is used. The water repellent film facilitates the attachment of the mineral particle to the air bubble. Many different chemicals are used as collectors. Oils, xanthates, dithiophosphates, petroleum sulfonates, and fatty amines are examples.

BULK TEST PROCEDURE

Previous sampling of the Merrill Crator indicated the material contained gold in the .06 to .17 oz/ton range. Ore processing consisted of removing the oversized material (+1 inch) by screening. The minus 1 inch material was then loaded into a 10 ton feed hopper equipped with a variable speed drive belt. The material was then fed into the General Dynamics vibratory mill at a 1,000 pounds per hour feed rate. The grind was controlled by a discharge grate with the undersized material flowing into a sump equipped with a 2 inch SRL pump. The material was then pumped into the 6 inch x 23 ft. Deister flotation column with the froth concentrate deslimed in a 2 inch Krebs cone and the tails discharged into a tailing sump.

TEST RESULTS

A 21 ton sample (Sample # 1) was removed from the first drill road switchback near the valley floor. The road cut shows a soil zone of 16 inches in thickness which may have diluted the gold values in the sample removed.

FLOTATION PARAMETERS

Gold Head Grade	.05 oz/ton
Gold Concentrate Grade	121.35 oz/ton
Gold Tails Grade	.01 oz/ton
Percentage solids in pulp	23%
Washwater Feed Rate	4 gallons per minute
Frother KI 444	10cc/min
Collector KI 11	80cc/min
pH	Natural
Concentration Ratio	3.035
Recovery	80.1%

A 24 ton sample (Sample # 2) was removed between switchbacks 2 & 3. The material showed a layering and sorting effect during deposition. Near the surface hematite staining of the groundmass was evident.

FLOTATION PARAMETERS

Gold Head Grade	.11 oz/ton
Gold Concentrate Grade	158 oz/ton
Gold Tails Grade	.03 oz/ton
Percentage solids in pulp	20 %
Washwater feed rate	5 gallons/minute
Frother KI 444	12cc/min

Collector KI 11	100cc/min
pH	Natural
Concentration ratio	1.995
Recovery	72.4%

A 20 ton sample (Sample # 3) was removed from the area between switchback # 1 and the vent area. The road cut averages about 6 feet in high and is a composite of fresh volcanoclastic material.

FLOTATION PARAMETERS

Gold Head Grade	.66 oz/ton
Gold Concentrate Grade	357 oz/ton
Gold Tails Grade	217 oz/ton
Percentage solids in pulp	20%
Washwater feed rate	5 gallon per minute
Frother KI 444	10 cc/min
Collector KI 11	100 cc/min
pH	Natural
Concentration Ratio	811
Recovery	67%

A 25 ton sample (Sample # 4) was removed from the vent area trench. The trench is approximately 15 feet deep, 12 feet wide and 25 feet long. The area is composited entirely of volcanoclastic material with visible sulphides within the vugs of the material.

FLOTATION PARAMETERS

Gold Head Grade	1.44 oz/ton
Gold Concentrate Grade	389 oz/ton
Gold Tails Grade	372 oz/ton

Percentage solids in pulp	20%
Washwater feed rate	5 gallons per minute
Frother KI 444	15 cc/min
Collector KI 11	120 cc/min
pH	Natural
Concentration Ratio	364
Recovery	74%

Sample # 5 was a composite of the material hauled down from the Merrill Crator. The 34 tons of material was removed from the 4 stockpiles, mixed thoroughly and loaded in the feed hopper. It is expected this sample represents the material that is exposed on the north side of the Merrill Crator.

FLOTATION PARAMETERS

Gold Head Grade	.14 oz/ton
Gold Concentrate Grade	219 oz/ton
Gold Tails Grade	.041 oz/ton
Percentage solids in pulp	20%
Washwater feed rate	5 gallons per minute
Frother KI 444	12 cc/min
Collector KI 11	100 cc/min
pH	Natural
Concentration Ratio	2,190
Recovery	70%

CONCLUSIONS

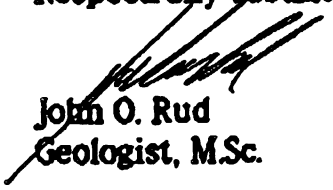
The 114 ton bulk column flotation sampling program produced 104 pounds of concentrate. A one pound sample of the material was then submitted to David H. Fell & Company, Inc., a gold refiner located in City of Commerce, California, for a projected gold recovery analysis. Mr. Larry Fell, Refinery Manager, reported that the concentrate contained 256 ounces of gold per ton. On November 5th, a 47.5 pound sample was then shipped to the refiner for processing. Completion date is projected to be November 25, 1992.

The area selected for sampling is located on the north side of the Merrill Crator. The reasons for this selection was the existence of a drill road which provided excellent exposures of material exceeding 20 feet in depth and good access to the excavated trench located in the vent area of the crator. The physical dimensions of the sample area depicted on Map #1 are 2,000 feet in a east-west direction, 3,000 feet in a north-south direction, with a average sample depth of 20 feet. Utilizing a 22 cubic feet per ton factor this area contains 5.5 millions tons of volcanicastic material.

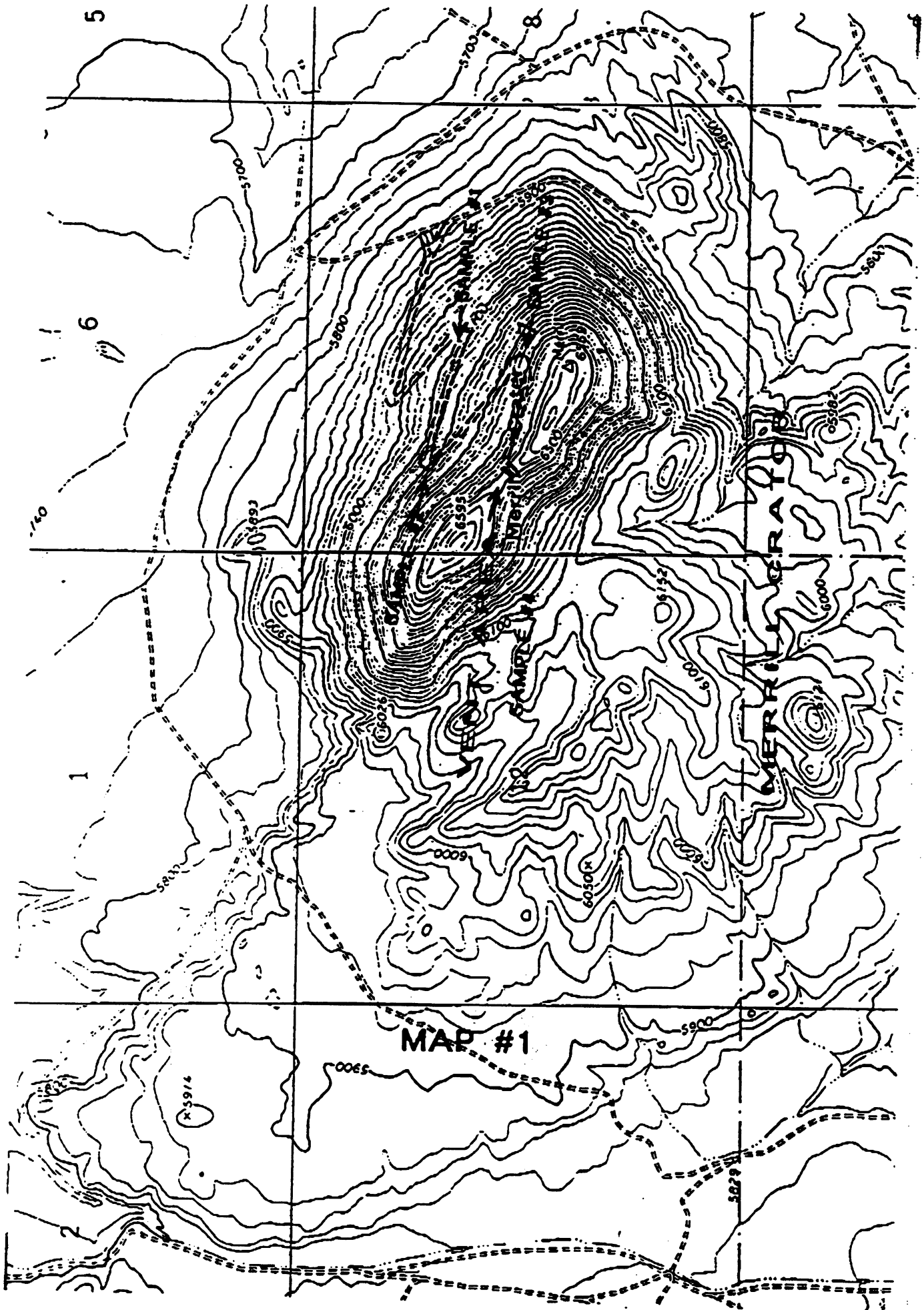
The composite sample taken from the north side of the crator indicates an average gold content of .142 ounces per ton with a recovery potential of 70.4 percent. Therefore, the average recoverable grade of gold within the sample area is projected to be .09 ounces per ton. It is expected that the recovery

percentage will increase during production due to increased efficiency in the grinding circuit and the fine tuning of the concentration circuit that occurs during the normal operations of a gold concentrating facility.

Respectfully submitted,



John O. Rud
Geologist, M.Sc.



CSM

Colorado School of Mines
Golden, Colorado 80401
303/273-3770

Metallurgical Engineering Department

August 20, 1987

Mr. A. Takemoto
1840 W. Amelita, Suite 1024
Mesa, AZ 85202

Re: CSM project 4-49044 Analysis of Cinder Cone Materials

Dear Mr. Takemoto:

Thank you for your letter dated August 19, 1987, enquiring about our progress on your project.

We have conducted mineralogical, SEM, EDX, AA and a number of gravity concentration procedures on the samples we have collected in the field earlier this summer from your property in Arizona.

While I am in the process of putting together the report, which should be ready in a few weeks, the following will outline some highlights of our findings:

- The materials collected in the field contain gold and silver values in varying proportions ranging between 2.4 ppm (~ 0.072 oz/mt) and 21.2 ppm (~ 0.68 oz/mt). They also contain small quantities of silver which we have detected during our microscopic work but have not quantitatively analyzed for.
- Gold and silver were observed to be in the native form, for which we have electron microscopic and energy dispersive x-ray data.
- Beside gold and silver, metallic minerals which we have identified as lead sulfide, iron sulfide, zinc sulfide and a smaller quantity of copper sulfide are present in your ore.
- The preliminary concentration experiments we carried out indicated that concentrates assaying higher gold content than the table feed could be obtained. The optimization of these tests can be undertaken if you commission us to do so.

Documentary data of our findings, with the maps and description of the field work that we did will be presented to you in the actual report itself.

I hope this information helps. With kind regards.

Yours sincerely,

B. Yarar
Professor





Mariah International, Inc.

1701 W. Charleston, Suite 510 • Las Vegas, Nevada 89102
(702) 382-8103

Phoenix, Arizona — (602) [REDACTED]

September 24, 1987

Subject: Colorado School of Mines Report

Gentlemen:

Please find enclosed a copy of the full report we received from the Colorado School of Mines. We are providing this material for your due diligence work, and not for promotional purposes. The School of Mines has received a number of broker calls requesting this report. They were retained by MARIAH to perform these analyses and consider this information proprietary to MARIAH. Therefore, they are not at liberty to discuss this report with anyone other than MARIAH's principles. In this light, we ask that your questions be directed to MARIAH at (602) 279-2098, and not to the Colorado School of Mines.

Thank you.

Donna Porter/for/
MARIAH INTERNATIONAL, INC.
1661 East Camelback Road
Suite #250
Phoenix, Arizona 85016

Enclosure

FINAL REPORT

Submitted to:

Mr. A. Takemoto
Cimarron Corporation/Mariah International
Suite 1701, W. Charleston
Las Vegas, Nevada 89102

"ANALYSIS OF CINDER CONE MATERIALS"

CSM Project No. 2522/4-49044

Principal Investigator:

Baki Yarar
Professor
Department of Metallurgical Engineering
Colorado School of Mines,
Golden, Colorado 80401

Final Report Date: September 1, 1987

Foreword and Caution

This final report is presented to Mr. A. Takemoto of Cimarron Corporation as stipulated in CSM Proposal No. 2522 and followup correspondence.

The studies reported here are "only analyses" and should not be taken to imply that the values in the samples analyzed can or cannot be extracted. Economics of a project involve extensive testing, pilot plant trials, knowledge of facts which fully characterize an ore deposit, energy and water problems, other engineering, environment, government regulations and management techniques, to cite just a few fundamental variables.

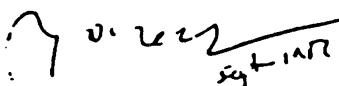
As this report covers analyses of samples only, and we have no information on any of the variables cited above, the contents of this report should not be construed in any way as a statement in connection with the economics of the extraction of values from the samples studied.

It should be noted by all parties that the Colorado School of Mines and its professors do not endorse or deny any business ventures that this report or its contents may relate to.

It follows therefore, that the name of the school or principal investigator should not be used in any advertisements or promotional materials directly or by implication unless authorized in writing.

We welcome any inquiries in writing from Cimarron Corporation regarding the contents of this report.

B. Yarar
Professor

 B. Yarar

Sample Collection

On May 21, 1987, 42 samples were collected by Dr. G. Pine from five different properties approximately 30 miles northwest of Flagstaff, Arizona. The samples were collected from cinder quarries at the following locations: SW 1/4 Sec 7, T25N R5E; NE 1/4 Sec 11, T25N, R4E; NE 1/4, Sec 17, T25N, R5E; NE 1/4 Sec 35, T25N, R5E; and NW 1/4 Sec 6, T24N, R6E (Elbert Mountain 15' and Kendrick Peak 7 1/2' Arizona Topo Sheets). See Appendix I for sample location maps.

On "flat" areas in the field the upper layers of material was scraped away and a 0.5 to 1.0 foot hole dug to obtain the sample. On "vertical" faces trenches were cut to obtain representative samples. Sample sizes ranged from 0.1 to 2.0 kg. However, eight larger samples ranging in weight from 4.8 to 11.2 kg were also collected.

The larger-weight samples were crushed to -10mm in Phoenix, Arizona, and all samples were shipped to the Colorado School of Mines, Golden, Colorado, for examination and analyses.

Sample Preparation

A 1.0 to 2.0 kg representative sample from the larger samples was taken and all 42 samples were crushed to -2.0mm using a roll crusher. The samples were then split by Jones Sample Splitter to 75 to 100 gram sizes which were pulverized to -400 mesh in a mechanical pulverizer.

The larger samples were ground in a rod mill and wet-sieved using a 28 mesh sieve. Material was re-ground until 100% of the sample passed through the 28 mesh sieve.

The -28 mesh material was run on a shaking table. A concentrate and tails were separated from each table feed. The tails from the first operation

were re-run (separating into a concentrate, combined with first run, and tails fraction). The table concentrate was split by Jones Sample Splitter to obtain 75 to 100 grams of material which was pulverized to -400 mesh in a mechanical pulverizer. See Appendix II for details of shaking table operation.

Also, a small amount of TAKE 3 table concentrate was hand panned and the residual "heavy" grains were examined using the Scanning Electron Microscope. Minerals identified in this very cursory examination were gold, pyrite, galena, and titaniferous magnetite beside gangue.

The pulverized materials (-400 mesh) were treated to obtain an organic extract of gold for AA analysis. The procedure is given in Appendix III.

Results of Analyses

Results of AA (atomic absorption spectrophotometry) analyses of all products are shown in Exhibits 1, 2, 3 and 4. Brief examination of the data indicates that all samples contain gold. Quarry A contains the highest average of gold (7.7ppm = 7.7 grams/m.t.) whereas Quarry D contains the lowest average of gold (3.9 ppm = 3.9 grams/m.t.).

The shaking Table Concentrate from bulk samples has about twice as much gold as the bulk sample. However, since the shaking Table Concentrate represents about 15% of the bulk sample weight, apparently a significant portion of the gold remains in the shaking Table Tails. It may be noted here that tabling trials were lab-scale and only exploratory. It should further be possible to improve recoveries and grades under optimal conditions of operation.

EXHIBIT 1
Results of AA Analyses

Sample #	Au (ppm)
1T	5.4
2	4.1
3	4.9
3T	5.4
4	4.1
5	3.8
6	3.9
6T	6.4
7	6.9
7T	6.1
8	7.6
9	17.5
10	6.4
11	5.0
12	177.1* 7.8
13	14.2
14	3.0
15	21.2
16	15.4
17	20.0
18	4.9
19	6.8
20	2.5
21	4.4
22	6.7
23	5.4
24	5.1
25	5.5
	7.5
	(6.5)
26	5.3
27	7.8
28	5.9
29	4.1
29T	12.3
	4.6
	(8.5)
30	7.6
31	5.0
32	3.5
33	5.3

EXHIBIT 1
Results of AA Analyses
(Continued)

Sample #	Au (ppm)
33T	12.2
	10.1
	(11.2)
34	4.2
35T	8.5
	11.1
	5.2
	(8.3)
36	4.8
37	1.8
38	5.5
39	2.4
40	5.7
40T	9.2
	21.7
	(15.5)
41	9.2
42	5.0

*Invalid Reading (?) (15.5) = average

Ti indicates shaking table concentrate. See Appendix I for data.

EXHIBIT 2

Results of AA Analyses by Quarry

QUARRY A			
Sample #	Au (ppm)	Sample #	Au (ppm)
1T	5.4	13	14.2
2	4.1	14	3.0
3	4.9	15	21.2
3T	5.4	16	15.4
4	4.1	17	20.0
5	3.8	18	4.9
6	3.9	19	6.8
6T	6.4	20	2.5
7	6.9	21	4.4
7T	6.1	22	6.7
8	7.6	23	5.4
9	17.5	24	5.1
10	6.4	25	6.5
11	5.0	26	5.3
12	7.8	27	7.8
QUARRY B			
Sample #	Au (ppm)	Sample #	Au (ppm)
28	5.9	30	7.6
29	4.1	31	5.0
29T	8.5	32	3.5
QUARRY C			
Sample #	Au (ppm)	Sample #	Au (ppm)
33	5.3	35T	8.3
33T	11.2	36	4.8
34	4.2		
QUARRY D			
Sample #	Au (ppm)	Sample #	Au (ppm)
37	1.8	40	5.7
38	5.5	40T	15.5
39	2.4		
QUARRY E			
Sample #	Au (ppm)	Sample #	Au (ppm)
41	9.2	42	5.0

EXHIBIT 2

Results of AA Analyses by Quarry

QUARRY A			
Sample #	Au (ppm)	Sample #	Au (ppm)
1T	5.4	13	14.2
2	4.1	14	3.0
3	4.9	15	21.2
3T	5.4	16	15.4
4	4.1	17	20.0
5	3.8	18	4.9
6	3.9	19	6.8
6T	6.4	20	2.5
7	6.9	21	4.4
7T	6.1	22	6.7
8	7.6	23	5.4
9	17.5	24	5.1
10	6.4	25	6.5
11	5.0	26	5.3
12	7.8	27	7.8
QUARRY B			
Sample #	Au (ppm)	Sample #	Au (ppm)
28	5.9	30	7.6
29	4.1	31	5.0
29T	8.5	32	3.5
QUARRY C			
Sample #	Au (ppm)	Sample #	Au (ppm)
33	5.3	35T	8.3
33T	11.2	36	4.8
34	4.2		
QUARRY D			
Sample #	Au (ppm)	Sample #	Au (ppm)
37	1.8	40	5.7
38	5.5	40T	15.5
39	2.4		
QUARRY E			
Sample #	Au (ppm)	Sample #	Au (ppm)
41	9.2	42	5.0

EXHIBIT 3

Average Au by Quarry

Quarry #	Au (ppm)	Number of Samples
A	7.7	26
B	5.2	5
C	4.8	3
D	3.8	4
E	7.1	2

*Note: Excludes the Table Concentrate Samples

EXHIBIT 4

Comparison of Bulk Sample to Table Concentrate

Sample #	Au (ppm)
1T	5.4
3	4.9
3T	5.4
6	3.9
6T	6.4
7	6.9
7T	6.1
29	4.1
29T	8.5
33	5.3
33T	11.2
35T	8.3
40	5.7
40T	15.5

Use of an External Referee Laboratory

It is common knowledge that different samples sent to various laboratories produce different results of analysis. As a matter of routine, we also sent representative samples to a local laboratory with which we have worked in the past (S.L.L.), and requested fire assays.

Their results, given in Appendix IV, indicated less than 0.02ppm gold, i.e., below detection limit in all bulk samples, except number 41.

These results are not surprising, since fire assay results are highly dependent on the formulation of the flux material. This is made clear by a U.S.G.S. publication entitled: A Manual for Fire Assaying and Determination of Noble Metals in Geological Materials, U.S.G.S. Publication No. 1445 (1977).

The same external laboratory did report gold and silver in concentrates. See Appendix IV.

Our fire assays, which were carried out with table concentrates, used the U.S.G.S. approach which consisted of analysis of the fire assay crucible charge by EDX, followed by flux formulation, and on this basis did produce fire assay beads. These are documented in Exhibits 4, 5, and 6

Spectral Analyses

Spectral analysis is a semi-quantitative method which shows the relative abundance of elements in a sample. While it records silver, it is not responsive to gold or platinum due to the noble (high ionization potential) of these elements. Appendix V shows the spectral analyses of all the samples.

Spectrographic analyses do not show any significant trends. Samples from Quarry B are high in Cr and Ni, whereas samples from Quarries C, D, and E are low in Cr and Ni. Quarry B has slightly higher Cu values. Table Concentrates show a slight increase in Cr, Ni, and Mn when compared to bulk samples.

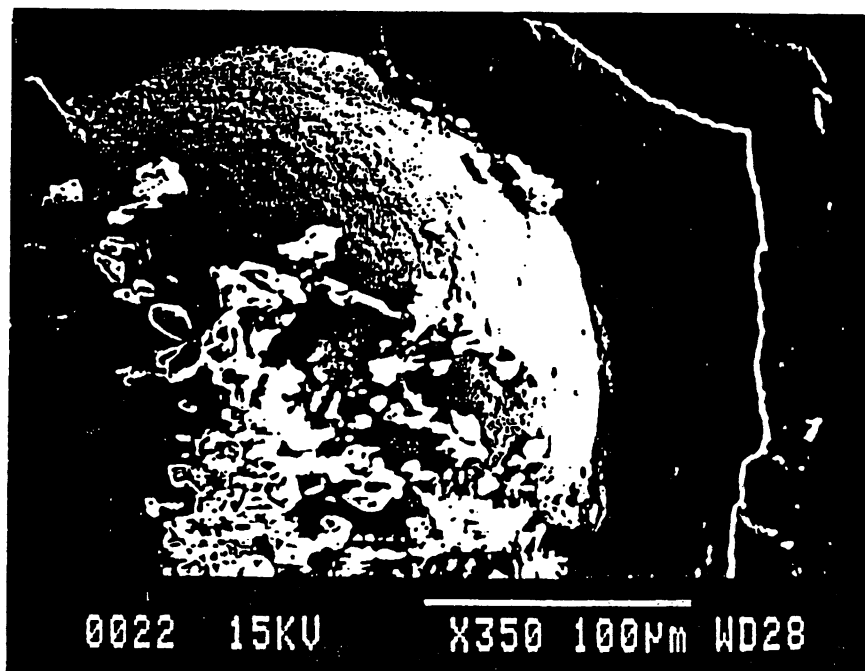


Exhibit 4: SEM Electron Micrograph of Fire Assay Bead.

Sample: Take-29 table concentrate.

EDX Analysis:

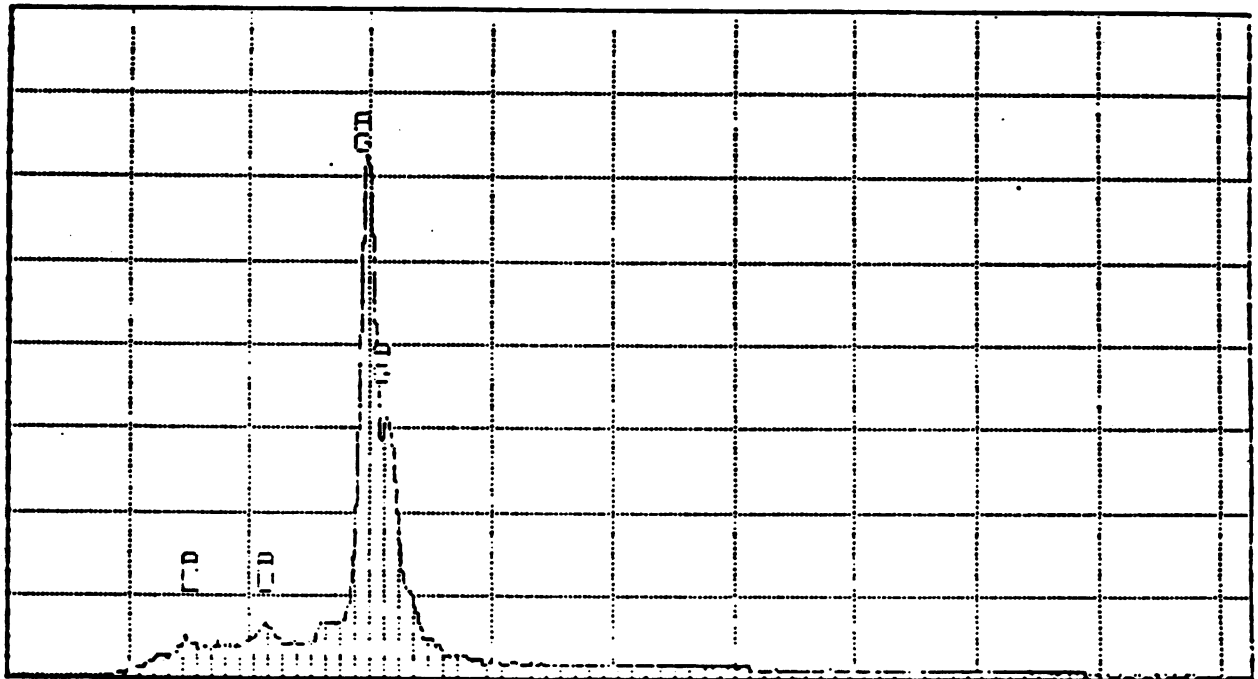
AU: 6.85%

Ag: 93.14%

See Exhibit on next page for EDX spectrum.

TN-5500 Colchada School of Mines / JEOL
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0.000

VFS = 4036 10.240

100 TAKE 29 TABLE CONC BEAD
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Exhibit 4-A: EDX spectrum of fire assay bead from sample: Take-29, table concentrate.

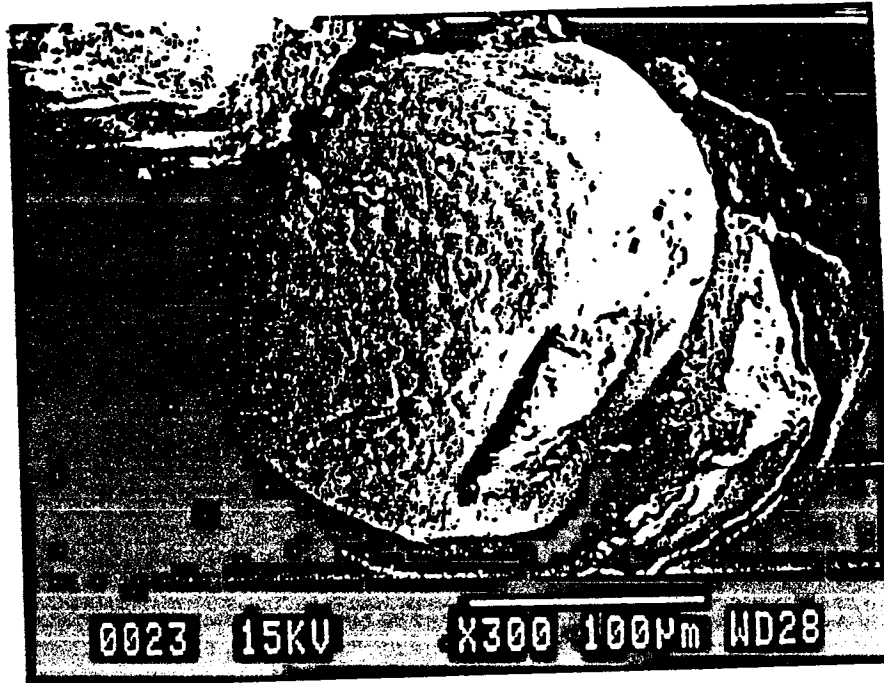


Exhibit 5: SEM electron micrograph of fire assay bead from Sample Take-33.

EDX Analysis:

Au: 76.21%

Ag: 20.79%

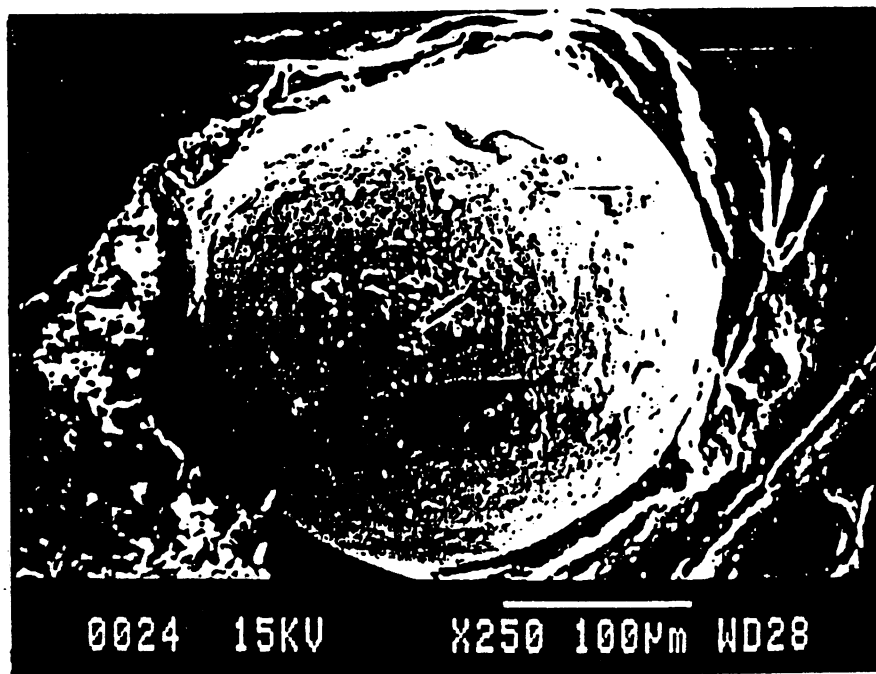


Exhibit 6: SEM electron micrograph of fire assay bead from Sample Take-40.

EDX Analysis:

Au: 51.75%

Ag: 48.25%

Gold and Silver Ratios and Other Non-Gangue Minerals

As was demonstrated in Exhibits 4, 5, and 6, the samples studied showed the presence of gold and silver together. These fire assay beads show gold to silver ratios of approximately 1:13, 1:1, and 1:3.

It is notable, on the other hand, that heavy individual grains (see for example, Exhibits 7 to 10) show gold plus silver together. It is common to find gold plus silver in association with one another in natural gold flakes.

Samples also showed the presence of lead, zinc, iron and copper mineralizations in the form of sulfides and their highly oxidized (tarnished) forms as can be seen from Exhibits 11 to 15. Exhibit 16 is a native silver grain. Our experience with such materials obtained from Merriam Crater near Flagstaff, Arizona, shows that these sulfide minerals and gold-bearing flakes and silver can be concentrated by flotation after pre-concentration procedures. We do caution that we have not conducted similar flotation-concentration studies with the samples which form the subject of this report.

Summary of Observations and Conclusions

1. We have collected 42 samples of material from the locations shown on the accompanying maps.
2. We studied these samples by SEM, EDX, fire assay and AA analysis.
3. We found that all samples contain gold and silver in the concentration range ppm = (g/t) to ppm = (g/t).
4. While panning of the original material does not show gold flakes, table concentrates invariably show gold and silver-bearing flakes in the heavy fraction, which also contains sulfides of Fe, Cu, Zn and Pb.

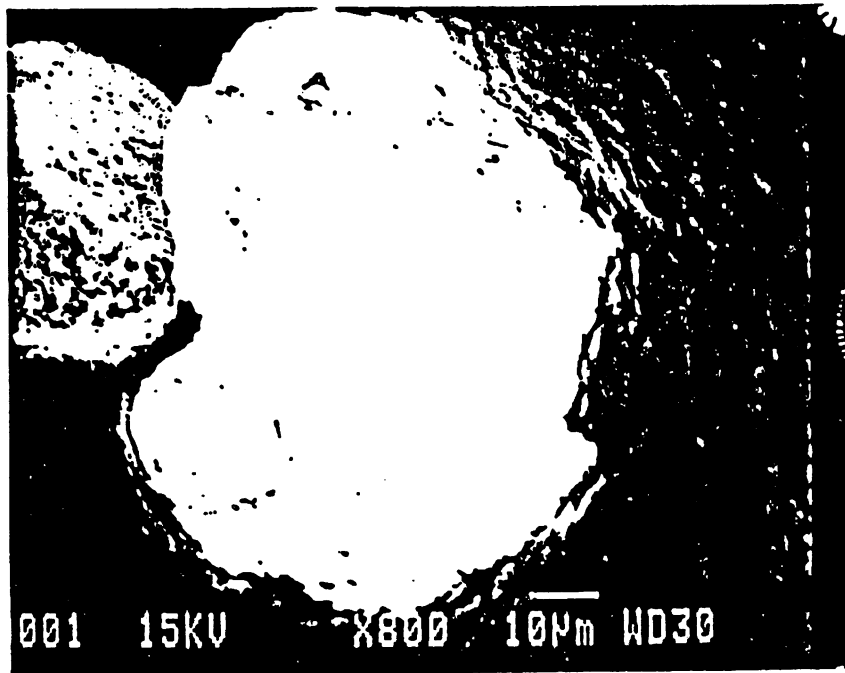
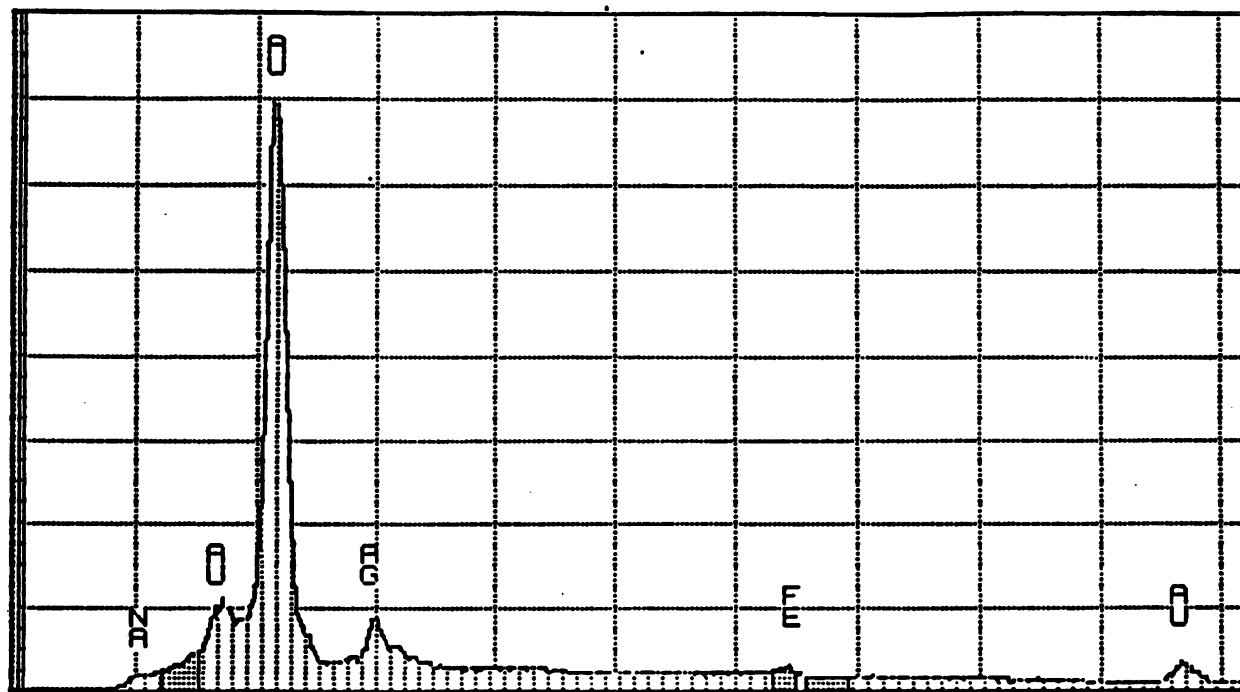


Exhibit 7: SEM electron micrograph of Take Sample-1, hand-panned table concentrate, gold-rich grain. See analysis and EDX spectrum on next page.



0.000 VFS = 4096 10.240
 100 TAKEMOTO 3, HAND PANNED TABLE CONC, GOLD
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 i j k l m n o p q r s t u v w x y z { | } ~

Exhibit 8: EDX spectrum of a gold-rich grain shown in Exhibit ___, and its analysis.

EDX Analysis::

Na: 0.06%, Au: 92.51%, Ag: 5.81%, Fe: 1.62%

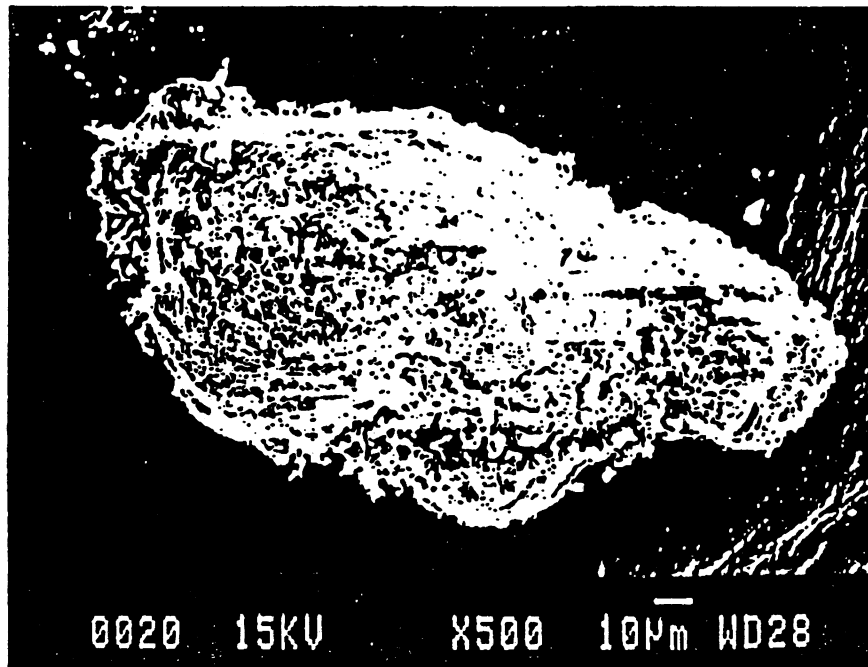
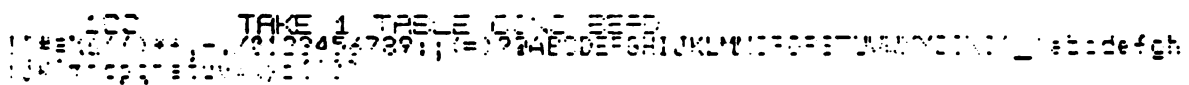


Exhibit 9: SEM photomicrograph of Take Sample-1, grain from table concentrate. See analysis and EDX spectrum on next page.

Cursor: 0.000% = 0



Ir: 13.81%
Ca: 7.80%
Au: 15.31%
Pb: 33.39%
Ag: 29.68%

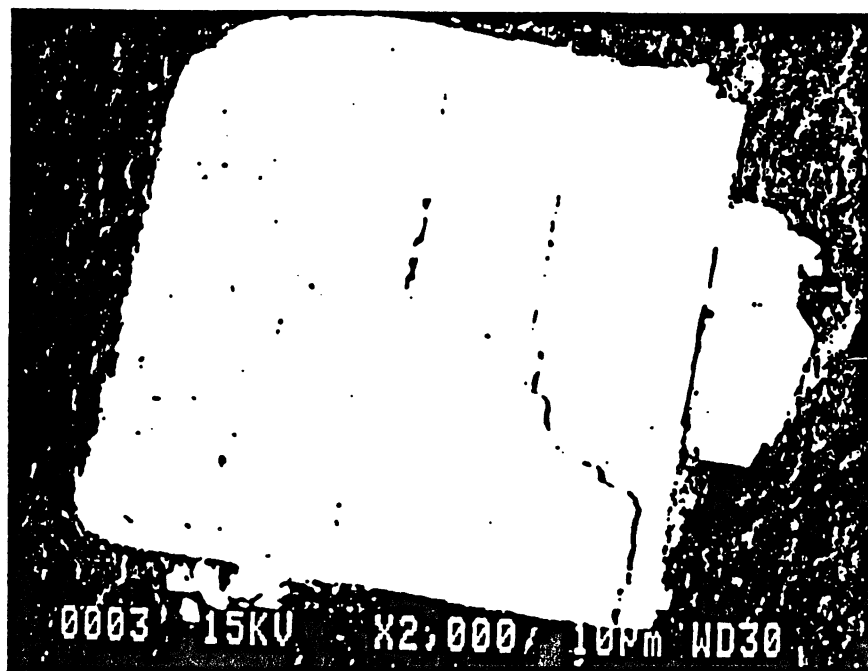


Exhibit 11: SEM electron micrograph of Sample, Take-1 table concentrate, hand-panning heavy fraction grain of galena.

EDX analysis:

Pb: 78.18%
S: 12.27%
Si: 1.14%
Fe: 4.04%
Cu: 4.02%
Al: 0.36%

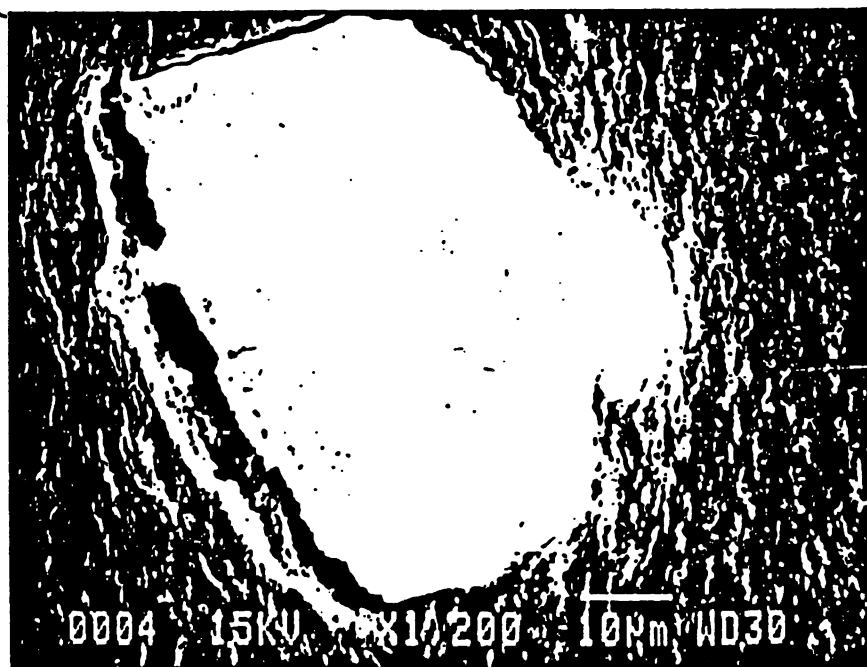


Exhibit 12: SEM electron micrograph of Sample Take-1 table concentrate, hand panned heavy grain.

EDX Analysis:

Mg: 6.85%
Al: 14.49%
Ti: 11.05%
Fe: 63.89%
Cu: 3.72%



Exhibit 13: SEM electron micrograph of galena grain from Sample Take-6 table concentrate.

EDX Analysis:

Pb: 85.34%

S: 14.66%

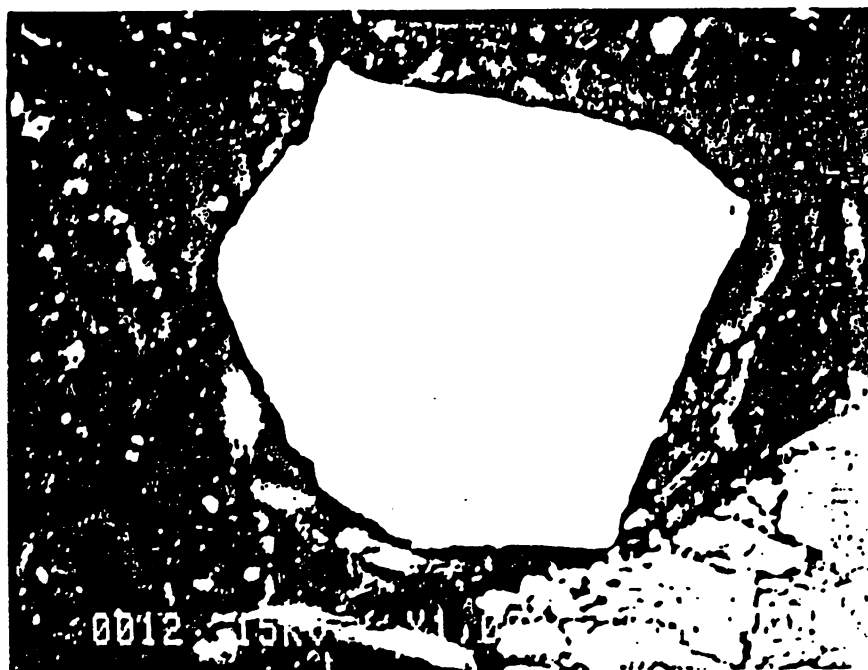


Exhibit 14: SEM electron micrograph of pyrite grain Sample Take-40 table concentrate.

EDX Analysis:

S: 58.46%

Fe: 41.54%



Exhibit 15: SEM electron micrograph of sphalerite grain (top satellite, light colored grain), Sample: Take-33, table concentrate.

EDX Analysis:

Zn: 23.66%

S: 48.01%

Fe: 28.32%

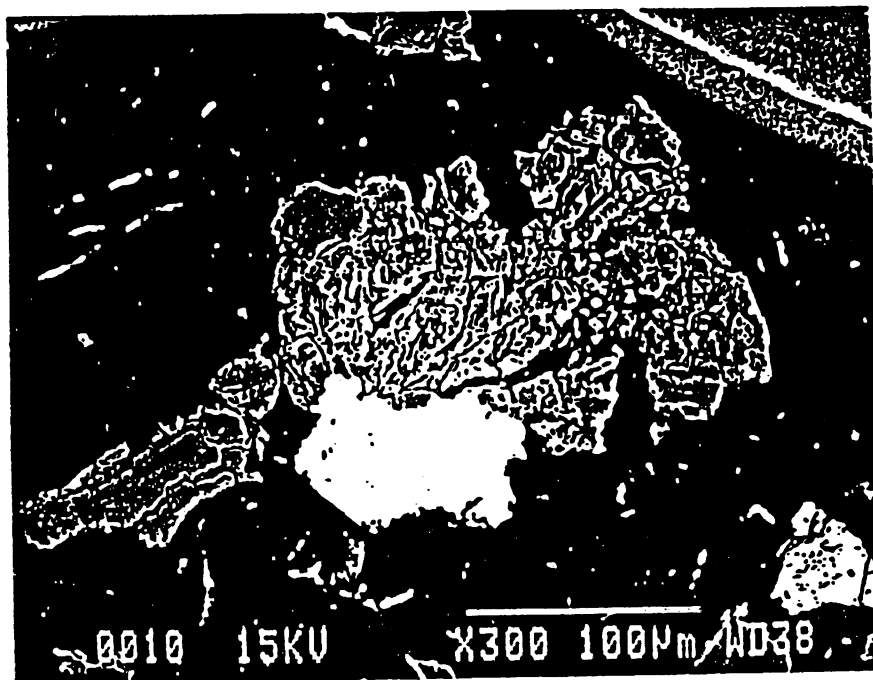


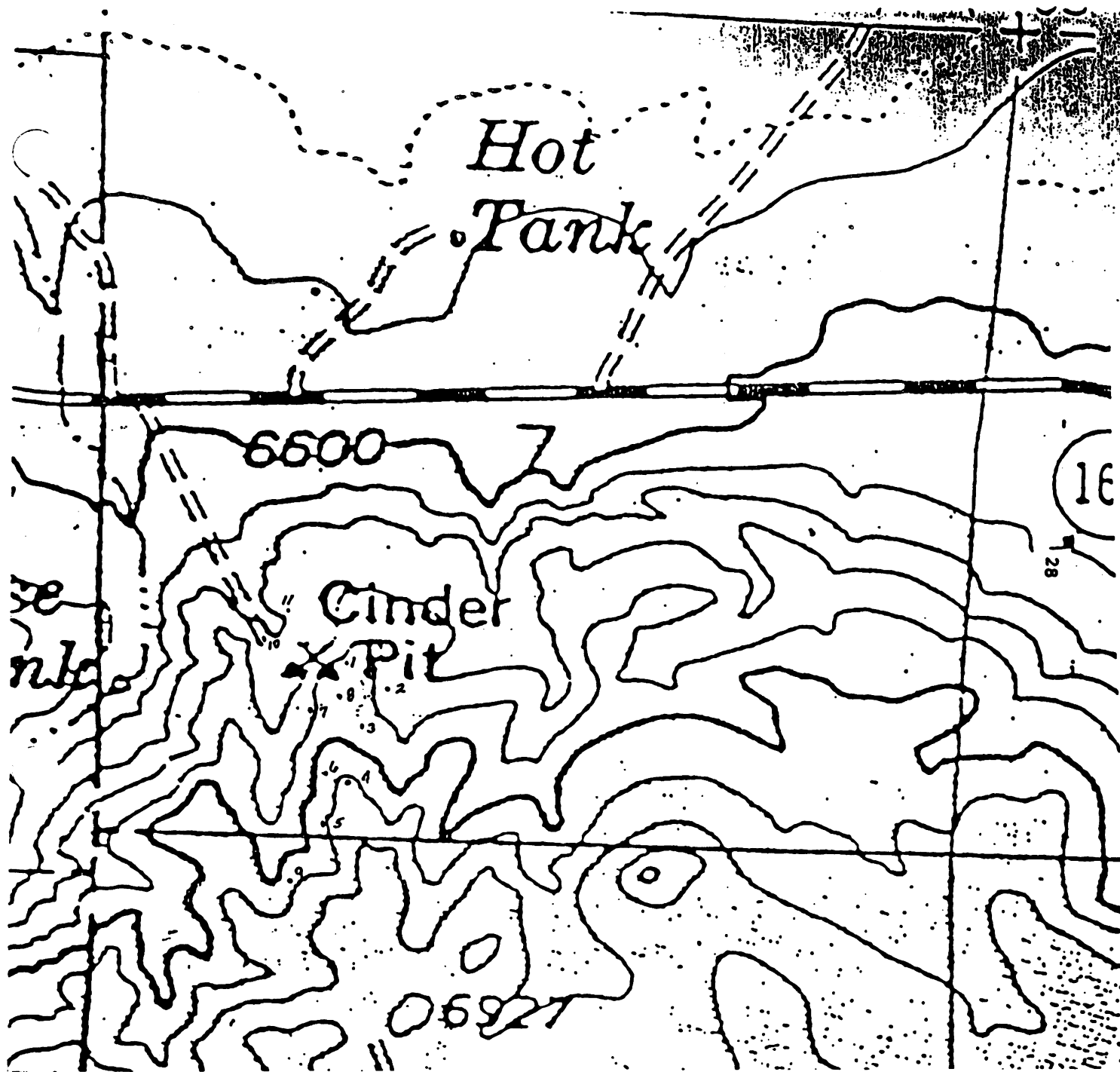
Exhibit 16: SEM electron micrograph of native silver grain. Sample: Take-6 table concentrate.

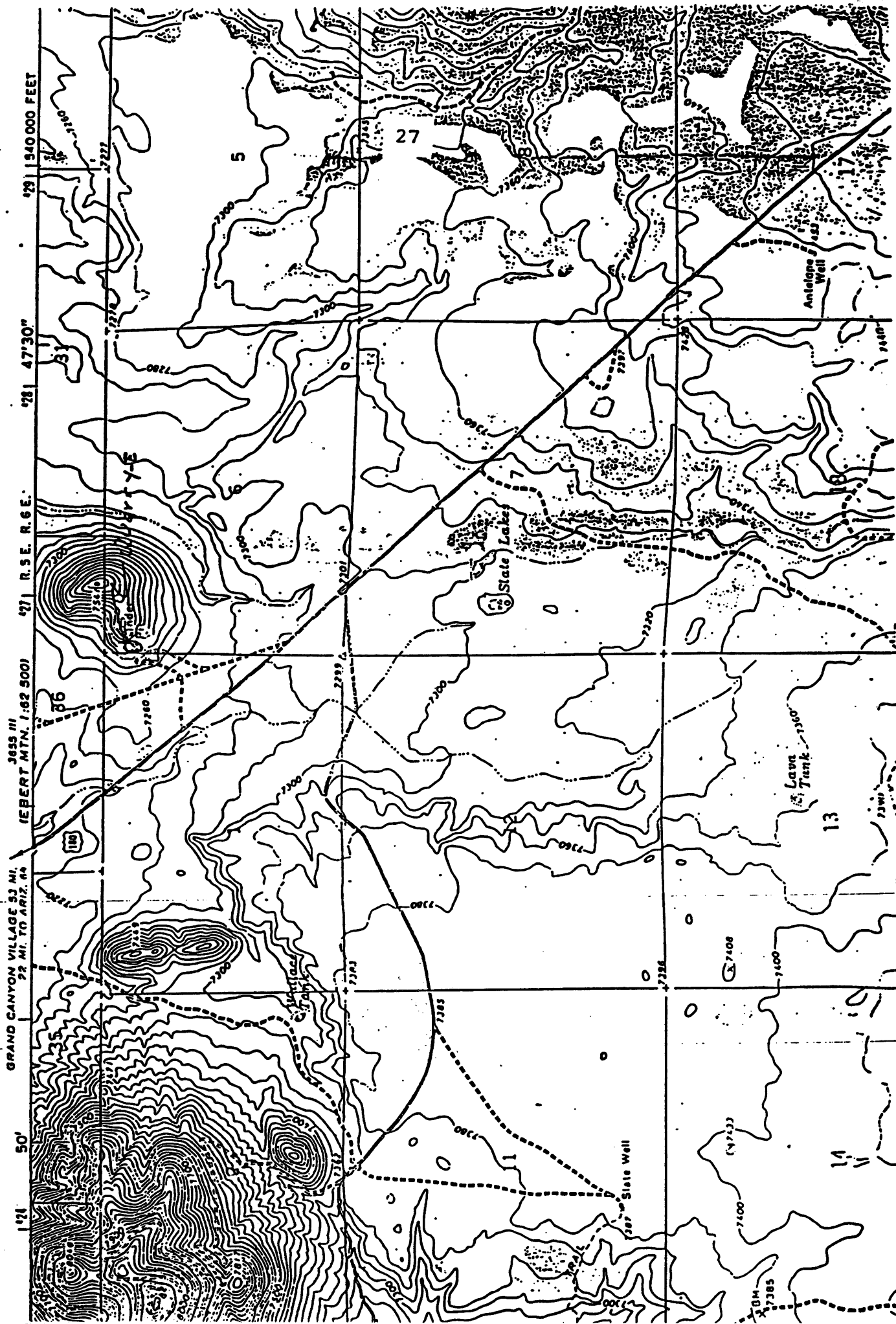
EDX Analysis:

Ag: 93.80
Si: 6.28%

APPENDIX I

Location Maps and Field Notes on Sample Collection



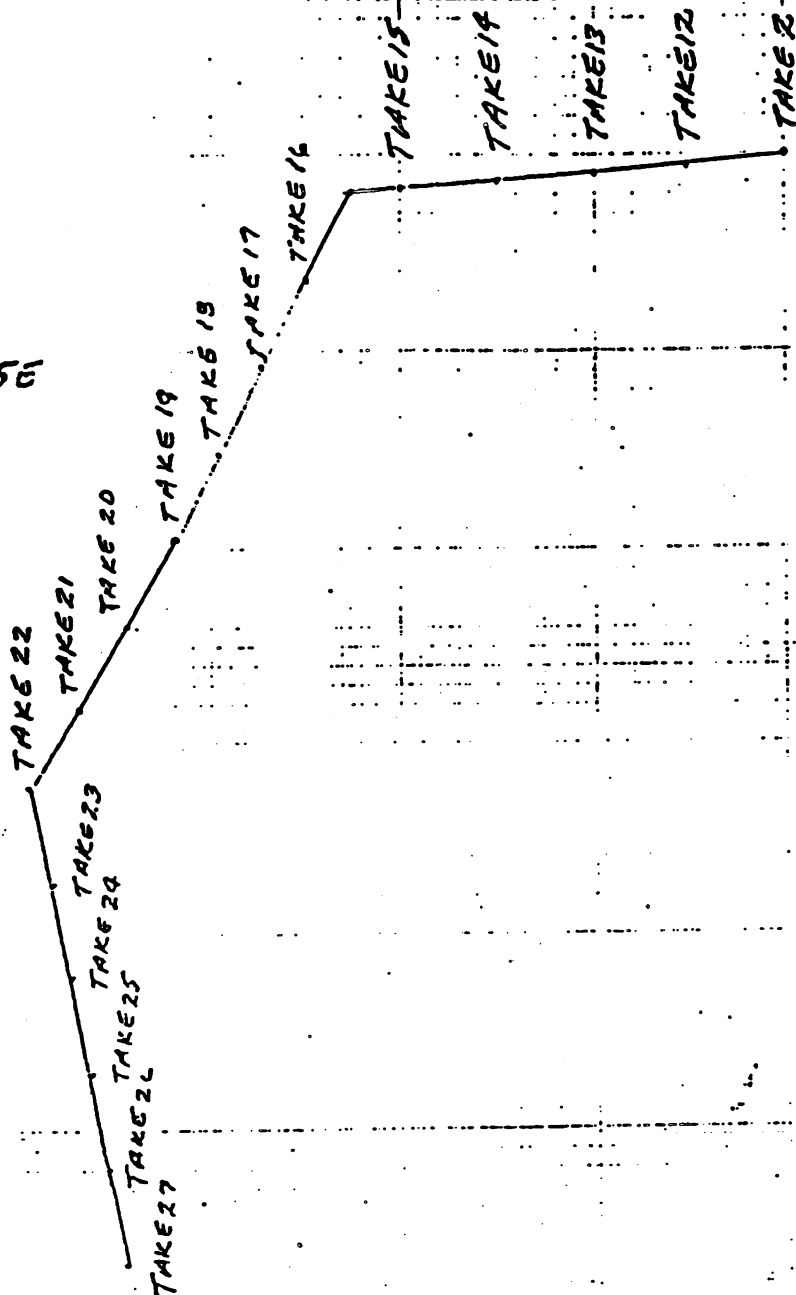


TAKEMOTO SAMPLE LOCATION MAP

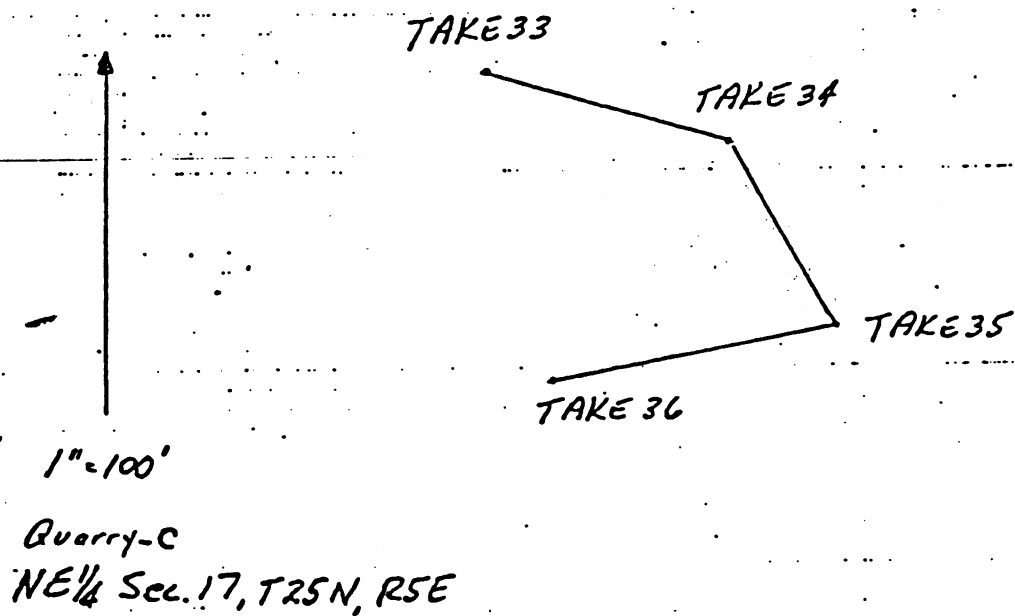
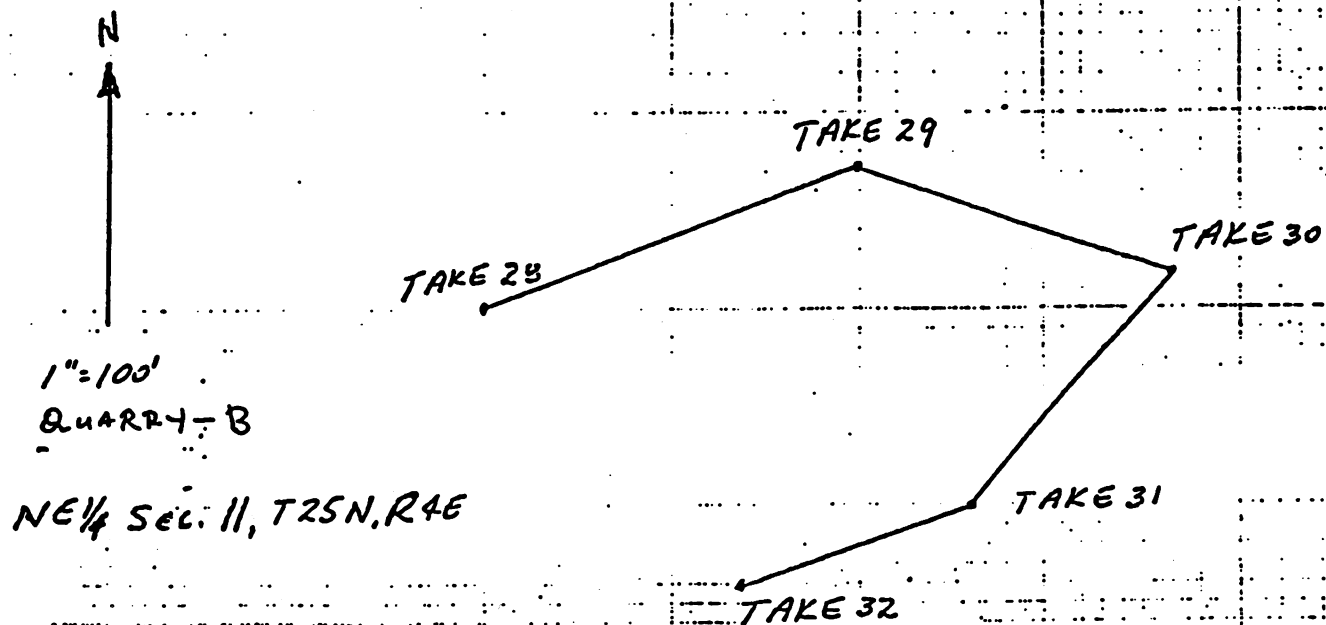


1" = 100'

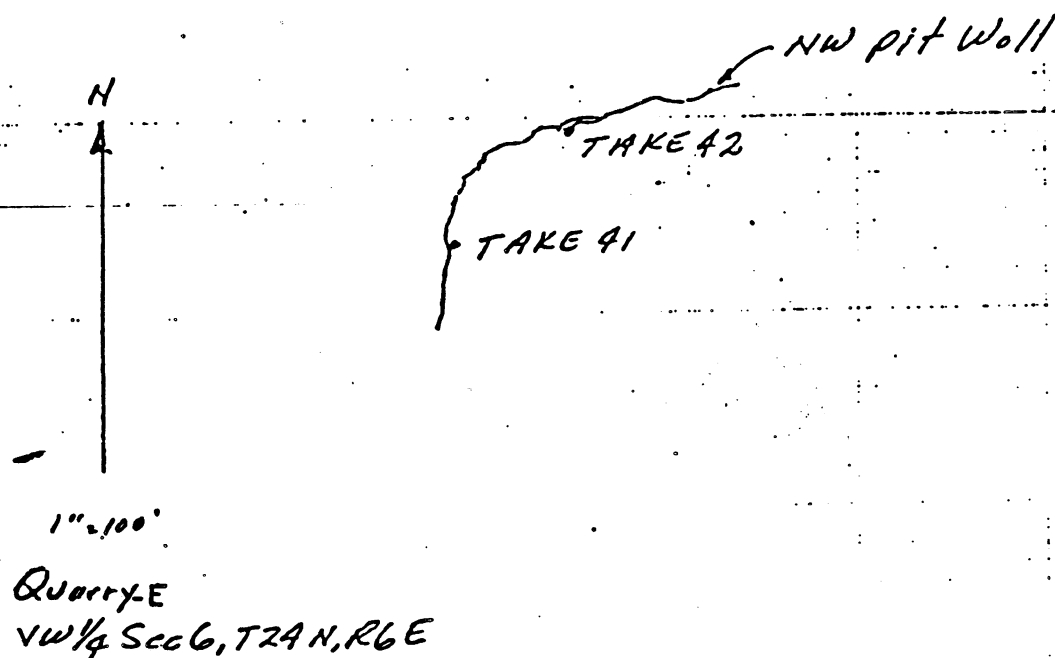
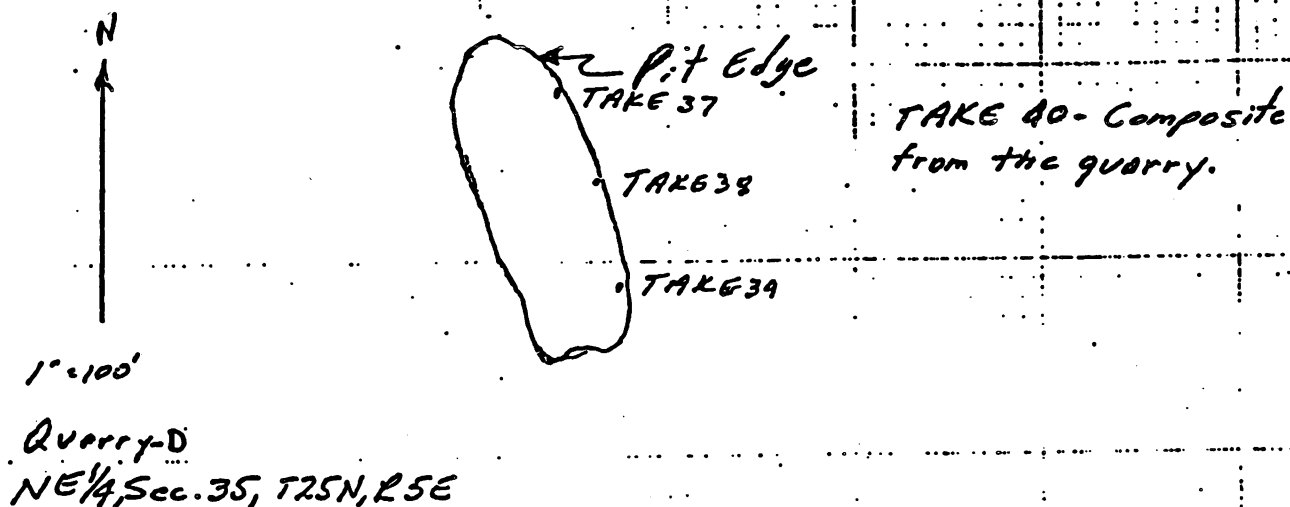
Quarry A
SW $\frac{1}{4}$ Sec. 7, T25N, R5E



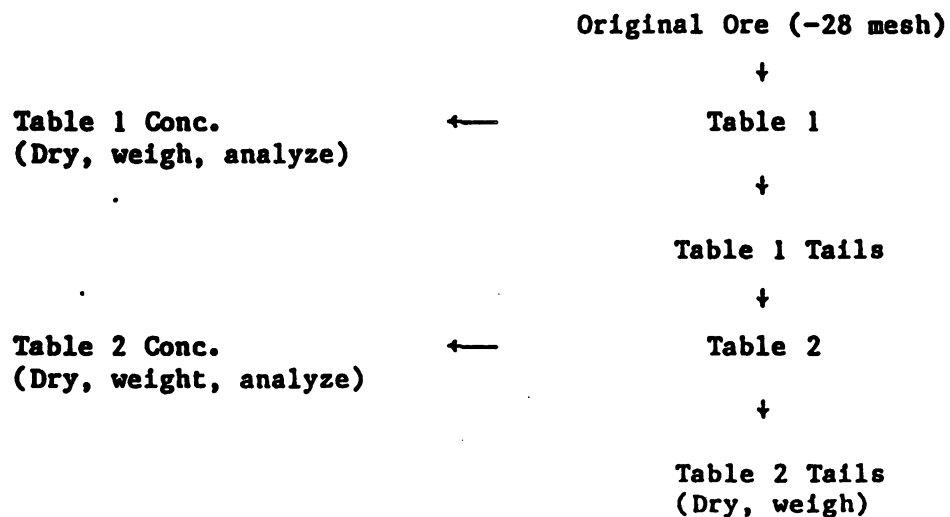
TAKEMOTO SAMPLE LOCATION MAP



TAKEMOTO SAMPLE LOCATION MAP



APPENDIX II: Flow Chart of Tabling Experiments



Results of Table Concentration

Sample	Table 1 Feed (g)	Table 2 Tails (g)	Table 2 Conc. (g)	% Conc. of Table 1 Feed
TAKE 1	6992	4560	563	8.1
TAKE 3	4776	3117	526	11.0
TAKE 6	11260	8956	1176	10.4
TAKE 7	9965	8028	1073	10.8
TAKE 29	7037	5715	963	13.7
TAKE 33	9451	7540	432	5.4
TAKE 35	5553	3173	560	10.1
TAKE 40	5594	3688	1048	22.1

All weights are dry or calculated dry from moisture content determinations and are in grams.

APPENDIX III

Treatment of Pulverized Samples for AA Analysis

1. In a 30ml porcelain crucible add in the following sequence, 4 gm sodium peroxide, 5.0 gm sample, and 9 gm sodium peroxide; mix; top up with 9-10 gm sodium peroxide.
2. Place crucible on tripod-stand. Carefully heat crucible in stand. Apply heat at bottom and sides with Bunsen burners.
3. Heat until molten and boiling.
4. Allow to boil for about 5 minutes.
5. Place crucible in beaker (400 to 600 ml) and allow to cool.
6. Add 20 ml distilled water; crucible is upright; let stand overnight.
7. Tip crucible on side.

8. Add distilled water to half the height of the crucible; allow reaction to proceed and cease.
9. Fill beaker to top of crucible with 20% HCl; allow reaction to cease.

10. Clean/soak crucible with/in acidic solution and remove from beaker. Heat the slurry to near dryness.
11. Add 50 ml of aqua regia and heat; a gelatinous mass of silicate gel forms after 4-6 hours of heating.
12. Add 100 ml distilled water to get gel into solution.
13. Add 50 ml HCl (conc.) and heat to dryness (silicate gel forms).
14. Add 100 ml distilled water and 50 ml HCl (conc.).
15. Warm (do not boil) and stir to dissolve solids.
16. Pour beaker's contents into 500 ml volumetric flask; add HCl (10%) to exact volume.
17. Shake flask and transfer a fraction to 100 ml volumetric flask.

18. Filter contents of 100 ml flask; dispose of solid.
19. Transfer filtrate (usually 80-90 ml) to separatory funnel and add 25 ml of MIBK.
20. Shake for 1 minute and allow phases to separate.
21. Draw off acid solution and dispose.
22. Draw off MIBK solution for AA analyses.
23. Take AA reading using MIBK solution obtained.
24. Compare data to MIBK solution readings used as standard and compute results as ppm gold in original ore sample.

APPENDIX IV

Fire Assay Results Reported by Our
External Referee Laboratory

Analysis of 48 Crushed Rock Samples

ITEM	SAMPLE NUMBER	Au (ppm)	Ag (ppm)
1	YATAKE-02	<.02	<.2
2	YATAKE-03	<.02	.4
3	YATAKE-04	<.02	<.2
4	YATAKE-05	<.02	<.2
5	YATAKE-06	<.02	.4
6	YATAKE-07	<.02	.6
7	YATAKE-08	<.02	.2
8	YATAKE-09	<.02	<.2
9	YATAKE-10	<.02	1.0
10	YATAKE-11	.03	1.0
11	YATAKE-12	<.02	<.2
12	YATAKE-13	<.02	<.2
13	YATAKE-14	<.02	<.2
14	YATAKE-15	<.02	<.2
15	YATAKE-16	<.02	<.2
16	YATAKE-17	<.02	<.2
17	YATAKE-18	<.02	<.2
18	YATAKE-19	<.02	<.2
19	YATAKE-20	<.02	<.2
20	YATAKE-21	<.02	<.2
21	YATAKE-22	<.02	<.2
22	YATAKE-23	<.02	.2
23	YATAKE-24	<.02	<.2
24	YATAKE-25	<.02	<.2
25	YATAKE-26	<.02	<.2

ITEM	SAMPLE NUMBER	Au (ppm)	Ag (ppm)
26	YATAKE-27	<.02	<.2
27	YATAKE-28	<.02	<.2
28	YATAKE-29	<.02	1.2
29	YATAKE-30	<.02	<.2
30	YATAKE-31	<.02	<.2
31	YATAKE-32	<.02	<.2
32	YATAKE-33	<.02	.4
33	YATAKE-34	<.02	<.2
34	YATAKE-36	.07	7.8
35	YATAKE-37	<.02	<.2
36	YATAKE-38	<.02	.2
37	YATAKE-39	<.02	<.2
38	YATAKE-40	<.02	2.0
39	YATAKE-41	.16	22.0
40	YATAKE-42	<.02	2.7
41	YATAKE-01TC	.72	1.0
42	YATAKE-03TC	.26	.6
43	YATAKE-06TC	.88	.6
44	YATAKE-07TC	.80	1.4
45	YATAKE-29TC	.12	6.6
46	YATAKE-33TC	2.60	2.4
47	YATAKE-35TC	.26	.8
48	YATAKE-40TC	.25	3.5

APPENDIX V

Spectral Analyses of Samples and Table Concentrates

JOB NO. DFR 128
PAGE 2

ITEM NO. SAMPLE NO.
1 = YATAKE-02
2 = YATAKE-03
3 = YATAKE-04
4 = YATAKE-05
5 = YATAKE-06
6 = YATAKE-07
7 = YATAKE-08
8 = YATAKE-09

ITEM	1	2	3	4	5	6	7	8
ELEMENT								
Fe	5%	5%	3%	3%	7%	5%	5%	5%
Ca	5%	2%	3%	2%	3%	3%	3%	2%
Mg	2%	1%	1%	1.5%	1%	1.5%	1%	0.5%
Ag	<1	<1	<1	<1	<1	<1	<1	<1
As	<200	<200	<200	<200	<200	<200	<200	<200
B	10	<10	<10	<10	<10	10	10	<10
Ba	300	200	200	300	300	300	300	300
Be	<2	<2	<2	<2	<2	<2	<2	<2
Bi	<10	<10	<10	<10	<10	<10	<10	<10
Cd	<50	<50	<50	<50	<50	<50	<50	<50
Co	50	50	30	30	100	50	70	70
Cr	70	30	20	20	100	70	70	30
Cu	100	50	50	30	100	70	70	50
Ga	10	10	10	<10	30	10	10	15
Ge	<20	<20	<20	<20	<20	<20	<20	<20
La	20	<20	<20	<20	<20	<20	<20	<20
Mn	1000	500	700	1000	1000	700	700	700
Mo	<2	<2	<2	<2	2	2	<2	<2
Nb	<20	<20	<20	<20	<20	<20	<20	<20
Ni	50	30	20	30	70	50	50	50
Pb	20	<10	10	10	10	10	10	15
Sb	<100	<100	<100	<100	<100	<100	<100	<100
Sc	20	20	15	<10	20	20	20	20
Sn	<10	<10	<10	<10	<10	<10	<10	<10
Sr	1000	500	500	500	500	700	700	500
Ti	10000	7000	7000	7000	10000	10000	10000	10000
V	100	100	100	100	100	100	100	100
W	<50	<50	<50	<50	<50	<50	<50	<50
Y	20	10	<10	<10	10	10	10	10
Zn	<200	<200	<200	<200	<200	<200	<200	<200
Zr	70	50	50	<20	50	50	70	100

ITEM NO. SAMPLE NO.
 9 = YATAKE-10
 10 = YATAKE-11
 11 = YATAKE-12
 12 = YATAKE-13
 13 = YATAKE-14
 14 = YATAKE-15
 15 = YATAKE-16
 16 = YATAKE-17

ITEM	9	10	11	12	13	14	15	16
ELEMENT								
Fe	5%	5%	5%	3%	2%	7%	5%	5%
Ca	3%	2%	3%	3%	1%	2%	2%	3%
Mg	1.5%	2%	1.5%	1.5%	1%	1.5%	1%	1%
Ag	<1	<1	<1	<1	<1	<1	<1	<1
As	<200	<200	<200	<200	<200	<200	<200	<200
B	<10	<10	10	<10	<10	<10	<10	<10
Ba	300	300	500	300	200	300	500	300
Be	<2	<2	<2	<2	<2	<2	<2	<2
Bi	<10	<10	<10	<10	<10	<10	<10	<10
Cd	<50	<50	<50	<50	<50	<50	<50	<50
Co	50	50	50	50	50	70	50	30
Cr	70	100	50	30	20	70	70	30
Cu	30	70	50	50	50	70	50	30
Ga	10	20	10	10	<10	15	10	10
Ge	<20	<20	<20	<20	<20	<20	<20	<20
La	<20	<20	<20	<20	<20	<20	<20	20
Mn	700	1000	1000	1000	300	1000	1000	1000
Mo	5	<2	<2	<2	<2	2	2	<2
Nb	<20	<20	<20	<20	<20	<20	<20	<20
Ni	50	70	30	30	30	50	50	20
Pb	10	15	<10	10	30	<10	<10	10
Sb	<100	<100	<100	<100	<100	<100	<100	<100
Sc	20	15	20	15	10	20	20	15
Sn	<10	<10	<10	<10	<10	<10	<10	<10
Sr	500	500	700	500	300	500	700	700
Ti	10000	5000	10000	5000	5000	7000	7000	7000
V	100	70	150	100	70	150	150	100
W	<50	<50	<50	<50	<50	<50	<50	<50
Y	10	<10	10	10	<10	10	10	10
Zn	<200	<200	<200	<200	<200	<200	<200	<200
Zr	50	20	50	30	20	50	100	50

JOB NO. DFR 128

PAGE 4

ITEM NO. SAMPLE NO.

17 = YATAKE-18

18 = YATAKE-19

19 = YATAKE-20

20 = YATAKE-21

21 = YATAKE-22

22 = YATAKE-23

23 = YATAKE-24

24 = YATAKE-25

ITEM	17	18	19	20	21	22	23	24
ELEMENT								
Fe	5%	7%	5%	7%	3%	5%	5%	5%
Ca	2%	5%	3%	3%	2%	5%	3%	2%
Mg	1%	2%	2%	2%	1%	2%	1.5%	1.5%
Ag	<1	<1	<1	<1	<1	<1	<1	<1
As	<200	<200	<200	<200	<200	<200	<200	<200
B	<10	10	<10	<10	10	10	10	<10
Ba	300	500	300	300	200	500	300	300
Be	<2	<2	<2	<2	<2	<2	<2	<2
Bi	<10	<10	<10	<10	<10	<10	<10	<10
Cd	<50	<50	<50	<50	<50	<50	<50	<50
Co	30	50	50	70	50	30	30	30
Cr	50	70	50	50	20	50	70	30
Cu	30	70	70	100	30	70	50	50
Ga	10	10	10	30	<10	20	10	20
Ge	<20	<20	<20	<20	<20	<20	<20	<20
La	<20	20	<20	<20	<20	20	20	<20
Mn	700	1500	1000	1500	700	2000	1000	1000
Mo	<2	2	<2	2	<2	<2	<2	<2
Nb	<20	<20	<20	<20	<20	<20	<20	<20
Ni	20	50	50	70	30	20	30	30
Pb	10	<10	<10	10	<10	10	<10	<10
Sb	<100	<100	<100	<100	<100	<100	<100	<100
Sc	15	20	20	20	15	20	20	15
Sn	<10	<10	<10	<10	<10	<10	<10	<10
Sp	500	1000	700	1000	500	1500	700	500
Ti	7000	10000	10000	>10000	7000	10000	10000	10000
V	100	100	100	150	100	150	100	100
W	<50	<50	<50	<50	<50	<50	<50	<50
Y	10	20	15	15	10	15	15	10
Zn	<200	<200	<200	<200	<200	<200	<200	<200
Zr	50	100	70	70	50	70	70	50

JOB NO. DFR 128
PAGE 5

ITEM NO. SAMPLE NO.
25 = YATAKE-26
26 = YATAKE-27
27 = YATAKE-28
28 = YATAKE-29
29 = YATAKE-30
30 = YATAKE-31
31 = YATAKE-32
32 = YATAKE-33

ITEM	25	26	27	28	29	30	31	32
ELEMENT								
Fe	5%	5%	3%	5%	5%	5%	5%	7%
Ca	3%	1.5%	3%	5%	3%	3%	3%	2%
Mg	1.5%	1%	2%	3%	2%	2%	2%	1%
Ag	<1	<1	<1	2	<1	<1	<1	<1
As	<200	<200	<200	<200	<200	<200	<200	<200
B	10	<10	10	10	10	<10	10	<10
Ba	500	300	500	700	500	300	300	300
Be	<2	<2	<2	<2	<2	<2	<2	<2
Bi	<10	<10	<10	<10	<10	<10	<10	<10
Cd	<50	<50	<50	<50	<50	<50	<50	<50
Co	30	50	30	30	50	50	50	50
Cr	70	50	500	700	700	500	500	<10
Cu	50	50	70	150	100	70	100	50
Ga	10	20	<10	20	<10	<10	10	10
Ge	<20	<20	<20	<20	<20	<20	<20	<20
La	<20	<20	20	20	<20	<20	<20	<20
Mn	1000	700	1000	2000	1000	1000	1000	1000
Mo	2	2	<2	<2	2	<2	<2	2
Nb	<20	<20	<20	<20	<20	<20	<20	<20
Ni	50	50	150	150	150	70	150	10
Pb	<10	<10	<10	15	<10	<10	<10	<10
Sb	<100	<100	<100	<100	<100	<100	<100	<100
Sc	20	20	20	20	30	20	20	20
Sn	<10	<10	<10	<10	<10	<10	<10	<10
Sr	700	500	500	500	500	500	300	500
Ti	10000	10000	7000	7000	7000	7000	7000	10000
V	100	100	100	100	100	100	100	150
W	<50	<50	<50	<50	<50	<50	<50	<50
Y	15	10	10	10	20	<10	10	15
Zn	<200	<200	<200	<200	<200	<200	<200	<200
Zr	50	50	70	70	70	30	50	70

JOB NO. DFR 128
PAGE 6

ITEM NO. SAMPLE NO.
33 = YATAKE-34
34 = YATAKE-36
35 = YATAKE-37
36 = YATAKE-38
37 = YATAKE-39
38 = YATAKE-40
39 = YATAKE-41
40 = YATAKE-42

ITEM	33	34	35	36	37	38	39	40
ELEMENT								
Fe	5%	3%	3%	5%	5%	2%	7%	3%
Ca	1%	3%	1.5%	2%	2%	2%	3%	2%
Hg	1%	1%	1%	2%	1%	1%	1.5%	1.5%
Ag	<1	7	<1	<1	<1	1.5	20	1.5
As	<200	<200	<200	<200	<200	<200	<200	<200
B	<10	10	10	<10	<10	<10	<10	<10
Ba	200	300	300	300	300	300	500	300
Be	<2	<2	<2	<2	<2	<2	<2	<2
Bi	<10	<10	<10	<10	<10	<10	<10	<10
Cd	<50	<50	<50	<50	<50	<50	<50	<50
Co	50	30	30	30	50	20	70	30
Cr	<10	<10	<10	<10	<10	<10	<10	<10
Cu	30	70	50	50	50	20	70	30
Ga	10	10	10	15	20	20	20	20
Ce	<20	<20	<20	<20	<20	<20	<20	<20
La	<20	<20	<20	<20	<20	<20	<20	<20
Mn	500	1500	1000	1000	1000	1500	1500	1000
Mo	<2	2	<2	2	2	<2	5	<2
Nb	<20	<20	<20	<20	<20	<20	<20	<20
Ni	15	5	10	20	10	5	20	7
Pb	<10	30	<10	<10	<10	20	150	10
Sb	<100	<100	<100	<100	<100	<100	<100	<100
Sc	10	20	15	20	15	10	20	10
Sn	<10	<10	<10	<10	<10	<10	<10	<10
Gr	300	700	300	500	300	500	500	500
Ti	7000	10000	10000	10000	10000	7000	>10000	7000
V	100	100	100	150	100	70	150	100
U	<50	<50	<50	<50	<50	<50	<50	<50
Y	<10	10	10	20	10	<10	20	10
Zn	<200	<200	<200	<200	<200	<200	<200	<200
Zr	50	70	70	100	100	100	50	100

JOB NO. DFR 128
PAGE 7

ITEM NO. SAMPLE NO.
41 = YATAKE-01TC
42 = YATAKE-03TC
43 = YATAKE-06TC
44 = YATAKE-07TC
45 = YATAKE-29TC
46 = YATAKE-33TC
47 = YATAKE-35TC
48 = YATAKE-40TC

ITEM	41	42	43	44	45	46	47	48
ELEMENT								
Fe	5%	3%	5%	3%	7%	5%	3%	5%
Ca	2%	3%	5%	3%	5%	3%	2%	1%
Mg	2%	2%	3%	3%	5%	1.5%	1%	1%
Ag	<1	<1	<1	1.5	5	1	<1	2
As	<200	<200	<200	<200	<200	<200	<200	<200
B	<10	<10	<10	<10	<10	<10	<10	<10
Ba	300	300	300	300	300	300	300	200
Be	<2	<2	<2	<2	<2	<2	<2	<2
Bi	<10	<10	<10	<10	<10	<10	<10	<10
Cd	<50	<50	<50	<50	<50	<50	<50	<50
Co	70	30	50	50	150	50	30	50
Cr	200	100	200	150	1500	20	<10	<10
Cu	50	30	50	30	150	50	30	30
Ga	20	10	15	10	10	10	10	10
Ge	<20	<20	<20	<20	<20	<20	<20	<20
La	<20	20	<20	<20	<20	50	<20	<20
Mn	700	1000	1500	1000	1500	1000	1000	700
Mo	<2	<2	<2	<2	2	<2	<2	<2
Nb	<20	<20	<20	<20	<20	<20	<20	<20
Ni	100	50	50	50	500	15	10	20
Pb	100	50	50	20	100	70	20	20
Sb	<100	<100	<100	<100	<100	<100	<100	<100
Sc	20	15	20	20	30	15	10	10
Sn	<10	<10	<10	<10	<10	<10	<10	<10
St	500	500	700	500	500	700	500	300
Ti	7000	7000	7000	7000	7000	10000	7000	7000
V	100	100	100	100	100	100	100	100
U	<50	<50	<50	<50	<50	<50	<50	<50
Y	<10	10	10	10	10	20	<10	<10
Zn	<200	<200	<200	<200	<200	<200	<200	<200
Zr	20	70	50	70	70	100	100	70



DAVID H. FELL
& COMPANY, INC.
6009 Bendini Boulevard
City of Commerce, CA 90040
(213) 722-9992 • FAX (213) 722-6567

DATE: 11/25/92

INVOICE: 4441

NAME: MARIAH INTERNATIONAL INC.
ADDRESS: 2221 W. MELINDA

w/c

CODE: M130005

JOB#: 24067

PHOENIX , AZ 85027

DUE DATE: 11/25/92

MATERIAL	WEIGHT RECD	GOLD	SILVER	PLATINUM	PALLADIUM	OTHER
CONCENTRATES	45.000 N/P	5.317	0.000	0.000	0.000	0.000
REFINED WEIGHT IN TOZ.-- TOTALS:		5.317	0.000	0.000	0.000	0.000

C H A R G E S					
REFINING: GOLD \$	50.00	RETURNING: GOLD \$	4.67	ALLOYING \$	0.00
PLATINUM \$	0.00	PLATINUM \$	0.00	SAMPLING \$	67.50
PALLADIUM \$	0.00	PALLADIUM \$	0.00	BAR CHARGE \$	5.00
SILVER \$	0.00	SILVER \$	0.00		0.00
	0.00	SMELTING \$	0.00	TOTAL	127.17

- 5.317 TOZ	GOLD RECOVERED
- 0.266 TOZ	5.000% RECOVERY FEE
- 0.380 TOZ	TOTAL CHARGES \$127.17
4.671 TOZ	FINE GOLD BAR RETURNED

\$ 127.17 CASH

TOTAL \$ 0.00

REC'D BY:



**DAVID H. FELL
& COMPANY, INC.**

6009 Bandini Boulevard

City of Commerce, CA 90040

(213) 722-9992 • FAX (213) 722-6567

I N V O I C E
No. 71574

Date: 11/25/92

M130005

S
O
L
D

S MARIAH INTERNATIONAL INC.
H 2221 W. MELINDA
I
P PHOENIX AZ 85027

Trans Date	Taxable	P.O. Number	Gold	Silver	Terms
11/25/92	NO	WILL CALL 11/30	334.350	3.740	COD

Quantity	Description	Price	Extension
4.671	TOZ FINE GOLD BAR RET. ON J24067	0.000	0.00
	****CUSTOMER WILL PICK UP 11/30****	0.000	0.00
	TOTAL	\$	0.00

RECEIVED IN GOOD ORDER BY _____

1.5% will be charged on overdue accounts

JAN 28 '93 08:52 ARIZONA PRECAST CO

P.02/93


**DAVID H. FELL
& COMPANY, INC.**

6009 Bandini Boulevard

City of Commerce, CA 90040

(213) 722-9992 • FAX (213) 722-6567

INVOICE: 4635

NAME: MARIAH INTERNATIONAL INC.
ADDRESS: 2221 W. MELINDA

PHOENIX , AZ 85027

CODE: MM13145

JOB#: 24185

DUE DATE: 1/ 5/92

MATERIAL	WEIGHT RECD	GOLD	SILVER	PLATINUM	PALLADIUM	OTHER
CONCENTRATE /DRY	53.000 N/P	3.287	0.000	0.000	0.000	0.000
POWDER	0.000 /O	0.000	0.000	0.000	0.000	0.000
FINED WEIGHT IN TOZ.-- TOTALS:		3.287	0.000	0.000	0.000	0.000

C H A R G E S

REFINING: GOLD \$	50.00	RETURNING: GOLD \$	0.00	ALLOYING \$	0.00
PLATINUM \$	0.00	PLATINUM \$	0.00	TREATMENT \$	79.50
PALLADIUM \$	0.00	PALLADIUM \$	0.00	BAR CHARGE \$	5.00
SILVER \$	0.00	SILVER \$	0.00	SHIPPING \$	10.00
\$	0.00	SMELTING \$	0.00	TOTAL DUE DHF	145.10

3.287 TOZ	GOLD RECOVERED
0.164 TOZ	5.000% RECOVERY FEE
3.123 TOZ	FINE GOLD BAR RETURNED

TOTAL \$ 0.00



DAVID H. FELL
& COMPANY, INC.
6009 Bandini Boulevard
City of Commerce, CA 90040
(213) 722-9992 • FAX (213) 722-6567

PRINTED DATE: 12/ 8/92
TIME: 11:35 AM

DATE: 12/ 8/92

JOB#: 24185

DUE DATE: 1/ 5/92

CODE: MM13145
NAME: MARIAH INTERNATIONAL INC.
ADDRESS: 2221 W. MELINDA

PHOENIX . AZ 85027

ATTENTION:
TELEPHONE: (602)581-5144

SPECIAL INSTRUCTIONS
REFINE THE GOLD FROM SAMPLES & SMELT TI
GOLD FROM CONCENTRATES
ADVANCES

CHK# \$ 0.00

CONTAINER MATERIAL
2 BUCKETS AU CONCENTRATE /DRY
POWDER

GROSS WT NET WT
57.000 P 0.000 P

D

CERTIFICATE OF ASSAY

Date Assayed 12-5-91

Mariah Guild Mark Joint Venture
1000 East Apache, Suite No. 109
Tempe, AZ 85281

Alpine essay

ATTN: Mr. Bill Allred

[illegible]

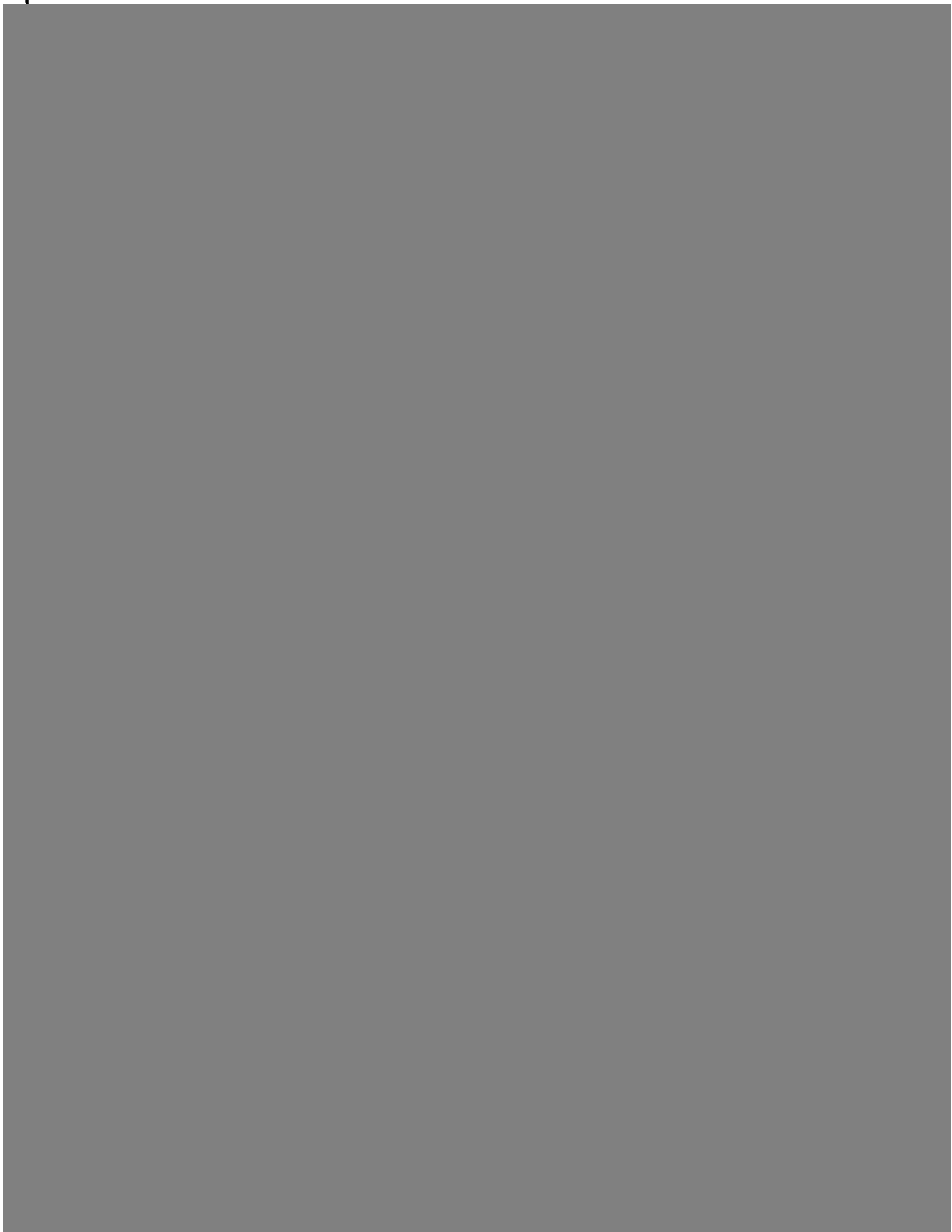
Date Assayed 12-17-91

Alpine essay

[illegible]

HWY. 30 W. • 108 CLEARSPRING DR.
TWIN FALLS, IDAHO 83301 • (208) 734-8807

TOTAL \$77.00



HOWARD L. ECKERSLEY

EXPERIENCE: Staff executive to Howard Hughes. Administered his personal and corporate enterprises as a top aide, traveling world wide as necessary. Involved in his many businesses, including electronics and aviation (TWA, Northeast Airlines, Hughes, Airwest, Hughes Helicopters), airports in Las Vegas, North Las Vegas and Salt Lake City.

President and Director of Astron Energy Companies. Managed the development and manufacture of the Vari-Vent, a new type of carburetor.

President and Board Chairman of Pan American Mines, Ltd., a publicly traded company on the Canadian Stock Exchange. Mined uranium in Arizona.

Co-Founder, Officer and Director of Aero-Spacelines, Inc. Worked in the administration of the design, construction and operation of the largest operating aircraft in the world. These airplanes were under contract to NASA and carried all of the large hardware for the U.S. space program. Today, they are used by NASA and the European Airbus Company.

Officer and Director of many other small companies, including insurance, paving, readymix, mining, real estate, and minerals processing.

Industrial Psychologist for Utah State Employment Services.

Fulfilled mission for the Church of Jesus Christ of Latter-Day Saints in New Zealand.

Served as Boatswain's Mate with the U.S. Navy during World War II in the Pacific.

EDUCATION: University of Washington, Seattle, Washington
University of California, Los Angeles, California
Brigham Young University, Provo, Utah
University of Utah, Salt Lake City, Utah

LIONEL A. DORSAY

BUSINESS EXPERIENCE:

1980 - present: Obtained real estate broker's license in Phoenix and became commercial real estate developer and broker. Developed office buildings, shopping centers and apartment complexes in multi-million dollar range.

1978-1980: **Whitehall Division of American Home Products, International Vice-President.**

Responsible for a \$100,000,000 international over-the-counter drug business based in New York. During this time, opened new territories, marketed plans (five year long range plans, operational plans) and developed new manufacturing facilities throughout the world.

1965-1978: **Armour & Company/Greyhound Corporation, International Marketing Manager.**

Responsible for organization and development of overseas agents and manufacturing facilities. In 1972, promoted to Vice-President for Armour Dial after Greyhound Corporation moved to Phoenix. Responsible for worldwide operations of \$100,000,000 chemical, pharmaceutical and consumer products business. Responsibilities included complete management authority and operations of overseas manufacturing plants, distributors, licensing, legal activities, etc. Required negotiations with top management and government officials all over the world. The business was extremely successful; however in 1978, the chemical and pharmaceutical activities of the Armour Dial Corporation was sold to Revlon.

Prior 1965: After naval service, hired as territorial manager for a Pennsylvania specialty chemical company. Developed new markets in the United States and abroad (based in Pennsylvania).

MILITARY SERVICE: NROTC scholarship to the University of Pennsylvania - upon graduation, commissioned as regular officer in U.S. Navy. Attended numerous specialized service schools including naval flight training - Honorable Discharge after four years of service as a Lieutenant (Naval Aviator).

EXTRA CURRICULAR ACTIVITIES:

Founding Director of the Grand Canyon State Bank of Arizona, now merged into National Bank of Arizona. Exchange Club of Scottsdale: tennis, golf and flying.

**RICHARD A. CAMPBELL
14028 PASEO CEVERA
SAN DIEGO, CA 92129**

(619) 484-4128

Mr. Campbell is a graduate of the University of Redlands with a B.S. in Business Administration and has 25 years of experience in sales, marketing and administration.

- 1992-Present: Mr. Campbell became an officer and director of Mariah International, Inc. and Guild Mark Industries, Inc. He is currently Vice President, Special Projects and Corporate Secretary for both companies, as well as a director. Mr. Campbell oversees the daily operations of the companies and is responsible for many of the company's major decisions. He is also the Director of Operations for the Merrill Crater Mining and Minerals LLC.
- 1989-1992: Mr. Campbell developed SportFlex, a fundraising vehicle for amateur sports at the college level and was involved in the sale and administration of this program to alumni supporters at many universities across America. This program was sold to American National Life.
- 1987-1989: Mr. Campbell joined the ranks of Metmor Financial, a division of Metropolitan Life, as a consultant to market, sell, and administer group insurance products to the existing client base, using flex benefits including pension, 401(k), and other group products.
- 1977-1987: He started the R.A. Campbell Company and became one of the most successful group insurance marketing and flex administration specialists in California. Author of "Employee Benefit Programs and Their Sale to the Consumer."
- 1975-1977: He rose from Sales Manager at Pacific Allied Insurance, Inc. to Vice President of Marketing and wrote more business than any other individual in the history of the group insurance business. He was responsible for over 500 sales and \$13,000,000 in premium.

- 1973-1975: As a new group underwriter, he wrote more group medical and dental business than any other sales representative had ever written for Pacific Mutual. He cultivated in excess of 50 brokers who requested his assistance in the sale and administration of his products.
- 1967-1973: Mr. Campbell was a dental consultant to the dental professions. His area was the nation's number one in sales for the L.D. Caulk Company. He was responsible for the sales and marketing efforts of 140 salespeople.

MAJOR AREA OF EXPERTISE

Mr. Campbell's experience includes excellent verbal and written skills with multiple certificates in pensions, 401(k), group insurance underwriting, estate planning, and the ability to communicate effectively at all levels of business.

POST GRADUATE EDUCATION

LaSalle University School of Law
Wharton School of Business
University of California, San Diego

FINANCIAL DATA

Preliminary estimates of reserves and recoverable values provide a basis for estimating the financial operating results of production. The following chart shows gross income based on three different productions based on:

- Gold price - \$340
- Ounces per ton - .14
- Recovery rate - 85%
- Operation days - 360

VOLUME	INCOME
200 Tons/Day	\$8,092
/Yr.	\$1,913,120
1000 Tons/Day	\$40,460
/Yr.	\$14,565,600
10,000 Tons/Day	\$404,600
/Yr.	\$145,656,000

OPERATING EXPENSES

Operating expenses for the mill were estimated to be less than \$150 dollars per ounce of gold due primarily to two reasons: 1) The simplicity of access to the ore being processed, and 2) The simplicity of the metallurgical process being used to recover the metallic values. Since the ore exists on the surface and is massive, very little overburden removal will be necessary. Mining will be easily accomplished utilizing bulldozers to strip the overburden aside, rip the surface and pile the ore. Front end loaders will then load the ore onto dump trucks, and carry the ore to the mill site. The metallurgical process being currently tested in the recovery process does not necessitate the inclusion of traditionally expensive, and ecologically abusive chemical materials. Actual operating expenses have been calculated based on recent production and are expected to be under \$65 per ounce for mining and milling costs, and under \$30 per ounce for refining costs. This is under \$100 per ounce and would allow Mariah to continue operations even if production decreases to less than 200 tons per day with gold dropping to under \$250 per ounce.

CAPITAL BUDGET

Flow sheets have been developed and capital costs to construct a 1000 ton a day plant have been determined by John Rud, M.Sc. Geologist in a detailed report to the Board of Directors. (This information is available on selected pages of the financials.)

SCIENTIFIC DATA

ASSAY REPORTS

Mariah has spent considerable resources over the past five years in testing the gold content of its mineral claims. A number of Certified and Registered Assayers have conducted mineralogical, spectrographic, and AA analysis, as well as standard and modified fire assays on samples taken from minerals under claim. The results have been positive and consistent with the standard practices allowed by the U.S. Bureau of Mines.

METALLURGICAL RECOVERY

Assays and metallurgical testing results conducted to date on Mariah's Merrill Crater project indicates recoverable values in excess of .14 ounces of gold per ton of ore. Mariah's chief geologist, John O. Rud, is currently engaged in testing new technological advancements designed to increase the metallurgical recovery of values from the materials that have been assayed. The most recent results have been extremely successful.

MINING POTENTIAL

Based on a recent report prepared by John O. Rud, geologist, Mariah's Merrill Crater claim is located 22 miles east of Flagstaff, Arizona within Township 21 North, Range 11 East, Sections 7 & 12. This claim is considered to be one of the larger deposits of volcanoclastic material in the San Franciscan volcanic field, with proven minable reserves of 5.5 million tons of ore and in excess of 500 million tons of probable reserves.

Mariah owns this land outright and has thousands of acres in Northern Arizona under claim, including 20 additional cinder cones. One of these properties under claim (Quarry "A") which has been extensively assayed and tested, possesses the following:

- Inferred ore reserves in excess of 53 million tons
- Probable ore reserves of 500 million tons

Quarry "A" includes three (3) 160 acre mining claims. Assays have been performed upon these claims on random samples taken from the property. The results were as favorable as those noted above.

INDEPENDENT VERIFICATION

Mariah has over the past several years, employed the services of a number of professionals within the mining industry for independent verification and certified results of their assays. These independent investigations were performed by Alpine Assay Twin Falls, Idaho; Jacobs Assay Office Tucson, Arizona; The Colorado School of Mines; Diester Concentrator Company, Tucson,

Arizona; David H. Fell Company, City of Commerce, California; General Kinematics, Chicago, Illinois; and others. Copies of those reports are included in the appendix.

BUSINESS DESCRIPTION

Mariah has acquired substantial volcanic mining properties, with efforts currently underway to acquire additional properties. The properties have been acquired as follows:

1. Company mining claims are filed on property owned by the Bureau of Land Management, Federal Forestry Department, and the State Of Arizona.
2. The Company has entered into mineral lease rights from individuals who have previously filed mining claims.
3. The Company has purchased fee land from individuals.

The mining properties can be classified into types of development as follows:

- A. Properties that have previously been operated as quarries for cinder rock. These properties have used a screen process which has left larger quantities of 1/8 minus ore on site. This material requires minimal if any crushing capabilities and substantially reduces the Company's cost to process this ore.
- B. Properties that have not been previously operated as quarries will require screening and crushing capabilities. This type of property will be developed with joint venture partners. The joint venture partners will be required to furnish the necessary capital and equipment to operate said property with the ore concentrates being delivered to Mariah's refinery for processing and sales of precious metals recovered.

All of the mining properties owned and under claim are open pit operations which will help to keep the costs of production at a minimal level, estimated to be less than \$150 per ounce.

The Company intends to construct an ore processing plant on its Merrill Crater project, near Flagstaff, Arizona. This property has excellent access to utilities, and should be operable on a year-round basis.

The Company will sell its precious metal ore concentrates to existing refineries, i.e., Johnson Matthey and Engelhard Metals, until it can construct its own refinery, in 1994.

MERRILL CRATER PROJECT

INTRODUCTION

During September 1992, Mariah conducted a pilot mill bulk sampling program on Merrill Crater. The objective was to determine the commercial viability of the area utilizing column flotation. The results obtained by the composite ore sample taken from the north side of the crater indicates an average gold content of .142 ounce per ton with a pilot mill recovery of 53 percent. The average recovered grade of gold within the sample was in excess of .07547 ounces per ton. It is expected that the recovery percentage will increase during the normal operations of a gold concentrating facility. (A complete report is available in the appendix.)

As a result of the findings in the November 23, 1992 report the Board of Directors commissioned Mr. John O. Rud to develop a plan for mill and mining construction - including equipment, costs, and availability. This was completed on December 15, 1992. (A list of the equipment and construction costs are on page 13 and 14 in the financial section of the business plan.)

The first plant will be constructed on property just adjacent to the Merrill Crater which is located 22 miles east of Flagstaff, Arizona.

GEOLOGY

The Merrill Cinder cone is within the Merriam Age strata which is approximately 50,000 years old. The composition of the cinders consists of aphanitic alkali olivine basalt. Basalt which is about 60 percent silica crystallizes faster than most other superheated magma and as a result, has a finer texture than many of the other volcanic materials. Phenocryst of hypersthene, clinopyroxene, plagioclase, and olivine a few millimeters in size, are surrounded by a very fine groundmass of highly oxidized material.

PLANT CONSTRUCTION

Projected costs for the Merrill Crater plant and construction, is as follows:

- Site Preparation
- Mining Equipment
- Crushing Equipment
- Grinding Equipment
- Flotation Equipment
- Solid/Liquid Separation
- Tailing Pond
- Structures and Ancillary Equipment

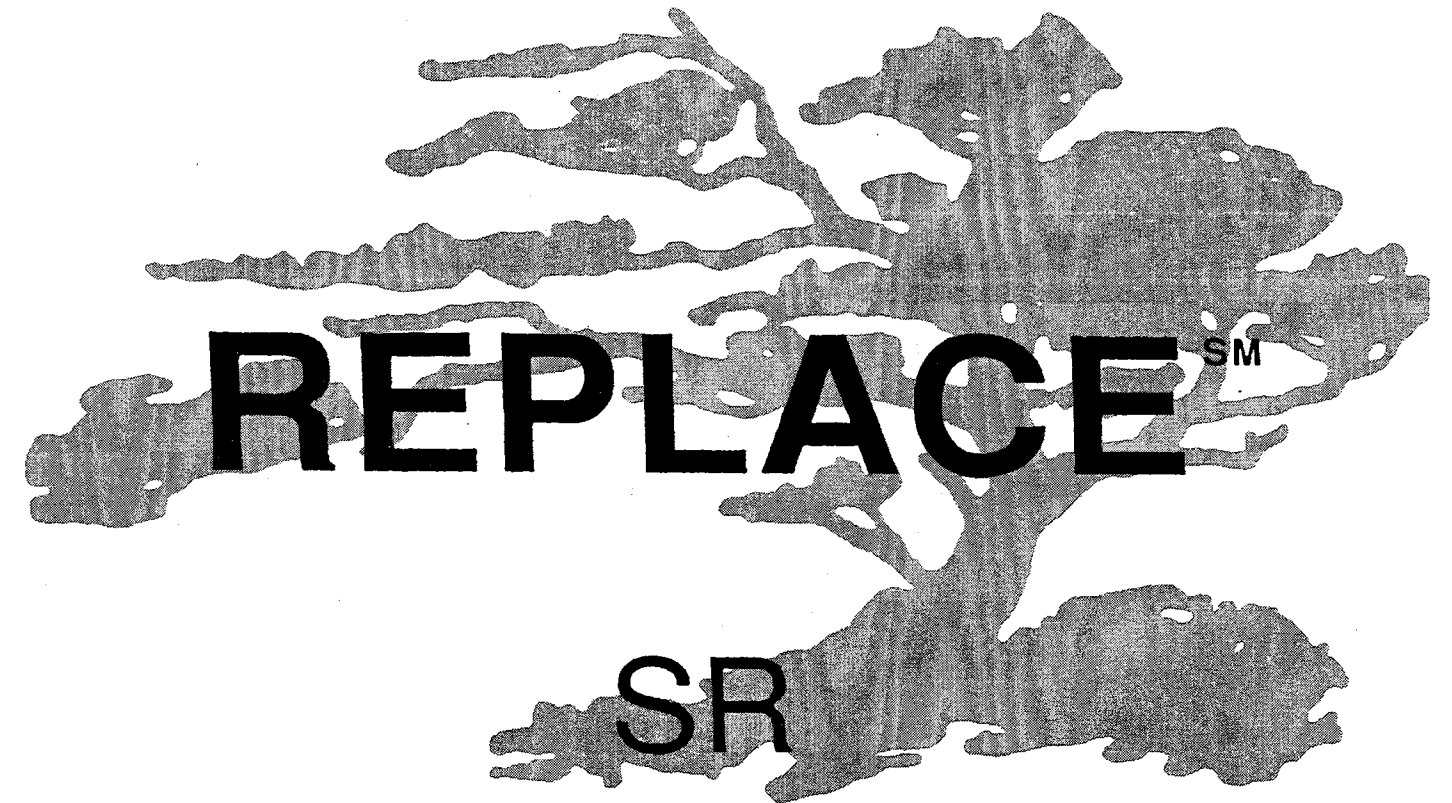
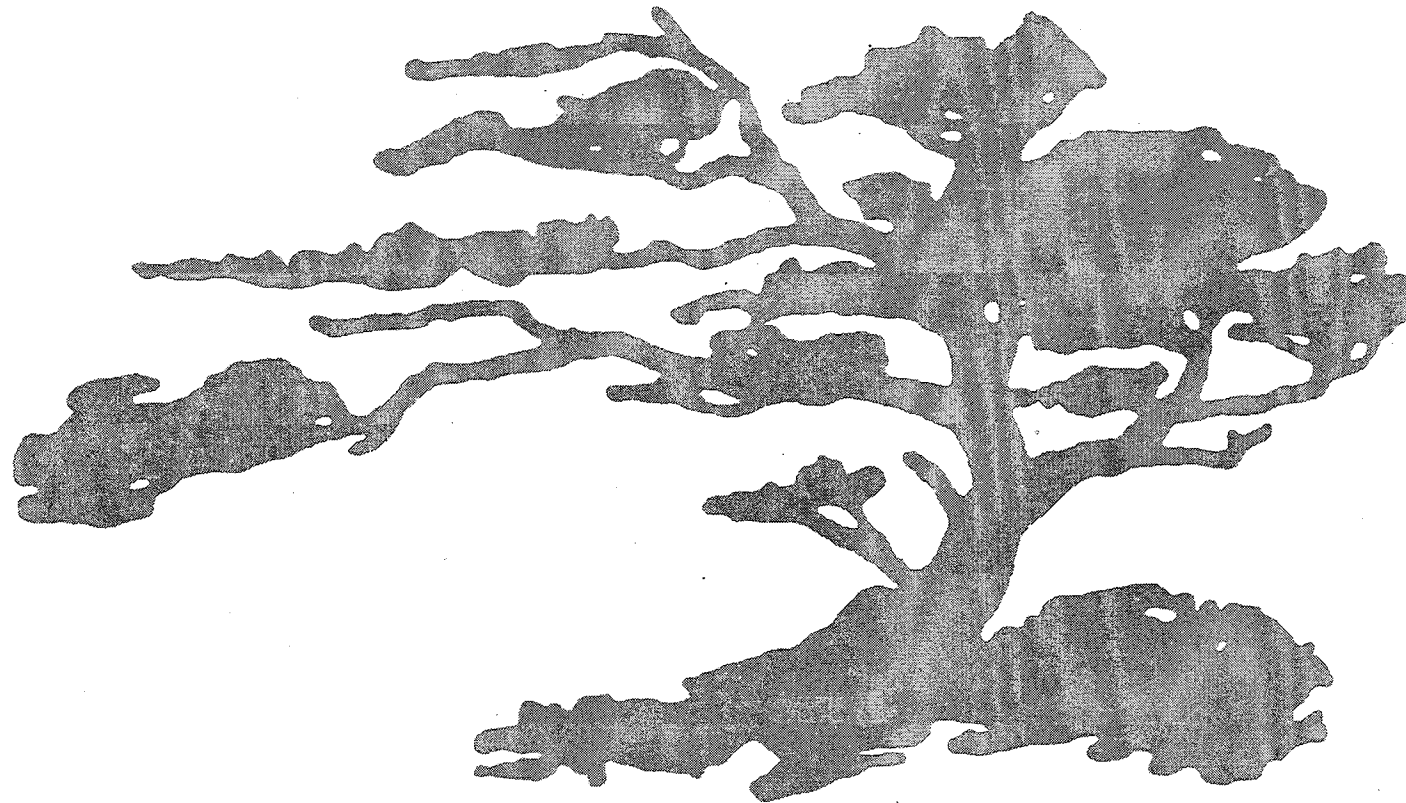
These costs were for a turn key operation and were between \$2,115,000 and \$3,198,000. After further review and consultation, management believes that the project can be built in the low \$2 million dollar range, because of some extremely low priced equipment that has been recently made available.

This plant, when in operation is designed to operate at a minimum rate of 1,000 tons of ore per day. Operating costs to produce an ounce of gold are among the lowest in the industry for gold producing plants. U.S. Bureau of Mines indicates that an average cost to produce one ounce of gold in 1992 was \$214, up from \$208 in 1991. Mariah's cost to produce one ounce of gold is under \$150, increasing gross revenues by over 42.5 percent.

Plant construction from site prep to full scale operation is scheduled to be approximately 180 days to allow for selected equipment fabrication. On site security would be provided by fencing and permanent staff on site.

CONCLUSIONS

Mariah has identified 5.5 million tons of minable reserves at an average grade of .142 ounces of gold per ton. Merrill Crater's probable reserves are in excess of 500 million tons of this relatively homogeneous material. At current prices the identified ore body of 5.5 million tons would have a commercial value in excess of \$265,000,000. Mariah intends to exploit this opportunity upon funding.



REPLACESM

SR

Soil Remineralization

A Market Whose Time Has Come

This memorandum does not constitute an offer to sell or the solicitation of an offer to buy. It does not purport to include all the information available for the companies mentioned. The reader is referred to the regular statistical services, company reports and any official prospectuses for further details.

ICP-MS Analysis of Merrill Crater Material
(Elemental Research, Inc., 5/27/93)

June 25, 1993

Minor Revisions Made: 6-17-93

SR

Soil Remineralization

A Market Whose Time Has Come

Table of Contents

Introduction	Page 1
The Case for Soil Remineralization	2
A Quick Tour of Soil Remineralization	3, 4
The Benefits of SR	5
Markets	6
Economic Factors	6, 7
Recent Developments	8
The Future	8
The Potential For Merrill Crater Material In Soil Remineralization	9

Micrograms			Micrograms			Typical Analysis of Azomite * (For Comparison)	
Element	Per Gram (ppm)	Approx. Percent	Element	Per Gram (ppm)	Approx. Percent		
Lithium	18	0.002%	Tin	4.9	Trace	<u>Major Minerals</u> Calcium (Ca) 8.000% Phosphorus (P) 0.140% Sodium (Na) 2.000% Chlorine (Cl) 0.002% Potassium (K) 5.300% Magnesium (Mg) 0.800% Sulfur (S) 0.200% Nitrogen (N) Trace	
Beryllium	2.8	Trace	Antimony	0.64	Trace		
Boron	54	0.005%	Tellurium	<0.3	Trace		
Magnesium	74000	7.400%	Iodine	1.8	Trace		
Aluminum	90000	9.000%	Caesium	0.5	Trace		
Silicon	Not Quant	>60%	Barium	1500	0.150%		
Calcium	98000	9.800%	Lanthanum	68	0.007%		
Scandium	28	0.003%	Cerium	140	0.014%		
Titanium	9100	0.910%	Praesodymium	17	0.002%		
Vanadium	270	0.027%	Neodymium	59	0.006%		
Chromium	420	0.042%	Samarium	9	0.001%	<u>Trace Elements</u> Iodine (I) Trace Manganese (Mn) 0.016% Iron (Fe) 1.300% Zinc (Zn) Trace Copper (Cu) Trace Molybdenum (Mo) Trace Fluorine (Fl) Trace Chromium (Cr) Trace Selenium (Se) Trace Silicon (Si) 65.70% Cobalt (Co) Trace Boron (B) Trace	
Manganese	2000	0.200%	Europium	2.7	Trace		
Iron	91000	9.100%	Gadolinium	7.4	0.001%		
Cobalt	62	0.006%	Terbium	1.1	Trace		
Nickel	160	0.016%	Dysprosium	4.3	Trace		
Copper	110	0.011%	Holmium	0.93	Trace		
Zinc	300	0.030%	Erbium	2.5	Trace		
Gallium	22	0.002%	Thulium	0.31	Trace		
Germanium	1.7	Trace	Ytterbium	2.1	Trace		
Arsenic	0.7	Trace	Hafnium	5.5	0.001%	<u>Guaranteed Minimum Analysis</u> Soluble K2O 0.200% Potassium (K) 4.000% Calcium (Ca) 1.800% Magnesium (Mg) 0.500% Chlorine (Cl) 0.100% Cobalt (Co) 0.002% Sodium (Na) 0.100%	
Bromine	16	0.002%	Tantalum	5.3	0.001%		
Selenium	<.10	Trace	Tungsten	0.19	Trace		
Rubidium	28	0.003%	Rhenium	<0.05	Trace		
Strontium	990	0.099%	Osmium	<0.04	Trace		
Yttrium	29	0.003%	Iridium	0.05	Trace		
Zirconium	150	0.015%	Platinum	<0.04	Trace		
Niobium	94	0.009%	Gold	<0.1	Trace		
Molybdenum	4.1	Trace	Mercury	<0.3	Trace		
Ruthenium	<0.6	Trace	Thallium	0.05	Trace		
Rhodium	0.6	Trace	Lead	12	0.001%		
Silver	2.5	Trace	Bismuth	0.23	Trace		
Palladium	0.83	Trace	Thorium	8.2	0.001%		
Cadmium	<0.1	Trace	Uranium	1.7	Trace		
Indium	0.1	Trace					

- Notes: 1. The total number of elements reported by ERI was 67, including 8 of the essential nutrients, shown in Bold Italics above.
2. Excluding Silicon, the 67 reported elements add up to 36.9% of the total. The Silicon value, which was not quantified for some reason, is probably on the order of 60% of the total.
3. The three primary plant food elements, Nitrogen, Phosphorus and Potassium, were not reported.
4. Carbon, Hydrogen and Oxygen (normally supplied by air and water) were also not reported.
5. Sulfur (a Macro-Nutrient), Chlorine (a Micro-Nutrient) and Sodium were not reported.

* Azomite is the trade name of Peak Minerals, Inc. for its Soil Remineralization materials.

Recent Developments

Although still in its infancy in the U. S., SR has begun to gain the interest and attention of the agricultural establishment in recent years. Several factors are behind this:

- Increasing environmental awareness and concern
- Pressures to reform or abandon many of the more onerous agricultural habits
- Diminishing returns from some traditional farming and silvaculture practices
- Active promotion of SR concepts by a few energetic and dedicated individuals
- Growing interest on the part aggregate producers, sensing a market opportunity
- Wider distribution of test results and other information on SR

This is not to say that a true groundswell has developed, but:

- The National Aggregate Association (the principal trade organization of the rock and quarry industry) has formed a Remineralization Task Force, which interfaces with appropriate State and Federal officials.

- U. S. Department of Agriculture has begun to coordinate soil studies in the context of potential benefits from soil remineralization. Although federal agencies are typically reactive and rarely take the initiative, there are signs that several individual staff members at USDA have become enthusiastic about the potential of SR. Their influence is expected to spread -- both within the agency and the agricultural community as a whole, where USDA is generally well-regarded.

- Plans are being formulated for international conferences on SR.
- Articles on SR are beginning to appear more frequently in the popular press.
- The current Administration solidly supports movement in this direction.

One of the prime movers in gaining wider exposure for SR is Joanna Campe, a dynamic young woman in Northampton, Massachusetts, who initiated a networking newsletter several years ago, and now publishes a magazine, *Remineralize the Earth*, three times a year. Ms. Campe maintains regular contact with many of the people who are actively involved in SR, and she is an excellent source of information on recent developments and current activities.

The Future

For SR to make real progress, it will require the sponsorship of a major, credible organization -- one which is willing to seriously involve itself in the research, development and marketing of the concept.

The stimulus could come from one of the large aggregate companies making the decision to commit millions of dollars to an all-out business venture in remineralization.

Or, it could be an existing powerhouse in commercial agriculture -- a chemical fertilizer concern, a forest products company, a large agricultural products, services or equipment firm, or an organization in the food or restaurant business, concerned about improving and sustaining the quality of its critical raw materials.

Introduction

The concept of Soil Remineralization (SR)* is simple:

It consists of returning to the soil the vital minerals and trace elements that have been removed over time by erosion, leaching, harvesting and grazing. To overcome this gradual depletion of minerals -- wearing-out of the soil, in effect -- it is possible to restore fertility (to fertilize) by direct application of mineral-rich material, typically a finely-ground glacial moraine, feldspar or other rock dust.

SR has been practiced, studied and written about for more than 100 years. *The Survival of Civilization*, an early 1980s book by John Hamaker and Donald Weaver, is widely credited as the most important recent factor in raising the world's awareness of the need for extensive remineralization of the earth's soils.

The authors note the causes and the implications of an alarming rise in atmospheric carbon dioxide levels in recent years, which they believe will trigger the next Ice Age in a very few years. They go on to examine this deterioration of the atmosphere in terms of its frightening connection to the long-term degradation of once-mineral-rich soils. Hamaker and Weaver then build a strong and comprehensive case for reversing the threat of these destructive developments through a process of massive remineralization of the earth's soils. Although their forecasts are dismissed by some as unduly alarmist and too immediate, the implications are enormous and global, going well beyond mere nutrition and crop yields -- to the preservation of viable atmospheric and climatic conditions for the earth, and indeed, to mankind's very survival.

Traditional participants in the practice, promotion and investigation of SR have been a polyglot assortment of organic gardening and environmental enthusiasts, a few rock dust suppliers, government agencies and commercial producers of crops and livestock, sustainable agriculture advocates, and a number of professionals in agriculture, forestry and soil science.

Interest in the merits of SR has begun to broaden beyond this small band of devotees in recent years, and there are increasing signs that mainstream agriculture and forestry are belatedly beginning to pay attention. New trials and investigations of the potential benefits of SR are underway or being initiated in a number of countries.

In this era of diminishing resources and growing concern for the long-term health of our planet, many organizations in agriculture, government and industry are beginning to reexamine -- and change -- their traditional methods and practices, for environmental soundness, sustainability, conservation, efficiency and in some cases, a more positive public image.

We believe that environmental pressures, population growth, and the need for more intelligent management of the earth's productive food and forest resources will be major driving forces in the times ahead. These factors provide a compelling case for the accelerated acceptance and application of SR in mainstream agriculture and forestry over the next several years. Therein lie substantial opportunities.

* Alternative descriptive terms for SR include Agrogeology, Natural Fertilization, Rock Fertilization, Soil Amelioration, Mineral Balance Restoration, Soil Regeneration, Mineral Fertilizing, Stone Flour Fertilization, etc.

Markets

Current and potential markets for SR encompass all types of commercial agriculture and forestry, as well as home gardens, orchards, and public lands. The small current size of markets in the United States reflects low levels of awareness and acceptance, the strong mindset of commercial agriculture, and the vested interests of the chemical fertilizer industry. Although many in agriculture may be aware of SR and its promise, a typical mainstream attitude seems to be that the evangelists of SR represent a lunatic fringe. Organic and other home gardeners, seeking better home-grown consistency, quality and flavor, have been far more receptive.

Markets in Europe, where SR investigation and use has a longer history, are more developed than in the U. S. With more than a dozen producers of SR materials actively promoting their remineralization products, we estimate the current Western European market to range between \$60MM and \$100MM.

The U. S. market is more fragmented, and since it is in the very early stages of development, its total current value at producer prices may be no more than one-fourth to one-half that of Europe.

Economic Factors

There are numerous sources of SR products in the U. S. The vast majority are local quarries selling fines and rock dust created in their normal crushing operations, at typical prices of \$1.00 to \$10.00 per ton, FOB. These low FOB values will not support significant marketing expense, so most quarries merely respond to whatever local demand and inquiries arise, making no effort to understand the technical aspects of their material, nor to promote it as a valuable or differentiated product. These operators have spotted an environmental bandwagon, and jumped on it. For the most part, they regard any sales of rock dust as an opportunistic sideline, generating incremental revenue and removing a nuisance byproduct of their main business operations.

The wide range in mineral composition and particle sizes of these local quarry materials assures significant variations in their safety and effectiveness as remineralizers. Scientific input in most cases is nil and mineralogical analyses are seldom provided, so a buyer of local quarry product has no assurance that he is getting an environmentally safe and effective mineralizer.

Since freight and handling are far and away the largest components of cost to the user of these products, the effective market area that a given quarry can serve economically is typically a radius of 50 miles or less. Any producer seeking to develop a wider and more upscale market for his material must consider establishment of a distribution network, and actively support the product with technical analyses, packaging, and informative promotional literature.

Apart from the many local quarries for which rock dust is a small sideline, several companies are trying to make a real business of their particular material, supporting their marketing efforts with comprehensive analyses, packaging, informative brochures, and university or other laboratory tests. Some of the more visible U. S. producers and marketers in this category of rock dust suppliers are the following companies:

• Peak Minerals, Colorado Springs, CO	Product Name:	Azomite
• U. S. Soil, Salida, CO	" "	Planters II
• Meridian Environmental Group, Okemos, MI	" "	Bio Plus Glacial Rock Powder
• Livingston-Graham, Irwindale, CA	" "	Earth Wealth Rock Dust
• Sunwalker Development, Inc., Tempe AZ	" "	Cherokee Pulverized Rock (CPR)
• Rado Rock Glacial Dust, Eureka, MT	" "	Rado Rock JB2

A Quick Tour of Soil Remineralization

Highly fertile soils are typically described as "young" or unweathered, as they contain primary minerals inherited from the parent material in glacial periods. "They generally provide abundant amounts of the essential plant nutrients. Fresh supplies of nutrient elements are continually furnished because weatherable minerals are still present." (*Thompson & Troeh, 1973*).

Liberation of soluble salts from unweathered primary rock particles is the prime factor in creating fertile soils. Natural fertility begins to decline when soils are impacted by man's activities and natural aging processes -- erosion and leaching. Over time, soils simply wear out.

SR is a straightforward approach to reversing this process. There are several key aspects to the rationale for restoring fertility to worn-out soils through remineralization:

1. A well-balanced mix of soil minerals is essential for health.
2. Mineral depletion due to man's activities and natural causes is a growing problem.
3. Over-dependence on chemical farming has well-documented drawbacks.
4. SR is an environment-friendly measure, with both short- and long-term benefits.

1. Soil Minerals Are Essential For Nutrition: It is universally recognized that plants, animals and human beings all require a steady intake of certain vital minerals, micro-nutrients and trace elements to promote healthy growth, general well-being and disease resistance. The catalog of essential plant and animal nutrients continues to grow, with advancing knowledge of the mechanisms of these elements in nutrition. A basic list of the most widely-recognized essentials would include these 16 elements:

<u>Macro-nutrients</u>	<u>Micro-nutrients</u>
Carbon (C)	Iron (Fe)
Hydrogen (H)	Manganese (Mn)
Oxygen (O ₂)	Zinc (Zn)
(typically supplied from air and water)	Copper (Cu)
	Boron (Bo)
	Molybdenum (Mo)
Nitrogen (N)	Chlorine (Cl)
Phosphorus (P)	(typically supplied from soil solids)
Potassium (K)	
Calcium (Ca)	
Magnesium (Mg)	
Sulphur (S)	
(typically supplied from soil solids)	

2. Mineral Depletion -- A Widespread and Increasing Problem: Minerals in the soil are gradually absorbed by all growing plants, in varying quantities -- sometimes substantial and sometimes minute. When these soil minerals are contained in agricultural crops, they are removed upon harvesting, and over time this process dramatically reduces the mineral balance of the soil. Thus, each successive crop is supported by, and contains when harvested, a steadily diminishing quantity and mix of valuable minerals.

The same phenomenon occurs as animals graze on pasture land, taking soil minerals from grasses and other plants. The minerals are permanently removed from the soil in that location when they are carried away in meat or milk. Natural erosion from wind and water also contributes to the depletion process.



MARIAH INTERNATIONAL, INC.
and
GUILD MARK INDUSTRIES, INC.

Deer Valley Airpark
Building D, Suite 7
702 West Melinda Drive
Phoenix, Arizona 85027
Phone: 602-492-9017 Fax: 602-492-9810

This memorandum does not constitute an offer to sell or solicitation of an offer to buy. It does not purport to include all the information available for the companies mentioned. The reader is referred to the regular statistical services, company reports and any official prospectuses for further details.



AGROGEOLOGICAL EVALUATION
OF THE
MERRILL CRATER

SUMMARY

In recent years soil scientists have conducted numerous studies to reduce the application of chemical fertilizers on the nation's farmland. Results from these analyses indicate remineralization can achieve the following benefits:

1. Remineralization will combat the effects of pests and diseases that effect plant growth.
2. Remineralization reduces the water requirements necessary for plant growth.
3. Remineralization has been proved to lower the cost of production and produce higher yields on treated lands.
4. Remineralized soils provide the necessary nutrients to increase the quality and quantity of the plants grown.

Respectfully submitted,

John O. Rud
Geologist, M. S.

REFERENCES

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AGROGEOLOGICAL EVALUATION OF THE MERRILL CRATER

INTRODUCTION

At the request of Mariah International Inc. a geologic evaluation of the Merrill Crater has been completed. The main emphasis of the study was to determine mineralogical and chemical characteristics of the volcanogenic deposit in regard to its utilization as a chemical-free fertilizer. The evaluation included determining the petrographic (the physical character of a rock) and chemical composition of the deposit.

The principle of agrogeology is simple. Agrogeology is the study of the natural fertilization that takes place when weathering breaks rocks into their constituent elements. Agrogeology was first studied in the early nineteenth century. However, the success of the artificial fertilizers killed interest in this natural approach until the late 1970's when Dr. Chesworth, a geologist at the University of Guelph in Ontario, combined his theoretical studies of rock decomposition to determine that weathering of a common volcanic rock like basalt made land more fertile.

Continuing studies indicate that volcanic rocks like basalt, supply the nutrients necessary for plant and animal growth. The essential elements for plant growth include: carbon, hydrogen, oxygen, nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, zinc, copper, boron, molybdenum and chlorine. In addition, the presence of rock fragments in the soil and on the soil surface significantly influence infiltration, runoff, and moisture storage which significantly effect plant growth.

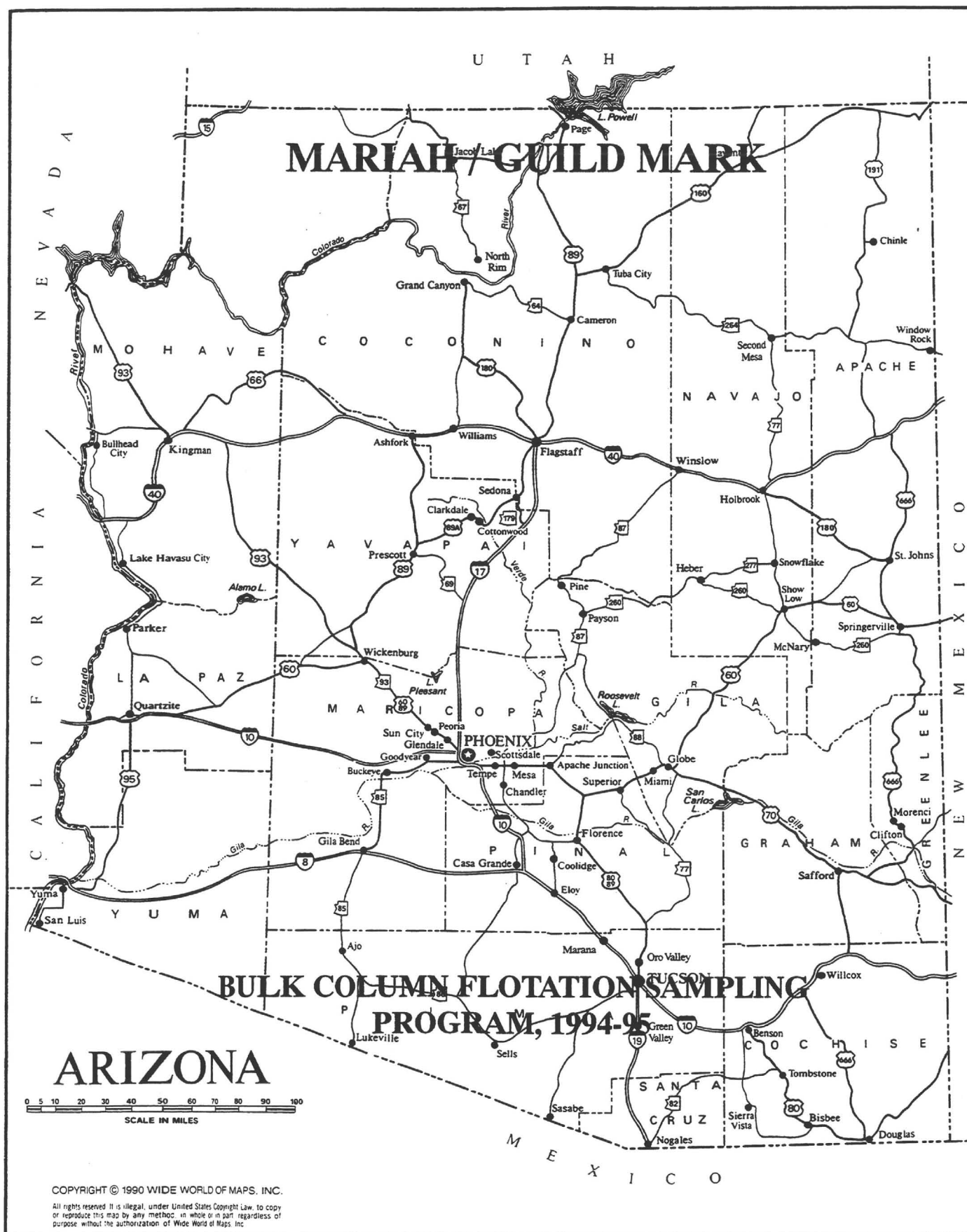
IN THE GARDEN

Try Using Less, or

LOS ANGELES TIMES

SUNDAY, MARCH 26, 1995





MARIAH INTERNATIONAL, INC.

GUILD MARK INDUSTRIES, INC.

**Pilot Plant Program
100 Ton Test
60 Day Run Cycle
\$100,000 Cost**

In January 1995 Mariah/Guild Mark intend to initiate a bulk sampling program on the Merrill Crater. The objective will be to determine the average grade of gold occurring in an area of the crater along the access road and from a trench located within the vent area of the cone.

Mariah/Guild Mark will use the services of some of the top mining research facilities in the country. Hazen Research of Colorado, specialists in process research, will provide one of their top senior engineers and work in conjunction with Pyramid Resources (who built our float column) to develop a comprehensive report verifying the results from this test. This report will prove conclusively that we have commercial quantities of gold and can utilize this report to obtain the financing necessary to build a 1,000 ton plant.

The company's have continued to receive requests for our soil "REPLACE." Alden Bryant, President of the Earth Regeneration Society, and a consultant for Mariah/Guild Mark has recently completed a proposal using our material in a soil program for the country of Haiti (see enclosed letter). We also have numerous other requests for our material and intend to pursue "full speed ahead" with this product upon the funding of the 1000 ton/day plant.

Mariah/Guild Mark has outlined the cost breakdown to perform this test and obtain a "bankable" report for funding. Interested parties will receive a one (1) year note @ 10% interest on their investment, plus an amount of Guild Mark stock equal to 50% of the loan amount based on a value of \$0.05 per share, i.e., \$10,000.00 loan @ 10% interest plus 50% of loan on \$5,000 @ \$0.05/share = 100,000 shares of Guild Mark 144 stock.

Investors will be required to complete the necessary forms enclosed in the packet and complete the promissory note in the proper amount. Checks are to be made out to Mariah International, Inc. and will be deposited in a separate account until \$100,000 is

accumulated to begin the program. In the event that the entire amount is not obtained within a reasonable time (45-60 days), all money will be returned to each investor and the project will be stopped. Mariah/Guild Mark will utilize the services of Don Stoker, CPA to audit and control the funds for this project and will file a report with the investors group on the project's activities. If you have any questions, please contact Richard Campbell at 602-492-9017.

**PILOT PLANT PROGRAM
100 TON TEST
60 Day Run Cycle
\$100,000 Cost**

Cost Breakdown

Plant Operation \$5,000/week	Total	\$40,000.00
Consulatant/Employee Salaries		
Plant Maintenance		
Chemical Reagents		
Miscellaneous Supplies		
Contingency Fund,		\$10,000.00
Major Breakdown of Equipment		
Independent Consultant Report		\$30,000.00
Process Engineering - Hazen Research		
Pyramid Resources		
1. Mineral Benefication		
2. Report on Results		
Administration		\$18,000.00
Land Payments		
Salaries		
Insurance		
Accounting		
Office & Supplies		
Shareholder Relations		
Auditor - Don Stoker, CPA - J.D.		\$ 2,000.00
Audit and File Report on Fund Allocation		

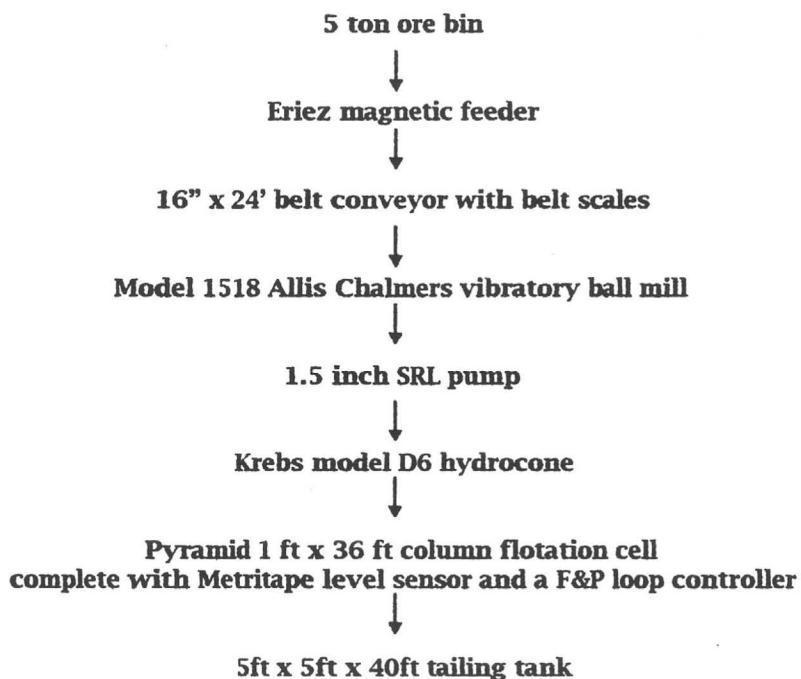
PILOT PLANT PROGRAM

Objectives

1. To determine the overall gold content of the Merrill Crator deposit to warrant the construction of a 1,000 tons-per-day concentrating plant.
2. Determine the optimum reagent combination and dosages to attain maximum recovery when the 1,000 tons- per-day concentrating plant is placed in operation.

Test Plant

Merrill Crator L.L.C. has constructed a one ton-per-hour column flotation plant. The circuit consists of:



The process utilized in the above circuit is called froth flotation. Froth flotation is a mineral separation process that utilizes the differential attraction of mineral surfaces towards the rising air bubbles in a mineral pulp suspension to separate mineral

particles of differing type. To make the process more efficient, organic chemicals called collectors are employed. Collectors are designed to attach selectively to the surface of one of the mineral components to be separated, making these particles water-repellent and increase the tendency to rise with the air stream.

Previous Column Flotation Bulk Sampling

During September, 1992, Mariah International, Inc. completed a 114 ton bulk column flotation sampling program which produced 104 pounds of gold concentrate. The program divided the 114 ton sample into five 20 to 25 ton samples. The head grade ranged from .05 to 1.44 oz/ton gold. Gold recovery ranged from 67% to 80.1%.

Completed results from this bulk sampling program indicated the Merrill Crator material averaged .074 oz/ton gold. The reagents utilized (Collector KI 11, Frother KI 444) during this program were manufactured by Kerley Chemical Company and averaged a 72% recovery rate.

Test program

The test program is designed to determine the overall gold content of the material removed from the Merrill Crator and evaluate the performance of several types of flotation reagents to determine gold recovery percentage expected during the operation of a commercial sized concentrating plant. At this time the material is trucked from the Merrill Crator near Flagstaff to the pilot plant located in Phoenix, Arizona. The material will then be processed by the pilot flotation plant in 5 ton batches. Samples are removed from the feed belt, concentrate tank, and tailing tank at 30 minute intervals. The composite sample for the 5 ton mill run is then submitted for assay to determine the following data:


1. The gold content of the head ore.
2. The gold content in the concentrate.
3. The gold content in the tails.

From the above data the concentration ratio and recovery percentage can be determined.

The test program is currently designed to determine the optimum type of reagent that will increase the recovery rate to its maximum. The preliminary tests have utilized the reagents manufactured by MINERAL REAGENTS INTERNATIONAL with good results.

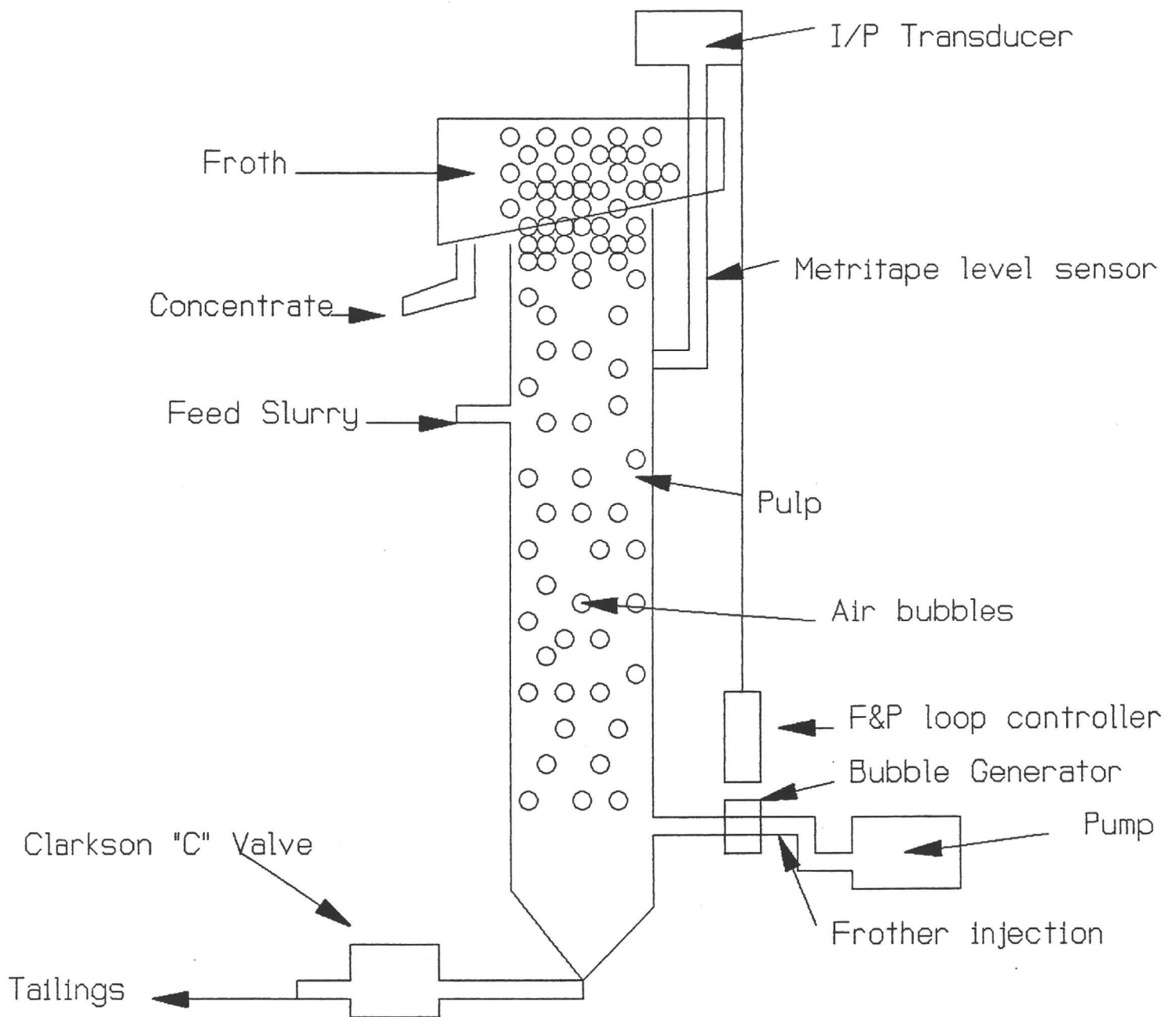
Future tests will utilize reagents manufactured by KERLEY CHEMICAL COMPANY, SHEREX CHEMICAL COMPANY, INC., and LUBRIZOL CORPORATION which will determine the optimum reagent and dosage to achieve maximum gold recovery from the Merrill Crator material.

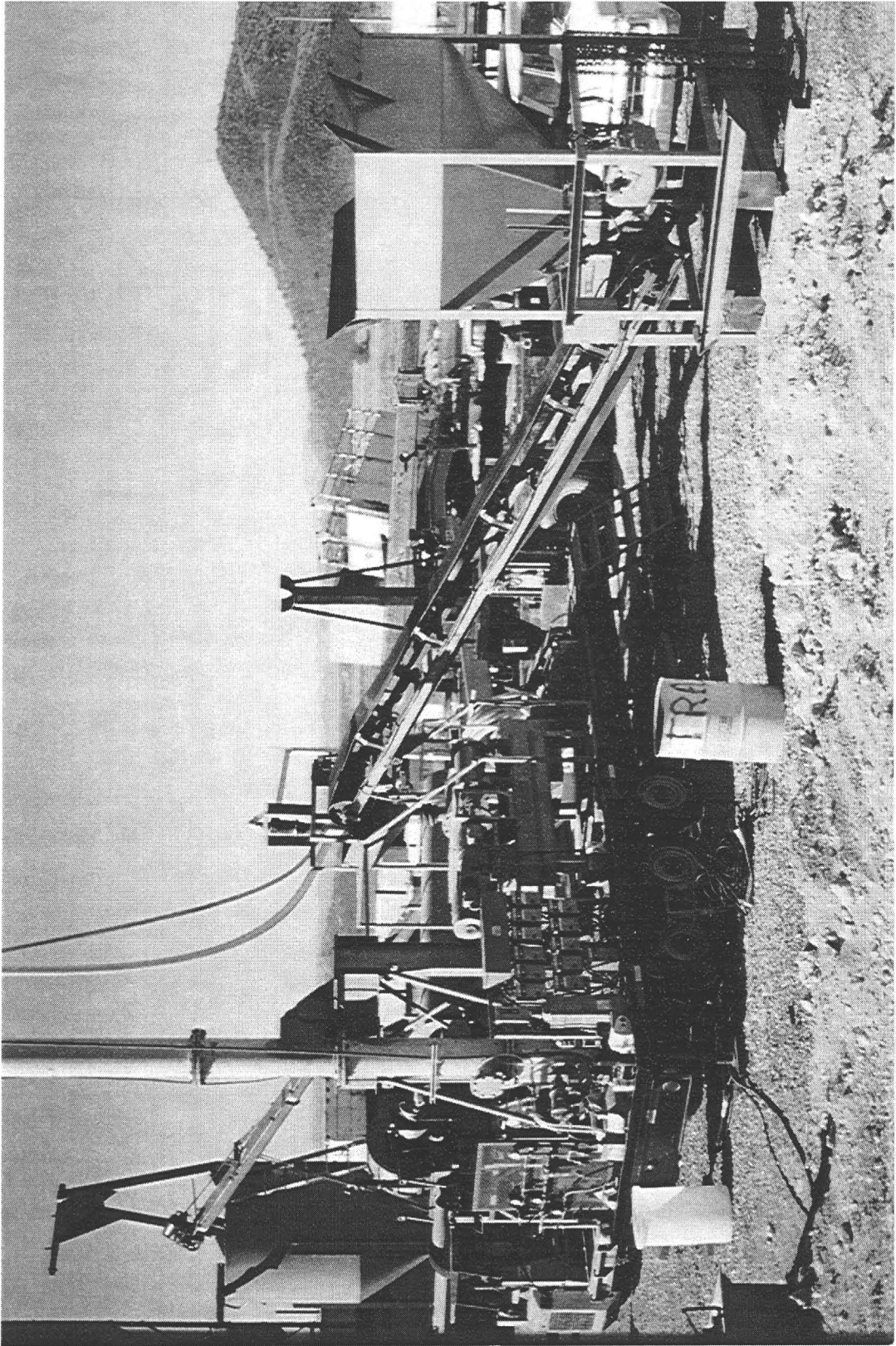
Respectfully submitted,



John O. Rud
Geologist, M.Sc.
December 12, 1994

Schematic diagram of a flotation column





ALDEN BRYANT & ASSOCIATES
1442A Walnut Street No. 57, Berkeley, California 94709
510 525 4877, Fax 510 559 8410

December 7, 1994

Richard Campbell
Vice President, Special Projects
Mariah International, Inc.
Deer Valley Airpark
702 West Melinda Lane
Bldg. D, Suite 7
Phoenix, AR 85027

Dear Dick:

Here is a project update letter. This year has seen a significant advance in natural mineral application for increased income in agriculture, more healthy plants, and therefore more healthful food for consumers. We have firsts on which to build. I recall that you attended the first meeting, participated in by U.S. Department of Agriculture personnel, private corporations involved in soil improvement, and various individuals who are leaders in soil remineralization work. REPLACE, developed by Mariah, is certainly an important product in this growth area.

REPLACE will also have a role in improving soil in forest areas, where the mineral content is down and the trees are dying -- as in Austria starting in the early 1980s.

There are proposals, and proposed contracts, now circulating in the U.S., and between the U.S. and other countries, for well-planned operations entitled "New Soil Movement of ----." These include rock dust for remineralization, as the basic ingredient for the whole process.

One example involves a proposal with U.S. suppliers and an overall ecological program for Haiti. I received correspondence starting a year ago from a Haitian who is now a U.S. citizen describing the deteriorated conditions with forests, streams, soil for agriculture, pollution of the soil, wood for cooking, and fodder for animals. The seven million people of Haiti can not live in that area much longer without a major ecological restoration.

The group in Florida has given me general outlines and has asked me to prepare a recommended program for their use. I am including a description of a small, steady, starting program ...ending up with a maximum development: in approximate figures, agriculture to go from 25% back to 50%; forests to go from 5 to 10% back to 30%; thus leaving 20% for urban areas, highways, and high mountain slopes that are not habitable.

This includes (1) recommendations for rock dust (REPLACE), (2) a non-toxic chemical to improve soil water retention which will also make the minerals of the rock powder more accessible for plant roots, (3) organic material (all possible daily waste products), fish emulsion (a new, improved U.S. product) and/or other material, (4) soil testing program to see if further microbe and enzyme applications would be essential in some cases, (5) "Austree" (a fast growing willow hybrid with foliage good for animal feed) for reforestation, primarily around agricultural areas, stream areas, watershed needs -- to be combined with an increase in local tree varieties for most effective diversification, (6) a steady long-term increase in solar cookers to replace the use of wood for cooking -- if solar cooking can be brought up to one half of food preparation, this will be a large saving of wood, then other methods will still have to be developed, and (7) pollution cleanup to the extent possible with best available solutions (Tri-X-14 for many uses) and with microbe and enzyme materials where appropriate.

The minimum program should start as soon as funds are made available either from private grant(s) or from U.S. funds as part of the Haiti development arrangements. The maximum REPLACE program would include a basis of 500 pounds per acre the first year, less in subsequent years, be applied to both agriculture and forests, and be delivered for approximately \$150 per ton from Phoenix, AZ. This program would be in the range of \$30 million per year for three years. A three-year program for 100 million divided by a population of 7 million people suggests \$14 per person. The total program described above could run to \$50 to \$75 per person -- to bring back the total agriculture, streams, fish, forests, watershed areas, and resultant improvement in living conditions, purchasing power, and general economic development.

I will be recommending specific products and processes for each part of the ecological restoration for Haiti. We will see what develops. This type of plan holds for most areas in the temperate zones of the world. Your connections with the Middle East and North Africa may also be an impetus for rapid international agricultural, forest, and health progress.

Sincerely,


Alden Bryant

MARIAH INTERNATIONAL, INC./GUILD MARK INDUSTRIES, INC.
702 West Melinda - Bldg D #7
Phoenix, Arizona 85027

PROMISSORY NOTE

\$ _____, 1994

For value received the undersigned promisor, **Mariah International, Inc./Guild Mark Industries, Inc.** hereby promises to pay to _____.

The principal balance above is subject to a simple interest of 10% per annum on the unpaid principal. Interest is payable twelve (12) months from the date of the above referenced note together with all principal. Pre-payment is allowed and there is no penalty.

Should default be made in payment of interest when due, the whole sum and principal interest shall become immediately due at the option of the holder of this note. Principal and interest payable in lawful money of the United States. If action is instituted on this note, we promise to pay a reasonable amount of attorney fees.

In the event the holder receives an amount in payment which is less than the principal due and interest accrued to date, then such payments first be allocated to any interest due, or any remaining amounts shall then be allocated to principal.

Principal and interest on this note shall be payable at such place as the holder of this note may designate. The maker, sureties, guarantors, and endorser hereby severely waive presentment for payment, demand and notice of dishonor and non-payment of this note, and consent to any and all extensions of time, renewals waivers or modifications that may be granted by the holder hereof with respect to the payment or provisions of this note.

This note shall be governed as to validity, interruption, construction, effect and to all other respects by the laws and decisions of the State of Arizona. Maker, holder and any sureties, endorser and guarantors submit to the personal jurisdiction of all courts in Arizona whether Federal or State and agree to any action pertaining to this note shall brought in an Arizona court.

This note is secured by the assets in Mariah/Guild Mark.

In witness whereof the undersigned has executed this note on the _____ day of _____, 1994.

Mariah International, Inc.
Guild Mark Industries, Inc.

Title

**ACCREDITED INVESTOR
SUBSCRIPTION AGREEMENT**

Gentlemen:

The following information is furnished as the undersigned subscription for _____ shares of Guild Mark Industries, Inc. restricted stock as a price of \$0.05 per share. These shares are to be issued by Mariah International, Inc. a Utah corporation and for you to determine if I am qualified to purchase the common stock (hereafter collectively the "securities") issued by the company under applicable federal regulations and applicable state securities law.

I, the undersigned, understand that you will rely upon the following information for purposes of such determination in that the securities will not be registered under the Securities Act in reliance upon exemption from registration provided thereby, and comparable exemptions under applicable state securities law.

I also understand that I may be required to supply a balance sheet, prior years' federal income tax returns or other appropriate documentation to verify and substantiate my status as an Accredited Investor.

ALL INFORMATION CONTAINED IN THIS SUBSCRIPTION AGREEMENT WILL BE TREATED CONFIDENTIALLY. However, it is agreed that you may present this document to such parties as you deem appropriate if called upon to establish that the proposed offer and sale of the Securities is exempt from registration under the Securities Act or meets the requirements of applicable state securities laws. I understand that a false statement by me will constitute a violation of my representations and warranties under this Subscription Agreement. My investment in the Securities will not be accepted until the Company determines that I satisfy all of the suitability standards.

I, the undersigned, hereby supply you with the following information and representations:

1. Full Name:

2. Residence Address (no P.O Boxes) Telephone Number:

() -

3. Business Address and Telephone Number:

() -

4. State in which the undersigned maintains principal residence:

5. State in which undersigned is registered to vote:

6. If this investment is to be made by an Entity (i.e. Company, Corporation, Pension Plan, Profit Sharing Plan), the undersigned further represents to you as follows:

(i) Name and Address of Entity Making Purchase (use legal name):

(ii) Name and Address of Person Making Investments Decision on behalf of Above Entity:

(iii) Position and Title of Person Making Investment Decision in the Above Entity:

7. Based on the definition of an "Accredited Investor" which appears below, I certify that I am an Accredited Investor.

Yes No

7A. I certify that I am an Accredited Investor because I fall within one of the following categories:

(PLEASE CHECK APPROPRIATE CATEGORY)

a. \$1,000,000 Net Worth Natural Person
A natural person whose individual new worth, or joint net worth with that person's spouse, at the time of his purchase exceeds \$1,000,00.

b. \$200,000 Natural Person.
A natural person who had "Individual Income" in excess of

\$200,000 in each of the two most recent years or joint income with that person's spouse in excess of \$300,000 in each of those years and has a reasonable expectation of reaching the same income level in the current year.

- c. _____ **Company, Corporate or Other Entity Investors**
The investor is a partnership, corporation or unincorporated association and all of the equity owners of that entity qualify as Accredited Investors under subparagraph (a) or (b) above. Investors that check this subparagraph (c) must furnish a separate copy of this Subscription Agreement for each equity owner with items 1 through X completed and executed on the Subscriber Signature Page by such equity owner.
- d. _____ **Revocable or Grantor Trust**
The Investor is a revocable or grantor trust and each Person with the power to revoke the trust qualifies as an Accredited Investor under (a) or (b) above. Investors that check this subparagraph (d) must furnish a separate copy of this Subscription Agreement for each Person with the power to revoke the trust with items 1 through 7A completed and executed on the Subscriber Signature Page by such Person.
- e. _____ **Investment Decision by Plan Fiduciary**
The Investor is an employee benefit plan within the meaning of Title I of the Employee Retirement Income Security Act of 1974, and the investment decision is made by a Plan fiduciary, as defined in Section 3 (21) of such Act which is a bank, savings and loan association, insurance company or registered investment advisor.
- f. _____ **Self-Directed Plan--Investment Decision Solely by Accredited Investor**
The Investor is a qualified profit sharing or defined contribution Plan, the Plan provides for segregated accounts for each Plan Participant, the governing documents of the Plan provide that each participant may direct the trustee to invest his or her funds in the investment vehicles of his or her choice and the purchase of the Units(s) is made pursuant to an exercise by the Plan Participant, who is an Accredited Investor under subparagraph (a) above, of such power to direct the investments of his or her segregated account. This Subscription Agreement must be completed and executed by such Plan Participant.

8. **Representations and Warranties.** I, the undersigned, represent and warrant as follows:

- a) I have such knowledge and experience in business and financial matters as will enable me to evaluate the merits and risks of the prospective investment and to make an informed investment decision. I am also aware that no state or Federal agency has reviewed or endorsed the Memorandum or the Securities, that the

matters as will enable me to evaluate the merits and risks of the prospective investment and to make an informed investment decision. I am also aware that no state or Federal agency has reviewed or endorsed the Memorandum or the Securities, that the Securities involve a high degree of economic risk.

- b) I have been advised and am fully aware that investing in the Securities is a speculative and uncertain undertaking, the advantages and benefits of which are generally limited to a certain class of investors and that the Securities may be sold only to persons who understand the nature of the Securities and the operations of the Company and for whom the investment is suitable. I represent that I meet such suitability requirements.
- c) I have relied on my own tax and legal adviser and my own investment counselor with respect to the investment considerations of purchasing the Securities as described in the Memorandum.

9. Miscellaneous

- a) I agree that I may not cancel, terminate or revoke this Agreement or any covenant hereunder and that this Agreement shall survive my death or disability and shall be binding upon my heirs, executors, administrators, successors and assigns.
- b) This Agreement shall be enforced, governed and construed in all respects in accordance with the laws of the State of Arizona.
- c) Within ten days after receipt of a written request from the Company, I agree to provide such information and to execute and deliver such documents as reasonably may be necessary to comply with any and all laws and ordinances to which the Company is subject.

10. Subscription

I hereby subscribe for _____ shares at a price of \$0.05 per Share for a total of \$ _____.

11. Registration and Address

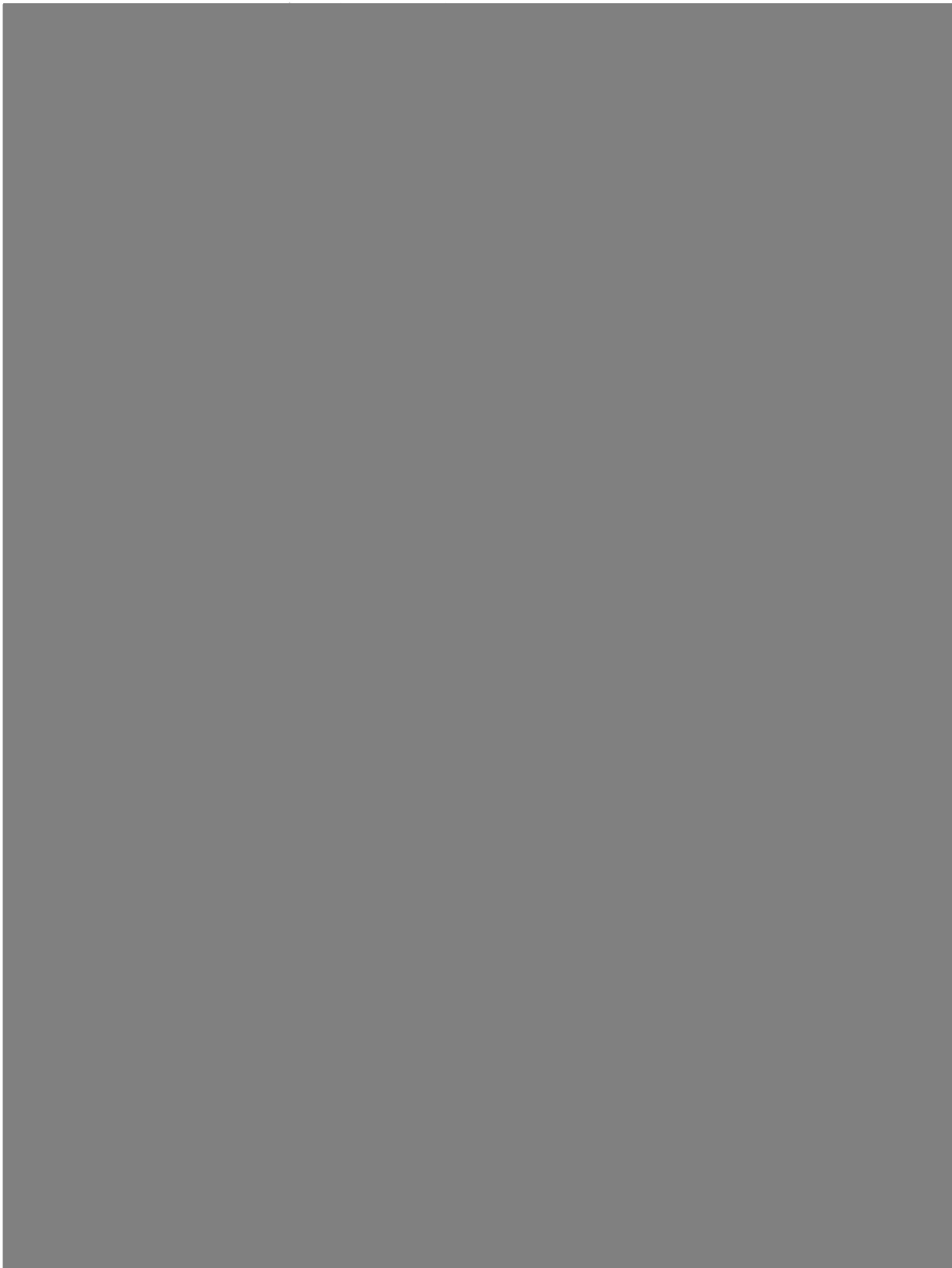
Mr./Mrs./Ms. _____

(Please Print Name(s) in which the Securities subscribed are to be registered hereunder.)

Social Security or Taxpayer ID Number of each subscriber

Communications to be sent to (check one):

Home _____ Business _____



Pyramid

No. 1 February 1992

The Worldwide Newsletter of Pyramid Resources

Welcome !

▲ ▲ ▲ ▲ ▲ ▲ ▲ ▲ ▲ ▲ ▲ ▲ ▲ ▲ ▲ ▲ ▲ ▲ ▲ ▲

We are pleased to announce the encore formation of our new company, Pyramid Resources. Pyramid has been created to bring the most cost effective process control and column flotation services available to the minerals industry. We have assembled a group of professionals who have proven track records as innovators and successful mineral processing practitioners and who know how to leverage technology into plant profits.

▲ **Technology, Experience, Service and Teamwork** make up the four cornerstones of our corporate pyramid. Couple these with your needs, opportunities and personnel and the

magic of pyramiding people power begins.

▲ **The concept is simple: BLITZKRIEG!**

Identifying, focusing, mobilizing, implementing and training are the elements of all successful projects. In a few short months substantial plant improvements can be realized by properly applying Pyramid's control and column flotation technologies. In the following pages we briefly introduce our people and technologies. Please fill out and return our reader survey card so we can learn about you and ultimately put our team to work in your plant so you can experience Pyramid's technology and service first hand.

In This Issue



Welcome.....1



Column Flotation
Myths.....2



Column Company
Check List.....3



Process Control-
Key to Improved
Plant Profits.....4



Pyramid's
Dictionary.....5



Bubble Generator
Study.....6



Column Flotation Myths

Over the past decade, column flotation has gradually gained acceptance within the minerals industry. This has resulted from a realization of the importance of proper design and selection of the best available sparger system. In addition, valuable experience has been obtained that allows column flotation to be implemented faster than ever.

Pyramid's staff has been involved in testing, design, manufacture and installation of over 60 commercial columns and sparger systems. We have developed our expertise over a combined 35 years of dedicated effort. Along the way we learned that column flotation has tremendous potential to improve existing operations and to make future installations more economical and efficient. We are dedicated to a single purpose; that is, to make column flotation work for your plant. To this end we would like to share some of our findings with you by way of listing and dispelling common column myths.

▲ Myth #1 - Column Cells Cannot Achieve High Recoveries

Early experience with columns (as compared to mechanical cells) suggested that higher grades could be achieved at the expense of recovery. Unfortunately, this feeling has remained and is generally believed to be true.

The real power of column flotation lies in its flexibility. When designed properly, columns achieve better grades and recoveries than mechanical cells in the same application. High grades are achieved through the use of deep froths and wash water. High recoveries can simultaneously be achieved by using increased air holdup, as compared to conventional cells, along with proper design. Mechanical cells normally have 6-8 percent volume air holdup whereas a column, with Pyramid's sparger system can easily be controlled to volume holdups of between 15 and 65 percent.

▲ Myth #2 - All Column Spargers Are The Same

We have always maintained that the sparger system is the heart of the flotation column. This belief and knowledge came about during the three year period the USBM sparger system was developed and optimized by Don Foot and Jeff McKay. During this time hundreds of tests were performed to evaluate and optimize the sparger options. Additionally, countless mineral systems were evaluated. As a result of this work, we know there are differences which do affect column performance. CANMET recently completed an independent analysis of column spargers which supports our findings. Their results are presented on page 6 of this

newsletter.

▲ Myth #3 - Columns Are Just a Piece of Pipe

One of the more common myths is that all columns are the same and that anyone can build one. There is a big difference between *building* and *running* a flotation column and *designing* and *operating* a flotation column. Too often we have seen columns installed that have been under designed in one fashion or another. This results in frustrated operators and plant managers and generates a general feeling that columns don't work.

Pyramid's approach is simple: **Do it right the first time!** We believe columns should not be bought out of a catalog based on a "one size fits all" approach. Just as you size a pump for proper application and performance, a flotation column should also be designed for each specific application. The point is that columns will achieve design criteria performance when properly designed and installed.

▲ Myth #4 - Column Cells Don't Require Control

We have talked to many people who think that columns don't require control because they control themselves somehow. Nothing could be further from the truth. As with all unit operations, column performance varies with changes in feed characteristics. Control of columns can be divided into two classes. The first is stabilizing or regulatory control and the second is metallurgical control.

Regulatory control is simply one or more control loops that are designed to maintain key process variables at operator entered setpoints, the most common being froth height. It is hoped that metallurgical performance will remain near target as feed variations are experienced. Unfortunately, this is often not the case.

Metallurgical control is very different in that on-line x-ray analysis is used to measure column performance continuously. As feed conditions change, causing variations in performance, individual control variables such as aeration rate, wash water rate, froth height and even bubble size and holdup can be changed to maintain and optimize the metallurgical performance.

▲ **When you have a question** regarding control or any aspect of column flotation we hope that you will call us. We will be happy to share our experiences with you and discuss your current needs.

- individual operators vary from one another in skill, dedication and process understanding,
- to avoid catastrophic problems, operators tend to be overly conservative.

These, and other problems with regulatory control are overcome by adding supervisory control to the regulatory system.

▲ **Supervisory Control** - The key to overcoming the inherent problems with regulatory control, involves automatically monitoring the process and calculating new "optimum" setpoints continuously. The new setpoints can be either displayed to the operators for use at their discretion or, preferably, downloaded automatically into the regulatory control system. Traditional programming of the control strategies, in sequential languages such as FORTRAN or C, has given way to implementing the strategies in "real-time" expert systems where the control rules are written in linguistic terms.

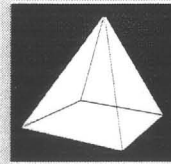
▲ **Real-Time Expert Control Systems** - The greatest improvement in the area of control in the past 5 years has been the emergence of real-time expert control systems. Control rules are written in linguistic terms that are easy to understand and modify. In the past, computer control strategies worked as long as the original programmer was maintaining the system. Once the system creator left the project, the strategy became unmaintainable. Using expert systems completely eliminates this problem.

The rules used by the real-time expert systems are normally based on plant experience, sound engineering practices, economic considerations and process models.

▲ **Model Based Control** - Process models are used to calculate unmeasured variables that are needed for optimized control. Additionally, these models are used in a predictive sense to determine optimum setpoints in conjunction with the expert system rules. Accurate process models exist for most mineral processing equipment such as crushers, grinding mills, mechanical and column flotation cells.

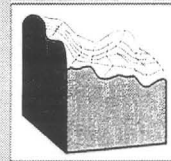
▲ **Neural Networks** - The newest tool to be added to the arsenal of process control weapons is Neural Networks (NN's). NN's learn by example, based on a simplistic model of the human brain. The key point is that adaptive learning can be added to the control strategy that allows the system to evolve and improve over time.

Pyramid's Dictionary



Pyr-a-mid \ˈpɪr-ə-mɪd\

1: to increase rapidly and progressively step by step on a broad base 2: to increase the impact of 3: to build up as if on the base of a pyramid.



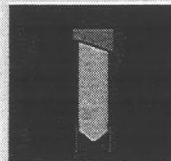
Op-ti-mize \ˈɒp-tə-mīz\

1: to make as perfect, effective, or functional as possible.



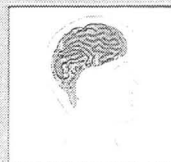
En-core \ˈæn-kō(ə)r\

1: a demand for repetition or reappearance.



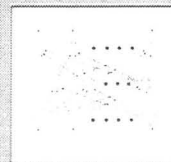
Flo-ta-tion Col-umn \flō-ˈtā-shən \ ˈkāl-əm \

1. a superior mineral recovery and concentrating device.



Ex-pert Sys-tem \ˈɛk-ˈspɜrt \ ˈsɪs-təm \

1. computer program that embodies the knowledge of an expert and applies that knowledge in a generalized way to the solving of problems.



Neu-ral Net-work \ˈn(y)ūr-əl \ ˈnet-wɜrk \

1. computer program that solves problems based on a model of the human brain.

In summary, process control is one of the most cost effective methods of increasing operating revenues. Pyramid's personnel have demonstrated their leadership and expertise throughout the world by designing and implementing over 22 systems in 6 different countries.

Please contact us so we can review your needs and opportunities and provide you with an evaluation of what additional process control in your plant can accomplish.

Independent Study at CANMET Shows U.S. Bureau of Mines Bubble Generator Superior to the Alternatives!

The sparger system can make or break a column installation. Pyramid Resources' staff developed and patented the U.S. Bureau of Mines external bubble generation system. In addition, Pyramid holds the license to market this technology.

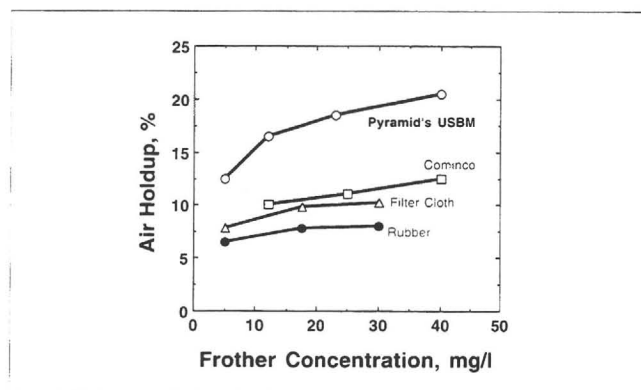
▲ Performance - In an independent study, CANMET judged the USBM sparger, marketed by Pyramid, to give superior performance as compared to alternative systems tested. Others tested included those offered by Cominco and Deister as well as rubber and filter cloth spargers. A summary of results related to bubble size is shown in Table 1. The data indicates that frother consumption for Pyramid's sparger is over 50 percent lower than its nearest competitor.

<u>Sparger</u>	Frother (mg/l)	Mean Dia. (cm)	80% Span (cm)
Pyramid	12.0	0.076	0.057
Filter	17.7	0.16	0.16
Rubber	17.5	0.13	0.15
Cominco	25.0	0.072	0.057

Table 1. Frother Concentration versus Bubble Size

Technical difficulties with the Deister sparger preempted its use. Figure 1 shows that, under the manufacturer's recommended operating condition, Pyramid's sparger gives air holdups consistently higher than all other sparger system tested. This translates into higher mineral recoveries at lower frother consumption.

▲ **Maintenance** - With the sparger system offered by Pyramid, maintenance is low. All sub-systems, including mainline air and water, external bubble generators, sparging tubes and sparger nozzles, are designed to be maintained, while operating to reduce costly downtime of the column. Wear of the sparger tubes is virtually eliminated by the use of threaded ceramic nozzles.



▲ Service - Pyramids dedication to service distinguishes us from other companies. We firmly believe in establishing long term relationships with our clients to create an atmosphere where our staff is fully accessible to you. In addition, we believe that no other company can match the technical and practical experience in column flotation that is offered by Pyramid.

▲ **Products** - Pyramid's solution oriented approach to column sparger systems offers the following products and services:

- *Sparger Retrofit of Existing Columns*
- *Sparger Systems for New Columns*
- *Sparger Installation & Training*
- *Flotation Column Consulting*

Reference: Cienski, T., Kuehn, L. and Reynolds, V., 1990.
"Air Spargers Evaluation Study," CANMET, Mineral
Sciences Laboratories, Division Report MSL 90-31.

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U.S. Bureau of Mines "CRADA's"

▲ ▲ ▲ ▲ ▲ ▲ ▲ ▲ ▲

During the past few years there has been significant research at the Tuscaloosa and Rolla Research Centers of the U.S. Bureau of Mines in high rate flotation and fuzzy logic/genetic algorithm use. Pyramid has followed this research and has established two cooperative research and development agreements with the Bureau of Mines to build upon, and commercialize, these technologies. We believe that both will contribute to plant optimization in the future.

▲ **High rate flotation** is a generic phrase that encompasses flotation machine and system concepts that dramatically increase the rate at which minerals can be floated and recovered. The objectives are to develop a flotation system that achieves typical industry standard recoveries in a fraction of the traditional retention time and with fewer and smaller flotation units. We are testing a number of innovative designs which we believe will ultimately be commercially successful.

▲ **Fuzzy logic control and genetic algorithms** are two terms that have received a lot of press during the last few years. Fuzzy logic control is a knowledge-based control strategy that can be used when a sufficiently accurate and yet not unreasonably complex model of the physical system that is to be controlled is unavailable or when a single precise measure of performance is not meaningful or practical. Since these are the conditions that are prevalent in mineral processing intelligent fuzzy control systems will soon become part of Pyramid's process control solution.

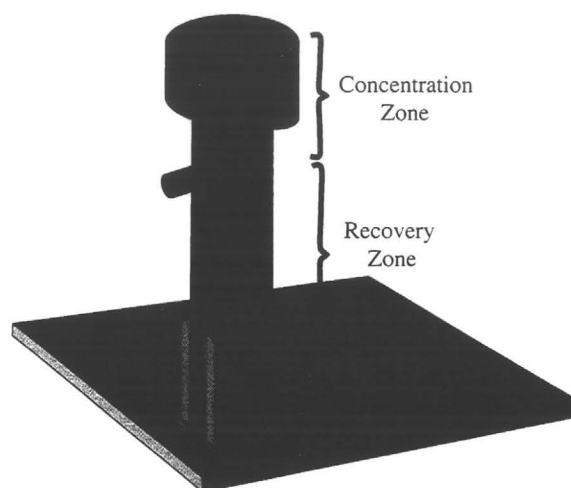
▲ **Genetic algorithms** (GA's) allow computer program solutions to "evolve" in ways that resemble natural selection so that complex and not fully understood problems can be solved. This concept of genetic natural selection eliminates one of the greatest hurdles in software design: specifying in advance all the features of a problem and the actions that should be taken to deal with them.

Our development work is centering on "genetic rules" that we will use to augment the hundreds of heuristic rules we already have in our control libraries for mineral processing applications.

Pyramid's External Bubble Generation System vs. Low Pressure Spargers

▲ ▲ ▲ ▲ ▲ ▲ ▲ ▲ ▲

Analyzing what type of sparger system will produce the best metallurgical results is really quite simple. We break the flotation process into two components; recovery and concentration.



Within each of these zones there are at least two important processes going on. The first is the rate of attachment of particles to the bubbles; the second is the rate that attached particles detach from the bubbles. There is an average rate of attachment and detachment for both the desired minerals and the gangue minerals.

▲ **Columns** are unique in that it is possible to control parameters that influence recovery independently of concentration and vice versa.

▲ **One of the key control variables** affecting recovery in flotation is the bubble. Bubbles have two characteristics, size and number, or total combined volume (air hold up). It is intuitive that both affect the probability of particles and bubbles colliding in a way that attachment occurs. Bubble size and number also impact the detachment rate, as does the amount of mixing in the column. When the collected particles leave the flotation zone and enter the concentration zone, wash water rate, froth depth and froth removal rate take over to

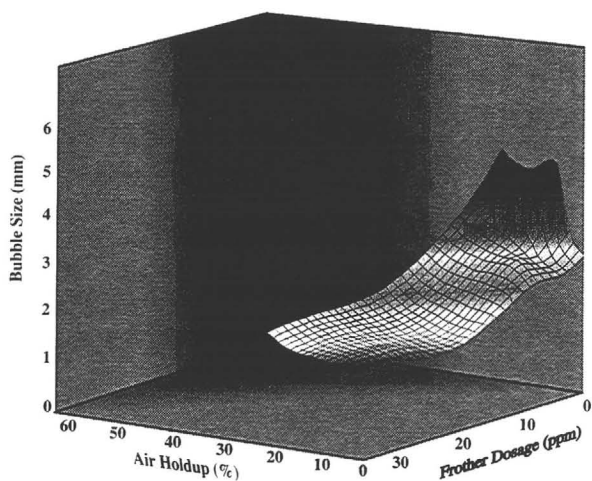


control the final concentration and recovery.

We group the following air sparger systems into the low pressure category:

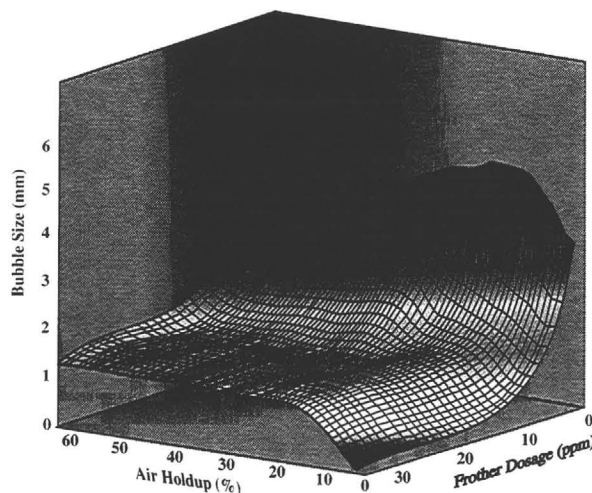
- filter cloth
- porex tubing
- floppy tubes

Each of these systems can operate at pressures below 40 PSIG. The following plots tell it all.



Low Pressure Sparger Performance

▲ **It is physically impossible** for low pressure systems to provide the range of combinations of bubble size and air hold-up that Pyramid's high pressure system can deliver. This simply means that Pyramid's bubble generation system and column design provides the maximum recoveries possible at designed concentrate grades, in the fewest stages possible.



Pyramid's External Bubble Generation System

Pyramid's Personalities

Darrel Twede - is one of Pyramid's senior process control engineers with 25 years experience in process control, software development and international project management.

Lee Barron - is our newest process engineer. Lee recently received his masters degree in metallurgical engineering and has experience in imaging systems and neural networks.

Doug Salmon - is a process control engineer with significant experience in developing expert systems for mineral processing applications. He is also an expert on object-oriented database systems.

Jeff McKay - is the co-inventor of the Bureau of Mines external bubble generator. He is world renowned for his expertise in column flotation and column scale-up and control.

Paul Keyser - comes from Virginia Polytechnic Institute where he worked in the development of the VPI sparger. He has extensive experience in coal and industrial minerals flotation.

Randy Ynchausti - has spent the last 10 years working in both the areas of column flotation and process control. He is well known for his column flotation control work and in expert control system development.

Don Foot - is one of the pioneers in the advancement of column flotation technology, and co-inventor of the U.S. Bureau of Mines external bubble generator. He has 19 years developing innovative processes in the minerals industry.

Lynn Hales - has been specifying, designing and implementing process control systems in mineral processing plants for 20 years. He has pioneered the development of expert systems in the industry and is an acknowledged innovator and industry leader.

▲ **To achieve comparable overall recoveries**, low pressure systems require more columns in series, or more stages, which dramatically increase costs and circuit complexity.



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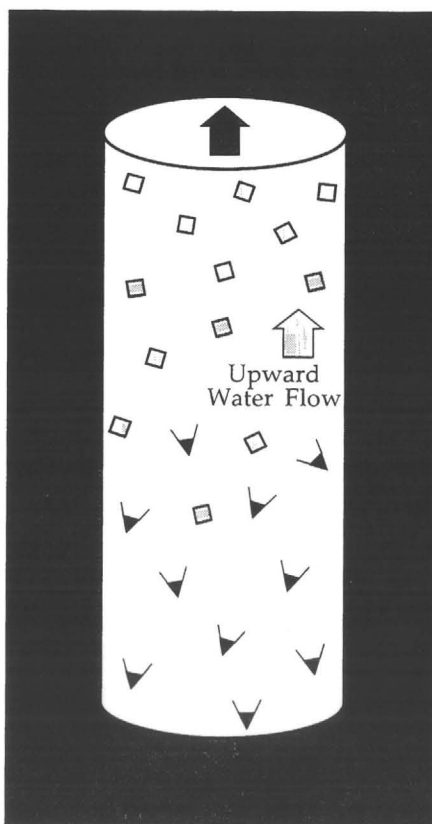
Process Mineralogy

Hazen Research, Inc. specializes in the relationship of mineralogy to mineral processing. Although this direct interplay is uncommon, it is an extraordinarily effective means of solving metallurgical problems during process development and in operating plants. The commercial ramifications of the work are always of prime importance. Our mineralogical laboratory is superbly staffed and equipped for characterization and analysis of ores, metallurgical products, tailings, residues, and wastes. Techniques typically utilized, either alone or in combination, are:

- Optical microscopy
- X-ray diffraction
- Electron microscopy
- Infrared spectroscopy
- Physical and chemical testing

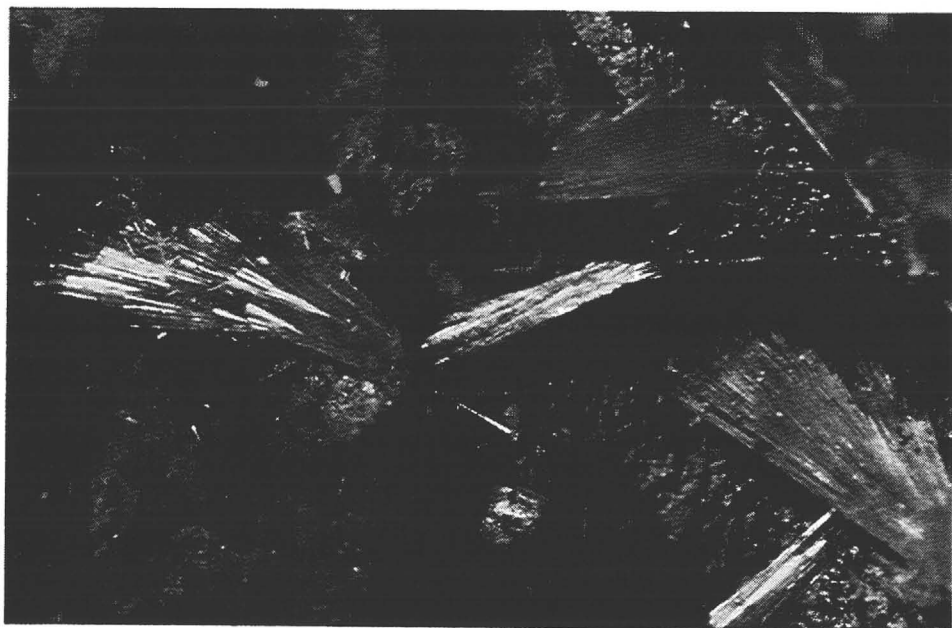
OPTICAL MICROSCOPY

In an operating flotation plant, excessive amounts of zinc were reporting to the copper concentrate. To solve this problem, polished sections were made of the concentrate which revealed chalcocite coatings on the sphalerite, explaining the undesirable results and indicating what corrective actions might be taken. An example of this chalcocite coating is shown in the photomicrograph at right. Problems such as this can frequently be resolved by skillful use of optical microscopy.



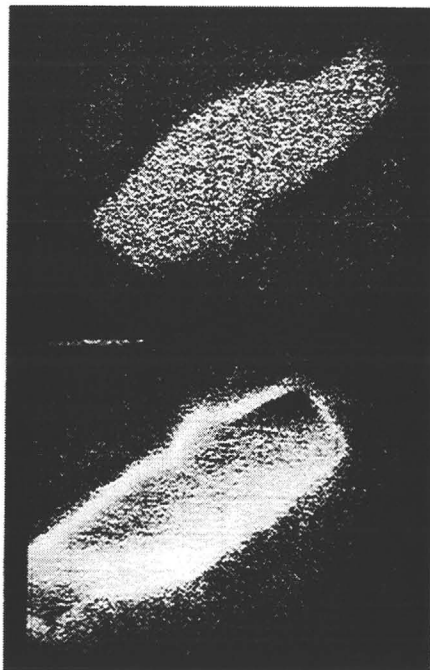
X-RAY DIFFRACTION

X-ray diffraction is particularly useful for the quantitative determination of nonmetallic minerals and very fine particles. This technique was used to evaluate a clay separation process where ordinary analytical methods could not distinguish between components in the separated fractions. The illustration at left shows selectively flocculated mineral particles being separated from the dispersed material by countercurrent water flow. The success of the differential flocculation could only be determined by x-ray diffraction.



ELECTRON MICROPROBE ANALYSIS

An understanding of the capabilities of the electron microprobe and thoughtful interpretation of the results can save time and money in solving some metallurgical problems. For example, the microprobe analyzer showed that silver was present in intimate association with manganese in the individual grains of a refractory silver ore, as seen in the photo at right. This knowledge resulted in redirection of the research effort.



INFRARED SPECTROSCOPY

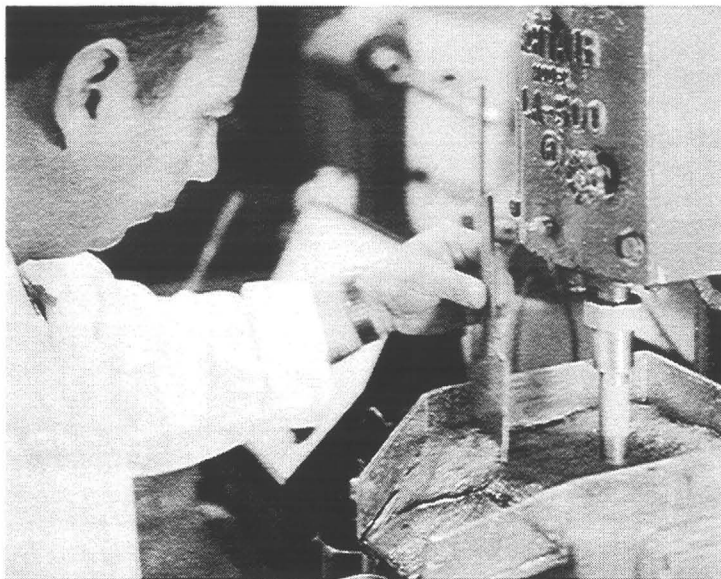
Variations in the composition of some minerals due to substitution can be detected by infrared spectroscopy. Clays in particular, which can be difficult to distinguish by x-ray diffraction, may be differentiated. Infrared spectroscopy can also be used to determine the amount of quartz in the presence of other silicate minerals.

PHYSICAL AND CHEMICAL TESTING

In addition to the instrumental techniques described above, problem-solving is augmented by a special mineral processing laboratory operated in combination with the mineralogical laboratory. Equipment is in place for gravity, electrostatic, low- and high-intensity magnetic separations; froth flotation; sizing; chemical procedures; and special applications. This facility and the technical excellence of the mineralogy staff make it possible to achieve extremely complex separations of ores, minerals, and other materials. Mineralogical support thus serves the entire company across a broad range of projects.

HAZEN RESEARCH, Inc.
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(303) 278-4550

FLOTATION . . . From examination of ores and small-scale testing to Pilot Plants . . . small or large!



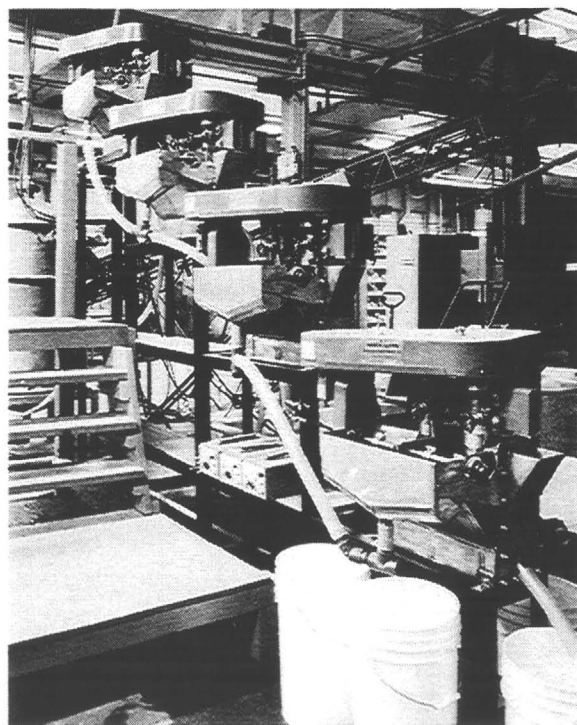
HAZEN RESEARCH is equipped to perform all phases of a project... from mineralogical examination and analysis of drill core samples through pilot plant operation, flowsheet preparation, economic evaluation, and development of process data.

Extensive in-house capabilities, such as, analytical services and equipment manufacture, can shorten a flotation test program and provide sound process development.

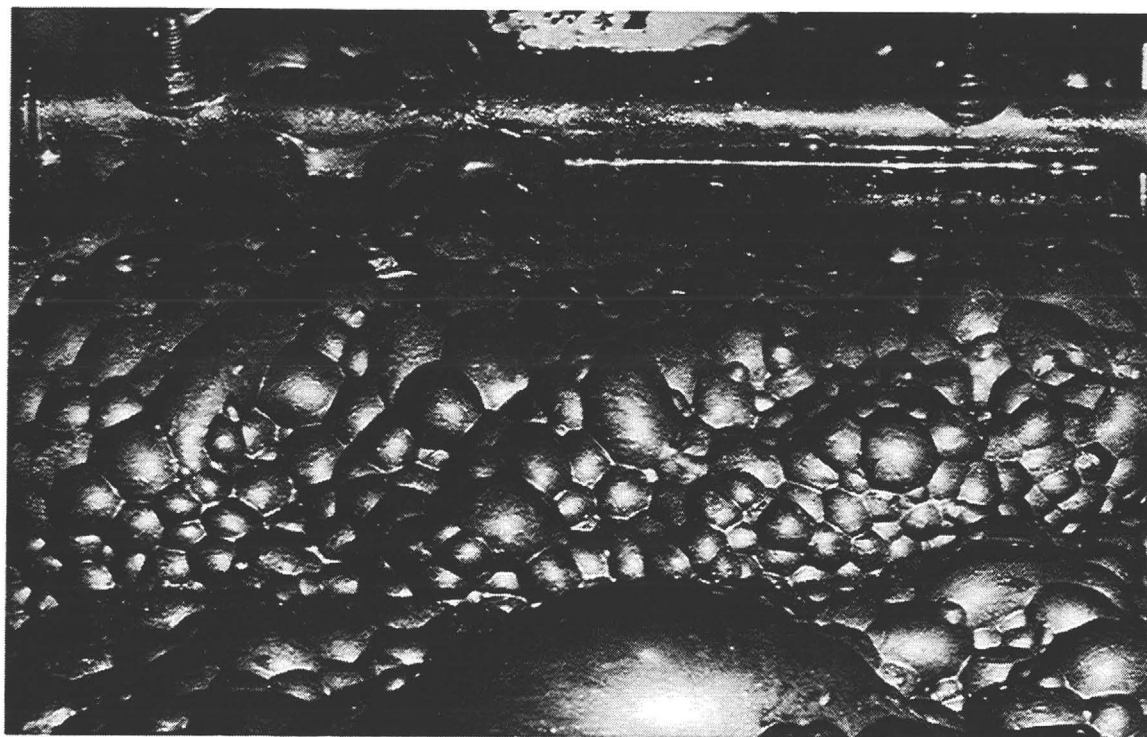
HAZEN'S experience includes the application of ion, foam, precipitate, vacuum, in-situ gas generation, flash, carrier, agglomeration, column, and froth flotation methods to precious metals, ferrous and nonferrous minerals, coal, oil shale, industrial minerals, and waste stream cleanup.

HAZEN RESEARCH can perform an entire flotation project or can work with your company in a cooperative program to supplement your facilities and capabilities and offers the following flotation services:

- Mineralogical studies
- Chemical analysis
- Bench-scale testing
- Pilot plant testing
- Plant consultation
- Pilot plant equipment manufacture
- Pilot plant design
- Grinding studies
- Preliminary process assessment studies



Hazen is the company that Industry needs today ...more than ever



HAZEN RESEARCH has experience in the flotation of ...

- Metallic and Sulfidic Gold Ores
- Complex and Massive Sulfide Ores
- Tailings and Nonconventional Process Streams for Reclamation of Values and/or Environmental Abatement
- Coal and Oil Shale
- Iron Ores
- Platinum Group Metals
- Phosphate Ores and Matrices
- Base-Metal Oxide Ores
- Native Metals Ores
- Heavy-Metal Oxide Salts
- Nonsilicate Minerals of Alkali and Earth Metals
- Soluble Salts
- Silicate Minerals



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QUALIFICATIONS HAZEN RESEARCH, INC.

Since 1961, Hazen Research, Inc. has provided the mineral, chemical, manufacturing, and metal industries with innovative technology to solve processing and related problems. Although Hazen is best and widely known for its innovative process development work for the mining/milling industry, the techniques and services developed to satisfy the needs of this industry have found wide application in the treatment of solid and liquid wastes.

In addition to providing a wide range of laboratory, pilot plant, and onsite process and cleanup services, Hazen's 125 employees, approximately 50 of whom are chemical, environmental, and metallurgical engineers, chemists and analysts, offer design, construction, startup, and consultant services. Such services assist clients in meeting production goals while complying with state, federal, and local regulations.

At its facilities in Golden, Colorado, Hazen's engineers, scientists, and technicians occupy 15 buildings comprising approximately 75,000 square feet of office, shop, testing laboratory, pilot plant, and analytical laboratory space.

Hazen, an employee-owned business, has to date worked on more than 8,000 projects.

EXPERTISE

Analytical Services

Hazen's permanent analytical group of 22 chemists and analysts, 17 of whom have degrees in analytical chemistry or related scientific disciplines, provides a total array of analytical services, from fire assaying and traditional "wet" chemistry to automated instrumental analysis by ICP.

Sample Preparation

Hazen has fully equipped sample preparation facilities which service the individual engineering groups during bench- and pilot-scale studies. These facilities are capable of handling small or large jobs, from individual assay pulp samples up to pilot-plant-size lots of minus nine-inch material.

Mineralogy/Geology

Hazen specializes in the relationship of mineralogy to mineral processing. Although this direct interplay is uncommon, it is an extraordinarily effective means of solving metallurgical problems during process development and in operating plants. The commercial ramifications of the work are always of prime importance. Our mineralogical laboratory is superbly staffed and equipped for characterization and analysis of ores, metallurgical products, tailings, residues, and wastes. Techniques typically utilized, either alone or in combination, are optical microscopy, x-ray diffraction, electron microscopy, infrared spectroscopy, and physical and chemical testing.

Hydrometallurgy

Hazen is probably best known for its hydrometallurgical expertise. Its technical staff has handled almost every conceivable feed through its laboratories and has simulated virtually all possible processes. Hazen takes special pride in its work in copper and precious metals recovery. In uranium processing, Hazen developed a special expertise and became the industry's innovator.

Solvent extraction, electrowinning, electrorefining, ion exchange, precipitation chemistry, pressure and oxidative leaching, carbon adsorption, and simulated heap, dump, and vat leaching techniques are performed routinely at Hazen.

Mineral Beneficiation

Hazen is particularly proud of its recent selective flocculation/flotation successes in the recovery of fine mineral values and of its work in sequential flotation for the selective recovery of copper, lead, zinc, and precious metal values. Flotation of industrial minerals is also a specialty.

Its technical staff is well-versed in gravity concentration methods and equipped with spirals, cones, gravity tables, and jigs. Dry and wet magnetic separators, permanent roll magnetic separators, and electrostatic equipment are available for process development studies.

Thermal Processing

If clients are interested in thermal process applications in mineral and waste treatments, they will find Hazen's diverse cache of furnaces especially useful. Hazen's bench- and pilot-scale equipment includes atmospheric fluidized beds, circulating fluidized beds, multiple-hearth furnaces, and kilns.

Coal, Oil Shale, and Tar Sands

In addition to providing analytical services, Hazen specializes in the treatment of coal, oil shale, and tar sands. For those concerned with coal quality, Hazen's innovative work in desulfurization, ash removal, and moisture reduction would be of special interest.

Environmental Services

Through its minerals activity, Hazen has become involved in environmental services, with particular emphasis on the disposal of wastes. Innovative studies, for example, into the destruction or fixation of cyanide, uranium, and metal-bearing wastes, especially arsenic and heavy metals, have been especially useful to our clients in mining and other industries.

Other Services

Hazen provides a number of services that complement its basic mineral-recovery studies. These include brief and inexpensive order-of-magnitude capital and operating cost estimates, revenue evaluations, feasibility studies, flowsheet design, material balances, and preliminary engineering. Hazen's engineers and technicians provide plant startup and process optimization services. Hazen also engineers, designs, and constructs modularized small plants.

Pilot Plants

Hazen is fully equipped with pilot plant support equipment including tanks, pumps, thickeners, filters, grinding and regrinding equipment, flotation cells, gravity concentration devices, feeders, boilers, instrumentation, rectifiers, electrowinning cells, etc., to provide the full range of pilot plant facilities as needed.

TECHNICAL COMPETENCE

Hazen was established to provide process research, development, and technical services to the metal, mineral processing, and chemical industries. Hazen's staff members provide a specialized expertise that is unique in the industry. The majority of its engineers have many years of industrial experience and know-how in program planning, process design, and operations. In addition to the professional staff, Hazen's technical staff of analysts and field technicians provides services in distant locations and at the Golden facilities.

Hazen assists clients with planning, recommendations, evaluations, consultation, research, and conceptual and fully-detailed designs relating to the development of chemical and mineral processing facilities.

As environmental problems were identified within the industries, Hazen was asked to assist in their solution. Not surprisingly, Hazen has been able to confirm repeatedly that the technologies and experiences essential to the mineral and chemical industries can be successfully applied to the solution of environmental problems.

Examples of environmental problems successfully addressed by Hazen include:

- Preparation of an engineering plan for the reclamation of the uranium mill tailings at Tuba City, Arizona.
- Preparation of a permit application to reprocess the tailings at the Argo Gold Mill in Idaho Springs, Colorado.
- Development of a process to remove cyanide from effluents before discharge to surface waters in the vicinity of Whitewood Creek, South Dakota.
- Sampling and analysis of flue-dust residues at the Anaconda Smelter in Montana. A hydrometallurgical process was developed to recover the metal values from the residues.
- Preparation of an environmental report and engineering plan to process low-grade uranium ore at the JD-5 Site near Naturita, Colorado.
- Evaluation of EPA effluent guidelines for the sand and gravel industry for the Crushed Stone Association.
- Presentation of expert testimony to the Colorado Water Quality Control Commission concerning the reclassification of streams and the modification of water quality standards in the state.
- Analysis of the EPA interim effluent guidelines for the mining and ore dressing point source (uranium, radium, and vanadium section) categories.

In general, these projects are only a sample of the thousands of evaluations and analyses Hazen has completed in more than 30 years of operation. Many projects have included field construction activities, materials handling, and ground surveying. Hazen has also provided other services to clients by arranging subcontracts with experienced firms capable of offering additional specialized technical skills.

SAFETY AND HEALTH PROGRAM

Although the Hazen Safety and Health Program is not specifically designed for hazardous-waste sites, it is appropriate for these sites, as for the many other locations where it has been successfully practiced. All sites to be considered will be surveyed by our safety and health staff prior to the commencement of work to determine the type and degree of hazards present.

Our professional and technical staff has been trained in the following areas using state-of-the-art techniques and equipment:

- Proper use of respiratory protection.
- Inhouse fire training.
- Use of monitoring equipment to detect the presence of toxic and flammable vapors or fumes and to check oxygen levels.
- Selection of protective equipment for hand and body, eyes and face, hearing, and respiratory systems.

In addition, 20% of our technical staff are trained in first aid, and an additional 10% have completed an Industrial Medical Technician (IMT) course.

All activities are conducted in compliance with applicable federal, state, and local regulations under the guidance of our corporate safety director.

MEDICAL MONITORING

Hazen participates in a proven medical monitoring program for employees exposed to, or potentially exposed to, hazardous or toxic materials. Specific health concerns requiring industrial hygiene monitoring and sampling revolve around physical agents such as heat, noise, radiation, and worker exposure to fumes, organic vapors, dusts, mists, and chemicals.

DECONTAMINATION

Hazen has years of experience with both chemical and radioactive decontamination of personnel and equipment in compliance with federal, Colorado, and Arizona regulations.

ANALYTICAL LABORATORY SERVICES

Hazen has provided commercial analytical laboratory services for more than 30 years. A part of Hazen's laboratory operations has been devoted to the analysis of water, industrial effluents, and process materials and wastes as a means of assessing the effect of industrial operations on the surrounding environment. This capability has been expanded to include a general testing and analysis service available to municipalities, governmental agencies, and private individuals.

**Hazen Research, Inc.**

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FAX: (303) 278-1528

PARTIAL LIST OF HAZEN'S CLIENTS

Aberford Resources Ltd.	Anaconda Minerals Co.	Bergsøe Metal Corp.
Aberfoyle Ltd.	Anamax Mining Co.	Bethlehem Steel Corp.
ADA Technologies Inc.	Aneka Tambang Cikotak Gold Unit	BHP-Utah International Inc.
Aero Mining Ltd.	Anschutz Mining Corp.	BHP-Utah Minerals
Aerofall Mills Ltd.	Anvil Mining Corp. Ltd.	Bienfait Coal Co. Ltd.
Aerojet Liquid Rocket Co.	Apache Energy & Minerals Co.	Big River Zinc Corp.
AGIP Mining Co. Inc.	Applied Industrial Materials Corp.	Bio-Cide International Inc.
Agnew Lake Mines Ltd.	Aquachlor Inc.	Bio-Mass Energy
Agrico Chemical Co.	Arch Mineral Corp.	Biotrol Inc.
Akminco	ARCO Chemical Co.	Black Butte Coal Co.
Akzo Chemicals Inc.	ARCO Coal Co.	Blue Cactus Mining Co.
Alamito Coal Co.	ARCO Petroleum Products Co.	Blue Mountain Minerals
Alcan Smelters & Chemicals Ltd.	Arenas y Productos Silicos S.A.	Blue Mountain Water District
Allco Steel Corp. Pty. Ltd.	Argo Gold Mill	Blue Ridge Gold Corp.
Allied Corp.	Armor Equipment Sales Corp.	Boise Cascade Corp.
Allied Chemical Corp.	Artech Recovery Systems Inc.	Bokum Resources Corp.
Allis-Chalmers Manufacturing Co.	Asamera Minerals U.S. Inc.	Boliden-Allis Inc.
Allis Mineral Systems Australia Ltd.	Asamera Oil Co.	Bond Gold Corp.
Almega Corp.	ASARCO Inc.	Bondar-Clegg
Alpar Resources Inc.	Ashland Construction Co.	Bonteso Gold Corp.
Alpha International Corp.	Associated Minerals (USA) Inc.	The Booth Co.
Aluminum Co. of America	Associated Sand & Gravel Co.	Boulder Exploration Group Inc.
Alunite Metallurgical Center	AT&T Nassau Metals Corp.	Boulder Gold N.L.
AMAX Coal Co.	Atlanta Gold Corp.	Boulder Group/Chrome Corp Int.
AMAX Exploration Inc.	Atlantic Richfield Co.	John T. Boyd Co.
AMAX Extractive R&D Inc.	Atlas Corp.	BP Alaska Exploration Inc.
AMAX Gold Inc.	Atlas Gold Mining Inc.	BP Minerals International Ltd.
AMAX Inc.	Atlas Minerals	Brenda Mines Ltd. (Noranda)
AMAX Magnesium Corp.	Atlas Precious Metals Inc.	Brewer Chemical
AMAX Nickel Refining Co. Inc.	Austral Oil Co.	British Steel Consultants Ltd.
AMAX of Canada Ltd.	Autlan Manganese Corp.	Brohm Mining Corp.
American Barrick Resources Corp.	AWC Inc.	Brooks Minerals Inc.
American Carbide Steel Corp.	Aztec Minerals	Brown Sand Inc.
American Cement Corp.		Brush Creek Mining Co.
American Central Energy Inc.	Babcock & Wilcox Co.	Brush Wellman Inc.
American Chemet Corp.	Badger Mining Corp.	Bullock Engineering Div. of Kilbom Inc.
American Coal Sales Inc.	Band-it Co.	The Bunker Hill Co.
American Consolidated Mining Co.	Barbone Cooperazione International	A.J. Burke Inc.
American Copper & Nickel Co. Inc.	Barite of America Inc.	Buttes Gas & Oil Co.
American Cyanamid Co.	Barnet Aluminum Corp.	
American Gilsonite Co.	Barneby & Sutcliffe Corp.	Caledonia Resources Ltd.
American Gold Minerals Corp.	Barr Engineering Co.	Calgon Carbon Corp.
American Gold Resources Co.	Barrack Mine Management Inc.	Calgon Mining Co.
American Iron Carbide Corp.	Barrett & Associates, Glenn	California Nickel Corp.
American Mine Services	Barrick Goldstrike Mines	California Portland Cement Co.
American Nuclear Corp.	Barrick Mercur Gold Mines Inc.	California Silver Inc.
American Oil Co.	Bateman Engineering	Callahan Mining Co.
American Petroleum Institute	Battelle Memorial Institute	Cambior Inc.
American Resins Corp.	Battle Mountain Gold Co.	Cambridge Resources Inc.
American Seed Trade Association	Baumgartner Resources	Camp Bird Joint Venture
American Strategic Metals	Bay Zinc Co. Inc.	Camp, Dresser & McKee Inc.
Amoco Metals Co.	Bear Creek Mining Co.	Canada Tungsten Mining Corp. Inc.
Amoco Minerals Co.	Bechtel Corp.	Canadian Electrolytic Zinc Ltd.
Amoco Oil Co.	Behre, Dolbear & Co.	Canadian Industries Ltd.
Amoco Production Co.	Beker Industries Corp.	Canadian Javelin Ltd.
Amoco Research Center	Bell Western Corp.	CanAm Resources Group Inc.
Amselco Exploration Inc.	Belridge Oil Co.	Canon Coal Co.
Anaconda Copper Co.	Bentley Resources Ltd.	Canonie Environmental Services Inc.

Hazen Client List, Page 2

Caprock Corp.	Commonwealth Edison	Eagle-Picher Industries Inc.
Carbon County Coal Co.	Compania de Real del Monte y Pachuca	Earth Resources
Caribbean Co-generation Co.	Compania Minera El Indio	Earth Search Inc.
Carlton Mines	Compania Minera et Tagerete S.A. de C.V.	Eastman Kodak Co.
Carpco Inc.	Cone Geochemical Inc.	Ebasco Services Inc.
Carson Hill Gold Mining Corp.	Conoco Inc.	Echo Bay Mines Ltd.
Catalyst Recovery Inc.	Consolidated Gold Fields Ltd.	EcoTek
Catalytic Inc.	Continental Ore Co.	Eldorado S.A.
Cato Research Corp.	Cooley Gravel Co.	Eli Lilly & Co.
Cedar Resources	Adolph Coors Co.	Elkem Metals Co.
Centennial Engineering Inc.	Coors Energy Co.	Empresa Minera de Mantos Blancos S.A.
Centennial Minerals Ltd.	Cooperazione International	Englehard Corp.
Centennial Silver Co.	Copetech Inc.	Energy Development Corp.
Century Geophysical Corp.	Copper Range Co.	Energy Fuels Corp.
Cerro Castillo S.A.	Coming Glass Works	Energy Fuels Nuclear Inc.
Cerro Corp.	Coronado Silver Corp.	Energy Resources Co.
Cerro Matoso S.A.	Cortez Gold Mines	Energy Technologies Group Inc.
CF&I Steel Corp.	Cotter Corp.	Engelhard Minerals & Chemicals Corp.
CH2M Hill Central Inc.	CPC International Inc.	Enrecon Incorporated
Cha-Kwaz Chauk Mining Ltd. Partnership	CR Exploration Co.	Enserch Exploration Inc.
Chapman, Wood & Griswold Inc.	CRI International	Ensign-Brickford Co.
Chase Manhattan Bank	Crescent Engineering Co.	ENSR Technology
Chem-Security (Alberta) Ltd.	Crown Resources International Inc.	Enviro Materials Corp.
Chemical & Metal Industries Inc.	Crystal Oil Co.	Environmental Restoration Systems Inc.
Chemical Waste Management Inc.	Custom Engineering Inc.	Environmental Systems Inc.
Chemstar Lime	Cyprus Beryllium Corp.	Envirotech Corp.
Chevron Corp.	Cyprus Casa Grande Corp.	EPRI (Electric Power Research Institute)
Chevron Research Co.	Cyprus Copper Co.	EPRI Center for Materials Production
The Chlorine Institute Inc.	Cyprus Exploration Co.	Equity Mining Corp.
Chrome Corp. of America	Cyprus Industrial Minerals	Eriez Magnetics
Chromium Mining & Smelting Corp.	Cyprus Metals Co.	ESI Resources Ltd.
Church & Dwight Co. Inc.	Cyprus Minerals Co.	Esso Eastern Inc.
Cia Minera Dona Ines de Collahuasi S.A.	Cyprus Mines Corp.	Esso Resources Canada Ltd.
Cia Minera Read de Angeles	Cyprus Sierrita Corp.	Eticam Inc.
CITCO International Minerals Co.		Eveready Battery Co. Inc.
Cities Service Co.	DCD Associates L.P.	Everest Exploration Co.
Citigold Alaska	Dalco Resources Co.	Excel-Mineral Co.
City Resources (Canada) Ltd.	Dallhold Resources Inc.	Exxon Chemical Americas
T.P. Clark Inc.	Dames & Moore	Exxon Chemicals International
Cleveland-Cliffs Iron Co.	Davy McKee Corp.	Exxon Coal Resources USA Inc.
Cleveland-Cliffs, Western Division	Decker Coal Co.	Exxon Co. USA
Cleveland Refractory Metals	Deepsea Ventures Inc.	Exxon Minerals Co.
Cleveland Silver Mines Inc.	Degussa Corp.	
Cliffs Engineering Inc.	DeKalb Mining Inc.	Falcon Explorations
Climax Molybdenum Co.	Delamar Silver Mine	Fallon Mining Co. Inc.
Climax Uranium Co.	Democrat Resources Inc.	Fansteel Metals
Coastal States Energy Co.	Denimil Resources U.S. Inc.	Fargo Oil Corp.
Coastal Uranium Inc.	Dennison Mines Inc.	Federal American Partners
Cobb Resources Corp.	Denizen Australia Pty. Ltd.	Ferro Corp.
Cobre de Hercules S.A.	Denver Equipment Co.	Ferrovanadium Corp. (Australia)
CoCa Mines Inc.	Denver Gold & Silver Exchange	Fertilizantes Fosfatados Mexicanos S.A.
Codelco Chile	Denver Mining Finance Corp.	Flambeau Paper Corp.
Colorado Aggregate Co.	Denver Research Institute	Florida Power & Light Co.
Colorado National Bank	Dickenson Mines Ltd.	Fluidyne Engineering Corp.
Colorado School of Mines	Dillingham Corp.	Fluor Daniel Inc.
Colorado Serum Co.	H.F. Ditchburn & Associates Ltd.	Fluor Mining & Metals Inc.
Colorado Springs Dept. of Public Utilities	Dixie Lime & Stone Co.	FMC Gold Corp.
Colorado Ute Electric Association	The Doe Run Co.	Footo Mineral Co.
Colosseum Gold Mines Ltd.	Dominion Mining Ltd.	Ford, Bacon & Davis Inc.
Colowyo Coal Co.	Dorchem International	Fort Cady Minerals Corp.
Columbia Cement Co.	Dorr-Oliver, Incorporated	Foster Wheeler Energy Corp.
Columbia Nitrogen Corp.	Dow Chemical Co.	Fountain Sand & Gravel Co.
Columbia River Carbonates	Draco Mines	Four Nines Inc.
Combustion Engineering	Dravo Corp.	Freeport Minerals Co.
Combustion Power Co. Inc.	Dresser Minerals	Freeport-McMoran Inc.
Cominco Alaska	E.I. duPont de Nemours & Co. Inc.	Fremont Energy Corp.
Cominco American Inc.	Duracell International Inc.	FRM Minerals Inc.

Frontier Airlines
Frontier Chemical Co.

The Galigher Co.
Garrett R&D Co.
Gates & Fox Co. Inc.
Gates Engineering Co.
Gemini Industries Inc.
General Atomics Co.
General Chemical Corp.
General Electric Co.
General Mills Inc.
General Motors Corp.
La Generale des Carrieres et du Zaire
Genesis Research Corp.
Geoco Inc.
Geomines S.A.
Getty Mineral Resources Co.
Getty Mining Co.
Getty Oil Co.
Getty Refining & Marketing Co.
Gibraltar Mines Ltd.
Glens Falls Water Treatment Plant
Global Marine Inc.
Golden Bear Operating Co. Ltd.
The Golden Cycle Corp.
Golden Giant Mines Inc.
Golden Reward Mining Co.
Golden Valley Electric Assoc. Inc.
Goldfield Corp.
Gold Fields Mining Corp.
Gold Fields Operating Co.
Goodyear Tire & Rubber Co.
Grace Nuclear
W.R. Grace & Co.
Graham Consultants
Grandview Resources Inc.
Granges Exploration Aktiebolag
Great American Industries Inc.
Great Lakes Chemical Corp.
Great West Minerals Inc.
Great Western Sugar Co.
Green Mountain Mining Venture
Gulf Canada Resources Ltd.
Gulf Chemical & Metallurgical Co.
Gulf Mineral Resources Co.
Gulf Oil Corp.
Gulf R&D Co.
GWF Power Systems
Gyorvary Mining Co. Inc.

Hanaya Group International
Handy & Harman
The Hanna Mining Co.
Harrison Western Corp.
Hartzell & Associates Inc.
Hecla Mining Co.
Hercules Inc.
Hi-Z Mining Corp.
Hiex International Corp.
Mauricio Hochschild & Cia. Ltda. S.A.
A.P. Hoeft Co.
Hoffmann-LaRoche Inc.
Holland & Hart Co.
Holme, Roberts & Owen
Holmes & Narver Inc.
Homestake Mining Co.

Homestead Minerals Corp.
Honeywell Inc.
Horizon Gold Corp.
Houston International Minerals
Houston Oil & Minerals Corp.
Hudson Bay Mining & Smelting Co. Ltd.
Humble Oil & Refining Co.
Humphreys Engineering Co.
Hydra-Co Enterprises Inc.
Hydro Resources Ltd.
Hydro-Chem Inc.
Hydrometals Inc.
Hydro-Search Inc.

IBM
Idaho Mining Co.
Ideal Cement Co.
IMC Chemical Corp.
Imperial Resource Recovery Associates
Independence Mining Co. Inc.
Indium Corp. of America
Industrial Compliance Technologies Inc.
Industrial Minera Mexico S.A.
Industrial Quartzite Ltd.
Industrial Resources Inc.
INEX Resources Inc.
Ingenieria del Pacifico (Chile)
Inlet Oil Corp.
Inmetco
In-Situ Inc.
Inspiration Resources Co.
Integrated Carbons Corp.
Intercoast Coal Co.
Intermountain Resources Inc.
International Corona Corp.
International Gold Bullion Exchange
International Harvester Co.
International Minerals & Chemical Corp.
International Process Systems Inc.
Interstate Minerals Corp.
Ionarc Smelter Ltd.
Iron Carbide Development Corp.
Iron Carbide Holdings Ltd.
Iron Ore Co. of Canada
ISL Ventures
Island Creek of China Ltd.
I-T Corp.

E.C. Jordan Co.
Jacobs Engineering Group
James International Ltd.
John Deere Component Works
John Deere Waterloo Tractor Works
Johns-Manville Corp.
Joy Manufacturing Co.

Kaiser Aluminum Technical Services Inc.
Raymond Kaiser Engineers Inc.
Kamyr Inc.
Kelco Technologies Inc.
Kellogg Corp.
Kelmene Corp.
Kennecott Corp.
Kennecott Engineering
Kennecott Explorations (Australia) Ltd.
Kennecott Minerals Co.
Kennecott Ridgeway Mining Co.

Kennedy Van Saun Co.
Kerr-McGee Chemical Corp.
Kerr-McGee Coal Corp.
Kerr-McGee Corp.
Key Lake Mining Corp.
Peter Kiewit Sons' Co.
Kilborn Ltd.
King, Murphy, Lavalin
Kleinfelder Inc.
Koppers Co. Inc.
KRC Aggregate
Krupp Industrietechnik GmbH
Kugler Oil Co.

La Dominica S.A. de C.V.
Lakefield Research
Lassen Gold Mining
Leadville Silver & Gold Inc.
Leesburg Land & Mining Inc.
Leslie Salt Co.
Lintree Mining Co.
Arthur D. Little Inc.
London Mine Venture
Lone Star Producing Co.
Long Island Lighting Co.
Louisiana Mining Corp.
LTV Aerospace Corp.
Lubrizol Corp.
Lucky Mc Uranium Corp.
Luossavaara-Kiirunavaara AB
Lurgi Corp.

A.R. MacPherson Consultants Ltd.
Magma Copper Co.
Magnetic Corp. of America
Magnum Mining Co.
Charles T. Main Inc.
Malapai Resources Co.
Mankomen Exploration Inc.
Mansfield Carbon Products Inc.
Manville R&D Center
Mapco Minerals Corp.
Maranatha Mining Group Inc.
Marathon Oil Co.
Marathon Resources Inc.
Marcona Corp.
Marigold Mining Co.
Marline Oil Corp.
Marston & Marston Inc.
Martin Marietta Aluminum Inc.
Martin-Marietta Corp.
Martin-Trost Associates
Master Metals Inc.
McCulley, Frick & Gilman Inc.
McNally Pittsburg Manufacturing Corp.
T.P. McNulty & Associates
MCR Geothermal Corp.
Meadows Resources Inc.
Meridian Gold Co.
Meridian Minerals Co.
Metal Refiners Ltd.
Metallurg Inc.
Metallurgical Processes Inc.
Mid-Continent Limestone Co.
Midrex Corp.
Mills Resources Inc.
Minas del Oro Corp.

Hazen Client List, Page 4

Mindoro Corp.
Minera Boyavar S.A.
Mineral Deposits Ltd.
Mineral Deposits (Americas) Inc.
Minerales Para La Industria S.A.
Minerals Exploration Co.
Minerals Recovery Corp.
Minex Resources Inc.
Minneapolis Honeywell
Minproc Canada Inc.
Minproc (USA) Inc.
Minproc Engineers Inc.
MK Environmental Services
Mobil Alternative Energy Inc.
Mobil Mining & Minerals Corp.
Mobil Oil Co.
Mobil R&D Corp.
Molycorp Inc.
Mono Power Co.
Monsanto Chemical Co.
Montana-Dakota Utilities Co.
Montana Environmental Lab
Montana Tunnels Gold Mining Inc.
Montreal Engineering Co. (Brazil)
W.S. Moore Co.
Morrison-Knudsen Co. Inc.
Mountain Fuel Supply Co.
Mountain States Resource Development Inc.
Mt. Nansen Mines Ltd.
Multi Mineral Corp.
Musto Explorations Ltd.

Nalco Chemical Co.
National Bulk Carriers Inc.
National Crushed Stone Association
National Southwire Corp.
Nedlog Technology Group
NEA Project Services
Neptune Resources Corp.
NERCO Inc.
NERCO Coal Corp.
NERCO Metals Inc.
NERCO Minerals Co.
New Frontier Trading Corp.
New Jersey Zinc Co.
Newmont Exploration Corp.
Newmont Metallurgical Services
New Wales Chemical Inc.
Nichols Engineering & Research Corp.
Nicor Mineral Ventures
Niro Atomizer Inc.
NL Industries Inc.
Noranda Exploration Ltd.
Norcen Energy Resources Ltd.
Nord Bethlehem Corp.
Nord Mining & Exploration Ltd.
Nord Rutile Ltd.
C.A. Norgren Co.
Norplex
Norplex/Oak
North American Coal Corp.
North American Mining & Minerals Co.
North American Phillips Corp.
North Lily Mining Co.
Northern Coal Co.
Northern Minerals Inc.
Northern Natural Gas Co.

Nova Pb Inc.
Nih Consultants Ltd.
Nuclear Assurance Corp.
Nuclear Dynamics Inc.
Nufuels Corp.
Nycal Corp.

Occidental Minerals Corp.
Occidental Oil Shale Inc.
Oceanography International Corp.
OEA Inc.
Oglebay Norton Co.
The Oil Shale Corp. (TOSCO)
Old Ben Coal Co.
Orbex Minerals Ltd.
Orbital Engineering Inc.
Oregon Metallurgical Corp.
Ore Sorters (North America) Inc.
Orion Oil Co.
Ortloff Minerals Services Corp.
Osage Hills Energy Co.
Outokumpu Engineering Inc.
Outokumpu Ecoenergy Inc.
Owens-Corning Fiberglass Corp.
Oxirane Chemical Co.
Ozark Mahoning Co.

Pace Corp.
Pacific Chemicals Engineering Ltd.
Pacific Coal Pty. Ltd.
Pan American Exploration
Panorama Resources Ltd.
Paranapanema S.A. Mineracaco Industria
Parrent Engineering Association
Parsons Overseas Co.
Parsons-Jurden Corp.
Pathfinder Mines Corp.
Pegasus Gold Corp.
Peko Gold Ltd.
Pennwalt Corp.
Pentanyl Technologies Inc.
Pentatech Ltd.
Petro-Nuclear Ltd.
Pfizer Inc.
PGP Industries Inc.
Phillips Chemical Co.
Phillips Coal Co.
Phillips Petroleum Co.
Phoenix Equity Corp.
Pikes Peak Mining Co.
Pima Mining Co.
Pincock, Allen & Holt Inc.
Pinson Mining Co.
Pioneer Nuclear Inc.
Pittsburg & McNally
Pittsburg & Midway Coal Co.
Pittsburgh Activated Carbon Co.
Placer Amex Inc.
Placer Dome Inc.
Plant-Roberts Chemicals
Plateau Resources (Consumers Power)
Plenty River Mining Co.
Plexus Resources Inc.
Polar Star Mines
Polysius Corp.
Portland General Electric
Power Engineering

PPG Industries Inc.
Prado Verde Inc.
Pratt & Whitney Aircraft Group
Preussag Inc.
Procon Inc.
Propaca Proceadora Paraguana C.A.
Public Service Co. of Colorado
Public Service Co. of New Mexico
Pumping Technology Transportation Inc.
Pyropower Corp.

Qit Fer et Titane Inc.
Quebec Iron & Titanium Inc.
Questex Industries Inc.
Quimica Floor S.A. de C.V.
Quintana Mineral Corp.

Rabbit Creek Mining Inc.
Rampart Exploration Co.
Ranchers Exploration & Development Corp.
Rayrock Resources Inc.
Redfield Rifle
Republic National Bank of Dallas
Resource Associates of Alaska Inc.
Resource Technology Associates
Resource Technologies Group Inc.
J.E. Reynolds & Associates
Reynolds Metals Co.
Richfield Resources
Ridgeway Mining Co.
Rio Algom Corp.
Rio Algom Ltd.
Rio Algom Mining Corp.
The River Smelting & Refining Co.
Riverside Testing Laboratories
David S. Robertson & Associates Inc.
Roberts & Schaefer Co.
Rochester & Pittsburgh Coal Co.
Rockwell International
Rocky Mountain Analytical Laboratory
Rocky Mountain Energy Co.
Rohm & Haas Co.
Roldiva Inc.
Rosario Dominicana S.A.
Rosario Resources Corp.
Rosebud Aluminum & Paper Inc.
A.H. Ross & Associates
Round Mountain Gold Corp.
Royal Gold Inc.
RSR Corp.

Safford Exploration & Mining
Salomon Temer
St. Cloud Mining Co.
St. Joe Minerals Corp.
Samincorp Inc.
San Francisco Mining Association
Sandtechnik Inc.
Santa Fe Pacific Mining Inc.
Santa Fe Mining Inc.
Saratoga Mines Inc.
Saskatchewan Research Council
Scientific Exploration
SCM Glidco Organics Corp.
Sea Sweep Inc.
Serpentix Conveyor Corp.
Sharon Steel Natural Resources

Hazen Client List, Page 5

S.W. Shattuck Chemical Co. Inc.	Terra Chemicals International Inc.	Utah International
Shattuck-Denn Mining Corp.	Tetra Technologies Inc.	Utah Power & Light Co.
Sheffield Industries Inc.	Texada Mines Pty. Ltd.	Utah Salt Co.
Shelley Carter Mining Inc.	Texas General Group Inc.	UV Industries Inc.
Sherman & Howard	Texasgulf Inc.	
Sierra Madre Minerals Development Corp.	Texas Petrochemical Corp.	Valley Camp Coal Co.
Sierra Resources Inc.	TG-Soda Ash	R.T. Vanderbilt Co.
Sierra Rutile Ltd.	Thermal Processes Inc.	Vegas Rock Inc.
Silver King Mines	3M Co.	Velsicol Chemical Corp.
Silver State Mining Corp.	3M Industrial Mineral Products Division	Ventura Minerals Co.
J.R. Simplot Co.	Timberline Mining Co.	Ventures Trident Inc.
Sindor Resources Inc.	Timet	Ventures West Minerals Ltd.
Siskon Corp.	Tipperary Corp.	The Veto Grande Companies Inc.
Sociedad Minera Carolina S.A.	Tosco Corp.	Victor-American Fuel Corp.
SOHIO Shale Oil Co.	Total Minerals Corp.	Victor Industries Inc.
Soiltech Inc.	Translogic Corp.	Virginia Materials Corp.
Solution Engineering Inc.	Transylvania International Inc.	Vitrofil Corp.
Solvay Minerals	Triad Investments Inc.	Vitro Minerals & Chemicals Co.
Sorcery Metals Inc.	Trident Petroleum Corp.	Von Roll Inc.
Soros Associates	TRW Electronic Products Inc.	Vulcan Iron Works Inc.
Southerland Mining Ltd.	Tucson Gas & Electric Co.	
Southern California Edison Co.	TVCN Communications Network Inc.	Waste-Tech Services Inc.
Southern Cross Mines Ltd.	Twin Buttes Exploration Inc.	Water Purification USA
Southern Illinois University		Watts, Griffiths & McQuat Ltd.
Southern Pacific Land Co.	Ultrapower Inc.	Wausau Papers
Southern Peru Copper Corp.	Ultrapower-Rocklin	Webco Inc.
Southern Union Production Co.	Umetco Minerals Corp.	Wellington Financial Group
Southland Mining Ltd.	UNC Mining & Milling	West Elk Coal Co.
Southwest Potash Corp.	UNC Reclamation	M.L. West
Southwestern Public Service Co.	UNC Teton Exploration Drilling Inc.	West Texas Metals Inc.
Special Resource Management	Unical Geothermal Division	Westcoast Oil & Gas Corp.
Standard Oil Co. of Ohio	Union Carbide Corp.	Western Coal Co.
Standard Slag Co.	Union Mines Inc.	Western Energy Co.
Stauffer Chemical Co.	Union Oil Co. of Canada Ltd.	Western Gold Reserves Inc.
Stearns Catalytic World Corp.	Union Oil Minerals Exploration Co.	Western Mining Corp.
Steffen Robertson & Kirsten	Union Texas Petroleum Co.	Western Nuclear Inc.
Stillwater PGM Resources	United Engineers & Constructors	Western Power Group Inc.
Stone & Webster Engineering Corp.	United Environmental Technologies	Western States Minerals Corp.
Storage Technology Corp.	United Gold Pty. Ltd.	Westinghouse Electric Co.
Strategic Metals International Inc.	United Nations Development Programme	Westley Mines Ltd.
Stringfellow Energy Consultants Inc.	United Nuclear Corp.	Westminco
Studsvik-Analytica AB	United States Gypsum Co.	Westmont Mining Inc.
Summitville Consolidated Mining Co. Inc.	United States Steel Corp.	Weston Paper & Manufacturing Co.
Sun Oil Co.	Universal Chemicals & Coatings Inc.	Roy Weston Inc.
Sunbeam Mining Co.	Universal Exploration Ltd.	Weston Services Inc.
Sunbelt Mining Co. Inc.	University of Denver	Westvaco Corp.
Sundance Oil Co.	University of Utah	Weyerhaeuser Co.
Sunnyside Gold Corp.	UOP Inc.	Wheelabrator-Frye Inc.
Sunray DX Oil Co.	Urangesellschaft U.S.A. Inc.	White Pine Copper
Sunshine Mining Co.	Urania Exploration Inc.	Williams Strategic Metals Inc.
Suntech Group	Uranium Resources Inc.	The Winters Co.
Superconductive Technologies Inc.	Urban Fuels Inc.	WMK Builders Products
Superior Oil Co.	USMX Inc.	Wold Nuclear Co.
Susquehanna Corp.	U.S. Army Corps of Engineers	Woodward-Clyde Federal Services
Sweeney Mining & Milling Corp.	U.S. Borax Research Corp.	Woodward-Clyde Consultants
Swindell-Dressler Co.	U.S. Bureau of Land Management	WR Metals Industries Inc.
Synfuels Engineering & Development	U.S. Bureau of Mines	Wright & McGill Co.
	U.S. District Court	Wright Engineers Ltd.
Tahloneka Resources Inc.	U.S. Energy/Crested Corp.	Wyoming Fuel Co.
Taiga Gold Inc.	U.S. Forest Service	Wyoming Minerals Corp.
Tapin Copper Mines	U.S. Dept. of Justice	
Techman Engineering Ltd.	U.S. Fish & Wildlife Service	Youngquist Mine Development
Teck Corp.	U.S. Geological Survey	Yuba Natural Resources Inc.
Teledyne (Wah Chang Albany)	U.S. Minerals Exploration Co.	
Teltech Inc.	U.S. National Renewable Energy Laboratory	Zincion
Tenneco Minerals Co.	U.S. Silica Co.	Zorich-Erker Engineering Inc.
Tennessee Valley Authority	U.S. Solar Energy Research Institute	Zum Nepco

Why 100% Natural **REPLACE™**

Is Healthy And Safe To Use In Your Garden

Because **REPLACE™** is completely non-toxic, it is safe to use around children and pets. It will not "burn" your plants or vegetables

no matter how much you use.

REPLACE™ contains finely ground and balanced minerals that stimulate micro-organism activity, increase nitrogen and build nutrients in your soil faster than your plants and vegetables can use them.



Here's Why Even The Best Organic Gardens Need Remarkable **REPLACE™** To Keep Soil Productive, Or To Correct Existing Deficiencies

1. Micro-organisms-bacteria, fungi, algae, and other tiny living animals and plants found in soil and vital to plant life, are chronically on the verge of starvation from lack of food.
2. Mineral balance in the soil usually is out of kilter—too low a proportion of certain essential elements due to leaching, erosion and plant consumption.
3. The nitrogen "fixing" cycle may be insufficient or erratic.
4. Biochemical cycles may not be generating or releasing major needed elements.

DIRECTIONS FOR USING **REPLACE™**

For best results, work (mix) **REPLACE™** into soil. Use the following quantities 2 to 4 times per year. Water as usual.

Potted Plants ... 4" to 8" pots 2 tsp ea.
8" to 12" pots 4 tsp ea.

Shrubby Small shrubs 1/2 lb.
Large shrubs 1 to 2 lbs.
(or 4 to 5 lbs. per 100 sq. ft.)

Flowers &
Vegetables* 5 lbs. per ea. 100 sq. ft.

1 ton per acre
2.5 tons per hectare

Lawns 1 to 2 lbs. per each 100 sq. ft.
Cover evenly when grass is dry, water thoroughly. For new lawns, cover seeds with clean topsoil first, then apply **REPLACE™** and keep soil well moistened.

Citrus & Trees Use **REPLACE™** according to age of trees. 1 lb. per each year. Feed into 12" deep holes at drip line annually.

*To areas in excess of 1 acre *for vegetables*, you may require a soil analysis with amounts of application varying from 1 - 3 tons annually.

Composting Add 2 - 20 lbs. of **REPLACE™** per cubic yard of compost, if doing pile or windrow composting.

REPLACE™ is a quality product from:

MARIAH INTERNATIONAL, INC.
702 W. Melinda Ln., Bldg. D, Suite 7

Phoenix, AZ 85027

Phone: 602.492.9017

Fax: 602.492.9810

REPLACE™

Nature's Minerals Produce Healthier Plants And Flowers

REPLACE™
67 MAJOR AND TRACE ELEMENTS FOR
GARDENS, COMPOST, LAWNS, TREES,
ORNAMENTALS, SHRUBS

- Ends micro-organism "starvation"
- Maintains delicate mineral balance of essential Nutrients in your soil
- Speeds composting
- Combats the effects of pests and diseases that affect plant growth
- Reduces the water requirements necessary for plant growth
- Will lower the cost of production and produce higher yields
- Will provide the necessary nutrients to increase the quality and quantity of the plants



How your garden benefits from **REPLACE™**

Nature's Way To Healthier Plants

Garden soil gets its fertility from a combination of climatic and biological processes. The soil which makes a good "home" for plant roots consists of minerals, air, water, decayed organic material and micro-organisms.

Prior to cultivation by man, naturally fertile soil was created by centuries of continuous decomposition of rock material—combined with the growth and decay of plants and organisms. Resulting productive soils contained a wide variety of elemental minerals essential to plant, animal and human nutrition. These elements originally came from very slow "weathering" and chemical transformation of rocks. Once released from rocks, these minerals, essential to plant life, became part of an organic cycle—going from soil to plants and back again. In a normal virgin soil, this important mineral balance is "automatically" maintained by this cycling. Man's intensive cultivation of land for food and other purposes breaks natural organic cycles by throwing the soil's mineral content out of balance. Much of the mineral plant nutrient goes into the crops and is not returned back to the same soil. Organic components then decrease because the micro-organisms which maintain them are starved for these nutrients which they need for sustenance and continued growth.

To illustrate, an acre of land planted in alfalfa must provide essential mineral elements—such as phosphorus, calcium, potassium, magnesium, iron, and many others, in

an amount which requires naturally "breaking down" two tons of original rock material per year.

This rate is many times faster than nature unaided can make these elements available. After a few years of intensive cultivation of this acre, it becomes necessary to restore the major minerals and organic material, especially phosphorus and potassium. Often nitrogen is deficient too, because the micro-organisms are starved for organic materials and can not fix enough nitrogen from the air to supply plant requirements.

Conventional agriculturalists add synthetic fertilizers to replace these "big three" essential nutrients (NPK). In this way, they continue to "force" plant growth from increasingly "worn out" land. These practices do not maintain the organic component or mineral balance.

Organic gardeners, by turning under "green manure" and compost, do maintain more of the organic component in their soil—and this is vital to keep alive and active the huge number of micro-organisms it takes to assure healthy plant life.

Micro-organisms, like plants, also need special nutrients—all the major and trace elements used up by plants (at least 30 different kinds) and probably a number of others yet to be identified by research.

REPLACE™ in its natural form provides these nutrients, quickly and completely, to restore the vital mineral balance for your soil and plants.

Here's How

REPLACE™ Can Help

REPLACE™ provides all the essential nutrients needed by starving micro-organisms and plants.

REPLACE™ contains mineral elements that "micro-organisms" and plants need in *balanced* proportions.

REPLACE™ minerals have already been broken down into tiny particles to facilitate use by "micro-organisms" (Note: Micro-organisms cannot move on their own to find the nutrients they need).

REPLACE™ expands and activates micro-organism populations. They in turn keep proper mineral balance for plants.

REPLACE™ minerals are used to build organic micro-organism cell structures. Then these minerals are excreted by the micro-organisms in the form of proteins, enzymes, and natural nutrients to be used by plants and other organisms. No need to hypo soil with synthetic chemicals to provide nutrients for plants.

REPLACE™ is long lasting—keeps on working and does not wash away. It binds with organic material, and slowly releases minerals throughout the growing season.

REPLACE™ speeds composting. Laboratory tested and proven. It doesn't matter which method is used for composting, **REPLACE™** will shorten composting time, add valuable nutrients, and reduce odor and provide the healthiest compost for gardens, shrubs and flowers.

Why 100% Natural **REPLACE™**

Is Healthy And Safe To Use In Your Garden

Because **REPLACE™** is completely non-toxic, it is safe to use around children and pets. It will not "burn" your plants or vegetables

no matter how much you use.

REPLACE™ contains finely ground and balanced minerals that stimulate micro-organism activity, increase nitrogen and build nutrients in your soil faster than your plants and vegetables can use them.



Here's Why Even The Best Organic Gardens Need Remarkable **REPLACE™** To Keep Soil Productive, Or To Correct Existing Deficiencies

1. Micro-organisms-bacteria, fungi, algae, and other tiny living animals and plants found in soil and vital to plant life, are chronically on the verge of starvation from lack of food.
2. Mineral balance in the soil usually is out of kilter—too low a proportion of certain essential elements due to leaching, erosion and plant consumption.
3. The nitrogen "fixing" cycle may be insufficient or erratic.
4. Biochemical cycles may not be generating or releasing major needed elements.

DIRECTIONS FOR USING **REPLACE™**

For best results, work (mix) **REPLACE™** into soil. Use the following quantities 2 to 4 times per year. Water as usual.

Potted Plants...4" to 8" pots 2 tsp ea.
8" to 12" pots 4 tsp ea.

Shrubby.....Small shrubs 1/2 lb.
Large shrubs 1 to 2 lbs.
(or 4 to 5 lbs. per 100 sq. ft.)

**Flowers &
Vegetables***5 lbs. per ea. 100 sq. ft.
1 ton per acre
2.5 tons per hectare

Lawns1 to 2 lbs. per each 100 sq. ft.
Cover evenly when grass is dry, water thoroughly. For new lawns, cover seeds with clean topsoil first, then apply **REPLACE™** and keep soil well moistened.

Citrus & Trees.....Use **REPLACE™** according to age of trees. 1 lb. per each year. Feed into 12" deep holes at drip line annually.

*To areas in excess of 1 acre *for vegetables*, you may require a soil analysis with amounts of application varying from 1 - 3 tons annually.

Composting Add 2 - 20 lbs. of **REPLACE™** per cubic yard of compost, if doing pile or windrow composting.

REPLACE™ is a quality product from:

MARIAH INTERNATIONAL, INC.
702 W. Melinda Ln., Bldg. D, Suite 7
Phoenix, AZ 85027

Phone: 602.492.9017
Fax: 602.492.9810

REPLACE™

Nature's Minerals
Produce Healthier
Plants And Flowers

REPLACE™
67 MAJOR AND TRACE ELEMENTS FOR
GARDENS, COMPOST, LAWNS, TREES,
ORNAMENTALS, SHRUBS

- Ends micro-organism "starvation"
- Maintains delicate mineral balance of essential Nutrients in your soil
- Speeds composting
- Combats the effects of pests and diseases that affect plant growth
- Reduces the water requirements necessary for plant growth
- Will lower the cost of production and produce higher yields
- Will provide the necessary nutrients to increase the quality and quantity of the plants



How your garden benefits from **REPLACE™**

Nature's Way To Healthier Plants

Garden soil gets its fertility from a combination of climatic and biological processes. The soil which makes a good "home" for plant roots consists of minerals, air, water, decayed organic material and micro-organisms.

Prior to cultivation by man, naturally fertile soil was created by centuries of continuous decomposition of rock material—combined with the growth and decay of plants and organisms. Resulting productive soils contained a wide variety of elemental minerals essential to plant, animal and human nutrition. These elements originally came from very slow "weathering" and chemical transformation of rocks. Once released from rocks, these minerals, essential to plant life, became part of an organic cycle—going from soil to plants and back again. In a normal virgin soil, this important mineral balance is "automatically" maintained by this cycling. Man's intensive cultivation of land for food and other purposes breaks natural organic cycles by throwing the soil's mineral content out of balance. Much of the mineral plant nutrient goes into the crops and is not returned back to the same soil. Organic components then decrease because the micro-organisms which maintain them are starved for these nutrients which they need for sustenance and continued growth.

To illustrate, an acre of land planted in alfalfa must provide essential mineral elements—such as phosphorus, calcium, potassium, magnesium, iron, and many others, in

an amount which requires naturally "breaking down" two tons of original rock material per year.

This rate is many times faster than nature unaided can make these elements available. After a few years of intensive cultivation of this acre, it becomes necessary to restore the major minerals and organic material, especially phosphorus and potassium. Often nitrogen is deficient too, because the micro-organisms are starved for organic materials and can not fix enough nitrogen from the air to supply plant requirements.

Conventional agriculturalists add synthetic fertilizers to replace these "big three" essential nutrients (NPK). In this way, they continue to "force" plant growth from increasingly "worn out" land. These practices do not maintain the organic component or mineral balance.

Organic gardeners, by turning under "green manure" and compost, do maintain more of the organic component in their soil—and this is vital to keep alive and active the huge number of micro-organisms it takes to assure healthy plant life.

Micro-organisms, like plants, also need special nutrients—all the major and trace elements used up by plants (at least 30 different kinds) and probably a number of others yet to be identified by research.

REPLACE™ in its natural form provides these nutrients, quickly and completely, to restore the vital mineral balance for your soil and plants.

Here's How

REPLACE™ Can Help

REPLACE™ provides all the essential nutrients needed by starving micro-organisms and plants.

REPLACE™ contains mineral elements that "micro-organisms" and plants need in *balanced* proportions.

REPLACE™ minerals have already been broken down into tiny particles to facilitate use by "micro-organisms" (Note: Micro-organisms cannot move on their own to find the nutrients they need).

REPLACE™ expands and activates micro-organism populations. They in turn keep proper mineral balance for plants.

REPLACE™ minerals are used to build organic micro-organism cell structures. Then these minerals are excreted by the micro-organisms in the form of proteins, enzymes, and natural nutrients to be used by plants and other organisms. No need to hypo soil with synthetic chemicals to provide nutrients for plants.

REPLACE™ is long lasting—keeps on working and does not wash away. It binds with organic material, and slowly releases minerals throughout the growing season.

REPLACE™ speeds composting. Laboratory tested and proven. It doesn't matter which method is used for composting, **REPLACE™** will shorten composting time, add valuable nutrients, and reduce odor and provide the healthiest compost for gardens, shrubs and flowers.





بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

Minnesota Pacific Agricultural Services Co. Inc.

A Hanndimar Subsidiary

P.O. Box 574 • Faribault, MN 56021 U.S.A. • Phone: 1+507+332-0518 • Fax: 1+507+332-0782

Fertilizers • Growth Regulators • Pesticides • Soil Remineralization



Image Transmission by Facsimile

MARIAH

MR. DICK CAMPBELL

CC. Mr. PIERSON

April 7, 94

URGENT

SUBJECT: REPLACE SALES IN THE ARAB WORLD

Dear Dick:

Further to above and our recent discussion, I have indications of firm orders for 100 tons to begin with for trial purposes at a price of \$450.00 per ton CIF Gulf Ports.

It may be possible to double those quantities almost right away because the difference between a 20' and a 40' container would cause a tremendous savings, so much so, that our customers may go for the 40' instead of the 20'.

It is very important for us to know when you will go into production before we engage ourselves into a firm commitment.

Once we receive letters of credit and or monies in payment we could be penalized for non-performance; but most important our reputation of 37 years in business would be hurt.

I kindly ask you to be very frank with me and to inform me when your situation will become resolved and your production starts.

I should inform you that once these orders are shipped and the product becomes applied this will lead to possibly further orders in excess of 5000 tons.

I await your news and again ask you to be very frank with me because I am committed morally already and our travelling representative Mr. Tariq Abu Saleh will be leaving to visit the customers by the end of next week and we have already given him the money to do that.

Thank you for your hospitality to us when we were in Phoenix and with best regards, from both Hannie and I.

Yours sincerely,

Omar Miqdadi.



An Independent AMVAC Chemical Corporation Sales Representative for the Arab World.

Registered Address: 402 Heritage Place, Faribault, Minnesota 56003

Dear Omar:

Attached is the evaluation
resulting from our experiment
with the two Products.

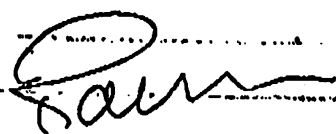
a Detailed evaluation will be
made available if you wish.

Please keep in mind that this
Summer was one of the hottest
summers in Kuwait 50°C !

With that heat, our results
were promising.

We'll discuss further in detail.

to H's of Lone





HANNDIMAR HOLDINGS INC.

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

sustainable agriculture thru our subsidiaries:

MINNESOTA PACIFIC AGRICULTURAL SERVICES INC.
Amvac products, growth regulators & quality Agricultural Materials

CEDAR SEEDS CORPORATION
high quality & hybrid seeds, selected by
OMAR KHALIL MIQDADI

AGGREGATE ORGANIC FERTILIZERS

SAMAD ABU-NEJMEH-
The fertilizer with a Golden Star
to remineralize the Earth

*Dear Jesus 6th
when I arrived
R.*

P.O. Box 574
Faribault, MN 55021 U.S.A.
Phone: 1+507+332-0518
Fax: 1+507+332-0782
Cellular: 1+507+330-9838

SEPTEMBER 4, 94
MARIAM
ATT; MR. CAMPBELL
MR. PIERSON

Dear friends:

The following 2 pages have come from my cousin in Kuwait yesterday and are self explanatory.
This is the man who has made the test for us in a very exclusive farm and garden; and I congratulate you on these excellent results.
I am forwarding these to the distributor in Kuwait and pushing for a trial order which hopefully can start around end October together with Egypt.

Wherever and whenever possible we will sell your REPLACE as is. This notwithstanding, I still wish to go ahead and set up my own brand and small crushing plant and pay you a royalty. I do not wish to approach anybody else and give you first refusal. I will have the necessary capital to do this and pay you the royalty. This will not interfere with my sales of REPLACE. I trust you will see this under a clear light and give me favourable reply.

Yours sincerely,
Omar K. Miqdadi.

Omar Miqdadi

400-450 lbs / Acre

We service what we supply, before, during and after the sale.
Registered Address: 402 Heritage Place, Faribault, MN 55021 U.S.A.

DATE: AUGUST 28, 1994

SUBJ : - "AGGRENE" FOLIAR FERTILIZER
- "REPLACE" SOIL RE-MINERALIZATION

THANK YOU FOR THE OPPORTUNITY YOU PROVIDED ME TO EVALUATE THE POTENTIAL APPLICATION OF ABOVE FERTILIZER SAMPLES IN OUR BIDA ESTATE GARDENS.

1. "AGGRENE"

AGGRENE IS A LIQUID FERTILIZER WITH AN IDEAL N-P-K RATIO ESSENTIAL TO NOURISH THE LAWNS. THE RESULT, NO DOUBT, WAS OBVIOUS; THE GROWTH EQUILIBRIUM BETWEEN THE LEAF AND THE ROOT WAS APPROPRIATELY MAINTAINED ENHANCING THE QUALITY OF GRASS IN THE LAWN. OUR CURRENT USE OF UREA (100% NITROGEN) HOWEVER ENCOURAGES ONLY THE LEAF GROWTH.

2. "REPLACE"

I HAVE TESTED IT AND IT IS A SUCCESS. THE SOIL BEING ALKALINE AND LACKING MAGNESIUM, MANGANESE AND OTHER MICRONUTRIENTS, "REPLACE" HELPED TO IMPROVE THE PH TO AN ACCEPTABLE NEUTRAL LEVEL. CHLOROSIS AND OTHER YELLOWING DISORDERS WERE THUS ELIMINATED. ITS PERFORMANCE DISPLAYED ON THE SHRUBS WAS INDEED PROMISING. HOWEVER MY ONLY CONCERN IS OVER ITS USE ON THE TREES; IT STATES THAT THE VOLUME REQUIREMENT PER YEAR OF A TREE-LIFE IS ONE POUND; AND THAT I FEEL IS A LARGE QUANTITY.

REGARDS,

VIMAL.

US65 0413 5/13/94 MF 1952 1960

John E. Bryan Inc.

300 Valley Street, Suite 206
Sausalito, California 94965
Telephone: (415) 331-7848
* Fax number: (415) 331-5725

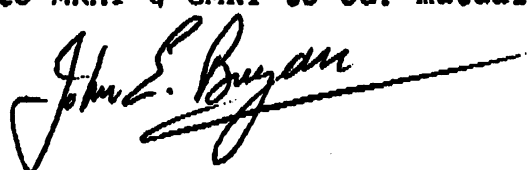
To: Dick Campbell Fax # 602 492-9810
From: John E. Bryan
Date: June 9th 1994
Re: Replace

At the suggestion of Dave Harrah, I am contacting you re the product 'Replace'

For many years I have been a stockholder of both Mariah & Guild Mark.

As you will see from my CV being sent with this memo, I have had quite an extensive career in horticulture, and I am the only American presently a Fellow of the Institute of Horticulture, being elected to this honor last year.

My support and name association + credentials might be of some help to MRHI & GMKI to our mutual benefit.



John E. Bryan
F. I. Hort.
;

CRM Industries
462 S. Gilbert Rd # 788
Mesa, AZ 85204
602-833-3820

John E. Bryan Inc.

300 Valley Street, Suite 206
Sausalito, California 94965
Telephone: (415) 331-7848
Fax number: (415) 331-5725

CURRICULUM VITAE

JOHN E. BRYAN

Date of Birth:

October 1, 1931

Place of Birth:

Plymouth, England

Nationality:

Citizen of the United States

EDUCATION:

English Public School, Dunheved
College, Cornwall, England.

Somerset Agricultural College
Graduated 1949, National
Certificate of Horticulture.

Royal Botanic Garden Edinburgh,
Scotland. Graduated 1955, Diploma
in Horticulture.

Awarded Royal Horticultural
Society's "Gardener's Scholarship"
1955-1958, given once every 3
years by the RHS and Worshipful
Company of Gardeners.

Wisley Gardens, RHS, 1955-1956.

Landscape Design, Parks Department
of the Hague, Holland, 1956-1957.

Landscape Architect, with the
Service Special des Autoroutes,
French Government 1957-1958

State of California, Lifetime
Teaching Credential, 1977.

**PROFESSIONAL EDUCATION
AND POSITIONS HELD:**

1946-1948

Apprentice to R.T. May, Nurseryman,
Devon, England. Practical
instruction in production of:
Bedding Plants, Bulbs, Vegetables,
Tomatoes, Cucumbers & Greenhouse
Management.

1949-1951

Bournemouth Parks Department.
Ornamental Plants, under glass
and outdoors; Indoor Decorating;
Lawns; Roses; Practical Aspects
of Park Management.

Page 2.
Continued -
PROFESSIONAL EDUCATION
AND POSITIONS HELD:

1958-1961

Manager of Herbaceous Perennial Nursery, Vilmorin-Andrieux, Paris France. In charge of Production & Marketing of many species of plants. Duties included: Propagation of & growing over 100,000 Dahlias each year. Staff of 25.

1961-1971

Sales Manager & Vice President, Oregon Bulb Farms, Inc. Responsibilities included: Compiling catalogs, Special Promotions, Shipping by land, sea & air, including export orders. Travelled widely in the United States, Canada & Europe. Contacts made with the World's leading Nurseries & Horticultural firms. Visited many Botanic Gardens & Arboreta, as well as Private gardens in the U.S.A. & abroad. Lectures given to many professional groups.

1971-1979

Director, Strybing Arboretum & Botanical Gardens, San Francisco California. Duties included giving Lectures & Practical Demonstrations to the Public & Professionals, Formulation of Educational Programs for the Public & Professional Gardeners. Management of County Fair Buildings.

1979-Present

President of John E. Bryan Inc. Horticultural Consultants.

HONORARY CONSULTANT:

1974

Atlanta Botanic Garden.

1975

Association of Botanic Gardens, Eugene, Oregon.

1976

Maltese Government.

HONORARY POSITIONS:

1962-1970	Chairman, Gresham Parks Commission Gresham, Oregon.
1966-1968	President, Columbia River Chapter, Oregon Association of Nurserymen.
1968-1971	State Director, Oregon Association of Nurserymen.
1969-1970	Director, North American Lily Society.
1970-1971	Member of the Agricultural Board of Oregon. Appointed by Governor Tom McCall.
1973-1975	Member, Open Space Committee. City of San Rafael, California.
1978-1982	Director, San Mateo Arboretum Society.
1982-Present	Advisory Board, San Francisco League of Urban Gardeners.

AWARDS:

1955-1958	Gardener's Scholarship. Royal Horticultural Society, Worshipful Company of Gardeners.
1982 & 1983	Quill & Trowel Communication Award: First Place Television. Garden Writers Association of America.
1984	Garden Writers Award: Newspaper Division, Bedding Plants, Inc.
1986	Communications Award, All-America Rose Selections.
1987	Fellow of the Garden Writers Association of America.
1988	<u>Growing Roses</u> - Received "Top Choice Award Best Video" rating for production & content, by Video Choice Magazine, Five Stars.

AWARDS Continued:

1990

Book of the Year Award, Garden
Writers Association of America.

1993

Elected Fellow of the Institute of
Horticulture, Great Britain.

PROFESSIONAL ASSOICATIONS
LIFE MEMBER:

International Dendrology Society.
Old Students Association, Somerset
Agricultural College.
Old Students Association, Wisley
Gardens.
Royal Botanic Garden Guild,
Edinburgh.
Strybing Arboretum Society.

MEMBER OF FOLLOWING:

American Federation of Television
& Radio Artists.
American Society of Consulting
Arborists.
Garden Writers Association of
America.
Institute of Horticulture.
International Society of
Arboriculture.
Royal Horticultural Society.
San Mateo Arboretum Society.

ARTICLES PUBLISHED:

Over 300 articles published in
Shelter Magazines & Professional
Publications in Europe & North
America.

BOOKS:

1974

The Edible Ornamental Garden
Co-Author with Coralie Castle.
Publishers: 101 Productions,
San Francisco; Penguin Books,
Australia; Pitman Publishing,
Great Britian.

1977

Small World Vegetable Gardening
Publishers: 101 Productions,
San Francisco; Penguin Books,
Australia; Pitman Publishing,
Great Britian; P. Bakker, Amsterdam
Holland, translated to Dutch.

BOOKS Continued:

1977

English Cloche Gardening
Guard 'N Gro Cloche Company,
Inverness, California.

1977

The Drought Gardener
Published by Chronicle Publishing
Company, San Francisco, California

1989

Bulbs (Two volumes)
Publishers: Timber Press, Inc.,
Portland, Oregon; A & C Black
Limited, London.

1992

Bulbs Hearst Garden Guides
Hearst Books, New York.

1994

John E. Bryan on Bulbs
Simon & Schuster, Inc., New York.

Consultant

Time-Life Encyclopedia of Gardening
Gardeners Companion; Sunset Books;
Ortho Books; Rodale Press; etc.

NEWSPAPER COLUMN:

1976-1981

Gardening Editor, San Francisco
Chronicle. Three columns/week.
Circulation 600,000 + .

REGIONAL EDITOR:

1988-Present

Flower & Gardening, The Home
Gardening Magazine.

PUBLISHER:

1979-Present

John E. Bryan Gardening Newsletter
Writer & publisher, 8 pages, monthly

LECTURES:

Many hundreds of lectures given
to Professional Associations,
Garden & Service Clubs.

PAPERS GIVEN:

Alumni Association, University
of California School of Dentistry.
American Medical Association.
International Shade Tree Conference.

TEACHING:

Adult Education, Albany School District.
St. Mary's College, Berkeley.
S.E. Asian Refugee Program.

JUDGING:

Alameda County Fair.
Marin County Fair.
Oakland Flower Show.
San Francisco Flower Show.
World of Plants, etc...

TELEVISION:

1979

Over Easy, Gardening Segments,
P.B.S., with Hugh Downs.

1976-1979

Gardening From the Ground Up
Host & writer of P.B.S. Series,
KQED-TV, San Francisco. Two 13
week series.

1979

Especially From Holland
P.B.S. Special, KQED-TV, San
Francisco. Recorded on location.

1979-1982

ABC-TV Channel 7, San Francisco,
Gardening Expert.

1982-1987

NBC-TV Channel 4, San Francisco,
Gardening Expert.

1990-Present

The Learning Channel.

RADIO:

Frequent Radio Broadcasts in
Europe, the United States & Canada.

AUDIO CASSETTES:

Author & narrator of series:
Understanding Watering,
Understanding Soils,
Understanding Plants,
Understanding Fertilizers
One Up Productions, San Francisco.

VIDEO TAPES:

1978-1988

Editor and on screen talent of
Greenday Video Magazine, Stamats
Communications, Cedar Rapids, Iowa.

1988

Growing Roses, One Up Productions,
San Francisco.

1988-Present

Gardening From the Ground Up
One Up Productions, 15 videos
from the P.B.S. series.

TOURS:

1972-Present

Tour leader (over 35 tours) to
gardens in Europe, North America,
Africa.

INTERESTS:

Photography, Writing, Acting,
Travel, Civic Activities,
Collecting Botanical Prints &
Old Maps.

SPORT:

Tennis.

LANGUAGES:

Dutch & French.

CLUBS:

Rotary International, The Family,
The Cogers, California Tennis Club.

**COUNTRIES -
GARDENS VISITED:**

Argentina, Australia, Austria,
Belgium, Botswana, Brazil, Canada,
Channel Islands, Denmark, England,
Fiji, France, Germany, Ireland,
Italy, Luxembourg, Malta, Mexico,
Monaco, The Netherlands, New
Zealand, Peru, Portugal, Scotland,
South Africa, Spain, Swaziland,
Switzerland, Tahiti, Turkey,
Wales, Yugoslavia, Zambia, Zimbabwe.

HONORS:

1990

Knight of Honor, Sovereign Order
of St. John of Jerusalem Knights
Hospitaller.

1993

Fellow of The Institute of
Horticulture, Great Britain. First
American so elected & so honored.

COLUMN FLOTATION TESTS

Flotation Test #1	Date <u>Jan 20, 1995</u>	Material: <u>Merrill Crator</u>
Weight of Material Processed: <u>3,420 lbs</u>		Pulp Density: <u>56%</u>
Frother: <u>Dowfroth 200 - 5 grams/ton</u>		
Collector: <u>MRI S-701 - 35 grams/ton</u>		
<u>pH</u>: 7.5	SCFM: <u>1400 - 1800</u>	Water Flow: <u>1.8 gal/min</u>
Sparger Pressure: <u>62 PSI</u>		Froth Level: <u>32 inches</u>
Head Assay: <u>.1351 oz/ton Gold</u>		Tail Assay: <u>nil</u>
Concentrate Assay: <u>.0881 oz/ton Gold</u>		Recovery: <u>100%</u>

COLUMN FLOTATION TESTS

Flotation Test #2

Date: Jan 24, 1995

Material: Merrill Crator

Weight of Material Processed: 1,620 lbs

Pulp Density: 58%

Frother: Dowfroth 200 - 5 grams/ton

Collector: MRI S-701 - 70 grams/ton

pH: 7.5

SCFM: 1400 - 1800

Water Flow: 1.85 gal/min

Sparger Pressure: 63 PSI

Froth Level: 34 inches

Head Assay: .960 oz/ton Gold

Tail Assay: .2687 oz/ton

Concentrate Assay: .nil oz/ton Gold

Recovery: 0%

COLUMN FLOTATION TESTS

Flotation Test #3

Date: Feb 2, 1995

Material: Merrill Crator

Weight of Material Processed: 3,670 lbs

Pulp Density: 64%

Frother: Dowfroth 200 - 5 grams/ton

Collector: MRI S-701 - 35 grams/ton

pH: 8.2

SCFM: 1400 - 1800

Water Flow: 1.85 gal/min

Sparger Pressure: 67 PSI

Froth Level: 30 inches

Head Assay: .0078 oz/ton Gold

Tail Assay: .0194 oz/ton

Concentrate Assay: .0139 oz/ton Gold

Recovery: %

COLUMN FLOTATION TESTS

Flotation Test #4

Date: Feb 3, 1995

Material: Merrill Crator

Weight of Material Processed: 3.570 lbs

Pulp Density: 63%

Frother: Dowfroth 200 - 8 grams/ton

Collector: MRI S-701 - 40 grams/ton

pH: 8.5

SCFM: 1400 - 1800

Water Flow: 1.85 gal/min

Sparger Pressure: 65 PSI

Froth Level: 30 inches

Head Assay: .0153 oz/ton Gold

Tail Assay: 4.04 oz/ton

Concentrate Assay: .0239 oz/ton Gold

Recovery: %

COLUMN FLOTATION TESTS

Flotation Test #5

Date: Feb 6, 1995

Material: Merrill Crator

Weight of Material Processed: 3.550 lbs

Pulp Density: 64%

Frother: KI 44 - 35 ml/ton

Collector: Xanthate - 86 grams/ton

pH: 8.5

SCFM: 1400 - 1800

Water Flow: 1.89 gal/min

Sparger Pressure: 72 PSI

Froth Level: 30 inches

Head Assay: .0107 oz/ton Gold

Tail Assay: .0128 oz/ton

Concentrate Assay: .0141 oz/ton Gold

Recovery: %

COLUMN FLOTATION TESTS

Flotation Test #6

Date: Feb 7, 1995

Material: Merrill Crator

Weight of Material Processed: 3.300 lbs

Pulp Density: 64%

Frother: KI 44 - 40 ml/ton

Collector: Xanthate - 72 grams/ton

pH: 8.5

SCFM: 1400 - 1800

Water Flow: 1.82 gal/min

Sparger Pressure: 65 PSI

Froth Level: 30 inches

Head Assay: .0291 oz/ton Gold

Tail Assay: .0084 oz/ton

Concentrate Assay: .0145 oz/ton Gold

Recovery: %

COLUMN FLOTATION TESTS

Flotation Test #7

Date: Feb 8, 1995

Material: Merrill Crator

Weight of Material Processed: 3,310 lbs

Pulp Density: 64%

Frother: KI 44 - 106 ml/ton

Collector: Xanthate - 112 grams/ton

pH: 8.0

SCFM: 1400 - 1800

Water Flow: 1.82 gal/min

Sparger Pressure: 67 PSI

Froth Level: 30 inches

Head Assay: .0068 oz/ton Gold

Tail Assay: .0050 oz/ton

Concentrate Assay: .0029 oz/ton Gold

Recovery: %

COLUMN FLOTATION TESTS

Flotation Test #8

Date: Feb 9, 1995

Material: Merrill Crator

Weight of Material Processed: 3,190 lbs

Pulp Density: 65%

Frother: HF 201 - 35 ml/ton

Collector: MRI S701 - 45 grams/ton

pH: 8.0

SCFM: 1400 - 1800

Water Flow: 1.82 gal/min

Sparger Pressure: 65 PSI

Froth Level: 30 inches

Head Assay: .0263 oz/ton Gold

Tail Assay: .0533 oz/ton

Concentrate Assay: .0129 oz/ton Gold

Recovery: %

COLUMN FLOTATION TESTS

Flotation Test #9

Date: Feb 10, 1995

Material: Merrill Crator

Weight of Material Processed: 3,080 lbs

Pulp Density: 66%

Frother: HF 201 - 70 ml/ton

Collector: MRI S701 - 45 grams/ton

pH: 8.2

SCFM: 1400 - 1800

Water Flow: 1.84 gal/min

Sparger Pressure: 71 PSI

Froth Level: 30 inches

Head Assay: .0153 oz/ton Gold

Tail Assay: .1102 oz/ton

Concentrate Assay: .0059 oz/ton Gold

Recovery: %

**THE EFFECT OF ROCK DUST (REPLACE™)
ON PLANT PRODUCTIVITY
AND
SELECTED SOIL PROPERTIES**

A Proposal Submitted to:

**Ken Solomon, Director of Research
California State University, Fresno
California Agricultural Technology Institute**

A Proposal Prepared by:

**Richard A. Campbell, Vice President
MARIAH INTERNATIONAL, INC.**

for

**Soil Remineralization for Economically and Ecologically
Sustainable Agriculture in the U.S.A.**

EFFECT OF ROCK DUST (REPLACE™) ON PLANT PRODUCTIVITY AND SELECTED SOIL PROPERTIES

Introduction:

Currently there is considerable interest in use of rock dust as a means of either fertilizing soils for certain nutrients or as a means revitalizing "tired" soil that has been intensively managed or is of very old age. Proponents point to natural phenomena such as volcanic activity, alluvial flooding such as occurs in the Nile Valley, glaciation, etc., as evidence that the additions of minerals are the basis of soil fertility. In addition, there are claims that freshly ground rock dust has a synergistic effect on soil biology due to the release of multiple nutrients. Intuitively from how soils are developed, this makes sense. However, a major factor that is typically overlooked is time. A mature or fertile soil usually takes thousands or tens of thousands of years to develop through chemical weathering and parallel evolution of biological activity which ultimately results in the establishment of a complex soil ecosystem. None the less, there has been an accumulation of anecdotal information on the benefits of rock dust and a limited number of scientific investigations on rock dust. The scientific literature will be briefly reviewed in relation to the proposed research.

Reports of rock dust have appeared in the agriculture literature for over 100 years. Much of this early work revolved around fertilizing for potassium (K). Of course, at this time, not all the essential nutrients has been established so non-potassium effects were not being attempted to be measured. As early as the 1850's Magnus (1850) and Missoux (1853) reported improved growth due to use of feldspar and granite quarry, respectively. Aitken (1887) in Scotland and Balentine (1889) in Maine reported that feldspars could provide significant amount of K. Conversely, Hartwell and Pember (1908) showed results that feldspar was only a slight source of K for plants and Cushman (1907) was of the opinion from his work that the question of feldspar rock dust was unsolved.

A major problem with some of the early work is that the authors were not specific in identifying the type of rock. For example, there are many types of feldspars. In a greenhouse study, Graham and Albrecht (1952) compared various minerals and found that the availability of K was in the following order orendite pumice > orendite > granite > alunite > illite > basalt > feldspar > rhyolite. In other studies with crops, biotite was superior to other minerals such as micas and muscovities in supplying K (Stahlberg, 1959; Mortland et al. 1957; De Turk, 1919).

More recent studies on minerals of volcanic origin have shown that these minerals can supply significant amounts of Ca and Mg (Roschnik, et al., 1967; Mahler and Fosberg, 1983). Also there is evidence that diabase powder can supply the micronutrients such as copper and zinc (Rasp, 1974).

Another major factor is soil type. For example Phleiderer (1986) reported that regardless of application rate, a soil high in nutrients did not respond to basalt dust where as on a light textured, low cation exchange soil there was a positive response to this dust. Stahlberg (1959) found that acid soils release more K from rock dust than more neutral soils.

Recent studies are showing that Soil Remineralization (SR) creates fertile soils much the same way the earth does through the process of glaciation, volcanism, and from alluvial deposits. Natural mixtures such as glacial moraine and single and mixed rock types contain a broad spectrum of minerals and trace elements which finely ground contribute to soil fertility for agriculture and are an ecological and economic alternative to the use of chemical fertilizers and pesticides.

Soil Remineralization (SR) has been shown to: increase yields, give higher brix readings, stimulate the growth of microorganisms and earthworm activity, increase the nutrient intake of plants, counter soil acidity, prevent soil erosion, increase the storage capacity of the soil, and to deter insects. Plants are more resistant to frost, drought, and disease (Hamaker 1982).

Enhanced flavor is another market advantage. Bob Cannard, one of the farmers in the U.S. to utilize SR has an exclusive contract to grow 75 varieties of vegetable and fruits with one of the most famous restaurants in the U.S., Chez Panisse (Alice Waters, founder of "California Cuisine").

Some highlights of previous research include:

- * In Europe four times the timber volume for pine seedlings remineralized with basalt after 24 years showed improvements for 60 years over the untreated control.
- * Men of the Trees in Australia has achieved five times the growth for some species of trees and shortened their potting-out time from five months to six weeks.
- * Dr. Robert Bruck has seen greater health and 27% and 19% increased height growth of 5,000 red spruce and fraser fir respectively, planted in an acid-rain devastated forest near Asheville, NC.
- * In Michigan, John Hamaker had two-and-a-half times the yield of corn (65 bushels/acre compared with 25 bushels/acre of neighboring farms using conventional methods) with no irrigation during dry conditions and with highly increased mineral content shown in tissue analysis.
- * A cost benefit analysis shows an 80% increase in banana production in Australia with a significant decrease in fertilizer costs (ARP pp 9-12).

In summary, there has been some work done on rock dust, but it has mostly been done with respect to K nutrition. There is evidence that the response of rock dust does vary with soil type. Consequently, what is needed, are studies that evaluate well characterized rock dust in terms of mineralogy and chemistry on a range of soil types varying in age and intensity of previous management. Furthermore, studies are needed that investigate the potential of rock dust to enhance manure or for manure to enhance the release of nutrients from rock dust.

The objectives of the proposed study are to investigate rock dust added to soils in relation to:

1. Availability of essential nutrients to plants,
2. Soil biology,
3. Soil types varying in age and history of management intensity, and
4. Usage with animal manure.

PROCEDURES

The general approach will be to impose various rock dust treatments, including Replace, in several greenhouse studies. This would allow for detailed studies under controlled conditions that can provide the necessary resolution to accurately measure treatment effects and to better understand the underlying mechanisms of these effects.

Experiment I: Effect of Rock Dust in Combination with Animal Manures on Plant Productivity, Nutrient Availability and Soil Biology

Commercially available steer manure without or with rock dust (one parts manure to one part rock dust on dry weight basis for each component) would be incubated for 30 days at 24 degrees C. The incubated manure samples would be evaluated for microbial biomass carbon (C) (an index of the amount of living microbial biomass in soil) and B-glucosidase activity (this enzyme is important in converting unavailable C to forms that microbes can use for energy). The manure of manure/rock dust mix would be mixed with soil (Jory, a old acid highly weathered soil used for both agriculture and forestry production) to give the equivalent rate of 20 tons manure/acre and with rock dust at the equivalent rate of 20 ton/acre. Another treatment would be the addition of composted manure and rock dust (i.e., rock dust is not composted with manure, but rather is added to soil separately from the manure, and then soil, manure and rock dust is thoroughly mixed). Another set of treatments would only receive rock dust at either 10 or 20 ton/acre (see Table 1 for description of treatments). Then all soils including the control (no rock dust or animal manure treatment) would be amended with 320 mg nitrogen/kg soil as ammonium nitrate and 100 mg P/kg as calcium phosphate. This would be done because rock dust does not contain enough nitrogen and phosphorus to meet crop requirements. One kg of soil (oven-dry basis) amended or unamended oil would be placed in non-draining pots.

Ryegrass (*lolium perenne* L.) would be grown in each pot by planting one gram of seed/pot. Ryegrass should be used as the indicator plant because it has a vigorous root system that would readily explore the soil and also it is a standard crop widely used in greenhouse plant nutrition studies. The pots would be maintained at 75% field capacity by daily watering with deionized water to replace water lost during the previous 24 hours, as determined by weighing 20 randomly selected pots. Three times weekly all pots would be weighed and adjusted to the preselected weight. Lighting in the greenhouse would be maintained for 15 hour days with daily temperature ranging from 20 to 24 degrees C.

The design of the experiment would be a completely randomized block with five treatments (composted manure, manure and rock dust composted together, rock dust and composted manure added to soil separately, rock dust alone, and control) with five replications.

The ryegrass would be grown for 60 days and harvested at 30 day intervals. The harvested plant tissue would be weighted, dried and ground to pass a 0.37 mm sieve. Plant tissue of the second harvest would be analyzed for the essential elements of P, K, Mg, S, Ca, Fe, Zn, Cu, B, and Mn by Inductively Coupled Plasma Emission Spectrometry (ICP). In addition, tissue would be analyzed for the non-essential elements of Na, Al and Ni (there is growing evidence that Ni may be an essential plant nutrient).

Nitrogen would be measured on plant material by the Kjeldahl method.

After the last harvest soil samples would be taken from each pot and analyzed for microbial biomass carbon and B-glucosidase activity. From selected pots, soil would also be analyzed for organic acids. This may be an indicator of stimulation of organic acid production by microbial activity due to rock dust. In turn, greater levels of organic acids may cause release of nutrients from rock dust. Selected pots would also be sampled and the soil by analyzed for extractable P, Ca, Mg, Zn, Cu, and B.

Experiment II: Effect of Rock Dust on Plant Productivity, Nutrient Availability, and Soil Biology as a Function of Soil Type

Because response of rock dust can vary as a function of soil type, four soils would be chosen that represent a range of age and classified types. A Jory sample would be taken from a commercial agriculture field and from a forested site that has been clear cut one or more times. In addition, two valley floor agriculture soils would be sampled that include a medium textured/fertile (Woodburn) and a light textured soil with low native fertility (Newberg).

The soils would be again tested in the greenhouse using the same methods outlined in Experiment I. Each soil would receive no rock dust treatment (control) or rock dust (20 tons/acre). Ryegrass would be the indicator crop and all the same plant and soil analyses would be run as described above in Experiment I.

The design of the experiment would be a completely randomized block as a 4 x 2 factorial with four soil types and two rock dust levels (0 or 20 tons/ha). There would be four replications of each treatment.

EXPECTED OUTCOMES AND IMPACTS

From the literature search, it is clear that plant response to rock dust varies according to the type of dust and according to soil type. The treatments included would provide information on the plant response in terms of plant growth as a function of rock dust alone or in combination with animal manure. In addition, the plant would be used to "test" the soil for all the essential nutrients in the presence or absence of rock dust by analyzing harvested tissue for these nutrients. Thus, if there is a plant growth response to rock dust, there would be data available to determine whether this was due to a nutritional effect. Close monitoring of soil biological indicators before and after the experiments would provide information on whether rock dust stimulates biological activity. The experiments have a rigorous statistical design with adequate replication to draw conclusions from the data. Budget projections to perform these experiments need to be completed and returned to R. A. Campbell, V.P. Mariah International, Inc., 702 W. Melinda Lane, Bldg. D., Suite 7, Phoenix, AZ 85027.

Telephone 602-492-9017 or FAX 602-492-9810.

Table 1. Treatments that would be used to test effects of rock dust on plant productivity and soil biology.

	<u>TREATMENTS</u>	<u>DESCRIPTION</u>
Experiment I	1. Control	Soil alone without treatments
	2. Rock dust - 10	Rock dust mixed with soil at 10 tons/acre
	3. Rock dust - 20	Rock dust mixed with soil at 20 tons/acre
	4. Composted manure and rock dust - preincubated	Rock dust mixed with manure in 1:1 ratio and incubated 30 days at 20% moisture. After incubating soil, manure/rock dust mixture is mixed with soil to give 20 tons/acre rates for both manure and rock dust
	5. Composted manure - no preincubation	Rock dust and composted manure mixed with soil just before planting ryegrass
Experiment II	1. Agricultural Jory soil	This is very old highly weathered, reddish soil - a site would be found that has been under intensive cultivation for 80 to 100 years
	2. Forested Jory soil	Same soil type as number 1 treatment, but forested site would be selected which has been logged
	3. Agricultural Woodburn soil	Fertile valley floor soil that has been intensively cultivated for 80 to 100 years
	4. Agricultural Newberg soil or related type	A lighter textured soil with lower native fertility than Woodburn - a site would be chosen that has been intensely cultivated for 80 to 100 years

Each soil type of Experiment II would be treated at either 0 or 20 tons rock dust/acre.

WORK SCHEDULE

<u>Activity</u>	1995									1996	
	<u>May</u>	<u>June</u>	<u>July</u>	<u>Aug</u>	<u>Sept</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Jan</u>	<u>Feb</u>	
Soil site selection and soil collection	X	X									
Experiment I											
Greenhouse work			X	X	X						
Lab analyses					X	X					
Data analysis						X	X				
Experiment II											
Greenhouse work						X	X	X			
Lab analyses								X	X		
Data analysis								X	X		
Data interpretation and write up						X	X	X	X	X	
Final report											X

BUDGET (Projections)

Technical Staff (Salary, Benefits and Payroll Tax) \$

Labor (Salary and Payroll Tax)

Lab Analyses

Soil Biology and Organic Acids

Soil Chemical Properties

Plant Tissue

Data Management and Statistical Analysis (approx. 80 hours)

Report Writing (approx. 120 hours)

Small Scale Greenhouse and Data Management Equipment

Expendable Greenhouse and Lab Materials

Greenhouse Rental

Soil Collection Travel

Miscellaneous Supplies and Incidentals

TOTAL \$

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FINAL REPORT

Submitted to:

**Mr. A. Takemoto
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Suite 1701, W. Charleston
Las Vegas, Nevada 89102.**

"ANALYSIS OF CINDER CONE MATERIALS"

CSM Project No. 2522/4-49044

Principal Investigator:

**Baki Yarar
Professor
Department of Metallurgical Engineering
Colorado School of Mines,
Golden, Colorado 80401**

Final Report Date: September 1, 1987

Foreword and Caution

This final report is presented to Mr. A. Takemoto of Cimarron Corporation as stipulated in CSM Proposal No. 2522 and followup correspondence.

The studies reported here are "only analyses" and should not be taken to imply that the values in the samples analyzed can or cannot be extracted. Economics of a project involve extensive testing, pilot plant trials, knowledge of facts which fully characterize an ore deposit, energy and water problems, other engineering, environment, government regulations and management techniques, to cite just a few fundamental variables.

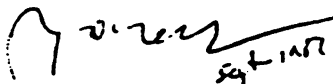
As this report covers analyses of samples only, and we have no information on any of the variables cited above, the contents of this report should not be construed in any way as a statement in connection with the economics of the extraction of values from the samples studied.

It should be noted by all parties that the Colorado School of Mines and its professors do not endorse or deny any business ventures that this report or its contents may relate to.

It follows therefore, that the name of the school or principal investigator should not be used in any advertisements or promotional materials directly or by implication unless authorized in writing.

We welcome any inquiries in writing from Cimarron Corporation regarding the contents of this report.

B. Yarar
Professor

A handwritten signature in dark ink, appearing to read "B. Yarar", with a date "Sept 1977" written below it.

Sample Collection

On May 21, 1987, 42 samples were collected by Dr. G. Pine from five different properties approximately 30 miles northwest of Flagstaff, Arizona. The samples were collected from cinder quarries at the following locations: SW 1/4 Sec 7, T25N R5E; NE 1/4 Sec 11, T25N, R4E; NE 1/4, Sec 17, T25N, R5E; NE 1/4 Sec 35, T25N, R5E; and NW 1/4 Sec 6, T24N, R6E (Elbert Mountain 15' and Kendrick Peak 7 1/2' Arizona Topo Sheets). See Appendix I for sample location maps.

On "flat" areas in the field the upper layers of material was scraped away and a 0.5 to 1.0 foot hole dug to obtain the sample. On "vertical" faces trenches were cut to obtain representative samples. Sample sizes ranged from 0.1 to 2.0 kg. However, eight larger samples ranging in weight from 4.8 to 11.2 kg were also collected.

The larger-weight samples were crushed to -10mm in Phoenix, Arizona, and all samples were shipped to the Colorado School of Mines, Golden, Colorado, for examination and analyses.

Sample Preparation

A 1.0 to 2.0 kg representative sample from the larger samples was taken and all 42 samples were crushed to -2.0mm using a roll crusher. The samples were then split by Jones Sample Splitter to 75 to 100 gram sizes which were pulverized to -400 mesh in a mechanical pulverizer.

The larger samples were ground in a rod mill and wet-sieved using a 28 mesh sieve. Material was re-ground until 100% of the sample passed through the 28 mesh sieve.

The -28 mesh material was run on a shaking table. A concentrate and tails were separated from each table feed. The tails from the first operation

were re-run (separating into a concentrate, combined with first run, and tails fraction). The table concentrate was split by Jones Sample Splitter to obtain 75 to 100 grams of material which was pulverized to -400 mesh in a mechanical pulverizer. See Appendix II for details of shaking table operation.

Also, a small amount of TAKE 3 table concentrate was hand panned and the residual "heavy" grains were examined using the Scanning Electron Microscope. Minerals identified in this very cursory examination were gold, pyrite, galena, and titaniferous magnetite beside gangue.

The pulverized materials (-400 mesh) were treated to obtain an organic extract of gold for AA analysis. The procedure is given in Appendix III.

Results of Analyses

Results of AA (atomic absorption spectrophotometry) analyses of all products are shown in Exhibits 1, 2, 3 and 4. Brief examination of the data indicates that all samples contain gold. Quarry A contains the highest average of gold (7.7ppm = 7.7 grams/m.t.) whereas Quarry D contains the lowest average of gold (3.9 ppm = 3.9 grams/m.t.).

The shaking Table Concentrate from bulk samples has about twice as much gold as the bulk sample. However, since the shaking Table Concentrate represents about 15% of the bulk sample weight, apparently a significant portion of the gold remains in the shaking Table Tails. It may be noted here that tabling trials were lab-scale and only exploratory. It should further be possible to improve recoveries and grades under optimal conditions of operation.

EXHIBIT 1

Results of AA Analyses

Sample #	Au (ppm)
1T	5.4
2	4.1
3	4.9
3T	5.4
4	4.1
5	3.8
6	3.9
6T	6.4
7	6.9
7T	6.1
8	7.6
9	17.5
10	6.4
11	5.0
12	177.1* 7.8
13	14.2
14	3.0
15	21.2
16	15.4
17	20.0
18	4.9
19	6.8
20	2.5
21	4.4
22	6.7
23	5.4
24	5.1
25	5.5
	7.5
	(6.5)
26	5.3
27	7.8
28	5.9
29	4.1
29T	12.3
	4.6
	(8.5)
30	7.6
31	5.0
32	3.5
33	5.3

EXHIBIT 1
Results of AA Analyses
(Continued)

Sample #	Au (ppm)
33T	12.2
	10.1
	(11.2)
34	4.2
35T	8.5
	11.1
	5.2
	(8.3)
36	4.8
37	1.8
38	5.5
39	2.4
40	5.7
40T	9.2
	21.7
	(15.5)
41	9.2
42	5.0

*Invalid Reading (?) (15.5) = average

Ti indicates shaking table concentrate. See Appendix I for data.

EXHIBIT 2

Results of AA Analyses by Quarry

QUARRY A			
Sample #	Au (ppm)	Sample #	Au (ppm)
1T	5.4	13	14.2
2	4.1	14	3.0
3	4.9	15	21.2
3T	5.4	16	15.4
4	4.1	17	20.0
5	3.8	18	4.9
6	3.9	19	6.8
6T	6.4	20	2.5
7	6.9	21	4.4
7T	6.1	22	6.7
8	7.6	23	5.4
9	17.5	24	5.1
10	6.4	25	6.5
11	5.0	26	5.3
12	7.8	27	7.8
QUARRY B			
Sample #	Au (ppm)	Sample #	Au (ppm)
28	5.9	30	7.6
29	4.1	31	5.0
29T	8.5	32	3.5
QUARRY C			
Sample #	Au (ppm)	Sample #	Au (ppm)
33	5.3	35T	8.3
33T	11.2	36	4.8
34	4.2		
QUARRY D			
Sample #	Au (ppm)	Sample #	Au (ppm)
37	1.8	40	5.7
38	5.5	40T	15.5
39	2.4		
QUARRY E			
Sample #	Au (ppm)	Sample #	Au (ppm)
41	9.2	42	5.0

EXHIBIT 3

Average Au by Quarry

Quarry #	Au (ppm)	Number of Samples
A	7.7	26
B	5.2	5
C	4.8	3
D	3.8	4
E	7.1	2

*Note: Excludes the Table Concentrate Samples

EXHIBIT 4

Comparison of Bulk Sample to Table Concentrate

Sample #	Au (ppm)
1T	5.4
3	4.9
3T	5.4
6	3.9
6T	6.4
7	6.9
7T	6.1
29	4.1
29T	8.5
33	5.3
33T	11.2
35T	8.3
40	5.7
40T	15.5

Use of an External Referee Laboratory

It is common knowledge that different samples sent to various laboratories produce different results of analysis. As a matter of routine, we also sent representative samples to a local laboratory with which we have worked in the past (S.L.L.), and requested fire assays.

Their results, given in Appendix IV, indicated less than 0.02ppm gold, i.e., below detection limit in all bulk samples, except number 41.

These results are not surprising, since fire assay results are highly dependent on the formulation of the flux material. This is made clear by a U.S.G.S. publication entitled: A Manual for Fire Assaying and Determination of Noble Metals in Geological Materials, U.S.G.S. Publication No. 1445 (1977).

The same external laboratory did report gold and silver in concentrates. See Appendix IV.

Our fire assays, which were carried out with table concentrates, used the U.S.G.S. approach which consisted of analysis of the fire assay crucible charge by EDX, followed by flux formulation, and on this basis did produce fire assay beads. These are documented in Exhibits 4, 5, and 6

Spectral Analyses

Spectral analysis is a semi-quantitative method which shows the relative abundance of elements in a sample. While it records silver, it is not responsive to gold or platinum due to the noble (high ionization potential) of these elements. Appendix V shows the spectral analyses of all the samples.

Spectrographic analyses do not show any significant trends. Samples from Quarry B are high in Cr and Ni, whereas samples from Quarries C, D, and E are low in Cr and Ni. Quarry B has slightly higher Cu values. Table Concentrates show a slight increase in Cr, Ni, and Mn when compared to bulk samples.

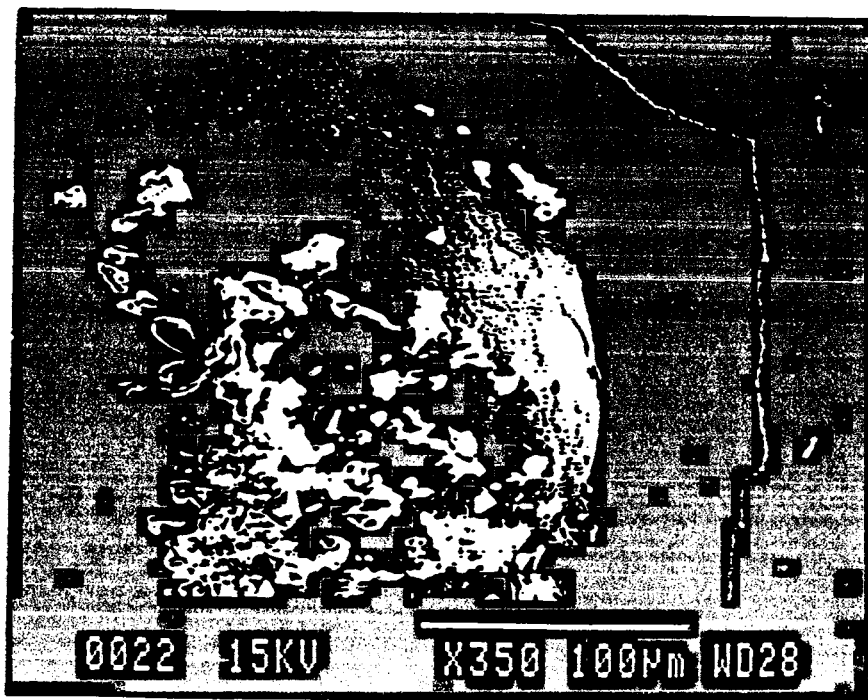


Exhibit 4: SEM Electron Micrograph of Fire Assay Bead.

Sample: Take-29 table concentrate.

EDX Analysis:

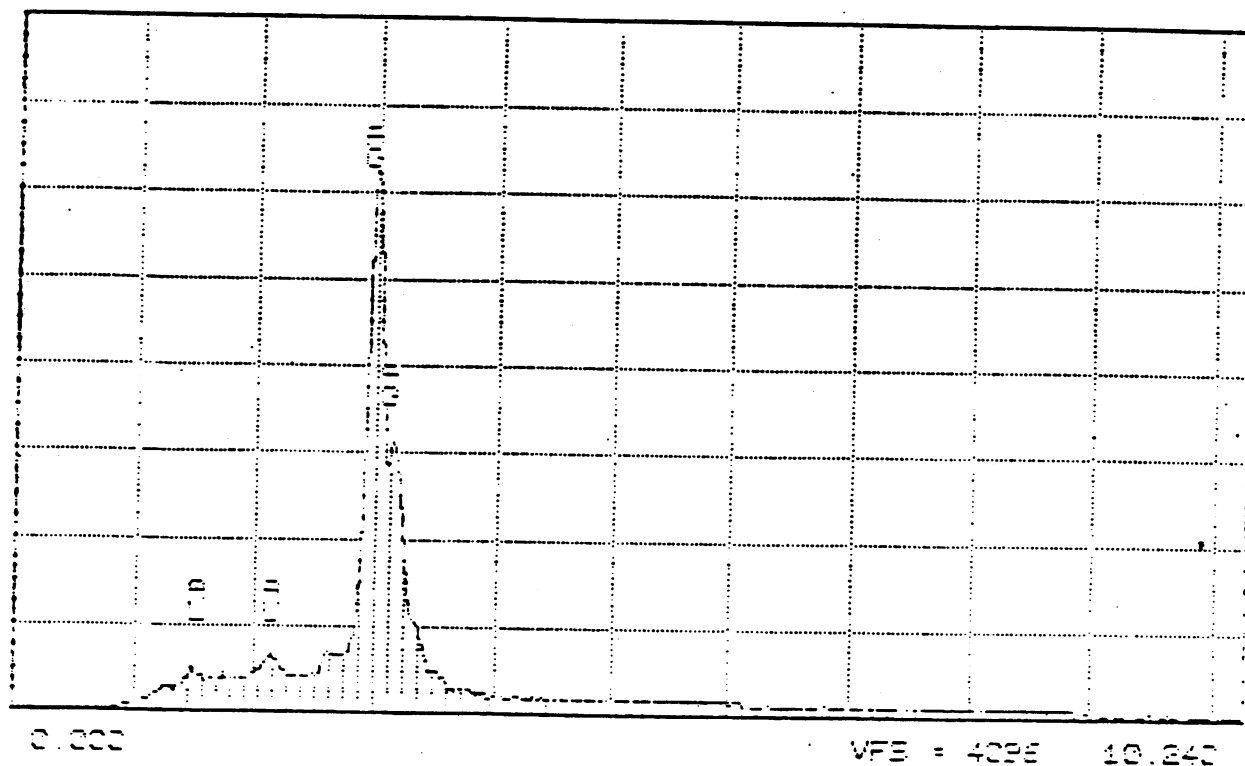
AU: 6.85%

Ag: 93.14%

See Exhibit on next page for EDX spectrum.

TUE 25-210-37 1211E

Cursor: 2.023keV = 0



```

100      TAKE 99-TAKE 8 COND BEED
101      IF=EXE(0)+- / 6123456789;K>0000DEFGHIJKLMNOPQRSTUVWXYZ0123456789 _abcdefghijklmnopqrstuvwxyz
102      LPROPR:=LUNOVRX(1)

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Exhibit 4-A: EDX spectrum of fire assay bead from sample: Take-29, table concentrate.

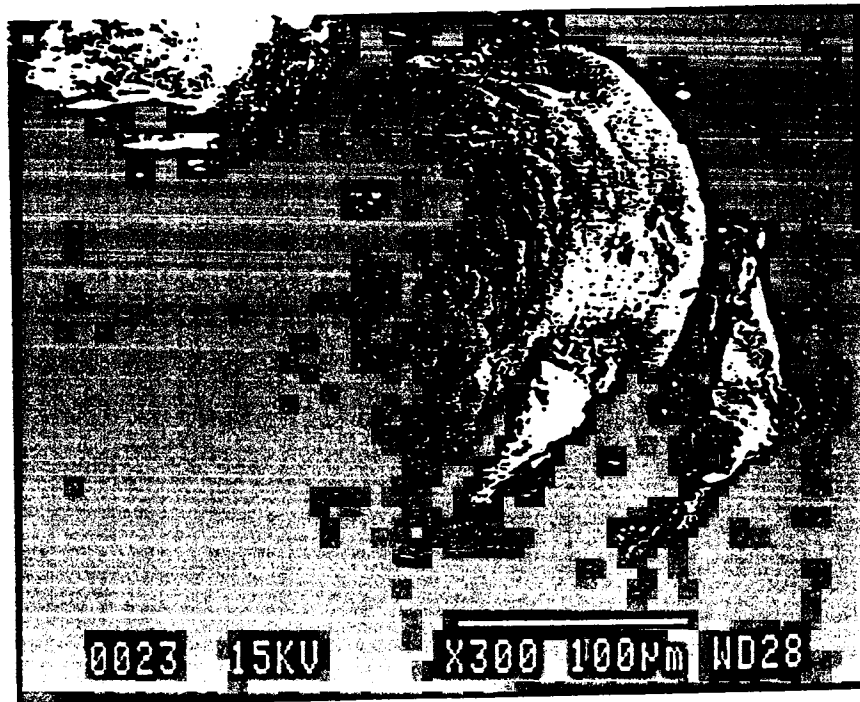


Exhibit 5: SEM electron micrograph of fire assay bead from Sample Take-33.

EDX Analysis:

Au: 76.21%

Ag: 20.79%

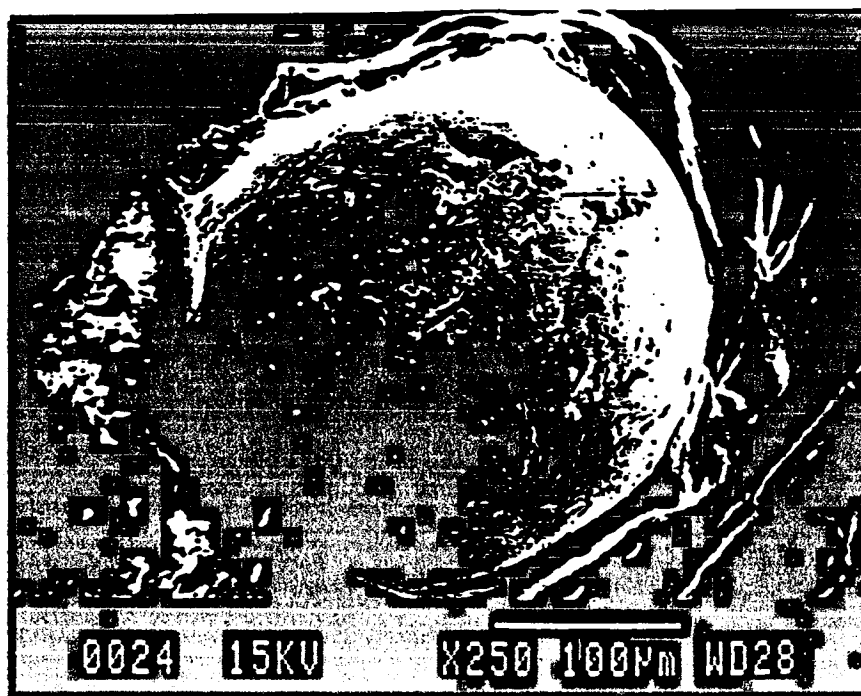


Exhibit 6: SEM electron micrograph of fire assay bead from Sample Take-40.

EDX Analysis:

Au: 51.75%

Ag: 48.25%

Gold and Silver Ratios and Other Non-Gangue Minerals

As was demonstrated in Exhibits 4, 5, and 6, the samples studied showed the presence of gold and silver together. These fire assay beads show gold to silver ratios of approximately 1:13, 1:1, and 1:3.

It is notable, on the other hand, that heavy individual grains (see for example, Exhibits 7 to 10) show gold plus silver together. It is common to find gold plus silver in association with one another in natural gold flakes.

Samples also showed the presence of lead, zinc, iron and copper mineralizations in the form of sulfides and their highly oxidized (tarnished) forms as can be seen from Exhibits 11 to 15. Exhibit 16 is a native silver grain. Our experience with such materials obtained from Merriam Crater near Flagstaff, Arizona, shows that these sulfide minerals and gold-bearing flakes and silver can be concentrated by flotation after pre-concentration procedures. We do caution that we have not conducted similar flotation-concentration studies with the samples which form the subject of this report.

Summary of Observations and Conclusions

1. We have collected 42 samples of material from the locations shown on the accompanying maps.
2. We studied these samples by SEM, EDX, fire assay and AA analysis.
3. We found that all samples contain gold and silver in the concentration range ppm = (g/t) to ppm = (g/t).
4. While panning of the original material does not show gold flakes, table concentrates invariably show gold and silver-bearing flakes in the heavy fraction, which also contains sulfides of Fe, Cu, Zn and Pb.

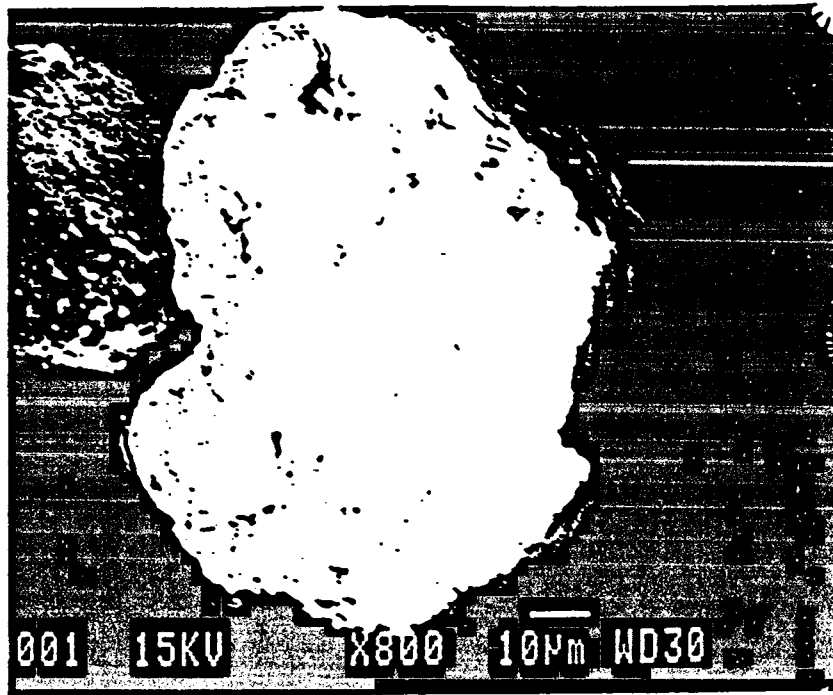
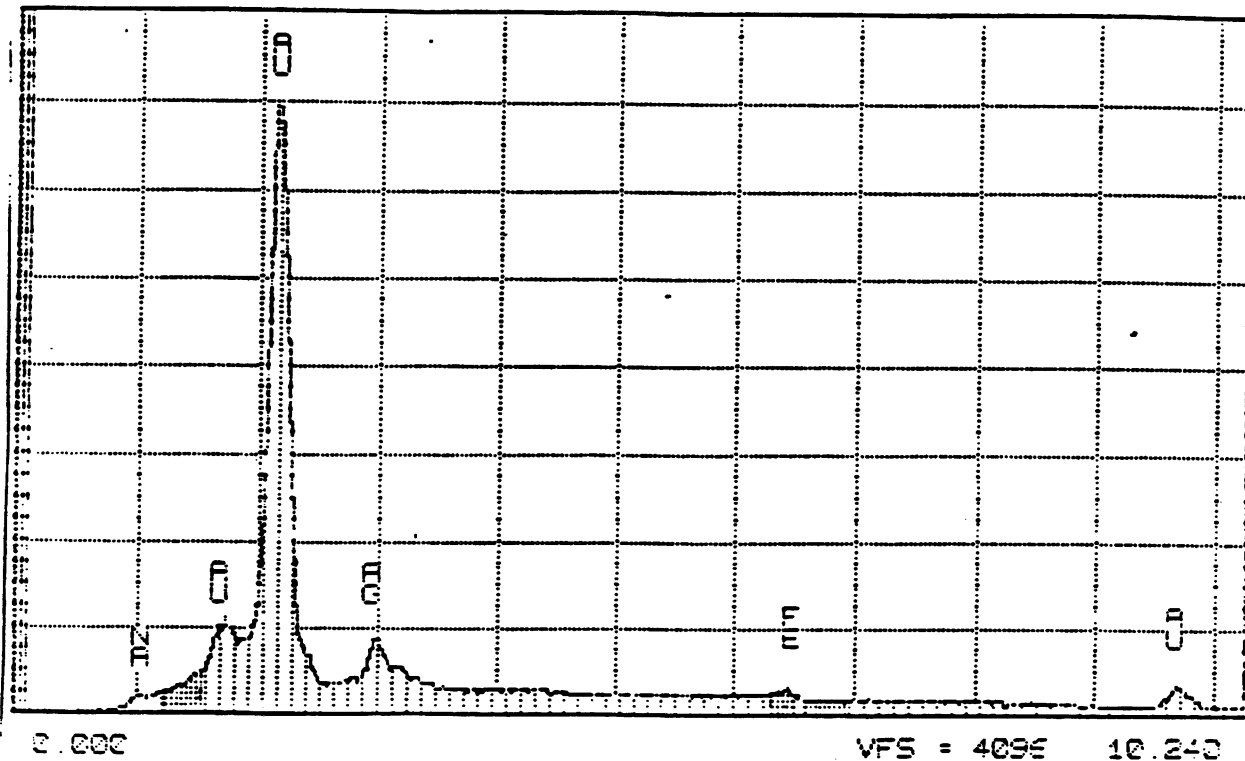


Exhibit 7: SEM electron micrograph of Take Sample-1, hand-panned table concentrate, gold-rich grain. See analysis and EDX spectrum on next page.



100 TAKEMOTO 3, HAND PANNED TABLE CONC, GOLD
 =%#() ** , - . / 0 1 2 3 4 5 6 7 8 9 : ; < = > ? @ A B C D E F G H I J K L M N O P Q R S T U V W X Y Z [\] ^ _ ` a b c d e f g h
 i j k l m n o p q r s t u v w x y z { | } ~

Exhibit 8: EDX spectrum of a gold-rich grain shown in Exhibit __, and its analysis.

EDX Analysis::

Na: 0.06Z, Au: 92.51Z, Ag: 5.81Z, Fe: 1.62Z

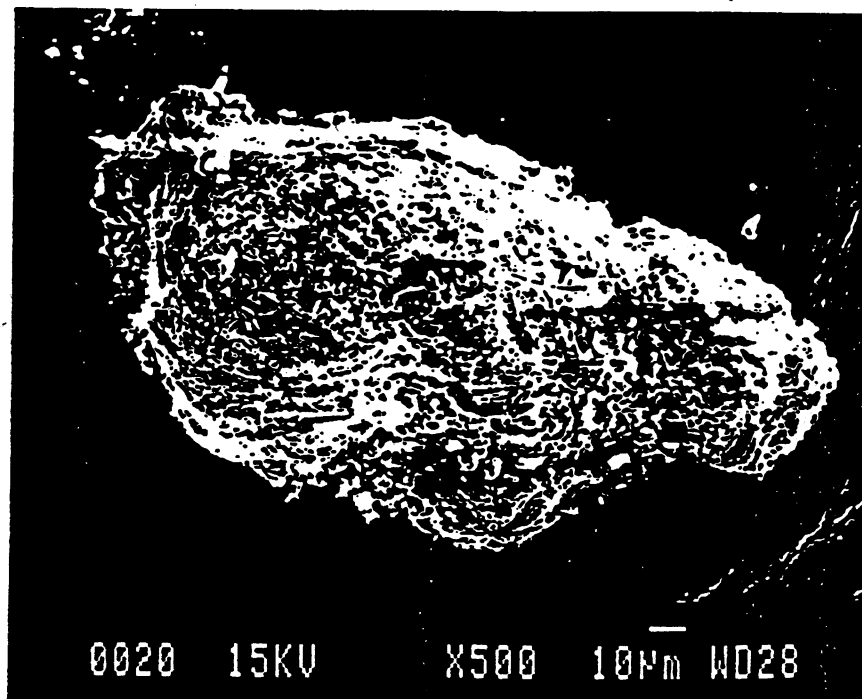
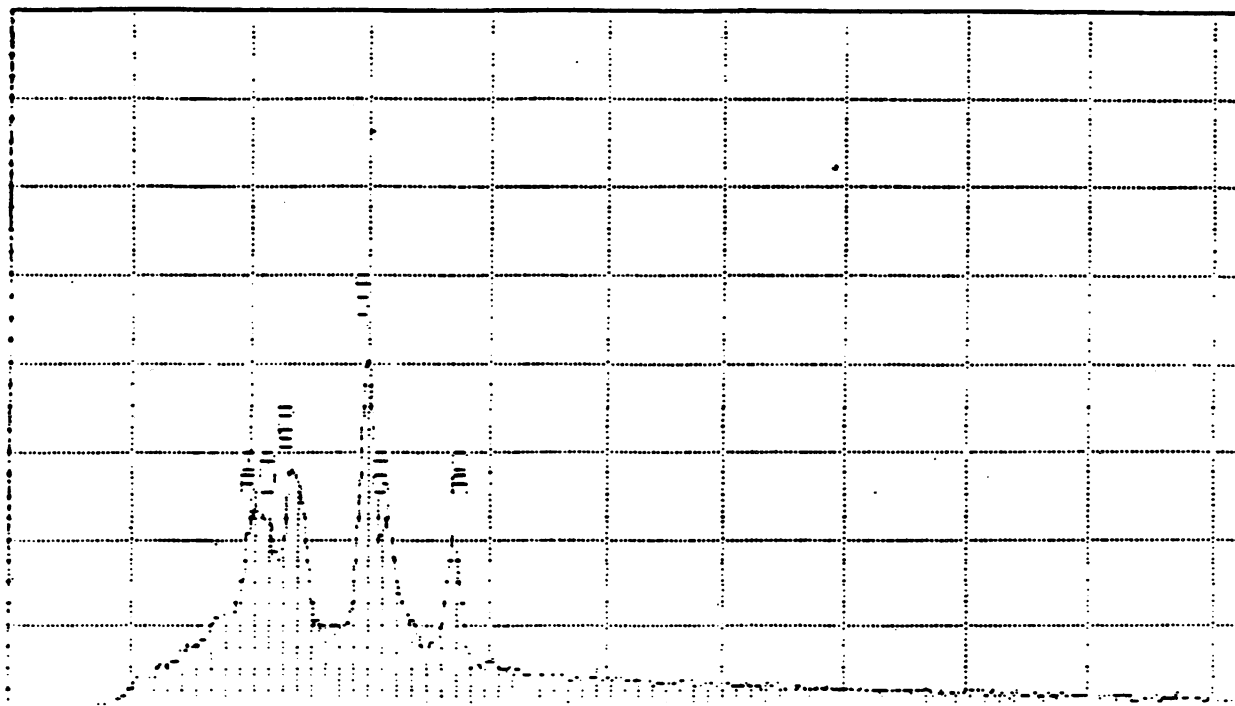


Exhibit 9: SEM photomicrograph of Take Sample-1, grain from table concentrate. See analysis and EDX spectrum on next page.

TN-5500 Colorado School of Mines / JEOL

TUE 25-AUG-87 11:29

Curscr: 0.032keV = 0



0.000

VFE = 1024 10.240

Exhibit 10: EDX spectrum of heavy grain shown in Exhibit ___ and its EDX analysis.

Ir: 13.81%
 Ca: 7.80%
 Au: 15.31%
 Pb: 33.39%
 Ag: 29.68%

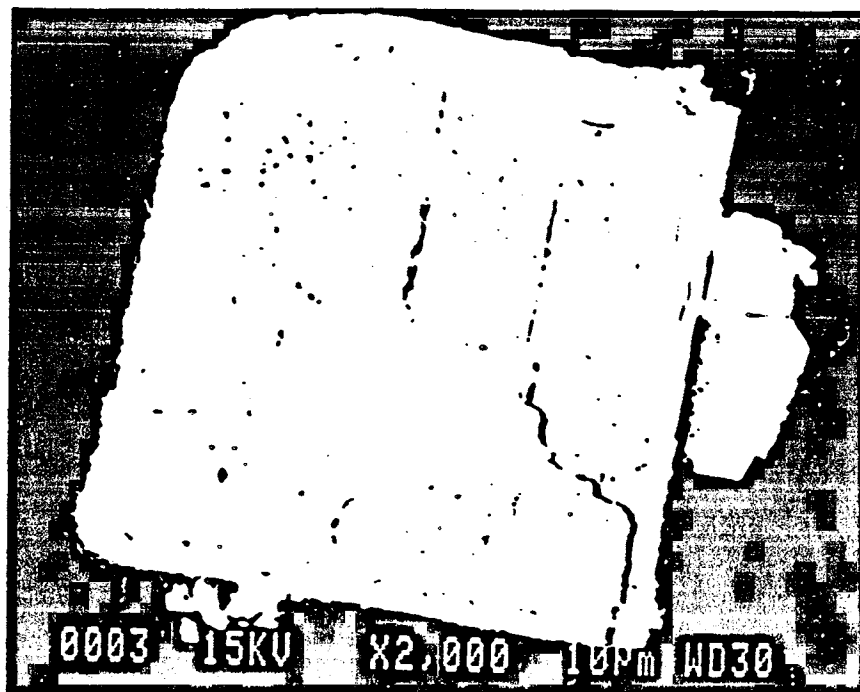


Exhibit 11: SEM electron micrograph of Sample, Take-1 table concentrate, hand-panning heavy fraction grain of galena.

EDX analysis:

Pb: 78.18%
S: 12.27%
Si: 1.14%
Fe: 4.04%
Cu: 4.02%
Al: 0.36%

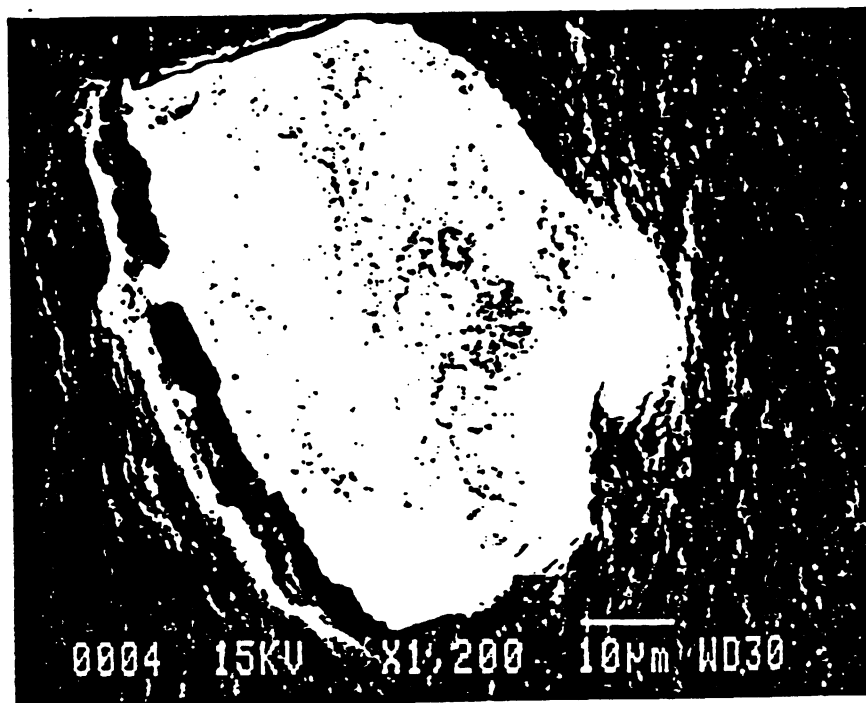


Exhibit 12: SEM electron micrograph of Sample Take-1 table concentrate, hand panned heavy grain.

EDX Analysis:

Mg: 6.85Z
Al: 14.49Z
Ti: 11.05Z
Fe: 63.89Z
Cu: 3.72Z



Exhibit 13: SEM electron micrograph of galena grain from Sample Take-6 table concentrate.

EDX Analysis:

Pb: 85.34%

S: 14.66%

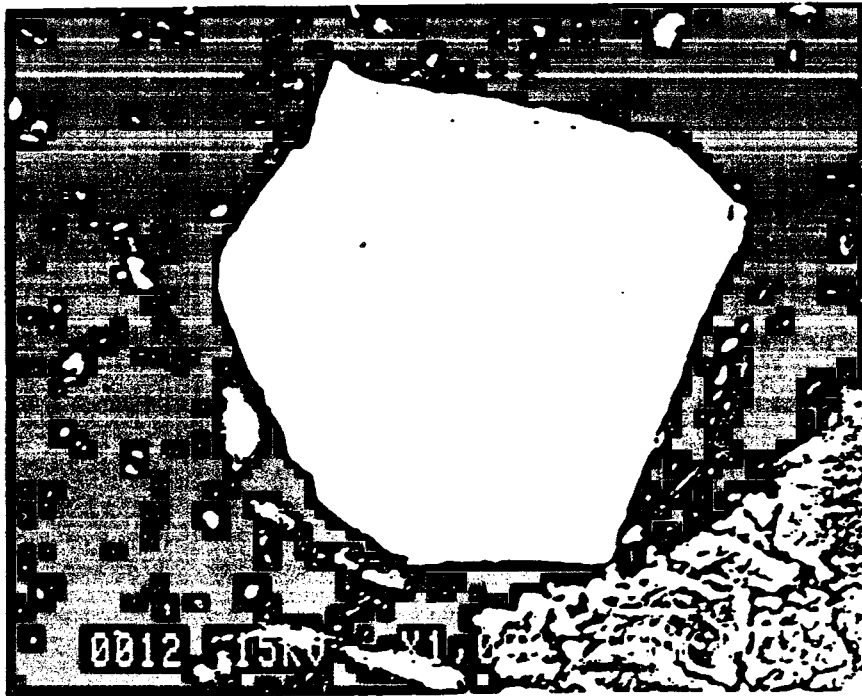


Exhibit 14: SEM electron micrograph of pyrite grain Sample Take-40 table concentrate.

EDX Analysis:

S: 58.46%

Fe: 41.54%

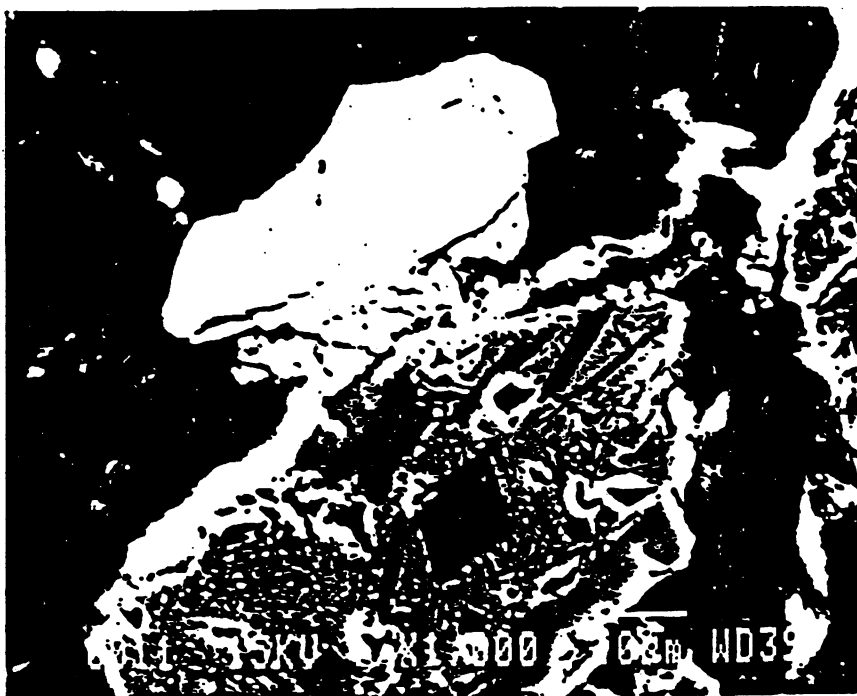


Exhibit 15: SEM electron micrograph of sphalerite grain (top satellite, light colored grain), Sample: Take-33, table concentrate.

EDX Analysis:

Zn: 23.66%

S: 48.01%

Fe: 28.32%

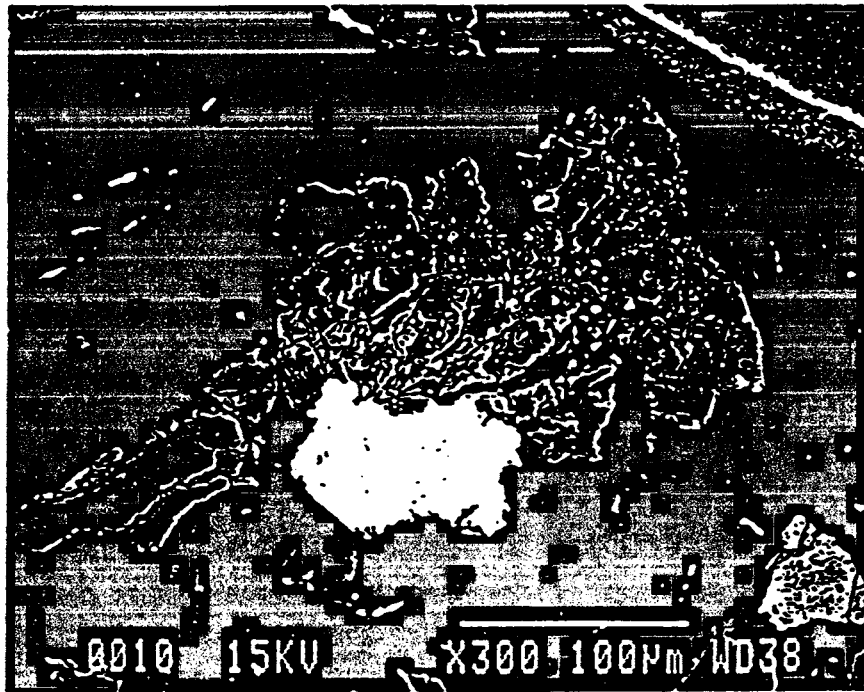


Exhibit 16: SEM electron micrograph of native silver grain. Sample: Take-6 table concentrate.

EDX Analysis:

Ag: 93.80

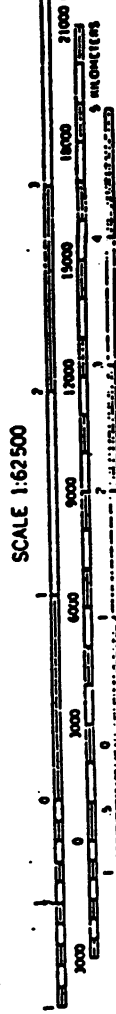
Si: 6.28%

APPENDIX I

Location Maps and Field Notes on Sample Collection



U.S. GOVT
D. 25
ARIZONA
QUADRANGLE LOCATION



CONTOUR INTERVAL 40 FEET
DOTTED LINES REPRESENT 20-FOOT CONTOURS
DATUM IS MEAN SEA LEVEL

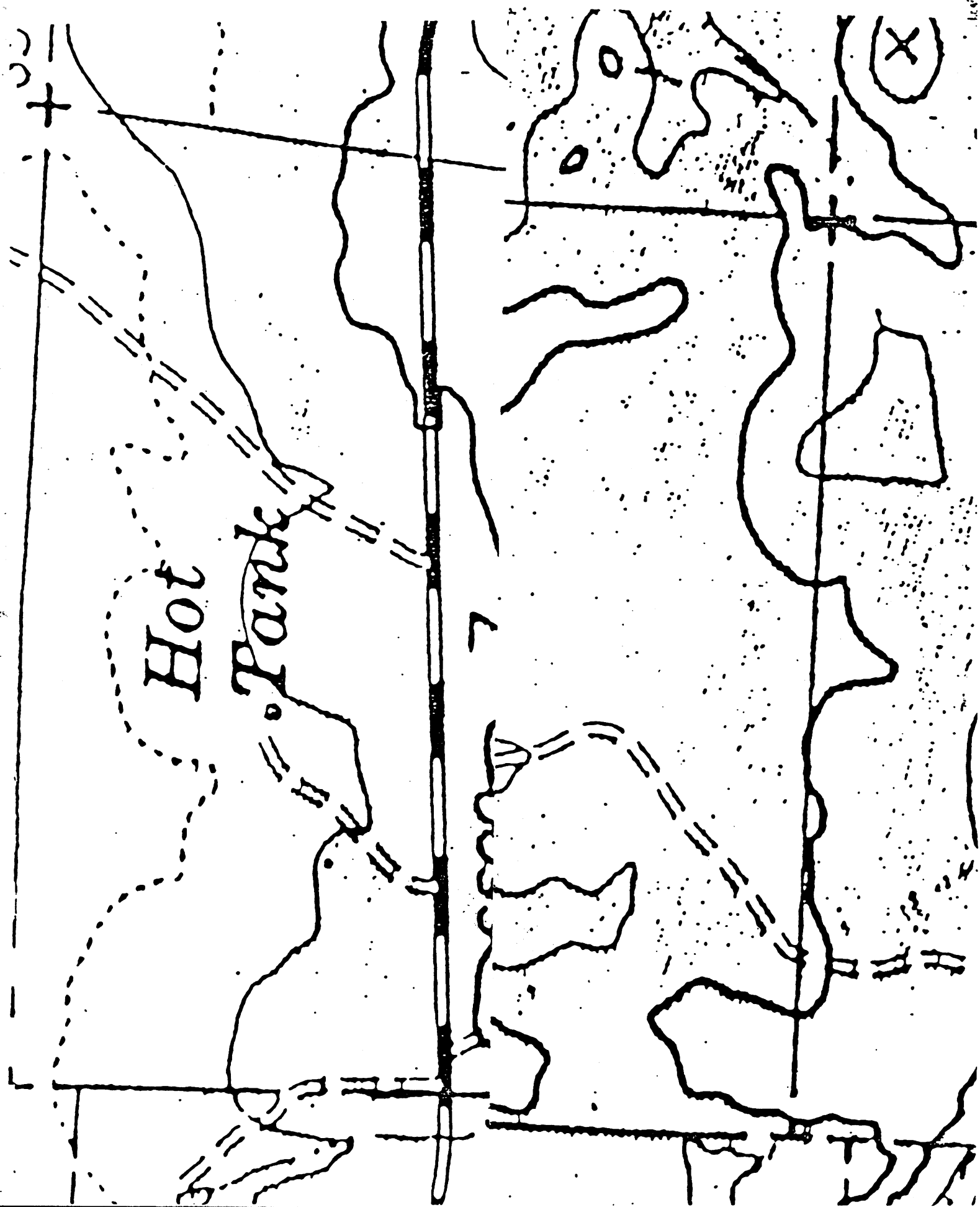
144°
MAGNETIC NORTH
TRUE NORTH
APPROXIMATE MEAN
MAGNETIC INCLINATION, 1960

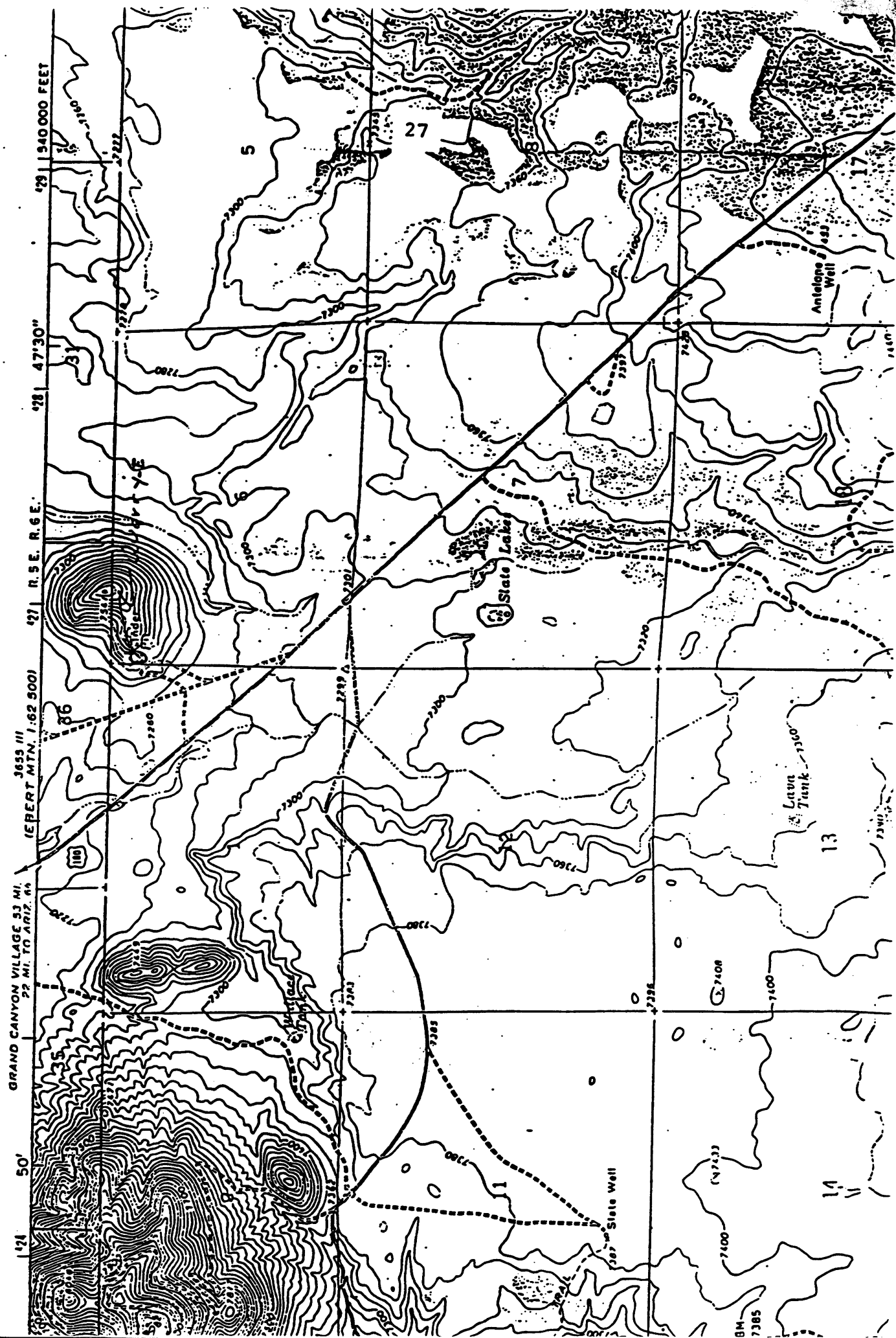
The Geological Survey
State Stream Commission

photogrammetric methods
check 1960
erican datum
dinate system, central zone
for grid ticks.

locations

THIS MAP COMPLETES WITH NATIONAL MAP ACCURACY STANDARDS
FOR SALE BY U.S. GEOLOGICAL SURVEY, D. 25, QUADRANGLE ON WASHINGTON 25, D. C.
A FOLDER OF GEOMORPHIC INFORMATION AND SYMBOLS IS AVAILABLE ON REQUEST



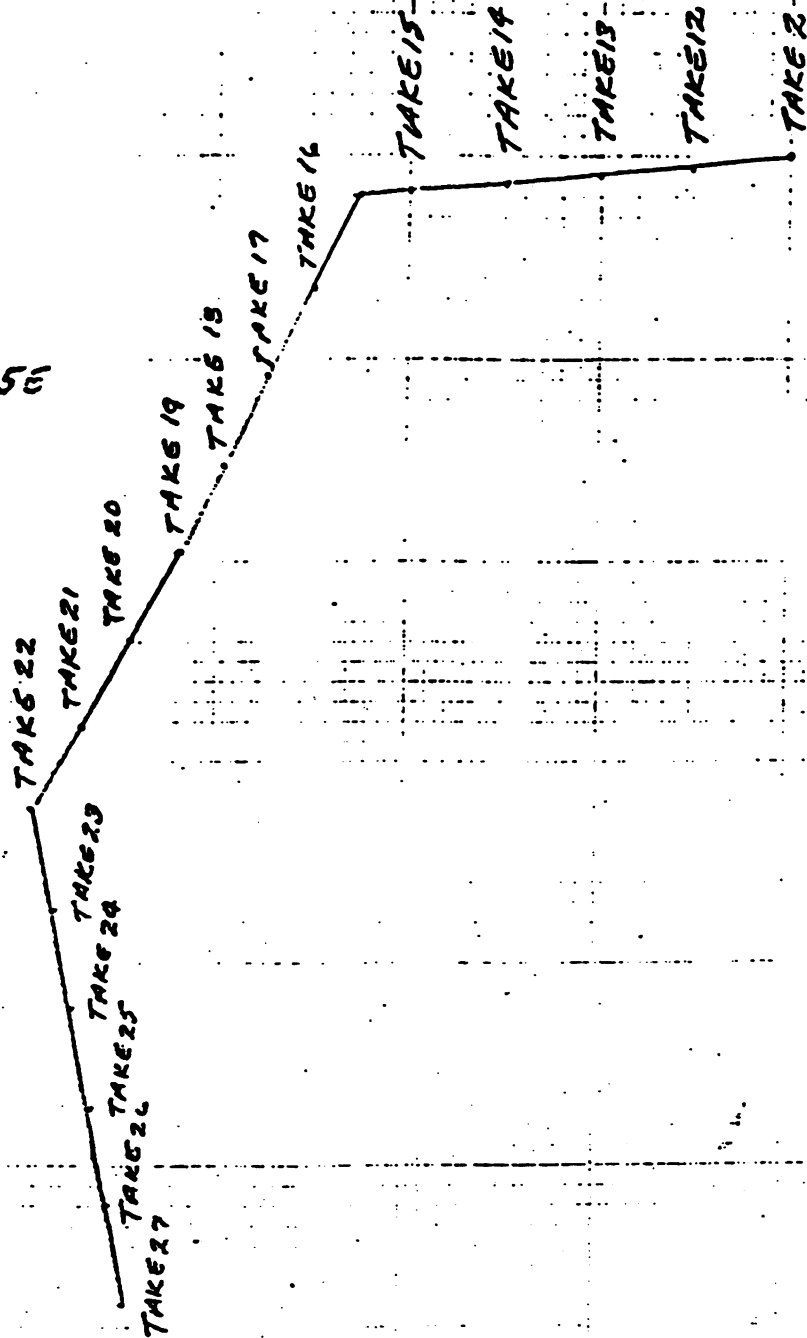


TAKEMOTO SAMPLE LOCATION MAP



1" = 100'

Quarry A
SW 1/4 Sec. 7, T25N, R5E



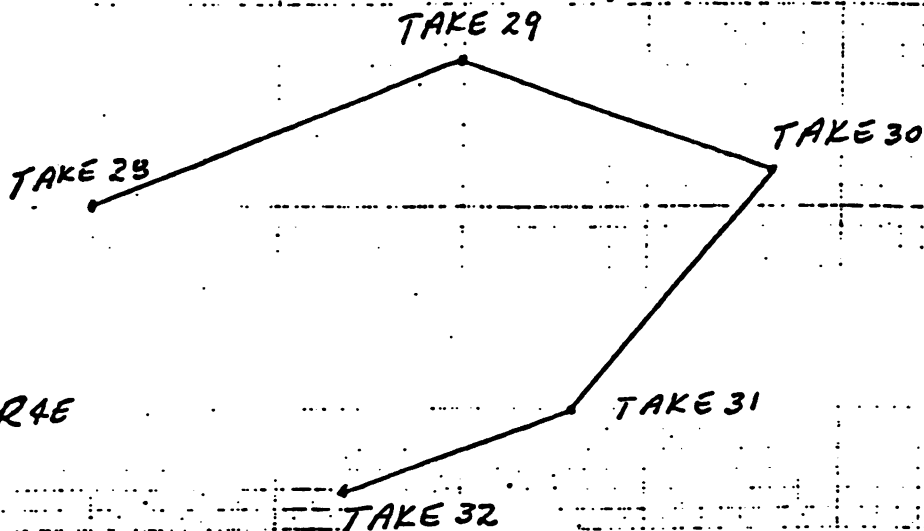
30
TAKEMOTO SAMPLE LOCATION MAP

N
↑

1"=100'

Quarry-B

NE $\frac{1}{4}$ Sec. 11, T25N, R4E

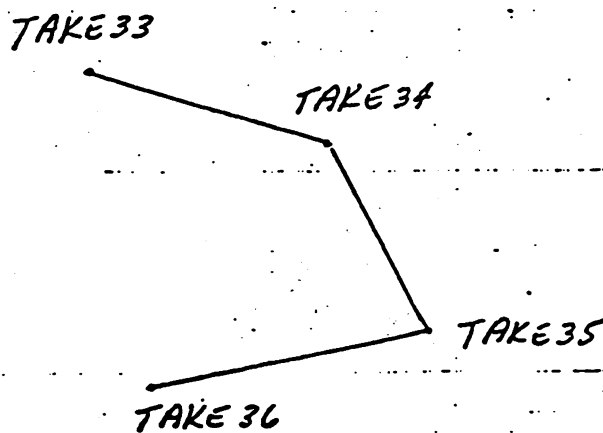


↑

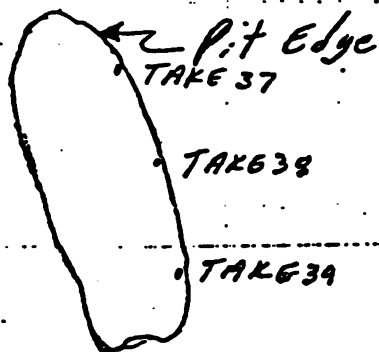
1"=100'

Quarry-C

NE $\frac{1}{4}$ Sec. 17, T25N, R5E



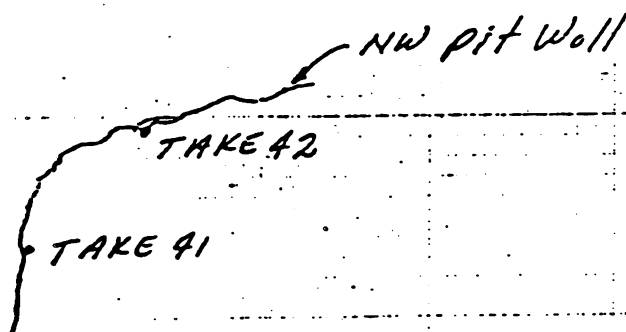
TAKEMOTO SAMPLE LOCATION MAP



TAKE 40 - Composite
from the quarry.

1" = 100'

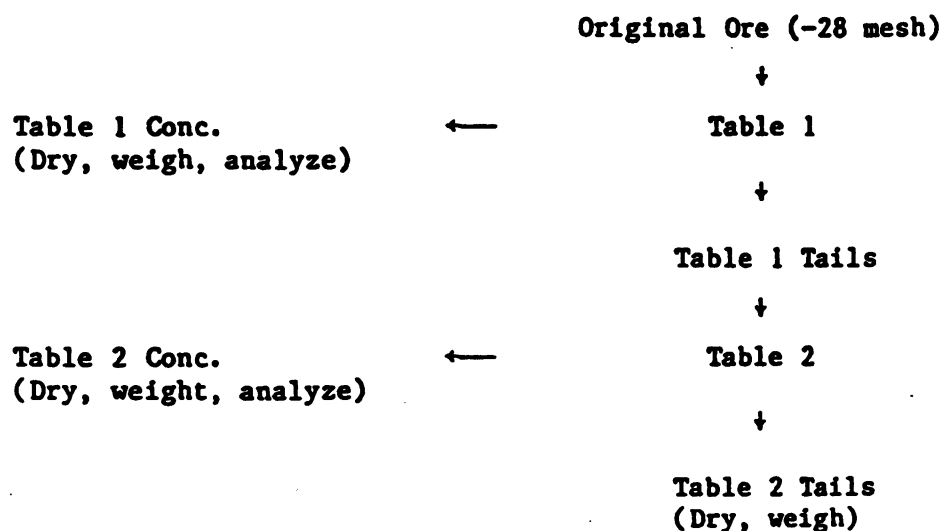
Quarry-D
NE $\frac{1}{4}$ Sec. 35, T25N, R5E



1" = 100'

Quarry-E
NW $\frac{1}{4}$ Sec 6, T24N, R6E

APPENDIX II: Flow Chart of Tabling Experiments



Results of Table Concentration

Sample	Table 1 Feed (g)	Table 2 Tails (g)	Table 2 Conc. (g)	% Conc. of Table 1 Feed
TAKE 1	6992	4560	563	8.1
TAKE 3	4776	3117	526	11.0
TAKE 6	11260	8956	1176	10.4
TAKE 7	9965	8028	1073	10.8
TAKE 29	7037	5715	963	13.7
TAKE 33	9451	7540	432	5.4
TAKE 35	5553	3173	560	10.1
TAKE 40	5594	3688	1048	22.1

All weights are dry or calculated dry from moisture content determinations and are in grams.

APPENDIX III

Treatment of Pulverized Samples for AA Analysis

1. In a 30ml porcelain crucible add in the following sequence, 4 gm sodium peroxide, 5.0 gm sample, and 9 gm sodium peroxide; mix; top up with 9-10 gm sodium peroxide.
2. Place crucible on tripod-stand. Carefully heat crucible in stand. Apply heat at bottom and sides with Bunsen burners.
3. Heat until molten and boiling.
4. Allow to boil for about 5 minutes.
5. Place crucible in beaker (400 to 600 ml) and allow to cool.
6. Add 20 ml distilled water; crucible is upright; let stand overnight.
7. Tip crucible on side.
8. Add distilled water to half the height of the crucible; allow reaction to proceed and cease.
9. Fill beaker to top of crucible with 20% HCl; allow reaction to cease.
10. Clean/soak crucible with/in acidic solution and remove from beaker. Heat the slurry to near dryness.
11. Add 50 ml of aqua regia and heat; a gelatinous mass of silicate gel forms after 4-6 hours of heating.
12. Add 100 ml distilled water to get gel into solution.
13. Add 50 ml HCl (conc.) and heat to dryness (silicate gel forms).
14. Add 100 ml distilled water and 50 ml HCl (conc.).
15. Warm (do not boil) and stir to dissolve solids.
16. Pour beaker's contents into 500 ml volumetric flask; add HCl (10%) to exact volume.
17. Shake flask and transfer a fraction to 100 ml volumetric flask.

18. Filter contents of 100 ml flask; dispose of solid.
19. Transfer filtrate (usually 80-90 ml) to separatory funnel and add 25 ml of MIBK.
20. Shake for 1 minute and allow phases to separate.
21. Draw off acid solution and dispose.
22. Draw off MIBK solution for AA analyses.
23. Take AA reading using MIBK solution obtained.
24. Compare data to MIBK solution readings used as standard and compute results as ppm gold in original ore sample.

APPENDIX IV

**Fire Assay Results Reported by Our
External Referee Laboratory**

Analysis of 48 Crushed Rock Samples

ITEM	SAMPLE NUMBER	Au (ppm)	Ag (ppm)
<hr/>			
1	YATAKE-02	<.02	<.2
2	YATAKE-03	<.02	.4
3	YATAKE-04	<.02	<.2
4	YATAKE-05	<.02	<.2
5	YATAKE-06	<.02	.4
6	YATAKE-07	<.02	.6
7	YATAKE-08	<.02	.2
8	YATAKE-09	<.02	<.2
9	YATAKE-10	<.02	1.0
10	YATAKE-11	.03	1.0
11	YATAKE-12	<.02	<.2
12	YATAKE-13	<.02	<.2
13	YATAKE-14	<.02	<.2
14	YATAKE-15	<.02	<.2
15	YATAKE-16	<.02	<.2
16	YATAKE-17	<.02	<.2
17	YATAKE-18	<.02	<.2
18	YATAKE-19	<.02	<.2
19	YATAKE-20	<.02	<.2
20	YATAKE-21	<.02	<.2
21	YATAKE-22	<.02	<.2
22	YATAKE-23	<.02	.2
23	YATAKE-24	<.02	<.2
24	YATAKE-25	<.02	<.2
25	YATAKE-26	<.02	<.2

ITEM	SAMPLE NUMBER	Au (ppm)	Ag (ppm)
<hr/>			
26	YATAKE-27	<.02	<.2
27	YATAKE-28	<.02	<.2
28	YATAKE-29	<.02	1.2
29	YATAKE-30	<.02	<.2
30	YATAKE-31	<.02	<.2
31	YATAKE-32	<.02	<.2
32	YATAKE-33	<.02	.4
33	YATAKE-34	<.02	<.2
34	YATAKE-36	.07	7.8
35	YATAKE-37	<.02	<.2
36	YATAKE-38	<.02	.2
37	YATAKE-39	<.02	<.2
38	YATAKE-40	<.02	2.0
39	YATAKE-41	.16	22.0
40	YATAKE-42	<.02	2.7
41	YATAKE-01TC	.72	1.0
42	YATAKE-03TC	.26	.6
43	YATAKE-06TC	.88	.6
44	YATAKE-07TC	.80	1.4
45	YATAKE-29TC	.12	6.6
46	YATAKE-33TC	2.60	2.4
47	YATAKE-35TC	.26	.8
48	YATAKE-40TC	.25	3.5

APPENDIX V

Spectral Analyses of Samples and Table Concentrates

ITEM NO. SAMPLE NO.

9 = YATAKE-10
10 = YATAKE-11
11 = YATAKE-12
12 = YATAKE-13
13 = YATAKE-14
14 = YATAKE-15
15 = YATAKE-16
16 = YATAKE-17

ITEM	9	10	11	12	13	14	15	16
ELEMENT								
Fe	5%	5%	5%	3%	2%	7%	5%	5%
Ca	3%	2%	3%	3%	1%	2%	2%	3%
Mg	1.5%	2%	1.5%	1.5%	1%	1.5%	1%	1%
Ag	<1	<1	<1	<1	<1	<1	<1	<1
Al	<200	<200	<200	<200	<200	<200	<200	<200
B	<10	<10	10	<10	<10	<10	<10	<10
Ba	300	300	500	300	200	300	500	300
Be	<2	<2	<2	<2	<2	<2	<2	<2
Bi	<10	<10	<10	<10	<10	<10	<10	<10
Cd	<50	<50	<50	<50	<50	<50	<50	<50
Co	50	50	50	50	50	70	50	30
Cr	70	100	50	30	20	70	70	30
Cu	30	70	50	50	50	70	50	30
Ga	10	20	10	10	<10	15	10	10
Ge	<20	<20	<20	<20	<20	<20	<20	<20
La	<20	<20	<20	<20	<20	<20	<20	20
Mn	700	1000	1000	1000	300	1000	1000	1000
Mo	5	<2	<2	<2	<2	2	2	<2
Nb	<20	<20	<20	<20	<20	<20	<20	<20
Ni	50	70	30	30	30	50	50	20
Pb	10	15	<10	10	30	<10	<10	10
Sb	<100	<100	<100	<100	<100	<100	<100	<100
Sc	20	15	20	15	10	20	20	15
Sn	<10	<10	<10	<10	<10	<10	<10	<10
Sr	500	500	700	500	300	500	700	700
Ti	10000	5000	10000	5000	5000	7000	7000	7000
V	100	70	150	100	70	150	150	100
W	<50	<50	<50	<50	<50	<50	<50	<50
Y	10	<10	10	10	<10	10	10	10
Zn	<200	<200	<200	<200	<200	<200	<200	<200
Zr	50	20	50	30	20	50	100	50

JOB NO. DFR 128
PAGE 4

ITEM NO. SAMPLE NO.
17 = YATAKE-18
18 = YATAKE-19
19 = YATAKE-20
20 = YATAKE-21
21 = YATAKE-22
22 = YATAKE-23
23 = YATAKE-24
24 = YATAKE-25

ITEM	17	18	19	20	21	22	23	24
ELEMENT								
Fe	5%	7%	5%	7%	3%	5%	5%	5%
Ca	2%	5%	3%	3%	2%	5%	3%	2%
Mg	1%	2%	2%	2%	1%	2%	1.5%	1.5%
Ag	<1	<1	<1	<1	<1	<1	<1	<1
As	<200	<200	<200	<200	<200	<200	<200	<200
B	<10	10	<10	<10	10	10	10	<10
Ba	300	500	300	300	200	500	300	300
Be	<2	<2	<2	<2	<2	<2	<2	<2
Bi	<10	<10	<10	<10	<10	<10	<10	<10
Cd	<50	<50	<50	<50	<50	<50	<50	<50
Co	30	50	50	70	50	30	30	30
Cr	50	70	50	50	20	50	70	30
Cu	30	70	70	100	30	70	50	50
Ga	10	10	10	30	<10	20	10	20
Ge	<20	<20	<20	<20	<20	<20	<20	<20
La	<20	20	<20	<20	<20	20	20	<20
Mn	700	1500	1000	1500	700	2000	1000	1000
Mo	<2	2	<2	2	<2	<2	<2	<2
Ni	<20	<20	<20	<20	<20	<20	<20	<20
Nb	20	50	50	70	30	20	30	30
Pb	10	<10	<10	10	<10	10	<10	<10
Sb	<100	<100	<100	<100	<100	<100	<100	<100
Sc	15	20	20	20	15	20	20	15
Sn	<10	<10	<10	<10	<10	<10	<10	<10
Sr	500	1000	700	1000	500	1500	700	500
Ti	7000	10000	10000	>10000	7000	10000	10000	10000
V	100	100	100	150	100	150	100	100
W	<50	<50	<50	<50	<50	<50	<50	<50
Y	10	20	15	15	10	15	15	10
Zn	<200	<200	<200	<200	<200	<200	<200	<200
Zr	50	100	70	70	50	70	70	50

JOB NO. DFR 128
PAGE 5

ITEM NO. SAMPLE NO.
25 = YATAKE-26
26 = YATAKE-27
27 = YATAKE-28
28 = YATAKE-29
29 = YATAKE-30
30 = YATAKE-31
31 = YATAKE-32
32 = YATAKE-33

ITEM	25	26	27	28	29	30	31	32
ELEMENT								
Fe	5%	5%	3%	5%	5%	5%	5%	7%
Ca	3%	1.5%	3%	5%	3%	3%	3%	2%
Mg	1.5%	1%	2%	3%	2%	2%	2%	1%
Ag	<1	<1	<1	2	<1	<1	<1	<1
As	<200	<200	<200	<200	<200	<200	<200	<200
B	10	<10	10	10	10	<10	10	<10
Ba	500	300	500	700	500	300	300	300
Be	<2	<2	<2	<2	<2	<2	<2	<2
Bi	<10	<10	<10	<10	<10	<10	<10	<10
Cd	<50	<50	<50	<50	<50	<50	<50	<50
Co	30	50	30	30	50	50	50	50
Cr	70	50	500	700	700	500	500	<10
Cu	50	50	70	150	100	70	100	50
Ga	10	20	<10	20	<10	<10	10	10
Ge	<20	<20	<20	<20	<20	<20	<20	<20
La	<20	<20	20	20	<20	<20	<20	<20
Mn	1000	700	1000	2000	1000	1000	1000	1000
Mo	2	2	<2	<2	2	<2	<2	2
Nb	<20	<20	<20	<20	<20	<20	<20	<20
Ni	50	50	150	150	150	70	150	10
Pb	<10	<10	<10	15	<10	<10	<10	<10
Sb	<100	<100	<100	<100	<100	<100	<100	<100
Sc	20	20	20	20	30	20	20	20
Sn	<10	<10	<10	<10	<10	<10	<10	<10
Sr	700	500	500	500	500	500	300	500
Ti	10000	10000	7000	7000	7000	7000	7000	10000
V	100	100	100	100	100	100	100	150
W	<50	<50	<50	<50	<50	<50	<50	<50
Y	15	10	10	10	20	<10	10	15
Zn	<200	<200	<200	<200	<200	<200	<200	<200
Zr	50	50	70	70	70	30	50	70

JOB NO. DFR 128
PAGE 6

ITEM NO. SAMPLE NO.
33 = YATAKE-34
34 = YATAKE-36
35 = YATAKE-37
36 = YATAKE-38
37 = YATAKE-39
38 = YATAKE-40
39 = YATAKE-41
40 = YATAKE-42

ITEM	33	34	35	36	37	38	39	40
ELEMENT								
Fe	5%	3%	3%	5%	5%	2%	7%	3%
Ca	1%	3%	1.5%	2%	2%	2%	3%	2%
Mg	1%	1%	1%	2%	1%	1%	1.5%	1.5%
Ag	<1	7	<1	<1	<1	1.5	20	1.5
As	<200	<200	<200	<200	<200	<200	<200	<200
B	<10	10	10	<10	<10	<10	<10	<10
Ba	200	300	300	300	300	300	500	300
Be	<2	<2	<2	<2	<2	<2	<2	<2
Bi	<10	<10	<10	<10	<10	<10	<10	<10
Cd	<50	<50	<50	<50	<50	<50	<50	<50
Co	50	30	30	30	50	20	70	30
Cr	<10	<10	<10	<10	<10	<10	<10	<10
Cu	30	70	50	50	50	20	70	30
Ga	10	10	10	15	20	20	20	20
Ge	<20	<20	<20	<20	<20	<20	<20	<20
La	<20	<20	<20	<20	<20	<20	<20	<20
Mn	500	1500	1000	1000	1000	1500	1500	1000
Mo	<2	2	<2	2	2	<2	5	<2
Nb	<20	<20	<20	<20	<20	<20	<20	<20
Ni	15	5	10	20	10	5	20	7
Pb	<10	30	<10	<10	<10	20	150	10
Sb	<100	<100	<100	<100	<100	<100	<100	<100
Sc	10	20	15	20	15	10	20	10
Sn	<10	<10	<10	<10	<10	<10	<10	<10
Sr	300	700	300	500	300	500	500	500
Ti	7000	10000	10000	10000	10000	7000	>10000	7000
V	100	100	100	150	100	70	150	100
W	<50	<50	<50	<50	<50	<50	<50	<50
Y	<10	10	10	20	10	<10	20	10
Zn	<200	<200	<200	<200	<200	<200	<200	<200
Zr	50	70	70	100	100	100	50	100

JOB NO. DFR 128
PAGE 7

ITEM NO. SAMPLE NO.
41 = YATAKE-01TC
42 = YATAKE-03TC
43 = YATAKE-06TC
44 = YATAKE-07TC
45 = YATAKE-29TC
46 = YATAKE-33TC
47 = YATAKE-35TC
48 = YATAKE-40TC

ITEM	41	42	43	44	45	46	47	48
ELEMENT								
Fe	5%	3%	5%	3%	7%	5%	3%	5%
Ca	2%	3%	5%	3%	5%	3%	2%	1%
Mg	2%	2%	3%	3%	5%	1.5%	1%	1%
Ag	<1	<1	<1	1.5	5	1	<1	2
As	<200	<200	<200	<200	<200	<200	<200	<200
B	<10	<10	<10	<10	<10	<10	<10	<10
Ba	300	300	300	300	300	300	300	200
Be	<2	<2	<2	<2	<2	<2	<2	<2
Bi	<10	<10	<10	<10	<10	<10	<10	<10
Cd	<50	<50	<50	<50	<50	<50	<50	<50
Co	70	30	50	50	150	50	30	50
Cr	200	100	200	150	1500	20	<10	<10
Cu	50	30	50	30	150	50	30	30
Ga	20	10	15	10	10	10	10	10
Ge	<20	<20	<20	<20	<20	<20	<20	<20
La	<20	20	<20	<20	<20	50	<20	<20
Mn	700	1000	1500	1000	1500	1000	1000	700
Mo	<2	<2	<2	<2	2	<2	<2	<2
Nb	<20	<20	<20	<20	<20	<20	<20	<20
Ni	100	50	50	50	500	15	10	20
Pb	100	50	50	20	100	70	20	20
Sb	<100	<100	<100	<100	<100	<100	<100	<100
Sc	20	15	20	20	30	15	10	10
Sn	<10	<10	<10	<10	<10	<10	<10	<10
Sr	500	500	700	500	500	700	500	300
Ti	7000	7000	7000	7000	7000	10000	7000	7000
V	100	100	100	100	100	100	100	100
W	<50	<50	<50	<50	<50	<50	<50	<50
Y	<10	10	10	10	10	20	<10	<10
Zn	<200	<200	<200	<200	<200	<200	<200	<200
Zr	20	70	50	70	70	100	100	70



December 29, 1994

Mr. Richard Campbell
Vice President, Special Projects
Mariah International, Inc.
Deer Valley Airpark
702 West Melinda Lane
Building D, Suite 7
Phoenix, Arizona 85027

Dear Dick,

Once again, it was a pleasure discussing Mariah's needs for Pyramid's consulting and engineering services. As per our discussion on 12/28/94, Pyramid is pleased to provide Mariah International with a quotation to provide metallurgical engineering services for the purpose of optimizing your pilot plant operations. Specifically, we propose the following step by step approach to optimize gold recovery and grade:

- **Step 1:** Analyze existing pilot plant data to determine if there is enough data to accurately predict plant performance. This will entail 2 to 3 days of data analysis at our office in Salt Lake City. Once completed, further tests can be identified.
- **Step 2:** Conduct additional pilot plant tests as identified from step 1. This will most likely entail 3 days of on-site testing. Statistically designed experiments will be conducted in an attempt to minimize the time needed to achieve optimal gold recovery and grade. Data collected during the tests will be analyzed and refining experiments, if necessary, will be recommended.
- **Step 3:** Conduct refining experiments outlined in step 2. It is estimated that an additional 3 days will be needed. As with step 2, the data will be analyzed. Based on all collected data, the recommended ranges for column operating variables will be determined.
- **Step 4:** It is recommended that confirmation tests be conducted under the operation conditions outline from step 3. This should take an addition 2 days of plant testing.

The entire test program should take a total of 8 days and is divided into 3 plant visits to allow sufficient time to analyze results from previous tests before conducting additional experiments. This will insure the highest probability of success.

The costs plant testing services are \$750 per day (usually 10 to 12 hour days) plus travel and living expenses billed at actual cost. Step 1 above will be conducted free of charge prior to the first plant visit. In addition, all assay costs are Mariah's responsibility.

Pyramid is committed to helping make this project a success. In addition to testing, Pyramid is extremely interested in overseeing the engineering, construction and start-up of Mariah's 1000 tpd process plant. To this end, I am putting together an initial estimate of capital and operating costs. The accuracy of the this estimate is +/- 30 percent. I will forward the results of the analysis upon completion.

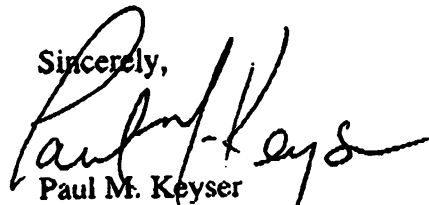
TOTAL P. 03

Mariah International, Inc.
Metallurgical Engineering Services

December 29, 1994

Pyramid Resources is please to provide Mariah International with this proposal. Should you have any questions, please feel free to contact me. I look forward to a long and good working relationship between our two companies.

Sincerely,



Paul M. Keyser
Project Manager

Pyramid Resources, Inc.

328 W. 200 S. Suite 100
Salt Lake City Utah 84101
(801) 521-7556

FAX Transmittal Form

Date: December 14, 1994
To: Richard Campbell
Company: Mariah International, Inc.
Fax No.: 602-492-9810
From: Paul M. Keyser, Project Manager
Subject: Test Oversight

You should receive 0 pages, excluding this page. If there is an error during transmission please contact our office by telephone at (801) 521-7556 or by FAX at (801) 7652.

Dick,

Just a quick note to express my thoughts on the plant test/confirmation that you wish to perform. I expressed a package to you that has Pyramid's client list, resumes of key personnel, newsletters and some of our publications in column flotation. I hope that you can use the information to your advantage.

To maximize gold recovery, I recommend a pre-test phase where we can optimize column operations. This should start immediately. I would be willing to review any data you currently have and recommend additional tests to attempt and improve gold recovery. There will be no charge for this part of the service (understanding your desire to minimize costs) as long as no travel is involved.

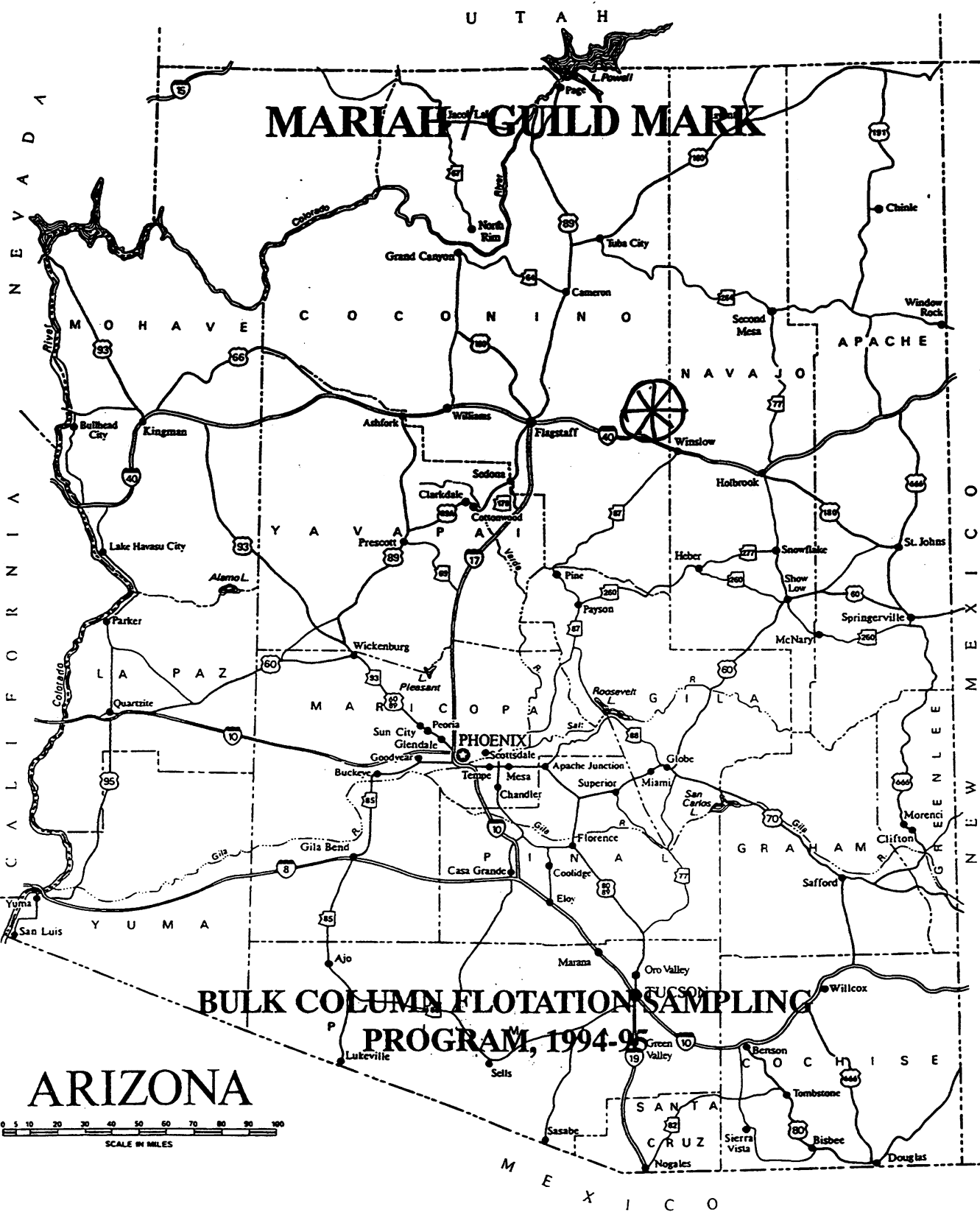
Once confirmation testing is conducted, the rate would be \$750 per day and will probably take 2 to 3 days. Having two independent parties (i.e., Hazen and Pyramid) that are in agreement will minimize any doubts. The details of the sampling and test program can be worked out later.

I hope that this is helpful. Let me know if I can be of further assistance.

Best Regards,

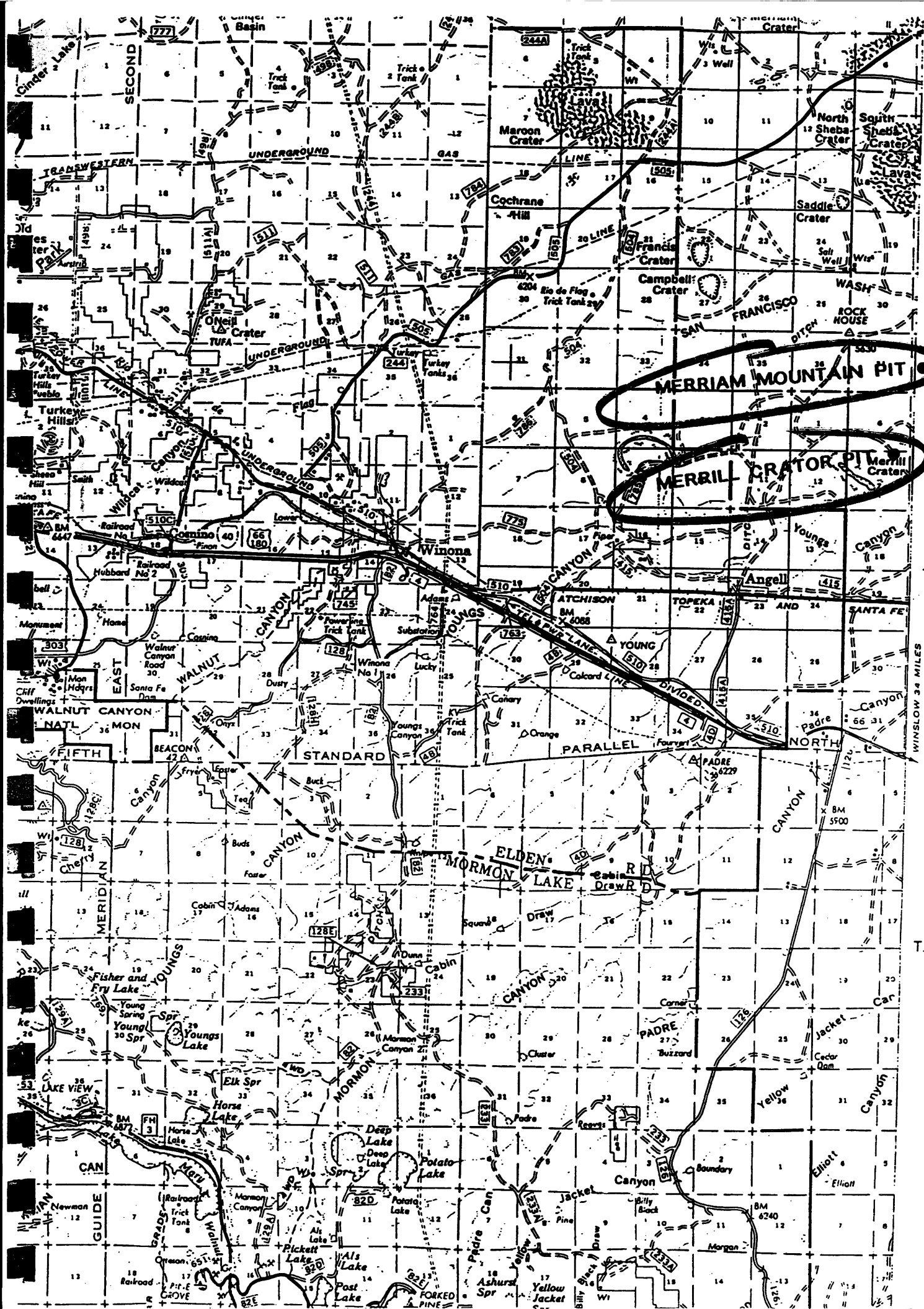


Paul M. Keyser



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T. 22 N.

T. 21 N.

T. 20 N.

R. 3 E.

R. 4 E.

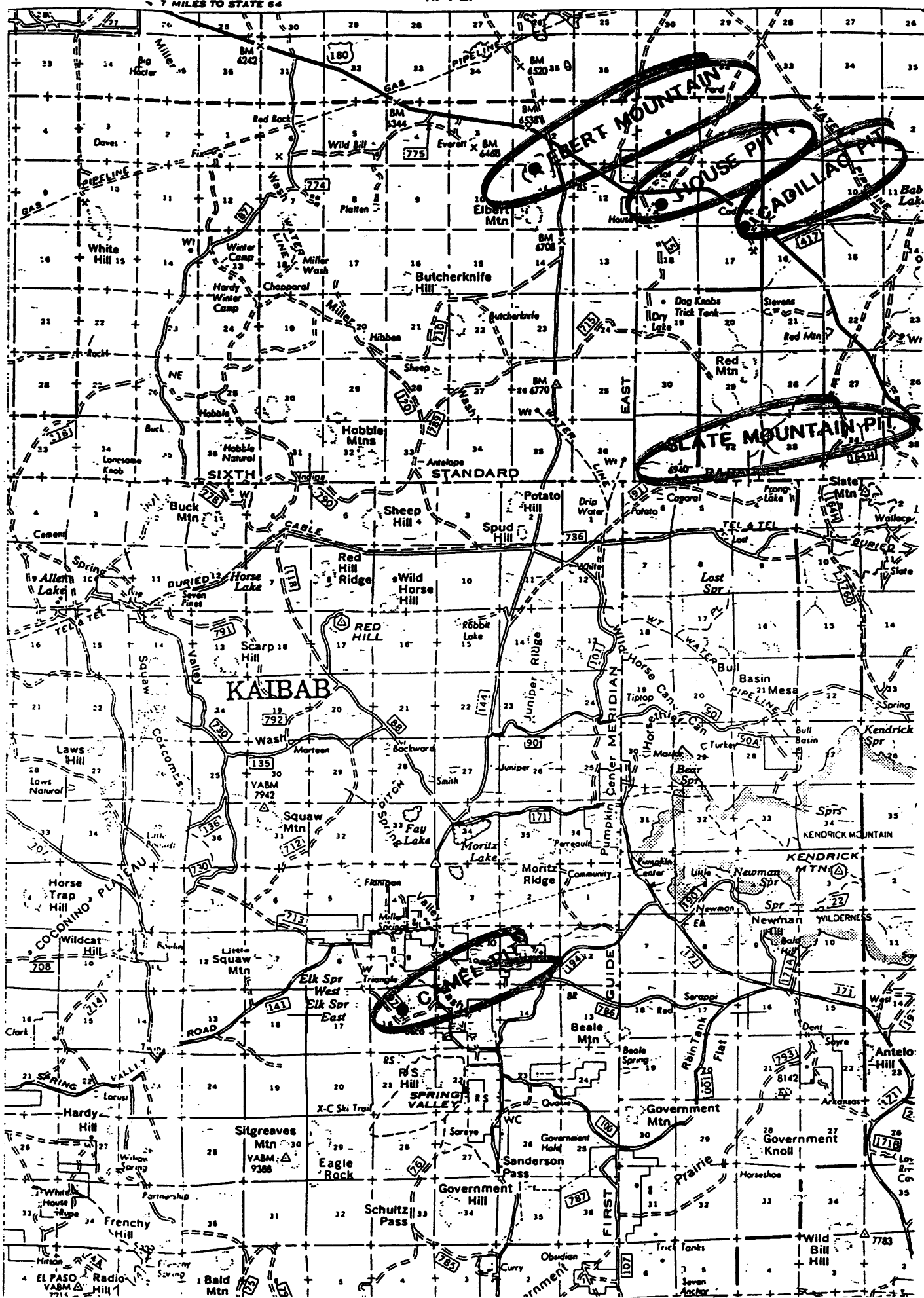
R. 5 E.

T. 26 N.

T. 25 N.

T. 24 N.

T. 23 N.



RESUME

JOHN O. RUD

933 E. Wahalla Ln.
Phoenix, Arizona
85024
(602) 581-9140

1992

RESUME

JOHN O. RUD
GEOLOGIST, M. SC.

PERSONAL DATA

Date of Birth:	November 23, 1938
Marital Status	Divorced
Health	Good

EDUCATION

1970 - Bachelor of Science (Geology)
University of Oregon
1971 - Master of Science (Geology)
University of Oregon

EXPERIENCE

General Partner and Manager of Southwest Color Supply

Located a source of red iron oxide to be used as a color pigment in the paint and concrete industry. Designed and constructed the processing facility. Southwest Color Supply is presently mining, processing, and selling a red iron oxide pigment

Geological Consultant

Completed reserve studies and pit design for Sunwalker Development Inc. on the Cherokee Rock Quarry. Quarry presently under production producing decorative rock aggregate.

Geological Consultant

Economic evaluation of the San Francisco Volcanic Field to determine its potential as a source of lightweight aggregate.

Geological Consultant

Completed a underground evaluation of the Bearup Mine, Glenwood, New Mexico. Presently supervising rehab of underground workings.

Geological Consultant

Completed Geological evaluations on 40 gold mines in Yavapai and Maricopa Counties for a Canadian firm to determine the economic potential of placing the Redtail Mill into a custom milling facility.

Geological Consultant

Ron Lewis Construction. Located and evaluated rock formations in northern Gila County for utilization as road base material. Quarry presently in production for AB & MA road base on Arizona state highway 260 road improvement projects.

1989 - 1990

Leased the RedTail gravity/flotation/cyanide mill near Congress AZ. Currently processing gold ores from the George Washington mine, Clementine mine and Pikes Peak mine. Mill is operating as a custom milling facility.

Formed a Public Company, (HIGHLAND RESOURCES INC. Director, Sec. Tres) Highland Resources Inc. leases the George Washington Gold mine near Wickenburg, Arizona. Raised initial funding to place the mine into production. Gold ore is being transported to the RedTail flotation/cyanide mill for processing.

1987-1988

Geological Consultant for a private company.

Located and assisted in the development of a 30 to 50 ton-per-day gold mine near Congress, Arizona. Consulted on the design, location of equipment and construction of the 150 TPD RedTail flotation/cyanide mill.

1987 - 1988

Geological Consultant for Real Estate Firm.

Conducted geological evaluation and detail feasibility studies on granite property near Apache Junction. Property is presently in production selling granite for landscaping purposes.

Conducted geological evaluation on a Gila River sand deposit. Property sold for development.

1986-1987

Geological Consultant for a private company.

Conducted evaluations on placer gold property near Congress, Arizona.

Leased agitation cyanide equipment to conduct tests on the gold potential of the mines in the Congress Area. Conducted extensive studies on the economic potential of magnetite, iron oxides, specularite, vermiculite, and perlite for industrial use. Developed pilot mill for initial processing of the above minerals.

Consulted on construction of processing plant for the iron oxide material. Plant is on standby waiting results from weathering tests being conducted by paint and roof tile manufacturers.

Geological Consultant for private company to develop the Crater sulphur-gypsum deposit near Big Pine, California. Market studies completed for foreign and domestic markets. Crater mine is in production.

1981-1985

Director and Vice President of exploration

A public corporation with holdings in a lead-silver mine in Yuma, County, Arizona and Cattle feeding operations in Iowa. The Lead-Silver mine has been developed to the 300 ft. level is on a standby status due to low silver prices. Extensive cyanide leach tests were completed. Leach pads installed and operated for the recovery of silver and gold.

1977 to 1983

Geological Consultant

Project included the geological evaluation of the Butterfield Placer deposit near Yuma, Arizona.

Geological evaluation of the Castle Dome mining district near Yuma, Arizona. Negotiated the purchase of all mining claims in the district. Retained all personnel for the development of the Hull Mine. Hull mine was developed to the 300 level and placed into production at 150 tons-per-day and operated at full capacity until the severe drop in silver prices in 1983.

Purchased and rehabilitated a 75 TPD portable gravity mill which was leased out to numerous mining companies for bulk sampling. Mill sold to local mining company and is presently operating in Mexico. Designed and supervised heap leach operation near Corborca, Mexico for a Canadian public company.

Consulted and supervised the Brick Mine decline development near Arivaca, Arizona for a public company listed on the Vancouver Exchange.

Geological Evaluation of the Little Jessie Mine near Humbolt, Arizona. Supervised rehabilitation of underground workings. Leased portable gravity mill for bulk sampling of dumps.

Geological evaluation of the open pit gold mine in Valley County, Idaho. Project was financed and placed into a production status.

Geological evaluation of the George Washington mine near Wickenburg, Arizona. Mine placed in production.

Geological evaluations of the fluorspar deposits in the Tonto Basin area of Arizona.

Initiated a fluorspar dump reclamation program. Purchased trucks and transported material for processing at the Tonto Fluorspar Mill. Acid grade fluorspar was sold to Allied Chemical.

1976-1977

Geological Consultant

Conducted geological evaluations in the Central City area, Colorado.

Geological evaluations of Uranium deposits near Green River, Utah.

Consulted and supervised the development of the Quito Mine, shipped gold-copper ore to the Central City Mill, at Central City, Colorado.

Consulted on the rehabilitation of the Black Hawk flotation mill near Idaho Springs, Colorado.

Purchased and shipped the Lamartine mine dumps to the Central City flotation mill.

1973 - 1976**Geological Consultant**

Geological evaluation of limestone deposits for sources of agricultural lime and decorative stone. Open two quarries near Medford, Oregon, and sold agricultural and decorative products. Operation was sold to major producer of agricultural products.

Geological evaluation of pumice deposit near Mt. Shasta California. Mine was open and material sold to the northern California block manufacturers. U.S. Government initiated action and purchased mine claims which were included in a new wilderness area.

Leased several mine dumps in central Nevada and conducted heap leaching operations.

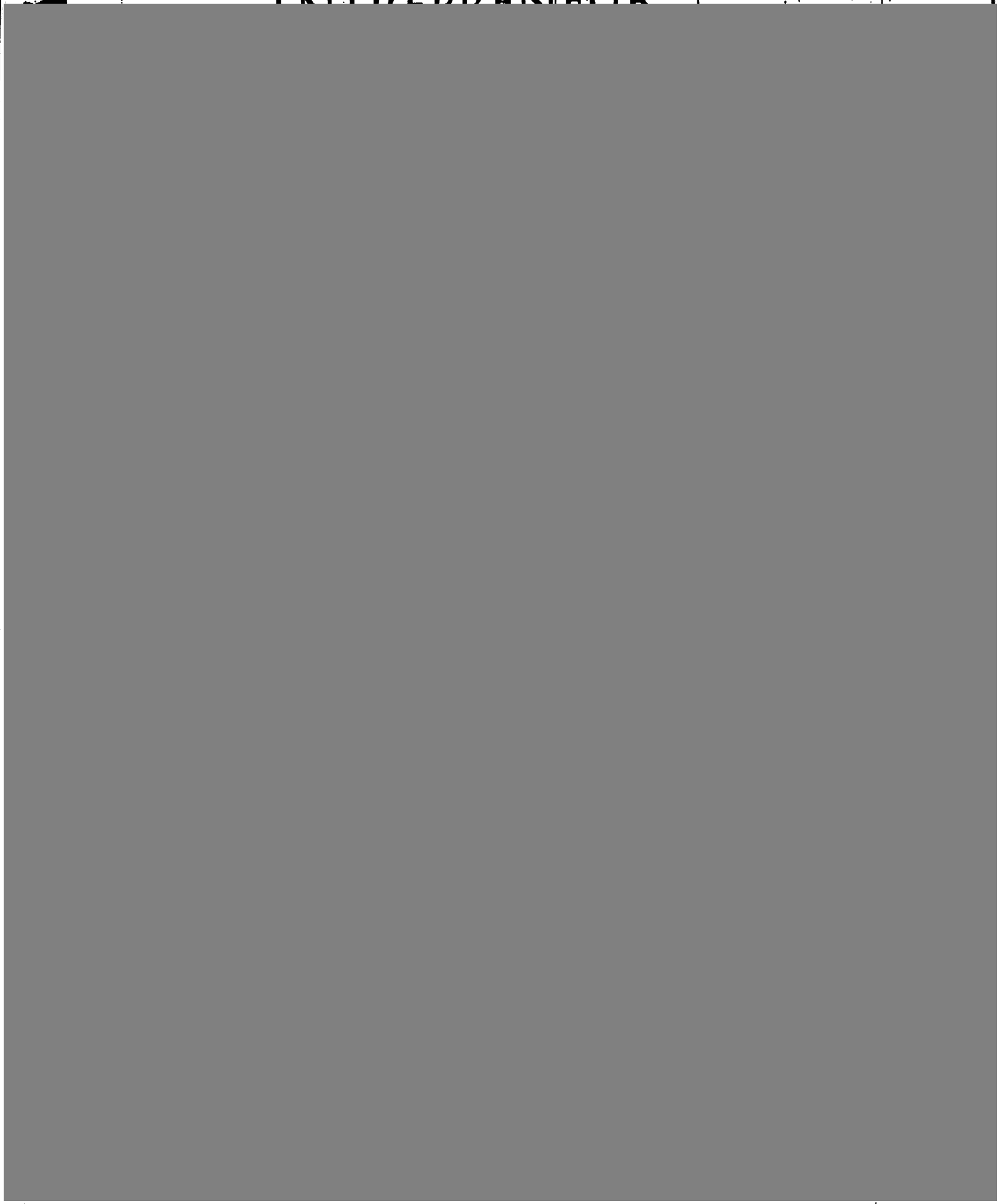
Consultant for Pacific Power & Light Co. Supervised drilling program on the Spring Creek Coal project near Decker, Montana.

1971 - 1973**Geological Consultant**

Consultant for numerous public companies trading on the Vancouver and Calgary exchanges. Extensive geological evaluations, geochemical, and geophysical surveys completed in the Highland Valley area near Kamloops, B.C.

1961 - 1967**Underground Miner**

Worked as a underground miner in numerous mines and diversion tunnels for dam construction in Washington, Idaho, and Montana area.





January 26, 1995

The Avalon Company, LTD.
Richard C. Jackson
2711 LBJ Freeway - Suite 122
Dallas TX 75234

Re: Mariah International, Inc./Guild Mark Industries, Inc.

Dear Rick:

At your request I am writing this brief review of the current business situation of the two companies listed above. These two companies basically act as a partnership even though they are listed separately on the electronic bulletin board under MRHI (Mariah) and GMKI (Guild Mark).

The companies are currently active in basically two major market areas as follows:

- 1) Volcanic cinder cone gold (Merrill Crater)
- 2) Fertilizer Production (Merrill Crater)

I will detail the basic activity under these categories as follows:

I. Merrill Crater volcanic cinder cone

a) We have under lease/purchase contract approximately 1000 acres of land in northern Arizona. We have conducted a bulk field test of this material as well as tests in the laboratory, and have shown yields of gold in excess of .10 ounce per ton. We have potentially hundreds of millions of tons of material from which to extract gold. The by-product of this gold production is a very finely ground inorganic product that we are promoting as a fertilizer. We have approximately \$100,000 worth of back orders for this fertilizer.

b) We have received funding of approximately \$350,000 and have constructed a portable five ton per day mill to process the volcanic cinder cone. This portable mill will provide the final commercial test of gold production at the same time providing the fertilizer material to supply our back orders under our trademark "REPLACE."

c) After finalizing the process through the portable five ton mill, we plan to put a 1000 ton per day per day mill on the Merrill Crater in order to produce large commercial quantities of gold as well as fertilizer. Our costs will be extremely low, i.e., under \$150 per ounce, and we will require between \$12,000,000 to \$15,000,000 to build the necessary plant and equipment.

II. Research evaluation of flotation for gold ore

Hazen Research, Inc. of Golden Colorado will perform our evaluation of our pilot plant operations for flotation of gold. The report will contain the following elements, and provide us with a "bankable" report for presentation to a financial lending institution. The report will include the following:

EXECUTIVE SUMMARY

INTRODUCTION

- Property Description
- Property Ownership
- Ore Description

SUMMARY AND CONCLUSIONS

TEST PROGRAM

- Circuit Description & Flow Sheet
- Sampling Points and Schedule
- Plant Activities

DISCUSSION OF RESULTS

- Operating Data
 - Product Analyses
 - Stream Data

RECOMMENDATIONS

- Circuit Modifications
- Reagent Modifications
- Additional Test work

APPENDIX

- Operators Log
- Operators Data Sheets
- Analytical Results Sheets

Pyramid Resources will provide metallurgical engineering services with the following step by step approach to optimize gold recovery and grade.

* **Step 1:** Analyze existing pilot plant data to determine if there is enough data to accurately predict plant performance. this will ental 2 to 3 days of data analysis at our office in Salt Lake city. Once completed, further tests can be identified.

* **Step 2:** Conduct additional pilot plant tests as identified from step 1. this will most likely entail 3 days of on-site testing. Statistically designed experiments will be conducted in an attempt to minimize the time needed to achieve optimal gold recovery and grade. Data collected during the tests will be analyzed and refining experiments, if necessary, will be

recommended.

* **Step 3:** Conduct refining experiments outlined in step 2. It is estimated that an additional 3 days will be needed. As with step 2, the data will be analyzed. Based on all collected data, the recommended ranges for column operating variables will be determined.

* **Step 4:** It is recommended that confirmation tests be conducted under the operation conditions outline from step 3. This should take an additional 2 days of plant testing.

A detailed analysis on the results will be prepared and submitted to Mariah/Guild Mark for presentation to lending sources.

IV) Financial Situation

a) Mariah/Guild Mark have been developmental companies and have not had income other than that from private placement, etc. The companies are currently up to date with audited financial statements for 1992/93 and are currently preparing this year's audited financial to supply to Standard and Poor.

V) Legal Situation

a) The company has currently engaged the firm of Tiffany & Hoffman in Phoenix as our SEC legal counsel. We also have commercial legal counsel and are involved with one law suit based upon claims from one old shareholder, which we feel has no merit. Currently the two companies together have an approximate \$5,000,000 tax loss carry forward. Detailed financial reports including notes relative to these reports are available from our independent auditors, Donald Stoker, CPA, J.D.

Page 4

b) All in all we feel that the Mariah/Guild Mark situation warrants a very intensive look by a company such as yours in order to provide the actual financial acumen and resources to allow our companies to reach the \$100,000,000 per year sales goal that we think is within our grasp within the next few years. We welcome a visit from your representative to review all these matters.

Sincerely,

A handwritten signature in cursive script, appearing to read "R. Campbell", written over the word "Sincerely,".

Richard A. Campbell
Corporate Secretary

RAC:hh



Hazen Research, Inc.
4601 Indiana Street • Golden, CO 80403
Tel: (303) 279-4501 • Telex 45-860
Fax: (303) 278-1528

December 14, 1994

FAX TRANSMITTAL ONLY

Mr. Dick Campbell
Mariah International Corporation
702 West Melinda Lane
Building D - Suite 7
Phoenix, Arizona 85027

Re: Evaluation of Flotation for Gold Ore
HRI Proposal 95-066

Dear Mr. Campbell:

In accordance with your request for Hazen Research, Inc. to provide services for evaluating flotation of cinder cone material to produce a gold concentrate, this letter will provide you with approximate cost estimates for Hazen's services.

These estimates are based on using your existing pilot plant in Phoenix for demonstrating the flotation process. You indicated that the pilot plant has a feed capacity of about one ton per hour.

We suggest that the pilot plant should be operated for about 13 days, 8 hours per day. Considering time to start up each morning, this means that about 100 tons of material would be processed. We believe that this is ample time to evaluate the process unless unforeseen circumstances arise.

The purpose of the program is to (1) verify that gold is contained in the feed material, (2) determine the concentration of gold in the flotation concentrate, (3) determine the percentage recovery of gold to a concentrate, and (4) prepare a report for presentation to a financial lending institution.

Mr. Cregg Bossard, a senior metallurgical engineer, will be assigned to the project by Hazen. Mr. Bossard's billing rate is \$90 per hour. Based on 13 days of plant operations, 8 hours per day, plus one day for travel and one day for plant review and startup, we estimate that charges for Mr. Bossard at the site will be \$10,800 plus transportation costs and living expenses in Phoenix. The estimated costs for final report preparation by Hazen are \$4,500 to \$5,500. Also, a large number of samples must be taken during the operation and assayed for gold and possibly other minor elements. Hazen's fire assay cost for gold is \$11 per sample. Assuming a total of possibly 100 samples for gold plus miscellaneous assays, the cost for assaying could be approximately \$1,500. Thus, the total estimated cost for the above described scope of work is \$17,300 plus expenses. After the final scope of the program is determined, some changes in the cost estimates may be required, such as time required for Mr. Bossard to prepare data sheets for the operation, etc. prior to his arrival in Phoenix.

Mr. Dick Campbell
December 14, 1994
Page 2

This program is predicated on Mariah International supplying all plant operating personnel, supplies, equipment, and sample preparation services.

We are prepared to start the program in January 1995. You mentioned that Pyramid International may participate in the program; we would welcome their involvement.

If you have any questions regarding this proposal, please let me know.

Very truly yours,



R. B. Coleman
Mining Sales

RBC/cb



Hazen Research, Inc.
4601 Indiana Street • Golden, CO 80403
Tel: (303) 279-4501 • Telex 45-860
Fax: (303) 278-1528

PROFESSIONAL SERVICES AGREEMENT

This Agreement, dated the 27th day of Jan, 1995, between Hazen Research, Inc., a Colorado Corporation, 4601 Indiana Street, Golden, Colorado 80403, hereinafter called "Hazen", and Mariah International Corp., 702 West Melinda Lane, Building D, Suite 7, Phoenix, Arizona 85027, hereinafter called "Client",

WITNESSETH:

WHEREAS, Hazen is willing and able to render services for performance of the work as hereinafter described, and

WHEREAS, Client desires to obtain said professional services for said work.

NOW THEREFORE, in consideration of the covenants and obligations hereinafter set forth, the parties agree as follows:

ARTICLE I SCOPE OF WORK

The work to be performed by Hazen under the terms of this Agreement consists of the evaluation of a pilot plant operation for flotation of gold. Details of the scope of work are contained in the accompanying Proposal 95-066, which becomes a part of this Agreement.

ARTICLE II COSTS

The estimated cost of the work is \$17,300 plus travel expenses. Costs will be charged to Client in accordance with this Article. If at any time Hazen decides that the costs of the work will exceed the estimate, Hazen will immediately notify Client. Unless Client within ten (10) days after receiving such notification agrees to a revised estimate and agrees to pay all actual costs of the work, Hazen and Client will plan a revised scope of the work so that the original estimate is not exceeded.

Charges for services by Hazen will be calculated at 3.37 times the base hourly rate for hours worked on this project, with a maximum rate of \$150 per hour and minimum hourly rates of \$80 for engineers and higher classifications, \$55 for technicians and senior technicians, and \$35 for secretaries and junior technicians. Records of hours charged to the project will be kept for each employee and made available to Client upon request.

Analytical charges for analyses performed by Hazen will be billed at the cost shown in Hazen's published analytical price schedule. A new analytical price schedule is published every year and normally takes effect on January 1. Therefore analytical prices are subject to change yearly.

Direct out-of-pocket costs for equipment, materials and services obtained external to Hazen will be billed to Client at direct cost plus 15%. Equipment purchased from Hazen subsidiaries will be billed at direct cost.

Direct out-of-pocket costs for analytical work obtained external to Hazen will be billed to Client at direct cost plus 20%.

Accounting records substantiating these charges to Client will be available for Client's inspection at any time during Hazen's normal working hours.

ARTICLE III PAYMENT

An initial payment of \$12,000 of the estimated cost is required to be paid prior to the start of work. If special equipment is authorized to be purchased prior to the start of work or during the course of work, Client shall advance funds therefor upon notice from Hazen and prior to purchase. A statement of actual charges will be submitted monthly or semi-monthly and such statements shall be paid by Client within fourteen (14) days after receipt. The initial deposit representing a percentage of the work will be credited against the final invoice which will also include the charges noted in Article IV. Any excess of the deposit over charges will be refunded to Client. A finance charge of 1.5% per month will be added to overdue accounts. Invoices will be submitted semi-monthly if charges greater than \$10,000 are incurred by mid-month. Failure by Client to make payments required hereunder may cause Hazen to suspend the work. In the event Client is in breach of this Agreement, Hazen shall be entitled to recover its costs, expenses, and reasonable legal fees as part of its damages.

ARTICLE IV SAMPLES

Client's unprocessed materials and ores, and the residues, concentrates, tailings, and waste materials resulting from or produced as part of the work will be shipped back to Client within sixty (60) days of completion of the work unless Client has made other arrangements for the disposition of the material. These materials are and shall remain the property of Client, and the project will remain open until all of the materials are removed from Hazen's property. Any cost for storage, monitoring of barrels, cleanup of any spillage not attributable to Hazen's neglect, preparing materials for disposal, and cost of disposal will be Client's responsibility.

ARTICLE V TIME

Hazen intends to begin the work in February 1995. It estimates that the work will be completed within four weeks of commencing the project and the report issued three weeks after completion of the pilot plant evaluation. If during the course of the work Hazen decides that the project cannot be completed within this time schedule, Hazen will notify Client so that Hazen and Client can decide on the course of action to be pursued.

ARTICLE VI INVENTIONS AND PATENTS

Hazen represents that each of its employees, contract laborers and consultants has entered into a contract of employment which provides for prompt disclosure and assignment to it of all inventions related to this project that are made by said employee during the course of his employment. Hazen agrees that, as to any invention related to this project that is made by any of its employees, contract laborers and consultants while working on this project, during the period of this Agreement, it shall in turn disclose and assign the same to Client, and upon the request and at the expense of Client and through attorneys named by Client, it shall cause said employee to make application for Letters Patent and to assign said application to Client.

Hazen makes no representation or warranty that the work proposed herein does not infringe or otherwise conflict with any existing patents or patent applications. Client is advised to undertake its own patent search before applying information developed under this Agreement.

ARTICLE VII NONDISCLOSURE

Hazen shall use its best efforts to prevent the disclosure of any information relative to the work to others than Client, unless authorized to do so by Client, and represents that it has entered into employment agreements with all employees, contract laborers and consultants requiring them not to disclose any such information.

ARTICLE VIII ADVERTISING AND PUBLICITY

Client shall not use the name of Hazen or of any of its employees in any advertising, publicity, or selling material without prior written approval of Hazen.

ARTICLE IX WARRANTY

Hazen will apply present engineering and/or scientific judgement and use a level of effort consistent with the standard of practice as measured on the date hereof and in the locale where the services are to be performed. Except as set forth herein, Hazen makes no warranty, expressed or implied, in fact or by law, whether of merchantability, fitness for a particular purpose or otherwise, concerning any of the materials or services which may be furnished by Hazen under this project. In the event that such "services" do not meet the above described standards, the sole remedy is for Hazen to reperform such "services" for Client at no charge to Client, provided that failure to meet the standards is called to the attention of the Hazen Project Manager assigned to the project within 60 days from the completion of this service.

ARTICLE X MISCELLANEOUS

Hazen represents that it carries liability insurance, workman's compensation and other appropriate insurance coverage. Evidence of insurance is available to Client upon request. To the best of its knowledge, Hazen is in compliance with applicable state and federal laws and regulations. This Agreement shall be governed by the laws of the state of Colorado and the parties' consent to the jurisdiction of the Colorado courts in any action to enforce or interpret this Agreement. In the event of litigation to enforce this Agreement or to collect payment thereon, the prevailing party shall be entitled to recover reasonable attorneys' fees and costs in addition to all other rights and remedies. Notice given hereunder shall be given in writing to the address of the parties contained herein. It shall be deemed given five (5) days after deposit of such notice in the United States mail, postage prepaid, addressed to the party. Notice may also be given personally or by facsimile transmission in which case notice shall be deemed given on the date of personal service or transmission.

ARTICLE XI TERMINATION

Client reserves the right to terminate this Agreement at any time, but agrees to advise Hazen in writing of its intent to terminate fifteen (15) days before the date of termination, with the understanding that Client shall pay any charges due Hazen up to and including the effective date of termination. In the absence of such notice, this Agreement shall automatically terminate on June 30, 1995.

HAZEN RESEARCH, INC.

Date: Jan 20, 1995

By: R. W. Carter

R. W. Carter
Vice President

MARIAH INTERNATIONAL CORP.

Date: Jan 27, 1995

By: [Signature]

Name Richard A. Campbell

Corp Secretary
Title

DATE: 4/12/95

TO: RANDY MOORE - CAMBION

FROM: DICK CAMPBELL

SUBJECT: RESULTS FROM PPTI on Merrill Carter head ore.

Dear Randy,

Here are the results from a sample of head ore taken by me and delivered to PPTI last month. The material was ground to - 325 and dried / not concentrated, and then shipped to Spring Valley, CA where it was split into 2- 1b samples. 1- a control # 10210 and the other # 10211 was the treated sample. These were then packaged up and sent to me on April 1, 2nd. I in turn hand delivered both 1b samples to David Fell. He faxed me the results this morning. As I had not received the hard copy, which is in the mail.

There is a nice increase in the treated material over the control sample. These samples are not con. as stated in this analysis, but are right out of the pile of cinder that you saw at the pilot plant during your visit several weeks ago.

I am also enclosing an overview of PPTI for your review. It certainly is interesting to say the least.

I look forward to hearing from you in the near future.

Regards
nd.

D43192

DATE RECEIVED 4/6/95
 NAME Dick Campbell
 ADDRESS 9 ORCHARD
PAVING CA 92720
 PHONE# 414 559-5157

JOB# 35211
 INVOICE# 97355
 DATE DUE _____
 DATE FINISHED 4/7/95

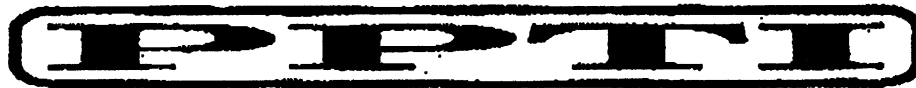
ASSAY FOR:

SAMPLE DESCRIPTION		GOLD	SILVER	PLATINUM	PALLADIUM
CON.	SAMPLE 10210-A	/	/		
CON.	" 10211-B	/	/		

2 SAMPLES ASSAYED @ 50 = 100
 _____ SAMPLES ASSAYED @ _____ = _____
 _____ SAMPLES ASSAYED @ _____ = _____

ASSAY RESULTS

SAMPLE	GOLD	SILVER	PLATINUM	PALLADIUM
CON # 10210	0.120 $\frac{\text{oz}}{\text{ton}}$	ND < 0.01 $\frac{\text{oz}}{\text{ton}}$		
CON # 10211	0.175 $\frac{\text{oz}}{\text{ton}}$	ND < 0.01 $\frac{\text{oz}}{\text{ton}}$		



Pulsed Power
for
Mineral Extraction
Overview

Pulsed Power Technologies, Inc.
P.O. Box 1419 • Spring Valley, CA 91979

Pulsed Power Technology for Mineral Extraction

The basic concepts for pulsed power mineral extraction stem from the useful effects that occur when a high energy plasma arc is discharged between electrodes that are submerged in a liquid. The flow rate of the liquid and the firing repetition rate of the high energy pulses are adjusted so that any mass of liquid will be exposed to more than one discharge as it passes through a confining shock chamber. The effects are described below:

First, the surrounding region is momentarily filled with hard ultra-violet light and soft x-rays. These effects cause the chamber to be filled with ions, free electrons and free radicals, until they can recombine into simpler and smaller compounds. Many of the complex molecules are broken down and recombined into carbon-dioxide, water, and nascent metals.

Second, in conjunction with the radiation, a shock wave is generated which propagates outward from the discharge. This is made up of a very high density pressure wave, followed immediately by a rarefaction wave. At the interface between these waves molecular bonds are broken down and further ionization is caused. The shock wave actually pulverizes such things as silicates, releasing many of the trapped metals. Most dissolved solids come out of solution, hygroscopic bonds are broken in suspended matter, and still more metals are reduced to nascent form, so that all of these solids can settle out quickly and be separated from the basic supporting liquid.

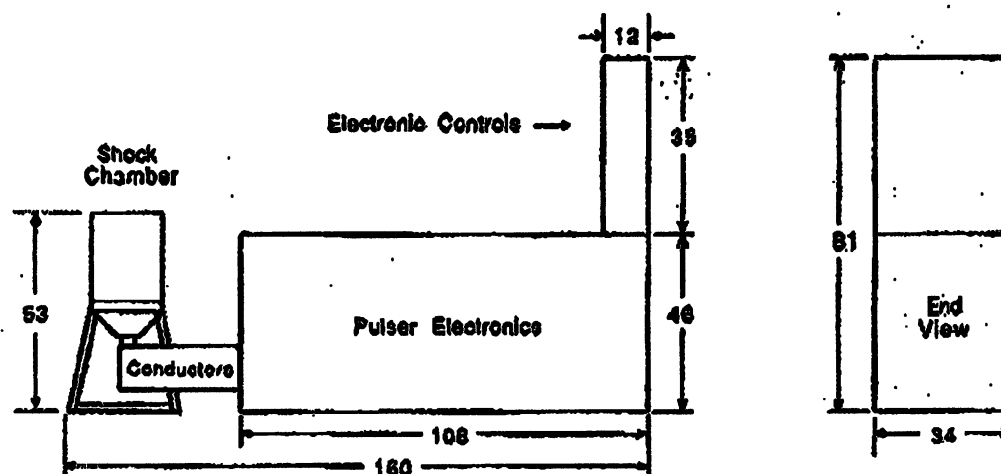
When all of this action is confined within a thick-walled chamber, the effects are further amplified as they reflect multiple times through the same materials within the enclosed liquid medium.

After passing through the PPTI pulsed plasma shock chamber, the fluid should then go through some means of separating the solids from the water. The water may then be reused in the process and the solids processed to pull out the freed metals.

The power requirement for this system is surprisingly low. It is appropriate to note that a 5,000 megawatt pulse of 5 microseconds duration fired 2 times per second requires only 50 kilowatts average power from the source. This should be sufficient to process roughly 800,000 to 1 million gallons of slurry per day. The separation phenomena that we are seeing are the result of the initiation of simultaneous high energy pulses in a multiplicity of physical regimes. The actual power injected into the liquid by the process will be less than that due to pumping and flow friction; and the further separation of the metals will definitely take more power than the pulsed plasma process.

The PPTI Model 500B Pulser Electronics and Shock Chamber are being acquired currently by the academic community, as research tools in the struggle to reclaim hazardous waste sites, and to find ways to clean up contaminated water. Significant testing has already been accomplished with previous versions of this equipment. Those earlier tests have shown that many compounds are broken down and heavy metals are precipitated by the pulsed power process. For example, a copper sulphate solution yielded nascent copper in the sludge that resulted after processing. Geothermal brines were also processed and they produced a metallic sludge. Ground water that was excessively contaminated with metallic salts and totally unuseable, became potable after pulsed power processing and removal of the resulting precipitate.

In size, the Pulser Electronics is in an enclosure that is approximately nine feet long, by four feet high, by three feet wide. At one end there is a electronic control box mounted on top that stands an additional three feet in height. This box is one foot thick and only slightly narrower than the width of the main enclosure. This electronic control box can be mounted remotely on a wall nearby, if that is desirable. At the opposite end of the Pulser Electronics from where the electronic control box is mounted, a pair of aluminum beams protrude about three feet outward along the axis of the main enclosure. These are the primary conductors going to the Shock Chamber. This chamber is 16 inches diameter, stands 28 inches in height, and is supported, with its axis vertical, by a steel frame. The interior of the chamber is 10 inches in diameter and 16 inches deep. There are six ports around the bottom of the chamber for the fluid to enter and a similar six ports around the top of the chamber for the processed effluent to exit. The electrodes are potted in a nonconducting high impact plastic, and mounted in the bottom of the Shock Chamber assembly. This assembly is almost five feet in height, and with the interconnecting conducting beams, adds almost five feet to the overall length of the system, bringing the total length to thirteen and a half feet. The Shock Chamber Assembly weighs a little over half a ton, and the Pulser Electronics comes to almost three-quarters of a ton. The engineering evaluation unit, the 500B, in a continuous running mode operates on 2.5 kw of 240 volt ac power. The higher powered unit, the 500C (capable of processing up to 1 million gallons of slurry per day), will utilize 50 kw of 480 volt ac power.



General Physical Layout (Inches)

Pulsed Power Technologies, Inc. (PPTI) was incorporated in the state of California in April of 1991, for the purpose of exploiting the effects of both pulsed plasmas and pulsed magnetic fields. The founders of the company have worked in this area of technology for several decades. The company is located at 2739 Via Orange Way, Suite 103, Spring Valley, California. Mail should be addressed to Pulsed Power Technologies, Inc., P.O. Box 1419, Spring Valley, CA 91979. The telephonenumber is 619-670-1612 and the FAX number is 619-698-1860.



**DAVID H. FELL
& COMPANY, INC.**

6009 Bandini Boulevard

City of Commerce, CA 90040

(213) 722-9992 • FAX (213) 722-6567

I N V O I C E
No. 71574

Date: 11/25/92

M130005

S
O
L
D

S MARIAH INTERNATIONAL INC.
H 2221 W. MELINDA
I
P PHOENIX AZ 85027

Trans Date	Taxable	P.O. Number	Gold	Silver	Terms
11/25/92	NO	WILL CALL 11/30	334.350	3.740	COD

Quantity	Description	Price	Extension
	4.671 TOZ FINE GOLD BAR RET. ON J24067	0.000	0.00
	****CUSTOMER WILL PICK UP 11/30****	0.000	0.00
	TOTAL	\$	0.00

RECEIVED IN GOOD ORDER BY _____

1.5% will be charged on overdue account



**DAVID H. FELL
& COMPANY, INC.**

6009 Sandini Boulevard

City of Commerce, CA 90040

(213) 722-9992 • FAX (213) 722-6567

INVOICE: 4635

NAME: MARIAH INTERNATIONAL INC.
ADDRESS: 2221 W. MELINDA
PHOENIX , AZ 85027

CODE: MM13145

JOB#: 24185

DUE DATE: 1/ 5/92

MATERIAL	WEIGHT	RECD	GOLD	SILVER	PLATINUM	PALLADIUM	OTHER
CONCENTRATE / DRY	53.000	N/P	3.287	0.000	0.000	0.000	0.000
POWDER	0.000	/O	0.000	0.000	0.000	0.000	0.000
NET WEIGHT IN TOZ.-- TOTALS:			3.287	0.000	0.000	0.000	0.000

CHARGES

REFINING: GOLD \$	50.00	RETURNING: GOLD \$	0.00	ALLOYING \$	0.00
PLATINUM \$	0.00	PLATINUM \$	0.00	TREATMENT \$	79.50
PALLADIUM \$	0.00	PALLADIUM \$	0.00	BAR CHARGE \$	5.00
SILVER \$	0.00	SILVER \$	0.00	SHIPPING \$	10.00
\$	0.00	SMELTING \$	0.00	TOTAL DUE DHF	145.10

3.287 TOZ GOLD RECOVERED
0.164 TOZ 5.000% RECOVERY FEE
3.123 TOZ FINE GOLD BAR RETURNED

TOTAL \$ 0.00



DAVID H. FELL
& COMPANY, INC.
6009 Bandini Boulevard
City of Commerce, CA 90040
(213) 722-9992 • FAX (213) 722-6567

PRINTED DATE: 12/ 8/92
TIME: 11:35 AM
DATE: 12/ 8/92
JOB#: 24185
DUE DATE: 1/ 5/92

CODE: MM13145
NAME: MARIAH INTERNATIONAL INC.
ADDRESS: 2221 W. MELINDA

PHOENIX , AZ 85027

ATTENTION:
TELEPHONE: (602)581-5144

SPECIAL INSTRUCTIONS
REFINE THE GOLD FROM SAMPLES & SMELT
GOLD FROM CONCENTRATES
ADVANCES

CHK# \$ 0.00

CONTAINER MATERIAL
2 BUCKETS AU CONCENTRATE / DRY
POWDER

GROSS WT NET WT
57.000 P 0.000 P

D



**DAVID H. FELL
& COMPANY, INC.**

8000 Bandini Blvd.,

City of Commerce, CA 90040

(213) 722-9992

Richard Campbell
14028 Paseo Cevera
San Diego, CA
92129

January 29, 1993

Dear Mr. Campbell,

We are pleased to offer you the following terms for processing your precious metal product;

Material: Gold concentrates containing approximately 250 oz./ton

Shipments: Approximately 1000 pounds/day or 7000 pounds/week

Treatment: \$ 1.25/pound

Assay charge: \$ 50.00 per lot

Metal accountability: Gold - 97 %
Silver - 90 %

Refining charges: Gold - \$ 5.00/oz. accountable metal
Silver - \$ 0.50/oz. accountable metal

Settlement date: 30 business days following receipt or sampling if represented.

Pricing date: Settlement date unless otherwise agreed upon.

Metal markets: Gold - London afternoon fix
Silver - Handy and Harman spot

I trust you will find these terms satisfactory. If you have any further questions or would like to arrange for material processing, please call me at (213) 722 - 9992.

Thank you for considering David H. Fell & Co., Inc. for your refining needs.

Sincerely,


Lawrence Fell
Vice President

**PRELIMINARY OPERATING AND CAPITAL COST ESTIMATE FOR A ONE
THOUSAND TON PER DAY MINE AND PLANT DEVELOPED FOR
MERRILL CRATOR LLC**

Submitted to:

**Mr. Richard Campbell
Vice President - Special Projects
Mariah International, Inc
Deer Valley Airpark
702 West Melinda Lane
Building D, Suite 7
Phoenix, Arizona 85027**

Prepared by:

**Pyramid Resources, Inc.
328 West 200 South, Suite 100
Salt Lake City, Utah 84101**

950106B

January 13, 1995

I. INTRODUCTION

Pyramid Resources has determined a preliminary estimate of the operating and capital costs for both mining and milling associated with the design, engineering, construction and start-up of a one thousand ton per day (1000 TPD) plant for Merrill Crator LLC located in Phoenix, Arizona. The cost estimate was prepared using the United States Bureau of Mine Cost Estimating System. The calculated cost values are based on empirical models constructed from correlating operating and capital cost data from numerous mines and plants to plant throughput. Therefore, care should be taken in interpretation of the results. It should also be noted that the accuracy of this estimate is claimed to be plus or minus 25 percent. Also, additional cost variations can be introduced by making changes in the process flowsheet and the basic assumptions of the analysis. As a result, this report is the first "best guess" of Mariah International's mining and processing needs and should be treated as a starting point for further discussions.

II. PROCESS FLOWSHEET

The flowsheet used for this analysis was developed using a one ton per hour pilot plant now in operation at Merrill Crator LLC. The process involves receiving mined material which is typically minus 3/8 inch and grinding to 80 percent passing 325 mesh. The ground feed is then conditioned with flotation reagents which render gold bearing minerals hydrophobic. After conditioning, the feed is pumped to a flotation column where the majority gold bearing minerals attach to rising air bubbles and are recovered in the concentrate. The remaining material reports to the column underflow. Both gold bearing concentrate and underflow streams are then subjected to a series of solid/liquid separation processes including thickening, filtration and drying. After drying, the final products are then ready for bagging and/or shipping.

III. MINING OPERATING AND CAPITAL COSTS

The operating and capital costs for the mining of the Merrill Crator deposit are based on the following assumptions:

- The mine will operate one shift per day
- There is no need for removal of overburden from the deposit
- The deposit is located on private property (no restoration is required)
- The deposit can be mined using scrapers
- Haulage distance is approximately 1 mile from the mill with a haul grade of 0%
- All administrative costs for the mine have been included in the mill administrative costs

Table 1 below summarizes the operating costs while Table 2 outlines the capital costs (adjusted to 1995 dollars) for mining as determined using the USBM Cost Estimating System. Results presented in Appendix 1 are in 1984 dollars.

Table 1. Summary of mining operating costs for Merrill Crator LLC.

Description	Labor (\$/ton)	Supplies (\$/ton)	Equipment (\$/ton)	Total (\$/ton)
Surface Mining Costs	\$0.71	\$0.00	\$0.41	\$1.12
General Mine Operations	\$0.49	\$0.03	\$0.06	\$0.58
Total Mine Operating Costs	\$1.20	\$0.03	\$0.47	\$1.70

Table 2. Summary of mining capital costs for Merrill Crator LLC.

Description	Capital Cost (\$ x 1,000)
Mining Equipment	\$1,140
Mine Plant	\$46
Infrastructure	\$176
Working Capital	\$279
Total Mine Capital Costs	\$1,641

IV. MILLING OPERATING AND CAPITAL COSTS

The operating and capital costs for milling of the Merrill Crator deposit are based on the following assumptions:

- 1000 TPD nominal feed rate to mill
- Feed size is minus 3/8 inch
- Grind size is 80 percent passing 325 mesh

Table 3 below summarizes the operating while Table 4 outlines the capital costs (again adjusted to 1995 dollars) for milling. Results presented in Appendix 2 are in 1984 dollars.

Table 3. Summary of milling operating costs for Merrill Crator LLC.

Description	Labor (\$/ton)	Supplies (\$/ton)	Equipment (\$/ton)	Total (\$/ton)
Grinding	\$3.60	\$1.50	\$0.90	\$6.00
Flotation	\$0.63	\$0.94	\$0.23	\$1.80
Solid/Liquid Separation	\$0.75	\$1.98	\$0.07	\$2.80
General Operations	\$0.10	\$0.27	\$0.10	\$0.47
Indirect Operating Costs	\$1.50	\$0.19	\$0.19	\$1.88
Total Mill Operating Costs	\$6.58	\$4.88	\$1.49	\$12.95

Table 4. Summary of milling capital costs for Merrill Crator LLC.

Description	Capital Cost (\$ x 1,000)
Grinding	\$1,222
Flotation	\$540
Solid/Liquid Separation	\$1,172
General Operations	\$4,788
Infrastructure	\$405
Design & Construction	\$829
Working Capital	\$708
Total Mill Capital Costs	\$9,664

Mariah International, Inc.
Budget Operating & Capital Cost

January 13, 1995

V. SUMMARY

As a result of the analysis, Pyramid Resources has been able to determine an estimate of the operating and capital cost required for a one thousand ton per day mill for Merrill Crator LLC. Table 5 below shows operating and capital costs for both mining and milling operations. As pointed out in the introduction of this report, this estimate is starting point for future analysis and carries an accuracy of plus or minus 25 percent.

Table 5. Operating and capital costs for Merrill Crator LLC.

Description	Operating Cost (\$/ton)	Capital Cost (\$ x 1,000)
Mining Operations	\$1.70	\$1,641
Milling Operations	\$12.95	\$9,664
Total:	\$14.65	\$11,305

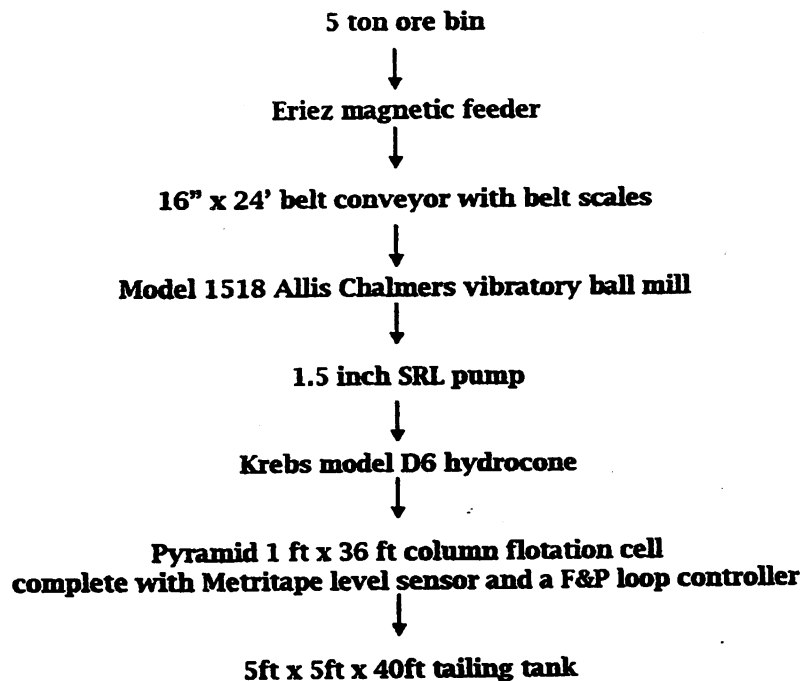
PILOT PLANT PROGRAM

Objectives

1. To determine the overall gold content of the Merrill Crator deposit to warrant the construction of a 1,000 tons-per-day concentrating plant.
2. Determine the optimum reagent combination and dosages to attain maximum recovery when the 1,000 tons- per-day concentrating plant is placed in operation.

Test Plant

Merrill Crator L.L.C. has constructed a one ton-per-hour column flotation plant. The circuit consists of:



The process utilized in the above circuit is called froth flotation. Froth flotation is a mineral separation process that utilizes the differential attraction of mineral surfaces towards the rising air bubbles in a mineral pulp suspension to separate mineral

particles of differing type. To make the process more efficient, organic chemicals called collectors are employed. Collectors are designed to attach selectively to the surface of one of the mineral components to be separated, making these particles water-repellent and increase the tendency to rise with the air stream.

Previous Column Flotation Bulk Sampling

During September, 1992, Mariah International, Inc. completed a 114 ton bulk column flotation sampling program which produced 104 pounds of gold concentrate. The program divided the 114 ton sample into five 20 to 25 ton samples. The head grade ranged from .05 to 1.44 oz/ton gold. Gold recovery ranged from 67% to 80.1%. Completed results from this bulk sampling program indicated the Merrill Crator material averaged .074 oz/ton gold. The reagents utilized (Collector KI 11, Frother KI 444) during this program were manufactured by Kerley Chemical Company and averaged a 72% recovery rate.

Test program

The test program is designed to determine the overall gold content of the material removed from the Merrill Crator and evaluate the performance of several types of flotation reagents to determine gold recovery percentage expected during the operation of a commercial sized concentrating plant. At this time the material is trucked from the Merrill Crator near Flagstaff to the pilot plant located in Phoenix, Arizona. The material will then be processed by the pilot flotation plant in 5 ton batches. Samples are removed from the feed belt, concentrate tank, and tailing tank at 30 minute intervals. The composite sample for the 5 ton mill run is then submitted for assay to determine the following data:

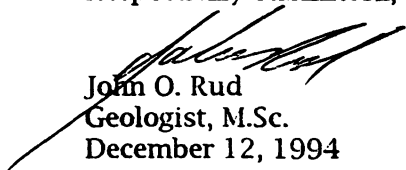
1. The gold content of the head ore.
2. The gold content in the concentrate.
3. The gold content in the tails.

From the above data the concentration ratio and recovery percentage can be determined.

The test program is currently designed to determine the optimum type of reagent that will increase the recovery rate to its maximum. The preliminary tests have utilized the reagents manufactured by MINERAL REAGENTS INTERNATIONAL with good results.

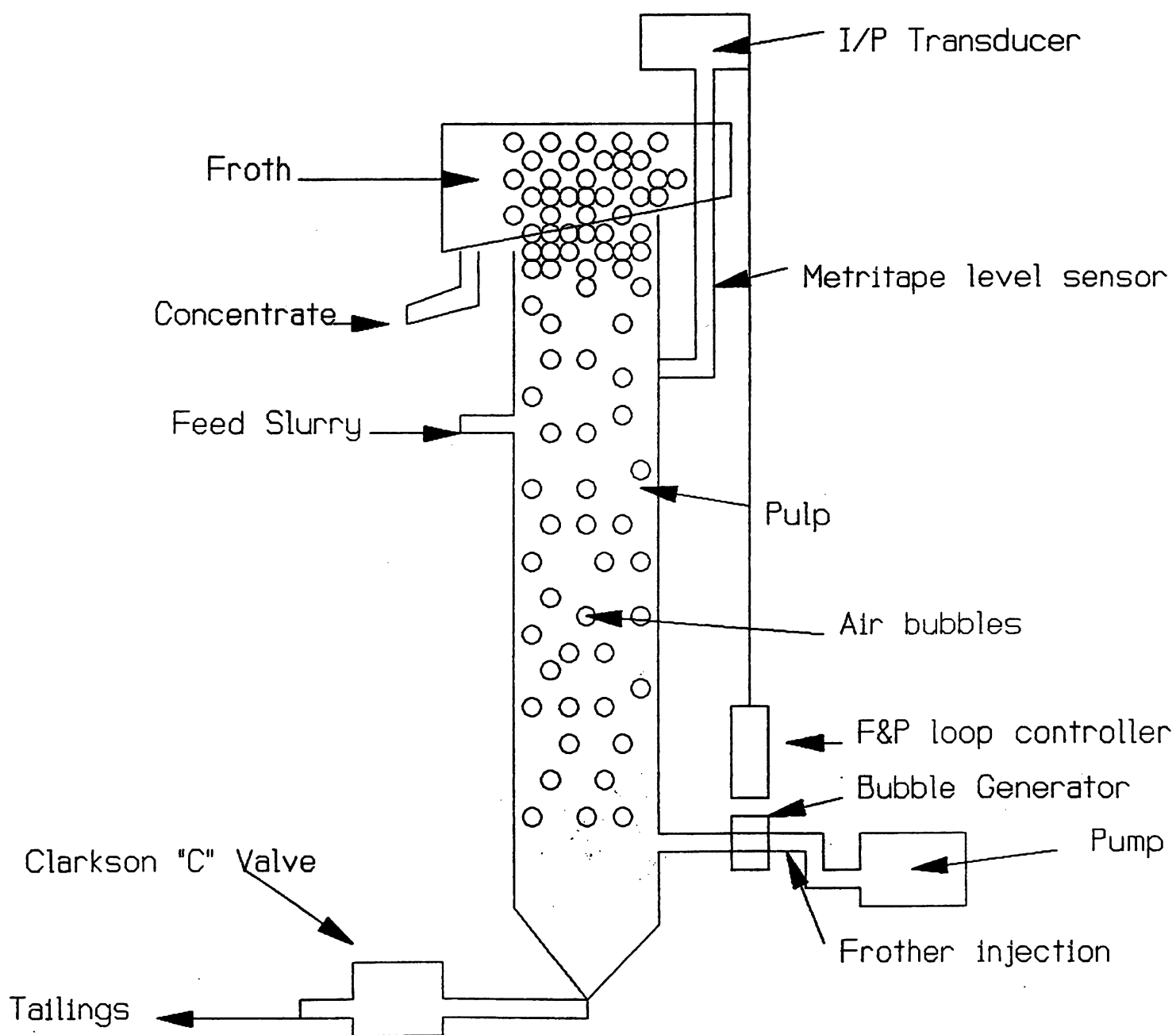
Future tests will utilize reagents manufactured by KERLEY CHEMICAL COMPANY, SHEREX CHEMICAL COMPANY, INC., and LUBRIZOL CORPORATION which will determine the optimum reagent and dosage to achieve maximum gold recovery from the Merrill Crator material.

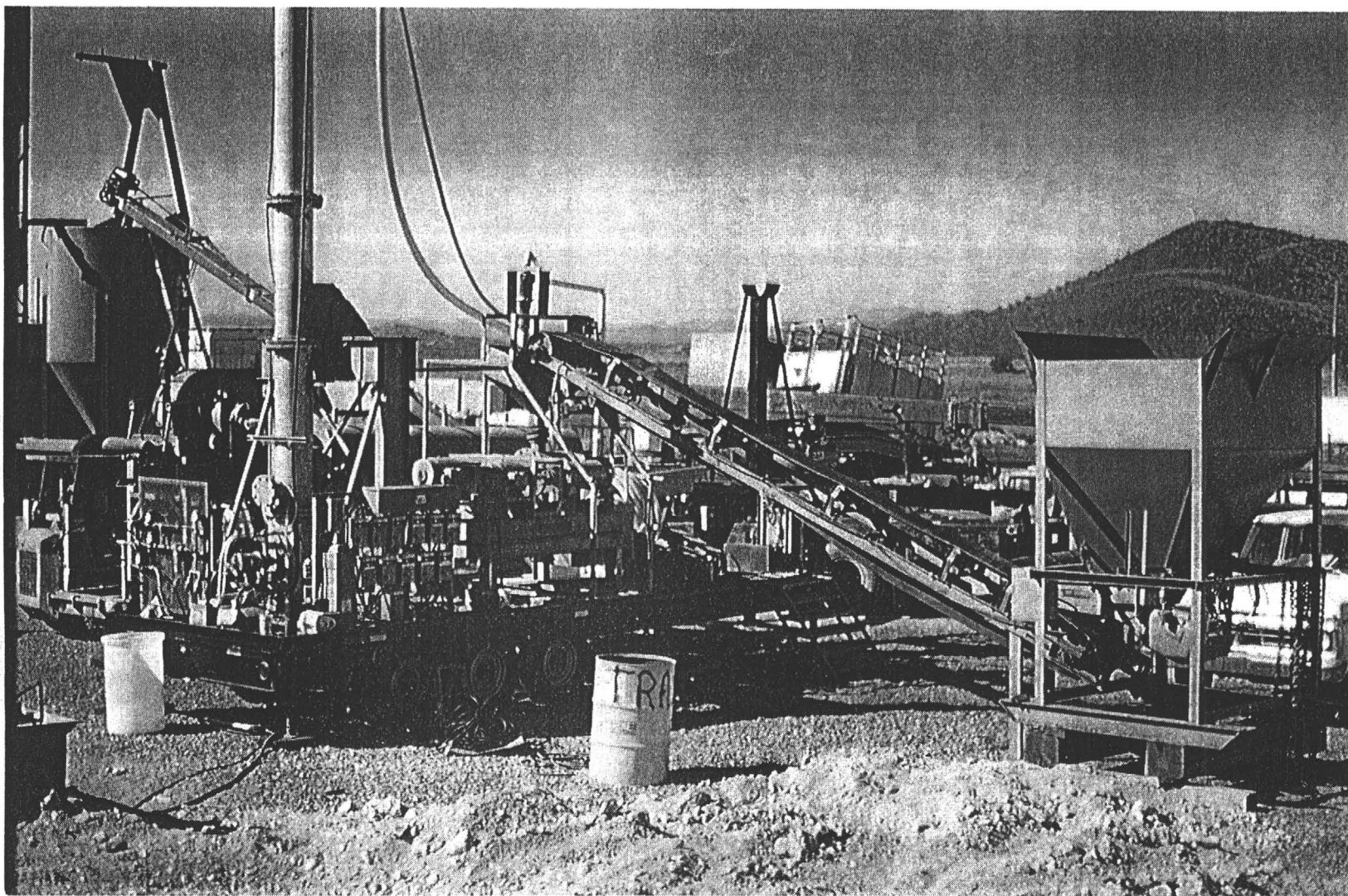
Respectfully submitted,



John O. Rud
Geologist, M.Sc.
December 12, 1994

Schematic diagram of a flotation column





**BULK SAMPLING AND COLUMN FLOTATION
OF THE
MERRILL CRATOR VOLCANICLASTIC DEPOSIT**

for

***Mariah International Inc.
Phoenix, Arizona***

by

**John O. Rud
Geologist, M.Sc.**

November 23, 1992

TABLE OF CONTENTS

	<u>page</u>
Introduction	1
Location	1
Access	2
Geology	2
Flotation	3
Column Flotation	4
Flotation Reagents	5
Bulk Test Procedure	6
Test Results	7
Conclusions	10

Map 1

BULK SAMPLING OF THE MERRILL CRATER by COLUMN FLOTATION

INTRODUCTION

During September, 1992 Mariah International Inc. initiated and completed a bulk sampling program on the Merrill Crator. The material was removed from the crator along the access road and a trench located within the vent area of the cone. The material was fed into a vibratory ball mill, ground, and concentrated by column flotation.

The objectives of the program was to determine the average grade of gold occurring in this area of the cone and the percentage of gold recovery that could be attained by utilizing column flotation.

LOCATION

The Merrill Crator is located 22 miles east of Flagstaff, Arizona within Township 21 North, Range 11 East, Sections 7 & 12. The Crator can be easily observed when traveling east from Flagstaff, Arizona and is considered to be one of the larger deposits of volcanoclastic material in the San Franciscan volcanic field.

ACCESS

Access to the Merrill Crator is provided by traveling east on Interstate 40 to the Winona Interchange, then 6 miles east on the north frontage road (formerly the Route 66 highway) to the Angell railroad crossing, then north to the east base of the crator.

GEOLOGY

The Merrill cinder cone is within the Merriam Age strata which is approximately 50,000 years old. The composition of the cinders consists of aphanitic alkali olivine basalt. Phenocrysts of hypersthene, clinopyroxene, plagioclase, and olivine a few millimeters in size, are surrounded by a very fine groundmass of highly oxidized material.

Cummings (Cummings, D., 1972, Mafic and Ultramafic Inclusion, Crator 160, San Francisco Volcanic Field, Arizona, U.S. Geol. Survey Prof. Paper 800B,) conducted an extensive study of the Crator 160 cinder cone. Although, Crator 160 is older than the Merriam Crator it occurs within the same volcanic event and therefore, will have the same compositional and textural features because of the similar geologic conditions.

Cummings states: "The cinders are aphanitic to porphyritic vesicular olivine basalt. They are characteristically reddish brown (hematite stained) on weathered surfaces and dark gray on fresh surfaces. Most cinders are rounded and show some evidence of aerodynamic shaping. The cinders and cinder beds are generally welded, so they were probably partly molten

when deposited. The bombs overlying the plagonite tuff range in size from 0.3 to 1.5 m. Many are almond shaped, and some of the larger bombs are broken."

Cummings also states " Opaque minerals include chromite, magnetite, and ilmenite.----Hematite, an alteration product, surrounds grains of magnetite, ilmenite, and augite. -----Crator 160 has abnormally high concentration of Ba, Sr, Rb, Ni, and Cr; high concentrations of Cu, Zr, and V; and low concentration of Y, compared with median concentrations of tholeiites and basalts. High concentrations of Ni, Cr, V, and Cu are characteristic of mafic rocks; high concentrations of Ba, Sr, Rb, and Zr, felsic rocks.

The high concentrations of Ba, Sr, Rb, and Zr may indicate contamination from basement granites and other felsic rocks. If the magma incorporated basement material, then assimilation must have been considerable in order to approach (or even exceed, as for Ba and Sr) the element abundances in granite."

FLOTATION

Froth flotation is considered to be the most widely used method for ore beneficiation. In ore beneficiation, flotation is a process in which valuable minerals are separated from worthless material or other valuable minerals by inducing them to gather in and on the surface of a froth layer. Sulphide and non-sulfide minerals as well as native metals are recovered by froth flotation.

This process is based on the ability of certain chemicals to modify the surface properties of the minerals. Other chemicals are used to generate the froth and still others are used to adjust the pH. Certain chemicals are capable of depressing the flotation of minerals that are either to be recovered at a later time or are not to be recovered.

The process of froth flotation entails crushing and grinding the ore to a fine size. This fine grinding separates the individual mineral particles from the waste rock and other mineral particles. The grinding is normally done in water with the resultant slurry call the "pulp". The pulp is processed in the column or conventional flotation cells which agitates the mixture and introduces air as small bubbles.

The ability of a mineral to float depends upon its surface properties. Chemical modification of these properties enables the mineral particles to attach to an air bubble in the column flotation cell. The air bubble and mineral particle rise through the pulp to the surface of the froth or foam that is present on the column flotation cell. Even though the air bubbles often break at this point, the mineral remains of the surface of the froth. The mineral is physically separate from the remaining pulp material and is removed for further processing.

COLUMN FLOTATION

Based on pilot concentration tests conducted by Deister Concentrator Co., Inc. test facility located in Tucson, Arizona a column flotation method of gold

recovery was selected. Column flotation advantages over conventional flotation include:

- Improved grade/recovery relationships.
- Superior process control through improved instrumentation.
- Lower capital costs.
- Lower operating costs.

The flotation column main characteristic is its ability to eliminate gangue entrainment in the concentrate. This is accomplished by introducing the feed one third down the column and is distributed evenly. The slurry then travels down the column counter-currently to a rising stream of bubbles which are produced in a sparging device. Particles which collide and attach to the bubbles are carried up the column, eventually reaching the interface between the pulp or collection zone and the froth zone. The froth zone is primarily gas with solids and liquid in the lamella between the bubbles. Washwater, which is added at the top of the column, filter down through this bed and washes the froth of entrained particles.

FLOTATION REAGENTS

A 200 pound sample was submitted to Deister Concentration Co., Inc., laboratory in Tucson for the initial column flotation testing. It was determined during this pilot test Kerley Mining Inc. KI 444 frother and KI 1 Sodium Isopropyl Xanthate collector would be suitable for this ore.

FROTHERS are liquids that produce the froth or foam on which the flotation process depends. The froth resembles soap suds and provides the physical

separation between the minerals floated and the pulp containing the waste. The froth must be strong enough to support the weight of the mineral floated and yet not be tenacious and non-flowing. It should have the tendency to break down when removed from the column flotation cell. The frother should not enhance the flotation of unwanted material.

COLLECTORS are chemicals which attaches to the mineral surface and produce a hydrophobic (water fearing) surface. While certain minerals are naturally hydrophobic and do not require a collector, recovery is often improved when a collector is used. The water repellent film facilitates the attachment of the mineral particle to the air bubble. Many different chemicals are used as collectors. Oils, xanthates, dithiophosphates, petroleum sulfonates, and fatty amines are examples.

BULK TEST PROCEDURE

Previous sampling of the Merrill Crator indicated the material contained gold in the .06 to .17 oz/ton range. Ore processing consisted of removing the oversized material (+1 inch) by screening. The minus 1 inch material was then loaded into a 10 ton feed hopper equipped with a variable speed drive belt. The material was then fed into the General Dynamics vibratory mill at a 1,000 pounds per hour feed rate. The grind was controlled by a discharge grate with the undersized material flowing into a sump equipped with a 2 inch SRL pump. The material was then pumped into the 6 inch x 23 ft. Deister flotation column with the froth concentrate deslimed in a 2 inch Krebs cone and the tails discharged into a tailing sump.

TEST RESULTS

A 21 ton sample (Sample # 1) was removed from the first drill road switchback near the valley floor. The road cut shows a soil zone of 16 inches in thickness which may have diluted the gold values in the sample removed.

FLOTATION PARAMETERS

Gold Head Grade	.05 oz/ton
Gold Concentrate Grade	121.35 oz/ton
Gold Tails Grade	.01 oz/ton
Percentage solids in pulp	23%
Washwater Feed Rate	4 gallons per minute
Frother KI 444	10cc/min
Collector KI 11	80cc/min
pH	Natural
Concentration Ratio	3.035
Recovery	80.1%

A 24 ton sample (Sample # 2) was removed between switchbacks 2 & 3. The material showed a layering and sorting effect during deposition. Near the surface hematite staining of the groundmass was evident.

FLOTATION PARAMETERS

Gold Head Grade	.11 oz/ton
Gold Concentrate Grade	158 oz/ton
Gold Tails Grade	.03 oz/ton
Percentage solids in pulp	20 %
Washwater feed rate	5 gallons/minute
Frother KI 444	12cc/min

Collector KI 11	100cc/min
pH	Natural
Concentration ratio	1.995
Recovery	72.4%

A 20 ton sample (Sample # 3) was removed from the area between switchback # 1 and the vent area. The road cut averages about 6 feet in high and is a composite of fresh volcanoclastic material.

FLOTATION PARAMETERS

Gold Head Grade	.66 oz/ton
Gold Concentrate Grade	357 oz/ton
Gold Tails Grade	217 oz/ton
Percentage solids in pulp	20%
Washwater feed rate	5 gallon per minute
Frother KI 444	10 cc/min
Collector KI 11	100 cc/min
pH	Natural
Concentration Ratio	811
Recovery	67%

A 25 ton sample (Sample # 4) was removed from the vent area trench. The trench is approximately 15 feet deep, 12 feet wide and 25 feet long. The area is composited entirely of volcanoclastic material with visible sulphides within the vugs of the material.

FLOTATION PARAMETERS

Gold Head Grade	1.44 oz/ton
Gold Concentrate Grade	389 oz/ton
Gold Tails Grade	.372 oz/ton

Percentage solids in pulp	20%
Washwater feed rate	5 gallons per minute
Frother KI 444	15 cc/min
Collector KI 11	120 cc/min
pH	Natural
Concentration Ratio	364
Recovery	74%

Sample # 5 was a composite of the material hauled down from the Merrill Crator. The 34 tons of material was removed from the 4 stockpiles, mixed thoroughly and loaded in the feed hopper. It is expected this sample represents the material that is exposed on the north side of the Merrill Crator.

FLOTATION PARAMETERS

Gold Head Grade	.14 oz/ton
Gold Concentrate Grade	219 oz/ton
Gold Tails Grade	.041 oz/ton
Percentage solids in pulp	20%
Washwater feed rate	5 gallons per minute
Frother KI 444	12 cc/min
Collector KI 11	100 cc/min
pH	Natural
Concentration Ratio	2,190
Recovery	70%

CONCLUSIONS

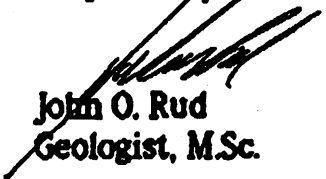
The 114 ton bulk column flotation sampling program produced 104 pounds of concentrate. A one pound sample of the material was then submitted to David H. Fell & Company, Inc., a gold refiner located in City of Commerce, California, for a projected gold recovery analysis. Mr. Larry Fell, Refinery Manager, reported that the concentrate contained 256 ounces of gold per ton. On November 5th, a 47.5 pound sample was then shipped to the refiner for processing. Completion date is projected to be November 25, 1992.

The area selected for sampling is located on the north side of the Merrill Crator. The reasons for this selection was the existence of a drill road which provided excellent exposures of material exceeding 20 feet in depth and good access to the excavated trench located in the vent area of the crator. The physical dimensions of the sample area depicted on Map #1 are 2,000 feet in a east-west direction, 3,000 feet in a north-south direction, with a average sample depth of 20 feet. Utilizing a 22 cubic feet per ton factor this area contains 5.5 millions tons of volcanicastic material.

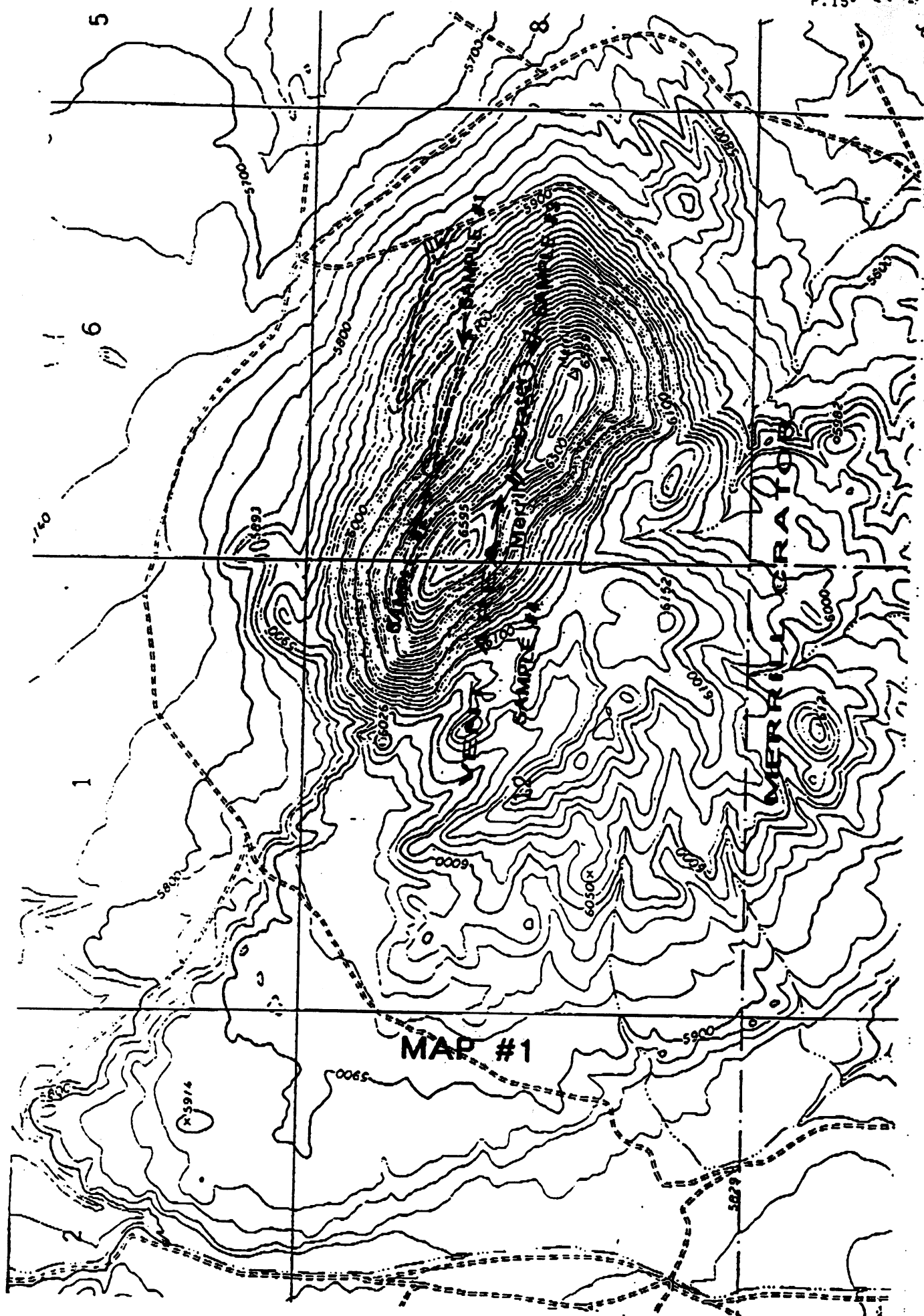
The composite sample taken from the north side of the crator indicates an average gold content of .142 ounces per ton with a recovery potential of 70.4 percent. Therefore, the average recoverable grade of gold within the sample area is projected to be .09 ounces per ton. It is expected that the recovery

percentage will increase during production due to increased efficiency in the grinding circuit and the fine tuning of the concentration circuit that occurs during the normal operations of a gold concentrating facility.

Respectfully submitted,



John O. Rud
Geologist, M.Sc.





DAVID H. FELL
& COMPANY, INC.
6009 Bandini Boulevard
City of Commerce, CA 90040
(213) 722-9992 • FAX (213) 722-6567

DATE: 11/25/92

INVOICE: 4441

NAME: MARIAH INTERNATIONAL INC.
ADDRESS: 2221 W. MELINDA

w/c

CODE: M130005

JOB#: 24067

PHOENIX , AZ 85027

DUE DATE: 11/25/92

MATERIAL	WEIGHT RECD	GOLD	SILVER	PLATINUM	PALLADIUM	OTHER
CONCENTRATES	45.000 N/P	5.317	0.000	0.000	0.000	0.000
REFINED WEIGHT IN TOZ.-- TOTALS:		5.317	0.000	0.000	0.000	0.000

C H A R G E S					
REFINING: GOLD \$	50.00	RETURNING: GOLD \$	4.67	ALLOYING \$	0.00
PLATINUM \$	0.00	PLATINUM \$	0.00	SAMPLING \$	67.50
PALLADIUM \$	0.00	PALLADIUM \$	0.00	BAR CHARGE \$	5.00
SILVER \$	0.00	SILVER \$	0.00		0.00
\$	0.00	SMELTING \$	0.00	TOTAL	127.17

5.317 TOZ		GOLD RECOVERED	
- 0.266 TOZ	5.000%	RECOVERY FEE	
- 0.380 TOZ		TOTAL CHARGES \$127.17	
4.671 TOZ		FINE GOLD BAR RETURNED	

\$ 127.17 CASH

TOTAL \$ 0.00

REC'D BY:

GOLD RECOVERY

FROM

PYROCLASTIC SCORIA

1987 - 1993

MARIAET INTERNATIONAL, INC.

May 1, 1993

TO: LON DORSAY, PRESIDENT

FROM: R.A. CAMPBELL, VICE PRESIDENT

RE: RESULTS FROM THE RECOVERY OF PRECIOUS METALS FROM CINDER
CONE DEPOSITS FROM 1987 TO THE PRESENT.

Dear Lon,

The following is a list of a few professional mining institutions and individuals along with their reports that have recovered gold in cinder deposits located in Northern Arizona over the past six years.

1. Colorado School of Mines (Sept. 1987) Dr. Baki Yarar
2. Davy McKee Corporation (Oct. 1987) Geo. H. Mellor, Sr. Process Engineer
3. Dr. Thomas Henrie (Mar. 1988 and Sept. 1989)
4. Dr. Jan Miller (Jan. 1989)
5. Dr. Ronald Atwood (July 1989 and Oct. 1989)
6. Fred L. Kircher (March 1988)
7. Western Technologies, Phoenix, AZ (Oct. 1989)
8. Dr. W.J. Guay (Oct. 1990 and Jan. 1991)
9. Abstract of disclosure and inventor report
10. John Rud, M.Sc. (Feb. 1992)
11. John Rud, M.Sc. (Nov. 1992)
12. David H. Fell Company (Nov. 1992, Jan. 1993)
13. Jacobs Assay Laboratory (June 1992)
14. John Rud - Resume
15. Deister Concentrator Co.- Report (Dec. 1992)

4500 SOUTH LAKESHORE DRIVE
SUITE 490
TEMPE, ARIZONA 85282
602. 820. 2092
602. 820. 4584 FAX



Davy McKee Corporation

2303 Camino Ramon
P.O. Box 5500
San Ramon, CA 94583
Tel.: (415) 866-1166
Telex: 470670

October 8, 1987

Mr. Floyd Bleak
1661 East Camelback
Suite 250
Phoenix, AZ 85016

Dear Mr. Bleak,

I take this opportunity to inform you of the analyses of the five samples which I took during my visit of July 28, 1987 to the Flagstaff, Arizona, Scorified Basalt Deposit.

The samples were prepared in Reno and sent to P&M Laboratories, Lancaster, CA, for analysis. Here, each sample was fused with sodium peroxide and the residue digested in nitric acid. From this solution, silver was precipitated as the chloride, gold precipitated with zinc dust and platinum and palladium determined on the A.A. The results of the analysis are as follows:

Chemical Analyses Oz/Ton

Sample I.D	Ag	Au	Pt	Pd
8-1-A	1.15	0.09	.01	trace
8-2-A	1.20	0.09	.01	trace
8-3-A	1.14	.14	.02	trace
8-4-A	2.88	.12	.02	trace
8-5-A	2.87	.09	.01	ND

Please remember, these samples were taken from the surface of the deposit and that the chemical analyses are by one laboratory only. If the analyses can be verified, then the gold reported in these samples has sufficient merit to justify further exploration work to determine the extent and variation in grade of the ore body.

I trust these results are encouraging and await your reaction.

Kind regards,

DMC ENGINEERS AND CONSTRUCTORS
A Division of Davy McKee Corporation

George

George H. Mallor
Senior Process Engineer

Enclosure

50 South Main, Suite 975 / Salt Lake City, Utah 84144 / (801) 531-6877

March 29, 1988

Board of Directors
Mariah International, Inc.
Valley Bank Plaza, 14th Floor
300 South Fourth Street
Las Vegas, Nevada 89101

Re: Sheep Hill Project

Gentlemen:

This report shall serve as an update of the report given to you on February 2, 1988.

Since that date various additional samples taken from the Sheep Hill mine (which may or may not reflect values on the property as a whole) have been fire assayed. In addition, various leach tests have been conducted on these samples. Both the fire assays and the leach tests have shown consistent levels of at least .75 ounces of recoverable gold per ton.

As a result of the further metallurgical testing that has been conducted, and with the aid of Wrethal Spendlove, I have developed a flow sheet for a mill. Utilizing an innovative, yet sound, metallurgical recovery process, it is my opinion that this mill can produce significant quantities of gold and silver in a cost-effective manner, if the quality of ore in the projected reserves remains consistent with the levels demonstrated in the aforementioned paragraph.

Sincerely,



Thomas A. Henrie, PhD
Project Consultant

TAH/mb

REPORT TO: Lynn Burr
FROM: Thomas A. Henrie
RE: Mariah International
DATE: 19 September 1989

As you know, the tests conducted at the pilot plant operation at Flagstaff and Oatman, Arizona have been completed and have been reasonably successful. All phases of gold and silver extraction from the samples of volcanic ash at Sheephill have been demonstrated. The strengths and weaknesses of the process technologies and equipment have been delineated. We have studied in both the laboratory and on pilot plant scale for the recovery of the precious metals from leach solutions.

The most effective system appears to be carbon adsorption. Normally a multi-stage system is used for carbon adsorption of precious metals from pregnant solutions. We were only prepared to use a single-stage reactor. We were not able to collect the majority of gold from the solution on the carbon, but samples of the carbon assayed significant loading. A system was not available to strip the gold from the carbon. As a result, we have been limited to assay results to determine gold values.

In the laboratory we also subjected a sample of loaded carbon to a standard stripping technique and have concluded that there are quantities of gold adsorbed to the carbon.

Our studies suggest that with the re-design of the carbon adsorption unit, the gold values from pregnant leach solutions can be effectively recovered.

RECEIVED JAN - 3 1989

J. D. Miller
1886 Atkin Avenue
Salt Lake City, UT 84106
December 28, 1988

Mr. Floyd Bleak, Vice President
Mariah Guildmark Joint Venture
5650 North Dodge Avenue
Flagstaff, Arizona 86004

Dear Mr. Bleak:

At the request of Mr. Lynn Burr I visited and reviewed the Flagstaff pilot plant operations of Mariah Guildmark on December 20, 1988. During this trip I had opportunity to tour and examine the Sheep Hill mine site, the leaching plant operations and the recovery circuit. The process/analytical development is a courageous effort in view of the many negative reports on the presence of gold in Arizona cinder cones. I was impressed with all phases of the rather large pilot operation and particularly so when it was reported to me that the operation had been assembled in about three months at a total cost of less than one million dollars - clearly excellent value for invested capital. The process is metallurgically sound.

During my tour of plant operations I supervised the sampling of the pregnant leach solution at 10:20 am and then returned to the analytical laboratory to supervise analysis of the sample. The analytical procedure was reviewed and found to be sound. A 150 ml sample of the pregnant leach solution ultimately yielded a 25 mg bead upon cupellation. A blank solution was run simultaneously for control (no bead of any significance was recovered from the control sample). The 25 mg bead recovered from the 150 ml sample of the pregnant leach solution was taken to Salt Lake City where it was analyzed and found to contain at least 20% gold.

In my opinion this metallurgical pilot plant effort at Sheep Hill under the direction of Dr. T. Henrie has demonstrated what appears to be an important technological breakthrough in the processing of refractory gold ores. Of course process economics must be evaluated and confirmed but at this time I expect the operation to be quite successful.

In conclusion, I should say that the staff cooperated with me fully and answered all questions regarding process details and analytical procedures.

Sincerely,

A handwritten signature in dark ink, appearing to be 'JDM', written over a horizontal line.

J. D. Miller
Professor of Metallurgy

c.c. J. L. Burr

BIOGRAPHICAL SKETCH

J. D. Miller received his B.S. degree, graduating with Distinction, from the Pennsylvania State University. His graduate degrees (M.S. and Ph.D.) in Metallurgical Engineering were earned at the Colorado School of Mines. Dr. Miller, who has been a research engineer with the Anaconda Company and at the Lawrence Livermore Laboratories as well as a consultant to industry and government agencies, joined the Metallurgy and Metallurgical Engineering faculty at the University of Utah in 1968 and currently holds the rank of Professor. In addition, he is the Director of the USBM Generic Center on Comminution and is the Associate Director of the Center for Advanced Coal Technology. He has been actively involved in research on the processing of coal and mineral resources. He has received the departmental teaching excellence award on two occasions and is well known for his numerous technical contributions in the areas of coal preparation, mineral processing, and hydrometallurgy. Recently his research activities have been directed toward gold recovery from alkaline cyanide solutions, advanced coal flotation technology, liberation analysis by x-ray computed tomography, and the development of the air-sparged hydrocyclone for fast flotation in a centrifugal field. He serves on the editorial boards of several technical journals, including Coal Preparation, International Journal of Mineral Processing, Hydrometallurgy, and Solvent Extraction and Ion Exchange.

Professor Miller has been presented the Marcus A. Grossman Award by The Metallurgical Society and the American Society for Metals for his significant hydrometallurgy research in the area of cementation reactions and is the eleventh recipient of the Van Diest Gold Medal given periodically by the Colorado School of Mines to alumni who have distinguished themselves in the mineral industry. Tar sand research contributions under his supervision were recognized with the Taggart Award of SME in 1986, and he was selected as an AIME Henry Krumb Lecturer for 1987. Dr. Miller is a member of American Chemical Society, Fine Particle Society, The Metallurgical Society and the Society of Mining Engineers. He has served on the SME Board of Directors and is a Past-Chairman of the Mineral Processing Division of SME. Recognition during the past year includes:

Stefanko Award, Coal Division, Society of Mining Engineers, 1988 - best paper award for research on the selective flotation of fossil resins.

Extractive Metallurgy Technology Award, The Metallurgical Society, 1988 - best paper award for research on the solvation extraction of gold from alkaline cyanide solutions.

Mr D. Newell

5 July 1989

Dear Doug:

This letter is to report my activities of last week and the progress made to define a gold/silver recovery process for Mariah.

On monday Tom Henry and myself went to Flagstaff to:

- A. Supervise the loading of "ore" to be trucked to Oatman for processing, and
- B. Initiate the repairs to the Merrill-Crowe plant.

With this accomplished we went to Oatman.

On Tuesday ore was loaded into the "reactor". There was some ore in the system that would not discharge. There was solution in the system from previous tests. These conditions coupled with the impossibility of weighing ore into the system prevents a mass balance. However, a lab test conducted by Tom and Red did put approximately one ounce of gold into cyanide solution per ton of solids.

The solution generated in the plant contained 1.6 opt gold and approximately three opt silver.

The Merrill-Crowe plant was set in place and operated for a very short time. The flow meter was inoperative (due to a blown transformer and rectifier). The float valves to control levels in the degassing tower and the pregnant solution tank have become inoperative which made solution flow control tricky and flow rates limited. The zinc feeder was totally inoperative and was replaced with a spoon and a timed "feeding". It quickly became apparent that the product pump seals were completely shot and needed to be replaced. To this end, on Wednesday Tom was returned to Provo and I came to Salt Lake City where I knew I could obtain parts, which I did.

On Thursday I returned to Oatman, the pump was reassembled and the system restarted.

During the time required for maintenance of the pump the pregnant solution was reassayed and found to still contain 1.6 opt gold. As expected gold is stable in cyanide solutions.

The Merrill-Crowe plant was started and operated for about one hour at an estimated 12 gpm (as opposed to 40 gpm of design). The vacuum was 18 to 19 in Hg (a good range).

Shortly into the run the coupling between the feed pump and motor started to fail. After a hour the solution that could be fed into the Merrill-Crowe plant was depleted and the plant was shut down.

Two samples of barren solution were assayed and were found to be barren of both gold and silver.

The product filters were opened and the precipitate (PPT) removed. It was observed that the filter papers in the product press had ruptured due to corrosion of the filter plates. This would result in the loss of PPT

The precipitate was collected, treated with sulfuric acid, fluxed, and a test melt was poured. The slag was extremity fluid (which is good) and the metal was soft and white (which indicates a high silver and gold content and very low copper content, which is good).

The remainder of the precipitate was being melted when I left (after a 20 hour day). A portion of the test button had been parted and exposed the black unannealed gold. The parted gold could not be weighed due to the insensitively of the balance at Oatman and could not be annealed because the furnace was too hot due the melting of the remaining PPT.

I can now conclude:

- A. Sheep Hill fines can be processed for gold and silver when
- B. they have been subjected to enough hypochlorite and
- C. leached with cyanide.
- D. The values can readily be recovered from the cyanide solutions with the proper application of the Merrill-Crowe process.
- E. Though the Sheep Hill deposit has not been evaluated in detail the fines appear to yield one opt gold and three opt silver.

I will be glad to discuss this information with you in detail at your request.

Sincerely

Ronald L Atwood

cc: J.D. Miller
filedas dn1.apr

TRANSMITTED FROM 801 584 3010

10.27.89 16:06 P.01 ALP SYSTEMS

ADVANCED PROCESSING TECHNOLOGIES, INC

Ronald Atwood, Ph.D.
President

285 Chipeta Way, MS 10124
University of Utah Research Park
Salt Lake City, Utah 84108

Telephone
(801) 584-3013
Fax
(801) 684-3010

Memo

27 October 1989

Via FAX
One (1) Page

To: N.C. Barry
From: R.L. Atwood
Subject: CINDER CONE PROCESS EVALUATION

As you requested I have investigated the proposed cinder cone process which is being by a group you represent.

One sample, represented to be a process intermediate, was given to me. This sample was assayed by a reputable fire assayer using conventual techniques. The results showed a significant quantity of gold.

The gold producing process appears to be developed enough that I would consider it to have a reasonable chance of being noncommercially successful. This is not to say that the process has been optimized or adapted to any given ore.

If you have any questions please feel free to call me.

RLA

Ronald L Atwood

filedae nb17.apt

We specialize in the separation, analysis and refining of precious metals

Kircher Ore & Refining Co.

ORE ANALYSES & CONSULTING

4750 Andrews Road
Medford, Oregon 97501
PHONE (503) 773-5775

F. L. KIRCHER, President
B. S., Mich. S. U. 1946

J. R. KIRCHER, Vice-Pres.
Jrny. Ore Analyst
1975-1980

S. J. KIRCHER, Sec.-Treas.
B.S., Mich. S. U. 1970

ASSAY REPORT

Mar. 29, 1988

Submitted by: Mariah International, Inc.

Address: 1701 W. Charleston, Suite 510

Las Vegas, Nevada 89102

I hereby certify that the sample(s) described below assay as follows:

Mine	Arizona Areas I, see page 4.			
Owner's Mark	Bl. C.	U. Rd.	L. Rd.	S. Bl
Gold, oz./ton	.26	.22	.24	.25
Platinum, oz./ton	.35	.25	.29	.30
Palladium, oz./ton	.07	.049	.069	.60
Rhodium, oz./ton	.011	.008	.010	.009
Iridium, oz./ton	tr.	tr.	tr.	tr.
Silver, oz./ton	.04	.041	.044	.07
Copper, %	.0124	.0082	.0056	.0077
Cobalt, %	.0033	.0026	.0016	.0024
Nickel, %	.0229	.0159	.0110	.0152
Sodium, %	.439	.0201	.145	.142
Potassium, %	.222	.0537	.0210	.0327
Iron, % (acid sol.)	4.49	3.89	1.56	5.83
Manganese, %	.0371	.0287	.0156	.0334
Magnesium, %	4.21	3.08	1.757	3.62
Calcium, %	.93	.37	.31	.30
Sulfur, %	>.1	>.1	>.1	>.1
*\$Worth/ton	\$307	\$234	\$268	\$275

All elements are determined by total wet-chemistry analysis.

*Gold,	\$ 450	per oz. (refiner's grade).
Platinum,	\$ 500	per oz. " "
Palladium,	\$ 130	per oz. " "
Rhodium,	\$ 500	per oz. " "

Fee: \$600

Fred L. Kircher

Fred L. Kircher, Metallurgical Chemist

Kircher Ore & Refining Co.

ORE ANALYSES & CONSULTING

4750 Andrews Road
Medford, Oregon 97501
PHONE (503) 773-5775

F. L. KIRCHER, President
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Jrny. Ore Analyst
1975-1980

S. J. KIRCHER, Sec.-Treas.
B.S., Mich. S. U. 1970

ASSAY REPORT

Mar. 29, 1988

Submitted by: Mariah International, Inc.

Address: 1701 W. Charleston, Suite 510

Las Vegas, Nevada 89102

I hereby certify that the sample(s) described below assay as follows:

Mine	Area II	Area III
Owner's Mark	Hill Sd.	Fines
Gold, oz./ton	.16	.20
Platinum, oz./ton	.15	.193
Palladium, oz./ton	.002	.035
Rhodium, oz./ton	.0036	.006
Iridium, oz./ton	tr.	tr.
Silver, oz./ton	.07	.085
Copper, %	.0126	.0077
Cobalt, %	.0021	.0030
Nickel, %	.0241	.0142
Sodium, %	.314	.280
Potassium, %	.0618	.443
Iron, % (acid sol.)	1.93	3.38
Manganese, %	.0188	.0366
Magnesium, %	3.08	3.38
Calcium, %	.29	.42
Sulfur, %	>.1	>.1
*\$Worth/ton	\$152	\$195

All elements are determined by total wet-chemistry analysis.

*Gold,	\$ 450	per oz. (refiner's grade).
Platinum,	\$ 500	per oz. " "
Palladium,	\$ 130	per oz. " "
Rhodium,	\$ 500	per oz. " "

Fee: \$300


Fred L. Kircher, Metallurgical Chemist

2. Observations

- A. The precious metal values found in the subject ores are acceptable, if they can be economically isolated.
- B. The subject ores pulverized fair. If required for production, it could produce wear on equipment and raise power consumption.
- C. All of the elements readily dissolved in the total wet-chemistry process which indicates ease of extraction from the raw ore and refining of the subsequent concentrate should the precious metals in the ores not be amenable to physical concentration.
- D. The copper, cobalt, nickel, manganese, iron, sodium and magnesium are relatively low with respect to leachant consumption should the subject ores be mass-leached.
- E. These low calcium content ores will not require sequestering if the ore would be mass-leached by organic leach processes.

Microscopic-metallurgical Examination of The Ores

The following ores were personally acquired by Mr. Robert Alvarez and the writer in the presence of the Mariah International, Inc. Vice President and submitted to KORC for a microscopic, mineralogical examination and evaluation on September 12, 1987. Four representative samples with respect to depth and mineralization were obtained from Area I, a composite sample was obtained from the hillside of Area II and as previously mentioned, a random sample was procured from Area III. These ores were evaluated by the writer, under the microscope at 100 X power, to determine the presence of precious metals and any other significant minerals and elements that may be of importance with respect to possible future processing parameters.

1. Black Cinders: This lava sample from Area I was obtained one through three feet underneath the exposed surface from the middle of the broad slope that has been opened with a front-end "ripper". It is entirely black in color with a honey-combed appearance on the outside but with a solid fused core in the middle of each ore specimen. This material is actually very light in density and is generally termed as lava ash or cinders. However, there is definite secondary enrichment as shown by the many elements found by the previous assays as well as definite small micron (5-35) sized nodules of gold and, separate nodules of the platinum family, all encapsulated in the ore. Therefore, this ore (and the accompanying ores) would be very difficult to physically concentrate. Hereafter, these separate nodules will be referred to as precious metals, collectively.
2. Upper Red Cinders: This ore was obtained in the same manner as 1 above and is identical to item 1 above except it is a deep red color and the precious metals are of smaller particle size (1-15 microns).
3. Lower Red Cinders: This ore is identical to item 2 above.
4. Solid Black Cinder: This specimen is a large (8 inches in diameter) lavic pumice mass with a fused obsidian like core and some honeycombed tentacles on the outside perimeter. Therefore, when the upper crust of the cinders are removed from the first few feet of the subject ore, these larger pieces will represent the largest volume of the total ore claim.
5. Hillside Composite: This is a composite sample taken from the Area II hillside. It is very similar mineralogically to the lava cinders reported above. The precious metals nodules (10-50 microns) are still encapsulated in the ore.
6. Rouge Plant Fines: This sample is from the Area III rouge plant immediately east of the Flagstaff, Arizona city limits. This large rouge body was formed in a similar way as the above volcanic cinders except for its density and oxidation (exposure) by the outside elements. It too has been secondarily enriched and it contains definite small sized (1-15 microns) precious metals encapsulated in the ore.

Microscopic-metallurgical Examination of The Ores

The following ores were personally acquired by the writer with the help of a miner and Mr. Robert Graham, President of

Conclusions

1. The precious metal integrity of the ore has been proven.
2. The precious metal values are of economic consideration.

Recommendations

The writer suggested to Robert Graham and Robert Alvarez in September of 1987 how all of precious metals in the subject Arizona Volcanic Ore could be more fully, yet economically extracted. At that time, a cyanide leach was being contemplated, as was being attempted by percolation with the Minneapolis #2 ore at Oatman, Arizona. From the hard earned experience of the writer over 35 years ago, cyanide will leach very little of the gold and none of the platinum family metals in the subject volcanic ore.

As was mentioned earlier herein, the writer has successfully extracted 95% of the precious metals from the same ore from a 100 ton per day plant as early as 1952. Not only did the writer offer his services to Mr. Alvarez, but the same offer was also made in Mr. Alvarez' presence to three men, who are stockholders of Mariah International, Inc., and who had a process engineering laboratory, west of downtown Las Vegas, on September 13, 1987.

These recommendations were "tabled" as was the Value Engineering of the subject ores for the past 6 months. However, the writer was there originally under the auspices of Mr. Alvarez and felt professionally obligated to him.

Please let us hear from you on this matter soon.

Respectfully submitted,

Fred L. Kircher

Fred L. Kircher
Metallurgical Chemist
&
Mining Consultant



**WESTERN
TECHNOLOGIES
INC.**

3737 East Broadway Road
P.O. Box 21387
Phoenix, Arizona 85036
(602) 437-3737

LABORATORY REPORT

CLIENT Augustin Construction
Canyon City Milling
P.O. Box 2163
Flagstaff, AZ 86003

SAMPLE NO. : 8915056
INVOICE NO.: 22191121
DATE : 11-02-89
REVIEWED BY: *M.E.*
PAGE : 1 OF 1

CLIENT SAMPLE ID : LV
SAMPLE TYPE : Virgin Ore Sample
SAMPLE SOURCE : --
SAMPLED BY : AC/Personnel
SUBMITTED BY : AC/Personnel

AUTHORIZED BY: AC/Personnel
CLIENT P.O. : --

SAMPLE DATE : 10-05-89
SUBMITTED ON : 10-06-89

DATA TABLE

TEST

[-----] PARAMETER [-----]	[-- RESULT -]	[- UNIT -]	[DATE]
Total Arsenic	130.	mg/Kg	10-12-89
Total Barium	85.	mg/Kg	10-12-89
Total Cadmium	5.0	mg/Kg	10-12-89
Total Chromium	3.0	mg/Kg	10-12-89
Total Lead	22.	mg/Kg	10-12-89
Total Mercury	<5.0	mg/Kg	10-27-89
Total Selenium	55.	mg/Kg	10-12-89
Total Silver	<1.0	mg/Kg	10-12-89
Total Gold	<50.	mg/Kg	10-27-89



**WESTERN
TECHNOLOGIES
INC.**

3737 East Broadway Road
P.O. Box 21387
Phoenix, Arizona 85036
(602) 437-3737

LABORATORY REPORT

CLIENT Augustin Construction
Canyon City Milling
P.O. Box 2163
Flagstaff, AZ 86003

SAMPLE NO. : 8915057
INVOICE NO. : 22191121
DATE : 11-02-89
REVIEWED BY: *m.e.*
PAGE : 1 OF 1

CLIENT SAMPLE ID : KM
SAMPLE TYPE : Virgin Ore Sample
SAMPLE SOURCE : --
SAMPLED BY : AC/Personnel
SUBMITTED BY : AC/Personnel

AUTHORIZED BY: AC/Personnel
CLIENT P.O. : --

SAMPLE DATE : 10-05-89
SUBMITTED ON : 10-06-89

DATA TABLE

PARAMETER	RESULT	UNIT	TEST DATE
Total Arsenic	70.	mg/Kg	10-12-89
Total Barium	85.	mg/Kg	10-12-89
Total Cadmium	7.0	mg/Kg	10-12-89
Total Chromium	44.	mg/Kg	10-12-89
Total Lead	16.	mg/Kg	10-12-89
Total Mercury	<5.0	mg/Kg	10-27-89
Total Selenium	49.	mg/Kg	10-12-89
Total Silver	<1.0	mg/Kg	10-12-89
Total Gold	<50.	mg/Kg	10-27-89



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(602) 437-3737

LABORATORY REPORT

CLIENT Augustin Construction
Canyon City Milling
P.O. Box 2163
Flagstaff, AZ 86003

SAMPLE NO. : 8915061
INVOICE NO. : 22191121
DATE : 11-02-89
REVIEWED BY: *M.C.*
PAGE : 1 OF 1

CLIENT SAMPLE ID : #04
SAMPLE TYPE: Virgin Ore
SAMPLE SOURCE: --
SAMPLED BY: AC/Personnel
SUBMITTED BY: AC/Personnel

AUTHORIZED BY: AC/Personnel
CLIENT P.O. : --

SAMPLE DATE : 10-05-89
SUBMITTED ON : 10-06-89

* DATA TABLE *

TEST			
[-----] PARAMETER [-----]	[-- RESULT --]	[-- UNIT --]	[DATE]
Total Arsenic	390.	mg/Kg	10-12-89
Total Barium	120.	mg/Kg	10-12-89
Total Cadmium	16.	mg/Kg	10-12-89
Total Chromium	31.	mg/Kg	10-12-89
Total Lead	43.	mg/Kg	10-12-89
Total Mercury	<5.0	mg/Kg	10-27-89
Total Selenium	150.	mg/Kg	10-12-89
Total Silver	<1.0	mg/Kg	10-12-89
Total Gold	90.	mg/Kg	10-30-89
Total Platinum	70.	mg/Kg	10-27-89



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SAMPLE NO. : 8915050
INVOICE NO.: 22191121
DATE : 11-02-89
REVIEWED BY: *M.E.*
PAGE : 1 OF 1

CLIENT SAMPLE ID : #01
SAMPLE TYPE: Ore Treated
SAMPLE SOURCE: Hydrochloride
SAMPLED BY: AC/Personnel
SUBMITTED BY: AC/Personnel

AUTHORIZED BY: AC/Personnel
CLIENT P.O. : --

SAMPLE DATE ..: 10-05-89
SUBMITTED ON : 10-06-89

DATA TABLE

TEST

[-----] PARAMETER [-----]	[-- RESULT --]	[-- UNIT --]	[DATE]
Total Arsenic	440.	mg/Kg	10-12-09
Total Barium	130.	mg/Kg	10-12-89
Total Cadmium	18.	mg/Kg	10-12-89
Total Chromium	50.	mg/Kg	10-12-89
Total Lead	50.	mg/Kg	10-12-89
Total Mercury	<5.0	mg/Kg	10-27-89
Total Selenium	180.	mg/Kg	10-12-89
Total Silver	<1.0	mg/Kg	10-12-89
Total Gold	65.	mg/Kg	10-27-89



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SAMPLE NO. : 8915063
INVOICE NO. : 22191121
DATE : 11-02-89
REVIEWED BY: *M.E.*
PAGE : 1 OF 1

CLIENT SAMPLE ID : #51
SAMPLE TYPE Solution
SAMPLE SOURCE From U1 Hydrochloride
SAMPLED BY AC/Personnel
SUBMITTED BY AC/Personnel

AUTHORIZED BY: AC/Personnel
CLIENT P.O. : --

SAMPLE DATE : 10-05-89
SUBMITTED ON : 10-06-89

D A T A T A B L E

TEST

PARAMETER	RESULT	UNIT	DATE
Total Arsenic	0.19	mg/L	10-30-89
Total Barium	0.45	mg/L	10-30-89
Total Cadmium	<0.05	mg/L	10-30-89
Total Chromium	1.1	mg/L	10-30-89
Total Lead	0.13	mg/L	10-30-89
Total Mercury	0.002	mg/L	10-27-89
Total Selenium	0.15	mg/L	10-30-89
Total Silver	0.03	mg/L	10-30-89
Total Gold	<1.0	mg/L	10-27-89



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SAMPLE NO. : 8915059
INVOICE NO. : 22141121
DATE : 11-02-89
REVIEWED BY: *m.g.*
PAGE : 1 OF 1

CLIENT SAMPLE ID : #02
SAMPLE TYPE : Ore Treated
SAMPLE SOURCE : Cyanide 2# Per Ton
SAMPLED BY : AC/Personnel
SUBMITTED BY : AC/Personnel

AUTHORIZED BY: AC/Personnel
CLIENT P.O. : --

SAMPLE DATE : 10-05-89
SUBMITTED ON : 10-06-89

D A T A T A B L E

TEST

PARAMETER	RESULT	UNIT	DATE
Total Arsenic	450.	mg/Kg	10-12-89
Total Barium	130.	mg/Kg	10-12-89
Total Cadmium	10.	mg/Kg	10-12-89
Total Chromium	50.	mg/Kg	10-12-89
Total Lead	50.	mg/Kg	10-12-89
Total Mercury	<5.0	mg/Kg	10-27-89
Total Selenium	170.	mg/Kg	10-12-89
Total Silver	<1.0	mg/Kg	10-12-89
Total Gold	50.	mg/Kg	10-27-89



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SAMPLE NO. : 8915064
INVOICE NO. : 22191121
DATE : 11-02-89
REVIEWED BY: *M.E.*
PAGE : 1 OF 1

CLIENT SAMPLE ID : NS2
SAMPLE TYPE: Solution
SAMPLE SOURCE: From 02 Cyanide
SAMPLED BY: AC/Personnel
SUBMITTED BY: AC/Personnel

AUTHORIZED BY: AC/Personnel
CLIENT P.O. : --

SAMPLE DATE : 10-05-89
SUBMITTED ON : 10-06-89

D A T A T A B L E

TEST

PARAMETER	RESULT	UNIT	DATE
Total Arsenic	0.32	mg/L	10-24-89
Total Barium	0.12	mg/L	10-24-89
Total Cadmium	<0.05	mg/L	10-24-89
Total Chromium	<0.05	mg/L	10-24-89
Total Lead	<0.05	mg/L	10-24-89
Total Mercury	<0.001	mg/L	10-27-89
Total Selenium	0.07	mg/L	10-24-89
Total Silver	<0.02	mg/L	10-24-89
Total Gold	<1.0	mg/L	10-27-89



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SAMPLE NO. : 8915062
INVOICE NO. : 22191121
DATE : 11-02-89
REVIEWED BY: *m.e.*
PAGE : 1 OF 1

CLIENT SAMPLE ID : #05
SAMPLE TYPE: Ore Treated *CHC/CON*
SAMPLE SOURCE: --
SAMPLED BY: AC/Personnel
SUBMITTED BY: AC/Personnel

AUTHORIZED BY: AC/Personnel
CLIENT P.O. : --
SAMPLE DATE : 10-05-89
SUBMITTED ON : 10-06-89

D A T A T A B L E

TEST

[-----] PARAMETER [-----]	[-- RESULT -]	[-- UNIT -]	[DATE]
Total Arsenic	310.	mg/Kg	10-30-89
Total Barium	110.	mg/Kg	10-30-89
Total Cadmium	13.	mg/Kg	10-12-89
Total Chromium	55.	mg/Kg	10-30-89
Total Lead	22.	mg/Kg	10-12-89
Total Mercury	<5.0	mg/Kg	10-27-89
Total Selenium	140.	mg/Kg	10-30-89
Total Silver	<1.0	mg/Kg	10-12-89
Total Gold	95.	mg/Kg	10-30-89
Total Platinum	55.	mg/Kg	10-27-89



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P.O. Box 2163
Flagstaff, AZ 86003

SAMPLE NO. : 8915065
INVOICE NO.: 22191121
DATE : 11-02-89
REVIEWED BY: *M.E.*
PAGE : 1 OF 1

CLIENT SAMPLE ID : W55
SAMPLE TYPE: Solution
SAMPLE SOURCE: From 05 Cyanide
SAMPLED BY: AC/Personnel
SUBMITTED BY: AC/Personnel

AUTHORIZED BY: AC/Personnel
CLIENT P.O. : --

SAMPLE DATE : 10-05-89
SUBMITTED ON : 10-06-89

D A T A T A B L E

TEST

[-----] PARAMETER [-----]	[-- RESULT --]	[-- UNIT --]	[DATE]
Total Arsenic	5.6	mg/L	10-24-89
Total Barium	2.3	mg/L	10-24-89
Total Cadmium	0.20	mg/L	10-24-89
Total Chromium	0.61	mg/L	10-24-89
Total Lead	0.67	mg/L	10-24-89
Total Mercury	<0.001	mg/L	10-27-89
Total Selenium	1.9	mg/L	10-24-89
Total Silver	0.05	mg/L	10-24-89
Total Gold	<1.0	mg/L	10-27-89



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P.O. Box 2163
Flagstaff, AZ 86003

SAMPLE NO. : 8915000
INVOICE NO. : 22191121
DATE : 11-02-89
REVIEWED BY: *m.e.*
PAGE : 1 OF 1

CLIENT SAMPLE ID : 403
SAMPLE TYPE : Ore Treated Sulfuric Acid
SAMPLE SOURCE : --
SAMPLED BY : AC/Personnel
SUBMITTED BY : AC/Personnel

AUTHORIZED BY: AC/Personnel
CLIENT P.O. : --

SAMPLE DATE : 10-05-89
SUBMITTED ON : 10-06-89

D A T A T A B L E

TEST

PARAMETER	RESULT	UNIT	DATE
Total Arsenic	370.	mg/Kg	10-12-89
Total Barium	85.	mg/Kg	10-12-89
Total Cadmium	14.	mg/Kg	10-12-89
Total Chromium	50.	mg/Kg	10-12-89
Total Lead	40.	mg/Kg	10-12-89
Total Mercury	<5.0	mg/Kg	10-27-89
Total Selenium	140.	mg/Kg	10-12-89
Total Silver	<1.0	mg/Kg	10-12-89
Total Gold	<50.	mg/Kg	10-27-89



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LABORATORY REPORT

CLIENT Augustin Construction
Attn: Jim Buell
Canyon City Milling
P.O. Box 2163
Flagstaff, AZ 86003

SAMPLE NO. : 8909505
INVOICE NO.: 22191104
DATE : 09-26-89
REVIEWED BY: *M.C.*
PAGE : 1 OF 1

CLIENT SAMPLE ID : Treated
SAMPLE TYPE: Cinders
SAMPLE SOURCE: --
SAMPLED BY: AC/Personnel
SUBMITTED BY: AC/J. Buell

AUTHORIZED BY: AC/J. Buell
CLIENT P.O. : --
SAMPLE DATE .: --
SUBMITTED ON : 09-08-89

* DATA TABLE *

[-----	PARAMETER	-----]	[-- RESULT --]	[-- UNIT --]	[TEST DATE]
Total Arsenic	.....:	220.	mg/Kg	09-18-89
Total Barium	.....:	160.	mg/Kg	09-18-89
Total Cadmium	.....:	18.	mg/Kg	09-18-89
Total Chromium	.....:	44.	mg/Kg	09-18-89
Total Lead	.....:	47.	mg/Kg	09-18-89
Total Mercury	.....:	<5.0	mg/Kg	09-21-89
Total Selenium:	180.	mg/Kg	09-18-89	
Total Silver:	<2.5	mg/Kg	09-18-89	
Total Gold:	140.	mg/Kg	09-22-89	



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Attn: Jim Buell
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P.O. Box 2163
Flagstaff, AZ 86003

SAMPLE NO. : 8909505
INVOICE NO.: 22191104
DATE : 09-26-89
REVIEWED BY: M.E.
PAGE : 1 OF 2

CLIENT SAMPLE ID : Treated
SAMPLE TYPE: Cinders
SAMPLE SOURCE: --
SAMPLED BY: AC/Personnel
SUBMITTED BY: AC/J. Buell

AUTHORIZED BY: AC/J. Buell
CLIENT P.O. : --
ANALYZED ON : 09-14-89
SAMPLE DATE : --
SUBMITTED ON : 09-08-89

REMARKS -

GC/MS SOLVENT SCREEN

***** DATA TABLE *****		
[-----] PARAMETER [-----]	[- RESULT -]	[- UNIT -]
Benzene	<10.	mg/Kg
1-Butanol (N-Butyl Alcohol)	<10.	mg/Kg
2-Butanone (Methyl Ethyl Ketone)	<10.	mg/Kg
2-Butoxyethanol (Butyl Cellosolve) ...	<10.	mg/Kg
Methanol (Methyl Alcohol)	<10.	mg/Kg
Butyl Ester Acetic Acid	<10.	mg/Kg
(Butyl Acetate)	<10.	mg/Kg
Carbon Tetrachloride	<10.	mg/Kg
1,1-Dichloroethane(1,1-DCA)	<10.	mg/Kg
1,2-Dichloroethane(1,2-DCA)	<10.	mg/Kg
1,1-Dichloroethene(1,1-DCE)	<10.	mg/Kg
Trans 1,2 Dichloroethene	<10.	mg/Kg
Dichloromethane(Methylene Chloride)...	<10.	mg/Kg
Dimethylbenzenes (Xylenes)	<10.	mg/Kg
1,4-Diethylene Dioxide(Dioxane)	<10.	mg/Kg
1,2-Ethanidiol(Ethylene Glycol)	<10.	mg/Kg
Ethanol(Ethyl Alcohol)	<10.	mg/Kg
2-Ethoxyethanol(Cellosolve)	<10.	mg/Kg
2-Ethoxyethyl Acetate	<10.	mg/Kg
(Cellosolve Acetate)	<10.	mg/Kg
Ethylbenzene	<10.	mg/Kg
Ethyl Ester Acetic Acid	<10.	mg/Kg
(Ethyl Acetate)	<10.	mg/Kg
2-Methoxyethanol(Methyl Cellosolve)...	<10.	mg/Kg
Methylbenzene(Toluene)	<10.	mg/Kg
Methyl Ester Acetic Acid	<10.	mg/Kg
(Methyl Acetate)	<10.	mg/Kg

(1) Copy to Client



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LABORATORY REPORT

CLIENT Augustin Construction
Attn: Jim Buell
Canyon City Milling
P.O. Box 2163
Flagstaff, AZ 86003

SAMPLE NO. : 8909504
INVOICE NO.: 22191104
DATE : 09-26-89
REVIEWED BY: *M.C.*
PAGE : 1 OF 1

CLIENT SAMPLE ID : Virgin
SAMPLE TYPE: Cinders
SAMPLE SOURCE: --
SAMPLED BY: AC/Personnel
SUBMITTED BY: AC/J. Buell

AUTHORIZED BY: AC/J. Buell
CLIENT P.O. : --

SAMPLE DATE .: --
SUBMITTED ON : 09-08-89

* DATA TABLE *

[-----	PARAMETER	-----]	[-- RESULT --]	[-- UNIT --]	TEST [DATE]
Total Arsenic	.....:	410.	mg/Kg	09-18-89
Total Barium	.....:	150.	mg/Kg	09-18-89
Total Cadmium	.....:	17.	mg/Kg	09-18-89
Total Chromium	.....:	44.	mg/Kg	09-18-89
Total Lead	.....:	44.	mg/Kg	09-18-89
Total Mercury	.....:	<5.0	mg/Kg	09-21-89
Total Selenium:	170.	mg/Kg	09-18-89	
Total Silver:	<2.5	mg/Kg	09-18-89	
Total Gold:	130.	mg/Kg	09-22-89	



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CLIENT Augustin Construction
Attn: Jim Buell
Canyon City Milling
P.O. Box 2163
Flagstaff, AZ 86003

SAMPLE NO. : 8909504
INVOICE NO.: 22191104
DATE : 09-26-89
REVIEWED BY: *m.c.*
PAGE : 1 OF 2

CLIENT SAMPLE ID : Virgin
SAMPLE TYPE: Cinders
SAMPLE SOURCE: --
SAMPLED BY: AC/Personnel
SUBMITTED BY: AC/J. Buell

AUTHORIZED BY: AC/J. Buell
CLIENT P.O. : --
ANALYZED ON .: 09-14-89
SAMPLE DATE .: --
SUBMITTED ON : 09-08-89

REMARKS -

GC/MS SOLVENT SCREEN

* DATA TABLE *

[----- PARAMETER -----]	[- RESULT -]	[- UNIT -]
Benzene	<10.	mg/Kg
1-Butanol (N-Butyl Alcohol)	<10.	mg/Kg
2-Butanone (Methyl Ethyl Ketone)	<10.	mg/Kg
2-Butoxyethanol (Butyl Cellosolve) ..	<10.	mg/Kg
Methanol (Methyl Alcohol)	<10.	mg/Kg
Butyl Ester Acetic Acid	<10.	mg/Kg
(Butyl Acetate)		
Carbon Tetrachloride	<10.	mg/Kg
1,1-Dichloroethane(1,1-DCA)	<10.	mg/Kg
1,2-Dichloroethane(1,2-DCA)	<10.	mg/Kg
1,1-Dichloroethene(1,1-DCE)	<10.	mg/Kg
Trans 1,2 Dichloroethene	<10.	mg/Kg
Dichloromethane(Methylene Chloride)...	<10.	mg/Kg
Dimethylbenzenes (Xylenes)	<10.	mg/Kg
1,4-Diethylene Dioxide(Dioxane)	<10.	mg/Kg
1,2-Ethanidiol(Ethylene Glycol)	<10.	mg/Kg
Ethanol(Ethyl Alcohol)	<10.	mg/Kg
2-Ethoxyethanol(Cellosolve)	<10.	mg/Kg
2-Ethoxyethyl Acetate	<10.	mg/Kg
(Cellosolve Acetate)		
Ethylbenzene	<10.	mg/Kg
Ethyl Ester Acetic Acid	<10.	mg/Kg
(Ethyl Acetate)		
2-Methoxyethanol(Methyl Cellosolve)...	<10.	mg/Kg
Methylbenzene(Toluene)	<10.	mg/Kg
Methyl Ester Acetic Acid	<10.	mg/Kg
(Methyl Acetate)		

W. J. GUAY

Consulting Metallurgist

October 7, 1990

Dear Lynn:

The smelting process that you have certainly indicates a good probability that it can be developed into a viable commercial process for the extraction of gold from cinder cone material of the type you smelted on september 18, 1990 from California, called Cima ore.

My main concerns are environmental. Although the analyses we received from Western Analytical indicated that thallium, selenium, and arsenic, should pose no major problems, I believe that we must get confirmation of these values from at least one other laboratory. The analyses we received indicated less than 5 ppm Tl in all samples (furnace, feed, slag, iron nodules, and lead). The final iron product showed 60 ppm Ga (gallium). This did not interfere with your electrolytic recovery system. The iron nodules showed 0.83 and 0.81% as from Sheep Hill and Cima respectively. This can probably be removed in refining. All products showed greater than 2% boron. This would not appear to be a problem either. The lead had 0.23% selenium. Without using lead I suppose it would go with the iron nodules, but can probably be refined out of the system.

I would estimate that capital cost requirements for direct smelting of minus 1/4" ore, using silica and soda ash, equal to the weight of the ore for flux would be anywhere from \$7,000,000 to \$12,000,000 for 100 tons of ore per day, and would go to \$28,000,000 to \$47,000,000 for 1000 tons of ore per day. The best chance for reducing capital costs would be to concentrate the ore ahead of tabling, as is being done at Sheep Hill. However, I would only produce a Table concentrate, with no further concentration. Sheep Hill experience shows that at a concentration ratio of 13 to 1 (1 ton of concentrate from 13 tons of ore), the concentrate is upgraded considerably. If we assume 13 to 1 for Cima and 20% recovery of gold in the concentrate, and a head assay of 3 oz. Au per ton, the concentrate will then run 7.802 per ton. A 100 ton per day plant would produce 7.7 tons per day concentrate of 7.8 oz. per ton. Smelting the concentrate would cost something of the order of \$211 per ton of concentrate, or \$16 per ton of ore.

Mr. Lynn E. Burr
October 7, 1990
Page 2

Assuming that grinding and concentration would cost \$15 per ton of ore and gaseous emission controls at \$25 per ton of concentrate (\$2 per ton of ore) we get $15 + 16 + 2 = \$33$ per ton of ore. We recovered 0.6 oz per ton of ore which is \$240 per ton at \$400 per ounce gold. At 35,000 tons of ore per year. (350 operating days) the operating profit would be \$8,400,000/year for an investment of maybe \$5,000,000 (1,200,000 for grinding and concentration and may \$3,800,000 more for a smelting plant to smelt 7.7 tons per day of concentrate).

The table tailings which would still contain a lot of gold can be saved for future processing. As profits are generated the plant could be expanded, but a 100 ton per day operation might be enough to get started.

Please bear in mind that these are rough approximations, but they do indicate the potential. In the weeks to come we can come up with much better numbers.

I can see a number of things which can be done starting immediately. We should try to increase the iron yield since I found 2% magnetics in the pulverized slag from the furnace runs of September 18. The following variables can be investigated:

1. Increase smelting temperatures
2. Add reductant (carbon) to bring down more iron
3. Increase smelting times

Further down the road we should run tests in an electric furnace that will allow temperatures up to 1500°C. At those temperatures we can make slags with silica and limestone, and get a major reduction in smelting costs.

For smelting costs I get costs varying from \$77/ton of furnace feed (ore or concentrate) to \$205/ton. The low figure is by using limestone and silica fluxes and coal for fuel. Use of electric heat and silica plus soda ash fluxes, raises the costs considerably. Electric heat however allows higher temperatures and minimizes the environmental problems, and will probably prove to be the best approach.

I will give you another report on costs with some details in the near future.

Sincerely,

Bill Guay
Bill Guay

SUMMARY REPORT
EXTRACTION OF GOLD FROM CIMA ORE

Oct. 21, 1990

From: W.J. Guay, Consulting Metallurgist
To: Lynn Burr, A Mark Refining Co.

This is a summary of my appraisal of your smelting process for extracting gold from volcanic cinders from California, called Cima ore, and from Flagstaff, Arizona, called Sheep Hill ore. On Sept., 18 and 19 I witnessed a series of four demonstration runs each day in which you smelted 25 lb of minus 1/4 inch Cima cinders in each run to which was added a suitable flux and 5 lb of Asarco test lead. The mixture was heated for two hours with natural gas. The furnace reached a temperature of 1000 - 1100 C in about an hour and held for about one more hour. The furnace produced a slag, lead bullion, and iron nodules. The iron was further refined to produce essentially pure gold representing a recovery of 1.83 ounces of gold per ton of cinders. In another recent run you recovered 1.59 ounces of essentially pure gold per ton of Cima cinders. Your records show that you have recovered 1.99 ounces of gold per ton of concentrates from Sheep Hill magnetic concentrates, 1.95 ounces of gold per ton of concentrates from Sheep Hill table concentrates, 3.33 ounces of gold per ton of Sheep Hill cinders, and 1.50 ounces of gold per ton of red cinders from Cima in other runs. I have no reason to doubt the authenticity of these numbers.

The iron represents only about 1.75 to 3.5 %, by weight, of the cinders fed to the furnace. You have thus produced iron assaying anywhere from 60 to 133 ounces of gold per ton. The iron product was also amenable to a simplified refining process for recovering essentially pure gold.

At this preliminary stage of development I would say that your Smelting- Refining process has a good chance of being developed into a commercially profitable operation.

As is nearly always the case however, in the early stages of

development there is the probability that there will be problems which will have to be overcome, and there is the need to do enough process research to maximize gold recovery and minimize operating costs.

My most immediate concern is the effect of impurities upon the recovery of gold and their possible environmental impact. We had Western Analytical here in Salt Lake City analyze the furnace feed, slag, lead, and iron furnace products for a scan of metallic elements, and for more specific analyses for gallium (Ga), and thallium (Tl), all by ICP (Inductively Coupled Plasma). These analyses showed less than 5 ppm Tl in all samples. The iron product from both Sheep Hill and Cima ore showed 60 ppm gallium (Ga), 0.83 and 0.81 % arsenic (As) respectively, 3.7 % phosphorus (P) from Cima, and 0.25 % boron (B) from Cima. We did not analyze for phosphorus and boron in Sheep Hill iron product.

I believe that the arsenic in the furnace iron can be dealt with adequately in refining. So little is known about gallium that I can't say anything about it at this time. The effect of phosphorus will have to be determined. Boron should not cause any particular problems. In the furnace runs witnessed on Sept. 18 and 19 the lead product from the furnace contained 0.23 % selenium (Se). This too should respond to familiar refining techniques for its removal. Without lead present it would probably go with the iron. You also had Sheep Hill cinders analyzed for a number of trace elements by Western Technologies, Inc. of Phoenix, Arizona by ICP. These analyses showed up to 410 ppm arsenic (As) and 170 ppm selenium (Se), which would concentrate in the furnace products to the level that we saw in the iron analysis at Salt Lake City, and tend to verify the Salt Lake analyses. Interestingly, Western Technologies reported 3.8 ounces of gold per ton of cinders by ICP. This indicates that we have a target for further improvement in gold recoveries.

One thing that concerns me is that both Western Technologies and Western Analytical use an acid digestion to prepare the samples for ICP. I think that we need further verification for these impurities by having one of these laboratories do a fusion with sodium peroxide prior to acid digestion in order to insure that

the entire sample has been put into solution. Acid digestion alone may not be enough.

You recently smelted 75 lb of table concentrate from Sheep Hill. So far we have only analyzed the iron for gold, so that we still can't say what the gold recovery is until we see assays for the lead that was present. The iron product however, was no higher in gold than the iron from cinders without concentration. If we can verify that the values can be concentrated then concentration would be of great economic benefit.

Variables which can be investigated to try to improve gold recovery are:

1. Increased smelting temperatures.
2. Add additives to the furnace to increase the yield of gold.
3. Increase the smelting time.

An increased smelting temperature would allow the use of more economical fluxes than we have been using. Increased temperatures will require the use of an electric furnace.

W. J. Gray

January 9, 1991

To: Lynn E. Burr, President, A-Mark Refining Co.
From: W.J. Guay, Consulting Metallurgist
Subject: Progress Report No. 1

Introduction

This report covers the period from Sept. 18, 1990 to Dec. 31, 1990, during which time six furnace campaigns were run at Searchlight, NV. The first two furnace campaigns were demonstration runs to allow me to observe your process in which you used lead as a collector for gold, silver and other precious metals. These were followed by three furnace campaigns in which no lead was added, using only iron as a collector. Variables which were investigated were the addition of carbon and varying the slag composition in order to try to increase the iron yield. The purpose of increasing the iron yield is to try to increase the amount of gold collected. The Sixth furnace campaign was run in as nearly identical a manner as possible to a fire assay which had shown 4.2 ounces of gold per ton of ore. Any failure to reproduce the fire assay results in the test furnace should indicate what further work needed to be done in order to approximate the fire assay results.

A second section of this report deals with impurity analyses in the ore and in the products of the process, and their effects upon further process development.

Experimental Results from Smelting Tests

Each of the first two campaigns consisted of four furnace runs each day in which you smelted 25 pounds of minus 1/4 inch Cima black cinders to which was added 22 pounds of borax for flux and 5 pounds of lead. The mixture was heated for two hours with natural gas. The furnace reached a temperature of 1000-1100 degrees C in about one hour. The furnace produced a slag, lead bullion, and nodules of an iron base alloy. The iron was then leached electrolytically, in which the iron nodules were used as the anode and stainless steel as the cathode. The electrolyte was twenty percent sulfuric acid. Iron, most of the silver, and a number of impurities are solubilized. The main purpose is to produce a leach residue which will carry nearly all of the gold and whatever platinum group metals are present. Most of the silver will go into solution. In the work covered by this report no attempt has been made to account for the silver.

In the first demonstration run of 9-18-90, in which lead was used, the gold recovered in the iron was 2.02 ounces per ton of ore. An additional 1.32 ounces per ton of ore was recovered in the lead, for a total recovery of 3.34 ounces per ton.

Table I shows a series of three furnace campaigns, G-1, G-2, and G-3 in which no lead was used. G-1 used borax as flux and flour as reductant, but was otherwise just like the demonstration runs, except that no lead was used. Gold recovered was 1.59 ounces per ton of ore. G-2 was run with activated carbon added to increase the iron recovery and hopefully the gold recovery. It was also run to get iron leach residue for impurity analysis. I tried to save all of the iron leach residue from G-2 to analyze it for impurities, but a lot of it stuck to the filter paper and some was lost in handling, so that gold recovery was low, and is therefore not reported. There was no increased iron recovery in the iron nodules in G-2 as had been hoped for. It was noted however that the slag contained a lot of entrapped iron particles. A 30.75 pound grab sample of the slag was taken, and later crushed in Salt Lake City to obtain a 1235 gram sample of minus 20 mesh material. From this sample 0.64 percent of the weight was removed by a powerful hand magnet. It was later realized that the minus twenty mesh slag still contained a lot of iron particles. Also, the 0.64 percent magnetics represents particles of locked iron and slag. Therefore, we did not obtain a good number for the amount of iron left in the slag by removing the magnetics with a hand magnet. We did reduce additional iron with the added carbon, but it remained in the slag.

A third campaign, G-3, was run with still more carbon added in the form of charcoal, to try to produce more iron. I also thought that the slag should be changed from the low melting point borax slag to one with a higher melting point because the borax slag might melt long before the additional carbon could reduce more iron, and would perhaps cover the iron oxide and interfere with its reduction by carbon. Results, however, showed that even less iron was produced than before. The entire weight of slag from G-3 was sampled accurately and a final 19 lb. sample of minus 20 mesh slag was produced. The amount of magnetics which could be picked out with a powerful hand magnet was only 0.39% of the weight of the slag. This again was locked slag and iron. The entire lot of minus twenty mesh slag from G-3 still contained a lot of locked iron and slag. As with G-2, the magnetics removed with a hand magnet did not give us a good number for the amount of reduced iron left in the slag. However, a 600 gram sample of G-3 slag was later pulverized to 79 percent minus 100 mesh and leached with 20 percent sulfuric acid to remove the iron. The leach liquor contained 13.2 gram/liter of iron, indicating an additional 13.62 pounds of metallic iron in the slag for a total of 4.97 pounds of iron in the nodules plus the slag. The acid leach residue (slag plus its contained iron leach residue) contained 1.52 ounces of gold per ton of slag. With a ratio of 1.73 pounds of slag per pound of ore the gold in the slag calculated back to 2.63 ounces of gold per ton of ore. Adding this to the gold in the nodules we get 4.33 ounces of gold per ton of ore in the nodules and the slag.

At the time that we ran G-2, (11-13-90), W. Spendlove came up with a fire assaying method for Cima ore which showed that it contained 4.2 ounces of gold per ton of ore. Based on this

TABLE I

Gold Produced from Furnace RunsFurnace Charge

<u>Furnace Campaign</u>	<u>Description</u>	<u>lb Ore</u>	<u>lb Flux</u>	<u>lb Lead</u>	<u>oz Silver</u>	<u>lb Reductant</u>	<u>Weight Iron Nodules</u>	<u>Iron Assay oz Au/ton</u>	<u>oz gold Recovered</u>
9-18-90	Demonstration Run for Guay	100	88-Borax	5	50	0	1.8 lb	112.5	2.02 from Iron 1.32 from Lead 3.34 Total
9-19-90	Demonstration	100	88-Borax	5	50	0	2.2 lb	No data	No data
G-1 (10-11-90)	First run, no lead	100	88-Borax	0	50	2-Flour	1.75 lb	91.1	1.59 from Iron
G-2 (11-13-90)	No lead. Added carbon	100	88-Borax	0	50	1-Act. Carbon	1.56 lb	No data*	No data*
G-3 (11-14-90)	No lead. Added more carbon and changed flux	100	36-Soda Ash 36-Silica 16-Borax	0	0	2-Char-coal	1.35 lb	125.8	1.70 Nodules 2.63 Iron in slag 4.33**
G-4 (11-28-90)	This run used lead	10	10-Soda Ash 10 Borax	0.53	0	0	0.21 lb	11.7	0.24 from Iron 0.75 from Lead 0.99 Total

* Too much handling loss for gold accountability

** Gold recovered in nodules and in iron trapped in slag

information, campaign G-4 was run with a series of five two pound runs, a total of 10 pounds of ore, using almost exactly the same procedure that was used in the Spendlove assay which showed 4.2 ounces of gold per ton of ore. One important variable was different. The temperature was not more than 1100°C in furnace campaign G-4, compared with 1175°C in the assay procedure. In the G-4 campaign, the ratio of flux to ore was increased from the usual 0.88 pounds of flux per pound of ore to 2 pounds of flux for each pound of ore. The flux was a 50-50 mix of soda ash and borax, the same as the assay flux, and lead was also used. The ore was ground to minus 65 mesh. Another unavoidable difference between the assay procedure and test G-4 was that in the assay the crucible was taken out of the furnace and stirred about every 20 minutes, something which was not achievable with G-4. Also, with G-4 after each 2 pound run all of the furnace contents were poured into a mold. Then the lead and iron were reintroduced into subsequent runs. In the assay only the slag was poured off after each one hour interval, and the new charge of ore and flux was then charged to the assay crucible which retained the iron and lead after each run.

Since we already had evidence that we needed higher temperatures (metallic iron left in the slag) I ran G-4 with the intent that if it could not produce about 4 ounces of gold per ton of ore, it would provide further evidence that the lower temperature of G-4, compared to the assay temperature, would be the most likely reason for the lower gold recovery. The recovery of only 0.99 ounces of gold per ton of ore in G-4 is further evidence that temperatures of 1100°C or less are not sufficient for good gold recovery. The lack of stirring of the furnace melt in G-4 could be a factor, but the lower temperature is more likely to be the major factor.

Conclusions from Smelting Tests

Table I leads to the following conclusions:

1. Two 100 pound furnace campaigns, G-1 and G-3, in which no lead was added to the furnace charge yielded gold in iron nodules amounting to 1.59 and 1.70 ounces per ton of ore, respectively. G-1 was run with an acid slag, and G-3 with a basic slag.

2. The increased use of carbon as a reductant to produce more iron in the nodules did result in more gold being collected by iron, but most of the gold went with the iron trapped in the slag. In test G-3, in addition to the gold in the nodules, there were 3.62 pounds of iron entrapped in the slag. The slag was ground, leached with acid to remove the iron, and assayed, showing that it contained 2.63 ounces of gold per ton of ore treated. The total gold in the nodules and slag was 4.33 ounces per ton of ore. The total iron in test G-3, nodules plus iron in the slag, was 4.97 pounds per ton of ore.

3. Either increased temperatures or changing the conditions of the melt to lower the melting point of the iron nodules are apparently needed. Evidence of this is the presence of iron in the slag in G-2 and G-3. Also, the comparison of G-4, the 10 pound campaign, with the fire assaying results, using an almost identical procedure, except for a higher temperature in the fire assay procedure, further indicates that the higher temperature is probably the reason for the higher gold recovery in the assay.

Chemistry of the Smelting Process

The following analyses were obtained for acid soluble iron:

Black Cima Ore	5.87%
Slag (9-18-90)	4.23%
Iron Nodules, Sheep Hill	93.2%
Iron Nodules, Cima	84.4%

The acid soluble iron in the ore can be assumed to be the amount that is available to make nodules. We have therefore used only a small percentage of the available iron for making nodules.

The first ICP scan of Cima ore for trace elements reported by Western Analytical of Salt Lake City on Oct. 4 was not too informative because of acid digestion being used for dissolution. The results are not included in this report. However, special analyses for gallium and thallium showed the following:

	Ga - ppm	Tl - ppm
Cima Black Ore	<10	<5
Cima Ore Slag (9-19)	<10	<5
Sheep Hill Iron	60	<5
Cima Iron (9-19)	60	<5
Cima Lead (9-19)	<10	<5

The levels of gallium in iron from Sheep Hill and Cima are significant. What its effect might be on the gold smelting process is unknown. Where it eventually ends up in the process has yet to be determined.

An ICP scan of iron nodules from Sheep Hill ore and iron nodules from Black Cima ore are shown in Table II. These scans show arsenic at 0.83 and 0.81 percent, and lead at 1.2 and 0.84 percent respectively. Since lead was used in the furnace charge

its presence in the iron samples can be disregarded. Later, in Test G-3, much lower levels of arsenic were produced in the iron nodules, probably because a more basic slag was used.

Platinum and palladium were not detected in the ICP scans. A more accurate special platinum analysis should be made. Silver was high because it was added to the furnace charge. Selenium at less than 200 ppm is not precise enough. Special analyses for selenium were run on other samples which are reported later. Also, thallium, at less than 200 ppm, is not precise enough. It also was analyzed by special analyses which is later reported. Later analyses of nodules showed iron at 84.4%, phosphorus at 3.7%, boron at 0.25%, and gold at 0.39%. When these figures are added to the figures in Table II for Cima Iron we get 92 weight percent accountability. The unaccounted 9 percent is probably silicon and carbon. The silicon was not solubilized in the acid digestion used in the ICP scan. Carbon was not analyzed for.

An ICP scan of the lead from the demonstration run on Cima ore of 9-19-90 is shown in Table III. This scan shows a possible objectionable level of selenium at 0.23 percent, but selenium has not shown up elsewhere at these levels in the work to date. Perhaps it is because lead is a good collector for selenium. Arsenic, antimony, and thallium are shown as less than 200 ppm, the limit of sensitivity of the analytical method. Since we do not intend using lead we will only pay attention to these elements in iron, and the products of iron treatment.

Results of the second ICP scan of Cima ore for trace elements are shown in Table IV. In this scan the sample was prepared by sodium peroxide fusion followed by acid dissolution, a better method of sample preparation.

Table II
ICF Scans

ELEMENT	WAVELENGTH (nm)	<u>Iron</u>	<u>Iron</u>
		<u>Sheep Hill</u>	<u>Cima</u>
		(%)	(%)
Arsenic	193.70	0.83	0.81
Zinc	213.86	0.038	0.007
Cadmium	214.44	0.003	0.002
Lead	220.35	1.2	0.84
Nickel	231.60	0.181	0.238
Barium	233.53	< 0.002	< 0.002
Iron	259.94	> 4.0	> 4.0
Manganese	257.61	0.076	< 0.005
Magnesium	285.21	< 0.005	< 0.005
Vanadium	290.88	0.040	0.029
Beryllium	313.04	< 0.002	< 0.002
Copper	324.75	0.041	0.013
Aluminum	396.15	0.02	0.03
Barium	455.40	< 0.002	< 0.002
Sodium	589.59	0.04	0.02
Lithium	670.78	< 0.01	< 0.01
Strontium	407.77	< 0.005	< 0.005
Bismuth	223.06	< 0.02	< 0.02
Cobalt	230.79	0.039	0.044
Platinum	265.95	< 0.01	< 0.01
Silver	328.07	0.172	< 0.025
Calcium	317.93	0.011	0.167
Palladium	340.46	< 0.02	< 0.02
Selenium	196.03	< 0.02	< 0.02
Molybdenum	202.02	< 0.005	< 0.005
Chromium	205.55	0.057	< 0.005
Antimony	206.83	< 0.02	< 0.02
Thallium	351.92	< 0.02	< 0.02

< = less than the value shown.
> = greater than the value shown.

Table III
ICP Scan of Lead from Furnace Run of 9-19-90

		<u>Lead</u>
		<u>Cima</u>
ELEMENT	WAVELENGTH (nm)	(%)
Arsenic	193.70	< 0.02
Zinc	213.86	0.003
Cadmium	214.44	< 0.002
Lead	220.35	> 4.0
Nickel	231.60	0.010
Barium	233.53	< 0.002
Iron	259.94	0.127
Manganese	257.61	< 0.005
Magnesium	285.21	0.010
Vanadium	290.88	0.003
Beryllium	313.04	< 0.002
Copper	324.75	0.048
Aluminum	396.15	< 0.01
Barium	455.40	< 0.002
Sodium	589.59	0.02
Lithium	670.78	< 0.01
Strontium	407.77	< 0.005
Bismuth	223.06	0.05
Silicon	251.61	0.02
Cobolt	230.79	< 0.005
Platinum	265.95	< 0.01
Silver	328.07	> 4.0
Calcium	317.93	0.008
Palladium	340.46	< 0.02
Selenium	196.03	0.23
Molybdenum	202.02	< 0.005
Chromium	205.55	< 0.005
Antimony	206.83	< 0.02
Thallium	351.92	< 0.02

< = less than the value shown.
> = greater than the value shown.

Table IV
ICP Scan - Cima Black Ore

Ore

Cima

ELEMENT	WAVELENGTH (nm)	(%)
Arsenic	193.70	< 0.02
Zinc	213.86	0.006
Cadmium	214.44	< 0.005
Lead	220.35	0.03
Nickel	231.60	0.005
Barium	233.53	0.031
Iron	259.94	> 4.
Manganese	257.61	0.09
Magnesium	285.21	> 2.00
Vanadium	290.88	0.014
Beryllium	313.04	< 0.005
Copper	324.75	0.004
Aluminum	396.15	> 4.
Barium	455.40	0.031
Sodium	589.59	1.0
Lithium	670.78	< 0.02
Strontium	407.77	0.021
Bismuth	223.06	< 0.02
Boron	249.77	0.60
Silicon	251.61	> 4.
Cobalt	230.79	< 0.005
Platinum	265.95	< 0.02
Silver	328.07	< 0.005
Calcium	317.93	2.7
Palladium	340.46	< 0.02
Selenium	196.03	< 0.02
Molybdenum	202.02	< 0.005
Chromium	205.55	0.010
Antimony	206.83	< 0.02
Thallium	351.92	< 0.02

< = less than the value shown.

> = greater than the value shown.

Major amounts of iron, magnesium, aluminum, calcium, and silicon are seen in Table IV. This is what we would expect with volcanic rock. You will note that arsenic, selenium, antimony, and thallium are all less than 200 ppm, the limits of detection. Lead was 0.03%. Platinum and silver were not detected. No subsequent effort was made to quantify the platinum, except for one assay bead which W. Spendlove could not part, and which is reported later. Gold requires a special procedure and is not picked up in a routine ICP scan.

Additional analyses for Cima Black ore were as follows:

<u>P</u> (%)	<u>F</u> (%)	<u>Se</u> (ppm)
0.72	0.114	<2

If all of the acid soluble iron, 5.87 percent, were to combine with phosphorus to form iron phosphide the iron would contain $0.72/5.87 = 12.26\%$ phosphorus, which product has a melting point between 1050 and 1100°C. The phosphorus and fluorine analyses were run after a sodium peroxide fusion which should have gotten all of these elements into solution. The selenium was run following an acid dissolution which was not what I specified. Later analyses for selenium in acid leach solutions and residues are more significant. A special analysis on iron nodules from Cima ore showed 0.25% boron and 3.7% phosphorus. Although silicon was not quantified it was later seen to be a major constituent of the iron leach residue. See Table V. It is readily apparent that only a small fraction of the phosphorus went into the iron. The rest can be either into the slag, or up the stock. Phosphorus manufacturers routinely dispose of most of the fluorine in the slag as $\text{CaO} \cdot \text{SiO}_2 \cdot 1/9 \text{CaF}_2$, but about 10 percent of it goes with the furnace gasses as fluosilicates, but most of that is condensed with the phosphorus content. Pig iron typically contains 91.75% iron, 3.50%C, 2.75%Si, 0.55%Mn, 1.10%P. The iron from this gold smelting process is similar in composition to pig iron.

The iron from the furnace campaign of 11-14-90, No. G-3, was leached electrolytically to produce a residue containing 0.73% phosphorus, and less than 100 ppm selenium. The residue was further analyzed by an ICP scan following a sodium peroxide fusion and acid dissolution. This analysis, shown in Table V, does not show objectionable levels of any impurities, except possibly lead at 0.23%. Thallium, antimony, and selenium in this highly enriched product, now containing 4558 ounces of gold per ton of residue, or 15.6% gold, were below the limits of detection which is 200 ppm for each of these elements. At 200 ppm any impurity would be only 0.13% of the weight of the gold, a very minor amount.

Table V also shows an analysis of the leach solution from leaching the iron nodules of test G-2. The solution was diluted to 10 grams of solution per gram of iron nodules going to leach. We can conclude from these solution analyses that the only objectionable element that was dissolved was thallium. At 10 ppm

in solution it means that 100 ppm Tl was present in the iron. This very small amount of thallium could easily be precipitated from the solution and disposed of safely. It represents only 0.064 percent of the weight of the gold in the residue. A production rate of 1.56 ounces of gold per ton of ore (Test G-2) would produce at most less than 0.002 ounces of Tl per ton of ore in the leach residue and 0.001 ounces of Tl per ton of ore in the leach solution. These are certainly minor amounts of thallium. Future work will have to be done to establish the final disposition of these minor amounts of thallium. Beyond the initial identification of 60 ppm gallium in both Sheep Hill and Cima iron, previously reported on p. 6, no further work was done to follow gallium. Special analyses were also run on the leach solution which also showed less than 1 ppm of both selenium and arsenic, confirming the ICP scan shown in Table V. Special analyses were also run on the iron leach residue from test G-3, showing 0.73% phosphorus and less than 100 ppm selenium. This tells us that most of the phosphorus in the iron goes into the leach solution, from which it can readily be disposed. The low level of selenium in the leach residue means that the final smelting of the leach residue to produce Dore' metal should not be complicated by selenium.

Table V
ICP Scan - Iron Leach Residue (11-14-90)
and Leach Solution (11-13-90)

ELEMENT	WAVELENGTH (nm)	SAMPLE: "Residue" (%)	SAMPLE: "Solution" (ppm)
Arsenic	193.70	< 0.02	< 1.
Zinc	213.86	0.006	18.
Cadmium	214.44	< 0.005	0.2
Lead	220.35	0.23	4.
Nickel	231.60	0.78	130.
Barium	233.53	< 0.005	< 1.
Iron	259.94	> 4.0	> 1000.
Manganese	257.61	0.13	16.
Magnesium	285.21	0.027	18.
Vanadium	290.88	0.02	2.
Beryllium	313.04	< 0.005	< 1.
Copper	324.75	0.050	2.
Aluminum	396.15	0.05	6.
Barium	455.40	< 0.005	< 1.
Sodium	589.59	0.03	12.
Lithium	670.78	< 0.02	< 1.
Strontium	407.77	< 0.005	< 1.
Bismuth	223.06	< 0.02	< 1.
Boron	249.77	0.13	73.
Silicon	251.61	> 4.0	30.
Cobalt	230.79	0.007	3.
Platinum	265.95	< 0.02	< 1.
Silver	328.07	1.7	< 1.
Calcium	317.93	0.043	30.
Palladium	340.46	< 0.02	< 1.
Selenium	196.03	< 0.02	< 1.
Molybdenum	202.02	< 0.02	< 1.
Chromium	205.55	1.0	170.
Antimony	206.83	< 0.02	< 1.
Thallium	351.92	< 0.02	10.

< = less than the value shown.

> = greater than the value shown.

Earlier (Table III) high selenium was observed in the lead when it was used as a collector. Without lead the selenium apparently goes into the slag.

One dore' assay bead from Sheep Hill ore was assayed by Western Analytical to show 0.11% platinum in the bead. This calculates to 0.003 ounce platinum per ton of ore. The only other positive evidence that I have seen of platinum is a sample "04-Virgin Ore" assaying 2 ounces of platinum per ton of ore and a sample "05-Treated Ore" assaying 1.6 ounces of platinum per ton of ore. The assays were done by Western Technologies, 11-02-89, using ICP. Samples were submitted by Augustine Construction.

Conclusions from the Investigation of Impurities in the Process

1. Gallium is present in the iron nodules at 60 ppm (1.8 ounces per ton of nodules). We did no further checking. It melts at 30°C, and boils at 1000°C. It is soluble in sulfuric acid and was probably leached from the nodules.

2. Although we saw 0.83% and 0.81% arsenic, respectively, for Sheep Hill and Cima Iron nodules when lead was used, later leaches of iron nodules without lead present showed very little arsenic in either the residue or the leach solution. A greatly decreased amount of arsenic was seen in iron nodules in Test G-3, probably because the slag was much more basic. The presence of lead should not have anything to do with arsenic in the iron nodules. The disposition of arsenic will have to be carefully monitored in future experiments. It can go into the furnace gases, into the slag, or into the nodules, depending upon furnace conditions.

3. Iron nodules are similar in composition to pig iron, containing both phosphorus and silicon. Carbon is probably present as well, but it was not analyzed for.

4. The presence of phosphorus and fluorine in the Cima Black ore suggests the presence of apatite, $\text{Ca}_5\text{F}(\text{PO}_4)_3$, a mineral commonly associated with volcanic rocks.

5. Acid leach residues of iron nodules did not show objectionable levels of any impurities, except possibly lead at 0.23%. Thallium, arsenic, antimony, and selenium were all below the limits of detection in the leach residue, the enriched product which will go to final smelting and refining. Thallium was detected at 10 ppm in the leach solution, but this should pose no major problem, if dealt with properly. Other impurities were at very low levels in the acid leach solution.

6. Tentatively, we can conclude that refining of the iron leach residue, as shown by the analyses in Table V, should not pose any particular problems in the final smelting and refining of the leach residue.

7. Mercury was not detected in any of this work. It requires a special analysis. We will have to check this out in future work.

8. We saw only one indication of a minor amount of platinum in this work, but we have not really tried to analyze for it except on that one occasion.

Discussion

1. Future work should be directed to increasing the amount of iron nodules produced per ton of ore to determine if that would result in the collection of additional gold. It has been demonstrated that the addition of carbon results in more iron alloy being produced, but it has gone into iron particles entrapped in the slag. The increased iron alloy can be melted to produce a larger weight of nodules, either by lowering the melting point or increasing the furnace temperature. One way to lower the melting point would be to put more of the phosphorus in the ore into the nodules. Generally speaking, the more acid the slag, the more the tendency would be to keep phosphorus out of the slag. However, most of it might only go up the stack instead of alloying with the iron to reduce its melting point. Therefore, it may not be practical to get many more alloying of the phosphorus in the ore. Increasing the furnace temperature to increase the iron yield in the nodules should be attempted.

2. Another factor which would increase the collecting power of the iron would be to add iron filings to the furnace. We may simply not be getting sufficient contact between the iron we have been making, and the gold in the ore.

3. The use of alloying elements other than phosphorus may be beneficial in lowering the melting point of the iron nodules. An alloy of 50% aluminum and 50% iron for example melts at 1165°C. However, a ternary alloy of iron, phosphorus, and aluminum would melt at still lower temperatures. Tests should be run with the addition of something of the order of 20 pounds of aluminum per ton of ore.

4. Some work should also be done to determine how well the gold could be collected in a copper smelter. A copper matte of 30% copper sulfide (Cu_2S) and 70% FeS for example melts at about 1000°C. It would be relatively

simple to run some smelting tests where Cu_2S and FeS are smelted with the cinders to determine how well the resulting copper matte collects gold. This would be a good test for the feasibility of treating the cinders in a copper smelter.

5. Increased smelting time may be of benefit in collecting more gold.

I

INVENTION REPORT

Lynn Burr
T. A Henrie

EXTRACTION OF PRECIOUS METAL VALUES FROM REFRACTORY ORES

ABSTRACT OF DISCLOSURE

The recovery of gold and other precious metals from a refractory ore with or without fluxing additives and with or without reducing agents is achieved by smelting the charge at sufficiently high temperature to produce a molten metal alloy and slag. The alloy and slag are separated by suitable means. The barren slag is discarded and the alloy is collected for precious metal recovery. The alloy is electrolyzed in a suitable acid or dissolved in an acid, leaving an undissolved portion which is separated from the liquors. The filtered solids contains most of the precious metal values. These solids can be processed to recover the precious metal values. Metals such as silver may be partitioned between the leach liquor and leach residue and therefore may be recovered from the solution and residue.

EXTRACTION OF GOLD AND OTHER PRECIOUS METALS FROM REFRACTORY ORES

This invention relates to the treatment of refractory igneous rocks to recover precious metals such as gold, silver, and platinum group metals. By refractory ore we mean ore that is difficult to treat by conventional procedures to obtain the metal or mineral values. The igneous material investigated to form the basis of this invention was volcanic tephra (cinders) which are the oxides of aluminum, calcium, iron, magnesium, silicon, etc. The ore is somewhat magnetic. A more drastic method than conventional procedures was investigated to extract the gold and other precious metal values. Direct smelting of the ore or the magnetic concentrate was studied and tested and found to be effective. Smelting is a metallurgical process in which metal is separated by fusion from earthy and other ore components. An example being the production of pig iron in a blast furnace.

In these investigations the refractory ore was either melted directly or with fluxing agents in a gas fired furnace. The charge was kept at temperature for sufficient time to completely melt the particles and become fluid enough to pour. The slag was poured into a slag pot, cooled, crushed and ground. Metallic nodules were extracted from the broken slag. These nodules were strongly magnetic, very hard and brittle. Chemical analyses of the nodules

showed that the principle component was iron with carbon and phosphorus in significant quantities. Other metals such as cobalt, copper, chromium, manganese, molybdenum, silicon, vanadium and zinc were present in small amounts. A photomicrograph of a polished nodule showed ferrite, pearlite and steadite as the dominant components. Strongly magnetic metal particles were also extracted from the finely ground slag. These particles contained less carbon than the nodules. The nodules were either anodically or directly digested in sulfuric acid solutions. The fine metal particles were digested in sulfuric acid solutions. The leach residues were washed, dried, oxidized and assayed for silver and gold.

EXAMPLES

(1) Three pounds of refractory ore, tephra, were charged to a crucible, placed in gas fired furnace, heated to approximately 2400 degrees fahrenheit and melted. The charge was held at temperature until it was sufficiently fluid to be poured. This required about one hour. Approximately 75% of the slag was poured into a slag pot and cooled. This left some slag and sludge in the hot crucible. The crucible was recharged with an additional three pounds of ore and the heating and pouring procedure repeated. The above procedure was followed a third and fourth time. Four charges were melted before all the slag and sludge was poured from the crucible. The slags from the four pours were cooled, crushed and ground separately. The metallic nodules were removed from the number four slag and weighed. The finer magnetic material, including small spheres were collected on a magnet, cleaned and weighed.

(2) The same procedure as (1) was followed except only one melt and pour was made.

(3) The same procedure as (1) was followed except 2.4 pounds of borax glass were added to each charge.

(4) The same procedure as (1) was followed except 2 pounds of borax glass and 0.4 pounds of soda ash were added to each charge.

(5) The same procedure as (1) was followed except a larger crucible and furnace were used, and 40 pounds of tephra were charged to each of two melts.

(6) The same procedure as (3) was followed except the larger crucible and furnace were used and 20 pounds of tephra and 16 pounds of borax glass were added to each of four melts.

RESULTS OF MELTING

The weight of nodules produced per pound of ore was more for example (6), nearly 20 grams per kilogram of ore, than for the other examples. The amounts of fine strongly magnetic material was however less in relative terms for example (6), than the other examples. There were no large nodules produced in example (2), only strongly magnetic particles and strongly magnetic fines.

RECOVERY OF METAL VALUES

The nodules collected from the slag ranged in size from 1 cm. thick and 15 cm. across to small balls 1 mm. in diameter. Chemical analyses showed that iron was the principal component with carbon and phosphorus in significant quantities. This material will be referred to as "nodules" throughout this report. A second metallic material was also collected from fine ground slag. This material was also strongly magnetic and appeared to be somewhat fused or at least sintered. Most of this material passed through a 35 mesh screen. It did not contain as much carbon as the nodules but showed significant amounts of phosphorus. This material will be referred to as "magnetic fines."

The nodules were either anodically or directly dissolved in sulfuric acid solutions. To anodically dissolve the nodule it was either connected through a rectifier to a lead cathode or through a connecting wire to a lead cathode (galvanic cell). A plastic bag made from fine mesh material was placed around the cathode to collect the unleached residue. The electrolyte was 10% sulfuric acid and in total amount of 5 ml. of concentrated sulfuric acid per gram of nodule. The solution was maintained at a temperature of 60 to 70 degrees Celsius throughout the digestion period. Periodic additions of either water or acid solutions were made to maintain the electrolyte level due to evaporation losses. To directly dissolve the nodule material, the nodules were either used as collected or crushed, screened and sized with similar sizes being digested together. The nodules were placed inside a plastic bag and immersed into the hot acid solution. The acid strength was 10% sulfuric acid and 5 ml. concentrated sulfuric acid per gram of metallic material. The solution temperature was maintained at 75 to 85 degrees Celsius throughout digestion. The solution level was maintained by additions of water.

The magnetic fines were cleaned by repeated magnetic separations and screened to -32 mesh. This fine material was added to hot water, about 50 ml. per gram of material. The temperature was maintained at 70 to 80 degrees Celsius and while stirring concentrated sulfuric acid was slowly and periodically added. The addition rate was controlled to maintain steady but not a vigorous reaction. Hydrogen gas was evolved from the metal surfaces indicating the reaction nature and progress. A magnet was moved across the bottom of the reaction vessel to determine if any unreacted iron values remained. It was noted that little if any graphite slime was in the leached residue. The leached residue from the nodules contained a material that was somewhat granular, brownish in color and was fairly easy to filter and a paste like material that looked like oily graphite and difficult to filter. The leached residue from the magnetic fines was granular easy to filter and appeared black in color.

The leached residues were separated from the leach liquors by cooling the liquor, settling, decantation and filtration. The residues were washed with water and partially dried. Soda ash and niter were mixed with the damp residue and the mixture was dried at the proper temperature. The mixture was placed in a crucible with a small amount of borax and slowly heated to between 600 and 700 degrees Celsius or until the nitrate was completely reacted and converted the metalloids and other materials to the higher valence states and releasing the gold and silver to the free state. Fluxing agents were added to the crucible and contents smelted. A Dore bead (gold and silver) was obtained by cupping the lead button.

SPECIAL NOTES

Two smelting tests should be noted; (1) In order to determine if addition of more carbonaceous material would increase the production of nodules, carbon briquettes were added to a 20 pound charge and smelted. No differences to comparable experiments were noted. (2) It was believed that lead may enhance the smelting process by enabling the liquid iron masses to coalesce and result in larger and increased production of nodular material. The strongly magnetic properties of the metallic masses and hence the ease of separation of the value material obviated the need of lead. The use of lead in the smelting process would also complicate safety and environmental control during the operation. For these reasons the use of lead was thought to be imprudent.

DEFINITION OF SPECIAL TERMS

FERRITE: Pure, or nearly pure, metallic iron, as a crystalline constituent the solute can be assumed to be carbon.

METALLOID: A nonmetal, as carbon or nitrogen, that can combine with a metal to form an alloy. An element such as silicon, phosphorus, arsenic, or tellurium, intermediate in properties between the typical metals and nonmetals.

PEARLITE: The lamellar mixture of ferrite and cementite in slowly cooled iron-carbon alloys.

REFRACTORY ORE: Ore, difficult to treat for recovery of valuable substances.

STEADITE: An eutectic consisting of iron phosphide and iron, as a constituent of gray cast iron.

TEPHRA: A collective term for all clastic volcanic materials including volcanic dust, ash, cinders, lapilli, scoria, pumice, bombs, and blocks.

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ABSTRACT OF THE DISCLOSURE

The recovery of gold from volcanic cinders is achieved by mixing the cinders with a suitable flux and reducing agent and smelting the mixture at a sufficiently high temperature to produce a molten iron alloy and a molten slag. The molten slag and iron alloy are separated by suitable means. The slag is discarded and the iron alloy is cooled to a solid state. The iron alloy is then dissolved in acid, leaving an undissolved portion which can be separated from the resulting leach liquor by filtration. The filtered solids contain nearly all of the gold, and platinum group metals that were present in the original ore. These solids can then be processed by well known technology to recover their gold, silver, and platinum group metal content in essentially pure form. The solution which contains most of the silver can also be treated by conventional means to recover that metal.

This invention relates to the treatment of volcanic igneous rocks, commonly called volcanic cinders, to recover gold, silver, and platinum group metals therefrom.

The volcanic ore which was investigated to form the basis of this invention is composed of silicates and oxides with major amounts of iron, magnesium, and aluminum, and lesser, but significant amounts of sodium, boron, calcium, fluorine, and phosphorus (from tenths of a per cent to three per cent of these elements). The ore contains a major amount of magnetite. At a grind of 43 per cent minus 65 mesh plus 200 mesh and 57 per cent minus 200 mesh, 54.6 per cent of the sample was strongly magnetic. Not all of this magnetic material is magnetite, however, since much of the magnetite is locked with non-magnetics. The phosphorus and fluorine are probably from apatite, $\text{Ca}_5\text{F}(\text{PO}_4)_3$, a mineral commonly associated with magnetite in igneous rocks.

Volcanic cinders, as typified by the ore used in the development of this process is extremely resistant to all of the procedures normally used in the treatment of precious metal ores. Therefore, it was decided to use direct smelting, a very drastic

and expensive procedure to recover the precious metals from the ore. A smelting process is one in which all of the materials charged to a smelting furnace are completely fused or melted, resulting in two or more liquid products which stratify into separate layers upon standing, with the slag, the liquid of lowest specific gravity, forming the top layer which is skimmed off. In most smelting operations the slag is the waste product which serves as a vehicle to eliminate substances which are not desired in the valuable products recovered from the lower layers of molten material. The bottom layer can be a metal such as lead in lead smelting, iron in iron smelting, or copper in some types of copper smelting. An intermediate layer can be a matte (principally molten sulfides), or a speiss (molten arsenides and/or antimonides). It is well known that molten lead serves as a solvent, or collector, for gold, silver, and the platinum group metals in the smelting of lead ores. Similarly, liquid copper and liquid mattes (molten sulfides of copper and iron, or nickel and iron) serve as collectors for the precious metals (gold, silver, and the platinum group) in copper and nickel smelters.

In these investigations lead was first considered as a possible molten solvent or collector of the precious metals in the smelting of volcanic cinders. Standard fire assaying is a miniature, laboratory sized, lead smelting process in which the materials charged to the laboratory crucible are smelted to result in two liquid layers, a lead layer which settles to the bottom of the crucible and a lower specific gravity slag layer on top of the lead layer which carries off the undesirable wastes in the ore. The lead contains the precious metals which are then recovered from the lead to complete the assay. Since standard fire assaying had repeatedly failed to recover the precious metals from volcanic cinders the conditions for using lead for a collector in a smelting process had to be changed from those used in fire assaying. A strongly reducing smelting charge was used in order to avoid the formation of any lead oxide in the slag. In standard fire assaying lead oxide is usually present, thus providing some oxidizing potential, a condition which this investigation sought to avoid.

Initially, experiments were conducted by charging 5 pounds of lead, 5 ounces of silver, 25 pounds of ore, and 21.5 pounds of borax for flux to a furnace crucible. A flux is a material which converts compounds that are infusible at a certain temperature into others which melt at this temperature. ~~For example, silica (SiO_2) is fusible only at very high temperatures.~~ But if sodium carbonate is added, the mixture can be fused at much lower temperatures. A mixture of one mole of silica (SiO_2) and one mole of sodium oxide (Na_2O) will melt at about 1020 C to form a slag of the composition Na_2SiO_3 , much lower than the melting point of either Na_2O or SiO_2 . The borax used in the experiments covered by this investigation, when mixed with the ore, lowered the melting point of the resulting mixture to allow the use of 1000-1100 degrees centigrade for forming a molten fluid slag. The silver was added to help in the collection of gold by the molten lead since silver and gold show complete mutual solubility in each other and the alloy has a lower melting point than pure gold. The added silver also aids in the later separation of gold and silver.

The mixture of ore, lead, silver, and borax was heated to 1000-1100 degrees centigrade and held for one hour. The slag was then skimmed, leaving a pool of molten lead in the bottom of the furnace. A second charge of 25 pounds of ore and 21.5 pounds of borax was then added, the temperature of the charge again raised to 1000-1100 degrees centigrade, held for one hour, and again the slag was skimmed off. The procedure was repeated twice more for a total of four furnace melts. At the end of four furnace melts it was observed that another metal had melted and collected as a separate layer on top of the lead layer. Further investigation showed that the metal was principally iron. The next stage of treatment was to dissolve the lead electrolytically in nitric acid, and to separately dissolve the iron electrolytically in a dilute sulfuric acid solution. In both cases an insoluble residue fell to the bottom of the electrolytic cell which was then filtered to separate it from the remaining acid. The residue was washed, dried, and further smelted by well known techniques to produce a final Dore' metal, which is essentially an alloy of gold and silver, containing the platinum group metals. It was thus demonstrated that both the lead and iron were collectors for gold. The next stage of development was to omit

the lead with the objective of using only the iron alloy to collect the gold and other precious metals. This procedure avoided the toxicity and environmental problems associated with lead. Copper could also be used as a collector for the precious metals, but this would involve the necessity of using an electrolytic copper refining plant, or other expensive procedure to recover the copper for recycle, which was thus avoided.

The process which was then investigated was very similar to the smelting of iron ore to produce pig iron. The procedure was the same as before, except for the omission of lead. The charge consisted of 5 ounces of silver, 25 pounds of ore, 21.5 pounds of borax for flux, and 0.5 pounds of wheat flour for a reducing agent. To reduce iron from iron oxide requires a reducing agent. The ore contains several per cent carbonaceous material which occurs naturally, and this provides most of the reducing agent. This material serves not only as a reducing agent, but also as an alloying element which allows the melting point of iron to be reduced, just as in pig iron production. The second most abundant element in the alloy after iron is a few per cent of silicon. The iron also contained 3 to 4 per cent phosphorus, which together with the silicon and carbon reduces ~~the resulting alloy~~ ^{melting point of the} to the temperature range of these investigations (1000-1100 C). The amount of iron alloy produced was 1.75 pounds from 100 pounds of ore.

A portion of the ^{iron} alloy was then dissolved electrolytically in a twenty per cent sulfuric acid solution. The iron alloy served as the anode and a stainless steel sheet as the cathode. A standard fire assay of the residue which remained after dissolving the iron showed that gold was a major constituent of the residue and that the iron alloy was a good collector for gold, in the absence of lead. Some silver was also present in the residue, but more of it went into solution as soluble silver sulfate than the amount that was left in the residue. Analysis also showed that the ^{gold-silver} bead which was obtained in a fire assay of the residue contained a small amount of platinum and palladium.

I have discovered a wholly new process to treat volcanic cinder ores for gold, silver, and platinum group metal recovery. These iron bearing ores are first smelted in a highly reducing atmosphere

to produce an iron alloy which is similar in chemical composition to commercial pig iron. This alloy acts as a solvent or collector for gold, silver, and the platinum group metals. This action is similar to the smelting of copper ores in which a molten matte (a mixture of iron and copper sulfides) collects gold, silver, and the platinum group metals, and to the smelting of lead ores in which molten lead collects these precious metals. The iron alloy is separated from the slag, then leached in a mineral acid, either with or without electrolysis. ~~In this case dilute sulfuric acid, to dissolve the iron.~~ ^{The experiments covered by these instructions} ~~was used to dissolve the iron.~~ The resulting mixture is then filtered to separate the liquid and solids. The solid residue then contains gold as a major constituent with lesser amounts of silver and the platinum group metals. Most of the silver is dissolved as silver sulfate in the sulfuric acid solution. Other major constituents are iron and silicon. The residue also contains some 30 additional minor constituents, mostly metals. The residue can be treated by well known smelting methods to produce a gold-silver bullion, containing the platinum group metals.

There are two unique features in this invention. The most unique feature is the use of a molten iron alloy as a collector for gold, silver, and the platinum group metals. The practice of iron smelting is well known. Also, the use of electrolytic acid dissolution to dissolve a metal collector of gold, silver, and the platinum group metals, followed by the recovery of these metals from the acid leach residue is conventionally used in copper smelting and refining and is thus also well known. However, the combination of iron smelting with electrolytic acid dissolution of the iron, followed by recovery of the gold, silver, and platinum group metals from the acid residue is a new way to recover these metals.

In conventional cyanide leaching of gold and silver ores the gold and silver are adsorbed by activated carbon. These metals are then desorbed into another solution in which the gold and silver are in much greater concentration than in the original cyanide solution, and from which the gold and silver can be electroplated onto steel wool. This is another case in which gold and silver are separated from iron by an acid dissolution of the iron. However, that is quite different from this invention in that there is only a surface attachment of the gold and silver onto the iron, and not

a complete alloying of the gold and silver with the iron. Also, of course, the cyanide process does not recover any platinum group metals which may be present in the ore.

The following ^{specific} example is illustrative, but not limitative of the practice of the invention. A furnace charge consisting of 25 pounds of ore crushed to minus one quarter inch, 22 pounds of borax, and 5 ounces of silver was thoroughly mixed, heated to 1000-1100 degrees centigrade and held for one hour. The borax was the flux. The reducing agent was the natural carbonaceous material in the ore. The slag was skimmed, leaving a small pool of molten iron in the bottom of the furnace. A second charge of 25 pounds of ore and 22 pounds of borax was again mixed, heated to 1000 - 1100 degrees centigrade, held for one hour, and again the slag was skimmed off. The procedure was repeated twice more for a total of four furnace melts. After the fourth skimming of slag the iron was poured into a mold, together with a small amount of remaining slag and allowed to cool. The cold slag was broken away from the iron. The weight of iron was 1.75 pounds. A 256 gram portion of the iron alloy was then dissolved electrolytically in a twenty per cent sulfuric acid solution. At the end of the iron dissolution there remained a slurry of undissolved residue and a solution containing the iron. The slurry was then filtered to separate the residue from the acid solution, washed, and dried. It weighed 6.4 grams, which amounted to 2.5 weight per cent of the iron alloy. A standard fire assay of the residue showed that it contained 12.5 per cent gold. These figures indicated that an avoirdupois ton of ore would yield 1.59 troy ounces of gold in the ^{acid} leach residue, from which it can readily be recovered by well known methods in a gold-silver bullion containing the platinum group metals.

A second specific example is also illustrative, but not limitative of the practice of the invention. A furnace charge consisting of 25 pounds of ore crushed to minus one quarter inch, 9 pounds of silica sand (SiO_2), 9 pounds of sodium carbonate, 4 pounds of borax, and 0.5 pounds of ~~wheatstarch~~ ^{charcoal} was thoroughly mixed, heated to 1000-1100 degrees centigrade and held for one hour. The silica sand, sodium

carbon and borax were fluxes, and the ~~flour~~^{charcoal} was a reducing agent. The ore also contained natural carbonaceous material which also served as a reducing agent. The slag was then skimmed, leaving a small pool of molten iron in the bottom of the furnace. A second charge of 25 pounds of ore, 9 pounds of silica (SiO_2), 9 pounds of sodium carbonate, 4 pounds of borax, and 0.5 pounds of ~~flour~~^{charcoal} was again mixed, heated to 1000-1100 degrees centigrade, held for one hour, and again the slag was skimmed off. The procedure was repeated twice more for a total of four furnace melts. After the fourth skimming of slag the iron was poured into a mold, together with a small amount of remaining slag, and allowed to cool. The cold slag was broken away from the iron. The weight of iron was 1.35 pounds. A 350 gram portion of the 1.35 pounds of iron alloy was then dissolved electrolytically in a twenty per cent sulfuric acid solution. At the end of the iron dissolution there remained a slurry of undissolved residue and a solution containing the iron. The slurry was then filtered to separate the residue from the acid solution, washed, and dried. It weighed 8.77 grams, representing 2.50 weight per cent of the iron alloy. A standard fire assay of the residue showed that it contained 15.6 per cent gold. These figures indicated that an avoirdupois ton of ore would yield 1.54 troy ounces of gold in the acid leach residue, from which it can readily be recovered by well known methods in a gold-silver bullion containing the platinum group metals.

I claim:

A method for treating volcanic cinders and other similar gold, silver, and platinum group metal bearing igneous ores for the recovery of these metals from the ore by mixing the ore with a suitable flux and reducing agent and heating the mixture to a sufficiently high temperature to produce a molten iron alloy and a molten slag. When the mixture of iron alloy and slag is allowed to settle, either in the furnace in which the melting takes place or in another container such as a mold or ladle, the iron alloy forms the bottom layer of molten material and the slag the top molten layer. If copper, or nickel, or both, along with sulfur are present, a third molten layer, between the alloy and the slag may form which may also contain some of the gold, silver, and platinum group metals. That layer would be a matte, which is usually a mixture of molten sulfides of copper and iron, but sometimes

contains nickel sulfide as a major constituent. The middle layer could also be a speiss, which is a mixture of molten arsenides or antimonides. It too could contain some of the gold, silver, and platinum group metals. The different molten layers can then be separated by conventional means and cooled to a solid state. The iron alloy will contain gold, ^{Silicon, Phosphorus,} ~~silica~~, and platinum group metals. The iron alloy is then leached with a dilute mineral acid to solubilize the iron which is the principal component of the alloy. Sulfuric, hydrochloric, and nitric, are all suitable acids. A 20 weight per cent sulfuric acid solution was used in the experiments covered by this invention, but the others could also be used. The dissolution can be aided by electrolysis in which the iron alloy is the anode, and any number of corrosion resistant materials can be used as the cathode. Increased temperatures up to 80 degrees centigrade or more can also aid in the dissolution of the iron. In general the acid will dissolve all but the most insoluble or noble metals present. The iron alloy produced in these experiments varied from 84 to 93 per cent iron, 3 to 4 per cent phosphorus, several per cent silicon, a few tenths of one per cent each of nickel, boron, and calcium, and less than one tenth of one per cent each of 26 other elements, mostly ~~metals~~. The calcium and boron may have been contained in entrapped slag. The iron alloy was thus similar in composition to pig iron. It's carbon content however was not determined. These analyses are illustrative, but not limitative of the composition of the iron alloy which can be produced by this method of treatment. After dissolution of the iron there remains an undissolved residue which can be separated from the resulting leach liquor by filtration. The filtered solids contain nearly all of the gold and platinum group metals. A small percentage of the gold however ^{can be} ~~is~~ solubilized, even with sulfuric acid, if electrolysis is used, because of the oxidizing potential at the anode. With sulfuric or nitric acids, most of the silver will be contained in the leach liquor, and can be recovered by precipitation as a chloride. If hydrochloric acid is used for leaching, the silver will remain in the residue. The filtered residue contains iron, silicon, and gold as the major constituents, ^{and may comprise} ~~comprising~~ more than 95 per cent of the weight of the residue, Minor constituents comprise some 30 additional elements, mostly metals. The gold,

platinum group metals, and whatever silver is present in these solids can be recovered by conventional smelting to produce a high grade bullion containing gold, silver, and the platinum group metals with only a very small amount of impurities. One such smelting method is that used in copper refineries to recover these precious metals from electrolytic refinery slimes. In this method a flux of silica and limestone is mixed with the slimes and the mixture melted down to produce a silicate slag which contains most of the impurities, and a precious metal bearing matte which requires further refining to remove sulfur and selenium. In the process of this invention the precious metal bullion, commonly called Dore' bullion, from smelting would be principally gold, silver, and platinum group metals, with only minor amounts of impurities remaining. This Dore' alloy is readily marketable to refiners and other buyers.

If a matte or speiss is formed, these would usually be sold ~~to a smelter for the recovery of their precious metal content.~~
either a copper or a lead

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**METALLURGICAL TESTING FOR THE
PRECIOUS METALS CONTENT WITHIN
THE PYROCLASTIC MATERIALS LOCATED
IN THE NORTHERN ARIZONA VOLCANIC FIELDS**

For

MARIAH-GUILD MARK INDUSTRIES JOINT VENTURE
Phoenix, Arizona

by

John O. Rud
Geologist, M.Sc.
February 12, 1992

CONCENTRATION AND EXTRACTION OF PRECIOUS METALS FROM VOLCANIC MATERIAL

SAMPLING PROGRAM

A program to sample and evaluate various cinder cones for Mariah International and Guildmark Industries Joint Venture was undertaken during November, 1991. A total of 7 cones was sampled in the Coconino and Kaibab National Forest Service area. The samples ranged in size from 150 to 3,400 pounds each and were taken in a manner to be representative of the material exposed in the existing quarries. The pyroclastic deposits sampled are listed below. (See location maps)

Camel Pit	Township 23 North, Range 4 East, Section 16
Ebert Mountain	Township 25 North, Range 4 East, Section 11
Cadillac Pit	Township 25 North, Range 5 East, Section 17
House Pit	Township 25 North, Range 5 East, Section 7
Slate Mountain	Township 25 North, Range 5 East, Section 35
Merriam Mountain	Township 23 North, Range 10 East, Section 24
Merrill Mountain	Township 21 North, Range 11 East, Section 7

The samples were then transported to a facility owned by Sunwalker Development Inc., which is located on Castle Hot Spring Road near Wickenburg, Arizona. The facility is equipped with Allis Chalmers 1518 Vibratory ball mill, a micro gold concentrating table, drying ovens, Rotap screen system, fire assay lab, and related equipment required to process the volcanic material.

R. 3 E. 7 MILES TO STATE 64

R. 4 E.

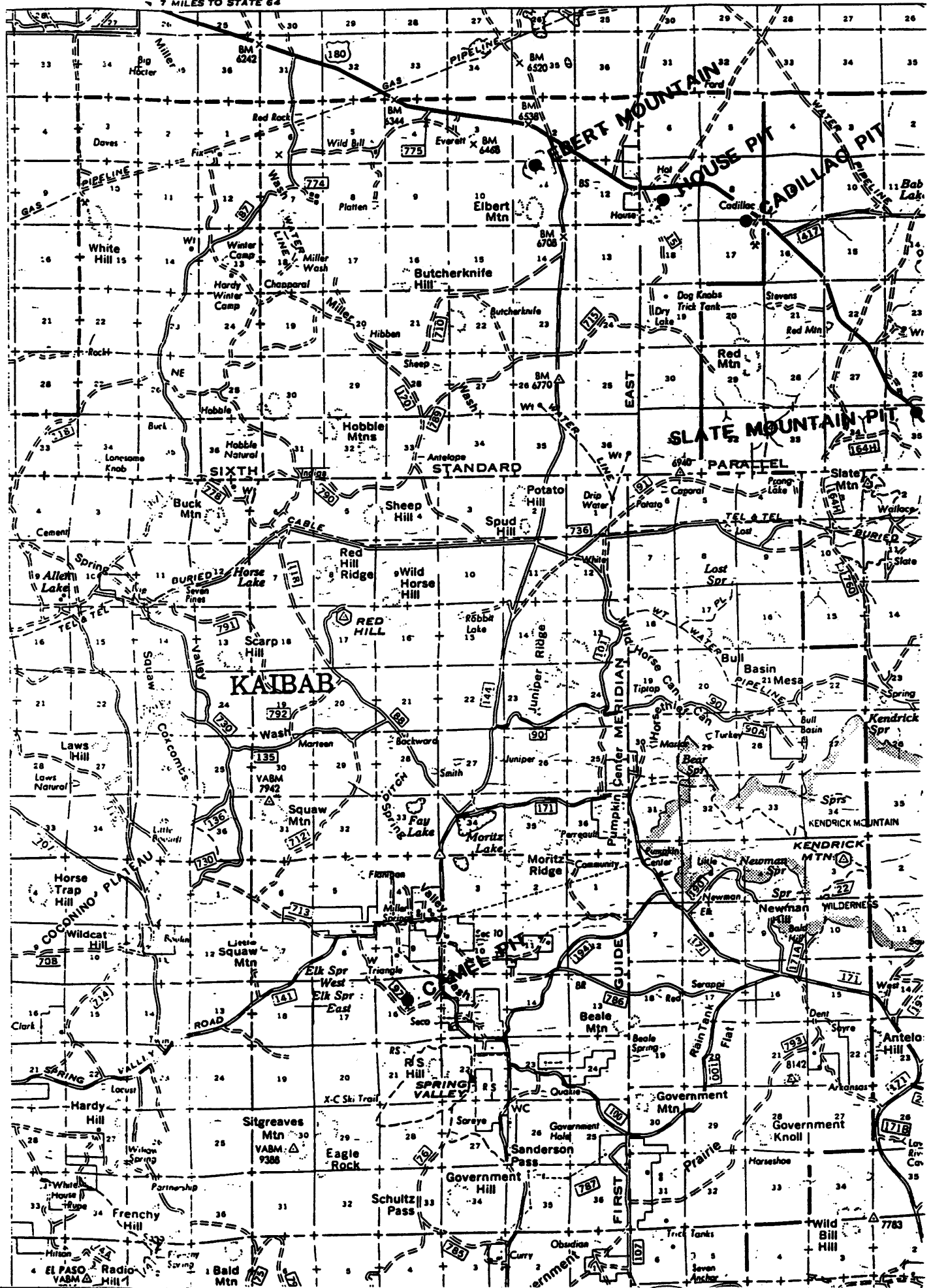
R. 5 E.

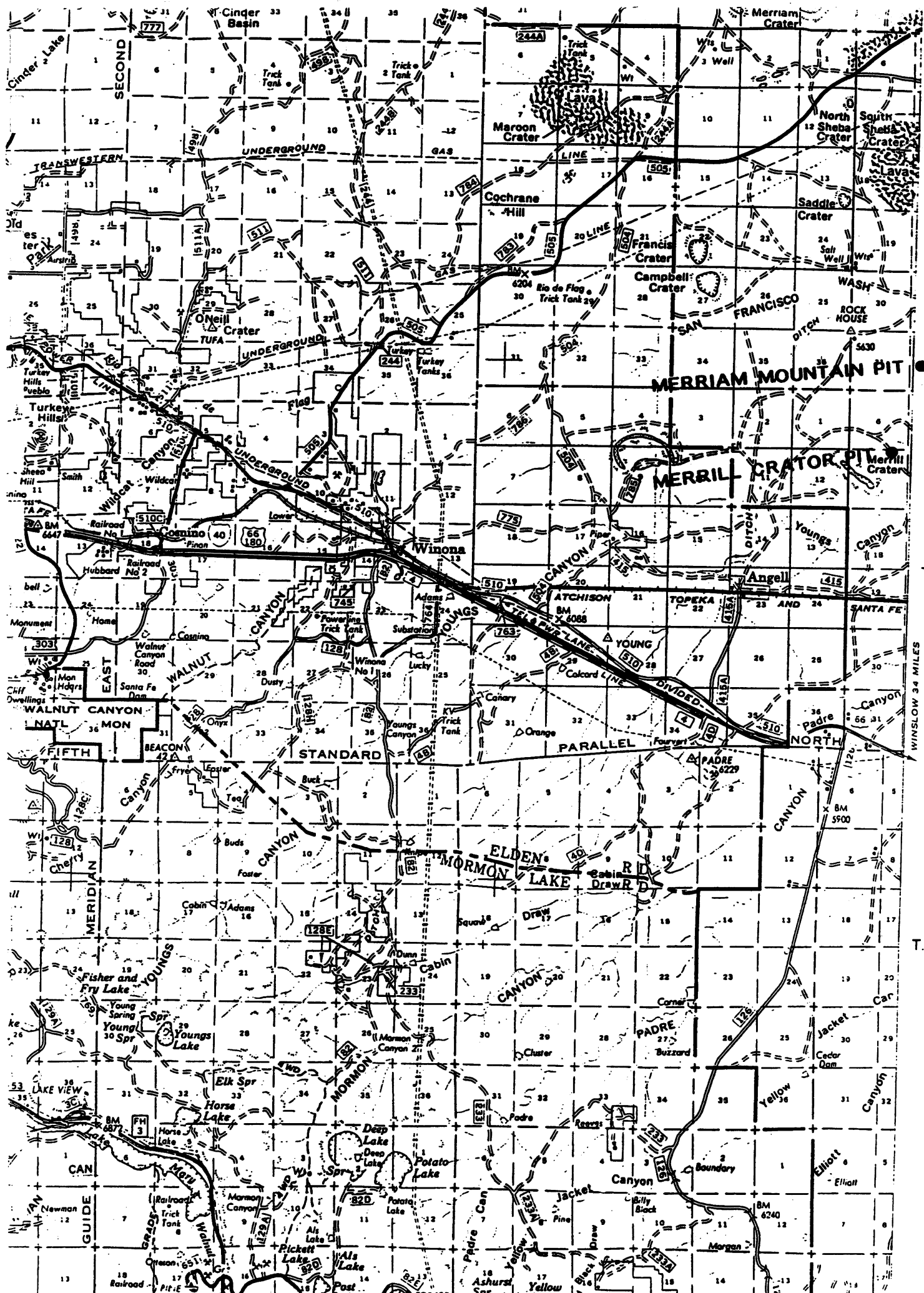
T. 26 N.

T. 25 N.

T. 24 N.

T. 23 N.





T. 22 N.

T. 21 N.

T. 20 N.

WINSLOW 34 MILES

PRIOR TESTING

A report, "**ANALYSIS OF CINDER CONE MATERIALS**" by Professor Baki Yarar, Department of Metallurgical Engineering, Colorado School of Mines, Golden Colorado, dated September 1, 1987 states "**Results of AA (atomic absorption spectrophotometry) analyses of all products are shown in Exhibits 1, 2, 3, and 4. Brief examination of the data indicates that all samples contain gold. Quarry A (House pit) contains the highest average of gold (7.7 ppm = 7.7 grams/m.t.) whereas Quarry D (Slate Mountain) contains the lowest average of gold (3.9 ppm = 3.9 grams/m.t.)**"

The Summary of Observations and Conclusions state:

1. **We have collected 42 samples of material from the locations shown on the accompanying maps.**
2. **We studied these samples by SEM, EDX, fire assay and AA analysis.**
3. **We found that all samples contain gold and silver in the concentration range.....ppm = (g/t) to ppm = (g/t)**
4. **While panning of the original material does not show gold flakes, table concentrates invariably show gold and silver bearing flakes in the heavy fraction, which also contains sulphides of Fe, Cu, Zn, and Pb.**

A report, **CONCENTRATION AND EXTRACTION OF VALUE ELEMENTS OF THE MERRIL AND MERRIAM PROPERTIES OF WMR BY FLOTATION** by B. Yarar, Ph.D. Professor of Metallurgical Engineering, Colorado School of Mines, Golden, Colorado, dated July 1, 1987

states that a 17 metric tons sample was removed from the Merriam Crator. AA analysis indicated the sample averaged .0651 oz/ton gold and .0075 oz/ton silver.

The report also states in the Conclusion and Recommendations, that:

1. All our experimental findings are based on a 17 metric ton sample taken from the Merriam property of WMR.
2. We found that this sample contains native gold, silver and copper as well as sulfide minerals such as FeS₂, PbS and ZnS.
3. These materials are highly disseminated in the matrix and are much lower grade than conventional complex-sulfide-gold-silver ore bodies. We stress that our studies did not aim at the discovery of any ore-body nor do we know if an ore-body exists in the area sampled. Therefore all economic calculations, or extrapolations to other regions of the area we sampled, need to be documented independently of our work.
4. The fact that the values in the sample, we studied are highly unconventional in grade and mode of occurrence notwithstanding, we found that a gravity pre-concentration produces a higher grade material.
5. We found that table concentrates can be ground and subjected to froth flotation, which gives concentrates assaying up to 84.28 grams of gold plus silver per ton of flotation concentrate.

- 6. Grinding of table concentrates to about 80%-150 mesh gives acceptable liberation.**
- 7. The Bond work index for 150 mesh grind of this material is 44.5 which indicates a very hard ore, requiring about 36 to 44 kWh per metric ton to be able to grind to liberation size.**
- 8. We find that desliming is essential for a successful flotation-concentration of the value components by conventional flotation reagents.**
- 9. We also found that a low pH and a frother which can withstand low pH pulps are favorable for obtaining high-grade flotation concentrates.**
- 10. Our leaching studies indicated that a conventional cyanide tank leaching leads to the passage of up to 20% of gold and silver into solution; if, the head ore is used, while 95% of gold and 85% of silver solubilization occurs when roasted table concentrates are subjected to leaching by cyanide.**
- 11. Our studies also indicates that higher leaching efficiencies are achieved if the material leached is finely ground i.e., 100%-200 mesh, roasted and then leached by cyanide.**
- 12. Our smelting experiments indicates that flotation concentrates can be smelted, giving a dore product containing 92.67% Au and 7.33% Ag; after, they have been roasted at 900°C.**

13. **We recommend that if any plant based on our findings is contemplated by the sponsors, it should first aim at demonstrating the process at pilot size and not as a profit-making installation.**
14. **We also recommend that any economic calculations on the part of the sponsors require a knowledge of the size and average grades of the ore-body by appropriate geological and engineering methods.**
15. **We visualize a potential recovery process for which economics have not been worked out, as given in Exhibit 54.**

CONCENTRATION PROCEDURE

Previous testing has indicated that the cinder material must be ground to a 80 percent passing -325 mesh to achieve 96%+ liberation. (Liberation means the separation of the mineral constituents of a rock)

To achieve the necessary grind the material was hand fed into a Allis Chalmers model 1518 vibratory mill at a 1,000 pounds per hour rate. The oversize material was then screened off and re-ground in the mill until 100% of the material passed a 200 mesh screen.

Screen analysis was then conducted on the material with the following results.

PRODUCT PARTICLE SIZE ANALYSIS
(Cumulative Passing)

<u>(Tyler) Mesh</u>	<u>Weight %</u>
100	100.0
200	100.0
250	95.5
325	80.2
400	60.9

Two head ore samples were then taken from each deposit and submitted to Alpine Assay of Twin Falls, Idaho for fire assay. The material was then hand fed onto two types of micro gold concentrating tables to compare recovery and concentrating efficiencies. The feed rate was approximately 500 lbs per hour with the heavy concentrate removed on a 10 minute interval.

TESTING RESULTS

TEST 1

A 540 pound of sample was removed from the Camel pit, ground in the AC vibratory mill, and sampled for fire assay. The material averaged .767 oz/ton gold and 1.43 oz/ton silver. The high gold content may be due to a nugget effect or a layer of material that has concentrated the gold over a long period of time. Continuing sampling of the Camel Pit to determine its average gold content is strongly recommended.

The ground material was then fed onto a micro gold table which produced 10 pounds of concentrates. (approximately 50 to 1 concentration ratio)
The concentrate was then smelted in a electric furnace utilizing a siliceous flux formulation from the **Manual of Fire Assaying and Determination of Noble Metals (U.S.G.S. Publ. No 1445 (1977))** The process produced 4.5 grams (.145 troy ounces) of Dore which indicates a recovery rate of approximately 70% was achieved on this test.

TEST 2

A 500 pound sample from the **Ebert Mountain pit** was ground in the AC vibratory mill and sampled for fire assay. The results indicated a gold content of .104 oz/ton and silver content of 1.135 oz/ton. The material was concentrated on a micro gold table producing 7.8 pounds of heavy concentrate. (Concentration ratio of 70 to 1) The concentrate was then smelted into a Dore bead that weighted .5 grams or .016 troy ounces. A recovery rate of 62% was realized on this test run.

TEST 3

A composite sample of 3,400 pounds was removed from the Merrill Crator and processed and sampled by the above procedure. The head ore assayed .228 oz/ton gold and 2.38 oz/ton silver. The tabling of the material produced 52 pounds of concentrate that was reduced to 14 pounds by additional concentration by tabling. The concentrate was then smelted and produced a 9 gram (.289 troy ounce) Dore bead. A 73% recovery was achieved by controlling the feed rate and using a head tank to control the water pressure to the table.

CERTIFICATE OF ASSAY

Mailen Gould Mark Jester Ventura
1000 East Apache, Suite N1, ...
Tempe, AZ 85281

Alpine Assay

ATTN: Mr. Bill Alford

DESCRIPTION	YIELD	OZ/TON AU	OZ/TON AG	GRAMS	CHARGES
315 251 # 1		0.260	3.66	25.5 Grams	103.00
315 251 # 2		0.066	1.11	9 Grams	19.00
315 352 # 1		0.120	1.18		19.00
315 352 # 2		0.088	1.09		18.00
315 256 # 1		0.316	1.66	4.5 Grams	19.00
315 256 # 2		1.218	1.22		19.00
315 356 # 1		0.094	1.24	.5 Grams	19.00
315 356 # 2		0.094	1.24		19.00
315 250 # 1		0.096	1.00		19.00
315 250 # 2		0.088	1.00		19.00

Dore Beads Produced During Test Program

The remaining samples from the various pits were then ground and sampled for fire assay with the following results:

<u>Deposit</u>	<u>Average gold content</u>	<u>Average silver content</u>
Cadillac Pit	.030 oz/ton gold	.07 oz/ton silver
Merriam Crator	.171 oz/ton gold	.07 oz/ton silver
Slate Mountain Pit	.088 oz/ton gold	1.04 oz/ton silver
House Pit	.095 oz/ton gold	1.17 oz/ton silver

The material was then used to determine optimum feed rates and concentrate removal times to maximize recovery and feed rates. The material was processed 4 times and then smelted to produce a 25.5 gram (.819 troy ounce) Dore product. The objective of this test was to determine optimum pilot mill size to be constructed and general processing data for future testing.

CONCLUSIONS and RECOMMENDATIONS

1. The completed testing program corroborates the data presented in the two Colorado School of Mines reports by Professor Yarar, Namely, that the pyroclastic material contains precious metals; the precious metals can be concentrated by gravity methods; the concentrates can be smelted into dore by standard flux formulations.
2. The testing program indicates a 60% to 70% range of recovery was achieved. Recommendations are hereby made to test and evaluate different micro-gold concentrators to determine if the recovery rate can be increased to the 80% range.

3. The results from the gravity concentrating process indicates a significant portion of the gold remains in the Tails. Recommendations are hereby made to determine if a Carbon-in-Pulp cyanide system can recover this gold and if it would be economically feasible to install this type of process in the milling circuit.
4. The metallurgical evaluation completed by the Colorado School of Mines indicates that the flotation process can increase the concentration ratio of the milling process substantially. Recommendations are hereby made to determine the economic feasibility of utilizing this process in the final mill circuit to increase the concentration ratio thereby, producing a high grade gold product which would be shipped to established gold refiners.
5. Strong recommendations are hereby made to construct a 50 tons-per-day pilot mill to determine the optimum milling circuit for the processing of this pyroclastic material. The pilot mill process would establish the overall grade of the selected cinder cones by bulk testing, determine the optimum concentration circuit with the highest percentage of precious metal recovery, and determine the economic feasibility of constructing a concentrating facility with a capacity exceeding 1,000 tons-per-day.

Respectfully submitted,

John O. Rud
Geologist, M.Sc.
February 12, 1992

12-5-91

Date Assayed 12-5-91

Alpine essay

[illegible]**FAX**

2.00

Thank You:

Date Assayed 12-17-91

Alpine Essay

[illegible]**FAX**

2.00

HWY. 30 W. • 108 CLEARSRING DR.
TWIN FALLS, IDAHO 83301 • (208) 734-8807

TOTAL \$77.00



Hazen Research, Inc.
4601 Indiana Street
Golden, Colorado 80403
Tel: (303) 279-4501

Bill Corbin 256-2990
Denise
FAX 256-8774

FAX TRANSMITTAL

Date: May 12, 1995

No.: 8316

Pages: 5

Time: 11:55

File: 8596

To: Randy Moore
Cambior
Reno, Nevada

Fax No.: 702-856-5189 4549

From: Bob Coleman
HAZEN RESEARCH, INC.
Fax No. (303) 278-1528

Message:

Attached are the preliminary flotation results on the four Mariah samples. The flotation concentrates are being reassayed with results available next week.

Regards,

Bob

R. B. Coleman

RBC/cb

Enclosures

IF YOU DO NOT RECEIVE ALL PAGES, PLEASE PHONE AS SOON AS POSSIBLE.

HAZEN RESEARCH, INC. PRELIMINARY DATA

Flotation Test Metallurgical Results

Test No: 2252-12 Test Date: 5/4/95
 Project: 8596
 Objective: Determine gold recovery by flotation
 Sample: Lower SB HRI No. 47830-4
 Grinds: 45 minutes/-kg at 50% solids in a Denver 5 x 12" steel ball mill P80 = 45.4 microns (77.6% passing 325 mesh)

Stage	Reagents, lbs/ton				Minutes		Grind	Pulp	
	Cytec	Jet A	PAX	Cytec	Problems			Cond	Froth
	6098	Karocon		242	MIBC	D87250			
Grind	0.038	0.050					45		
Rougher 1			0.050		0.020	0.020		1	5
Rougher 2			0.050	0.030				2	5

Observations:

Product	Dry Wt.		Weight		Analysis		Distribution	
	g	%	Au	oz/ton	Au	%		
Rougher concentrate	41.80	4.23	0.077			91.9		
Rougher tailing	946.80	95.77	0.0003			8.1		
Calculated Feed	988.60	100.00	0.0035			100.0		
Head, Direct, AA finish			<0.0003					
Head, Direct, Fine Assay			0.002					

HAZEN RESEARCH, INC. PRELIMINARY DATA

Flotation Test Metallurgical Results

Test No: 2252-11 Test Date: 5/4/95
 Project: 3596
 Objective: Determine gold recovery by flotation
 Sample: Upper SB HRI No. 47830-3
 Grind: 45 minutes/1.2g at 50% solids in a Denver 5 x 12" steel ball mill P80 = 46.3 microns (75.1% passing 325 mesh)

Stage	Reagents, lbs/ton				Frothless		Minutes		pH
	Cytec	Jel A	PAX	Cytec	MIBC	DF250	Grind	Cond	
Grind	6098	0.043		242			45		9.53
Rougher 1			0.050		0.020	0.014		1	5 9.54-9.63
Rougher 2			0.050	0.030	0.014			2	5 9.44-9.61

Observations:

Product	Dry Wt, %	Weight %	Analyses		Distillations	
			As	As	As	%
Rougher concentrate	38.40	9.87	0.150		87.0	
Rougher tailing	953.80	96.13	0.0009		13.0	
Calculated Feed	992.20	100.00	0.0067		100.0	
Head, Dimes, AA finish			<0.0003			
Head, Dimes, Fine Assay			<0.001			

HAZEN RESEARCH, INC. PRELIMINARY DATA

Filtration Test Metallurgical Results

Test No: 2252-10 Test Date: 5/4/93
 Project: 8596
 Objective: Determine gold recovery by filtration
 Sample: Vent Fil HRI No. 47830-2
 Grind: 45 minutes/-kg at 50% solids in a Denver 5 x 12" steel ball mill P80 = 46.2 minus (77.7% passing 325 mesh)

Stage	Reagents, lb/ft				Filtration		Minutes		Pulp pH
	Cyto 6098	Jet A Kemene	PAX	Cyto 242	MIBC	DF250	Grid	Coat	
Grid	0.038					0.020	45	5	9.60
Conditioner		0.022						1	9.60-9.50
Rougher 1		0.050			0.034			2	9.50
Rougher 2		0.050		0.030	0.014				

Observations: There was a small amount of grayish (carbonaceous?) material bordering the feed.
 The tailings responded OK to lime flocculation.

Product	Analyses			Distribution	
	Dry Wt, %	Weight %	Au oz/t	Au %	
Rougher concentrate	46.20	4.57	0.111	81.6	
Rougher tailing	94.30	91.43	0.0012	10.4	
Calculated Feed	1010.70	100.00	0.0062	100.0	
Head, Direct, AA finish			0.0006		
Head, Direct, Fine Assay			<0.001		

2252-9
5/1/95

HAZEN RESEARCH, INC. PRELIMINARY DATA

Flotation Test Metallurgical Results
5/4/95

Test No: 2252-9 Test Date: 5/4/95
 Project: 8596
 Objective: Determine gold recovery by flotation
 Samples: Vent Stockpile HRI No. 47830-1
 Grind: 45 minutes/1-lb at 50% solids in a Denver 5 x 12" steel ball mill P80 = 47.0 microns (76.7% passing 325 mesh)

Stage	Reagents, lbs/lb				Frother		Minutes		Pulp pH
	Cytec	Jet A	PAX	Cytec	MIBC	D1250	Grind	Cond	
Grind	6098			242			45		9.55
Rougher 1	0.038		0.050		0.020	0.020		1	9.55-9.97
Rougher 2		0.014	0.050	0.030				2	9.59-9.25

Observations: There was a small amount of grayish (carbonaceous?) material bordering the froth. This slurry required a lot of frother.
 The froth improved significantly with the 242. Products did not float with low dosage of non-ionic flocc (Percol 351)

Product	Analyzes			Distributions		
	Dry Wt, g	Weight %	Au oz/tl	Au %		
Rougher concentrate	50.00	5.02	0.209	86.0		
Rougher tailing	945.60	94.98	0.0018	14.0		
Calculated Feed	995.60	100.00	0.0122	100.0		
Head, Direct, AA Finish			0.0003			
Head, Direct, Fine Assay			0.0001			



Hazen Research, Inc.
4601 Indiana Street
Golden, Colorado 80403
Tel: (303) 279-4501

FAX TRANSMITTAL

Date: May 12, 1995

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To: Randy Moore
Cambior
Reno, Nevada

Fax No.: ~~702-856-5189~~ 4549

From: Bob Coleman
HAZEN RESEARCH, INC.
Fax No. (303) 278-1528

Message:

Attached are the preliminary flotation results on the four Mariah samples. The flotation concentrates are being reassayed with results available next week.

Regards,

A handwritten signature in cursive script that reads "Bob".

R. B. Coleman

RBC/cb

Enclosures

IF YOU DO NOT RECEIVE ALL PAGES, PLEASE PHONE AS SOON AS POSSIBLE.

HAZEN RESEARCH, INC. PRELIMINARY DATA

Test No: 2252-12 Test Date: 5/4/95 Production Test Metallurgical Results
 Project: 8596
 Objective: Determine gold recovery by flotation
 Sample: Lower SB HRJ No. 47830-4
 Grind: 45 minutes/-kg at 50% solids in a Denver 5 x 12" steel ball mill P80 = 45.4 microns (77.6% passing 325 mesh)

Stage	Reagents, lbs/t				Problems			Grind		Minutes		Pulp pH
	Cyne	Jet A	Kerosene	PAX	242	MIBC	DE250			Coal	Reck	
Grind	0.038	0.030							45			
Rougher 1			0.050			0.020	0.020			1	5	9.44-9.37
Rougher 2			0.050		0.090					2	5	9.38-9.30

Observations:

Product	Dry Wt. %	Weight %	Analyses		Distillations	
			Au oz/t	Au %	Au %	Au %
Rougher concentrate	41.80	4.23	0.077		91.9	
Rougher tailing	946.80	95.77	0.0003		8.1	
Calculated Feed	988.60	100.00	0.0035		100.0	
Head, Discard, AA, froth			<0.0003			
Head, Discard, Fine Alloy			0.002			

MAY 12 '95 12:18

BAZER RESEARCH, INC.
PRELIMINARY DATA

Flotation Test Metallurgical Results

Test No: 2252-11 Test Date: 5/4/95
 Project: 8596
 Objective: Determine gold recovery by flotation
 Sample: Ureter 8B HRI No. 47830-3
 Grind: 45 minutes/1 kg at 90% solids in a Denver 5 x 12" steel ball mill P80 = 46.8 microns (75.1% passing 325 mesh)

Stage	Reagents, lbs/ton				Probes			Minutes			Pulp pH
	Cycle	Int A	PAX	Cycle	242	MDIC	DP250	Grind	Coat	Flash	
Grind	0.098	0.043						45			9.53
Rougher 1									1	5	9.54-9.43
Rougher 2									2	5	9.44-9.41

Observations:

Product	Dry Wt, %	Weight %	Analyses		Distributions		
			Au	Ag	Au	Ag	
Rougher concentrate	38.40	3.87	0.130		87.0		
Rougher tailing	953.80	96.13	0.0009		13.0		
Calculated Feed	992.20	100.00	0.0067		100.0		
Head, Direct, AA Fault			<0.0003				
Head, Direct, Fine Assay			<0.001				

2252-11-YEA
5/4/95

HAZEN RESEARCH, INC. PRELIMINARY DATA

Flotation Test Metallurgical Results

Test No: 2252-10 Test Date: 5/4/95
 Project: 8596
 Objective: Determine gold recovery by flotation
 Sample: Vent Fil HRI No. 47330-2
 Grind: 45 minutes/-kg at 50% solids in a Danner 5 x 12" steel ball mill P80 = 46.2 microns (77.7% passing 325 mesh)

Stage	Reagents, %/t						Grind	Minutes		Pulp pH
	Cyano	NaA	PAX	Cyano	Prothion	Coat		Froth		
	6008	Kemene		242	MBBC	DP250				
Grind	0.038						45	5		9.60
Conditioner		0.022				0.020		1	5	9.60-9.50
Rougher 1			0.050		0.034			2	5	9.50
Rougher 2			0.050	0.050	0.014					

Observations: There was a small amount of greyish (carbonaceous?) material bordering the froth.
 The tailings responded OK to lime flocculation.

Product	Dry Wt, %	Weight %	Analyses		Disturbances	
			Au	g/t	Au	g
Rougher concentrate	46.20	4.57	0.111		81.6	
Rougher tailing	94.50	95.43	0.0012		10.4	
Calculated Feed	100.00	100.00	0.0062		100.0	
Feed, Direct, AA finish			0.0006			
Feed, Direct, Fine Assay			<0.001			

HAZEN RESEARCH, INC.
PRELIMINARY DATA

Test No:

Test Date:

Flotation Test Metallurgical Results

5/4/95

Project:

4396

Objective:

Determine gold recovery by flotation

Sample:

Vent Stockpile HRI No. 47800.1

Grind:

45 minutes/kg at 50% solids in a Deere 5 x 12" steel ball mill

P80 =

47.0

microns

(76.7% passing 325 mesh)

Stage	Reagents, lbs					Minutes			Pulp pH
	Cytec	In A	PAX	Cytec	Protein	Grind	Coat	Fresh	
	6008	Kerosene		242	MIBC	DP250			
Grind	0.038						45		9.55
Reagent 1			0.050		0.020	0.020	1	5	9.55-9.57
Reagent 2		0.014	0.050	0.030			2	5	9.39-9.25

Observations: There was a small amount of grayish (carbonaceous?) material bordering the froth. The slurry required a lot of frother.

The froth improved significantly with the 242. Frothers did not flow with low dosage of non-ionic froth (Procol 351)

Product	Dry Wt, g	Weight %	Analysis		Distillations	
			Au	wt%	Au	%
Rougher concentrate	50.00	5.02	0.209		86.0	
Rougher tailing	945.60	94.98	0.0018		14.0	
Calculated Feed	995.60	100.00	0.0122		100.0	
Head, Diced, AA Froth			0.0003			
Head, Diced, Pine Assy			0.001			

714-559-5157

Richard Campbell

714-559-5157

Dxc

Marrah International Inc.

114 T 105 lbs conc

con to Refinery

2.5 gal rec

8.604 oz rec from con.

float - 325 grind mix w floe & reagent &
calcium float.

con float. Assay.

Dell Chem new reagent trying

high sulfides.

flu w/ sulfides.

.07 rec possible.

cored sample. depth 7' 100'

chemical plug + orthoclase fertilizer.

Assay -

Fire Assay

Hazen got fire assay

Bob Colman

floated → .12/t

Key to Assay - grind size. - 325 grind. 80%

Double recovery in flu w/ Electron Bombardment

very high Ag increase recovery

Paul Keyser w/ Pyramid Resources

- Colorado School of Mines - different methods of recovery.
Autoclave - too much ~~\$\$~~ even though good results.

U of A. metallurgist. - Geologist needs to tell me
who.

- Smelter

- gold

→ Paul Keyser }

→ Bob (last name) }

Geologist

John Reed

602

~~1992-2017~~ 1992-2017

U of A metallurgist

Bacter

Tom Andrey - US Bur. of Mines

Hazen Research Inc

Bob Coleman 303-279-4501

Pyramid Resources

801-521-7556

John Rod 602-492-9017

Cyanide leach tests on - 400 mesh?

Colorado School of Mines Baki Yazar

Dept of Metallurgical Engineering

Golden, CO

CAMBIOR

April 14, 1995

Mr. Bob Coleman
HAZEN RESEARCH
4601 Indian Street
Golden, CO 80403

Dear Bob:

Enclosed are four samples from the Mariah International property; they are as follows:

Vent Stockpile	Bags 1-4
Vent Pit	Bags 1-4
Upper SB	Bags 1-2
Lower SB	Bags 1-2

As we discussed, please crush to -325 mesh and run fire assays. Then run a flotation of the cinder cone material to produce a gold concentrate and check gold content.

Call if there are any questions. I look forward to the results.

Sincerely,

CAMBIOR EXPLORATION USA, INC.



Randy Moore
Senior Geologist

RM:lat

Cambior Exploration USA, Inc.

230 South Rock Blvd., Suite #23, Reno, Nevada 89502-2345, USA, Telephone 702-856-5189, Fax 702-856-4549

Bob Coulman Hazen

3/17/95

→ Fire Assoc - No 600 gms

Send small sample - Assigned

Hands rec. 005

1002

008

Flooded small sample

not on internal slide 12

looked with scope

Saw pieces of electron

Pilot Plant - Hazen

Pyramid goal co.

Hazen will only Fire Assoc

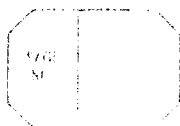
200 T - Hazen 1/2

Do not have to flood to assay

prob requires

fine grind?

Foot-Pace → Hazen



3/18/95

John Rud

-3/8" 150 Tons cut from road.

N:1-402 through leader

15 mm sample Belt

10 samples - compos. .09

Tails done same way

recovery one day none the next.

Ag-sulfate coating

Grid core w/ sample

500 lbs from each sample pt

grind & compos. sample

little Cu work on samples.

300 mesh. CIP

Brackets - Co School of Mines 5 grad Brackets Processed.

10 Samples Second Run .09 to Head - 40 Tons

Blappu