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PRINTED: 03/18/2003

ARIZONA DEPARTMENT OF MINES AND MINERAL RESOURCES AZMILS DATA

PRIMARY NAME: AGUILA PROJECT PGM PROMOTION 1

ALTERNATE NAMES:
JAMES INTERNATIONAL

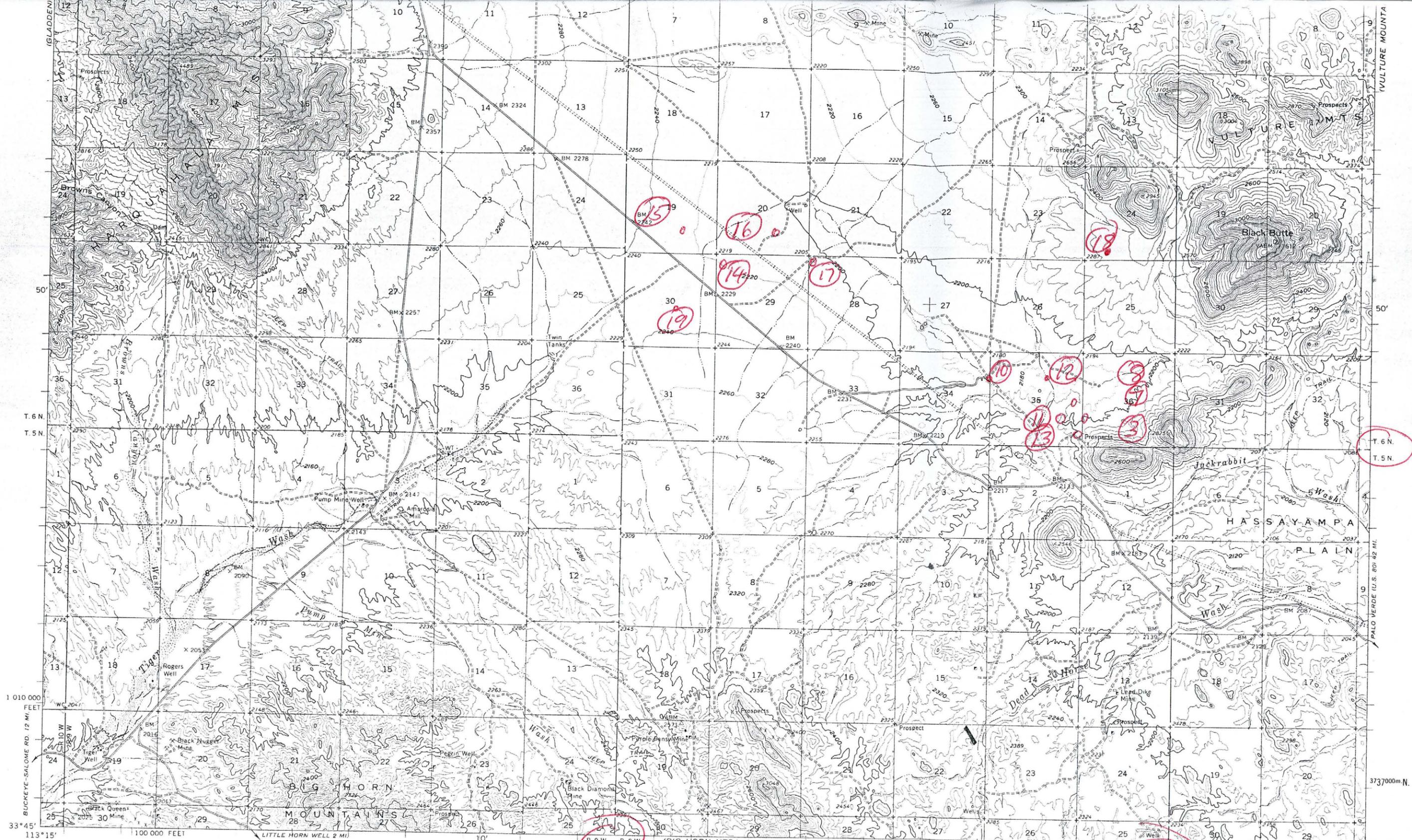
MARICOPA COUNTY MILS NUMBER: 799

LOCATION: TOWNSHIP 6 N RANGE 8 W SECTION 35 QUARTER SE
LATITUDE: N 33DEG 51MIN 21SEC LONGITUDE: W 113DEG 01MIN 15SEC
TOPO MAP NAME: BLACK BUTTE - 7.5 MIN

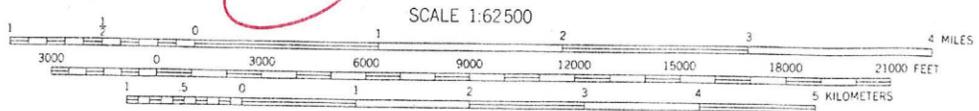
CURRENT STATUS: OTHER

COMMODITY:
UNKNOWN

BIBLIOGRAPHY:
ADMMR AGUILA PROJECT PGM PROMOTION 1 FILE
INCLUDES SAMPLE SITES AND DRILL HOLES IN THE
NORTH HALF OF THE SECTION



Mapped, edited, and published by the Geological Survey
 Control by USGS and USC&GS
 Topography by photogrammetric methods from aerial
 photographs taken 1951 and 1960. Field checked 1962
 Polyconic projection. 1927 North American datum
 10,000-foot grid based on Arizona coordinate system, central zone
 1000-meter Universal Transverse Mercator grid ticks,
 zone 12, shown in blue



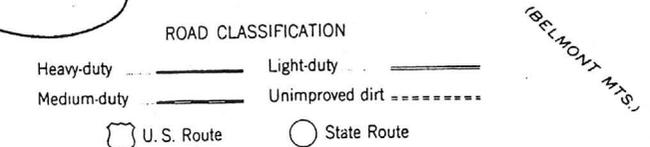
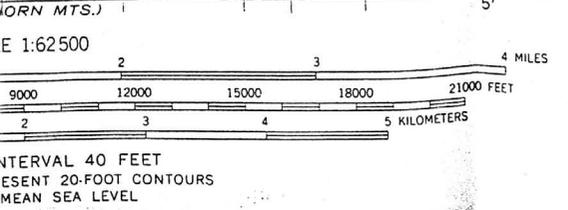
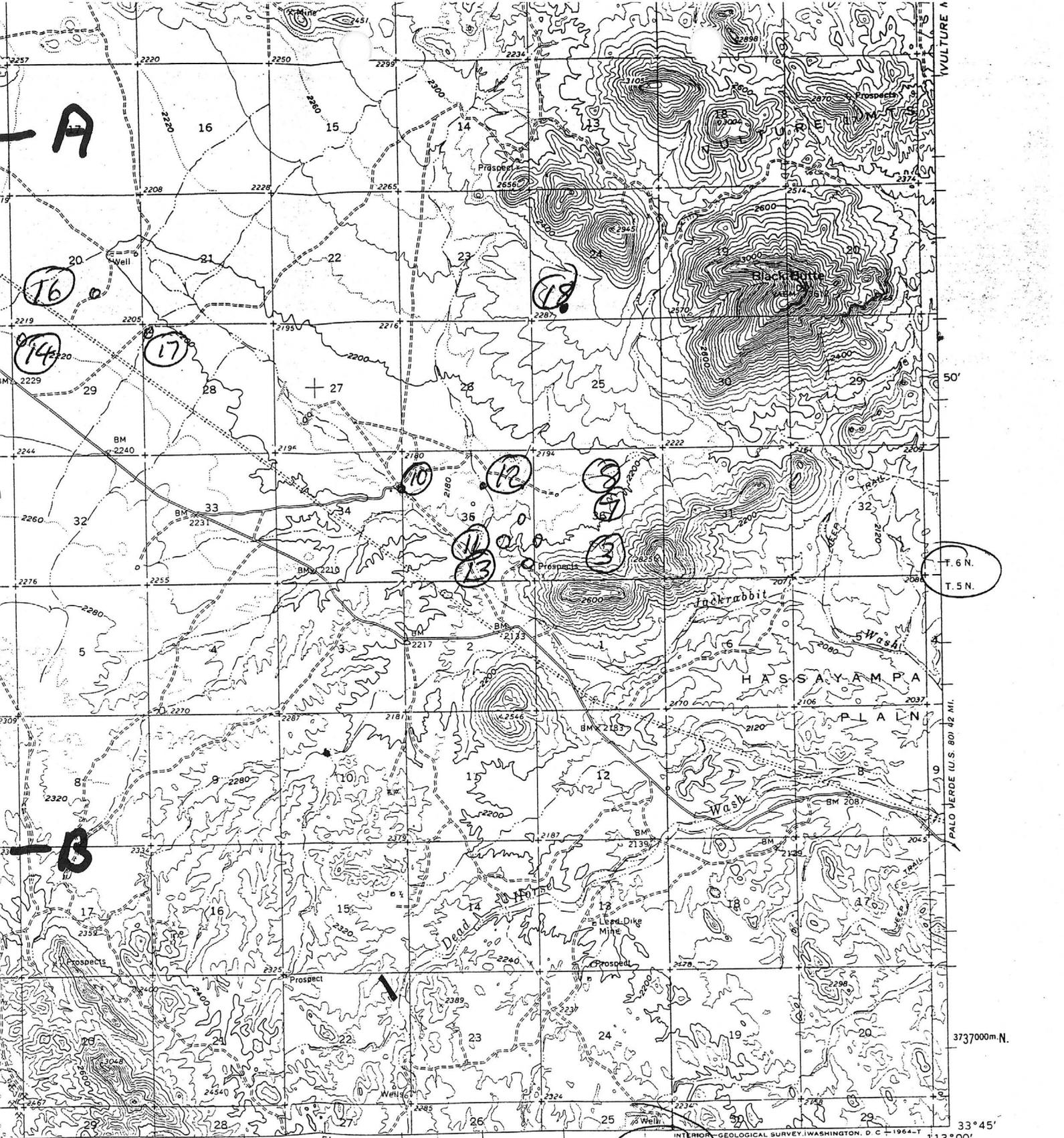
CONTOUR INTERVAL 40 FEET
 DOTTED LINES REPRESENT 20 FOOT CONTOURS
 DATUM IS MEAN SEA LEVEL



ROAD CLASSIFICATION
 Heavy-duty ——— Light-duty ———
 Medium-duty ——— Unimproved dirt - - - - -
 U.S. Route □ State Route ○

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
 FOR SALE BY U. S. GEOLOGICAL SURVEY, DENVER 25, COLORADO OR WASHINGTON 25, D. C.
 A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

AGUILA, ARIZ.
 N3345—W11300/15



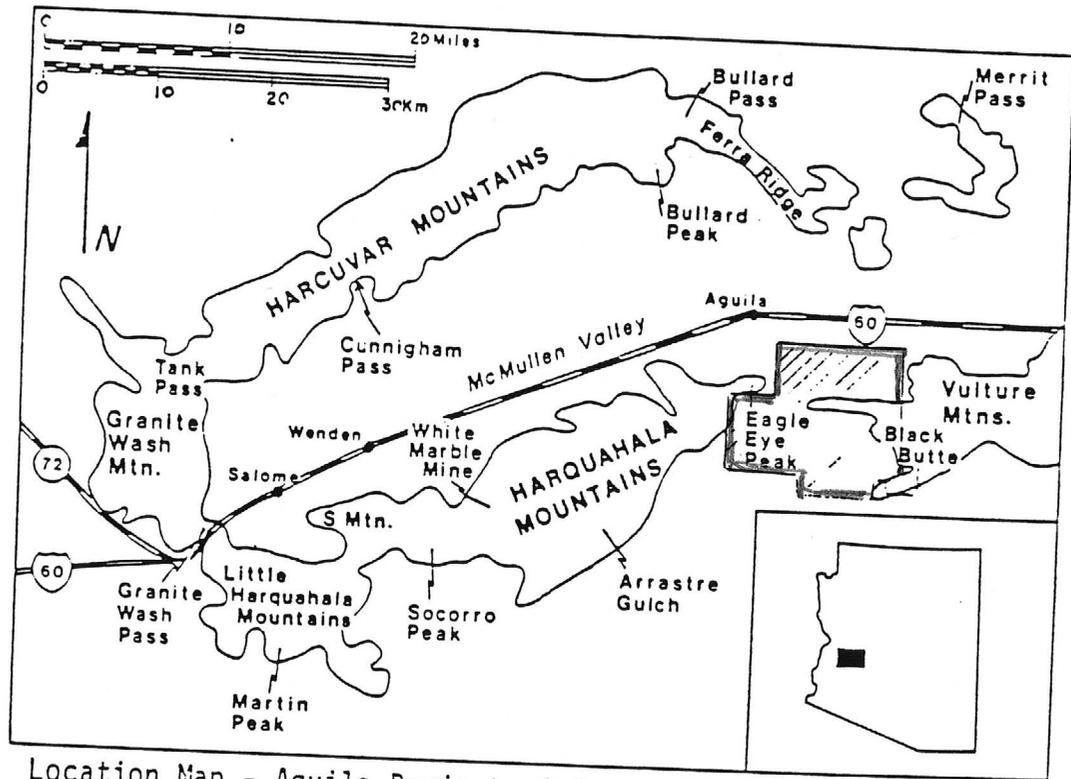
AGUILA, ARIZ.
N3345—W11300/15

1962

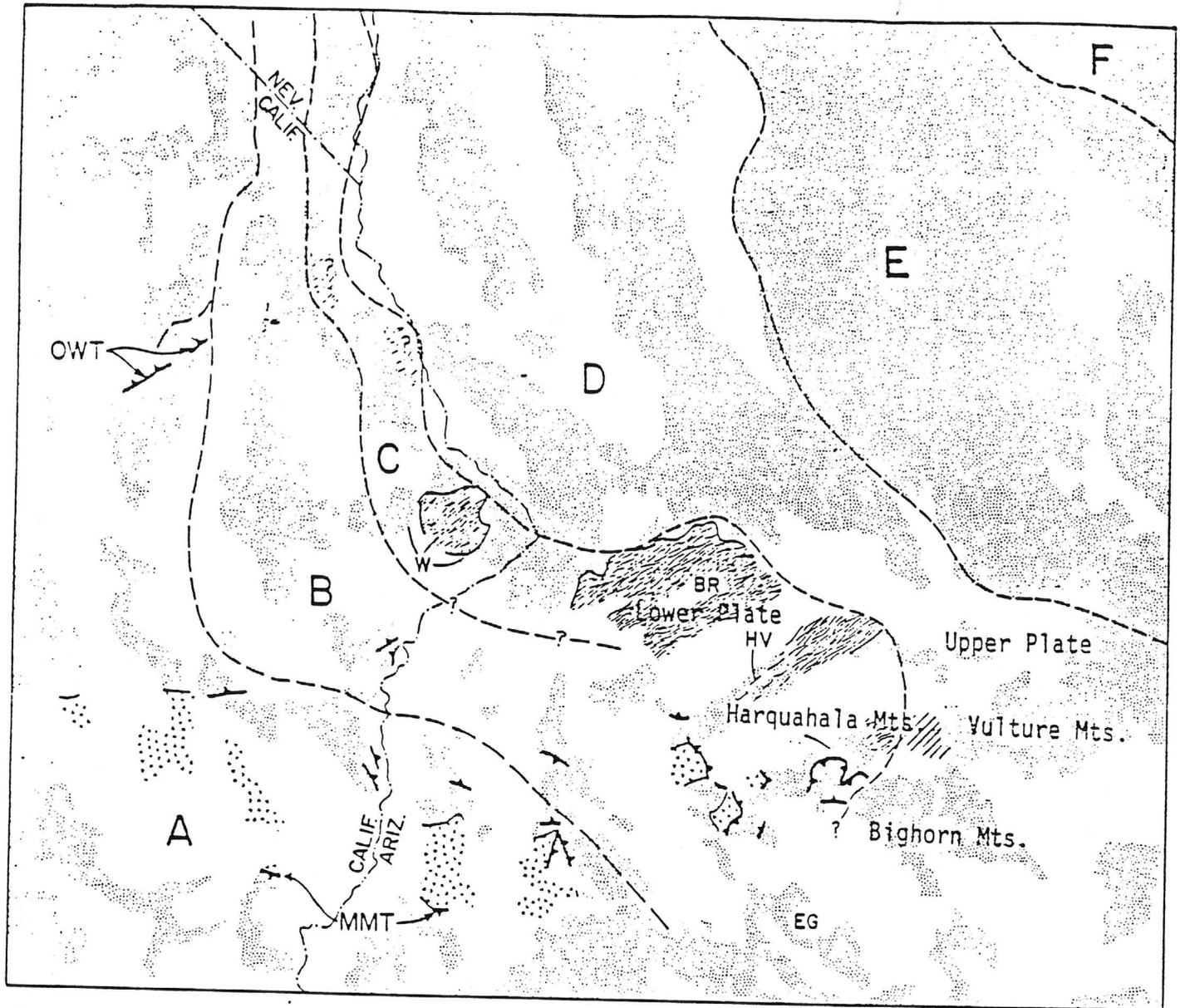
NATIONAL MAP ACCURACY STANDARDS
ENVER 25, COLORADO OR WASHINGTON 25, D. C.
MAPS AND SYMBOLS IS AVAILABLE ON REQUEST



AAA



Location Map - Aguilá Project of James International



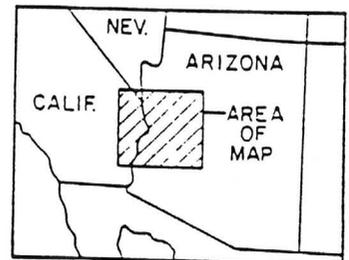
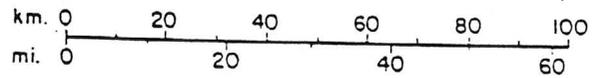
 ROCKS WITH TERTIARY MYLONITIC FABRIC

 MESOZOIC SEDIMENTARY ROCKS OF McCOY MOUNTAINS FORMATION, AND JURASSIC VOLCANIC SUBSTRATE

 ALL OTHER PRE-QUATERNARY ROCKS

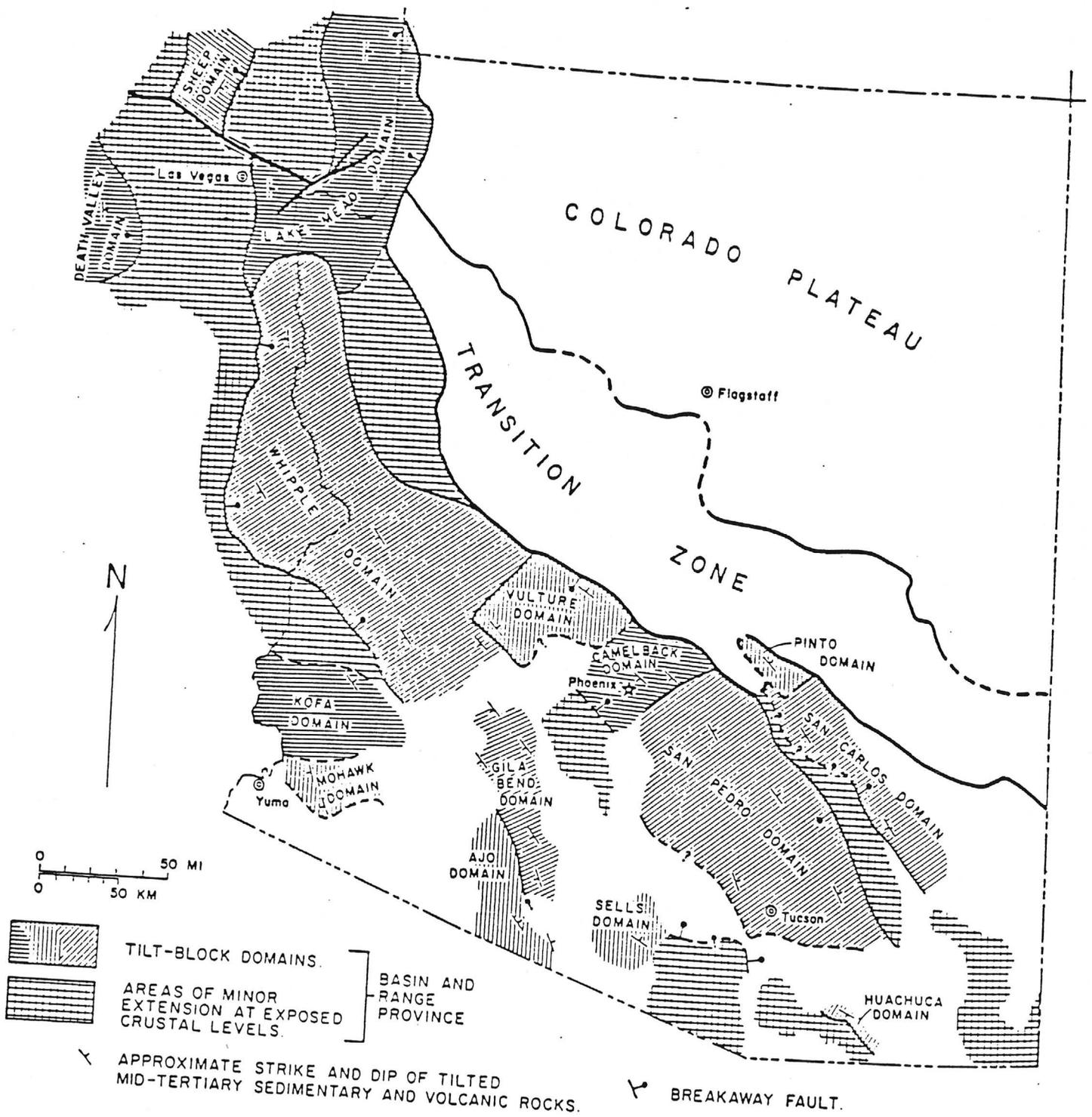
 THRUST FAULT

 Aguila Project Area

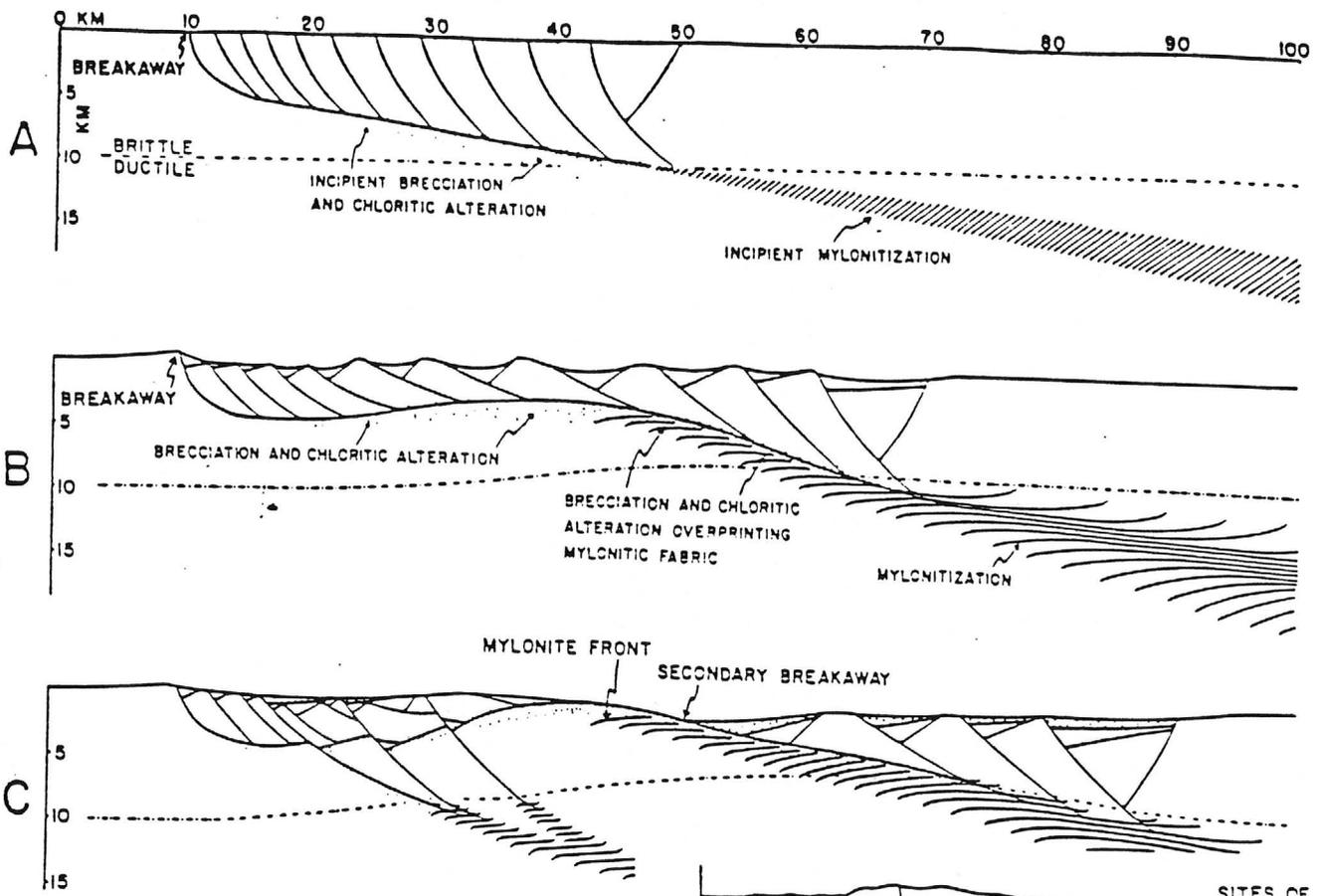


Highly simplified tectonic map of west-central Arizona and adjacent parts of southeastern California. OWT=Old Woman thrust, MMT=Mule Mountains thrust, all other thrust faults shown are part of the Maria fold and thrust belt. Mid-Tertiary tectonic domains are: (A) area of only minor extensional faulting at exposed upper-crustal levels, (B) synformal keel of distended rocks above detachment faults of the Whipple tilt-block domain, (C) belt of arched, uplifted,

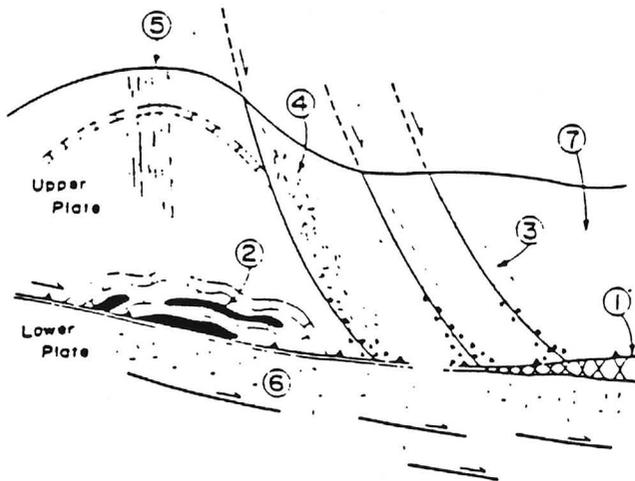
lower-plate crystalline rocks, including Tertiary mylonites, (D) wedge-shaped (in cross section) upper plate of tilted fault blocks above detachment faults of the Whipple tilt-block domain, (E) Transition Zone, and (F) Colorado Plateau. W=Whipple Mountains, BR=Buckskin-Rawhide Mountains, HV=Harcurvar Mountains, H=Harquahala Mountains, B=Bighorn Mountains, EG=Eagletail Mountains, V=Vulture Mountains.



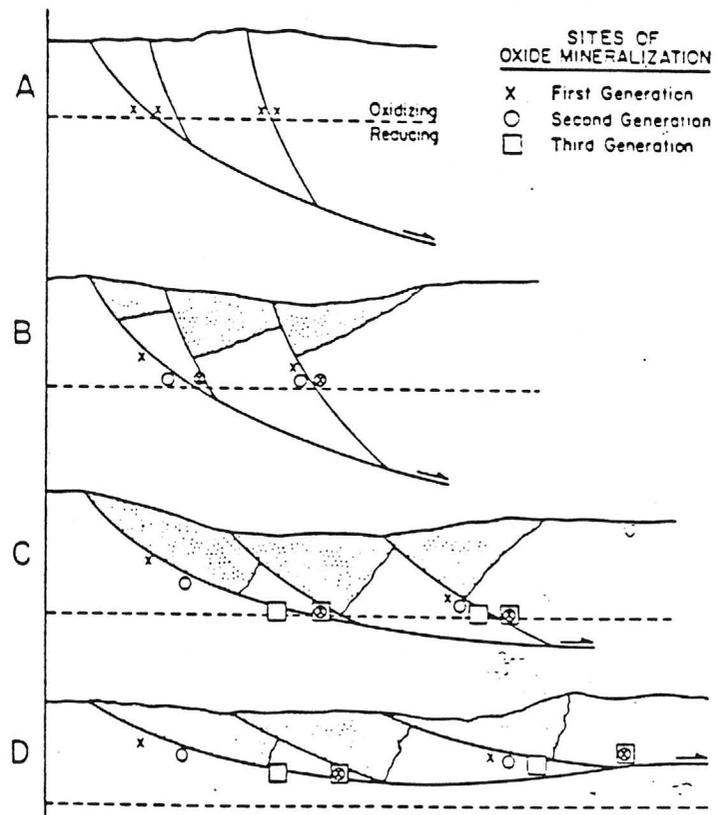
Map of tilt-block domains in the Basin and Range Province of Arizona and adjacent areas.



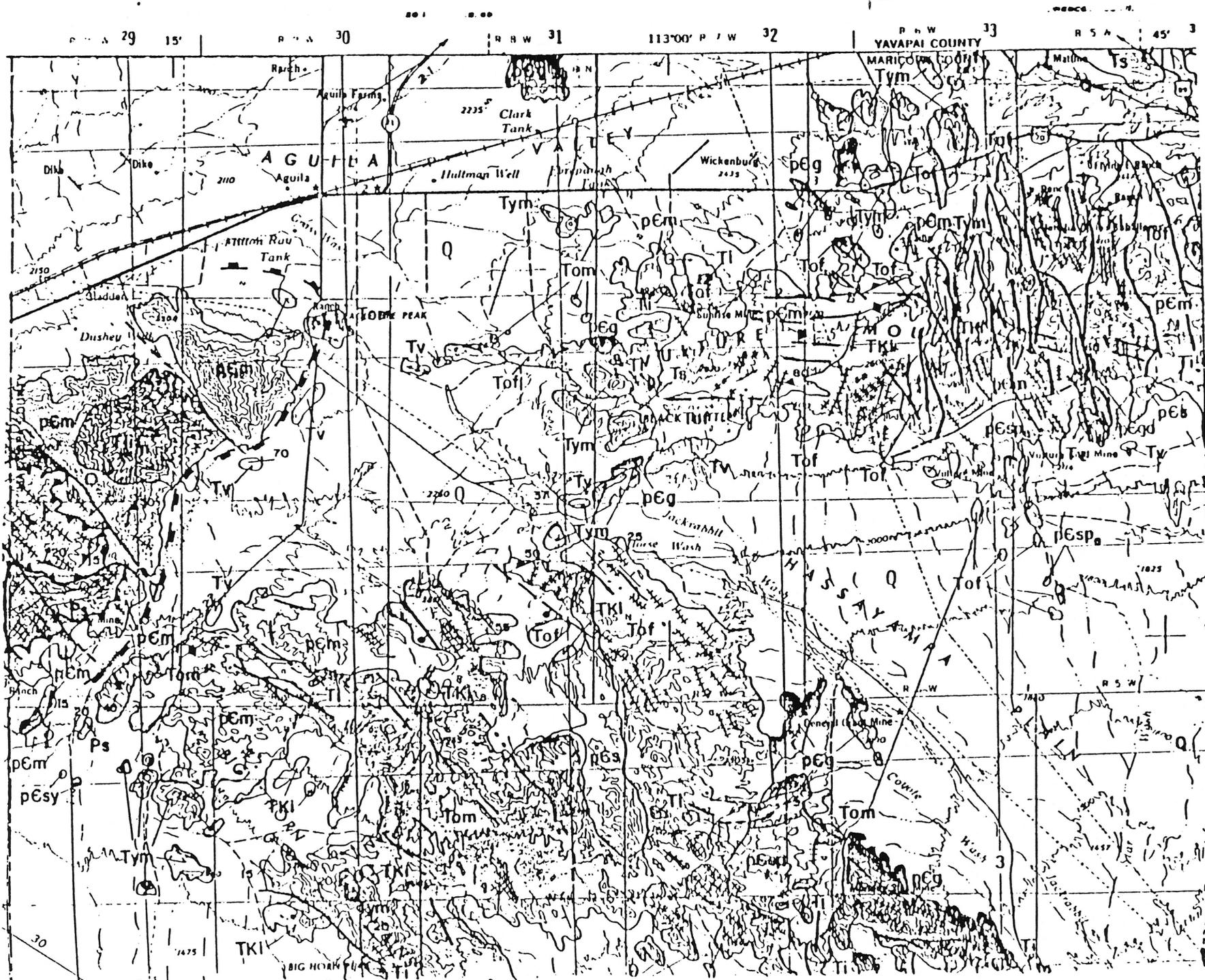
Schematic cross sections showing the evolution of detachment faults and mylonitic detachment complexes; (a) initiation of movement on the detachment zone; (b) isostatic uplift and arching due to variable amounts of upper-plate distension; and (c) one-sided denudation of original detachment zone, and arching caused by reverse drag above structurally deeper, listric normal faults.



Diagrammatic model of mineralization loci in detachment fault-related deposits. 1. Along fault zones; 2. replacing reactive units; 3. in gash veins; 4. listric fault breccia; 5. fold-axis veins; 6. chlorite breccia; 7. tear faults.



Hypothetical evolutionary cross sections showing sites of oxide mineralization during extensional faulting and isostatic uplift of lower-plate rocks. Oxide mineralization is inferred to have occurred where reduced, metal-bearing, aqueous fluids, ascending along fault zones, mixed with shallower level oxidized fluids and precipitated oxide minerals. Movement of subhorizontal redox interface and hanging-wall rocks down gently to moderately dipping footwall at same rate resulted in continuous mineralization at some upper-plate sites over substantial periods of geologic time (sections A, B, C); this mineralization produced large orebodies. Detachment faults are inferred to have dipped more steeply at time of mineralization and to have undergone later rotation to subhorizontal attitudes. Mineralization, rather than occurring in discrete generations or intervals, would probably have been continuous, and it eventually stopped when detachment fault was uplifted through redox interface (section D). Also shown in section D is mineral deposit originally formed in hanging wall



Geologic Map of the Aguilá Project Area of James International.

Sedimentary Units

Q Quarternary alluvial cover
P_s Paleozoic sedimentary rx (undivided)

Volcanic Units

T_{ym} younger Tertiary rx, mostly basaltic < 19my B.P.
T_{of} older Tertiary rx, mostly silicic volc. rx > 19my B.P.
T_{om} older Tertiary rx, intermed. comp. (andesites-dacites)
T_v Tertiary volcanics (undivided); mostly Miocene 30 to 18 my B.P.

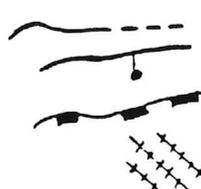
Intrusive Units

T_{li_m} Lower Tertiary (40 to 50 my B.P.) garnet bearing granites, containing biotite/muscovite
T_{ki} Laramide (75 to 50 my B.P.) plutonic rx
T_i Tertiary hypabyssal intrusives (undivided)
pG_g Precambrian granite

Metamorphic Units

pG_{sp_e} Precambrian Pinal Schist
pG_{sy} Precambrian Yavapai Series schist
pG_s Precambrian schist (undivided)
pG_m Precambrian metamorphic rx. (undivided)

Structural Symbols

 fault
normal fault
detachment fault-low angle extensional strux.
bars on hanging wall
Tertiary dikes



Douglas Mountain Exploration

I.L. Turner
Registered Professional Geologist

November 9, 1986

To: Mr. Maurice James Baytown, TX
From: I.L. Turner Golden, CO
Subject: Status report on geological aspects of your Eagle Eye mineral properties near Aguila, Arizona as well as work proposed for the near term.

INTRODUCTION

Following our two recent group meetings at Baytown on 10/17 and 10/29 where we heard of the plans for choosing a reliable assay laboratory and discussed the site at Eagle Eye to collect bulk samples, Jerry James and I traveled to the Aguila - Phoenix/Tucson areas on November 4 - 6. At Aguila, we collected approximately 1,700 lbs of near-surface material from the site of 1985 hole No. 13. A caliche hard pan prevented us from getting any deeper than 3 feet however. The bulk of this sample (1,500 lbs) was delivered to Mountain States Engineering in Tucson on the evening of 11/5. The remaining 200 lbs. of material was taken to Baytown by Jerry on 11/6.

SAMPLE SELECTION/TESTING

Laboratories

At this time, six laboratories are participating in a "round robin" analysis of three samples for Pt, Rh and Au. The three samples are:

- 1) Lead blast furnace slag from Utah
- 2) Aguila drill hole sample split from DH 17 (45-60 ft ?)
- 3) Merensky Reef standard

The laboratories participating in this round robin are:

- 1) Utah International - Sunnyvale, CA
- 2) Ledoux Labs -
- 3) ACS Labs. - Houston, TX
- 4) ARL - Brea, CA
- 5) Quanta Trace - Vancouver, B.C.
- 6) J.B. Labs - Phoenix, AZ

The samples are being analyzed via total dissolution and DCP.

Bulk Sample for Mountain States Engineering

We initially intended to collect a near-surface alluvium sample from the site of DH 16. The 1985 ACS Lab assay:



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<u>ft.</u>	<u>Pt (ppm)</u>
0-5	0.48
20-25	1.6

In order to reconfirm the above, D. Zunkel selected splits from the bucket samples of hole 16: 0-5 ft., 5-10 ft., 10-15 ft. The early results received by telephone reported that values were "not detectable". Later, on 11/7, more thoroughly analyzed results were received:

<u>ft.</u>	<u>Au</u>	<u>Pt</u>	<u>Rh</u>	<u>(all ppm)</u>
0 - 5	.04	.45	.49	
5 -10	.04	.46	.50	
10 -15	.06	1.10	1.12	

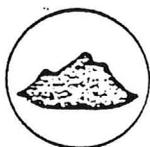
The earlier telephoned report caused us to consider another site for bulk sample collection: Drill hole 13, located 4 miles to the southeast of hole 16 provided the following 1985 ACS Lab analyses:

<u>Hole 13 :</u>	<u>ft.</u>	<u>Au</u>	<u>Pt</u>	<u>Ag</u>	<u>(all ppm)</u>
	0 - 5	<.10	1.3	1.4	
	20 -25	<.10	1.2	0.5	
	45 -50	.28	1.6	0.5	

	145-150	1.10	2.0	<0.1	

Hole 13 bottomed at 165 feet depth. Most of the other holes went to at least 200 feet depth (away from sites in outcrop) suggesting that hole 13 drilled through alluvium but encountered bedrock somewhere around 160 feet depth (no drill logs are currently available for any of the 1985 holes).

It was suggested that analyses of the five foot intervals for the top 25 feet of hole 13 be made as well as the bottom 20 feet of this hole (to determine if there might be a concentration of values at the alluvium/bedrock interface). Analyses received on 11/7 and the earlier 1985 values are presented on the following page:



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Depth (ft)	Nov. 1986		1985	
	Pt	Rh (ppm)	Pt	Au (ppm)
0 - 5	1.98	0.5	1.3	0.1
0 - 5 (repl)	2.10	0.43	-	-
-----?				
10 - 15	0.23	0.08	-	-
15 - 20	1.86	ND	-	-
20 - 25	3.84	0.11	1.2	0.1

140-145	2.14	0.41	-	-
145-150	0.32	0.31	2.0	1.1
150-155	1.30	0.28	-	-
155-160	3.9	0.26	-	-

Representativeness of 11/5 Sample

The 1,700 lbs of sample collected on 11/5 near hole 13 could possibly return analyses of 2.0 ppm Pt. Unfortunately, we were only able to trench to the three foot depth (by hand) because of a very smooth, hard caliche* layer. The sample taken was segregated into three zones: Upper 1 foot - mostly unconsolidated alluvial gravel and soil. Next 1 foot - includes interface of zone 1 with underlying indurated caliche. Two to three foot zone: clean, white caliche surrounding occasional fragments of alluvium.

It is possible that the 0 - 5 ft. values reported for the drill hole cuttings could have come from the 3 - 5 ft. depth and our 11/5 three foot sample is non-representative. However, the fact that previously dug samples in the project area were obviously taken from the top one foot (because of difficulty in digging) and still returned Pt values of interest is encouraging.

MOST PROSPECTIVE AREAS
(BASED ON 1985 SOIL GRIDS)

The only records available concerning the 615-odd soil samples taken late in 1985 are the analytical reports of ACS Labs. The sample designator is of some help inasmuch as it locates the section (1 square mile) in which the sample was taken. Hence: 8 - 26 - K10 tells us that Section 26 (of Range 3W) was the 10th sample taken along a line by Clair Kunkel. The samples were spaced at 100 yd intervals and 17-18 samples covered a mile. By scanning the analytical results, different sections yielded better results than others. Some sections have had more lines sampled than others however:

*

caliche is common in the arid southwestern U.S. and is an in-place precipitate of mostly calcium carbonate that ranges from inches to as much as three feet in thickness. It often occurs as an impermeable and strongly indurated layer that is formed by evaporative processes such as capillary action in which soil solutions rise to the surface and, upon evaporation deposit their salt contents on or in the near-surface materials.



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Better Sections

Mostly Negative Sections

<u>Section</u>	<u>No. of Lines</u>	<u>Section</u>	<u>No. of Lines</u>
35	6	1 (T5H)	2
36	2	2 (T5N)	2
26	4	23	5
14	4	13	1

Note: There is also a series 1300 to 1350; 1500-1530; 1600-1700 that gives no clue as to their locations (at least 130 samples!)

It is likely that the minimum line spacing was $\frac{1}{2}$ mile (4 lines per section) and where 6 lines are indicated, the extra 2 were E - W tie lines.

It should be noted that a 300 ft. by 1320 sample spacing (100yds X 440 yds) is a reconnaissance spacing in most minerals exploration and is considered to be preliminary in nature.

WORK TO BE DONE - NEAR TERM

Our recent trip to Aguila/Eagle Eye has given me a better feel for the overall project. As enthusiasm and field activity increases certain factors previously considered to be relatively unimportant now require attention. These are (not necessarily in order of action or importance):

- 1) Obtain drill logs and soil geochemical sample location maps from D. McFarland OR ...
- 2) Obtain assistance from C. Kunkel in reviewing his 1935 field notes in an attempt to reconstruct some of the more attractive soil sample survey lines.
- 3) Consider overstaking with placer claims the previously-staked lode claims in section 35 because of the preponderance of mineralized alluvium in most of that section*. This really should be done prior to much mechanized field activity. Figure 1 is a diagrammatic cross section showing these lode and placer relationships.
- 4) Backhoe trenching of selected sites in the vicinity of holes 13, 16 and 17.
- 5) Fill-in soil sampling between lines having attractive 1935 values in sections 26, 35, 36 and 14.
- 6) Baseline soil sampling of the Aguila plant site prior to any recovery activity by Eagle Eye Mining.
- 7) Though not a geologic matter, it has been noted that the year-old lode claim posts (and presumably the older, Association placer claim posts) are in need of maintenance -- some are down and their identifying markings are rapidly fading. Consideration should be given to using aluminum "greenhouse tags" for more durable marking.
- 8) Consider the merits of utilizing an Air Trac type drill with compress-

*

This claim staking proposal is covered separately in my 11/9 memo to Bill Miller. The status of section 36 is apparently secure since it is currently covered by a State lease.



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or to drill closely-spaced holes (100 foot grid) to 100-200 foot depths.

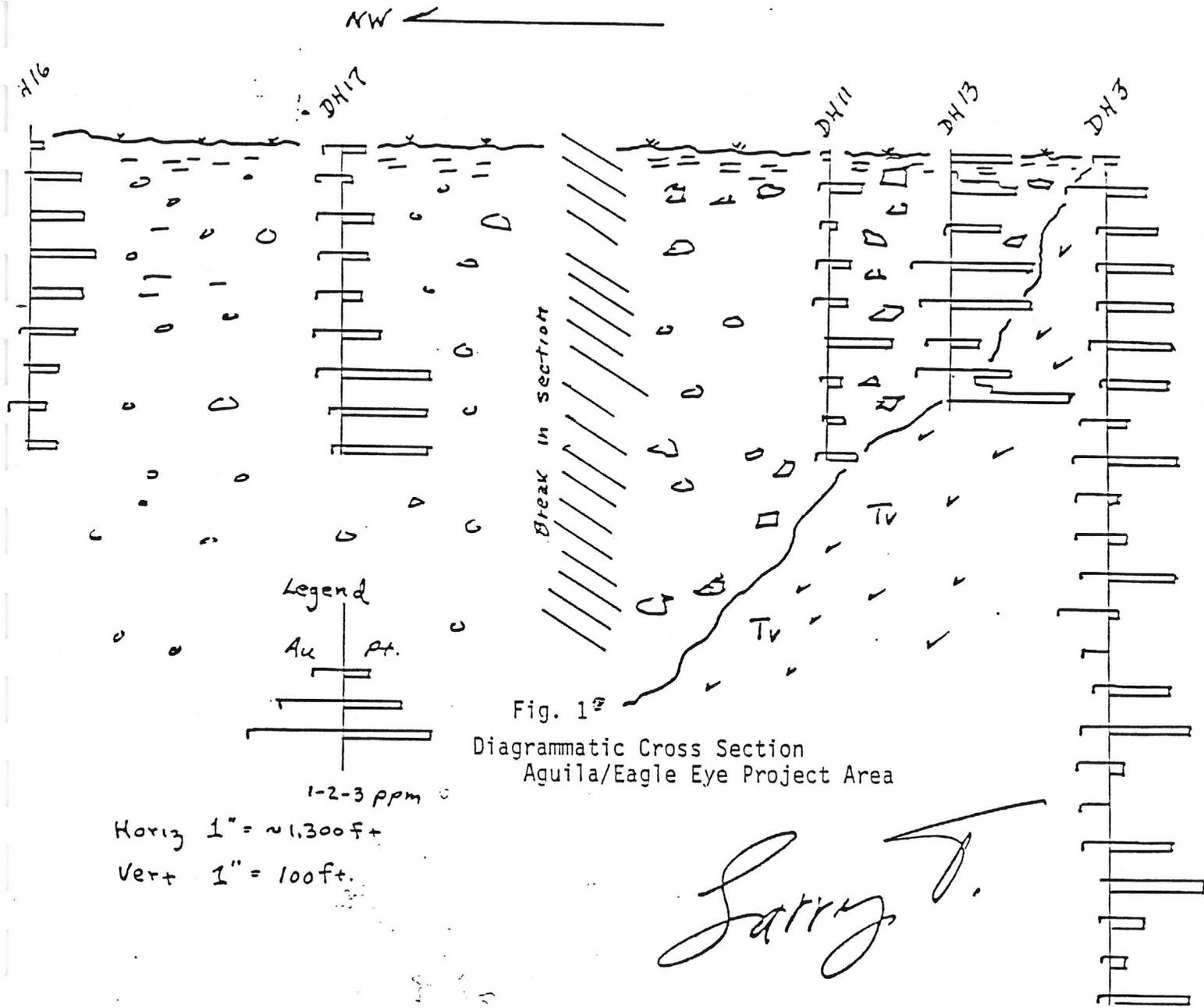


Fig. 1st
Diagrammatic Cross Section
Aquila/Eagle Eye Project Area

Horiz 1" = ~1,300ft
Vert 1" = 100ft.

Larry J.

Xc: Mr. Robert E. Lee - Houston



Douglas Mountain Exploration

I.L. Turner
Registered Professional Geologist

January 11, 1987

To: Mr. Maurice James James International Inc. Baytown, Texas
From: I.L. Turner Golden, Colorado

Subject: ASSESSMENT OF SOIL SAMPLE AND OTHER MISCELLANEOUS FILES
RECEIVED FROM THE OFFICE OF D.G. MC FARLAND AND ASSOCIATES

INTRODUCTION

A small, cardboard file box was collected from the office of Theron Messer (Mountain States Consultants) on December 12, 1986. The contents are purportedly the entire files of D.G. Mc Farland's work on the Aguila Project, Maricopa County, Arizona of James International, Inc.

These files consist of a 1 inch = 1000 scale work map that depicts the locations of some of the soil samples that were collected by Mc Farland and at least three others, a 1 inch = 50 feet scale plane table work map of the outcrop area in Section 35, six poorly kept 3 X 5 inch spiral field notebooks (mostly empty) and a set of assay sheets, copies of which were already available. Other items of little use at this time consist of Mc Farland's correspondence file with James International, another copy of the Chamberlain Report and published NURE regional compilations of soil, water and airborne geophysical data. Drill logs for the reverse circulation holes that were drilled are also available but are mostly incomplete.

By referring back and forth to the map showing sample locations and the sketchy field notes, I was able to "back into" the various locations of approximately 75 percent of the 702 assays that are available. The sample assays that remain an enigma are the 156 samples that make up the 1300 - 1500 - 1600 series. Mc Farland states (12/6/86 letter to M. James) that at least part of the 1600 series are a replicate sampling of his N-S line 8-35-M and that, while at least five of the original M series samples contained gold, none of the replicating five did. There are therefore approximately 150 samples and assays whose site locations remain unknown to me at this time. The effect of these samples are at least treated statistically, as will be seen below.

CRITIQUE OF AVAILABLE SOIL DATA

A base map at a scale of 1 inch = 1000 feet is attached wherein all available information has been used to plot as much information as possible on the distribution of gold and platinum analyses. A second map series is available at a scale of 1 inch = 500 feet. Here, I have plotted the same data



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but more room is available for ease of plotting in the more cluttered areas as well as adding new information/interpretation.

Two general areas continue to be of interest: The South Area (Secs. 35 and 36) where the 1985 drilling of holes 3,7,8,11,12 and 13 took place. A North Area consisting of mostly the SE $\frac{1}{2}$ of Sec. 14 and the W $\frac{1}{2}$ of Sec. 13, T6N, R8W. Only the South Area will be addressed in detail at this time but the statistical analyses presented below and in the following tables use the entire sample population.

General Analysis of Data

In his 12/12/85 letter, Mc Farland is alarmed to have found that early returns on his replicate analyses for gold on line 8-35-M are in marked disagreement with earlier values for the same soil stations. He cautions James International to postpone drilling start-up until this inconsistency is resolved. A six hole series was drilled anyway and was based on outcrop information (holes 3,7,8,) and as step-outs to these holes (holes 11,12,13). The remaining six holes were drilled testing spectral anomalies as interpreted by T. Chamberlain from available Landsat data.

The question raised by Mc Farland was whether ACS Labs had enough control on their procedure for gold analysis to provide reliable results. Tables 1,2,and 3 were constructed here to first review the assay results for Au, Pt and Ag by Laboratory Batch No. (date of assay in chronological order). The question can then be asked whether there was a time when the laboratory may have changed its procedure or some other factor may have been unknowingly changed.

Table 1 lists chronologically the number of samples analyzed and the relative numbers and percentages of samples above "background" ($tr = > 0.1$ ppm)* for each of the three elements. Initial inspection of this table gives the impression that indeed there are lesser numbers of anomalous values for all three elements for those analyses made after November 6. Table 2 is a continuation of Table 1: Thru Nov. 6, 68% of the 325 samples analyzed for gold and 42% of the samples analyzed for platinum are anomalous. After Nov. 6, 33% of the 377 samples analyzed for gold and 0% of those analyzed for platinum are anomalous.

Upon Closer Examination

As the various footnotes of Table 1 indicate, there are extenuating factors relative to certain sample populations and locations that make the suspicion cited above less obvious: Lab. No. 9057 consists of 78 highly anomalous

*

Background as used here perhaps should more rightly be termed above detection limit. It is not meant to imply geochemical background.



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TABLE 1

DATE OF ANALYSES VS. ABOVE BACKGROUND AU - PT - AG VALUES
 AGUILA PROJECT SOIL SAMPLES AND DRILL CUTTINGS
 ACS LABS - OCT. 1935 thru JAN. 1936

Lab. No.	Date	No. Samples	Au > tr (%)	Pt > tr (%)	Ag > tr (%)
8918	10/7	15	8 (53)	NA ¹	9 (60)
8945	10/18	84	76 (90)	22 (26)	35 (42)
8951	10/18	50	20 (40)	8 (16)	4 (8)
8972	10/22	29	17 (59)	16 (55)	2 (7)
9038	10/30	29	22 (76)	25 (86)	9 (31)
9057 ²	11/6	78	72 (92)	51 (65)	2 (3)
9060	11/6	40	5 (13)	14 (35)	0 -
-----?-----?-----?-----?-----					
9081	11/15	83	11 (13)	0 -	6 ³ (7)
9082	11/19	64	12 (19)	0 -	0 -
9105	11/19	65	41 (63)	0 -	3 ³ (5)
9112	11/22	52	35 (67)	0 -	4 (8)
9123	12/10	113	25 (22)	0 -	32 (28)
TOTAL		<u>702</u>	<u>344 (49)</u>	<u>136 (19)</u>	<u>106 (15)</u>

DRILL HOLE CUTTINGS - Holes 3,7,8,11,12,13,14,15,16,17,19

9252A	1/3	49	46	48	27
9269	1/10	59	49	54	30
TOTAL		<u>108</u>	<u>95 (88)</u>	<u>102 (94)</u>	<u>57 (53)</u>

¹ sample not analyzed for Pt

² 9057 Series consists of 78 "SP" samples reportedly from a Mn dump

³ includes a total of 29 close-spaced E-W line samples in anomalous area of Section 35



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TABLE 2

TOTAL SOIL ANALYSES VS ABOVE BACKGROUND AU - PT - AG
- - COMPARISON OF OCTOBER THRU 11/6 AND POST 11/6 TOTALS

	<u>No. Samples</u>	<u>Au > tr (%)</u>	<u>Pt > tr (%)</u>	<u>Ag > tr (%)</u>
<u>10/7 thru 11/6</u>	325	220 (68)	136 (42)	61 (19)
11/15 thru 12/10	377	124 (33)	0 -	45 (12)
Total	<u>702</u>	<u>344 (49)</u>	<u>136 (19)</u>	<u>106 (15)</u>



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samples that were collected over manganese dump rock. When these 78 samples are removed from the pre November 15 population, the percentage of anomalous Au falls to 60% and anomalous Pt to 34%. Still, the absolute failure to detect Pt in the post Nov. 6 analyses is significant.

Table 3 is an attempt to learn if the "mysterious" 1300 - 1500 - 1600 series behaved any differently. Once again, the comparison is 79% for Au and 93% for Pt prior to Nov. 15 and 49% for Au and 0% for Pt afterward.

CONSIDERATION OF THE DRILLING ASSAYS

Analyses for Au, Pt and Ag of the 108 samples taken from the eleven drill holes (bottom Table 1) show that 88% of these are anomalous in Au, 94% are in Pt and 53% are in Ag. Admittedly we are dealing with rock samples here rather than the generally lower metal content soil samples, yet the gold samples are certainly anomalous (0.5 to multi ppm) and the Pt samples are very much so (1 to 4 ppm).

IN CONCLUSION

If there truly was some sort of laboratory correction or change intentional or otherwise that took place between November 6 and November 15, it was not so great as to totally eliminate anomalous gold in the later soil samples and it certainly doesn't seem to detract from the January, 1986 analyses of the drill hole cuttings.

Examination of the 1 inch = 500 foot soil plot map for the South Area shows two areas that are persistantly anomalous in gold. The platinum anomalies are more suspect since they are limited to but one soil line.

FUTURE WORK

If no further soil work is to be done prior to drilling, I suggest that our efforts be confined to the two areas enclosed by the greater than 0.8 ppm contours on the 1 inch = 500 foot map.

Drilling in the southernmost anomaly has a greater chance of testing the overlying gravels, the gravel/bedrock interface and the underlying rock itself than will drilling in the northern anomaly.

It is unfortunate that the available data are in such disarray but it can be seen that at least this disarray is not total.



Douglas Mountain Exploration

TABLE 3

DATE OF ANALYSES VS. ABOVE BACKGROUND AU - PT - AG VALUES
 1300 - 1500 - 1600 SERIES *
 ACS LABS

	<u>Lab. No.</u>	<u>Date</u>	<u>No. Samples</u>	<u>Au > tr (%)</u>	<u>Pt > tr (%)</u>	<u>Ag > tr (%)</u>
00 Series	9038	10/30	9	8 (89)	8 (89)	3 (33)
	9060	11/6	5	3 (60)	5 (100)	0 -
	9081	11/15	17	2 (12)	0 -	0 0
	9082	11/19	10	4 (40)	0 -	0 -
1500 Series	9123	12/10	15	15 (100)	0 -	13 (87)
1500 Series	9081	11/15	14	4 (29)	0 -	0 -
	9082	11/19	13	0 -	0 -	0 -
	9105	11/19	20	9 (45)	0 -	3 (15)
	9112	11/22	39	29 (74)	0 -	4 (10)
	9123	12/10	14	6 (43)	0 -	4 (29)

1300 - 1500 - 1600 SERIES
 PRE 11/6 VS POST 11/6

thru 11/6	14	11 (79)	13 (93)	3 (21)
post 11/6	142	69 (49)	0 -	24 (17)
Total	<u>156</u>	<u>80 (53)</u>	<u>13 (8)</u>	<u>27 (17)</u>

*

note that the collection locations of the bulk of these samples (> 90%) remain unknown at this time

- 6) Mix ore sample, flux mixture, and collector mixture (5b1) by rolling and grind by a single pass through a clean Bico mill.
- 7) Agglomerate by a method to be determined by experimentation (see Attachment II).
 - a) starter slag mixture (3)
 - b) ore sample/flux/collector mixture (6)

This is necessary to minimize loss of material during furnace charging. Weigh the agglomerated starter slag to the nearest gm. Weigh the agglomerated ore/flux/collector mixture to the nearest gm.

- 8) Gradually charge agglomerated starter slag mixture to a weighed alumina crucible in electric arc furnace and melt to a fluid slag; measure temperature with optical pyrometer.
- 9) Gradually add agglomerated ore/flux/collector mixture to crucible maintaining a fluid slag. When all mixture is added, continue heating for 15 minutes to assure collection of PGMs; measure temperature; weigh any mixture not charged to the furnace.
- 10) Turn off furnace and allow melt to settle and freeze in crucible; when cool, weigh crucible and contents. Separate slag (Slag 1) and metal (Metal 1) from crucible; weigh Slag 1, Metal 1, and pieces of crucible to nearest gm.
- 11) Grind Slag 1 to 100% - 100 mesh in a clean Bico mill; weigh Slag 1, split out a 2000 gm sample by riffing or cone and quartering, and retain 2-30 gm samples. Mix 2000 gms Slag 1 and collector mixture (5b2) and agglomerate as in 7. Weigh Slag 1 not used in agglomeration.
- 12) Gradually charge agglomerated mixture into second weighed alumina crucible and reheat in electric arc furnace as in 9 to produce fluid slag. When slag is fluid, continue heating for 15 minutes; measure temperature.
- 13) Turn off furnace and allow melt to settle and freeze in crucible; when cool, weigh crucible and contents. Separate slag (Slag 2) and metal (Metal 2) from crucible (as in 10). Weigh Slag 2, Metal 2, and crucible pieces to nearest gm.
- 14) Crush Slag 2 in mortar and pestle and grind to 100% - 20 mesh; sample by riffing or cone and quartering and retain 2-30 gm samples.
- 15) Drill or saw Metal 1 and Metal 2 to obtain 2-30 gm cross sectional samples of Metal 1 and 2-10 gm samples of Metal 2.
- 16) Submit Metal 1, Metal 2, Slag 1 and Slag 2 samples for Fe/Au/Pt/Rh analyses.

- 17) Calculate feed ore Au/Pt/Rh content from weights and analyses according to formula:

$$O = \frac{a M_1 + 2b M_2}{\emptyset}$$

where O = feed ore PGM analysis
 \emptyset = weight of ore sample
a = analysis of PGM in Metal 1
M₁ = weight of Metal 1
b = analysis of PGM in Metal 2
M₂ = weight of Metal 2

PGM content of fluxes and collector constituents are assumed not detectable. CuO, C, and fluxes will be assayed if required, however.

- 18) Calculate material balance based on Fe (or equivalent) analyses of ore, fluxes, slags, and metal; balance should close within 5%.

$$wG + f F + g \emptyset = h M_1 + i M_2 + j S_2 + k S_1$$

where g = analysis of Fe in ore sample
h = analysis of Fe in Metal 1
i = analysis of Fe in Metal 2
j = analysis of Fe in Slag 2
f = analysis of Fe in ore flux
w = analysis of Fe in starter slag
k = analysis of Fe in Slag 1
F = weight of ore flux
G = weight of starter slag
S₁ = weight of Slag 1 not used to form Slag 2
S₂ = weight of Slag 2

Cautions

- 1) All crushing, grinding, mixing, and weighing equipment must be cleaned thoroughly before each use to prevent contamination. See Attachment 3 for additional comments on contamination prevention.
- 2) All weighing should be to nearest gm.

ATTACHMENT 1

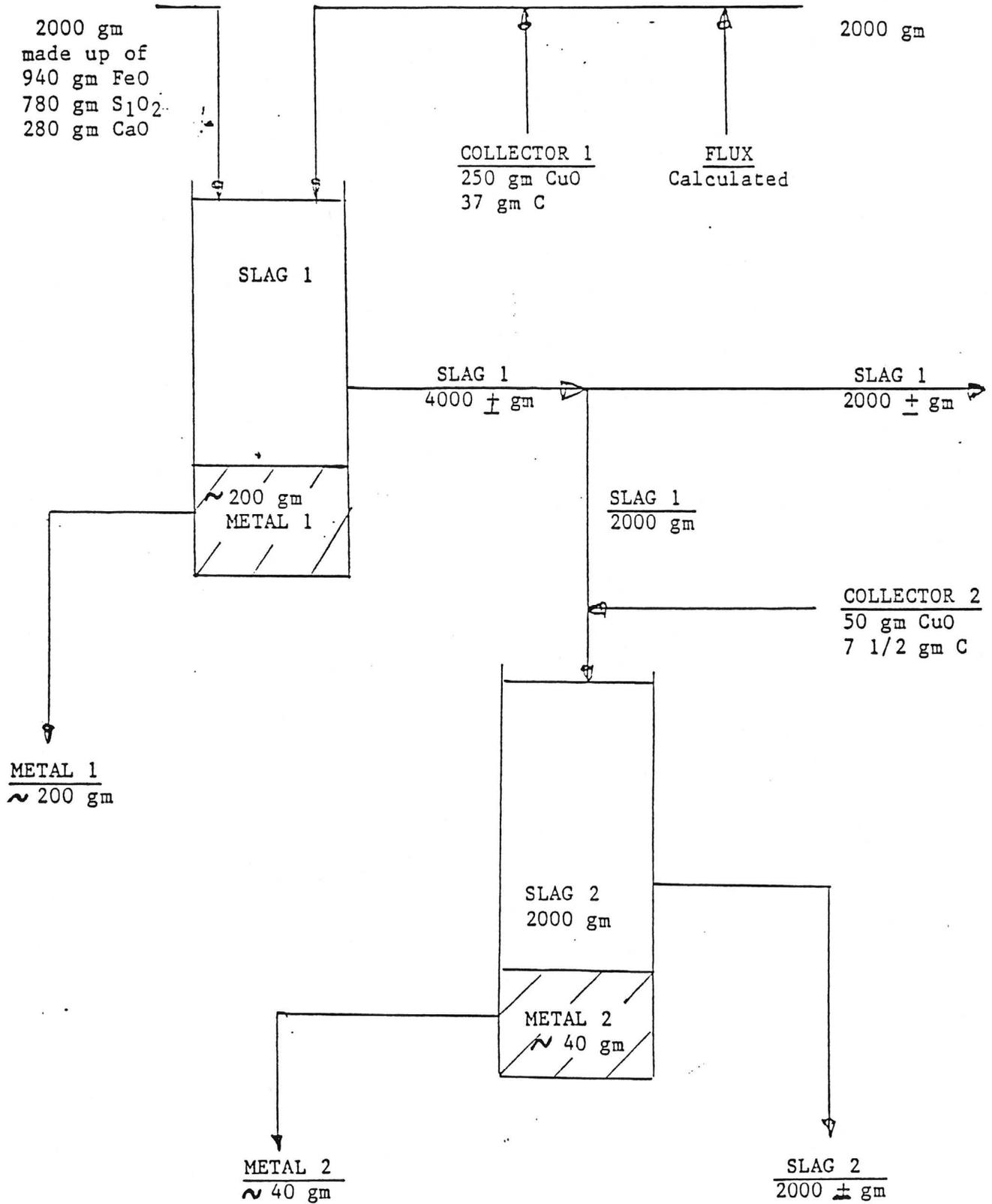
AGUILA ORE ANALYTICAL PROCEDURE FLOW DIAGRAM

STARTER SLAG

2000 gm
made up of
940 gm FeO
780 gm SiO₂
280 gm CaO

ORE SAMPLE

2000 gm



ATTACHMENT 2

Agglomeration Experimental Program

If either the starter slag mixture or the fluxed Aguila ore is added to an operating electric arc furnace, dust losses will be unacceptably high. Dusting losses can be reduced by agglomerating the charge. Three approaches are suggested below. They should be tested on a sample of approximately 100 gms.

- 1) addition of water followed by casting, curing and drying
 - 2) addition of sodium silicate
 - 3) addition of Portland cement
-
- 1) Water addition would be the simplest technique and would rely on the reaction of the unslaked lime with the silica to bind the material together. Sufficient water (about 30%) would be added to make a stiff paste which would be thoroughly mixed. The material would be poured out onto a sheet of plastic in a 1/2" thick layer and allowed to air harden. Final curing would be done at 100°C or higher, in an oven. The cured material will be broken up with a hammer. Alternatively, the material can be cast into a plastic grid and removed after curing as small 1/2" cubes. Although this method will probably be satisfactory for the synthetic slag, its utility with the Aguila ore must await the ore assay. If the lime requirements are low, in all likelihood, method 2 or 3 will be required.
 - 2) Instead of water, an aqueous solution of sodium silicate would be added to the ground ore; fluxing corrections for the sodium silicate added will be made. The balance of the preparative procedures is the same as 1).
 - 3) Instead of water, Portland cement about 5% by weight will be added, appropriate flux corrections would be made, and water would be added to make a stiff paste. Preparative procedures would be as in 1).

In all cases, the final dry weight of the agglomerated starter slag and the fluxed Aguila ore will be recorded along with the weight of water, water glass (sodium silicate) and Portland cement added.

ATTACHMENT 3

Contamination Considerations

The very low level of platinum and iridium group metals present in Aguila ore, combined with the potential for contamination at James International in Baytown because of the many and varied platinum group metal bearing materials at that location, creates significant operating problems in carrying out the proposed testwork (fire assay in effect) on Aguila ore.

Ideally, the work would be best undertaken at another site free of potential contamination. In the absence of this option the following is recommended.

Sample Drying - The drying oven should be thoroughly cleaned by scrubbing with detergent and rinsing with demineralized water prior to use. If simply plugged in rather than wired in, it should be removed to a dust-free location as far from precious metals as possible.

Coning and Quartering - This cannot be done in the smelting area. A clean vacuumed office space with a bare floor would be preferable. Fresh paper should be used for each sample preparation.

Grinding - Only the BICO mill should be used for grinding, and that only after removal and replacement of the grinding discs and scrupulous cleaning of the mill. Several hundred grams of silica should be ground in the mill and discarded prior to using the mill on the samples. The synthetic slag should be ground before the Aguila ore.

Crushing - The jaw crusher may not be safely used for crushing samples. Instead an iron mortar and pestle should be purchased and used for breaking up larger material to a size which may be fed to the BICO mill. Although this is a laborious process it eliminates a potential source of substantial contamination.

Smelting Tests - The furnace and all ancillary equipment must be scrupulously cleaned prior to use. Crucibles used for smelting tests must be kept closed and away from any contamination. At the completion of the smelting test the crucible should be covered during the cooling period.

Copper Oxide Collector - This material should be analyzed for platinum and rhodium. Fire assay is not required for this analysis. Dissolution plus ICP or direct DC spark should be adequate at the contemplated detection levels.

Preparation of Slag from Smelting Operations - As mentioned previously, the slab should be crushed in a cast iron mortar and pestle and then ground in the BICO mill. Precautions described before in the use of the mill must be observed. The slag should be

ground to -20 mesh, coned and quartered to 500 grams, the 500 gram sample ground to -100 mesh and split to 100 gram samples by cone and quartering.

Sampling of the Copper Button - The copper button must first be freed of all slag. Then it should be sawed in half across its major diameter using a new, clean hacksaw blade. Using either half of the button, a second cut should be made parallel to the first cut to produce a slice approximately 1/16" thick. This slice should be pickled in a solution of hydrochloric acid plus hydrogen peroxide to remove surface contamination due to the saw blade, then rinsed in distilled water and dried.

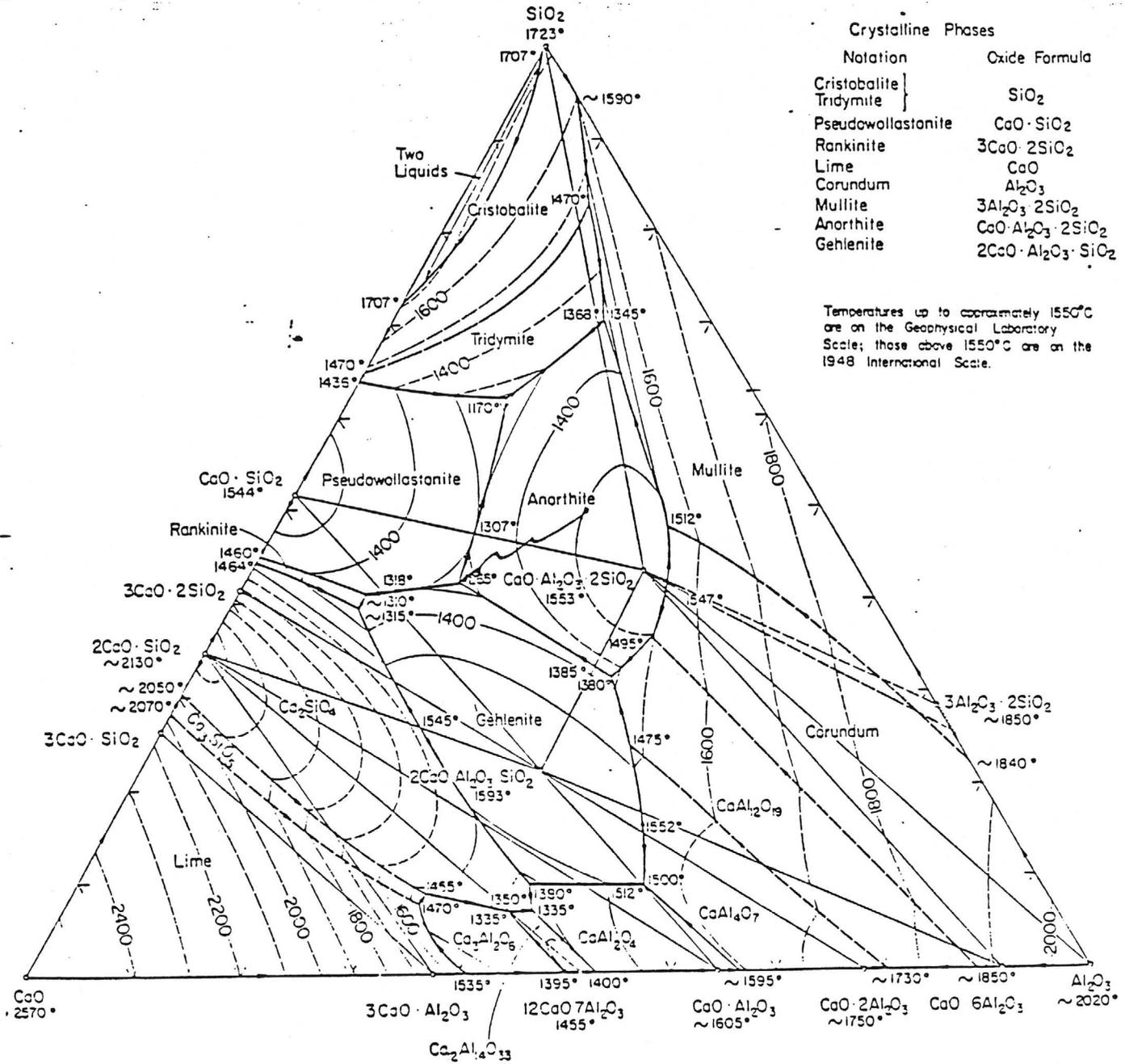


FIG. 630.—System CaO-Al₂O₃-SiO₂; composite.

E. F. Osborn and Arnulf Muan, revised and redrawn "Phase Equilibrium Diagrams of Oxide Systems," Plate 1, published by the American Ceramic Society and the Edward Orton, Jr., Ceramic Foundation, 1960.

Principal References

L. Dav, E. S. Shepherd, and F. E. Wright, *Am. J. Sci.* (4th series), 22, 285-302 (1906).
 J. H. Weich and W. Gutt, *J. Am. Ceram. Soc.*, 42, 11-15 (1959).
 N. L. Bowen and J. W. Greig, *J. Am. Ceram. Soc.*, 7, 238-34 (1924); corrections, *ibid.*, 410.
 V. A. Teropov and F. Ya. Galakhov, *Voprosy Petrograf. i Mineral., Akad. Nauk S.S.S.R.*, 2, 245-55 (1953).
 J. A. Rankin and F. E. Wright, *Am. J. Sci.* (4th Series), 39, 1-79 (1915).
 J. W. Greig, *Am. J. Sci.* (5th Series), 13, 1-44; 133-54 (1927).
 N. E. Filonenko and I. V. Iavrov, *Zhur. Prikl. Khim.*, 23, 1049-56 (1950); *J. Appl. Chem. (U.S.S.R.)*, 23, 1105-12 (1950) (English translation).
 Shigeo Aramaki and Rustum Roy, *J. Am. Ceram. Soc.*, 42, 344-45 (1959).

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15 December 1986

TO: Maurice L. James

FROM: A. D. Zunkel *Z*

SUBJECT: Mountain States Engineering Test Program Monitoring, 2-4 December 1986

INTRODUCTION

On 2-4 December 1986, I visited Mountain States Engineering in Tucson, Arizona to monitor the key operations of our program to produce PGM-containing concentrates from a bulk sample of Aguila geologic material. The sample was obtained by Larry Turner and Jerry James on Wednesday, 5 November 1986, by surface sampling near Drill Hole 13.

CONCENTRATION PROGRAM

The program objective is to produce concentrates from Aguila geologic materials by various mineral beneficiation methods and determine which method or methods yield a reasonable recovery of PGMs. The beneficiation methods selected for examination were:

- o jigging
- o tabling
- o froth flotation
- o dry magnetic separation
- o dry electrostatic separation

The following paragraphs detail my observations and conclusions regarding the tests. These thoughts, however, must be tempered with the fact that no mineralogical examination or chemical analyses for precious or platinum group metals were done on any products generated during the work. The simplified flowsheet giving the sequence of operations performed and the material balance is attached as Table 1. You may wish to refer to this flowsheet as I describe these tests and results.

Affiliate: Jan H. Reimers and Associates Inc.
Oakville, Ontario, Canada

Principals: W.R. Snelgrove, P. Eng. and John C. Taylor, P. Eng.

Sample Preparation

1634 pounds of Aguila material were delivered to Mountain States Engineering in three lots representing three successive 1-foot horizontal slices hand dug near Drill Hole 13. Since these samples were significantly different in type of material and size distribution, the decision was made to stage crush all samples to -1/4" rather than screen at 1/4" and reject the +1/4" as originally planned. Following crushing to -1/4", the three samples were composited into 1554 pounds of master sample for the test program.

The master sample was screened at 20 mesh to produce 854 pounds of coarse +20 mesh and 700 pounds of fine -20 mesh material. The fractions were subjected to minerals beneficiation techniques most applicable for minerals recovery for the respective size fractions:

- | <u>+20 mesh</u> | <u>-20 mesh</u> |
|-----------------|----------------------------|
| o jigging | o tabling |
| | o froth flotation |
| | o dry magnetic separation |
| | o electrostatic separation |

Concentrates from these operations were to be analyzed by Mountain States Engineers for gangue forming constituents for slag composition calculations and then by Eagle Eye Mining Company personnel for gold, platinum, and rhodium by the Baytown electric arc furnace technique.

Jigging

100 pounds of the +20 mesh material were processed in a 4" x 6" Denver mineral laboratory jig. Three products were generated:

- o 1.9 pounds of hutch concentrate
- o 2.1 pounds of bed
- o 91.5 pounds of tails

The jig operated properly; the heavy hutch concentrate represents a material concentration ratio of 52:1. No unusual events occurred during the test; the product had no unusual or notable visual characteristics.

Tabling

100 pounds of -20 mesh material were processed on a 40" x 18" Wilfley laboratory table. Two products were generated:

- o 16 pounds of table rougher concentrate
- o 77.2 pounds of table tails

The table was operated to maximize recovery by making a large rougher concentrate split which would contain most of the heavy minerals. The rougher concentrate contained a significant amount of what appeared to be magnetite, a smaller amount of an unidentified iridescent mineral, and a significant amount of apparent gangue material. The table operated well with no unusual occurrences.

To maximize grade of the material recovered from the table, the table rougher concentrate was processed on an 18" laboratory Archimedes spiral to produce:

- o 0.21 pounds of spiral concentrate
- o 15.8 pounds of spiral tails

The separation of the magnetite-appearing mineral from the gangue was excellent, producing a black magnetic concentrate and a clean tails.

Since 0.21 pounds of spiral concentrate was bordering on too small for analyses by the electric arc furnace technique, an additional 200 pounds of -20 mesh material was processed on the table and spiral to produce:

- o 0.48 pounds of spiral concentrates
- o 24.1 pounds of spiral tails
- o 164.0 pounds of table tails

This second table-spiral test showed behavior similar to that of the first test; the products were similar also. The material concentration ratio to spiral concentrates for the combined three tests was 435:1.

Froth Flotation

Tails from the table tests were subjected to froth flotation to recover fine values. Three 2.2 pound tests were run in a Denver laboratory flotation cell to examine the effects of grind on the flotation product. One sample was floated as received; one with 5 minute polish grind; one with 15 minute fine grind. Reagents were added which float sulfides, oxides, carbonates, and metals to produce a nonselective rougher flotation concentrate. Appropriate activators and frothers were also added. The results were:

Test	Rougher Flotation Concentrates (Pounds)	Rougher Flotation Tails (Pounds)
JM-6	0.20	2.09
JM-7	0.32	1.97
JM-8	<u>0.43</u>	<u>1.86</u>
	0.95	5.92

All tests behaved the same, producing a very slimy froth which was impossible to differentiate from the slurry; no visible separation between minerals seemed to occur. This is not surprising since little, if any, sulfides are present and any metallics would be very fine. Only the amount of mineral floated changed with grind--more rougher concentrate with finer grind. Concentration ratios varied from 5.3 to 11 for the three tests. These three concentrates can be composited for analyses via the electric arc furnace technique.

Dry Magnetic Separation

26.4 pounds of -20 mesh material was processed on a laboratory Carpco dry magnetic separator. Dry separation is preferred due to potential water availability problems in the Aguila area. Maximum magnetic intensity was selected to maximize recovery of magnetic materials. Hand magnet scalping was then used to pick up residual material not recovered by the separator. The results were:

- o 0.25 pounds of magnetic concentrates
- o 26.1 pounds of nonmagnetic tails

The separation was reasonably effective considering the spectrum of particle sizes in the feed. Fines in the feed tend to be entrapped in the magnetic material and carried over to the concentrates. Magnetic separator operation appeared normal; the concentrate was highly magnetic with nonmagnetic fines attached. Concentration ratio was 106:1.

Electrostatic Separation

4.4 pounds of -20 mesh material was processed on a laboratory Carpco electrostatic separator. Maximum electrostatic field strength was selected to maximize recovery of conductors. Bulk processing of the sample was unsuccessful as no separation and excessive dusting occurred at the conditions selected. The sample was then screened into -20 +48 mesh, -48 +100 mesh, -100 +200 mesh, and -200 mesh fractions and processed under conditions suitable for each size fraction. Dusting was still a problem but not as severe as with the bulk sample. Results were as follows:

<u>Size Fraction</u> (Mesh)	<u>Conductors</u> (Pounds)	<u>Nonconductors</u> (Pounds)
-20 +48	0.098	1.17
-48 +100	0.006	0.63
-100 +200	0.075	1.21
-200	--	0.87
Total	<u>0.179</u>	<u>3.88</u>

Visually no difference was observed between the conductors (concentrates) and nonconductors (tailings). Concentration ratio was 25:1.

CONCENTRATE ANALYSES

Concentrate samples were analyzed by Mountain States Engineering for gangue constituents and loss on ignition (LOI) so slag composition for the electric arc furnace procedure can be calculated.

Material	CaO	Fe ₂ O ₃	Al ₂ O ₃	MgO (%)	SiO ₂	Na ₂ O	LOI
Spiral concentrate	10.4	24.3	4.5	5.6	26.1	2.7	4.1
Jig hutch concentrate	25.6	2.9	5.1	1.7	28.5	12.6	25.7
Magnetics concentrate	10.9	23.0	7.6	2.5	34.2	4.5	11.5
Flotation rougher concentrate	29.8	1.9	5.1	1.8	22.0	14.6	32.7

Review of these data suggest that concentrates produced by the spiral and magnetic separator were very similar and much different from those produced by jigging and flotation, which were also very similar. Au, Pt, and Rh analyses are awaited.

SAMPLES REMAINING / COST OF ADDITIONAL TESTS

All samples not returned to Baytown for electric arc furnace procedures remain at Mountain States for further testing if warranted. The quantities remaining are:

- o 690 pounds +20 mesh feed
- o 305 pounds -20 mesh feed
- o 225 pounds table tails

The cost of additional test work is estimated by Mountain States Engineering at:

- o 100 pound jigging test - \$400
- o 100 pound table test - \$500
- o 22 pound flotation test - \$500
- o 200 pound wet magnetic separator test - \$630

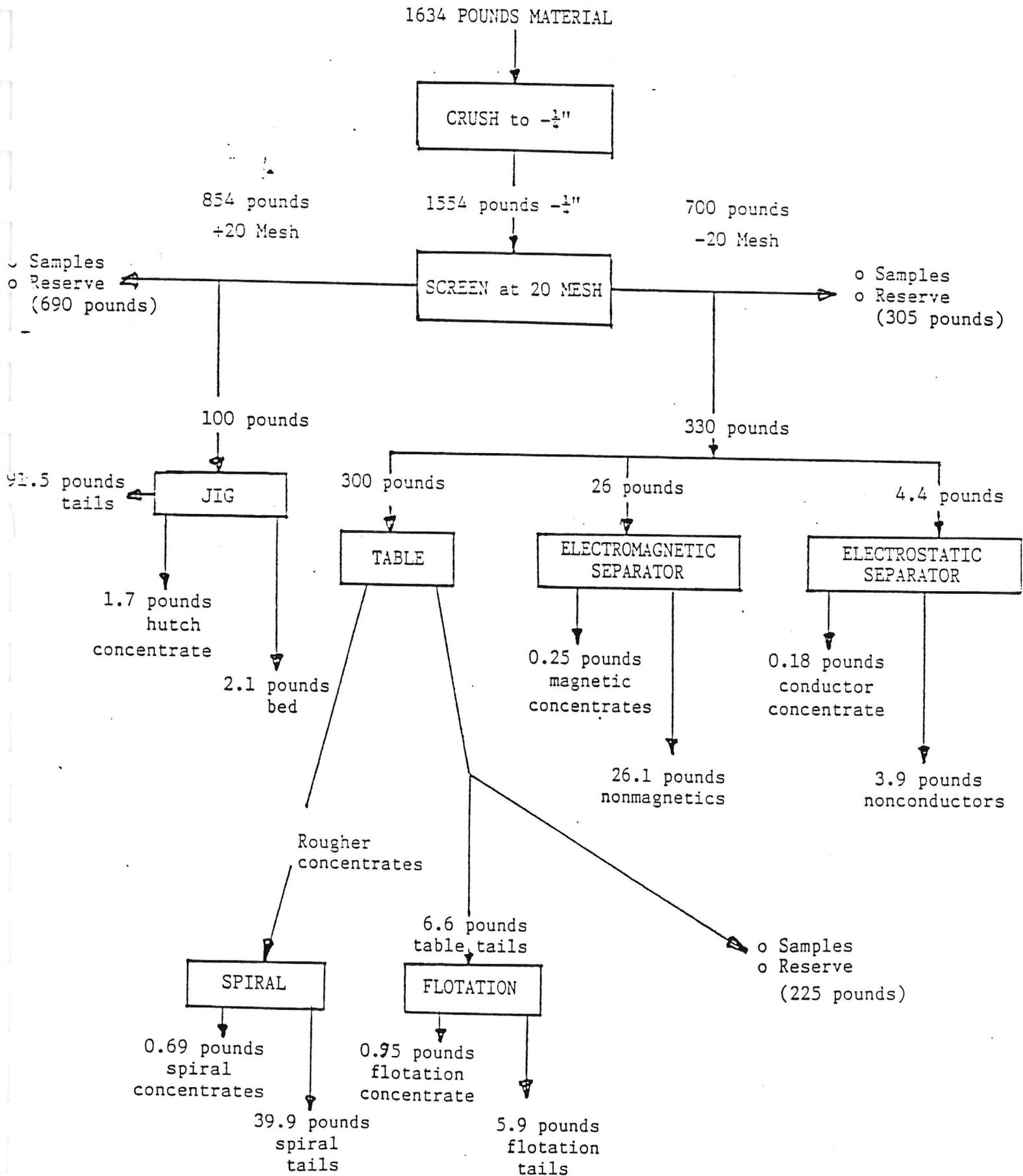
SUMMARY

Tests of the five beneficiation methods physically produced concentrates from Aguila material. However, which methods to pursue, if any, await Au, Pt, and Rh analyses from the electric arc furnace procedure.

A formal report is being prepared by Mountain States Engineering which will detail further the procedures followed and the test results. No recommendations will be offered. This report will be available 19 December 1986.

cc: J. E. Hoffmann
R. E. Lee

TABLE 1. SIMPLIFIED AGUILA MATERIAL FLOWSHEET



AGUILA PROJECT:
PRELIMINARY METALLURGICAL INVESTIGATION

For

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By

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Prepared By: James F. Minno
James F. Minno
Process Engineer

Approved By: Joseph F. Shirley
Joseph F. Shirley
Senior Vice President
General Manager

Project No. 2618

Date: December 17, 1986



INTRODUCTION

A suite of (3) three rock samples weighing approximately 500 pounds each and identified as 1F-JL, 2F-JL, and 3F-JL were received on November 6, 1986 at the Mountain States Research and Development (MSRD) laboratories in Tucson, Arizona. Each sample was separately crushed, sampled and analyzed for platinum, rhodium, gold and silver. All samples were then combined and identified as Composite No. 1. The composite was sampled, analyzed for platinum, rhodium, gold and silver and used for metallurgical testing. The test program included screening, gravity concentration, magnetic separation, electrostatic separation, flotation, screen analysis and chemical analysis. All metallurgical tests and analysis were performed according to accepted standard laboratory practices. Test work was directed and observed by Mr. Doug Zunkel, client representative for Eagle-Eye Mining. At client request report will not include metallurgical discussion, conclusions or recommendations.

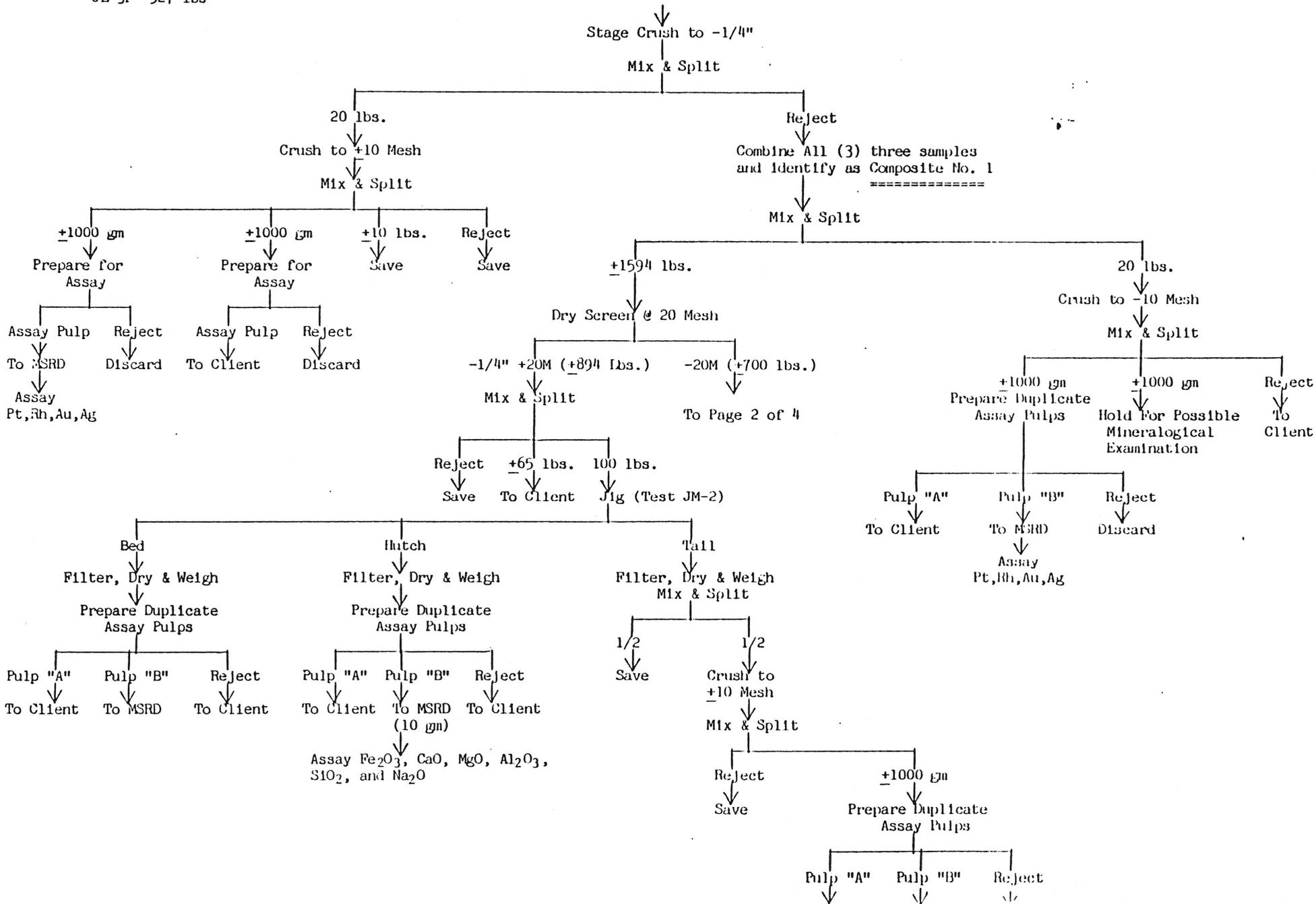
TEST PROGRAM/PRODUCT SUMMARY

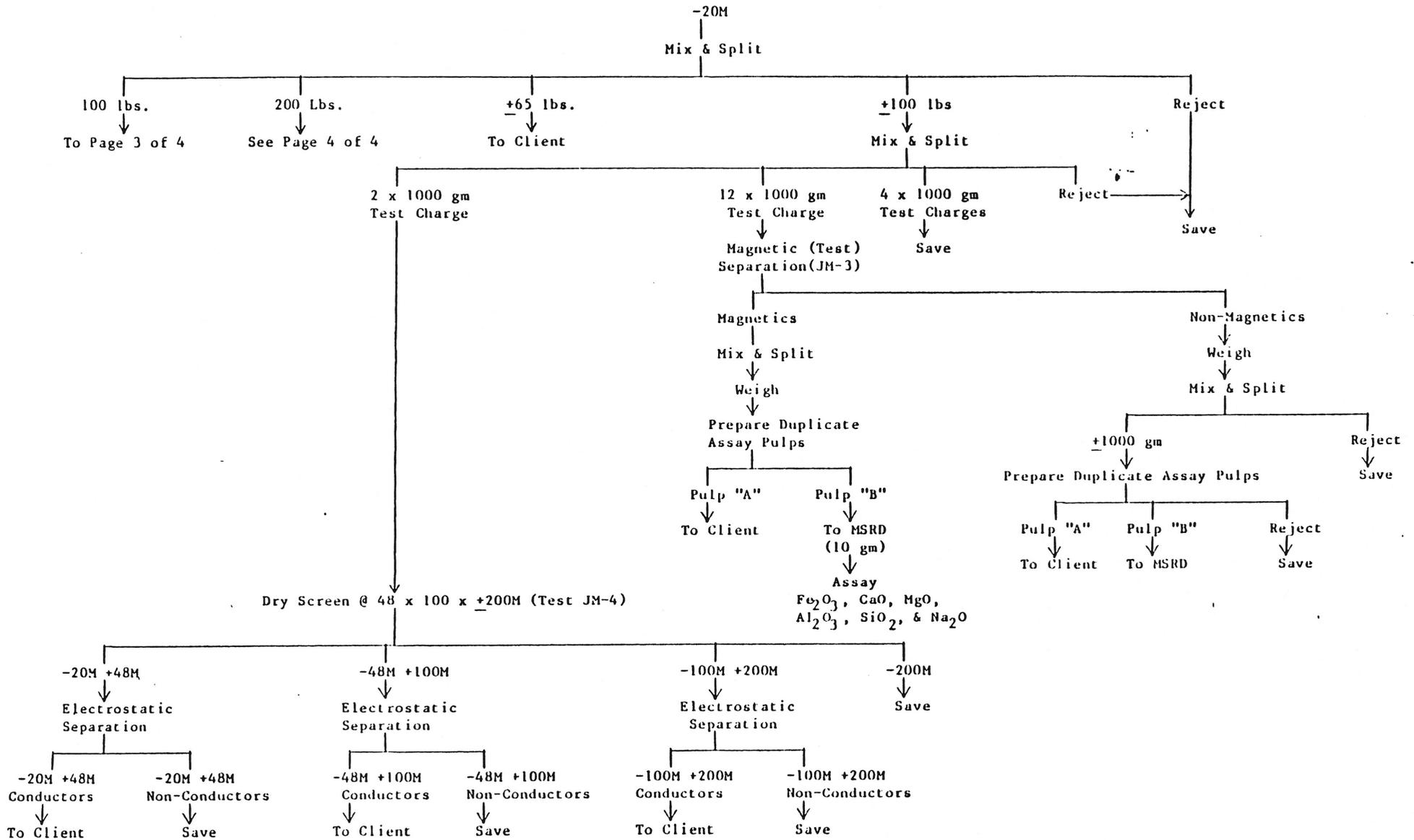
Test No.	Feed Weight		Feed Size	Test Description	Test Products	Product Weight	
	Pounds	Kgs.				Pounds	Kgs.
JM-1 	100.00 	45.360 	-20M 	Tabling followed by cleaning of table concentrate utilizing an Archimedes Spiral.	Archimedes Spiral Conc. Archimedes Spiral Tail Table Tail	0.21 15.80 77.19	0.0975 7.1651 35.0134
JM-2 	100.00 	45.360 	-1/4" +20M 	Jig	Jig Hutch Jig Bed Jig Tail	1.84 2.08 91.52	0.8346 0.9416 41.5123
JM-3 		12.000 	-20M 	Magnetic Separation	Magnetics Non-Magnetics		0.1120 11.8880
JM-4 		2.000 	-20M 	Dry Screening followed by Electro Static Separation on individual screen fractions	-20M +48M Conductors -20M +48M Non-Conductors -48M +100 Conductors -48M +100M Non Conductors -100M +200M Conductors -100M +200M Non-Conductors -200 Mesh		0.0447 0.5318 0.0028 0.2872 0.0345 0.5507 0.3934
JM-5 	200.00 	90.720 	-20M 	Tabling followed by cleaning of table concentrate utilizing an Archimedes Spiral.	Archimedes Spiral Conc. Archimedes Spiral Tail	0.48 24.10 142.02	0.2197 10.9318 64.4184
JM-6 		1.0000 	-20M 	Bulk Rougher Flotation (-20M) Rougher Tail	Rougher Concentrate		0.0900 0.9498
JM-7 		1.0000 	-20M 	Bulk Rougher Flotation (Polish Grind)	Rougher Concentrate Rougher Tail		0.1475 0.8934
JM-8 		1.0000 	-20M 	Bulk Rougher Flotation (Fine Grind)	Rougher Concentrate Rougher Tail		0.1958 0.8470

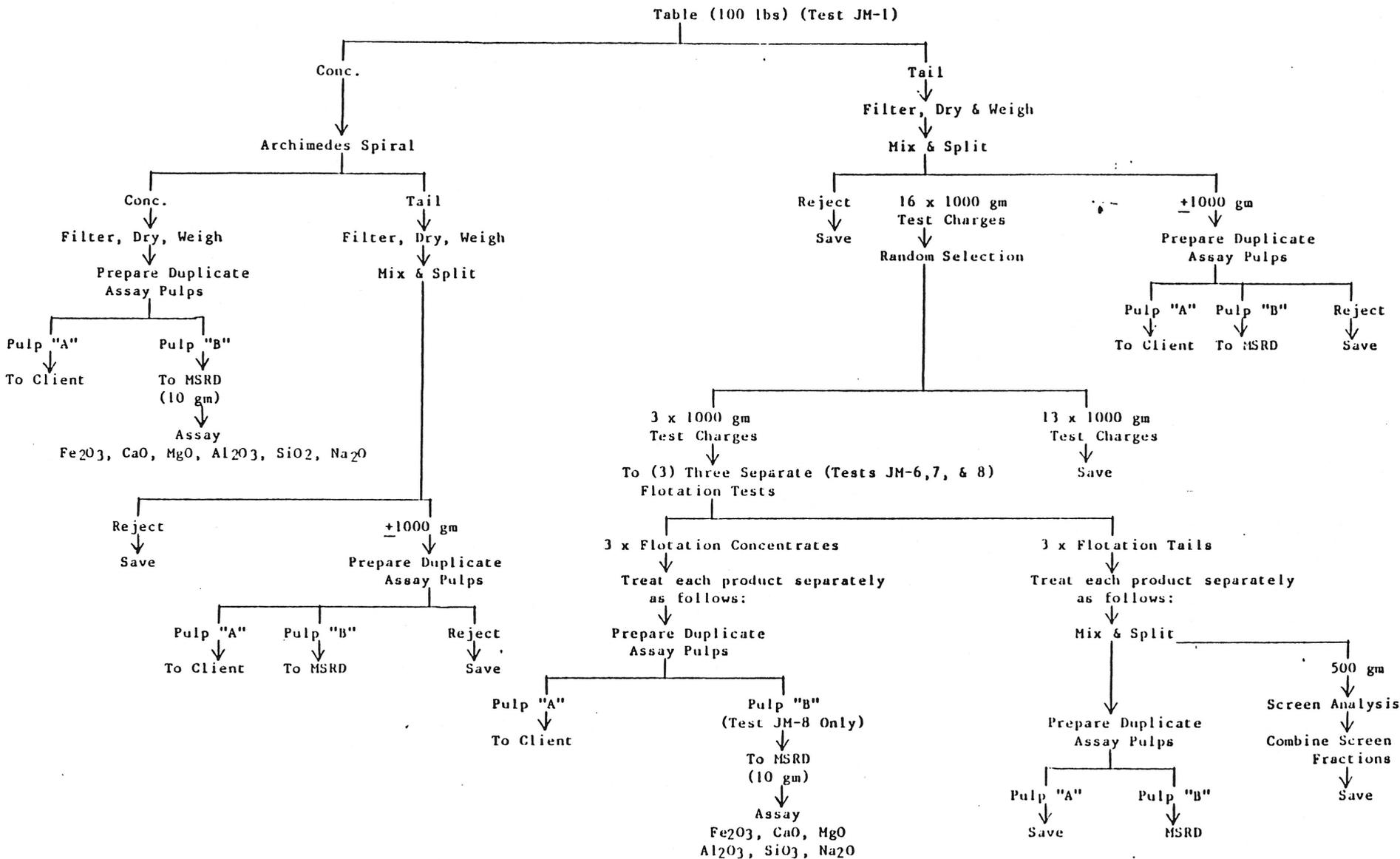
SAMPLE PREPARATION AND TEST PROCEDURE FLOWSHEET

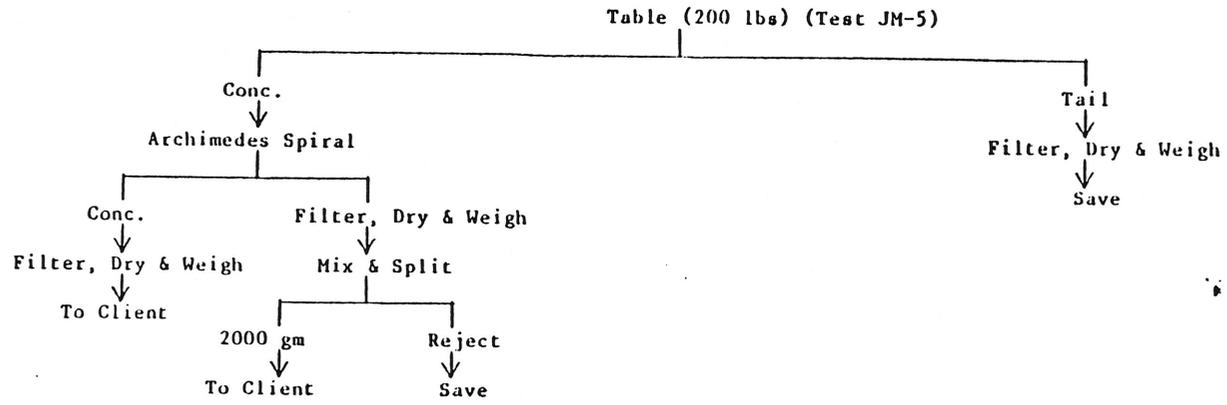
Samples: JL-1F 562 lbs
 JL-2F 545 lbs
 JL-3F 527 lbs

Treat each sample separately as follows:









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BLOCK FLOW DIAGRAM: AGUILLA ORE PROCESSING

Introduction

This report provides a block flow diagram for processing of Aguilla ore. A brief description of the various steps shown in the block flow diagram is offered below. It should be recognized that the flow diagram shown is indicative of the overall processing approach but subject to considerable modifications as required.

Processing Steps

Crushing and Grinding - Conventional crushing and grinding equipment will be employed e.g. jaw crushers, crushing rolls, etc. Wet grinding will be avoided if possible.

Screening - Dry screening will be employed. Preliminary indications suggest that a comparatively coarse screening will be sufficient.

Concentration - Jigging and air tabling will be considered, among other processes, for gravity concentration. Conventional magnetic separation techniques will be employed with this dry feed.

Charge Preparation - The charge materials will be intensively mixed by pug milling or similar techniques. The mixture will probably require agglomeration by briquetting or pelletizing.

Electric Furnace - The material will be smelted under controlled reducing conditions to produce a fluid slag and a copper-precious metals bearing melt. Dust and fume from the furnace will be captured in a high energy scrubber and recycled to the charge preparation step.

Atomization - The copper will be air or water atomized to produce a finely divided product readily leachable in the subsequent step.

Countercurrent Leaching - Two stage countercurrent leaching will be employed to generate a rich precious metals concentrate while ensuring no loss of precious metal values in the leach liquor.

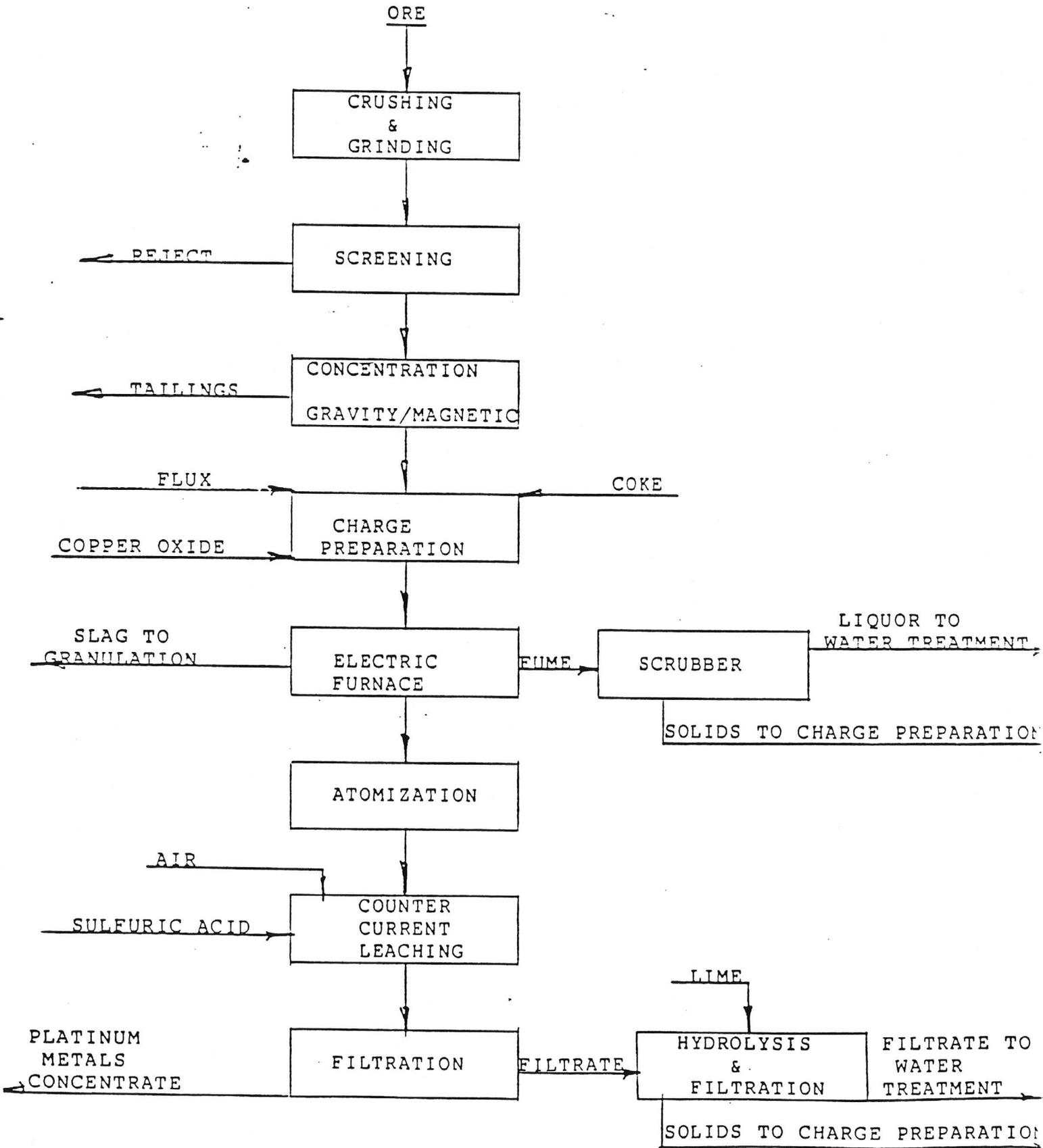
Filtration - Filtration will recover the precious metals, as finely divided solids, from the copper sulfate solution generated by leaching. The concentrate should be about 10% precious metals.

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Oakville, Ontario, Canada

Principals: W.R. Snelgrove, P. Eng. and John C. Taylor, P. Eng.

Filtrate - The filtrate will be neutralized with lime to precipitate the copper as a basic salt. The copper containing cake will be recycled back to the charge preparation step.

BLOCK FLOW DIAGRAM: AGUILLA ORE PROCESSING



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16 February 1987

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FROM: Alan D. Zunkel *z*

SUBJECT: Aguila Platinum Recovery

Based on Quantatrace's preliminary analytical results for platinum in Aguila smelting test materials which you provided me on 12 February 1987 and weight data from the Mountain States Engineering Aguila ore beneficiation test program conducted in December 1986 (summarized in Table 1), the platinum material balances shown in Table 2 for magnetic concentration and flotation concentration are calculated:

TABLE 1. AGUILA MATERIAL PRELIMINARY ANALYSES AND WEIGHTS

Material	Platinum Analyses (ppm/opt)	Material Weight (tons, based on 1 ton head ore feed)
Head Ore	3.3/0.096	1.00
-20 Mesh Material	3/0.087	0.44
Magnetic Concentrate	111/3.2	0.0042
Flotation Concentrate	13/0.38	0.046

TABLE 2. AGUILA PLATINUM MATERIAL BALANCES

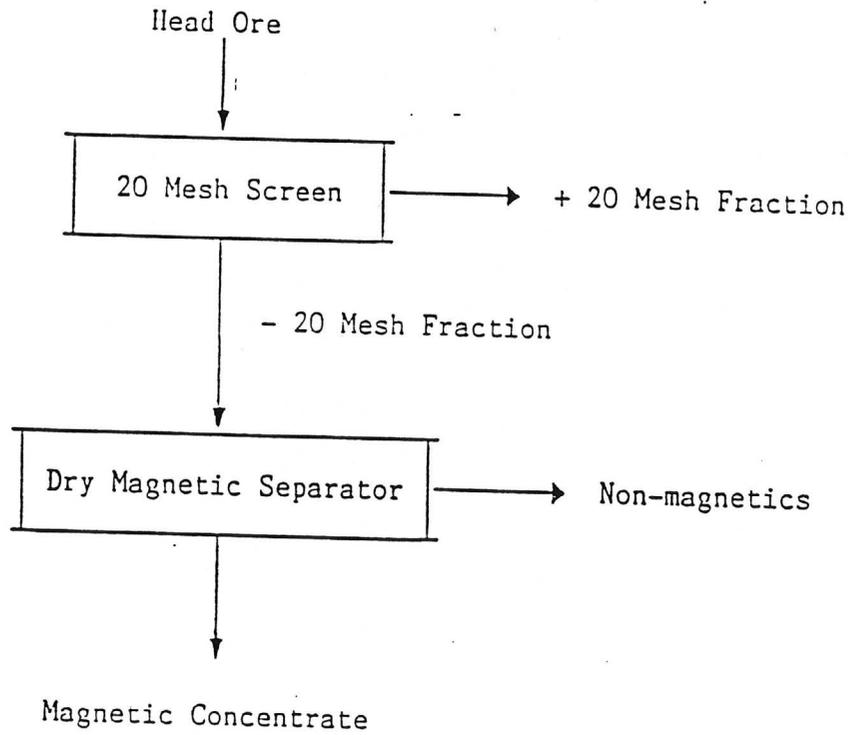
	<u>Magnetic Concentrate</u>	<u>Flotation Concentrate</u>
Total Platinum in Head Ore (oz)	0.096	0.096
Platinum to Concentration Operation (oz)	0.038	0.038
Platinum in Concentrate (oz)	0.014	0.017
Platinum Recovery from Head Ore (%)	14	18
Platinum Recovery in Concentration Operation (%)	36	46

Affiliate: Jan H. Reimers and Associates Inc.
Oakville, Ontario, Canada

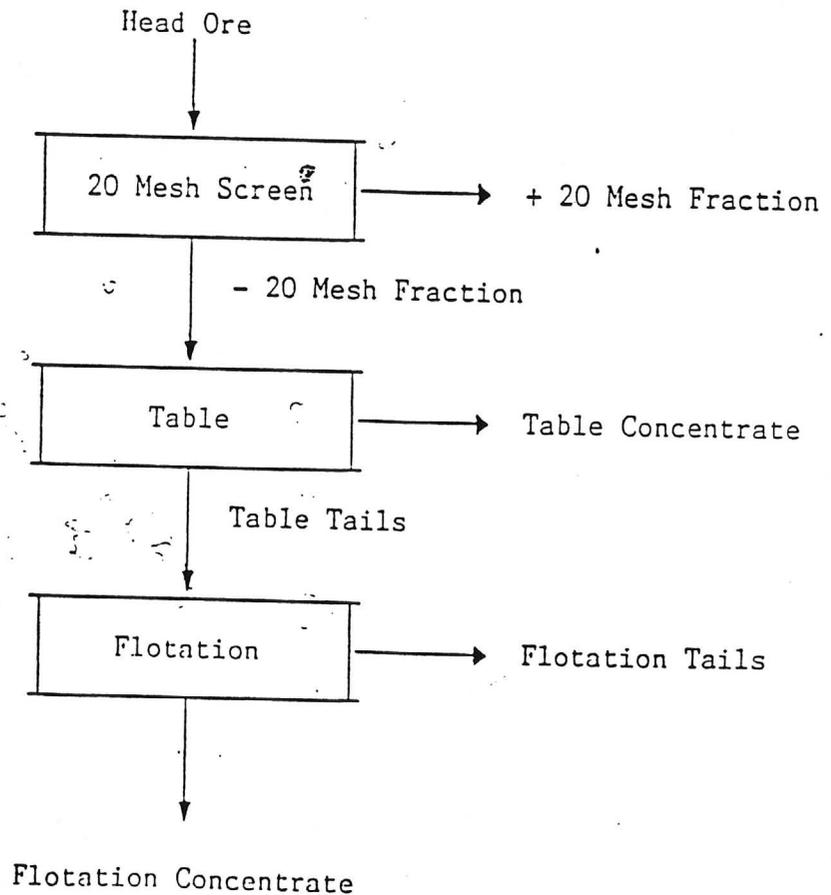
Principals: W.R. Snelgrove, P. Eng. and John C. Taylor, P. Eng.

The flowsheets represented in these material balances are:

MAGNETIC CONCENTRATION
CIRCUIT



FLOTATION CIRCUIT



From these data, the following conclusions can be drawn:

- o Dry magnetic concentration upgrades Aguila ore to a magnetic platinum-bearing concentrate which can be further processed for platinum recovery. Approximately 14% platinum recovery from head ore can be expected in the magnetic concentration step.
- o If adequate water is available, an additional 18% of the platinum contained in the head ore can be recovered by flotation of the nonmagnetics.
- o Since the concentration steps have not been optimized, improvement in recovery beyond those levels stated above can be expected.
- o Assessment of concentration and recovery of other precious and platinum group metals in head ore such as gold, ruthenium, osmium, iridium, and palladium await completion of sample analysis by Quantatrace.

ADZ/cc

cc: Mr. J. E. Hoffmann
Mr. R. E. Lee
Mr. S. C. Finch

JAN H. REIMERS AND ASSOCIATES USA INC.

Consulting Metallurgists

P.O. BOX 420545

HOUSTON, TEXAS

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Principals:

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SMELTING TESTS OF AGUILLA ORE SAMPLES

Introduction

Smelting tests were made on a variety of ore samples from James International to determine their platinum content. This report briefly describes the smelting procedure and the results obtained on Runs 46, 49, and 52.

Procedure

The procedure set forth below has as its objective concentrating the gold, platinum, and iridium metals content of the various ore samples in a metal button by smelting the sample in the presence of copper oxide under reducing conditions. Appendix 1) Aguilla Ore Analytical Procedure, although modified somewhat in actual application, provides a more detailed description of the smelting practice.

- 1) Grind the sample to at least -60 mesh.
- 2) Split out, by cone and quartering, the weight of sample for the fusion test.
- 3) Calculate the flux additions for the slag composition chosen.
- 4) Mix flux additions, copper oxide, coke, and ore sample thoroughly by rolling on paper.
- 5) Pass all of the sample through the BICO disc mill to produce an approximately -100 mesh product. Mix again by rolling on paper.
- 6) Smelt the sample by gradually feeding the charge into a pool of molten copper metal in a clay graphite crucible heated by a pair of DC arc graphite electrodes.
- 7) When the charge is completely fused, heat for an additional 5 - 10 minutes.
- 8) Turn off the power, withdraw the electrodes and allow the charge to freeze.

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Principals: W.R. Snelgrove, P. Eng. and John C. Taylor, P. Eng.

- 9) Recover and weigh the slag and copper alloy button.
- 10) Sample the button by drilling and analyze for copper, silicon and iron.

Results

Results are provided below for Runs 46, 49, and 52. In all three runs flux additions were calculated to produce the 1265 C. ternary eutectic slag composition in the system CaO-Al₂O₃-SiO₂. Appendix II shows the constitution diagram for this ternary system. The actual composition sought is marked.

Table I Smelting Results

	<u>Run 46</u>	<u>Run 49</u>	<u>Run 52</u>
Aguilla Ore Fraction	Magnetic Conc.	Head Ore Comp.	-20 Mesh Ore
Wt of Ore Fraction (g)	50	1153.8	2000
Total Charge Wt. (g)	2550.5	2115.3	3724.3
Copper Alloy Wt. (g)	414.6	385.7	474.6
Copper/Silicon (%)	91.5/7.2	80/11.5	85/10
Copper Recovery (%)	89.4	84.9	89.7%

The copper alloy buttons were drilled and the drillings submitted to Quantatrace Laboratories in Burnaby, British Columbia for analysis. The results are shown below in Table II

Table II Analysis of Copper Alloy Buttons (ppm)

	Ag	Au	Pt	Pd	Rh	Ru	Os	Ir
Run 46								
Run 49	21	6	9	30	<3	30	39	90
Run 52								

Discussion

A number of aspects of this study are discussed below.

Fuming and Dusting Loss - The intensity of the arc smelting process coupled with the finely divided nature of the charge created a substantial loss of material during charging/smelting operation. The copper recovery from each smelting operation has been used to define this overall loss. In other words, if the copper recovery, as in Run 46, is 89.4%, then the assumption is made that the recovery of precious metals is only 89.4% and that the amount of precious metals in the ore sample is 1/.894 times as great as that found. This is a legitimate method of defining the actual recoverable precious metal values since dusting losses in a commercial unit should be less than 2% of the charged material.

Phase Settling Time - Typically, residence time of the slag and metal phases in a commercial operation is at least several hours. In the arc smelting tests actual settling time is the time between removal of the arc electrodes and the solidification of the melt. This occurred in a few minutes. Performing these smelting tests in a commercial furnace will undoubtedly improve the distribution of precious metals between the slag and metal phase, i.e. the recovery of platinum metals into the metal phase will be greater.

Slag/Metal Separation - A cleanly defined boundary and a clear separation was achieved in all of the smelting tests. This was due to two factors. The first was the large density difference between the metallic and slag phases. The second was a well defined slag composition with the requisite melting point, fluidity and density to ensure good phase separation.

Calculation of Precious Metals, Content of Ore or Concentrate - To determine the precious metal content of the ore refer to Table I and perform the following operations.

- 1) Multiply the weight of the copper alloy in grams by the analysis in ppm for the metals under consideration.
- 2) Divide this value by 1000 to obtain the weight of metal recovered in milligrams.
- 3) Divide this value by the copper recovery expressed as a decimal, i.e. divide copper recovery in % by 100. Then divide this number into the values obtained in step 2).
- 4) Divide the values obtained in step 3 by the weight of the ore fraction in grams.
- 5) Multiply this value by 1000 to obtain the precious metals content of the ore fraction in ppm.

The procedure is demonstrated below for Run 49, Head Ore Composite, using the palladium assay (30 ppm).

- | | | | |
|----|---------------|---|------------------------------------|
| 1) | 385.7 x 30 | = | 11571 |
| 2) | 11571/1000 | = | 11.571 |
| 3) | 11.571/.80 | = | 14.461 |
| 4) | 14.461/1153.8 | = | .01253 |
| 5) | .01253 x 1000 | = | 12.53 ppm Pd in Head Ore Composite |

If the ore fraction is a concentrate e.g. magnetic concentrate, then the value obtained in step 5) above must be multiplied by the ratio (wt. of concentrate/weight of ore to concentrating step) to obtain the ore assay.

Conclusion

Based on the analyses of the copper alloys generated by a reduction smelting of Aguilla ore in the presence of copper oxide, the presence of the precious metals silver, gold, platinum, palladium, ruthenium, osmium and iridium has been demonstrated. These values are sufficiently high to provide financial incentive for developing and installing a commercial process for their recovery.

Appendix I

Aguila Ore Analytical Procedure

The procedure outlined below has as its objective the determination of precious and platinum group metals in Aguila ore and concentrate samples. Although it uses fairly conventional smelting and collection techniques, it differs from normal fire assaying procedures in that the smelting step takes place in an electric arc furnace. The use of an electric arc furnace allows attainment of higher temperatures than those normally encountered in conventional fire assaying.

This procedure is the starting point for fine tuning. As experience is accumulated, changes will undoubtedly be made and steps added or deleted.

- 1) Crush the entire ore sample (at least 5000 gms) in a mortar and pestle and clean Bico mill to pass 20 mesh. Split the sample by riffing or cone and quartering to 1000 gm. Recomposite the balance of the ore sample. Grind the 1000 gm sample to 100% - 100 mesh in a clean Bico mill.
- 2) Split the 1000 gm sample into 2-100 gm samples by riffing or cone and quartering. Reserve the remaining 800 gm.
 - a) Determine moisture on 1-100 gm sample by drying for 24 hours in an oven at 120°C. Weigh sample to nearest gm before and after drying.
 - b) Analyze 1-100 gm sample for CaO, Fe₂O₃, MnO₂, SiO₂, MgO, Al₂O₃, Na₂O, sulfide sulfur, sulfate sulfur, CO₂, and LOI. Oxide, LOI, and moisture must account for >90% of sample weight.
- 3) Prepare 2000 gm sample of starter slag from purchased reagents by weighing 940 gm FeO, 780 gm silica, and 280 gms burned lime. Mix by rolling and grind by a single pass through a clean Bico mill.
- 4) Calculate flux requirement for ore based on lowest melting ternary eutectic in CaO-Al₂O₃-SiO₂ system. Split 2000 gm sample of ore from material recomposited in Step 1 by riffing or cone and quartering. Reserve balance of ore.
- 5) Weigh to nearest gm:
 - a) ore fluxes as calculated from purchased FeO, silica, and burned lime
 - b) two collector mixtures consisting of:
 - 1) 250 gm CuO and 37 gm C
 - 2) 50 gm CuO and 7 1/2 gm C

Reserve 30 gm samples of CuO and C for future analysis if required.

200
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Resumes

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14 February 1987

Theron O Messer, Director
Mountain States Resource Development, Inc.
165 South Union Blvd. Suite 704
Lakewood, Colorado 80228

Dear Theron:

Pursuant to your request of 11 February 1987 I have set forth below 1) the various professional societies I am or have been a member of and technical committees which I have chaired within the societies; 2) a brief description of the document which I prepared on the operation of a platinum and iridium metals refinery.

Professional Societies and Committees

Member: The Metal Society of the American Institute of Metallurgical Engineers (TMS AIME)

Chaired the following technical Committees:

- * Electrolytic Processes Committee.
- * Lead Zinc Tin Committee.
- * Copper Nickel Cobalt Precious Metals Committee.

Fellow: Institute of Mining and Metallurgy, London (IMM)

Member: Canadian Institute of Metallurgy (CIM)

Member: International Copper Researchers Association (INCRA)

Member: International Precious Metals Institute (IPMI)

Former Member of the following:

- * International Lead Zinc Researchers Association (ILZRO)
- * Department of Energy (DOE) ad hoc committee on Energy Conservation in the Electrolytic Industry
- * Selenium Tellurium Development Association

Affiliate: Jan H. Reimers and Associates Inc.
Oakville, Ontario, Canada

Principals: W.R. Snelgrove, P. Eng. and John C. Taylor, P. Eng.

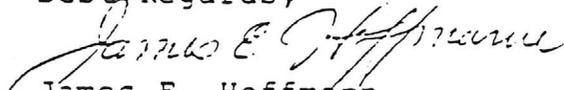
Manual of Operations Platinum-Iridium Metals Refinery

This technical manual of operations began with the electrolytic parting of Dore bullion and ended with the production of the pure metals: silver, gold, platinum, palladium, rhodium, iridium, and ruthenium. Preparation of this manual involved the following:

- * Defining all the process chemistry of the separation and purification of the above metals.
- * Confirming and quantifying the chemical reactions in actual industrial plant practice.
- * Modifying the chemistry when needed to accomodate changes in plant feed or processing priorities.
- * Maintaining an awareness of changes in the technology to keep operations current.

I hope the above information meets your needs.

Best Regards,


James E. Hoffmann

JEH/lrh

EXPERIENCE, RECORD, BACKGROUND

and

OUTLINE OF SERVICES

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September 1986

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INTRODUCTION

Jan H. Reimers and Associates USA Inc., Consulting Metallurgists, was formed in September 1986 to serve the nonferrous extractive metallurgy industry in the United States and throughout the world. We are affiliated with Jan H. Reimers and Associates Inc., Oakville, Ontario, Canada who have been incorporated since 1953.

The two firms, though affiliated, operate independently and have no long term contractual arrangements with any process licensor, engineering firm, or equipment manufacturer. The combined background, knowledge, experience, and resources of the two firms are shared, thereby providing the client with their pooled expertise. This brochure gives a partial list of clients, a summary of our recent projects, and the experience of the principals.

The collective operating and technical service experience of the individual members of the firms includes senior responsible positions in copper, nickel, lead, zinc, rare and precious metals smelters and refineries in Canada, the United States, South America, Europe, Africa, and Australia. Messrs. Snelgrove and Taylor are Professional Engineers and registered Consulting Engineers in Ontario. Messrs. Hoffmann and Zunkel anticipate early certification as Professional Engineers licensed in Texas.

The firms have worked with engineering and operating companies on many grassroots and expansion projects and therefore have extensive background upon which to carry out:

- Preliminary and definitive feasibility studies of new projects and revisions to existing plants.
- Guidance, on the clients' behalf, to engineering firms selected on subsequent project phases including detailed engineering, construction, and startup.
- Evaluation of metallurgical processes, both established and under development, including comparison of alternatives.
- Practical and economic assessment of new processes, including review of research and pilot plant programs and plant scale tests.

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- Review of environmental factors, including working conditions, connected with metallurgical plants.
- Other metallurgical consulting services such as plant operation audits for efficiency improvement, contract negotiations, materials of construction reviews, etc.

Depending on the depth required, our studies can include preliminary plant design based on layout, flowsheets, and equipment specifications. Such studies can form the basis of subsequent detailed engineering by large firms.

R E S U M E

JAMES E. HOFFMANN

- General: U.S. citizen by birth
Born 1937 - Newark, New Jersey
Married with seven children
- Education: B.S. Chemical Engineering, 1958
New Jersey Institute of Technology
M.S. Chemical Engineering, 1965
New Jersey Institute of Technology
- Languages: Some German and French
- Patents: U.S. 3,249,399 "Process for Chlorination of Electrolytic Copper Refinery Slimes", Hoffmann et al
U.S. 3,658,510 "Recovery of Silver from Electrolytic Copper Refinery Slimes", Hoffmann et al
U.S. 3,996,046 "Extraction and Purification of Silver from Sulfated Residues", Hoffmann et al
U.S. 4,367,128 "Energy Efficient Self-Regulating Process for Winning Copper from Aqueous Solutions", Batzold & Hoffmann
U.S. 4,421,552 "Dead Roast-Oxide Flash Reduction Process for Copper Concentrates", Hoffmann et al
U.S. 4,439,288 "Process for Reducing Zinc Consumption in Zinc Electrolyte Purification", Hoffmann
European Patent (U.S. No. 342,093) "A Process for Production of Metal Calcine of Low Sulfur Content", Hoffmann
U.S. 4,560,453 "Efficient, Safe Method for Decoppering Copper Refinery Electrolyte", Hoffmann et al
Numerous foreign listings on the above U.S. patents.

CONSULTING AND INDUSTRIAL EXPERIENCE

1986 to date Jan H. Reimers and Associates USA Inc.

Became principal in 1986.

Exxon Minerals Company

- 1983-1986 Senior Research Associate, responsible for development and execution of all extractive metallurgical research and development. Major project responsibilities included:
- Design and execution of roasting studies for arseniferous, pyritic gold concentrate. Involved in developing new roasting technology for high (20%) arsenic content, gold concentrates.

Résumé - J. E. Hoffmann (cont'd)

- Design, construction and operation of a pilot flash smelter for treatment of complex sulfides and massive pyrites.
- Technical and economic evaluation of the free world's major zinc refineries. This involved detailed energy and material balances as well as manning studies.
- Development of hybrid leaching/beneficiation technologies for treating highly disseminated complex sulfide orebodies, to improve single metal concentrate purity and recovery.

1978-1983

Senior Staff Engineer, responsible for laboratory and engineering evaluations of both pioneering and extant technologies and their potential applicability to Exxon mineral concentrates. Major responsibilities included:

- Design and operation of an integrated, continuous miniplant for evaluation of the amenability of Exxon high iron zinc concentrates to conventional roast, leach, jarosite, electrowin technology and the Sherritt Gordon pressure leach process.
- Development of an energy efficient dead roast, leach, purify electrowin process for Exxon copper concentrates.
- Design, development and engineering evaluation of a dead roast, flash reduction process for smelting copper concentrates.
- Experimental and engineering evaluation of in-situ electrolytic hypochlorination of low grade moly sulfide concentrates.
- Development of application of hydrogen fuel cell technologies to electrowinning of copper and zinc with attendant energy reduction.
- Detailed evaluation of the production costs for smelting and refining copper in various European and Japanese smelter-refineries. Was involved in detailed and highly site-specific evaluation of material and energy balances, manning requirements and consumables.
- Structured and managed a major engineering evaluation of extant copper smelting processes. The study provided detailed engineering data on the capital and operating costs of smelting copper by electric furnace, OK flash, Inco flash and the Noranda process.

Amex Base Metals Research and Development, Inc.

1975-1978

Manager Chemical Metallurgy. Corporate consultant on process chemistry problems in lead, nickel, zinc, copper and precious metals. Supervision of a group of engineers and chemists in laboratory evaluations of various research projects. Company representative to various technical committees. Complete redesign and process definition for a platinum/iridium metals refinery.

Résumé - J. E. Hoffmann (cont'd)

- 1971-1975 Senior Research Supervisor. Process engineer for project engineering of electrolytic anode slimes wet chlorination operation. Design and operation responsibilities for the pilot plant evaluation of wet chlorination technology. Design and operation responsibilities of scrubbing arsenic fume in cadmium plant operation. Technical assistant for startup of effluent treatment plants in zinc refinery, molybdenum conversion operations and precious metals refinery. Definition of black copper converter blowing cycle for control of anode solubility downstream in tankhouse.
- 1966-1971 Research Supervisor, responsible for design operation and installation of a tellurium electrowinning facility, evaluation of LIX technology applied to oxide and sulfide dump leaching, development of refining techniques for high nickel-tin (5-10%), copper anodes, supervision of lab scale development of alkaline zinc purification techniques, explored and developed technology for producing electro-deposited dispersion hardened copper alloys.
- 1962-1966 Group Leader, responsible for technical startup of a plant for production of semiconductor grade germanium from smelter fumes. Evaluated the chemistry of arsenic-antimony float slimes in copper refining. Evaluated a variety of plating systems.
- 1958-1962 Investigator. Shift supervision on cupola (copper blast furnace) and briquetting operations. Research studies on the hydrometallurgy of germanium. Evaluation of pyro- and hydrometallurgical processes for recovery of nonferrous metal values from various flue dusts, fumes and scrap feeds.

TECHNICAL SOCIETIES

- Fellow: Institute of Mining and Metallurgy, London (IMM)
- Member: International Precious Metals Institute (IPMI)
Canadian Institute of Metallurgists (CIM)
International Copper Research Association (INCRA)
American Institute of Metallurgical Engineers (AIME)
- Member and Former Chairman: Electrolytic Processes Committee
Lead, Zinc, Tin Committee
Copper, Nickel, Cobalt, P.M. Committee
- Member: Professional Affairs Committee

PAPERS AND PUBLICATIONS

- Electrodeposition of Dispersion Hardened Copper Alumina Alloys.
Electrowinning of Copper from High Nickel Content Electrolytes.

Résumé - J. E. Hoffmann (cont'd)

Wet Chlorination of Copper Refinery Slimes.

Evaluation of MnO₂ Impregnated Sintered Titanium Anodes for Copper Electrowinning.

The Recovery of High Purity Silver from Sulfated Slimes.

Germanium Extraction and Refining: A Retrospective and an Update.

Recovery of Selenium from Copper Refinery Slimes.

Emerging Technologies in Lead Smelting.

Complementary Sciences (JOM Editorial)

Editor: Proceedings of the Reinhardt Schuhmann International Symposium on Innovative Technology and Reactor Design in Extractive Metallurgy, published by TMS-AIME.

Chief

Editor: The Electrowinning and Refining of Copper, published by TMS-AIME.

COPPER PROJECTS

<u>Company</u>	<u>Year</u>	<u>Assignment</u>
Amax Base Metals Carteret, New Jersey	1961	Evaluation of high silver content anodes in copper refining.
	1962	Evaluation of flocculant systems in copper refining.
	1963	Evaluation of high arsenic electrolytes and float slimes formation. Evaluation of the Chapungo Process.
	1964-70	Evaluation of LIX reagents and technology.
	1965	Development and evaluation of monitoring and control techniques for copper tankhouse addition agents.
	1966-69	Process development for use of soluble high nickel-tin anodes in liberators.
	1971	Develop parameters for electrowinning of copper from high nickel electrolytes. Evaluation of titanium blanks and full term deposits using a PCR tankhouse.
	1973-75	Amax Process Engineering representative on ANAMAX project.
	1976	Process engineering evaluation of CLEAR process.
	Exxon Minerals Company Houston, Texas	1979
1981-82		Engineering evaluation of the dead roast, flash reduction process for copper smelting.
1981-83		Laboratory and evaluation of a dead roast, jarosite conversion, electrowin process for copper. Development of H ₂ fuel cell technology in copper electrowinning.
1984		Managed the development of H ₂ fuel cell technology for copper recovery from mine waters.

Copper Projects (cont'd)

<u>Company</u>	<u>Year</u>	<u>Assignment</u>
Exxon Minerals Company Houston, Texas	1984	Developed arsine-free liberation techniques.
	1985	Supervised exploration and evaluation of electrowinning copper from cuprous chloride solutions.

COMPLEX SULFIDES/MASSIVE PYRITES

<u>Company</u>	<u>Year</u>	<u>Assignment</u>
Exxon Minerals Company Houston, Texas	1980-81	Experimentally evaluate the applicability of the Elkem process to treating Exxon's Crandon bulk concentrate. An engineering evaluation of chloride hydrometallurgical processes for treating complex concentrates.
	1982-85	Design, construct and supervise operation of a flash smelter for treating massive pyrites and complex sulfides.
	1985-86	Develop a hybrid leaching-beneficiation process for producing good grade and recovery of single metal concentrates from massive pyrites.

BYPRODUCT METALS

<u>Company</u>	<u>Year</u>	<u>Assignment</u>
Amax Base Metals Carteret, New Jersey	1959	Evaluation of the Soda Ash Process for selenium recovery from copper refinery slimes.
	1962-63	Startup responsibilities for a plant producing semiconductor grade germanium from smelter fume.
	1963	Process development for producing electronic grade (5-9s) tellurium.
	1965-66	Design, pilot and commercially install a tellurium electrowinning facility.
	1965-67	Design and develop the process chemistry of dry chlorination of refinery slimes.
	1966	Evaluate the Niter fluxing process for selenium purification.
	1967-71	Define, develop, pilot and assume process engineering responsibilities for a plant for the wet chlorination of refinery slimes.
	1968	Evaluate and revamp the process chemistry of a Thum-Balbach parting plant operating with high copper Doré.
	1969	Develop a hydrometallurgical process for production of high purity silver from impure silver chloride.
	1970	Elimination of all nitric acid chemistry from gold refinery. Evaluate gold reduction/purification options.
	1971	Complete process inventory and assessment for the flow of tellurium and selenium through a secondary copper refinery from cupola to final metal product.
	1971-74	Development of the process chemistry for sulfation roasting of slimes from lab to semi-works unit.
	1973-74	Development of process for recovery of high purity silver from sulfated slimes residue.

Byproduct Metals (cont'd)

<u>Company</u>	<u>Year</u>	<u>Assignment</u>
Amax Base Metals Carteret, New Jersey	1974-76	Review, revise and streamline complex process chemistry of a gold, platinum and iridium group metals refinery, including new materials of construction.
	1975	Revision of heat treating process for cadmium oxide to produce a product readily soluble in organic acids.
Exxon Minerals Company Houston, Texas	1983	Determination of byproduct metals recovery (silver and cadmium) from processing of Crandon concentrate.

GOLD PROJECTS

<u>Company</u>	<u>Year</u>	<u>Assignment</u>
Amax Base Metals Carteret, New Jersey	1965	Evaluate the conversion of a gold refinery from sulfuric acid-boiling to aqua regia treatment.
	1970	Evaluate the use of titanium blanks instead of gold foil for cathode starting sheets.
		Evaluate the economics of in-situ hypochlorination for treatment of refractory gold ores.
	1971	Develop wet chlorination technique for solubilization of gold.
	1972	Develop new technologies for precipitation of gold from solution.
Exxon Minerals Company Houston, Texas	1985	Engineering evaluation of Arseno process for recovery of gold from Arseno pyrite.
	1986	Development of equipment and research procedures for roasting of complex, high arsenic, pyritic gold concentrates.

LEAD, ZINC, TIN PROJECTS

<u>Company</u>	<u>Year</u>	<u>Assignment</u>
Amax Base Metals Carteret, New Jersey	1966	Develop technology for recovery of tin from black copper refinery slimes.
	1969	Develop purification processes for alkaline zincate electrolyte.
	1971	Develop technology for recovery of cobalt and cadmium from cementation cake generated during 1st stage purification of pregnant zinc sulfate leach liquor.
	1973-75	Develop and evaluate RLE technology for recovery of copper, lead and cobalt values from copper dross.
	1973-76	Evaluation of various processes for purification of pregnant zinc leach liquors.
Exxon Minerals Company Houston, Texas	1981-83	Design and operate an integrated zinc mini plant for evaluation of zinc concentrate response to RLE and SG processing.
	1983-84	Evaluate, technically and economically the free world's major zinc refineries. Develop operating costs.
	1984	Develop a seriatim of major lead smelters and assess their technical competitiveness.

NICKEL PROJECTS

<u>Company</u>	<u>Year</u>	<u>Assignment</u>
Amax Base Metals Carteret, New Jersey	1968	Improve the purity of nickel sulfate salts generated in nickel plant evaporation of liberator acid.
	1971	Evaluate the process chemistry of nickel-ammonium double salts for production of a high purity nickel oxide intermediate product.
	1972-73	Evaluate leaching processes employed at Port Nickel refinery. Improve technology for production of nickelic oxide.
	1974	Eliminate selenium impurity contamination of nickel powder product.

POLLUTION ABATEMENT & EFFLUENT TREATMENT PROJECTS

<u>Company</u>	<u>Year</u>	<u>Assignment</u>
Amax Base Metals Carteret, New Jersey	1969	Develop technology for treating copper nitrate effluent from zirconium rolling operations.
	1971	Select, install and supervise operation of a pilot high energy scrubber for removal of arsenic compounds from roaster gas.
	1972	Assist in defining process chemistry for water treatment plant for all effluents from zinc refinery.
	1973	Inventory, characterize and develop treatment chemistry for cell effluent streams from a gold, silver, platinum metals refinery.
	1976	Startup of the wet gas cleaning circuit of a sulfuric acid plant fed by a molybdenum sulfide conversion plant. Treatment of wet gas scrubber effluent.

R E S U M E

A. D. ZUNKEL

General: U.S. citizen by birth
Born 1941 - Bethany, Missouri
Married with two children

Education: B.S. Metallurgical Engineering, 1964
Missouri School of Mines
M.S. Metallurgical Engineering, 1966
Colorado School of Mines
D.Sc. Metallurgical Engineering, 1967
Colorado School of Mines

Military

Service: U.S. Army Corp of Engineers, 1967-1969, Captain

Languages: Some Spanish, Portuguese, French, German

Patents: U.S. Patent 3,947,561, 1976, Mercury Removal from Sulfuric Acid
Canadian Patent 1,035,544, 1978, Mercury Removal from Sulfuric Acid

CONSULTING AND INDUSTRIAL EXPERIENCE

1986 to date Jan H. Reimers and Associates USA Inc.

Became principal in 1986.

Exxon Minerals Company

1984-1986 Manager of Technical Services, responsible for providing technical support in mining, metallurgy, civil, environmental, mechanical, geotechnical and electrical engineering to company copper, uranium and gold operations and copper, zinc and lead development projects and acquisition studies.

1984 Senior Staff Advisor, responsible for developing business strategy and tactics for marketing products from zinc-copper-lead mine.

1982-1984 Manager of Minerals Processing, responsible for developing new and improving existing processes and providing technical support in metallurgical engineering to company operations, projects and acquisition activities.

1980-1982 Manager of Business Environment and Commodity Analysis, responsible for supply/demand/price forecasting for commodities of interest, assessing the business environment in countries of interest for current and potential operations, and negotiating entry permits for these countries.

1978-1980 Manager of Minerals Processing Research, responsible for establishing programs, staffing, and facilities for minerals processing and extractive metallurgy research and technical service in support of company's newly established minerals business.

Résumé - A. D. Zunkel (cont'd)

St. Joe Minerals Corporation

- 1976-1978 General Superintendent, Monaca Zinc Smelter, responsible for operation and maintenance of 180,000 MTPY electrothermic zinc smelter employing 1600 salary and payroll personnel.
- 1975-1976 Superintendent, Roaster-Acid Department, responsible for operation and maintenance of 1200 MTPD roaster-acid complex in zinc smelter employing 9 roasters, 6 acid units, and 80 salary and payroll personnel.
- 1972-1975 Manager of Extractive Metallurgy, responsible for providing technical support in extractive metallurgy to company zinc, zinc oxide, lead, silver, gold, iron pellet, and copper operations, projects and acquisition activities.
- 1969-1972 Senior Extractive Metallurgist, responsible for planning and executing research projects to improve roasting, sintering, furnacing, and refining processes at Monaca, PA zinc smelter and Herculaneum, MO lead smelter.

1967-1969 U.S. Army

Responsible for nondestructive testing laboratory involved in quality control activities on Apollo Program tanks, fuels, and oxidizers.

TECHNICAL SOCIETIES

Member of: American Institute of Mining, Metallurgical and Petroleum Engineers (AIME), 1987 President-elect, 1986 Vice President, past Chairman of Publications, Program, Long Range Planning, and Education and Professional Affairs Committee, and Board of Directors Member.

Canadian Institute of Mining and Metallurgy (CIMM)

Institute of Mining and Metallurgy (IMM)

PUBLICATIONS

"Thermodynamics of the $TiS-TiS_2$ System", Australasian Institute of Mining and Metallurgy Transactions, 1967.

"Thermodynamics of the $PbO-As_2O_3$ System", Metallurgical Transactions AIME, 1968.

"Thermodynamics of the $PbO-Sb_2O_3$ System", Metallurgical Transactions 1969.

"International Sulfide Smelting Symposium", Editor, TMS-AIME, 1983.

"Complex Sulfides Symposium", Editor, TMS-AIME, 1985.

COPPER PROJECTS

<u>Company</u>	<u>Year</u>	<u>Assignment</u>
St. Joe Minerals Corporation Monaca, PA.	1973	Evaluation of QSOP process for application at El Pachon.
	1974	Process selection and design for El Indio gold-copper concentrates.
Exxon Minerals Company Houston, Texas	1978	Evaluation of milling alternatives for Los Bronces expansion.
	1980-81	Evaluation of smelting alternatives for Chagres, including present and potential future processes.
	1982	Evaluation of Chagres reverb furnace for energy utilization improvement. Conceptual design of and cost estimate on copper mine-mill-smelter complex in Portugal.
	1985	Evaluation of milling alternatives for El Soldado expansion. Identification and solution of H ₂ SO ₄ plant catalyst degradation.

LEAD AND ZINC PROJECTS

<u>Company</u>	<u>Year</u>	<u>Assignment</u>	
St. Joe Minerals Corporation Monaca, PA	1969-70	Detailed analysis of electrothermic zinc process for improvement opportunities.	
	1970-72	Evaluation of QSL process for application at Herculaneum.	
	1970-75	Design and execution of program to improve quality of photoconductive zinc oxide, including complete reactor redesign. Improved throughput rates and product quality for zinc roasting and sintering operations.	
	1972-74	Evaluation of processing methods for cadmium plant residues.	
	1973	Evaluation of constructing and operating an electrolytic zinc plant in Israel, including development of capital and operating costs. Evaluation of all available processes for removing mercury from sulfuric acid.	
	1973-75	Evaluation of cyclone smelting for application to zinc processing. Develop, install and operate process for removing mercury from sulfuric acid.	
	1974-75	Redesign zinc metal condensers to increase recovery and decrease blue powder formation.	
	1974-76	Zinc smelting/refining technology evaluation for potential smelter replacement.	
	1975	Design air atomized zinc dust production unit for cadmium cementation.	
	1976-78	Zinc smelter modernization study.	
	Exxon Minerals Company Houston, Texas	1980-82	Design and cost estimates on zinc refinery to process Crandon concentrates.
		1982	Evaluate existing zinc refinery for acquisition.

Lead and Zinc Projects (con'd)

<u>Company</u>	<u>Year</u>	<u>Assignment</u>
Exxon Minerals Company Houston, Texas	1984	Development of business plan for Crandon zinc, copper and lead concentrates.
	1984	Evaluate existing lead mine-mill-smelter for acquisition.
	1984	Comparison of existing and new lead smelting processes for installation at potential lead smelter acquisition.
	1985-86	Redesign and reestimate Crandon mine-mill to lower costs and improve profitability.

PRECIOUS METALS PROJECTS

<u>Company</u>	<u>Year</u>	<u>Assignment</u>
St. Joe Minerals Corporation Monaca, PA	1973	Acquisition study for Cobalt, Ontario silver refinery.
	1973-74	Start-up and process improvement on Cobalt, Ontario silver refinery.
Exxon Minerals Company Houston, Texas	1983	Design oxide ore processing plant for Harbour Lights.
	1984	Select and pilot test roasting technology for Harbour Lights sulfide ore.
	1986	Design sulfide processing plant for Harbour Lights.
	1986	Risk analysis on Harbour Lights roasting plant.
	1986	Evaluation of Arseno Process for use on Harbour Lights gold concentrates.

MISCELLANEOUS PROJECTS AND INVESTIGATIONS

<u>Company</u>	<u>Year</u>	<u>Assignment</u>
St. Joe Minerals Corporation Monaca, PA	1970-78	Confidential acquisition evaluations.
	1973	Evaluation of proprietary processes for aluminum and magnesium production.
Exxon Minerals Company Houston, Texas	1978-86	Confidential acquisition evaluations.
	1979-81	Develop improved uranium extraction process.
	1981-83	Evaluation and comparison of new methods of ore sorting for copper and uranium ores.
	1982	Evaluation of vanadium recovery from flexicoker residues.

R E S U M E

W. R. N. SNELGROVE, P. Eng.

- General: Canadian citizen by birth
Born 1925 - Vancouver, B.C.
Married with three children
- Education: B.A.Sc. in Metallurgical Engineering, 1949
University of British Columbia
- Military
Service: 1943-1945 Royal Canadian Air Force - Pilot; Pilot Officer
- Languages: Some Portuguese and Spanish
- Patents: Inventor of Canadian Patent No. 809,647, U.S. No. 3,504,429 and U.K. No. 1,067,297 and other countries, pertaining to continuous casting of anodes for copper refining.
- Inventor of U.K. Patent No. 1,290,672 pertaining to the treatment of scrap copper alloys by hydrometallurgical and electrolytic techniques to recover their main constituents.
- Co-inventor of U.S. Patent No. 4,108,639 "Process for Recovering Platinum Group Metals from Ores also Containing Nickel, Copper and Iron". Also patented in other countries.

CONSULTING AND INDUSTRIAL EXPERIENCE

- 1974 to date Jan H. Reimers and Associates Inc.
Became principal in the firm in 1980.
- 1970 - 1974 A. H. Ross & Associates, Toronto, Canada
Associate in firm of consulting metallurgical engineers specializing in non-ferrous milling and extractive metallurgy. Worked on copper, zinc, lead, nickel, molybdenum and precious metals projects. One patent.
- 1964 - 1970 British Copper Refiners Ltd., Prescott, Lancashire, England
Chief Metallurgical Engineer and Member of the Board of Directors. Included responsibility for electrolytic copper refinery project from conceptual stage to commissioning. Independent consulting on copper electrowinning plant and electrolytic silver refinery. Two patents.
- 1963 - 1964 Compania Espanola de Minas de Rio Tinto, Madrid, Spain
Feasibility studies for new copper smelter.
- 1953 - 1962 Rhodesian Selection Trust Group
a) Assistant to the Consulting Metallurgical Engineer, London, England.

Résumé - W. R. N. Snelgrove (cont'd)

Rhodesian Selection Trust Group (cont'd)

- b) Chief Research Officer, Northern Rhodesia (now Zambia).
Set up and operated a metallurgical research and development laboratory for the Group mines.
- c) Cobalt Plant Superintendent, N'dola, Zambia.
Fluosolids roasting and electric smelting of a copper-cobalt concentrate. Developed and piloted a hydrometallurgical process for treating sulphate-roasted concentrate.
- d) Assistant and Acting Smelter Superintendent, Mufulira, Zambia.
Large copper smelter.

1952 - 1953 University of British Columbia

Research Assistant; worked on uranium extraction.

1949 - 1952 Plumbum S/A - Brazil

Chief Metallurgist in charge of small lead smelter, refinery and electrolytic silver refinery.

TECHNICAL SOCIETIES

Member of: Association of Professional Engineers of Ontario; designated as Metallurgical Consulting Engineer.

Canadian Institute of Mining and Metallurgy (C.I.M.M.)

American Institute of Mining, Metallurgical and Petroleum Engineers (A.I.M.E.)

Institution of Mining and Metallurgy (I.M.M.) London, England

PUBLICATIONS "Chibuluma Cobalt Plant", Extractive Metallurgy of Copper, Nickel and Cobalt, Interscience Publishers, New York, 1961

"The Continuous Casting of Anodes at British Copper Refiners Limited", co-author with M.J. Barber, Institute of Metals, International Conference "Copper and its Alloys", Amsterdam 1970

"A Hydrometallurgical Process for the Recovery of Copper and Zinc from Alloy Scrap", paper presented at the Canadian Institute of Mining and Metallurgy, Montreal 1978

"The Recovery of Values from Non-Ferrous Smelter Slags", co-author with John C. Taylor, P. Eng., CIM Conference, Halifax 1980

"Considerations in the Modification of Existing Non-Ferrous Smelters", co-author with John C. Taylor, Kunming, China 1984

"Impurity Removal and Byproduct Recovery in Non-Ferrous Smelting", co-author with John C. Taylor, CIM Conference, Vancouver 1985

R E S U M E

JOHN C. TAYLOR, P. Eng.

General: Born 1932 - Married - Three children
Citizenship: Canadian citizen by birth
Education: Elementary and High School, Grade 13, St. Andrew's College,
Aurora, Ontario - B.A.Sc., Metallurgical Engineering,
University of Toronto, 1958
Military Service: 1952-1958, Lieutenant with the 48th Highlanders of Canada,
final position Battalion Training Officer
Languages: Some French

CONSULTING AND INDUSTRIAL EXPERIENCE

1973 to date Jan H. Reimers and Associates Inc.

Became principal in the firm in 1980.

International Nickel Co. Ltd., Copper Cliff, Ontario

1972 - 1973 Assistant Division Metallurgist, responsible for all input data used in production schedules, metallurgical forecasts, accounting, evaluation, environmental calculations and management reports. Acted as in-house consultant for the Ontario Division.

1969 - 1972 Supervisor of Recruiting and Employment (Ontario Division) responsible for the operation of a six-man department whose function was to recruit staff employees, both technical and non-technical, administer personnel policies, manpower planning, pre-employment medicals, and preliminary training of new employees. Also responsible for budgeting and cost control within the staff personnel department as a whole.

1966 - 1969 Assistant Plant Metallurgist assisting Plant Metallurgist in administering the sampling, analytical and quality control department. Special assignments included meeting the customers as a technical representative, mainly in the area of iron ore agglomeration, and completing special metallurgical calculations for senior management. Final project comprised the co-ordination of a computerized on-stream analytical system for a 27,000 TPD mill. This included limited computer control of some areas of the process and complete data logging facilities using an I.B.M. system.

1963 - 1966 Superintendent of Pelletizing Plant responsible for the operation, maintenance, scheduling of two iron ore pelletizing machines and a force of 80 hourly-rated employees. During this period the second line was successfully started up and brought on-line to bring the plant capacity up to 3,000 LTPD.

Résumé - John C. Taylor (cont'd)

International Nickel Co. Ltd. (cont'd)

- 1961 - 1963 Pellet Boss at the Pellet Plant responsible for plant testing and development. Assisted with scheduling operations, trouble-shooting and direction of hourly-rated labour force.
- 1960 - 1961 Process Engineer in Roaster-Kiln and Ammonia Leach Departments carrying out general test work, special metallurgical evaluations and assisting supervision in on-site inspection during the construction phase of the plant expansion, and relieving supervisors as required.
- 1959 - 1960 Graduate Engineer in the Smelter Reduction Section carrying out special assignments, assisting in personnel and labour relations work, and trouble-shooting in the smelting process.

Noranda Mines Ltd., Iron-Sulphur Division, Port Robinson, Ontario and Sulphuric Acid Division, Cutler, Ontario

- 1958 - 1959 Technical Assistant responsible for sampling, laboratory, plant testing, pelletizing and gas cleaning operations.

TECHNICAL SOCIETIES

- Member of: Association of Professional Engineers of Ontario; designated as Metallurgical Consulting Engineer. Made an Officer in the Order of the Sons of Martha, an honorary society, in 1985.
- Canadian Institute of Mining and Metallurgy (C.I.M.M.)
- American Institute of Mining, Metallurgical and Petroleum Engineers (A.I.M.E.), past Chairman of the Pyrometallurgical Committee, TMS-AIME, and co-editor of "Copper Smelting-An Update", AIME, 1982

PUBLICATIONS

- "Iron Ore Agglomeration at Copper Cliff", AIME Symposium, Pittsburgh 1965
- "Recent Trends in Copper Extraction", Efficient Use of Fuels Symposium, Chicago 1974
- "Occupational Health and Safety in Metallurgical Plants", Canadian Mining & Metallurgical Bulletin, June 1978
- "Approaches to Dust and Fume Control in Copper and Nickel Smelters", AIME, New Orleans 1979
- "The Recovery of Values from Non-Ferrous Smelter Slags", co-author with W.R. Snelgrove, CIM Conference, Halifax 1980
- "Copper Smelting - An Overview", co-author with D. B. George of Kennecott and Dr. H. Traulsen of Lurgi, AIME, Dallas 1982
- "The Future of Lead Smelting", co-author with Jan H. Reimers, International Sulfide Smelting Symposium, AIME, San Francisco 1983

Résumé - John C. Taylor (cont'd)

PUBLICATIONS: "Non-Ferrous Metallurgy - A Source of Sulphur Products",
SULPHUR-84, Calgary 1984.

"Considerations in the Modification of Existing Non-Ferrous
Smelters", co-authored with W.R. Snelgrove, Kunming, China 1984.

"Impurity Removal and Byproduct Recovery in Non-Ferrous Smelting",
co-authored with W.R.N. Snelgrove, CIM Conference of Metallurgists,
Vancouver 1985.

"Start-up of Metallurgical Plants", AIME Annual Meeting,
New Orleans 1986.

January, 1986

PARTIAL LIST OF CLIENTS TO DATE

MINING AND METAL PRODUCING COMPANIES

Canadian Companies

Bethlehem Copper Corporation, Ashcroft, B.C.
Brinco Limited, Toronto, Ont.
Brunswick Mining & Smelting Corporation, Toronto, Ont.
Campbell Chibougamau Mines Ltd., Toronto, Ont.
Canadian Copper Refiners Ltd., Montreal, Que.
Canadian Industries Limited, Toronto, Ont.
Cominco Ltd., Montreal, Que.
Cyprus Anvil Mining Corporation, Vancouver, B.C.
Equity Mining Corporation Ltd., Vancouver, B.C.
Esso Minerals Canada, Calgary, Alta.
Great Lakes Nickel Ltd., Toronto, Ont.
Hudson Bay Mining & Smelting Co., Flin Flon, Man.
Lacana Mining Corporation, Toronto, Ont.
Noranda Mines Limited, Toronto, Ont.
Phillips Barratt Kaiser Engineering Ltd., Vancouver, B.C.
Phillips Cables Ltd., Brockville, Ont.
Placer Development Limited, Vancouver, B.C.
Rio Algom Mines Ltd., Toronto, Ont.
Sherritt Gordon Mines Ltd., Toronto, Ont.
Texasgulf Canada Ltd. (now Kidd Creek Mines Ltd.), Toronto & Timmins, Ont.

United States Companies

The Anaconda Company, Butte, Montana & Denver, Colorado
Cerro Corporation, New York, NY
Cities Service Company, New York, NY & Atlanta, GA
Continental Oil Company, Denver, CO
Cyprus Mines Corporation, Los Angeles, CA and Bagdad, Arizona
Dow Chemical Company, Midland, Michigan
Ethyl Corporation, Baton Rouge, LA
Exxon Minerals Company, Houston, TX
Freeport Sulphur Co. (Freeport Minerals Co.), New York, NY
Getty Oil Company, Los Angeles, CA
Hecla Mining Company, Kellogg, Idaho
Howe Sound Co. (Howmet Corp.), New York, NY
Kennecott Copper Corporation, New York, NY and Salt Lake City, Utah
Molybdenum Corporation of America, Pittsburgh, PA
Monsanto Chemical Company, St. Louis, Missouri
The New Jersey Zinc Co. (Gulf & Western), Palmerton, PA
Newmont Mining Corporation, New York, NY
Olin Corporation, New York, NY
St. Joe Zinc Co. and St. Joe Minerals Corporation, Monaca, PA
SKF Steel Inc., Avon, Connecticut
Southwire Corporation, Carrollton, GA
Tennessee Copper Company (Cities Service Co.), Copperhill, Tennessee
Texas Instruments Inc., Attleboro, Massachusetts
Texasgulf Inc., Stamford, Connecticut
Williams Strategic Metals, Denver, Colorado

European Companies

I/S Anortal, Oslo, Norway
A/S Årdal og Sunndal Verk, Oslo, Norway
Boliden Metall AB, Skelleftehamn, Sweden
Bor Mining & Smelting Enterprise, Beograd, Yugoslavia
Elkem A/S, Oslo, Norway
Empresa de Desenvolvimento Mineiro de Alentejo, EP (E.D.M.A.), Lisboa, Portugal
Granges International Mining, Stockholm, Sweden
Hellenic Industrial & Mining Investment Co., Athens, Greece
Norsk Hydro A/S, Oslo, Norway
Otokumpu Oy, Helsinki, Finland
Quimica de Portugal E.P. (QUIMIGAL), Lisboa, Portugal
Rio Tinto Mining Co. (RTZ), London, England
Selection Trust Limited, London, England
Smelter Corporation of Ireland Limited, Dublin, Ireland

Australian Companies

Australian Mining & Smelting Ltd., Melbourne, Australia & Bristol, England
CRA Limited, Melbourne
Electrolytic Refining & Smelting Co. of Australasia Ltd., Port Kembla, NSW
M.I.M. Holdings Limited (Mount Isa Mines), Brisbane, Queensland
Roxby Management Services Pty. Ltd., Adelaide
Sulphide Corporation Pty. Ltd., Boolaroo, NSW
Western Mining Corporation, Melbourne & Perth, WA

Other Overseas Companies

Akita Zinc Co. Ltd., Tokyo, Japan
PT Aneka Tambang, Jakarta, Indonesia
Atlas Consolidated Mining & Development Corporation, Manila, Philippines
Banco Minera del Peru, Lima, Peru
Dowa Mining Company, Tokyo, Japan
Kuwait Engineering Operation and Management, Kuwait
Mitsubishi Metal Corporation, Naoshima, Japan
Philippine Associated Smelting & Refining Corp. (PASAR), Isabel, Philippines
Société Nationale de Sidérurgie, Algiers, Algeria
A. Soriano Corporation, Manila, Philippines

GOVERNMENT AND INTERNATIONAL AGENCIES

CANMET, Government of Canada
Environment Canada, Government of Canada
Department of Natural Resources, Government of New Brunswick
Department of Industrial Development, Government of Newfoundland
Ministry of Natural Resources, Government of Ontario
Ministry of Economy, Government of Iran
Ministry of Industry, Government of Norway
United Nations, New York and UNIDO, Vienna, Austria
in connection with work in: Brazil, Burma, Indonesia, Iran.

RESEARCH ORGANIZATIONS

Stanford Research Institute, Menlo Park, California, U.S.A.

COPPER PROJECTS

<u>Company</u>	<u>Year</u>	<u>Assignments</u>
Chibougamau Smelter Inc. (Campbell Chibougamau Mines Ltd.) Montreal, Canada	1954 - 1958	Estimates of electric and flash smelters. Recovery of sulphur from smelter gases.
Rometales S.A. Santa Lucia, Cuba (for Krebs & Cie, Paris, France)	1956 - 1960	Advise on planning, design and construction of copper roasting, leaching and electrolytic refining plant for Minas de Matahambre (in operation).
Indian Copper Corporation (with John Miles & Partners London, England)	1958 - 1969	Review of all copper smelting processes. Advise on design and building of electrolytic copper refinery. Flash smelter with sulphuric acid plant, and refinery now in operation.
Boliden Mining Company Stockholm, Sweden	1959 - 1963	Investigation of various problems in connection with copper and pyrites.
Cerro de Pasco Corporation New York, N.Y. (for Arthur G. McKee & Co., Cleveland, Ohio)	1960 - 1961	Participation in study of copper smelter for Rio Blanco copper mine in Chile, South America.
Rio Tinto Mining of Central Africa Ltd. Salisbury, Rhodesia and London, England	1960 - 1964	Planning of copper and nickel smelting and refining plant for Empress Mine (in operation since 1967).
Bor Copper Smelter Bor, Yugoslavia (for Arthur G. McKee & Co., San Francisco)	1962 - 1963	Advise on modernization of Europe's largest copper smelter. Also production of sulphuric acid from smelter gases (modernization partly carried out).
Joma Bergverk Oslo, Norway	1964 - 1968	Studies of copper-zinc-pyrite processing facilities for mine in Northern Norway.
Khetri Copper Project New Delhi, India (for Arthur G. McKee & Co., San Francisco)	1964 - 1968	Advise on studies and preliminary designs for copper smelter and electrolytic copper refinery. Flash smelter has since been built.
Southwire Corporation Carrollton, Georgia, USA	1965 - 1967	Advise on study of copper refining project (in operation since 1971).

Copper Projects (cont'd)

<u>Company</u>	<u>Year</u>	<u>Assignments</u>
Texasgulf Sulphur Company New York, N. Y.	1965 - 1967	Copper smelting and refining studies in connection with development of large copper-silver-lead-zinc orebody in Timmins, Ontario.
Great Lakes Nickel Limited Montreal, Canada	1966 - 1975	Preliminary design and detailed estimates of smelting and refining plant for large low-grade copper-nickel deposit near Thunder Bay.
Western Mining Corporation Melbourne, Australia	1966 - 1972	Advise on planning of smelting and refining facilities for important nickel-copper mines being developed in Kambalda area of Western Australia (nickel-copper flash smelter in operation at Kalgoorlie).
Phillips Cables Company Brockville, Ontario, Canada	1968	Preliminary study of copper smelter in British Columbia, Canada.
Conzinc Riotinto of Australia	1968 - 1971	Evaluation of Worera continuous copper smelting process.
Verdigris Project Arizona, U.S.A. Joint venture of: Cities Service Co., New York Bagdad Copper Corp., Arizona Hecla Mining Company, Idaho	1970 - 1971	Detailed study of large copper smelter with extensive air pollution control facilities including sulphuric acid and elemental sulphur recovery. Also preliminary study of electrolytic copper refinery.
Bethlehem Copper Corporation Ashcroft, B.C., Canada	1971 - 1972	Copper smelter study including comparison of smelting and sulphur recovery methods.
	1972 - 1973	Electric copper smelter study.
	1973	Study of Anaconda's Arbiter process.
Group consisting of: Bethlehem Copper Corporation Newmont Mining Corporation Noranda Mines Limited Placer Development Limited	1972	Comparison of following copper smelting methods: Electric smelting Flash smelting Reverberatory smelting including detailed estimates based on preliminary designs.
Continental Oil Company Denver, Colorado	1973	Copper smelter study including detailed estimates based on preliminary design.

Copper Projects (cont'd)

<u>Company</u>	<u>Year</u>	<u>Assignments</u>
Elkem A/S Oslo, Norway	1973	Review of modernization and expansion program for electric copper smelter in Northern Norway.
Cyprus Mines Corporation (Bagdad, Arizona)	1973 - 1975	Copper smelting and refining studies, including flash smelting and Noranda's new continuous smelting process.
Atlas Consolidated Mining & Development Corporation (A. Soriano Corporation) Makati, Rizal, Philippines	1973 - 1975	Copper smelting and refining studies, including Anaconda's Arbiter process. Copper flash smelter study with detailed estimates based on preliminary design.
Texasgulf Inc. (now Kidd Creek Mines Ltd.) Toronto and Timmins, Ontario	1973 - 1977	Detailed studies of copper smelter and refinery at Timmins, Ontario, including recovery of sulphuric acid, silver, selenium and slag fuming. Participation in, and review of tonnage smelting tests in Finland and Japan.
	1977 - 1982	General consulting services during design, construction and start-up of production plant at Timmins, which went successfully on-line in July, 1981.
Gränges International Mining Stockholm, Sweden	1975	Preliminary evaluation of metallurgical processes for a project in Latin America.
Canadian Copper Refiners Ltd. (subsidiary of Noranda Inc., Montreal, Québec)	1975	Review of copper electrolyte purification system.
Coopers & Lybrand Phoenix, Arizona	1976	Review of copper smelting cost accounting.
Bethlehem Copper Corporation Vancouver, B. C.	1976	Review of copper concentrate treatment terms.
Kuwait Engineering Operation and Management Kuwait	1976 - 1977	Review and estimates of alternative copper smelting and hydro-metallurgical processes for extension of copper project in Mauritania, West Africa.

Copper Projects (cont'd)

<u>Company</u>	<u>Year</u>	<u>Assignments</u>
Elkem A/S Oslo, Norway	1976 - 1978	Evaluation of hydrometallurgical copper process based on chloride solutions, including detailed cost estimates based on preliminary plant design.
	1979 - 1983	Continuing advice on further development of process.
Equity Mining Corp. Ltd. Vancouver, B. C.	1977	Review of concentrate treatment terms and process alternatives.
Anaconda Company Butte, Montana, U.S.A.	1977	Review of Arbiter process and recommendations to improve plant performance.
Western Mining Corporation Melbourne and Perth, Australia	1977 - still in progress	Evaluation and cost estimates of copper processes, including Inco oxygen flash smelting and hydro-metallurgy, in connection with copper-uranium project in South Australia. (See Roxby Management).
M.I.M. Holdings Limited (Mount Isa Mines) Brisbane, Australia	1977 - 1978	Study of effect of oxygen enrichment on reverberatory furnace performance.
Anaconda Copper Company Denver, Colorado	1978 - 1983	Economic and technical review of modern copper smelting and refining process alternatives. General consulting services.
Roxby Management Services Adelaide, South Australia	1980 - still in progress	Copper and gold recovery aspects of Roxby Downs (Olympic Dam) copper-gold-uranium project, including pyro- and hydrometallurgical alternatives. Detailed smelter estimates started 1982.
Exxon Research & Engineering Co. Florham Park, N. J., U.S.A.	1980 - 1982	Evaluation of new copper smelting process.
Kennecott Minerals Company Process Technology Salt Lake City, Utah, U.S.A.	1981 - 1982	Evaluation of the SMOC process. Evaluation of anode slimes treatment processes.
The Electrolytic Refining & Smelting Co. of Australasia Port Kembla, N.S.W.	1981	Evaluation of copper smelting processes.
Superior Oil (for Brown & Root, Inc.) Houston, Texas	1981 - 1982	Participation in smelting process selection for the Quebrada project in Chile.

Copper Projects (cont'd)

<u>Company</u>	<u>Year</u>	<u>Assignments</u>
Kennecott Minerals Co. Salt Lake City, Utah, USA	1982	Evaluation of copper and nickel refining process for Babbitt copper-nickel deposit. Independent evaluation of Chino smelter revisions as required by EPA.
Codelco Chuquicamata, Chile (for Davy McKee Corp., San Ramon, CA, USA)	1982 - 1983	Detailed planning of new flash smelter, and its integration with existing facilities.
Boliden Metall AB Skelleftehamn, Sweden	1982	Cleaning of copper converter process and ventilation gases.
Empresa de Desenvolvimento do Alentejo (EDMA) and Química de Portugal (QUIMIGAL) Lisboa, Portugal	1982 - still in progress	Evaluation of smelting and refining process alternatives for Sines Copper Project in Portugal.
Denison Mines Limited Toronto, Canada	1983	Technical evaluation of copper smelter and refinery in Taiwan.
Tennessee Chemical Company Copperhill, Tennessee, USA	1983	Review of copper smelting operations.
Magma Copper Company San Manuel, Arizona	1983	Investigation into converter gas handling.
Sociedade Mineira de Neves-Corvo (SOMINCOR) Lisboa, Portugal	1983	Review of concentrate treatment terms and impact of the interaction of contract factors.
Kidd Creek Mines Ltd. Timmins, Ontario	1984	Technical evaluation of a Top Blown Rotary Converter.
Williams Strategic Metals, Inc. Denver, Colorado, USA	1984 - 1985	Evaluation, including pilot plant tests, of the CONTOP process to treat smelter byproducts.
Phillips Barratt Kaiser Engineering Ltd. Vancouver, B. C.	1984	Audit of concentrate smelting contract and advice on negotiations.
Mitsubishi Metal Corporation Naoshima, Japan	1985	Consulting services in connection with conventional smelter operations.
Philippine Associated Smelting and Refining Corp. (PASAR) Isabel, Leyte, Philippines	1985 - still in progress	Technical audit of smelter and refinery operations, including sampling. General consulting services.

LEAD AND ZINC PROJECTS

<u>Company</u>	<u>Year</u>	<u>Assignments</u>
Zinco de Mexico (Zincamex) and Cia. Metallurgica Penoles Mexico, D.F.	1958 - 1961	Comparative estimates of all processes, including retorting, electrolytic zinc and Imperial Smelting Process (plant built at Saltillo, Mexico).
East Coast Smelting & Chemical Co., Subsidiary of Brunswick Mining & Smelting Corporation, Toronto, Canada	1960 - 1961	Study and estimates of Imperial smelter, including lead and zinc refining, and recovery of sulphur from smelter gases (Imperial smelter built at Bathurst, N.B.).
Noranda Mines Limited Toronto, Canada	1961	Study including estimates of Imperial smelter (electrolytic plant built at Valleyfield, P.Q.).
Burma Corporation (1951) Ltd. Mantu and Rangoon, Burma (through United Nations, N.Y.)	1962 - 1965	Study and estimates of lead-zinc complex including electrolytic zinc, lead smelting and refining, and Imperial smelting.
Banco Minero del Peru Later: Empresa Mineral del Peru (also known as Peruzinc) Lima, Peru	1964 - 1965 and 1970	Review of estimates of, and proposals on Imperial Smelting and electrolytic zinc.
Standard Metals Corporation Denver, Colorado	1964 - 1969	Technical and economic study of Imperial smelter, including refining of zinc and lead and recovery of sulphur from smelter gases.
Texasgulf Sulphur Company New York, N.Y.	1964 - 1968	Preliminary evaluation of all processes, including Imperial Smelting, vertical retort and St. Joe electrothermic. Subsequently, detailed feasibility study of electrolytic zinc plant, based on testwork on TGS zinc concentrates (electrolytic zinc plant built near Timmins, Ontario).
Sherritt Gordon Mines Ltd. Toronto, Ontario	1965	Estimate of plant for producing electrolytic zinc from pressure leaching solution.
Tara Exploration and Development Co. Ltd. Dublin, Ireland	1966 - 1968	Study of Imperial Smelter including refining of zinc and lead and recovery of sulphur from smelter gases.
Cominco Ltd. Montreal, Quebec	1967	Confidential.

Lead and Zinc Projects (cont'd)

<u>Company</u>	<u>Year</u>	<u>Assignments</u>
Ethyl Corporation Baton Rouge, LA, U.S.A.	1967	Review of lead smelting and refining economics.
Government of Iran Tameran, Iran (through UNIDO, Vienna)	1968 - 1970	Study of possibilities for processing lead and zinc ores in Iran, including Waelz process, Imperial Smelting, electrolytic zinc, slag fuming, blast furnace and electric lead smelting.
Smelter Corporation of Ireland Dublin, Ireland	1969 - 1970	Study of electrolytic zinc plant, including sulphuric acid recovery.
Akita Zinc Co. Ltd. Tokyo, Japan	1969 - 1972	Review of electrolytic zinc process and plant design (80,000 tons/year electrolytic zinc plant operating since 1972 at Iijima, Japan).
	1976	Confidential study.
Conzinc Riotinto of Australia Limited Melbourne, Australia	1971 - 1972	Evaluation of proposed joint venture with Billiton of Holland (150,000 tons/year electrolytic zinc plant at Budel, Holland).
Government of Ontario Ministry of Natural Resources Toronto, Canada	1972	Report on feasibility of establishing new zinc processing facilities in the Province of Ontario.
Cyprus Anvil Mining Corp. Vancouver, Canada	1973 - 1974	Evaluation of lead and zinc smelting economics.
	1975 - 1976	Review of zinc and lead concentrate treatment terms and review of new lead smelting processes.
	1977 - 1982	Updates of lead smelter economics and evaluation of TBRC and Kivcet processes for treatment of lead concentrates.
Cyprus Mines Corporation Los Angeles, CA, U.S.A.	1974	Evaluation of new hydrometallurgical lead-zinc process.
Australian Mining & Smelting (Europe) Ltd. Bristol, England	1974 - 1975	Advise on Budel Zinc Plant (Holland) operations, including process changes and equipment additions.
Hudson Bay Mining & Smelting Company Limited Flin Flon, Manitoba, Canada	1976	Modernization of zinc melting, alloying and casting facilities, with special emphasis on pollution control.

Lead and Zinc Projects (cont'd)

<u>Company</u>	<u>Year</u>	<u>Assignments</u>
St. Joe Minerals Corporation Monaca, PA, U.S.A.	1977 - 1978	Zinc smelter modernization study.
	1978 - 1980	Feasibility studies of electrolytic zinc plant with detailed cost estimates based on preliminary plant design and a number of process alternatives.
	1980 - 1982	Studies of new lead technology, including smelting, refining and hydrometallurgical processes.
Société Nationale de Sidérurgie (SNS), Algiers, Algeria	1977 - 1984	Evaluate and advise on production problems at Ghazaouet electrolytic zinc plant.
Exxon Minerals Company Houston, Texas, U.S.A.	1979 - 1981	Zinc plant study, including evaluation of present and potential future processes.
The Anaconda Company Denver, Colorado and Butte, Montana	1979 - 1980	Study of process alternatives for recovering zinc and other values from copper slag.
P.T. Aneka Tambang Jakarta, Indonesia	1979 - 1980	Study and basic engineering design of small electrolytic zinc plant.
Sulphide Corporation Pty. Ltd. Boolaroo, NSW, Australia	1979 - 1981	Study and estimates of electrolytic zinc plant addition to existing lead-zinc smelter.
Canadian Government Environment Canada	1979	Technical review of papers on lead and zinc for publication by Environment Canada.
Westmin Resources Vancouver, B.C.	1983	General comments on recovery of precious metals in electrolytic zinc plants.
SKF Steel, Inc. Avon, Connecticut, U.S.A.	1984	Evaluation of zinc production costs in connection with plasma smelting.

NICKEL PROJECTS

<u>Company</u>	<u>Year</u>	<u>Assignments</u>
Freeport Sulphur Company New Orleans and New York	1957 - 1958	Nickel processing cost evaluation of Mao Bay project in Cuba (started operations in 1959).
Outokumpu Oy Pori, Finland	1959	Investigations in connection with electrolytic nickel refinery (started operations in 1960).
Planning of Empress Nickel Project in Rhodesia (in operation since 1967):		
(1) Rio Tinto Mining Co. London, England and Salisbury, Rhodesia	1956 - 1958	Comparison of various smelting methods for nickel ores, and detailed engineering estimate of reverberatory nickel smelter.
(2) Rio Tinto Management Services Ltd. London, England	1960 - 1961	Evaluation of nickel solvent extraction process and electrolytic nickel refining.
(3) Rio Algom Mines Ltd. Toronto, Canada	1961 - 1962	Detailed engineering study of electrolytic nickel and copper refinery.
Great Lakes Nickel Limited Montreal and Toronto, Canada	1966 - 1974	Studies, including planning and review of testwork, detailed engineering studies and estimates, etc. of copper-nickel-platinum smelting and refining facilities for low grade copper-nickel deposit near Thunder Bay, Ontario.
Western Mining Corporation Ltd. Melbourne and Perth Australia	1967 - still in progress	Studies and planning, including advice on detailed engineering of metallurgical projects, including nickel refinery at Kwinana (in operation since 1970), nickel smelter at Kalgoorlie (in operation since 1973), and other projects. Review of other nickel processes.
Conzinc Riotinto of Australia Melbourne, Australia	1968 - 1971	Evaluation of possible application of Worcra continuous smelting process to nickel smelting.
	1981	Nickel production cost study.
Ethyl Corporation Baton Rouge, LA, U.S.A.	1968 - 1971	Development and evaluation of new nickel-cobalt extraction and refining process.

Nickel Projects (cont'd)

<u>Company</u>	<u>Year</u>	<u>Assignments</u>
A. Soriano Corporation (Atlas Consolidated Mining Development Corporation) Manila, Philippines	1968 - 1972	Studies and planning of lateritic nickel projects including ferro-nickel smelter in Palawan, hydro-metallurgical nickel plant in Mindanao, and segregation process.
Anonymous client	1971	Review of Greenvale Nickel Project in Queensland, Australia for potential partner in project.
Selection Trust Limited London, England	1972 - 1975	Advice in connection with electrolytic nickel refinery and nickel smelting process selection for Agnew Project, Western Australia.
Derry, Michener & Booth Toronto, Canada	1978	Evaluation of laterite nickel project in Oregon, USA, including cost estimates of proposed hydro-metallurgical nickel plant.
Kennecott Minerals Company Salt Lake City, Utah, USA	1982	Evaluation of smelting and refining processes for Babbitt copper-nickel deposit.
Anaconda Minerals Company Denver, Colorado	1983	Review of laterite and sulphide nickel mining and processing operations.
Environment Canada Ottawa, Canada	1985	General review of nickel smelting and refining processes.

MISCELLANEOUS PROJECTS AND INVESTIGATIONS

Since 1953 a number of studies have been carried out in fields other than those listed under the previous headings. Some of the more recent of these are summarized below.

<u>Company</u>	<u>Year</u>	<u>Assignments</u>
UNIDO - assistance to the Government of Indonesia	1975	Review of the equipment and training program required to improve the efficiency of the Mining and Metallurgical Institute of Bandung, Java, Indonesia.
Ontario Government - Royal Commission on Health and Safety of Workers in Mines	1975	Description of the extractive metallurgical industry in Ontario which outlines potential sources of hazards in the industry and highlights some of the current trends in process and plant design.
Newfoundland Government Dept. of Industrial Development	1975	Study of the feasibility of establishing power-intensive metallurgical industries in Newfoundland including a comparison of power costs from various sources.
Canadian Government Environment Canada	1975	Sulphur containment review of Canadian nonferrous smelters with particular emphasis on the practical methods of sulphur fixation.
	1979 & 1983	Revised and updated above report for publication.
The Dow Chemical Company Freeport, Texas	1976	Confidential.
New Brunswick Government Dept. of Natural Resources	1976	Confidential.
Canadian Government Environment Canada	1976	Review of processes for mercury control in gases.
	1976 - 1977	Review of processes for arsenic control in gases.
Kennecott Copper Corporation New York, N.Y.	1976 - 1979	Confidential study covering a number of metallurgical processes.
New Brunswick Government Dept. of Natural Resources	1978	Evaluation of byproduct iron ore process using a chloride leach.

Miscellaneous Projects and Investigations (cont'd)

<u>Company</u>	<u>Year</u>	<u>Assignments</u>
C-I-L Inc. Montreal, Canada	1978	Review of Canadian nonferrous metallurgical industry, with emphasis on sulphur recovery potential.
	1984	Updated above study.
Exxon Minerals Company, U.S.A. Houston, Texas	1978 - 1979	Base metals processing cost comparisons.
Horanda Mines Limited Toronto, Canada	1979	Review of cobalt recovery processes for treating arsenical cobalt concentrates.
P.T. Aneka Tambang Jakarta, Indonesia	1979 - 1980	Study of proposed integrated zinc, lead and copper smelting and refining complex in Indonesia.
	1982 - 1983	Revision and update of above study, including cash flows, etc.
Texas Instruments Inc. Attleboro, Massachusetts	1980	Preliminary study of processes for gold and silver recovery from scrap by electrorefining.
Lacana Mining Corporation Toronto, Canada	1980	Preliminary evaluation of plasma torch technology.
Kidd Creek Mines Ltd. Toronto, Ontario	1982	Preliminary review of sulphur fixation methods applicable to copper smelters.
Royal Society of Canada	1982	Peer Review of report by U.S./Canada Work Group on transboundary air pollution as it applies to non-ferrous metallurgical plants.
	1984	Chairmanship of Control Committee reviewing the Federal Government LRTAP program.
Canadian Government, E.P.S. Ottawa, Canada	1984 - 1985	Technical review of alternative methods of fixing sulphur at Thompson, Manitoba.
Thunder Basin Coal Co. (ARCO) Wright, Wyoming	1983 - 1984	General consulting services, principally in material handling.
Outokumpu Oy Helsinki, Finland	1984	Handling and processing of smelter gases.
Granges Exploration Ltd. Vancouver, B. C.	1985	Technical evaluation of a copper smelter and zinc plant at Flin Flon, Manitoba.
CANMET, Canadian Government Ottawa, Canada	1985	Assessment of methods of dry way chlorination of complex sulphide concentrates.



STATE OF ARIZONA

DEPARTMENT OF MINES AND MINERAL RESOURCES
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NOTE TO READERS

The following pages constitute a document titled *Summary of Aguila Project, April 27, 1987*. It has been received by the Arizona Department of Mines and Mineral Resources from an anonymous source. The Department of Mines and Mineral Resources has serious concerns about the validity of some of the information contained in portions of the document.

The Arizona Department of Mines and Mineral Resources is not responsible for the accuracy of the records, information, or opinions that may be contained in this document. We collect all available data on mineral properties regardless of our view of its accuracy.

Please feel encouraged to discuss these concerns with the Department staff.

Summary of Aguila Project

April 27, 1987

Introduction

The Aguila Project is located approximately 5 miles south of Aguila, Arizona and consists of over 30,000 acres of leased and located mining claims. Maurice James is acting as agent for himself and other owners. The property is known to contain gold and silver. There is data to indicate that platinum group metals are present.

Geological Studies

During the last quarter of 1985, an exploration program covering four square miles of the land position was completed. Seven hundred soil samples were taken and twelve reverse circulation drill holes were completed. Test results indicate widespread existence of gold, silver and other platinum group metals throughout the sampled areas.

The project geologist who supervised the 1985 program concluded a gold-platinum resource of approximately 20 million tons. This area is located in a one-section area of the land position. Based on the results of all of the drill holes, there is a strong indication that nearly all of the land position is related to the gold-platinum mineralization identified in the exploration program.

Metallurgical Studies

Several reports by Mountain States Engineering and Jan Reimers and Associates USA Inc. have been developed. The results of the studies indicate Aguila ore containing gold and silver can be recovered using the proprietary process. Upon substantial indication of investment interest and execution of a secrecy agreement, the basic process will be shown to a mutually agreed upon mining professional.

OPTION PROPOSAL

Payment to owner for option #1: \$600,000.00.

- Owner's geologist and investor representative will agree on the sample to be taken.
- Samples will be delivered to an independent engineering company for preparation and splitting.
- One split of samples will be given to owner for processing and assaying. Remaining samples to remain in possession of engineering company.
- Upon completion of assays by owner and analysis of dore beads by an outside laboratory, the independent engineering company will process and fire assay their split of samples using proprietary procedures and under owners' supervision. Dore beads will be analyzed by laboratory of independent engineering firms's choice.
- Owner and engineering firm will do beneficiation studies with both owner and engineering firm to do assays as outlined above.
- Owner and engineering firm will cooperate on a process cost estimate.

Payment to owner for option #2: \$1,400,000.00.

- Drill and sample per recognized procedures to define ore body and prove reserves. Develop and define the most economical process for treatment of ore.
 - Pyrometallurgical
 - Hydrometallurgical
 - Potential for sale

OPTION PROPOSAL

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- Owner will do beaker-scale studies to confirm process and then build a one-ton-per-day pilot plant for minimum 30-day operation with results documented and repeated to show recoverable values and costs.
- Preliminary design specs for commercial plant.

Payment of option #3 will be as follows:

- If studies and recovery are satisfactory, investor will pay owner \$40.00 per ounce of gold contained in proven reserves investor purchases.
- In addition, investor will pay license holder of proprietary technology on a sliding scale in relationship to the ability of technology to enhance the recovery of gold, silver and pgm.

JAN H. REIMERS AND ASSOCIATES USA INC.

Consulting Metallurgical Engineers

P.O. BOX 420545 HOUSTON, TEXAS, USA 77242-0545

Principals:

J.E. Hoffmann, FIMM, P.E.

A.D. Zunkel, D.Sc., P.E.

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Telecopier: (713) 440-8504

27 April 1987

Maurice James, President
James International
P.O. Box 873
Baytown, Texas 77528

Dear Maurice:

This letter will confirm that I participated in the development of sampling procedures and fire assay techniques for determination of the gold content of a composite sample of Aguila ore.

Based on my discussions with the various personnel involved in this work, and a review of the results obtained; it is my opinion that the preparative procedures and fire assay techniques used for determining the gold content of the various precious metal bearing ore samples were carried out in a reproducible fashion consistent with the stipulated process steps and with careful attention to detail.

To substantiate this assertion, the results of the actual fire assays are shown below in Table I. All samples for fire assay were splits from the same head sample. The head was an ore composite from seven sampling sites on the Aguila property. The same fire assay fluxing formula was used in all cases, as was the amount of silver added for inquartation. The number designation for the samples refers to ore pretreatments prior to fire assay. Samples with the letter designation X, are fire assay blanks.

Affiliate: Jan H. Reimers and Associates Inc. Oakville, Ontario, Canada

Principals: W.R.N. Snelgrove, P. Eng. and John C. Taylor, P. Eng.

Table I Assay of Aguila Ore Composite

<u>Sample No.</u>	<u>Silver Bead</u>		<u>Ore Assay Opt</u>
	<u>Weight (mg)</u>	<u>Gold Assay (%)</u>	
2A	41.5		
2B	40.6		
Avg of 2A+2B		.085	.017
2C	40.7		
2D	39.5		
2X	41.6		
3X	41.6		
Avg of 2X+3X		.0885	.0321
3A	41.4		
3B	41.7		
Avg of 3A+3B		.307	.0621
3D	40.6		
5A	41.0		
5B	40.0		
Avg of 5A+5B		.149	.0293
5C	40.9		
5D	39.0		
5X	39.4		
8A	41.0		
8B	40.7		
Avg of 8A+8B		.193	.0384
8C	40.4		
8D	40.7		
8X	40.5		

$$\text{Average value of Aguila Ore} = \frac{(2A+2B)+(3A+3B)+(5A+5B)+(8A+8B)}{8} = .0364^* \text{ opt}$$

A review of the data above demonstrates the following.

* The fire assay was performed with a high degree of reproducibility. This is confirmed by the consistent weight of the silver bead. Standard deviation in bead weight is only ± 0.74 mg.

* The very low gold value obtained on the assay of combined beads 2X+3X, fire assay blanks, demonstrate that inadvertent contamination of the samples did not occur.

Additional confirmation of these results was obtained when individual samples from the sites used to produce the composite sample were fire assayed at the American Society for Applied Technology. These assays are shown below.

*It should be mentioned that gold values in excess of ten times those shown above were obtained on samples subjected to special fusion pretreatments. However, these results are preliminary and subject to further testing.

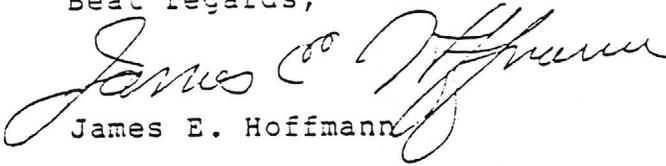
Table II Assays of Aguila Ore from Sites 1-7

<u>Sample/Site No.</u>	<u>Gold Assay (opt)</u>
AF-1	.04
AF-2	.03
AF-3	.01
AF-4	.03
AF-5	.05
AF-6	.06
AF-7	.04
Average gold value	.0371 opt = 16.69 @ ^{\$} 450/oz.

Conclusion

Gold values of .03-.04 opt have been demonstrated for samples of Aguila ore. These results have been confirmed both by fire assay of composite site samples of Aguila ore and separate fire assay determinations of individuals site samples.

Best regards,


James E. Hoffmann

cibility are different from those producible in the laboratory and have not yet been determined.

The separation of the platinum metals into soluble and insoluble fractions for analysis has already been mentioned. The insoluble fraction is reduced by repeated treatments with alkaline oxidizing fluxes, and thereafter is gotten into solution. For scientific comparisons, these two fractions may be separately analyzed, as was done for the writer in 1945 by Johnson, Matthey and Co. with a sample of platinum metals contributed by the Goodnews Bay Mining Co., Alaska. Ordinarily, however, the soluble and insoluble fractions are combined for final analysis. The presence of black sand that cannot entirely be removed from placer platinum metals has already been noted. These remaining minerals go into solution at the refineries, either in the aqua regia, or along with the insoluble fractions that are treated with fluxes. Hence invariably there is given, even in superior commercial analyses, a percentage of "impurities." This item includes the base metals that constitute the dross of the platinum alloys, the dross of any free gold that may be present, any lead shot, solder, or similar materials not recognized by the producer, and the base metals of the included black sand. Recent investigations have also shown that minute grains of chromite, chalcopryrite, and other minerals are intergrown in some of the natural platinum alloys. Thus in the platinum metals of the Goodnews Bay Mining Co., grains of chromite and chalcopryrite are clearly visible in polished sections at magnifications as low as 50 diameters. These facts lead to the conclusion that the true dross of natural platinum alloys, even in handpicked samples, is difficult to determine with precision.

Chemical analyses of the natural platinum alloys are of different classes, with different degrees of dependability. Analyses are divided by the writer into two general classes, which are designated as superior and inferior analyses. Superior analyses are considered to be those wherein the percentages of all the component platinum metals are determined, with or without the base metals of the dross. Exceedingly few such analyses are available of the platinum metals produced in foreign countries. Numerous analyses of this kind have been made by the U.S. Bureau of Standards, and one was made by the U.S. Geological Survey. Most assayers are incapable of making high-grade analyses of the platinum metals and alloys, and concerns which are capable of doing such analytical work do not always do so, as the cost may be prohibitive. Another reason why such analyses, if made, are not published is that it may be to the advantage of either the producer

or the processor, or both, that such results should not be generally known. The best analyses available to the writer are those made by Johnson, Matthey and Co., Inc., of Malvern, Pa., for the Goodnews Bay Mining Co. of Alaska. Few other superior analyses appear in this report.

Inferior analyses include two general types. One type, which is the most prevalent, is essentially an analysis of only that part of the sample which dissolves in hot aqua regia. The insoluble fraction, whose total weight is known, is presented as osmium plus iridium, or perhaps as osmiridium. It commonly contains more iridium than osmium, as well as ruthenium and small amounts of platinum and rhodium. Therefore in such inferior analyses, the tenors of platinum, iridium, and rhodium are too low, and the tenor of ruthenium is neglected and rarely mentioned. Only the percentage of palladium is correct. The analyses of the platinum metals from Russia, because one part of the iridium is separately stated, whereas another part is reported as osmiridium, appear to be of this type; many other analyses in this report are of similar character.

A second type of inferior analysis is one wherein only the soluble platinum and palladium are reported and the soluble iridium and rhodium are added either to the platinum or to the insoluble fraction reported as iridium plus osmium. This procedure is common practice where the alloy contains only small amounts of iridium, osmium, ruthenium, and rhodium. Such analyses have little value, but they cannot be ignored, because they show at least the tenor in palladium and a minimum tenor in platinum. Examples of these are shown by the two mean analyses of Colombian platinum published by Singewald (1950, p. 174).

The problem thus arises how to present and interpret chemical analyses that are available in the literature. If, in addition to the percentages of some or all the platinum metals, the contents of copper, iron, and other base metals are specifically stated, the latter percentages cannot be ignored, and are stated as a part of the analysis with the implicit understanding that these tenors do not necessarily represent dross. If percentages of the base metals are not given, the gold (which is commonly free gold) is deleted, and the analysis is recomputed in terms of the platinum metals to total 100 percent. Even, however, if the tenors of the base metals are given, such recomputed analyses of the platinum metals alone serve a useful purpose in comparing different alloys with one another.

Copy

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Consulting Metallurgists

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HOUSTON, TEXAS

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Principals:

J.E. Hoffmann, FIMM

A.D. Zunkel, D.Sc.

17 October 1986

Telephone: (713) 493-9441

(713) 586-7740

Telex: 06-982354 (Canada)

TO: Maurice James

FROM: A. D. Zunkel *Z*

SUBJECT: Status Report and Action Plan for the PGM Projects

This memo presents the current status of activities on the recovery of PGM's from ores, slags, and auto catalyst of interest of James International/Eagle Eye Mining Company and an action plan to progress toward commercial production.

Current Status

Here is the status of activities currently underway:

Analytical Procedures

My first assignment since being retained as a consultant was to find or develop an accurate and reliable analytical method for determining precious metals (PMs) and platinum group metals (PGMs) in ores, slags, and metals. The need for this work has arisen from wide discrepancies in analyses obtained from several laboratories on ostensibly the same sample of a variety of materials. This problem was confirmed on Montana black slag by significantly differing results obtained by Lakefield Research and ACS. Lakefield's results using fire assay + AA and ICP finish were substantially lower than ACS's using digestion + DCP and ICP-MS.

To resolve this problem, the decision was taken to develop with Applied Research Laboratories in Brea, California, a total digestion + DCP technique and conduct a two phase round robin with a number of analytical labs to determine who could provide accurate results using this method. Samples of black slag and Aguila ore prepared by Mountain States Engineering and a reference standard will be analyzed on the first round for Au, Pt, and Rh. The selected labs will be allowed to analyze the samples by any method they choose on the second round. Data will be analyzed, and the appropriate method and lab recommended.

The reference sample selected for use in the round robin is SARM-7, a Merensky Reef platinum ore from South Africa. This reference standard was analyzed by ACS who didn't know it was a standard with these results:

Affiliate: Jan H. Reimers and Associates Inc.
Oakville, Ontario, Canada

Principals: W.R. Snelgrove, P. Eng. and John C. Taylor, P. Eng.

SARM-7 Analyses in ppm	Au	Pt	Pd	Rh
Certified Values	0.31	3.74	1.53	0.24
ACS (average of 4 analyses)	0.37	2.66	1.41	0.40 (0.23)*
% Difference	+19	-29	-8	+67 (-4)*

* average of 3 analyses - one outlying value discarded

These data suggest ACS, while not within the desired 95% confidence levels on any element except Rh, are reasonably close and their results can be used for guidance until either their accuracy is improved or a more accurate lab identified.

Mineralogy

Samples of Aguila ore and Utah slag were sent to Hazen Research Inc. (HRI) in Golden, Colorado for mineralogical analysis to identify minerals present and potential opportunities for concentration. Results were:

Aguila ore - highly oxidized, non-sulfide-bearing, abundant hydrated iron oxides, highly altered to clays, some tramp metallics

Utah slag - abundant metallics, copper-nickel matte, metallic lead, abundant spinels and silicates

These results suggest that flotation and/or gravity methods may be applicable to what appears to be a lead blast furnace slag to recover values. This slag probably originated at Tooele, Utah.

However, flotation is probably not applicable to the Aguila ore for concentration. Gravity and hydrometallurgical methods should be tested.

Gravity Concentration Tests

Preliminary tabling tests were run on Montana black slag, Arizona cinders, and a purported heat treated Aguila ore sample at JB Laboratories in Phoenix, Arizona on 2-4 October 1986.

Visual observations on these tests indicated the following:

- o Montana black slag - significant concentration of contained matte prills in the 1st and 2nd concentrates with less in the middlings. The tails appeared reasonably free of matte prills.
- o Arizona cinders - silica seemed to be concentrated in the 1st and 2nd concentrates.

Maurice James
17 October 1986
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- o Heat-treated Aguilera - nice pyrite concentrate present on 1st and 2nd cuts with significant fine pyrite in middlings and tails. Presence of pyrite in this case doesn't make sense based on HRI mineralogy and high heat treatment temperature.

A material balance on these tests will be calculated based on ACS analyses when available.

Another tabling test on fine Aguilera ore was conducted on 10-11 October at JB Labs. Some concentrate was produced but did not appear to contain the pyrite noted in the tests referred to above. A material balance for this test will be calculated based on ACS analyses when available.

While these tests show some potential for upgrading (or more precisely skimming) the various materials, we must keep in mind that they are very preliminary and in no way can be or should be interpreted as producing optimum results. Additional systematic testwork will be required to optimize.

Smelting Tests

Elmer Sunday is conducting tests to smelt in an electric furnace various materials including Montana black shales, Aguilera ore, and auto catalyst with the objective of collecting the PGM's into a metallic phase from which they can be recovered. Mr. Sunday probably will report on these tests separately.

Refining Tests

Jim Hoffmann has prepared equipment list and test plan to define a refining procedure for recovering PGM from the copper-rich metallic phase used to collect them in the smelting tests. This equipment is presently being purchased.

Action Plan

The essential elements of converting any of the PGM-containing resources to a successful commercial venture are:

- o Develop accurate analytical method
- o Determine size and type of resource
- o Define mining method and equipment
- o Develop extraction method and design process
- o Define product and specifications
- o Estimate capital and operating costs
- o Determine economic

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The specific action plans dependent on your business goals and cannot be developed in detail until you decide your priorities. I can, however, provide very preliminary estimates of the times and costs involved in most of items listed above.

Develop Accurate Analytical Method

An accurate analytical method must be determined promptly for all projects and project phases. Without accurate assays we cannot quantify resources or carry out meaningful laboratory tests or pilot work. The analytical round robin will begin on 24 October 1986 and will be completed by 20 November 1986. The estimated cost is:

o Sample preparation:	\$ 600
o Standards: \$100 x 2	200
o Analyses: 2 runs x 6 labs x 3 samples x 3 analyses x \$30	3,200
o Data analysis and reporting: 2 days x \$650	<u>1,300</u>
TOTAL	\$5,300

Determine Size and Value Resource

I am not qualified to estimate the time and cost of this step; a geologist must do this. However, as a minimum, these steps must be undertaken on Aguila ore or the slag dumps:

- o Core drilling to confirm resource extent
- o Bulk sampling for metallurgical testing
- o Mineralogy on cores
- o Chemical analysis of cores
- o Ore body outline and resource calculation

Once a geologist defines how many cores must be drilled and how deep, we can then estimate the cost and time requirement for this phase. Sufficient resource must be identified to carry the operation at least through the payback period if outside funding is sought.

Define Mining Method and Equipment

We will be mining ore or reclaiming slag initially by open pit methods. A mining consultant should be hired to develop a mine plan for at least 10 years of production at whatever mining rate is selected and to specify the required equipment. A rough estimate of the time and cost for this phase is 1-3 months following geologic studies and \$10,000 - \$20,000.

Hydrologic studies should also be considered if water is anticipated to be a problem in the area. A preliminary hydrologic study might cost \$15,000 and proceed concurrent with the core drilling program.

Develop Extraction Method and Design Process

Extraction of values from ore/slag will likely be a combination of a gravity/flotation or a pyrometallurgical process for initial concentration, a smelting process to further concentrate the values, and a refining step to upgrade the PGM's to a saleable form. If sufficiently high grade concentrates can be produced at any point of the above sequence, sale of that material should be considered. A rough estimate of the maximum time and cost for developing the extraction method to the point that costs can be estimated for a single material once a representative bulk sample is obtained follows:

o Initial concentration lab/pilot plant	\$400,000
+ lab tax - \$10,000	
+ pilot plant - \$30,000 plus equipment	
o Smelting process lab/pilot plant	200,000
o Refining lab/pilot plant	200,000
o Process integration and design	300,000
	<hr/>
TOTAL	\$1100,000

Total elapsed time following receipt of bulk sample to produce the process design would be 6 months. The concentration lab pilot plant work and the smelting refining work can proceed somewhat concurrently..

Define Product Specifications

Before the capital and operating cost estimate can be prepared, the product from the operation must be specified. This would be determined by contact with potential consumers of master alloy, slimes, doré, crude metals, or refined metal. This activity would proceed concurrent with extraction method development and cost at \$10,000.

Estimate Capital and Operating Cost

An engineering firm with mining/metallurgical design and cost estimating experience should be hired to convert the mine plan and metallurgical process determined above to a + 15% capital and operating cost estimate. Considering that the mining and metallurgical operations will be relatively simple, the cost estimates should not exceed \$100,000 and take 3 months after design is complete.

Determine Economic

With the income, operating costs, capital costs and construction schedule identified in previous phases, a discounted cash flow analysis of the project with sensitivity to product price, capital cost, and operating cost should be conducted prior to appropriation. That analysis should be conducted inhouse and would take a 1-2 weeks and cost \$3-5,000.

Maurice James
17 October 1986
Page 6

Summary

Before the total time and cost estimate for the project can be estimated, the resource definition requirements must be specified. I recommend a geologist/geologic engineer be retained to develop this information as soon as possible. A mining engineer will also be needed soon to begin mine plan development. Also keep in mind the potential need for such items as:

- o Environmental studies to satisfy local, state and federal requirements on both mine and smelter.
- o Archeological studies to assure no historical sites will be disturbed, etc.

These can add significantly to the time and cost of developing the project.

Following appropriation, the detailed engineering, procurement, and construction phases of the project must be completed and the project started up. Details on these project phases can be developed later.

ADZ/pmb
cc: J. E. Hoffmann
Oakville

JAN H. REIMERS AND ASSOCIATES USA INC.

Consulting Metallurgists

P.O. BOX 420545

HOUSTON, TEXAS

77242-0545

Principals:

J.E. Hoffmann, FIMM

A.D. Zunkel, D.Sc.

Telephone: (713) 493-9441

(713) 586-7740

Telex: 06-982354 (Canada)

17 December 1986

TO: Maurice L. James

FROM: Alan D. Zunkel *Z*

SUBJECT: Analytical Round Robin Results and Recommendations

INTRODUCTION

On 27 October 1986 an analytical round robin was initiated with the goals to:

- o identify an analytical procedure for Au, Pt, and Rh at the 1-10 ppm level using total sample dissolution and DCP finish which was accurate, reliable, and would confirm, if possible, the validity of previous analyses done on Eagle Eye Mining Company geologic materials. If total sample dissolution is not applicable, identify alternative methods.
- o identify laboratories who were capable of analyzing these geologic materials reliably, reproducibly, and at reasonable cost.

The strategy used was to send two sets of three samples prepared by Mountain States Engineering from bulk samples supplied them of:

- o SARM-7 (South African Bureau of Standards; Merensky Reef Standard - analysis attached as Appendix 1)
- o Montana black slag (analysis unknown)
- o Aguila Drill Hole 13 geologic material (analysis unknown)

to six analytical laboratories:

- o ACS Laboratories, Houston, Texas
- o JB Laboratories, Phoenix, Arizona
- o Quantatrace Laboratories, Burnaby, British Columbia
- o Ledoux Laboratories, Teaneck, New Jersey
- o Utah International, Sunnyvale, California
- o ARL, Brea, California

and compare results for Au, Pt, and Rh, focusing particularly on the SARM-7 standard with known values. The criterion for selecting these six laboratories was that they all had capability of analyzing geologic material specimens using DCP finish.

Affiliate: Jan H. Reimers and Associates Inc.
Oakville, Ontario, Canada

Principals: W.R. Snelgrove, P. Eng. and John C. Taylor, P. Eng.

In Phase I, each laboratory was asked to analyze the three samples by a method recommended by ARL in Brea, California, the developer and marketer of Beckman DCP equipment. This method involved total dissolution of the sample in aqua regia (and HF, if necessary) followed by analysis of the resultant solution by DCP. The detailed procedure is attached as Appendix 2. In Phase II, each laboratory was asked to analyze the same three samples by whatever procedure was most favored by them for Au, Pt, and Rh in geologic materials.

RESULTS

Here are the results for the two phases of the round robin, starting with Phase I.

Phase I Results

The analytical results for Au, Pt, and Rh from Phase I are tabulated below:

TABLE 1. PHASE I RESULTS

SARM-7

Laboratory	Au	Pt (ppm)	Rh
ACS	0.39/0.06	0.16/0.09	0.04/0.04
JB	0.15	0.66	0.24
QTL	2/2	10/9	13/5
LL	4.8/8.3	35.6/29.5	39.1/37.0
UI	ND	ND	ND
ARL	18	42	10
Average	4.0	14.1	11.6
Standard Value	0.31	3.74	0.24

Montana Black Slag

Laboratory	Au	Pt (ppm)	Rh
ACS	0.93/1.20	0.72/0.72	0.80/0.56
JB	0.17	0.43	0.26
QTL	9/<1	7/<5	14/<5
LL	7.5/7.7	32/33	60/68
UI	--	--	--
ARL	19	44	18
Average	5.8	15.4	20.8

Aguilla Drill Hole 13

Laboratory	Au	Pt (ppm)	Rh
ACS	0.58/10.38	0.58/0.10	0.13/0.14
JB	0.221	0.62	0.26
QTL	2/11	<5/<5	8/<5
LL	2.1/12.4	12.6/12.6	24.9/26.3
UI	---	---	---
ARL	115	33	9
Average	3.0	9.4	9.2

The results for Phase II are tabulated below:

TABLE 21. PHASE II RESULTS

SARM-7

Laboratory	Method	Au	Pt (ppm)	Rh
ACS	aqua regia + DCEP	0.06/0.14	0.09/0.67	0.04/0.10
JB	aqua regia + DCEP	0.072	0.52	0.75
ARL	--	--	--	--
Average	aqua regia + DCEP	0.09	0.42	0.13
QTL	fire assay + IICP	0.52/0.30	4.05/3.40	<0.07/<0.07
LL	fire assay + IICP	0.46/0.32	6.0/4.2	0.65/0.54
UI	fire assay + DCEP	0.28	4.85	0.09
Average	fire assay + IICP	0.38	4.50	0.28
Standard Value	variable	0.31	3.74	0.24
MSE	fire assay + IICP	0.14	2.40	0.24

Montana Black Slag

Laboratory	Method	Au	Pt (ppm)	Rh
ACS	aqua regia + DCP	0.65/1.20	3.40/0.72	0.46/0.56
JB	aqua regia + DCP	0.25	0.62	0.42
ARL	---	---	---	---
Average	aqua regia + DCP	0.70	1.58	0.48
QTL	fire assay + ICP	0.16/0.10	0.09/0.10	<0.07/<0.07
LL	fire assay + ICP	0.21/0.23	<0.04	<0.04
UI	fire assay + DCP	0.05	<0.01	<0.01
Average	fire assay + ICP	0.15	<0.04	<0.07
MSE	fire assay + ICP	0.03	ND	ND

Aguila Drill Hole 13

Laboratory	Method	Au	Pt (ppm)	Rh
ACS	aqua regia + DCP	0.05/0.38	0.55/0.10	0.20/0.14
JB	aqua regia + DCP	0.04	0.28	0.13
ARL	---	---	---	---
Average	aqua regia + DCP	0.16	0.31	0.16
QTL	fire assay + ICP	0.65/0.03	0.05/0.06	<0.03/<0.03
LL	fire assay + ICP	0.22/0.19	<0.04	<0.04
UI	fire assay + DCP	0.01	<0.01	<0.01
Average	fire assay + ICP	0.22	<0.04	<0.04
MSE	fire assay + ICP	ND	ND	ND

DISCUSSION

The round robin results show that the sample digestion using aqua regia method, whether that suggested by ARL or that chosen by JB and ACS as their preferred method, produced analyses of SARM-7 far different from accepted values. Also the range of the analyses among laboratories is very wide.

TABLE 3. SARM-7 BY DIGESTION IN AQUA REGIA

Method	Au	Pt (DDM)	Rh
Phase I (ARL suggestion)	4.0	14.1	11.6
Phase II (ASC/JB selection)	0.09	0.42	0.13
Standard Value	0.31	3.74	0.24

These wide variations in ranges are due to interferences created by elements such as iron and manganese in the samples which, due to total digestion of the sample, are present in the solution to be analyzed by ICP or DCP and are not corrected for properly. Without considerable sophistication in the computer analysis techniques, detailed understanding of the nature of the samples being analyzed, and well-developed skills of the analyst, this method is subject to wide variation in results.

The results demonstrate much closer agreement with accepted SARM-7 values using fire assay and DCP/ICPF finish. In this technique, the interfering elements such as iron and manganese are slagged off during smelting, leaving only the precious and platinum group metals in the solution to be analyzed when the dore bead is dissolved.

TABLE 4. SARM-7 BY FIRE ASSAY

Method	Au	Pt (DDM)	Rh
Phase II (Fire Assay)	0.38	4.50	0.28
Standard Value	0.31	3.74	0.24

Considering then that the aqua regia digestion assays are unreliable, the likely values for Au, Pt, and Rh in the Montana black slag and Aguila Drill Hole 13 material are those obtained by fire assay:

TABLE 5. MONTANA BLACK SLAG AND AGUILA DRILL HOLE 13
BY FIRE ASSAY

Material	Au	Pt (ppm)	Rh
Montana Black Slag	0.15	<0.04	<0.07
Aguila Drill Hole 13 Material	0.22	<0.04	<0.04

By comparing individual laboratory results to accepted SARM-7 values, the laboratory which performed best can be determined. This discussion will be limited to fire assay results.

TABLE 6. INDIVIDUAL LABORATORY PERFORMANCE ON SARM-7

Laboratory	Au	Pt (ppm)	Rh
Standard Value	0.31	3.74	0.24
Ledoux	0.39	5.1	0.60
Δ from standard	+0.08	+1.36	+0.36
% Δ from standard	+26	+36	+150
Quantatrace	0.41	3.72	<0.07
Δ from standard	+0.10	-0.02	--
% Δ from standard	+32	-0.5	--
Utah International	0.28	4.85	0.09
Δ from standard	-0.03	+1.11	-0.15
% Δ from standard	-9.6	+30	-62
Mountain States	0.14	2.40	0.24
Δ from standard	-0.17	-1.34	0.00
% Δ from standard	-55	-36	0

For individual metal analysis, Utah International was closest on Au, Quantatrace on Pt; and Mountain States on Rh. Overall, no single laboratory was within ±25% (a reasonable agreement at these low levels) on all analyses. Due to the importance of platinum, however, to potential Eagle Eye Mining Company projects, Quantatrace would be preferred. They should be advised, however, to review their procedures for Rh.

CONCLUSIONS

The conclusions drawn from this round robin are:

- o Aqua regia dissolution methods for geologic materials can be unreliable for determining Au, Pt, and Rh at the 1-10 ppm level due to interferences unless the nature of the sample is well understood and considerable care is exercised in sample dissolution and data analysis.
- o Fire assay methods are reliable for determining Au, Pt, and Rh at the 1-10 ppm level due to removal of most interfering elements by the procedure.
- o Fire assay methods will produce analytical results for Au, Pt, and Rh which can be used for guidance in geologic exploration and mineralogical/metallurgical testing. Quantatrace Laboratories, Burnaby, British Columbia, performed best on Pt, the element of primary concern in present Eagle Eye Mining Company projects, and is thus recommended for future analytical work.

cc: J. E. Hoffmann
R. E. Lee

Attachments

THE ESTIMATOR AND CONFIDENCE LIMITS OF THE CERTIFIED VALUE

Statistical tests were used to identify outlying results which were then removed from the main population of results. The mean of the set means was weighted by a standard procedure known as "inverse variance", which is a weighting by the inverse of the sum of the variance of the set mean and the between-set variance. The certified values in 12 are the weighted means. For the confidence limits, the variance of the weighted mean was calculated. Close agreement was obtained by the use of other forms of weighting. See 18.1 for further information and for the mathematical expressions for the weighting technique and the confidence limits of the weighted mean.

NOTE: The certified value is an estimate of the "true" value based upon the best available data at the time of certification.

17. NAMES OF ANALYSTS / INVESTIGATORS / CO-OPERATING LABORATORIES

AUSTRALIA

Australian Mineral Development Laboratories	Frewville
Quantum Laboratories (Pty) Ltd	Brisbane
Supervise-Sheen Laboratories (Pty) Ltd	Queens Park
Western Mining Corp. Ltd	Belmont

BELGIUM

Rijksuniversiteit-Gent, Laboratorium voor Analytische Chemi	Ghent
Instituut voor Nucleaire Wetenschappen	Ghent
SA Metallurgie Hoboken-Overpelt	Hoboken
Université Catholique de Louvain, Laboratoire de Traitement des Minerais	Louvain-la-Neuve

CANADA

Canadian Copper Refiners Ltd	Montreal
Department of Energy, Mines and Resources, Analytical Chemistry Section	Ottawa
Department of Natural Resources, Analysis and Control Service	Ste-Foy, Quebec
Falconbridge Nickel Mines Ltd., Metallurgical Laboratories	Thornhill
International Nickel Co of Canada Ltd, J Roy Gordon Research Laboratory	Ontario
Noranda Mines Ltd	Noranda

FRANCE

Bureau de Recherches Géologiques et Minières	Orleans
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GREAT BRITAIN

Alfred H Knight Ltd	Wallasey, Cheshire
Robertson Research International	Llandudno, North Wales

SOUTH AFRICA

Anglo American Corp. of SA Ltd., Anglo American Research Laboratory	Crown Mines
Anglo Transvaal Consolidated Investment Co Ltd	Johannesburg
Atomic Energy Board	Pelindaba
Corner House Laboratories (1968) (Pty) Ltd	Johannesburg
Johannesburg Consolidated Investment Co Ltd, Minerals Processing Research Laboratory	Knights
McLachlan and Lazar (Pty) Ltd	Johannesburg
National Institute for Metallurgy	Randburg
Rio Tinto Management Services SA (Pty) Ltd	Johannesburg
Rustenburg Platinum Mines Ltd	Rustenburg
Western Platinum Ltd	Johannesburg

UNITED STATES OF AMERICA

Cornell University	Ithaca
Engelhard Minerals and Chemicals Corp	New Jersey
Hazen Research Inc.	Golden, Colorado

UNITED STATES OF AMERICA (Continued)

Ledoux and Co	Teaneck, New Jersey
Newmont Exploration Ltd	Danbury, Connecticut
Pennsylvania State University	University Park, Pennsylvania
United States Department of the Interior, Geological Survey	Denver, Colorado
United States Department of the Interior, Bureau of Mines	Reno, Nevada

ZIMBABWE

Rhodesia Chrome Mines Ltd	Selukwe
---------------------------------	---------

18. REFERENCES:

PREPARATION AND CERTIFICATION PROCEDURES USED IN THIS SAMPLE

- 18.1 Steele, T W, et al.: Preparation and certification of a reference sample of a precious metal ore — Report No. 1696-1975 of the National Institute for Metallurgy.

This report is available free of charge from the National Institute for Metallurgy.

19. SIGNATURE / NAME OF CERTIFYING OFFICER/S

T W Steele,
Director, Analytical Chemistry Division,
National Institute for Metallurgy.

I JOE KRELIC WENT TO THE CLAIMS OF MAURICE JAMES
NEAR THE TOWN OF AGULIA , ARIZONA AT THE SECTION COR.
OF 13, 14, 23, 24, - 23, 24, 25, 26, - 30, 19, 25, 24,
13, 24, AND REMOVED FROM ACROSSTHE STRATA
OF A BACK HOE CUT, SAMPLES OF EACH. THEN PROCEEDED
TO WALT STATLER A REGISTERED ASSAYER, WHERE WE
SPLIT PULVERIZED INTO 10 TEN SAMPLES OF EACH HOLE
PLACED AND SEALED EACH ENVELOPE WITH THE ASSAYERS
STAMP.

Joe A Krelie
3593 Indian Bend Dr.
St Rt Mayer, Ariz. 86333

43,60 square feet in one acre

208.71 feet on four sides, one acre

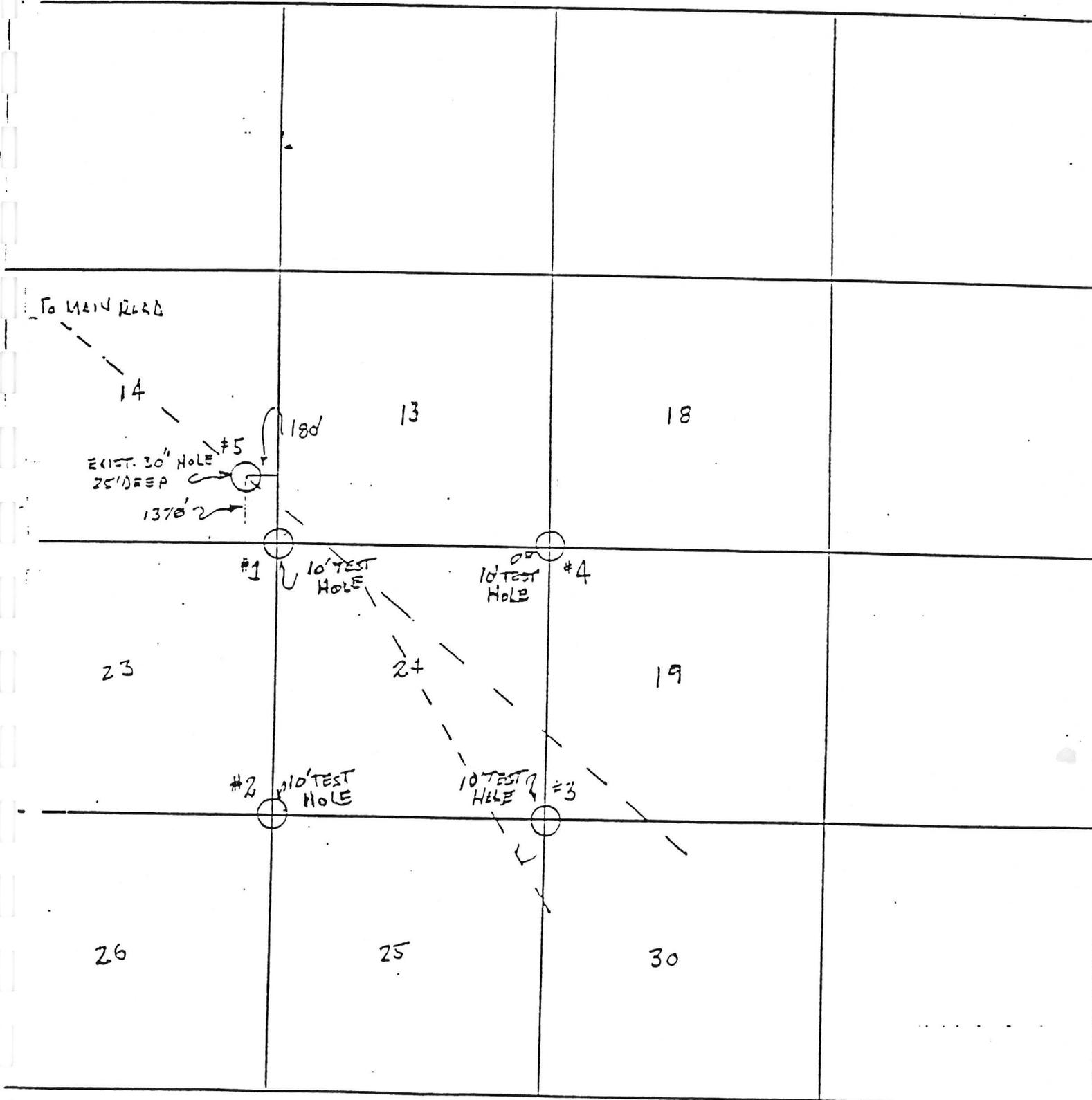
5280 feet)
320 rods)1
1760 yards)Mile
80 chains)

2640 feet)
160 rods)1/2
880 yards)Mile
40 chains)

1320 feet)
80 rods)1/4
440 yards)Mile
20 chains)

4 rods)
16 1/2 feet)
1 chain)
66 feet)
25 links)

ion Township Range



TEST HOLES LOCATED BY

Charles R.L.S.

UH

University of
Houston
University
Park

Department of
Chemistry
4800 Calhoun
Houston, Texas 77004
713.749.2512

March 28, 1985

TO WHOM IT MAY CONCERN:

On March 21, 1985, certified and sealed samples (4) were received. The seals were broken in our presence on March 22, 1985 and chemical extraction was carried out at the Cat Metals Stafford facility. We supervised all operations and manipulations involving these samples. Fractions of the leach liquor were carried to Los Angeles to Geochemical Services Company, where analysis was performed using ICP-Massspectrometry. The presence of gold, silver, indium and rhodium was confirmed in the samples that were tested. All experiments in Los Angeles were carried out in our presence.


John L. Bear, Ph.D.
Chairman of Chemistry


Robert A. Howard, Ph.D.
President Cat Metals Inc.

JLB/drm

	AG	AU	PD	PT	IR	OS	RH	R
	.09	1.11	-	.38	9.92	0.17	-	7
	.03	.99	.03	.03	.79	5.16	-	7
	-	-	-	.03	.44	0.20	-	
	.03	-	.03	-	.20	.09	-	3
	.15	2.10	.06	.44	11.35	5.62	-	18
our Sample Average	.04	.53	.015	.11	2.84	1.41	-	4
value Per oz.	6.00	300.00	115.00	275.00	29.00	990.00	1000.00	140
Current Market Value	.24	159.00	1.72	30.25	81.78	1386.00	-	652

TELEX/TWXX

WESTERN UNION

TELEX/TWXX

WESTERN UNION

MESSAGE # 17
RCV LN 1

680701EUMDVR LW

81881 UM B
GARTEX AUTOMATIC CALL
DO NOT INTERRUPT
1988.07.31.1408 REF:081888 0067 01

01.27.1988 081888

TELEX TO UNION MINES INC., DENVER

ATTN : MR. R. C. LAIRD

PLEASE FIND HEREBELOW THE RESULTS OF THE ANALYSIS MADE BY MHO - JULY
1988 - OF THE D#7 IRON BUTTON FROM THE WICKENBERG PLATINIFEROUS
DEPOSIT, ARIZONA :

AG	26	PPM
AL	LESS THAN 1	PPM
BT	4.0	PPM
CD	11.0	PPM
CE	11.0	PPM
CR	11.0	PPM
CU	6.0	PPM
CO	LESS THAN 6	PPM

BEST REGARDS.

M. SCHMIDT
UNION MINES, INC.
MI

81881 UM B
680701EUMDVR LW
BY

OPERATION 188 8808 LISTED 08:08 MET 07/31/88

Cannon Microprobe / S.E.M.

October 16, 1986

Mr. Maurice James
Baytown, TX

Dear Mr. James:

Sorry for the long delay in sending your report.

Your brother and I were disappointed that my instrument could not verify the presence of platinum group metals in your ores and smelter products.

I did find gold, although in somewhat smaller amounts than reported by the other lab you are working with. Assuming PGE are actually present in your "dore", I have no explanation for my instruments inability to pick it up.

Should you be pulling assay beads from your materials in the future, I would like to mention that the microprobe is very well suited to the analysis of beads. All metals are resolved with easily achieved detection limits of 0.1 wt%. Several labs are now sending me their "difficult" beads, especially those thought to contain Osmium and Iridium.

Sincerely,



Bart Cannon

Cannon Microprobe / S.E.M.

MICROPROBE ANALYSIS OF IRON "DORE"

338

James International
Box 873
Baytown, TX 77520

Maurice James

October, 16, 1986

DESCRIPTION OF SAMPLE

Coarse iron lump showing arborescent crystal intergrowths.

PURPOSE OF ANALYSIS

Determine precious metal content.

ANALYTICAL PROCEDURE

Prepare polished thick sections.

Analysis in ARL EMX-SM electron microprobe.

Trace precious metal content using pure iron background counting statistics.

HCl digestion followed by collection of insolubles and microprobe analysis.

Polished sample surface etched to show insolubles.

PROBE OPERATING CONDITIONS

Accelerating Voltage = 20kv
Beam Current = .1 ua
Spot size = 1um

D A T A - - - - -

No Platinum Group Elements could be detected in the polished surface of the "dore".

Gold is present in trace quantities in the iron.

Analysis point	Gold, wt %	Gold, Oz/short ton
A	0.023	6.9
B	0.013	3.9
C	0.014	4.2
D	0.019	5.7
E	0.017	5.1

Insolubles from HCl digestion are graphite. Graphite grains were embedded in casting resin and polished to expose the interiors. No trace precious metals could be detected in the microprobe.

Cannon Microprobe / S.E.M.

MICROPROBE ANALYSIS OF IRON "DORE"

P kiln # 7 336

James International
Box 873
Baytown, TX 77520

Maurice James

October, 16, 1986

DESCRIPTION OF SAMPLE

Coarse iron lump showing arborescent crystal intergrowths.

PURPOSE OF ANALYSIS

Determine precious metal content.

ANALYTICAL PROCEDURE

Prepare polished thick sections.

Analysis in ARL EMX-SM electron microprobe.

Trace precious metal content using pure iron background counting statistics.

HCl digestion followed by collection of insolubles and microprobe analysis.

PROBE OPERATING CONDITIONS

Accelerating Voltage = 20kv
Beam Current = .1 ua
Spot size = 1um

D A T A - - - - -

No Platinum Group Elements could be detected in the polished surface of the "dore".

Gold is present in trace quantities in the iron.

Analysis point	Gold, wt %	Gold, Oz/short ton
A	0.014	4.2
B	0.018	5.4
C	0.009	2.7
D	0.021	6.3
E	0.011	3.3

Insolubles from HCl digestion are graphite. Graphite grains were embedded in casting resin and polished to expose the interiors. No trace precious metals could be detected in the microprobe.

Cannon Microprobe / S.E.M.

MICROPROBE ANALYSIS OF SMELTER SLAG

Mr. Lee James
Bellingham, WA
September 5, 1986

DESCRIPTION OF SAMPLE

Coarse crushed pitchy black slag.

PURPOSE OF ANALYSIS

Determine precious metal content of sample.

ANALYTICAL PROCEDURE

1.25" diameter plastic casting prepared from undigested sample.

Grains analyzed were hand selected under stereo microscope.

Preliminary examination with Leitz Ortholux ore microscope. Microprobe analysis using wavelength dispersive x-ray spectrometers in an ARL EMX-SM electron microprobe.

PROBE OPERATING CONDITIONS

Accelerating voltage = 20kv
Beam current = .1ua
Spot size = 1 micron

D A T A - - - - -

Non metallic grains showed no precious metal content above the detection limits of 0.02 wt %.

Spherical metallic "droplets" are copper sulphide. Several grains of unreacted chalcopyrite were observed.

Several copper sulphide grains showed from 1.2 wt % to 2.0 wt % dissolved silver.

No gold or platinum group elements could be detected as trace constituents in the metallic phases.

PRECIOUS METAL ANALYSES

Sample Pitchy Slag

grains <u>1, 4</u>	grains <u>7</u>	grains _____	grains _____
<u>CuS s-n</u>	<u>CuS c-n</u>	_____	_____
Ag <u>1.2</u> wt %	Ag <u>2.0</u> wt %	Ag _____ wt %	Ag _____ wt %
Pd _____	Pd _____	Pd _____	Pd _____
Rh _____	Rh _____	Rh _____	Rh _____

Cannon Microprobe / S.E.M.

MICROPROBE ANALYSIS OF SMELTER SLAG

Mr. Lee James
James International
Bellingham, WA

September 5, 1986

DESCRIPTION OF SAMPLE

Coarse nodular gray slag.

PURPOSE OF ANALYSIS

Determine precious metal content of sample.

ANALYTICAL PROCEDURE

1.25" diameter plastic casting prepared from undigested sample.

Grains analyzed were hand selected under stereo microscope from rod crushings.

Preliminary examination with Leitz Ortholux ore microscope. Microprobe analysis using wavelength dispersive x-ray spectrometers in an ARL EMX-SM electron microprobe.

PROBE OPERATING CONDITIONS

Accelerating voltage = 20kv
Beam current = .1ua
Spot size = 1 micron

D A T A - - - - -

Coarse, complex metallic grains are relatively abundant in selected slag clasts. The multiphase components include webs of lead which envelope a copper-antimony alloy, and a silver-antimony alloy.

The silver-antimony alloy contains 70 wt. % to 80 wt. % Ag and 20 wt. % to 30 wt. % antimony. It occurs as 20 to 60 micron inclusions, and comprises less than 2 % of the volume of the metallic clots. No data is available regarding the actual abundance of these clots within the slag.

One site within the lead "webbing" of one of the metallic clots showed 0.2 wt% iridium. A discrete grain could not be located suggesting that the analysis resulted from encounter with a grain smaller than the diameter of resolution of the electron beam and light optics (1 micron). A possibility exists that slightly elevated count rate interpreted as an iridium encounter has resulted from an irregular x-ray take off angle or a 2nd order "reflection" peak from Sb L_{beta} 2. Similar elevated counts at the iridium position were not noted on the antimony bearing copper phase, however.

Cannon Microprobe / S.E.M.

PRECIOUS METAL ANALYSES

Sample nodular slag James International Sept 5, 1986

grains #1 #14
Ag-Sb phase

Ag 72.0 wt %
Pd _____
Rh _____
Ru _____
Au _____
Pt _____
Ir _____
Os _____
Sb 18.0

grains #14
Pb-Ir (?) phase

Ag _____ wt %
Pd _____
Rh _____
Ru _____
Au _____
Pt _____
Ir 0.2
Os _____
Pb 76.0

grains _____

Ag _____ wt %
Pd _____
Rh _____
Ru _____
Au _____
Pt _____
Ir _____
Os _____

grains _____

Ag _____ wt %
Pd _____
Rh _____
Ru _____
Au _____
Pt _____
Ir _____
Os _____

ACS LABS

ANALYTICAL CONSULTING SERVICES
8251 Corporate Drive • Houston, Texas 77038 • (713) 995-8080

January 3, 1986

Eagle Eye Mining Company

Subject: Analysis of 49 core drill samples.

Re: Lab No. 9252-A

Analytical Data: Results reported in ppm, sample basis.

Sample ID	Gold	Platinum	Silver
DH3			
0 - 5'	0.4	0.4	0.16
20 - 25'	1.3	1.4	0.12
45 - 50'	0.12	1.7	0.30
70 - 75'	0.38	2.1	<0.10
95 - 100'	0.28	2.1	<0.10
DH7			
0 - 5'	0.18	0.40	0.10
20 - 25'	0.18	0.28	0.14
45 - 50'	<0.10	1.20	<0.10
70 - 75'	0.26	2.8	0.10
95 - 100'	0.90	2.8	0.60
120 - 125'	0.86	2.3	0.12
145 - 150'	0.96	2.6	<0.10
170 - 175'	0.76	1.2	<0.10
195 - 200'	0.34	1.4	0.30
DH8			
0 - 5'	0.28	3.4	<0.10
20 - 25'	0.52	<0.10	<0.10
45 - 50'	0.12	1.4	<0.10
70 - 75'	0.20	1.7	0.22
95 - 100'	0.94	0.48	<0.10
120 - 125'	0.62	0.46	0.54
145 - 150'	0.28	1.1	0.68
170 - 175'	1.10	0.6	0.40
195 - 200'	0.80	0.74	<0.10
DH11			
0 - 5'	0.32	0.12	0.50
20 - 25'	0.34	1.20	0.38
45 - 50'	0.34	0.28	0.16
70 - 75'	0.40	0.74	0.46
95 - 100'	0.52	0.64	0.46
120 - 125'	0.22	2.1	0.42
145 - 150'	0.28	0.48	<0.10
170 - 175'	0.26	0.50	<0.1
195 - 200'	0.44	0.80	<0.1

Eagle Eye Mining Co.
Lab No. 9252-A
Page -2-

Sample ID	Gold	Platinum	Silver
DH14			
0 - 5'	0.14	0.82	0.44
20 - 25'	0.80	0.52	1.0
45 - 50'	0.28	0.96	0.28
70 - 75'	0.14	1.30	0.80
95 - 100'	0.16	1.30	0.34
DH16			
0 - 5'	<0.10	0.48	0.28
20 - 25'	0.14	1.60	0.14
45 - 50'	0.12	1.64	<0.10
70 - 75'	<0.10	2.0	<0.10
95 - 100'	6.4	1.7	<0.10
120 - 125'	0.32	1.6	<0.10
145 - 150'	0.28	0.95	<0.10
170 - 175'	0.72	0.56	<0.10
195 - 200'	0.76	0.86	<0.10
DH19			
0 - 5'	0.52	0.75	0.60
20 - 25'	0.25	1.7	<0.10
45 - 50'	0.16	1.2	<0.10

ANALYTICAL CONSULTING SERVICES, INC.


Ernie P. Williams
Director

EPW/bdm.

ACS LABS

ANALYTICAL CONSULTING SERVICES
6251 Corporate Drive • Houston, Texas 77038 • (713) 995-8080

January 10, 1986

Eagle Eye Mining Company

Subject: Analysis of 59 Drill Hole samples.

Re: Lab No. 9269

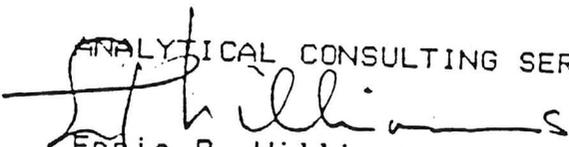
Analytical Data: Results reported in ppm, sample basis.

Sample ID	Gold	Platinum	Silver
DH3			
120 - 125'	0.58	2.2	2.7
145 - 150'	0.22	1.8	1.6
170 - 175'	0.90	0.56	2.8
195 - 200'	1.10	2.2	3.9
220 - 225'	1.0	0.16	1.3
245 - 250'	1.0	0.66	3.5
270 - 275'	0.80	2.1	2.5
295 - 300'	1.6	0.20	1.4
320 - 325'	0.70	<0.1	2.4
345 - 350'	<0.10	2.0	1.4
370 - 375'	0.80	2.5	2.6
395 - 400'	1.0	0.5	2.3
420 - 425'	0.98	<0.1	2.6
445 - 450'	0.96	2.0	3.4
470 - 475'	0.36	2.9	2.3
495 - 500'	0.54	1.0	4.0
520 - 525'	0.34	0.48	0.8
545 - 550'	0.42	2.4	3.2
DH12			
0 - 5'	0.62	1.3	0.48
20 - 25'	0.30	1.1	<0.1
45 - 50'	<0.1	0.6	0.4
70 - 75'	<0.1	<0.1	0.3
95 - 100'	<0.1	1.0	<0.1
120 - 125'	0.40	<0.1	<0.1
145 - 150'	0.60	<0.1	<0.1
170 - 175'	<0.10	0.26	<0.1
195 - 200'	0.40	0.35	<0.1
DH13			
0 - 5'	<0.10	1.3	1.4
20 - 25'	<0.10	1.2	0.5
45 - 50'	0.28	1.6	0.5
70 - 75'	1.3	2.7	<0.10
95 - 100'	1.0	2.6	1.5
120 - 125'	0.8	0.90	<0.10
145 - 150'	1.10	2.0	<0.10

Eagle Eye Mining Co.
 Lab No. 9269
 Page -2-

Sample ID	Gold	Platinum	Silver
DH14			
120 - 125'	0.36	4.0	<0.10
145 - 150'	<0.10	1.2	<0.10
170 - 175'	0.50	0.7	<0.10
195 - 200'	1.4	1.6	<0.10
DH15			
0 - 5'	0.44	0.18	0.42
20 - 25'	0.22	0.46	<0.10
45 - 50'	0.40	0.45	0.28
70 - 75'	<0.10	0.42	0.29
95 - 100'	0.70	1.20	0.18
120 - 125'	0.49	1.60	<0.10
145 - 150'	0.54	3.0	<0.10
DH17			
0 - 5'	0.60	0.80	1.0
20 - 25'	0.90	0.22	1.1
45 - 50'	0.90	1.0	0.75
70 - 75'	0.84	0.78	0.42
95 - 100'	0.92	0.62	0.50
120 - 125'	1.0	2.4	0.40
145 - 150'	0.80	3.0	4.0
170 - 175'	0.48	2.8	0.10
195 - 200'	0.32	2.8	<0.10
DH18			
0 - 5'	<0.10	0.50	0.70
20 - 25'	0.60	0.25	0.30
45 - 50'	0.40	0.30	0.20
70 - 75'	0.70	0.20	<0.10
95 - 100'	0.65	0.84	<0.10

ANALYTICAL CONSULTING SERVICES, INC.


 Ernie P. Williams
 Director

EPW/bdm.

TO: Project Manager
FROM: Project Geologist
DATE January 15, 1986
RE: Progress Report: Aguila Project, Aguila, AZ

Between November 5 and December 15, 1985, a mineralized zone 1,600 feet in length by 1,320 feet in width was partially mapped and sampled. Ten holes were proposed to test the gold-platinum mineralization believed to be present. Management cancelled (via depth limitation) seven of the drill holes located within this mineralized zone. Drill hole numbers DH3, DH7 and DH8 were completed to 555 feet, 200 feet and 200 feet respectively.

A geochemical anomaly in the SE 1/4, Section 35 (having minus 80 mesh soil values between 0.8 ppm and 1.9 ppm) was drilled by the reverse rotary method to a depth of 200 feet (DH 11 and DH12). The highest values obtained were 0.62 ppm Au and 2.1 ppm Pt. The difference between the low gold values obtained in drilling and the soil sample analysis are probably a result of analytical error on the soil sample analysis.

Drill hole 13 was drilled north of DH3 for the purpose of tying together the mineralization on the hill in Section 35 with the mineralization indicated by the geochemical anomaly. DH13 was sampled over a five foot length every 25 feet. A 80 foot section between 70 feet and 150 feet averaged 1.05 ppm Au (0.03 oz Au/t). The hole averaged 1.75 ppm Pt (.051 oz/t Pt). The intercept between 70 and 150 feet averaged 0.059 oz/t Pt.

Drill hole 3 was drilled to a total depth of 555 feet. A potential 40 feet intercept of 1.3 ppm Au (0.038 oz/t Au) may exist between a depth of 5 and 45 feet. The intercept between 170 and 450 feet averages 0.903 ppm Au (0.0263 oz Au/t). The intercept between 20 and 550 feet averages 1.40 ppm Pt (0.041 oz/t Pt). Several small, high grade intercepts exist which have a mineable thickness.

Drill hole 8 has a total depth of 200 feet. The average gold content is 0.54 ppm Au (0.016 oz/t Au). The gold content increases dramatically in the ten last 30 feet to approximately twice the average value for the hole. The average platinum content is 1.10 ppm Pt (0.032 oz/t Pt). This hole should be deepened to 600 feet.

Drill hole 7 was completed to a depth of 200 feet. An 80 foot intercept between 95 and 175 feet was found to have an average

value of 0.87 ppm Au (0.025 oz/t Au). The intercept between 50 and 200 feet contained an average value of 2.04 ppm Pt (0.059 oz/t Pt). The hole averages 1.66 ppm Pt (0.048 oz/t Pt) over its total length. This hole should be deepened to 600 feet.

Based on the analytical results obtained from ACS Labs on DH3, DH7, DH8 and DH13, these have a combined platinum-gold resource of approximately 20 million, four containing 0.04 oz Pt/t and 0.015 oz/t Au.

Drill hole numbers DH4, DH15, DH16, DH18 and DH19 contain interesting gold and platinum values. However, no conclusions can be drawn without further trenching and drilling.

Prior to making any additional expenditures, the rate of recovery and recovery cost of the gold and platinum values should be determined.

Before a formal geologic report can be written, the following work must be completed:

1. All drill holes must be completely sampled and assayed.
2. A geologic literature search must be completed and the published and unpublished reports summarized.
3. The previously completed geochemical samples must be rechecked.
4. The geologic mapping in the SE 1/4 of Section 35 and SW 1/4 of Section 36 must be completed with sampling for gold and platinum.
5. All drill hole locations must be surveyed for location and elevation.

Drill hole numbers DH7, DH8 and DH13 should be deepened to 500 feet each and six (6) new 500 foot deep holes should be drilled to further prove-up the property. This drilling could add an additional 10 to 20 million tons to the resource estimates.

The international engineering firm of Dames & Moore is willing to participate in writing the report. Richard Brittain of Dames & Moore (Phoenix office) will make the arrangements.

It should be noted that: (1) I have not seen any verification of the ACS analytical results (check assays); (2) ACS has not performed well in the past and check assays (run blind) have shown a 1900 percent error factor; (3) the tonnage described above is a resource estimate and not an estimate of ore reserves.

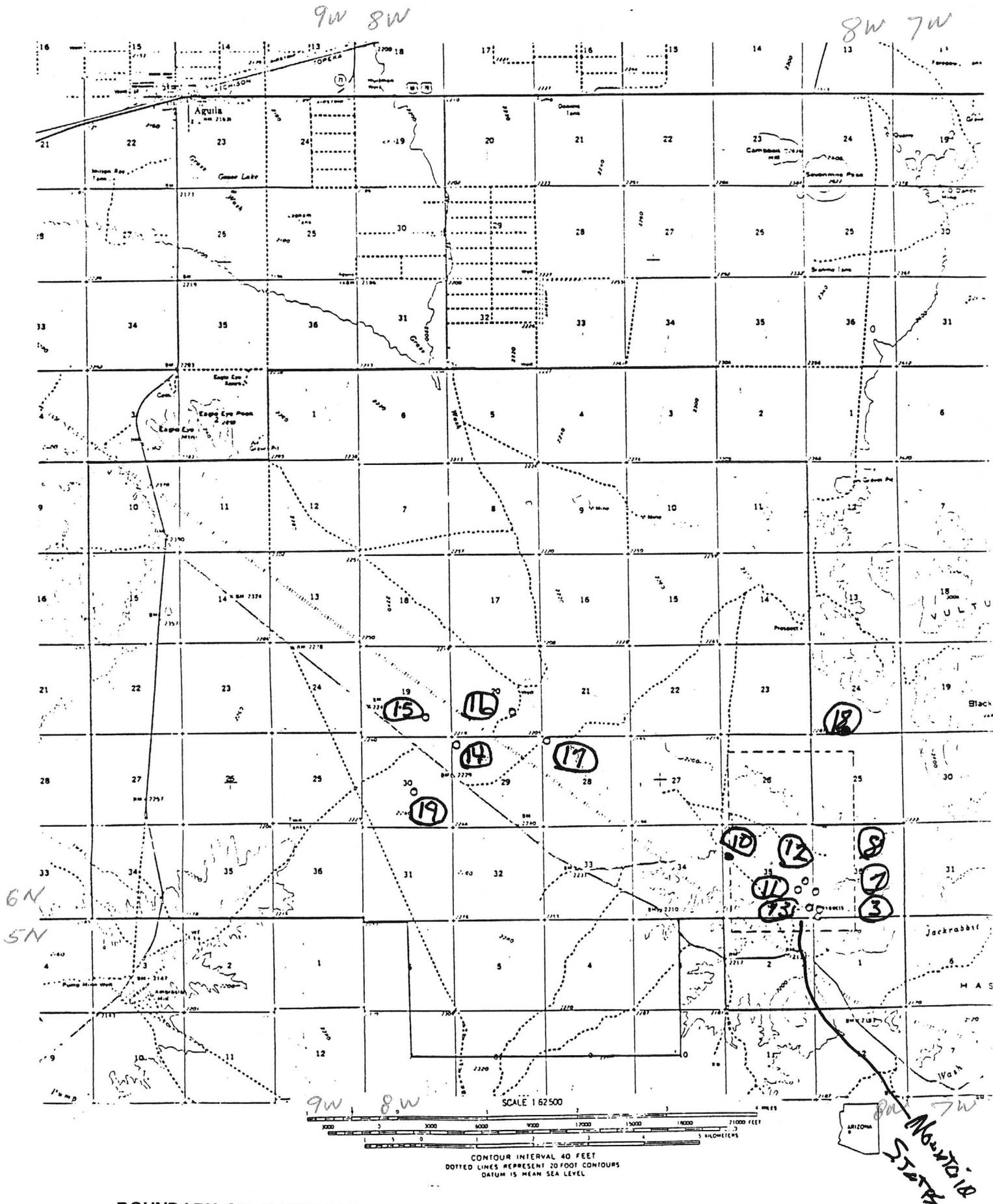
At present, there is no information to indicate that the gold and platinum can be mined, milled and recovered, shipped and marketed at a profit and there is insufficient geological information (assays, mapping, etc.) to classify the material as ore. (Ore is

defined as rock which can be mined and milled and sold at a profit.) See "Principles of a Resource/Reserve Classification for Minerals" which is attached. The ACS Labs analyses of January 3, 1986 and January 10, 1986 are also attached.

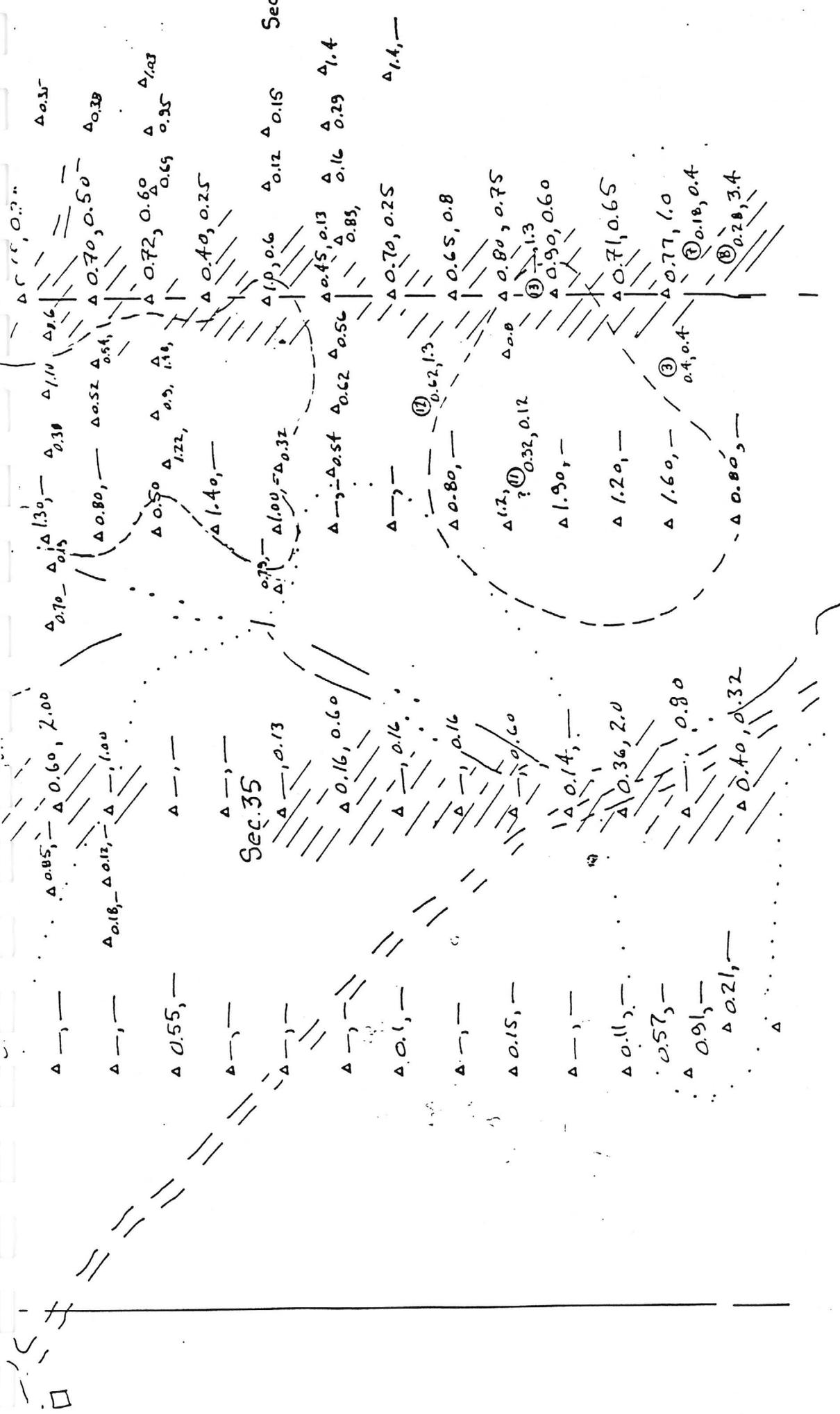
PLATE 1

Aguila Mining Properties of James International Inc.

Maricopa Co. Arizona



BOUNDARY OF JAMES INTERNATIONAL



Part of Aguila Mining Properties of James International Inc.

Maricopa Co. Arizona

PLATE 2



Douglas Mountain Exploration

I.L. Turner
Registered Professional Geologist

PRECIOUS METALS OCCURRENCE
AT
JAMES INTERNATIONAL'S
AGUILA/EAGLE EYE PROPERTIES
MARICOPA COUNTY, ARIZONA

DATA INTERPRETATION AND WORK PROPOSAL
FEB. 1987

SUMMARY / RECOMMENDATIONS

Gold, platinum and other platinum group elements are reported to occur in the 0.0X to multi-ppm range from select soil, rock and drill hole cuttings taken from the approximately four square miles that were explored of the 44 square mile property. The property, located 60 miles WNW of Phoenix, underwent an exploration program during the last quarter of 1985. Approximately 700 soil sites were analyzed for Au, Pt and Ag. Twelve holes were drilled for a total of 2,440 feet.

Geologically, the area is comprised mostly of Tertiary volcanics and intrusives that are overlain by thick, Quaternary alluvial gravels. It is in the upper plate of a middle Tertiary detachment fault. Extension tectonics have played a major role and the resulting high geothermal gradient may have influenced the mineralization in the area.

Base and precious metals having lesser occurrences of platinum group metals have previously been recognized in southern Nevada and in south-central Arizona.

Considerable effort and money have been spent by James International in resolving the problems inherent in analyzing the platinum group metals as well as in determining the validity of the assays of the many samples taken during the current program.

A continuing exploration program of soil sampling, back hoe trenching and reverse circulation drilling is proposed. The drilling program would consist of two phases and would total 65 holes drilled to 300 feet depth each for a direct cost (including assays) of \$235,500. This program would test the 475 acres indicated to be the most anomalous based on the 1985 soil sampling and drilling. An additional \$15,000 would be required to include further testing of the "hardrock" area that is reported to have at least 25 five-foot cuttings intervals assaying greater than 1 ppm Pt in 955 feet of total drilling for three holes.



Douglas Mountain Exploration

INTRODUCTION

Gold, platinum and other platinum group metal (PGMs) elements are reported to occur in the 0.0X to multi-ppm range from select soil, rock and drill cuttings taken from James International's Eagle Eye/Aguila mining properties. The samples were part of an exploration program that consisted of field mapping, soil sampling, Landsat imagery analysis and a 12 hole drilling program that was conducted by D.G. McFarland and Associates during the last quarter of 1985.

Results of this program were quite encouraging, albeit erratic and therefore suspect. The present writer has been retained to organize and interpret the data generated in late 1985 and, if possible, propose a geologic rationale for the presence of the gold and PGMs in what appear to be economic or near-economic amounts. As indicated, the assaying of PGMs is very difficult; this has been recognized to be a problem for many years. James International has expended considerable time and money in an effort to resolve this problem. In a parallel effort the Company has attempted to by-pass the problem by concentrating bulk samples in order to obtain assayable beads by refinery methods. The precious metals being reported indicate that further exploration is justified.

Three short reports written by Turner to M. James on July 5, 1986, November 9, 1986 and January 11, 1987 are appended here as back-up to this summary. Some of the illustrations are repeated for ease of access. Plates 1 and 2 referred to below are also applicable to the January 11, 1987 report.

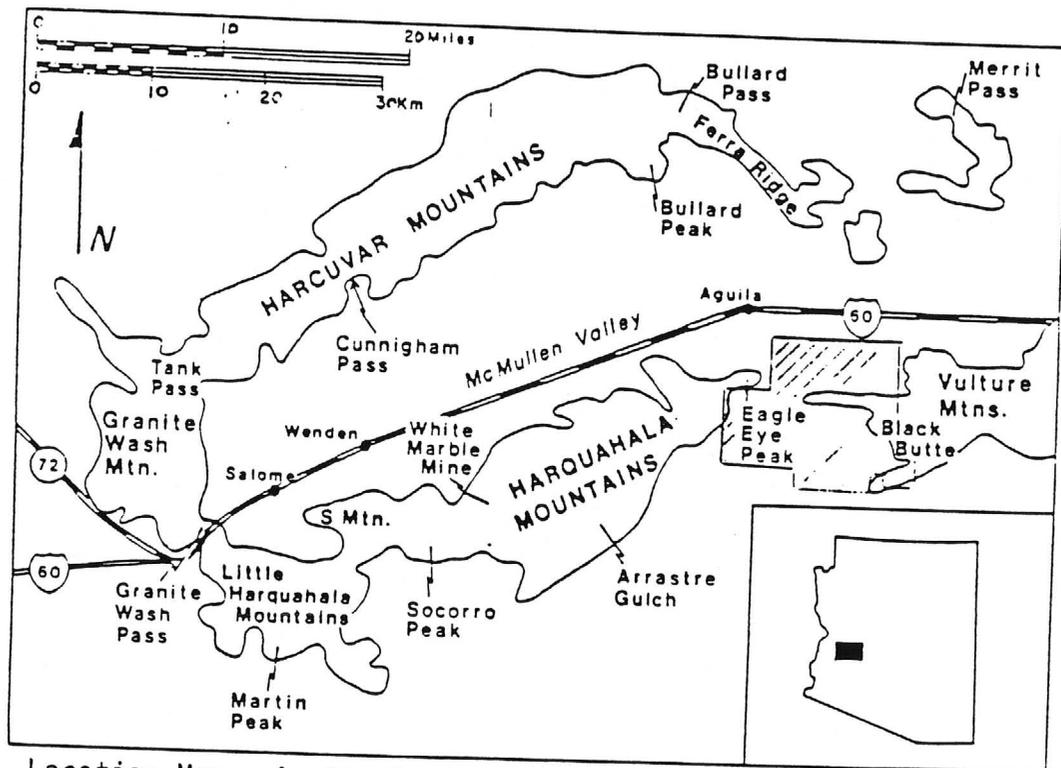
SIZE AND LOCATION OF PROPERTIES

James International controls approximately 44 square miles of mineral rights (via placer and lode claims) in the area between the eastern Harquahala and western Vulture Mountains. The properties are located about 22 miles west of Wickenburg and 60 miles WNW of Phoenix.

GEOLOGY

The area is underlain by Quaternary alluvial gravels that are greater than 500 feet thick in places. Areas of bedrock outcrops consist of Precambrian metamorphic rocks, Precambrian granite, later Tertiary intrusives and considerable areas of Tertiary volcanics - the youngest being basaltic and aged younger than 19 my BP.

Structurally, the Aguila properties are in the Basin and Range Province and are underlain by the Vulture tilt-block domain. They are contained in an upper plate that overlies a middle Tertiary detachment fault. The entire region has undergone extension tectonics since Oligocene time with resulting



Location Map - Aguilá Project of James International

crustal thinning and accompanying high geothermal gradients.

Base and precious metals mineralization are recognized from southern Nevada, southeastern California into south-central Arizona. PGMs are less widely reported however. They have been recovered as by-products from Cu-Ni-Co ores at Bunkerville and Cu-Au ore from the Boss Mine - both in northeastern Clark County, Nevada (NE of Las Vegas). In Arizona, PGMs have historically been recovered during copper refining. Most recently, PGM assays have been reported (aside from the area under discussion) from the Black Rock District, northeast of Wickenburg (the Oro Grande Mine). In a quite different reported occurrence, there has been considerable speculation regarding PGMs in various cinder cones near Flagstaff and south of Winslow.

WORK DONE

General

During the last quarter of 1985, D.G. McFarland and Assocs. of Arvada, Colorado instituted a program of limited field mapping, soil sampling and reverse circulation drilling. Concomitant with this work, T. Chamberlain, Chamberlain Assocs. Ltd. of Fort Collins, Colorado completed a Landsat analysis of the Aguila/Eagle Eye project area.

Soil Sampling

Soil samples (mostly C-horizon) were collected from the four square miles that make up sections 14, 23, 26 and 35 along the western edge of the project area. A total of 858 samples were collected although at least 156 were replicates from previously sampled sites. Lines were mostly oriented N-S, spaced at $\frac{1}{2}$ mile intervals and sampled at 300 foot spacing. Some E-W cross lines were sampled in Section 35 and in the western part of Section 36.

The minus 80 mesh fraction of each sample was analyzed for Au, Pt and Ag via the Induced Coupled Plasma method. Other elements such as boron, manganese, barium, antimony, rhenium, mercury, bismuth and arsenic were also analyzed for in the early part of the program.

Results and interpretation of this work are discussed in detail in the accompanying memo: Turner to James, Jan. 11, 1987 and are depicted on Plate 2.

Drilling

During December of 1985, 12 reverse circulation holes were drilled with their depths ranging from 60 to 555 feet. The 12 holes totalled 2,440 feet and averaged 203 feet. Though samples were collected every five feet, analyses were made only for the five foot interval that occurred every 25 feet. Gold, platinum and silver were the main elements tested. Since the initial series of analyses was conducted, other intervals have been analyzed and several different laboratories and testing methods have been utilized.

Plate 1 depicts the locations of these holes. Six were drilled in the southeast corner of the area in Sections 35 and 36. Four of these six were either collared in volcanic bedrock or encountered it at depth. The remaining eight holes were drilled entirely in Quaternary gravel fill. Six of these holes were widely spaced farther to the west to test various spectral images as interpreted by Chamberlain Assocs.

The accompanying memo: Turner to James, Nov. 9, 1986 (p. 5) provides a diagrammatic cross-section of part of the drilled area.

Assays/Analyses

Considerable effort and money have been spent in determining the validity of the various assays and analyses for the PGMs in the many samples taken from the property. At least five laboratories and four analytical methods have been used. Zunkel and Hoffman of Jan H. Reimers and Assocs. USA have been most recently involved in determining the validity of the techniques and results of/from the laboratories involved. The reader is referred to their reports on the matter.

Some of the problems encountered in the early assays of soil samples and drill cuttings are discussed in the above mentioned memo: Turner to James, Jan. 11, 1987.

WORK PROPOSED

Eight recommendations for work to be done are made in my memo of Nov. 9, 1986. Items 1 and 2 dealing with receipt of old data are complete. Of the items remaining for consideration, those dealing directly with evaluation of the property concern additional soil sampling, trenching and drilling. It is assumed that all new soil analyses and trenching/drilling assays will uniformly follow the agreed-upon procedures that were determined to be valid during the studies of the past six months.

Soil Sampling

Additional soil sampling is proposed to achieve two purposes: 1) Limited fill-in sampling in areas that provided attractive values in 1985. 2) Reconnaissance surveys in other parts of the greater-than 35 square miles of the project area that has yet to be tested. This work could of course await completion of the more immediate work proposed above and below.

Back Hoe Trenching

Much can be learned concerning the nature and distribution of the reported mineralization cut in the near surface by earlier drill holes such as 13, 16 and 17. Back hoe trenching could also be used to obtain preliminary bulk samples.

5.

Drilling

Plate 2 at a scale of 1 inch = 500 feet depicts the two areas in Section 35 that appear to be the most prospective based on the reported soil and 1985 drill hole values. It should be noted that the two areas (the northernmost is approximately 1,200 X 3,000 feet; the southern is 1,400 X 1,600 feet) are here defined as anomalous areas having Au values greater than 0.8 ppm that are contained within a larger area having soil values greater than 0.2 ppm Au. Areas reporting anomalous Pt values are more erratic but at least in one instance, coincide with the eastern side of the two highest gold areas. Whether the erratic Pt distribution is caused by the possible analysis problems mentioned above or by actual geologic distribution remains to be determined. Any proposed drilling program can be designed to test which of these possibilities applies.

A close approximation as to direct drilling and assay costs to drill the two anomalous areas to a depth of 300 feet in two phases of drilling is presented below. The assumptions are: reverse circulation drilling at \$10 per foot, samples taken and assayed for two elements for each five foot interval at \$10 per sample. Phase 1 drilling would be at 1,000 foot collar spacing and Phase 2 spacings would be reduced to 500-550 feet. The latter spacing could be close enough given a relatively uniform distribution of mineralization. It should be pointed out however that final drill hole spacings of 100 to 200 feet are not uncommon. It should also be pointed out that drilling costs can be greatly reduced if the ground conditions are good and the client is willing to take a calculated risk and contract the drilling on an hourly rate. I have had recent experience in this part of Arizona where the cost per foot (using an hourly rate of \$185/hr) worked out to \$5.50 /ft.

	<u>No. Holes</u>	<u>Depth</u>	<u>Total Feet</u>	<u>Cost @\$10/ft</u>	<u>Total Cost</u>
Phase 1	22	300 ft.	6,600	\$66,000	
	Plus 60 samples/hole x 22 x \$10			<u>13,200</u>	\$79,200
Phase 2	43	300 ft.	12,900	\$129,000	
	Plus 60 samples/hole x 43 x \$10			<u>25,800</u>	154,800
	Mobilization 2 X @ \$750 ea.				1,500
	Total estimate for two phases:				<u>\$235,500</u>

The above program would test approximately 475 acres to a depth of 300 feet at an average drill hole spacing of about 525 feet.

Area Tested by Holes 3-7-8 . This "hardrock" area drilled by McFarland bears special consideration because of very anomalous values returned for the "five feet every 25 feet" samples. Twenty-five intervals in the three holes returned Pt values greater than 1 ppm (one as high as 3.4 ppm). Certainly the unassayed intervals should be analyzed prior to deepening holes 7, 8 and 13. McFarland recognized this shortcoming regarding complete assay values when he provided an estimate of a "combined platinum-gold resource (emphasis mine) of approximately 20 million (tons)." Deepening of holes 7 and 8 would add an additional 800 feet or approximately \$10,000. Assaying of the unassayed intervals mentioned above would add an additional \$1,800.

The total estimated direct cost of drilling and assaying is therefore almost \$250,000.

V. S. Turner

July 5, 1986

To: Mr. Maurice James - James International, Baytown, Texas
From: I.L. Turner - Douglas Mtn. Exploration, Golden, Colorado

Subject: Supporting geologic compilation for the Aguila Project area-
Maricopa County, Arizona

The attached, brief introduction and series of figures are provided for your use as introductory material to acquaint prospective co-venturers with your Aguila project/property.

I am not aware if you already have such material but the brief reports provided to me that were written at the end of 1985 and in January, 1986 seem to indicate that such material has not been available.

Neither the earlier Landsat study nor your geologist's report discusses the most recently proposed (1980-86) structural concepts being set forth for the west-central Arizona, southeast California and Nevada Basin and Range Province. In general, these concepts invoke extensional tectonics that subsequently caused low angle detachment faulting, upward movement of hot, lower plate rocks, mixing of metal bearing aqueous solutions with cooler oxidized waters and deposition of base and precious metals mineralization. Later, high angle normal faulting was accompanied by dominantly basaltic volcanism.

While the above may not seem to be particularly germane to whether a hoped-for co-venturer will take on your Aguila project, there are certain aspects of the above model that should be noted:

- 1) The widespread existence of both bedded and vein manganese mineralization is explained as part of the detachment fault model.
- 2) Manganese deposits are relatively wide-spread along a NW-SE trend from southeast California to the Aguila Project area/ Bighorn Mountains (The Artillery Peak occurrence in the eastern Rawhide Mountains is the largest known manganese orebody in the United States)
- 3) Reference to the literature on platinum abundance in rocks assigns the highest values (for other than the ultramafics) to basalts - 0.03 ppm to 0.21 ppm*.
- 4) Occurrences of gold as well as the base metals are explained by the model.

Since platinum is so unique and scarce a metal (especially in the United States), a similarly unique mechanism might have to be invoked to explain its presence at Aguila.


I.L.T.

* Wright, T.L. and Fleischer, M. 1965: Geochemistry of the platinum metals - USGS Bull. 1214-A. 24pp.

GEOLOGIC COMPILATION
FOR THE
AGUILA PROJECT AREA
Maricopa County, Arizona
July, 1986

The attached figures provide basic location and geologic maps as well as more regional maps and schematic sections that support the concept of base and precious metals mineralization associated with Middle Tertiary detachment faults.

Spencer and Reynolds, 1986, p. 102 give the following accounting in one of several recent papers on Mid Tertiary tectonics:

The middle Tertiary tectonic evolution of the Basin and Range Province of Arizona and the Southwest was dominated by large magnitude crustal extension and locally voluminous silicic magmatism. Major crustal thinning resulted from crustal extension, which occurred, at least at upper crustal levels, by movement on large-displacement low-angle normal faults (detachment faults). Modification of the landscape was extreme, with formation of various volcanic eruptive centers, including calderas, and numerous sedimentary basins above tilting normal-fault blocks . . .

The Basin and Range Province of Arizona and the Southwest was the site of two episodes of Cenozoic extension . . . The first episode of extension occurred during Oligocene to mid-Miocene time and resulted in formation of detachment faults, low-angle ductile shear zones (metamorphic core complexes), and regional domains of tilted fault blocks. Middle Tertiary volcanic and sedimentary rocks, and older rocks, were typically tilted to moderate to steep dips by movement on listric or planar normal faults that merge downward with, or are truncated by, an underlying, gently dipping detachment fault or a system of multiple, gently dipping normal faults. Volcanic rocks erupted during this period of extension are primarily ash-flow tuffs and flows of silicic to intermediate composition . . . At about 13 - 15 Ma detachment faults became inactive and high-angle normal faults became the dominant, active extensional structures. High-angle normal faulting was accompanied by dominantly basaltic volcanism. Elongate sedimentary basins and flanking ranges and range-bounding faults formed during this later, "Basin and Range" episode of extension. The mid-Tertiary episode of extension was characterized by large-magnitude crustal extension and crustal thinning, with extension occurring primarily in a ENE-WNW direction. The younger Basin and Range episode resulted in much less extension and crustal thinning, and was directed in an E-W to WNW direction.

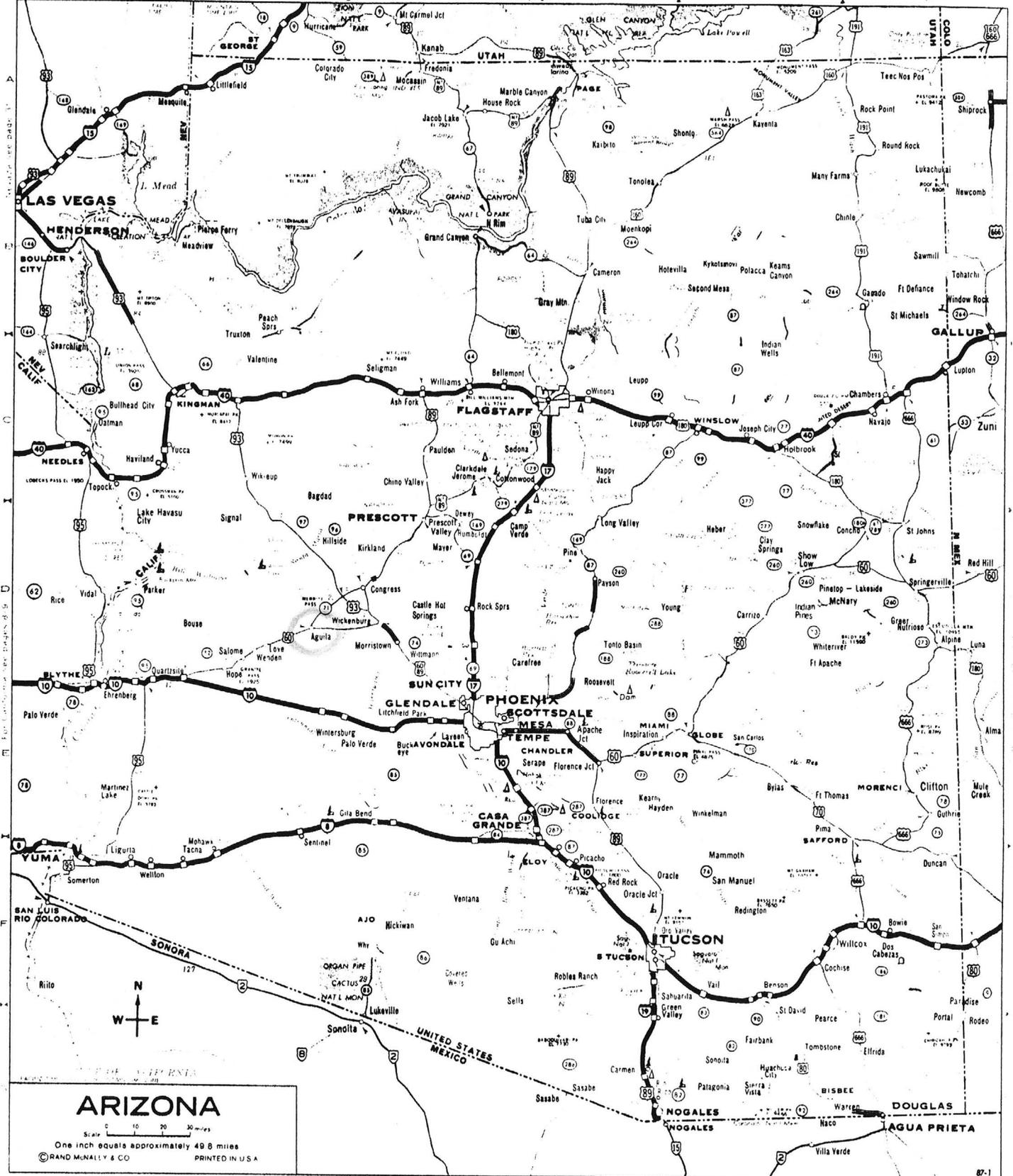
In a later paper, Spencer and Welty, 1986, pp 195 - 198 carry on their thesis to say:

Mineralization is characterized by early copper and iron sulfides, followed by massive specular hematite, in turn followed by fracture-filling chrysocolla and malachite. Mineralization occurred during faulting and was associated with unusually high geothermal gradients that were at least partially due to detachment-fault movement that brought hot, lower-plate rocks up from great depth and juxtaposed them with cool, near-surface, upper plate rocks. Mixing of ascending, reduced, metal-bearing aqueous solutions with higher level, oxidized fluids is proposed as an important process leading to oxide mineralization. Movement of the redox interface down normal-fault ramps at the same rate as displacement of hanging-wall rocks resulted in continuous mineralization at some upper-plate sites over significant periods of geologic time; this produced the largest orebodies. Aqueous solutions that precipitated iron oxides near the detachment fault carried manganese oxides to higher levels where vein and strata-bound sedimentary manganese oxides were deposited.

Attachs:

Spencer, J.E. and Reynolds, S.J. 1986: Some aspects of the middle Tertiary tectonics of Arizona and Southeastern California in: Arizona Geological Soc. Digest, Vol. XVI, 1986 .

Spencer, J.E. and Welty, J.W. 1986: Possible controls of base- and precious-metal mineralization associated with Tertiary detachment faults in the lower Colorado River trough, Arizona and California in: Geology, Vol. 14 pp 195-198, March, 1986.



ARIZONA

ARIZONA
 Population: 2,718,425
 (1980 Census)
 Land Area: 113,510 Sq. Mi.
 Capital: Phoenix

Cities and Towns

- | | | | | | | | |
|----------------------|----------------------|----------------------|-------------------------|--------------------|-------------------------|-----------------------|---------------------|
| Agua Prieta.....E-3 | Begdad.....C-2 | Duncan.....F-4 | Happy Jack.....C-4 | McNary.....D-5 | Patagonia.....G-5 | St. David.....G-5 | Sun City.....E-3 |
| Alamo.....E-3 | Bisbee.....G-5 | Ehrenberg.....F-1 | Hayden.....E-5 | Mayfield.....D-3 | Payson.....D-4 | St. Johns.....D-6 | Superior.....E-4 |
| Apache Jct.....E-4 | Buckeye.....E-3 | Eloy.....F-4 | Heber.....D-5 | Mesa.....E-4 | Peach Springs.....B-2 | Salome.....D-2 | Tempe.....E-3 |
| Avondale.....E-3 | Camp Verde.....D-4 | Flagstaff.....C-4 | Holbrook.....C-5 | Miami.....E-5 | Phoenix.....E-3 | San Carlos.....E-5 | Tombstone.....G-5 |
| Chandler.....E-4 | Casa Grande.....E-4 | Florence.....E-4 | Huachuca City.....G-5 | Mocasin.....A-3 | Picacho.....F-4 | Scottsdale.....E-3 | Tuba City.....B-4 |
| Chino Valley.....C-3 | Chandler.....E-4 | Ft. Defiance.....B-6 | Humboldt.....D-3 | Moenkopi.....B-4 | Pima.....E-5 | Sedona.....C-4 | Tucson.....F-4 |
| Clarkdale.....C-3 | Chino Valley.....C-3 | Fl. Thomas.....E-5 | Jerome.....G-3 | Morenci.....E-6 | Pinetop.....E-5 | Seligman.....C-3 | Wellton.....F-1 |
| Clifton.....D-2 | Clarkdale.....C-3 | Fredonia.....A-3 | Joseph City.....C-5 | Morristown.....D-3 | Lakeside.....D-5 | Sells.....G-4 | Whitriver.....D-5 |
| Ajo.....F-3 | Clifton.....D-2 | Glendale.....E-6 | Kayenta.....A-5 | Naco.....G-5 | Polacca.....B-5 | Show Low.....D-5 | Willcox.....F-5 |
| Apache Jct.....E-4 | Coolidge.....E-4 | Globe.....E-5 | Keams Canyon.....B-5 | Nogales.....G-4 | Prescott.....D-3 | Snowflake.....D-5 | Williams.....C-3 |
| Ash Fork.....C-3 | Cottonwood.....C-3 | Grand Canyon.....B-3 | Kingman.....C-1 | Nurillobo.....D-6 | Prescott Valley.....D-3 | Springerville.....D-6 | Window Rock.....B-6 |
| Avondale.....E-3 | Douglas.....G-6 | Green Valley.....G-4 | Litchfield Park.....E-3 | Oracle.....F-5 | Quartzsite.....E-1 | | Winslow.....B-6 |
| | | Gu Achl.....F-3 | | Page.....A-4 | Safford.....E-6 | | Yuma.....F-1 |

Scale
 One inch equals approximately 49.8 miles
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