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Arizona Geological Survey
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Tucson, Arizona 85701
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James Doyle Sell Mining Collection

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JDS

ASARCO

Southwestern Exploration Division

October 21, 1985

R. L. Brown, Jr.
New York Office

Scout Drilling
SWED, 1986

Attached are six scout drilling proposals, along with two drilling thoughts. The latter having insufficient work to justify drilling thoughts at this time.

Six areas were part of the winter Mohave Program and follow-up, while two held by the Mining Department are from other examinations.

Three areas have SWED unpatented claims covering parts of the area and two have Mining Department patented claims.

James D. Sell

James D. Sell

JDS:mek
Atts.

cc: W. L. Kurtz

New York, October 4, 1985

MEMORANDUM FOR: All Exploration Managers.

Please provide me before October 20 a one half typewritten page description of each of the precious metals prospects in your division which you think should be scout drilled on a first pass basis during 1986. Each description should be accompanied by a 8½" x 11" map on which is compiled and summarized all the geologic and geochemical data (including assay data) that in your view justify such drilling.

R. L. Brown

ASARCO Incorporated

OCT 15 1985

SW Exploration

Sent 10/21/05

	ASARCO
Browns Ranch Fault	64 claims
Cady Hot Springs	46 claims
Castle Mine	20 claims
Ochre Springs	1 pat.
Gold Hill Mine	11 pat.
Gold Reef	None
Black Butte	None, needs investigation
Groover Mine	None, needs mapping.

Other Possibles (Not sent).

Maria - Gypsy Mine zone T15, R11E San Bern. Co. TDV.
Jumbo Vn., Gold Springs T33S R20W (fluid inclusion studies) Iron Co, UT JDS
Mohawk Pass Yuma Co, AZ JDS
Shadow Mtns T17N, R11E San Bern. Co, CA LMA
WLK No Copper World Mine 16N, 13E San Bern. Co, CA LMA
GP? WLK No Mohawk Mine 16N. 13E San Bern. Co, CA LMA
Ready for Road. Morning Star Mine 15N, 14E San Bern Co, CA LMA
TDV veins north of Cedar City ? UT
TDV massive qtz, where? needs fluid inclusion study CA
Beaver Carbonate shear, good Ag values UT
Hardshell, deep mantle type under Si Cap. Ag
Gold Road, Sharon Steel, Coltmen Ag
Constellation Gold Bar, AZ bx pipes
Regment ? ICC silica flex
Delbrae Buckeye Zone ? Ag
Newmonts banded Fe, Brockshaw Mtns ?

JDS

ASARCO

Exploration Department
Southwestern United States Division

James D. Sell
Manager

October 21, 1985

Mr. J. R. Montgomery
ASARCO Geophysical Div.
3422 South 700 West
Salt Lake City, Utah 84119

SWED Area
Geophysical Work, 1986?

Dear Jerry:

Attached are eight areas, five of which are partially covered by Asarco claims. I believe some geophysical work is justified in tracing out the fault structures and possibly the argillic altered zone (as at Browns Ranch Fault).

What do you think?

All of these were sent (10/21/85) to R. L. Brown as per his request memo on possible drilling sites.

Sincerely yours,

James D. Sell

JDS:mek
Att.

ASARCO Incorporated P. O. Box 5747 Tucson, Az 85703
1150 North 7th Avenue (602) 792-3010

SWED EXPLORATION DRILLING PROPOSAL

Browns Ranch Fault
T29S, R42E
San Bernardino Co., CA

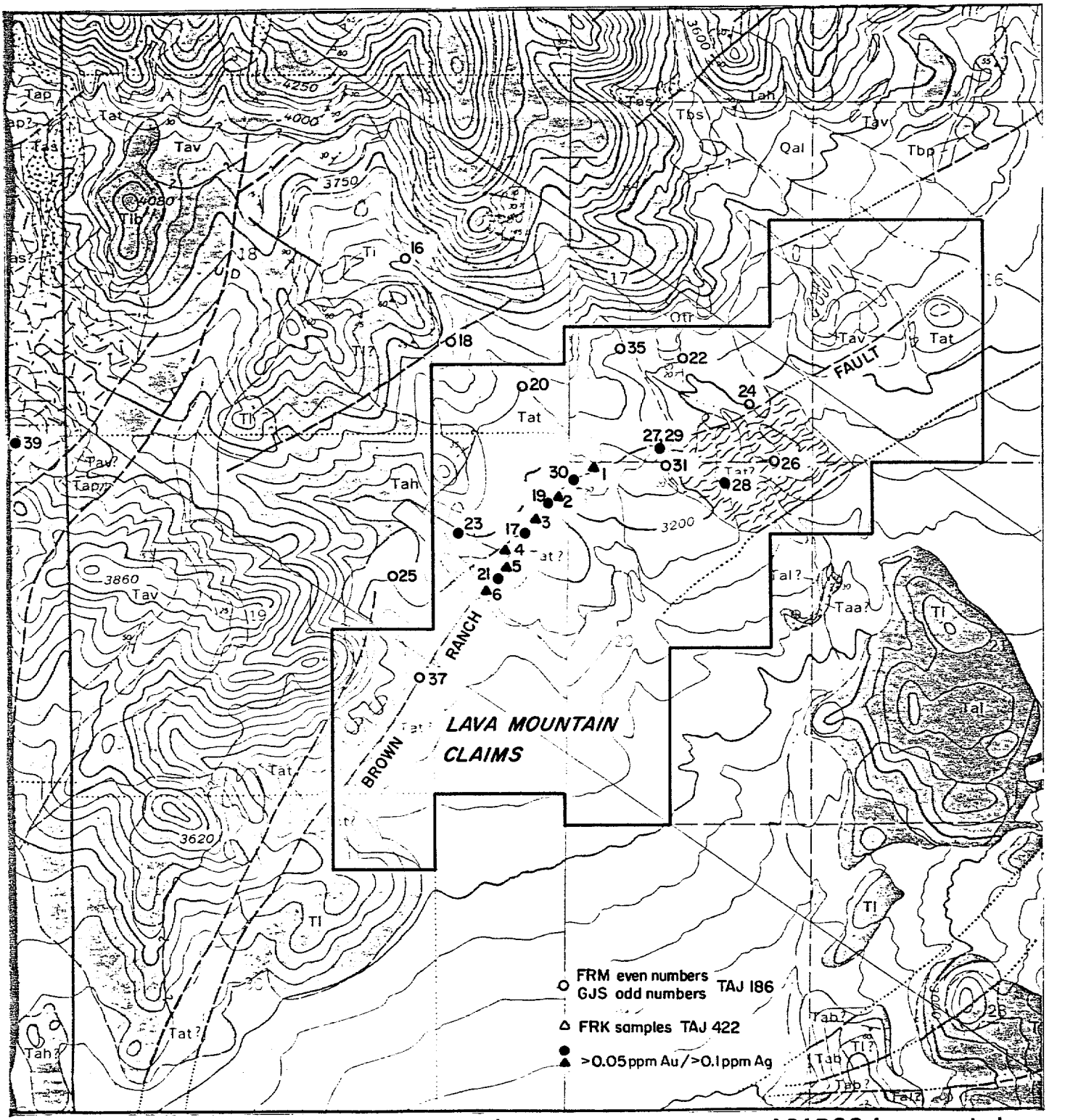
Asarco has staked 64 claims along the anomalous Browns Ranch Fault zone. The area has altered volcanics cut by the fault zone. The alteration width widens along cross faults and carries anomalous gold-silver with arsenic and mercury. The potential for significant stratiform and vein/hot spring argillic-advanced argillic precious metal deposits in permeable sediments, volcanics, and breccias is the target.

Geophysics should help in outlining the fault structure as well as argillic altered units under the gravel cover. Detailed mapping is in progress.

James D. Sell

James D. Sell

Map 6259
Tabulation 2555



Topographic Base from USGS PP 457 plate 1

ASARCO Incorporated

1985 GOLD PROGRAM

AMS Sheet: Trona, Ca.

USGS Quad.: Klinker Mtn., Ca. 7 1/2'
Cuddleback Lake, Ca. 15'

Examined by: F.R.Koutz

Follow-up Recommended: Yes ☑ No ☐

SCALE: 1"=2000'

map no. 6259 **date** 7/3/85

Twsp.: 29S **Rng.:** 42E **Sec.:** 16-21,30

Prospect Name: Brown's Ranch Fault

Owner: H & M Co. (June 1982)

State: California

County: San Bernardino

District:

MILS and/or Terradata # _____ / _____

KMT: EVEN SAMPLES F.A. MICHAEL
ODD SAMPLES G.J. STATHIS / lower ½ of Page
JUNE 1982 notes and Assays summarized
From GJS Aug 7, 1982 Report

PAGE 1 of 1

DRILLING INFORMATION

Contractor
Date drilled
Hole diameter
Inclination

PROJECT Browns Ranch Fault HOLE NO. BRF

T29S R42E NW/4 SEC 20

Elev 3200' Final Depth
Coord N/S Coord E/W
Logged by F. Rehfeldt Date logged Evening 13 MAY 85

KLINKER MTN 7½ MIN + 15' Cudahy BACK LAKE QUADS

BRF SKYLINE TAJ-4/22

DEPTH from	DEPTH to	Interval	AA Assay ppm Au	Ag	As	Hg	E-spec Sb/Mn	Cr/Ti	Co/Sr	Fe/V	Ba/Zr	Hematite	Goethite	Jarosite	Added SiO2		Rock Type	REMARKS
																		ALL WKS MOD clay-SER. ALTERED
1A	JOHx	3'⊥	.18	1.4	340	1.0	100/100	200/3000	1500/500	1/100	1500/100	—	3	—	60% SiO2	WELL Bleached	Felsic Bx +	wh to LT TAN OPALINE silica VEIN & Bx zone 3-6' wide, HVY replite Sec'ted. ?? Alunite?
1B	10'Hx	5'⊥	.06	2.0	130	.6	(HW sample of 1A)					—	5 Fx	—	10% QTZ	"	Felsic	Rotten, BLEACH - Lithic lapilli tuff, does not outcrop well. Pelitent cover to NE
2A	NGOE	5'	.26	2.4	440	.7						1/4	6	T	10% SiO2		felsite	Rotten wh. bleached & vuggy, cut across w/ End of Trench; vugs = leached lapilli?
2B	N60E	10'H	.10	1.0	400	.5						T	3	—	Minor		Alsite	well bleached, vuggy lithic lapilli tuff, weakly Bx'd, stockwork veinlets (QTZ)
2C		3'⊥	.29	6.2	215	1.4	100/100	300/3000	.3/500	15/100	1500/100	T	3	—	80% SiO2		felsite	+Fg silica veins 1-3' thick, N30E, 40°E veins (on top of small hill)
2D		5'H	.33	41.0	530	4.1						—	6	1/2% MnOx	15% SiO2		felsite	- vein zone ! NEXT to steep road parallel to vein zone
2E	(HW of 2D)	10'⊥	.10	3.2	380	.5						—	2	—	5% SiO2 VNTS	HVY NRS.	felsite	HW cut of 2D, strongly bleached white but weakly welded (?) lithic lapilli texture STREE fence
3		3'H10'	.25	14.0	400	2.1						T	5	1/2% MnOx	30% SiO2		felsite	bleached silicified N-S ±10° silica seams + shears
4		10'⊙	.05	2.0	210	.8	100/200	300/3000	.5/1000	2/100	2000/70	—	7	1/2% MnOx	85% SiO2		silica	Bx - bleached felsite (vuggy) N40W Fx, V. sharp silica frags. WY ROAD
5		10'⊙	.06	3.4	145	.6						1/8	4	T	60 SiO2	1/4 MnOx	felsite	bleached, Bx'd + silicified, 10% vugs, Low subcrop. E of ROAD
6		20' x 8'	.18	20.0	270	1.3	200/200	500/1000	.15/700	15/100	2000/50	—	3	T	80 SiO2	1/4 MnOx	Bx-cgl	felsite Frags, all bleached + fractured ! vein Bx (?) Bx frags. Rounded, LOW SUB-CROP
16	KMT Series TAJ		<.002	<.2	30	.12		small Loc. outcrops									Tuff	Green, vfg, brit. A few QTZ blebs ↑ LAST outcrop to SW Below Pedi GRAV
17	185		.22	9.4	60	2.8							Mod		Silicif		Flt-Bx	Silicif, chalced QTZ. N15E SSSE
18			<	<	20	.12						✓					tuff	Similar to #16 But green Alt on Fx with hem.
19		pit	.110	3.4	160	1.1							Mod			Bleach	Rhyol. TUFF	Bx'd, sheared, Phosp. Pit in #17 structure. (SAME PIT AS BRF-2A+B)
20			<	.2	50	2.9										bleach.	Tuff	bleached, clay w/ silica veins + blebs (white patches)
21		OUT CROP	.29	20.	100	1.9							Mod		Sica veins	Bleach	Rhyol TUFF	Bx'd sheared, Outcrop of #17 Rock Type.
22			<	.2	10	.13											Tuff	- porous $CaCO_3$ - cgl: Frags of Andesite flows
23		HOX 60'	.09	1.8	160	.26							—		Silic.	STR. Bleach	1/3 Rock	vuler, silicif. + str. Argillic.
24		50'?	.013	.8	30	1.4						str:	Feox				Tuff Bx	N30E 50' zone, white fg.
25			<	<.2	30	.05											Latite	UNALT + UNMIN., purplish grey.
26		20'?	.038	2.0	10	.36									Vnlts		Tuff Bx	zone - 20' Feox, silica vnlts - in wash
27		4-5'?	.006	<.2	40	1.6							Light				Opalite	Bx, 4-5' capping, overlies seds 25°S dip.
28		10'	<	.2	20	.10											Auto Bx	Andesite N-S, 60°E Flt zone: ADIT IN WASH.
29			.180	2.8	20	2.1											Seds.	Tuffaceous 10'S' Below opalite capping, also blocky vuler. Seds 25°S
30		5'	.07	1.8	300	1.0	(similar to BRF: 1B-?)											Flt zone in fg tuff-Andesite, bleached Feox on Fx
31			.022	.2	20	1.9												Opalite Bx As #27
33			.16	.2	20	.16							Mod				Seds	strongly sheared
35			.005	<.2	20	.85						Mod STAIN					As	#33
37		10'	<.002	<.2	20	1.7									Mod 10% SiO2		Shear	zone, 10' wide in dK purplish-grey latite

SWED EXPLORATION DRILLING PROPOSAL

Cady Hot Springs
T8N, R7W
San Bernardino Co., CA

Asarco has staked 46 claims covering parts of an anomalous hot spring sinter deposit system and alluvial cover through which the Duval Industrial Minerals group drilled several holes and also intercepted hot spring deposits and jasperoid.

Although the gold values are near non-existent, the silver values support a precious metal system as does the mercury, arsenic, moly, and tellurium value pathfinders elements.

It is believed that three basin-range type faults provide the plumbing for the metal values and the silica-iron which has formed jasperoids in portions of the deposits.

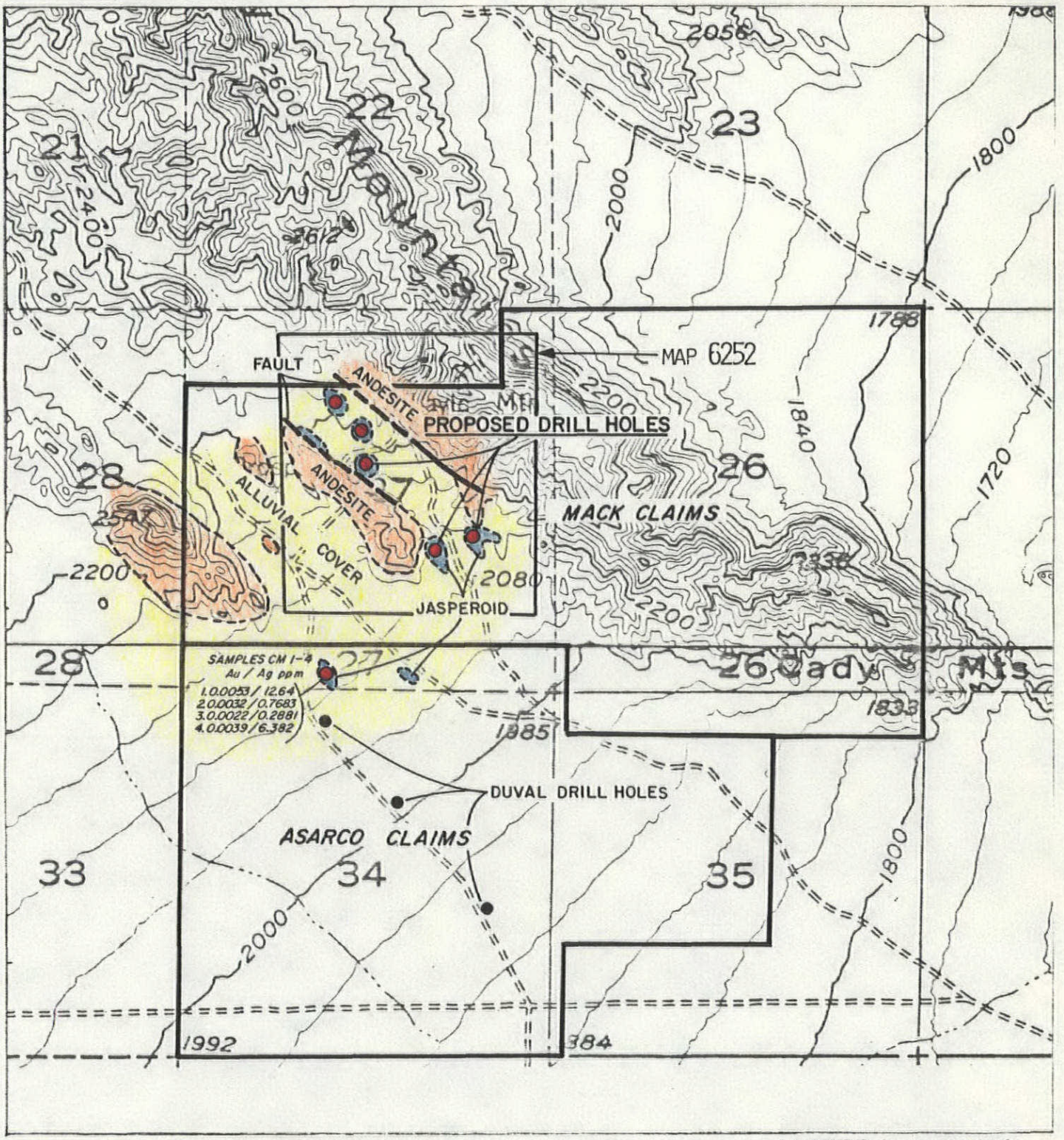
The best outcrops are on the Mack claims to the north which are open to negotiations.

Geophysics should assist in tracing the faults. Detailed mapping of the area is in progress.

James D. Sell

James D. Sell

map 6252 and 6253
GSI CM-1 thru CM-17



ASARCO Incorporated

1985 GOLD PROGRAM

AMS Sheet: San Bernardino, Ca.

USGS Quad.: Broadwell Lake & Ludlow, Ca. 15'

Twsp.: 8N **Rng.:** 7W **Sec.:** 26, 27, 34, 35

Prospect Name: Cady Hot Springs

Owner: F. Mack

Examined by: Tony Dalla Vista

Follow-up Recommended: Yes☒ No☐

State: California

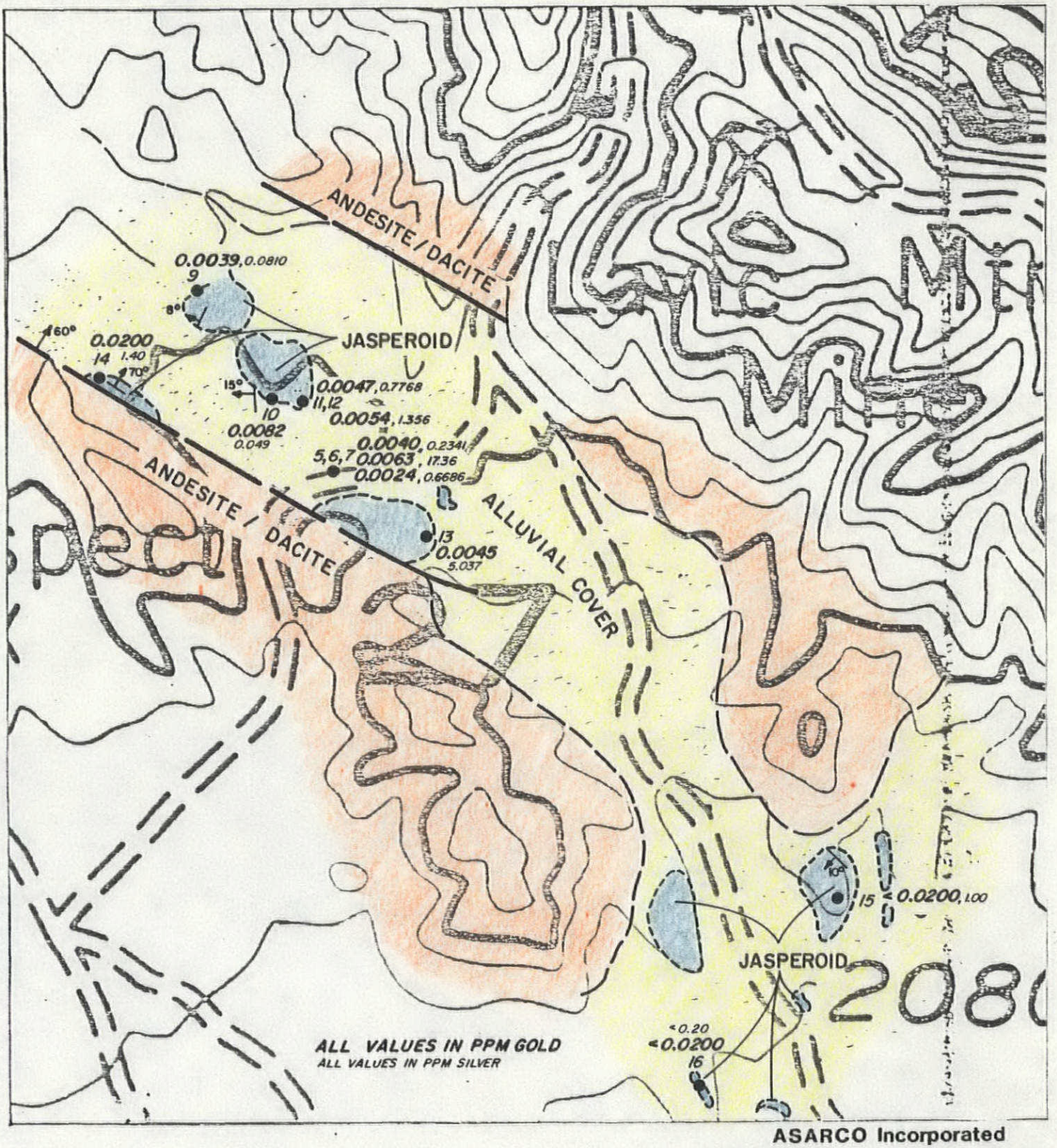
County: San Bernardino

District: Sleeping Beauty

SCALE: 1"=2000'

MILS and/or Terradata # _____ / _____

map no. 6253 **date** 6/25/85



ASARCO Incorporated

1985 GOLD PROGRAM

AMS Sheet: San Bernardino, Ca.

USGS Quad.: Broadwell Lake, Ca. 15'

Twsp.: 8N **Rng.:** 7W **Sec.:** 27

Prospect Name: Cady Hot Springs

Owner: F. Mack

Examined by: Tony Dalla Vista

Follow-up Recommended: Yes☒ No☐

State: California

County: San Bernardino

District: Sleeping Beauty

SCALE: 1"=500' approx.

MILS and/or Terradata # _____ / _____

map no. 6252 **date** 6/25/85

ASARCO, Inc.
P.O. Box 5747
Tucson, AZ 85703-0747 tel:602/792-3010

Report Date: 03/21/85

	Sample ID	#	Ag ppm	As ppm	Au ppm	Cu ppm	Hg ppm	Mo ppm	Pb ppm	Sb ppm	Tl ppm	Zn ppm
T.D.V. Cady Mtns	CM 1	21	12.64	271.1	.0053	64.22	4.334	10.59	744.5	18.43	<.956	363.6
	CM 2	22	.7683	52.71	.0032	8.990	.8233	2.267	127.7	2.510	<.978	37.45
	CM 3	23	.2881	66.31	.0022	9.280	.8287	1.317	151.1	1.163	<.977	65.64
	CM 4	24	6.382	345.1	.0039	50.04	9.208	18.34	1082.	4.928	3.232	471.3
	CM 5	25	.2341	171.7	.0040	9.193	2.134	14.03	70.43	27.57	<.895	128.0
	CM 6	26	17.36	268.7	.0063	155.3	8.469	15.56	2075	15.70	1.466	289.0
	CM 7	27	.6686	24.27	.0024	21.05	.8371	6.206	219.9	6.231	<.904	51.18
	CM 8	28	<.048	1583.	.0036	786.1	<.481	71.19	2918	9.256	65.23	2070
T.D.V. Cady Mtns	CM-9	1	.0810	26.51	.0037	7.805	1.112	4.837	84.76	2.314	<.932	16.17
	CM-10	2	<.049	765.0	.0082	17.75	<.498	17.74	327.7	31.09	2.984	272.9
	CM-11	3	.7768	29.84	.0047	8.100	1.075	4.265	136.9	4.672	<.972	37.20
	CM-12	4	1.356	24.81	.0054	26.39	1.586	5.108	424.2	3.526	1.403	43.34
	CM-13	5	5.037	74.78	.0045	84.31	4.156	6.449	552.4	5.425	1.335	80.06

ITEM	SAMPLE NO.	Au (ppm)	Ag (ppm)
7	CM-14	.02	1.4
8	CM-15	<.02	1.0
9	CM-16	<.02	<.2
10	CM-17	<.02	<.2
11	SM-13	<.02	<.2

T.D.V. Cady Mtns

SWED EXPLORATION DRILLING PROPOSAL

Castle Mine Area
Marble Mountains
T6,7N, R13E
San Bernardino Co., CA

Twenty Asarco claims cover the alluvial area at the Marble prospect. Part of the block covers portions of claims held by others in the area of the Castle Mine.

Two gold-bearing vein systems with up to 0.2 opt gold in outcrop, with anomalous pathfinder mercury, molybdenum, and copper values, are projected to intersect under the alluvial cover staked by Asarco. This intersection area should provide a well shattered zone capable of hosting a breccia pipe ore zone.

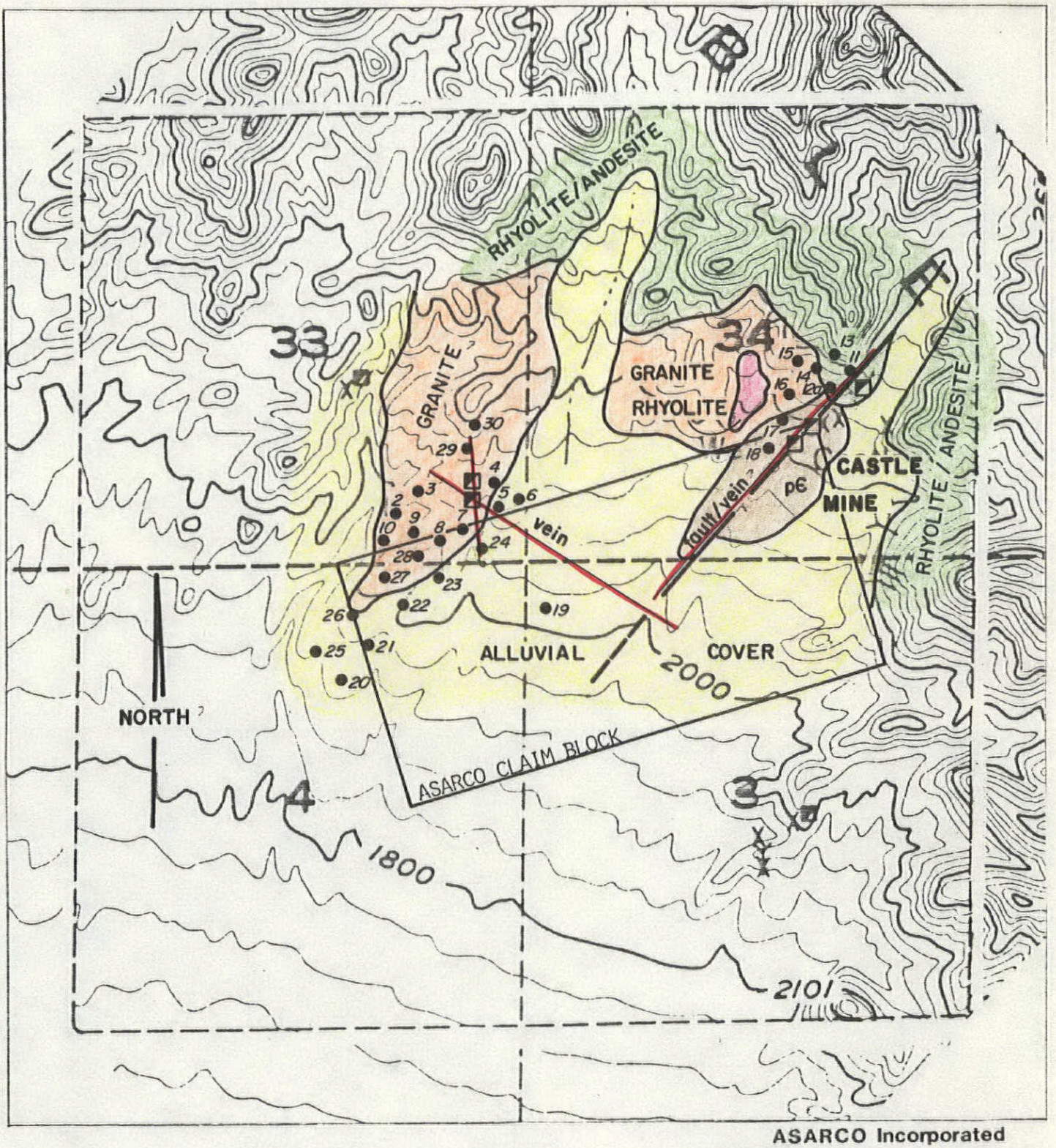
Geophysics should help trace the structures.

Detailed mapping of bedrock exposures is now in progress.

James D. Sell

James D. Sell

map 6260
GSI MM-1 thru -30.



ASARCO Incorporated

1985 GOLD PROGRAM

Samples are MM-1 thru MM-30

AMS Sheet: Needles, Ca.

USGS Quad.: Cadiz, Ca 15'

Twsp.: 6,7N **Rng.:** 13 E **Sec.:** 3,4,33,34

Prospect Name: Castle Mine Area

Owner:

Examined by: Tony Dalla Vista

Follow-up Recommended: Yes☒ No☐

State: California

County: San Bernardino

SCALE: 1"=1650'

District:

MILS and/or Terradata # _____ / _____

map no. 6260 **date** 7/8/85

Geochemical Analysis Repo

TO: Mr. Tony Dalla Vista
ASARCO, Inc.
P.O. Box 5747
Tucson, AZ 85703-0747 tel:602/792-3010

Lot Identity: ASB-50513A

Report Date: 05/15/85

MARBLE / CASTLE MINE

Sample ID	#	Ag	As	Au	Cu	Hg	Mo	Pb	Sb	Tl	
		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	
MM 1	29	.0678	15.66	.0038	9.187	<.483	3.023	25.13	2.773	.9783	2
MM 2	30	9.055	13.44	13.18	5039	24.71	4.277	432.4	81.96	<.955	1
MM 3	31	.2256	7.022	.2579	137.3	1.014	2.160	38.04	28.55	<.915	5
MM 4	32	.2274	2.438	.0192	59.91	.7088	2.674	5.266	2.392	<.934	2
MM 5	33	7.580	11.41	8.106	4915	8.888	13.63	252.6	30.10	<.935	1
MM 6	34	.3747	4.044	.1110	115.3	<.486	2.690	52.01	1.960	<.973	6
MM 7	35	2.016	2.952	1.495	577.5	1.185	2.466	28.14	9.201	<.968	7
MM 8	36	.0662	2.903	.0116	27.90	.7344	9.081	4.925	1.759	<.909	5
MM 9	37	.0794	3.111	.0511	37.95	.5651	14.47	3.485	1.695	<.924	3
MM 10	38	1.927	2.976	.1512	1046.	2.776	1.514	9.688	11.26	<.967	2
MM 11A	21	.1533	12.69	.2468	1144.	<.500	2.908	5.502	4.970	<1.00	5
MM 12A	22	.3119	52.87	.0018	766.7	.5104	1.381	19.36	1.406	<.988	4
MM 13	23	3.245	2.770	15.60	21.86	<.500	2.403	6.738	<1.00	<1.00	7
MM 14	24	<.049	14.19	.0036	10.40	<.490	3.096	12.03	4.018	<.980	1
MM 15	25	<.048	3.166	<.001	18.97	<.488	24.50	3.831	1.384	<.976	6
MM 16	26	<.049	1.216	<.001	6.105	<.490	4.856	2.213	<.980	<.980	5
MM 17	27	<.050	117.9	.0020	13.55	<.500	4.333	10.44	2.911	<1.00	7
MM 18	28	.4749	14.59	.7389	46.25	<.496	5.059	17.86	1.028	<.992	7
MM-19	19	.0697	5.935	.0242	7.944	<.478	10.45	4.513	<.957	1.536	
MM-20	20	.0663	7.695	.0572	49.17	<.464	6.488	16.57	6.912	<.929	
MM-21	21	<.044	5.213	.0290	45.70	<.440	5.423	2.722	5.538	<.880	
MM-22	22	<.050	10.16	<.001	52.95	<.500	27.18	11.95	10.89	<1.00	
MM-23	23	<.049	1.264	<.001	36.82	<.498	6.328	5.941	1.437	<.996	
MM-24	24	.0628	1.192	<.001	19.84	<.496	11.14	7.396	2.380	<.992	
MM-25	25	.6548	10.82	.5897	202.8	<.492	13.27	14.38	58.69	<.984	
MM-26	26	.1018	5.704	.1127	59.45	<.492	9.354	13.03	17.24	<.984	
MM-27	27	.0924	4.613	.0192	61.70	<.498	.9887	6.434	6.226	<.996	
MM-28	28	<.049	10.64	<.001	6.691	<.494	2.485	4.543	6.188	<.988	
MM-29	29	.3955	16.56	.0820	178.3	<.484	3.102	10.26	1.953	<.968	
MM-30	30	.1676	2.584	.0073	78.48	<.494	4.343	12.10	2.245	1.354	

SWED EXPLORATION DRILLING PROPOSAL

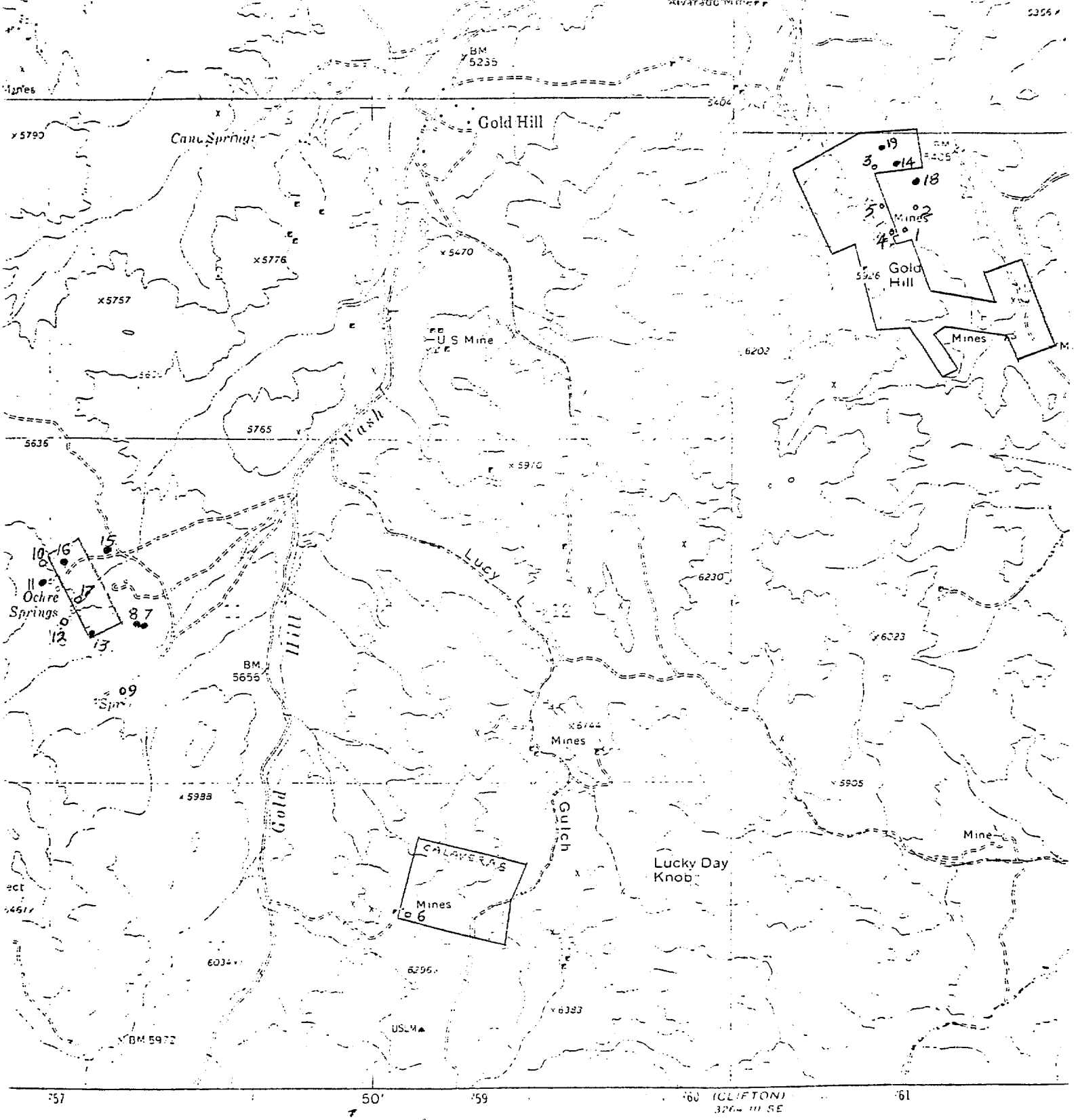
Ochre Springs Area
Gold Hill
Clifton Mining District
T8S, R18W
Tooele County, Utah

A single patented claim is held by the Mining Department. Sampling in the area shows a number of anomalous samples in jasperoid and altered shale. About one mile to the northwest, Superior Oil Minerals Company drilled 28 rotary holes in a zone with similar surface values and outlined about 300,000 tons at 0.038 opt Au, at a depth of 330 feet below the surface. The ore zone is 35 feet thick in a blind limestone along a thrust fault.

James D. Sell

James D. Sell

Plate 2, Gold Hill Topo
Page 2 (SAA), Table 1
Attachment C



Sample Site
Anomalous Value
Claim Locations
Approx.

anomalies
>30.1 ppm. Au

SCALE 1:24 000

1000 2000 3000 4000 5000 6000 7000 FEET

1 KILOMETER

CONTOUR INTERVAL 40 FEET
DOTTED LINES REPRESENT 20 FOOT CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

UTM GRID AND 1971 MAGNETIC NORTH
DECLINATION AT CENTER OF SHEET

1973

AMS 3264 III NE—SERIES V897

GOLD HILL, UTAH

NE 4 GOLD HILL 15' QUADRANGLE

N4007 5—W11345/7.5

Plate 2

Samples from the Ochre Springs area assayed as follows:

Gold Hill Assays

Sample #	Au PPM	Ag PPM	As PPM	Rock Type
SAGH 7	.094	.188	62.61	Blk shale E adit
SAGH 8	.113	1.057	45.64	Ochreous mtl from E adit
SAGH 9	<.094	.254	39.15	Blk shale S end Asarco claim
SAGH 10	<.087	.250	186.50	Jasperoid outcrop abv blk shale
SAGH 11	<.093	5.129	86.12	Jasperoid outcrop abv blk shale
SAGH 12	<.087	.452	75.46	Jasperoid outcrop abv blk shale
SAGH 13	<.093	1.431	248.30	Jasperoid outcrop abv blk shale
SAGH 15	.133	.340	3.76	Rtry drill hole cuttings, blk shale
SAGH 16	.177	.362	23.44	Blk shale from dump
SAGH 17	<.095	.185	18.12	Blk shale dump mtl

Samples 7, 8, 11, 13, 15 and 16 are anomalous, indicating the area warrants additional study. (See Plate 2 for sample locations and Plate 3 for 10 element assay details.)

Asarco's Gold Hill Mine claim group (11 patented claims) covers a former Au, Pb, Cu, As (15.6%) producer. Ore was extracted from several underground levels and a large glory hole located on top of Gold Hill (see Photos 3 and 5). The ore occurs in a skarn-like replacement zone at the contact of, or in proximity to, the Ochre Mountain limestone and a tertiary quartz monzonite intrusive. A quartz vein and quartz porphyry dike also appear related to mineralization. A band of quartz jasperoid occurs roughly parallel to the contact zone (see Photos 3 and 4). Black shales that could serve as a host for Carlin-type mineralization lie adjacent to the jasperoid zone. These shales were sampled with the following results:

Gold Hill Assays

Sample #	Au PPM	Ag PPM	As PPM	Rock Type
SAGH 1	<.086	1.218	8.56	Blk limy shale
SAGH 2	<.098	.083	26.77	Blk shale
SAGH 3	<.086	.132	668.70	Blk shale, dump
SAGH 4	<.082	.535	2551.00	Jasperoid near glory hole
SAGH 5	<.079	.295	172.90	Jasperoid ridge
SAGH 14	.110	.098	35.80	Blk shale dump near old shaft
SAGH 18	.102	.426	42.29	Blk shale
SAGH 19	.102	.064	19.31	Blk ferruginous shale

Samples 14, 18 and 19 are anomalous and should be followed up by a more thorough examination. Asarco does not, however, control

TO: Mr. S. A Anzalone
ASARCO, Inc.
P O. Box 5747
Tucson, AZ 85703-0747 Phone: 602/792-3010

Lot Identity: [illegible]

Report Date: 08/23/84

Sample ID	#	Ag	As	Au	Cu	Hg	Mo	Pb	Sb	Tl	Zn
		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
ASARCO SAGH-1	1	1.218	8.563	<.036	26.69	<.434	5.510	16.07	1.163	<.869	87.52
ASARCO SAGH-2	2	.0829	26.77	<.098	27.13	<.490	7.256	12.84	3.457	<.980	59.01
ASARCO SAGH-3	3	.1323	663.7	<.036	17.24	<.430	3.117	30.82	16.73	<.860	60.77
ASARCO SAGH-4	4	.5354	2551	<.082	10.57	.7673	13.50	15.35	130.9	<.829	30.97
ASARCO SAGH-5	5	.2950	172.9	<.077	22.24	<.397	7.175	30.13	40.81	<.795	29.73
ASARCO SAGH-6	6	.5943	96.17	<.077	288.9	1.621	19.52	68.70	71.00	<.797	33.55
ASARCO SAGH-7	7	.1875	62.61	.0941	16.25	<.454	2.387	28.24	1.621	<.908	150.5
ASARCO SAGH-8	8	1.057	45.64	.1127	54.60	1.618	20.83	67.33	3.494	<.945	670.6
ASARCO SAGH-9	9	.2541	39.15	<.074	27.97	<.473	3.118	77.38	2.380	<.946	144.4
ASARCO SAGH-10	10	.2496	186.5	<.087	10.33	1.073	8.951	43.62	22.53	<.872	74.63
ASARCO SAGH-11	11	5.129	86.12	<.073	5.569	1.498	9.596	9.197	15.33	<.935	2191.
ASARCO SAGH-12	12	.4523	75.46	<.087	3.100	<.436	4.266	10.51	9.037	<.872	85.34
ASARCO SAGH-13	13	1.431	248.3	<.093	10.63	1.518	35.95	125.8	29.86	<.931	140.8
ASARCO SAGH-14	14	.0973	35.30	.1397	7.987	<.478	4.774	12.60	7.149	<.956	231.4
ASARCO SAGH-15	15	.3404	3.761	.1329	10.95	.4651	9.437	6.151	<.929	<.929	180.3
ASARCO SAGH-16	16	.3613	23.44	.1774	81.76	<.477	7.373	45.71	1.232	<.954	154.4
ASARCO SAGH-17	17	.1853	18.12	<.095	20.28	<.475	3.296	22.37	<.950	<.950	120.0
ASARCO SAGH-18	18	.4261	42.27	.1015	15.38	<.430	4.952	15.75	1.905	<.860	142.5
ASARCO SAGH-19	19	.0636	19.31	.1018	7.999	<.475	4.472	11.84	1.602	<.951	98.09

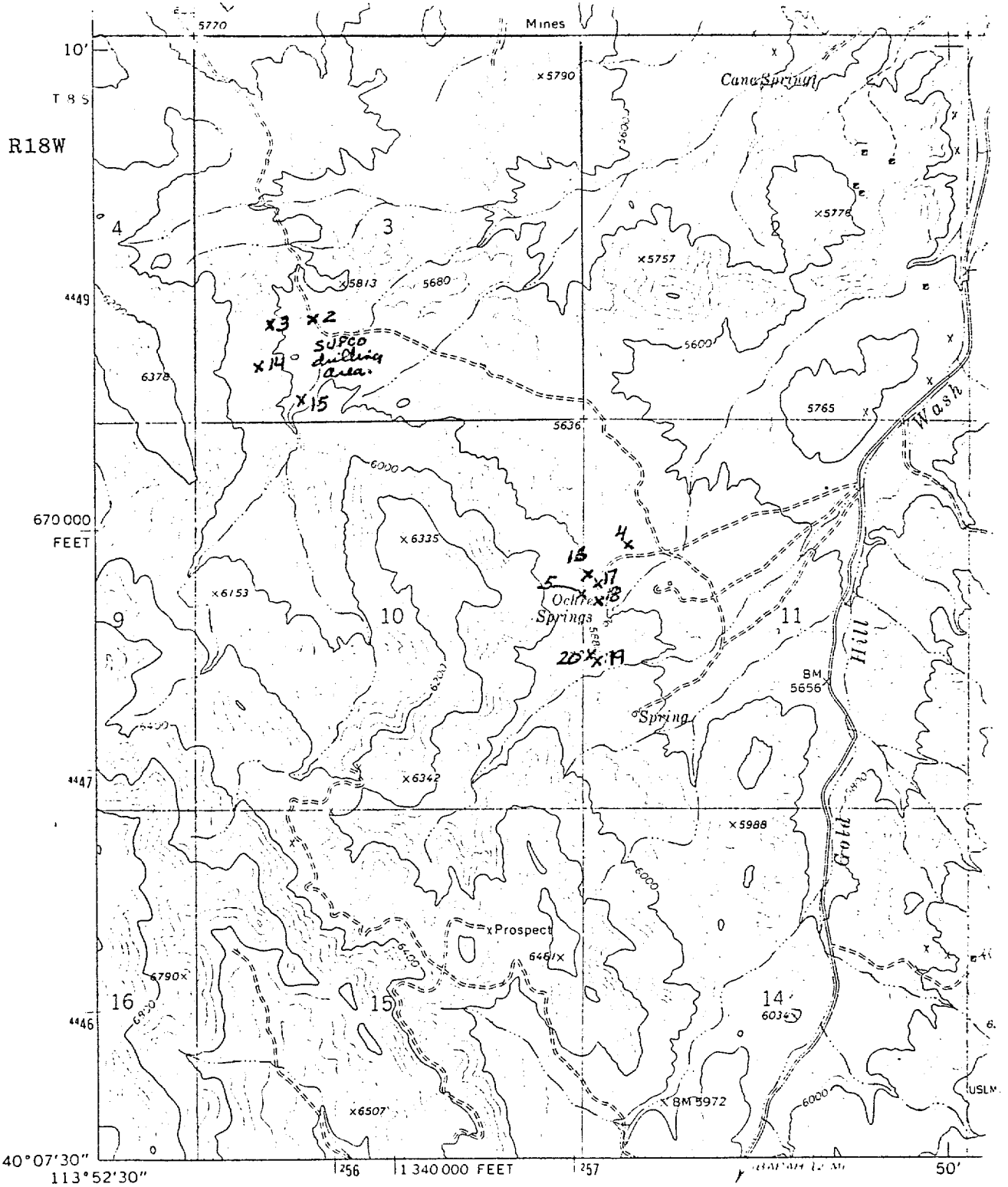
Jasperoid

Ashes Springs Area

This report has been reviewed and approved by:

William S. Henderson, Lab Director/Chemist

Date 8/23/84



(IBAPAH) 3264 III SW

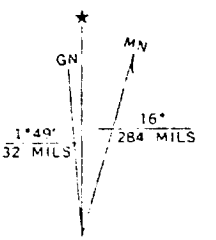
Mapped, edited, and published by the Geological Survey

Control by USGS and NOS/NOAA

Topography by photogrammetric methods from aerial photographs taken 1973. Field checked 1973

Projection and 10,000-foot grid ticks: Utah coordinate system, central zone (Lambert conformal conic)
1000-meter Universal Transverse Mercator grid ticks, zone 12, shown in blue. 1927 North American datum

Where omitted, land lines have not been established



UTM GRID AND 1973 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

Gold Hill, UT 7½' Topo

Sample Descriptions and Gold-Silver Values

Gold Hill Area, Clifton Mining District
Tooele County, Utah

Gold Hill, UT 7½' Quad
Utah Gold Hill (UGH-) Series
Samples collected by J. D. Sell and W. L. Kurtz July 28-29 and August 3-4, 1984

UGH- 1. "Cactus Bell" area. T7S, R18W, NE¼ NE¼ Sec. 28. Jasperoid, white-grey-reddish in Cambrian limestone below shale. Around 200 feet of recrystallized limestone with jasperoid masses and lenses throughout rudely stratiform. Fifty foot cut in upper third of sequence.
Au @ <3 ppb, Ag @ 3.3 ppm

UGH- 2. Superior Oil Minerals Co. drilling area (SUPCO). T8S, R18W, NE¼ SW¼ Sec. 3. Jasperoid rotary chips from SUPCO hole HOG 84-15.
Au @ <3 ppb, Ag @ 0.6 ppm

UGH- 3. SUPCO area. T8S, R18W, NW¼ SW¼ Sec. 3. Jasperoid (mainly) and black shale rotary chips from SUPCO hole HOG 84-21.
Au @ 78 ppb, Ag @ 0.8 ppm

UGH- 4. Ochre Springs area. T8S, R18W, SW¼ NW¼ Sec. 11. Mainly black sooty carbon shale and minor jasperoid rotary chips from Freeport hole GH-14.
Au @ <3 ppb, Ag @ 1.7 ppm

UGH- 5. Ochre Springs area. T8S, R18W, SW¼ NW¼ Sec. 11. Jasperoid ledge above springs. Red-orange jasperoid with abundant barite.
Au @ <3 ppb, Ag @ 0.5 ppm

UGH- 6. Alvarado Mine area. T7S, R18W, SE¼ SE¼ Sec. 36. Three foot vein of sheared quartz with copper and manganese stain, with marmorization of limestone adjacent to diorite mass in small pit.
Au @ 5600 ppb, Ag @ 263 ppm

UGH- 7. Alvarado Mine area. T7S, R18W, SE¼ SE¼ Sec. 36. Muck pile from main inclined shaft. Crushed quartz with variable FeOx, some quartz druse and minor carbonate.
Au @ 380 ppb, Ag @ 60 ppm

UGH- 8. Gold Hill Mine area. T7S, R17W, SE¼ SW¼ Sec. 31. One foot quartz-FeOx vein parallel to bedding in limestone (N30°W, 55°E). Same as Freeport's(?) sample tag 64790 GH.
Au @ 30 ppb, Ag @ 2.3 ppm

UGH- 9. Gold Hill Mine area. T7S, R17W, SE¼ SW¼ Sec. 31. NE cross fractured zone cutting main Gold Hill quartz vein on ridge. Light orange-brown FeOx with sintery silica, in pit.
Au @ 7 ppb, Ag @ 0.9 ppm

UGH-10. Gold Hill Mine area. T8S, R17W, NE¼ NW¼ Sec. 6. NE cross fracture, 5 feet wide, with white druse, some light FeOx, quartz stringers.
Au @ 61 ppb, Ag @ 0.6 ppm

UGH-11. Gold Hill Mine area. T8S, R17W, NE¼ SW¼ Sec. 6. Adjacent to sample UGH-10, a 25 foot cut across main quartz and quartz stringer zone of GH vein along ridge.
Au @ 63 ppb, Ag @ 0.5 ppm

UGH-12. Gold Hill Mine area. T8S, R17W NE¼ NW¼ Sec. 6. In black sooty shale with some siliceous intrabeds, FeOx throughout on shale partings and fractures. HW shale to GH quartz vein.
Au @ 20 ppb, Ag @ 0.4 ppm

UGH-13. Gold Hill Mine area. T8S, R17W, NE¼ NW¼ Sec. 6. A stockwork quartz mass on the west (footwall) side of main GH quartz vein above main decline to workings. Abundant quartz, quartz vein, druse, and breccia filling in bleached and silicified unit (limestone).
Au @ 38 ppb, Ag @ 0.7 ppm

UGH-14. SUPCO area. T8S, R18W, SW¼ SW¼ Sec. 3. At tunnel dump, black sooty shale with ¼"-½" white calcite veins.
Au @ <0.02 ppm, Ag @ 0.04 opt

UGH-15. SUPCO area. T8S, R18W, SE¼ SW¼ Sec. 3. White quartz and black shale from rotary cuttings from SUPCO hole HOG-17.
Au @ <0.02 ppm, Ag @ <0.01 opt

UGH-16. Ochre Springs area. T8S, R18W, SW¼ NW¼ Sec. 11. Dump material from west spring. Dump sample of black sooty shale, some carbonate and gypsum.
Au @ <0.02 ppm, Ag @ 0.04 opt

UGH-17. Ochre Springs area. T8S, R18W, SW¼ NW¼ Sec. 11. Dump material from center spring. Dump sample of black sooty shale, some carbonate and gypsum.
Au @ <0.02 ppm, Ag @ <0.01 opt

UGH-18. Ochre Springs area. T8S, R18W, SW¼ NW¼ Sec. 11. Jasperoid ledge above springs, with red-orange FeOx and barite. Located between center and eastern springs.
Au @ <0.02 ppm, AG @ 0.06 opt

UGH-19. Long Spring (Ochre Springs area). T8S, R18W, NW¼ SW¼ Sec. 11. In pit of black sooty shale.
Au @ <0.02 ppm, Ag @ <0.01 opt

UGH-20. Long Spring (Ochre Springs area). T8S, R18W, NW¼ SW¼ Sec. 11. Fifty feet westerly from UGH-19, in overlying jasperoid of dense red-orange-some yellow FeOx, with barite, brecciated.
Au @ 0.02 ppm, Ag @ <0.01 opt

UGH-21. Gold Hill area, T8S, R17W, NE¼ NW¼ Sec. 6. Dump sample on NE side of quartz vein in black sooty HW shale with red-orange-black FeOx.
Au @ <0.02 ppm, Ag @ <0.01 opt

UGH-22. Gold Hill area. T8S, R17W, NE¼ NW¼ Sec. 6. Outcrop of blocky, 1"-4" argillaceous black shale with orange-red black FeOx. At post #3-6426(?) on old patent survey(?) in gulch.
Au @ <0.02 ppm, Ag @ <0.01 opt

UGH-23. Gold Hill area. T8S, R17W, NE¼ NW¼ Sec. 6. At deep (100'+) shaft, dump sample, medium fractured black shale with FeOx on fractures and as small masses along partings.
Au @ <0.02 ppm, Ag @ <0.01 opt

UGH-24. Gold Hill area. T8S, R17W, NW¼ NE¼ Sec. 6. Outcrop in flaggy carbonate and black shiny shale intrabedded. Some crinoid amd other fossil trash, some FeOx and small quartz veins.
Au @ <0.02 ppm, Ag @ <0.01 opt

Table 1

Gold Hill Group Sample Returns

Tooele County, Utah

Area	Sample No.	Sample Type*	Au (ppm)	Ag (ppm)
Cactus Bell	UGH- 1	jasp oc	<0.003	3.3 (0.1 opt)
SUPCO	UGH- 2	jasp rdh	<0.003	0.6
	UGH- 3	jasp rdh	0.078 (0.002 opt)	0.8
	UGH-14	shale dump	<0.02	1.37 (0.04 opt)
	UGH-15	jasp sh rdh	<0.02	<0.3
Ochre Springs	UGH- 4	sh jasp rdh	<0.003	1.7 (0.05 opt)
	UGH- 5	jasp oc	<0.003	0.5
	UGH-16	shale dump	<0.02	13.7 (0.4 opt)
	UGH-17	shale dump	<0.02	<0.3
	UGH-18	jasp oc	<0.02	2.06 (0.06 opt)
	UGH-19	shale dump	<0.02	<0.3
	UGH-20	jasp oc	0.02	<0.3
Alvarado Mine	UGH- 6	vein oc	5.60 (0.16 opt)	263 (7.7 opt)
	UGH- 7	gossan dump	0.38 (0.01 opt)	60 (1.8 opt)
Gold Hill Mine	UGH- 8	qtz vn oc	0.03	2.3 (0.07 opt)
	UGH- 9	qtz st oc	0.007	0.9
	UGH-10	qtz st oc	0.061 (0.002 opt)	0.6
	UGH-11	qtz vn oc	0.063 (0.002 opt)	0.5
	UGH-12	shale oc	0.020	0.4
	UGH-13	qtz stwk oc	0.038	0.7
	UGH-21	shale dump	<0.02	<0.3
	UGH-22	shale oc	<0.02	<0.3
	UGH-23	shale dump	<0.02	<0.3
	UGH-24	sh lms oc	<0.02	<0.3

*jasp jasperoid
oc outcrop
rdh rotary drill hole rock chips
sh shale
qtz quartz
st stringer
vn vein
stwk stockwork
lms limestone

SWED EXPLORATION DRILLING PROPOSAL

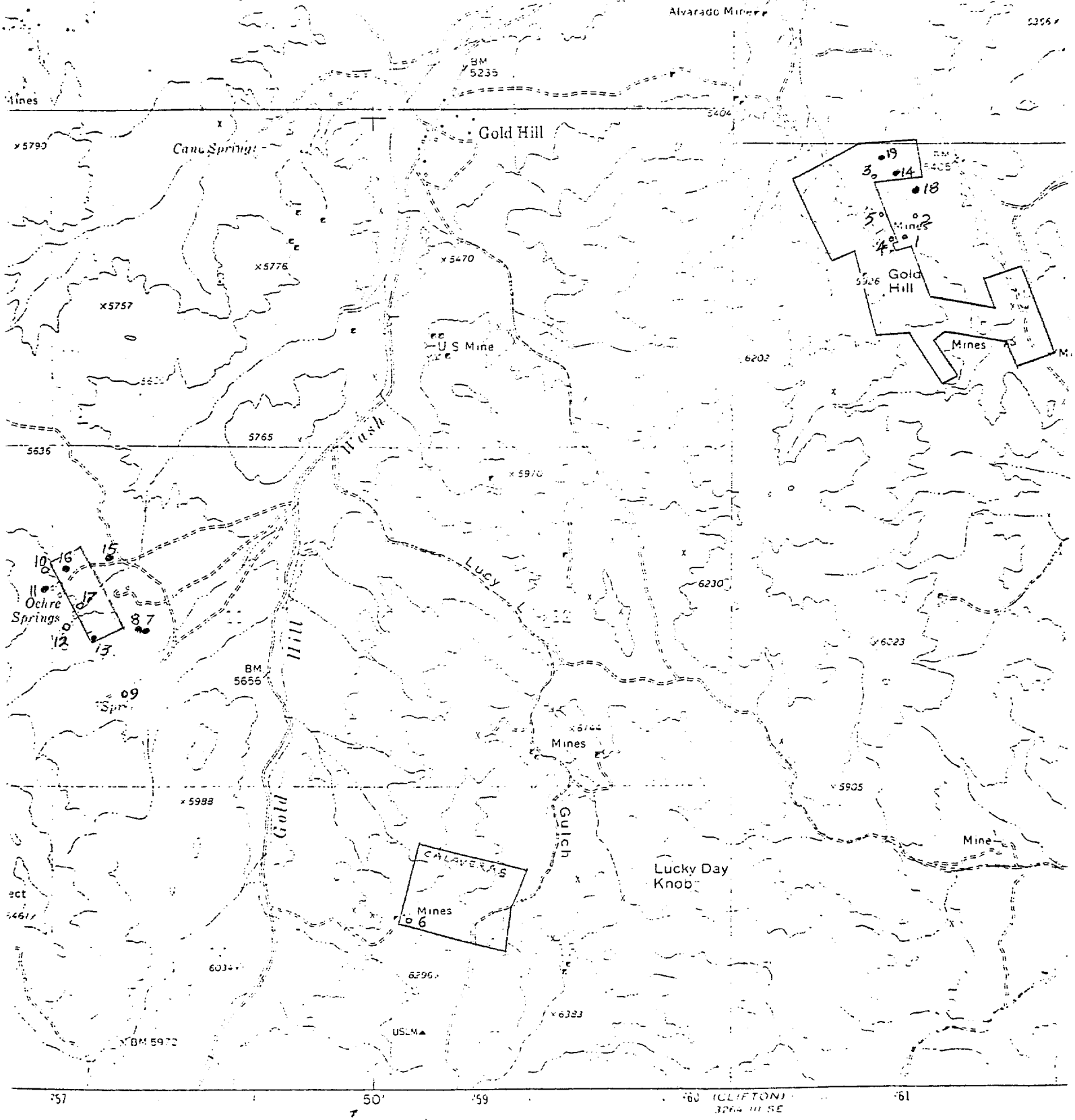
Gold Hill Mine
Clifton Mining District
T8S, R17W
Tooele County, Utah

Eleven patented claims are held by the Mining Department. Weakly anomalous values are found in black shales which are stratigraphically above a favorable limestone which was drilled elsewhere by SUPCO and 0.038 opt Au was found. Based on the low anomalous values found over the SUPCO drilling (see Ochre Springs Area report), the Gold Hill Mine area is of interest.

James D. Sell

James D. Sell

Plate 2, Gold Hill Topo
Page 2 (SAA), Table 1
Attachment C



Sample Site
Anomalous Value
Claim Locations
Approx.

SCALE 1:24 000

CONTOUR INTERVAL 40 FEET
DOTTED LINES REPRESENT 20 FOOT CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

UTM GRID AND 1973 MAGNETIC NORTH
DECLINATION AT CENTER OF SHEET

1973

AMS 3264 III NE—SERIES V897

GOLD HILL, UTAH

NE 4 GOLD HILL 15' QUADRANGLE
N4007 5—W11345/7.5

Plate 2

Samples from the Ochre Springs area assayed as follows:

Gold Hill Assays

Sample #	Au PPM	Ag PPM	As PPM	Rock Type
SAGH 7	.094	.188	62.61	Blk shale E adit
SAGH 8	.113	1.057	45.64	Ochreous mtl from E adit
SAGH 9	<.094	.254	39.15	Blk shale S end Asarco claim
SAGH 10	<.087	.250	186.50	Jasperoid outcrop abv blk shale
SAGH 11	<.093	5.129	86.12	Jasperoid outcrop abv blk shale
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		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
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Jasperoid

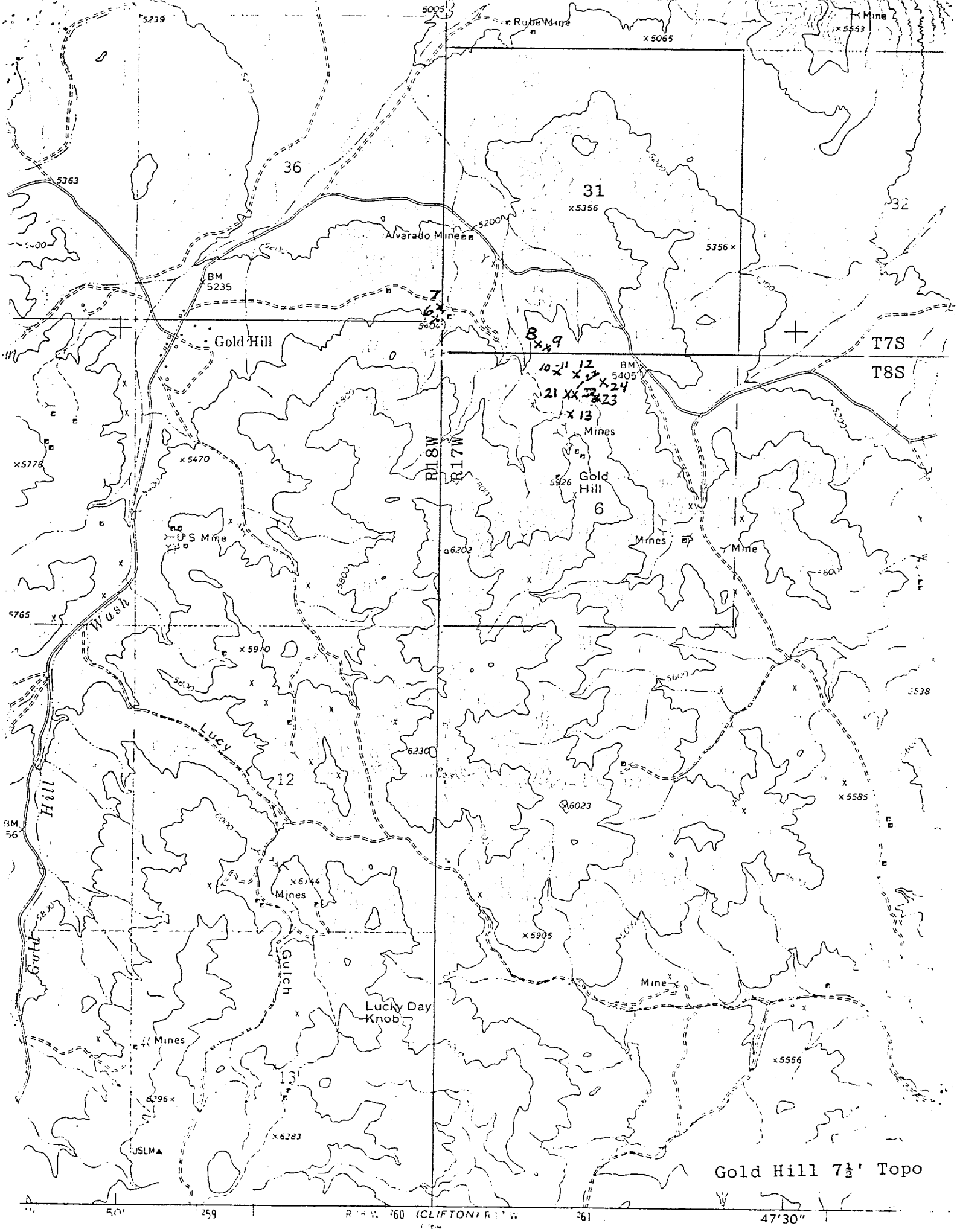
active springs area

This report has been reviewed and approved by:

William S. Henderson, Lab Director/Chemist

Date 8/23/84

Plate 3


Rube Mine
Mine
5065
5553
5239
5005
36
31
32
5356
5363
Alvarado Mine
BM
5235
Gold Hill
T7S
T8S
BM
5405
Mines
R18W
R17W
Gold
Hill
6
5926
5470
5776
US Mine
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Mine
6202
5765
Wash
5910
Lucy
12
6230
6023
5585
Hill
Mines
Gulch
5905
Mine
Lucky Day
Knob
Mines
13
5556
6296
6383
USLM
Gold Hill 7½' Topo
47'30"

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UGH-11. Gold Hill Mine area. T8S, R17W, NE¼ SW¼ Sec. 6. Adjacent to sample UGH-10, a 25 foot cut across main quartz and quartz stringer zone of GH vein along ridge.
Au @ 63 ppb, Ag @ 0.5 ppm

UGH-12. Gold Hill Mine area. T8S, R17W NE¼ NW¼ Sec. 6. In black sooty shale with some siliceous intrabeds, FeOx throughout on shale partings and fractures. HW shale to GH quartz vein.
Au @ 20 ppb, Ag @ 0.4 ppm

UGH-13. Gold Hill Mine area. T8S, R17W, NE¼ NW¼ Sec. 6. A stockwork quartz mass on the west (footwall) side of main GH quartz vein above main decline to workings. Abundant quartz, quartz vein, druse, and breccia filling in bleached and silicified unit (limestone).
Au @ 38 ppb, Ag @ 0.7 ppm

UGH-14. SUPCO area. T8S, R18W, SW¼ SW¼ Sec. 3. At tunnel dump, black sooty shale with ¼"-½" white calcite veins.
Au @ <0.02 ppm, Ag @ 0.04 opt

UGH-15. SUPCO area. T8S, R18W, SE¼ SW¼ Sec. 3. White quartz and black shale from rotary cuttings from SUPCO hole HOG-17.
Au @ <0.02 ppm, Ag @ <0.01 opt

UGH-16. Ochre Springs area. T8S, R18W, SW¼ NW¼ Sec. 11. Dump material from west spring. Dump sample of black sooty shale, some carbonate and gypsum.
Au @ <0.02 ppm, Ag @ 0.04 opt

UGH-17. Ochre Springs area. T8S, R18W, SW¼ NW¼ Sec. 11. Dump material from center spring. Dump sample of black sooty shale, some carbonate and gypsum.
Au @ <0.02 ppm, Ag @ <0.01 opt

UGH-18. Ochre Springs area. T8S, R18W, SW¼ NW¼ Sec. 11. Jasperoid ledge above springs, with red-orange FeOx and barite. Located between center and eastern springs.
Au @ <0.02 ppm, AG @ 0.06 opt

UGH-19. Long Spring (Ochre Springs area). T8S, R18W, NW¼ SW¼ Sec. 11. In pit of black sooty shale.
Au @ <0.02 ppm, Ag @ <0.01 opt

UGH-20. Long Spring (Ochre Springs area). T8S, R18W, NW¼ SW¼ Sec. 11. Fifty feet westerly from UGH-19, in overlying jasperoid of dense red-orange-some yellow FeOx, with barite, brecciated.
Au @ 0.02 ppm, Ag @ <0.01 opt

UGH-21. Gold Hill area, T8S, R17W, NE¼ NW¼ Sec. 6. Dump sample on NE side of quartz vein in black sooty HW shale with red-orange-black FeOx.
Au @ <0.02 ppm, Ag @ <0.01 opt

UGH-22. Gold Hill area. T8S, R17W, NE¼ NW¼ Sec. 6. Outcrop of blocky, 1"-4" argillaceous black shale with orange-red black FeOx. At post #3-6426(?) on old patent survey(?) in gulch.
Au @ <0.02 ppm, Ag @ <0.01 opt

UGH-23. Gold Hill area. T8S, R17W, NE¼ NW¼ Sec. 6. At deep (100'+) shaft, dump sample, medium fractured black shale with FeOx on fractures and as small masses along partings.
Au @ <0.02 ppm, Ag @ <0.01 opt

UGH-24. Gold Hill area. T8S, R17W, NW¼ NE¼ Sec. 6. Outcrop in flaggy carbonate and black shiny shale intrabedded. Some crinoid amd other fossil trash, some FeOx and small quartz veins.
Au @ <0.02 ppm, Ag @ <0.01 opt

Table 1

Gold Hill Group Sample Returns

Tooele County, Utah

Area	Sample No.	Sample Type*	Au (ppm)	Ag (ppm)
Cactus Bell	UGH- 1	jasp oc	<0.003	3.3 (0.1 opt)
SUPCO	UGH- 2	jasp rdh	<0.003	0.6
	UGH- 3	jasp rdh	0.078 (0.002 opt)	0.8
	UGH-14	shale dump	<0.02	1.37 (0.04 opt)
	UGH-15	jasp sh rdh	<0.02	<0.3
Ochre Springs	UGH- 4	sh jasp rdh	<0.003	1.7 (0.05 opt)
	UGH- 5	jasp oc	<0.003	0.5
	UGH-16	shale dump	<0.02	13.7 (0.4 opt)
	UGH-17	shale dump	<0.02	<0.3
	UGH-18	jasp oc	<0.02	2.06 (0.06 opt)
	UGH-19	shale dump	<0.02	<0.3
	UGH-20	jasp oc	0.02	<0.3
Alvarado Mine	UGH- 6	vein oc	5.60 (0.16 opt)	263 (7.7 opt)
	UGH- 7	gossan dump	0.38 (0.01 opt)	60 (1.8 opt)
Gold Hill Mine	UGH- 8	qtz vn oc	0.03	2.3 (0.07 opt)
	UGH- 9	qtz st oc	0.007	0.9
	UGH-10	qtz st oc	0.061 (0.002 opt)	0.6
	UGH-11	qtz vn oc	0.063 (0.002 opt)	0.5
	UGH-12	shale oc	0.020	0.4
	UGH-13	qtz stwk oc	0.038	0.7
	UGH-21	shale dump	<0.02	<0.3
	UGH-22	shale oc	<0.02	<0.3
	UGH-23	shale dump	<0.02	<0.3
	UGH-24	sh lms oc	<0.02	<0.3

*jasp jasperoid
oc outcrop
rdh rotary drill hole rock chips
sh shale
qtz quartz
st stringer
vn vein
stwk stockwork
lms limestone

SWED EXPLORATION DRILLING PROPOSAL

Gold Reef Mine
T6N, R3E
San Bernardino Co., CA

Asarco has no claims in the area and permission to evaluate the 32 unpatented claim block of F. Mack was verbally received.

The Newmont, Goldfields, and Mack sampling shows a few anomalous precious metal values on the north end around the old workings in pyrite-quartz structures. These are within a quartz latite dike swarm and have a moderate dip to the northeast. No values occur in the pyritized quartz latite dikes or the quartz monzonite host rock.

Westward at the base of the ridge and at the edge of the zone of quartz latite dikes is a gneissic zone which has an apparent 30° dip or less to the northeast along parts of the exposures. Exposures of broken and crushed monzonite are found in the valley west of the gneiss. No anomalous precious metal values were found in the gneissic-crushed zone monzonite.

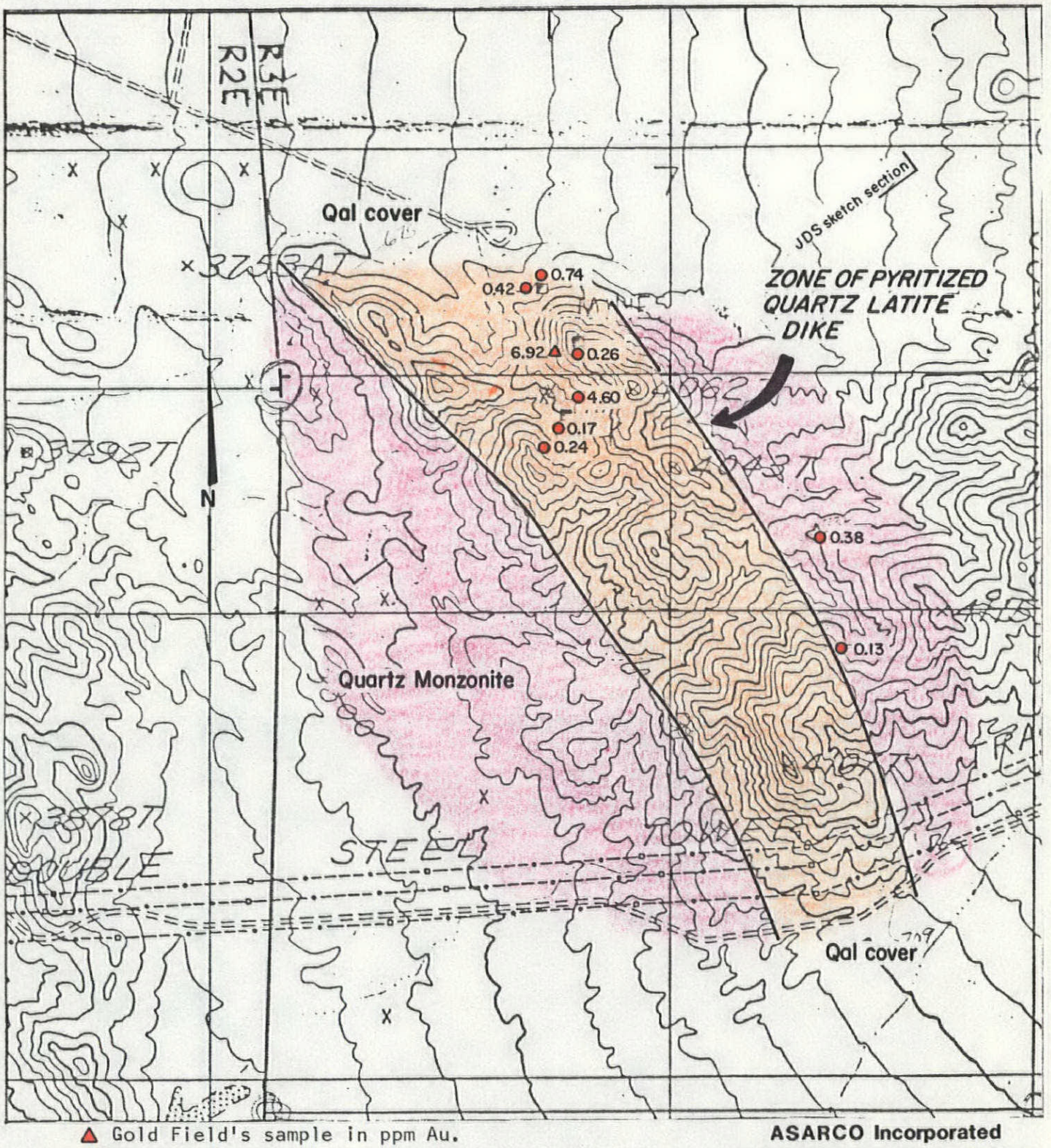
Although not well documented, the western gneissic zone could be a flat fault structure and the metal bearing quartz veins to the east in the dike zone could represent the high-angled listric faults which root in the flatter structure. Their intersection provides the crushed zone and increase permeability for deposition of precious metals which may extend eastward along the flat fault (assuming a fluid flow source from the east).

A report by H.G. Kreis is in press and shows the area mapping at 1"=200'. He found no evidence for disseminated mineralization, and hence, no potential, and believes the gneissic zone to be a reflection of the border phase of the quartz monzonite.

James D. Sell

James D. Sell

Map
Sketch



▲ Gold Field's sample in ppm Au.

● Newmont sample in ppm Au.

ASARCO Incorporated

1985 GOLD PROGRAM

AMS Sheet: _____

USGS Quad.: Fry Mtns.,Ca. 7.5'

Twsp.: 6N **Rng.:** 3E **Sec.:** 7 & 18

Prospect Name: Gold Reef Mine Area

Owner: _____

Examined by: H.G.Kreis

Follow-up Recommended: Yes☐ No☐

State: California

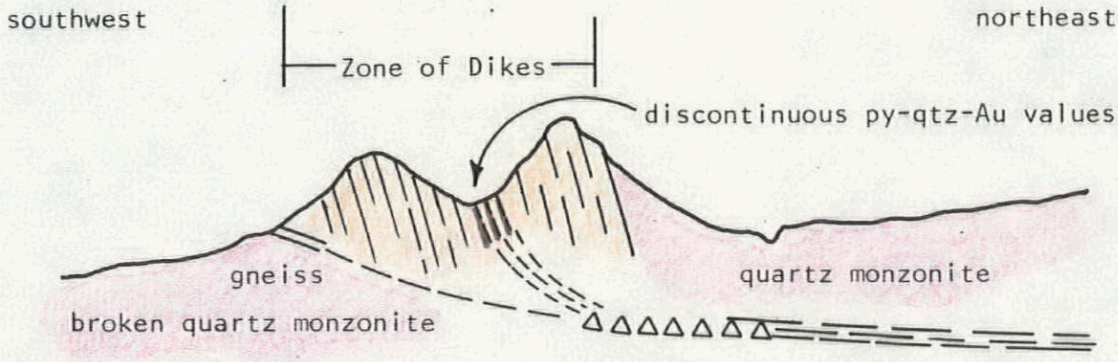
County: San Bernardino

SCALE: 1"=2000'approx.

District: _____

MILS and/or Terradata # _____ / _____

map no. 6306 **date** 10/21/85



SKETCH OF "DETACHMENT" ZONE CONCEPT GOLD REEF AREA
JDS

ASARCO Incorporated

1985 GOLD PROGRAM

AMS Sheet: _____

USGS Quad.: Fry Mtns., Ca. 7.5'

Examined by: H.G.K. sketch by J.D.Sell

Follow-up Recommended: Yes☐ No☐

SCALE: 1"=2000' approx

Twsp.: 6N **Rng.:** 3E **Sec.:** 7 & 18

Prospect Name: Gold Reef Mine Area

Owner: _____

State: California

County: San Bernardino

District: _____

MILS and/or Terradata # _____ / _____

map no. 6307 **date** 10/21/85

SWED THOUGHTS

Black Butte Prospect
Golden Glade, Inc.
T7S, R16E
San Bernardino Co., CA

This property was a submittal with several photographs suggesting a brecciated copper stained flattish structure. Several holes are alluded to on the down dip extension to have anomalous gold values.

M. Miller did not get to the area nor has anyone else in SWED. Very difficult access may have isolated the area from the hoards of the Mohave. A detailed investigation and possible drilling in the pediment is warranted.

James D. Sell

James D. Sell

Map Location

SWED THOUGHTS

Groover Mine Area
T2S, R11E
Riverside Co., CA

Asarco has no claims in the area.

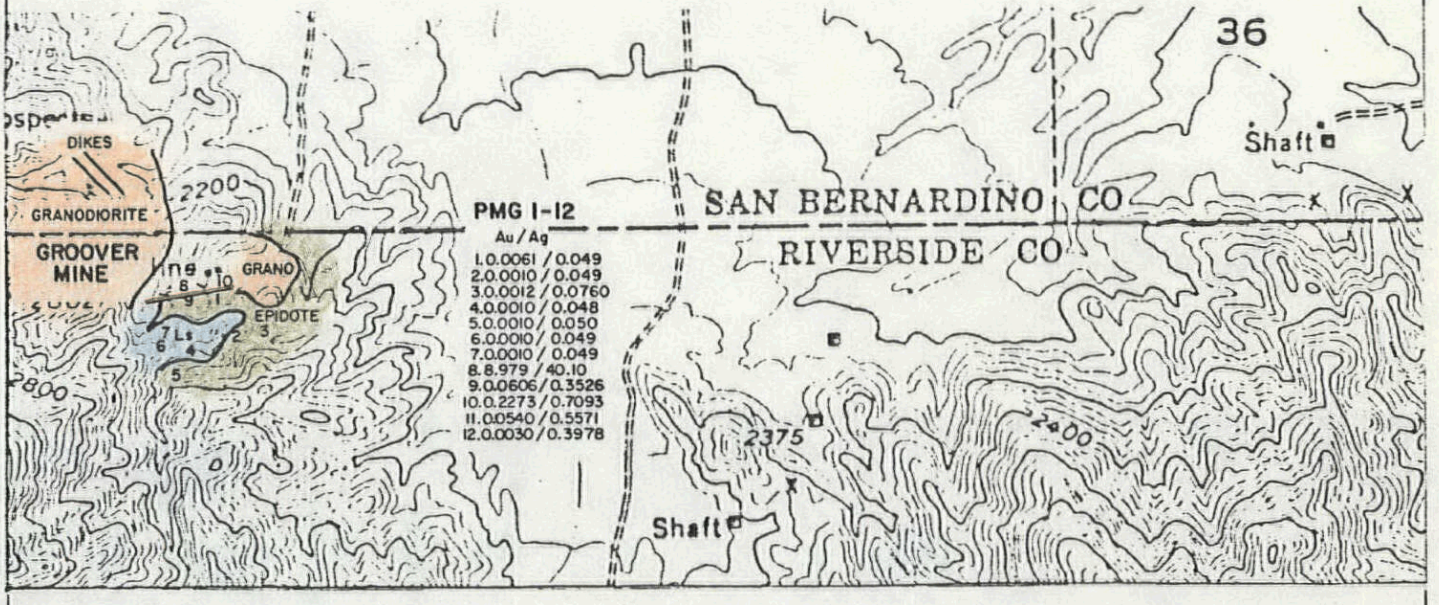
A flat fault up to 40 feet thick with anomalous gold-silver values in skarn is one of probably three such structures in the ara. All of the structures have a 30°-40° northeasterly dip into the valley. Hi-angled quartz veins and epidote veins up to 30' thick are in the suspected hanging wall block and suggest a stacked detachment zone making an attractive target in the valley to the east.

Detailed mapping is planned for the zone.

James D. Sell

James D. Sell

Map 6254
Samples on map, PMG-1 thru -12



Note: All values in ppm.

ASARCO Incorporated

1985 GOLD PROGRAM

AMS Sheet: San Bernardino, Ca.

USGS Quad.: Valley Mtn.,Ca. 15'

Twsp.: 1 S **Rng.:** 11 E **Sec.:** unsurveyed

Prospect Name: Groover Mine Area

Owner:

Examined by: Tony Dalla Vista

Follow-up Recommended: Yes☒ No☐

State: California

County: San Bernardino

SCALE: 1"=1/2mile approx

District: Dale Mining Dist.

MILS and/or Terradata # _____ / _____

map no. 6308 **date** 10/21/85

JDS

ASARCO

Southwestern Exploration Division

October 12, 1984

F. T. Graybeal
New York Office

Area Activities
Mother Lode Reconnaissance, CA

I forward the G. J. Stathis (with H. G. Kreis' input) report on the Sonora Mining Corporation's Jamestown California Gold Project. I also attach a copy (which I telecopied to you on 10/11/84) of the announcement in the Western Mining News that Echo Bay was dropping out of the Jamestown Project. Perhaps additional information will appear in the Northern Miner publication. Asarco does not know why Echo Bay is giving up so it behooves us to try and determine if the reserve and grade, 25 million tons at 0.065 opt Au, is valid and open for possible participation.

A memo is forthcoming on the Royal-Mountain King property where NERCO Minerals has also just relinquished their option after drilling 113 holes in addition to the 130 holes drilled by Mother Lode Gold Mining, the underlying owner. Stringham-Gay worked out the value using "a probable reserve of 1.5 million tons at 0.073 opt Au with an 0.04 opt Au cutoff grade" and state that it is not viable at this time as a mill must be operated since the ore is non-leachable. The Stathis-Kreis review suggests that the drill results show no continuity of gold values and that the reserve may actually be as low as 500,000 tons at 0.07 opt Au. This would eliminate the Royal-Mountain King drilled area from any further consideration.

H. G. Kreis reports that the Gold Fields Shingle Springs deposit (Big Canyon-Vandalia Mines) is rumored to be up for a joint venture. HGK-GJS will try and review the Shingle Springs data when they return to the reconnaissance. Basically I see no reason for Gold Fields to offer a joint venture on a "mine", so I suspect here again a lack of continuity for the grade-tonnage desired. In addition we have to recognize the real environmental problems as suggested in the California Mining article (appended) where an initiative to restrict open-pit mining in El Dorado County is being put on the November ballot for a vote.

The Callahan Keystone-Lincoln property data, for which I signed the Letter of Confidentiality so that we can review the data, will be reviewed by Kreis-Stathis when they return to California. Apparently Callahan discounts any open-pit potential among the city lots, but felt that an 0.5 opt Au zone might be mined underground.

J. D. Sell

JDS/cg

Attachments

cc: WLK, HGK, GJS, JRS-WDG

also to FILE
HGK

YBS

Western Illinois Times September 21, 1984
Vol. 16, No. 36, p. 4.

ASARCO

Southwestern Exploration Division

October 10, 1984

To: J. D. Sell

From: G. J. Stathis

Observations, Conclusions, and Recommendations based on Results of the Mother Lode Gold Mines Consolidated & NERCO Minerals Company's Drill Programs at the Royal-Mountain King Mines Area Hodson Mining District Calaveras County, CA

Introduction

On September 8th of this year, Hank Kreis and I met, at Mother Lode Gold Mines Consolidated (MLGM), San Andreas, CA field office, with a Mr. Grant W. Metzger, the Vice President and Director of the San Francisco based MLGM to discuss, review and acquire data of MLGM's California-Seaton property in Amador County. Also present at the Sept. 8th meeting was a Mr. Ed Buchanan who, based out of San Andreas, serves as a consultant to MLGM on mining and milling matters. During this meeting a routine inquiry was made as to how things were going at the Royal-Mountain King. We were informed that NERCO had suddenly (August) "bailed out" of the Royal-Mountain King area and had turned over all their factual data to MLGM. According to Metzger, approximately a dozen companies were currently taking a "hard look" at this data. Curiously enough Mr. Metzger never called to let me know the property was available. I had called Metzger early last fall inquiring as to the availability of the property and told him I had worked on it in 1969. At that time Mr. Metzger informed me the property was in the stage of final agreement and signing (party unidentified) and thus unavailable; however, Metzger took down my phone, address, etc. should the property come open. Due to previous commitments, on our part and Mr. Metzger's as well, meetings weren't held until Sept. 12 & 13, 1984 to discuss, copy, etc. data on the Royal-Mountain King property. We also met and reviewed data with MLGM's geologist Michael Burns.

Observations-Conclusions

The first major disappointment, during the data review, came when Hank and I were shown the geology-assay cross sections of drill results based primarily on

a) MLGM's Drill Program #1 - 130 holes drilled in 1980, and

b) NERCO's 1984 Phase I and Phase II Drill Hole Programs - total 113 holes.

Visual inspection of the cross sections showed a decided lack of continuity of ore horizons between most of the drill holes which could substantiate a claimed (NERCO, MLGM) combined +7 m.t. of .07 opt gold from two ore zones on the property, hitherto referred to as the S½ and the N½ ore zones respectively (see Plate 1). Hank has completed a thorough review of the cross sections and I am in agreement with his verbal communication that:

1. No continuity of mineralization appears to exist in the N½ ore zone to support MLGM-NERCO's contention of +3 m.t. of gold ore here.
2. Considerably less than +3 m.t. of gold ore occurs in the S½ ore zone. Possibly 1½ m.t. of unoxidized, .07 opt rock at approximately 4:1 waste:ore stripping ratio occurs here.

At the time of my 1969 field examination-sampling and data compilation (included assay results of 33 combined drill holes from a 1955 New Jersey Zinc drill program and a 1958-59 Yuba Consolidated drill program), I had concluded that an overall potential of possibly as much as 46 m.t. of 0.04 opt gold existed in the area based on downdip projection of favorable lithology. However, cross section analyses of available diamond drill data indicated "a highly erratic, three dimensional picture of mineralization. There is no well defined, ore horizon in the area of concentrated drilling (mostly Yuba)." The area studied in 1969 takes in both the currently designated N½ and S½ ore zones. Fifteen years and about 260 drill holes later not much has changed at the Royal-Mountain King Mines area! I believe it was a mistake for MLGM-NERCO to have done most of their exploratory drilling on a grid system. MLGM "wasted" a lot of their holes on the extreme west side of their grid, drilling into what I have outlined as a "dead zone" (Plate 1) having no significant gold assay returns whatsoever.

An examination of NERCO's 1" = 100' and 1" = 300' surface geology maps and reports of March 29, 1984 and August 1984 have led to the following observations-conclusions regarding the geologic environment at the S½ and N½ ore zones respectively:

A. S½ Ore Zone

1. The Hodson vein-fault zone is the dominant "plumbing" structure on the west (f.w.) side.
2. Two wedges of serpentine rock occur here.
3. Altered basalt and shale host the gold mineralization. According to Kreis, the cross sections show that most of the mineralization

occurs in the shale which dips easterly under the basalt. Ground prep. in the shale was, no doubt, aided by the east dipping, Hodson fault zone.

B. N½ Ore Zone

1. Has an alternating sequence of intercalated, east dipping basalt and carbonaceous shale.

2. A serpentine body is in the southern half portion of the pit outline.

3. A nearly east-west, left lateral fault cuts just south of the central half of the proposed pit outline. Ground prep?

Possible explanations offered as to why mineralization in the N½ ore zone area is more erratic relative to that in the S½ ore zone area may be due to:

1. The Hodson fault zone, as mapped, narrows considerably northwards and quite possibly passes into the Mountain King vein structure. Thus ground prep. was much less developed.

2. The shale interbeds more with the basalt to the north than it does onto the south. Thus there is less, volumetrically, of the more potentially favorable (with respect to mineralization) shale to the north. Inspection of the cross sections show this is exactly the situation occurring here. That is to say, there is less shale to the north (N½ pit area).

Summary-General

The following briefly summarizes some of the salient features derived from the recent exploration drill activity at the Royal-Mountain King area which diminishes, somewhat, the residual potential of the district:

1. Sizeable tonnage reduction of the claimed combined +7 m.t. of 0.067 to 0.070 opt gold.

2. No oxide reserve. Thus, milling of the primary ore required.

3. High stripping ratios indicated.

4. Very erratic, 3-D nature of the mineralization would require considerable close spaced, step-out drilling to prove out ore continuity.

Summary-Residual Targets

Eight specific residual targets are briefly discussed in pp. 18-22 of the March 29, 1984 NERCO report. In my opinion, based on work done in 1969, two areas mentioned in the NERCO report remain as valid, but somewhat long-shot residual exploration targets for possible substantial tonnage of open pit, disseminated gold mineralization.

1. Felix Mining Company Property - The property extends from the Wilbur Womble Mine southwards to the Gold Knoll Mine and takes in approximately 6000 feet plus strike length of the Hodson fault zone. Slate, basalt and serpentine occur on the property. Some anomalous gold assay results were obtained locally at this property by me in 1969 (see Plate 3).

2. Morning Star Quartz Vein Zone Area - The area is covered by the Morning Star, Dublin and Snowstorm patented mining claims. Area is of exploratory interest because of:

   a) Presence of a northwest trending, enechelon quartz vein zone cutting mostly basalt and some intercalated shale rocks. A strike length of at least 3000 feet along the quartz vein zone is present.

   b) The Morning Star open pit located at the east central area of the patented Morning Star lode claim produced approximately 50,000 tons of 0.11 opt gold ore prior to 1936.

   c) Once again, some anomalous gold assay values were obtained by me, in 1969, from rock chip samples collected locally in this area (Plate 3). Acquisition of the 3 claims was recommended on p. 10 of my Sept. 19, 1969 report. Also drilling was recommended in this particular area (p. 12, Diagram A of 9/19/69 report).

   d) Mineralization from the Morning Star quartz vein zone area may extend eastward 600 feet or so and include possible mineralization from the 3600 foot long largely untested Brown vein (Plate 1). The Brown vein is one of the eight residual NERCO targets.

References Cited

a) Kreis, H., 1984 - in prep. Ore Reserves.

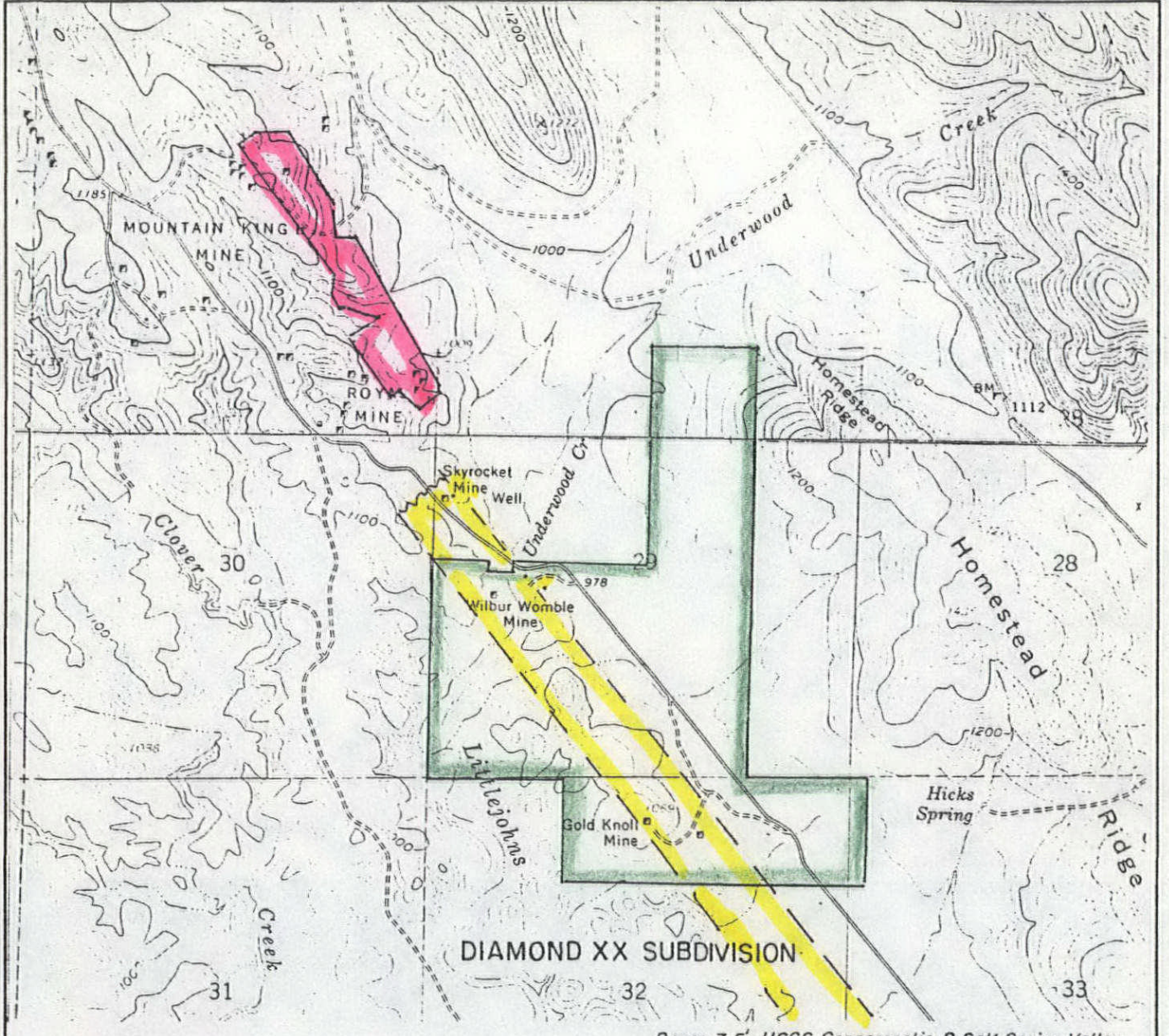
b) NERCO, March 29, 1984; Royal-Mountain King Project, Phase I, Final Report (R. J. Sandberg, et al.).

c) Stathis, G. J., Sept. 19, 1969; Report on the Royal-Mountain King Mines Property, Hodson (Madam Felix, Copperopolis) Mining District, Calaveras Co., CA.

d) Stathis, G. J., Nov. 28, 1969; Addendum to the Sept. 19, 1969 Report on the Royal-Mountain King Mines.

G. J. Stathis

GJS/cg
Attachments
cc: WLKurtz
HGKreis



Base: 7.5' USGS Copperopolis & Salt Spring Valley

Morning Star Qtz Vein Zone Area

Felix Mining Co. Property

Hodson Fault Zone (approximately)

ASARCO INCORPORATED

area: ROYAL-MTN KING MINES	data by	state: CALIFORNIA	township-range: T. 2 N., R. 12 E.	revisions-date
title: LOCATION MAP-Residual Targets	drawn by: G.J. STATHIS	county: CALAVERAS	map number	PLATE 2
mining district: HODSON	date: Oct. 1984	1,000' 0 2,000' 4,000		
		contour interval: 20 ft.		

1980

The Mineral Industry of Arizona

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Arizona Bureau of Geology and Mineral Technology, for collecting information on all nonfuel minerals.

By Lorraine B. Burgin[1]

The value of Arizona nonfuel mineral production decreased from $2.5 billion in 1979 to $2.4 billion in 1980. Despite a copper strike, Arizona again ranked first in national production of nonfuel minerals. Based upon the total value of all metal produced in the Nation in 1980, copper was first, and Arizona's copper production was 64.8% of the national total. The State ranked second in molybdenum produced, with 24% of the national total coming from its mines, second in silver, with 18% of domestic production, and fourth in gold, with 7.6% of that production. All of these metals were principally recovered as byproducts or coproducts of copper production.

Table 1.—Nonfuel mineral production in Arizona[1]

Mineral	1979 Quantity	1979 Value (thousands)	1980 Quantity	1980 Value (thousands)
Clays ... thousand short tons	138	$642	151	$1,151
Copper (recoverable content of ores, etc.) ... metric tons	946,002	1,940,211	757,314	1,709,997
Gem stones	NA	4,000	NA	3,100
Gold (recoverable content of ores, etc.) ... troy ounces	101,840	31,316	72,773	44,578
Gypsum ... thousand short tons	231	1,245	209	2,017
Lead (recoverable content of ores, etc.) ... metric tons	354	411	401	375
Lime ... thousand short tons	673	27,186	514	23,904
Molybdenum (content of concentrate) ... thousand pounds	35,101	213,065	35,668	341,965
Pumice ... thousand short tons	940	2,367	990	3,228
Sand and gravel ... do	[2]30,520	[2]74,716	24,399	73,773
Silver (recoverable content of ores, etc.) ... thousand troy ounces	7,479	82,941	5,668	116,984
Stone:				
Crushed ... thousand short tons	5,769	21,401	5,224	21,565
Dimension ... do	5	110	W	45
Combined value of asbestos, cement, fluorspar (1979), perlite, pyrites, salt, sand and gravel (industrial, 1979), tungsten, and zinc	XX	90,870	XX	83,032
Total	XX	2,490,481	XX	2,425,714

NA Not available. W Withheld to avoid disclosing company proprietary data. XX Not applicable.
[1]*Production as measured by mine shipments, sales, or marketable production (including consumption by producers).*
[2]Excludes industrial sand; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Arizona, by county

(Thousands)

County	1978	1979	Minerals produced in 1979 in order of value
Apache	$2,315	$1,900	Pumice, sand and gravel, clays, stone.
Cochise	20,932	29,479	Copper, lime, stone, sand and gravel, silver, gold, lead.
Coconino	W	2,521	Pumice, sand and gravel, stone.
Gila	175,340	253,024	Copper, molybdenum, silver, sand and gravel, gold, lime, asbestos, fluorspar, stone, clays.
Graham	W	496	Sand and gravel, pumice.
Greenlee	264,204	385,755	Copper, silver, gold, lime, stone, sand and gravel, lead.
Maricopa	W	W	Sand and gravel, salt, lime, stone, clays, gold, copper, silver, lead.
Mohave	46,515	52,813	Copper, molybdenum, stone, silver, sand and gravel, zinc, gold, lead.
Navajo	3,294	2,942	Sand and gravel.
Pima	595,005	914,846	Copper, molybdenum, cement, silver, sand and gravel, stone, gold, lead, clays, zinc, tungsten.
Pinal	393,127	589,683	Copper, molybdenum, silver, gold, stone, sand and gravel, lime, gypsum, perlite, lead, pyrites, zinc.
Santa Cruz	1,457	W	Sand and gravel, tungsten.
Yavapai	148,293	199,699	Copper, cement, molybdenum, lime, stone, silver, sand and gravel, gold, gypsum, clays, lead.
Yuma	W	W	Sand and gravel, stone, lead, silver, copper, gold, zinc.
Undistributed[1]	54,144	57,323	
Total	[2]1,704,628	2,490,481	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."
[1]Includes value of nonfuel mineral production that cannot be assigned to specific counties, gem stones, and values indicated by symbol W.
[2]Data do not add to total shown because of independent rounding.

Table 3.—Indicators of Arizona business activity

		1979	1980[p]	Change, percent
Employment and labor force, annual average:				
Total civilian labor force	thousands	1,052.0	1,126.0	+7.0
Unemployment	do	53.0	75.0	+41.5
Employment (nonagricultural):				
Mining[1]	do	21.8	20.4	-6.4
Manufacturing	do	144.1	152.6	+5.9
Contract construction	do	86.5	75.2	-13.1
Transportation and public utilities	do	48.8	50.2	+2.9
Wholesale and retail trade	do	233.4	240.6	+3.1
Finance, insurance, real estate	do	55.6	57.4	+3.2
Services	do	193.5	205.1	+6.0
Government	do	196.2	201.6	+2.8
Total nonagricultural employment[1]	do	979.9	[2]1,003.3	+2.4
Personal income:				
Total	millions	$20,674	$23,521.0	+13.8
Per capita		$8,438	$8,649.0	+2.5
Construction activity:				
Number of private and public residential units authorized		53,752	36,619	-31.9
Value of nonresidential construction	millions	$718.9	$733.6	+2.0
Value of State road contract awards	do	$130.0	$117.0	-10.0
Shipments of portland cement to and within the State	thousand short tons	1,808	1,457	-19.4
Nonfuel mineral production value:				
Total crude mineral value	millions	$2,490.5	$2,425.7	-2.6
Value per capita, resident population		$1,017	$892	-12.3
Value per square mile		$21,864	$21,295	-2.6

[p]Preliminary.
[1]Includes bituminous coal and oil and gas extraction.
[2]Data do not add to total shown because of independent rounding.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

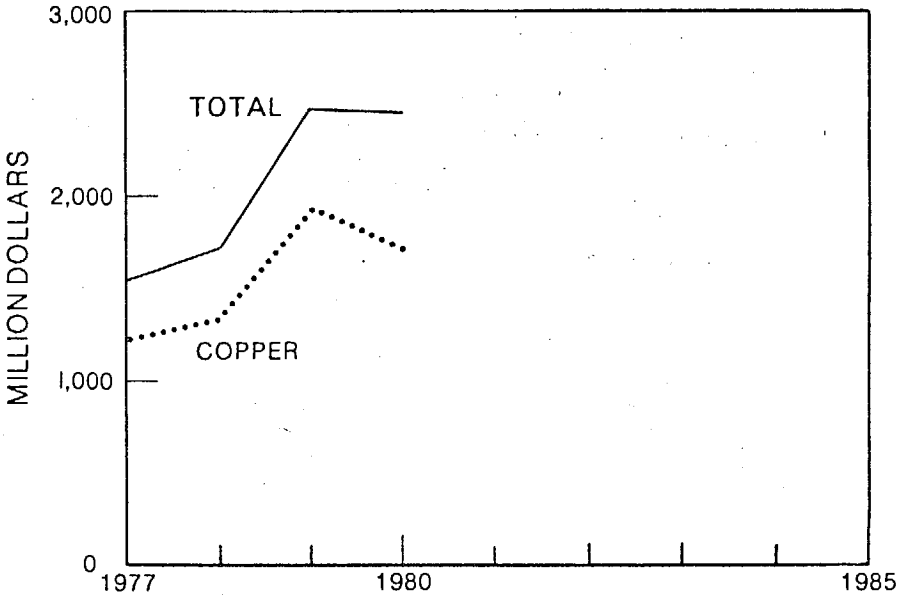


Figure 1.—Value of mine production of copper and total value of nonfuel mineral production in Arizona.

Metal production declined to about $2.2 billion in 1980, about 91.3% of the total value of nonfuel mineral production in the State. Although the value of copper production in the State dropped because of the copper strike, the dramatic increase in the prices of molybdenum, silver, and gold, and to a lesser extent copper, kept the total value of nonfuel mineral production high.

According to value of production, portland cement, sand and gravel, lime, and crushed stone were the leading commodities in the nonmetals group in 1980. Lime and asbestos declined in value of output.

Trends and Developments.—Speculation in the commodities markets significantly affected the rise in copper and precious metals prices to record levels in the first quarter of 1980. However, prices of these metals dropped severely by the second quarter, recovered somewhat in the third quarter during the copper strike, then weakened again in the last quarter. The copper strike, the depressed automobile and housing markets, and reduced demand for the high-priced metals in jewelry, electronic, and photographic industries contributed to the decline in copper, gold, and silver production even though the overall prices were higher than those of 1979.

The steady increase in the demand for molybdenum, leading to rising prices from 1974 to 1979, prompted large investments in exploration as well as the reevaluation of older properties with potential for molybdenum production. During 1980, the demand for molybdenum declined, allowing producers time to rebuild inventories. In 1980, a number of Arizona copper operations installed new molybdenum flotation circuits or reactivated existing circuits in their concentrators, thus accounting for the increased production of molybdenum in the State.

Improvements to increase productivity were noted at copper operations. To achieve higher recovery and more fuel and maintenance efficiency, at least four companies substituted 1,000-cubic-foot cells for smaller cells in concentrator flotation circuits.

Exploration for new ore bodies and reopening of old properties, stimulated by the high prices of metals at the beginning of the year, were not immediately diminished by weakened prices at yearend. Ranchers Exploration and Development Corp. drilled claims leased from Albert C. Harding and

.eith Pike near Pleasant in the Hieroglyph- : Mountains 30 miles north of Phoenix. Of he 39 holes drilled from mid-June 1980 to earend, 34 reportedly showed evidence of nineralization. The property is held by Ranchers Gold and Exploration-1980, a imited partnership in which Ranchers as eneral partner and manager owns 60% of he operation. Activities stimulated by the igher metal prices included leaching oper- tions at old gold properties such as the ilver Cross Mine north of Cave Creek in Maricopa County and the Harquahala Mine n Yuma County. Higher prices also encour- ged exploration and prospecting at the Black Diamond Mine on the east slope of he Dragoon Mountains in Cochise County, n the Oatman area in Mohave County, in he Trigo Mountains near Yuma, where New Jersey Zinc Exploration Co., a subsid- ary of Gulf + Western Industries, Inc., nvestigated silver deposits in the Silver- Eureka mining district, and at Bisbee, where Phelps Dodge Corp. explored aban- doned mines. In the Martinez mining dis- rict in Yavapai County, the old Congress Mine was reopened by Congress Consolidat- d Gold Mining Co. Renamed the Gunsling- r, the old McCracken Mine near Kingman n Mohave County was reopened by Canadi- n Natural Resources, Ltd., and by the Fisher-Watt Mining Co. In the Tombstone rea, activity included exploration drilling y Occidental Minerals Co., exploration in he Gambasino Dream Mine and the Nicho- s Mine by Silver Ridge Mining Co., a ubsidiary of Houston Mining and Re- ources, Inc., and heap leaching for silver ear the old underground Contention Mine wned by the Escapule family.[2]

Legislation and Government Pro- rams.—An important piece of legislation elevant to every facet of life in Arizona, ncluding the mining industry, was passed t a special legislative session on June 4, 980. Over 2 years in preparation, the Ground Water Management Act estab- ished a Department of Water Resources nd designated water basins, subbasins, and rrigation nonexpansion areas. Agriculture, which uses 90% of the water, was expected o be most affected by the new act, which provided for planned withdrawal and re- harging of the water basins in Arizona. Arizona's mining industries use less than % of the State's water.

In 1980, the Arizona Legislature passed he controversial "Sagebrush Rebellion" ill which would allow the State to claim ost of the public domain managed by the U.S. Department of the Interior's Bureau of Land Management (BLM) in the State. Proponents of the bill felt implementing the multiple-use concept in land management by Federal agencies had slowed to unacceptable levels. The BLM administers 12.5 million acres in Arizona. Military and Indian Reservations, national parks, monuments, wildlife, and other sanctuaries would not be included in the proposed transfer of lands to the State. Governor Bruce Babbit's veto of the bill on April 8 was overriden on April 18. Arizona was the fifth State to pass "Sagebrush Rebellion" legislation. The legislature also appropriated $60,000 to join Nevada in a lawsuit challenging the Federal Government's right to control the land.

Some recent activities of BLM are based on a 1976 Federal Land Policy and Management Act which required the agency to make recommendations to Congress for lands to be designated as wilderness areas. The "initial inventory" took place between October 1978 and September 1979, and 54% of the Arizona land inventoried was identified as nonwilderness. The "intensive inventory," which included examining the areas identified as wilderness, occurred between September 1979 and November 1980. The inventory decision report was published in November 1980.[3] In this intensive inventory phase, the lands were examined to determine whether they would have the wilderness qualities the Congress required. In a third phase, from November 1980 to October 1991, lands established as Wilderness Study Areas were to be studied to determine the effect of a wilderness designation; the U.S. Geological Survey and the Bureau of Mines were to assess the mineral resources in the proposed wilderness areas. Lands designated primitive or natural areas before November 1975 were called instant-study areas, and BLM made recommendations to the President as to their suitability in 1980. Instant-study areas in Arizona were Aravaipa Canyon Primitive Area (Safford District), Paiute Primitive Area, Paria Canyon Primitive Area, Vermilion Cliffs Natural Area, Big Sage Natural Area, and the Turbinella-Gambel Oak Natural Area (Arizona Strip District).

In 1980, the BLM Wilderness Study Areas under investigation by the Bureau of Mines included Crossman Peak, Lime Hills, Narrows, Pigeon Canyon, Sand Cove, and Snap Point—a total of 212,700 acres in Mohave County; and the Gila-San Francisco Area—a total of 46,000 acres in Graham and Greenlee Counties.

The Forest Service Wilderness Areas under study by the Bureau of Mines in 1980 included Mazatzal (205,346 acres) in Gila, Maricopa, and Yavapai Counties; Pusch Ridge (56,430 acres) in Pima County; Superstition (124,140 acres) and Superstition Wilderness addition (20,500 acres) in Gila, Maricopa, and Pinal Counties.

In 1980, the second Forest Service Roadless Area Review and Evaluation (RARE II) Further Planning Areas under study by the Bureau of Mines included the following: Bunk Robinson Peak (15,850 acres) and Whitmire Canyon (12,740 acres) in Cochise County, Ariz., both with additional acreage in Hidalgo County, N. Mex.; the Dragoon Mountains (32,820 acres), North End (23,550 acres) area, and Winchester (14,100 acres) area in Cochise County; Whetstone (36,610 acres) in Cochise and Pima Counties; Kanab Creek (9,008 acres) in Coconino and Mohave Counties; Fossil Springs (14,090 acres) in Coconino, Gila, and Yavapai Counties; Rattlesnake (32,870 acres), West Clear Creek (31,850 acres), and Wet Beaver (9,890 acres) in Coconino and Yavapai Counties; Strawberry Crater North (1,790 acres) and South (8,050 acres) in Coconino Counties; Mazatzal Wilderness Contiguous (83,700 acres) in Gila, Maricopa, and Yavapai Counties; Arnold Mesa (28,320 acres) in Yavapai County; Hell's Gate (30,400 acres) in Gila County; and Hell's Hole (34,330 acres) in Greenlee County, Ariz., and additional acreage in Catron County, N. Mex. A total of 419,968 acres is included in the Arizona RARE II study further planning areas.

In 1980, four Government publications became available on the following:[4] The mineral resource potential of the Paiute Instant (Primitive) Study Area; a map of mines and prospects of the Paiute Primitive Area, Mohave County, Ariz.; a report on the Turbinella-Gambel Oak Instant Study Area; and a preliminary report on the mineral resource potential of the Vermilion Cliffs-Paria Canyon Instant Study Area, Coconino County, Ariz., and Kane County, Utah.

From January 1 to December 31, 1980, the Bureau of Mines awarded $1,624,953 in new research contracts and grants and modified existing contracts to the State of Arizona, the Univeristy of Arizona, and seven private companies. The projects covered such subjects as underground rescue and emergency programs, maintenance service, impact rock breakers, inventory of mine waste embankments, surface and underground openings, planning for optimized mining land use, utilizing water harvesting, a borehole mining tool, impact of mining on ground water, and in situ leaching of metallic ores.

Under the Surface Mining Control and Reclamation Act of 1977, the Arizona Mining and Mineral Resources and Research Institute received a $302,492 research grant in 1980 from the Office of Surface Mining.

REVIEW BY NONFUEL MINERAL COMMODITIES

METALS

Beryllium.—Brush Wellman, Inc., opened a new plant in Tucson to manufacture high-quality beryllia ceramic from beryllium oxide powder supplied by its Elmore, Ohio, facility for use as a substrate by the electronics industry.

Copper.—Because of the copper strike, which lasted as long as 5 months at some operations, tons of copper produced in the State dropped almost 20%. Value of production declined 11.8% owing to the higher prices paid for copper during the year; the 1979 average price was $0.92 per pound versus $1.01 per pound in 1980. Riding on speculation in gold and silver, the price of copper ranged from $1.43 per pound in mid-February 1980 to $0.85 in December. Although the copper strike effected a decline in production, the depressed auto and construction industries also contributed to the slower-than-expected recovery of the copper market after the strike.

Table 4.—Arizona: Production and value of copper in Arizona and the United States

Year	Arizona copper production		U.S. copper production		Arizona
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)	Percent of U.S. copper production
1976	929,339	$1,425,994	1,456,561	$2,234,975	63.8
1977	838,038	1,234,168	1,364,374	2,009,297	61.4
1978	891,405	1,306,866	1,357,586	1,990,323	65.7
1979	946,002	1,940,211	r1,443,556	2,960,676	65.5
1980	757,314	1,709,997	1,168,311	2,638,020	64.8

rRevised.

Table 5.—Arizona: Fifteen leading copper-producing mines in 1980, in order of output

Rank in 1980	Rank in 1979	Mine	County	Operator	Source of copper in 1980
1	r1	Morenci	Greenlee	Phelps Dodge Corp	Copper ore and precipitates.
2	4	Sierrita	Pima	Duval Corp	Copper ore.
3	2	Twin Buttes	do	Anamax Mining Co	Do.
4	r5	Ray Pit	Pinal	Kennecott Copper Corp	Copper ore and precipitates.
5	r3	San Manuel	do	Magma Copper Co	Copper ore and tailings.
6	r7	Bagdad	Yavapai	Cyprus Bagdad Copper Co	Copper ore.
7	r6	Pinto Valley	Gila	Cities Service Co	Copper ore and precipitates.
8	r10	Inspiration	do	Inspiration Consolidated Copper Co.	Do.
9		Eisenhower	Pima	Eisenhower Mining Co	Copper ore.
10		Pima	do	Cyprus Pima Mining Co	Do.
11	r9	New Cornelia	do	Phelps Dodge Corp	Do.
12	15	Esperanza	do	Duval Corp	Copper ore and precipitates.
13	r11	Magma	Pinal	Magma Copper Co	Copper ore.
14	8	Metcalf	Greenlee	Phelps Dodge Corp	Copper ore and precipitates.
15	r14	Sacaton Unit	Pinal	ASARCO Incorporated	Copper ore.
	r12	Mission	Pima	do	Do.
	r13	Silver Bell	do	do	Copper ore and precipitates.

rRevised.

Table 6.—Arizona: Material handled and copper produced at 15 leading copper open pit and underground mines

Mine	Ore mined (thousand metric tons)		Waste material removed (excluding material placed in leach dumps) (thousand metric tons)		Material placed in leach dumps (thousand metric tons)		Total copper produced[1] (metric tons)	
	1979	1980	1979	1980	1979	1980	1979	1980
OPEN PIT								
Morenci	19,690	16,051	17,551	11,832	8,885	14,983	101,091	120,659
Sierrita	30,312	32,086	33,384	35,612	--	--	91,657	93,666
Twin Buttes	12,620	10,006	35,347	29,209	1,739	2,020	101,930	84,283
Ray	12,883	10,142	--	--	35,107	29,946	93,160	76,360
Bagdad	13,239	13,771	21,972	19,712	1,253	863	52,960	58,024
Pinto Valley	15,634	10,037	--	--	27,470	16,299	64,348	42,416
Inspiration	5,498	3,795	9,677	NA	8,782	NA	r36,991	32,779
Eisenhower	NA	6,602	NA	17,109	NA	--	NA	30,867
Pima	W	6,630	NA	47,343	NA	--	W	26,821
New Cornelia	9,230	6,388	9,481	8,126	--	--	39,615	26,224
Esperanza	4,445	5,504	--	1,470	--	2,715	11,373	21,782
Metcalf	8,369	2,193	12,222	3,622	7,066	3,284	40,300	15,914
Sacaton Unit	3,634	3,465	11,215	7,668	--	--	19,384	14,603
Mission	4,370	W	3,329	W	--	--	25,422	W
UNDERGROUND								
San Manuel	19,803	12,522	135	20	--	--	111,307	72,696
Superior (Magma)	883	505	82	93	--	--	37,334	21,886

rRevised. NA Not available. W Withheld to avoid disclosing company proprietary data.
[1]Gross metal content.

Table 7.—Arizona: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by county

County	Lode mines producing[1]	Material sold or treated (metric tons)	Gold		Silver	
			Troy ounces	Value	Troy ounces	Value
1978, total	30	163,198,046	92,989	$17,998,020	6,637,838	$35,844,325
1979, total	42	185,485,876	101,840	31,315,805	7,478,942	82,941,467
1980:						
Gila	8	18,927,386	(2)	(2)	(2)	(2)
Pima	10	69,408,261	(2)	(2)	3,183,033	65,697,801
Pinal	5	26,875,415	30,947	18,956,894	1,093,799	22,576,012
Undistributed[3]	11	39,084,245	41,826	25,620,936	1,390,983	28,709,889
Total	34	154,295,307	72,773	44,577,830	5,667,815	116,983,702

	Copper		Lead		Zinc		Total value
	Metric tons	Value	Metric tons	Value	Metric tons	Value	
1978, total	891,404	$1,306,865,541	416	$309,129	W	W	$1,282,294,796
1979, total	946,002	1,940,211,347	354	410,996	W	W	W
1980:							
Gila	91,501	206,606,856	--	--	--	--	210,803,215
Pima	282,748	638,438,427	(2)	(2)	W	W	W
Pinal	177,470	400,723,422	--	--	W	W	W
Undistributed[3]	205,595	464,227,857	401	375,180	W	W	W
Total	757,314	1,709,996,562	401	375,180	W	W	W

W Withheld to avoid disclosing company proprietary data.
[1]Operations at miscellaneous cleanups not counted as mines.
[2]Included in "Undistributed."
[3]Includes Cochise, Greenlee, Maricopa, Mohave, Yavapai, and Yuma Counties and items indicated by footnote 2 combined to avoid disclosing company proprietary data.

Table 8.—Arizona: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1980, by class of ore or other source material

Source	Number of mines	Material sold or treated (metric tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)
Lode ore:							
Gold	1	45,359	1,000	500	--	--	--
Silver	3	3,217	97	20,980	--	--	--
Copper	27	153,905,834	71,533	5,640,703	690,307	325	W
Lead	3	1,764	--	1,485	--	35	--
Total	34	153,956,174	72,630	5,663,668	690,307	360	W
Other lode material:							
Gold-silver tailings and copper tailings[1]	2	[2]226,525	143	4,147	1,741	40	--
Copper precipitates	8	112,608	--	--	65,266	--	--
Total	10	339,133	143	4,147	67,007	40	--
Grand total	44	154,295,307	72,773	5,667,815	757,314	[3]401	W

W Withheld to avoid disclosing company proprietary data.
[1]Combined to avoid disclosing company confidential data.
[2]Excludes newly generated tailings.
[3]Data do not add to total shown because of independent rounding.

Table 9.—Arizona: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1980, by type of material processed and method of recovery

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)
Lode:					
Cyanidation	1,000	500	--	--	--
Acid leaching (vat, tank, heap)[1]	--	--	85,101	--	--
Smelting of concentrates	71,447	5,636,733	604,823	349	W
Direct smelting of:					
Ore	183	26,435	383	11	--
Precipitates	--	--	65,266	--	--
Tailings	143	4,147	1,741	40	--
Total[2]	326	30,582	67,389	52	
Grand total[2]	72,773	5,667,815	757,314	401	W

W Withheld to avoid disclosing company proprietary data.
[1]Includes copper recovered by electrowinning process.
[2]Data may not add to totals shown because of independent rounding.

The Anamax Mining Co., under an equal partnership between AMAX Inc., and The Anaconda Company (a subsidiary of the Atlantic Richfield Co.), operated the Twin Buttes mine-mill and hydrometallurgical complex about 25 miles south of Tucson, Pima County. Twin Buttes has an annual design capacity of 90,000 tons of copper contained in concentrates from sulfide ore and approximately 36,000 tons of cathode copper from the oxide ore. The Anamax partnership includes mining and milling copper sulfide ore. Each company then purchases its share of the copper concentrate thus produced and arranges for smelting, refining, and sales. At the copper oxide operation, the partnership has responsibility through the production of electrowon cathode copper, at which point each partner purchases its share of copper and is responsible for its own sales. In 1980, most of the AMAX copper concentrates were sold to Nippon Mining Co., Ltd., of Japan.

The AMAX 1980 annual report noted that the Twin Buttes Mine (including the AMAX share of the adjacent Eisenhower Mining property) has estimated reserves of 211 million tons of sulfide ore with an average grade of 0.65% copper and 20 million tons of oxide ore with an average grade of 0.96% copper. In 1980, AMAX reported copper production declined, partly because of the strike, which lasted from July 31 to October 24, and partly because of a lower grade of sulfide ore from the Eisenhower Mining Co. The sulfide ore grade dropped from 0.94% to 0.82% in 1980.

On November 3, 1980, pursuant to a consent order between the Federal Trade Commission and the Atlantic Richfield Co., The Anaconda Copper Co. offered for sale its 50% interest in the Anamax Mining Co. Anaconda has until 1984 to complete the transaction.

Anamax completed the new tailings dam and water reclamation system in 1980 and began reclaiming a significant amount of the sulfide-mill water requirements. The company was also actively seeking new sources of water. Ground water management legislation passed in the State in 1980, the company reported, would allow the firm

sufficient water to meet future requirements; however, the constitutionality of that legislation was challenged. The Papago Indian Tribe and the U.S. Government, in 1975, brought action in the courts against Anamax Mining Co. and others for withdrawing surface and underground water from the Santa Cruz River Basin. In 1980, an amended complaint added 1,750 defendants. The Tribe claims the prior right to such water as necessary for use on the San Xavier Indian Reservation.

ASARCO Incorporated owns and operates the Mission and San Xavier open pit mines near Sahuarita, Pima County, about 15 miles south of Tucson; the Silver Bell open pit mine at Silver Bell, Pima County, 38 miles northwest of Tucson; and the Sacaton open pit mine, some 5 miles northwest of Casa Grande, Pinal County. The company also owns and operates the Hayden smelter at Hayden, Pinal County. Ores are processed through concentrators at each of the mines.

The 1980 Asarco annual report listed reserves at its properties as of December 31, 1980, as follows: San Xavier, 165,805,000 short tons of ore with an average of 0.52% copper per ton and 0.06 ounce of silver; Mission, 94,003,000 short tons with an average of 0.76% copper and 0.14 ounce of silver; and Sacaton, 26,055,000 short tons with an average of 1% copper.

Asarco's Mission, San Xavier, Silver Bell, and Hayden operations were closed by the copper strike, which lasted from July 1 to November 24. The company had about 1,500 employees at the involved Arizona properties. The Sacaton property, which was not unionized, continued to operate.

During the year, Asarco replaced the Mission Mine truck fleet with new 170-ton ore-haulage trucks, which were expected to consume 12 1/2% less fuel per ton of ore. Maintenance shops were expanded to accommodate these large vehicles. In addition, the larger flotation cells installed in the concentrator were expected to achieve a 25% savings in power costs, reduce maintenance and labor costs, and to increase copper recovery.

According to the Asarco 1980 annual report, work at the Sacaton property proceeded in sinking two shafts for development of an underground ore body near the present open pit mine. By yearend, the 20-foot-diameter production shaft had advanced to a depth of 1,500 feet, and the 14-foot-diameter ventilation shaft was sunk to a depth of 130 feet. Completion of the shafts and the start of underground development work were expected in 1981, and production would begin about 1984 when the present 11,000-ton-per-day open pit operation will be phased down. Planned for production at 7,000 short tons per day, the new underground mine is expected to have 1.25% copper ore.

At the Hayden copper smelter, the secondary exhaust hoods installed on the converter furnaces greatly improved operations and reduced the emission of sulfur dioxide to lower levels. The installation also improved working conditions and air-quality controls and effected higher operating rates. Begun in November 1978, the project was completed by mid-1980 at a cost of $4 million.

During the year, Asarco negotiated with the Environmental Protection Agency (EPA) on a proposal to modernize the Hayden smelter with the installation of a flash smelter. EPA, copper producers, and the State of Arizona disagreed as to methods of emission control for Arizona smelters. EPA favored a constant emission rate, whereas copper producers and the State favored multipoint roll-back systems which allow fluctuations in the emission rate based on weather conditions, variances among smelters, and the concentrates they produce. Completion of the negotiations was expected in 1981.

Retention of water rights and compliance with air pollution standards continued to be problems during the year. The new Ground Water Code was expected to allow Asarco operations to continue in the Santa Cruz Valley, subject only to any accrued claims for damages to various concerns such as farm organizations and the City of Tucson that have instituted suits against mining companies in the area. Asarco also uses the San Pedro River Watershed to supply its water needs at its Hayden smelter. Mining companies and other water users have had their rights to those waters challenged by the Gila River Indian Community. In 1980, the matter was ordered to the State courts.

Under a general partnership known as the Eisenhower Mining Co., Anamax Mining Co. and Asarco, are developing, mining, and concentrating the ores of the Palo Verde copper deposit about 15 miles south of Tucson, Pima County. The Palo Verde Mine is north of the Twin Buttes Mine, between Asarco's Mission and San Xavier Mines. Although Asarco operates the mine,

ores from each partner's interest in the Eisenhower property are processed into concentrates either at Asarco's Mission mill or at the Anamax Twin Buttes mill. Anamax has crushing facilities near the Palo Verde property and a 6.5-mile conveyor system to transport its ore to its Twin Buttes mill.

According to the 1980 AMAX Securities and Exchange Commission (SEC) Form 10K annual report (10K Report), Anamax processed 4 million tons of ore from the Eisenhower Mining Co. and recovered 22,382 tons of copper in concentrate. Asarco, in its 1980 annual report, recorded the recovery of 11,600 tons of copper as its share from the Eisenhower property, down from the 12,100 tons recovered in 1979. (Particulars of the company arrangements in the partnership are detailed in the 1978-79 Minerals Yearbook.[5] Production in 1980 declined when the Eisenhower Mine was shut down from July 1 to November 24 because of the copper industry strike.

According to the Asarco 1980 annual report, the total reserves of the partnership as of December 31, 1980, were an estimated 147,002,900 tons containing 0.12 ounce per ton of silver and 0.64% copper. Asarco ascertained its portion to be 38,148,000 tons of ore containing an average of 0.72% copper and 0.14 ounce per ton of silver.

The Cities Service Co. Miami Copper Operations in Gila County consist of the Pinto Valley open pit mine and a 50,000-short-ton-per-day concentrator located 6 miles west of Miami, plus a solvent extraction-electrowinning plant that processes leach waters from the old Miami copper mine at Miami. The latter plant recovers 11 million pounds of copper per year.

During the year, Cities Service was constructing a solvent extraction-electrowinning plant at the Pinto Valley site, scheduled for completion in July 1981. Site preparation began in May, and in July construction commenced on the $26 million facility. Three waste dumps with a surface of about 71 acres will be leached by the distribution of 6,600 gallons per minute of leach solution. The collection and distribution system will include three pump stations, 4.25 miles of pipeline to the dumps, about 16 miles of spray lines over the area, and three 3,000-gallon-per-minute pumps to return the solution 1 mile to the solvent extraction-electrowinning plant. Designed to treat up to 6,000 pounds of solution per minute, the new plant is expected to recover 10 to 11 million pounds of electrolytic-grade copper per year.

Cities Service also continued work on the Miami East project revived in 1979. A drilling program in the late 1960's discovered a deep-lying ore body; to determine the size and grade of the ore body, the old Miami Copper No. 5 shaft was deepened to 3,500 feet, and extensive drifting was carried out laterally on the 2,900- and 3,300-foot levels into the ore zones. In 1974, the No. 11 ventilation shaft was put down to 2,900 feet, and by October 1975 a connection was made to the No. 5 shaft. A second shaft was down 2,010 feet when development was terminated on the entire Miami East project in October 1975, because of a severe drop in copper prices. With higher metal prices, work was resumed in 1979, and the mine is scheduled to come onstream in 1982.

According to the Cities Service 1980 annual report, reserves in the Pinto Valley open pit mine and the underground mine were estimated to be 419.4 million tons with an average grade of 0.449% copper. Byproducts of copper production included molybdenum, gold, silver, and turquoise.

Cyprus Mines Corp., acquired by Standard Oil Co. (Indiana) in 1979, became an operating subsidiary of Amoco Minerals Co. (also a subsidiary of Standard) in 1980. During the year, Cyprus operated the Cyprus Bagdad, Cyprus Pima, and Cyprus Johnson open pit mines and the Cyprus metallurgical process demonstration plant. Although many copper operations in the State were closed during the copper strike, the nonunionized Cyprus mines maintained a normal production schedule.

The Cyprus Bagdad complex, 120 miles northwest of Phoenix in Yavapai County, consists of the open pit Cyprus Bagdad Mine, a 40,000-ton-per-day sulfide concentrator, and a dump-leaching, solvent extraction-electrowinning operation. In 1980, the company employed 817 people including 390 at the mine, 186 at the mill, and 30 at the solvent-extraction plant.

According to Niemi,[6] the $220 million expansion completed in 1977 included an in-pit primary crusher and a 6,400-foot-long conveyor system for transporting the crushed ore over a 1,020-foot rise to a 55,000-short-ton, live-ore stockpile above the concentrator. The three 32-foot-diameter primary autogenous grinding mills that were installed in the concentrator were the largest in use in the Southwest. Tailings flow through a 5,000-foot-long pipeline to a 240-acre pond where water is reclaimed for mill use. Fresh water is obtained 30 miles northwest of Bagdad in the Big Sandy Valley near Wikieup. The solvent-extraction operation recovers 40,000 pounds per day of pure copper cathode from solutions pumped over the approximately 100 million short tons of oxide ore stockpile.

Cyprus Bagdad initiated an expansion program during the year to increase copper production about 30%, to approximately 85,000 short tons per year by 1982.

Niemi also reported that reserves, as of 1980, were over 300 million short tons of sulfide ore averaging 0.49% copper, 0.014% molybdenum, and trace silver, plus approximately 38 million short tons of overlying oxide ore with an acid-soluble copper content of about 0.35%. An additional 100 million short tons of oxide ore with an acid-soluble content of about 0.19% have been stockpiled from previous mining operations.

In response to EPA charges of contamination of tributaries of Burro Creek in 1980, Cyprus Bagdad hired hydrologic consultants to study the discharge problem.

The Cyprus Pima Mine of Cyprus Pima Mining Co.—owned 50.01% by Cyprus Mines Corp., 24.99% by Utah International (a division of General Electric), and 25% by Union Oil—is about 16 miles south of Tucson. Late in 1980, the company rehabilitated some of its shutdown mill facilities to increase the concentrator capacity from 18,000 to 32,500 tons of ore per day.

Duval Corp., a subsidiary of Pennzoil, Co., operated the Sierrita and Esperanza open pit copper-molybdenum mines 32 miles south of Tucson, Pima County. The company's Mineral Park open pit copper-molybdenum mine in Mohave County is 15 miles northwest of Kingman. At each mine, the ores are processed through concentrators for producing copper and molybdenum concentrates. The design capacity of the Sierrita concentrator is 82,500 short tons per day; the Esperanza concentrator has a daily capacity of 15,000 short tons; and the Mineral Park concentrator has a capacity of 19,000 short tons per day. At Esperanza and Mineral Park, copper is also recovered at leach-precipitation facilities. Products are sold as copper concentrates and precipitates, processed at Duval's Copper Leach Electrolysis and Regeneration (CLEAR) process hydrometallurgical plant, or toll smelted and refined by others for redelivery to and marketing by Duval.

According to the 1980 Pennzoil 10K Report, as of December 30, 1980, reserves were estimated to be 398,752,000 short tons of ore with an average grade of 0.3% copper and 0.035% molybdenum at Sierrita; 54,959,000 short tons of ore with an average grade of 0.27% copper and 0.033% molybdenum at Esperanza; and 43,832,000 short tons of ore with an average grade of 0.19% copper and 0.051% molybdenum at Mineral Park.

Factors stemming from the copper strikes at other companies may have contributed to the 9% increase in the total copper production from all Duval copper properties in Arizona and Nevada. The strike at Duval, begun September 30, lasted only 5 days, compared with the nearly 3-month shutdown other companies in the State sustained.

Located near the Sierrita property, Duval's pollution-free CLEAR process hydrometallurgical plant treated approximately one-fourth of Duval's copper production. Designed to produce 40,000 short tons of copper crystals per year, the plant, still being fine-tuned, was operated at about 91% capacity in 1980. With the CLEAR process, copper crystals (equivalent to high-grade blister copper) were electrolytically recovered from concentrates produced at the Esperanza and Sierrita properties and from precipitates produced at the Esperanza and Mineral Park properties. The 99.4% pure product is sold as such or processed by conventional toll-electrolytic copper refineries for redelivery and marketing by Duval. Recovered as a byproduct of copper purification, iron and sulfur are prepared at the plant for a fertilizer.

Late in the year, Duval purchased, for $1,000 an acre, approximately 6,284 acres of State land adjacent to its Sierrita-Esperanza properties in Pima County, and another 586 acres at its Mineral Park properties in Mohave County. The company had leased the properties since the mid-1960's for tailings ponds and waste dumps. Duval made a $1.3 million downpayment, 20% of the total purchase price; the rest would be paid over 25 years at 10.5% annual interest. The State retained oil and mineral rights to the land, and no water rights were attached to the land.

Water litigation continued in the Duval area of Pima County. Duval, as well as other mining companies and agricultural, municipal, and industrial interests, makes substantial water withdrawals from an underground aquifer in the upper Santa Cruz Basin in the county. In 1979, Duval, three

other copper mining companies, and agricultural interests reached settlement of a suit regarding the rights of the mining companies to withdraw water from the aquifer. Present claims to the water come from an earlier action (1975) in which the Papago Indian Tribe asserted prior rights to water. In 1980, Duval was added as a defendant.

An integrated natural resource company, Inspiration Consolidated Copper Co., operated the Thornton, Live Oak, Red Hill, and Joe Bush open pit copper mines at Inspiration. The company also operated the upper and lower Ox Hide open pit mine about 3 miles west of Inspiration in the Globe-Miami mining district, Gila County, and the Christmas open pit copper mine and mill about 35 miles south of Globe in the Banner mining district, Pinal County. At Inspiration, the complex includes three-stage crushing facilities, a vat leaching plant, a concentrator, a precipitation and solvent-extraction plant, electrowinning and electrorefining plants, a smelter, a sulfuric acid plant, and a continuous rod-fabricating plant. The smelter and electrorefining plant also treated outside ores on a toll basis.

Reduced production and deliveries of copper from the Inspiration area mines were due in part to the 115-day strike, which shut down the metallurgical treatment route through the smelter, and to various commissioning and startup delays after the strike. The strike idled about 1,600 workers.

Production at the Christmas open pit mine increased. At the Sanchez mine near Safford, Graham County, development remained suspended.

According to the Inspiration 1980 annual report, as of December 31, 1980, estimated reserves at the Inspiration area mines (including the Ox Hide) were 265,333,000 dry short tons at a grade of 0.55% copper; at the Christmas open pit mine, 11,613,000 dry short tons at a grade of 0.62% copper; at the inactive Christmas underground mine, 20,131,000 dry short tons at a grade of 1.78% copper; and at the Sanchez Mine, 79,362,000 dry short tons at a grade of 0.36% copper.

In late June, less than 5 months after start of construction, the company installed a $16 million patented ferric-cure leach system designed to produce leach solutions quickly and to provide high recovery rates from ores containing copper oxide minerals and chalcocite. The process is integrated with Inspiration's new $14 million solvent-extraction plant completed in October 1979. The third phase of a seven-stage $15 million modernization of the concentrator was completed. Expected results were improved recovery of copper and molybdenum in the concentrates, a reduction in energy consumption, and fewer personnel. Engineering continued on a project to bring the smelter into full compliance with the ambient air quality and sulfur dioxide emission regulations at designed plant capacity. Crushing, screening, and handling of secondary material, modernization of process control instrumentation, and modifications to one Hoboken converter are in an accelerated phase of the project. For the most part, the strike did not interrupt work by outside contractors.

Inspiration leased land on a tailings dam to a nearby town for constructing a sewage-treatment plant. The effluent was to be used for irrigating vegetation on tailings. The company is also developing a subdivision to supply quality housing for its employees and others in the area. Development costs will be recovered through land sales to builders.

Inspiration proposed a $7 million water-management system that would treat contaminated water on the site at a rate of 3,000 gallons per minute to obtain a goal of zero discharge of contaminants.

The company arranged a financing program totaling $150 million to further the modernization, expansion, and environmental control programs of its operations in Arizona. Funding will include an offering of $90 million in tax-exempt pollution-control bonds.

Ray Mines Division of Kennecott Minerals Co., a subsidiary of Kennecott Corp., operated an open pit mine, a silicate vat-leach and electrowinning plant near the mine at Ray, Pinal County, and a concentrator and smelter at Hayden, Gila County. Sulfide ore is crushed at the mine and then shipped 22 miles to the concentrator at Hayden. Copper concentrates are treated at Kennecott's Hayden smelter; the copper anodes are then shipped to the company's east coast electrolytic refinery in Maryland.

According to the Kennecott 1980 annual report, the Ray Mines Division mined, milled, and treated 11,180,000 net tons of ore in 1980 compared with 14,202,000 net tons in 1979. Copper recovered was 84,269 net tons in 1980 compared with 117,233 net tons in 1979; the average grade of ore, however, was 0.916% in 1980 compared with 0.876% in 1979. The decreased production was attributed to the copper strike.

On March 1, 1980, Ray Mines brought onstream its new copper solvent-extraction plant. Constructed within the confines of an 11-year-old silicate-ore-leaching plant in the mine area, the plant cost an estimated $10 million. Designed to treat a maximum of 108 short tons per day by upgrading the quality of the pregnant leach solutions at the silicate ore leach plant, the solvent-extraction addition was to produce a more concentrated and purified copper electrolyte for the tankhouse than the vat leach liquors formerly presented. Previously, cathode copper from the silicate plant had to be reprocessed at the Hayden smelter. This new procedure is expected to increase the company's overall production by releasing additional smelting and refining capacity for sulfide concentrates. A brief description of the plant and its construction within the highly confined area appeared in two articles.[7]

In addition to the solvent-extraction plant in 1980, a new $750,000 acid-plant drying tower was constructed to replace the existing drying tower built in 1968 and rebricked in 1973.

The San Manuel Division of Magma Copper Co., a wholly owned subsidiary of Newmont Mining Corp., operates the largest underground copper mine in the United States. The mine and plant are 43 miles north of Tucson in Pinal County. The surface plant includes a concentrator, a smelter, a refinery capable of producing 200,000 tons of copper annually, and a 120,000-ton-annual-capacity continuous-cast copper rod-mill. American Metal Market, June 7, 1980, reported that Magma produced 125,000 tons of rod in 1979, three-quarters of its total copper production. At present production levels, reserves at San Manuel are expected to last well into the next century. As of December 31, 1980, the company reported Magma's ore reserves at San Manuel totaled 325,943,000 short tons with an average grade of 0.713% copper. The Kalamazoo ore body, the downfaulted segment of the San Manuel ore body, is scheduled for production in 1983. At Kalamazoo, reserves totaled 327,410,000 short tons with an average grade of 0.719% copper.

Production at San Manuel dropped from 21,970,000 tons of ore and smelter slag milled in 1979 to 13,887,000 tons in 1980. Average grade of ore improved from 0.63% copper in 1979 to 0.65% copper in 1980. The decrease in production resulted mainly from the strike and a fire in the San Manuel Mine.

During the year, throughput at the San Manuel smelter was curtailed 9.5% to comply with air-pollution regulations. Magma employed a converter-gas collection and cooling system and a sulfuric acid plant to reduce emissions of sulfur dioxide, as well as additional supplementary control systems involving air-quality monitoring and intermittent curtailments of operations. Enforcement of 1978 EPA and 1979 Arizona sulfur dioxide emission regulations, designed to achieve compliance solely by positive engineering controls with ambient-air-quality standards, had been stayed. Up to late 1980, Magma had expended $47 million for environmentally related capital additions; 1980 costs, including loss of production during curtailments, were estimated to be between $0.10 and $0.15 per pound of refined copper produced.

Among several hundred property owners, Magma is defendant in a legal action brought by the Gila River Indian Community for adjudication of its rights to the waters of the San Pedro watershed. The tribe claims prior rights to the surface and subsurface flow of the San Pedro River and its tributaries, and to ground waters of the San Pedro River and ground waters under the Gila River Reservation. At San Manuel, Magma obtains its industrial and potable water from dewatering its underground mine and from deep wells.

The high cost of energy prompted the company to study new means to reduce energy consumption at the San Manuel concentrator. In 1980, the development and installation of an angular spiraling system in the ball mill circuit contributed to a 16.7% decrease in ball mill energy consumption from 7.02 to 5.85 kilowatt-hours per dry ton, accounting for a $900,000-per-year reduction in operating cost to the concentrator division.[8]

The Bureau of Mines described batch-scale tests on a sample of porphyry copper mill tailings as part of a study to determine the feasibility of rutile recovery from this source. San Manuel samples contain 0.75% titania.[9] Another item appeared that briefly discussed the possibility of using such U.S. porphyry copper deposits as Bagdad, Bingham, and San Manuel as sources of rutile.[10]

The Superior Division of Magma Copper Co. operates an underground mine and a concentrator at Superior, Pinal County, 60

iles east of Phoenix. Ore concentrates are eated at the San Manuel smelter and efinery. According to the Newmont 1980 nnual report, the Superior Division milled 69,800 tons of ore at an average grade of .32% copper in 1980, compared with 64,000 tons at 4.41% copper in 1979. The opper strike, which lasted 4 months, and a re in December, which shut down operations for a week, resulted in a 41% decrease in production at the Magma Superior Mine. Ore reserves at Superior were an estimated 6,019,000 tons of 5.5% copper at he end of 1980.

The Lakeshore Mine, on the Papago Indian Reservation 28 miles southwest of Casa Grande, Pinal County, was operated by Noranda Exploration Co., Inc., a wholly owned subsidiary of Noranda Mines, Ltd., of Toronto, Canada. On October 31, 1978, Hecla Mining Co. and El Paso Natural Gas erminated their lease agreement and turned the Lakeshore back to the Papagos. In 1979, Noranda acquired the property from he Papago Indian Tribe and commenced a program of mine and plant rehabilitation.

Production from the oxide portion of the mine was resumed the fourth quarter of 1980. The ore was block-caved at 4,000 short tons per day, then vat-leached for the electrowinning plant at 2,000 short tons per day; the remainder was stockpiled.[11] Only partial production of the expected 6,000 short tons per day was achieved because of he 3 1/2-month copper strike which reduced the supply of sulfuric acid from the smelters. About 300 tons per day of sulfuric acid was required for the full operation of the vat-leach plant, and low-cost acid from in-State smelters was not available.[12] Copper cathode produced at the existing facilities was low grade; however, to improve the quality, Noranda was constructing a $7 million solvent-extraction plant with completion scheduled for mid-1981. The new solvent-extraction plant will be placed in the circuit between the vat-leaching and electrowinning facilities.

Mining the sulfide ore body and rehabilitating the concentrator will be reassessed in 1981. Production from this ore body would depend on improved economic conditions and higher copper prices.

Phelps Dodge Corp. ranked second in the State in total production of copper. The company owns and operates the Morenci and Metcalf open pit mines in Greenlee County, 169 miles northeast of Tucson, and the New Cornelia open pit mine at Ajo, Pima County, 130 miles west of Tucson. At each mine site, the copper ores are processed through concentrators. In addition, at the Morenci, Metcalf, and the closed Bisbee mines, certain low-grade copper materials are leached and copper recovered at precipitate plants. The concentrates and precipitate copper are then treated at one of the Phelps Dodge smelters at Douglas, Ajo, or Morenci. On a contract basis, these smelters also treated concentrates for others, including Cyprus Bagdad and Cyprus Pima.

In 1980, according to the company annual report, 176,500 short tons of copper in ores, concentrates, and precipitates was recovered from the Morenci, Metcalf, New Cornelia, and Bisbee properties, compared with 242,300 short tons in 1979.

The decrease in copper production at the Phelps Dodge Arizona properties was primarily attributed to the 100-day strike, and to the reduction in operating schedules at the Morenci and Metcalf mines and concentrators. Beginning in May and continuing through the year, Morenci and Metcalf operated on a 5-day workweek instead of the normal 6-day schedule. The company reported that settlement of the strike would increase hourly costs by almost 3-1/2% a year for the next 3 years in addition to quarterly wage adjustments tied to changes in the Consumer Price Index.

Because of weakened copper demand, lower copper prices, and higher operating costs, plans were being implemented late in December to place the Metcalf Mine on standby and to supply the Morenci and Metcalf concentrators with ore from the Morenci Mine. The procedure was expected to lower unit costs by lowering the overall waste ratio and by delivering a slightly higher grade of ore to the concentrators. In a program to improve recovery at the Morenci concentrator, the company replaced about half of the older 66-cubic-foot primary flotation cells with 1,000-cubic-foot cells; the remainder will be replaced in 1981.

At Ajo, preparations were made to expand the pit to extend the life of the New Cornelia Mine. In 1980, the company purchased employee-owned homes on Phelps Dodge property in the affected area, and arrangements were made for resettlement of the occupants. By yearend, site preparation was underway for relocating the mining engineering office and the locomotive-maintenance shop and for constructing a new office, change-room building, and mine garage. In early February 1980, construction commenced on a new $3 million byproduct molybdenum concentrator with a design capacity of 600 tons per day of copper concentrate; completed in early November, the plant was operated initially at 450 tons per day.

The company continued developing its low-grade sulfide copper deposit at Safford, Graham County. About $73 million (exclusive of $11.7 million of related capitalized interest) had been invested in the property since 1969, including $7.7 million during 1980; $6.1 million was spent in 1979. No date has been set for bringing this property into production. Although the Copper Basin property southwest of Prescott remained inactive, land-exchange preparations were underway.

During the year, Phelps Dodge developed a program to invest over $100 million in additional pollution controls at its Morenci and Ajo smelters. The equipment would be installed to meet current Federal and State environmental standards. The company, however, predicted that unless present Federal environmental laws were eased or the economics of such installations improved, the Douglas smelter would be closed in 1987. EPA proposed that a sulfuric acid plant should be constructed at the Douglas smelter. Concerning Ajo, the company said that before deciding to close that smelter rather than carry out further air-quality-control measures, various alternatives would be evaluated to determine an economically preferable way of handling production (such as the sale or toll smelting of concentrates). No major expenditures for bringing the Ajo smelter into compliance with Clean Air Standards are required before 1983.

In October 1980, Phelps Dodge entered into an agreement with Dravo Corp. to retrofit existing reverberatory furnaces to oxygen flash smelting units. The company planned pilot tests of the new oxygen-sprinkle process at its Morenci facility.

According to the 1979 Phelps Dodge annual report, the company had, since 1970, made total capital expenditures of $204.6 million at the three Arizona smelters to enable the plants to meet acceptable air-quality requirements. The smelters have operated under State permits that require sulfur dioxide emissions to be curtailed when abnormal weather conditions might cause these emissions to exceed ambient-air standards around the smelter. These requirements have resulted in lower production and higher costs at the smelters, particularly Morenci. Local meteorological conditions allow the Ajo smelter to operate almost continually. In December 1980, the Pima County Industrial Authority approved Phelps Dodge's request to refinance the $28 million in bonds originally issued to provide capital for installing pollution controls at the Ajo smelter; the 7-year bonds were issued in 1973. The reissue of the new 15-year, tax-free bonds was prompted by the anticipated expense of additional pollution controls at the Morenci and Ajo smelters.

Other matters of environmental importance were being studied such as the impact of floodwaters on the Chase Canyon waste dumps at Morenci and exposure of workers to arsenic, heat, lead, noise, and sulfur dioxide at the various smelters.

During the year, legislative, judicial, and administrative branches of government and industry studied water availability. The Morenci operation, which uses about 18,500-acre-feet of water, was involved in such a judicial study. Various Indian tribes are claiming prior and paramount rights to water being used by many. Phelps Dodge contends rights to certain waters were established many years ago by agreements and judicial decrees. State proceedings that relate to the Gila River, Little Colorado River, Verde River, and Salt River watersheds could affect virtually all water usage of the Morenci property.

According to the Continental Materials Corp. 1980 annual report, Continental Catalina, Inc., a partner in the Oracle Ridge mining partners (which includes Union Miniere, S.A., of Brussels) continued phase 1 of a new program to evaluate the Oracle Ridge Mine. The mine is on the north slope of the Santa Catalina Mountains north of Tucson. From April to December 1980, approximately 6,000 feet of underground drilling, 6,000 feet of surface drilling, and underground drifting into several ore blocks were completed. The company reported that assays tended to confirm earlier reserve estimates in certain rock formations. American Metal Market, April 17, 1980, reported that ore reserves, originally estimated at 11 million tons, were in 1980 estimated to be between 4 and 7.5 million tons with about 2.25% copper.

Getty Oil Co. and Hanna Mining Co., in an equally owned joint venture operated by Casa Grande Copper Co. (a Hanna subsidiary), reported as of December 31, 1980, an estimate of approximately 350 million tons

at 1.05% copper ores in place at their Casa Grande copper deposit. In 1980, engineering studies and metallurgical tests continued at the oxide and sulfide copper deposit discovered in 1976 near Casa Grande, Pinal County. Construction of a pilot mining shaft, bulk sampling, and drilling from underground workings will be necessary to determine whether a commercial deposit exists.

Occidental Minerals Corp., a subsidiary of Occidental Petroleum Corp., terminated its exploration and testing project on the Van Dyke Copper Co. and Sho-Me Copper Co. copper deposit in the Miami mining district, Gila County. Early in the century, Cleve Van Dyke, who patented the original property, made available the top 40 feet of the area for the Miami townsite and retained the remaining subsurface mineral rights. The two mining companies were organized later, and the properties were operated sporadically from the early twenties into the forties. In 1968, Occidental leased the Van Dyke and Sho-Me and began an exploration and testing program on the deposit, which underlies the town of Miami. Eventually, an estimated 100 million tons of oxide ore with an average grade of 0.5% copper was blocked out. The deposit lies east of the Miami fault and dips 15° from a depth of about 1,100 feet to 2,000 feet.

Occidental planned to leach the copper by injecting a solution of 2% to 4% sulfuric acid and return the solution through a solvent-extraction and electrowinning plant to recover the copper. The company proposed sinking a shaft outside the town, then driving drifts from which solution wells would be drilled. The use of hydraulic fracturing would eliminate underground detonations at all of the operations. Three injection wells and 12 recovery wells were proposed for the test project. In January 1980, fearing possible contamination of ground water, the town council rejected the testing permit, and Occidental referred the matter to the courts. Although the company was upheld in the lower court, Occidental decided to drop its option to purchase the subsurface rights and direct its exploration efforts elsewhere. Over $11 million was reportedly spent on exploration and tests, and the company was prepared to spend another $16 million to test the in situ method.

Throughout the year, Ranchers Exploration and Development Corp. continued to recover copper at its Bluebird operation near Miami, Gila County. Employees at the Bluebird did not participate in the copper strike. Ore was open-pit-mined, heap-leached, and processed through a solvent extraction-electrowinning plant on the property. Constructed in 1968, the facility was the first commercial plant to recover copper by solvent extraction-electrowinning, resulting in recovery of a 99.95% pure copper cathode.

Ranchers also leached copper at the Old Reliable Mine near Mammoth, Pinal County, in 1980. The Old Reliable was the first copper deposit to be blasted on a large scale and leached entirely in place.

Gold.—Gold is recovered in the State principally as a byproduct of copper production. The 28.5% decline in the amount of gold produced during 1980 was the result of the copper strike. The 42.3% increase in the total value of gold produced reflected the increase in the price of gold from an average unit price of $307.50 per troy ounce in 1979 to $612.56 per troy ounce in 1980. Fifteen large-scale operations recovered byproduct gold in 1980, and eight small precious and base-metal operations (under 100,000 tons of material sold or treated) recovered gold in 1980. Gold production was obtained from the following large-scale operations listed in descending order of the value of production: Morenci, San Manuel, New Cornelia, Superior, Sacaton, Christmas, Metcalf, Bagdad, Twin Buttes, Pima, Eisenhower, Inspiration, Ray, Sierrita, and Pinto Valley.

Lead.—Although lead output increased 13% in amount, the value of lead production decreased over 8% because of the drop in the price of lead, from $0.5264 per pound in 1979 to $0.4245 per pound in 1980. Three large copper operations recovered byproduct lead in 1980, and five small mines recovered lead in their base metal operations. The mines producing lead were Mission, Sierrita, Tiger Tailings Dump, Contract, Gold Hill, Sacaton, Phillips, and McCulley.

Molybdenum.—As in 1979, Arizona was ranked second in amount of molybdenum shipped during 1980. Molybdenum is recovered as a coproduct or byproduct at the following mines, listed according to value of production: Sierrita, Mineral Park, Twin Buttes, San Manuel, Esperanza, Eisenhower, Cyprus Bagdad, Pima, Ray, Pinto Valley, Morenci, Silver Bell, Inspiration, Mission, and Ajo. The new producers were Ajo and Morenci. The increases in production by eight of the mines reported were partly attributed to the new output and to the short duration of the copper strike at those mines.

Output increased only 1.6%, whereas the value of production increased about 60%, principally because of the rise in price during most of the year. The average price increased from $6.07 to $8.93 per pound of molybdenum contained in technical-grade molybdic oxide. The Arizona Bureau of Geology and Mineral Technology published a description of molybdenum in Arizona and an analysis of the geologic implications of its occurrence. Over one-half of the total Arizona production has come from the Pima mining district.[13] The Arizona Department of Mineral Resources, in 1979, described molybdenum occurrences in Arizona, including the small mines.[14]

Silver.—The State ranked second in the U.S. output of silver, and the metal was recovered principally as a byproduct of copper production. The 24% decline in the amount of silver produced during 1980 was the result of the copper strike, which continued until early November before all companies had settled. Value of silver production, however, increased 41% because of the rise in the price of silver, from an average unit price of $11.09 per troy ounce in 1979 to $20.63 per troy ounce in 1980. Leading producers of silver listed by value of production include the Sierrita, Twin Buttes, Morenci, Bagdad, Superior, San Manuel, Eisenhower, Pima, Ray, New Cornelia, Mineral Park, Sacaton, Christmas, Mission, Silver Bell, Metcalf, Inspiration, San Xavier, and Campbell. Nine small operations recovered silver from precious and base metal mines.

Tungsten.—Production of tungsten declined in 1980; only one company mined scheelite during the year. Leigh Garnsey mined a small amount of tungsten from a property in Pima County. Roberto Hernandes, S & S Systems, and James E. Thornton recorded no production.

The Boriana Mining Co. abandoned efforts to recover tungsten from the tailings and mine dumps of the old Boriana Mine near Yuma, Mohave County. The Boriana was once one of the largest tungsten producers in the United States, and between 1938 and 1943 ore was treated in a 150-ton gravity mill. In 1979, a 500-short-ton-per-day mill was constructed to process the material with a new steam-flotation process similar to another operation in Siberia. Operated for 7 months, the mill failed to produce a marketable product; and before operators could perfect the process, financial difficulties forced the company to offer the mill for sale early in 1980. The mill was constructed following a 1976 federally financed study that sought to locate sufficient ore reserves to justify a mill for recycling tailings. The Arizona Bureau of Geology and Mineral Technology was under a 12-month Federal contract to continue exploration in the area in 1980.

Zinc.—Zinc production in Arizona dropped severely in 1980, with only two large copper operations recovering a minor amount of the metal as a byproduct. No small base metal operations recovered zinc. Contributing factors were the copper strike, low prices, and declines in the principal market (the construction and automobile industries). The average price of the metal increased from $0.373 per pound in 1979 to $0.374 per pound in 1980.

NONMETALS

Asbestos.—Following a nationwide trend, asbestos production in Arizona continued to decline. As in 1979, California, Vermont, and Arizona shipped asbestos. Jaquays Mining Corp. mined a low-iron chrysotile 33 miles northeast of Globe and processed the ore at its mill at Globe. The product was marketed for use in the filter industry. Early in the year, officials ordered abandoned asbestos mills in the area dismantled, tailings covered with 6 inches of new topsoil, and trailer park residents of a subdivision on old tailings temporarily relocated away from the area being decontaminated. State health officials granted Jaquays an operating permit requiring compliance with air-pollution-control measures in the mine, mill, tailings, and other phases of the operation. Asbestos has been mined and milled in the area for over 50 years.

Cement.—Two firms produced cement in the State. The Phoenix Cement Co., a division of Gifford-Hill & Co., Inc., has offices in Phoenix and a quarry and plant 2 miles northwest of Clarkdale in Yavapai County; the Arizona Portland Cement Co., a division of California Portland Cement Co., has offices in Phoenix and a quarry 5 miles from the plant at Rillito, Pima County, which is approximately 17 miles west of Tucson. Production of portland and masonry cement in the State decreased in amount of value, partly because of the decline in construction.

The 1980 California Portland Cement Co.

annual report noted its plant at Rillito has an annual capacity of 1,150,000 short tons. The company also reported importing clinker used in cement manufacture from Japan and Canada to supplement its own production in 1980.

In response to citizen complaints, the State Air Quality Control Bureau sampled air quality near the cement plants at Clarkdale and Rillito during the year. Particulates in the air were reported to come from unpaved roads in the area, as well as from the cement plants.

Clays.—In 1980, total clay production increased in value and amount over that of 1979. Nonswelling bentonite was mined in Apache County at the Cheto pit 6 miles southeast of Sanders by Filtrol Corp. and at the Cheto 1 by United Catalysts, Inc., of Louisville, Ky. In Yavapai County, Superior Co. also mined a nonswelling bentonite at the Verde Mine near Clarkdale. Common clay shale was mined by the Phoenix Brick Yard at the Tolleson clay pit in Maricopa County and at the Pantano pit in Pima County, by Magma Copper Co. at the Magma property in Pinal County, and by Phoenix Cement Co. at the Lakebed Mine in Yavapai County. McKusick Mosaic Co. obtained ball clay from the Weary Lode Mine in Gila County.

Bentonite, used in the filter industry and in agriculture, was shipped to Mississippi, Utah, and overseas. A low-swelling montmorillonite clay has been used in making beauty preparations, in refining and decolorizing mineral and edible oils, in making catalysts for refining petroleum, and in desiccants.[15] Ball clay for tile and wind chimes, cosmetic additives, sealants, and slip-glazing material was mined at The Weary Lode property 5 miles west of Globe. Common clay was used principally for face brick and for portland cement.

Gem Stones.—Preliminary estimates showed a decline in the value of gem stones in Arizona. Two excellent issues of the Mineralogical Record, May-June 1980 and July-August 1980, described mineral specimens and famous mineral localities in southern Arizona.[16]

Gypsum.—Production of crude gypsum decreased in amount in 1980. The major producer of crude and calcined gypsum for wallboard was the National Gypsum Co. with its quarry and crusher at Feldman near Winkelman, Pinal County, and its calcining and wallboard plant in Phoenix, Maricopa County. Another producer of crude gypsum was Superior Companies with a quarry and crushing and screening plant at Camp Verde near Clarkdale in Yavapai County, and another quarry and plant near Winkelman. Superior mined gypsum for cement additives at both sites. Pinal Mammoth Gypsum Co. mined gypsum for agriculture 6 miles north of Mammoth in Pinal County.

Lime.—Because the copper industry is a leading consumer of lime in Arizona, the 5-month copper strike effected a decline in the amount and value of lime produced in 1980. The following companies produced lime during the year: Paul Lime Division of Can-Am Corp. at Douglas in Cochise County; Flintkote Co. of Genstar, Ltd. (Canada), at Nelson in Yavapai County; Magma Copper Co. near San Manuel in Pinal County; Ray Mines Division of Kennecott Minerals Corp. near Ray in Gila County; Phelps Dodge Corp. near Morenci in Greenlee County; and Amstar Corp. near Chandler in Maricopa County.

In August 1979, Paul Lime Division completed the 400-metric-ton-per-day two-shafted vertical kiln announced in September 1978. Designed in Switzerland, the new kiln was expected to have low fuel consumption, to permit midproduction changes in feed sizes without disrupting the process, and to allow the production rate of the kiln to be cut back from normal without affecting the fuel efficiency or the quality of lime produced.[17] Although major consumers of the chemical lime manufactured by Paul Lime are the copper concentrating mills, the product is also used for pollution control and water purification.

Perlite.—Two companies, Filters International, Inc., and Harborlite Corp., produced crude perlite near Superior in Pinal County. Production in 1980 increased in amount and value over that of 1979. The Guzman Construction Co. mine remained inactive during 1980. Perlite serves as a filtering agent for beverages, chemicals, pharmaceuticals, and sugar, as well as an agricultural fertilizer carrier. Concrete aggregate, plaster board, and insulation board also contain perlite. Principal markets for the perlite were in Louisiana, Illinois, Texas, California, and Michigan.

Pumice and Volcanic Cinder.—Nine producers mined pumice or volcanic cinders from 34 operations at various locations in Apache, Coconino, and Graham Counties. Government agencies obtained volcanic cinder from pits in Apache and Coconino Counties for use in road construction. The private companies that mined volcanic cinder for roads were Flagstaff Cinder Sales at its Black Pit and Red Hill operations near Flagstaff, and P. Zanzucchi at the Zanzucchi property, also near Flagstaff. Superlite Builders Supply removed scoria from the Darling Pit near Flagstaff for use in cinder blocks; Gila Valley Block Co. processed volcanic cinder at the P-B-T Pit near Safford in Graham County for the same purpose, as well as for landscaping and as an insulating medium. Pumice was mined by Apple Masonry, Inc., at the Apple Mine near Flagstaff, and Gila Valley Block Co. at the P-B-T Pit. Most private contractors prepared the pumice or cinder before marketing. Material used for road construction increased in amount but decreased in total value of production, whereas that used in building construction declined in amount and increased in value. The average value of pumice and volcanic cinder increased from $2.52 per ton in 1979 to $3.26 per ton in 1980.

Pyrites.—Magma Copper Co., Superior Division sold pyrite from its Magma Mine in 1980.

Salt.—Southwest Salt Co. uses solar evaporation to recover salt from brine wells drilled into a massive salt deposit 880 feet below the surface west of Phoenix, Maricopa County. Salt continues to be marketed for use as a water softener, as a tanning agent, and as cattle feed. In 1980, production declined in amount, but the value increased. Adjacent to the saltworks, propane and butane are stored in a solution cavity in washed-out salt.

Sand and Gravel.—The fifth most valuable commodity in the State was sand and gravel, ranked after copper, molybdenum, silver, and cement. Construction and industrial sand was obtained from 106 producers at 152 operations located in Maricopa, Pima, Yuma, Yavapai, Pinal, Gila, Coconino, Cochise, Mohave, Navajo, Apache, Graham, Santa Cruz, and Greenlee Counties. Maricopa, Pima, and Yuma Counties used by far the most sand and gravel. Leading producers of construction sand and gravel included Tanner Co.-United Metro Division, with deposits in Maricopa, Yuma, Pima, and Pinal Counties; the Arizona Sand and Rock Co., Union Rock and Material Corp., Nesbitt Construction Co., Allied Concrete and Materials Co., and Phoenix Sand and Rock Co., all with deposits in Maricopa County; and Columbia Building Materials, Inc., and Granite Construction Co., in Pima County. Producers of industrial sand included A. J. Gilbert Construction Co. in Cochise County; Arizona Silica Sand Co. in Apache County; Don Kelland Materials in Yuma County; and Little Hills Mines, Inc., in Pinal County.

Table 10.—Arizona: Construction sand and gravel sold or used, by major use category

Use	1979 Quantity (thousand short tons)	1979 Value (thousands)	1979 Value per ton	1980 Quantity (thousand short tons)	1980 Value (thousands)	1980 Value per ton
Concrete aggregate	8,065	$25,985	$3.22	6,710	$24,416	$3.64
Plaster and gunite sands	770	1,966	2.55	638	1,911	3.00
Concrete products	720	2,669	3.71	507	1,879	3.70
Asphaltic concrete	5,270	13,901	2.64	3,853	12,061	3.13
Road base and coverings	10,667	21,337	2.00	9,459	24,799	2.62
Fill	4,625	7,746	1.67	2,804	5,925	2.11
Snow and ice control	82	82	1.00	29	33	1.17
Railroad ballast	4	14	3.14	W	W	3.12
Other	318	1,017	3.20	W	W	3.53
Total[1] or average	30,520	74,716	2.45	24,229	71,838	2.96

W Withheld to avoid disclosng company proprietary data; included in "Total."
[1]Data may not add to totals shown because of independent rounding.

Table 11.—Arizona: Sand and gravel sold or used by producers, by use

Use	1979 Quantity (thousand short tons)	1979 Value (thousands)	1979 Value per ton	1980 Quantity (thousand short tons)	1980 Value (thousands)	1980 Value per ton
Construction:						
Sand	9,640	$23,516	$2.44	6,712	$20,781	$3.10
Gravel	20,880	51,200	2.45	17,517	51,057	2.91
Total or average	30,520	74,716	2.45	24,229	71,838	2.96
Industrial:						
Sand	W	W	W	W	W	11.41
Gravel	W	W	W	W	W	8.67
Total or average	W	W	W	170	1,936	11.37
Grand total or average	W	W	W	24,399	[1]73,773	3.02

W Withheld to avoid disclosing company proprietary data; included in "Total."
[1]Data do not add to total shown because of independent rounding.

Stone.—Although stone production declined in amount in 1980, value increased over that of 1979. Crushed stone comprised more than 99% of the total stone output.

Two companies produced limestone for cement: Phoenix Cement Co., a division of Gifford-Hill & Co., Inc., in Yavapai County, and Arizona Portland Cement Co., a division of California Portland Cement Co., in Pima County.

Lime used in copper operations was manufactured from limestone by the Flintkote Lime Co. a Genstar, Ltd., (Canada) company in Yavapai County; by the Paul Lime Division of Can-Am Corp. in Cochise County; by the Ray Mines Division of Kennecott Minerals Co. and by the San Manuel Mine of Magma Copper Co. in Pinal County. Phelps Dodge Corp. in Greenlee County, McFarland-Hullinger, Ray Mines, and Magma Copper mined limestone in Pinal County for use as a flux in copper smelters. Magma Copper and Little Hill Mines, Inc., in Pinal County and Charlie Nichols in Gila County mined sandstone or siliceous ores also used as a flux.

In other applications, Robert E. McKee, Inc., in Mohave County, mined and crushed dolomite for use as railroad ballast; J & A Mining Corp. in Pinal County mined limestone for filler; J. D. Dutton, Inc., in Coconino County and Granite Construction Co. in Pima County produced limestone for road construction; and Superior Co. in Apache County crushed limestone for treating sulfur dioxide stack gases. Paul Lime also crushed limestone for lime manufacture, for use in sugar refining, for treatment of stack gases, and for such uses as terrazzo and exposed aggregates.

Crushed granite was produced by Sanner Contracting Co., Madison Granite Co., Tall Stone & Supply Co., Inc., and Choctaw Materials, Inc., in Maricopa County; and by A & A Materials, Inc., in Pinal County. Some of the material was used for terrazzo and exposed aggregate. O. B. Willis Construction Co. prepared refractory sandstone in Greenlee County.

Crushed marble was produced for such uses as poultry grit, terrazzo and exposed aggregate, roofing granules, and fine aggregate by Andrada Marble Co. and Catalina Marble Co. in Pima County; and Sun Landscaping & Supply Co. quarried and crushed marble in Yuma County for terrazzo and exposed aggregate.

Catalina Marble Co. quarried dimension marble in Pima County, and J. Bowman cut dimension sandstone for flagging in Coconino County.

Table 12.—Arizona: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1979 Quantity	1979 Value	1980 Quantity	1980 Value
Poultry grit and mineral food	W	W	14	142
Bituminous aggregate	4	6	W	W
Dense-graded roadbase stone	--	--	53	W
Other construction aggregate and roadstone	204	544	209	365
Railroad ballast	W	W	W	2,813
Manufactured fine aggregate	W	W	80	762
Terrazzo and exposed aggregate	31	289	151	718
Lime manufacture	1,265	5,935	950	4,851
Flux stone	702	2,867	465	2,052
Other fillers or extenders	--	--	36	W
Roofing granules	14	199	7	93
Sulfur removal from stack gases	33	242	W	W
Other[2]	3,516	11,319	3,259	9,769
Total	5,769	21,401	5,224	21,565

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Includes limestone, granite, marble, and sandstone.
[2]Includes stone used for concrete aggregate (1979), surface treatment aggregate (1979), riprap and jetty stone, filter stone, cement manufacture, refractory stone, sugar refinery, and unspecified uses.

Vermiculite.—W. R. Grace & Co. continued to ship crude vermiculite into the State for processing and marketing. Production of the exfoliated vermiculite, which increased in amount and value, was used for construction and agriculture.

Zeolites.—The 1980 production of chabazite from the Bowie, Ariz., deposit reportedly declined sharply from 1979 levels. Shipping, however, was resumed by The Anaconda Copper Mining Co. and Union Carbide Corp. in December 1980. Anaconda trucked the chabazite to its new processing facility at Yerington, Nev., and Union Carbide shipped its chabazite by rail to a custom milling plant operated by TAKO at Hackleburg, Ala. The product was then bagged and trucked to the Linde Div. molecular sieve manufacturing plant at Chickasaw near Mobile, Ala.

Occidental Minerals staked claims covering mordenite occurrences near McHeffy Butte, almost 10 miles south of Oatman, and in the Black Mountains about 18 miles north of Union Pass in Mohave County. With Great Western Sugar Co., the company is reportedly studying the feasibility of using clinoptilolite as a soil conditioner to increase the yield from sugar beets.[16]

[1]State mineral specialist, Bureau of Mines, Denver, Colo.

[2]Engineering and Mining Journal. Pelletizing Aids Tombstone Leaching Operations. V. 182, No. 1, January 1981, pp. 94-95.

[3]Bureau of Land Management. Wilderness Review, Arizona. Intensive Inventory Decision Report, November 1980, 243 pp.; available from Arizona State Office, 2400 Valley Bank Center, Phoenix, AZ 85073 (602-261-3141).

[4]Villalobos, H. A., and L. W. Hamm. Map Showing Mineral Resource Potential of the Paiute Instant (Primitive) Study Area. U.S. Geol. Survey MF 1160-D, 1981; U.S. Geol. Survey Open File Report 80-984, 1980, 12 pp.

Hamm, L. W. Mines and Prospects Map of Paiute Primitive Study Area, Mohave County, Ariz. U.S. Geol. Survey, MF 1160-C, 1980, scale 1:24,000.

Throckmorton, M. L. Geologic Map of Turbinella-Gambel Oak Instant Study Area, Mohave County, Ariz. U.S. Geol. Survey MF 1146-A, 1980.

Bush, A. L., and M. E. Lane. Preliminary Report on the Mineral Resource Potential of the Vermilion Cliffs-Paria Canyon Instant Study Area, Coconino County, Ariz. and Kane County, Utah. U.S. Geol. Survey Open File Report 80-1056, 1980, 32 pp.

[5]Burgin, L. B. The Mineral Industry of Arizona. BuMines Minerals Yearbook, 1978-79, v. 2, 1981, pp. 53-75.

[6]Niemi, L. Cyprus Bagdad: Successful Expansion Creates "State-of-the-Art" Copper-Molybdenum Producer in Arizona. Eng. and Min. J., v. 181, No. 8, August 1980, pp. 56-63.

[7]Engineering Mining Journal. Kennecott's New Solvent Extraction Plant Onstream. V. 181, No. 6, June 1980, pp. 36, 39. Rocky Mountain Construction. Sundt Completes Kennecott Solvent Extraction Plant. V. 61, No. 2, Sept. 19, 1980, pp. 46-47.

[8]Dopson, G. W. Energy Conservation in the San Manuel Concentrator. Min. Cong. J., v. 66, No. 10, October 1980, pp. 17-20, 30.

[9]Llewellyn, T. O., and G. V. Sullivan. Recovery of Rutile From a Porphyry Copper Tailings Sample. BuMines RI 8462, 1980, 18 pp.

[10]Engineering and Mining Journal. Byproduct Rutile Could Make U.S. Self-sufficient. V. 181, No. 7, July 1980, p. 57.

[11]Engineering Mining Journal. Lakeshore Copper Returned to Life by Noranda. V. 181, No. 10, October 1980, p. 43.

[12]Pay Dirt (Ariz. edition). Full Production for Lakeshore As Soon As Strike Ends 1980. No. 494, August 1980, pp. 1, 12.

[13]Wilt, J. C., and Stanley B. Keith. Molybdenum in Arizona. Arizona Bureau of Geology & Mineral Technology, Fieldnotes, v. 10, No. 3, September 1980, pp. 1-3, 6-9, 12.

[14]Hicks, C. J. Molybdenum Occurrences in Arizona. Arizona Department of Mineral Resources, Mineral Report No. 3, September 1979, p. 37.

[15]Pierce, H. W. Industrial Rocks and Minerals of Arizona. Arizona Bureau of Geology & Mineral Technology, Fieldnotes, v. 10, No. 2, June 1980, pp. 1-3, 10-11.

[16]The Mineralogical Record. Arizona-I. V. 11, No. 3, May-June 1980, pp. 135-191. (Various authors and articles); Arizona-II. V. 11, No. 4, July-August 1980, pp. 203-265. (Various authors and articles).

[17]Pit and Quarry. Shaft Kiln Addition Boosts Paul Lime Capacity. V. 72, No. 11, May 1980, pp. 57-59, 90.

[18]Eyde, T. H. Zeolites. Min. Eng., v. 33, No. 5, May 1981, p. 592.

Table 13.—Principal producers

Commodity and company	Address	Type of activity	County
Asbestos:			
Jaquays Mining Corp	1219 South 19th Ave. Phoenix, AZ 85009	Underground mine crushing, screening, air-separation plant.	Gila.
Cement:			
Arizona Portland Cement Co.,[1] Div. of California Portland Cement Co.	Box 338 Rillito, AZ 85246	Quarry and dry-process, 3-rotary-kiln plant.	Pima.
Phoenix Cement Co.,[2] Div. of Gifford-Hill, Inc.	2505 West Beryl Box 35395 Phoenix, AZ 85069	do	Yavapai.
Cinder:			
Flagstaff Cinder Sales, Inc	Old Highway 66 Box 2796 Flagstaff, AZ 86003	Quarry	Coconino.
Superlite Builders Supply	4150 West Turney Box 23163 Phoenix, AZ 85063	Open pit mine	Do.
Clays:			
Filtrol Corp	Box 155 Sanders, AZ 86512	do	Apache.
Phoenix Brick Yard	1814 South 7th Ave. Phoenix, AZ 85007	do	Maricopa.
Copper:			
Anamax Mining Co.,[3 4 5] a subsidiary of Atlantic Richfield Co., Twin Buttes Mine.	Box 127 Sahuarita, AZ 85629	Open pit and underground mines and plant.	Pima.
ASARCO Incorporated:			
Hayden Unit	Box 98 Hayden, AZ 85235	Smelter	Gila.
Mission Unit.[3 4 6]	Box 111 Sahuarita, AZ 85629	Open pit mine and mill	Pima.
Sacaton.[4 5 6 7]	Box V Casa Grande, AZ 85222	do	Pinal.
San Xavier Unit.[4]	Box 111 Sahuarita, AZ 85629	Open pit mine	Pima.
Silver Bell Unit.[3 4]	Silver Bell, AZ 85270	Open pit mine, mill, leach dumps, precipitation plant.	Do.
Southwestern Mining Dept. Western Operations headquarters.	1150 North 7th Ave. Box 5747 Tucson, AZ 85703	Office and research	Do.
The Anaconda Co., Mineral Resources Group.	Box 27007 Tucson, AZ 85726	do	Do.
Cities Service Co., Miami Operations: Pinto Valley Mine.[3]	Box 100 Miami, AZ 85539	Open pit mine, mill, leach dumps, in-place leaching precipitation plants.	Gila.
Cyprus Mines Corp., a subsidiary of Amoco Minerals Co. Standard Oil Co. (Indiana):			
Cyprus Bagdad Copper Co.[3 4 5]	Box 245 Bagdad, AZ 86321	Open pit mine and mill	Yavapai.
Cyprus Johnson Copper Co	Drawer R Benson, AZ 85602	Open pit mine, heap leach, solvent extraction-electrowinning plant.	Cochise.
Cyprus Pima Mining Co.[3 4 5]	Box 7187 Tucson, AZ 85725	Open pit mine and mill	Pima.
Duval Corp., a subsidiary of Pennzoil Co.:			
Esperanza and Sierrita properties.[3 4 5 6 7]	Box 125 Sahuarita, AZ 85629	Open pit mines, mills, leach dumps, precipitation plant.	Do.
Mineral Park property.[3 4]	Box 1271 Kingman, AZ 86401	do	Mohave.
Eisenhower Mining Co., Palo Verde Mine.[4 5]	Box 39 Sahuarita, AZ 85629	Open pit mine	Pima.
Inspiration Consolidated Copper Co.[3 4 5]	Box 4444 Claypool, AZ 85532	Open pit mine, mill, vat leaching plant, electrowinning plant, in-place leaching, heap leaching, precipitation plant, rod plant rolling mill, custom smelter, electrolytic refinery.	Gila.
Christmas Mine.[4 5]	Box 4444 Claypool, AZ 85532	Open pit mine and concentrator.	Do.
Ox Hide Mine	Box 4444 Claypool, AZ 85532	Open pit mine	Do.
Kennecott Corp., Ray Mines Div.[3 4 5]	Hayden, AZ 85235	Open pit mine, precipitation, vat leaching, electrowinning plants, smelter.	Gila and Pinal.
Magma Copper Co.:			
San Manuel Div.[3 4 5]	Box M San Manuel, AZ 85631	Underground mine, mill, smelter, refinery.	Pinal.
Superior Div.[4 5]	Box 37 Superior AZ 85273	Underground mine and mill	Do.

Table 13.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Copper —Continued			
Phelps Dodge Corp.:			
Copper Queen Branch	Bisbee, AZ 85603	Underground mine, leach dumps, in-place leaching, precipitation plant.	Cochise.
Douglas Reduction Works	Drawer E Douglas, AZ 85607	Smelter	Do.
Morenci and Metcalf Branch.[3 4 5]	Morenci, AZ 85540	Open pit mines, mills, leach dumps, precipitation plant, smelter.	Greenlee.
New Cornelia Branch.[3 4 5]	Drawer 9 Ajo, AZ 85321	Open pit mine, mill and smelter.	Pima.
Ranchers Exploration and Development Co., Bluebird Mine.	Box 880 Miami, AZ 85539	Open pit mine, dump leach, solvent extraction plant, electrowinning plant.	Gila.
Dolomite:			
Robert E. McKee Inc	Box 107 Peach Springs, AZ 86434	Quarry	Mohave.
Gold:			
Magma Copper Co.:			
San Manuel Div	Box M San Manuel, AZ 85631	See Copper	Pinal.
Superior Div	Box 37 Superior, AZ 85273	do	Do.
Phelps Dodge Corp.:			
Morenci and Metcalf Branch	Morenci, AZ 85540	do	Greenlee.
New Cornelia Branch	Drawer 9 Ajo, AZ 85321	do	Pima.
Gypsum:			
National Gypsum Co	Star Route, Box 90 Winkelman, AZ 85292	Open pit mine and plant	Pinal.
Pinal-Mammoth Gypsum	2020 South 9th St. Coolidge, AZ 85228	Mine	Do.
Superior Companies.[8]	2402 South 19th Ave. Phoenix, AZ 85009	Quarries and plant	Pinal and Yavapai.
Lime:			
Paul Lime Div. of Can-Am Corp	Drawer T Douglas, AZ 85607	3 lime kilns	Cochise.
Kennecott Corp., Ray Mines Div	Hayden, AZ 85235	Kiln	Gila.
Phelps Dodge Corp., Morenci Branch.	Morenci, AZ 85540	Rotary kiln, fluidized-bed-kiln plant.	Greenlee.
Amstar Corp	11800 East Riggs Rd. Chandler, AZ 85224	Kiln	Maricopa.
The Flintkote Co., Div. of Genstar, Ltd.	Box 197 Peach Springs, AZ 86434	Quarries and plant	Yavapai.
Perlite:			
Filters International, Inc	Box Z Superior, AZ 85273	Open pit mine and plant	Pinal.
Harborlite Corp	Box 960 Superior, AZ 85273	do	Do.
Salt:			
Southwest Salt Co	Box 1237 Litchfield Park, AZ 85340	Solar evaporation of brine from wells.	Maricopa.
Sand and gravel:			
Arizona Sand and Rock Co., Div. of California Portland Cement Co.	1801 East University Box 20067 Phoenix, AZ 85036	Plants	Do.
Tanner Co., United Metro Div	3640 South 19th Ave. Box 20128 Phoenix, AZ 85036	Open pits and plant	Maricopa and Pima.
Union Rock and Materials Corp	2800 South Central Ave. Box 8007 Phoenix, AZ 85066	Plant	Do.
Silica flux:			
Little Hill Mines, Inc	Box 332 Oracle, AZ 85603	Open pit mine	Pinal.
McFarland-Hullinger	Box 811 Tucson, AZ 85702	Plant and quarry	Gila.
O. Brice Willis	Box 1325 Clifton, AZ 85533	Open pit mine	Greenlee.
Stone:			
Andrada Marble Co	4901 East Drexel Tucson, AZ 85706	Quarry	Pima.
Vermiculite (exfoliated):			
W. R. Grace & Co	2925 Lyndon B. Johnson Freeway Dallas, TX 75234	Plants	Maricopa and Yuma.

[1]Also lime.
[2]Also clays.
[3]Also molybdenum.
[4]Also silver.
[5]Also gold.
[6]Also lead.
[7]

ASARCO

Southwestern Exploration Division

July 29, 1981

TO: W. D. Payne

FROM: J. D. Sell

Reevaluation of Vein Structures
Superior East Project
Pinal County, Arizona

Evaluation of drill data intercepts of the quartz-sulfide vein (qsv) system(s) found in the A-8, A-9, A-10, A-11, A-12, and A-14 holes, based on the oriented core studies which suggested a southerly dip component to a north-northeasterly striking system, now suggest the following:

A. Using the drill holes A-8 and A-10, the best fit is a strike direction of N70°E.

B. Holes A-8 and A-10 intercepted the same qsv system. Unfortunately the hole A-10 was located north of the best fit and hence cored only the footwall portion of the qsv under the oxidized surface.

C. Using the N70°E strike and hole A-14 as a control point, it would be necessary to change the strike direction to more N65°E for the best fit to be the same structure as hole A-12 presently being drilled. As reported, hole A-14 cut only 173 feet of 0.45% and is interpreted to be the basal portion of a qsv system. Thus to fully test this qsv in hole A-14 it will be necessary to move out some 400 to 500 feet south of A-14. Wedging is probably not warranted for that distance of a move-out and a new surface hole is recommended.

D. Using A-14 and A-12 as the same structure, the hole A-9 would be a separate qsv structure and would project to lie between A-8 and A-14.

E. Using the N65-70°E strike, the intercept in hole A-11 is thus a separate qsv structure.

F. Using the above, it is more likely that hole A-12 will need to go to around 5700 foot depth to intercept the A-11 structure dipping south. (Note: The A-12 intercept is not accurately plotted as I have failed to catch up with and reduce a survey plot of the hole. Thus the above may be changed by a factor when all is plotted correctly.)

G. As it presently appears, four qsv zones have been cut in the drilling around A-8:

1) The A-8 to A-10 zone
2) The A-9 zone
3) The A-12 to A-14 zone
4) The A-11 zone

(Note: Checking of the various intercepts and their plots has not been made. The above suggestions should be considered preliminary until all data points are verified.)

James D. Sell

James D. Sell

JDS:lb
Att: Preliminary map

	Subsea
A-8 Collar 4671'	
top of bedrock p€pi& minor bfp 3226'	+1445
A-2 Type SB	
basal flt zone @ 15-20°; 3775'	+ 896
leached qsv in oxidized zone	
oxide/sulfide 3879'	+ 792
646' @ 1.57%	
base of qsv system 4525'	+ 146
4907 TD	- 236

- -

A-9 Collar 4640'	
top of bedrock p€pi, minor bfp 3275'	+1365
M-1A SB type to 3337'; A-2 SB type below	
basal fault zone @ 10°; 3687'	+ 953
leached qsv in oxidized zone	
oxide/sulfide 4044'	+ 596
626' @ 0.81%	
base of qsv system 4670'	- 30
4903 TD	- 263

- -

A-10 Collar 4585'	
top of bedrock p€pi & Lbfp-Lsg 3375'	+1210
M1A Type SB to 3406	
A-2 Type SB to 3859	
basal fault zone @ 20°; 3859'	+ 726
leached qsv in oxidized zone	
oxide/sulfide 3953'	+ 632
296' @ 0.29% (tail end of qsv)	
base of qsv system 4249'	+ 336
low grade	
4282 TD	+ 303

- -

A-11 Collar 4608'	
top of bedrock p€pi & Lbfp 3492'	+1116
A-2 Type SB, leached capping	
basal fault @ 15-20°; 4072'	+ 536
oxide/sulfide 4261	+ 347
291' @ 0.40%	
4553 top of qsv system	+ 55
533' @ 1.12%	
5086 bottom of qsv system	- 478
89' @ 0.26%	
5175 TD	- 567

- -

	Subsea
A-12 (Navi-drill hole from A-11, collar 4608')	
top of bedrock p€pi & Lbfp 3500	+1108
A-2 Type SB	
basal fault ±4070	+ 538
leached qsv in oxidized zone	
oxide/sulfide 4171	+ 437
1086' @ 0.62 (317' @ 0.64)	
(4488)	
(260' @ 0.92)	
(4748)	
(509' @ 0.46)	
base of qsv system 5257	- 649
low grade	
5724 TD	-1116

- -

A-13 Collar 4728'	
top of bedrock 3071' p€pi & Lbfp	+1657
A-2 type SB, leached capping	
Basal fault zone, flattish; 3251	+1477
prob. low grade	
oxide/sulfide 3499	+1229
138' @ 0.32	
Top of qsv system? 3637	+1091
392' @ 0.67	
base of qsv system 4029	+ 699
low grade	
4663' TD	+ 65

- -

A-14 Collar 4694'	
top of bedrock p€pi & Lbfp 3841	+ 853
A-2 Type SB	
basal fault 10-15°; 4010	+ 684
qsv in oxide zone	
oxide/sulfide 4096	+ 598
173' @ 0.45 (53' @ 0.53)	
(4149)	
(99' @ 0.25) lower part of qsv system	
(4248)	
(21' @ 1.20)	
base of qsv system 4269	+ 425
low grade below	
5738 TD	-1044

- -

AI-2	
Collar 4715'	
top of bedrock 2616 = subsea	+2099
basal fault zone = 2771 = subsea	+1944
Entire hole partially oxidized	
(2850 subsea =	+1865
best intercept (310' @ 0.37%	
(3160 subsea =	+1555
3612 TD	+1103

- -

Called Chuck Sell, Dist. Geol. USGS
Reno (702) 826-1654

9/26/ a special request my company is not interested to pursue the project further at this time
JRS

(Check not in. P. Hohwart call Tomorrow & I will send message. JRS). Done .... see File Memo to C. Seal. 9/27.

September 22, 1983

Mr. J. R. Stringham
Tucson Exploration Office

Crypto Mine, Utah

Dear Mr. Stringham:

This will acknowledge the receipt here of your September 13 memorandum on this subject. As I read through your covering letter, it seemed to me that you did not fully understand the nature of my inquiry.

In your previous work you determined that even given a strong zinc price (47¢) in the near future, Crypto would not be at all attractive. On the basis of that work, we decided that we would not negotiate further with Utah. I was however surprised that the indicated outcome was so poor, and was curious to know what price of zinc would be required to make the prospect profitable. I had it in mind that Crypto, at 8% zinc, good tonnage and amenable to trackless mining would be about as an attractive a zinc prospect as is apt to come our way.

The determination on the basis of your back-of-envelope calculations, that it would take 75¢ zinc to give a 15% discounted cash flow rate of return looks ominous for those zinc deposits which have no precious metal credits.

At any rate, I wish to emphasize and to make it clear to everybody that I have not been, and still am not, interested in dickering further with Utah. I simply wished through this exercise to size up the economic realities inherent in bringing new zinc deposits into production at this time.

Yours very truly,
Original signed by
R. L. Brown

R. L. Brown

cc: WLKurtz
JDSell
DDHarper

RECEIVED
SEP 26 1983
S. W. U. S. EXPL. DIV.

ASARCO

Southwestern Exploration Division

September 13, 1983

To: R. L. Brown
New York Office

From: J. R. Stringham

Price of zinc necessary to allow fair returns from Crypto.

Attached are calculations indicating at what price zinc would have to reach to make the Crypto mine prospect attractive. Assuming favorable conditions for mining, milling, and waste disposal, 75¢ zinc would make the property attractive.

Basic Assumptions

Mining and milling costs are not easy to assign without some idea of the rock characteristics. I assumed, as I did in the exercise on Magnum Resources, that we would be able to use trackless mining and approach Leadville mining costs. I used a milling cost of $10 per ton, near Leadville's, even though only one concentrate would be made. My doubts about the effect of zinc oxide upon the flotation process made me cautious on cost and recovery.

The transportation, smelting and refining costs were given me by C.E. Dunne of Ore Purchasing in New York. I used the more favorable of the two schedules for the concentrate grade that I assumed. That grade was the better of the two that I used before. Dunne, in answer to my question, said that the price/cost escalator moves in a fairly narrow range, pretty close to the price of zinc when a contract is written; I didn't use it in my calculations; based on present prices we'd need very high priced zinc to make the project favorable.

After consulting with Jim Sell and Bill Kurtz, I made the assumption that we probably would enter into a joint venture with Utah. I added $2M to the $2M that they invested and loaded it into the costs of year one. So the calculations you see are for the whole project; splits of costs and profits would be fifty-fifty.

Conclusions

I would hesitate to recommend that we enter into any agreement with Utah. If zinc does reach the 75¢ level, many of our costs would move with it, I'm afraid. Then too, I've made the most favorable assumptions for mining costs and metallurgical results. Don Crowell cautions that storing tailings and getting water supplies might be critically important in the area as well. If you all decide to continue dickering with Utah, perhaps a little more research into these areas of concern might be considered.

Please let me know if there is anything else you'd like for me to do on this project.

J. R. Stringham

cc: W. L. Kurtz
J. D. Sell

Crypto 5,000,000 tm 8% Zn Ore, No Payable Au, Ag

Sotheville: Zn Concentrate 9-8-83

Case I:

53.5 lb Zn, 8% Fe, 83% Recovery, 8% Hg

R/C 53.5 / (8.0 x 83) = 8.06

		50 (50¢
Value	53.5 x 20 x .85 x (0.70 - 0.016) =	622.10 (713.5
Cost.	T.C = 160.00	
	Price Dif. Max $3 x 8 = 240	
	HgO Penalty (9-8.5) .43 = 0.22	
	184.22	
	FRT 40/.91 (HgO) = 43.96	
	228.18	228.18
NSR/Ton Ore		393.92 (451.37
/Ton Ore		46.97 (60.15

— x — x

Continued

Value	(53.5 - (.15 x 8)) x 20 x .85 x 0.70 =	622.37 (713.5
Cost:		
	TC = $125.94	
	Mg Upside $24/t = 17.92	
	Fe 1.46 x 8 = 11.68	
	HgO Penalty (9-6) x .4875 = 1.46	
	FRT $55/.91 (HgO) = 60.24	
	217.44	217.44
NSR / Ton Ore		404.93 (464.
/ Ton Ore		59.24 (61.5

Zn 70¢/lb 50.24 x 500,000 t/year = $25,120,000/year

9-8-83

Mining, Milling, Transport to Mill Head

Mining $25 / Ton
Milling 10 / Ton
Transportation $1 / Ton
$36 / Ton × 2000 × 250 = $18,000,000 / year

Investment (Other than exploration)

Year (2+3) Depr.	$15.0M	For 2000 tpd single line flotation, crusher, warehouse, change house, maintenance buildings (No allowance for tailings problems or water supply problems)
Year (1) Depr.	5.0 M	Mist, HF, surface mine building, mine machinery.
Year (1-2)	3.0 M	Shaft 16'ϕ, 1500' deep, $2000/ft
Year (3)	1.0 M	3500' U.G. Dev @ $300/ft
Total	$24 M	
Sunk Costs	4 M	($2M J.I. $2M ASR to earn 1/2)
	28 M	

CRYPTO CASE II - ZM $.80 - 9-13-83

YEAR	CASH FLOW	D.C.F.
1	-981.000	-981.000
2	-796.000	-629.896
3	-701.000	-438.965
4	727.000	360.249
5	1084.000	425.063
6	1082.000	335.744
7	1049.000	257.580
8	976.000	189.646
9	904.000	139.001
10	904.000	109.995
11	904.000	87.042
12	904.000	68.879
13	1268.000	76.453
TOTAL	7324.000	-0.210

RETURN ON INVESTMENT = 26.370 PCT.

CASE II CRYPTO 9-13-83

	CAPITAL INVEST.	NSR	ROYALTY NSR	ROYALTY NET PROFIT	NSR AFTER ROYALTY	OPER. COST	TOTAL OPER. COST	CASH FLOW BEFORE TAX	DEPREC.	DEPLET.	TAXABLE INCOME	INCOME TAX	CASH FLOW AFTER TAX
1	9.0						1.5	(10.5)			(1.5)	(0.19)	(9.81)
2	7.5						1.5	(9.0)	0.75		(2.25)	(1.04)	(7.96)
3	7.5						1.0	(8.5)	2.23		(3.23)	(1.46)	(7.01)
4		5.8					22.5	8.3	3.93	2.24	2.24	1.03	7.27
5							12.0	12.8	4.27	1.77	1.77	1.96	10.84
6									4.20	4.30	4.30	1.98	10.42
7									3.15	1.62	5.03	2.31	10.49
8									1.57	4.42	6.61	3.04	9.76
9										1.62	8.16	3.76	9.04
10													
11													
12													
13							13.5	17.3					10.65
14													
15													
16													
17													26.37% ROI
18													
19													
20													

DEPRECIATION SEE CASE I

15% OCCS: Yr 4 } - 462, Yr 13 }

DEPLETION 20% ROI: Yr 4 = 2.24, 5 =

Cost SEE CASE I

CRYPTO - 9-13-83 Tn $0.70/lb 9-13-83

YEAR	CASH FLOW	D.C.F.
1	-981.000	-981.000
2	-796.000	-693.985
3	-701.000	-532.333
4	335.000	222.001
5	645.000	372.655
6	643.000	323.388
7	619.000	271.839
8	583.000	223.216
9	547.000	182.592
10	547.000	159.191
11	547.000	138.789
12	547.000	121.002
13	997.000	192.281
TOTAL	3532.000	-0.364

RETURN ON INVESTMENT = 14.700 PCT.

[illegible] 9-13-83

	CAPITAL INVEST.	NSR	ROYALTY NSR	ROYALTY NET PROFIT	NSR AFTER ROYALTY	OPER. COST	TOTAL OPER. COST	CASH FLOW BEFORE TAX	DEPREC.	DEPLET.	TAXABLE INCOME	INCOME TAX 44%	CASH FLOW AFTER TAX	
1	8.0	(Tot 40 Sub Costs)				1.5		(10.5)			(1.0)	(0.44)	(9.91)	
2	7.5					1.5		(9.0)	0.75		(2.25)	(1.00)	(7.76)	
3	7.5					1.0		(8.5)	2.33		(3.83)	(1.69)	(7.01)	
4		25.1			with gulp	22.5		2.6	3.83	0.4	(1.63)	(0.72)	3.25	
5						16.0		7.1	4.27	1.42	1.41	0.65	6.45	
6									4.20	1.45	1.45	0.67	6.43	
7									3.15	1.98	1.00	0.41	6.19	
8									1.57	2.77	2.77	1.27	5.83	
9										3.55	3.55	1.63	5.47	
10										3.55	3.55	1.63	5.47	
11										3.55	3.55	1.63	5.47	
12										3.55	3.55	1.63	5.47	
13					No Lap Gap	13.5		11.6		3.55	3.55	1.63	9.97	
14														
15														
16													147%	ROI
17														
18														
19														
20														

Depreciation

100% 5.0M x 0.15	=	$0.75M
3-4. (7.5M x 0.15) + (5.0 x .22)	=	2.33
4-14 (7.5 x 0.15) + (7.5 x .22) + (5 x .21)	=	3.83
5 (7.5 x .21) + (2.5 x .21)	=	4.27
6 - 20 x .21	=	4.20
7 - 15 x .21	=	3.15
8 - 7.5 x .21	=	1.57

Depletion 15% gross

Yr 4 3.77

50% Net

Yr 4	0
Yr 5	1.42
	1.45
	1.98
	2.71
	3.55
	3.55

Cost Depletion

$4.0M / 5 years x 0.5M tons = $0.4/year

ASARCO

Southwestern Exploration Division

August 23, 1983

TO: R. L. Brown
New York Office

FROM: J. R. Stringham

Crypto Resources Zinc Concentrate

Attached you will find liquidation of two types of zinc concentrates that might be produced from the Crypto zinc prospect. You will note that the value of the better, as shipped from the mill would be $21.04 per ton. The more likely concentrate, the one with 51% zinc and 12% iron, would have a value of only $18.53 per ton shipped from the mill. With 100% recovery of the zinc, a $40 freight cost and a $146 treatment charge, the value shipped from the mill for the 53.5% concentrate would be $31 per ton of ore.

The configuration of the orebody as indicated by Utah International geologists makes me doubt that we can mine this ore for less than $30 per ton. Milling costs with zinc oxides in some of the reserves would probably run at least $10 per ton. The total cost of mining and milling then would be $40 per ton or more.

There are no payable quantities of silver and any cadmium recovered would not add any appreciable value.

It is obvious from these figures that at 48¢ zinc this deposit would have no value. Given the fact that costs would almost certainly go up as the price of zinc rose, there would seem to be very little reason to pursue negotiations for this prospect.

J. R. Stringham

JRS:mek

cc: W. L. Kurtz
J. D. Sell

ANALYSIS: CRYPTO CONCENTRATE

Data from A. J. Kroha - Treat at Cominco, B.C.

Case I

53.5% Zn, 8% Fe in Conc. - 83% Recovery, 48¢/lb. Zn

Zn 53.5 x 85% = 909.5# (0.48 - 0.012) =		$425.65
Treatment Charge (as of 8/31/83)	$160	
Price Diff. (48-40) x $3.00	24	184.00
Pay Shipper NSR		241.65
Frt. Eureka - Cominco 59/.92		64.13
Value FOB Cars Railhead		$177.52
Ratio Concentration: .535/(.83 x .08) = 8.06		
Value/Ton of Ore $177.52/8.06		$22.03

Case II

51% Zn, 12% Fe in Conc. - 83% Recovery, 48¢/lb. Zn

Zn 51 - 8 = 860# (0.48 - 0.012) =		$402.48
Treatment Charge	$160.00	
Price Diff. (48-40) x $3.00	24.00	
Iron Penalty (12-8) x $1.00	4.00	188.00
Pay Shipper NSR		214.48
Frt. Eureka - Cominco		64.13
Value FOB Cars Railhead		$150.35
Ratio Concentration: .51/(.83 x .08) = 7.68		
Value/Ton of Ore $150.35/7.68		$19.57

Haulage Mine to Railhead at Delta, about 50 miles @ 0.08/round trip mile would lower value at mill ((0.08 x 100)/8.06 = 0.99;
(0.08 x 100)/7.68 = 1.04)

to respectively: 53.5% Conc: $21.04 Shipped from mill

51.0% Conc: $18.53 Shipped from mill

ASARCO

Southwestern Exploration Division

August 5, 1983

File Memorandum

Crypto Project
Utah International Inc.
Juab County, Utah

Mr. Chuck Seel, UII Exploration Manager, Reno, Nevada, (702)-826-1654, called 8/4/83 to state that the Crypto Project has been placed in the hands of Ray Morley for J.V. discussions:

Mr. Ray Morley, Regional Manager
Western United States Metals
Utah International Incorporated
Denver, Colorado
Phone: 303-278-4730

He restated that all terms are open for discussion and that they would be pleased to have some input with Asarco.

Further geologic data can be studied at their Reno office, but all discussions toward some agreement should be through Mr. Morley.

They anticipate an August 15 start date for the 1982-83 assessment year hole.

James D. Sell

James D. Sell

JDS/cg

cc: RLBrown
WLKurtz

WLK

JOS - JRS

Lone Mtn Shaw
Chloron
Grant Co, NM

As JRS indicates, the value of the products at the Lone Mtn Shaw is 35.00 to 45.00/ton at the recovery and value stated.

With Ground Hog type costs of around 30-35/ton & milling (Kleiner) at $4-5/ton that doesn't leave much for recovery on $2 mill investment, shafts, development, mill upgrading, etc.

As with Cresto — the low silver values and nominal Cu Pb Zn values — things look rather grim, irregardless of the tonnage.

To do much more we'd need to look at the drill hole data — continuity in space & lateral — to see if better mining methods would lower the cost, etc.

The Ground Hog on 1969 → 1978 averaged

2.43% Pb
0.56% Cu
11.53% Zn
1.20 opt Ag

vs

No Lead
2.04% Cu
4.64% Zn
1.09 opt Ag

Lone Mtn Reserves

Any higher grade zones?

Jm

Cu_2FeS_2 63.54 + 55.85 + 32.064 = [illegible]

[illegible] / [illegible] = [illegible]

Lone Mtn Shaw
Grant Co, NM

02.04 × [illegible] × [illegible] = 36.77 lbs

25% concentrate : 500 lbs/ton

P/C = 500/36.73 = 13.62

Ag : 1.19 × .6 = 0.65 ; × 13.62 = 8.91

Au 0.006 × .5 = 0.003 ; × 13.62 = 0.04

Au =	(0.04 − 0.02) × .95 × (345 − 5) =	6.46	
Ag =	(8.91 − 1.0) × .95 × (750 − 0.30) =	54.10	
Cu	(25 − 1) × 20 × (61 − 0.10) =	244.80	336.00
		305.36	396.36

Freight 15 cwt/.9 = 16.67

Smelter 62.50

79.17 — 79.17 — 79.17

226.19 — 317.39

[illegible]

at 80¢ Cu. — 322.80

at 1.00 Cu — 330.35

10-5-84

Zn @ 45¢ adds $13.30/ton to above

@ 50¢ adds $15.00/ton to above.

} if, pay finish ±

		holes			
14,346'	BCWC	18		$980,000	1-18
26,476'	HG	4 new,	7 deepened	$76,000	19-22
11,178	Chev	3 new,	3 deepened	630,000	23-24-25
54,000		25		2,486,000	

@25 holes = $99,440 per hole
@≅30 holes = $82,867 per hole

upper zone ≅ 1700' to go thru it
lower zone ≅ 3000-3500 into Bliss ss.

BCWC ave 908' per hole
HC on ≅ 8 holes = 3,310/hole
Chev on ≅ 5 holes = 2,235'/hole

GHog

To shallow for

1- ~~to shallow~~ for lower unit
2 upper unit
3 intrusive
4 intrusive
5.
6. upper unit
7. below lower
8.
9 below lower
10
11 below lower
12 below lower
13 below lower
14 below lower
15. below lower
16 intrusive
17
18

19 below lower
20 below lower
21
22 below lower

23 below upper, ~~the unit~~
24 below upper, then unit.
25 below upper, then unit.

$50,000/hole 5 holes x 1700'/hole ÷ in 250,000 exp = ≅ $30/ft.
$75,000/hole 4 " x 1700'/hole ÷ in 300,000 exp ≅ $44/ft
$100,000/hole 4 " x 1700'/hole ÷ in 400,000 exp ≅ $60/ft.

Ground Hog 1964-1978
Pb 2.43%
Cu 0.56%
Zn 11.53%
Ag 1.2 opt

ASARCO

Exploration Department
Southwestern United States Division

October 11, 1984

To: R. L. Brown
New York Office

From: J. R. Stringham

Chief Consolidated
Target Assessment

As you requested last month at the AMC convention, I have prepared an analysis of the exploration targets on the Chief Consolidated property.

Conclusion

A chimney with 1.5 million tons averaging 0.06 opt Au, 16 opt Ag and 6% Pb, with its bottom around 2000 feet deep would probably be a satisfactory ore body. I estimate that such ore would allow a return of 17.08% with a small improvement in metal prices. My calculations are attached.

Parameters Used

Ore Body - I assumed that a 1½ million ton ore body would be found with the grade noted above. It would be located south of the Chief #1 shaft, contiguous horizontally and vertically and in competent ground. It would be about 800 feet in height and about 200 feet in diameter on the 2000 foot level. Lead would occur as cerussite.

The grade assumed is close to the historical average for the 3,500,000 tons mined from Chief Consolidated (0.058 opt Au, 15.1 opt Ag and 5.9% Pb). It seems likely that a chimney, if located, would average more. The mantos mined over the last 26 years of mine life ran only 0.025 opt Au, 5.7 opt Ag and 4.4% Pb. Zinc was present at a grade of 4.35% during these latter years, but apparently wasn't significant in the higher chimneys.

Mill Operating and Construction - Don Crowell estimates that lead recovery could be 80% and silver 75%. I used 60% for gold recovery.

A short review of literature on the subject of lead oxide concentration led me to believe that such recoveries for lead and silver would not be unusual.

ASARCO Incorporated P. O. Box 5747 Tucson, Az 85703-0747
1150 North 7th Avenue (602) 792-3010

Don estimated the $4M mill construction costs from recent experiences. He assumed that we would be able to buy secondhand equipment and have it installed at favorable rates.

Mine development and operating costs were estimated using Leadville's, the ones I'd developed for my Gold Road calculations, and the Mining Cost Service manual. The results appear reasonable for a competent ore body at 2000 feet from the surface.

Metal Prices - At present day metal prices, this ore body would not allow a satisfactory return. I used prices which did look realistically attainable during the one-year exploration and three-year development and construction period assumed.

Summary

If an ore body of this size or larger can be found with the grade assumed, it should be minable at a profit. The metallurgists are reluctant to estimate recoveries and grade of oxide or mixed oxide-sulfide lead ores. The silver, by far the best paying element, may not report in the most economic carrier. Other problems may well surface too, but such a target should be satisfactory. Better grade, higher tonnage or higher prices, of course, would increase the return.

J. R. Stringham

JRS:mek
att.

cc: J. D. Sell

CHIEF CONSOLIDATED

INVESTMENT EXPENDITURES

SUMMARY:

Mine Development	$10.2M
Mill Construction	4.0
Surface, Environmental, Power	3.0
Sub-Total	$17.2M
Contingency @25%	4.3
Exploration Costs	2.0
Total Investment	$23.5M

OPERATING COSTS:

Mining	$40.00/ton
Milling	10.00/ton
	$50.00/ton

Royalty: $55,000/year until production
5% NSR until payback; then
greater of 5% NSR or 30% NP.

PARAMETERS:

Reserve: 1,500,000 tons

Quality	Au	Ag	Pb (all oxide)
Price:	$350	$8.00	$0.30
Grade:	0.06	16.0	6%
Recovery:	60%	75%	80%

Rate: 500 t/d; 150,000 t/yr.

CALCULATIONS OF INVESTMENT & COSTS

INVESTMENT:

From Mining Cost Service, factored from similar depth mines and conditions

Mine Development	$13,194,000
Mill Construction	7,106,000
	20,300,000

Mine Costs	$37.42
Mill Costs	$15.00
	$52.42

From my files for mine and Don Crowell's for mill.

Mine Development

Hoisting Shaft	12'd - 2500' @ $1500/ft.	=	$3.8M
Vent Shaft	7'd - 2000' @ $700/ft.	=	1.4
Raising & Drifting	(600+2300) = 2900' @ $400/ft.	=	1.2
Equipping			3.8
			$10.2M

Mining Costs (from Gold Road analysis increased for greater depth (higher power consumption for hoisting & ventilation) lower breakings costs (because of size and concentration or ore body).	$40.00
Don Crowell estimates (based upon Coeur's costs and adjusted) $8.50/ton. I have increased to $10.00 for power and labor differentials.	$10.00
	$50.00

RETURN CALCULATIONS

	Au	Ag	Pb
Ore Grade:	0.06 opt	16.0 opt	6.0%
Recovery:	60%	75%	80%
Price:	$350	$8.00	$0.30
Concentrate Grade:	0.49 opt	162 opt	65%

Calculated as follows:

(0.65 x 2000)/(.06 x 2000 x .8) = 13.5 Ratio of Concentration
Au: 0.06 x .60 x 13.5 = 0.49
Ag: 16.0 x .75 x 13.5 = 162.0

Smelter Return:

Au	(0.49 - 0.02) x .95 x (350 - 5)	=	154
Ag	(162 - 1.0) x .95 x (8 - 0.25)	=	1185
Pb	(65 - 1.5) x 20 x .9 x (0.3 - 0.09 - 0.0561)	=	176
			1515
Smelting, Refining & Freight			(144)
			1371 per ton of conc.
	÷ 13.5		102
Less Royalty 5% NSR			5
			97 per ton of ore

150,000 x 102 =	15,300,000	NSR
150,000 x 50 =	7,500,000	Cost
	765,000	Royalty

MISCELLANEOUS CALCULATIONS

Depletion

(15.3 - 0.76) 0.15	=	2.18
(7.04 - 1.65) x .5	=	2.70
6.22 x .5	=	3.11
15.3 x .15	=	2.30

Depreciation

$11.0M x .15	=	1.65
11.0M x .22	=	2.42
11.0M x .21	=	2.31

U.S. Tax

	Capital Payback				
(1.41)	7.06 @ 8%	3 Yrs.	=	8.89	
(1.78)	5.86 "	2 Yrs.	=	6.83	
(1.73)	10.76 "	1 Yr.	=	11.62	
1.48				27.35	
1.12	1 Yr. @ 8%			29.54	
1.17			-	7.04	(1)
1.15				22.50	
0.0	1 Yr. @ 8%			24.30	
			-	7.04	(2)
				17.26	
	1 Yr. @ 8%			18.64	
			-	7.04	(3)
				11.60	
	1 Yr. @ 8%			12.53	
			-	7.02	
				5.51	
				5.95	
			-	5.87	

C. #3 10-10-84

	CAPITAL INVEST.	NSR	ROYALTY NSR	ROYALTY NET PROFIT	NSR AFTER ROYALTY	OPER. COST	TOTAL OPER. COST	CASH FLOW BEFORE TAX	DEPREC.	DEPLET.	TAXABLE INCOME	INCOME TAX	CASH FLOW AFTER TAX
1	7.0		0.06			3.0	3.06	(7.06)			(3.06)	(1.41)	(7.06)
2	2.0		0.06			3.8	3.86	(5.86)			(3.86)	(1.78)	(5.86)
3	7.0		0.06			3.7	3.76	(10.76)			(3.76)	(1.73)	(10.76)
4		15.3	0.76		14.54	7.5	8.26	7.04	1.65	2.18	3.21	–	7.04
5									2.42		2.44	–	7.04
6									2.31		2.55	–	7.04
7									2.31		2.55	0.02	7.02
8									2.31		2.55	1.17	5.87
9				1.58	13.72		9.08	6.22		2.30	5.56	2.53	3.69
10													
11													
12													
13													
14													

CC NUMBER 3 CASE J.P.S. 10/10/84

YAR	CASH FLOW	D.C.F.
1	-7060.000	-7060.000
2	-5867.000	-5005.125
3	-10760.000	-7949.594
4	7040.000	4386.570
5	7040.000	3746.647
6	7040.000	3200.077
7	7020.000	2725.476
8	5870.000	1946.529
9	3690.000	1045.121
10	3690.000	892.656
11	3690.000	762.433
12	3690.000	651.207
13	3690.000	556.207
OTAL	28780.000	-1.792

ETURN ON INVESTMENT = 17.080 PCT.

ASARCO

Southwestern Exploration Division

November 27, 1979

Superior East Project
Pinal County, Arizona

A pro-forma feasibility study has been made which shows the following after tax internal rates of return:

	Total Project			Project with Property Obligations		
Cu price	$1.00	1.30	1.60	$1.00	1.30	1.60
DCFROR	16.12%	24.33%	30.74%	15.27%	22.96%	27.95%

Feasibility was based on the following criteria:

Reserves: Primary orebody - high grade disseminated and fracture vein controlled.

100,000,000 tons @ 1.25% Cu } 90% mined grade,
110,000,000 tons @ 1.14% Cu } 110% mined tons.

Mining: See attached sketch for configuation of orebody (J.D.Sell) with a presumed strike of 4,000', 300' wide and 1,000' thick. Block caving used for a mining system rated at 20,000 tpd with a 16-year life.

Milling: Standard flotation flow sheet for 20,000 tpd producing high grade concentrates.

Capital Costs: See attached estimate by George Percival.

Mine preproduction	$140,300,000
Mill	100,000,000
Engineering	4,000,000
Working Capital	8,700,000
	$253,000,000

NSR: See A.J.Kroha's estimate to adjust for George Percival's comment (chalcopyrite concentrates estimated at 0.33/lb smelting).

Cu price	smelter	Grade	tpd	NSR/lb	Rec'y	NSR/ton
$1.00	.26	1.14 -	20 -	.74 -	.95 =	16.03
1.30	"	"	"	1.04	" =	22.53
1.60	"	"	"	1.34	" =	29.02

>>>

Operating Costs: See attached estimate by George Percival.

	Total Project per ton	Project with with property obligations Cu $1.00	$1.30	$1.60
Direct mining	$3.71	3.71	3.71	3.71
Indirect "	1.48	1.48	1.48	1.48
Direct milling	1.49	1.49	1.49	1.49
Indirect "	0.59	0.59	0.59	0.59
Management fee	--	0.05	0.05	0.05
3% royalty	--	0.48	0.68	0.87
	$7.27	7.80	8.00	8.19

Also attached are print-outs and work sheets for the above six rates of return and a copy of the initial request.

Property obligations include:

1) 3% NSR to CanUS Ltd upon production until $20,000,000 paid;

2) 0.05 per ton management fee;

3) Mining agreement with Continental Materials based on net profit lease. Net profits shared 80-20% after payback of all pre-mining expenses (including exploration), plus 1% over the prime rate, less $500,000 deductible. This also covers post-mining operation captial costs.

R.B.C.
R. B. Crist.

RBC:jlh
attachment
c.c. W.L.Kurtz
F.T.Graybeal ✓
J.D.Sell
G.Percival

ASARCO

Southwestern Mining Department

November 20, 1979

Mr. R. B. Crist
Tucson Office

SUPERIOR EAST

This study is a quick analysis of the Superior East prospect based on meager information and must not be considered as final. Ore reserves are not fully defined. Under these circumstances opinions can vary considerably but an attempt has been made to establish some cost parameters.

The ore consists of bornite in a quartz vein complex in a schistose rock. The vein does have gougy areas but it is not certain that this material will cave readily but an assumption has been made that block caving will be the mining system as at this time it is doubtful that a more costly system will be feasible.

In general, two production shafts will be sunk to ±5,000 feet with operating levels at the 4,000 and 5,000 elevations. Levels will be interconnected with ramps within the mine to establish a stoping level at 4,500' elevation initially. By preliminary calculations the orebody dips at 60° and this necessitates the shorter caving lift of ±500 feet. Trackless electric equipment will be used throughout the operation wherever possible to alleviate the ventilation problems caused by 140°F temperatures. Electric rail haulage is contemplated on the 5,000' level to the production shafts.

Drainage is considered to be minimal.

The extreme temperatures will necessitate refrigeration and adequate ventilation which will require detailed study.

The Net Smelter Return as listed on the guide sheet should be reviewed with the Smelting Department. The deduction shown is applicable to a chalcopyrite concentrate but not a bornite concentrate which will be much higher grade in copper.

Pre-development costs are not estimated and will include exploration costs, roads, permits, etc.

MINE PRE-PRODUCTION DEVELOPMENT COSTS

Two (2) production shafts 5,000' @ $5,000 (completed with sets, etc.)	-	$ 50,000,000
One (1) service shaft with waste hoisting 5,000 x $4,000	-	20,000,000
Two (2) ventilation raises 4,000' @ $800	-	6,400,000
4,000' level development 12,000' @ $400	-	4,800,000
5,000' level development 18,000' @ $400	-	7,200,000
Inter-level ramps (4,000' level to 5,000' level)	-	1,000,000
Stope preparation (raises, drawpoints, undercutting, etc.)	-	8,000,000
Core drilling 20,000' @ $30	-	600,000
Mine equipment	-	12,000,000
Surface facilities (buildings, headframe, hoists, etc.)	-	19,900,000
Ventilation & refrigeration	-	2,000,000 (?)
Water Supply (wells, delivery, power, distribution, etc.)	-	1,800,000
Tailings disposal	-	2,500,000
Power supply	-	4,100,000
Sub Total		$140,300,000

MILL

Capital Cost (20,000 tons @ $5,000)	-	$100,000,000
Sub Total	-	$240,300,000
Engineering & Construction Fees	-	$ 4,000,000
Grand Total	-	$244,300,000
WORKING CAPITAL	-	$ 8,700,000
TOTAL	-	$253,000,000

By interpolating information from various sources, the 1979 operating costs for this block caving system are estimated as follows:

Direct Mining	-	$3.71/ton
Indirect "	-	1.48/ton
Direct Milling	-	1.49/ton
Indirect "	-	0.59/ton
Total	-	$7.27/ton

George Percival

GP/mc
attach.

cc: TEScartaccini - w/attach.

35-37% Cu – concentrate grade

Cu	700-20, 97.5% = 663# ($1.00)		663.00
TC		= 79.86	
RC	633 (.12391)	= 78.44	158.30
			504.70

$$\frac{700 - 663 + 158.30}{700} = 27.90 \text{ ¢/lb}$$

E. SUPERIOR TOTAL PROJECT PROFORMA FEASIBILITY CU 1.00 GRADE 1.25 11-26-79

YEAR	CASH FLOW	D.C.F.
1	-15000.000	-15000.000
2	-35000.000	-30141.242
3	-45000.000	-33373.270
4	-60000.000	-38320.449
5	-98000.000	-53901.215
6	63936.000	30283.848
7	63936.000	26079.793
8	62996.000	22129.148
9	52345.000	15835.074
10	51127.000	13319.508
11	50061.000	11231.309
12	49129.000	9492.094
13	48313.000	8038.609
14	47599.000	6820.371
15	47599.000	5873.555
16	47599.000	5058.176
17	47599.000	4355.992
18	47599.000	3751.287
19	47599.000	3230.525
20	47599.000	2782.058
21	47599.000	2395.848
TOTAL	569635.000	-58.789

RETURN ON INVESTMENT = 16.120 PCT.

(000 omitted) 11/26/79

Superior East - Total Project
Preliminary Feasibility
Cu 1.00 Grade 1.25%

YR	CAP. EXP NSR	OPR. COST	CASH FLOW Before TAX	DEPREC.	DEPLET.	TAXABLE INCOME	INC TAX	CASH FLOW After TAX
1	-15,000							
2	-35,000							
3	-45,000							
4	-60,000							
5	-98,000							
6	+ 117,[illegible]	53,071	63,936	31,625	16,161	16,150	7,429	63,936
7				27,672	17,551	18,731	8,616	63,936
8				24,213		22,170	10,198	62,996
9				21,186		25,197	11,591	52,345
10				18,538		27,845	12,809	51,127
11				16,221		30,162	13,875	50,061
12				14,193		32,190	14,807	49,129
13				12,419		33,964	15,623	48,313
14				10,867		35,516	16,337	47,599
15								
16								
17								
18								
19								
20								
21								

2 yr carryforward

Return / Cap.

① INV. Tax Credit 10%		25,300	17871	9255		63,936	4.2 yrs
		7,429	8616	[illegible]		[illegible]	
		17,871	9255	- 943		62,996	

E. SUPERIOR TOTAL PROJECT PROFORMA FEASIBILITY CU 1.30 GRADE 1.25 11-26-79

YEAR	CASH FLOW	D.C.F.
1	-15000.000	-15000.000
2	-35000.000	-28150.898
3	-45000.000	-29111.254
4	-60000.000	-31219.352
5	-98000.000	-41013.133
6	111333.000	37475.289
7	84214.000	22799.723
8	82623.000	17991.625
9	81231.000	14227.070
10	80013.000	11271.414
11	78947.000	8944.945
12	78014.000	7109.496
13	77198.000	5658.434
14	76484.000	4509.047
15	76484.000	3626.680
16	76484.000	2916.980
17	76484.000	2346.160
18	76484.000	1887.043
19	76484.000	1517.771
20	76484.000	1220.760
21	76484.000	981.871
TOTAL	1032445.00	-10.196

RETURN ON INVESTMENT = 24.330 PCT.

Proforma Feasibility
Cu 1.30 Grade 1.25%

4e							
- 15,000							
- 35,000							
- 45,000							
- 60,000	OPR	Cash Flow	DEPREC.	DEPLET.	TAXABLE	INC	Cash Flow
- 98,000	Cost	Before Tax			INCOME	TAX	After Tax
+ 164,442	53,071	111,371	31,625	24,663	55,083	25,338	111,333
			27,672		59,036	27,167	84,214
			24,213		62,495	28,748	82,623
			21,186		65,522	30,140	81,231
			18,538		68,170	31,358	80,013
			16,221		70,487	32,424	78,947
			14,193		72,515	33,367	78,014
			12,417		74,289	34,173	77,198
			10,867		75,841	34,887	76,484
		Inv. Tax Credit	25,300		Return of Capital		

2.25 gms

E. SUPERIOR TOTAL PROJECT PROFORMA FEASIBILITY CU 1.60 GRADE 1.25 11-26-79

YEAR	CASH FLOW	D.C.F.
1	-15000.000	-15000.000
2	-35000.000	-26770.691
3	-45000.000	-26326.652
4	-60000.000	-26848.867
5	-98000.000	-33542.262
6	140223.000	36709.383
7	113105.000	22648.070
8	111513.000	17079.152
9	110121.000	12900.379
10	108903.000	9758.059
11	107837.000	7390.656
12	106904.000	5604.031
13	106088.000	4253.676
14	105374.000	3231.644
15	105374.000	2471.810
16	105374.000	1890.630
17	105374.000	1446.100
18	105374.000	1106.088
19	105374.000	846.021
20	105374.000	647.102
21	105374.000	494.953
TOTAL	1494686.00	-10.507

RETURN ON INVESTMENT = 30.740 PCT.

Superior East - Total Project
Pro forma Feasibility
CO 1.66 Grade 1.25 %

P INV. NSR	OPR COST	CASH FLOW Before TAX	DEPREC.	DEPLET.	TAXABLE INCOME	INC. TAX	CASH FLOW After TAX
-15,000							
-35,000							
-45,000							
-60,000							
-98,000							
+211,878	53,071	158,807	31,625	31,782	95,400	43,884	140,223
			27,672		99,353	45,702	113,105
			24,213		102,812	47,294	111,513
			21,186		105,839	48,686	110,121
			18,538		108,487	49,904	108,903
			16,221		110,804	50,970	107,837
			14,193		112,832	51,903	106,904
			12,419		114,605	52,719	106,088
			10,867		116,158	53,433	105,374

INV. TAX Cred 25,300

Return of Capital
2 yrs.

E. SUPERIOR (WITH OBLIGATIONS) PROFORMA FEAS. CU 1.00 GRADE 1.25 11-26-79

YEAR	CASH FLOW	D.C.F.
1	-15000.000	-15000.000
2	-35000.000	-30363.508
3	-45000.000	-33867.277
4	-60000.000	-39174.449
5	-98000.000	-55508.773
6	60067.000	29515.855
7	60067.000	25605.855
8	60067.000	22213.816
9	51285.000	16453.617
10	48795.000	13580.953
11	48372.000	11679.730
12	48917.000	10246.660
13	46932.000	8528.555
14	44604.000	7031.762
15	44604.000	6100.254
16	44604.000	5292.145
17	44604.000	4591.086
18	44604.000	3982.899
19	44604.000	3455.278
20	44604.000	2997.551
21	44604.000	2600.462
TOTAL	528334.000	-37.300

RETURN ON INVESTMENT = 15.270 PCT.

11/26/79

Superior East - with Property obligations
Proforma Feasibility
Cu $1.00 Grade 1.25%

YR	CAP INV	NSR	OPR. COST	CASH FLOW Before Tax	ASARCO 80% of Net Profits after Payback of ALL Pyramiding - including Explor. plus 1% int. over Prime Rate $500,000 deductible: DEPREC. ALL	Depletion 97%-100%	TAXABLE inc. 80% N.P.	CANUS 3% NSR 3% Deplet $20,000,000 limit	Cont. Mgmt 20% N.P. $500,000 deductible		ASARCO INC. TAX	ASARCO CASH FLOW After Tax	PAYBACK ACCUM.
1	15,000												
2	35,000												
3	45,000												
4	60,000												
5	98,000												
6	117,007	56,940	60,067	31,625	13,394	14,548	(426) 3,510	500			6,692	60,067	
7				27,672	15,711	16,684	(426) 3,510	—			7,675	60,067	
8				24,213	17,024	18,830	(527) 3,510	—			8,661	60,067	180,201
9				21,186	"	21,857	3,510	—			8,782	51,285	231,486
10				18,538	"	24,505	3,510 (369.0)	—			11,272	48,795	280,281
11		55,884	61,123	16,221	17,182	27,720	2,450	—			12,751	48,372	328,650
12		53,436	63,571	14,193	17,551	31,857	—	—			14,654	48,917	377,567
13				12,419		31,410	—	2,190			14449	46,932	(32,423) 410,100
14				10,867		28,122	—	7031			12,936	44,604	
15							—						
16							—						
17							—						
18							—						
19							—						
20							—						
21							—						
							20,000	58,938					

Payback 100% of Net Profits, Less $500,000 for 253,000 Cap. 6,000 Expl. 151,000 Int.

Inv. Tax Credit 25,300.

6692	25,300	10,054
7675	23,028	1,272
8661	1,272	9,782

E. SUPERIOR (WITH OBLIGATIONS) PROFORMA FEAS. CU 1.30 GRADE 1.25 11-26-79

YEAR	CASH FLOW	D.C.F.
1	-15000.000	-15000.000
2	-35000.000	-28464.562
3	-45000.000	-29763.602
4	-60000.000	-32274.586
5	-98000.000	-42871.828
6	104532.000	37190.469
7	81713.000	23643.402
8	78612.000	18498.828
9	77220.000	14778.203
10	77857.000	12117.855
11	71178.000	9009.699
12	70027.000	7208.859
13	69019.000	5778.379
14	68137.000	4639.344
15	68137.000	3773.054
16	68137.000	3068.524
17	68137.000	2495.549
18	68137.000	2029.563
19	68137.000	1650.589
20	68137.000	1342.380
21	68137.000	1091.722
TOTAL	922254.000	-57.958

RETURN ON INVESTMENT = 22.960 PCT.

Superior East - with royalty obligations

Proforma Feasibility

Cu $1.30 Grade 1.25%

Cap. Inv.

NSR

Yr		OPR Cost	Cash Flow Before Taxes	ASARCO 80% of NET Profits after Payback of ALL Pre-Mining Costs plus 1% over Payment. $500,000 deductible. ALL DEPREC.	(97-100%) DEPLETION	80% N.P TAXABLE INC.	CANUS 3% NSR 3% Depl.	Court Atty 20% N.P. 500,000-Deduct	ASARCO INC. TAX	ASARCO CASH FLOW AFTER TAX	Payback ACCUM.
1	-15,000										
2	-25,500										
3	-35,000										
4	-60,000										
5	-78,000										
6	+114,442	58,400	106,042	31,625	22,197	51,718	4,633 2466	500	23,791	104,532	
7		"	"	27,612	"	56,171	4,633 "	—	25,839	81,713	
8		"	"	24,213	"	59,690	4,633 "	—	27,430	78,61[illegible]	264,857
9		"	"	21,186	"	62,657	4,633 "	—	28,822	77,22[illegible]	342,077
10		55,007	109,435	18,538	24,433	64,664	1,468 238	1,860	29,718	77,857	416,000
11		53,436	111,006	16,221	24,6[illegible]	56,[illegible]	—	14,024	25,8[illegible]	71,17[illegible]	
12				14,193		57,718	—	14,429	26,550	70,027	
13				12,419		59,136	—	14,784	27,203	69,019	
14				10,867		60,378	—	15,095	27,774	68,137	
15							—				
16							—				
17							—				
18							—				
19							—				
20							—				
21							—				
							20,000	60,872			

INV. Tax credit 25,300

Payback 410,000

E. SUPERIOR (WITH OBLIGATIONS) PROFORMA FEAS. CU 1.60 GRADE 1.25 11-26-79

YEAR	CASH FLOW	D.C.F.
1	-15000.000	-15000.000
2	-35000.000	-27354.430
3	-45000.000	-27487.285
4	-60000.000	-28643.773
5	-98000.000	-36564.930
6	110588.000	32248.262
7	109040.000	24850.996
8	107448.000	19138.855
9	103645.000	14428.645
10	96033.000	10448.582
11	95172.000	8092.930
12	94019.000	6248.441
13	93012.000	4831.195
14	92130.000	3740.043
15	92130.000	2923.050
16	92130.000	2284.525
17	92130.000	1785.482
18	92130.000	1395.453
19	92130.000	1090.624
20	92130.000	852.382
21	92130.000	666.184
TOTAL	1292997.00	-24.605

RETURN ON INVESTMENT = 27.950 PCT.

11/20/79 Superior East with property consignments

Proforma Feasibility

Cu 1.60 Grade 1.25%

ASARCO

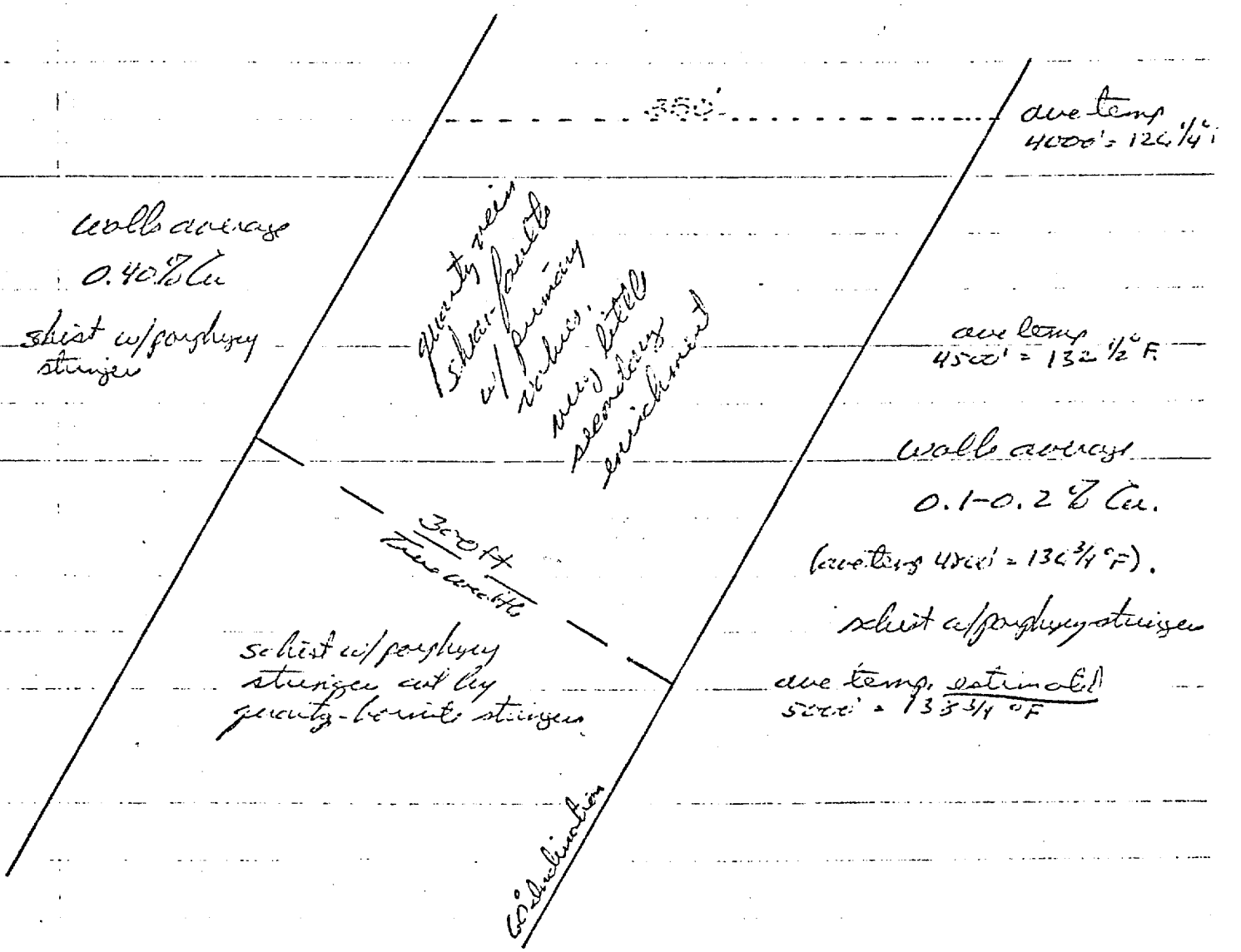
80% of N.P. After Payback

Yr	Capital Exp.	NSR	OPR. Cost	Cash Flow Before Taxes	DEPREC	Depletion	80% N.P. TAXABLE INC.	CANUS 3% NSR 3% DEPL	Cont. MTR 20% N.P. (500,000 ded)	ASARCO INC TAX	ASARCO Cash Flow After Tax	Payback ACCUM
1	-12,000											
2	-35,000											
3	-45,000											
4	-60,000											
5	-98,000											
6	+211,875		59,787	152,091	31,625	30,829	89,137	6,356 1043	500	41,003	110,5[illegible]	
7			"	"	27,672		93,590	6,356 "		43,051	109,[illegible]	245,192
8			"	"	24,213		97,049	6,356 "		44,643	107,458	352,646
9			54,357	157,511	21,186		95,611	932	9,885	43,981	103,645	+[illegible]
10			53,456	158,442	18,538		87,900		21,975	40,434	96,[illegible]	
11					16,221		89,114		22,278	40,972	95,172	
12					14,193		90,736		22,684	41,739	94,[illegible]	
13					12,419		92,155		23,039	42,391	93,012	
14					10,869		93,397		23,349	42,963	92,130	
15												
16												
17												
18												
19												
20												
21								20,000	123,912			

INVEST TAX Credit 25,200

[illegible] 3,354

Top of ore below surface ranges from 3879' to 4262' use 4000' depth as average.



(3 holes) (1 hole)

Ag ranges: 0.41 oz/ton, upper areas; to 0.75 oz/ton deeper

Au ranges: 0.009 oz/ton, " " ; to 0.015 oz/ton " ".

ASARCO

RECEIVED

SEP 4 - 1979

EXPLORATION DEPARTMENT

Exploration Department
T. C. Osborne
Vice President

August 30, 1979

Mr. W. L. Kurtz
Tucson Office

Arizona
Superior East Project

Dear Mr. Kurtz:

I'm in agreement with the opinion expressed by Mr. Graybeal's memorandum of August 6 which I know you share, to the effect that exploration of the A-8 discovery has reached the point at which acceleration of drilling is warranted in order to determine tonnage and grade. Although I reserve the right to quibble about details later on, in general you and Mr. Graybeal should plan to include provision for the program in your 1980 budget proposal. I agree two drills should be the minimum during the first year, and we might wish to increase this to three or even four drills during 1981 if the 1980 results are favorable.

We would likely have no difficulty finding a joint venture partner to share cost of the program if we desired, but my initial thought is that the financial commitment is within our capabilities and it will be best to proceed alone.

In considering the proposal, we need a firmer handle on possible economics of the deposit. Therefore, I would like to have from you not later than December 1 a pro forma feasibility outline using horseback figures, for a model of 100 million tons at 1.25% Cu above the 5,000' level. I expect Mr. Skidmore or others in the Mining Department can help you with estimates of development and operating block cave — and capital costs derived from Sacaton studies. The scenario should assume that drilling has been completed and Year 1 starts with development shaft sinking. Use 1979 capital and operating costs and work out potential after-tax internal rates of return for various copper prices. The analysis should show returns both for the total project and for Asarco's share after provision for Continental's net proceeds royalty. If any questions arise, please call.

Very truly yours,

T. C. Osborne

cc: FTGraybeal

DMJ. 11/8/84

APPENDIX 1

Conventions Used for Blocking Ore Reserves at the Buffalo Boy Mine*

Proved Ore

1. Ore must be channel sampled at intervals not exceeding 5 ft. and no individual sample may exceed 5 ft. in length (this latter requisite has been ignored for the 10-84 estimate because some of Metzer's samples do exceed 5 ft. in length and no alternative is available.)

2. As a general rule samples having assays 2 or more orders of magnitude higher than neighboring samples will be ignored. The following 3 samples were deleted from the 10-84 estimate:

Au oz.	Ag oz.	Width Ft.
336.56	14.56	2.5
613.00	18.96	4.0
7,616.00	27.22	1.7

3. The cutoff grade for blocking shall be 0.10 oz. Au.

4. A minimum of 3 contiguous sample lines each having an average assay value equal to or greater than cutoff grade is required to create an ore block.

5. Ore blocks shall be drawn as rectangles except where their shape must be altered to conform to straight-line approximations of stoping contours or assay distributions.

6. The height of an ore block shall be determined by the length of ore exposed in a drift, stope, raise, winze, or shaft:

Horizontal Extension, Ft.	Vertical Allowance, Ft.
0 - 50	10
51 - 100	15
101 - 200	20
201+	25

7. Blocks of equal height may be drawn above and below a drift, but not below a stope where original drift assays are lacking.

8. Raise assays shall not be used for estimating grade except where no drift assays are available. (Raises typically fail to expose an entire vein width and thus may produce biased sampling of the vein.)

Indicated Ore

1. No block of indicated ore may be considered for proved blocks less than 50 ft. long or for proved ore blocks drawn along raises, winzes, and shafts.

2. Indicated ore may be blocked above a back block of proved ore or below a sill block of proved ore and shall be drawn as a 45 degree triangle whose base forms the length of the proved block and whose point shall not extend more than 100 ft. (one level interval) from the mine level.

3. Where triangular blocks of indicated ore on adjacent levels intersect the blocks may be redrawn as one by connecting the superposed corners of the upper and lower proved blocks.

*Based on the method of ore reserve calculation developed by P.C.Henshaw for use at the Tayoltita mine and subsequently modified by D.M.Smith, Jr. and D.K.Hall.