CONTACT INFORMATION
Mining Records Curator
Arizona Geological Survey
416 W. Congress St., Suite 100
Tucson, Arizona 85701
520-770-3500
http://www.azgs.az.gov
inquiries@azgs.az.gov

The following file is part of the

James Doyle Sell Mining Collection

ACCESS STATEMENT

These digitized collections are accessible for purposes of education and research. We have indicated what we know about copyright and rights of privacy, publicity, or trademark. Due to the nature of archival collections, we are not always able to identify this information. We are eager to hear from any rights owners, so that we may obtain accurate information. Upon request, we will remove material from public view while we address a rights issue.

CONSTRAINTS STATEMENT

The Arizona Geological Survey does not claim to control all rights for all materials in its collection. These rights include, but are not limited to: copyright, privacy rights, and cultural protection rights. The User hereby assumes all responsibility for obtaining any rights to use the material in excess of "fair use."

The Survey makes no intellectual property claims to the products created by individual authors in the manuscript collections, except when the author deeded those rights to the Survey or when those authors were employed by the State of Arizona and created intellectual products as a function of their official duties. The Survey does maintain property rights to the physical and digital representations of the works.

QUALITY STATEMENT

The Arizona Geological Survey is not responsible for the accuracy of the records, information, or opinions that may be contained in the files. The Survey collects, catalogs, and archives data on mineral properties regardless of its views of the veracity or accuracy of those data.

TAB

Superior East
Reports Misc.

Miscellaneous Drill Holes, Reports, & Thoughts.

Kerr-McGee (1964-1966) (OF-1A & DC-1)
Miami Copper - Superior Oil (1964) DCA #1 & DCA #2.
Newmont (See in ASARCO).

ASARCO includes: (partial listing).

Zoned Ash-Flow Sheet (4-1-68)
Preliminary Superior 7½' Quad Map (May 5, 1970)
Whitetail Eyl Prospect (June 2, 1970)
Drilling Activity - Log of hole M-1
United Verde Drill Holes (A30-31) Dec. 23, 1970
Porphyry Cu Lineament Concept & Rotated Tw Study (Expl. Meeting 3-11-71
Superior East Proj. East Edge of Dacite (Jan. 27, 1971).
Samples of Tertiary Basalt (April 1, 1971)
Drill Hole Data (April 12, 1971)
Drill Hole Information (April 15, 1971)
Production - Grade - Reserves - Major Mines (June 14, 1971)
Isotopic Ages - Setton Hwy, Arnett Creek, Stone House (June 25, 7
Biotite Studies (Sept. 1, 1971)
Coring Rates, CP-50, Holes M-1A, A-1, A-4 (Nov. 8, 1971)
SE Proj. Drilling Summary Letter to R.L. Hornbrook (Dec. 17, 1971)
Drill Hole Info (1/1972)
Porosity - Permeability Data (Jan. 24, 1972)
Stratiform Deposits (Feb. 7, 1972)
Proposed Drill Holes & Costs (2, 1972)
Drill Hole Geology 1971-1972 (May 30, 1972)
Native Copper (June 2, 1972)
1971-1972 Summation Report w/ Recommendations (Draft) 8/30/72.

Tops of Units, Holes A-7 & AI-1 (June 29, 1973)
Kirby Corzell's State Lease Drill Hole (Aug. 6, 1973)
Log of Rotary Hole M-1 (74?)
Slide Block Information (Aug 28, 1974)
Boyles Drilling Contract (12/15/74)
Notes of Drilling - Rotary & Core. (Dec. 74)
#6 Shaft & S. Vn at Magma (75?)
Newmont Drilling on State Leases (Feb 5, 1975)
Tonto vs Others - Drilling Rates (Nov '75)
Newmont - Corzell Drill Hole abandoned (Feb 19, 1976)
Directionally Controlled Re-Drill of Hole A-8 (Dec 1, 1976)
Displacement - Devils Canyon Fault. (Feb 7, 1977)
Newmont Hole B-6 (Sept 22, 1977)
Newmont Hole B-7 (Oct. 4, 1977)
Geochem of Holes B-6, B-7 & Elsewhere (Oct. 11, 1977)
Au-Ag Results, Newmont Holes (Nov. 15, 1977)
Salt River Power Hydroelectric Pumped Storage Plan (Jun 1, 1979)
Drilling Fluid Formulas (Feb 6, 1980)
Schedule of Drilling (March 4, 1980)
Directional Survey & Temp. Report, Hole A-14. (March 5, 1981)
Oriented Core, Hole A-12. (June 15, 1981)
Goniometer Readings. (June 26, 1981)
Assay Results A-13 (Aug 5, 1981)
Assay Results A-14 (Aug. 10, 1981)
Assay Report, Holes A-12 & A-12-A (Jan 15, 1982
Joy Drilling Proposal (Jan. 7, 1983)
Dept Water Resources Application (Feb 21, 1984)
Best Fit Claims (July 16, 1984)
Water Rights Adjudication (Nov. 13, 1984)
Closure of Continental Materials Office (Dec 19, 1984)

Water Rights - Devils Canyon (Oct. 9, 1985)

KERR-McGEE OIL INDUSTRIES, INC.
INTERNAL CORRESPONDENCE

TO E.E. Jones

DATE January 15, 1965

FROM R.C. Barkley

SUBJECT Evaluation and Drilling Report of Oak Flat and Devils Canyon Areas, Pinal County, Arizona

Oak Flat Area

Preliminary Recommendations

Drilling was recommended in the Oak Flat area by Mike Fitzgerald on the basis of a structural intersection of three prominent structures projected underneath the post-ore dacite cover. A study and comparison of other orebodies in the area indicates that chance of sulfide mineralization near each structural intersection are about five out of seven.

Results of Drilling

Drilling was commenced the 17th of September, 1964, by C.C. Smith Drilling Co. A rotary-type Failing 1500 rig that was rigged for a 2000 foot capacity was used for the first hole. A total of 671 feet was drilled into the dacite when the drillers encountered trouble twisting off the pipe and losing the bit cones in the hole. Five days were spent in trying to retrieve the bit cones and junk basket before abandoning the hole on the 24th of September.

An offset (DDH OF-1A) to the abandoned hole DDH OF-1, was started on October 27 by C.C. Smith Drilling Company. A rotary-type Failing 2500 rig was used in drilling the offset hole. A total of 2150 feet was drilled in DDH OF-1A to complete the hole on November 15.

Three vitrophyre zones were encountered from 1635 to 1670 feet; 1790 to 1840 feet; and from 1875 to 1930 feet respectively. A vitrophyre and basal tuff zone predominantly is a marker horizon for the dacite over most of the exposed area. The white tuff zone was absent below all of the vitrophyre zones in the hole. The three vitrophyre zones could represent either a reverse fault or flows within the dacite. Total thickness of the dacite is 1995 feet. A zone from 1995 to 2050 feet consists mainly of black shale and lime fragments with minor orange silicified particles and may represent a weathered zone of the Whitetail conglomerate. From 2050 to 2150 feet a diabase was encountered with core taken from 2130 to 2150 feet. Assays of the cored interval from 2130 to 2140 feet are a trace of gold and silver, and 0.07% Cu. A standard assay of the cored interval from 2140 to 2145 feet are 0.06 oz. Ag and 0.004 oz. Au. A petrographic description of thin sections from the core by M. Wood of the University of Arizona is as follows:

Plagioclase	- 78%
Augite	- 10%
Chlorite	- trace
Magnetite?	- 12%

The texture is diabasic with a well aligned fabric of plagioclase laths. Augite is interstitial. The megascopic banded appearance is unrecognizable in thin section. The fine-grained equigranular texture indicates a hypabyssal (dike) origin.

Conclusions and Recommendations

The Apache group is exposed north and west of the hole, so that the diabase encountered in the hole may be a diabasic intrusive within the Apache group. Anomalous values of gold, silver and copper in the diabase may indicate adjacent mineralization. It is recommended that an induced polarization survey be made down the hole and an area around the hole that can be effectively surveyed to see if any sulfides are present.

A breakdown of the costs for hole #OF-1 and OF-1A excluding surveying and claim staking is as follows:

Road Construction and Repair (including drill site and mud pits)		$5516.49
Drilling	OF-1 (abandoned)	5455.70
	OF-1A (offset)	12137.50
	Total	$17,593.20
Rotary Bits	13 size 4 3/4" rotary bits @ $37.00/bit	$ 481.00
	25 size 6 1/4" rotary bits @ $75.00/bit	1875.00
	Total	$2356.00
Surface Casing		$ 50.67
Water	21 loads @ $1.00/load	$ 21.00
Loss of Circulation Material		$2768.85
	Total	$28,306.21

Excluding road construction expenses, average cost per foot is $10.60.

Devils Canyon Area

Preliminary Recommendations

A hole was recommended 5½ miles north of Ray in the Devils Canyon area by Mike Fitzgerald on the basis of an intersection of three major structural trends projected underneath post-mineral rocks.

Results of Drilling

Drilling was started the 27th of November, 1964 and completed to a total depth of 2303 feet on December 17 by C.C. Smith Drilling Co. A Failing 2500 rotary-type drill rig was used to drill the hole.

Total thickness of dacite is 1130 feet. Vitrophyre is present from 1130 to 1160 feet and a white tuff unit was encountered from 1160 to 1165 feet. A thickness of 1138 feet was drilled into the Whitetail conglomerate from 1165 to 2303 feet. Due to a slower drilling rate, excessive thickness of the conglomerate, and increased drilling costs, the hole was bottomed in the Whitetail conglomerate. From 1165 to 1800 feet the conglomerate consists mostly of smaller pebbles and cobbles. From 1800 to 2303 feet the conglomerate contains larger size pebbles and boulders which decreased the rate of drilling considerably.

Conclusions and Recommendations

Before the drilling started, the thickest known section of Whitetail conglomerate was about 800 feet, exposed on Teapot Mountain north of Ray. As drilling progressed information was received that the Whitetail conglomerate was 1834 feet thick in Inspiration's hole three miles north of DDH DC-1. During the course of the drilling of this hole a reconnaissance of the Whitetail conglomerate exposed ½ mile south and west of the drill hole revealed the possibility of an excessive thickness of the conglomerate, that is generally tilted 15° to 40° to the northeast.

From this information a basin of Whitetail conglomerate can be projected from north of Ray to at least Section 26, T1S, R13E, for over 8 miles with Devils Canyon forming the west boundary of the basin.

It is recommended that an induced polarization survey be made down the hole and an area around the hole that can be effectively surveyed to see if any sulfides are present. More detailed mapping should be done in the area south and west of the drill hole of the Whitetail conglomerate and pre-mineral rocks to better understand the structures involved. Sufficient money has been spent on road construction and drilling to hold the State Leases until August 8, 1966.

The log of Inspiration's hole is as follows:

0-1105 feet	- Dacite
1105-2939 feet	- Whitetail conglomerat
2939-3240 feet	- Diabase
3240-3475 T.D.	- Pinal Schist

Inspiration encountered no sulfides in the diabase or schist as reported by Burt Reed, Chief Geologist for Inspiration. Core fragments of the schist found around their drill site were barren of any sulfides.

A breakdown of costs for hole #DC-1 is as follows:

Road Construction (including drill site and mud pits)	$15,247.50
help move rig to road, approximately	325.00
Total	$15,572.50
Drilling	$12,787.50
12 hours to move to highway, approximately	300.00
Total	$13,087.50
Rotary Bits	
27 size 6 1/4" rotary bits @ $75.00/bit	$2025.00
cost for setting diamonds in diamond bit, approx.	60.00
Total	$2085.00
Surface Casing	$ 20.82
Loss of Circulation Material, approximately	$1600.00
Total	$32,365.82

Excluding road construction costs, the average cost per foot is $7.29.

Inspiration's cost on their hole, which was cored from the surface, averaged $25.00/foot.

R. C. Barkley

R.C. Barkley

RCB/jh
enc.

E. E. Jones

Mike J. Fitzgerald

June 10, 1966

Proposed Assessment work in the Dacite Area, Pinal County, Arizona

Summary

Two prospects, Devils Canyon and Oak Flat, have been investigated in the dacite-covered area between Superior and Miami, Arizona. Each is located at the projected intersection of major structural trends which are known or strongly believed to control copper mineralization in known orebodies in the area. Drilling did not encounter pre-ore rocks in either of the prospects. Geologic work during and subsequent to drilling of the Devils Canyon Prospect, the more southerly of the two, indicates that pre-ore rocks in that area are probably too deep to be reached economically. However, drilling by other companies coupled with projected structural relationships indicates that pre-ore rocks may occur only a few hundred feet below the OF-1A hole in the north prospect (Oak Flat) and a limited amount of further drilling is recommended.

Devils Canyon Prospect

A brief log of the rocks encountered in the DC-1 drill hole is as follows:

0	-	1130	Tertiary dacite
1130	-	1160	vitrophyre
1160	-	1165	tuff
1165	-	2303	Whitetail conglomerate

The drilling results indicate that the projected structural intersection occurs in a pre-Tertiary topographic low which is filled with Whitetail conglomerate. Dips of the bedding in the exposed Whitetail south of the drill hole indicate that the conglomerate thickens to the north and it has previously been recommended that the prospect be dropped.

Oak Flat Prospect

The Oak Flat Prospect covers the projected intersection of three major structural trends; the Sleeping Beauty fault zone, the Ray fault, and the east-west zone of stronger copper mineralization which extends westward from the Copper Springs Prospect. The Copper Cities and Castle Dome porphyry copper orebodies lie within the broad Sleeping Beauty fault zone to the northeast of the dacite cover and the vein and replacement orebodies of the Magma Copper Company lie within the projection of the zone on the west side of the dacite at Superior. The Ray fault appears to have had an important effect on the localization of the orebodies at Ray and the OF-1A drill hole lies within the Sleeping Beauty zone just east of its projected intersection with the Ray Fault.

The geology of the area and the methods used to define and project the structural trends has been discussed in considerable detail in a previous report (Structural Features in the Miami-Superior-Kay, Arizona Region and Indicated Buried Prospect, May, 1964).

Two areas of mineralization exposed within the Sleeping Beauty zone have a direct bearing on drilling under the dacite. One is the Cactus orebody which lies on the east edge of the dacite. The orebody, which contains about 10 million tons of oxidized copper ore, occurs in a thrust plate and all available evidence seems to indicate that the plate moved to its present position from an area to the southwest subsequent to ore deposition and secondary enrichment. The other is the eastern portion of the Superior district where Magma's extensive exploration has disclosed the presence of considerable tonnages of replacement ore in limestone to the east of the present mine workings.

Summary of Drilling Results in the Northern Portion of the Dacite:

The Kerr-McGee OF-1A drill hole did not encounter pre-ore rocks and bottomed in Tertiary andesite at 2150 feet. A brief log of the hole is as follows:

OF-1A

0	-	1995	Tertiary dacite
1995	-	2050	Whitetail conglomerate
2050	-	2150	andesite -

The identification of whitetail conglomerate at 1995 - 2050 is not positive. If the material in this interval is not whitetail, the unit, if present, may lie at greater depths.

The three holes drilled by Miami Copper and Superior Oil have some bearing on whether or not the OF-1A drill hole should be deepened. Generalized logs of these holes are as follows:

DCA-1

Located 3.2 miles N 21 E of OF-1A

0	-	1360	Tertiary dacite
1360	-	1845	felsite
1845	-	2210	andesite
2210	-	4011	Whitetail conglomerate

DCA-2

Located 2.5 miles N 52 E of OF-1A

0	-	1430	Tertiary dacite
1430	-	1525	Whitetail conglomerate
1525	-	1575	Precambrian Pinal schist (exotic copper)
1575	-	1678	Cretaceous quartz monzonite (exotic copper)
1678	-	1772	Precambrian Pinal schist (exotic copper)

DCA-3

Located 1.7 miles S 88 E of OF-1A

0	-	1400	Tertiary dacite
1400	-	1415	vitrophyre
1415	-	1490	dacite tuff
1490	-	2430	basalt
2430	-	3000	Whitetail conglomerate

The location of each of the holes, the outline of the Kerr-McGee claims, and the projections of the structural trends are shown on the accompanying map. It is believed to be very significant that the only pre-dacite high encountered in the deep drilling to date (DCA-2) was along the projection of the Sleeping Beauty fault zone. Pre-ore rocks exposed on the edge of the dacite are topographically high east of the DCA-2 hole and west of the OF-1A hole suggesting that a high pre-dacite topographic trend, possibly associated with the Sleeping Beauty fault, may extend entirely across the present dacite exposure. If this trend is actually present, the high encountered in the DCA-2 hole may extend into the area of the OF-1A drill hole.

Exotic copper was encountered under but near the edge of the dacite southwest of the Cactus deposit in the 1930's and the drilling of DCA-2 establishes that the exotic copper extends further southwestward. The pattern of exotic copper occurrences under the dacite strongly suggests that the source of the copper, presumably the remainder of the enriched porphyry-type orebody of which the small Cactus deposit is a part, lies further to the southwest.

The OF-1A hole is located near and just to the east of the projected intersections of the Sleeping Beauty and Ray faults, the most likely location for the occurrence of disseminated copper mineralization, and, in view of the above drilling data, it appears to be worthwhile to deepen the hole in an attempt to reach pre-ore rocks. As the depth to pre-ore rocks in the area is at least 2200 feet it is believed that secondary enrichment related to the early Tertiary erosion surface, similar to that in the Miami-Inspiration and Ray orebodies, would probably have to be present to bring the grade of disseminated primary mineralization up to commercial ranges for depths in excess of 2000 feet. As it is not likely that extensive enrichment related to the early Tertiary erosion surface would occur under a great thickness of pre-dacite volcanics due to the unfavorable erosional environment, it is believed that if pre-ore rocks are not encountered within 500 feet of the bottom of the OF-1A hole the drilling could safely be terminated and the prospect dropped.

Should the actual location of the Ray fault zone be to the east of OF-1A, limestone should be present below the Tertiary rocks. The mechanism of displacement along the zone is not known but the total displacement must be at least 4000 to 5000 feet. There is some suggestion that the displacement may be in the form of step-faulting across a broad area as step-faulting has been noted in the Magma mine workings. However, displacement along the observed step-faults is small. In any event, the persistance of replacement ore down-dip in the favorable beds near the base of the Devonian Martin limestone coupled with the presence of zinc in the up-dip horizons suggests that the source of the copper may be to the east.

The probable presence of disseminated copper mineralization in the crystalline rocks east of the Ray fault suggests that the mineralization in the limestone may have the same source and, if so, it is entirely possible that tactite-type copper mineralization may occur in the limestones near the Ray fault zone. Thus, if the OF-1A hole does lie west of the Ray fault, there is a distinct possibility that disseminated copper mineralization may occur in that area in silicated limestones. In fact, indications of silication in the limestone accompanied by evidence of sulfide mineralization would be extremely suggestive that disseminated copper mineralization lies further to the east even if significant copper values were not encountered.

Conclusions

Projection of structural zones coupled with drilling by other companies in the dacite seems to indicate that there is a fair chance that pre-ore rocks may occur within a few hundred feet below the bottom of the OF-1A drill hole, and the location of the hole in relation to the projected structural zones is believed to be very favorable for the presence of disseminated copper mineralization. The presence of mineable ore in the pre-ore rocks is probably dependant on the presence of secondary enrichment related to the early Tertiary erosion surface so deepening the OF-1A drill hole 500 feet should be sufficient to test for the possibility of ore.

Recommendations

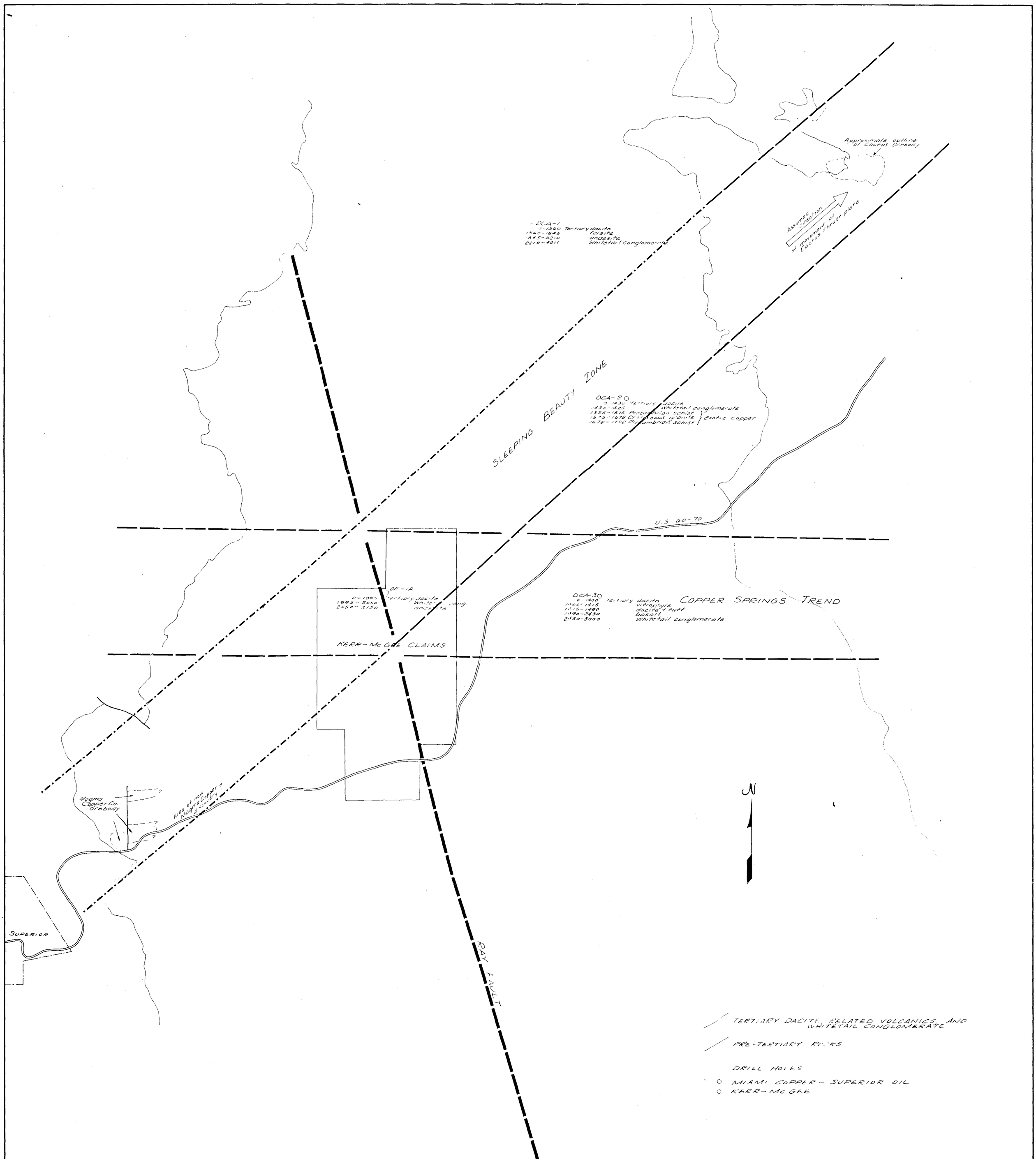
It is recommended that the OF-1A drill hole be deepened 500 feet in an attempt to reach pre-ore rocks. The hardness of the andesite encountered in the last 100 feet of drilling indicates that the deepening would have to be done with a core drill. Estimated costs are as follows:

Road repair	$ 300.
Cleaning existing hole ..... setting casing, etc.	500.
Cementing	500.
Mobilization	400.
Drilling: (500 ft at $10/ft) ...	5,000.
TOTAL	$6,700.

Mike J. Fitzgerald

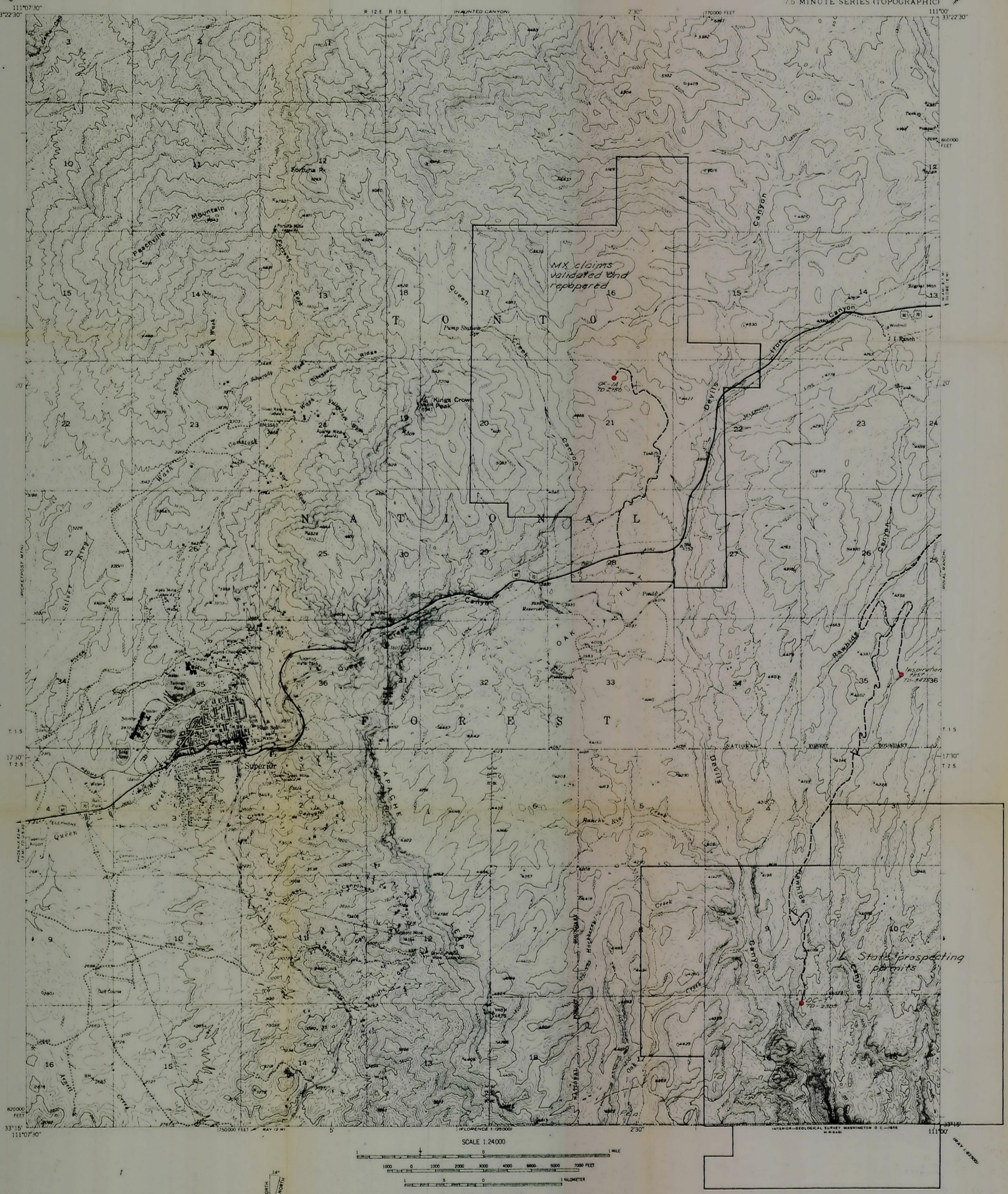
MJF/mf

CC: S. E. Jerome
P. C. Ellsworth
R. K. Corn



KERR-McGEE CORPORATION MINERAL EXPLORATION DEPARTMENT	GENERALIZED GEOLOGY AND STRUCTURAL PROJECTIONS OAK FLAT PROSPECT	STATE: ARIZONA COUNTY: PINAL AREA: DISTRICT: SUMMIT SURVEY:	GEOLOGY BY: M.J. FITZGERALD CONTOURED ON: CONTOUR INTERVAL: DRAWN BY: M.J.F. TRACED BY: C.A.B.	REVISIONS (Name & Date) REFERENCES: Pinal Ranch (Peterson) Prof. Paper 342 Western Half Superior Quad. (Peterson)
DATE: June 1966 SCALE: 1" = 2000'				Haunted Canyon (D. Peterson) Dacite Thesis

SUPERIOR QUADRANGLE
ARIZONA–PINAL CO
7.5 MINUTE SERIES (TOPOGRAPHIC)



SCALE 1:24000

1 MILE

7000 FEET

1 KILOMETER

CONTOUR INTERVAL 40 FEET
DATUM IS MEAN SEA LEVEL

TRUE NORTH
MAGNETIC NORTH
14°
APPROXIMATE MEAN DECLINATION, 1948

Td – dacite
Tw – whitetail
PEa – Apache group

SUPERIOR, ARIZ.
N3315–W11100/7.5
1948

KERR-McGEE OIL INDUSTRIES, INC.

District Oak Flat
Hole Number OF-1A
Spudded 10-27-64
Completed 11-15-64
Total Depth 2150 feet
Driller C.C. Smith
Logged By R.C.B.

County Pinal State Arizona
Claim MX-65 Sec 21 T. 1S R. 13E
Elevation
Hole Size 6¼"
Core Size 3 3/4" cored from 2130 to 2150'
Hole Angle Vertical
Collar Coords. N.
E.

Depth	Int.	%Core Rcvy	Samp. No.	Assays Cu	Mo	Rock Type	Rock Description	Alteration	Mineralization
0-1470						Dacite	red-brown; hard	some clay alteration	none
1470-1635						Dacite	yellow-brown and gray; hard and well indurated	some clay alteration	some limonite staining
1635-1670						Vitrophyre	dark gray and black; glassy with conchoidal fractures		
1670-1790		PLUGGED				Dacite	yellow-brown and gray	some clay alteration	abundant limonite coating
1790-1840						Vitrophyre	black, glassy with conchoidal fractures		
1840-1875						Dacite	reddish-brown	some clay alteration	decreased amount of limonite
1875-1930						Vitrophyre	black, glassy with conchoidal fractures		
1930-1995						Dacite	red-brown	some clay alteration	
1995-2050						Whitetail? conglomerate	predominant black shale and lime fragments; minor orange particles		

District Oak Flat Hole Number OF-1A Page Number 2

Depth	Int.	%Core Rcvy	Samp. No.	Assays Cu %	Mo	Au oz	Ag oz	Rock Type	Rock Description	Alteration	Mineralization
2050-2060			6067	.05				Diabase	Black, hard, dense	Trace amount of chlorite	None apparent
2060-2070			6068	nil				"	"	"	"
2070-2080			6069	nil				"	"	"	"
2080-2090			6070	.05				"	"	"	"
2090-2100			6071	nil				"	"	"	"
2100-2110			6072	.04				"	"	"	"
2110-2120			6073	nil				"	"	"	"
2120-2130			6074	.05				"	"	"	"
2130-2140		100	6065	0.07		trace	trace	"	"	"	"
2140-2145		100	6061			0.06	0.004	"	"	"	"
2145-2150		100	6066	.06		trace	trace	"	"	"	"

PLUGGED

KERR-McGEE OIL INDUSTRIES, INC.

District Devils Canyon
Hole Number DC-1
Spudded 11-27-64
Completed 12-17-64
Total Depth 2303 feet
Driller C.C. Smith
Logged By R.C.B.

County Pinal State Arizona
Claim NE 1/2 Sec 16 T. 2S R. 13E
Elevation
Hole Size 6¼"
Core Size
Hole Angle Vertical
Collar Coords. N.
E.

Depth	Int.	%Core Rcvy	Samp. No.	Assays Cu	Assays Mo	Rock Type	Rock Description	Alteration	Mineralization
0-1130						Dacite	Red-brown; hard	some clay alteration	some limonite coating
1130-1160						Vitrophyre	dark brown and black; flattened phenocrysts		
1160-1165						Tuff	white and soft	mostly altered to clay	
1165-1800						Whitetail conglomerate	smaller pebbles and grit cemented by red mud		
1800-2303						Whitetail conglomerate	larger pebbles and boulders; much harder drilling		

PLUGGED

Attach A-5

MIAMI COPPER CO.

MIAMI, ARIZONA

THE SUPERIOR OIL CO.

ROTARY DRILL HOLE DCA #1

COORDINATES

ELEV. OF KELLY 4760

SIZE OF HOLE 9 inch

Location: Corner Melvin 1,2,7,8

JUL 28 1964

MINERALS DIVISION TUCSON

DATE	FOOTAGE	TYPE OF ROCK	REMARKS
1964			
5-18	0- 40	Dacite; somewhat glassy; verging	Same as 430 - 460
5-19	40- 70	on welded tuff? in places	Same as 430 - 460
"	70-100	"	Same as 430 - 460
"	100-130	"	Same as 430 - 460
140 ft.			
5-20	130-160	"	Same as 430 - 460
	160-190	"	Same as 430 - 460
	190-220	"	Same as 430 - 460
	220-250	"	Same as 430 - 460
	250-280	"	Same as 430 - 460
	280-310	"	Same as 430 - 460
	300-330	"	Same as 430 - 460
	330-370	"	Same as 430 - 460
	370-400	"	Same as 430 - 460
	400-430	"	Same as 430 - 460
	430-460	"	100% brown-pink dacite; may be verging on welded tuff; somewhat glassy
470			
5-21	460-490	Glassy dacite	100% very glassy rhyolite (vitrophyre)
"	490-520	"	70% dark glass; 30% very glassy (vitrophyre)?
"	520-550	Dacite (very glassy) with felsite zones	35-45% dacite; 35-45% dirty white felsite; 15-20% glass (light & dark)
"	550-580	"	Very fine; probably dacite
"	580-610	"	Same as 640-670
"	610-640	"	Same as 640-670
"	640-670	"	Very fine; mostly glass (light & dark) with a few dacite frags.
"	670-700	"	Very fine sample; probably same as 700-730.
"	700-730	"	60-65% glass as below; 30-35% felsite as below; 5% dacite
"	730-760	- Break at 745 Felsite; with	45-50% dirty white felsite; 45-50% glass (dark & light); 5% dacite
"	760-790	glassy zones & also dacite zones (Glass may be from	50-60% dirth white felsite; 30-40% glass (dark & light); 5% dacite
"	790-820	glassy dacite	Same as 820-850; probably more glass present.
"	820-850	"	Same as 900-930; some of felsite getting more glassy.
"	850-880	"	Same as 900-930
"	870-900	"	Same as 900-930

MIAMI COPPER CO.

MIAMI, ARIZONA

Location: Corner Melvin 1,2,7,8

ROTARY DRILL HOLE DCA #1
COORDINATES
ELEV. OF KELLY 4760
SIZE OF HOLE 9 inch

DATE	FOOTAGE	TYPE OF ROCK	REMARKS
1964			
928			
5-22	900- 930	"	80-90% gray felsite: dacite; dark and light glass.
"	930- 960	"	Very fine sample probably same as 990-1020.
"	960- 990	"	60-70% as below; 20-30% glass (gray, clear, pink & brown) 5-10% dacite
"	990-1020	"	80-90% gray felsite (looks greasy); dark glass; dacite
"	1020-1050	Dacite, very glassy in places	80-90% gray glass; felsite gray (tan tint); dacite
"	1050-1080	Some red-brown volcanics present	50% gray glass; 25-30% gray (tan tint felsite); 20-25% dacite
"	1080-1110	"	Same as 1110-1140
"	1110-1140	"	60-70% gray glass (from dacite?); 30-40% dacite (limonite after biotite)
"	1140-1150	"	No sample
"	1150-1180	"	Same as 1240-1270
1198			
5-23	1180-1210	"	Same as 1240-1270; plus gray sugary-glassy material
"	1210-1240	"	Same as 1240-1270
"	1240-1270	"	90-95% dacite (some frags. very glassy); red-brown volcanics; limonite stained dacite.
"	1270-1300	"	Same as 1330-1360
"	1300-1330	"	Same as 1330-1360
"	1330-1360	"	Most of sample glass derived from dacite original rock probably 70% dacite 25% red brown volcanic, 5% pink felsite
"	1330-1360	"	85-95% dacite (very glassy); gray felsite; red-brown volcanic
"	1360-1390	Felsite with volcanic & glassy zones	Same as 1640-1668; plus dark glass & dacite frags. much limonite staining
"	1390-1410		Same as 1510-1540
"	1410-1425	"	40% gray & pink felsite; 50% gray glass red-brown volcanics; dacite
1428			
5-24	1420-1450	"	30% felsite (gray & pink); 40-50% dacite 15-20% red-brown volcanics; dark & light glass.
"	1450-1480	"	90% gray (green tint) felsite; looks somewhat like serpentine; pink felsite, dacite, red-brown volcanics; dark & light glass.
"	1480-1510	"	Same as 1510-1540; plus quartz gneiss? with oxidized biotite.

MIAMI COPPER CO.

MIAMI, ARIZONA

Location: Corner Melvin 1,2,7,8

ROTARY DRILL HOLE DCA #1
COORDINATES
ELEV. OF KELLY 4760
SIZE OF HOLE 9 inch

DATE	FOOTAGE	TYPE OF ROCK	REMARKS
1964			
5-24	1510-1540	"	35-45% felsite as below; 15% pink felsite; 20-25% dacite; 10% red-brown volcanics; dark & light glass; biotite oxidized in some of felsite.
"	1540-1570	"	Same as 1640-1668
"	1570-1580		No sample
"	1580-1610	"	Same as 1640-1668; plus dacite frag; less pink felsite.
"	1610-1640	"	Same as 1640-1668; plus black glass & gray dacite-andesite with limonite after biotite.
1644			
5-25	1640-1668	"	65-70% felsite as below; 20% pink felsite with biotite; red-brown volcanics clear quartz (glass)
5-26	-5-30 Regaining circulation with Zeogel		
5-30	1668-1675	Core ✓	Volcanics
5-31	-6-2 No returns		
	1693-1734	"	Same as 1736-1740; possibly 50-60% quartz (glass)
1746	1736-1740	"	65% felsite as below; 25-30% black quartz (glass); pink quartz; red-brown volcanics
6-4			
"	1740-1755	"	90% gray (yellow tint) felsite; glassy; red-brown volcanics; black quartz (glass?)
"	1755-1770		No sample
"	1770-1785	"	50-60% yellow-green white felsite. 25% red brown volcanic (dacite?); 10-15% dark andesite, black quartz (glass); diabase (altered)
"	1785-1800	"	Same as 1815-1830; increase of siltstone (volcanic?).
"	1800-1815		Same as 1815-1830; slightly more felsite quartzite with pyrite; red volcanic rocks.
"	1815-1830	"	30% red-brown volcanic; 50-60% yellow-white felsite; quartz; andesite; diabase rhyolitic frags.
"	1830-1845		Transition zone; 45% andesite; 45% white ophanitic igneous rock, red siltstone; quartz; diabase?
"	1845-1850	Andesite? amygdaloidal in place	Same as 1860-1875; slightly more amygdaloidal material.
"	1850-1855	"	Same as 1860-1875; but much of material is amygdaloidal (50%)

MIAMI COPPER CO.

MIAMI, ARIZONA

Location: Corner Melvin 1,2,7,8

ROTARY DRILL HOLE DCA #1
COORDINATES
ELEV. OF KELLY 4760
SIZE OF HOLE 9 inch

DATE	FOOTAGE	TYPE OF ROCK	REMARKS
1964			
"	1855-1860	"	Same as 1860-1875
"	1860-1875	"	Same as 2050-2065; plus feldspar?
"	1875-1890	"	Same as 2195-2210; plus amygdaloidal volcanics & red volcanics?
"	1890-1905	"	Same as 2195-2210
"	1905-1920	"	Same as 2050-2065
1930			
6-5	1920-1935	"	Same as 2050-2065
"	1935-1950	"	Same as 1980-1995; plus igneous rocks
"	1950-1965	"	Same as 1980-1995
"	1965-1980	"	Same as 1980-1995
"	1980-1995	"	Same as 2095-2110; plus altered diabase
"	1995-2010	"	Same as 2095-2110
"	2010-2025	"	Same as 2050-2065
2033			
6-6	2020-2035	"	Same as 2050-2065
"	2035-2050	"	Same as 2195-2210
"	2050-2065	"	Same as 2095-2110; plus amygdaloidal basalt?
"	2065-2080	"	Same as 2195-2210
"	2080-2095	"	Same as 2095-2110
"	2005-2110	"	Same as 2165-2180; few inclusions.
2115			
6-7	2110-2125	"	Same as 2165-2180
"	2125-2130	"	Same as 2165-2180
"	2130-2134	"	Same as 2165-2180
"	2134-2150	"	Same as 2165-2180
"	2150-2165	"	Same as 2165-2180
"	2165-2180	"	Same as 2195-2210; no diabase
"	2180-2195	"	Same as 2195-2210
"	2195-2210	"	90% gray brown (bronze tint) andesite?; red siltstone; diabase; quartz; quartzite
"	2210-2225	Conglomerate	75-80% dark andesite? frags; 15% diabase; mafics; sandstone; red siltstone; very small amount of magnetite
"	2225-2240	"	Same as 2240-2255; plus sandstone
"	2240-2255	"	60-65% dark & light quartzite & andesite; 25% diabase; quatz; mafics, feldspar; red siltstone; amygdaloidal basalt
2257			
6-8	2255-2270	"	Same as 2270-2285; plus granitic frags.
"	2270-2285	"	Same as 2700-2715; no basalt; plus red siltstone; possibly more diabase.
"	2285-2300	"	Same as 2700-2715; no basalt; plus red siltstone & brown gray limestone
"	2300-2315	"	Same as 2344

MIAMI COPPER CO.

MIAMI, ARIZONA

Location: Corner Melvin 1,2,7,8

ROTARY DRILL HOLE DCA #1
COORDINATES
ELEV. OF KELLY 4760
SIZE OF HOLE 9 inch

DATE	FOOTAGE	TYPE OF ROCK	REMARKS
1964			
6-8	2315-2340	Conglomerate	No sample
"	2344(Circulate)	"	Same as 2700-2715; no basalt; plus red siltstone.
2345	2340-2350	"	Same as 2700-2715; plus red siltstone & Gneiss.
6-9			
"	2350-2360	"	Same as 2375-2380; plus gray brown limestone.
	2360-2370	"	Same as 2380-2390
2375			
6-10	2370-2375		Core 0.018% Cu; 0.004 OxCu
"	2375-2380	"	Same as 2700-2715; no basalt; plus red siltstone.
"	2380-2390	"	Same as 2700-2715, plus red siltstone.
"	2390-2400	"	Same as 2700-2715; no basalt
"	2400-2415		No sample
"	2415-2425	"	Same as 2700-2715; plus red siltstone
"	2425-2440	"	Same as 2700-2715; no basalt
"	2440-2455	"	Same as 2685-2700; no basalt
"	2455-2470	"	Same as 2700-2715; plus red siltstone.
"	2470-2485		Same as 2685-2700, no basalt
"	2485-2500	"	Same as 2685-2700, no basalt
"	2500-2515	"	Same as 2700-2715, plus red siltstone; no basalt
"	2515-2530	"	Same as 2700-2715; plus limonite staining
"	2530-2545	"	Same as 2700-2715
"	2545-2560	"	Same as 2700-2715, plus red siltstone
"	2560-2575	"	Same as 2700-2715; plus aplite? & red siltstone; no basalt.
2580			
6-11	2588-2595	"	Same as 2700-2715
"	2595-2610	"	Same as 2685-2700; no basalt
"	2610-2625	"	Same as 2700-2715; no basalt; plus mica schist.
"	2625-2640	"	Same as 2700-2715; no basalt; plus rhyolite? frag.
"	2640-2655	"	Same as 2700-2715; plus red siltstone
"	2655-2670	"	Same as 2685-2700
"	2670-2685	"	Same as 2685-2700; no basalt
"	2685-2700	"	Same as 2700-2715; plus red siltstone & gray-brown limestone.
"	2700-2715	"	40-50% diabase; 35-45% dark & light quartzite & andesite; quartz, feldspar; amygdaloidal basalt; mafics; magnetite; sandstone.
"	2715-2730	"	Same as 2730-2733

MIAMI COPPER CO.

MIAMI, ARIZONA

Location: Corner Melvin 1,2,7,8

ROTARY DRILL HOLE DCA #1

COORDINATES

ELEV. OF KELLY 4760

SIZE OF HOLE 9 inch

DATE	FOOTAGE	TYPE OF ROCK	REMARKS
1964			
2733			
6-12	2730-2733	Conglomerate	Same as 2750-2765, no limestone; no limonite stains; plus amygdaloidal basalt
"	2733-2750	"	Same as 2750-2765; plus limonite stains no sandstone
"	2750-2765	"	Same as 2765-2780; more andesite frags. no red siltstone.
"	2765-2780	"	50-60% diabase; 30-40% dark & light quartzite & andesite; brn. ls.; red siltstone quartz; feldspar; magnetite; mafics; sandstone.
"	2780-2795	"	Same as 2840-2855; no limestone; plus mica schist & andesite frags.
2810	2795-2810	"	Same as 2825-2840; more andesite frags. less quartzite; no granitic frags; brn. limestone
"	2810-2825	"	Same as 2825-2840; plus rhyolite frags. brown limestone; amygdaloidal basalt
6-13	2825-2840	"	50-60% diabase; 30-40% dark & light quartzite; magnetite, mafics; igneous rock frags.
"	2840-2855	"	40-50% diabase, 40-50% quartzite & andesite, quartz, feldspar; brown limestone; amygdaloidal basalt, mafics; magnetite, red siltstone, gypsum filled fractures.
"	2855-2870	"	Same as 3395-3410
2882			
6-14	2870-2885	"	Same as 3395-3410
"	2885-2900	"	Same as 3395-3410; plus native Cu in quartz-mica schist.
"	2900-2915	"	Same as 3395-3410, plus rhyolite frag.
"	2915-2930	"	Same as 3040-3055
"	2930-2945	"	Same as 2945-2959; possibly more diabase.
2959	2945-2959	"	Same as 3395-3410; plus tan limestone
6-15	2959-2971	"	Core 0.024% Cu, 0.010 OxCu
6-16	2971-2980	"	Same as 3395-3410
"	2980-2995	"	Same as 3040-3055
"	2995-3010	"	Same as 3040-3055
"	3010-3025	"	Same as 3040-3055
"	3025-3040	"	Same as 3395-3410
"	3040-3055	"	Same as 3395-3410; plus granitic? frag.
"	3055-3070	"	Same as 3395-3410; plus dark brown limestone
"	3070-3085	"	Same as 3395-3410; plus rhyolite? frags.
3100	3085-3100	"	Same as 3395-3410
6-17	3100-3115	"	Same as 3130-3145

MIAMI COPPER CO.

MIAMI, ARIZONA

Location: Corner Melvin 1,2,7,8

ROTARY DRILL HOLE DCA #1
COORDINATES
ELEV. OF KELLY 4760
SIZE OF HOLE 9 inch

DATE	FOOTAGE	TYPE OF ROCK	REMARKS
1964			
6-17	3115-3130	Conglomerate	No sample
"	3130-3145	"	Same as 3395-3410; plus serpentine
"	3145-3160	"	Same as 3175-3190
"	3160-3175	"	Same as 3175-3190; plus rhyolite frag.
"	3175-3190	"	Same as 3395-3410, plus some limonite staining
"	3190-3205	"	Same as 3395-3410
"	3205-3215	"	Same as 3395-3410
3224			
6-18	3215-3230	"	Same as 3395-3410
"	3230-3245	"	Same as 3260-3275
"	3245-3260	"	Same as 3430-3445; plus granitic? frags.
"	3260-3275	"	Same as 3395-3410; plus brown limestone & limonite staining.
"	3275-3290		No sample
"	3290-3305	"	Same as 3395-3410
"	3305-3312	"	No sample
"	3312-3320	"	Same as 3335-3350
"	3320-3335	"	Same as 3430-3445
3344			
6-19	3335-3350	"	Same as 3395-3410; plus limonite stains
"	3350-3365	"	Same as 3395-3410
"	3365-3380	"	Same as 3395-3410, no andesite
"	3380-3395	"	Same as 3395-3410; plus brown limestone
"	3395-3410	"	Same as 3430-3445; possibly more diabase
"	3410-3415		No sample
"	3415-3430	"	Same as 3430-3445
"	3430-3445	"	50-55% diabase; 40-45% dark & light quartzite & andesite; magnetite; mafics feldspar, quartz, mica schist; red siltstone.
"	3445-3460	"	Same as 3460-3475; plus red sandstone & limonite stains.
"	3460-3475	"	Same as 3552-3562; plus mica schist & serpentine.
"	3475-3490	"	Same as 3552-3562
"	3490-3505	"	40-50% diabase; 40-50% dark & light andesite & quartzite; quartz; feldspar; brown limestone; magnetite, mafics; pyrite
3510			
6-20	3505-3514	"	Same as 3552-3562; plus igneous rock frag. (type?)
"	3514-3525	"	Core sample; 0.024 % Cu; 0.008% OxCu; Same as 3552-3562; possibly more diabase; dacite? frag; fractures filled with gypsum

MIAMI COPPER CO.

MIAMI, ARIZONA

Location: Corner Melvin 1,2,7,8

ROTARY DRILL HOLE DCA #1
COORDINATES
ELEV. OF KELLY 4760
SIZE OF HOLE 9 inch

DATE	FOOTAGE	TYPE OF ROCK	REMARKS
1964			
3550			
6-21	3525-3542	Conglomerate	Core sample; same as 3552-3562; plus ryholite frag.
"	3542-3552	"	Core sample; same as 3552-3562; plus mica schist, limonite staining; rhyolite & dolomite? frags.
"	3552-3568	"	Core sample; 40-50% diabase; 40-50% green to white quartzite & andesite; quartz; feldspar; magnetite; mafics.
3568			
6-22	3568-3580	"	Same as 3580-3595; plus brown-black Dolomite?
"	3580-3595	"	Same as 3600-3610; plus red siltstone & pyrite.
"	3595-3600		No sample
"	3600-3610	"	50-55% diabase; 35-90% green to white quartzite & andesite; mica schist; quartz; feldspar, magnetite, mafics; limonite stains
"	3610-3620	"	Same as 3645-3660; less mica schist & limonite staining
"	3620-3630	"	Same as 3645-3660; plus rhyolite? frag.
"	3630-3645	"	Same as 3645-3660
"	3645-3660	"	Same as 3660-3675; some limonite staining on several frags.
3675	3660-3675	"	50-55% green-white quartzite & andesite; 35-40% diabase; quartz; feldspar; mica schist; magnetite & mafics.
6-23			
"	3675-3690	"	60-70% green-brown to white quartzite andesite; 20-30% diabase; micaschist; feldspar; magnetite; mafics
"	3690-3705	"	Same as 3705-3720; no evidence of fractures.
"	3705-3720	"	85% green-brown-red-white quartzite & andesite; diabase; feldspar; mica schist; magnetite; mafics; fractures filled with quartz
"	3720-3735	"	Same as 3765-3780; slightly more quartzite & andesite;
"	3735-3750	"	Same as 3765-3780
3754			
6-24	3750-3765	"	Same as 3765-3780
"	3765-3780	"	80% quartzite & andesite as below; diabase mica schist; mafics; magnetite; feldspar.
"	3780-3795	"	Same as 3795-3810; less mica schist.
"	3795-3810	"	60-70% quartzite & andesite as below; 20% diabase; mica schist, magnetite; mafics; quartz; feldspar.

MIAMI COPPER CO.

MIAMI, ARIZONA

Location: Corner Melvin 1,2,7,8

ROTARY DRILL HOLE DCA #1
COORDINATES
ELEV. OF KELLY 4760
SIZE OF HOLE 9 inch

DATE	FOOTAGE	TYPE OF ROCK	REMARKS
1964			
6-24	3810-3825	Conglomerate	Same as 3870-3885; minor serpentine? red sandstone.
"	3825-3840	"	Same as 3870-3885; plus plagioclase & red sandstone
"	3840-3855	"	Same as 3870-3885
"	3855-3870	"	Same as 3870-3885
"	3870-3885	"	80% quartzite & andesite as below; mica schist; diabase; mafics; magnetite;
3900	3885--3900	"	Same as 3900-3915; plus mica schist& oxidized pyrite?; no granitic or mudstone frags.
6-25	3900-3915	"	80% green-brown-white quartzite & andesite; diabase; feldspar; granitic? frag; red-brown mudstone; magnetite; mafics
"	3915-3920	"	No sample
"	3920-3930	"	75% green-brown-white quartzite & andesite; diabase; brown limestone; mica schist; feldspar; quartz; mafics;magnetite.
"	3930-3940	"	Same as 3940-3950; pyrite has a green coating on it.
"	3940-3950	"	85% brown-green-white quartzite & andesite; diabase, quartz; feldspar; red-orange quartizte?; magnetite; pyrite.
"	3950-3965	"	85% brown-green-white quartzite & andesite; yellow tan limestone; mica schist magnetite; pyrite; mafics
"	3965-3980	"	Same as 3980-3995; less limestone; some diabase & weathered diabase
"	3980-3995	"	75-85% green-brown to white quartzite & andesite; 5-10% brown limestone; quartz; feldspar; mica schist; magnetite; mafics
4000	3995-4000	"	80-85% green-brown to white quartzite & andesite; mica schist; limestone (brown-gray); quartz; diabase; much magnetite; some mafics; one xl of pyrite;
6-26	4000-4011.5	"	Core 0.020% Cu; 0.004% OxCu

NOTE: FOR OPERATIONAL REASONS THIS HOLE WAS LOGGED FROM THE BOTTOM UP.

MIAMI COPPER CO.

MIAMI, ARIZONA

THE SUPERIOR OIL CO.

ROTARY DRILL HOLE DCA #2
COORDINATES
ELEV. OF KELLY 4720
SIZE OF HOLE 7-7/8 inch

Location: Corner AG 1,2,9,10

JUL 28 1964

MINERALS DIVISION TUCSON

DATE	FOOTAGE	TYPE OF ROCK	REMARKS
1964			
7-3	0- 15	Dacite	100% pink-brown dacite; somewhat glassy.
"	15- 30	"	Same as 0-15
7-4	30- 45	"	Same as 0-15
"	45- 60	"	Same as 0-15; magnetitic metallic is probably mostly from bit
"	60- 75	"	Same as 0-15
7-5	75- 90	"	Same as 0-15
"	90- 105	"	Oil stained?; probably same as 0-15
"	105- 120	"	Same as 0-15
"	120- 135	"	Same as 0-15
"	135-150	"	Same as 0-15
"	150-165	"	Same as 0-15
"	165-180	"	Same as 0-15
"	180-195	"	Same as 0-15
"	195-210	"	"
"	210-225	"	"
"	225-240	"	"
"	240-255	"	"
"	255-270	"	"
"	270-285	"	"
"	285-300	"	"
"	300-315	"	"
"	315-330	"	"
"	330-345	"	"
"	345-360	"	" plus one piece of blue black andesite?
"	360-375	"	Same as 345-360
"	375-390	"	Same as 0-15
"	390-405	"	Same as 345-360
"	405-420	"	Same as 0-15
"	420-435	"	"
"	435-450	"	"
"	450-465	"	Same as 0-15; plus black-green andesite" (several fragments)
"	465-480	"	Same as 450-465; plus more andesite
"	480-495	"	Same as 0-15
"	495-510	"	" ; plus some of Xls show evidence of flowage.
"	510-525	"	Same as 450-465
"	525-540	"	"
"	540-555	"	"
"	555-570	"	Same as 0-15
"	570-585	"	Same as 450-465
"	585-600	"	Same as 0-15
"	600-615	"	" black(bronze tint) glassy frags.

MIAMI COPPER CO.

MIAMI, ARIZONA

Location: Corner Ag 1 ,2,9,10

ROTARY DRILL HOLE DCA #2
COORDINATES
ELEV. OF KELLY 4720
SIZE OF HOLE 7-7/8

DATE	FOOTAGE	TYPE OF ROCK	REMARKS
1964			
7-5	615-630	Dacite	Same as 0-15
"	630-645	"	"
"	645-660	"	"
7-6	660-675	"	Same as 450-465
"	675-690	"	Same as 0-15
"	690-705	"	"
"	705-720	"	"
"	720-735	"	"
"	735-750	"	"
"	750-765	"	Same as 0-15
"	765-780	"	" ; plus brown-black oily
			looking material (contamination from rig?)
"	780-795	"	Same as 450-465
"	795-810	"	Same as 765-780
"	810-825	"	Same as 0-15
"	825-840	"	"
"	840-855	"	"
"	855-870	"	"
"	870-885	"	Same as 495-510
"	885-900	"	"
"	900-915	"	Same as 0-15
"	915-930	"	"
"	930-945	"	Same as 765-780
7-7	945-960	"	Same as 0-15
"	960-975	"	"
"	975-990	"	"
"	990-1005	"	"
"	1005-1020	"	"
"	1020-1035	"	"
"	1035-1050	"	"
"	1050-1065	"	Same as 450-465
"	1065-1080	"	Same as 0-15; plus dull orange waxy
			soft mineral?
"	1080-1095	"	Same as 450-465; plus red brown andesite?
			very few frags).
"	1095-1110	Rhyolite & glass	
		interbedded	40-50% dacite; 40-50% black glass;
			10-15% dark & light quartzite?
			(silicified felsite??)
"	1110-1125	"	Same as 1095-1110; possibly 50-60% black
			glass.
"	1125-1210		No sample
7-9	1210-1225	Dacite	Cement used to seal off water & later
			drilled out.

MIAMI COPPE.. CO.

MIAMI, ARIZONA

Location: Corner Ag 1,2,9,10

ROTARY DR .L HOLE DCA #2
COORDINATES
ELEV. OF KELLY 4720
SIZE OF HOLE 7-7/8

DATE	FOOTAGE	TYPE OF ROCK	REMARKS
1964			
7-9	1225-1240	Dacite	95+-% dacite; brown with red tint; slightly darker than 0-15 dacite; also has light quartzite & light felsite with biotite;
"	1240-1255	"	Same as 1225-1240
"	1255-1270	"	"
"	1270- ?		No sample
7-10	? -1340	Quartz rich sandstone or conglomerate	95+-% quartz, quartzite (light & colored) & feldspar; schist; biotite, red-brown mudstone.
7-11	1340-1355	Conglomerate	55-65% quartz & quartzite (light & colored); 25-30% dacite; black glass; schist; black-green andesite
7-12	1355-1370	"	Same as 1340-1355; plus pink igneous rock rich in biotite;
"	1370-1385	"	Same as 1340-1355
"	1385-1400	"	60-70% quartz & quartzite (light & colored); 20-25% schist? (biotite-quartz) 5% dacite; a few red-brown & one orange igneous fragment;
"	1400-1415	"	Same as 1385-1400; no red brown igneous frags.; possibly slightly more schist
"	1415-1430	"	Same as 1385-1400
"	1430-1445	"	" ; plus black-green andesite?
"	1445-1460	"	Same as 1430-1445; less schist & more quartz-quartzite present than in 1385-1400
	HOLE BOTTOM 1471		

ZONED ASH–FLOW SHEET IN THE REGION AROUND SUPERIOR, ARIZONA[1]*

By

Donald W. Peterson
U.S. Geological Survey, Menlo Park, California

INTRODUCTION

Remnants of a thick Tertiary ash-flow sheet cover large areas in parts of Gila, Pinal, and Maricopa Counties, Arizona (Fig. 1). The ash-flow sheet is of particular local interest because it covers potential mineral exploration targets in a region that has many ore deposits. This report briefly describes the physical features of the ash-flow sheet and explains how internal zoning can help interpret its structure.

Previous Work

The ash-flow sheet was first studied in the Globe 15-minute quadrangle by Ransome (1903, p. 88-95), who described the basal tuff correctly but considered the vitrophyre and the rest of the unit to be thick, massive lava flows of dacitic composition. Short and others (1943, p. 45-49) described the sheet near Superior as alternating dacitic lava flows and tuff deposits. N. P. Peterson carefully described the deposit in the vicinity of Globe and Miami (1962, p. 38-41). He realized that lava flows of this composition would be erupted as relatively short, viscous flows with contorted flow structures. This deposit, however, actually covers hundreds of square miles and contains uncontorted, flat to moderately tilted structures, so he concluded that it was probably laid down by several ash flows or incandescent clouds (N. P. Peterson, 1962, p. 40-41).

I have made additional studies of the deposit and have concluded that it is composed of a number of ash flows erupted in rapid enough succession to form an ash-flow sheet that is, in general, a simple cooling unit. The present report, outlining this thesis, is chiefly a condensation of an earlier open-file report (D. W. Peterson, 1961a).

Terminology

The terms used in this report follow the terminology proposed by Smith (1960a, p. 800-801). Abbreviated versions of several of Smith's definitions are repeated here.

Ash flow: The basic unit of ash-flow deposits; the deposit resulting from the passage of one nuée ardente.

Ash-flow sheet: Any unspecified sheetlike unit or group of units considered to be of ash-flow origin.

Welded tuff: A rock or rock body in which vitric particles have some degree of cohesion by reason of having been hot and viscous at the time of their emplacement.

Cooling unit: A single or multiple ash-flow deposit that can be shown to have undergone continuous cooling.

Simple cooling unit: An ash flow or sequence of ash flows that has had an essentially uninterrupted cooling history.

Compound cooling unit: One that shows departures in expectable zonation and other properties which result from simple cooling, because the intervals between ash flows were too great for readjustment to a single-unit cooling gradient.

To understand the definition of " ash flow" it may be helpful to review Smith's concept of "nuée ardente". He emphasized the original observation that a nuee ardente is composed of two parts, a basal avalanche that contains the bulk of the erupted material, and an overriding cloud of expanding gas and dust (Smith, 1960a, p. 802-804). Although a nuée ardente is both a type of eruption and an agent of transport, Smith emphasized its role as an agent of transport of material from the vent to its final resting place.

The deposit in the vicinity of Superior, Miami, and Globe is an "ash-flow sheet" made up of an undetermined number of separate "ash flows" that in most places cannot be individually recognized. Part of the deposit is composed of "welded tuff," and part is non-welded. In most places the ash-flow sheet constitutes a "simple cooling unit," but locally it grades laterally into a "compound cooling unit."

In most of the literature describing the area, "dacite" has been used to designate the rock type (Ransome, 1903, 1919, 1923; Short and others, 1943; Peterson and others, 1951; N.P. Peterson, 1962, 1963), and the name is firmly established in current local usage. Dacite is defined as a volcanic rock with

---

1. Publication authorized by the Director, U.S. Geological Survey

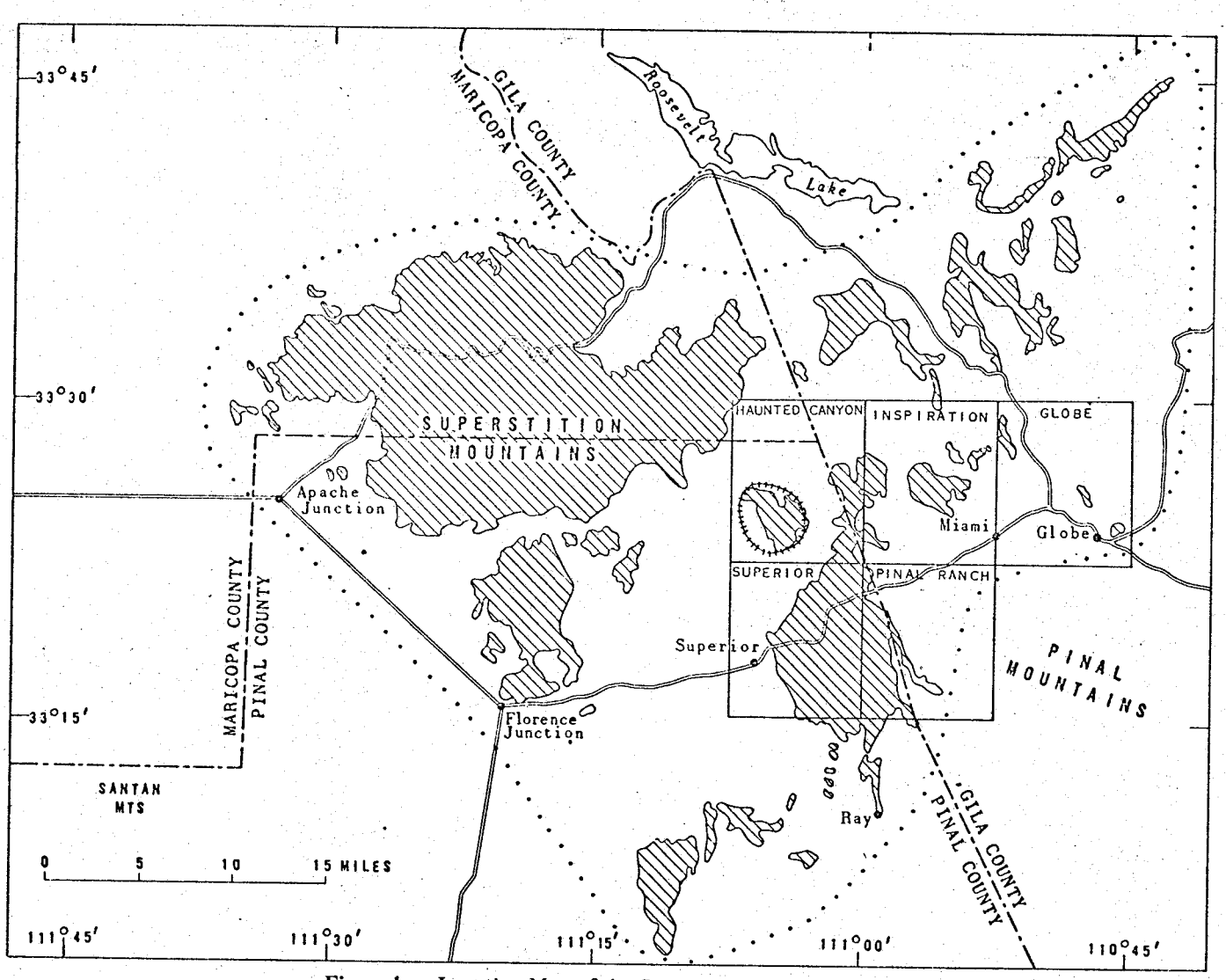


Figure 1 — Location Map of the Superior, Arizona Region

numerous quartz and feldspar phenocrysts, the feldspar phenocrysts being mostly plagioclase; on this basis dacite is a valid name for the rock. It should be recognized, however, that on the basis of its chemical composition, the rock is a quartz latite (Peterson, 1961a, p. 111).

ORIGINAL EXTENT, VOLUME, AND AGE

The area in which the ash-flow sheet crops out is shown in Figure 1. The deposit has been recognized from 10 miles west of the Superstition Mountains to the Salt River near Cherry Creek, and from a mile east of Globe to the vicinity of Ray. Outcrops of ash-flow rocks in the Santan Mountains may be part of the same sheet, but the correlation is not yet certain. The possible original extent of the sheet is indicated in Figure 1; this area is about 1500 square miles, but it may exceed 2000 square miles.

The maximum exposed thickness of the sheet is 2000 feet just east of Superior. Thicknesses of over 1000 feet are common in the central part of the area shown in Figure 1, and the sheet gradually thins toward its margin. The original thickness of the sheet is difficult to determine because of dissection by erosion and the irregular pre-eruption topography. However, 500 feet seems to be a reasonable estimate for the average thickness. This leads to an estimated volume for the sheet of about 150 cubic miles.

Ransome (1903, p. 94-95) assigned a Tertiary (?) age to the deposit, and this age is confirmed by isotope age dating techniques. Creasey and Kistler (1962, p. 1) determined an apparent absolute age of 20 million years on K-Ar ratios in biotite obtained from vitrophyre at the base of the deposit east of Superior. Damon and Bikerman (1964, p. 72) obtained an age of 19.9±0.9 million years on biotite from dacite about 2 miles east of Superior. (They

used a slightly different decay constant and recalculated the age obtained by Creasey and Kistler to 19.4 million years.) These dates all indicate a middle Miocene age.

FIELD DESCRIPTION

Zoning

All of the zones of welded ash flows defined and described by Smith (1960b) are present in this ash-flow sheet, and they are diagrammatically represented in Figure 2. The three fundamental zones that depend

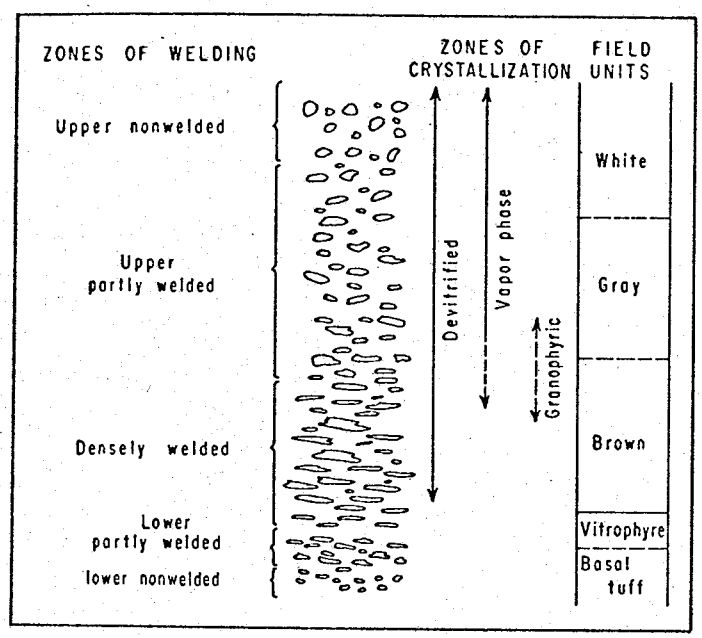


Figure 2 – Physical characteristics of the ash flow sheet

on the degree of welding include (1) upper and lower zones of no welding, (2) upper and lower zones of partial welding, and (3) the zone of dense welding. Superimposed on all but the lower part of the sheet are three zones representing the different types of crystallization that took place during the cooling of the sheet: (1) devitrification, (2) vapor-phase crystallization, and (3) granophyric crystallization. The zones of crystallization are superimposed upon the three fundamental zones of welding. In addition, the zones of crystallization overlap one another. In most vertical sections through the sheet, the successive zones in part follow the same pattern as indicated in Figure 2, without repetition or regression. This pattern indicates that, despite its great thickness, the sheet consists of a single cooling unit in most places.

The rocks of all the zones have certain features in common. Throughout the entire sheet the rocks are porphyritic with a similar phenocryst assemblage; in hand specimen phenocrysts can be identified as feldspar, quartz, biotite, accessory iron oxide, and lesser variable amounts of hornblende and sphene. Phenocrysts constitute from one-fourth to nearly one-half the volume of the rock; they range in size from barely discernible with the hand lens to 3 mm, and most are ½ to 1 mm in diameter.

Lithic inclusions are common throughout the ash-flow sheet, and generally make up 1 or 2 per cent of the rock. In the lower part of the sheet, however, they become much more abundant, generally making up about 10 per cent and locally as much as 25 per cent of the rock. All the older rocks of the district occur as inclusions. Most are angular chips a fraction of an inch in diameter, some are several inches across, and a few scattered boulders several feet in diameter have been observed.

In the field it has been convenient to map the following five units rather than the zones of crystallization or welding: (1) basal tuff, (2) vitrophyre, (3) brown unit, (4) gray unit, and (5) white unit. Some of these units have been mapped in part of the Superior quadrangle; Figure 3 shows their generalized distribution.

(1) The basal tuff includes the lower zone of no welding and part of the lower zone of partial welding. The glass shows no appreciable crystallization. The base of the ash-flow sheet consists of nonwelded crystal tuff wherever observed. The basal tuff is poorly to moderately indurated and weathers to gentle, subdued slopes. It is generally light gray to white but locally grades to shades of yellowish gray and moderate red. The basal tuff ranges in thickness from 2 to 100 feet or more, averaging about 10 to 20 feet.

The matrix of the nonwelded tuff is powdery and generally uniform; in addition to phenocrysts and lithic inclusions, it locally contains pumice lapilli and blocks. In the nonwelded tuff, orientation of constituents is random. Upward into the zone of partial welding, however, the pumice fragments and glass shards become flattened and uniformly oriented; as the tuff becomes more firmly consolidated, its specific gravity increases, and discs of black glass appear and become progressively more abundant upward. These changes all result from a progressive upward increase in the degree of welding. The zone of partial welding (the upper part of the basal tuff) ranges in thickness from a few inches to about 40 feet, averaging from 1 to 6 feet.

(2) The vitrophyre includes the lower part of the zone of dense welding that lacks superimposed crystallization. The lower part of the vitrophyre may also include the upper part of the lower zone of partial welding (Fig. 2). Most of the vitrophyre is a densely welded tuff composed of a matrix of black glass containing the normal assemblage of phenocrysts and sparse to abundant lithic inclusions. It is generally

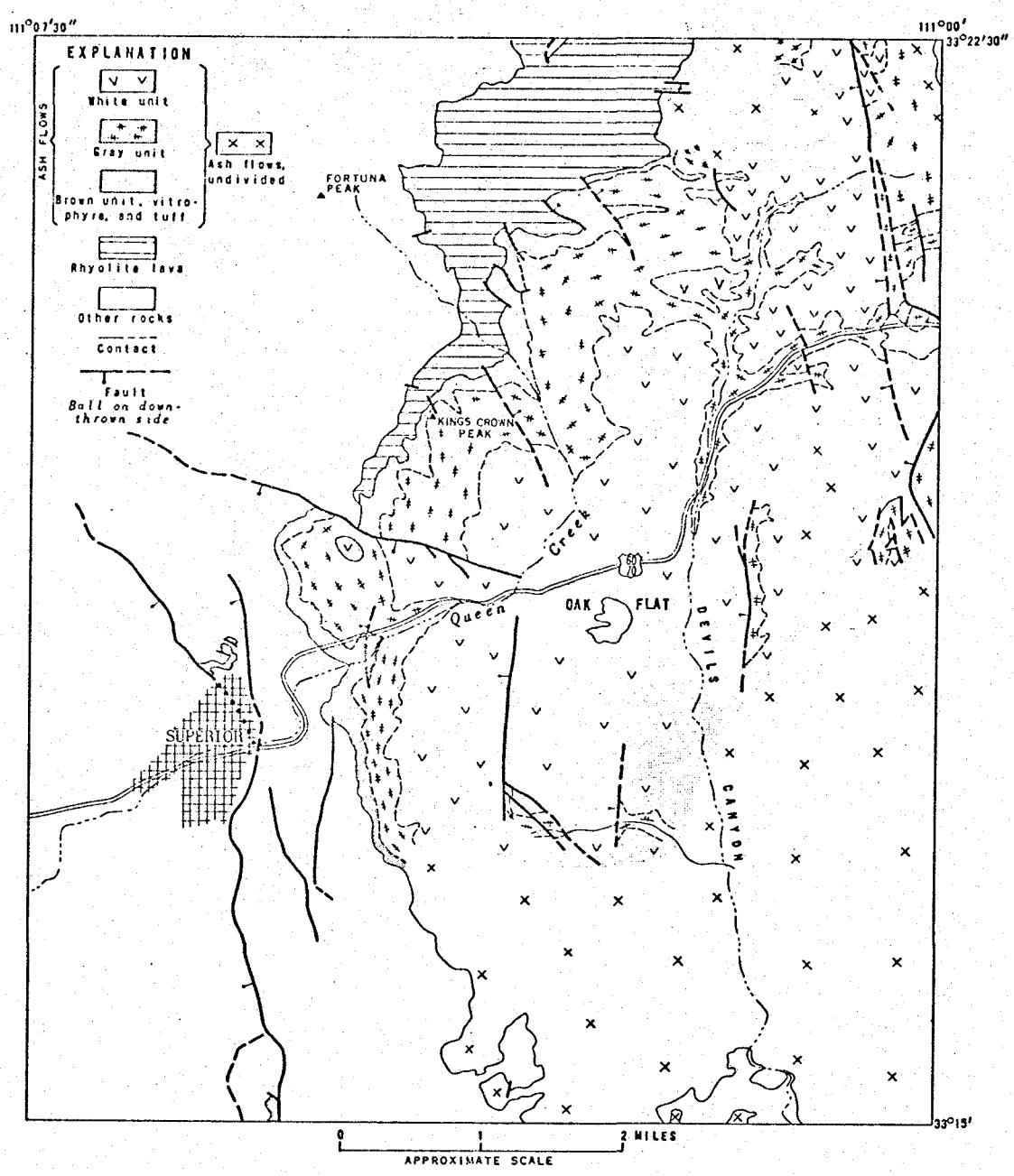


Figure 3 – Generalized geologic map of the Superior quadrangle, showing the distribution of recognized field units within the ash flow sheet. Recognition of the units has permitted identification of several faults within the sheet.

firm and resistant to weathering and stands out as a ledge above the softer basal tuff. The vitrophyre weathers to a dark gray or dark brown color that contrasts with the lighter colors of overlying and underlying rocks. It ranges in thickness from 2 to 80 feet and averages from 5 to 25 feet.

(3) The brown unit consists of the part of the zone of dense welding upon which has been superimposed the zone of devitrification. It also may include the lower part of the upper zone of partial welding, in which thin scattered lenticles that underwent vapor-phase crystallization are present. The dominant characteristic of the brown unit is a devitrification of the original glass of the groundmass to a dense, hard, flinty rock that is light brown to reddish brown in color. Careful scrutiny of the groundmass with a hand lens reveals eutaxitic structures characteristic of densely welded tuff; these structures show clearly under the microscope. The intensity of devitrification crystallization increases upward. This is expressed megascopically by a gradual change in color from brown to brownish gray to reddish gray. The thin,

light-colored lenticles in the upper part of the brown unit are flattened pumice fragments that have retained enough porosity to allow slight vapor phase crystallization; they gradually become more abundant upward into the upper zone of partial welding. The thickness of the brown unit cannot be given precisely, because of its gradational upper boundary, but it generally ranges from 20 to 200 feet. In Queen Creek Canyon the brown unit reaches its maximum thickness of about 450 feet.

(4) The gray unit lies entirely within the upper zone of partial welding, upon which the zone of devitrification crystallization has been strongly superimposed. This crystallization reaches the maximum coarseness in the gray unit, and in many places the original "welded-tuff texture" is obscured by the superimposed crystallization. The color of the rock ranges from reddish gray to medium and light gray. Pumice fragments are strongly flattened in the lower part of the unit and partly flattened in the upper part; as their flattening decreases, the amount of vapor-phase crystallization increases. However, welding of the groundmass throughout the gray unit was strong enough to confine vapor-phase crystallization chiefly to the pumice fragments. Both the lower and upper contacts of the gray unit are gradational. The unit ranges from a few feet to over a thousand feet in thickness.

(5) The white unit includes the upper part of the upper zone of partial welding and the entire upper zone of no welding. Its main characteristic is that vapor-phase crystallization not only occupies the pumice fragments but also permeates the groundmass and is there superimposed upon the devitrification crystallization. Crystallization is so intense that generally the original vitroclastic textures have been completely obliterated. The rock has an aphanitic groundmass that generally lacks planar or oriented structures. The color on the fresh surface is light gray to white; it weathers brownish gray to reddish gray, nearly the same as the gray unit. Pumice fragments range from partly flattened to nearly equidimensional in shape. On unweathered surfaces they are difficult to distinguish from the enclosing rock, but as the rock weathers to a darker color, the pumice fragments become more discernible. In most places erosion has removed a substantial part of the white unit, and only in the vicinity of Oak Flat, 4 miles east of Superior, has the original upper surface of the unit been recognized. The white unit has a maximum thickness of about 800 feet and averages perhaps 200 to 300 feet, but thicknesses are uncertain because of the gradational lower contact and the eroded upper surface.

Granophyric Crystallization

Smith (1960b, p. 152) defines granophyric crystallization as follows:

> "In silicic welded tuffs granophyric crystallization is characterized by groundmass quartz intergrown with, or as blebs associated with, alkalic feldspar and minor accessory minerals. The aggregate shows granophyric or micrographic textures similar to those shown by many slowly cooled rhyolitic flows, domes, and shallow intrusive rocks."

Granophyric textures are identified in thin section in specimens from the central part of the very thick section east of Superior. These textures occur chiefly in the centers of flattened pumice fragments in the lower part of the gray unit. The granophyric crystallization evidently took place where cooling was slowest and was promoted by the presence of residual vapors in the pumice fragments. The position of the granophyric crystallization zone illustrates well how the various zones of crystallization are superimposed on one another. This zone is thin, poorly defined, and discontinuous, and it is superimposed upon the zone of devitrification at a horizon where the zone of vapor-phase crystallization is also present.

Pumice Fragments

Light-colored cognate inclusions that are locally abundant in some parts of the ash-flow sheet have been identified as pumice fragments. They are lenticular to ovoid in shape; toward the top they are equidimensional, but downward they become progressively more flattened. Most of the inclusions range from 1 to 4 inches in their longest dimension, but both larger and smaller sizes are common. In general their light color contrasts with the slightly darker enclosing rock. Most of them carry approximately the same assemblage of phenocrysts in about the same proportions as the matrix and, except for their lighter color, appear to be practically the same rock. An important difference is that many of the phenocrysts in the enclosing rock are broken, whereas they are generally unbroken in the pumice fragments. The original pumiceous texture of the fragments has been largely obscured or obliterated by devitrification and vapor-phase crystallization, so that the fragments are now essentially a porphyritic rock with a uniform aphanitic groundmass.

The flattening of pumice fragments has been given considerable study (Peterson, 1961b). The apparent flatness of a fragment is defined as the ratio of its length to its height—a ratio which has a rather wide range of values at any given outcrop. The flattening ratio is defined as the mean value of the apparent

flatnesses of a representative number (generally 30 or 40) of fragments. This ratio can be calculated either as an arithmetical average or as the mean of the logarithms of the apparent flatnesses. These two methods yield slightly different values; the logarithmic flattening ratio is more rigorous, but the arithmetical flattening ratio is easier to calculate in the field. Figure 4

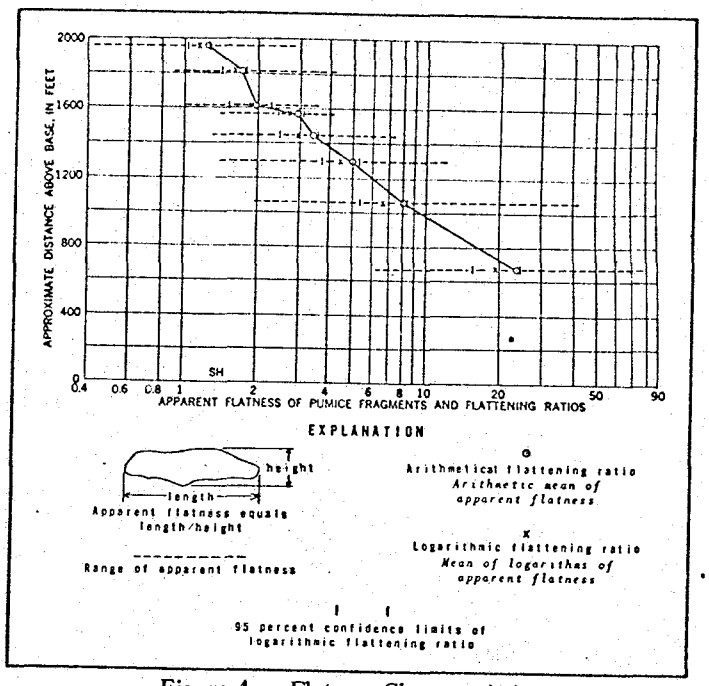


Figure 4 – Flatness Characteristics

shows the relation of the flattening ratio to the stratigraphic position in the ash-flow sheet; the flattening ratio increases as the depth of burial increases. This curve was obtained from fragments in the section of rocks exposed in roadcuts along U.S. Highway 60-70 between Superior and Oak Flat. Curves from other localities show similar relations.

Studies of flattening ratios have made it possible to estimate the amount of throw on faults in the ash-flow sheet. The flattening ratio also is a tool for estimating the distance of an outcrop below the original top of the sheet. Such applications are somewhat limited, however, because outcrops suitable for measurement of fragments are not numerous.

STRUCTURE OF THE ASH-FLOW SHEET

The term "sheet" appropriately describes the gross structure of the ash flows, inasmuch as the horizontal dimensions are many times greater than the thickness and the deposit extends over a wide area. The sheet was deposited on a surface of moderate to locally steep relief.

The attitude of most layering ranges from horizontal to dips of about 30°, but in a few places the dips are as much as 60°. The planar structure on which attitudes are measured is generally a joint system distinct to indistinct, that lies parallel to the plane of flattening of the pumice fragments. It seems likely that the structures originally were nearly horizontal and that the higher dips are due to post-solidification tilting. If the still-plastic rock had been deposited with an appreciable angle of dip, the rock would probably have flowed laterally, yet no evidence for such flowage has been recognized.

In earlier maps and reports, few faults were noted within the ash flows because of the uniform appearance of weathered surfaces from near the base to the top of the sheet. However, the distinct changes in lithology due to zoning and the systematic changes in the flattening ratio of pumice fragments provide the criteria that permit faults within the sheet to be recognized and mapped. A fresh surface must be obtained to identify the zone, so the work is rather slow and tedious; therefore, zones have been mapped and faults studied in detail in only a part of the Superior quadrangle (Fig. 3).

Several faults cutting the ash-flow sheet have been recognized, most of which probably belong to a single set. Most of the faults trend north to northwest, and the west or southwest side is dropped down, although a few have the opposite sense of displacement. Hammer and Peterson (in press) describe two principal sets of faults that cut the rocks of the Superior area. The older set trends principally eastward, and many of the faults are mineralized. Most of these faults are pre-Tertiary in age. The younger set trends north to northwest; its faults displace faults of the older set and offset Tertiary as well as older rocks. In general these faults are not mineralized. Most of the faults illustrated in Figure 3 belong to this second set.

Nearly everywhere the ash-flow sheet is cut by a system of vertical or nearly-vertical joints. The joints vary from clearly defined to indistinct, and from widely to closely spaced; most are from 5 to 15 feet apart. The joints commonly form distinct systems, in which parallel joints extend continuously for several hundred feet to more than a mile. In many places two joint systems intersect each other at angles from 60° to 90°. The continuity of the joints suggests that they are of tectonic origin, and are not simple cooling cracks. However, polygonal cooling joints are found in a few places, mostly in the vitrophyre.

SOURCE

The major source or sources of the ash flows have not yet been identified. Further study in areas west of the Haunted Canyon and Superior quadrangles may ultimately reveal the major eruptive center. However, a small caldera, about 3 miles in diameter, has been recognized in the southwestern part of the Haunted

Canyon quadrangle (Peterson, 1961a); its position is outlined in Figure 1. This caldera was probably the source for part of the deposit. At most, however, it could have supplied about 10 cubic miles of material –only a fraction of the total volume of the sheet (Peterson, 1961a, p. 71-72).

The caldera is a crudely circular structure in which ash flows and underlying rhyolite are downdropped and are surrounded by rocks of Paleozoic and Precambrian age (Peterson, 1960). The relations between the volcanic rocks and the older rocks around the border of the structure are complex and chaotic, and the older rocks are locally intruded by dikes of vitroclastic material similar to that in the ash-flow sheet. Local zones of alteration are common in the ash flows and rhyolite within the caldera. Erosion has removed all traces of any original topographic expression of a collapse feature, but the foregoing evidence is considered sufficient to identify the caldera (Peterson, 1961a, p. 66-72). Similar structures, perhaps larger, may lie farther west. M. F. Sheridan has tentatively recognized caldera-like structures in the western part of the Superstition Mountains (oral communication, 1967), which may provide additional sources for the ash flows.

PETROGRAPHY AND MINERALOGY

The nature, distribution, and appearance of phenocrysts throughout most of the ash-flow sheet are remarkably constant. They are nearly uniformly distributed, and constitute from 35 to 45 per cent of the rock. Plagioclase is the most abundant phenocryst mineral, followed by lesser amounts of quartz, biotite, sanidine, and opaque oxides. Hornblende is present in some specimens and absent in others. Sphene, apatite, and zircon are common accessory minerals, and a few specimens contain a little tourmaline. Over a hundred modal analyses show that the relative proportions of the different phenocryst minerals show a slight but systematic change from the bottom to the top of the sheet. Plagioclase decreases slightly, and quartz and sanidine increase.

The major phenocrysts average between ½ and 1 mm in diameter, but a few are as large as 3 mm. Except for the phenocrysts in pumice fragments, a high proportion of phenocrysts throughout the sheet are broken, and tiny angular crystal fragments are scattered through the matrix.

The plagioclase crystals, constituting from 55 to 80 per cent of all phenocrysts, are generally subhedral, rarely anhedral, and are commonly twinned after one or more twin laws. Most are distinctly zoned, showing either normal or oscillatory-normal patterns. Optical and X-ray diffraction studies of the plagioclase have not shown a unique composition, but they indicate that it lies in the range from oligoclase to andesine and probably has an intermediate structural state.

The ash-flow sheet generally contains only a small number of sanidine phenocrysts, about 1/2 to 5 per cent of the phenocrysts. In the white unit, however, sanidine makes up from 6 to 15 per cent of the phenocrysts. In all units the sanidine is subhedral or euhedral, and some crystals show slight to moderate corrosion and embayment of their borders. Most are untwinned, but a few are twinned on the Carlsbad law. X-ray diffraction study indicates an approximate composition of Or_{85}-Ab_{15}.

Quartz phenocrysts are anhedral and approximately equant, and they generally have deeply embayed borders. Quartz constitutes from 5 to 14 per cent of the phenocrysts in most of the ash-flow sheet, but from 11 to 25 per cent in the white unit. Grains are clear and unaltered, and some contain liquid inclusions. The quartz in most specimens shows slightly undulatory extinction.

In all parts of the sheet biotite makes up from 5 to 13 per cent of the phenocrysts and averages about 8 per cent. Biotite phenocrysts are generally euhedral or subhedral and form tabular books and flakes; many grains are distorted and bent. "Bird's-eye" structure is common, and pleochroism is pronounced with X = yellow, Y = Z = dark brown. Biotite in the lower part of the sheet is fresh, but in the upper part of the brown unit it is slightly altered, and farther upward the alteration becomes progressively more intense. Alteration begins as bleaching at the crystal boundaries and development of small clots of opaque oxides in the bleached areas. The bleaching progresses inward with further alteration, particularly along cleavage planes, and the opaque clots enlarge. Alteration is most intense in the white unit, where biotite is either replaced by chlorite or is completely bleached and accompanied by large concentrations of opaque oxide clots.

HISTORY OF THE ASH-FLOW SHEET

The magma, with a chemical composition of quartz latite, probably originated by selective melting of sialic material at a depth of several kilometers (Peterson, 1961a, p. 113-115). As it migrated upward it cooled, and plagioclase, sanidine, quartz, biotite, and other minerals crystallized. As crystallization continued, gas pressure rose; when about 40 per cent of the magma had crystallized, it found its way explosively to the surface. The properties of the magma–such as temperature, viscosity, and gas content–were such that it erupted as nuées ardentes. Gas escaped with enough violence to disrupt the magma into ash-sized particles, and the explosively vesiculating magma rapidly spread laterally in all directions as a gas-charged avalanche.

Mobility was aided by air engulfed by the incandescent mass; the suddenly heated air expanded violently, speeding the avalanche forward along its path and creating a constant turbulence within it (McTaggart, 1960). Billowing clouds of dust undoubtedly rose to great heights, but the bulk of the material was carried by the basal avalanche.

Successive eruptions rapidly followed one another; each eruption was an individual pulse separated from the next pulse by hours or days, but each successive layer was added before the next underlying layer had cooled appreciably. Each eruptive pulse added from a few tens to several hundred feet of material to the deposit. The erupted material had sufficient energy and mobility to travel distances of as much as 20 miles. The original relief was moderate to steep, perhaps on the order of 1000 feet; the deposits filled in valleys and ultimately covered hills under depths of several hundred feet.

The first material that came to rest on the cool prevolcanic surface was quickly chilled, and the glass particles became rigid enough to resist deformation. This material (the lower nonwelded zone) formed an insulating blanket causing material above it to cool more slowly, so that shards and pumice fragments retained their plasticity long enough to be deformed and flattened by the weight of the overlying material, thereby giving rise to the lower partly welded zone. The vitrophyre represents a layer in which the particles were plastic enough to become greatly flattened and thoroughly welded together, yet were chilled quickly enough to form a glass.

In a thick layer above the vitrophyre the still-plastic particles were deformed by the overlying load and thoroughly welded. Cooling, however, was slower, and the originally glassy constituents devitrified to form the cryptocrystalline, aphanitic groundmass characteristic of the brown unit. Higher in the sheet the overlying load was smaller and the degree of welding gradually decreased, so that some porosity was retained. Escaping gases collected in these pore spaces to promote additional crystallization. The intensity of vapor-phase crystallization increased upward as the degree of welding decreased and became still more intense through the gray unit. Finally the upward-streaming gases permeated all the spaces between particles to cause vapor-phase crystallization through the entire white unit. As crystallization became more complete, the outlines of particles became more diffuse because crystals grew across shard boundaries. Near the top of the sheet the particles were essentially undeformed and nonwelded, but their original outlines were ultimately obliterated by crystallization, owing to long contact with upward-rising hot gases.

The region was either standing high or was uplifted soon after the ash-flow eruptions, for erosion deeply dissected the sheet and locally cut entirely through it. Fluvial deposition followed, and the Gila Conglomerate was deposited in local basins. In some areas air-fall tuffs and lava flows, ranging in composition from basalt to rhyolite, were erupted and locally interfinger with the Gila Conglomerate. Abundant faults cut both the ash-flow sheet and the younger rocks.

Renewed uplift halted deposition of the Gila, erosion continued to dissect the ash-flow sheet and to cut into the younger rocks, and gradually the present-day topography developed.

REFERENCES

Creasey, S. C., and Kistler, R. W., 1962, Age of some copper-bearing porphyries and other igneous rocks in southeastern Arizona, in Geological Survey research 1962: U. S. Geol. Survey Prof. Paper 450-D, p. D1-D5.

Damon, P. E., and Bikerman, Michael, 1964, Potassium-argon dating of post-Laramide plutonic and volcanic rocks within the Basin and Range province of southeastern Arizona and adjacent areas: Arizona Geol. Soc. Digest, v. 7, p. 63-78.

Hammer, D. F., and Peterson, D. W., (in press), Geology of the Magma mine area, Arizona: A.I.M.E. Graton-Sales Volume.

McTaggart, K. C., 1960, The mobility of nuées ardentes: Am. Jour. Sci., v. 258, no. 5, p. 369-382.

Peterson, D. W., 1960, Geologic map of the Haunted Canyon quadrangle, Arizona: U.S. Geol. Survey Geol. Quad. Map GQ-128, scale 1:24,000.

———1961a, Dacitic ash-flow sheet near Superior and Globe, Arizona: Stanford Univ., Stanford, Calif., Ph. D. thesis, 130 p.; U.S. Geol. Survey open-file report, April 3, 1961, 130 p.

———1961b, Flattening ratios of pumice fragments in an ash-flow sheet near Superior, Arizona, in Geological Survey research 1961: U.S. Geol. Survey Prof. Paper 424-D, p. D82-D84.

———1962, Preliminary geologic map of the western part of the Superior quadrangle, Pinal County, Arizona: U.S. Geol. Survey Mineral Inv. Field Studies Map MF-253, scale 1:12,000.

Peterson, N. P., 1962, Geology and ore deposits of the Globe-Miami district, Arizona: U.S. Geol. Survey Prof. Paper 342, 151 p.

———1963, Geology of the Pinal Ranch quadrangle, Arizona: U.S. Geol. Survey Bull. 1141-H, p. H1-H18.

Peterson, N. P., Gilbert, C. M., and Quick, G. L., 1951, Geology and ore deposits of the Castle Dome area, Gila County, Arizona: U.S. Geol. Survey Bull. 971, 134 p.

Ransome, F. L., 1903, Geology of the Globe copper district, Arizona: U.S. Geol. Survey Prof. Paper 12, 168 p.

———1919, The copper deposits of Ray and Miami, Arizona: U.S. Geol. Survey Prof. Paper 115, 192 p.

———1923, Description of the Ray quadrangle, Ray, Arizona: U.S. Geol. Survey Geol. Atlas, Folio 217, 24 p., 4 maps, scale 1:62,500.

Short, M. N., Galbraith, F. W., Harshman, E. N., Kuhn, T. H., and Wilson, E. D., 1943, Geology and ore deposits of the Superior mining area, Arizona: Arizona Bur. Mines Bull. 151, geol. ser. 16, 159 p.

Smith, R. L., 1960a, Ash flows: Geol. Soc. America Bull., v. 71, no. 6, p. 795-841.

———1960b, Zones and zonal variations in welded ash flows: U.S. Geol. Survey Prof. Paper 354-F, p. 149-159.

1-12-71

SUPCO office

From files: Ben D. April 14, 1970.

DCA #1. Elev. 4760, 9" hole started 5-18-64, completed 6-26-64.

0-1360 Dacite

1360-1935? felsite (or 2210, supco pt.) @ 1670± lost circulation

(1935) - first igneous rock + alt dk fragments in cuttings.

1935 (2210) - 4011.5 TD - Whitetail Conglomerate.

located at corner of Melvin 1, 2, 7, & 8.

Mercury sniffer ran over holes DCA-1 & 2, and down hole #1. samples ran 8-37 ppb Hg.

→ Note that Hg also over Castle Dome area.

DCA #2. Elev. 4720, 7 7/8" hole 7-3-64 to 7-12-64

located at corner of AG 1, 2, 9, & 10.

0 - 1095 (?) Td.

1095-1270 (rhy, dacite, & felsite reported).

1270-1340 lost circulation - no sample.

1270-1471 (T.D.). Whitetail Conglomerate

hole then deepened from 6-27-65 to 7-24-65.

1430-1471 (repeat) Tw.

1471-1525 Tw total Cu 0.008 → 0.038

1525-1575 Schist " " 0.016 → 0.026

1575-1680 brittle gr. & gr. } somewhat bx; some Cu stain chrysocolla " " 0.014 → 0.095

1680-1772 Schist " " 0.020 → 0.075

sulfide sample 0.09 → 0.18 in lower part.

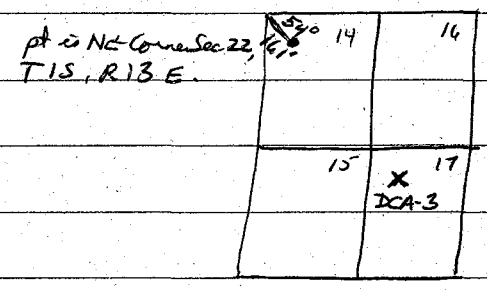
perhaps minor pyrite in bottom but still highly oxidized

Schultz granite had absent to very weak alteration.

from Supco files

DCA-3 Elev. 4440 5⅝" hole 5-7-65 to 6-21-65

located in Echo #17; 291 ft, S58°20'E from common corner of Echo 14, 15, 16, 17, in NW¼, Sec. 23, T1S, R13E.



Very hi IP response in Tw core – both by ANACONDA & SUPCO.

0-1505 Td

1505-2430 red vole & basalt

2430-2999.5 TD. Tw

0-1490 Td
1490-2430 - Tw
2430-2999.5 Tw
} letter to Zeh Jones.

K-M's OF-1A 0-1995 Td

1995-2050 Tw

2050-2150 TD. Hb

Note: Magnetic basement estimated at 4000 ft.

K-M's DC-1 0-1165 Td

1165-2303 TD. Tw.

Magnetic basement estimated at 3300 ft.

Woody Simmons

Letter to DWP from WWS.

Hole 1. 0-500 Td

500-1675 Tav

1675-4011.5 Tw.

Hole 2. 0-1095 Td

1095-1225 Rhy & Volc. glass.

1225-1270 Td.

1270-1340 Poor Sample.

1340-1525 Tw

1525-1575 Pend sch.

1575-1678 K. granit.

1678-1772 Pend sch.

Hole 3. 0-1400 Td

1400-1415 Vitrophyre

1415-1490 Td & tuff

1490-2430 Basalt

2430-2999.5 Tw.

From X-Section in Lyco files:

UVCC, DDH #4, 0 - 1264 - Td, tuff at base.
1264 - 1600 T.D. (336' @ 0.116% Cu.) in schist

UVCC, DDH #5, 0 - 655 - Td.
655 - 835 T.D. (180' @ 0.40± % Cu), in schist

HS 1 0 - 233' T.D. (233' @ 0.20± % Cu). in diabase?

HS 2 0 - 65? - schist?
65? - 168 T.D. (103' @ 0.09% Cu) in schist?

HS 4 0 - 144' T.D. (144' @ 0.08± % Cu) in diabase?

all values as silicates or carbonates — No Sulfides.
See p. 140-141 of USGS PP 342 — Globe-Miami
Powers Gulch (44 Group).

JDS

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

May 5, 1970

MEMORANDUM

TO: W. E. Saegart

FROM: J. D. Sell

Geologic Map, File No. 2263
Superior (7 1/2') Quadrangle
Pinal County, Arizona

A geology map of the Superior 7 1/2 minute quadrangle has been compiled from available information and submitted as Map File No. 2263. The source data is:

East half: Peterson, D. W., 1961. Dacitic ash-flow sheet near Superior and Globe, Arizona. California - Stanford University Ph.D thesis, 130 pages, Plate 4, scale 1:24,000.

West half: Peterson, D. W., 1962. Preliminary geologic map of the western part of the Superior quadrangle, Pinal County, Arizona. USGS Map MF-253, 1 sheet, scale 1:12,000.

In general, the sedimentary rock units on the west side show a progressive step-down from the north edge of the map (along east-west faults) to the town of Superior, and the pattern continues southward with modification by some horst-graben structures. Long north-south faults cut the earlier east-west system and for the most part the west sides are down-dropped. The pattern also exists on the dacite plateau area as mapped by Peterson through the measurement of flattened pumice fragments in the dacitic flows (USGS P.P. 424-D, p.82-84).

One shallow and nine deep drill holes have been collared in the dacite plateau. Also, Magma's #6 shaft has penetrated the dacite and their new #9 shaft is presently being sunk further east of #6.

Table I is a short resume of the available drill hole data, listed from north to south:

Table I. Dacite Plateau Drill Hole Information

Number	Section	Depth to Premineral Rock	Total Depth	Rock Type
U-4	2	1264	1600	Schist, Cu oxide
U-5	2	665	835	Schist, Cu Oxide
DCA-1	3	---	4011	Whitetail Cgl.
DCA-2	11	1525	1712	Schist-K granite, Cu oxide
CE-1	14	---	2850	Early Volcanics
DCA-3	23	---	3000	Whitetail Cgl.
CE-2	22	No information	---	---
OF-1A	21	2050	2150	Diabase, No values
I	35	2939	3475	Diabase-schist, No values
DC-1	16	---	2303	Whitetail Cgl.
#6	36	1400 (?)	3800	Limestones, quartzite, diabase

James D. Sell

James D. Sell

JDS/kvs

~~0001~~ 04 L

0002 04 4C

~~357~~

~~0001 04 L~~

0001 05 W

~~360~~

EXPLANATION

Qt	Talus
Qal	Alluvium
QTb	Basalt
QTg	Gila conglomerate
Td	Dacite (undiv.)
Tda	Ash-fall tuff
Tdw	White zone
Tdg	Grey zone
Tdb	Basal zone
Tev	Early volcanics
Tr	Rhyolite (relative age uncertain)
Tw	Whitetail conglomerate
Tqmp	Quartz monzonite porphyry
Tqp	Quartz porphyry
Tdp	Diorite porphyry
Tqd	Quartz diorite
P	Paleozoic units (Naco, Escabrosa, Martin limestones)
b	Bolsa quartzite (Cambrian age)
db	Diabase (Precambrian age)
t	Troy quartzite (Precambrian age)
Au	Apache group (undivided)
sc	Pinal schist

Fault w/estimated displacement

Deep test hole

Geologic Map

SUPERIOR 7.5' QUADRANGLE

Pinal County, Arizona

J.D.S. May 5, 1970

Scale 1:24,000

1 1/2 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

2263

Jim - This memo given to WES on 6/2/70

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

June 2, 1970

MEMORANDUM TO: W. E. Saegart

Whitetail Conglomerate Proposal
Dacite Area
Globe-Superior District
Gila-Pinal Counties, Arizona

Some thirteen outcrops of Whitetail Conglomerate have been mapped by D. W. Peterson and shown on the Superior 7 1/2' Quadrangle (ASARCO File Map 2263 and USGS Map GQ-818) which immediately underly Dacite or the Early Volcanic units and overly the pre-mineral units.

Esewhere in the Ray and Globe districts are isolated Whitetail units which, when studied, would add valuable information on the Whitetail deposition.

It is proposed that a study be made of these outcrops with the following objectives:

A. Stream deposition direction (i.e., source area).

B. Rock units, clasts, involved.

C. Especial note of granitoid and porphyritic clasts.

D. Especial note of alteration and mineralization and type of clast involved.

E. Sampling of conglomerate units throughout units with supplementary samples of altered and mineralized clasts.

F. Report and maps of depositional directions, source area, depositional basins, structural highs, values, etc., in the make-up of the depositional history of the Whitetail.

G. Possible post-depositional history of Whitetail sedimentation.

During the study additional outcrops may be found and it may well be desired and necessary to study the outcropping units found in the Haunted Canyon quadrangle immediately to the north for control in deciphering the Whitetail history.

JDS/kvs

James D. Sell

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

September 25, 1970

TO: W. E. Saegart

FROM: J. D. Sell

SUBJECT: Drilling Activity
Superior East Area
Pinal County, Arizona

On Thursday, September 24, 1970, during a tour of the project area with H. L. Crittendon, we talked with the drillers on two rigs presently drilling on the Dacite Plateau.

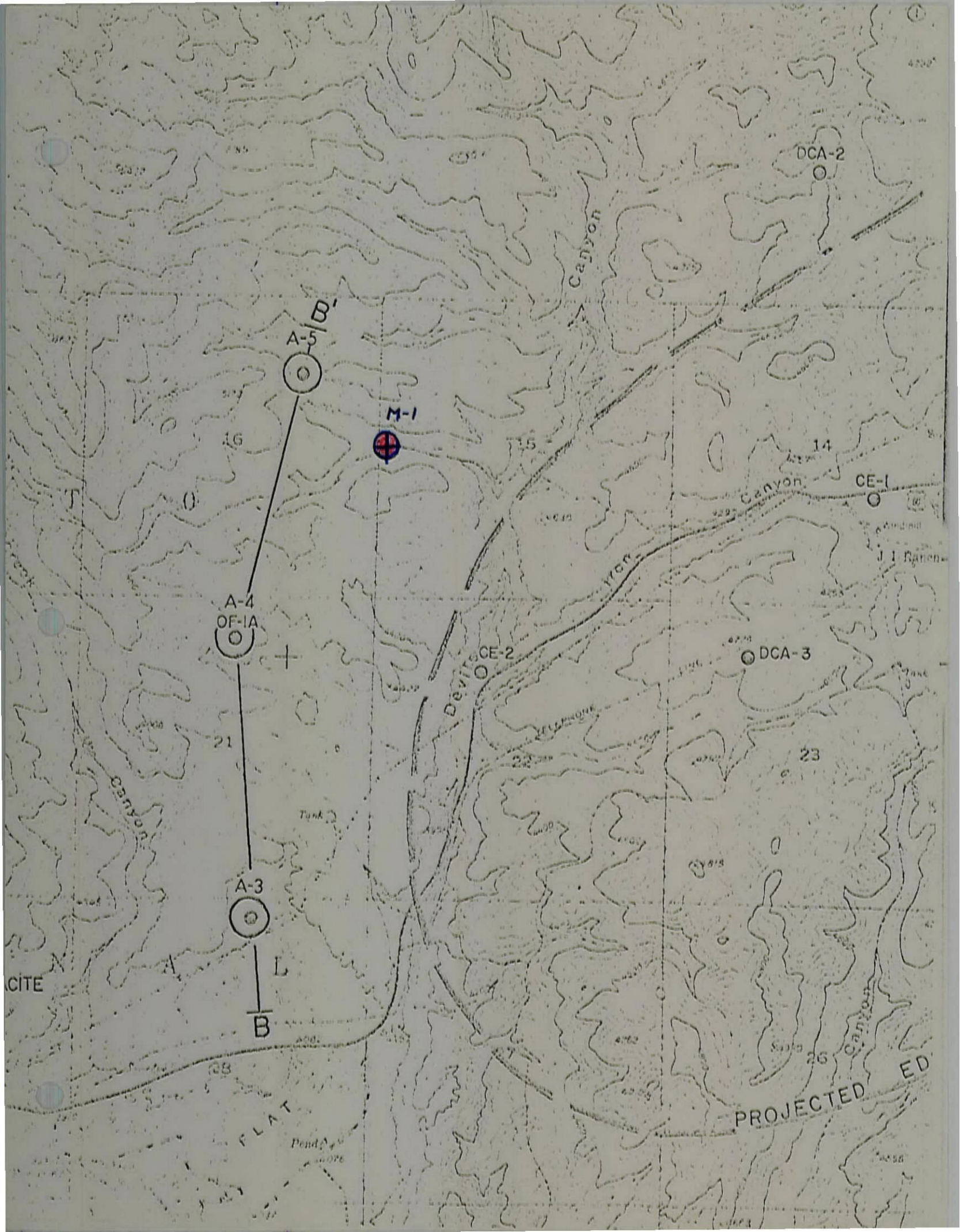
1. Continental Minerals Corporation
   Margaret Group
   East boundary of Section 15, T1S, R13E
   Hole M-1 (Continental Minerals designation)
   Present depth 1077 feet, still in dacite
   Whatley Drilling Company; Mayhew 1500 Rig.
   They have cemented several times and are making water.

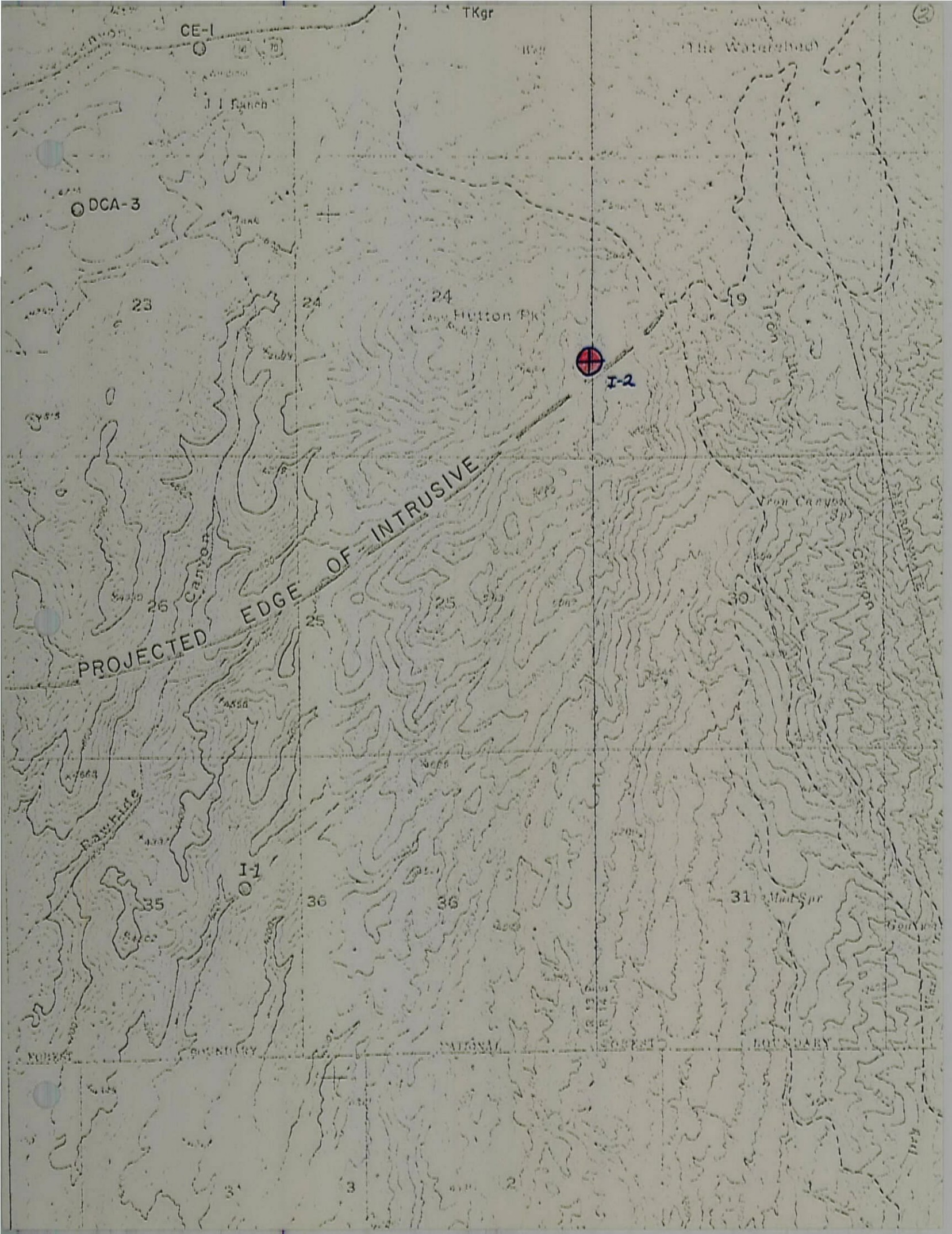
2. Inspiration Consolidated Copper Company
   No information on claim group
   NE 1/4, SE 1/4, Section 24, T1S, R13E
   Hole "I-2" (my designation; unknown ICC number)
   Present depth 1182 feet; still in dacite
   J. O. Barnes Drilling Company; Franks 1000 Rig.
   They have considerable water but have large compressor for high pressure, large volume air delivery.

The position of the two rigs is shown on the attached sheets copied from the Superior East project proposal geologic map.

J. D. Sell

JDS:mw
Att.


DCA-2
B'
A-5
M-1
16
15
14
CE-1
Canyon
J J Ranch
A-4
OF-1A
CE-2
DCA-3
Devils
21
23
Canyon
Tank
A-3
A
L
B
CITE
28
26
FLAT
Pond
PROJECTED
ED

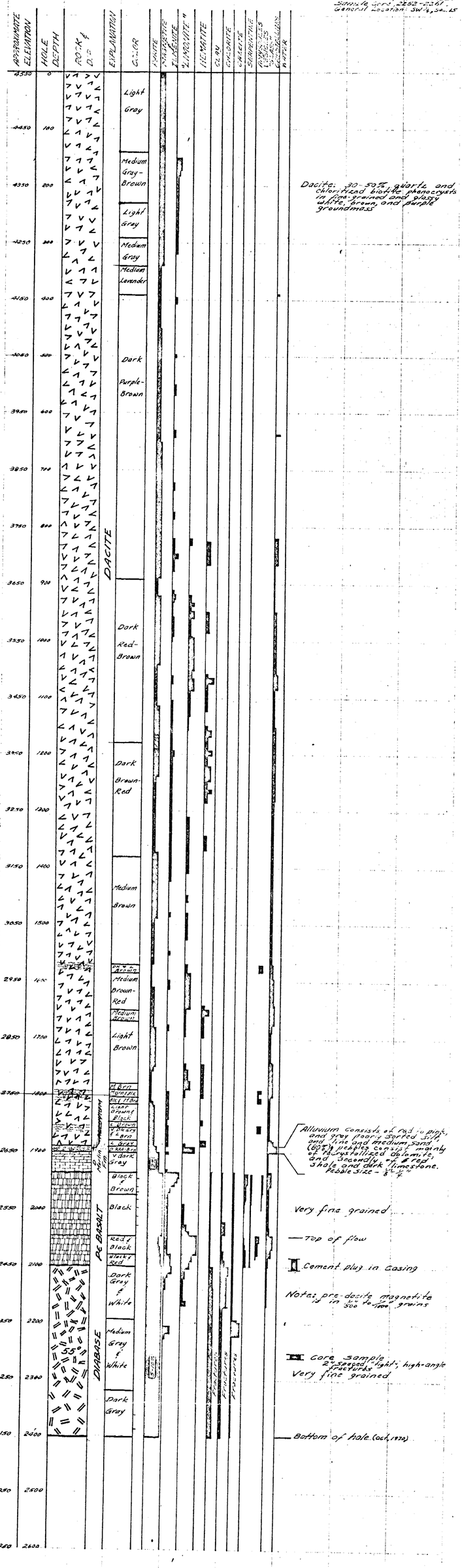

TKgr
CE-1
J I Ranch
DCA-3
23
24
24
Hutton Pk
19
I-2
PROJECTED EDGE OF INTRUSIVE
26
25
25
30
Canyon
Rawhide
I-1
35
36
36
31
Mud Spr
3
3
2

MARGARET-GROUP HOLE 1

Logged by C.J. Srbsek
Continental Copper Inc.

Drilled Oct-Nov, 1970
Collar Elevation 4550 +

5⅞" ROTARY ROCK BIT
w/ Calyx Pa 240
21 Cement Plug 2281 to 2300
Sample were 2202-2281
General location: SW¼, Sec. 15



JDS

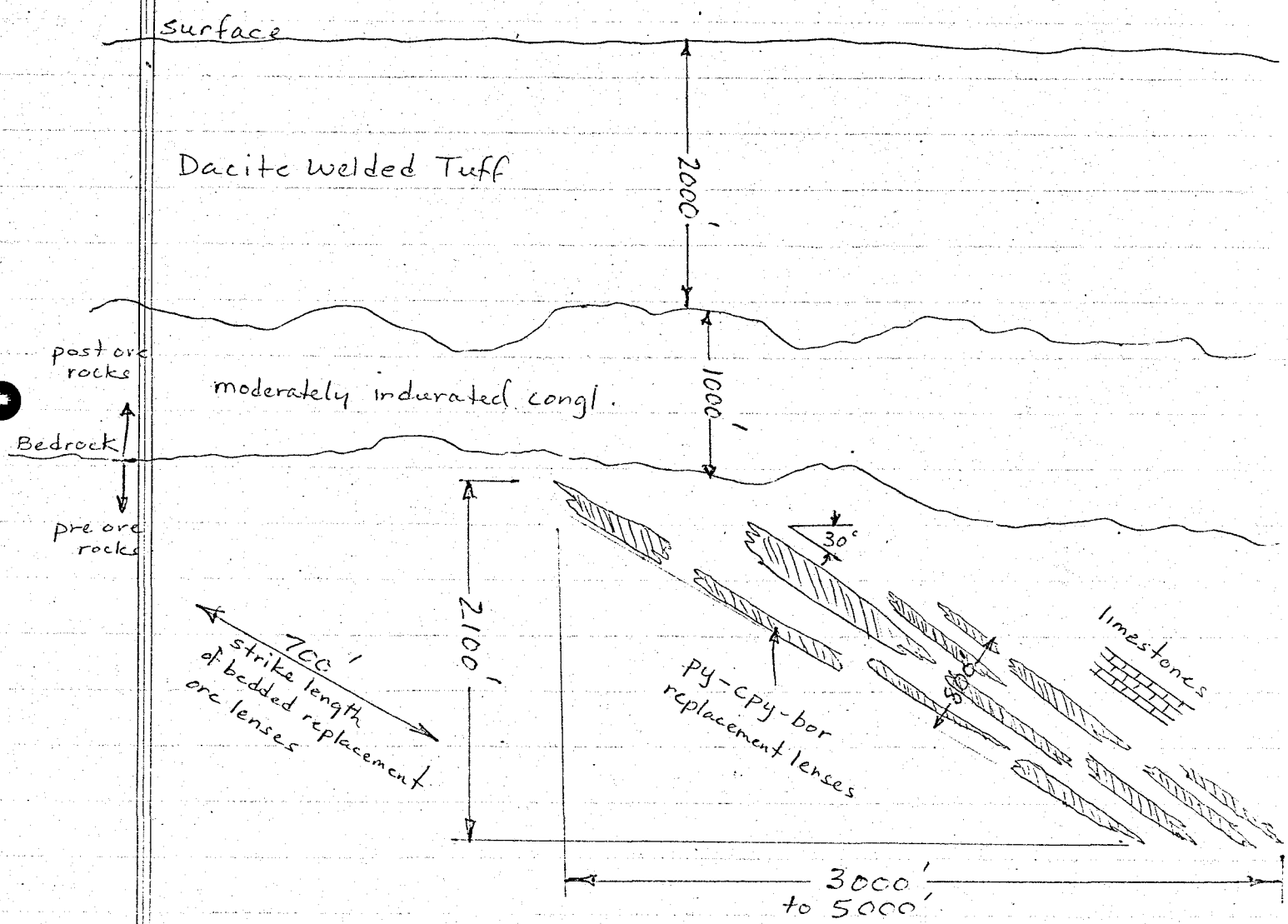
your copy

Hypothetical primary replacement Copper Deposit in limestone

W.E.S.
DEC 9 1970

Assume: 15,000,000 tons @ ± 6% Cu
allow 20% mining dilution
or. mined reserve 18,000,000 tons @ ± 5% Cu

Longitudinal Section



mining method: Horizontal transverse slots (undercut) with cemented sand fill

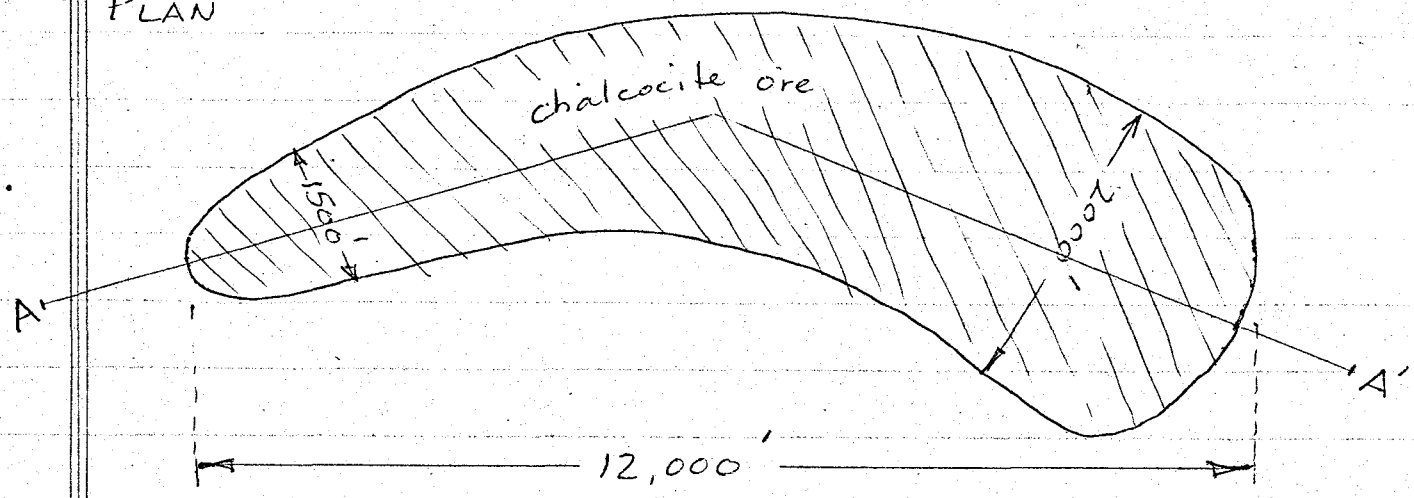
JDS
your copy

W.E.S.
DEC 9 1970

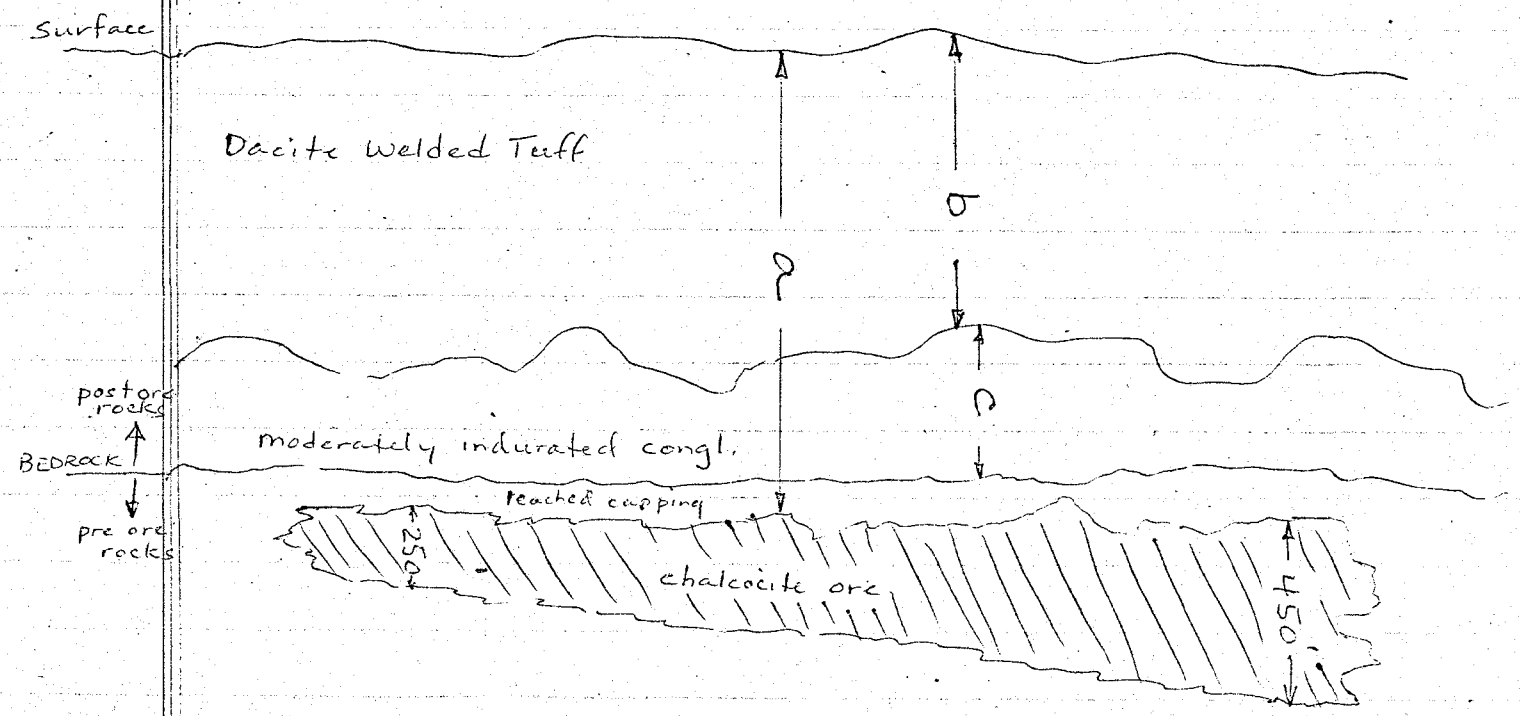
Hypothetical chalcocite enrich. Por. Cu Deposit # 1

Assume: 400,000,000 tons @ 1.25% Cu

PLAN



Section A-A'



	Case I	Case II
a	2000'	4500'
b	1400'	2400'
c	500'	2000'

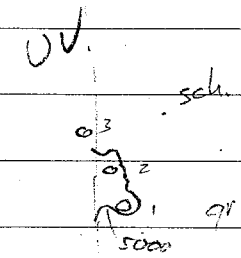
UV holes - N Peterson 12/17/70

HC PR

Hole No. 1 Oct 1. 1930 elev 5022 ft

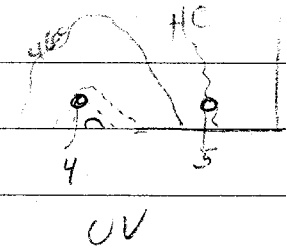
0-711 Dacite
711-780. Sch, [illegible] Fe & chrysos.

731-741	0.04 Cu	2.01 ox Fe
41-51	0.14	1.95
51-61	0.06	1.75
61-69	0.14	1.66
69-780	0.04	1.95



Hole 2. 1/27/31 to 3/26/31 elev. 4922 ft.
3.6

Duluth - Nottingham - Magnus.



AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

December 23, 1970

FILE MEMORANDUM

Re: United Verde Drill Holes (1930-31)
Dacite area west of Powers Gulch
Superior East Project
Pinal County, Arizona

Attached are copies of the location, drill hole depths, rock types and some assays, of five United Verde rotary-plunger drill holes in the old 64 Group area of Powers Gulch.

The information is from hand copied records secured from and by N. P. Peterson, retired USGS geologist in Globe.

James D. Sell

James D. Sell

JDS:mw
Att.
cc: D. T. Friel
W. E. Saegart w/o att.

AMERICAN SMELTING AND REFINING COMPANY
EXPLORATION DEPARTMENT
SOUTHWESTERN UNITED STATES DIVISION
P. O. BOX ~~5795~~ 5747, TUCSON, ARIZONA 85703
1150 NORTH 7TH AVENUE
TELEPHONE 602-792-3010

December 23, 1970

Dr. N. P. Peterson
Box 1211
Globe, Arizona 85501

Dear Sir:

I wish to thank you for the loan of your notes on the United Verde drill holes in the old 64 Group area.

I have taken the liberty of making an extra copy for yourself so that your files will always contain a copy of the information that is becoming more elusive with time.

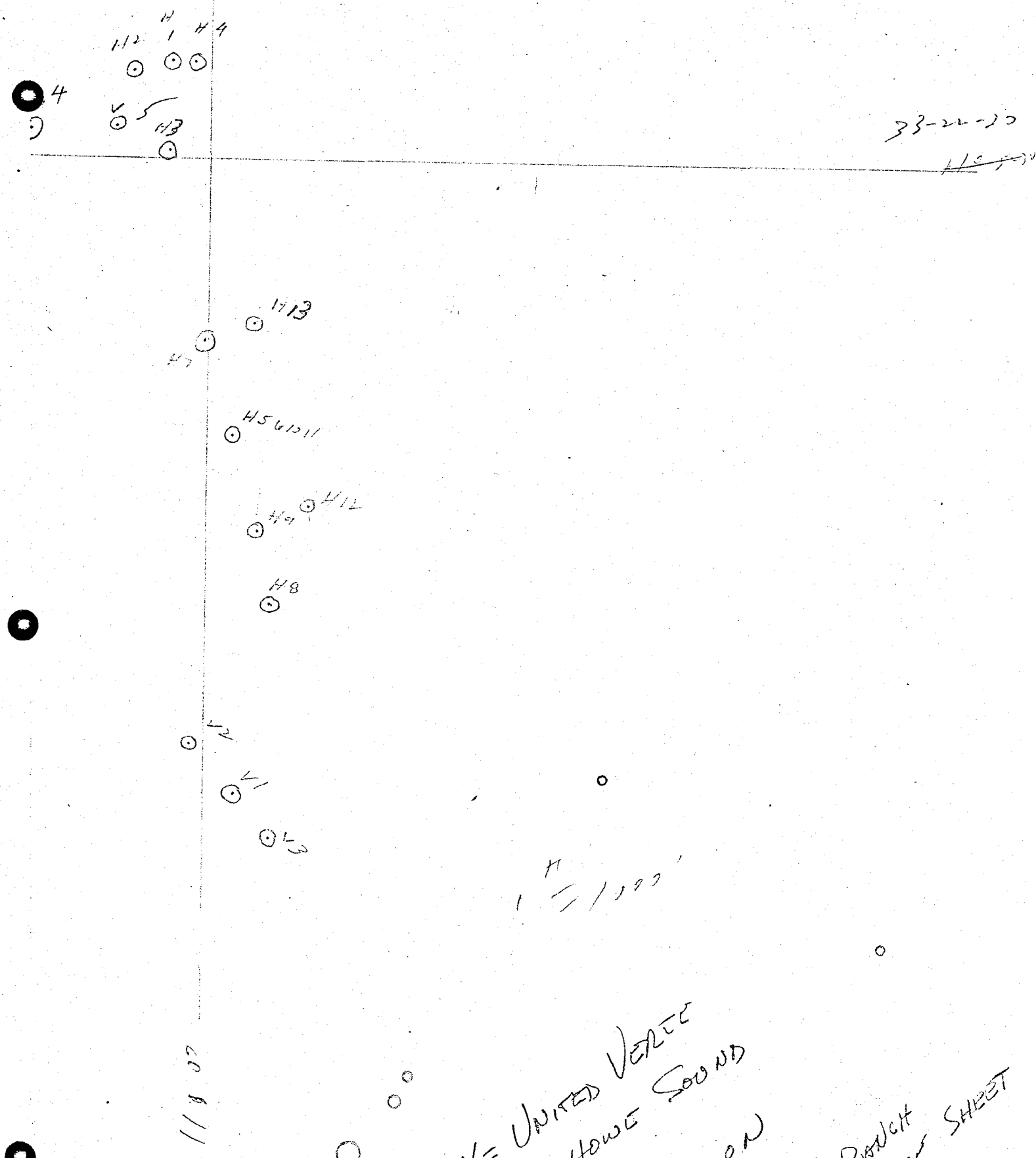
Thanks again for your help and aid in our search for drilling and geologic information.

Sincerely,

James D. Sell

James D. Sell

JDS:mw
Enc.


H2
H1
H4
4
V5
H3
33-22-10
H13
H7
H5 6 10 11
H9
H12
H8
V2
V1
V3
1" = 1000'
V= UNITED VERTE
H= HOWE SOUND
PLOT ON
BE-69
&
PUNL RANGE
TRAVERSE SHEET

Hole No. 1

64 Mine option Oct. 1, 1930 Elev. of collar 5022 ft.

0-711 Dacite

711-780 Schist with only slight evidence of mineralization. Occasional spot of iron oxide and 2 or 3 films of chrysocolla. No doubt the core ground up would average somewhat better than that recovered. Good sludge samples obtained for most of schist, and these do not show enough iron to color sludges

731-741	0.04 % Cu	2.01 % ox Fe
741-751	0.14	1.95
751-761	0.06	1.75
761-769	0.14	1.66
769-780	0.04	1.95

Hole No. 2

64 mine option, 1/27/31 to 3/26/31 Elev. of collar 4922'

0-680	Dacite
680-710	Obsidian
710-723	Somewhat altered dacite
723-732	Whitish altered dacite
732-737	No core
737-742	Greenish chloritic schist with little brown limonite
742-747	Fair schist with very little copper stain
747-752	Very lean schist
752-757	Barren schist
757-762	Some soft red material, no core
762-767	No core
767-770	Very poor capping
770-780	Mixed barren and fairly good capping
780-806	No core
806-816	Fairly good capping in blocky quartzitic schist
816-969	No core, mostly all or mostly schist
969-973	Fair to good granite capping
973-976	Good granite capping
976-986	Fair granite capping
986-996	Little fair granite capping, rest fair schist
996-1000	Very poor schist capping
1000-1015	0.4' lean schist, 0.7' barren granite, 0.4' barren schist
1015-1030	Almost barren schist
1030-1045	No limonite but 0.2% copper as chrysocolla
1045-1058	As above but with 0.3% Cu

Hole No. 2 (Continued)

1058-1068 As above but with 0.1% Cu
1068-1078 Barren
1078-1088 First half about 0.3% Cu, last half couple spots only
1088-1098 8" barren schist, 8" 0.3% Cu, rest almost barren
1098-1108 Barren and broken schist
1108-1118 Barren schist
1118-1135 No Core
1135-1146 Barren gray chloritic schist, somewhat quartzitic.

	Core Ft.	Ox. Fe	Sludge % Cu.
737-742	0.25	1.45%	.05
742-747	2.00	1.60	.03
747-752	0.3	2.40	.02
752-757	0.5	1.65	.01
757-762	0	1.82	.01
762-767	0	1.50	.01
767-770	0.6	2.22	.02
770-780	0.7	1.80	.04
780-786	0	1.90	.01
786-796	0	2.06	.01
796-806	0	2.52	.01
806-816	0.7	2.42	.01
816-822	0	2.77	.01
822-832	0	2.35	.01
832-843	0	2.88	.13
843-853	0	2.35	.05
853-863	0	2.15	.05

863-873	0	2.80	.05		
873-883	0	2.90	.03		
883-893	0	2.38	.02		
893-903	0	2.65	.03		
903-913	0	2.95	.04		
913-923	0	2.75	nil		
923-933	0	2.55	.05		
933-943	0	2.65	.04		
943-953	0	2.43	.04		
953-969	0	2.65	.04		
969-973	5.0				
973-986	1.9				
986-1000	1.2	2.85	.076		
1000-1015	1.5	2.80	.098		Cu
1015-1030	1.3	3.00	.114		.128 % Cu
1030-1045	0.7	2.15	.325		.364
1045-1058	2.5	2.30	.41		.396
1058-1068	1.0	2.30	.325		.300
1068-1078	2.0	2.45	.392	116'	.246
1078-1088	4.2	2.45	.268	0.314	.407
1088-1098	3.0	255	.240		.225
1098-1108	0.7	3.40	.172		.129
1108-1118	1.2	3.00	.277		.118
1118-1128	0	2.65	.277		
1128-1135	6	2.15	.430		
1135-1146	1.5	2.20	.344		.118

Hole No. 3

64 Mine Option 1/29/31 to 3/2/31 El. of collar - 5029'

0 - 618	Dacite, 1 piece of obsidian ½" long.
618 - 625	No record
625 - 635	Barren granite, no sludge
635 - 645	Broken granite, very little limonite, no sludge
645 - 660	Barren granite, no sludge, 1.3' core
660 - 690	" " " " , 1' core
690 - 713	No core, no sludge
713 - 721	Almost barren, no sludge, 0.5' core
721 - 742	No core, no sludge
742 - 752	2" barren core, 4" fair to good. Sludge red most of the time. Probably much less than half of sludge recovered
752 - 762	No core or sludge. A few ounces in sludge collector is pretty good granite cuttings. From here on no sludge was obtained except in sludge catcher.
762 - 772	Sludge good, core very lean.
772 - 782	Sludge fair, not as good as preceding.
782 - 791	Pretty poor, but not barren sludge
791 - 802	Sludge pretty poor but not barren
802 - 812	Sludge very poor
812 - 825	Core barren, broken granite, sludge very poor
825 - 839	Core barren granite, sludge very poor
839 - 850	" " " " " " , couple of oxidized pyrite spots.
850 - 875	Core barren granite, sludge very poor

No ASSAYS

Hole No. 4

64 Mine option 1/20/31 to 5/22/31 El. of collar 4721'

0-1150	Pink dacite, getting yellowish from 1090-1150
1150-1170	Yellowish altered dacite.
1170-1215	Obsidian
1215-1235	Yellow, altered dacite
1235-1410	Excellent to good capping, considerable quartzy schist throughout. Little chrysocolla at 1410'. Possibly a little less iron toward 1410 but still very good. Schistosity generally steep.
1410-1528	Good schist capping as judged from sludge and core.
1528-1565	Excellent capping
1565-1570	Red sand
1570-1580	Greenish quartzitic schist with very little iron
1580-1589	Probably dacite dike (?) containing numerous fragments of schist. Little chrysocolla
1589-1590	White, soft, tuff-like dacite. Little chrysocolla.
1590-1600	Reddish and grayish quartzitic schist, poor to fair capping.

	Core	Sludge % Cu.
1234-1260	3.0 ft.	.065
1260-1280	1.4	.140
1280-1305	0.3	.189
1305-1335	1.4	.180
1335-1355	0.6	.198
1355-1385	1.2	.128
1385-1410	0.5	.103
1410-1435	1.0	.103
1435-1465	1.2	.126
1465-1487	1.7	.054
1487-1507	1.1	.072
1507-1528	1.7	.054
1528-1535	0.4	.110
1535-1555	1.7	.090
1555-1575	2.0	.110
1575-1590	4.0	.100
1590-1600	3.0	.100

366' @ 0.115%

Hole No. 5

64 Mine option 4/6/31 to 5/20/31 El. of Collar 4379'

0-30	Boulders and granite
30-418	Pink? dacite
418-435	Obsidian
435-488	Yellowish, pinkish, and white altered dacite
488-586	Excellent schist capping
586-654	Good capping
654-675	Mixed poor and good capping but former has chrysocolla
675-724	Little iron but very poor capping, some chrysocolla
724-835	Practically no limonite, but little between 731-733, but fair scattering of chrysocolla, About 0.8' core of 3.0% Cu as chrysocolla in run between 747-760 top of which is 0.3 ft. below 760. Less chrysocolla 760-~~835~~ 790. Blocky quartzitic schist 735-748, 759-835. Schistosity and bedding flat. Very little chrysocolla in core 790-810 and practically none 810-835

% Cu

	Core		Sludge	
488-500	0.8		.054	
500-510	1.0		.045	
510-520	1.5		.063	
520-535	1.8		.081	
535-546	0.3	.054	.135	
546-556	0.9	.064	.225	
556-566	0.6	.064	.225	166' @ .175
566-577	0.4	.086	.288	
577-586	0.8	.107	.244	
586-598	0.3	.150	.297	
598-616	1.7	.086	.244	
616-630	2.3	.086	.225	
630-654	0.6	.128	.153	
654-675	2.4	.139	.324	
675-700	0.7	.203	.364	
700-715	1.0	.192	.306	
715-730	4.8	.192	.620	
730-733	0.7	.460	1.208	156' @ 0.54
733-747	1.3	.556	.640	75' @ 0.75
747-760	2.5	1.050	1.028	
760-769	1.6	.192	.837	
769-776	0.5	.481	.870	
776-790	0.4	.332	.520	
790-810	1.5	.139	.380	
810-814	1.0	.075	.180	
814-825	0.2		.180	
825-835	1.8		.080	

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

January 27, 1971

TO: J. D. SELL

FROM: G. S. Barnett

one to DTF.

Subject: Superior East Project
East Edge of Dacite

I am submitting to you two copies of data concerning the eastern edge of the Dacite Plateau. Specifically, this data consists of a general geology map (geology after N. P. Peterson); geology of the Iron Canyon Prospect, which includes detailed studies of the Lorraine adit, Craig adit, and Snyder Group.

The Iron Canyon Prospect is mapped at a 1" = 500' scale. This is more detailed than any study we have had previously. The Schultze Granite outcrop is significantly different from that shown by N. P. Peterson in Bulletin 1141-H, Plate 1. In addition, a more extensive coverage of workings, leached capping and foliations in the Pinal Schist is provided. I have colored in those areas which I felt would correspond to our conventions for combined alteration-mineralization designation.

A combined map of assay data and detailed geology is provided for the Lorraine adit. The map is at a 1" = 50' scale and includes Au, Ag, MoS_2, Cu and CuOx assays. From the portal of the Lorraine adit, to a point approximately 265 feet into the adit, the foliation of the Pinal Schist is generally dipping to the northwest. The map shows "strong fracturing and abundant iron oxides" beginning at this point. Further along the adit the foliation of the schist dips consistently to the southeast. These changes in the direction of dip of the foliation may be indicative of a sycline in the Pinal Schist. Such a structure may have served to localize mineralization in this area.

The Craig adit is also mapped at a 1" = 50' scale. A diabase sill(?) is shown which was not shown on N. P. Peterson's map.

The Snyder Group workings are also shown at a 1" = 50' scale. I could not determine the exact locations of the workings shown in the detailed mapping. Doug Friel, in his examination of this area, should be able to determine which workings were mapped.

The more general map is drawn at a scale of 1" = 2000 ' (geology after N. P. Peterson). The only significant difference noted is the extension of southernmost vein well into the Pinal Schist.

Doug Friel received a copy of these maps as he is primary investigator for this area.

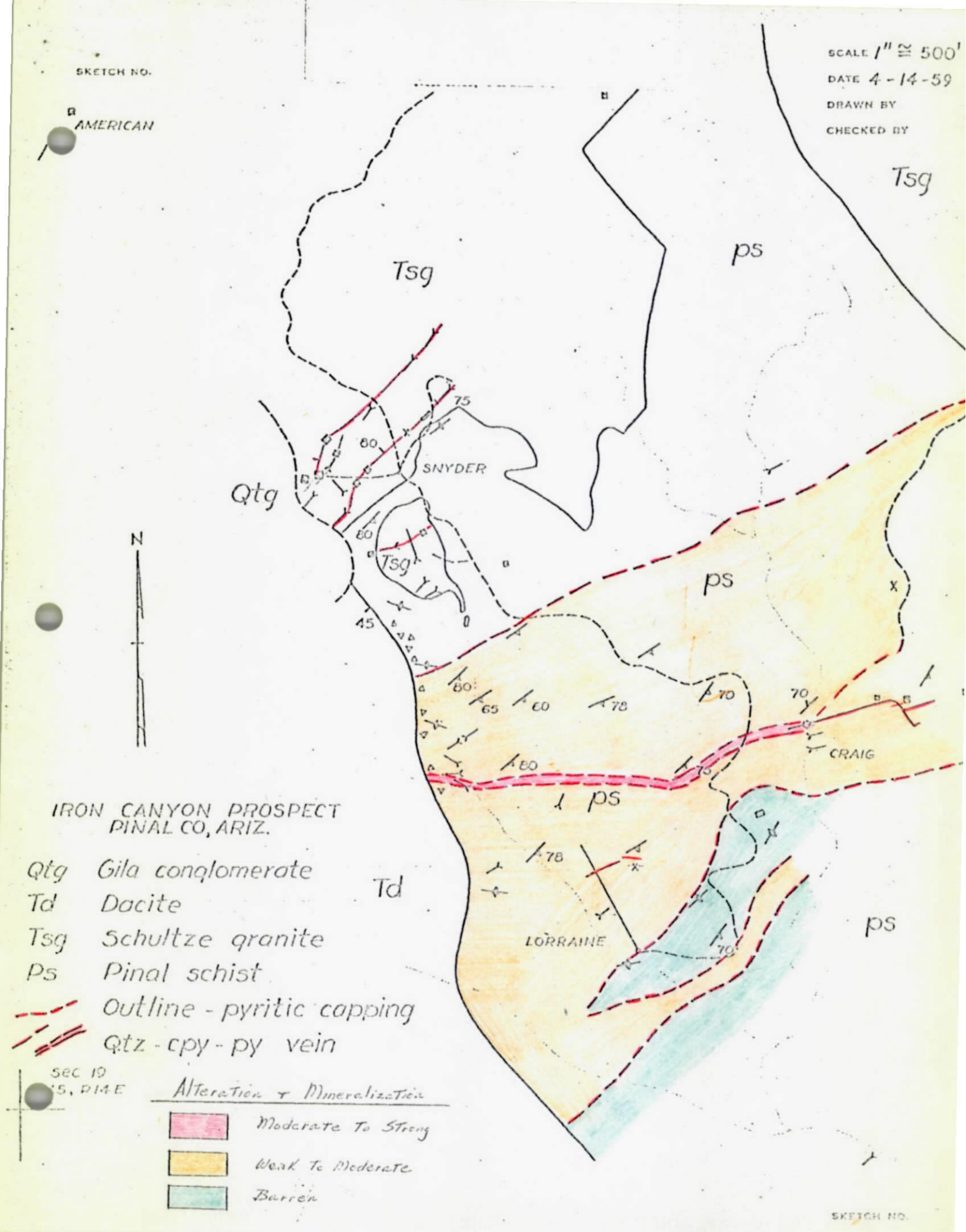
George S. Barnett

George S. Barnett

GSB:mw
Enc.
cc: W. E. Saegart
W. L. Kurtz

SKETCH NO.

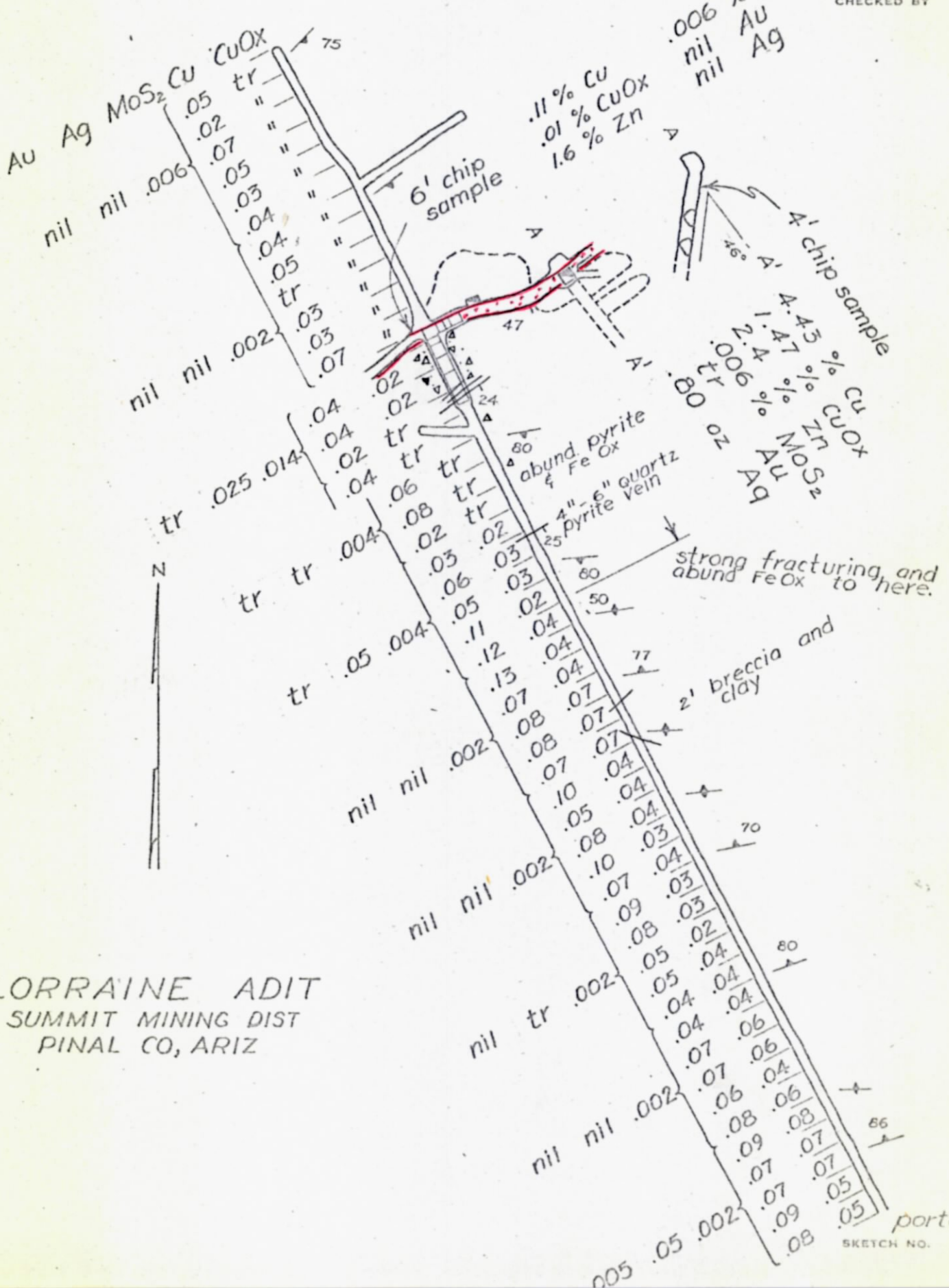
SCALE 1" ≅ 500'
DATE 4-14-59
DRAWN BY
CHECKED BY



SKETCH NO.

SKETCH NO.

SCALE 1" = 50'
DATE 3-17-59
DRAWN BY
CHECKED BY



LORRAINE ADIT
SUMMIT MINING DIST
PINAL CO, ARIZ

SKETCH NO.

SKETCH NO.

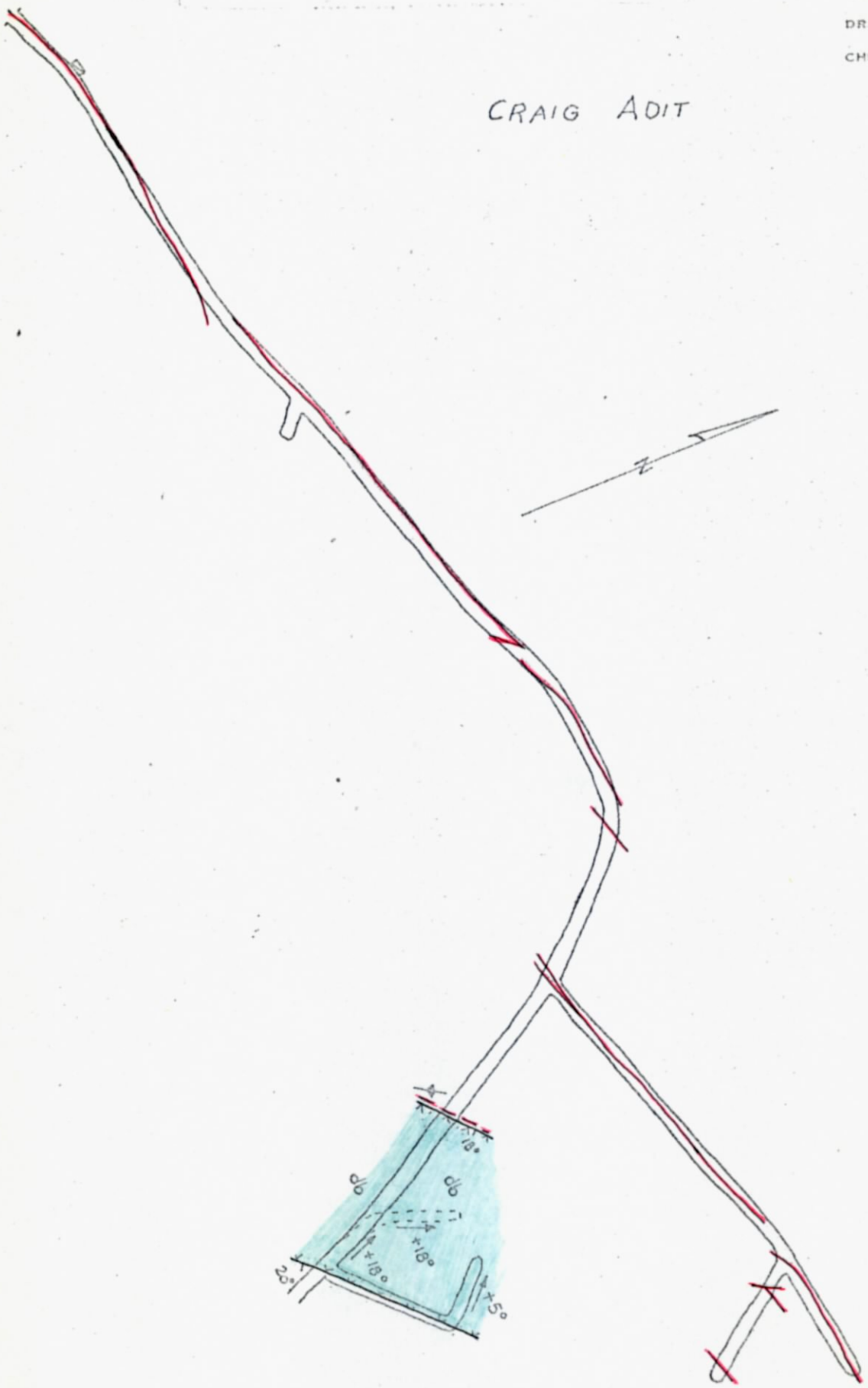
SCALE 1" = 50'

DATE

DRAWN BY

CHECKED BY

CRAIG ADIT



SKETCH NO.

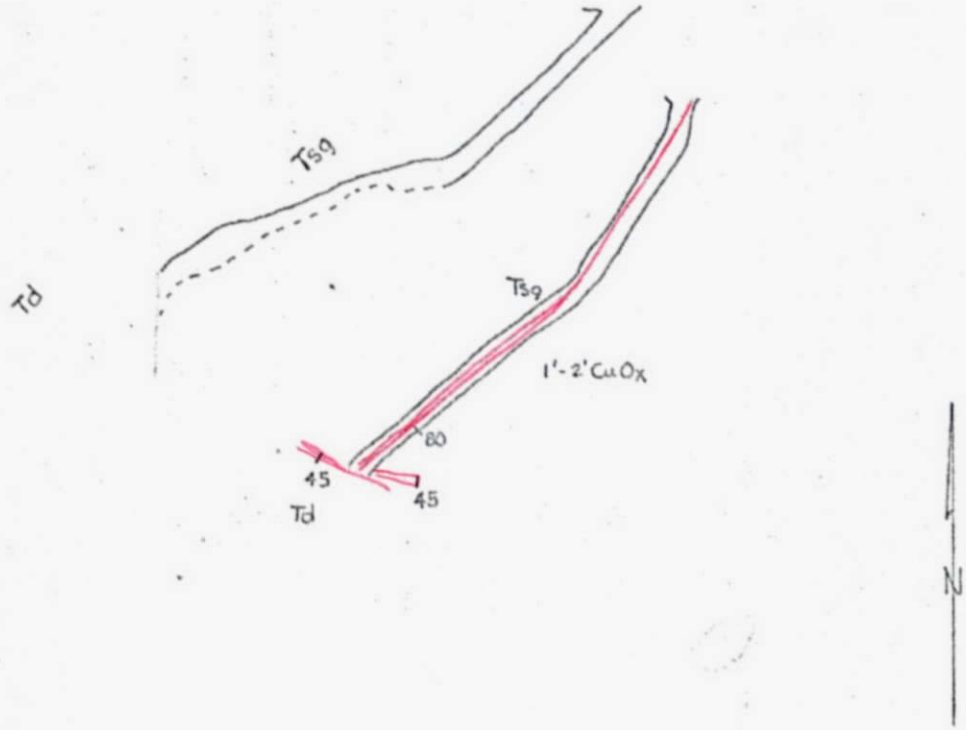
SKETCH NO.

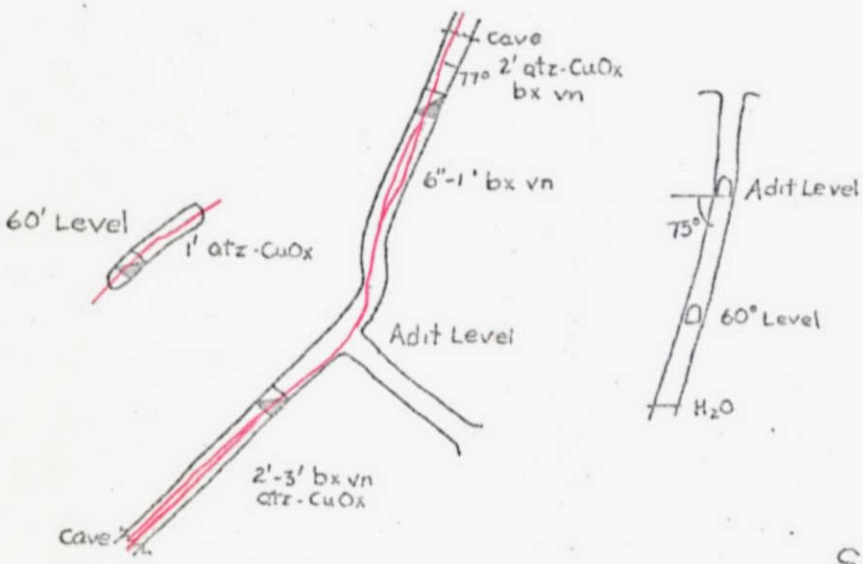
SCALE 1" = 50'

DATE

DRAWN BY

CHECKED BY



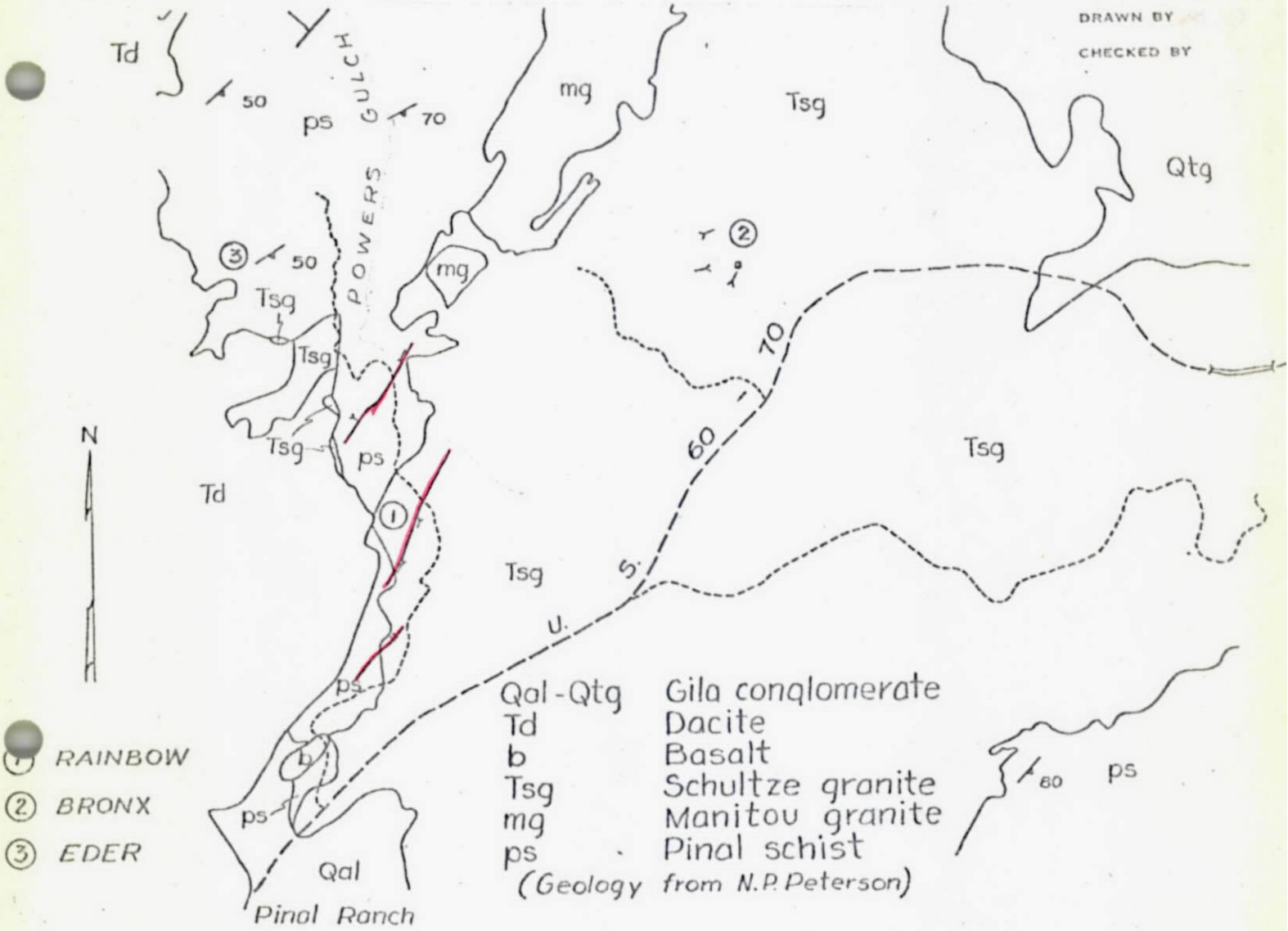


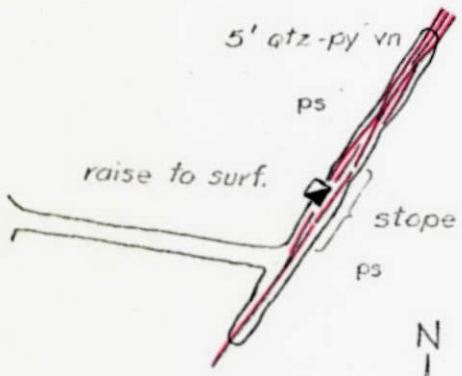
Snyder Group Workings

SKETCH NO.

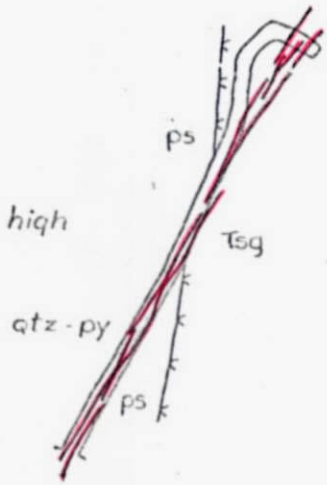
SKETCH NO.

SCALE 1" = 2000'
DATE 4-22-59
DRAWN BY
CHECKED BY





Adit near SW end of North vein.



Adit near NE end of North vein.

Adit near mid point of Middle vein.

N

1" = 50'

SKETCH NO.

Superior East: Porphyry Copper Lineament Concepts and Related Whitetail Conglomerate Study

by James D. Sell, Exploration Geologist
Southwest Department
For presentation at Annual Exploration Meeting
Chandler, Arizona March 11-13, 1971

The Superior East project is a study of the geology, structure, and mineralization of an area between Globe and Superior, and north
S-1 of Ray, Arizona. (SLIDE ONE, Please) The project area encompasses some one hundred twenty square miles, of which seventy square miles are covered by post-mineral conglomerates and volcanics.

The drawing of lines or lineaments has long been practiced in Arizona (3, 4, 7, 10, 11, 13, 14, 18, 22, 23, 26) and today the use of the computer for assimilation of the vast amounts of data is being utilized (1,8). The fundamental factor of deep-seated lineament structures as loci for mineral targets was expressed by Billingsley and Locke (4) as:

> "The essence of a mining district is the presence of such competent rocks with long-lived, deep, penetrating breaks re-opened to permit passage of heat and associated products from depths to surface"...

As exhibited in SLIDE ONE, we might express the major porphyry copper mineral deposits of Arizona as four rather broad northwest trending belts From left to right, they are named: (1) the Ajo, (2) the Northwest, (3) the Central, and (4) the Morenci belt.

In general, it is found that the loci for mineralized porphyry copper deposits are where these belts cut northeast-trending structures, as expressed by Landwehr (14). (SLIDE TWO, Please) Landwehr has named the major northwest belts in Arizona as: (1) the Colorado, through Jerome-Bagdad; (2) the Globe, through Globe-Ajo; and (3) the Bisbee--Morenci, through Morenci to Pima-Bisbee. As noted, these cover a wide swath. Synopsis of the trend-direction analysis has been reported in publications by Marv Barnes (1) and Lowell and Guilbert (17).

S-3 SLIDE THREE, Please, shows the Silver Bell deposit is a graphic study of the district trends mapped by Courtright (21). Here the mineralized northeast-trending fractures and fissures are enclosed in an overall northwesterly-trending alteration zone.

ASARCO geologist Blucher (5) in 1957 initiated a porphyry copper
S-4 reconnaissance program in the Globe-Superior region. (SLIDE FOUR, Please) Blucher covered the area in some detail and discovered and reported on a number of mineralized areas which had not been previously reported or were little known. These deposits were not of economic importance at the

time of his study, and at present have remained in that status for the most part, although some of the areas have been drilled. Blucher was impressed, as later was N. P. Peterson (20) of the USGS, in the apparent alignment or elongation of the known ore deposits of the Globe-Miami area and the apparent fact that this trend passed under the large post-mineral cover area of our present Superior East project, and the deposits at Magma and Silver King were situated where the trend emerges from under the volcanic cover.

Further investigation verified that the northeastward trend of the older Precambrian grain of the region had been followed by the younger Precambrian diabase intrusives and subsequently by the Tertiary igneous intrusives and many of the dominantly mineralized vein deposits. Thus it was reasonably evident that the northeast trend represented deeply-rooted structures of prime importance.

Later work in the Superior area has also shown the importance of the northeast structures as recurring movement along them is evident in older Precambrian, younger Precambrian, Laramide, early Tertiary volcanic, and late Tertiary volcanic times.

Continued work along this trend to the southwest by Blucher and Kinnison (6) in the Blackwater District also indicated a strong northeast trend to the mineralization and alteration outlines. Expanded reconnaissance in the area resulted in the discovery of the Poston Butte mineralization with a known alteration-mineralization extent of three miles of strike length northeast, by one mile in width. Only a small outcrop of several hundred square feet is known but even here the fracture pattern has a dominant northeasterly to easterly trend.

Next, Kinnison and Blucher extended their reconnaissance to the southwest where the small altered and mineralized hill of the Sacaton deposit was located (12). Drilling blind through the alluvium outlined a strongly oriented northeasternly-trending alteration-mineralization area.

Beck (2) followed up the reconnaissance with more detailed work in the north Sacaton area and found a northeasterly-trending zone in which aplite dikes were cut or bordered by diabase dikes which, in turn, were cut and bordered by a swarm of dioritic-monzonitic dikes and bodies of Laramide age. Outside of this three-mile-wide zone, the Precambrian granite basement rocks are cut by only a few aplitic dikes.

Deep alluvial drilling southwest of the Sacaton deposit outlined a similar northeast-trending alteration-mineralization zone in the Santa Cruz area, as reported by Wojcik (27).

By this time some sixty-five linear miles of exposures had been examined along this apparent productive northeasterly trend, and it was my good fortune to be able to continue the investigation (24, 25)

to the southwest for another forty-five linear miles where the study was terminated somewhat inside an active Air Force bombing range. Again it was conclusively demonstrated that the northeast-trending zone was persistent and had been active from older Precambrian through Tertiary time. Several intrusive and altered areas were found but follow-up work was not encouraging.

This one hundred ten mile long zone of northeasterly-trending structures has been active over the entire geologic time span and has influenced sedimentation, intrusive activity, and alteration-mineralization. Its importance as a deep-rooted primary structure is impressive and, as elsewhere in Southern Arizona, where this structure is cut by northwest trending elements mineral concentrations tend to occur.

At present Asarco is supporting further work along this northeasterly productive trend. Compilation and integration of all previous mapping coupled with additional work will be the basis of re-evaluating an accumulation of age-dates and aeromagnetic trends.

In the evaluation of this N 10° E lineament trend and its productive mineral potential, it was readily apparent that a large area of post-mineral cover existed between the mining area at Superior and the productive area of Globe-Miami.

Compilation and integration of all the available information will enforce our hunt for an ore body in this permissive area (Lasky, 15). Drilling targets in the area are of the three known classes: (1) The Miami-Inspiration class of large tonnage of relatively high-grade secondary chalcocite ore bodies located along the Schultze granite-Pinal schist contact, and having substantial oxide copper outside the main zone; (2) the satellitic porphyry intrusive class exemplified by the large Castle Dome-Pinto Valley class which is generally located several miles from the granite-schist contact; and (3) the Magma class of limestone replacement deposit having a possible genetic relationship, with a presently poorly-understood porphyry breccia intrusive.

The relative position of the known ore bodies and alteration zones
S-5 are shown on SLIDE FIVE, Please. The importance of the northeast-trending lineament zone has been established, but the productive capacity of the area is even more impressive.

The Miami-Inspiration ore body has produced through 1969 an excess of 375 million tons of ore with a recovered 3-1/4 million tons of copper, Reserves in this block is still substantial and several pit expansions are now underway. Also, the faulted segment of the same ore body, named Miami East, now being drilled by Miami and Occidental, is believed to contain an excess of 130 million tons with a grade of + 1.5% copper.

The Copper Cities deposit (Miami Copper) in fifteen years has produced 52 million tons of ore and recovered 300 thousand tons of

copper. Another pit, Diamond H, is ready for production on the southwest end of the same alteration zone, and between the two pits a large reserve of around 0.3% copper is known. Ultimate production from the zone is unknown, but large.

The Bluebird and Oxhide deposits are nonsulfide deposits of reprecipitated values probably leached from the Miami-Inspiration deposit or possibly from an undiscovered deposit lying to the northwest now covered by mid-Tertiary dacite. Production of around 65 million pounds of copper has been made to date and reserves probably amount to at least double this amount.

The Castle Dome area is a "worked out" deposit having produced 41 million tons of ore with a recovered 514 million pounds of copper from 1943-1953. Since that date, 64 million pounds of precipitate copper has been produced from leach dumps over the deposit. Under the Castle Dome area is the newly reported Pinto Valley project with a released figure of 350 million tons of 0.45% copper. Actual reserves are probably nearer 550 million tons at the same grade.

The Cactus-Carlota deposit is primarily a nonsulfide deposit in brecciated Pinal schist and is underlain by a flat, gravity type fault. Little production from the area has been made but reserves probably range between 75 and 100 million tons, half of which is commercial at the present time. The deposit is controlled by Miami and Homestake Production Company. The west end of the deposit (Carlota portion) is entirely covered by dacite.

To the southwest, a zone of nonsulfide copper is found in the schist and is underlain by a flat fault similar to Cactus-Carlota. The exotic mineralization passes under the dacite cover. Several drill holes put down in 1930-1931 were 1000 feet west of the dacite cover and all encountered values of nonsulfide copper. In 1965, a joint venture hole between Superior Oil and Miami Copper was placed some 3000 feet west of the dacite edge. It also encountered nonsulfide copper values.

This zone of exotic copper values will be further evaluated by drilling in search for the continued nonsulfide copper in the upper plate of the gravity slide fault as well as for the source area for this copper.

On the northwest side of the Superior East area are two alteration-mineralization zones. One is a Silver King where $6.5 million in silver had been extracted at the turn of the century from a small pipe-like deposit. The Silver King intrusive is pre-Whitetail in age, and abundant clasts of the Silver King diorite prophyry are found in the conglomerate immediately in the area. An alteration zone separate from the pipe-deposit is known which passes northeasterly under the Whitetail and overlying dacite. Evaluation of this zone is in progress. The Rock House zone, to the north, occurs in both Precambrian Pinal schist and post-dacite intrusive, contains pyrite with minor values, and is probably related to solfataric activity connected with the volcanism.

In the Magma area, a blind mineralized breccia is known in the area of the new No. 9 shaft. This shaft was collared in dacite, and as of last week was at a depth of 2100 feet in Whitetail Conglomerate. The new shaft will increase the air base and hoisting capacity for exploitation of the Magma stacked replacement ore bodies. An announced reserve of ten million tons of 5.8% copper is reported but this is calculated only to the 3900 level. Mineralization in scattered holes is known to the 4300 level but no reserve calculations have been released. Total production at Magma from the vein and replacement deposits has been 15-1/2 million tons of ore with 810 thousand tons of copper recovered. Little is known of the mineralized breccia, and during a recent tour at Magma we were politely refused passage into the area where they are presently diamond drilling an up-hole at the shaft site station in the breccia. All of the replacement limestone ore is totally blind and covered by dacite. ← March 4, 1971

The renewed interest in the Volcanic covered area between Globe and Superior has resulted in the accumulation of data on many facets of the problem. The present Asarco studies in the Superior East area include re-evaluation of the adjacent mineralization around the edge of the plateau, an evaluation of the Whitetail conglomerate of Oligocene age, an evaluation of the mid-Miocene volcanics, and a structural interpretation of the entire region. Dual elevation aero-magnetics has been completed over the area as well as new color photography by the Salt Lake Geophysical Division. A preliminary review of computer statistical drilling target evaluation has also been run.

The Whitetail conglomerate is the first post-mineral unit of the district. Recent age dating of a tuff unit in the conglomerate indicated a 34 m.y. date in the Ray district. Our study is through traverses in the scattered outcrop areas. Altered fragments are sought, and where found they are collected for assay. The tuffaceous silt matrix is also sieved and sampled and being assayed for values. The type of clasts are recorded and, where possible, the transport direction is determined. 32 →

The dacite, with a dated age of 20 m.y., was subjected to a study by D. W. Peterson (18) of the USGS. Peterson suggested that the dacite mass is an ignimbrite or ash-flow tuff, and thus equidimensional pumice fragments in the column of tuff would be progressively flattened as the mass cooled and settled. The most deformed or elongated pumice would be at the base, and the least would be at the top. A phase of his study included a study of the flattening ratio. Part of our work has been to verify this method of depth determination and expand the coverage. To date it appears the dacite is more variable than suggested by Peterson, and only gross position can be determined. A photo interpretation of the fracture pattern--intensity and relative age--on the Plateau is also underway. This is being coupled with expansion of a study into the surrounding pre-mineral units and a total evaluation being made of the relative high-low position of blocks.

Thirteen relatively deep drill holes, plus two of Magma's shafts, are known to be on the Plateau. Information on these penetrations is being gathered. Four of the holes penetrated into pre-mineral units; two are reported to have penetrated, but some questions remain; and the remaining seven holes were terminated either in early volcanics or Whitetail conglomerate beneath the dacite cover.

A recent study released by USGS (16) on the trace-element of biotite in granitoid rocks of the Sierrita district points up a further approach. The excellent exposures and biotite content of the Laramide Schultze granite of the Globe-Miami district makes this unit amenable to such a study, and particular care will be taken in the area where the granite passes under the dacite cover. The copper mineralization related to the Schultze granite has recently been studied and released in a thesis by Clary (9).

Asarco is not alone on the plateau (SLIDE SIX, Please) but we have a land position along with Inspiration Consolidated Copper Company, Magma Copper Company, and Continental Materials Corporation. Other companies such as Banner Mining Company have holdings off the Plateau area in the pre-mineral exposure. Negotiations are in progress with Continental Materials Corporation on their holdings.

As mentioned previously, drilling penetrations (SLIDE SEVEN, Please) in the Plateau area is restricted to four holes into pre-mineral rock out of some thirteen attempts. The four completions are near the eastern edge of the Plateau, and three intercepted nonsulfide exotic copper, while the fourth (southern) hole was barren.

In our Superior East drilling project, it is proposed to re-enter and deepen four holes, which presently range in depth from 1500 feet to 3000 feet in depth. Two of these were thought to be in premineral units by the previous operators but re-evaluation of the core by thin-section and with increased knowledge of the geology of the area, it is firmly believed that the holes terminated in post-mineral units. Completion of these holes will provide valuable geologic information as well as testing for the western edge of the Schultze granite where an Inspiration-Miami type body is permissible along the contact in schist and the incidence of rich limestone replacement bodies in the Paleozoic units.

Several new holes are proposed to further test the contact zone and also the continuation and source area of the eastern exotic copper zone. This phase of the high cost drilling area is expected to cost $300,000 with testing of adjacent target areas on a continuing basis to be $150,000 or a total of $450,000 for a two-year program in the Superior East project area.

Thank you.

REFERENCES

1. Barnes, Marvin P., 1970, Porphyry copper deposits - a computer analysis of geological parameters: Univ. of Utah PhD Dissertation, 200 pages. Also AIME Preprint 70-L-111, with W. T. Parry.

2. Beck, David B., 1965, ASARCO unpublished mapping notes.

3. Billingsley, Paul, and Locke, Augustus, 1935, Tectonic position of ore districts in the Rocky Mountain Region: AIME Trans., vol. 115, p. 59-68.

4. Billingsley, Paul, and Locke, Augustus, 1941, Structure of ore districts in the continental framework: AIME Trans. vol. 144, p. 9-64.

5. Blucher, A. G., Jr., 1958, Porphyry copper reconnaissance in the Globe-Superior region: ASARCO report, 12 pages.

6. Blucher, A. G. Jr., 1960, Blackwater and Posten Buttes prospects: ASARCO report, 18 pages.

7. Burnham, C. Wayne, 1959, Metallogenic provinces of the southwestern United States and northern Mexico: New Mexico Bureau of Mines Bulletin 65, 76 pages.

8. Carson, W. P., 1970, Computerized lineament tectonics and porphyry copper deposits in southeast Arizona and southwest New Mexico: Verbal presentation to Arizona AIME, Tucson, December 7, 1970. Also Stanford University PhD disseration.

9. Clary, Thomas A., 1970, Geologic study of the Schultze granite and related copper mineralization: Arizona State University (Tempe), Master of Science thesis, 37 pages.

10. Comstock, Theodore B., 1900, The geology and vein-phenomena of Arizona: AIME Trans., vol. 30, p. 1038-1101.

11. Hulin, Carlton D., 1948, Factors in the localization of mineralized districts: AIME Trans., vol. 178, p. 36-57.

12. Kinnison, John E., and Blucher, A. G., Jr., 1961, Sacaton porphyry copper prospect: ASARCO report, 2 pages.

13. Kutina, Jan., 1969, Hydrothermal ore deposits in the western United States - a new concept of structural control of distribution: Science, vol. 165, p. 1113-1119.

14. Landwehr, W. R., 1967, Belts of major mineralization in western United States: Econ. Geol. vol. 62, no. 4, p. 494-501.

15. Lasky, Samuel G., 1948, The search for concealed deposits - a reorientation of philosophy: AIME Trans., vol. 178, p. 82-89.

16. Lovering, T. G., et al, 1970, Copper in biotite from igneous rocks in southern Arizona as an ore indicator, p. 1-8 in USGS Prof. Paper 700-B, Geol. Survey Research 1970, Chapter B, 265 pages.

REFERENCES

17. Lowell, J. David and Guilbert, John M., 1970, Lateral and vertical alteration-mineralization zoning in porphyry copper deposits: Econ. Geol., vol. 65, no. 4, p. 373-408.

18. Mayo, Evans B., 1959, Lineament tectonics and some ore districts of the southwest: AIME Trans., vol. 211, p. 1169-1175.

19. Peterson, D. W., 1961, Flattening ratios of pumice fragments in an ash-flow sheet near Superior, Arizona, p. 82-84 in USGS Prof. Paper 424-D, Geol. Survey Research 1961, Chapter D, 408 pages. Also Stanford University PhD dissertation.

20. Peterson, N. P., 1962, the geology and ore deposits of the Globe-Miami district, Arizona: USGS Prof. Paper 342, 151 pages.

21. Richard, Kenyon, and Courtright, James H., 1966, Structure and Mineralization at Silver Bell, Arizona, p. 157-163 in Titley, R. S., and Hicks, Carol L., Editors, Geology of the porphyry copper deposits: Univ. of Arizona Press, 287 pages.

22. Schmitt, Harrison A., 1935, Structural associations of certain metalliferous deposits in southwestern United States and northern Mexico: AIME Trans., vol. 115, p. 36-58.

23. Schmitt, Harrison A., 1966, the porphyry copper deposits in their regional setting, p. 17-33 in Titley, S. R., and Hicks, Carol L., Editors, Geology of the porphyry copper deposits: Univ. of Arizona Press, 287 pages.

24. Sell, James D., 1964, Table Top region: ASARCO report, 18 pages.

25. Sell, James D., 1965, Sand Tank region: ASARCO report, 25 pages.

26. Wertz, Jacques B., 1970, The Texas lineament and its economic significance in southeast Arizona: Econ. Geol., vol. 65, no. 2, p. 166-181.

27. Wojcik, J. R., 1966, Santa Cruz summary: ASARCO report, 5 pages.

SLIDES

ONE: JHC Ariz.-New Mex. Porp. Map with NW Trend overlay
TWO: JHC Ariz.-New Mex. Porp. Map with NE Trend overlay
THREE: KR-JHC Mineral Fissure - Alt. Trend at Silver Bell
FOUR: JHC Ariz.-New Mex. Porp. Map updated
FIVE: WES Orebody Map of Globe-Superior Trend updated
SIX: Land Status of the Plateau area
SEVEN: Drill hole locations on the Plateau area

1971

Surface Hole Conditions

DCA-1. 12"(?) Surface casing with welded cap. No info.

DCA-2. 12" ID casing to ±30', open below.

DCA-3. 5 5/8" hole, open, uncased.

M-1. 6" surface pipe. 4" std, standard pipe (3 1/2" ID) to 2405' TD

M-a 6 7/8" uncased, open, water at ±60 ft.

OF-1A. 7" surface pipe with top plug of wood (?).

DC-1. 7" hole with 7 1/2" surface pipe; plugged at ±100 ft.

I-1. 3" standard pipe capped.

I-(3) (next to road branch) 5" surface pipe.

Clean out: @ 750^{00} drawing line, 3 days per hole.

4 holes × 3 = 12 × 750 = 9000^{00} = 10,000^{-}

for 9300 @ 1^{00}/ft = 9300 } +

Casing of 9300 ft @ 1^{50}/ft = 14 000^{-} = 14,000^{-}

Total rotary: 1000 4100 800 = 5900 ft @ 10 ft

" casing 1000 1450 1000 1200 500 1000 = 6350 ft @ 20 ft

6350 GT. 12,250 @ 20/ft = 245,000

269,000

2400
2150
1770
3000
9300

A 3	3500
#4	4000
EOT	4000
HC	3000
	14,500
	20
	290,000

$20\overline{)150,000}$ 7500

ICC 223,171,772 4,050,590,376

152,702,609 2,500,073,136

375,877,381 6,550,663,512

3.¼

2000 | 6551

6000

5

300,000

2000

600,000,000

3,250,000

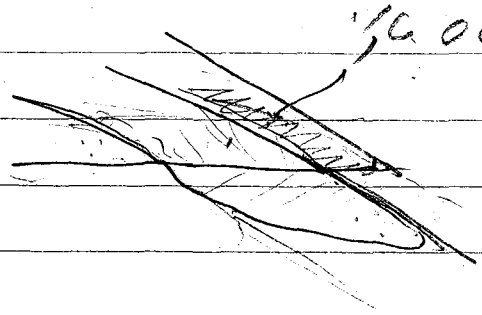
2000

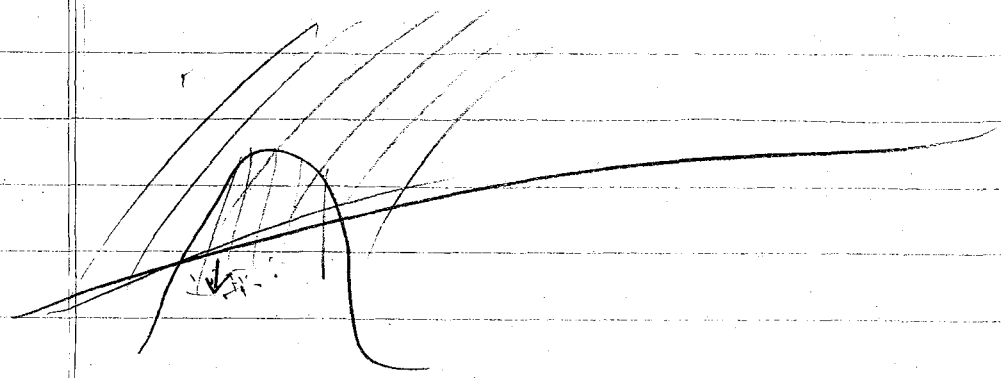
6,500,000,000

500,000 lb

2000

1,000,000,000





New Holes

1). SE 1/4, Sec. 2, T1S, R13E A-3

1000'± Td

1000 ± Coring

≐ 2000 TD.

2). NW 1/4, Sec. 5, T2S, R13E.

2300 Td

1800 Tw

1650 Pal

5750 TD

3) NE 1/4, Sec. 4, T2S, R13E.

Same as no. 2 test.

Reentered Holes

4) SW 1/4, Sec. 15, T1S, R13E.

Contentlield Material M-1 hole (Whatley).

5 5/8 rotary drill hole to 2402'.

4" OD standard black pipe with cement plug at 2084-2105.

Deepen 1000 ft by Coring (basalt in bottom).

5.) NW 1/4, Sec. 21, T1S, R13E

Ken-McGee Hole OF-1A.

7" surface pipe with wooden surface plug?.

2150 total depth ; 6 1/4 rotary w/ 3 3/4" core from 2130-2150.

Deepen 1200 ft by coring. (basalt in bottom).

6) SE 1/4, Sec. 11, T 1S, R 13E.

Superior-Miami hole DCA-2.

Technical Air Services. 7 7/8 hole.

TD #772 in schist.

Deepen 500 feet by coring.

7) NW 1/4, Sec. 23, T1S, R13E.

Superior-Miami DCA-3

C.C. Smith

open hole 5 7/8 hole.

TD 3000' in Tw conglomerate.

Deepen 1000 feet by coring.

All data [illegible]
[illegible] SB 3/4/71

MIAMI COPPER - SUPERIOR OIL

NO. 1 HAUNTED CANYON

0 - 1845 DACITE

2210 ANDESITE/BASALT

4011 WHITETAIL

NO. 2 PINAL RANCH NORTH

0 - 1340 DACITE

1535 WHITETAIL

1772 SCHIST, GRANITE & GNEISS
.05 to .10 Cu

NO. 3 PINAL RANCH SOUTH

0 - 1400 DACITE

1505 VITROPHYRE & TUFF

2430 BASALT/ANDESITE

3000 WHITETAIL

INSPIRATION - DEVIL'S CANYON

0 - 1025 DACITE

1086 VITROPHYRE & TUFF

2939 WHITETAIL (db, ps, md)

3475 PINAL SCHIST - BARREN &
UNALTERED - BROKEN

KERR-McGEE - DEVIL'S CANYON

0 - 1165 DACITE

2303 WHITETAIL

KERR-McGEE - OAK FLAT

0 - 1995 DACITE

2050 WHITETAIL

2150 DIABASE - BARREN & UNALTERED

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

April 1, 1971

TO: J. D. Sell

FROM: G. S. Barnett

Re: SAMPLES OF TERTIARY BASALT

Attached are the results of a geochem sampling of a basalt(s) or basaltic andesite(s) which underlies the Earlier volcanics and/or dacite in the Superior Region.

The results and comments on their probable significance are as follows:

DCA-1: Ag = 0.02 oz/T; Cu - 47 ppm; Pb = 26 ppm; Zn = 66 ppm; represents drill core from DCA-3 (initial designation in error). This specimen was abundantly green stained and had minute flakes which were thought to be native copper. Geochem results indicate only background in this sample.

QTb: Ag - Tr.; Cu - 16 ppm; Pb - 28 ppm; Zn = 70 ppm; is a sample that was collected on an outcrop of basalt northwest of Sutton's Summit. Values are minor. This basalt has been mapped as QTb, but its weathered, fractured condition, and resemblance to other units, suggest that this basalt is in fact Tertiary. A subsequent check indicated agreement to this classification by Nels Peterson (Personal communication James D. Sell).

TB-Cu: Cu - 880 ppm; Pb = 70 ppm; Zn = 133 ppm; Fe = 3.15%; Cu Ox = 550 ppm; was collected northeast of the Tony Ranch in the Haunted Canyon area. The basalt contains an abundant green oxide mineral lining silicified fractures. The 880 ppm total copper with 550 ppm oxide, suggest that the majority of the copper is exotic or being leached from the basalt proper. This basalt overlies the Whitetail Conglomerate and may well be a source for some of the exotic copper in the Whitetail. Alternatively, this copper may be derived from an uphill source area.

TB-Hill: Cu = 21 ppm; Pb = 15 ppm; this sample was collected north-northwest of Tony Ranch. This basalt exhibited no green staining, but did have abundant Fe-Mn oxides. It is possible that the copper has been leached from the basalt and transported down flowage planes and deposited northeast of TB - Hill.

JK-1: Cu = 28 ppm; Pb = 20 ppm; Zn = 78 ppm; Ox Cu = 36 ppm; this sample was collected near the Wood Camp intrusive by John King. There is some doubt whether this rock was Tertiary basalt or Precambrian in age. I believe the sample to be chloritized Precambrian basalt.

The basalt was but meagerly tested, therefore possibilities exist for an unsampled locale to have an economically recoverable amount of copper as either oxide and/or sulfides. It is most probable that this copper will be in oxide and/or carbonate form, minable by a conventional mining method(s) (open pit, block caving, leaching.) The basalt has an indeterminate thickness, but reaches at least 502 feet in a Continental Materials' drill hole (M-1).

Calculations of thickness for the basalt in the Tony Ranch area indicate a maximum depth of approximately 650 feet. A thickness of approximately 940 feet was intercepted in a drill hole, DCA-3, under the main dacite mass.

I would suggest that further sampling of the Tertiary basalt be conducted on the rather remote chance that an economically recoverable amount may be located. This basalt will probably be encountered in many drill holes that penetrate the Dacite and/or Earlier volcanics and as such is a very important postmineral unit.

Thank you,

George S. Barnett

George S. Barnett

GSB:sh

3226 East 46th Street

Phone 624-0049

AMERICAN ANALYTICAL and RESEARCH LABORATORIES W. G. K.

ASSAYERS · CHEMISTS · METALLURGISTS

FEB 8 1971

TUCSON, ARIZONA 85713

SAMPLE SUBMITTED BY American Smelting & Refining Company
Mr. G. Barnett

DATE Feb. 4, 1971

SAMPLE MARKED	GOLD OZ./TON	SILVER OZ./TON	PPM COPPER	PPM LEAD	PPM ZINC	PERCENT MOLYBDENUM	PERCENT IRON	PPM Ox Cu
TB - Cu			880	70	133		3.15	550
TB - Hill			21	15	89			28
JK - 1			28	20	78			36

Invoice # 5923

CHARGES $ 16.25

REGISTERED ASSAYER
CERTIFICATE NO. 6852
PETE S. FLORES
Date Signed 2/4/71
Arizona U. S. A.

Pete S. Flores

ASSAYER-CHEMIST

3226 East 46th Street

Phone 624-0049

AMERICAN ANALYTICAL and RESEARCH LABORATORIES

ASSAYERS · CHEMISTS · METALLURGISTS

TUCSON, ARIZONA 85713

SAMPLE SUBMITTED BY American Smelting & Refining Company

Mr. George Barnett

DATE Dec. 28, 1970

SAMPLE MARKED	GOLD OZ./TON	SILVER OZ./TON	~~PERCENT~~ PPM COPPER	~~PERCENT~~ PPM LEAD	~~PERCENT~~ PPM ZINC	PERCENT MOLYBDENUM	PERCENT IRON	
DCA - 1		0.02	47	26	66			
QTB		Trace	16	28	70			

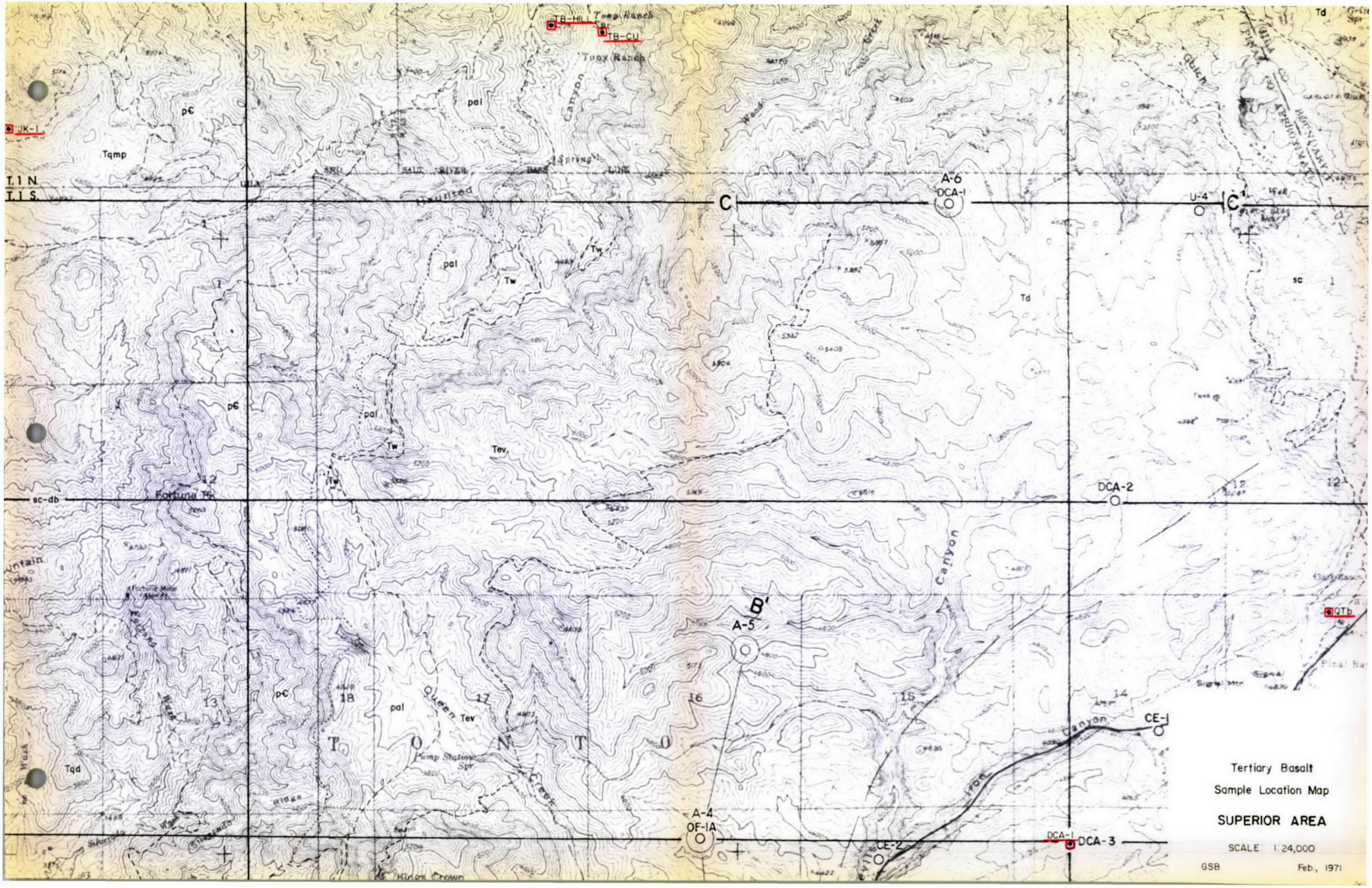
K.V.D.S.
DEC 31 1970

REGISTERED ASSAYER
CERTIFICATE NO. 6852
PETE S. FLORES
Date Signed 12/28/70
Arizona U. S. A.

Invoice # 5778

CHARGES $ 10.50

ASSAYER - CHEMIST



Tertiary Basalt

Sample Location Map

SUPERIOR AREA

SCALE 1:24,000

GSB Feb., 1971

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

April 1, 1971

TO: James D. Sell

FROM: George S. Barnett

Re: SUPERIOR PROJECT - LOGGING OF SAMPLES FROM CONTINENTAL MATERIALS DRILL HOLE (M-1)

All chip samples and selected portions of cored section for drill hole M-1 (total depth 2402 feet) were examined by me. The following is my interpretation of the section as represented by the samples examined:

0'	-	354' ± 10'	Tdw = Tertiary dacite (white unit)
354'	-	1180' ± 10'	Tdg = Tertiary dacite (gray unit)
1180' ±	-	1420'	Tdb or Tdg = Tertiary dacite (red-brown unit)
1420'	-	1575'	Tdb = Tertiary dacite (yellowish-tan brown unit)
1570' (1575' - 1590)	-	1600'	Tdb = Vitreous (probable vitric zone)
1600'	-	1800'	Tdb - Tuff?
1800'	-	1830'	Vitrophyre
1830'	-	1890'	Tdb - Tuff
1890'	-	1900'	Basal Cgl. - Tuffaceous? (may be rubble on "Ta" surface)
1900'	-	2402'	(Ta) Tertiary andesite or basaltic andesite

This may be generalized to the following:

TERTIARY	0' - 1890'	dacite	
	1890' - 1900'	tuffaceous(?) conglomerate	
	1900' - 2402'	basaltic - andesite	

George S. Barnett
George S. Barnett

GSB:sh

TAB

Drill Data

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

April 12, 1971

TO: W. E. Saegart

FROM: J. D. Sell

Re: DRILL HOLE DATA
SUPERIOR EAST PROJECT
PINAL COUNTY, ARIZONA

Attached is data on eighteen penetrations scattered in the Dacite Plateau area. The information is to accompany the modified Superior East Project map #2271.

All formation data is open for interpretation and where Asarco has reinterpreted logs the information is also listed or noted.

James D. Sell

James D. Sell

JDS:sh

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

DRILL HOLE DATA - SUPERIOR EAST AREA

HOLE NUMBER:	Shaft No.9
COMPANY:	Magma Copper Company
DRILLING CONTRACTOR:	Centennial Development Company
LOCATION:	NW$\frac{1}{4}$ NW$\frac{1}{4}$, Sec. 32, T 1 S, R 13 E
COLLAR ELEVATION:	4190
TOTAL DEPTH:	Scheduled for 4900 feet
HOLE SIZE:	22 feet, circular

FORMATIONS:	0 - 1875	T dacite	(includes vitrophyre and tuff)
	1875 - 2100	Tw	(as of March 4, 1971)
	TD		

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

DRILL HOLE DATA - SUPERIOR EAST AREA

HOLE NUMBER: OF-1A

COMPANY: Kerr-McGee

DRILLING CONTRACTOR: C. C. Smith

LOCATION: NW$\frac{1}{4}$ NE$\frac{1}{4}$, Sec. 21, T 1 S, R 13 E

COLLAR ELEVATION: 4410

TOTAL DEPTH: 2150

HOLE SIZE: 6$\frac{1}{4}$" rotary; 3-3/4" core

CORED INTERVAL: 2130-2150 (w/0.06-0.07% Cu) in Asarco's files

LOGS & CUTTINGS: Drilling Log in Asarco files
Schlumberger I-ES and FDC/GR logs to 1860 feet.
(4/9/71) in Asarco files

OTHER: Drilled 10-27-64 to 11-15-64

FORMATIONS:

00- 1635	T dacite	0 - 1995	T dacite
1635 - 1670	T vitrophyre	1995 - 2050	T Whitetail w/volc.?
1670 - 1790	T dacite		
1790 - 1840	T vitrophyre	2050 - 2150	T basalt andesite
1840 - 1875	T dacite		
1875 - 1930	T vitrophyre	TD	
1930 - 1995	T dacite		
1995 - 2050	T Whitetail Conglomerate (?)		
2050 - 2150	diabase(?)		
TD			

Re-evaluation suggest unit is post-mineral andesite. (Asarco thin-section).

Core samples ran 0.06% Cu with trace Au - Ag.

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

DRILL HOLE DATA - SUPERIOR EAST AREA

HOLE NUMBER:	DC-1
COMPANY:	Kerr-McGee
DRILLING CONTRACTOR:	C. C. Smith
LOCATION:	NE$\frac{1}{4}$ NE$\frac{1}{4}$, Sec. 16, T 2 S, R 13 E
COLLAR ELEVATION:	3990
TOTAL DEPTH:	2303
HOLE SIZE:	6$\frac{1}{4}$" rotary
CORED INTERVAL:	None
LOGS & CUTTINGS:	Log in Asarco file
OTHER:	Drilled 11/27/64 to 12/17/64

FORMATIONS:

0 - 1130	T dacite
1130 - 1160	T vitrophyre
1160 - 1165	T tuff
1165 - 1800	T Whitetail Cgl., w/red sand cement.
1800 - 2303	T Whitetail Cgl., larger pebbles, harder drilling.
TD.	

0 - 1165	T dacite
1165 - 2303	T Whitetail
TD	

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

DRILL HOLE DATA - SUPERIOR EAST AREA

HOLE NUMBER:	DCA-1
COMPANY:	Superior-Miami Joint Venture
DRILLING CONTRACTOR:	Technical Air Services
LOCATION:	NW$\frac{1}{4}$ NE$\frac{1}{4}$, Sec. 3, T 1 S, R 13 E
COLLAR ELEVATION:	4760
TOTAL DEPTH:	4011.5 feet
HOLE SIZE:	9" with 12" surface casing.
CORED INTERVAL:	1668-1675 (volcanics); 2370-2375(Tw; 0.018% Cu, 0.004% Ox Cu); 2959-2971 (Tw; 0.024% Cu, 0.010% Ox Cu); 3514-3568 (Tw; 0.024% Cu, 0.008% Ox Cu); 4000-4011.5 (Tw; 0.020% Cu, 0.004% Ox Cu)
LOGS & CUTTINGS:	Log in Asarco files; See W.W. Simmons for cuttings
OTHER:	Drilled 5-18-64 to 6-26-64
FORMATIONS:	(reinterpreted from log)

0 - 460	T dacite
460 - 520	T vitrophyre
520 - 550	T tuff (dirty white felsite)
550 - 2210	T early volcanics, felsite, glass, some dacite(?), andesite in lower portions.
2210 - 4011.5	T Whitetail Cgl.; w/sandstone, quartzite, siltstone, granite, limestone, andesite, basalt and gneiss.

TD

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

DRILL HOLE DATA - SUPERIOR EAST AREA

HOLE NUMBER:	DCA-2
COMPANY:	Superior-Miami Joint Venture
DRILLING CONTRACTOR:	Technical Air Service
LOCATION:	NW$\frac{1}{4}$ SE$\frac{1}{4}$, Sec. 11, T 1 S, R 13 E
COLLAR ELEVATION:	4720
TOTAL DEPTH:	1772
HOLE SIZE:	7-7/8" (37 feet of 13$\frac{1}{2}$" casing at surface)
CORED INTERVAL:	Unknown
LOGS & CUTTINGS:	Log to 1471 in Asarco file. See W. W. Simmons for core and cuttings. Schlumberger I-ES and FDC/GR logs to 1291 feet (4-8-71) in Asarco files.
OTHER:	Drilled 7-3-64 to 7-12-64 and 6-27-65 to 7-24-65
FORMATIONS:	(reinterpretation from log)

0 - 1095	T dacite
1095 - 1300(?)	T early volcanics; rhyolite, glass, felsite
1300(?) - 1460	T Whitetail Cgl.; granite, qtzite, schist andesite
1460 - 1525	T Whitetail Cgl. (KM report)
1525 - 1575	Pe Pinal schist (w/exotic Cu)
1575 - 1678	K quartz monzonite (w/exotic Cu)
1678 - 1772	Pe Pinal schist (w/exotic Cu)

TD

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

DRILL HOLE DATA - SUPERIOR EAST AREA

HOLE NUMBER:	DCA-3
COMPANY:	Superior-Miami Joint Venture
DRILLING CONTRACTOR:	C. C. Smith
LOCATION:	NW$\frac{1}{4}$ NW$\frac{1}{4}$, Sec. 23, T 1 S, R 13 E
COLLAR ELEVATION:	4640
TOTAL DEPTH:	3000
HOLE SIZE:	5-5/8" @ surface, no casing
CORED INTERVAL:	Unknown
LOGS & CUTTINGS:	See W. W. Simmons
OTHER:	Drilled May - June 1965 Schlumberger hit bridge at 680 feet, unable to penetrate - No log.

FORMATIONS:

0 - 1400	T dacite
1400 - 1415	T vitrophyre
1415 - 1490	T tuff
1490 - 2430	Tev, basalt
2430 - 3000	T Whitetail Cgl.
TD	

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

DRILL HOLE DATA - SUPERIOR EAST AREA

HOLE NUMBER:	U-2
COMPANY:	United Verde
DRILLING CONTRACTOR:	Unknown
LOCATION:	NW$\frac{1}{4}$ NW$\frac{1}{4}$, Sec. 12, T 1 S, R 13 E
COLLAR ELEVATION:	4922 (?)
TOTAL DEPTH:	1146
HOLE SIZE:	Unknown
CORED INTERVAL	737 to 1146
LOGS & CUTTINGS:	X-Section & log in Asarco files. Sample from 1030-1146 averaged 116 feet at 0.314% Cu.
OTHER:	Drilled 1/27/31 to 3/26/31

FORMATIONS

0 - 600	T dacite
600 - 710	T vitrophyre (obsidian)
710 - 735	T tuff (last core from 732-737)
735 - 806	PE Schist, barren to poor copping
806 - 969	PE Schist, good copping
969 - 996	T granite, good copping
996 - 1030	PE Schist, barren, no copper
1030 - 1068	PE Schist, no limenite but 0.1-0.3% Cu, exotic
1068 - 1146	PE Schist, barren
TD	

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

DRILL HOLE DATA - SUPERIOR EAST AREA

HOLE NUMBER:	U-4
COMPANY:	United Verde
DRILLING CONTRACTOR:	Unknown
LOCATION:	NE$\frac{1}{4}$ NE$\frac{1}{4}$, Sec. 2, T 1 S, R 13 E
COLLAR ELEVATION:	4640 (4721?)
TOTAL DEPTH:	1600
HOLE SIZE:	Unknown
CORED INTERVAL:	1234 - 1600
LOGS & CUTTINGS:	X-Section & log in Asarco files. Sample from 1234- 1600 averages 366 feet at 0.115% Cu.
OTHER:	Drilled from 1/20/31 to 5/22/31

FORMATIONS:

0 - 1170	T dacite
1170 - 1215	T vitrophyre, obsidian
1215 - 1235	T tuff (yellow alt dacite)
1235 - 1565	PE Schist, good capping w/0.115% Cu, exotic
1565 - 1570	Red Sand
1570 - 1589	Dacite dike?, w/frag. of schist containing chyrocolla
1589 - 1590	tuff like dacite, little chyrocolla
1590 - 1600	PE Schist, poor to fair capping.
TD	

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

DRILL HOLE DATA - SUPERIOR EAST AREA

HOLE NUMBER:	U-5
COMPANY:	United Verde
DRILLING CONTRACTOR:	Unknown
LOCATION:	NW$\frac{1}{4}$ NW$\frac{1}{4}$, Sec. 1, T 1 S, R 13 E
COLLAR ELEVATION:	4165
TOTAL DEPTH:	835
HOLE SIZE:	Unknown
CORED INTERVAL:	488-835
LOGS & CUTTINGS:	X-Section & Log in Asarco files.
OTHER:	

FORMATIONS:

0 - 30	Surface gravels
30 - 418	T dacite
418 - 435	T vitrophyre, obsidian
435 - 488	T tuff, alt dacite
488 - 675	PE Schist, good capping
675 - 835	PE Schist, poor capping, but exotic copper
TD	

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

DRILL HOLE DATA - SUPERIOR EAST AREA

HOLE NUMBER:	CE-1
COMPANY:	Cibola Exploration
DRILLING CONTRACTOR:	Unknown
LOCATION:	NW$\frac{1}{4}$ SE$\frac{1}{4}$, Sec. 14, T 1 S, R 13 E
COLLAR ELEVATION:	4485
TOTAL DEPTH:	2850 ?
HOLE SIZE:	Unknown
CORED INTERVAL:	Unknown
LOGS & CUTTINGS:	Log in Magma Copper Files. May secure.
OTHER:	
FORMATIONS:	take by word of mouth --- 10th hand!

0 - 2200	T dacite
2200 - 2850	Tev
TD	

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

DRILL HOLE DATA - SUPERIOR EAST AREA

HOLE NUMBER:	CE-2
COMPANY	Cibola Exploration
DRILLING CONTRACTOR:	Unknown
LOCATION:	SE$\frac{1}{4}$ NW$\frac{1}{4}$, Sec. 22, T 1 S, R 13 E
COLLAR ELEVATION:	4080
TOTAL DEPTH:	Unknown
HOLE SIZE:	Unknown
CORED INTERVAL:	Unknown
LOGS & CUTTINGS:	In Magma files.
OTHER:	
FORMATIONS:	No information other than probably bottomed in basalt.

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

DRILL HOLE DATA - SUPERIOR EAST AREA

AOF-1

HOLE NUMBER:	1-1
COMPANY:	Inspiration Consolidated Copper Company
CRILLING CONTRACTOR:	Boyles Brothers
LOCATION:	SE$\frac{1}{4}$ NE$\frac{1}{4}$, Sec. 35, T 1 S, R 13 E
COLLAR ELEVATION:	4200
TOTAL DEPTH:	3475
HOLE SIZE:	? 3" standard pipe at surface
CORED INTERVAL:	Total
LOGS & CUTTINGS:	Log synopsis supplied by Kerr-McGee
OTHER:	
FORMATIONS:	Kerr-McGee

0 - 1105	T dacite
1105 - 2939	T Whitetail
2939 - 3240	PE diabase No sulfides reported
3240 - 3475	PE Schist
TD	

Other Source G.S.B.

0 - 1025	T dacite
1025 - 1086	T vitrophyre & tuff
1086 - 2939	T Whitetail (db, ps, md)
2939 - 3475	PE Schist, barren & unaltered
TD	

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

DRILL HOLE DATA - SUPERIOR EAST AREA

A-OF-3

HOLE NUMBER: I-2

COMPANY: Inspiration

DRILLING CONTRACTOR:

LOCATION: SW$\frac{1}{4}$ NW$\frac{1}{4}$, Sec. 25, T 1 S, R 13 E

COLLAR ELEVATION: 4520

TOTAL DEPTH:

HOLE SIZE:

CORED INTERVAL:

LOGS & CUTTINGS: Unknown hole

OTHER: prob. assesment

FORMATIONS:

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

DRILL HOLE DATA - SUPERIOR EAST AREA

AOF-2

HOLE NUMBER:	1-3
COMPANY:	Inspiration
DRILLING CONTRACTOR:	Wilson of Casa Grande, Arizona
LOCATION:	SW$\frac{1}{4}$ SE$\frac{1}{4}$, Sec. 24, T 1 S, R 13 E verbal T. Brock
COLLAR ELEVATION:	4975
TOTAL DEPTH:	Unknown but said to be 790 in Tw?
HOLE SIZE:	5" Surface pipe. See Assess. file note
CORED INTERVAL:	
LOGS & CUTTINGS:	
OTHER:	
FORMATIONS:	Tw chips of Pc sc, db, qtzite. at drill site.

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

DRILL HOLE DATA - SUPERIOR EAST AREA

A0F-4

HOLE NUMBER: 1-4

COMPANY: Inspiration

DRILLING CONTRACTOR: Boyles Brothers - verbal from Mathews

LOCATION: SE$\frac{1}{4}$ SE$\frac{1}{4}$, Sec. 24, T 1 S, R 13 E

COLLAR ELEVATION: 5000

TOTAL DEPTH: 3000 verbal from Mathews

HOLE SIZE:

CORED INTERVAL:

LOGS & CUTTINGS:

OTHER:

FORMATIONS: 0 - T dacite

- 3000 T Whitetail

TD

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

DRILL HOLE DATA - SUPERIOR EAST AREA

A-08-5

HOLE NUMBER:	I-5
COMPANY:	Inspiration
DRILLING CONTRACTOR:	J. O. Barnes
LOCATION:	NE$\frac{1}{4}$ SE$\frac{1}{4}$, Sec. 24, T 1 S, R 13 E
COLLAR ELEVATION:	5100
TOTAL DEPTH:	1410
HOLE SIZE	6 $\frac{1}{4}$" rotary
CORED INTERVAL:	None
LOGS & CUTTINGS:	
OTHER:	Drilled to 11/23/70
FORMATIONS:	from cuttings & trouble observations
	0 - 1150 T dacite
	1150 - 1410 T whitetail
	TD

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

DRILL HOLE DATA - SUPERIOR EAST AREA

HOLE NUMBER:	I-6
COMPANY:	Inspiration
DRILLING CONTRACTOR:	Boyles Brothers
LOCATION:	SW$\frac{1}{4}$ SE$\frac{1}{4}$, Sec. 35, T 1 N, R 13 E
COLLAR ELEVATION:	3840
TOTAL DEPTH:	2000 (?) Inclined - 55° @ N 36° W
HOLE SIZE	NQ?
CORED INTERVAL:	Total
LOGS & CUTTINGS:	
OTHER:	Fall of 1970
FORMATIONS:	0 - 2000 T dacite; verbal J. Levine
	TD

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

DRILL HOLE DATA - SUPERIOR EAST AREA

HOLE NUMBER	M-W
COMPANY	Continental Materials
DRILLING CONTRACTOR:	Whatley Drilling Company
LOCATION:	NE$\frac{1}{4}$ NE$\frac{1}{4}$, Sec. 21, T 1 S, R 13 E
COLLAR ELEVATION:	4280
TOTAL DEPTH:	200
HOLE S ZE:	6-7/8" uncased
CORED INTERVAL:	None
LOGS & CUTTINGS:	
OTHER:	Water-well for M-1
FORMATIONS:	0 - 200 T dacite
	TD

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

DRILL HOLE DATA - SUPERIOR EAST AREA

HOLE NUMBER:	M-1
COMPANY:	Continental Minerals Company
DRILLING CONTRACTOR:	Whatley Drilling Company
LOCATION:	SW$\frac{1}{4}$ SW$\frac{1}{4}$, Sec. 15, T 1 S, R 13 E
COLLAR ELEVATION:	4550
TOTAL DEPTH:	2402
HOLE SIZE:	5-5/8" rotary w/3-3/4" core, 3$\frac{1}{2}$" ID casing to 2402'
CORED INTERVAL:	2252-2261 (Asarco thin section = andesitic basalt)
LOGS & CUTTINGS:	In Asarco files.
OTHER:	Drilled Sept. - Oct. 1970

FORMATIONS:

By C.M.

0 - 1890	T Dacite
1890 - 1900	Alluvium
1900 - 1936	D Martin Lms.
1936 - 2100	PE basalt
2100 - 2402	PE diabase
TD	

Relogged Cuttings by Asarco

0 - 355	T dacite, white
355 - 1180	T dacite, gray
1180 - 1420	T dacite, red-brown
1420 - 1575	T dacite, yellow-tan
1575 - 1600	T dacite, vitreous (?)
1600 - 1800	T dacite, tuff
1800 - 1830	T dacite, vitrophyre
1830 - 1890	T dacite, tuff
1890 - 1900	Basal cgl.-tuff(?)
1900 - 2402	T basalt (Tev)
TD	

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

April 15, 1971

TO: J. D. Sell

FROM: G. S. Barnett

Re: DRILL HOLE INFORMATION
AVAILABLE ON DACITE PLATEAU

The detailed logs for seven drill holes in the dacite have been examined by me. The following are my interpretations of those logs. Also included is a drill hole location map as Attachment A.

These data have been included in Addenda B, (memo Geo. S. Barnett to Mr. Bill Saegart, 4-16-71). However, I believe that the interpretations offered as significantly different from those available previously and are valuable as a separate and smaller memorandum.

Thank you,

George S. Barnett

George S. Barnett

GSB:sh

cc: WESaegart

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

April 15, 1971

TO: J. D. Sell

FROM: G. S. BARNETT

Re: INTERPRETED AND GENERALIZED LOGS, SUPERIOR DACITE DRILL HOLES

DRILL HOLE	DESIGNATION	COMPANY
No. 1	(DCA-1) Haunted Canyon	Miami Copper/ Superior Oil

DEPTHS (in Ft.)	UNITS	THICKNESS (in Ft.)
0 - 550	dacite	550' (tuff?)
550 - 1020	dirty white felsite (dacite tuff?)	470'
1020 - 1785	Tev (Earlier volcanics)	765'
1785 - 2210	Andesite (Basaltic andesite?)	465'
2210 - 3040	Whitetail Conglomerate (volcanic fragments?)	830'
3040 - 4011.5	Whitetail Conglomerate (sedimentary clasts)	971.5
4011.5	TOTAL DEPTH	

DRILL HOLE	DESIGNATION	COMPANY
No. 2	(DCA-2) Pinal Ranch North	Miami Copper/ Superior Oil

DEPTHS (in Ft.)	UNITS	THICKNESS (in Ft.)
0 - 1095	dacite? dacite	1095'
1095 - 1270	dacite? rhyolite?(dacite tuff unit?)	175'
1270 - 1471 (initial stopping point)	Whitetail Conglomerate	255' - 265'
1471 - 1525 (+10'?)	Whitetail Conglomerate	
1525 (+ 10'?) - 1772	Pinal Schist, Schultze granite, and gneiss. 0.05-0.10 Cu	
1471	TOTAL DEPTH (INITIALLY)	
1772	TOTAL DEPTH (FINAL)	

DRILL HOLE	DESIGNATION	COMPANY
No. 3	(DCA-3) Pinal Ranch South	Miami Copper/ Superior Oil

DEPTHS (in Ft.)		UNITS		THICKNESS (in Ft.)
0 - 1400		dacite		1400'
1400 - 1415	dacite	vitrophyre	1490'	15'
1415 - 1490		dacite tuff		75'
1490 - 2430		basalt or basaltic andesite		940'
2430 - 3000		Whitetail Conglomerate		570'
3000		TOTAL DEPTH		

DRILL HOLE	DESGINATION	COMPANY
I	Devil's Canyon (I.C.C.C.)	Inspiration Consolidated Copper Co.

DEPTHS (in Ft.)		UNITS		THICKNESS (in Ft.)
0-- 1025	dacite	dacite	1086'	1025'
1025 - 1086		vitrophyre & tuff		61'
1086 - 2939		Whitetail Conglomerate (db, sch, md)		1853'
2939 - 3475		Pinal Schist & Diabase (barren, unaltered, broken)		536'
3475		TOTAL DEPTH		

DRILL HOLE	DESIGNATION	COMPANY
OF-1A	(Oak Flat North)	Kerr-McGee

DEPTHS (in Ft.)		UNITS		THICKNESS (in Ft.)
0 - 1635		dacite		1635'
1635 - 1670	Dacite	vitrophyre	1790'	35'
1670 - 1790		dacite tuff (Earlier volcanics?)		120'
1790 - 1995		Earlier volcanics?		205'
1995 - 2050		Volcanic? Conglomerate		55'

(continued)

DEPTHS (in Ft.)	UNITS	THICKNESS (in Ft.)
2050 - 2150	basaltic andesite	100'
2150	TOTAL DEPTH	

DRILL HOLE	DESIGNATION	COMPANY
DC-1	(Devil's Canyon)	Kerr-McGee

DEPTHS (in Ft.)		UNITS		THICKNESS (in Ft.)
0 - 1130		dacite		1130'
1130 - 1160	Dacite	vitrophyre	1165'	30'
1160 - 1165		tuff		5'
1165 - 2303		Whitetail Conglomerate		1138'
2303		TOTAL DEPTH		

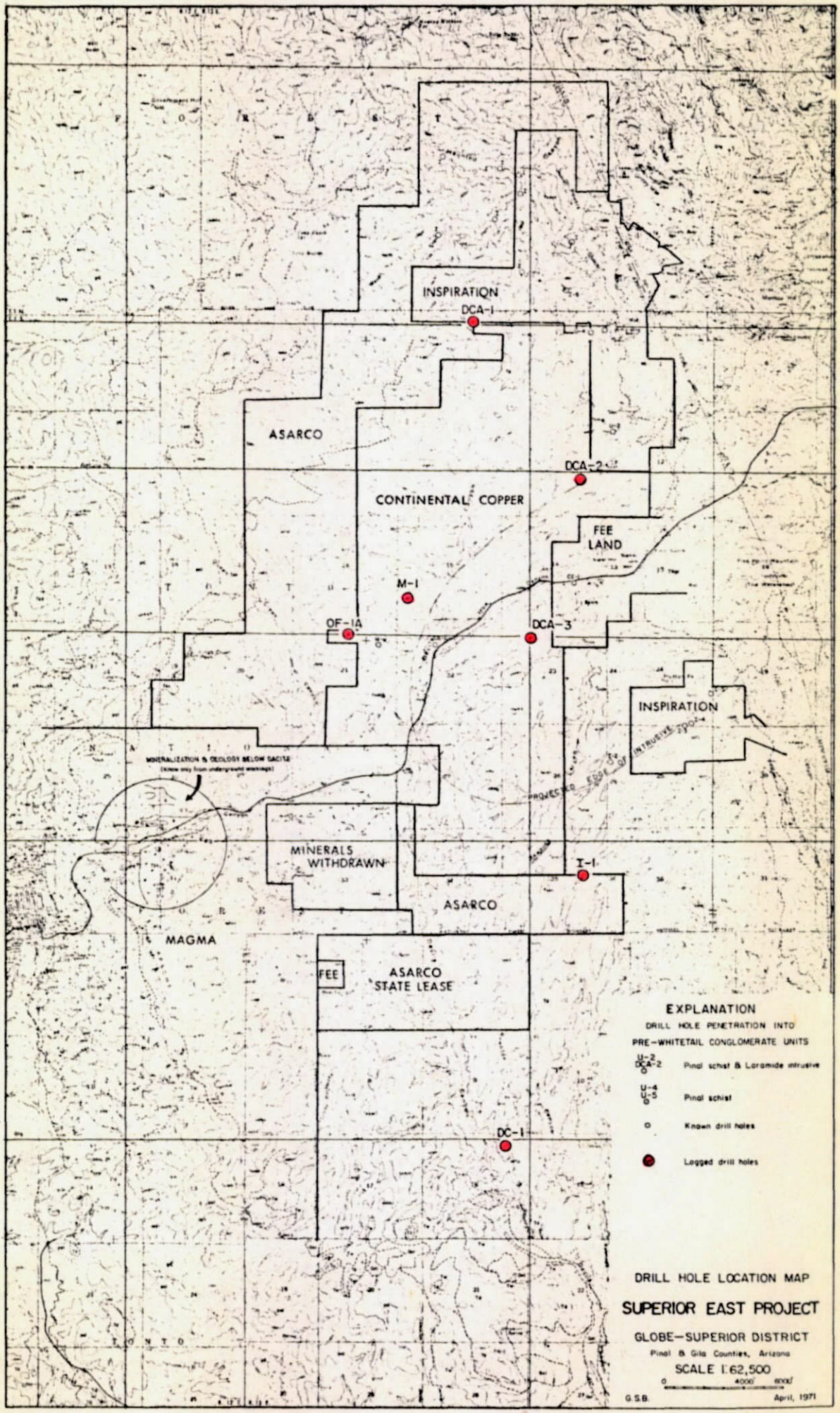
DRILL HOLE	DESIGNATION	COMPANY
M-1	(M-1)	Continental Materials

DEPTHS (in Ft.)		UNITS		THICKNESS (in Ft.)
0 - 1800		dacite		1800'
1800 - 1830	Dacite	vitrophyre	1890'	30'
1830 - 1890		tuff		60'
1890 - 1900		tuffaceous? conglomerate		10'
1900 - 2402		basaltic andesite		502'

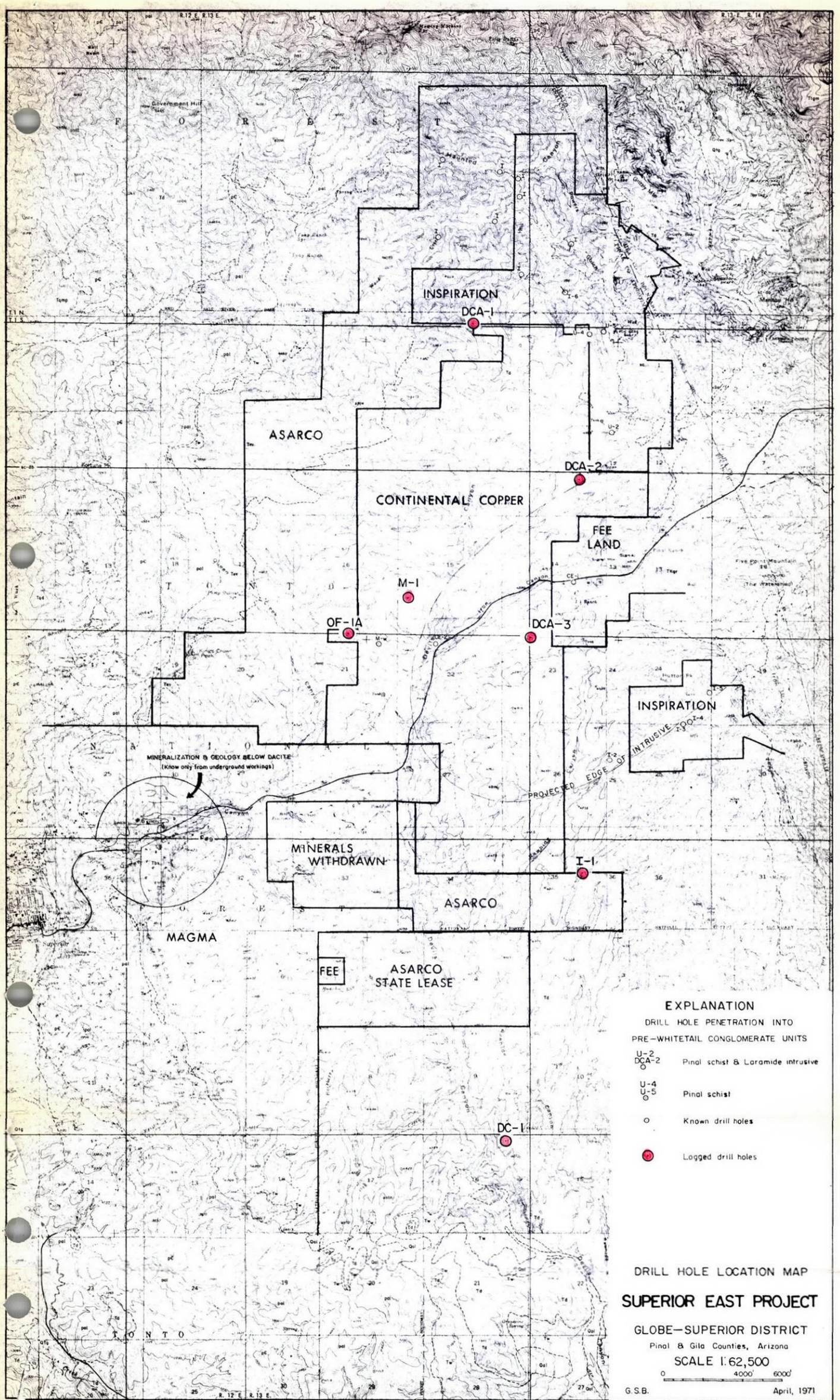
George S. Barnett

GSB:sh

George S. Barnett


INSPIRATION
DCA-1
ASARCO
DCA-2
CONTINENTAL COPPER
FEE
LAND
M-1
OF-1A
DCA-3
INSPIRATION
MINERALIZATION & GEOLOGY BELOW GAGE
(Know only from underground workings)
MINERALS
WITHDRAWN
I-1
ASARCO
MAGMA
FEE
ASARCO
STATE LEASE
DC-1
EXPLANATION
DRILL HOLE PENETRATION INTO
PRE-WHITETAIL CONGLOMERATE UNITS
U-2
DCA-2
Pinal schist & Laramide intrusive
U-4
U-5
Pinal schist
Known drill holes
Logged drill holes
DRILL HOLE LOCATION MAP
SUPERIOR EAST PROJECT
GLOBE-SUPERIOR DISTRICT
Pinal & Gila Counties, Arizona
SCALE 1:62,500
0
4000'
8000'
G.S.B.
April, 1971

2430


INSPIRATION
DCA-1
ASARCO
DCA-2
CONTINENTAL COPPER
FEE LAND
M-1
OF-1A
DCA-3
INSPIRATION
MINERALIZATION & GEOLOGY BELOW DACITE
(Know only from underground workings)
PROJECTED EDGE OF INTRUSIVE
MINERALS WITHDRAWN
I-1
ASARCO
MAGMA
FEE
ASARCO STATE LEASE
DC-1
EXPLANATION
DRILL HOLE PENETRATION INTO
PRE-WHITETAIL CONGLOMERATE UNITS
U-2 DCA-2 Pinal schist & Laramide intrusive
U-4 U-5 Pinal schist
Known drill holes
Logged drill holes
DRILL HOLE LOCATION MAP
SUPERIOR EAST PROJECT
GLOBE—SUPERIOR DISTRICT
Pinal & Gila Counties, Arizona
SCALE 1:62,500
0 4000' 6000'
G.S.B.
April, 1971

2430

TABLE I

DRILL HOLE INFORMATION SHOWING ROCK UNITS AND KNOWN ASSAYS.

DACITE PLATEAU

Map No.	Company	Location	Collar Elev.±	Rock Unit	Information	Thickness
CE-1	Cibola Expl.	NW¼ SE¼, Sec.14,T1S,R13E	4485	grey Td	0-2200, Td 2200-2850 TD, Tev	2200+ 650+
CE-2	Cibola Expl.	SE¼ NW¼, Sec.22,T1S,R13E	4080	grey Td	No information	
OF-1A	Kerr-McGee	NW¼ NE¼, Sec.21,T1S,R13E	4410	white Td	0-1995, Td 1995-2050, Tw 2050-2150 TD, db (dike?) nil to 0.07% Cu	1995+ 55' 100+
DC-1	Kerr-McGee	NE¼ NE¼, Sec.16,T2S,R13E	3990	Td	0-1165, Td 1165-2303 TD, Tw	1165+ 1138+
I	Inspiration	SE¼ NE¼, Sec.35,T1S,R13E	4200	Td	0-1105, Td 1105-2939, Tw 2939-3240, db 3240-3475 TD, sc No sulfides reported.	1105+ 1834 301 235+
DCA-1	Miami-Superior	NW¼ NE¼, Sec.3,T1S,R13E (unsurveyed)	4780	Td	0-1360, Td 1360-1845 felsite } Tev 1845-2210 Andesite } 2210-4011 TD, Tw NOTE: log shows db and igneous rocks as high as 1935; but 90% of rock is andesite. @ 2885 - native Cu frag. in schist @ 2959-2971 core; 0.024% Cu @ 3514-3525 core; 0.024% Cu @ 4000-4011 core; 0.020% Cu	1360+ 850 1801+

TABLE 1 - page 2

Map No.	Company	Location	Collar Elev.±	Rock Unit	Information	Thickness
DCA-2	Miami-Superior	NE¼ SW¼, Sec.11,T1S,R13E (unsurveyed)	4800	white Td	0-1340, Td	1430+
					1340-1525, Tw	95
					1525-1575, sc w/ex Cu	50
					1575-1678, Kqm w/ex Cu	103
					1678-1772, TD, sc w/ex Cu	94+
					NOTE: Lost circulation from 1270-1340 - ? on Tw contact	
					@ 1471-1525; 0.008 to 0.038% Cu	
					@ 1525-1575; 0.016 to 0.026% Cu	
					@ 1575-1680; 0.014 to 0.095% Cu	
					@ 1680-1772; 0.020 to 0.075% Cu	
					total copper values; a sulfide, still highly oxidized, sample at bottom ran 0.09 to 0.18% Cu	
DCA-3	Miami-Superior	NW¼ NW¼, Sec.23,T1S,R13E	4640	white Td	0-1400, Td } Td	
					1400-1415, vitroph. } Td	1490+
					1415-1490, tuff } Td	
					1490-2430, basalt, Tev	940
					2430-3000, TD, Tw	570+
U-4	United Verde	SW¼ NE¼, Sec.2,T1S,R13E	4640	Dacite	0-1264, Td	1264+
					1264-1600, TD, sc	336+
					0.116% copper, exotic	
U-5	United Verde	SE¼ NE¼, Sec.2, T1S,R13E	4165	Dacite	0-655, Td	655+
					655-835 TD, sc	180+
					0.40% copper, exotic	

TD = total depth
Td = Dacite
Tev = Early Volcanics
Tw = Whitetail conglomerate
Kqm = Schultze quartz monzonite
sc = Pinal Schist
ex Cu = exotic copper

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

W.L. Drillhole

W.E.S.
MAY 27 1971

May 25, 1971

TO: J. D. Sell

FROM: H. L. Crittendon

Drilling Progress
Superior East Project

Boyles Bros. Drilling Co. commenced drilling operations on the Superior East Project April 6, 1971. At this date, 3377 feet of rotary drilling and 1001 feet of diamond drilling have been completed.

The following will be a summary of drilling progress to date, with a tabulation of hours for the month of April. Comments regarding the drilling operations and difficulties encountered will be given as a matter of record.

Hole No. A-1

This hole presented considerable difficulties unrelated to hole conditions. The original plan was to carry the hole to depth by hammer drilling until hole conditions required that casing be set. However, the hammer drill was put out of order by the blowing of an "O" ring for which there was no immediate replacement. The broken "O" ring was caused by trying to ream a ten inch drill collar stabilizer behind a 9-7/8" hole. The swing shift driller had assumed the hole was crooked and did not check the collar to see if it was oversize. Drilling was continued with the tri-cone bit without the hammer with tolerable penetration rates (1 to 25 minutes/foot) carrying 6,000 to 18,000# on the bit. The I-R hammer was not used after being repaired because the Dresser bit representative claimed that the bit was not designed for hammer drilling and possible failure of the bit would occur if hammer drilling was continued. However, torque developed in broken ground causing two twist-offs in the 2-7/8" drill pipe being utilized (both joints of twisted-off pipe were definitely worn and fatigued). In both cases, the pipe was successfully fished out. At 809 feet, a large crevice in the dacite caused a complete loss of air circulation - - - it was then decided to case the hole with 7" OD casing and continue with a 6-1/4" rockbit, still using air as the circulating medium. This crevice would definitely have caused lost circulation problems if mud drilling had been used and either a good cement job or casing the hole would have been required to regain circulation. Air drilling continued satisfactorily with the 6-1/4" rockbit, however, water was encountered immediately beyond the casing and foam injection was used. After the vitrophyre was encountered at approximately 1260 feet, a very soft formation was encountered with more water inflow (10-30 gals./min.?). Very few cuttings were recovered in this formation and were of a very fine size. After reaching a depth of 1317 feet approximately 70 feet of fill had sloughed into the hole and it was decided to case the hole for coring. casing was washed to bottom with some difficulty and cemented in place.

Two days of drilling time were lost due to compressor failure.

A time distribution of April is tabulated below.

Chargeable Time (Hrs.)				Non-Chargeable (Hrs.)				Size of Hole Footage			
Drill-	Casing	Move & Set-up	Misc.	Fish-ing	Mob	Equip. Repair	Misc	12-3/8"	9-7/8"	6-1/4"	Total Depth
200¼	35¼	69	54-3/4	14¼	25¼	32½	13½	6'	811'	506'	1317'

Direct Drilling Expense*

Boyles	$20,818.00
IR (est.)	4,600.00
Chevron	902.77
Misc. (est.	500.00
Total	$26,820.00
Cost/Foot	$ 20.37

*Attributed to drilling operations only

Contractor's Equipment

Drill rig: Failings model "2500"
Drill collars: (2) 30' x 8" diameter, (2) 20' x 8" diameter with stabilizers
Drill pipe: 2-7/8" IF API
Bits: (1) 9-7/8" Security model M-8, assortment 6-1/4" rockbits
Mack boom truck with fifth wheel
Ford F-600 water truck 1,000 gal.
Gardner Denver steam pump for injection
IR
Model HHE Compressor Rated 1,200 scfm @ 250 psi (350 psi intermittant)
IR Hammerdrill model DDH 2076

Hole M-1

This hole was originally drilled to a depth of 2,402 feet by Whatley Drilling Co. for Continental ~~Exploration~~ Copper. 3-1/2" standard pipe was floated to bottom (not cemented). ASARCO pulled the 3-1/2" pipe and replaced it with 1,882 feet of 4" pipe and 520 feet of NC flush joint casing. A mud pack was placed at the bottom of the casing in hopes of sealing the casing and enabling it to be recovered at the termination of the hole. When diamond drilling was commenced, approximately twenty feet of extremely hard dense andesite was encountered at the bottom of the hole causing very slow penetration and very high bit wear. High torque developed due to a metal to

metal contact with the drill rods and the black pipe. The cause of this condition is not known but the principal point of contact was near the surface. I believe that the casing was stretched beyond its yield point in setting which possibly buckled it near surface. Bud Mathews of Boyles believes that the torque was caused by a crooked hole...however, no drag was noted in pulling or setting of the casing. The casing then apparently wore completely in two and allowed circulation to flow up the outside. Moderate to severe intermittent loss of circulation occurred in the upper shaly portions of the Whitetail...hole conditioning procedures were not adequate and the contractor attempted to maintain a high viscosity, low-solids drilling mud throughout the lost circulation zones despite a verbal agreement with the previous foreman that this would not be done. Twenty-five 50# bags of Wasatch 25 (a Quik-Trol type additive) were added before NX casing was set. After NX casing was set, torque was reduced to a minimal amount and full circulation was regained.

Time distribution - April

Chargeable		Non-Chargeable			Drilling		
Casing	Set-up & Misc.*	Mob	Equip. repair	Drilling	Misc.	NC	Core recovery
74 hrs.	64 hrs.	22	2	168½	18½	261 ft.	98%

*Includes place & drill through mud pack, make up rods, etc.

Contractor's Equipment

CP-50 Diamond drill
± 3500' NC wireline drill rod
3-15/16" oversize semi-pilot NC bits
± 2500' (New style) upset NX wireline rods
± 2000' NX wireline rods
Boyles stabilized oversize NX core barrels w/chrome inner-tubes
(1) Ford model - 600 water truck - 1000 gal. capacity

Contractors invoice for April was $16,705.76. A cost per foot not meaningful at this time due to necessary casing and preparations to complete hole.

Hole A-4

Drilling commenced on May 1. Principal difficulties to date have been broken hammer bits and large quantities of water inflow. Three Mission 8-7/8" hammer bits were broken and (1) Mission 6-1/8" hammer bit. Apparent cause of bit breakage was improper heat treatment at the factory (Mission representative). Seven inch casing was set at 1,082 feet in order to seal

off large influx of water (± 100 gal./min). Cementing was not tried because three previous cement jobs attempted at 360' (± 15 gal./min.) and 380' (± 30 gal./min.) were not successful. After setting 7" casing and continuing with a 6-1/4" hammer, progress continued more or less satisfactorily with the hole being reasonably dry but picking up some water, until a hard dense andesite and more water (± 20 gal./min.) were encountered at approximately 1970 feet. Hammer drilling progress was reduced drastically to 20-40 min./foot due to hard rock and changing of the choke in the hammer to unload heavy column of water (May 21).

Contractors Equipment

Same as A-1 with the following exceptions:

Mission model A60-70 hammer drill
Mission megadrill (6-6¼")
Mission 8-7/8" button bits
Mission 6" and 6-1/4" button bits
Bean model 20 pump for injection
Boyles of Canada - one cylinder injection pump

HLC/wes

H. L. Crittendon

HLC:sh

TAB

Production-Grade

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

June 16, 1971

TO: W. E. Saegart

FROM: J. D. Sell

PRODUCTION - GRADE - RESERVES
MAJOR MINES - SUPERIOR EAST
PROJECT AREA
PINAL - GILA COUNTIES, ARIZONA

I have recently compiled, from various sources, the production figures from the Cities Services, Inspiration, Kennecott, Newmont, and Ranchers properties in their mines surrounding the Superior East project area.

The total tonnage-grades are impressive for the district as well as the continued reserve and potential. The tonnage-grade figures for the total strip-dump-leach operations at Ox Hide and Blue Bird are not equatable since leach production from the dumps will continue long after mining has ceased and thus the actual recoverable copper per ton will increase over the figure presently given.

Company and Mine	Ore, Tons	Total Copper, Lbs.	Ave. Prod. Grade
Cities Services (thru 1969)			
Miami	152,702,609	2,500,073,136	0.82
Copper Cities	52,125,634	613,606,930	0.59
Castle Dome	41,442,617	578,183,368	0.70
Inspiration (thru 1970)			
Inspiration	231,980,858	4,159,552,910	0.90
Ox Hide	8,963,285	21,490,703	0.12
Kennecott (thru 1970)			
Ray	208,173,274	4,213,477,221	1.01
Newmont (thru 1970)			
Magma	15,986,604	1,664,480,207	5.21
Ranchers (thru June 1970)			
Blue Bird	13,399,700	60,045,703	0.22
TOTAL	724,774,581 tons of ore	13,810,800,178 pounds of produced copper	

Reserve figures are difficult to secure but the following notes are published figures.

Cities Services

Miami: Leaching practices currently produce 13,000,000 pounds of copper per year with an anticipated gradual decrease in forthcoming years. Miami has asked ICC for the return of the Miami ground now occupied by ICC housing and with known alteration and leached capping in the area it suggests expansion of working areas in that direction. Also, Miami and Inspiration are presently stripping their common boundary for production in the pit area.

Copper Cities: The December 31, 1968 figure of 31,000,000 tons of 0.55% copper reserves was released for both Copper Cities and Diamond H pits with a recoverable 290,000,000 pounds of copper. Approximately 18 million tons is at Copper Cities and 13 million tons of ore at Diamond H. Each pit occupies the distant ends of the same alteration zone which is known to contain values of 0.3% copper.

Castle Dome: Leaching has been discontinued at this area, other than the collection of extraneous water flowing from the area. The new Pinto Valley project includes the Castle Dome area and figures of 350,000,000 tons of 0.45% are reported.

Inspiration

Inspiration: Expansion of the pit area between the Live Oak and Thornton pits is underway in stripping the Red Hill area with a proven reserve of 24 million tons of 0.62%. Ore production is scheduled for late 1971.

Ox Hide: No reserve figure has been released for this deposit. Inspiration has announced the Barney ore deposit to the west and northwest of the Live Oak pit which is similar to the Ox Hide and will also be dump leached.

Inspiration in the 1970 annual report listed total area reserves of 1,507,622,000 pounds of recoverable copper.

Kennecott

Ray: Recent pit expansion east of the Ray fault has added considerable reserves but no firm figures are known.

Newmont

Magma: Reserves of 10,100,000 tons of 5.88% copper continued to be announced. This includes the stacked replacement ore as well as the previous known but unmined portions. The reserve is open ended to the east.

Ranchers

Blue Bird: The annual report of 1970 lists 13,500,000 tons of 0.50% copper and a potential of much more. Also, the present unrecovered copper on the leach dumps will continue to produce leach copper for considerable time.

Inspiration-Miami-Occidental: The faulted segment of the massive Inspiration-Miami ore body (which has produced about one-half of all the copper listed in the tonnage-grade tabulation) has been intercepted by the three named companies. Inspiration is on the north and releases depths of 4800 - 5500 feet to mineral intercepts (5 holes drilled in the current program). Miami is in the middle and released depths of 2460 - 3300 feet with an average ore intercept of 465 feet averaging 1.51% copper, based on six holes (some 15 have now been drilled). Occidental is on the south and released depths of 1100 - 2000 feet showing 103 - 368 feet of ore running 0.56 - 1.26% copper as oxide, based on ten intercepts out of 18 holes drilled. Both Miami and Occidental are running feasibility studies and Miami is deepening their No. 5 shaft for exploration purposes.

J. D. Sell

JDS:sh

TELEDYNE ISOTOPES
WESTWOOD LABORATORIES

50 VAN BUREN AVENUE

WESTWOOD, NEW JERSEY 07675

(201) 664-7070 TWX (710) 990-7503

June 28, 1971

Mr. John C. Balla
American Smelting and Refining Company
Exploration Department
P. O. Box 5795
Tucson, Arizona 85703

Dear Mr. Balla:

Subject: W. O. No. 3-3449-212
P. O. No. T 9496

I am pleased to report the following results on samples submitted to us for analysis:

low argon suggests alteration or contamination PED 7/9/71 (KB)

Sample No.	ISOTOPES Number	Isotopic Age (m.y.)	scc Ar^{Rad}/gm	Ar^{Rad}/Ar^{Tot}	% K
SK-1 Silver King	KA 71-41	20.0 ± 1.5	1.50×10^{-6}	.14	1.88
60-100 mesh hornblende		21.8 ± 0.8	1.63×10^{-6}	.28	1.85
SP-1	KA 71-42	49.3 ± 1.0	12.15×10^{-6}	56	6.16
40-60 mesh biotite		48.8 ± 1.0	12.02×10^{-6}	62	6.02
AC-1	KA 71-43	70.2 ± 1.4	18.7×10^{-6}	71.1	6.55
(Arnett Creek)		73.3 ± 1.5	19.6×10^{-6}	88.0	6.57
SH-1 Pinal Stone House		19.6 ± 0.6	1.353×10^{-6}	33	1.69
20-40 mesh biotite (and chlorite)		21.6 ± 1.0	1.490×10^{-6}	23	1.74

The constants used for the age calculation are: $\lambda_\beta = 4.72 \times 10^{-10} . y^{-1}$, $\lambda_e = 0.585 \times 10^{-10} . y^{-1}$ and $K^{40} = 1.19 \times 10^{-4}$ atom percent of natural potassium.

The error indicated for the reported ages takes into account all sources of analytical error. We use an RMS summation of errors method similar to that discussed by Cox and Dalrymple in J. Geophys. Res. 72 (10), p. 2603-14. This may be a somewhat ideal approach. In practice, the reproducibility of measurements may be somewhat worse for various reasons. In all cases the larger errors are reported.

Please be advised that Mr. Senechal has left Teledyne Isotopes and I would appreciate your directing future correspondence to me. We look forward to being of continuing service to you.

Very truly yours,

for Donald F. Schutz, Vice President
Manager, Westwood Laboratories

DFS:pob

Inspiration Consolidated Copper Company

INSPIRATION, ARIZONA 85537

July 1, 1971

Mr. James D. Sell
2762 W. Holladay Street
Tucson, Arizona 85706

Dear Jim:

This is to notify you of the authorization given you via telephone for Asarco to continue probing the Old Miami Copper Drill hole with any drilling equipment you feel will do the job. This authorization is given with the understanding that no drilling will be done beyond the bottom of the hole without a signed agreement.

As also discussed with you, Asarco will notify this office when continuation of the probing begins.

Sincerely yours,

René G. von Boeck

Rene G. von Boeck
Asst. Chief Exploration Geologist

RGvB/sla
cc: Mr. R. R. Hyde
Mr. R. C. Cole
Mr. H. W. Olmstead
Mr. G. H. Ladendorff
Mr. J. Lavin

AMERICAN SMELTING AND REFINING COMPANY
SOUTHWESTERN EXPLORATION DIVISION
P. O. BOX 5747, TUCSON, ARIZONA 85703

1150 NORTH 7TH AVENUE
TELEPHONE 602-792-3010

July 7, 1971

Mr. Rene' G. von Boeck
Assistant Chief Exploration Geologist
Inspiration Consolidated Copper Company
Inspiration, Arizona 85537

Dear Rene':

Your letter of July 1, arrived to confirm the authorization that Asarco may continue to probe the Old Miami Copper Drill Hole north of Sutton Summit.

We are still in the process of inquiring into various ways to approach the problem, but, as you request, we will notify your office prior to moving on another rig. It is further understood that no probing will be done below the depth of the old hole - - - which we understand to be 4011 feet, without further written agreements between ICC and Asarco.

Sincerely,

James D. Sell

James D. Sell

JDS:van

cc: WESaegart
WLKurtz
HLCrittendon
RBCummings

J.D.S.

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

July 9, 1971

TO: C. K. Moss - Salt Lake City Office

FROM: J. D. Sell

Dear Cal:

Thanks for the return letter on the inquiring about J. R. King's biotite sample from drill hole M-1A. The sample of solid and crushed portions has been returned here by Mr. E. H. Phillips from the sample SG-30.

Thank you.

Sincerely,

James D. Sell

James D. Sell

JDS:sh

cc: EHPhillips - Salt Lake City

AMERICAN SMELTING AND REFINING COMPANY
SOUTHWESTERN EXPLORATION DIVISION
P. O. BOX 5747, TUCSON, ARIZONA 85703

1150 NORTH 7TH AVENUE
TELEPHONE 602-792-3010

August 13, 1971

Mr. Hugh Olmstead
Inspiration Consolidated Copper Company
Inspiration, Arizona 85537

Dear Mr. Olmstead:

This will inform you that we are now moving a cable tool rig on our DCA-3 location, south of the Miami-Superior highway and should be entering this hole about August 16. Dependent on moving time, and condition encountered in DCA-3, we should be setting up on DCA-1 on or about August 21. I will be in Miami all during the week and will inform you when the rig will definitely be on location. The contractor for this work is Moss-Weber Drilling, Inc., out of Chandler, Arizona.

Your personnel will be most welcome to observe the equipment and cleaning operation on DCA-3 prior to moving on DCA-1. If you should have any questions, I can usually be reached at 473-3802 or 473-3772 in Miami.

Yours truly,

H. L. Crittendon

HLC:van

cc: WLKurtz
JDSell

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

August 13, 1971

FILE MEMORANDUM

PROBING DCA-1
SUPERIOR EAST
PINAL COUNTY, ARIZONA

Today, August 13, I telephoned Mr. Hugh Olmstead to inquire about our liability in the event of losing any cable or tools down the hole in our attempt to clean out DCA-1

Hugh says that as far as he is concerned ICC does not intend to enter the hole if Asarco fails in the attempt to clean it out and thus, there is no liability on Asarco if junk is left in the hole.

Hugh also confirmed that the hole is 4011 feet deep.

James D. Sell

James D. Sell

JDS:sg

cc: HLCrittendon
WLKurtz
RBCrist

AMERICAN SMELTING AND REFINING COMPANY
SOUTHWESTERN EXPLORATION DIVISION
P. O. BOX 5747, TUCSON, ARIZONA 85703

W. E. SAEGART
SUPERVISOR

W. L. KURTZ
ASSISTANT SUPERVISOR

1150 NORTH 7TH AVENUE
TELEPHONE 602-792-3010

August 31, 1971

Mr. Hugh W. Olmstead
Chief Exploration Geologist
Inspiration Consolidated Copper Co.
Inspiration, Arizona 85537

Dear Mr. Olmstead:

As we mutually agreed upon, ASARCO has re-occupied drill site DCA-1 located on your Ghost Group of mines. The approximate location of DCA-1 is NW/NE of Section 3, T1S, R13E, G&SRB&M.

We have now determined that casing can be placed to or near the original depth of the hole. We also mutually agreed that ASARCO will have the right but not the obligation, at its expense, to deepen this hole by diamond drilling with the following understandings and agreements:

1. Any mineral discovery made by ASARCO in the deepening of this hole will be for the exclusive benefit of Inspiration Consolidated Copper Co. provided, however, that ASARCO shall have the right to all geological information obtained from such drilling.

2. Copies of geologic logs and assay data will be given to Inspiration. Also, Inspiration can inspect the drilling at any time and may log the core.

AMERICAN SMELTING AND REFINING COMPANY

By W. L. Kurtz
W. L. Kurtz, Supervisor

The foregoing does meet with our understanding.

INSPIRATION CONSOLIDATED COPPER CO.

By_____

cc: J.J.Collins, Director of Exploration
ASARCO - New York Office

R.R.Hyde, Vice President
Inspiration Consolidated Copper Co.
25 Broadway
New York, New York

G.H.Ladendorff, Attorney at Law
716 Arizona Bank Building
34 West Monroe
Phoenix, Arizona 85003

bc: RBCrist
JDSell
RBCummings

Cpy for GJS, JCB, JDS

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

SEP 1 1971
W. L. K.

September 1, 1971

TO: W. L. Kurtz

FROM: G. S. Barnett

Biotite Studies

A memo was circulated concerning areas of potential application for biotite or mafic minerals' separation and analysis as an exploration guide. However, an orientation survey has not been conducted for this method, other than to check the results obtained by the USGS in selected areas. I am not aware of the exact nature of studies we have, or are conducting, nor am I aware of the entire background information available. However, it would seem to me that more information must be available for us to be able to effectively use this method. It would also seem that we are not actively seeking this type of information, but rather waiting for others to do it. Inevitably it seems that any data of this nature which might be collected is done so as a sideline by a geologist whose primary responsibility must (and does) lie with some "more important" project and/or reconnaissance work. The data which needs to be collected is often of such a large volume that we leave it to the USGS or some other group to do. I think what little information we do have concerning this method should be encouraging enough to lead us to conduct a well organized, full scale determination of the value and applicability this method may have.

With this in mind and realizing that when and if enough information is available to absolutely prove the validity of this technique, then everyone will have this technique at their disposal (and will probably be using it). I would suggest that we conduct orientation surveys around as many known deposits as possible, especially our own. By using a pre-determined grid along radial (?) traverse lines leading into deposits we could obtain this information. Access to operating properties is a problem, however, we really aren't interested in ore-grade or nearly ore-grade material -- as when this is at or near the surface it has been claimed or is being mined -- but rather in what the periphery looks like, geochemically and physically.

Immediate applications of this technique would be propylitically altered areas where lateral or vertical zoning could lead to discovery (as Silver Bell East?) Kalamazoo brought this out dramatically and has caused many such areas to be drilled -- possibly not in the most favorable sites. A sampling of the

monzonite southwest of the Oxide Pit at Silver Bell would give an indication of the type of changes we could expect where essentially barren, propylitically altered rock comes within 2000' of the pit.

The number of deposits and length of time required for a study of this nature may require that we offer this problem to a masters candidate, have it done by a consulting firm, turn it over to the Exploration Services Division or hire someone specifically to conduct this and/or related studies. The importance of determining the validity and applying this method is extremely high at this time when we are looking for deeper and/or concealed deposits. A guide with this potential should be worth checking out completely.

I would also suggest that a group of our geologists get together, analyze maps of the known porphyry coppers and plan the spacing and location of sampling traverses. The elements analyzed for can be either pre-determined, random sampled or selected on a spot basis. With a pre-determined spacing or grid, we could also put the results on computer cards, run an analysis and graph the results from tape. This would aid in determining the distribution pattern, whether logarithmic or linear and allow for multiple runs deleting certain values to determine necessary and valuable sample taking intervals.

George S. Barnett

George S. Barnett

GSB:lad

CM for JDS, WLK

RECEIVED

Inspiration Consolidated Copper Company

OCT 4 1971

INSPIRATION, ARIZONA 85537

S. W. U. S. EXPL. DIV.

Superior East

W. L. K.

OCT 4 1971

September 30, 1971

Mr. W. L. Kurtz, Supervisor
American Smelting and Refining Co.
Southwestern Exploration Division
P.O. Box 5747
Tucson, Arizona 85703

Dear Bill:

As a final check to be certain of actual possession of the area where the Miami Copper Company Rotary Drill Hole DCA #1 is situated, we meticuously reviewed applicable and respective claim location notices. In this review, we became aware of the fact that Can. U.S., Ltd which is owned by Continental Copper, Inc. whose claims now are under your control, located Margaret 329 unpatented lode claim on April 11, 1969 whereas Inspiration's Ghost 110 unpatented lode claim was located on April 17, 1969. At the time of posting the Ghost 110 location notice and monumenting claims on the south end which covered the DCA #1, we did not observe the Margaret 329 location notice. Thus the questionable possession of hole.

However, the courthouse records clearly show respective data and we are satisfied that the Margaret 329 claim predates our Ghost 110 claim by seven days and possession of hole DCA #1 is in the boundaries of Margaret 329 claim.

A mineral land surveyor, Ted Gant, will soon establish a common boundary in the areas of conflict between our Ghost claims and the Margaret claims and between our Ghost claims and your Carrie and Kay claims on the western end of our Ghost claims. This work is scheduled for this fall, but it may be sometime before it is completed. I'm sure it will be beneficial to both of us when finished.

I have discussed this in some detail with Bob Crist and briefly with you, but feel some record for file purposes is appropriate.

Please let me know if we need to further consider.

Sincerely yours,

Hugh W. Olmstead

Hugh W. Olmstead
Chief Exploration Geologist

HWO/sla
cc: Mr. R. R. Hyde
Mr. R. C. Cole
Mr. G. H. Ladendorff
Mr. R. B. Crist

TAB

A-1

Drill Rept.

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

October 27, 1971

TO: J. D. Sell

FROM: R. B. Cummings

Daily Drill Data - Unit Contacts
Drill Hole A-1
Core Rig, CP-50
Superior East Project
Pinal County, Arizona

Attached is a daily log of the coring on drill hole A-1. The information shown is the date, depth of hole at end of day, the footage cut during the day, the hours charged to drilling, the number of shifts involved, short comments on the delays involved, the size of core, the geologic units and contact footages.

Compiled from this daily data is a breakdown of the shifts and footage by a) depth bracket based on Boyles footage rate contract, and b) by geologic units encountered.

R. B. Cummings

RBC:lad
Attachs.

DRILL HOLE A-1 CORING, CP-50

DATE	DEPTH AT END OF DAY	FOOTAGE	DRILLING HOURS	DRILLING SHIFTS	DELAYS	FORMATION
July 14	1309	--	--	-	Setting up rig.	NC Core
15	1323	14	8	2	8 hrs. setting up rig.	Dacite
16	1363	40	14	2	2 hrs. equip. repair.	
17	1389	26	15-1/2	2	1/2 hr. equip. repair.	1374
18	--	--	--	-		
19	1415	26	16	2	Trouble with casing.	
20	1441	26	16	2	Worked on casing; bit change	
21	1441	0	12	2	4 hrs. equip. repair, 16 hrs. cementing.	Schist Breccia
22	1441	0	0	2	16 hrs. cementing.	
23	1467	26	16	2		
24	1495	28	16	2		
25	--	--	--	-		
26	1553	58	24	3		1527 Whitetail Congl.
27	1599	46	24	3		1566 Schist Breccia
28	1649	50	24	3		1572 Fault Zone
29	1697	48	24	3		1585 Schist
30	1736	39	24	3		
31	1757	21	24	3	Bit change.	

Aug.	1	--	--	--	-	
	2	1786	29	24	3	
	3	1830	44	24	3	
	4	1879	49	24	3	
	5	1923	44	24	3	Bit change.
	6	1950	27	20	3	Completed bit change; 4 hrs. equip. repair.
	7	1980	30	24	3	
	8	--	--	--	-	
	9	2017	37	24	3	Bit change.
	10	2073	56	24	3	
	11	2121	48	24	3	
	12	2129	8	3	1	End of hole; 5 hrs. tearing-down. NC Core

DRILL HOLE A-1

Drilling Time, by footage brackets, including down time.

DEPTH	SIZE	SHIFTS	DAYS	FOOTAGE	FT/SHIFT	TROUBLES
1309-1495	NC	17	9	186	10.9	Bit change; problem w/casing, cement.
1495-1980	NC	36	12	485	13.5	Two bit changes.
1980-2129	NC	10	4	149	14.9	One bit change.
Totals:		63	25	820	13.0 average	

Rock Unit	Internal	Size	Shifts to Depth		Footage	Ft/Shift
Dacite	1309-1374	NC	3	1363	54	18.0
Schist Bx.	1374-1527	NC	17*	1553	190	11.2
Whitetail Cgl.	1527-1566	NC)				
Schist Bx.	1566-1572	NC)	3	1599	46	15.3
Fault Zone	1572-1585	NC)				
Schist	1585-2129	NC	40	2129	530	13.3
Totals:	1309-2129		63		820	13.0

* Includes four shifts of repair, cementing, and drilling out cement.

Drilling Perf

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

October 27, 1971

TO: J. D. Sell

FROM: R. B. Cummings

Drill Hole A-4
Rotary Drilling Cost Summary
Superior East Project
Pinal County, Arizona

Air rotary drilling was initiated by Boyles Brothers Drilling Co. on May 1, 1971. Boyles Brothers used a Failing 2500 drill rig with an Ingersoll Rand HHE three-stage compressor. Boyles was terminated from the hole on May 25, 1971 after drilling to a depth of 2077'. Shelton Drilling Co. re-entered the hole on June 12, 1971 and deepened it to 3593' (a total of 1516') by July 21, 1971. Four-inch casing was cemented in at 3593' in preparation for coring. The second stage of the drilling was done with mud using a Mayhew 3000.

Hole diameter and an inventory of casing remaining in the hole are shown below:

	Hole Size					Casing Size		
	12-3/8"	9-7/8"	9"	6-1/4"-6"	5-5/8"	10"	7"	4"
Depth	6'	18'	1082'	2077'	3593'	6'	1082'	3593'

Costs have been computed on the rotary portion of hole A-4 through the September account. No further costs are expected. In the cost breakdown which follows, the May account has been separated from the remainder of the costs in order to compare costs incurred by Boyles and Shelton.

	Boyles Brothers		Shelton		Total	
	Cost	$/ft	Cost	$/ft	Cost	$/ft
a. Direct Drilling	$30,200.26*	$14.54	$37,645.52	$24.83	$67,845.78	$18.88
b. Site Preparation	897.00	0.43	1,976.29	1.30	2,873.29	0.80
c. Sampling	1,607.12	0.78	2,149.83	1.42	3,756.95	1.05
d. Supervision	1,736.24	0.84	3,369.49	2.22	5,105.73	1.42
	$34,440.62	$16.58	$45,141.13	$29.78	$79,581.75	$22.15

*Rebate on used bits and materials may be as much as $500.00.

In order to get a meaningful comparison between the two contractors, several factors must be considered. On completion of drilling the hole was cased with 4" casing. If the cost of the casing for Boyles portion of the hole (2077') is added to their direct drilling cost and subtracted from Shelton's cost, the direct drilling cost would be $16.04/foot for Boyles Brothers and $22.78/foot for Shelton Drilling. Almost $2,000.00 was spent to improve the drill site for the larger rig of Shelton's. Part of the higher sampling cost during Shelton's part of the drilling was due to assay costs. The higher supervision cost in the later part of drilling was due to slower drilling rate.

Average drilling rates (excluding setting-up time) were 36.3'/shift for Boyles Brothers and 15.6'/shift for Shelton Drilling Co. A detailed report on drilling rates is being compiled and will be submitted shortly.

Samplers were employed until July 15 (to a depth of 3390'). The samplers cost $0.73/foot for the Boyles Brothers portion of the drilling and $1.29/foot for the Shelton portion of the drilling which was sampled. The total cost of the samplers (over 3390') was $0.95/foot.

R. B. Cummings

RBC:lad

cc: HLCrittendon

TAB

A-4

Drilling Report

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

October 27, 1971

TO: J. D. Sell

FROM: R. B. Cummings

Daily Drill Data - Unit Contacts
Drill Hole A-4
Core Rig, CP-50
Superior East Project
Pinal County, Arizona

Attached is a daily log of the coring on drill hole A-4. The information shown is the date, depth of hole at end of day, the footage cut during the day, the hours charged to drilling, the number of shifts involved, short comments on the delays involved, the size of core, the geologic units and contact footages.

Compiled from this daily data is a breakdown of the shifts and footage by a) depth bracket based on Boyles footage rate contract, and b) by geologic units encountered.

R. B. Cummings

RBC:lad
Attachs.

DRILL HOLE A-4 CORING, CP-50

DATE	DEPTH AT END OF DAY	FOOTAGE	DRILLING HOURS	DRILLING SHIFTS	DELAYS	FORMATION
Aug. 16	3593	--	--	-	Setting up rig.	NX Core
17	3623	30	16	2		Whitetail Congl.
18	3702	79	24	3		
19	3772	70	22	3	2 hrs. equip. repair.	
20	3831	59	24	3		
21	3851	20	24	3	Bit change.	
22	--	--	--	-		
23	3920	69	24	3		
24	4000	80	24	3		
25	4060	60	24	3		
26	4123	63	24	3	Bit change.	
27	4193	70	24	3		
28	4241	48	24	3		
29	--	--	--	-		
30	4301	60	24	3		
30	4371	70	24	3		
Sept. 1	4432	61	24	3		

Sep.	2	4471	39	24	3	Bit change.	Whitetail Congl.
	3	4543	72	24	3		
	4	4583	40	24	3		
	5	--	--	--	-		
	6	--	--	--	-		
	7	4642	59	24	3		
	8	4651	9	24	3	Dropped rods & pulled same.	
	9	4720	69	24	3		
	10	4740	20	24	3	WL broke, pulled rods.	
	11	4790	50	24	3		
	12	--	--	--	-		
	13	4840	50	24	3		
	14	4890	50	22	3	2 hrs. equip. repair.	
	15	4950	60	24	3		
	16	4980	30	23	3	One hour equip. repair; pulled rods.	
	17	5039	59	24	3		
	18	5063	24	24	3		
	19	--	--	--	-		
	20	5103	40	24	3		
	21	5163	60	24	3		

	22	5213	50	24	3		Whitetail Congl.
	23	5242	29	23	3	1 hr. equip. repair; bit change.	
	24	5302	60	24	3		
	25	5342	40	24	3		
	26	--	--	--	-		
	27	5392	50	24	3		
	28	5422	30	12	3	12 hrs. equip. repair; hydraulic system.	
	29	5476	54	24	3		
	30	5523	47	24	3		
Oct.	1	5523	0	17	3	7 hr. equip. repair, hoisting valve; changed bit.	
	2	5580	57	24	3		
	3	--	--	--	-		
	4	5623	43	24	3		
	5	5683	60	24	3		
	6	5733	50	24	3		
	7	5783	50	24	3		
	8	5801	18	21	3	3 hrs. surveying; bit change.	
	9	5861	60	24	3		
	10	5921	60	24	3		
	11	5981	60	24	3		

Oct	12	6040	59	24	3		Whitetail Congl.
	13	6099	59	24	3		
	14	6133	14	24	3	WL broke, pulled rods; bit change.	
	15	6153	40	24	3	Added cable, tripped in.	
	16	6193	40	24	3		
	17	--	--	--	-		
	18	6232	39	20	3	4 hrs. equip. repair, hydraulic system.	
	19	6291	59	24	3		
	20	6333	42	24	3		6336
	21	6388	55	24	3		Limestone slide block
	22	6433	45	24	3		
	23	6443	10	24	3	Start of bit change.	6448
	24	--	--	--	-		Whitetail Congl.
	25	6461	18	24	3	Completed bit change, cored 18 feet, broke WL, pulled rods	6484
	26	6491	30	24	3	Completed pull to recover WL; back into hole.	Limestone and Limestone breccia
	27	6520	29	24	3	8 hrs. lost on sticking rods.	
	28	6530	10	24	3	Stuck rods several times.	6571
	29	6580	50	24	3		fault
	30	6588	8	16	2	Pulled rods into casing	6575 Porphyritic Biotite Quartz Monzonite with Schist inclusions
	31	--	--	--	-		

Nov. 1	6590	2	8	1	2 shifts standby for GP velocity probe.	
2	6613	23	24	3	Problems with overshot retriever.	
3	6643	30	24	3	1 hr. equip., hydraulic valve, repair.	
4	6664	21	24	3	Termination of hole.	6664

DRILL HOLE A-4

Drilling time, by footage brackets, including down time.

DEPTH	SIZE	SHIFTS	DAYS	FOOTAGE	FT/SHIFT	TROUBLES
3593-4000	NX	20	7	407	20.4	One bit change.
4000-4471	NX	24	8	471	19.6	Two bit changes.
4471-4980	NX	33	11	509	16.0	Dropped rods, broke WL cable, pulled rods.
4980-5523	NX	36	12	543	15.1	One bit change, repair hydr. system.
5523-5981	NX	30	10	458	15.3	Two bit changes, repair hoist system.
5981-6232	NX	18	6	251	13.9	One bit change, WL cable, hydraulic repair.
6232-6491	NX	21	7	259	12.3	One bit change, broke WL cable, pulled rods.
6491-6664	NX	21	8	173	8.2	Sticking rods, overshot problems, repair work.
Totals:		203	69	3071	15.1 average	

ROCK UNIT	DEPTH	SIZE	SHIFTS TO DEPTH		FOOTAGE	FT/SHIFT
Whitetail Cgl.	3593-6484	NX	182	6491	2898	15.9
Limestone (Me)	6484-6571	NX	9	6580	89	9.9
Fault zone	6571-6575	NX	2	6588	8	4.0
Quartz Monzonite	6575-6664	NX	10	6664	76	7.6
Totals:	3593-6664		203		3071	15.1

Daily Perf.

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

October 27, 1971

TO: J. D. Sell

FROM: R. B. Cummings

Drill Hole A-5
Rotary Drilling Cost Summary
Superior East Project
Pinal County, Arizona

Rotary drilling was initiated on July 28, 1971 by Shelton Drilling Co. The hole was drilled with air to a depth of 640' and with mud to a final rotary depth of 3145'. Drilling operations ceased on August 28, 1971. Four-inch casing was cemented in at 3145' in preparation for coring. The hole was drilled with the same Mayhew 3000 that was used on hole A-4.

Hole diameter and an inventory of casing remaining in the hole are shown below:

	Hole Size			Casing Size
	8-3/4"	6-3/4"	6-1/4"	4"
Depth	92'	1335'	3145'	3145'

Costs have been computed on the rotary portion of A-5 through the September account. No further costs are expected. A cost breakdown follows:

	Cost	$/ft.
a. Direct Drilling	$46,045.28	$14.64
b. Site Preparation	5,789.00	1.84
c. Sampling	136.11	0.04
d. Supervision	1,811.07	0.58
Total	$53,781.46	$17.10

Note: See Drill Hole Summaries report dated October 1, 1971 for explanation of categories.

The average drilling rate (excluding setting-up time) was 37.4'/shift. A detailed report on drilling rates is being compiled for submittal.

R. B. Cummings

RBC:lad

cc: HLCrittendon

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

October 27, 1971

TO: J. D. Sell

FROM: R. B. Cummings

Drill Hole M-1A
Drilling and Cost Summary
Superior East Project
Pinal County, Arizona

Drill hole M-1A was rotary drilled to a depth of 2402' for Continental Materials in September and October, 1970. After rotary drilling, the hole was cased to the bottom with 3-1/2" casing. Prior to ASARCO's re-entry of the hole, the 3-1/2" casing was pulled and 4" casing was set to 2402'. Coring operations began on April 21, 1971 and continued until July 3, 1971. The hole was deepened from 2402' to 5322' (a total of 2920'). The coring was done by Boyles Brothers and was drilled with a CP-50 core rig.

Hole diameter and an inventory of casing remaining in the hole is shown below:

	Hole Size			Casing Size		
	5-5/8"	NC	NX	4" std	4" flush joint	NX
Depth	2402'	2953'	5322'	1882'	1882-2402'	2353-2953'
Total	2402'	551'	2369'	1882'	520'	600'

Costs have been computed through the September account. No further costs are expected. A cost breakdown follows:

	Cost	$/ft
a. Direct Drilling	$85,779.70	$29.36
b. Site Preparation	648.41	0.22
c. Sampling	3,007.95	1.03
d. Supervision	6,590.11	2.26
Total	$96,026.17	$32.86

Note: Explanation of cost categories can be found in my report on Drill Hole Summaries dated October 1, 1971.

Several extraordinary items are included in the direct drilling costs. These costs did not reflect drilling performance. They are listed below:

Pulling 3-1/2" casing	$ 720.00
Installation of 4" casing and mud pack and drilling through mud pack, etc..	1,740.00
Drill hole survey	1,081.30
	$3,541.30

Drilling mud and additives cost (which is included in the direct drilling cost) was $1.94/foot.

The average drilling rate was 15.7'/shift.

Upon completion of the drilling, the Salt Lake City office attempted to emplace two geophysical electrodes in the hole. The first electrode was successfully emplaced, but the second got free and fell in on top of the first. Both electrodes, with a substantial amount of wire, are in the hole at a depth of about 4500'. The hole is now capped with a welded iron plate.

R. B. Cummings

RBC:lad

cc: HLCrittendon

TAB

M-1A

Daily Perf

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

October 27, 1971

TO: J. D. Sell

FROM: R. B. Cummings

Daily Drill Data - Unit Contacts
Drill Hole M-1A
Core Rig, CP-50
Superior East Project
Pinal County, Arizona

Attached is a daily log of the coring on drill hole M-1A. The information shown is the date, depth of hole at end of day, the footage cut during the day, the hours charged to drilling, the number of shifts involved, short comments on the delays involved, the size of the core, the geologic units and contact footages.

Compiled from this daily data is a breakdown of the shifts and footage by a) depth bracket based on Boyles footage rate contract, and b) by geologic units encountered.

R. B. Cummings

RBC:lad
Attachs.

DRILL HOLE M-1A CORING, CP-50

DATE	DEPTH AT END OF DAY	FOOTAGE	DRILLING HOURS	DRILLING SHIFTS	DELAYS	FORMATION
April 20	2402	--	--	-	Setting up; pulling old casing.	NC Core
21	2416	14	12	2	4 hrs. setting-up.	Earlier Volcanic
22	2425	9	16	2		
23	2440	15	16	2		2428 Mudstone Whitetail
24	2460	20	16	2		
25	--	--	--	-		
26	2487	27	16	2		
27	2533	46	24	3		
28	2578	45	24	3		
29	2623	45	24	3		
30	2663	40	24	3		
May 1	2693	30	24	3		
2	--	--	--	-		
3	2723	30	24	3		
4	2762	39	19	3	5 hrs. equip. repair.	
5	2802	40	24	3		
6	2812	10	24	3	Bit change.	
7	2843	31	24	3		

8	2864	21	23	3	1 hr. equip. repair.	
9	--	--	--	-		
10	2883	19	23	3	1 hr. equip. repair.	
11	2903	20	23	3	1 hr. equip repair.	Mudstone Whitetail 2920
12	2943	40	24	3		Quartz Monzonite Slide Block
13	2953	10	24	3	Bottomed for casing point.	NC Core
14	2953	0	--	3	16 hrs. breaking out rods and 8 hrs. casing.	
15	2953	0	--	3	16 hrs. casing; 8 hrs. rods.	
16	--	--	--	-	Casing completed. Change from NC to NX.	NX Core
17	3033	80	24	3		QM Slide Block 3108
18	3120	87	24	3		Whitetail Congl.
19	3200	80	24	3		
20	3273	73	24	3	Bit change.	
21	3353	80	24	3		
22	3413	60	24	3		
23	--	--	--	-		
24	3481	68	24	3		
25	3551	70	24	3		
26	3621	70	24	3	Bit change.	
27	3710	89	24	3		

28	3724	14	4	3	4 hrs. equip. repair; 16 hrs. parts delay.	Whitetail Congl.
29	3724	0	0	3	8 hrs. equip. repair; 16 hrs. parts delay.	
30	--	--	--	-		
31	3773	49	19	3	5 hrs. equip. repair.	
June 1	3853	80	24	3		
2	3912	59	24	3	Bit change.	
3	3982	70	24	3		
4	4040	58	22	3	3 hrs. equip. repair.	
5	4080	40	24	3	Bit change.	
6	--	--	--	-		
7	4123	43	21	3	3 hrs. equip. repair.	
8	4203	80	24	3		
9	4273	70	24	3		
10	4343	70	24	3		
11	4381	38	24	3		
12	4430	49	24	3		
13	--	--	--	-		
14	4493	63	23	3	1 hr. equip. repair.	
15	4543	50	20	3	4 hrs. surveying; bit change.	
16	4603	60	24	3		

17	4673	70	24	3		Whitetail Congl.
18	4742	69	24	3		
19	4782	40	24	3	Bit change.	
20	--	--	--	-		
21	4843	61	24	3		
22	4913	70	24	3		4898 Redbeds (Supai)
23	4981	68	24	3		
24	5033	52	24	3		
25	5092	59	24	3		
26	5122	30	24	3	Bit change.	5108 Naco Limestone
27	--	--	--	-		
28	5160	38	24	3		
29	5213	53	24	3		
30	5213	0	16	3	8 hrs. equip. repair.	
July 1	5263	50	20	3	4 hrs. equip. repair.	
2	5312	49	24	3		
3	5322	10	16	2	Closed down, end of hole.	Naco Limestone

DRILL HOLE M-1A

Drilling time, by footage brackets, including down time.

DEPTH	SIZE	SHIFTS	DAYS	FOOTAGE	FT/SHIFT	TROUBLES
2402-2487	NC	10	5	85	8.5	None.
2487-2953	NC	45	15	466	9.7	One bit change, equip. repair.
Casing	--	6	2	--	--	
2953-3481	NX	21	7	598	28.5	One bit change.
3481-3982	NX	27	9	431	16.0	Equip. repair, two bit changes.
3982-4493	NX	27	9	511	18.9	One bit change.
4493-4981	NX	24	8	488	20.3	Two bit changes; surveying hole
4981-5322	NX	26	9	341	13.1	Three bit changes.
Totals:		186	64	2920	15.7 average	

15.2

NC Coring, 55 shifts for 551 feet = 10.0 feet/shift average.

NX Coring, 125 shifts for 2369 feet = 18.9 feet/shift average.

ROCK UNIT	DEPTH	SIZE	SHIFTS TO DEPTH		FOOTAGE	FT/SHIFT
Early Volcanics	2402-2428	NC	4	2425	23	5.7
Mudstone Whitetail	2428-2920	NC	45	2903	478	10.6
QM Slide Block)	2920-3108	NC	6	2953	50	8.3
QM Slide Block)		NX	6	3120	167	27.8
Whitetail Cgl.	3108-4898	NX	90	4913	1793	19.9
Redbeds (Supai)	4898-5108	NX	9	5092	179	19.9
Naco Limestone	5108-5322	NX	20	5322	230	11.5
Setting casing, converting to NX			6	(2953)	0	--
Totals:			186		2920	15.7

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

November 8, 1971

TO: W. L. Kurtz

FROM: J. D. Sell

Coring Rates CP-50
Drill Holes M-1A, A-1, A-4
Superior East Project
Pinal County, Arizona

Coring rates for the first three holes have been compiled. All holes were cored by Boyles Brothers using a CP-50. Essentially the same drillers and helpers have been on the rig throughout the program. Overall, regardless of whether on a two or three shift per day basis, the following averages were determined.

NC Core, 118 shifts, 1371 feet for 11.6 feet/shift
NX Core, 334 shifts, 5440 feet for 16.3 feet/shift

The above figures include all down time from start of coring to our termination of the hole.

Coring rates were also calculated based on the rock units encountered. The figures are not rigorous due to the necessity of calculating values at the termination of shift days which generally does not coincide with formational breaks.

Dacite, NC, 3 shifts and 54 feet equals 18.0 feet/shift
Earlier Volcanics, NC, 4 shifts and 23 feet equals 5.7 feet/shift
Mudstone Whitetail, NC, 45 shifts and 478 feet equals 10.6 feet/shift
Whitetail Conglomerate, NX, 260 shifts and 4539 feet equals 17.5 feet/shift
Fault zone, NX, 2 shifts and 8 feet equals 4.0 feet/shift
Quartz Monzonite Breccia, NC, 6 shifts and 50 feet equals 8.3 feet/shift
Quartz Monzonite Breccia, NX, 6 shifts and 167 feet equals 27.8 feet/shift
Quartz Monzonite, sheared, NX, 10 shifts and 76 feet equals 7.6 feet/shift
Redbeds (Supai), NX, 9 shifts and 179 feet equals 19.9 feet/shift
Naco Limestone, NX, 20 shifts and 230 feet equals 11.5 feet/shift
Escabrosa Limestone, NX, 9 shifts and 89 feet equals 9.9 feet/shift
Schist Breccia, NC, 17 shifts and 190 feet equals 11.2 feet/shift
Schist, NC, 40 shifts and 530 feet equals 13.3 feet/shift

Depth also is a factor in the penetration rate, however, only the coring in the Whitetail Conglomerate has been of sufficient duration to supply

the comparative information. Tabulated below is the average coring rates based on the Boyles Brothers rate changes (depth), rock type, and the calculated value per shift.

Footage	Rock Type, Size	Feet/ Shift	Value/ Foot	$/ Shift
1300-1500	Dacite, NC	18.0	$12.90	$232.20
1300-1500	Schist Bx., NC	11.2	12.90	144.48
1500-2000	Whitetail & Fault Zone, NC	15.3	13.90	212.67
2000-2500	Schist, NC	13.3	14.90	198.17
200-2500	Early Volc., NC	5.7	14.90	84.93
2500-3000	Mudstone WT., NC	10.6	16.50	174.90
2500-3000	QM Slide, NC	8.3	16.50	136.95
3000-3500	QM Slide, NX	27.8	17.30	480.94
3000-3500	Whitetail Cgl., NX	24.1	17.30	416.93
3500-4000	Whitetail Cgl., NX	21.4	19.30	413.02
4000-4500	Whitetail Cgl., NX	19.3	21.60	416.88
4500-5000	Whitetail Cgl., NX	17.2	24.98	428.28
4500-5000	Redbeds (Supai), NX	22.7	24.90	565.23
5000-6000	Redbeds (Supai), NX	18.5	29.90	553.15
5000-6000	Naco Limestone, NX	11.5	29.90	343.85
5000-6000	Whitetail Cgl., NX	15.2	29.90	454.48
6000-6250	Whitetail Cgl., NX	10.7	34.90	373.43
6250-6700	Whitetail Cgl., NX	11.9	39.90	474.81
6250-6700	Escabrosa Limestone, NX	11.5	39.90	458.85
6250-6700	Fault Zone, NX	4.0	39.90	159.60
6250-6700	Quartz Monzonite, NX	7.6	39.90	303.24

As before, the dollar value is not rigorous because of the error in the average foot per shift figure for the various rock types. However, it does point up the fact that Boyles Brothers is maintaining a good footage per shift in the deep holes and receiving a large dollar value.

James D. Sell

James D. Sell

JDS:sg

cc: RBCummings
HLCrittendon

DRILL HOLE AI-1

Drilling Time, by Footage Brackets, including down time.

Depth	Size	Shifts	Days	Footage*	Ft./Shift	Delays
2800-3000	NC	29	9-2/3	189	6.5	Iron junk in hole, clean, cement; 1 bit.
3000-3272	NC	27	9-2/3	283	10.5	New motor, servo system, & other equip. repair; 2 bits.
3272-3500	NX	39	16	227	5.8	Mechanical repairs; new rig; cont. repair; 1 bit.
3500-3967	NX	28	9-2/3	468	16.7	Minor repair; hole survey; 3 bits.
2800-3967		123	45	1167	9.5	

*Footage taken to shift nearest final depth.

Drilling Time, by Rock Unit, including down time.

Rock Unit	Depth	Size	Shifts to Depth		Footage	Ft./Shift
Whitetail Cgl. (M-1A type slide block)	2800-3046	NC	34	3052	252	7.41
Sc-gr slide block (A-2 type)	3046-3238	NC	15	3240	188	12.5
Pinal Schist w/Aplite	3238-3272	NC	7	3272	32	4.6
Pinal Schist w/Aplite	3272-3967	NX	67	3967	695	10.4
	2800-3967		123		1167	9.5

DRILL HOLE A-1

Drilling Time, by footage brackets, including down time.

DEPTH	SIZE	SHIFTS	DAYS	FOOTAGE	FT/SHIFT	TROUBLES
1309-1495	NC	17	9	186	10.9	Bit change; problem w/casing, cement.
1495-1980	NC	36	12	485	13.5	Two bit changes.
1980-2129	NC	10	4	149	14.9	One bit change.
Totals:		63	25	820	13.0 average	

Rock Unit	Interval	Size	Shifts to Depth		Footage	Ft/Shift
Dacite	1309-1374	NC	3	1363	54	18.0
Schist Bx.	1374-1527	NC	17*	1553	190	11.2
Whitetail Cgl.	1527-1566	NC)				
Schist Bx.	1566-1572	NC)	3	1599	46	15.3
Fault Zone	1572-1585	NC)				
Schist	1585-2129	NC	40	2129	530	13.3
Totals:	1309-2129		63		820	13.0

* Includes four shifts of repair, cementing, and drilling out cement.

DRILL HOLE A-2, CORING

Drilling Time, by footage brackets, including down time.

Depth	Size	Shifts	Days	Footage	Ft/Shift	Troubles
4079-4513	NQ(NX)	36	12	434	12.1	4 bit changes; equip. repair.
4513-4521	NQ(NX)	3	1	8	2.7	Broke shiv wheel; rods stuck and lost.
Totals		39	13	442	11.3 average	

Rock Unit	Interval	Size	Shifts	to Depth	Footage	Ft/Shift
Quartz Monzonite (62%) and Pinal Schist (38%) Mixed	4079-4352	NQ(NX)	21	4352	273	13.0
Schist (93%) and Quartz Monzonite (7%) Mixed	4352-4513	NQ(NX)	15	4513	161	10.7
Unknown (Not Recovered)	4513-4521	NQ(NX)	3	4521	8	2.7
Totals			39		442	11.3 average

DRILL HOLE A-2W, CORING

Drilling time, by footage brackets, including down time.

DEPTH	SIZE	SHIFTS	DAYS	FOOTAGE	FT/SHIFT	TROUBLES
4230-4514	NQ(NX)	25	9	284	11.4	4 bit changes.
4514-4940	NQ(NX)	47	16	426	9.1	8 bit changes; equip. repair; stuck rods. Lost core barrel and 818 feet of rods.
Totals		72	25	710	9.9 average	

ROCK UNIT	INTERVAL	SHIFTS TO DEPTH		FOOTAGE	FT/SHIFT
Q. Monzonite 74%, P. Schist 26%	4230-4327	8	4327	97	12.1
P. Schist 89%, Q. Monzonite 11%	4327-4465	14	4465	138	9.9
P. Schist 53%, Q.Monzonite 47%	4465-4569	9	4569	104	11.6
P. Schist 82%, Q.Monzonite 18%	4569-4865	30	4765	296	9.9
Q. Monzonite 73%, P. Schist 27%	4865-4940	11	4940	75	6.8
Totals		72		710	9.9 average

Drill Hole A-3
Tonto Drilling Company

Drilling Time, by Footage Bracket, including down time

Depth	Size	Shifts	Days	Footage	ft./Shift	Troubles
Drilling Cement:						
(1210-1501)	Core	7½	3	291	38.8	Overshot & swivel repair
(1501-1940)	Tricone	3¾	1½	439	117.1	
Coring Whitetail:						
1940-2498	HQ	21	7½	558	26.6	Rig & WL repair; 1 bit change
2498-2978	HQ	15	5	480	32.0	Running HQ casing w/shoe
—	—	—	—	—	—	—
2978-3482	NQ	16½	6	504	30.5	Hydraulic problems; 1 bit change.
3482-3983	NQ	31	12½	501	16.2	2 fishing jobs; gyroscope repair problems; 2 bit changes.
3983-4513	NQ	15	5	530	35.3	1 bit change
4513-5013	NQ	15¾	6	500	31.7	Rig problems; closed two days (not included) for parts; 1 bit change.
5013-5490	NQ	19½	6½	477	24.5	Included 4½ shifts of hoist repair; 2 bit changes.
5490-6008	NQ	22½	8	518	23.0	Servo & cooling problems. Does not include 5 days pump work; 1 bit change.
1940-2978	HQ*	36	12½	1038	28.8 average*	
2978-6008	NQ**	120¼	44	3030	25.2 average**	
1940-6008		156¼	56½	4068	26.0 average.	

* Rock type was Whitetail Conglomerate, mudstone variety, HQ-NQ size core.

** Rock type was Whitetail Conglomerate, cobble to boulder variety, NQ-NX size core. The average includes the coring of a diabase slide block at 5885-5930. If separated out it would be:

Whitetail	NQ	118¾	43½	2991	25.2
Diabase	NQ	1½	½	49	32.7 average.

DRILL HOLE A-4

Drilling time, by footage brackets, including down time.

DEPTH	SIZE	SHIFTS	DAYS	FOOTAGE	FT/SHIFT	TROUBLES
3593-4000	NX	20	7	407	20.4	One bit change.
4000-4471	NX	24	8	471	19.6	Two bit changes.
4471-4980	NX	33	11	509	16.0	Dropped rods, broke WL cable, pulled rods.
4980-5523	NX	36	12	543	15.1	One bit change, repair hydr. system.
5523-5981	NX	30	10	458	15.3	Two bit changes, repair hoist system.
5981-6232	NX	18	6	251	13.9	One bit change, WL cable, hydraulic repair.
6232-6491	NX	21	7	259	12.3	One bit change, broke WL cable, pulled rods.
6491-6664	NX	21	8	173	8.2	Sticking rods, overshot problems, repair work.
Totals:		203	69	3071	15.1 average	

ROCK UNIT	DEPTH	SIZE	SHIFTS TO DEPTH		FOOTAGE	FT/SHIFT
Whitetail Cgl.	3593-6484	NX	182	6491	2898	15.9
Limestone (Me)	6484-6571	NX	9	6580	89	9.9
Fault zone	6571-6575	NX	2	6588	8	4.0
Quartz Monzonite	6575-6664	NX	10	6664	76	7.6
Totals:	3593-6664		203		3071	15.1

DRILL HOLE A-7
(All NX Core)

Drilling Time, by Footage Brackets, including down time:

Depth	Shifts	Days	Footage	Ft/Shift	Troubles
3150-3506	18	6	356	19.8	Drilling cement; mislatch; 1 bit change.
3506-4006	19	6-1/3	500	26.3	Minor equip. repair; 1 bit change.
4006-4500	19-1/2	17-2/3	494	25.3	Minor equip. repair; 2 bit changes.
4500-4992	45	16-1/3	492	10.9	Holidays; caving hole; lots of cementing; 1 bit change.
4992-5492	34	11-1/3	500	14.7	Mislatches; Hydraulic lines; sloughing hole.
5492-6000	26	8-2/3	508	19.5	Minor; 1 bit change.
6000*-6042	3-1/2	1-2/3	42	12.0	Minor; hole surveying.
3150-6042	165	58	2892	17.5 average	

Drilling Time, by Rock Type, including down time:

Rock Unit	Depth	Shifts to Depth		Footage	Ft/Shift
Whitetail Cgl.	3150-5610	141-1/2	5612	2462	17.4
Supai Frm.	5610-5810	6	5800	188	31.3
Naco Lms.*	5810-6042	17-1/2	6042	242	13.8
	3150-6042	165		2892	17.5 average

*See Note at end of Daily Log Sheet.

Footage and Footage/Shift Comparisons between A-7, A-4, & M-1A:

Rock Units	(Footage) and Ft/Shift					
	A-7		A-4		M-1A	
Whitetail Cgl.	(2462)	17.4	(2898)	15.9	(1793)	19.9
Supai	(188)	31.3	--	--	(179)	19.9
Naco/Esc.	(242)	13.8	(89)	9.9	(230)	11.5

TAB

M-1A

DRILL HOLE M-1A

Drilling time, by footage brackets, including down time.

DEPTH	SIZE	SHIFTS	DAYS	FOOTAGE	FT/SHIFT	TROUBLES
2402-2487	NC	10	5	85	8.5	None.
2487-2953	NC	45	15	466	9.7	One bit change, equip. repair.
Casing	--	6	2	--	--	
2953-3481	NX	21	7	598	28.5	One bit change.
3481-3982	NX	27	9	431	16.0	Equip. repair, two bit changes.
3982-4493	NX	27	9	511	18.9	One bit change.
4493-4981	NX	24	8	488	20.3	Two bit changes; surveying hole
4981-5322	NX	26	9	341	13.1	Three bit changes.
Totals:		186	64	2920	15.7 average	

NC Coring, 55 shifts for 551 feet = 10.0 feet/shift average.

NX Coring, 125 shifts for 2369 feet = 18.9 feet/shift average.

ROCK UNIT	DEPTH	SIZE	SHIFTS TO DEPTH		FOOTAGE	FT/SHIFT
Early Volcanics	2402-2428	NC	4	2425	23	5.7
Mudstone Whitetail	2428-2920	NC	45	2903	478	10.6
QM Slide Block)	2920-3108	NC	6	2953	50	8.3
QM Slide Block)		NX	6	3120	167	27.8
Whitetail Cgl.	3108-4898	NX	90	4913	1793	19.9
Redbeds (Supai)	4898-5108	NX	9	5092	179	19.9
Naco Limestone	5108-5322	NX	20	5322	230	11.5
Setting casing, converting to NX			6	(2953)	0	--
Totals:			186		2920	15.7

TAB

DCA-1A

TCA-1A

ROCK UNIT	DEPTH	SHIFTS TO DEPTH		FOOTAGE	FT/SHIFT
Whitetail Cgl. (Tw)	4002-4669	32	4662	660	20.6
Naco Ls. (Pn)	4669-4998	19	4997	335	17.6
Escabrosa Ls. (Me)	4998-5452	52	5448	451	8.7
Martin Ls. (Dm)	5452-5768	76	5770	338	4.4
Troy Qtzite (p€t)	5768-5813	5	5813	43	8.6
TOTALS	4002-5813	184	5813	1811	9.8

TCA-1A

NOTE: Extensive cementing was necessary to stablize shale zones in the lower part of the Naco limestone. The cementing took place during the time that the Martin limestone was being drilled. If delay time caused by shale zones in the Naco is subtracted from the Martin limestone and added to the Naco limestone the data for these units is as follows:

ROCK UNIT	DEPTH	SHIFTS TO DEPTH		FOOTAGE	FT/SHIFT
Naco Ls (Pn)	4669-4998	66	4997	335	5.1
Martin Ls (Dm)	5452-5768	29	5770	338	11.7

DRILL HOLE ~~A-4~~ DCA-1A.

Drilling time by footage brackets, including down time.

DEPTH	SHIFTS	DAYS	FOOTAGE	FT/SHIFT	TROUBLES
4002-4512	26	10	510	19.6	One bit change.
4512-4997	25	10	485	19.4	Two bit changes, snow.
4997-5503	55	19	506	9.2	Three bit changes, lost circulation, problems with overshot retriever.
5503-5813	78	26	310	4.0	Extensive problems and cementing with cave zones at 4900 and 4990.
TOTALS	184	65	1811	9.8 average	

Drilling time by footage brackets, excluding cementing time.

4002-5503	SAME AS ABOVE.				
5503-5813	36	12	310	8.6	Drilling problems with cave zones at 4900 and 4990'.
TOTALS	142	53	1811	12.8	

TAB

DCA-2A

DCA-2A

Drilling Time, by Footage Brackets, including down time (except as noted):

Depth	Shifts	Days	Footage	Ft/Shift	Troubles
1352-1497	11	4 2/3	145	13.2	3 shifts drilling cement, 1 bit change
1497-2002	25	8 1/3	505	20.2	1 bit change.
2002-2422	21 1/2	7 1/2	420	19.5	3 bit changes, rods stuck, reduced to BX, cemented, etc. (DOES NOT include 2-3 1/2 shifts (15-1/3 days) spent on reductions from NX to BX at 2090 feet).
1352-2422	57 1/2	20 1/2	1070	18.6	

Drilling Time, by Rock Type, including down time (except as noted):

Rock Unit	Depth	Shifts to Depth		Footage	Ft/Shift
NX					
Whitetail Cgl.	1352-1452	9	1435	83	9.2
Prial Schist	1452-1540	4	1542	107	26.8
Schultze Gr.	1540-1676	7	1680	138	19.7
Prial Schist	1676-1804	6	1796	116	19.3
Schultze Gr.	1804-1827	2	1836	40	20.0
Prial Schist	1827-2080	11	2080	244	22.2
BX					
Prial Schist	2080-2422	18 1/2	2422	342	18.5
	1352-2422	57 1/2		1070	18.6

TAB

DCA-3A

DCA-3A

Drilling Time by Footage Brackets, including downtime (except as noted).

Depth	Shifts	Days	Footage	Ft/Shift	Remarks
2980-3506	28	9 1/3	526	18.8	2 bit changes, minor repair.
3506-4010	27	9	504	18.7	2 bit changes; minor repair; 2 shifts hydraulic problem.
4010-4338	32	10 2/3	328	10.3	Does not include 13 shifts (4 1/3 days) grouting & cementing. 5 bit changes; numerous problems, mud, etc.
—	—	— (2)	—	—	2 days lost of stuck rods, deviating hole, redrilling lost footage & changing engine.
4338-4507	15	5	169	11.3	No bit change, numerous problems.
4507-5002	40	13 1/3	495	12.4	4 bit changes, " "
5002-5154	10 1/2	3 1/2	152	14.5	1 bit change, hole survey.
2980-5154	152 1/2	50 5/6	2174	14.3	

Drilling Time, by Rock Type, including down time (except as noted)

Rock Unit	Depth	Shifts to Depth		Footage	Ft/Shift
Whitetail Cgl.	2980-4081	62	4077	1097	17.7
sc-gm SB.	4081-4157	7*	4146	69	9.9
Whitetail Cgl.	4157-4274	14	4269	123	8.8
gm SB.	4274-4394	12	4392	123	10.3
Whitetail Cgl.	4394-4454	4	4450	58	14.5
Schultz Gr.	4454-4809	26	4813	363	14.0
Pond Schist.	4809-5154	27 1/2	5154	341	12.4
	2980-5154	152 1/2		2174	14.3

* Does not include 13 shifts of down time for grouting & cementing

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

November 15, 1971

TO: J. D. Sell

FROM: R. B. Cummings

Daily Drill Data
Drill Hole A-5
Rotary Drilling
Superior East Project
Pinal County, Arizona

Attached is a daily log of the rotary drilling on drill hole A-5. The information shown is the date, depth at the end of the day, footage drilled during the day, number of hours charged to drilling and number of shifts involved, explanation of delays, size of the hole and type of drilling (air or mud), and the geologic formation.

Compiled from this data is a breakdown of the shifts and footage by a) depth -- using approximate 1000' intervals, b) hole size, c) air vs. mud for the total hole, d) air vs. mud for a given bit size (6-3/4"), and e) rock unit.

R. B. Cummings lad

R. B. Cummings

RBC:lad
Attachs.

DRILL HOLE A-5 ROTARY DRILLING MAYHEW 3000

DATE	DEPTH END OF DAY	FOOTAGE	DRILLING HOURS	DRILLING SHIFTS	DELAYS	HOLE SIZE	FORMATION
July 27	0	--	--	-	Setting up rig.		
28	14	14	10	2	Finish setting up.	8-3/4-air	Dacite
29	61	47	9	2	Unloading equipment.		
30	92	31	10-1/2	2	4-1/2 hrs. equip. repair, bit change.		
31	--	--	--	-			
Aug. 1	--	--	--	-			
2	280	188	16	2		6-3/4-air	
3	557	277	23	3	1 hr. equip. repair.		
4	642	85	14	3	Rig for mud, 5 hrs. equip. repair, bit change.	640 6-3/4-mud	
5	730	88	16-1/2	3	4 hrs. equip. repair, 3-1/2 hrs. parts delay, checked bit.		
6	871	141	18-1/2	3	5-1/2 hrs. equip. repair.		
7	1024	153	15	3	5 hrs. equip. repair, 4 hrs. cement.		
8	--	--	--	-			
9	1170	146	23	3	1 hr. equip. repair.		
10	1324	154	23	3	1 hr. equip. repair.		
11	1338	14	6-1/2	3	4 hrs. equip. repair, 13-1/2 hrs. misc. delay; 5 hrs. coring; bit change.	1335 6-1/4-mud	

12	1374	36	21-1/2	3	2-1/2 hrs. equip. repair; 15 hrs. coring.	
13	1525	151	23-1/2	3	1/2 hr. equip. repair.	
14	1663	138	23	3	1 hr. equip. repair, bit change.	
15	--	--	--	-		
16	1805	142	24	3		
17	2041	236	21-1/2	3	Work on mud pit.	
18	2141	100	12-1/2	3	6-1/2 hrs. equip. repair, 5 hrs. parts delay, bit change.	
19	2148	7	3-1/2	3	1-1/2 hrs. equip. repair, 19 hrs. parts delay.	
20	2290	142	22	3	2 hrs. equip. repair.	2159 Dacite-tuff
21	2489	199	20	3	2-1/2 hrs. equip. repair, 1-1/2 hrs. work on mud pit.	2274 Earlier Volcanics
22	2585	96	10	3	14 hrs. equip. repair & rig maintenance.	
23	2676	91	24	3	Bit change.	2600 Whitetail Mudstone
24	2815	139	24	3		
25	2930	115	23	3	1 hr. equip. repair, bit change.	
26	3048	118	22	3	2 hr. equip. repair.	2999 Whitetail Conglom.
27	3141	93	22	3	2 hrs. equip. repair.	
28	3145	4	14	3	Twisted off, 5 hrs. parts delay, 5 hrs. fishing, bit change.	
29	--	--	--	3	Casing, Tear down.	

DRILL HOLE A-5

Drilling time by depth brackets, including down time.

DEPTH	SIZE	SHIFTS	DAYS	FOOTAGE	FT/SHIFT	DELAYS
0-998	8-3/4 & 6-3/4	22	9	998	45.4	Finish setting up, minor repairs.
998-2041	6-3/4 & 6-1/4	25	8	1043	41.7	Spot coring, moderate repairs.
2041-3048	6-1/4	27	9	1007	37.3	Major repairs, parts delay.
3048-3145	6-1/4	6	2	97	16.2	Twisted off, 7 hrs. delay, 5 hrs. fishing,
0-3145		80	28	3145	39.3	terminated hole.

Drilling time by bit size.

BIT SIZE	DEPTH	SHIFTS TO DEPTH		FOOTAGE	FT/SHIFT
8-3/4	0-92	6	92	92	15.3
6-3/4	92-1335	26	1338	1246	47.9
6-1/4	1335-3145	48	3145	1807	37.6

Drilling time by air and mud - total hole.

AIR/MUD	DEPTH	SHIFTS TO DEPTH		FOOTAGE	FT/SHIFT
AIR	0-640	14	642	642	45.9
MUD	640-3145	66	3145	2503	38.0

Drilling time by air and mud - 6-3/4" bit.

AIR/MUD	DEPTH	SHIFTS TO DEPTH		FOOTAGE	FT/SHIFT
AIR	92-640	8	642	550	68.8
MUD	640-1335	15	1324*	682	45.5

*The interval 1324-1338 was not included because much of the time involved included preparation for change in drill rod size and coring.

DRILL HOLE A-5 -- Continued

Drilling time by rock unit.

ROCK UNIT	DEPTH	SIZE	SHIFTS TO DEPTH		FOOTAGE	FT/SHIFT
Dacite	0-2159	8-3/4-6-1/4	53	2148	2148	40.5
Dacite-Tuft	2159-2274	6-1/4	3	2290	142	47.3
Early Volcanics	2274-2600	6-1/4	7	2611	321	45.9
Whitetail-mudstone	2600-2999	6-1/4	10	3003	392	39.2
Whitetail-cgl.	2999-3145	6-1/4	7	3145	142	20.3

TAB

A-1

Drilling Rept

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

November 22, 1971

TO: J. D. Sell

FROM: R. B. Cummings

Daily Drill Data
Drill Hole A-1
Rotary Drilling
Superior East Project
Pinal County, Arizona

Attached is a daily log of the rotary drilling on hole A-1. The information shown is the date, depth at the end of the day, number of hours charged to drilling and number of shifts involved, explanation of delays, size of the hole, and the geologic formation.

Compiled from this data is the average drill rate.

R. B. Cummings
lad

R. B. Cummings

RBC:lad
Attach.

DRILL HOLE A-1 ROTARY DRILLING FAILING 2500

DATE	DEPTH AT END OF DAY	FOOTAGE	DRILLING HOURS	DRILLING SHIFTS	DELAYS	HOLE SIZE	FORMATION
April 8	--	--	--	-	Setting up.		
9	6	6	3	1	Setting up.	12-3/4" 6'	Dacite
10	61	55	18	3	6 hrs. equip. repair.		
11	--	--	--	-			
12	132	71	13-1/2	3	Reverse drill collars, 8 hrs. ream oversize stabilizer.		
13	214	82	19-1/2	3	4-1/2 hrs. equip. repair.		
14	459	245	19-1/2	3	4-1/2 hrs. equip. repair.		
15	615	156	24	3		9-7/8"	
16	696	81	9-1/2	3	Twisted-off, fished -- 14-1/2 hrs.		
17	784	88	24	3			
18	--	--	--	-			
19	811	27	5-1/2	3	Came out of hole, hauled casing, 2 hrs. equip. repair.	811	
20	811	0	0	2	Casing, cementing, and haulind drill collars.		
21	811	0	0	3	24 hrs. compressor delay.		
22	843	32	1-1/2	3	14-1/2 hrs. compressor delay, 4-1/2 hrs. equip. repair, 3-1/2 hrs. drilling cement.		
23	1086	243	17	3	1 hr. equip. repair, materials delay	6-1/4"	

24	1221	135	14	3	4 hrs. equip. repair, 6 hrs. parts delay, bit change.		1250 Vitrophype
25	--	--	--	-			1297 Dacite Tuff
26	1309	88	20	3	3 hrs. equip. repair, bit change.	1309 All Air	1309
27	--	--	--	-	End of hole.		

DRILL HOLE A-1

DEPTH	SIZE	SHIFTS	DAYS	FOOTAGE	FT/SHIFT
0-1309	12-3/8" to 6-1/4"	42	15	1309	31.2

TAB

A-4

Drilling Dept

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

November 22, 1971

TO: J. D. Sell

FROM: R. B. Cummings

Daily Drill Data
Drill Hole A-4
Rotary Drilling
Superior East Project
Pinal County, Arizona

Attached is a daily log of the rotary drilling on drill hole A-4. Note that there are two phases of rotary drilling; one with Boyles Brothers Drilling Company using a Failing 2500, and the second with Shelton Drilling Company using a Mayhew 3000. The information shown is the date, depth at the end of the day, number of hours charged to drilling and the number of shifts involved, explanation of delays, size of the hole and type of drilling (air or mud), and the geologic formation.

Compiled from this data is a breakdown of the shifts and footage by a) contractor and air vs. mud, b) contractor, excluding parts and materials delays, c) depth -- using approximate 1000' intervals, d) bit size, and e) rock unit.

R. B. Cummings

RBC:sg
attachs.

DRILL HOLE A-4 ROTARY DRILLING FAILING 2500

DATE	DEPTH AT END OF DAY	FOOTAGE	DRILLING HOURS	DRILLING SHIFTS	DELAYS	HOLE SIZE	FORMATION
May 1	14	14	7-1/2	2	6 hrs. set-up, cement surfact casing 3rd shift set-up	12-3/8"-air	Dacite
2	-	-	-	-		6' 9-7/8"	
3	283	269	11-1/2	3	Twisted off bit, 10-1/2 hrs. fishing	18'	
4	358	75	4	3	Continued fishing, twisted off again, fishing		
5	564	206	11	3	Continued fishing, twisted off again, fishing		
6	613	49	5	3	19 hrs. cementing		
7	613	0	0	3	2nd cement job	9"-air	
8	613	0	0	3	3rd cement job, 8 hrs. equip. repair		
9	-	-	-	-			
10	921	308	24	3			
11	1082	161	22-1/2	3	1-1/2 hrs. equip repair, changed choke on hammer twice		
12	1082	0	0	3	14 hrs. casing, 4 hrs. equip. repair, 6 hrs. standby		
13	1082	0	0	3	1-1/2 hrs. casing, remainder waiting on casing and prep. for cement		
14	1082	0	0	3	7 hrs. equip repair, 17 hrs. cement	1082'	
15	1365	283	24	3			
16	-	-	-	-			
17	1612	247	19	3	5 hrs. equip repair		
18	1630	18	4	3	Twisted off bit, 4 hrs. fishing, 16 hrs. wait on bit		
19	1762	132	18	3	6 hrs. equip. repair, checked bit		

DRILL HOLE A-4 ROTARY DRILLING FAILING 2500

DATE	DEPTH END OF DAY	FOOTAGE	DRILLING HOURS	DRILLING SHIFTS	DELAYS	HOLE SIZE	FORMATION
May 20	1968	206	23	3	Removed choke from hammer, 1 hr. Asarco stand by	6-1/4 to 6" air	Dacite 1975 Early Volcanics
21	2028	60	24	3	Installed choke in hammer		
22	2077	49	24	3			
23	-	-	-	-			
24	2077	0	6	3	Bit change, 4 hrs. equip. repair, 14 hrs. waiting on bit		
25	2077	0	10-1/2	2	Bit change, 4 hrs. reaming, 5-1/2 hrs. equip. delay, Boyles terminated	2077	
26	-	-	-	-	Tear down		

Note: Boyles Brothers rotary contract terminated on May 26. Shelton Drilling Company rotary contract initiated with drilling on June 10 in same hole location

DRILL HOLE A-4 ROTARY DRILLING MAYHEW 3000

June 10	2077	-	-	-	Setting-up	2077	Early Volcanics
11	2077	0	14	2	2 hrs. equip delay, 5 hrs. lost circulation, strapping rods on way in		
12	2077	0	4	2	Repair mud pit		
13	2077	0	6	1			
14	2183	106	24	3	Bit change		2133' Whitetail Mudstone
15	2294	111	17	3	Repair brakes, bit change		
16	2294	0	0	3	Parts delay, work on brakes		
17	2383	89	16	3	Repair brakes, bit change		
18	2527	144	24	3	Bit change		

DRILL HOLE A-4 ROTARY DRILLING MAYHEW 3000

DATE	DEPTH END OF DAY	FOOTAGE	DRILLING HOURS	DRILLING SHIFTS	DELAYS	HOLE SIZE	FORMATION
June 19	2640	113	16	2			
20	2640	-	-	1	Tried to re-center rig		
21	2659	19	9	3	2 hrs. equip. repair, 13 hrs. parts delay		
22	2696	37	14	3	3 hrs. equip. repair, 7 hrs. parts delay	5-5/8"-mud	
23	2744	48	24	3	18 hrs. coring, 2 bit changes		
24	2804	60	22	3	2 hrs. equip. repair, bit change, 2 hrs. reaming		
25	2888	84	24	3	Bit change, 1 hr. reaming		
26	2920	32	15	2	1 hr. cementing, bit change		2920' Whitetail Conglom.
27	2944	24	8	1	2 hrs. reaming		
28	3014	70	24	3	Bit change, 2 hrs. reaming		
29	3040	26	11	3	1 hr. equip. repair, 12 hrs. parts delay, transmission out, bit changes		
30	3040	-	-	3	22 hrs. parts delay, 2 hrs. equip. repair		
July 1	3078	38	19	3	5 hrs. equip. repair, 2 bit changes		
2	3119	41	24	3	17 hrs. coring, 2 bit changes		
3	3121	2	4	1/2			
4	-	-	-	-			
5	3171	50	19	2-1/2	1 hr. equip. repair, bit change		
6	3221	50	24	3	2 bit changes		
7	3267	46	23-1/2	3	1/2 hr. equip. repair, 2 bit changes, 2 hrs. reaming		

DRILL HOLE A-4 ROTARY DRILLING MAYHEW 3000

DATE	DEPTH END OF DAY	FOOTAGE	DRILLING HOURS	DRILLING SHIFTS	DELAYS	HOLE SIZE	FORMATION
July 8	3321	54	20	3	Bit change, wait on drill pipe		
9	3321	-	-	-	Trip out of hole, 21 hrs. parts delay		
10	3321	-	-	3	24 hrs. parts delay		
11	-	-	-	-			
12	3321	-	-	-	24 hrs. parts delay		
13	3321	-	-	-	24 hrs. parts delay		
14	3321	-	-	2	16 hrs. parts delay		
15	3384	63	24	3			
16	3436	52	21	3	3 hrs. equip. repair, 2 bit changes		
17	3487	51	19	3	5 hrs. equip. repair, bit change		
18	-	-	-	-			
19	3520	33	11	2	5 hrs. equip. repair, bit change		
20	3546	26	15	3	9 hrs. equip. repair, bit change		
21	3593	47	21	3	3 hrs. tear down, bit change	3593	3593
22	-	-	-	-	Casing, Termination of hole		

DRILL HOLE A-4

Drilling time by contractor, and air and mud, including down time.

CONTRACTOR	DEPTH	SIZE	SHIFTS	DAYS	FOOTAGE	FT/SHIFT	DELAYS
Boyles-air	0-2077	12-3/8-6-1/4 air	61	21	2077	34.0	Major delays-bits, cementing and broken casing
Shelton-mud	2077-3593	5-5/8 mud	96	37	1516	15.8	Major delays-waiting on parts, repairs, bit changes, spot coring

Drilling time by contractor, excluding parts and materials delays.

CONTRACTOR	DEPTH	SHIFTS	FOOTAGE	FT/SHIFT	ELIMINATED DELAYS
Boyles	0-2077	52	2077	39.9	9 shifts waiting on casing and bits
Shelton	2077-3593	77	1516	19.7	19 shifts waiting on parts

NOTE: Approximately 100 hours (over twelve shifts) were used by Shelton in "tripping" (going into and out of the hole) for bit changes. In all 29 bits were used. Boyles "tripping" time for bit changes was very minor. On hole A-5 (see report dated November 15, 1971) Shelton used more expensive button bits. Shelton drilled over twice the footage on A-5 as on A-4, but used only 8 bits and consumed less than 35 hours in "tripping" for bit changes.

Drilling time by depth intervals, including down time.

DEPTH	SIZE	SHIFTS	DAYS	FOOTAGE	FT/SHIFT	DELAYS
0-1004	12-3/8"to9"	25	9	1004	40.2	Broken bits, cementing
1004-2011	9" + 6-1/4"	26	9	1007	38.7	Casing
2011-3014	6-1/4"+5-5/8"	54	21	1003	18.6	Major repairs and parts delays, bit changes
3014-3593	5-5/8"	52	19	579	11.1	Major repairs and parts delays, bit changes
0-3593		157	58	3593	22.9	

Drilling time by bit size, including down time.

BIT SIZE	DEPTH	SHIFTS TO DEPTH		FOOTAGE	FT/SHIFT
12-3/8"to9"	1082	31*	1082	1082	34.9
6-1/4"	1082-2077	30*	2077	995	33.2
5-5/8"	2077	96	3593	1516	15.8

* A total of 9 shifts were consumed in materials delay, casing and cementing when casing was set at 1082'. 5 shifts were charged to 12-3/8" to 9" bit size and 4 shifts were charged to 6-1/4" bit size.

Drilling time by rock unit, including down time.

ROCK UNIT	DEPTH	SIZE	SHIFTS TO DEPTH		FOOTAGE	FT/SHIFT
Dacite	0-1975	12-3/8"-6-1/4"	50	1968	1968	39.4
Early Volcanics	1975-2133	6-1/4"+5-5/8"	18	2146	178	9.9
Whitetail-mudstone	2133-2920	5-5/8"	33	2920	774	23.5
Whitetial-conglom.	2920-3593	5-5/8"	56	3593	673	12.0
Total Hole			157		3593	22.9

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

December 17, 1971

MEMORANDUM FOR J. J. COLLINS
New York Office

Superior East Project

Per your request, I enclose the east-west and north-south cross sections of the Superior East Project. Also enclosed is a copy of your memorandum, December 13, 1971, to R. L. Hennebach with a few additions Mr. Sell and I thought appropriate.

Please note that we have indicated the property boundaries on the cross sections. Mr. Crist has inquired into obtaining a prospecting permit on the Oak Flat Withdrawal Area and believes that we can obtain one. Hopefully, we will be able to give you all the details when you visit us in January.

W. L. Kurtz

WLK:lad
Encs.

cc: JHCourtright
JDSell

12-13

From: J. J. Collins

To: Mr Kurtz

Pl correct where necessary

Retyped with minor changes by Kurtz & Sell.

Bill
Dec 17, 1971

RECEIVED
DEC 15 1971
S. W. U. S. EXPL. DIV.

New York, December 13, 1971

MEMORANDUM FOR: Mr. R. L. Hennebach

Superior East, Arizona

The attached map and this tabulation may help to put this project in perspective. From north to south and west to east:

Hole DCA-1
An old Inspiration hole (but actually in one of our claims) was reentered last month and our core drilling started from 4002 ft. At the end of November depth was 4307 ft. No ore.

Hole A-1
A new Asarco hole 2129 ft. deep. Bottomed in pyritized basement schist. No ore.

Hole DCA-2
An old hole bottomed in pyritized basement schist and Tertiary granite. No ore.

Hole M-1A
An old hole reentered, drilled from 2402 ft., and bottomed at 5322 ft. in weakly mineralized Paleozoic limestone and with visible native copper in the overlying Whitetail conglomerate.

Hole OF-1A
An old hole. Stoped in volcanics.

Hole DCA-3
An old hole in Whitetail conglomerate. No ore. Could not be reentered.

Hole A-5
A new Asarco hole rotary drilled to 3145 ft. and waiting for the core drilling rig. Rotary cuttings from Whitetail conglomerate show visible native copper.

9 - Magma's #9 shaft 2960 ft. deep. Cut 1400 feet of Whitetail conglomerate with native copper. Minor mineralization in underlying breccia.

Hole A-4
A new Asarco hole bottomed at 6664 ft. in November in monzonite with traces of mineralization, but the surprising thing is the amount of native copper in the Whitetail conglomerate: 1460 ft. average 0.66% Cu, from 5080 to 6540 ft. (or 860 feet average 0.81% from 5680-6540).

Hole I-1
An old hole bottomed in basement schist at 3475 ft.

Summary
The mineralization in the conglomerate and limestone in Hole A-4 is not what we were looking for and the depth is extreme. Nevertheless, its existence encourages search for the bedrock source. The discovery should be kept confidential while we negotiate a permit or lease on the adjoining state land.

John J. Collins

Attach.

New York, December 13, 1971

MEMORANDUM FOR: Mr. R. L. Hennebach

Superior East, Arizona

The attached map and this tabulation may help to put this project in perspective. From north to south and west to east:

Hole DCA-1

An old Inspiration hole (but actually in one of our claims) was reentered last month and our core drilling started from 4000 ft. At the end of November depth was 4307 ft. No ore.

Hole A-1

A new Asarco hole 2129 ft. deep. Bottomed in pegmatized basement schist. No ore.

Hole DCA-2

An old hole bottomed in pegmatized basement schist and Tertiary granite. No ore.

Hole M-1A

An old hole reentered, drilled from 2400 ft., and bottomed at 5322 ft. in weakly mineralized Paleozoic limestone, and with visible native copper in the overlying Whitetail Conglomerate.

Hole OF-1A

An old hole. Stoped in volcanics.

Hole DCA-3

An old hole in Whitetail conglomerate. No ore. Could not be reentered.

Hole A-5

A new Asarco hole rotary drilled to 3145 ft. and waiting for the core drilling rig. Rotary cuttings from Whitetail Conglomerate show visible native copper.

9 - Magma's #9 shaft 2960 ft. deep. Cut ore. 1400 feet of Whitetail Conglomerate with native copper. Minor mineralization in underlying limestone.

Hole A-4

A new Asarco hole bottomed at 6664 ft. in November in monzonite with traces of mineralization, but the surprising thing is the amount of native copper in the Whitetail conglomerate: 1460 ft. average 0.66% Cu, from 5080 to 6540 ft., (or 160 feet average 0.81% from 5480-6540).

Hole I-1

An old hole bottomed in basement schist at 3475 ft.

Summary

The mineralization in the conglomerate and limestone in Hole A-4 is not what we were looking for and the depth is extreme. Nevertheless, its existence encourages search for the bedrock source. The discovery should be kept confidential while we negotiate a permit or lease on the adjoining state land.

John J. Collins

Attach.

SUPERIOR EAST PROJECT

The Superior East drilling commenced on April 6, 1971, and as of December 15, 1971, a total of 8047 feet of rotary drilling and 7816 feet of diamond coring had been completed. General statistics for the five holes are shown in Table 1 and located on the attached summary drilling progress map.

Table 1

Hole Number	Footage Start	Footage Complete	Type Drilling	Mineral Intercepts
A-1	Surface	1309	Rotary	----
A-1	1309	2129	Core	Trace copper oxide and sulfide
A-4	Surface	3593	Rotary	----
A-4	3593	6664	Core	5680-6540 = 860 ft. @ 0.81% Cu, or 5080-6540 = 1460 ft. @ 0.66% Cu with minor gold-silver.
A-5	Surface	3145	Rotary	Native Cu in cuttings.
DCA-1A	4002	5007	Core	None
M-1A	2402	5322	Core	3370-3520 = 150 ft. @ 0.15% Cu 3850-4040 = 190 ft. @ 0.15% Cu with trace gold-silver.

Significant geologic conclusions:

1. Interception of quartz monzonite porphyry, typical of the mineralized porphyries, with alteration and weak pyrite, chalcopyrite, and molybdenite in A-4.

2. Interception of a flat fault in A-1, correlating with known structures.

3. Native copper in a thick prism of post mineral Whitetail Conglomerate.

4. Paleozoic limestones, favorable for replacement ore bodies, are now indicated to extend under much of the Dacite plateau.

5. Movement in monzonite slide block in M-1A probably originated from east or southeast from major Tertiary Schultze granite area.

Significant mineral conclusions:

1. Weak pyritic and copper mineralization extends over a large area of bedrock as found in holes A-1, DCA-2, M-1A, A-4, and possibly I-1.

2. Visible and assayable copper, mainly native, is found in the post-mineral Whitetail Conglomerate in a large volume as found in holes DCA-2, M-1A, A-4, A-5, possibly DCA-3, and in Magma No. 9 shaft and haulage drift.

3. Significant native copper in conglomerate intercepts were cut in hole M-1A, and especially in hole A-4 where 860 feet of 0.81% copper is found, and in Magma No. 9 shaft where 1400 feet of ± 0.4% copper (also as native) is verbally reported.

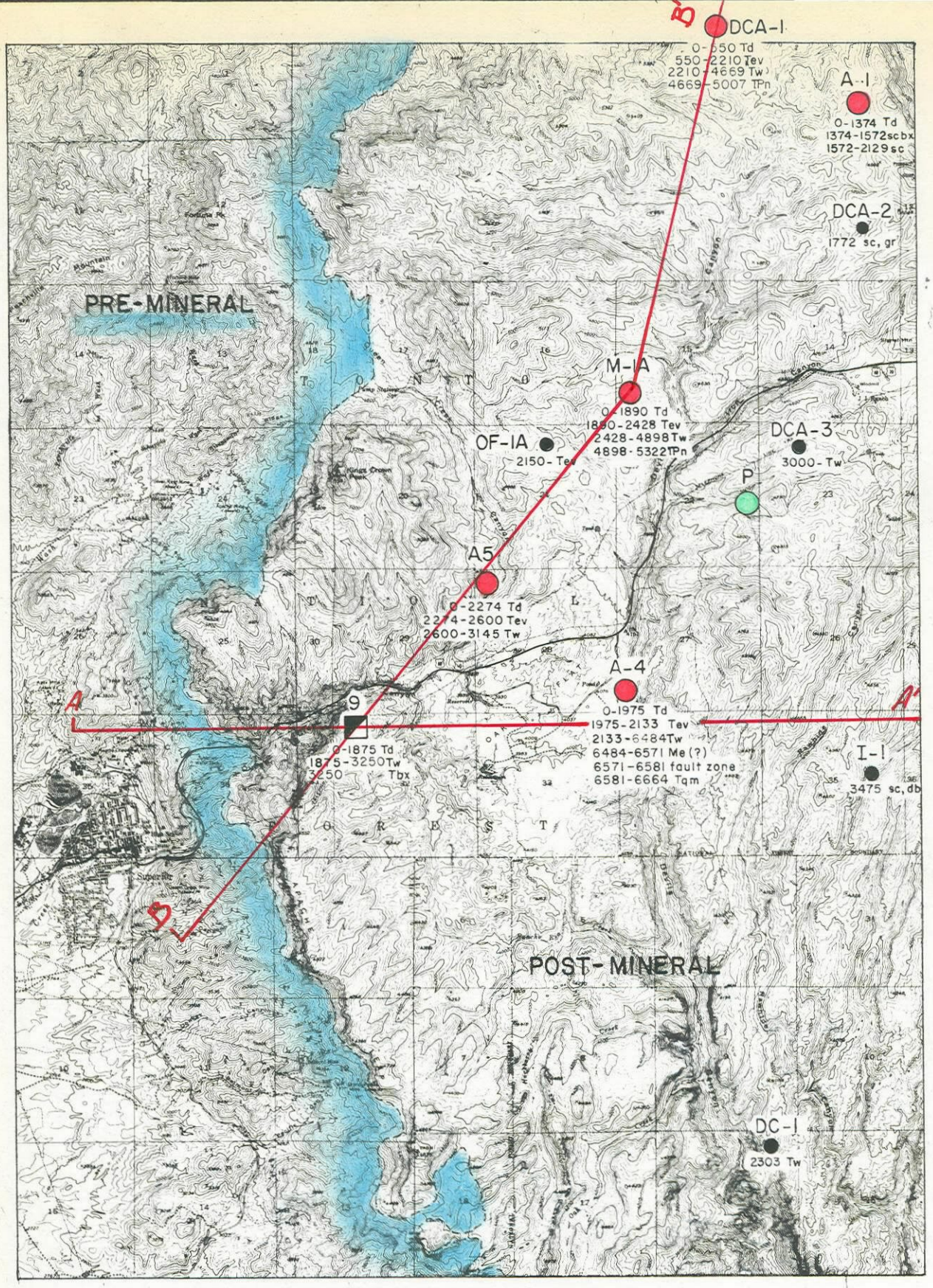
Continued work includes a) coring of A-5 from its cased depth, along the favorable mineral projections of Magma workings; and b) a new hole, Northeast of A-4 and in the center of the projected nose area of the Schultze granite stock of Tertiary age.

Of the four holes completed to premineral bedrock, one intercepted a favorable quartz monzonite porphyry which is weakly altered and mineralized. The next two holes scheduled should materially increase our knowledge of the pre-mineral units and statistically increase our probability from 38% to 50% as expressed in M. P. Barnes' memo of April 26, 1971.

James D. Sell

James D. Sell
Dec. 15, 1971

JDS:lad



EXPLANATION

- Previous drill hole
- ASARCO drill hole
- Magma's #9 shaft

DCA-1 (hole designation)
4011 Tw
Rock type
Bottom hole depth

P
Proposed drill site

POST-MINERAL ROCK UNIT

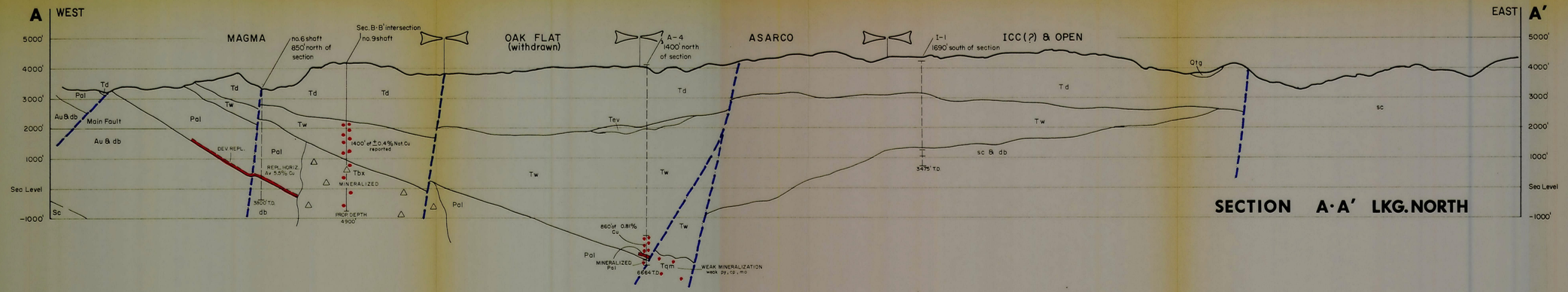
Td - Dacite
Tev - Early volcanics
Tw - Whitetail

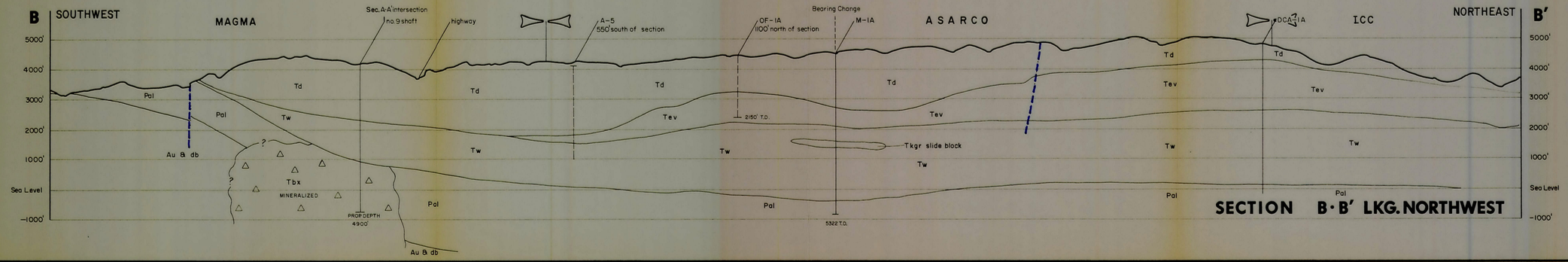
PRE-MINERAL ROCK UNIT

Tbx - Breccia
Tqm - Quartz Monzonite
Tgr - Granite
TPn - Naco limestone
Me - Escabrosa limestone
p€db - Diabase
p€sc - Schist

Summary

DRILLING PROGRESS MAP
for the month of _____
SUPERIOR EAST
GILA & PINAL COUNTY, ARIZONA
SCALE: 1" = 1 mile
J. D. S.
2463





EXPLANATION

Qtg	Quaternary Cover	POST-MINERAL
Td	Tertiary Dacite	POST-MINERAL
Tev	Early Volcanics	POST-MINERAL
Tw	Whitetail Conglomerate	POST-MINERAL
TKgr Tqm	Laramide Intrusive	POST-MINERAL
Tbx	Mineralized Breccia	PRE-MINERAL
Pal	Paleozoic Sediments	PRE-MINERAL
Au & db	Precambrian Sediments and Diabase	PRE-MINERAL
sc	Precambrian Pinal Schist	PRE-MINERAL

ASARCO

SECTIONS THROUGH DRILL HOLES

SUPERIOR EAST
PINAL COUNTY, ARIZONA

SCALE 1" = 2000'

DECEMBER, 1971

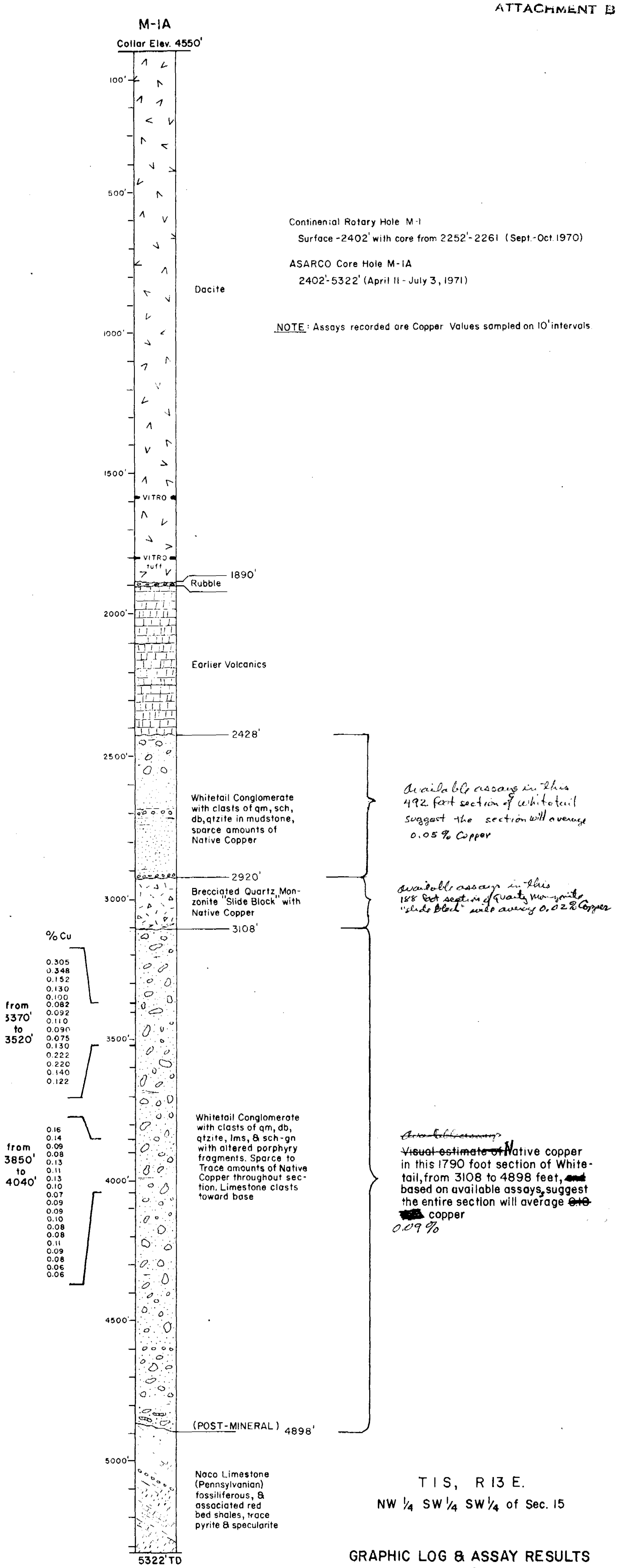
J. D. SELL

mn 2336 a DAM

TAB

M-1A

ATTACHMENT B



T 1 S, R 13 E.

NW 1/4 SW 1/4 SW 1/4 of Sec. 15

GRAPHIC LOG & ASSAY RESULTS
of
DRILL HOLE M-1A

SUPERIOR EAST PROJECT

GILA & PINAL COUNTIES, ARIZONA

SCALE: 1" = 300'

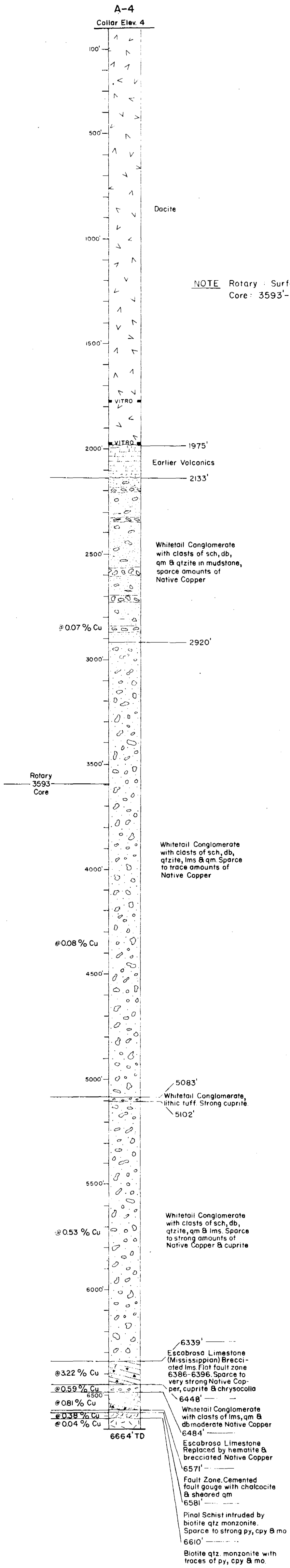
J.D.S. July 8, 1971

2486

TAB

A-4

J.D. Sell



NOTE Rotary : Surface - 3593' (May 1 - July 21, 1971)
Core : 3593'- 6664' (August 17 - November 4, 1971)

NOTE:
5080-6540 = 1460 ft. @ 0.76 % Cu
5680-6540 = 860 ft. @ 0.98 % Cu

T 1 S, R 13 E

SW 1/4 SW 1/4 SW 1/4 Sec. 27

GRAPHIC LOG & ASSAY RESULTS
of
DRILL HOLE A-4
SUPERIOR EAST PROJECT

GILA & PINAL COUNTIES, ARIZONA

SCALE : 1" = 300'

R.B.C. Dec. 2, 1971

2486 - B

± (1972)

Drill Hole Info:

Location: 1800' N of Township boundary (T15, T1N), and 8600 ft westward from Carlota Mine BM 3642
5-7/8 rdh, collar all dacite cuttings around.
water @ ± 200 feet. Plywood sign — no paper left
offid of labor for assessment ?
3" capped pipe some 3½' tall marked XC-1 on cap.
(on map in NE corner of K142 claim).

Location: 4700' N of Township Boundary in T1N; and 10,300 ft northwesterly from Carlota Mine BM 3642.
Badly torn paper near 6" capped hole (1 ft above ground)
E F Read, FCC. Rotary hole POLE #4, located on ?70 claim, Docket (Final) 387, p. 17?
Pole #4 is claimed as location work 3000×3000 with date of loc. on 9 claims as: Mar. 10, 1964 (3); March 11 (2), March 12 (3), March 13 (1).
Drilled May 27 thru May 28, 1964. ?40 ft.
Docket 387, p. 144, 146, 147, 148, 149, 172, 176, 178, 180 on GHOST claims.

Location: 3500 N of Township Boundary in T1N, and 5500 feet northwesterly from Carlota Mine BM 3642.
Inspection shows inclined DDH to SE at 45° with dacite, diabase, pend schist core fragment.

Drill Hole Info:

Location: NW 1/4 NE 1/4, Sec. 25, T1S, R13E.
Drilled: by Wilson (?) for ICC (?)
Map # I-2.
Report: by Tom Brock (JO Barnes) as being ± 850 ft ending in river gravels.

#

Location: "SE Corn Sec. 24, T1S, R13E"
"about 3200 ft SE of Hutton Peak"
found in Pinal Co. Docket 370, page 407.
CROOK 48 drilled for ICC on Crook 48. (Validation hole?)
Recheck. (See also note under Pinal: D. 275, p. 265-266

#

Location: NE 1/4 SE 1/4, Sec. 26, T1S, R13E
six foot stand pipe. for ICC?
Recheck.

#

Telephone call to Hugh Olmstead, Chief Geologist, ICC, (ph. 473-2411, ext 366) on Friday Oct 23, 1970. He mentioned 4 ICC exploration holes. Also would check w/ NY on giving info out. HLC late (Nov. 3) called him & Hugh said NY said No without some fee.

Drill Hole Info:

Location: 1000 ft N of ~~[illegible]~~ Township boundary in T1N and 6500 ft ~~[illegible]~~ WSW of Carlota Mine BM 3642. being drilled by Boyle Bro in Oct-~~[illegible]~~ 1970. Doug Friel checked out – see him. Some 86 stand of rods (20') on 24? Oct. Drill (DDH) at 45° to NW. Rig moved ? on Friday 30 October. Rob. Ice.

Location: SE 1/4 boundary with Sec. 24, and Sec. 19. map No I-3.
being drilled by JC Barnes.
Verbal info by Tom Brech suggests
bottom of Waite ± 1000'
@ 1183 in Whitetail from cuttings exam.
by ~~[illegible]~~ Oct 29 they had rotary'd down
to 1410 – still in whitetail (?), but fell up during trip to 1266. (Air drilling).
Converting to mud on Oct 29 (Still waiting on Nov. 3. Nov. 3 exam shows dominant schist frag w/ little cgl suggestion. ? in schist with caving cgl above?

Drill Hole Info:

Gila ~~Final~~ Docket 247, p. 417

For ICC, Boyles Bro drilled an exploration hole to a depth of 786 feet on Conto 119 between Sept. 1, 1967, & Sept 1, 1968, at a cost of $6650.00

CONTO 119

Gila ~~Final~~ Docket 201, p. 265

for ICC, Boyles Bro drilled an exploration hole in excess of 14 000.00. between Sept 1, 1965 & Sept 1, 1966 Where ?! See D. 200, p. 593 ?

Gila(?) ~~Final~~ Docket 170, p. 231.

Bohme between 1 Sept 63 & 1 Sept 64 drilled 2 holes on Pierto Copper 2-13 & Quartz Site 2-4 for MCC

CDX-1 ; 0-112.5' CDX-2 ; 0-2,852.0'

*CDX-2 drilled in center of Quartzite No. 23

((Help! No Quartzite 23 !! listed))

Pierto Copper No. 3, D. 48, p. 291

Quartz Site No. 2, D. 24, p. 52

" " No. 3, D. 24, p. 53.

Gila ~~Final~~ Docket 275, p. 265-266

ICC did 1 Sept 68 & 1 Sept 69 spend 5 800.00 by LA Drilled down-hole hammer to 842 feet on Crook 48

CROOK 48

Crook 48, Final Doc. 370, p. 470.

Jan 1, 1972

Geological Survey Research 1971
Prof. Paper 750-C, p. C117-C126.

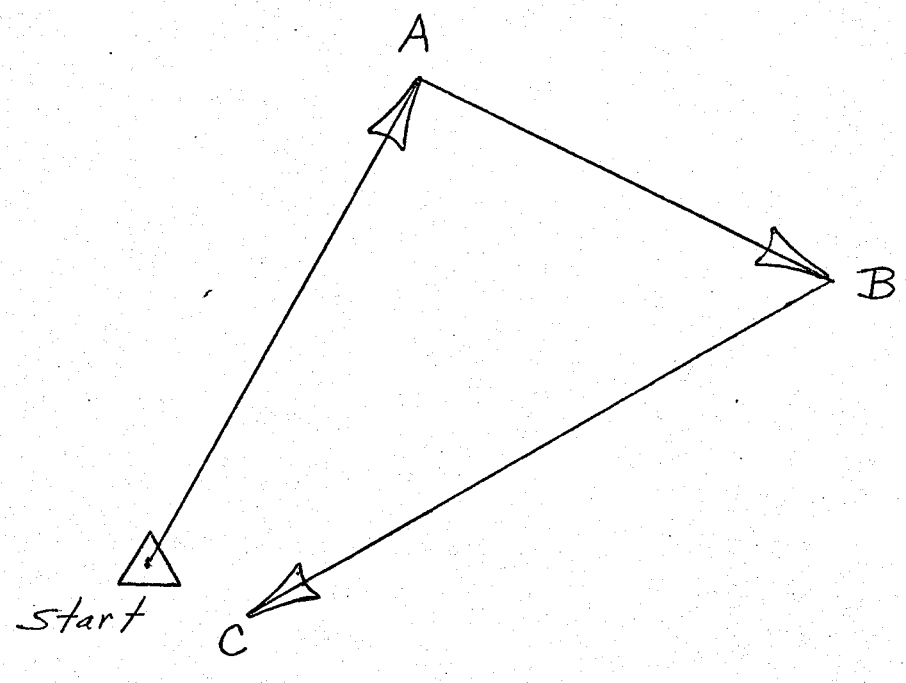
Summary of Mineralogic & Lithologic Characteristics of Tertiary Sedimentary Rocks in the Middle Rocky Mountains and the Northern Great Plains.
by NM Denson & WA Chisholm.

Page 125:
"7. Collapse of many parts of mountain ranges occurred near the close of the Pliocene (2-3 m.y.) Displacement of as much as 2000-3000 feet were largely along Laramide faults, but were in directions opposite to Laramide movements. These late Pliocene collapse features, (were) generally down on the mountain wind side ...".

Triangle Number _____

Patrol _____

Troop _____



Segment	Bearing	Distance
Start to pt. A	_____	_____
Pt. A to pt. B		
Pt. B to pt. C.		

Distance Error _____

Points Recieved _____

AMERICAN SMELTING AND REFINING COMPANY
SOUTHWESTERN EXPLORATION DIVISION
P. O. BOX 5747, TUCSON, ARIZONA 85703

1150 NORTH 7TH AVENUE
TELEPHONE 602-792-3010

January 26, 1972

Mr. Gordon Mohl
Core Laboratories, Inc.
817 West Main Street
Farmington, New Mexico 87401

Dear Mr. Mohl:

I am sending you, under separate cover, three core samples on which we would like you to determine porosity, vertical permeability, and horizontal permeability. These samples have been numbered M1A-4686, A4-3744, and DCA1-4626.

We are interested in the permeability of these core samples in relation to fresh water.

Very truly yours,

W. L. Kurtz
Manager of Exploration

WLK:lad

cc: JDSell

CA-20

CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS, TEXAS

Page No.

CORE ANALYSIS RESULTS

Company AMERICAN SMELTING & REFINING COMPANY
Formation
File RP-3-2528
Date Report 2-4-72
Well
Core Type
Analysts MOHL
Field
Drilling Fluid
County State Elev. Location

Lithological Abbreviations

SAND-SD SHALE-SH LIME-LM	DOLOMITE-DOL CHERT-CH GYPSUM-GYP	ANHYDRITE-ANHY CONGLOMERATE-CONG FOSSILIFEROUS-FOSS	SANDY-SDY SHALY-SHY LIMY-LMY	FINE-FN MEDIUM-MED COARSE-CSE	CRYSTALLINE-XLN GRAIN-GRN GRANULAR-GRNL	BROWN-BRN GRAY-GY VUGGY-VGY	FRACTURED-FRAC LAMINATION-LAM STYLOLITIC-STY	SLIGH VERY WITH

SAMPLE NUMBER	DEPTH FEET	PERMEABILITY MILLIDARCYS HORIZ. K_L	PERMEABILITY MILLIDARCYS VERT. K_L	POROSITY PER CENT	RESIDUAL SATURATION PER CENT PORE OIL	RESIDUAL SATURATION PER CENT PORE TOTAL WATER	SAMPLE DESCRIPTION AND REMARKS
A-4	3744	42 *	0.38	2.4			
DCA-1	4626	0.01	0.01	1.9			
M-1A	4686	0.01	0.01	1.6			

* DENOTES FRACTURE PERMEABILITY

POROSITY AND PERMEABILITY ONLY WITH VERTICAL PERMEABILITY

These analyses, opinons or interpretations are based on observations and materials supplied by the client to whom, and for whose exclusive and confiden this report is made. The interpretations or opinions expressed represent the best judgment of Core Laboratories, Inc. (all errors and omissions, excepte as to the productivity, proper ope Core Laboratories, Inc. and its officers and employees assume no responsibility and make no warranty or representations, is used or relied upon.

CA-20

CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS, TEXAS

Page No.

CORE ANALYSIS RESULTS

Company AMERICAN SMELTING & REFINING COMPANY
Formation
File RP-3-2528
Well
Core Type
Date Report 2-4-72
Field
Drilling Fluid
Analysts MOHL
County State Elev. Location

Lithological Abbreviations

SAND-SD	DOLOMITE-DOL	ANHYDRITE-ANHY	SANDY-SDY	FINE-FN	CRYSTALLINE-XLN	BROWN-BRN	FRACTURED-FRAC	SLIGHTLY-SL/
SHALE-SH	CHERT-CH	CONGLOMERATE-CONG	SHALY-SHY	MEDIUM-MED	GRAIN-GRN	GRAY-GY	LAMINATION-LAM	VERY-V/
LIME-LM	GYPSUM-GYP	FOSSILIFEROUS-FOSS	LIMY-LMY	COARSE-CSE	GRANULAR-GRNL	VUGGY-VGY	STYLOLITIC-STY	WITH-W/

SAMPLE NUMBER	DEPTH FEET	PERMEABILITY MILLIDARCYS HORIZ. K_L	PERMEABILITY MILLIDARCYS VERT. K_L	POROSITY PER CENT	RESIDUAL SATURATION PER CENT PORE OIL	RESIDUAL SATURATION PER CENT PORE TOTAL WATER	SAMPLE DESCRIPTION AND REMARKS
A-4	3744	42 *	0.38	2.4			
DCA-1	4626	0.01	0.01	1.9			
M-1A	4686	0.01	0.01	1.6			

* DENOTES FRACTURE PERMEABILITY

POROSITY AND PERMEABILITY ONLY WITH VERTICAL PERMEABILITY

These analyses, opinons or interpretations are based on observations and materials supplied by the client to whom, and for whose exclusive and confidential use, this report is made. The interpretations or opinions expressed represent the best judgment of Core Laboratories, Inc. (all errors and omissions excepted); but Core Laboratories, Inc. and its officers and employees, assume no responsibility and make no warranty or representations, as to the productivity, proper operations, or profitability of any oil, gas or other mineral well or sand in connection with which such report is used or relied upon.

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

February 7, 1972

Memorandum

TO: W. L. Kurtz

FROM: J. D. Sell

Permeability-Porosity Tests
Whitetail Conglomerate Samples
Superior East Project
Pinal County, Arizona

Three Whitetail Conglomerate samples have been submitted to Core Laboratories, Inc. under your cover letter of January 26, 1972. Sample numbers and descriptions follow:

DCA-1A, 4626 feet.

Matrix = 20%; clasts = 80% with median size of 0.2 inches.
Matrix is very fine fragmented limestone, quartzite, schist and rare diabase with very minor reddish-brown mud. Overall color is brownish grey.
Clasts range in size from 0.05" to 0.20" with few larger fragments up to 0.35". Clasts predominantly limestone with some quartzite and silicic limestone. Tight packing in general appearance.
Fine to coarse segregation suggests deposition with 65° inclination to core axis.

M-1A, 4686 feet.

Matrix = 20%; clasts = 80% with median size of 0.1 inch.
Matrix is dark muddy brown with abundant debris of schist and diabase.
Clasts are subangular to subrounded with median size of ± 0.1". No large fragment size. Clasts predominantly schist with diabase.
Possible rude sorting perpendicular to core axis.

A-4, 3744 feet.

Matrix = 60%; clasts = 40% with median size of 0.4 inches.
Matrix is dark muddy brown with abundant debris (-1/16" size) of diabase, quartzite, and schist.
Clasts are angular, show no preferred orientation, and are predominatly schist with subordinant diabase and quartzite. One large, 1/2" x 1-1/2", clast of schist surrounded by 1/4" zone of specularite crystals.
Relatively dense with unsorted material as general appearance.

James D. Sell

JDS:lad

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

February 11, 1972

Memorandum

TO: W. L. Kurtz

FROM: J. D. Sell

Core Lab Results
Permeability-Porosity Tests
Superior East Drill Core
Pinal County, Arizona

Results of the testing of core from the Whitetail conglomerate in drill holes DCA-1A, M-1A, and A-4 have been received and distributed to you and the project file. Your cover letter to Core Lab. was dated Janaury 26, 1972 and a description of the core was recorded in my file memorandum dated February 7, 1972.

I have not compared the results of these cores with other ASARCO core tested, but, as can be seen, the results are of interest. Hole DCA-1A and M-1A both are relatively non-mineral in character and the matrix-clast size was small (mainly less than 0.2 inches in particle diameter). The horizontal and vertical permeability of these specimens is 0.01 millidarcys and the porosity of DCA-1A = 1.9% and M-1A = 1.6%. Hole A-4 is considered to be a mineralized zone and the sample contained more matrix material and less clast material with the clasts having a median size of 0.4 inches. The vertical permeability of the sample equals 0.38 millidarcys (horizontal permeability was 42.0 but controlled by fractures and, hence, not representative) while the porosity = 2.4%.

Although the three samples are not representative of the entire basin, they do suggest increased permeability-porosity in the area of greatest mineralization in the Whitetail conglomerate.

James D. Sell

JDS:lad

JDS

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

February 17, 1972

TO: W. L. Kurtz

FROM: N. P. Whaley

SUPERIOR EAST PROJECT.
COMMENTS ON LABORATORY
DETERMINATIONS OF PERMEA-
BILITY AND POROSITY OF
SELECTED CORE SAMPLES OF
THE WHITETAIL CONGLOMERATE

Reference: Core Laboratories, Inc. report, File RP-3-2528, dated 2-4-72 (copies attached).

Their unit of permeability is the millidarcy and is symbolized as K_L (permeability-laboratory).

Basic definitions: Darcy. A standard unit of permeability. One darcy is equivalent to the passage of one cubic centimeter of fluid of one centipoise viscosity flowing in one second under a pressure differential of one atmosphere through a porous medium having an area of cross-section of one square centimeter and a length of one centimeter. A millidarcy is one one-thousandth. (Glossary of Geology and Related Sciences, A.G.I., Wash., D. C., 1957.)

For ground water or any solution with which we might be concerned, e.g., water-sulfuric acid, factors such as specific weight or dynamic viscosity can generally be ignored.

In the above referenced report Core Laboratories indicates the following values were found for three samples:

Sample No.	Permeability (millidarcys) Horiz K_L	Vert K_L	Porosity (%)
A-4	42*	0.38	2.4
DCA-1	0.01	0.01	1.9
M-1A	0.01	0.01	1.6

*Denotes fracture premeability.

Comparison of these values with the following table of average values of permeability for alluvial media will give you some basis for evaluation.

Class	Permeability (darcys)	Permeability (gpd/ft^2)
Gravel	10^3 - 10^5	10^4 - 10^6
Clean sands (good aquifers)	1 - 10^3	10 - 10^4
Clayey sands, fine sands (poor aquifers)	10^{-3} - 1	10^{-2} - 10

(Table modified from Hydrogeology, Davis & DeWiest, 1966, p. 164.)

In their recent report to this company ("preliminary Report on Hydrogeology of Poston Butte Area, and Relationship to Proposed In-Situ Leaching", Jan. 1972, p. 12), Halpenny and Greene suggest the following initial approximations for permeability for the three units comprising that aquifer system:

Unit	Horiz. Permeability (gpd/ft^2)	Vert. Permeability (gpd/ft^2)
Alluvium	1,000	50
Conglomerate	333	17
Bedrock	250	250

Ostensibly the values reported by Core Laboratories for the Whitetail conglomerate indicate a rather impermeable or "tight" medium, but in a partially indurated or indurated, anisotropic rock unit the permeability values derived from laboratory tests usually do not reflect the effective permeability of the unit considered as a whole.

The porosity values reported for these samples are within the range of most crystalline, intrusive-extrusive, or metamorphic rocks.

Actual field tests by withdrawal pumping or, considering the extremely low laboratory permeabilities of this case, by injection are the only meaningful approaches for estimated hydraulic conductivity within the unit.

N. P. Whaley

N. P. Whaley

NPW:sg
attach.

cc: JDSell

AMERICAN SMELTING AND REFINING COMPANY
ROCKY MOUNTAIN EXPLORATION DIVISION
1805 SOUTH BELLAIRE STREET. DENVER. COLORADO 80222

February 7, 1972

TELEPHONE 303-757-5107

Mr. J.J. Collins
Director of Exploration
ASARCO
120 Broadway
New York, New York 10005

Monthly Report
Stratiform Deposits
January, 1972

Dear Sir:

Land negotiations continued in the Truscott area of Texas, and it is anticipated that negotiations will be successfully concluded. Drilling should commence in February.

Dr. Krason spent a week in Arizona visiting mines and prospects, and spent one day looking at core from the Superior East project. At the end of the month Mr. Hoskins and myself made arrangements to inspect the same core.

It is clear that a major stratiform copper ore body of the first rank is indicated. The discovery hole is of major importance from the standpoint of stratiform theory, showing what appears megascopically to be native copper. In addition, stratiform ore bodies with vertical columns approaching 1000 feet imply at least some and probably substantial up dip, down dip, and lateral continuity. If lateral continuity is 500 feet in all directions away from the hole, some 80,000,000 tons are indicated. As native copper apparently exists in grades of up to .5% or better, up dip, about a mile and a half away, there are probably large tonnages of copper bearing rock.

The rocks should grind easily, recovery should be good, and producing a sulfur deficient product in this day of smelter problems and costs derived from excess sulfur, appears to have attraction.

We are impressed, and conclude that we should consider that conglomerates in any closed basin environment associated with volcanics, and/or sources of copper, deserve immediate attention as possible major stratiform copper ore hosts.

Mr. J.J. Collins February 7, 1972

The week of January 10-15 was spent in Missouri with Messrs. Hoskins and Beverly, in company with Mr. Vance Greene, examining core. The Kennecott Mine was also visited. Mr. Beverly has prepared a file memorandum listing observations made which should aid in awareness of significant features associated with ore deposition in dolomite.

The last of the month was spent at the Earth Resources copper mine at Cuba, New Mexico, with Messrs. Kurtz and Sell of Tucson. This mine is claimed to have 10,000,000 tons of copper ore. Whether or not such is in fact the case, it is an excellent example of stratiform copper sulfides and oxides in a limited erosional remnant of the host sandstones.

Very truly yours,

Stephen Von Fay

Stephen Von Fay

SVF/pn
cc: JHCourtright
bcc: JSell

1972

Proposed ASARCO Drill Holes & Cost.

Hole	Present Depth	Proposed Depth	Drilling - Casing - Cem, etc. foot - type	(days)	Cost $1500 ea/day mi, tam	Road-Site	Overhead @ $200
M-1	2402		0 - 1900 Td	3.500 (drilled)			
			1900 - 2900 Tew	8			
			2900 - 3300 ? Tw	5			
			3300 - ~~3500~~ 4400 Tgr & Sc.	4			
				17	26,000	—	
OF-1A	2150		0 - 1995 Td	6.500 (drilled)			
			1995 - 2050 - Intermediate casing	(drilled)			
			2050 - 2800 Tew	11			
			2800 - 3200 ? Tw	5			
			3200 - 3400 ? Paleozoic	4			
				20	30,000	1,000	
A-4	—		0 - 2000 Td	10			
			2000 - 3500 ? Tw	19			
			3500 - 5200 ? Pal	28			
				57	85,500	2,500	
A-5			0 - 1800 Td	9			
			1800 - 3200 ? Tw	18			
			3200 - 5000 ? Pal	30			
				57	85,500	2,500	
A-6			0 - 1500 ? Tew	8			
			1500 - 2000 ? Tw	8			
			2000 - 2500 ? Sc. Pal	8			
				24	36,000	5,000	
A-7			0 - 400 ? Td	2			
			400 - 1900 ? Tew	25			
			1900 - 3700 ? Tw	22			
			3700 - 4000 ? Sc/Pr	5			
				54	81,000	6,500	
A-8			0 - 1000 ? Td	5			
			1000 - 2200 ? Tew	20			
			2200 - 3700 ? Tw	20			
			3700 - 4000 ? Sc/Pr.	5			
				50	75,000	10,000	
			23,100 ft.	279 days			

1 day
Td 200'
Tew
Tw
Co 60'

$5000/mi road
Not incl Tax office

Over

							rodbolt
DCA-1	4011	4011 - 5011 (1000')	4+ 17 days	$31,500	—		
DCA-2	1772	1772 - 2272 (500')	2+ 9 days	16,500	—		
DCA-3	3000	3000 - 4000 (1000')	3+ 17 days	30,000	—		
A-1	—	0 - 1300 Td 1300 - 2300 SC	7 17 24	36,000	3000		8 months hire @ $200/mo ≅ 42,000 office & field opp
A-2	—	0 - 2300 Td 2300 - 4100 Tw 4100 - 5750 Rbl	12 23 28 63	94,500	5,000		
A-3	—	0 - 1200 Td 1201 - 3500 Tw 3500 - 4000 SC/Rbl	4 29 17 52	78,000	1500		overhead of $21/ft ≅ 75,000
		37,600 ft.	470 days	705,000	37,000		

drill + rod + overhead + 10% ≅ 882,000

May 24-27 1972
Tokyo

Format
July 5, 1971

Manuscript
Oct 1 1971

DCA-1 1800 +

DCA-3 600 +

I-4 2000 +

I-1 1800

DC-1 1100 +

92,800
75,000
167,800

Road				TD	Drill
2000	A-2 & A-3	A	[12,800]		
NONE	M-1	C	40,500	4400	2000 —
[illegible]000	A-1	C	46,000	2300	2300
1000	DCA-3	C	45,000	4500	1500 —
1500	A-4	A	80,000	4000	4000
7500			224,300	15,200	9800
			7500		
			20,000		
			251,800		
Logging			5000		
			256,000		30,000
Conting.			4000		
			260,000		

20
7
20
228
32
260

Drill Hole	Present Depth	Rock Type	Estimated Work Cost: Clean Out footage	Clean Out Cost	Rotary foot.	Rotary Cost	Casing foot.	Casing Cost	Coring foot.	Coring Cost	Est Drilling Cost	Mobil system	Road work	Est. Total Depth	Target	Claim Group	Area Ship	
+ M-1	2402	Ter basalt	—	500	—	—	—	—	1500	30,000	30,500	500	—	3900'	Proj. edge of intrusive	N	C	4" OD casing set to bottom; ready to core.
+ A-1	—	Dacite	—	—	1300	23,400	1300	2,600	1000	20,000	46,000	500	yes	2300'	Exotic copper in thrust plate plus potential source.	N	C	Need short road plus site area.
DCA-2	1772	pE Schist	1772	5,400	—	—	1772	3,600	500	10,000	19,000	—	—	2272'	Exotic copper in thrust plate plus edge of intrusive	N	C	5 7/8" hole, 30 ft of surface casing
+ DCA-3	3000	Whitetail Cgl.	3000	9,000	—	—	3000	6,000	1000	20,000	35,000	—	—	4000'	Central area of intrusive in down-faulted block.	S	C	5 7/8" hole; no casing
A-2	—	Dacite	—	—	2300	41,400	2300	4,600	3200	64,000	110,000	500	yes	5500'	Northern Paleozoic block along South edge projection	~~State~~ + S	A	Need 1-1½ mile of road plus site area
A-3	—	Dacite	—	—	400	7,200	400	800	—	—	8,000	500	yes	ultimately 4000	Southern edge of seismic high	~~State~~ + S	A	Need road clean up plus site area.
OF-1A	2150	Ter basalt	2150	4500	—	—	2150	6,300	1000	20,000	32,800	—	yes	3150'	Proj. nose area of intrusive	N	C	no info on hole status
A-4	—	Dacite	—	—	2000	36,000	2000	4,000	3200	64,000	104,000	—	plays	5200'	Proj. of nose area plus paleozoics	S	A	Need minor road work plus site area
A-5	—	Dacite	—	—	1800	32,400	1800	3,600	3200	64,000	100,000	—	plays	5000'	Paleozoics along east Magma trend.	N	A	Need minor road work plus site area.
DCA-1	4011	Whitetail Cgl.	4011	12,000	—	—	4011	8,000	1000	20,000	40,000	—	—	5011'	Satellite porphyry trend	I C	C	Hole (9") capped - No info on condition.
A-6	—	Ter rhyolites	—	—	1500	27,000	1500	3,000	1000	20,000	50,000	—	yes	2500'	Thrust slide area source	N	A	Need rehab drill road plus more geol.
A-7	—	Dacite	—	—	1900	34,200	1900	3,800	2100	42,000	80,000	—	yes	4000'	Satellite trend zone.	N	A	Need 1-1½ mile road work plus site area
A-8	—	Dacite	—	—	2200	39,600	2200	4,400	1800	36,000	80,000	—	yes	4000'	Pesc-Tgr edge zone	N	C	Need 1-1½ mile road work plus site area.
											745,300		37,000		overhead = 40,000			N Group: 503 claims = $50,300
											less 25% = 563							S Group: 169 claims + 2 lease = 16,900 + 12,400 = $29,300
															drill + road + over = 926,000	10%		Claims: $79,600 per year

Est. base:
$3.00/ft cleanout
$2.00/ft casing
$18.00/ft rotary drilling
$20.00/ft coring

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

January 13, 1972

TO: J. D. Sell

FROM: R. B. Cummings

Drill Hole A-4
Core Drilling Cost Summary
Superior East Project
Pinal County, Arizona

Core drilling was initiated by Boyles Brothers Drilling Co. on August 17, 1971. A CP-50 core rig was used. The hole was cased to a depth of 3593' with 4" casing. Coring started at this point and was terminated at 6664' on November 4, 1971. The total footage cored was 3071'. All of this footage was drilled with NX bits.

Reports on the rotary drilling costs and the daily drill data for both rotary and the daily drill data for both rotary and core drilling have been submitted.

Costs have been computed for the coring on Hole A-4 through the November account. Only minor costs are expected to be added. A core drilling cost breakdown follows:

	Cost	$/ft
a. Direct Drilling	$ 95,638.17	$31.14
b. Site Preparation	84.00	.03
c. Sampling	1,554.75	.51
d. Supervision	5,122.20	1.67
Total	$102,399.12	$33.35

Note: Explanation of cost categories can be found in my report on Drill Hole Summaries dated October 1, 1971.

Drilling mud and additive cost (included in direct drilling cost) was $3,727.17 or $1.21/foot.

The total cost of Hole A-4 (rotary and core drilling) is tabulated below.

	Rotary		Core		Total	
	Cost	$/ft	Cost	$/ft	Cost	$/ft
a. Direct Drilling	$67,845.78	$18.88	$ 95,638.17	$31.14	$163,483.95	$24.53
b. Site Preparation	2,873.29	.80	84.00	.03	2,957.29	.44
c. Sampling	3,756.95	1.05	1,554.75	.51	5,311.70	.80
d. Supervision	5,105.73	1.42	5,122.20	1.67	10,227.93	1.53
Totals	$79,581.75	$22.15	$102,399.12	$33.35	$181,980.87	$27.30

Upon completion of drilling operations, the Salt Lake City office placed two geophysical electrodes in the hole. One electrode is on the bottom of the hole and the other is positioned just beneath the bottom of the 4" casing (3593').
The hole is now capped awaiting geophysical testing.

R. B. Cummings
R. B. Cummings /lad

RBC:lad

TAB

A-2

WLK

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

March 27, 1972

TO: J. D. Sell

FROM: R. B. Cummings

DAILY DRILL DATA
DRILL HOLE A-2
ROTARY DRILLING
SUPERIOR EAST PROJECT
PINAL COUNTY, ARIZONA

Mayhew 3000

Attached is a daily log of the rotary drilling on drill hole A-2. The information shown is the date, depth at the end of the day, footage drilled during the day, number of hours charged to drilling, and number of shifts involved, explanation of delays, size of the hole, and geologic formation.

Compiled from this data is a breakdown of the shifts and footage by a) 1000' depth increments, b) bit size, and c) geologic unit.

R. B. Cummings

R. B. Cummings

RBC:sg
attach.

DRILL HOLE [illegible]2 - ROTARY
SUPERIOR EAST PROJECT

DATE	DEPTH AT END OF DAY	FOOTAGE	DRILLING HOURS	DRILLING SHIFTS	DELAYS	HOLE SIZE	FORMATION
Jan. 12, 1972	0	-	-	-	Setting up	15"	Dacite
13	21	21	11	2	Wait on surface cement.	21'	
14	246	225	17	3	" " " " Set up.		
15	723	477	24	3			
16	1055	332	24	3	Bit change	8-3/4"	
17	1318	263	23	3	1 hr. equip. repair, bit change.		1330'
18	1486	168	15	3	Bit change. 9 hrs. wait on drill pipe.		Early Volcanics
19	1748	262	24	3			
20	1863	115	13	3	Bit change. 11 hrs. casing		
21	1863	0	0	3	Wait on H_2O, pull casing	1863'	
22	1863	0	0	3	Laying down casing. Clean hole.		
23	1863	0	0	3	Cleaned hole, ran casing, cement.		
24	1863	0	0	3	Wait on cement, trip to bottom.		
25	2004	141	19	3	4 hrs. drilling plug, 1 hr. equipt repair.		2020' Whitetail Mudstone
26	2422	418	24	3	Bit change		
27	2574	152	8	3	16 hrs. coring.		
28	2878	304	19	3	5 hrs. reaming hole.	6-1/4"	2810' Whitetail Cgl.
29	3370	492	24	3	Bit change.		
30	3550	11	24	3	13 hrs. coring		
31	-	-	-	-	-		

DRILL HOLE A-2 - ROTARY
SUPERIOR EAST PROJECT

DATE	DEPTH AT END OF DAY	FOOTAGE	DRILLING HOURS	DRILLING SHIFTS	DELAYS	HOLE SIZE	FORMATION
Feb. 1	-	-	-	-	-		
2	-	-	-	-	-		
3	-	-	-	-	-		
4	-	-	-	-	-		
5	3592	42	15	2	1 hr. reaming. Picking up 2-7/8" drill pipe.		
6	4006	414	24	3			3920' Qtz. Monzonite
7	4076	70	8	3	15 hr. coring, 1 hr. equipt. repair		4076'
8	4076	0	0	0	Wait on casing and prepare to case	4076'	

NOTE: Hole A-2 was drilled with a Mayhew-3000 using high pressure air.

DRILL HOLE A-2 - ROTARY
SUPERIOR EAST PROJECT

Drilling time by depth brackets, including down time.

DEPTH	SIZE	SHIFTS	DAYS	FOOTAGE	FT./SHIFT	DELAYS
0-1055	15" & 8-3/4"	11	4	1055	95.9	
1055-2004	8-3/4"&6-1/4"	27	9	949	35.1	Casing - 14 shifts. Minor parts delay.
2004-3035	6-1/4"	10-1/2	3.5	1031	98.2	Spot core.
3035-4076	6-1/4"	12-1/2	9.5	1041	83.3	Spot core
0-4076		61	26	4076	66.8	

Drilling time by bit size, including down time.

BIT SIZE	DEPTH	SHIFTS TO DEPTH		FOOTAGE	FT./SHIFT
15" & 8-3/4"	0-1863	27.5	1863	1863	67.7
6-1/4"	1863-4076	33.5	4076	2213	66.1

Note: installation of 7" casing required 14 shifts. These were divided evenly between the 8-3/4" and the 6-1/4" bit size.

Drilling time by rock unit.

ROCK UNIT	DEPTH	SHIFTS TO DEPTH		FOOTAGE	FT./SHIFT
Dacite	0-1330	14	1318	1318	94.1
Early Volcanics*	1330-2020	24	2004	686	28.6*
Whitetail-Mudstone	2020-2810	9	2878	874	97.1
Whitetail-cgl.	2810-3920	10	3902	1024	102.4
Quartz-Monzonite	3920-4076	4	4076	174	43.5
	0-4076	61	4076	4076	66.8

*Note: 14 shifts were spent in setting 7" casing. All of this time is recorded under Early Volcanics. If this time is eliminated, the FT./SHIFT for the Early Volcanics is 68.6 ft.

TAB

A-2

Drill Performance

W. L. K.
MAY 25 1972

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

May 18, 1972

TO: W. L. Kurtz

FROM: J. D. Sell

Daily Drill Data
Drill Hole A-2
Diamond Core Drilling
Longyear - TRK Mounted 44
Superior East Project
Pinal County, Arizona

Attached is a daily log of the coring on drill hole A-2. The information shown is the date, depth of hole at end of day, the footage cut during the day, the hours charged to drilling, the number of shifts involved, short comments on the delays involved, the size of core, the geologic units and contact footages.

Compiled from this daily data is a breakdown of the shifts and footage by a) depth bracket based on Longyear's footage rate contract, and b) by geologic units encountered.

James D. Sell

James D. Sell

JDS:lad
Attach.

cc: HLCrittendon

DRILL HOLE A-2 CORING
LONGYEAR TRK-44

DATE	DEPTH AT END OF DAY	FOOTAGE	DRILLING HOURS	DRILLING SHIFTS	DELAYS	FORMATION
1972 Feb. 21-24	4078			11	Setting up; making up drill string; drilling out plug and cave to 4078.	
25-29	4079			12	Cemented; drilling out cement to 4079.	
March 1-3	4079			8	Stuck rods and core tube, recovered them, cemented, drilled back down.	NQ Wireline 4079
4	4107	28	22	3	Mixed mud.	
5	--	--	--	--		
6	4138	31	16	3	Tripping; bit change (59').	p€pi cut by dikes and masses of Tqm
7	4185	47	14	3	Rods; equip. repair.	
8	4231	46	24	3		
9	4291	60	24	3	Bit change (153').	4288-4295 fault.
10	4314	23	8	3	Tripping.	Tqm 4321
11	4352	38	22	3	Equip. repair.	
12	--	--	--	--		
13	4364	12	9	3	Tripping; bit change (73').	
14	4409	45	23	3		
15	4433	24	16	3	Tripping; bit change (69').	p€pi with minor Tqm
16	4463	30	16	3	Tripping.	
17	4513	50	24	3		

18	4521	8	4	3	Shiv wheel broke; repair; rods stuck.	↓ 4521
19	--	--	--	--		
20-31	4521	--	--	16-1/2	Attempt to recover rods and core. Hole abandoned.	
April 1-17	4230	--	--	17-1/2	Lost core barrel, 8 ft. of core, and 265 feet of NQ rods. Whipstock (wedge) installed.	

DRILL HOLE A-2, CORING

Drilling Time, by footage brackets, including down time.

Depth	Size	Shifts	Days	Footage	Ft/Shift	Troubles
4079-4513	NQ(NX)	36	12	434	12.1	4 bit changes; equip. repair.
4513-4521	NQ(NX)	3	1	8	2.7	Broke shiv wheel; rods stuck and lost.
Totals		39	13	442	11.3 average	

Rock Unit	Interval	Size	Shifts	to Depth	Footage	Ft/Shift
Quartz Monzonite (62%) and Pinal Schist (38%) Mixed	4079-4352	NQ(NX)	21	4352	273	13.0
Schist (93%) and Quartz Monzonite (7%) Mixed	4352-4513	NQ(NX)	15	4513	161	10.7
Unknown (Not Recovered)	4513-4521	NQ(NX)	3	4521	8	2.7
Totals			39		442	11.3 average

TAB

A-2W

W. L. K.
MAY 25 1972

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

May 23, 1972

TO: W. L. Kurtz

FROM: J. D. Sell

Daily Drill Data
Drill Hole A-2W (Wedge)
Diamond Core Drilling
Longyear - TRK Mounted 44
Superior East Project
Pinal County, Arizona

Attached is a daily log of the coring on drill hole A-2W. This is a wedged hole taking off from the original hole A-2 at a depth of 4230 feet. The same crews worked both A-2 and A-2W. The information shown is the date, depth of hole at the end of the day, the footage cut during the day, the hours charged to drilling, the number of shifts involved, short comments on the delays involved, the size of the core, the geologic units and contact footages.

Compiled from this daily data is a breakdown of the shifts and footage by a) depth bracket based on Longyear's footage rate contract, and b) by geologic units encountered.

James D. Sell

James D. Sell

JDS:lad
Attach.
cc: HLCrittendon

DRILL HOLE A-2W (WHIPSTOCK WEDGE)
Longyear, Truck Mounted 44

DATE	DEPTH AT END OF DAY	FOOTAGE	DRILLING HOURS	DRILLING SHIFTS	DELAYS	FORMATION
1972 April 18	4230	--	--	2	Drilling out of whipstock.	NQ Wireline 4230 p€pi cut by dike & masses of Tqm
19	4236	6	4	3	Change to coring bit.	
20	4295	59	24	3		4276-4289 Fault
21	4327	32	13	2	Tripping; bit change (97').	Tqm
22	4335	8	9	2	Tripping; bit change (8')	4320
23	--	--	--	-		
24	4373	38	16	3		
25	4391	18	9	3	Tripping; bit change (47'); survey	
26	4415	24	11	3	Survey; tripping; bit change (33')	p€pi with dike and masses of Tqm
27	4465	50	20	3	Tripping.	
28	4514	49	24	3		
29	4526	12	5	3	Tripping; bit change (104').	
30	--	--	--	-		
May 1	4569	43	22	3	Tripping; bit change (50').	
2	4600	31	14-1/2	3		
3	4617	17	12	3	Tripping; bit change (40').	4613-4622 Fault

4	4641	24	12	3	Tripping; bit change (32').
5	4701	60	24	3	
6	4717	16	9	3	Tripping; bit change (67').
7	--	--	--	-	
8	4726	9	6	3	Tripping; bit change (9'); equip. repair.
9	4747	21	13	3	Tripping; bit change (21').
10	4778	31	16	3	Tripping; bit change (40').
11	4817	39	21	3	Rig repair.
12	4865	48	24	3	
13	4875	10	1-1/2	2	Tripping; bit change (97').
14	--	--	--	-	
15	4877	2	1	3	Tripping; added new light-weight rods (1000').
16	4895	18	8	3	Split pipe; tripping; recovered rods.
17	4940	45	20-1/2	3	Stuck rods.
18	4940	--	--	3	Stuck rods; hole abandoned. 818 feet of NQ(NX) rods and core barrel lost.

p€pi cut by dikes and masses of Tqm

4940

DRILL HOLE A-2W, CORING

Drilling time, by footage brackets, including down time.

DEPTH	SIZE	SHIFTS	DAYS	FOOTAGE	FT/SHIFT	TROUBLES
4230-4514	NQ(NX)	25	9	284	11.4	4 bit changes.
4514-4940	NQ(NX)	47	16	426	9.1	8 bit changes; equip. repair; stuck rods. Lost core barrel and 818 feet of rods.
Totals		72	25	710	9.9 average	

ROCK UNIT	INTERVAL	SHIFTS TO DEPTH		FOOTAGE	FT/SHIFT
Q. Monzonite 74%, P. Schist 26%	4230-4327	8	4327	97	12.1
P. Schist 89%, Q. Monzonite 11%	4327-4465	14	4465	138	9.9
P. Schist 53%, Q.Monzonite 47%	4465-4569	9	4569	104	11.6
P. Schist 82%, Q.Monzonite 18%	4569-4865	30	4765	296	9.9
Q. Monzonite 73%, P. Schist 27%	4865-4940	11	4940	75	6.8
Totals		72		710	9.9 average

AH-1 3539 - 3678 Me
- 3863 Dm

upper shale 3678 - 3723
upper lms 3723 - 3774
Glitts 3774 - 3787
lower lms 3787 - 3826
basal cgl 3826 - 3863 TD (twisted off)

TAB

1971-1972 Rpt.

Shasta Royal Inn
PO Box 567
Mt. Shasta,
Calif. 96067

~~[illegible]~~

ASARCO
c/o Shasta Royal Inn
916-235-4811

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

May 30, 1972

TO: J. D. Sell

FROM: R. B. Cummings

DRILL HOLE GEOLOGY
1971 and 1972
SUPERIOR EAST PROJECT
PINAL COUNTY, ARIZONA

From April, 1971 through March, 1972, I was in charge of the dav to day operations of the drilling and sampling on the Superior East Project. A number of reports on drill hole costs, drilling performance, and drill hole assays have been submitted and may be found in the files. Following is my report on the geology of the drill holes.

Robert B Cummings

RBC:sg

Drill Hole Geology

1971-1972

Superior East Project

Robert B. Cummings

TEXT

SUMMARY 1

INTRODUCTION 1

GEOLOGY OF DRILL HOLES

Summary 4

Drill Hole DCA-1A 4

Drill Hole A-1 5

Drill Hole M-1A 5

Drill Hole A-2 5

Drill Hole A-5 5

Drill Hole A-4 5

GEOLOGY OF ROCK UNITS

Precambrian Pend Schist 6

Precambrian Troy Quartzite 6

Devonian Martin Limestone 7

Mississippian Escabrosa Limestone 7

Pennsylvanian Naco Limestone 8

Permian Supai Formation 8

Tertiary Quartz Monzonite 8

Tertiary Whitetail Conglomerate

General 10

Lower Member 11

Upper Member 17

Tertiary Earlier Volcanics 18

Tertiary Dacite 18
STRUCTURE 19
ALTERATION AND MINERALIZATION 23
Bedded Replacement Mineralization. 23
Porphyry Copper Mineralization 24
Exotic Copper Mineralization. 28
EXPLORATION POSSIBILITIES 30
RECOMMENDATIONS 31

ILLUSTRATIONS

Figures:
1. Location of Drill Holes pg 2
2. General Geology of Each Drill Hole. 3
Appendix: ~~following text~~
1. Detailed Geology log of Each Drill Hole.
Log 1.
Log 2
Log 3
Log 4
Log 5
Log 6
Attachment: Following text
1. Plan Map of Geology
2. Sections
3 Sections
4 Sections 2-2'

DRILL HOLE GEOLOGY
1971 - 1972
SUPERIOR EAST PROJECT

Robert B. Cummings

SUMMARY

The subject area is located in Pinal county, Arizona between the porphyry copper deposits of the Globe-Miami district and the bedded replacement deposits of the Superior district. The pre-mineral geology of the Superior East area is covered by a thick post-mineral sequence of Tertiary conglomerate and volcanic rocks. Just east of the subject area, the southwesterly trending Laramide Schultze Granite goes under the volcanic cover to the southwest. The Schultze Granite and associated porphyritic intrusives are responsible for the porphyry copper mineralization in the Globe-Miami district. The primary object of the drilling in the Superior East Project is to test the covered extension of Schultze Granite for porphyry copper mineralization.

The important findings developed in the drilling at Superior East are as follows:

1. The northwest contact of the main Schultze Granite mass was interpreted with increased certainty.

2. Detailed knowledge of the structural history of the covered area and its significance in the search for ore deposits in the area was gained.

3. Strong exotic copper mineralization was located in the deepest portion of the Whitetail conglomerate.

4. Three widely spaced drill holes were found to contain porphyry copper alteration and mineralization varying from what might be expected on the fringe of a deposit to that which might occur within the ore zone.

In regard to the last finding, one drill hole penetrated leached capping which is interpreted to represent the oxidation of a chalcocite blanket. This occurrence is a gravity slide block which was moved laterally to its present position. Three drill holes are recommended to search for the major portion of the chalcocite blanket.

INTRODUCTION

The objective of the Superior East Project is to test for concealed mineralization between the Miami and the Superior districts. The prime target is possible porphyry copper-type mineralization in the western extension of the Schultze Granite and associated porphyries.

To date, six holes have been drilled or deepened and five pre-mineral penetrations have been made. The sixth hole is cased and ready for coring to pre-mineral bedrock. Figure 1 shows the location of the drill holes. Figure 2 shows the general geology of each drill hole.

GEOLOGY OF DRILL HOLES

SUMMARY

The geology of the Miami and Superior districts has been described in detail. Good detailed descriptions of the rock units can be found in USGS Professional Paper 342, "Geology and Ore Deposits of the Globe-Miami District, Arizona", by N. P. Peterson, (1962). The oldest pre-mineral rocks in the general project area are early Precambrian Pinal schist and late Precambrian Apache group sediments. Late Precambrian diabase intruded the older rocks and a thick sequence of Paleozoic sediments was deposited. All rocks were later intruded by Laramide granitic rocks which were accompanied by large scale copper mineralization. Later faulting occurred which formed a basin into which the Tertiary Whitetail conglomerate was deposited. The basin was gradually filled and was eventually completely destroyed by two separate stages of Tertiary volcanism (Tertiary earlier volcanics and Tertiary dacite).

A detailed geology log of each drill hole can be found in Appendix 1. In order to facilitate the understanding of the overall geologic picture, a brief summary of the geology of each drill hole (with the sea level elevation of the pre-mineral bedrock contact) is found below and is followed by a more detailed description of each geologic unit.

Drill Hole DCA-1A

DCA-1A penetrated 550 feet of Tertiary dacite and thick sections of Tertiary earlier volcanics (1660') and Tertiary Whitetail conglomerate (2459'). Note: Unless otherwise stated, thickness refers to vertical thickness and dips in drill holes are relative to the hole. The Whitetail conglomerate dips 20-30° in the lower portions. (ASARCO re-entered the hole at a depth of 4002 feet and the geology above that point is known only through pre-existing logs.) Pre-mineral bedrock was penetrated at a depth of 4669 feet (+91' above sea level). The pre-mineral penetration found a normal sequence of Paleozoic sediments (Pennsylvanian Naco Limestone, Mississippian Escabrosa Limestone, and Devonian Martin Limestone) underlain by Precambrian Troy quartzite. All sediments dip 30-45°. The total thickness (vertical) of sediments penetrated was 1144 feet. Numerous beds with replacement textures were found in the limestones.

Drill Hole A-1

A-1 cut 1374 feet of Tertiary dacite and went directly into a post-mineral breccia similar to the Cactus breccia at an elevation of +3346 feet above sea level. The Cactus breccia is in the form of a slide block 198 feet thick. Below this slide block, 39 feet of lithic tuff representing the Whitetail conglomerate was found underlain by 6 more feet of Cactus breccia. Below the second structural block, a moderately dipping fault zone was found. Beneath this fault zone, shattered Precambrian Pinal Schist was penetrated from 1585 to 2129 feet. Traces of oxidized copper minerals were found in the Cactus breccia. Up to 2% (by volume) pyrite with traces of chalcopyrite were found in the schist.

Drill Hole M-1A

M-1A penetrated 1900 feet of dacite, 528 feet of earlier volcanics, and 2470 feet of Whitetail conglomerate (including a slide block of Laramide quartz monzonite, 188 feet thick). The pre-mineral bedrock contact was found at a depth of 4898 feet (-398' below sea level). The pre-mineral rocks are gently dipping Permian Supai formation and Pennsylvanian Naco Limestone. A total of 414 feet of the sediments were penetrated. Minor amounts of exotic native copper mineralization were found in the Whitetail.

Drill Hole A-2

A-2 cut 1330 feet of dacite, 690 feet of earlier volcanics, and 1900 feet of Whitetail conglomerate before Laramide quartz monzonite was penetrated at a depth of 3920 feet (+420' above sea level). The quartz monzonite, with numerous schist inclusions, is found to a depth of 4288 feet. A flat fault was cut from 4288-4295 feet. Below this zone, Precambrian Pinal Schist was found with minor dikes of quartz monzonite. Trace amounts of exotic native copper and oxidized copper minerals were found in the Whitetail. Both quartz monzonite and schist are altered and contain mineralization in the form of pyrite, chalcocite and bornite.

Drill Hole A-5

A-5 intersected 2274 feet of dacite, 326 feet of earlier volcanics, and 545 feet of Whitetail conglomerate. The hole bottomed in Whitetail at a depth of 3145 feet and is ready for coring. Sparce amounts of native copper were found in the Whitetail.

Drill Hole A-4

A-4 penetrated 1975 feet of dacite, 158 feet of earlier volcanics, and 4160 feet of Whitetail conglomerate before entering a slide block of Mississippian Escabrosa limestone which was 109 feet thick. Beneath the slide block, 36 feet of Whitetail conglomerate was cut. The Whitetail-bedrock contact was found at a depth of 6484 feet (-2384' below sea level). The pre-mineral bedrock is altered and replaced limestone of

probable Mississippian age. The Mississippian Escabrosa limestone persists to a depth of 6563 feet where it is cut by a moderately dipping fault zone. Beneath the fault zone, from 6580 feet to the bottom of the hole at 6664 feet, the rock is Laramide quartz monzonite porphyry with included Precambrian Pinal Schist. Strong exotic mineralization in the form of native copper and lesser amounts of cuprite and chrysocolla are found in the Whitetail conglomerate and limestone slide block. The quartz monzonite porphyry and included schist are weakly altered and mineralized with pyrite, chalcopyrite, and molybdenite.

GEOLOGY OF ROCK UNITS

Precambrian Pinal Schist

Pinal schist is found in holes A-1, A-2 and A-4. Hole A-1 penetrated 557 feet of Pinal schist and bottomed in it. The schist in A-1 is of two varieties: quartz-sericite schist and quartz-sericite-chlorite schist. Both types are fine-grained, but the latter type is often slightly coarser in grain size and somewhat gneissic in nature. The quartz sericite variety is light gray in color, usually poorly foliated and contains less than 10% chlorite and biotite. The quartz-sericite-chlorite schist is gray to dark gray, has well developed schistosity and contains more than 20% chlorite and some biotite. Both types contain disseminated magnetite and white quartz bands and veinlets are common in both. Schistosity varies from 30°-90° but is usually 60°-90°.

The Pinal schist in hole A-2 occurs as inclusions in Tertiary (?) quartz monzonite above a flat fault and as a large mass intruded by quartz monzonite below the flat fault. The schist in A-2 is altered to such an extent that the original nature of the rock is in doubt. The rock is light gray in color and consists of about 60% quartz, 30% biotite, and 10% chlorite and sericite. Originally it was probably a quartz-biotite schist. Schistosity is less than 20° above the flat fault (4288'-4295') and from 45°-90° below the fault. In hole A-4, Pinal schist is found as a roof pendant in and intruded by quartz monzonite porphyry. The rock is gray in color, fine-grained and is a quartz-biotite-chlorite-sericite schist with schistosity from 40°-60°. This rock was probably similar to the original schist in A-2.

Precambrian Troy Quartzite

The only hole to cut Troy quartzite was DCA-1A. It penetrated a stratigraphic thickness of 34 feet and was terminated in Troy. The unit is variable in nature and includes (in order of decreasing abundance) argillaceous sandstone, argillaceous quartzite, pure quartzite, and sandy mudstone. Thin pebbly layers are often interbedded with the argillaceous sandstone, argillaceous quartzite and quartzite. The rocks usually have a reddish colored argillaceous cement with some detrital hematite and magnetite. Some crossbedding is present but the formation dips an average of 40°.

Devonian Martin Limestone

A true thickness of about 275 feet of Martin Limestone was cut in hole DCA-1A. The base of the unit is marked by a distinctive brown pebble conglomerate which is 9 feet thick. Above the conglomerate, the lower half of the unit is dolomitic limestone with some sandy and shaly portions. The sandy portions are more common toward the base. The upper half of the unit consists mostly of shaly limestone with some limestone and 9 feet of greenish gray to maroon limy shale at the top of the unit. Fossiliferous zones are common in the upper half of the unit. Minor slump brecciation is also present. Numerous beds showing replacement textures are found in the dolomitic limestones. Bedding varies from 20° to 30° and averages about 30°.

In hole A-4, two intersections of altered and brecciated Escabrosa limestone contain beds which bear a certain resemblence to the lower part of the Martin. These intervals may be siltstone, silty limestone or silicified limestone. The rocks in question occur at depths of 6438-6448 feet and 6539-6563 feet. They were logged as Escabrosa limestone because of the nature of the surrounding carbonate rocks but it is also possible that they may represent sandy portions of the Martin limestone.

Mississippian Escabrosa Limestone

A true thickness of 395 feet of Escabrosa limestone was cut in hole DCA-1A. The unit is mainly light gray to gray, fine-grained, massive limestone and dolomitic limestone. Thin chert beds, slump breccias and light greenish clay seams are common. A strong oolitic zone (32 feet in thickness) was found 145 feet from the base. Several beds with replacement textures were found.

Two intersections of Escabrosa were made in hole A-4. One of these occurrences was a slide block with a vertical thickness of 109 feet. The limestone in this block is brecciated and mineralized and closely resembles the Escabrosa from DCA-1A. It is light to dark gray, fine to medium grained, and dolomitic in spots. An oolitic bed was found from 6398 feet to 6408 feet and light greenish clay is common. Two features of this intersection do not correlate with the Escabrosa from hole DCA-1A. These are a ten foot thick shale bed found from 6386-6396 feet and a limy siltstone, which resembles the lower part of the Martin limestone, found from 6438-6448 feet.

The second intersection of Escabrosa limestone in A-4 is found from 6484 feet to 6563 feet. It is massively replaced by hematite and is strongly silicified and fractured. Bedding is approximately 20°. The true thickness is 74 feet but the unit is bottomed by faulting.

Pennsylvanian Naco Limestone

Naco limestone is found in drill holes DCA-1A and M-1A. A true thickness of about 250 feet was found in DCA-1A. The base of the formation was not reached in M-1A but a true thickness of at least 200 feet was penetrated. The base of the formation as seen in hole DCA-1A is a regolith seven feet in thickness. The regolith consists of chert clasts (weathered from the Escabrosa limestone) in a brown shaly matrix. Above the basal unit in DCA-1A, a true thickness of 90 feet of interbedded shale and slump brecciated limestone was found. The shale is dark brown to reddish brown and contains knobby clasts of limestone and masses of clay. The limestone is light gray to gray, fine-grained, somewhat shaly and contains nodules and thin beds of chert. Minor faulting in this zone has probably duplicated and/or cut out part of the section. The rest of the Naco (about 150 feet in true thickness) in DCA-1A and the Naco from M-1A are very similar. In both holes, the limestone is generally light gray to buff colored, fine-grained, and shaly or muddy. Thin shale beds are found as are wispy mud seams. In general, the limestone in M-1A is more shaly than in hole DCA-1A. Slump brecciation and chert beds and nodules are common. Fusilinids are common in DCA-1A. Greenish clay seams, similar to those from the Escabrosa in holes DCA-1A and A-4, are found in the Naco in hole M-1A but not in hole DCA-1A. In hole M-1A bedding varies from 10° to 40° and averages about 20°. In hole DCA-1A, the bedding varies from 30°-45° in the upper part of the Naco and from 50°-55° in the lower, shaly portion.

Permian Supai Formation

A true thickness of about 180 feet of the Supai formation was penetrated in hole M-1A. The base of the formation is marked by a four foot thick reddish muddy soil regolith with some limestone clasts. Above this unit is a 15 foot conglomerate with a reddish, limy, muddy matrix and abundant (55% by volume) limestone clasts. The remainder of the Supai consists of limy mudstone, fine-grained lithic sandstone and sandy mudstone. All rocks are generally reddish brown in color. Lithic clasts of limestone and minor diabase and quartzite are common especially near the base. Bedding is 30°.

Tertiary Quartz Monzonite

Laramide quartz monzonite and quartz monzonite porphyry were found in holes M-1A, A-2 and A-4. The quartz monzonite in M-1A does not occur as bedrock but as a slide block (188 feet in thickness) in the upper part of the Whitetail conglomerate. In hole A-2, quartz monzonite is found as an irregular mass with inclusions of schist and as intruding bodies within the Pinal Schist. Quartz monzonite porphyry in hole A-4 occurs as thin dikes in Pinal Schist and as a mass of undetermined size.

The quartz monzonite in M-1A is pink to light gray in color, medium-grained, and slightly prophyritic. It is composed of 55% plagioclase, 20% orthoclase (some as phenocrysts up to 3 cm. in length), 20% quartz (a portion of which occurs as quartz eyes up to 8 mm. in diameter), and 5% shreddy biotite. A potassium-argon age date on the biotites from this quartz monzonite gave a date of 59.9 ± 2.2 million years. This complete intersection of quartz monzonite (188 feet in thickness from 2920 feet in depth to 3107.5 feet) is tectonically brecciated. The strongest brecciation occurs at the base and the top of the slide block. The basal 39 feet of the slide block is sheared as well as brecciated. Breccia clasts are sub-rounded to sub-angular and show effects of rotation. The matrix of the breccia is mainly crushed quartz monzonite and is gradational with the clasts. The remainder of the breccia contains angular clasts with many open cavities and a gritty matrix of crushed quartz monzonite. Weak argillic alteration of plagioclase was found with traces of limonite after pyrite and sparce amounts of native copper.

In hole A-2, the top of the quartz monzonite, as interpreted from rotary cuttings, was found at a depth of 3920 feet. Rotary drilling continued to a depth of 4075 feet so textural and structural relations of the rock in that interval are obscured. In the cored interval, the original nature of the rock was largely destroyed by alteration and brecciation. The quartz monzonite found in hole A-2 is light tan to pink in color, fine to medium-grained, and slightly porphyritic. Cuttings from the upper part of the quartz monzonite revealed fine-grained plagioclase laths in parallel to sub-parallel alignment and some quartz eyes. This occurrence may represent fine-grained porphyry dikes intruding the medium-grained quartz monzonite. The intrusive from the cored portion of the hole is composed of approximately 50% plagioclase, 25% orthoclase (some as large irregular phenocrysts up to 3 cm. in length), 20% quartz (some as rounded quartz eyes up to 6 mm. in diameter), and less than 5% shreddy biotite. Two fine-grained dikes were found at depths of 4226 feet to 4432 feet and 4314 feet to 4321 feet. Both dikes have 5-10% orthoclase phenocrysts up to about 3 mm. in length. The upper dike contains 1-2% corroded quartz eyes and the lower dike contains 1-2% fine biotite. Both have an aphanitic groundmass which is aplitic in the upper dike.

The distribution of the quartz monzonite in hole A-2 is gradational. From the Whitetail contact at a depth of 3920 feet to 4203 feet, the quartz monzonite is the dominant rock type. A minor amount of Pinal Schist in the form of inclusions is present to this depth. A fault zone was penetrated from 4203 feet to 4208 feet. This zone has some 60° dipping gouge but gouge-breccia predominates and it is generally flat. Below this zone to a depth of 4288 feet, quartz monzonite and schist are found in approximately equal quantities. The quartz monzonite is intruding the schist. Intrusive contacts vary from 40° to 70°. Another flat fault was cut from 4288 feet to 4295 feet. Directly beneath this fault a thickness of 26 feet of quartz monzonite was found. From that point to the bottom of the hole, the rock consists of schist intruded by an occasional quartz monzonite dike.

The distribution outlined above suggests that hole A-2 contains three separate structural blocks; at least two of which have moved some distance. This thought is further supported by strong post-mineral fracturing and brecciation which occurs in the quartz monzonite and the schist above the lower flat fault zone. Below this fault zone, the rocks are fractured but not brecciated. In addition, thorough oxidation is found above the flat fault and only traces of oxidation are found below 4314 feet.

Strong alteration is found in the quartz monzonite in A-2. Mineralization in the form of pyrite and chalcocite with sparce bornite and chalcopyrite (?) is also found. This will be discussed in greater detail under Alteration and Mineralization.

Quartz monzonite porphyry is found at the bottom of drill hole A-4. It is gray in color, medium-grained, and has a porphyritic texture. Phenocrysts make up 80% of the rock. The phenocrysts are 75% plagioclase, 15% quartz (some of which occurs as poorly developed eyes, especially within 10 feet of the bottom of the hole), 5% shreddy biotite which may be crowded around the borders of other grains, and 5% orthoclase. The groundmass is gray in color and aphanitic. Microscopic results show the groundmass to consist of orthoclase and quartz. A potassium-argon age date on the biotites gave an age of 62.6 ± 2.3 million years.

The quartz monzonite porphyry is found as thin, irregular dikes and masses intruding Pinal Schist from a depth of 6580 feet to 6610 feet. It is also found assimilating schist. A fault dipping 45° is found at a depth of 6610 feet. Below the fault to the bottom of the hole at 6664 feet, the only rock types is the quartz monzonite porphyry.

Weak to moderate alteration and traces of mineralization in the form of pyrite, chalcopyrite and molybdenite are found in the quartz monzonite porphyry.

Similarities between the three different quartz monzonites are obvious. In composition, all three are nearly identical. The overall textural similarity of the quartz monzonites from hole M-1A and A-2 suggest that they are closely related. It is felt that these two intrusives represent border phases of the main Schultze granite mass and that the quartz monzonite porphyry from hole A-4 is a part of that main mass. The available age dates (62.6 ± 2.3 m.y. for A-4 and 59.9 ± 2.2 m.y. for M-1A) are very close and do not really resolve the problem.

Tertiary Whitetail Conglomerate

General. The Whitetail conglomerate is a terrestrial conglomerate of Oligocene age. All six holes drilled by ASARCO intersected at least some Whitetail. The Whitetail can be divided into two separate members. The lower portion is a poorly sorted conglomerate which is only rarely stratified, contains a large variety of clasts, and a gritty, muddy and locally tuffaceous matrix. The upper portion of the Whitetail is fine-grained and shows a better degree of sorting and stratification and is more tuffaceous in nature. Rock types include mudstone, lithic sandstone, and lithic tuff, with minor shale and limestone beds.

It should be noted that good information on the finer-grained portion of the Whitetail is limited. Only two drill holes were cored completely through the Whitetail. Hole A-1 penetrated a thin fault wedge which contained a lithic tuff which is probably from the upper part of the Whitetail. Hole M-1A cut the Whitetail from top to bottom but the contact between the conglomerate and the fine grained portion was obscured by the quartz monzonite slide block. All the other holes were rotary drilled through the fine-grained portion of the Whitetail and the contact in these holes is open to interpretation and is probably gradational in nature. See Figure 2 for the distribution of both portions of the Whitetail in each drill hole.

Lower Member. The base of the Whitetail was deposited on a number of different rock types in the subject area. Starting on the north with hole DCA-1A, the base of the Whitetail rests in angular unconformity on Pennsylvanian Naco Limestone. The contact is irregular and steep. The limestone is dipping 45° while the Whitetail near the contact dips 35°-60°. In hole A-1 only 39 feet of Whitetail was found. It occurs in a fault block but was found to rest on post-mineral schist breccia. The contact was irregular and an attitude could not be obtained. In hole DCA-2 (drilled for Superior Oil and Miami Copper), the Whitetail rests on Pinal schist. In hole M-1A the Whitetail dips 30°-60° near the contact. The contact is an angular unconformity with the Permian Supai Formation. The contact dips 60° and the Supai dips 30°. The Whitetail rests on Tertiary quartz monzonite in hole A-2. The base has not yet been penetrated in hole A-5. In hole A-4, the base of the Whitetail rests on Mississippian Escabrosa limestone. The limestone is probably dipping about 20° while measured dips in the Whitetail near the contact vary from 0° to 10°. The Whitetail rests on a pre-mineral breccia in Magma's #9 shaft and on Precambrian diabase in Inspiration's hole I-1.

The conglomerate member of the Whitetail is an unsorted conglomerate which has all the aspects of being deposited in a continuously subsiding basin. The matrix of the conglomerate contains all size fractions from mud to grit but the grit-sized particle usually predominates. The material which makes up the matrix is mainly small rock fragments (usually siliceous in nature). Small biotite flakes and magnetite-ilmenite grains are also present. The color of the matrix is quite variable. Observed matrix colors are gray, brownish gray, dark brown, brown, reddish brown, brownish red and greenish brown. The matrix color is often found to be dependant on the composition of the clasts. The conglomerates with a large variety of rock type clasts (schist, diabase, sediments and intrusive) usually have a brown to brownish gray matrix. Schist conglomerate has a reddish brown color while the diabase-rich variety in hole DCA-1A may have a greenish brown matrix.

The clasts of the conglomerate vary in size from that of the matrix to boulders 2 or 3 feet in diameter. The clasts are generally sub-angular to sub-rounded in shape. Clasts commonly make up 60% (by volume) of the total rock. The composition of the clasts is extremely variable but includes all older rocks.

It would be expected that the detritus from an area undergoing continuous gradual erosion would be deposited in a reverse stratigraphic sequence (clasts of the youngest material on the bottom and the oldest material on the top). In general, this was found to be true but the large variety of clasts found all through the conglomerate indicate that the source areas were in many different levels of exposure. Only one of the drill holes showed a good correlation between the clasts near the base of the conglomerate and the underlying pre-mineral rock. This occurred at DCA-1A where 109 feet of an essentially monolithic limestone conglomerate (in the cored interval) above the limestone conglomerate had a predominance of diabase clasts. The clasts near the base of the conglomerate in hole M-1A are mainly diabase and quartz monzonite porphyry with about 25% limestone and quartzite. The clasts near the base of hole A-2 (and all through the conglomerate) are mainly schist with minor amounts of quartz monzonite and diabase. In hole A-4, the basal portion of the Whitetail (beneath the slide block) from a depth of 6448-6484 feet contains clasts of limestone (60%) with equal amounts of quartz monzonite porphyry and diabase. Directly above the slide block, the clasts are made up of about equal quantities of diabase, schist, and Paleozoic sediments with minor quartz monzonite porphyry. From the above data it is apparent that the pre-mineral rock type in a given location can not usually be predicted from the suite of clasts just above bedrock.

In order to better understand the pre-Whitetail geology and the geologic processes which were taking place during Whitetail time, the general clast make-up of each drill hole is discussed below. In order to simplify the description, all thickness will refer to vertical thickness.

In drill hole DCA-1A, the basal limestone conglomerate (109 feet in thickness) is overlain by conglomerate with 60-70% diabase and Precambrian Ruin Granite clasts and 15-20% each of quartzite and limestone. This suite persists up at least to where coring was initiated at a depth of 4002 feet. From that point to the top of the Whitetail, our only information is the original drill log of rotary mud cuttings. This log indicates that quartzite and diabase clasts predominate above 4002 feet with some schist, limestone, andesite, and granite (Ruin?) and that no fine-grained member is present.

In hole M-1A, from the base at 4898 feet to a depth of 4685 feet, the clasts are made up of about equal amounts of diabase, quartz monzonite porphyry and limestone (with quartzite). Some of these clasts are altered (clast alteration is abundant from 4776-4851 feet). From 4685 feet up to a depth of 3856 feet, the clasts are mostly diabase (about 60%) with limestone and quartzite (about 30%) and the remainder quartz monzonite porphyry. Some clasts are altered (abundant from 4410-4531 feet). At 3856 feet, a significant change occurs. Below this point no schist clasts are seen while above this point no limestone (representing Paleozoic rocks) is seen. From 3856 feet to the bottom of the slide block at 3107.5 feet, schist makes up 65% of the clasts while quartz monzonite and quartz monzonite porphyry make up 20% and diabase about 15% of the clasts. Some alteration is present and in places it is abundant.

In the above interval, the quartz monzonite shows a significant gradational change. From the bottom of the Whitetail up to a depth of about 3681 feet, the intrusive clasts are solely a fine-grained quartz monzonite porphyry with small quartz eyes and feldspar phenocrysts in an aphanitic groundmass. These clasts are often altered. Several clasts show copper mineralization above a depth of 3856 feet. They are probably a border phase of the Schultze or from dikes feeding from the main intrusive mass. Above 3681 feet to a depth of 3378 feet, the quartz monzonite porphyry described above occurs with a medium-grained quartz monzonite similar to that which is found in the slide block above (2920 feet to 3107.5 feet). The quartz monzonite contains some alteration and leached pyritic mineralization. The quartz monzonite porphyry clasts contain some strong quartz-sericite alteration with leached chalcocite mineralization. Several clasts were found which contained strong disseminated chalcocite mineralization. From 3378 feet, up to the base of the slide block at 3107.5 feet, the intrusive clasts are all similar to or identical to the slide block.

In drill hole A-2, the Whitetail clasts are predominantly schist. Schist usually makes up 80% to 90% of the total volume of clasts. The remainder is divided equally between diabase and quartz monzonite with traces of quartzite. The interval 3459 feet to 3540 feet contained mostly quartz monzonite cuttings. It is believed that this interval is a slide block of quartz monzonite in the Whitetail. Alteration in the schist and quartz monzonite clasts is common to abundant. No limestone clasts were seen.

Drill hole A-5 penetrated only 146 feet of the conglomerate member of the Whitetail before it was cased in preparation for coring. The clasts are about 90% schist and 10% diabase and quartz monzonite. Alteration in the clasts is common.

In drill hole A-4, the basal portion (6448-6484 feet) of the Whitetail contains clasts of limestone (60%) with equal amounts of quartz monzonite porphyry and diabase. Alteration is common. Above the limestone slide block, from a depth of 6245 feet to 6339 feet, the clasts are 30% diabase, 30% schist, 30% Paleozoic sediments and 10% quartz monzonite porphyry. Alteration is common. From a depth of 6068 feet to 6245 feet, the clasts are 50% diabase, 25% schist, 15% Paleozoic and Precambrian sediments and 10% quartz monzonite porphyry (and andesite). Alteration in clasts is minor. Above this interval, from a depth of 5336 feet to 6068 feet, the conglomerate is predominantly schist conglomerate (with minor diabase and quartz monzonite porphyry). Alteration of clasts is abundant. Interbedded within the schist conglomerate are thin beds of mixed conglomerate with diabase, schist, sediments (Paleozoic and Precambrian) and minor quartz monzonite porphyry. Below a depth of 6019 feet, mudstone or shale makes up a good portion of the sediments but above that point it is absent. Above 5336 feet to a point 4398 feet in depth, the clasts are well mixed with diabase and schist, abundant and minor amounts of sediments and quartz monzonite. Alteration of clasts is nil to minor. Above 4456 feet the only sediments found are Precambrian in age. From 4398 feet to the top of the conglomerate member at 2920 feet, the clasts are 70% to 80% schist with minor diabase, quartz monzonite, and Precambrian sediments. Alteration of clasts is minor (common from 3642 feet to 3808 feet).

The intrusive clasts found in the conglomerate in A-4 show a gradational change similar to that in M-1A. In the lower portions of the conglomerate, the quartz monzonite porphyry is fine-grained and sub-volcanic in appearance. Going up the hole, the clasts become coarser in grain size and more diverse in texture.

From the above information, a number of conclusions can be drawn about the pre-Whitetail geology and the intra-Whitetail geology. It is apparent that uplift and/or subsidence must have initiated Whitetail deposition. In the project area, this subsidence and/or uplift probably took place along the northerly trending Devils Canyon fault (see Attachment 1). There is no doubt that this structure is present since the Paleozoic sediments found in holes M-1A and A-4 are completely striped from the area of A-2. Any of the east-west sections show that the ultimate displacement of the Devils Canyon fault is great. The displacement on the Devils Canyon fault probably took place gradually and formed an irregular north trending topographic high which passed west of A-1 and A-2 and east of A-4, M-1A, and DCA-1A. This high was a dominating factor in the direction of flow of the Whitetail deposition in the project area.

The source area for at least the lower part of the Whitetail in hole DCA-1A must have been to the north because of the presence of Ruin granite and diabase clasts and the lack of schist clasts. The flow direction was probably southerly along the high caused by the Devils Canyon fault. This deposition must have fingered-out before drill hole M-1A was reached because no Ruin granite clasts are found in M-1A.

A similar suite of clasts is found in M-1A below 3856 feet except that the Ruin granite is absent and quartz monzonite porphyry is present. The source for this material must also have been to the north but not far enough north to pick up Ruin granite. Some contribution must have come from an area eroding the roof of a granitic mass giving the fine-grained quartz monzonite porphyry. Such an area would be the Porphyry Mountain (Castle Dome) area. At that time, erosion would not have exposed the schist (as it has now) and the eroding suite would have been similar to what is found in M-1A (below 3856 feet). A source this far east would require the flow to cross the Devils Canyon uplift but it does not seem unlikely that low areas would exist at a number of places along its length.

In early Whitetail time, the A-2 area (and all the area along the Devils Canyon uplift) was undergoing erosion. This erosion probably took place as a gradual continuous uplift. The material which was eroded consisted of Paleozoic sediments (probably as much as 1000 feet or more), Precambrian sediments, schist, and porphyritic quartz monzonite related to the main Schultze granite mass. This material must have been shed to both the east and the west (and possibly the south).

The very earliest Whitetail deposition in hole A-4 probably came across the gentle slope from the Superior region to the west. This is indicated by the lack of schist clasts. This original deposition must have sealed off the area to the west as a source area. Above the basal conglomerate, schist clasts are always present and deposition was probably coming from the immediate vicinity of A-4 off the Devils Canyon uplift, through the Devils Canyon uplift from a source further east, and around the southern end of the uplift, also from a source to the east. Most of the schist conglomerates probably came from east of the uplift since most of the uplifted area was probably still underlain by sediments.

Later in Whitetail time (corresponding to the upper part of the conglomerate), Paleozoic sediments were completely removed from the source areas of the Whitetail in holes M-1A and A-4. This occurred at a depth of 3856 feet in M-1A and 4456 feet in hole A-4 and probably corresponds to the final stripping of the Paleozoic sediments from the Devils Canyon uplift. In hole M-1A, this point probably also corresponds to a change in flow direction because 3856 feet in depth also marks the lowest schist clast to be seen. At this point, the source for M-1A must have been fairly nearby and to the east. The presence of unoxidized chalcocite in clasts indicates that the source area must have been within several miles. In the area of hole A-4, sedimentation probably continued to come from the northeast, east, and southeast.

Deposition probably began in the area around A-2 at some time before Paleozoic sediments were eliminated from the source areas of A-4 and M-1A. Deposition was initiated by uplift on the east side of the Rawhide Canyon fault (east of the Devils Canyon fault). The source for the conglomerate in A-2 was to the east. In this area, all the sediments had been eroded and the main source rock was schist with minor quartz monzonite and diabase.

Although the general nature of the conglomerate is to be poorly sorted, certain distinctive units are found which do show some degree of sorting. Generally, these more well sorted units contain only clasts which are less than two inches in diameter while the typical poorly sorted variety contains many clasts greater than 6 inches in diameter. The more well sorted units also have a better degree of packing with a clast to matrix ratio of 80:20 or 70:30 versus 60:40 for the typical conglomerate. Many (but not all) of the beds which show a better degree of sorting contain a greater abundance of schist clasts than do the adjacent beds. The sorted beds occur only sparingly in hole DCA-1A but are fairly common in holes M-1A and A-4. In hole A-4, the interval 5352 feet to 6068 feet is dominated by a nearly monolithic schist conglomerate which is fairly well sorted.

Several thin lithic tuff units are found interbedded with the conglomerate in hole A-4. The tuffs are found at 3808-3810 feet, 3976-3984 feet, 4201.5-4230.0 feet and 5083-5112 feet (with conglomerate at 5102-5108 feet). These tuffs contain lithic clasts (up to 30% of the rock) of schist, diabase, and black volcanic material in a light gray, very fine-grained, tuffaceous groundmass. In addition to the tuff units, several

zones were found in the conglomerate which had tuffaceous or ashy material in the matrix. No evidence of tuffaceous activity was found below a depth of 5112 feet. Because of the nature of the rotary cuttings, it is not known whether any tuff occurs above a depth of 3593 feet. The only evidence of tuffaceous activity found in the conglomerate in hole M-1A was two thin tuffaceous mudstone beds at depths of 3818-3819 feet and 3837-3838 feet. No tuffaceous material was seen in drill hole DCA-1A. Tuffaceous material is a fairly common constituant of the conglomerate matrix from hole A-2. It is not known whether any tuff units occur because of the nature of the rotary cuttings. where?

A tuff unit from the upper part of the Whitetail near Ray (approximately 8 miles south of the project area) gave an age date of 32 million years. In that area, the Whitetail has an exposed thickness of only 600 feet. It is not known whether the portion of the Whitetail which produced the date correlates with the conglomerate member of the Whitetail or the upper fine-grained (and more tuffaceous) member.

Stratification is rare in the conglomerate member of the Whitetail but thin gritty layers with no clasts are found and can be used to determine an angle of dip. In hole DCA-1A, the dip varies from 30° to 60° within 170 feet of the base. Above that point (from a depth of 4002 feet to about 4528 feet), the dip of the Whitetail varies from 20° to 30°. In hole M-1A, a similar steepening of the dip is found near the base. In this case, the dip varies from 30° to 60° near the base (from a depth of 4870 feet to the base at 4898 feet). Above this point, from a depth of about 3800 feet to 4870 feet, the dip ranges from 15° to 30°. From the top of the conglomerate (at a depth of 3107.5 feet) to 3800 feet, the dip ranges from 0° to 10°. In hole A-4, the dip of the beds near the base was found to be 0° to 10°. The shallow dip here may have been brought about by tilting or draging of the beds adjacent to the branch of the Devils Canyon fault (see Section L-L' on Attachment 4). Above the slide block in A-4, the beds dip 10°-20° except in the upper portion of the cored interval where flat attitudes were found to a depth of about 4200 feet.

It should be noted that the dip of the conglomerate member of the Whitetail increases to the north from hole A-4 to hole DCA-1A (see Figure 1). This probably indicates that the subsidence which initiated Whitetail deposition was originally of greater magnitude in the north than in the south.

The true thickness of the conglomerate member of the Whitetail is difficult to determine exactly because of the nature of the rotary cuttings. (The exact contact with the fine-grained member above is not definite and the angle of inclination of the beds is not known.) Certain assumptions were made for the dip of the beds using available data and the following true thicknesses for the conglomerate member of the Whitetail were computed:

DCA-1A	-	2330'
M-1A	-	1776'
A-2	-	1445'
A-4	-	3460'

As can be seen, drill hole A-4 contains much more conglomerate than the rest of the holes. This portion of the basin must have been in subsidence for a much greater amount of time than to the north.

Upper Member. The fine-grained member of the Whitetail was found in all but one of the drill holes in the project area. The true thickness found or interpreted in each drill hole is as follows: A-4 - 787 feet; A-5 - 399 feet; A-2 - 405 feet; M-1A - 492 feet; DCA-2 - 70(?) feet; A-1 - 31 feet; DCA-1A - 0 feet.

space more or move to left & down one

Only two of the holes were cored through the fine-grained member so the geology is not as well known as the conglomerate member. The contact with the lower conglomerate member appears to be gradational in holes A-2, A-4, and A-5. In hole M-1A, the actual contact was obscured by the quartz monzonite slide block. Below the slide block, the conglomerate member is present and above the block (188 feet thick) the fine-grained member is present.

In hole M-1A, the geology is well known (see Appendix 1, Log 6). The main rock types are lithic sandstone, mudstone, shale, and lithic tuff with minor conglomerate and limestone. The lithic sandstone is fine-grained and varies from dark gray to light green in color. Visible lithic grains (and pebbles) include schist, quartz monzonite, diabase, limestone, quartzite, and volcanic jasperoid. Cementing material varies from argillaceous to limy to glauconitic (above 2553 feet) to tuffaceous. Mudstone and shale are dark green to reddish brown in color and often slightly limy and gritty. Numerous aragonite nodules up to 1 inch in diameter are common. The main lithic tuff unit occurs from 2553 feet to 2640 feet. It appears to be water lain and consists of 70-80% lithic and crystal fragments in a very fine-grained, tuffaceous matrix. Minor thin tuff units are found below the unit described above. Conglomerate beds are found from 2448-2460 feet and 2640-2675 feet. The matrix is light reddish brown, gritty, and tuffaceous. Clasts are sub-angular, up to 6 inches in diameter and make up 60-70% of the rock. The upper conglomerate bed clasts are 60% quartz monzonite, 35% schist and 5% diabase, limestone and quartzite. The lower conglomerate bed clasts are 75% quartz monzonite and 25% schist. In both cases, the quartz monzonite is identical to that found in the slide block. In the lower unit, some of the quartz monzonite clasts are brecciated. Two thin slump brecciated limestone beds were found. In general, sandstone predominates above 2675 feet and mudstone and shale predominates below 2675 feet. Bedding as high as 15° was found above the lithic tuff but in most places it was flat.

Cuttings from the other drill holes indicate a similar suite of rocks in the fine-grained member of the Whitetail but several differences were noted. In hole A-4, the main rock type was gritty, limy and somewhat tuffaceous mudstone. Conglomerate lenses are much more common in A-4 than M-1A. The calsts of the conglomerate are schist and quartz monzonite. Limestone was also found in minor amounts. In hole A-5, mudstone, similar to that in A-4, makes up most of the fine-grained member. Only minor conglomerate is thought to be present. In hole A-2, a fine-grained

gritty lithic tuff is the main rock type. Mudstone and minor amounts of conglomerate are also found. In hole A-1, the thin intercept of Whitetail is a fine to medium-grained water lain lithic tuff. Clasts make up 50% of the rock and are schist, altered feldspar (?), and volcanic jasperiod. Bedding is 25°-45°.

During late Whitetail time, the deep basin in the central part of the project area gradually became filled with detritus as uplift moved eastward and diminished in magnitude. Gradually the energy needed to transport coarse detritus was lost and the area around holes M-1A, A-5, and A-4 received only fine sediments. At the same time, increasing volcanic activity evidenced by tuffaceous deposits took place. The fine-grained members may not be exact time equivalents in all places. As mudstone and sandstone deposition was taking place at M-1A, A-5 and A-4, the area near A-2 may still have been receiving coarse detritus. This would seem logical since A-2 is farther east and closer to the source. The abundant tuffaceous matrix found in the conglomerate in A-2 may correlate in time to the tuffaceous material of the fine-grained member in holes to the west. The area near A-1 was still on higher ground and received only minor deposition. DCA-1A, on the down dropped side of the Devils Canyon fault, received conglomerate deposition late into Whitetail time until lavas of the early volcanics covered the area.

Tertiary Earlier Volcanics

Near the end of Whitetail time, volcanic activity increased in magnitude and finally culminated in extensive eruptions. The earlier volcanics are thickest in the northwest part of the project area (Haunted Canyon). The source for these rocks could probably be found in this area. The units thin out to the south (DCA-1A contains 1660 feet of earlier volcanics and A-4 contains only 158 feet). The earlier volcanics were deposited over the somewhat irregular Whitetail surface and probably filled in low topographic areas.

The main rock type of the earlier volcanics in the project area is a dark gray to black, very fine-grained, andesite basalt. Some crystal tuff is also found. Toward the source area, rhyolites and perlites are found.

Tertiary Dacite

After a brief period of erosion following the eruption of the earlier volcanics, an extensive ash flow sheet of dacite material was laid down. As material accumulated, the ash was welded from heat and the weight of the overlying material.

The base of the dacite is usually marked by a non-welded tuff which may be overlain by a black vitrophyre. The non-welded tuff was found to vary from 0-115 feet in thickness and the vitrophyre from 5-60 feet in thickness. The bulk of the dacite is a welded ash flow tuff with fine-grained phenocrysts and fragments of quartz, feldspar, and biotite in a

fine-grained aphanitic groundmass. Lithic clasts and pumice fragments are also common. Thin vitrophyre units or glass-rich zones of welded tuff may be found above the basal non-welded tuff. The color of the dacite shows a color zonation from brown near the base to orange in the middle and light gray on top. The thickness of the dacite in the drill holes varies from 550 feet at DCA-1A to 2274 feet at A-5. The original thickness of the dacite was probably fairly uniform except from local topographic variations in the pre-dacite surface. Later faulting and erosion also caused variations. Age dates show the base of the dacite to be about 19.4 million years old.

STRUCTURE

Before the intrusion of the Schultze granite in the early Tertiary system, the project area was underlain by Precambrian schist and sediments (which were intruded by Precambrian diabase) and Paleozoic sediments. Structurally, the area was relatively undisturbed with the possible exception of some northeasterly trending faults along a Precambrian weakness. If any Mesozoic sedimentation had taken place, it may have been completely or partially eroded along with some Paleozoic sediments. In the project area, Paleozoic sediments covered the area. Just east of the project area, substantial uplift had taken place (according to N.L. Peterson, 1962) in the Pinal Mountains and the complete Paleozoic sequence had been eroded, exposing Precambrian Pinal schist.

In early Tertiary time, the Schultze granite was intruded along an ancient northeasterly trending zone of weakness. More northeasterly faulting accompanied intrusion and the overlying Paleozoic sediments were jostled and tilted with some blocks being eroded farther and others being preserved. Erosion was taking place at this time, but evidence of its deposition is not to be found. Before the deposition of the Whitetail conglomerate, a set of northerly trending normal faults became active. In the subject area, this activity started with the Devils Canyon fault in the west part of the Superior East property. Relative movement on this set of faults is up on the east and down on the west. Gradually, Whitetail deposition eroded the upthrown blocks and filled the downthrown blocks. As deposition was taking place, portions of the upthrown blocks were weakened and sliding occurred, which moved masses of premineral rock onto post-mineral Whitetail conglomerate. Movement on the northerly trending faults gradually migrated to the east in the subject area. In a like manner, erosion and deposition moved eastward. Eventually, the basin filled and volcanic activity covered the area. The northerly trending faults remained active on the east margin of the subject area after eruption of the dacite. Relative movement on the last phase of this faulting was great as the Schultze granite east of the project area was eroded to a deep level and deposited to the east in the form of Gila conglomerate.

The relationships discussed above are shown in the attached sections (see Attachments 2, 3, and 4). Some of these were not observed directly but were inferred from the sections and other observations. The pertenant structural relationships found or inferred in each hole is discussed below.

Drill hole A-4 intersected what is probably a branch of the Devils Canyon fault from 6563 feet to 6580 feet. The fault zone is quite complex, containing wedges of Escabrosa limestone from the hanging wall, sheared and welded chloritic material, cemented fault gouge, and sheared quartz monzonite, Beneath the fault zone is a fractured inclusion of Pinal schist (from 6580-6610 feet) intruded by quartz monzonite porphyry dikes. The schist inclusion is in fault contact below with unoxidized Laramide quartz monzonite porphyry. This intercept represents the westernmost occurrence known of Schultze granite.

An intra-Whitetail slide block is found in hole A-4 from 6639 feet to 6448 feet. This block is Escabrosa limestone as is the bedrock material below. The block sits on only 36 feet of Whitetail conglomerate. Early movement on the Devils Canyon fault tilted the downthrown block of sediments to the east and sliding took place.

Drill hole A-5 has not yet been drilled to conpletion. It has penetrated 545 feet of Whitetail and is now at a depth of 3145 feet. Projections from surface outcrops to the west and from section L-L' indicate that Paleozoic sediments should be intersected above a depth of 4500 feet.

The bottom of drill hole A-2 is at a depth of 4513 feet and is in Pinal schist. The hole was lost at this point and the hole will be deepened by an offset whipstock hole. The schist is altered, mineralized, intruded by quartz monzonite dikes and is probably close to the main intrusive mass. A strong flat fault is found from 4288 feet to 4295 feet. Above this fault, up to a depth of 4208 feet, altered schist and altered quartz monzonite are found in equal quantities. Another flat fault is found from 4203 feet to 4208 feet. Above this fault, to the Whitetail contact at 3920 feet, the dominant rock type is altered quartz monzonite with only minor schist. All rocks above the lower flat fault show intense fracturing and post-mineral brecciation with almost complete oxidation. Below this fault, the rocks are not brecciated and show only traces of oxidation below 4314 feet. It is apparent that the quartz monzonite above 4288 feet has been moved laterally (in a northerly or westerly direction) into place from the main part of the Schultze mass. The nature of the schist suggests that the movement was probably not of great magnitude; probably several thousand feet at most. Movement on the Rawhide Canyon fault to the east (see section K-K') caused the quartz monzonite block to slide out over the schist. Since the intrusive contact probably flairs out with depth, the drill hole may eventually intersect it.

It is believed that another slide block of quartz monzonite was penetrated above the bedrock contact in the Whitetail from 3495 feet to 3540 feet. This is an interpretation based on rotary cuttings. As seen from section K-K', it would seem logical that both slides came off the main intrusive mass from the east or south.

Drill hole M-1A intersected pre-mineral sediments of Permian and Pennsylvanian age. They are dipping 20° to 30°, probably to the east. It is interesting to note that in the three pre-mineral penetrations made west of the Devils Canyon fault, the Paleozoic bedrock which was found at the base of the Whitetail does not correspond to what would be predicted from what is found on the west edge of the dacite cover. North of the Magma fault (which runs east-west and is covered by Whitetail just north of section E-E' on Attachment 1), the Whitetail rests on Devonian or Mississippian rocks while south of the fault the Whitetail is found directly over Pennsylvanian and Permian respectively. Hole A-4 is just slightly north of the projection of the fault but pre-mineral bedrock is Mississippian limestone.

An intra-Whitetail slide block of quartz monzonite is found between the conglomerate member and the fine-grained member of the Whitetail in M-1A. The slide block occurs at a depth of 2920 feet to 3107.5 feet. The quartz monzonite probably represents a border phase of the Schultze granite. The first reflection seismic survey conducted by J. W. Cooksley (for Continental Materials) revealed a "central high area" covering the southern half of section 15. This was interpreted by Cooksley to be an area of relatively shallow cover. The area outlined by the "central high" may actually be the outline of the slide block found in M-1A. If this is true, the slide block moved almost due west to its present position. If one compares sections K-K' with C-C' and D-D', it seems apparent that the only possible source area for the slide block would be to the east. The main intrusive mass is step faulted downward to the west so the western portion would never have had enough elevation to move the block to its present position in M-1A.

The basement rock found in hole A-1 is Pinal schist which has been strongly fractured, shattered, and brecciated in places. (See Appendix 1, Log 1). The schist is found on the footwall of a steep normal fault which is probably related to the Devils Canyon-Rawhide Canyon fault system to the west. It is felt that the broken nature of the schist is due to its close proximity to the fault.

The hanging wall of the fault consists of a thin intercept of schist breccia (1566 feet to 1572 feet) which is apparently depositionally overlain by a lithic tuff from the Whitetail conglomerate (1527 feet to 1566 feet). The Whitetail is in turn, overlain by more schist breccia (1373.5 feet to 1527 feet). The contact between the upper block of schist breccia and the Whitetail is flat and sheared. This is a fault contact along which the schist breccia was thrust or slid over the Whitetail.

The schist breccia is a post-mineral tectonic breccia containing 95% or more schist clasts and up to 5% clasts of quartz monzonite and quartz monzonite porphyry. This breccia is very similar or identical to the Cactus breccia which is mineralized at the Carlota mine to the northeast. The matrix of the breccia is light brick red to reddish brown in color. It is silty in appearance and consists of crushed quartz, feldspar, biotite, magnetite, and iron oxide as stain. The clasts are sub-rounded to sub-angular, up to 12 inches in diameter and poorly sorted. The clast to matrix ratio varies from 60:40 to 80:20.

In his report to you (dated May 10, 1971), F. T. Graybeal concludes that brecciation of the Cactus breccia occurred during thrusting. In hole A-1, it is apparent that thrusting and brecciation of the "Cactus type breccia" occurred prior to late Whitetail deposition and that a second period of sliding took place at some time after Whitetail deposition. From section J-J' (Attachment 4), it is apparent that the Cactus Breccia could not have originated west of the Devils Canyon-Rawhide Canyon fault. In the A-1 area, the Cactus breccia probably came from the east or northeast.

Hole DCA-1A intersected pre-mineral bedrock at 4669 feet. The bedrock was the Pennsylvanian Naco limestone. The hole then penetrated a normal sequence of Paleozoic sediments and bottomed in Precambrian Troy quartzite. Faulting was seen in the sediments but it was only of minor magnitude. As one can see from section J-J' (Attachment), DCA-1A and A-1 are on different sides of the Devils Canyon-Rawhide Canyon fault system. It is apparent that the relative movement on the fault in this area is at least 2500 feet.

The main structural conclusion developed in the drilling is that the Schultze granite continues westward through the project area under cover and probably noses out at some point under Oak Flat. Step faulting has gradually down-dropped the intrusive to the west and had two major effects on the Schultze in the project area. The most obvious effect is that the depth to the intrusive mass increases to the west. The Schultze outcrops as high as 5481 feet <u>above</u> sea level (at Five Point Mountain, southeast of Pinal Ranch) east of the project area but was not intersected in hole A-4 until an elevation of 2480 feet <u>below</u> sea level was reached.

Secondly, the intrusive has been exposed to increasingly deeper levels of erosion from west to east. Thus, if the Schultze is to be found in the main down-dropped block west of the Devils Canyon fault (see section L-L') it will probably be overlain by Paleozoic sediments and would never have been exposed to oxidation or erosion. As one moves to the east, deeper levels of erosion can be expected because as the step faulting progressed from west to east with time, it was continually eroding the area east of the fault and depositing sediment to the west of the fault; thus preserving the area to the west in a less advanced stage of erosion. The final stage of erosion occurred east of the unnamed fault which runs north-south near Pinal Ranch (see section D-D'). This fault may have been active in Whitetail time but its main period of movement was post-dacite. At this time, the Schultze granite was exposed

and eroded to a deep level and the detritus was deposited to the east as Gila conglomerate. The Schultze granite which is found in outcrop east of Pinal Ranch has a coarse-grained porphyritic texture. This texture represents a level which is probably several thousand feet deeper into the intrusion than is represented by the intrusive in hole A-2.

The drilling to date has enabled us to revise the possible outline of the Schultze granite under cover (see Attachment 1). It is now apparent that the Schultze intrusive mass extends to the southwest as far as A-4. It undoubtedly occurs farther west than this point and may eventually connect with the mineralized intrusive breccia found in Magma's #9 shaft. We still have no real information on the south edge of the intrusive but it is fairly certain that the intrusive is narrower than originally believed as the north edge must pass to the southeast of A-2. The edge of the intrusive probably continues from the A-2 area to the northeast and into the Pinal Ranch area.

ALTERATION AND MINERALIZATION

Two periods of mineralization were found in the drilling at the Superior East project. The first period of mineralization is related to the Laramide granitic intrusives. The first period of mineralization includes porphyry copper-type mineralization in the Pinal schist and intrusive rocks and bedded replacement mineralization in Paleozoic sediments. As would be expected, significant wallrock alteration is found with these types of mineralization. The second period of mineralization occurred during or after deposition of the Tertiary Whitetail conglomerate. This mineralization is exotic in nature, was formed at low temperatures and exhibits little of any alteration effects. Most of the younger mineralization is found in the Whitetail conglomerate.

Bedded Replacement Mineralization

Of the first period of mineralization, the bedded replacement type is the least significant. This type of mineralization was found in holes A-4 and DCA-1A. In drill hole A-4, the first bedrock penetrated was limestone of Mississippian age. It was found from 6484 to 6563 feet. The interval from 6484 to 6539 feet is completely replaced by massive metallic hematite and specularite with minor amounts of red earthy hematite and geothite. Minor pods of strongly silicified limestone are also present. No sulfide minerals were found but the silicified material contains abundant casts of limonite after sulfides. The sulfide casts were all interpreted to be after pyrite. It is felt that this intercept represents the main replacement horizon in the Mississippian Escabrosa limestone. Although this bed is not mineralized with chalcopyrite and bornite, as is found at the Magma mine, the alteration of the replaced

bed went as high as 2.55% copper but this is due entirely to exotic native copper mineralization.

A number of replaced but unmineralized beds were found in the Escabrosa and Martin limestones in hole DCA-1A. The alteration effects in these beds are much more subtle than in hole A-4 but solution breccia textures are common. The main feature of this texture is the presence of thin, curved, open cavities which are often lined with very fine drusy dolomite(?) crystals. Thin clacite veinlets are found throughout the limestones but are often more abundant in the replaced beds. Dolomitization is found in the replaced beds but also in rocks which do not have replacement textures. A number of samples were taken in, above and below the replaced beds and were analyzed for a number of trace and major elements. The results may be found with the geology log (Appendix 1, Log 5). The results for MgO show that dolomitization is present in the replaced beds but not necessarily to a greater extent than in the surrounding rock. The dolomitization process probably took place well before the replacement process or just prior to replacement activity. Very fine-grained silicification is also found in the replaced beds. All of the replaced beds are of greater hardness than the surrounding limestone or dolomitic limestone but no silica coarse-grained enough to be identified as such was seen. Analytical results show a wide variation in the amount of silica present. In addition to the above, minor amounts of manganese staining, iron staining, and bleaching were found with scattered traces of limonite after pyrite and no sulfides. Copper values are low (below 45 ppm) and do not show a significant (if any) enrichment in the replaced beds compared to the rock above or below.

Seven separate replaced beds were found throughout the Escabrosa limestone in hole DCA-1A. One bed had a stratigraphic thickness of 19 feet but the remaining six beds were all less than 8 feet in thickness. The upper portion of the Martin limestone contained no replaced beds but the lower portion (from a depth of 5595 feet to 5757.5 feet) was about 85% replaced as described above.

The alteration of carbonate rocks as described above has been observed as a fringe effect of the bedded replacement deposits at the Magma Mine (J. D. Sell, oral communication). It is not known how far this fringe effect extends from commercially mineralized areas but it is thought to be a considerable distance.

Porphyry Copper Mineralization

Of major consequence in the Superior East drilling is porphyry copper-type mineralization which is found in Precambrian Pinal schist and/or Laramide intrusive rocks in three widely spaced drill holes. Drill holes A-1 and A-4 intersected weak alteration and mineralization in Pinal schist and quartz monzonite porphyry with Pinal schist respectively. Drill hole A-2 intersected intensely altered Pinal schist and porphyritic quartz monzonite with weak to strong mineralization.

Pinal schist from hole A-1 shows only weak alteration and mineralization. The schist was oxidized to a depth of 1771 feet and the oxidized portion of the schist (1585-1771 feet) is weakly argillized in the form of thin argillic layers along fractures and foliation planes. Since this alteration does not persist into the sulfide zone, it is probably supergene in nature. Bands of silica flooding less than 1/4 inch thick are found related to fractures near the base of the oxide zone and traces of specularite and limonite after pyrite are found from 1585 feet to 1717 feet. From 1717 feet to the base of oxidation (at 1771 feet), 1/2% to 1% limonite after pyrite was seen. (Unless otherwise noted, estimates of sulfide content will refer to volume percentage.) The increased leached sulfide content in the lower part of the oxide zone corresponds with the weak silica flooding. The sulfide mineralization is definately fracture controlled as only minor dissemination was seen.

Alteration in the sulfide zone increases with depth but the overall intensity is still only weak. Weak silica flooding related to fractures is found throughout the sulfide zone. Secondary chlorite is also found on fractures. From a depth of 2018 feet to the bottom of the hole at 2129 feet, thin quartz-sericite-chlorite selvages on fractures are common along with thin quartz veinlets. The quartz veinlets make up 5-10% of the rock from 2018 feet to 2129 feet. The pyrite content varies from traces to 1-2% and traces of chalcopyrite are also found. The sulfide content does not show an increasing or decreasing trend with depth. The sulfides are mainly on or related to fractures or in quartz veinlets. In general, the structures which control sulfide mineralization are randomly orientated but a slight preference for flat fractures may be present. The small amounts of chalcopyrite which were seen were generally marginal to pyrite relative to the controlling fracture or veinlet.

A number of samples from the schist were assayed and the results are shown in Appendix 1, Log 1. Visually, the best chalcopyrite occurred from 1940 to 1955 feet. This zone contained the highest assays in the schist (0.06% Cu for 1940 feet to 1950 feet and 0.04% Cu for 1950 feet to 1960 feet). The average copper content for samples from the oxide zone was 0.01% while samples from the sulfide zone averaged 0.026%. The molybdenum content of the schist is also low. Only one sample assayed over 0.0015%.

Drill hole A-4 penetrated 84 feet of weak porphyry copper-type mineralization from 6580 feet to the bottom of the hole at 6664 feet. From 6580 feet to 6610 feet the rock is Pinal schist which is intruded by thin Laramide quartz monzonite porphyry dikes. The schist and the quartz monzonite porphyry are weakly argillized and chloritized (including secondary chlorite on fractures). Irregular quartz veinlets (up to 5% of the rock) cut both schist and quartz monzonite porphyry. Sulfide mineralization in the form of pyrite, chalcopyrite and molybdenite is found in both rocks along with traces of specularite. The total sulfide content of the rock is estimated to be 1% by volume with pyrite and chalcopyrite in approximately equal proportions. Most of the sulfides are found in the schist as disseminations and in or associated with quartz veinlets. One seven inch thick quartz vein with strong chalcopyrite was found at 5506 feet.

The inclusion of schist described above is bottomed at 6610 feet by a 45° dipping fault. The Laramide quartz monzonite porphyry below the fault is similar to the dikes above the fault. It is weak to moderately altered with weak to moderate argillization of feldspar phenocrysts (some in groundmass also), weak chloritization and traces of sericitization. Thin quartz veinlets are very poorly developed above 6644 feet but make up 5% of the rock below 6644 feet. Salmon colored limonite staining is found in quartz veinlets and feldspars (especially below 6644 feet). Pyrite, chalcopyrite, molybdenite, and specularite are found mostly on fractures and in quartz veinlets with minor dissemination. The total sulfide content is estimated to be about 1/2% by volume.

Assay results (see Appendix 1, Log 3) from A-4 are low except for one sample which contained the high grade quartz vein mentioned above. The assays do verify that the schist contains the best mineralization. The schist averages 0.38% copper or 0.17% copper if the sample with the high grade quartz vein is eliminated. The quartz monzonite porphyry averages only 0.04% copper. Only one sample assayed more than 0.0045% (45 ppm) molybdenum and it was only 0.0122%.

The most encouraging porphyry copper type mineralization found to date in the Superior East project is from drill hole A-2. (Note: The writer's first hand knowledge of the geology of the drill hole exists to a depth of 4513 feet. This report will include only information up to that point in the drilling of the hole, which was lost at 4521 feet with eight feet of core unrecovered, along with a core barrel and several hundred feet of rods. It is not felt that the conclusions drawn below will be greatly effected by drilling which took place after my leaving the project.) As described in the STRUCTURE section, brecciated Laramide porphyritic quartz monzonite with Pinal schist inclusions was found as a slide block over Pinal schist which is intruded by porphyritic quartz monzonite dikes.

Alteration in both the quartz monzonite and the schist may vary rapidly in intensity and alteration type. The overall intensity of alteration in the drill hole is moderate to strong. The quartz monzonite contains argillization, silicification, and quartz-sericite alteration. Argillic alteration is always at least weakly developed. It is the most pervasive alteration type and generally the only alteration type in the less well altered intercepts. In the weakly altered areas, the original texture is visible but plagioclase phenocrysts are destroyed and the groundmass is partially clouded. Biotites remain intact in the weak argillic alteration and can be identified through moderate argillization. Silicification varies from weak to strong in intensity and usually replaces the groundmass. Quartz-sericite is the dominant alteration type when the overall rock alteration is strong. The quartz-sericite is often related to fractures and commonly occurs in pod shaped bodies. In the oxide zone (base of oxidation is at 4314 feet), the quartz-sericite is often coarse-grained. Quartz veinlets (of random attitude) are common in the quartz monzonite and may make up 10% of the rock. The overall intensity of alteration in the quartz monzonite shows no vertical zonation except that below the flat fault (4288-4295 feet), quartz-sericite alteration is not as well developed as above the fault.

Alteration in the schist varies from weak to strong. The main alteration types are silicification and quartz-sericite with lesser amounts of argillization and chloritization. In the upper part of the oxidized zone (above a depth of 4226 feet), the schist is usually strongly altered with the texture only faintly visible and quartz-sericite being the main alteration type. In the lower part of the oxidized zone, the texture is clearly visible and secondary silica and chlorite are the main alteration products. Below the flat fault (4288-4295 feet), the schist is thought to be strongly altered even though fresh(?) biotite is abundant. The fresh looking biotite occurs in thin layers (usually less than 0.5 mm thick) which alternate with thicker layers (1.0 mm or more) of quartz. The banding of the rock does not appear to be the normal schistosity but is probably the result of total recrystallization and probably the addition of secondary silica. Minor argillic and quartz-sericite alteration are found in some of the bands and on cross cutting fractures. From 4471 feet to 4509 feet, the schist is intensely altered with quartz-sericite and argillization (probably in relation to some local strong quartz veining). Quartz veining is common in the schist and abundant in the interval 4321 feet to 4509 feet where over 10% of the rock may be quartz veinlets. No preferred attitude was found for the veinlets. Two or three separate ages of veining were found to be present.

Mineralization above the flat fault (4288-4295 feet) is almost totally oxidized but the leached cavities indicate that the total sulfide content of the rock averaged 1% to 3% by volume. The quartz monzonite appears to have been a slightly better host than the schist for sulfide mineralization. Numerous pods of unoxidized sulfides were found containing pyrite and chalcocite replacing pyrite but no chalcopyrite or bornite were seen. Both sulfides were found on fractures and in disseminations. The better sulfide mineralization is related to the better quartz-sericite mineralization. The chalcocite is unusual in occurrence in that it is shiny and has a good metallic luster. Its color is steel gray but tinges of red are seen on oxidizing edges. Microprobe work has identified minor amounts of hematite occurring with the chalcocite. The chalcocite is definately supergene although partially replaced pyrite or chalcopyrite is not seen.

The bulk of the rock is oxidized and contains limonites which are difficult to interpret. They are hematitic in nature but most do not have the good "live" texture expected from chalcocite. The limonites commonly fill voids and fractures. Intense brecciation which occurred after supergene enrichment appears to have redistributed a certain amount of the limonites and obscured their original nature. In addition, minor amounts of specularite were found which may be contributing hematitic limonites. It is felt that a good portion of the limonites have oxidized from chalcocite and that this leached capping represents a chalcocite blanket from the interior of a porphyry copper deposit. This is evidenced by the amount of chalcocite found in unoxidized remnants and by unoxidized chalcocite filled fractures which can be traced into the oxidized equivalent containg hematitic limonites which are typical throughout the oxidized zone.

Mineralization below the flat fault should not necessarily correlate with that above since lateral displacement has taken place. The rock is oxidized to a depth of 4314 feet. Mineralization below the fault consists of pyrite and bornite with chalcocite replacing both sulfides. Traces of chalcopyrite were found in a quartz monzonite dike (4509-4513 feet). The total sulfide content averages about 1% by volume with pyrite, bornite, and chalcocite occurring in approximately equal quantities. All sulfides are very fine-grained and occur in quartz veinlets and in fine disseminated grains (often in alteration bands in the schist). Mineralization does not appear to favor one rock type over the other. Two short intercepts of locally strong mineralization (see Appendix 1, Log 2: 4480-4490 feet and 4500-4510 feet) were found to be related to strong quartz veining.

Assay results for A-2 are shown with the geologic log (Appendix 1, Log 2). The oxidized upper plate of the slide block averages only 0.06% copper with some erratic values up to 0.30% copper corresponding to unoxidized pods with remnant chalcocite mineralization. The lower plate averages only 0.12% copper from 4295 feet to 4340 feet but the interval from 4340 feet to 4480 feet (140 feet) averages 0.40% copper. The bottom of the hole, 4480 feet to ~~4510~~ 4513 feet, averaged 1.18% copper due to the high grade quartz veins mentioned above. Molybdenum values are anomalous but not high throughout the hole.

Exotic Copper Mineralization

Exotic copper mineralization was found in substantial amounts (often in excess of 0.50% copper) in the lower 1400 feet of the Whitetail conglomerate in drill hole A-4 and in lesser amounts (usually averaging less than 0.15% copper) in drill holes A-2, A-5 and M-1A. The bulk (at least 90%) of the minerlaization is in the form of native copper with cuprite making up most of the remainder. Malachite is found in trace amounts in several holes and chrysocolla with tenorite is well developed in a local area of the limestone slide block in hole A-4.

The bulk of exotic copper mineralization is found in the conglomerate but several occurrences in the older rocks were also seen. The most notable of these is the limestone slide block in A-4 which was well mineralized throughout and contains one thirty foot intercept which averages 10.00% copper. In addition, the replaced and altered limestone beneath the Whitetail in A-4 is mineralized and the quartz monzonite slide block in M-1A contains traces of native copper near the top and base.

The native copper is found as small grains and thin disseminated flecks up to 1.0 mm in diameter and as sheet-type masses which vary in thickness from less than 0.5 mm to about 10 mm. The small grains and flecks are found disseminated in the matrix of the conglomerate, on the interface between the matrix and clasts, and disseminated on fractures in clasts. The sheet-type masses are found wrapped around clast borders, along fractures

in the clasts and to some extent, in the matrix (usually as an extension of a sheet which occurs in or wrapped around a clast). The native copper mineralization is found in or around all types of clasts but certain clast types seem to be favored more than others. Diabase is a good host in holes A-4 and M-1A but schist seems to be preferentially mineralized over diabase in A-2. In drill hole A-2, the schist is mineralized with thin flecks oriented parallel to schistosity while in the other holes, the copper occurs mainly as sheets cross-cutting schistosity. While, in general, schist clasts are fairly well mineralized in A-4, the numerous schist conglomerates near the bottom of the hole are only weakly mineralized compared with the surrounding conglomerate. The most spectacular mineralization occurs in mudstone clasts which are only found below 6000 feet in A-4. Limestone clasts are usually not well mineralized. Isolated occurrences of native copper with calcite, gypsum, or light green clay are also found.

From the above description, it is apparent that the copper was not transported in solid form along with or in the clasts of the conglomerate. Although certain rock types are preferentially mineralized over others, the copper was not seen to be replacing specific minerals within the the clast. The only exception to this rule was found in several mineralized quartz monzonite clasts in which the native copper was found to replace chalcocite.

Cuprite is found as brilliant red crystalline grains and as red earthy material. It usually occurs as a thin paint on clast borders and in the matrix of the conglomerate. The strongly mineralized lithic tuff (5083-5112 feet) in A-4 contains cuprite on fractures and as thick (up to 2.0 mm) coatings around small lithic clasts. In places, a light greenish clay mineral is found with the cuprite. The better cuprite mineralization is restricted to the upper half of the best mineralization in A-4 and in the slide block in A-4.

The mineralization in the limestone slide block is anomalous in nature. Most of the intercept (6339-6448 feet) is brecciated limestone which contains some light green clay in the matrix. Native copper and traces of malachite are found in the matrix and in direct contact with the limestone. A mudstone bed is found from 6386 feet to 6396 feet. It is strongly mineralized with native copper and cuprite and traces of tenorite and malachite. Beneath the mudstone (from 6396 feet to 6408 feet) abundant chrysocolla with minor cuprite and tenorite are found to replace limestone.

Assay results are shown on each geologic log. (All samples are not listed in the logs since the logs were shorted in places to conserve space. All samples are listed in separate assay result reports which can be found in the files. None of the areas which were omitted from the logs containd significant mineralization.) The entire section of Whitetail (2470 feet, including the quartz monzonite slide block) in M-1A averages 0.074% copper. The best intercept of any length (150 feet) occurs in the conglomerate member and averages 0.154% copper. In hole A-2, the entire 1900 foot section of Whitetail averages 0.055% copper and

the best intercept is 624 feet of 0.11% copper. No assays were run from hole A-5 but visual estimates indicate that the Whitetail intersected to date averages less than 0.05% copper. Very encouraging assay results were found in hole A-4. The entire section of Whitetail (4351 feet including the limestone slide block) averages 0.295% copper. The Whitetail above a depth of 5080 feet averages only 0.075% copper while the Whitetail below 5080 feet averages 0.745% copper. A number of good, high grade intercepts are found in the lower section.

The origin of the exotic copper in the Whitetail is an intriguing question. The method of transport of the copper into the Whitetail basin must have been by meteoric waters via oxidation of a large surface deposit or deposits. Deposition of this copper in the Whitetail, in the form of native copper, must have taken a special set of physical and chemical conditions. In his report on this topic, F. T. Graybeal (May 31, 1972) proposes a model for a reasonable set of conditions which would explain this interesting deposit.

The source for the native copper is unknown but several possibilities exist. These are:

1. A porphyry copper deposit which might be burried under the dacite east of the Devils Canyon fault.

2. Any of the deposits in the Castle Dome-Miami-Inspiration complex of porphyry coppers.

3. The Copper Springs alteration zone (southeast of Castle Dome) which may be the eroded root of a large copper deposit.

4. The Ray porphyry copper deposit south of the project area.

EXPLORATION POSSIBILITIES

Three good exploration possibilities exist for the Superior East project. The primary target is still porphyry copper mineralization with significant secondary enrichment. The drilling completed during 1971 and to date in 1972 indicates the probability that such mineralization exists and where it might be found. The alteration and mineralization intersected in the schist in hole A-1 indicates that it may be on the fringe of porphyry copper mineralization at best. The occurrence of altered and mineralized schist and quartz monzonite in the bottom of hole A-4 is difficult to interpret. The low total sulfide content and lack of good alteration or strong pervasive mineralization is discouraging. On the other hand, the porphyritic nature of the rock and the mere presence of this type of alteration and mineralization are significant. In this case it would seem just as valid to argue that this intercept came from near the center of a porphyry copper deposit at depth as it would

be to argue that it came from fringe type alteration. Sections L-L' and E-E' illustrate how this intercept in A-4 might be at least 1000 feet below the eroded surface of the intrusive (and thus, in a deep portion of a potential porphyry copper deposit). The alteration and mineralization found in A-2 is definately from porphyry copper-type mineralization. The leached capping found above the thrust fault probably oxidized from a secondary chalcocite blanket of ore grade from near the center of a deposit. Below the thrust, the unoxidized schist contains marginal mineralization which probably comes from near the edge of the ore zone. The probable configuration of the Schultze granite as shown on Attachment 1 indicates that the leached capping found above the thrust fault in A-2 must have come off the main intrusive mass from the south, southeast, or east. The primary exploration target developed in the current phase of the Superior East project exists to the southeast of drill hole A-2 where porphyry copper mineralization is likely to be found. In addition, the northwestern contact of the Schultze granite between A-4 and DCA-3 is of prime interest for the same reason.

The second major exploration possibility concerns the deeply burried exotic copper mineralization found in hole A-4. In A-4 the interval from 5680 feet to 6540 feet (a total of 860 feet) contains an average of 0.98% copper. The conclusion one can draw from this figure is obvious. This occurrence may be a copper deposit of major magnitude. Since little is known of the origin of this occurrence, it is difficult to estimate a probable size for the deposit. No matter what the mode of origin for this deposit is thought to be, the size of the deposit must be of major proportions.

A third exploration possibility is for bedded replacement deposits in the Paleozoic sediments. The fact that replaced (although unmineralized) sediments are found in A-4 leaves open the possibility that this type of mineralization might be found between Magma's #9 shaft and A-4. In addition, the area around A-5 would hold similar possibilities.

RECOMMENDATIONS

A number of exploration possibilities have been discussed above. Since all three targets would require an extensive amount of deep expensive drilling, the most attractive target should be chosen and drilled. It is felt that the most attractive target at Superior East is in the search for enriched porphyry copper mineralization. It is recommended that further drilling be done in the vicinity of hole A-2 in search for ore grade porphyry copper mineralization. Because of the expense of the drilling, it is recommended that three holes be drilled in the next phase of exploration. These holes should be spaced on a 1500 foot grid and located south, southeast, and east of hole A-2.

RBC:sg
attach.

Robert B. Cummings

FIGURE 2

GENERALIZED GEOLOGY OF DRILL HOLES - SUPERIOR EAST

Thick		Elev.
	A-1	
		4720
1374	Td	
		3346
153	pЄpi-bx	
		3193
39	Tw	
		3154
6	pЄpi-bx	
		3148
557+	pЄpi	
		2591
2129-TD		

Thick		Elev.
	A-2	
		4340
1330	Td	
		3010
690	Tev	
		2320
405	Tw-fg	
		1915
1495	Tw-cgl	
		420
368	Tqm & pЄpi	
		52
225+	pЄpi	
		-173
4513-TD		

Thick		Elev.
	A-4	
		4100
1975	Td	
		2015
158	Tev	
		1967
787	Tw-fg	
		1180
3419	Tw-cgl	
		-2239
109	Me	
		-2348
36	Tw	
		-2384
91	Me	
		-2475
89+	Tqm	
		-2564
6664-TD		

Thick		Elev.
	A-5	
		4020
2274	Td	
		1746
326	Tev	
		1420
399	Tw-fg	
		1021
146+	Tw-cgl	
		875
3145-TD		

Thick		Elev.
	M-1A	
		4500
1900	Td	
		2600
528	Tev	
		2072
492	Tw-fg	
		1580
188	Tqm	
		1382
1790	Tw-cgl	
		-398
210	Ps	
		-608
214+	ℙn	
		-822
5322-TD		

Thick		Elev.
	DCA-1A	
		4760
550	Td	
		4210
1660	Tev	
		2550
2459	Tw	
		91
329	ℙn	
		-238
454	Me	
		-692
316	Dm	
		-1008
45+	pЄt	
		-1053
5813-TD		

EXPLANATION

Post-Mineral Rock Unit

Td - Dacite
Tev - Early Volcanics
Tw - Whitetail
fg - fine-grained member
cgl - conglomerate member

Pre-Mineral Rock Unit

Tqm - Quartz Monzonite
Ps - Supai Formation
ℙn - Naco Limestone
Me - Escabrosa Limestone
Dm - Martin Limestone
pЄt - Troy Quartzite
pЄpi - Pinal Schist
bx - breccia

1. A-1
2. A-2
3. A-4
4. A-5
5. DCA-1A
6. M-1A

TAB

1

GEOLOGIC LOG

PROJECT Superior East
SW1/4, SE1/4, Sec. 2

Page 1 of 2

Drill Hole A-1 | Location T 1 S, R 13 E | Dates Drilled Rotary 4/9/71-4/27/71, Core 7/15/71-8/12/71

Total Depth 2129 | Collar Elevation 4720 | Logged By R. B. Cummings

Depth SURFACE	DESCRIPTION	ALTERATION & MINERALIZATION	From	To	Cu %	Pb %	Zn %	Mo %	Au + Ag	
50	DACITE (Td). Welded ash flow tuff. Abundant fine to med. grained phenocrysts of quartz, feldspar, & biotite in a lt. colored aphanitic groundmass. Lithic clasts & pumice fragments are common. Color of the dacite is orange from the surface to 1100' & brown from 1100' to 1250'. Black vitrophyre occurs from 1250-1297. This unit is black to dark gray volcanic glass w/minor phenocrysts as above. Lt. colored unwelded tuff occurs from 1297-1309.	NOTE: Hole A-1 was drilled to a depth of 1309 by air rotary drilling. The log to this point is based on rotary cuttings. From 1309-2129 the hole was core drilled.								
Column Condensed										
1300	1309 Td. Brn strongly welded vitric tuff. Groundmass dense, hard & aphanitic. Abundant phenocrysts of qtz, plag, sanidine, & biotite. Numerous lithic clasts (up to 2") of dark silicified material. Many clasts are flattened. Tr. chalcedony on fractures.									
	1332 Td. Buff colored weld tuff. Not as strongly welded as above. Groundmass is not as dense as above-contains tiny visible phenocrysts. Phenocrysts & clasts are as above. Soft, gray, non-welded tuff 1473-1473.5. Contact w/pЄpi-bx below is irregular.									
1350	1373.5 CACTUS BRECCIA (pЄpi-bx). Matrix lt. brick red (1373.5-1415) to lt. reddish brn (1415- 95) & very fine grained. Matrix has a silty appearance (most Tw-cgl matrix looks gritty & muddy). Composition of matrix is mainly crushed qtz w/minor feldspar(?), biotite, magnetite & FeOx. Clasts sub-rounded to sub-angular, up to 12" in size, poorly sorted & composed of 95% schist & gneissic schist & 5% Tqm & Tqmp. Abundant alteration of clases: sc-bleached w/up to 1% FeOx → py; Tqm-strong qtz-sericite w/2-4% FeOx → py & cc. Clast:Matris = 60:40 to 70:30. Minor vertical fracturing. Numerous thin soft crumbly zones.	Sparce malachite in matrix & Tqm clasts.	1380	1390	0.18	Tr.	0.01	.0053	Au - Trace, Ag - 0.19 oz/ton	
1400			1390	1400	0.19	Tr	0.01	.0034		
			1420	1430	0.12	0.01	Tr	.0039		
1450										
1500	1495 pЄpi-bx. Similar to bx above but matrix is reddish-brn to brn. Clasts sub-rounded to sub-angular, up to 6", well packed & 100% sc & gn-sc. Schist clasts are not bleached but have traces of FeOx → py. Clast:Matrix = 80:20.		1480	1490	0.03	Tr	Tr	.0012		
	1522 pЄpi-bx. As 1373.5-1495 w/lt. reddish brn matrix but no Tqm clasts.		1510	1520	0.15	0.01	0.01	.0011		
1550	1527 WHITETAIL CGL. (Tw). Water lain lithic tuff. Matrix fine to med grained, brn to gray to H. green & tuffaceous. Clasts angular to sub-rounded up to 3", composed of sc, altered feldspar(?) & jasperoid. Clast:Matrix - 50:50. Bedding-25-45°. Ash flow tuff 1532-35.	Note: Contact @1527 is irregular. Tw below contact is sheared. Contact @ 1566 is also irregular but may be depositional.	1540	1550	0.02	Tr	0.01	.0003		
	1566 pЄpi-bx. Schist bx as 1495-1522.									
	1572 PINAL SCHIST (pЄpi). Fault zone. Str clay gouge w/sc. Clasts 1572-74. Sheared sc w/str gouge zones & transported FeOx. Shearing - 30° to vertical.									
	1585 pЄpi Qtz - sericite sc & qtz-sericite-chlorite sc. Both are fine grained. Qtz-sericite sc is lt. gray, contains less than 10% chlorite & biotite, & is usually only poorly foliated. Qtz-sericite-chlorite sc is gray to dark gray, contains more than 20% chlorite & biotite (minor) & is well foliated -60 °. Both contain disseminated magnetite. Spatial relation between types is irregular & complex. Fracturing str. & random - the rock is shattered. Numerous bx zones occur. Most bx zones are thin (less than 6'). Some thicker as 1630-41 & 1675-88. Bx zones contain some clay gouge. Faults w/rotated clas. in gouge matrix at 1641-51 & 1712-17.	Wk. bleaching of sc.-probably due to argillization along foliation planes. Traces of FeOx → py. Tr. specularite on fractures.	1620	1630	0.02	Tr	0.01	.0032	Composite of all nineteen samples assayed as follows:	
1650			1660	1670	Tr	Tr	Tr	.0009		
1700										

GEOLOGIC LOG

PROJECT Superior East

Drill Hole A-1 Location _____ Dates Drilled _____

Total Depth _____ Collar Elevation _____ Logged By R. B. Cummings

Depth	DESCRIPTION	ALTERATION & MINERALIZATION
1700		
	1717 p€pi. Shattered schist as 1585-1717. Schistosity 60°-90°. Minor white qtz bands (metamorphic). Bx zones not as common as 1585-1717.	Thin (less than 1/4") bands of SiO_2 flooding around fractures. 1/2 to 1% FeOx →py on fractures. ~~Trace py. 1/2-1% py w/qtz veins at~~ 1741-47.
1750		
	1771 p€pi. Shattered schist as 1717-71. Schistosity 30°-90°.	Wk SiO_2 flooding on fractures (favors flat fractures). Minor chlorite on fractures. 1-2% py-most on flat fractures. Minor disseminated.
1800		
	1807 p€pi. Shattered schist as 1717-71. Good bx 1811-23 & 1843-64.	Wk SiO_2 flooding & chlorite on fractures. 1/2% py on fractures & w/qtz veinlets. Tr cpy @ 1877, 1884 & 1887.
1850		
1900		
	1909 p€pi. Shattered schist as 1717-71 but only minor qtz-sericite chlorite sc. Schistosity - 45°to70°	Wk selvages of qtz-sericite on fractures. Chlorite on fractures. Traces of py & cpy (1924-40) on fractures.
	1940 p€pi. Shattered schist as 1909-1940. Numerous thin bx zones 1960-2017.	Wk qtz-sericite veinlets & fracture filling ~~best on flat fractures. Wk chlorite on~~ fractures. 1% py on fractures & veinlets. (1-2% from 1940-55) Traces cpy-best 1940-55. Cpy usually marginal to py.
1950		
2000		
	2018 p€pi. Shattered schist as 1940-2018. Schistosity 60°-90°. Fracturing very strong. Numerous thin bx zones (also bx at 2027-42).	Abundant thin qtz-sericite-chlorite selvages 5-10% qtz veinlets-random. Less than 1/2% py. Tr. cpy. Tr. purple fluorite (?) at 2043.
2050		
2100	2094 p€pi. Shattered schist as 2018-2094.	Abundant thin qtz-sericite-chlorite selvages 5-10% qtz veinlets. 1-2% py & traces cpy on fractures & in qtz veinlets.
	2129 T.D.	
2150		

NOTE: All dips or angles of inclination referred to in this log were measured from a plane at right angles to the axis of the core. The stratigraphic column on the left side of the page is meant to be a graphical representation. Dipping features (contacts, etc.) are shown in their true vertical position on the right side of the column.

ASSAY RESULTS

From	To	Cu%	Pb %	Zn %	Mo%	Au + Ag
1750	1760	0.01	Tr	0.01	.0008	Composite of all nineteen samples assayed as follows: Au - Trace, Ag - 0.19 oz/ton
1820	1830	0.01	Tr	Tr	.0012	
1880	1890	0.01	Tr	Tr	.0009	
1920	1930	0.02	Tr	Tr	.0010	
1930	1940	0.02	Tr	Tr	.0010	
1940	1950	0.06	Tr	0.01	.0135	
1950	1960	0.04	Tr	0.01	.0009	
1960	1970	0.02	Tr	0.01	.0011	
2030	2040	0.02	Tr	Tr	.0014	
2100	2110	0.03	0.01	Tr	.0010	
2120	2129	0.03	Tr	Tr	.0010	

TAB

2

GEOLOGIC LOG

PROJECT Superior East
NE1/4, SE1/4, Sec. 22

Drill Hole A-2 Location T 1 S, R 13 E Dates Drilled Rotary 1/13/72-2/7/72 Core 2/21/72-3/18/72

Total Depth 4521' Collar Elevation 4340' Logged By R. B. Cummings

Depth SURFACE	DESCRIPTION	ALTERATION & MINERALIZATION
	DACITE (Td) welded ash flow tuff. Abundant fine to medium grained phenocrysts of qtz, feldspar, & biotite in a lt. colored aphanitic groundmass. Lithic clasts & pumice fragments are also common. Color is as follows: 0- 720 gray; 720-1120 orange; 1120-1330 brown	
50	A thin vitrophyre unit occurs within the brn dacite from 1225' to 1231'. The vitrophyre is black to dark gray glass w/minor phenocrysts as above. The basal unit of very fine grained unwelded tuff occurs from 1302-1330.	
100	Column Condensed	
1250	NOTE: All dips or angles of inclination referred to in this log were measured from a plane at right angles to the axis of the core. The stratigraphic column on the left side of the page is meant to be a graphical representation. Dipping features (contacts, etc.) are shown in their true vertical position on the right side of the column.	Note: Hole A-2 was drilled by air rotary drilling to a depth of 4075'. This log to that point is from rotary cuttings and spot cores from 2559-74 and 3540-50.
1300		
1330	EARLIER VOLCANICS (Tev). Very fine grained dark gray to black andisitic basalt. Some red to reddish brn andesitic basalt occurs between 1690-1955.	Minor celadonite filled amygdules.
1350	Column Condensed	
2000		
2020	WHITETAIL CONGLOMERATE (Tw). Lithic tuff, mudstone, & minor cgl. Lithic tuff is fine grained & lt. green in color. Mudstone is lt. tan to dark brn, fine grained, somewhat gritty & tuffaceous. Cgl contains mostly sc clasts. Lithic ~~tuff is predominant rock type from 2020-2300.~~	Sparce native Cu in sc clasts.
2050	Column Condensed	
2400		
2425	Tw. Cgl. Matrix tan to brn, fine grained, muddy, gritty & tuffaceous. Clasts 90% sc, & 10% db, qtzite & qm?? Alteration in clasts common.	Traces of native Cu in sc. clasts.
2450		
2500		

ASSAY RESULTS

From	To	Cu %	Weighted Ave. % Cu
1989	2021	Tr	
2021	2052	0.02	2021 — 215' @ 0.01% Cu
2052	2081	0.01	2236 — 732' @ 0.04% Cu
2390	2422	0.03	
2422	2452	0.03	
2452	2484	0.04	
2482	2515	0.04	

GEOLOGIC LOG

PROJECT Superior East

Drill Hole A-2 Location _____ Dates Drilled _____

Total Depth _____ Collar Elevation _____ Logged By R. B. Cummings

Depth	DESCRIPTION	ALTERATION & MINERALIZATION	From	To	Cu %	Mo ppm	Weighted Ave. % Cu
2500	Column Condensed						
			2787	2818	0.05		
2800	2810 Tw. Conglomerate. As 2425 to 2810. But clasts 80% sc, 10% db, & 10% qm & qtzite. Alteration of clasts common to abundant.	Sparce native Cu in sc & db clasts. Sparce malachite and cuprite from 3339-3459.	2818	2848	0.02		732' @ 0.04% Cu
2850			2848	2878	0.05		
	Column Condensed						2968
3400			3400	3429	0.17		
			3429	3459	0.10		
3450	3459 Tw. Conglomerate. Matrix - little or no matrix seen in cuttings. Clasts mostly qmp (fine grained w/some clear qtz eyes). Minor sc. Alteration of clasts is abundant.	Sparce native Cu, cuprite & malachite.	3459	3490	0.07		
3500	NOTE: This interval may be a slide block of qmp.		3490	3522	0.05		624' @ 0.11% Cu
			3522	3550	0.11		
3550	3540 Tw Conglomerate. Matrix is red to reddish brn, fine grained, gritty and tuffaceous. Note: spot core taken from 3540-3550 showed tuffaceous matrix w/ abundant lithic clasts of mudstone & some rounded qtz. Clasts are 90% sc, & 10% qmp. Alteration is common to abundant.	Sparce native Cu, malachite & cuprite.	3550	3561	0.22		
			3561	3592	0.16		
3600			3592	3622	0.05		3592
	Column Condensed						343' @ 0.02% Cu
3900			3904	3935	0.03	26	
3950	3920 QUARTZ MONZONITE PORPHYRY (Tertiary?) (Tqm). Fine to medium grained qtz monzonite porphyry. Visible in cuttings are fine grained plagioclase laths in parallel to sub-parallel allignment, fine grained biotite & some qtz eyes. Some schist inclusions(?).	Mod to strong alteration-silicification, argillic alteration of plagioclase, & coarse grained qtz-sericite. Traces of disseminated specularite & cc.(?).	3935	3964	0.02	21	3935
			3964	3995	0.12	39	
4000			3995	4027	0.03	52	

GEOLOGIC LOG

PROJECT Superior East

Drill Hole A-2 Location _____ Dates Drilled _____

Total Depth _____ Collar Elevation _____ Logged By R. B. Cummings

Depth	DESCRIPTION	ALTERATION & MINERALIZATION
4000–4050	Tqm & Pinal Schist (pCpi). Tqm is lt. tan, med. grained qtz monzonite w/ slight tendancy towards porphyritic text. Plagioclase laths up to 2.0 mm, fine shreddy biotite, minor rounded qtz eyes, & rare irregular k-spar phenocrysts are seen along w/fine grained qtz & feldspar. Miarolitic cavities are common. Fine grain biotite sc from 4110-20. Strong random fracturing. Brecciated-post mineral. Str FeOx on fractures.	Strong alteration. Variable-wk to str qtz-sericite & silicification & mod to str argillization. Qtz-sericite has lt. greenish cast, is often related to fractures & is often coarse grained. Wk to str qtz veinlets. Traces cc; str @ 4075 & 4081-82.5. Tr py on fract & dissem. FeOx→sulf = 1% from 4075-89 & 4110-20. Rest = 2-3% (In part after cc.)
4050–4100	4075	
4100–4150	4120 Tqm & minor pCpi. Tqm probably similar to above. Texture only faintly visible. pCpi is biotite sc inclusion 4158-66. Relict schistosity-20°. Thin Tqm dike-let @ 4163. Very str brecciation. Clasts generally angular-minor rounding. Str FeOx onfractures.	Str. qtz sericite. Str silicification (silf.) & qtz veining from 4120-31. Traces py & cc. (Str-cc on fract. & as thick disseminations-4121-26) 2-3% FeOx→sulfides (cc in part).
4150–4200	4166 Tqm & minor pCpi. Rock types as above. Sc inclusions @ 4182-88 & 4203-08. Well fractured & brecciated (not as str. as 4120-66). Argillized Tqm has sheared & granulated appearance. Fault gouge @ 4203-60°. Flat gouge-bx @ 4203-08.	Mod to str argillization & wk-str qtz-sericite. Wk-str qtz veinlets. Traces of cc. 1-3% FeOx→sulf (cc. in part) Best FeOx→sulf in qtz-sericite.
4200–4250	4208 Tqm & pCpi. (equal volume of Tqm & pCpi) Tqm @4226-32, 36-43, & 48-75. Tqm as above except 4226-32 which is fine grained w/aplitic texture. Contacts between Tqm & pCpi are intrusive-40°-70° & bx. pCpi is as above. Schistosity is flat to gentle. Str fracturing & brecciation in both rocks. Some rounding of clasts. Tqm sheared & granulated. Gouge-bx zone 4260-62.	Mod to str argillization & silicification(silf) w/wk qtz-sericite in Tqm. Wk-str silf. in sc.-biotite in part replaced by chlorite & may be rxl'ized. Silf. occurs as bands (may be rxl'ized.) between bands of biotite. Mod-str qtz veining. Traces of specularite. FeOx→sulf is 1% or less from 4208-62, 3-5% @ 4262-75, & 1-2% @ 4275-88.
4250–4300	4288 pCpi. Sc as above. Flat Fault Zone. Str gouge-bx @4288-90. Str gouge @ 4290-91. This zone marks the base of intense oxidation & brecciation.	Schist altered as above w/1-2% FeOx→sulfides.
4300–4350	4295 Tqm as above (see description 4075-4120) from 4295-4314. Shearing & crushing common. From 4314-21 Tqm is salmon colored & fine grained w/2% biotite & 5-10% k-spar(?) up to 3.0 mm in an aphanitic groundmass. This rock is not sheared Neither rock is brecciated. Only traces of oxidation below 4314.	Mod to str argillization 4295-4314. Wk argillization 4314-21. Traces of qtz-sericite on fractures. Trs. of py, cc & specularite. Local str cc & 1% FeOx-sulf from 4295-4314
4350–4400	4321 pCpi w/minor Tqm. Biotite sc as above. Relict schistosity dips 40-90°. Tqm is lt. tan & med grained as described in interval 4075-4120. Dikes at 4334-42 & 4410-17 (upper contact dips 50° & lower contact dips 80°). Several thin (1') dikelets occur throughout interval. Rocks are fractured but not brecciated.	Str silf. in sc. Biotite has been recrystallized (?) & crowded into thin layers (most are <.5mm) which alternate w/thicker layers(1.0mm) of secondary & recrystallized qtz. Minor clays & sericite are found in some bands. Local str qtz-sericite is found. Qtz veining abundant. 2 or 3 ages of veining are present. Veinlets are usually <.5 cm. Tqm wk to str argillic & minor qtz-sericite alteration, 1/2 -2%. Py, bor (below 4342) & cc are found. Cc is replacing py & bor. Py & bor are in veinlets & alteration bands.
4400–4450		
4450–4500	4471 pCpi w/minor Tqm. Rock types as above 4321-4471. Tqm @ 4409- . Well fractured. gouge-bx w/rounded clasts @ 4498-4500. Fault-Bx (well cemented) @4504-70°. Gouge Bx as 4498-4500 @ 4505-09.	Str qtz-sericite, argillization & silf. Str qtz veinlets esp 4485-89. 1-2% py, cc, & bor w/tr cpy (?) in Tqm. Sulfides in qtz veinlets & disseminated esp in qtz-sericite. Very str cc @ 4434-89. & bor. @ 4505

ASSAY RESULTS

From	To	Cu%	Mo%	Au+Ag oz/ton	Weighted Ave. %Cu
4027	4055	0.04	66		
4055	4076	0.04	89		
4076	4978	0.16	36		
4078	4080	0.18	11		
4080	4090	0.14	14		
4090	4100	0.01	26		
4100	4110	0.02	30		
4110	4120	0.05	12		
4120	4130	0.30	24		
4130	4140	0.01	33		
4140	4150	0.01	16		
4150	4160	0.01	34		
4160	4170	0.01	21		405' @ 0.06% Cu
4170	4180	0.07	32		
4180	4190	Trace	17		
4190	4200	0.06	14		
4200	4210	0.01	20		
4210	4220	0.16	53		
4220	4230	0.26	25		
4230	4240	Trace	23		
4240	4250	0.01	15		
4250	4260	0.01	14		
4260	4270	0.01	32		
4270	4280	0.01	23		
4280	4290	0.01	8		
4290	4300	Trace	17		
4300	4310	Trace	11	4300	
4310	4320	0.22	11		
4320	4330	0.20	12	Tr Au	
4330	4340	0.11	12	.07 Ag	4340
4340	4350	0.37	8		
4350	4360	0.63	12	4350	
4360	4370	0.39	8		
4370	4380	0.40	16	Tr Au	
4380	4390	0.36	11	.04 Ag	
4390	4400	0.35	118		
4400	4410	0.42	14	4400	
4410	4420	0.51	7		140' @ 0.40% Cu
4420	4430	0.31	24	Tr Au	
4430	4440	0.35	20	.10 Ag	
4440	4450	0.27	5		
4450	4460	0.33	12	4450	
44-0	4470	0.48	67		
4470	4480	0.49	16	Tr Au	
4480	4490	2.40	6	.10 Ag	4480
4490	4500	0.42	7		

GEOLOGIC LOG

PROJECT Superior East

Drill Hole A-2 Location _____ Dates Drilled _____

Total Depth _____ Collar Elevation _____ Logged By R.B. Cummings

Depth	DESCRIPTION	ALTERATION & MINERALIZATION	ASSAY RESULTS From	To	Cu %		Mo ppm			Weighted Ave. % Cu
4500	See last page.		4500	4510	1.01		18			4510 30' @ 1.28% Cu
	4513 T.D. NOTE: HOLE drilled to 4521', with the last eight feet lost in hole along with core barrel and some rods.									
4550										

TAB

3

GEOLOGIC LOG

PROJECT Superior East
SW1/4, SW1/4, Sec. 27

Drill Hole A-4 | Location T 1 S, R 13 E | Dates Drilled Rotary 5/1/71-7/21/71, Core 8/17/71-11/7/71

Total Depth 6664' | Collar Elevation 4100 | Logged By R.B.Cummings

Depth SURFACE	DESCRIPTION	ALTERATION & MINERALIZATION	ASSAY RESULTS From	To	Cu %					Weighted Ave. % Cu
	DACITE (Td). Welded ash flow tuff. Abundant fine to medium grained phenocrysts of quartz feldspar & biotite in a lt. colored aphanitic groundmass. Lithic clasts & pumice fragments are also common. Color is as follows: 0 - 570 - gray; 570 - 1030 - orange; 1030 - 1975 - brown									
50	Two thin vitrophyre units occur at 1772-76 & 1970-75. They consist of black to gray glass w/minor phenocrysts as above.	NOTE: All dips or angles of inclination referred to in this log were measured from a plane at right angles to the axis of the core. The stratagraphic column on the left side of the page is meant to be a graphical representation. Dipping features (contact, etc.) are shown in their true vertical position on the right side of the column.								
Column Condensed										
1900										
1950										
	1975 EARLIER VOLCANICS (Tev). Andesitic basalt. Dark gray to blk & very fine grained.									
2000										
2050										
2100										
2150	2133 WHITETAIL CONGLOMERATE (Tw). Mudstone, conglomerate & minor limestone. Mudstone, fine grained, muddy, gritty & slightly limy (tuffaceous in part). Conglomerate w/brn. mudstone matrix & schist (sc), qtz monzonite (qm), white to lt. gray limestone (probably as thin beds).	Sparce to trace native Cu in matrix & clasts.								
2200										
Column Condensed			2212	2236	0.01					2212 — 573' @ 0.05% Cu
2300			2898	2920	0.18					2785
	2920 Tw. Cgl. Matrix fine grained, muddy & gritty. Clasts 80% sc, 15% db, & 5% qm. Minor alteration in clasts.	Sparce to traces of native Cu in matrix & clasts.	2920 2928	2928 2958	0.12 0.13					353' @ 0.12% Cu
2950										

GEOLOGIC LOG

PROJECT Superior East

Drill Hole A-4 Location _____ Dates Drilled _____

Total Depth _____ Collar Elevation _____ Logged By R.B. Cummings

Depth	DESCRIPTION	ALTERATION & MINERALIZATION
2950	Column Condensed	
	NOTE: Coring started at 3593. To this point the log was intrepretted from rotary cuttings and spot cores at 2703-37 and 3092-3119.	
3550		
3600	3593 Tw. Unsorted cgl. Matrix fine grained, dark brn to gray-brn, gritty, muddy & slightly limy in spots. Clasts-subrounded to sub-angular, from grit to +8" in size, & composed of 85% sc & 15% db. Minor alteration in clasts (epidote in db & 2-4% FeOx →py. in sc). Clast:Matrix = 60:40 w/several well packed zones (80:20) at 3593-99 & 3637-41. Reddish brn matrix 3641-42.	Sparce native Cu in matrix & clasts.
3650	3642 Tw. Poorly sorted cgl. Matrix as above. Clasts as above but composed of 80% sc, 20% db & traces of qm. Altered clasts common (20% of the sc). Clast:Matrix = 60:40. Several thin zones of well sorted, well packed cgl are present. Clasts are no larger than 2" and clast:Matrix = 80:20. Matrix from 3804-08 is light gray & tuffaceous.	Sparce native Cu.
3700		
3750		
3800	3808–3810 Tw. Lithic tuff. Very fine grained, lt. gray ashy material w/30% lithic (sc & db) clasts up to 2". Dip - 0°.	
	Tw. Poorly sorted cgl. Matrix - fine grained, dk brn to gray brn, gritty & muddy. Clasts sub-rounded to sub-angular, from grit to 8" in size & composed of 80% sc, 20% db & traces of qm & qtzite. Alteration of clasts-minor. Clast:Matrix = 60:40 w/minor 80:20 zones. Lithic tuff 3976-84 w/fine grained tuffaceous matrix & 30% clasts.	Sparce native Cu.
3850		
3900		
3950		
4000	3990 Tw. Poorly sorted cgl. Matrix-finegrained, reddish brn to brnish gray, muddy & gritty. Clasts - sub-rounded to sub-angular, up to 12' in size & composed of 70% sc, 20-25%	Sparce native Cu.

ASSAY RESULTS

From	To	Cu %					Weighted Ave. % Cu
2958	2969	0.10					
							—3138'—
3549	3569	0.08					
3569	3593	0.07					455' @ 0.06% Cu
3593	3610	0.09					—3593'—
3690	3710	0.05					
							1487' @ 0.08% Cu
3790	3810	0.05					
3890	3910	0.06					
3990	4010	0.18					

GEOLOGIC LOG

PROJECT Superior East

Drill Hole A-4 Location _____ Dates Drilled _____

Total Depth _____ Collar Elevation _____ Logged By R.B. Cummings

Depth	DESCRIPTION	ALTERATION & MINERALIZATION	ASSAY RESULTS From	To	Cu %	Weighted Ave. % Cu
4000	db & 5-10% qtzite & Barnes Cg. Minor alteration of clasts. Clast:Matrix = 60:40. Bedding - 0°.					
	4028 Tw. Poorly sorted cgl. Matrix fine grained, dark brn to gray brn, muddy, gritty & ashy (in spots). Clasts as above w/traces of andesite porphyry. Clast:Matrix = 60:40. Well sorted & well packed 4071-83.	Sparce native Cu.				
4050						
4100			4090	4110	0.05	
4150	4149 Tw. Poorly sorted cgl. As above w/lt. brn to gray ashy matrix.					
	4161 Tw. Cgl. Matrix fine grained, dark brn to gray brn, muddy & gritty. Clasts-sub-rounded to sub-angular, up to 18' in size, composed of 60% sc, 25% db, 15% qtzite & Barnes Cg. (Apache Group), & traces of qm-and. por. Minor alteration of clasts. Sorting & packing generally poor - Clast:Matrix = 60:40 but well packed & sorted zones are present: 4173-80, 4271-74 & 4381-98. ~~Fine grained lithic tuff 4201.5-4203. Bedding - of tuff 0°,~~ @ 4366 - 20°.	Sparce native Cu.				
4200			4190	4210	0.09	
4250						1487' @ 0.08% Cu
4300			4290	4310	0.05	
4350						
4400	4398 Tw. Poorly sorted cgl. Matrix-fine grained, brn to gray brn, gritty, muddy & ashy. Strong ash matrix: 4441-56. Clasts - sub-rounded to sub-angular, up to 14" in size and composed of 30% sc, 40% db & 30% Apache group. Clasts unaltered. Clast:Matrix = 60:40 except 4421-29 - 80:20.	Sparce native Cu.	4390	4410	0.05	
4450	4456 Tw. Poorly sorted cgl. Matrix - fine grained, brn to dark brn, muddy & gritty. Clasts - sub-rounded to sub-angular, up to 18" & composed of 45% db, 30% sc, 25% Apache group & ls, & traces of qm. Trace altered clasts. Clast:Matrix = 60:40 except well packed zones @ 4533-37, 4569-75 & 4581-88. These zones have rounded clasts & larger amount of sc than above. Strong red matrix with specularite @ 4600-04.	Sparce native Cu.				
4500			4490	4510	0.04	

NOTE: This is the first occurrance of ls. clasts.

GEOLOGIC LOG

PROJECT Superior East

Drill Hole A-4 Location _____ Dates Drilled _____

Total Depth _____ Collar Elevation _____ Logged By R. B. Cummings

Depth	DESCRIPTION	ALTERATION & MINERALIZATION	ASSAY RESULTS From	To	Cu %	Weighted Avg. % Cu
4500						
4550						
4600	4604 Tw. Poorly sorted cgl. Matrix fine grained, dark brn to lt. reddish brn, muddy & gritty. Clasts - sub-rounded to sub-angular up to 12", & composed of 40% db, 35% Apache group & ls, & 25% sc. Trace altered clasts. Clast:Matrix = 60:40 to 70:30.	Sparce native Cu.	4590	4610	0.16	
4650	4656 Tw. Cgl. Matrix as above but lt. brn. Clasts sub-rounded to sub-angular, up to 8" & composed of 40% db, 40% sc, & 20% Apache group & ls. Minor altered clasts. Well packed & some good sorting (clast 2"). Clast:Matrix - 70:30 to 80:20. Strong fracturing 4673-80. ~60°-90°. White gypsum on fractures.	Sparce native Cu. Native Cu w/gypsum in vug @ 4675.				
4700	4700 Tw. Cgl. Matrix fine grained, gray to dark gray-brn, muddy, gritty & somewhat ashy. Clasts sub-rounded to sub-angular, up to 18", composed of 45-60% db, 20-35% sc, 20% Apache group & ls, & traces qm. Minor altered clasts. Clast:Matrix is generally 60:40 to 70:30 but 80:20 also occurs in well sorted well packed zones - 4765-70, 4834-40, 4887-93, 4933-35, & 4942-71. Steep fractures (+70°) with red transported FeOx (cuprite also?) & gypsum @ 4755-57 & 4890-98. Bedding - 15° @ 4936.	Sparce native Cu w/gypsum @4755-57. Sparce cuprite?? w/FeOx.	4690	4710	0.06	
4750						
4800			4790	4810	0.04	1452' @ 0.08% Cu
4850						
4900			4890	4910	0.20	
4950						
5000	4971 Tw. Poorly sorted cgl. Matrix fine grained, dark gray to brn w/local reddish areas, muddy, & gritty. Clasts as above but 60% db, 20% sc & 20% Apache group & ls. Minor alteration of clasts. Clast:Matrix = 60:40 to 70:30.	Sparce native Cu.	4990	5010	0.07	

GEOLOGIC LOG

PROJECT Superior East

Drill Hole A-4 Location _____ Dates Drilled _____

Total Depth _____ Collar Elevation _____ Logged By R.B. Cummings

Depth	DESCRIPTION	ALTERATION & MINERALIZATION
5000		
5050		
5100	5083 Tw. Lithic tuff & cgl. Tuff very fine grained, lt. gray w/5% biotite & qtz fragments. Abundant lithic clasts including sc, db & black silicified material. Bedding 0-15°. Cgl- 5102-08. Gray, gritty, tuffaceous matrix w/clasts up to 6" - 45% sc, 35% db & 20% sediments. Clast:Matrix = 60:40.	Str. cuprite 5083-5108. Cuprite is crystalline & earthy on fractures w/qtz & gypsum, disseminated in matrix & on borders of clasts. wk native Cu 5102-08(cgl
5150	5112 Tw. Poorly sorted cgl. Matrix dark reddish brn, fine grained, muddy & gritty. Clasts-subrounded to sub-angular, up to 8", composed of 45% sc, 35% db, & 20% sediments. Trace alteration in clasts. Clast:Matrix = 60:40. Minor, thin well packed zones.	Variable but strong cuprite & native Cu. Cuprite mainly on clast borders, sometimes with greenish clay. Native Cu disseminated in matrix & clasts (mostly db) & on fractures in db & sc. Traces of malachite @ 5260 & 5302.
5200		
5250		
5300		
5350	5336 Tw. Poorly sorted cgl. Matrix fine grained, brownish red, gritty& muddy. Clasts subrounded to sub-angular up to 8" composed of 70% sc, 15% db & 15% sediments. Minor altered clasts. Clast:Matrix - 70:30.	Sparce cuprite & native Cu.
5400	5352 Tw. Schist cgl. Matrix fine grained brownish-red, gritty & slightly muddy. Clasts tabular shaped, angular to sub-angular, up to 6" well sorted, well packed & composed of +99% sc & trace qtz porphyry. Alteration common in clasts mostly wk silicification w/traces of FeOx → py. Clast:Matrix = 80:20. Bedding @ 5399-10°.	Sparce native Cu from 5535-50.
5450		
5500		

ASSAY RESULTS

From	To	Cu %	Cu Ox %	Au & Ag	Weighted Avg. % Cu
5010	5030	0.07			
5030	5050	0.07			
5050	5070	0.06			
5070	5080	0.03	0.01		
5080	5090	1.36	1.01	5080	5080
5090	5100	1.24	0.93		
5100	5120	1.17	0.66		
5120	5140	0.31	0.07	Composite .002 oz/ton Au 0.10 oz/ton Ag	
5140	5160	0.93	0.34		
5160	5180	0.57	0.27		
5180	5195	0.19	0.04	5180	270' @ 0.89% Cu
5195	5215	1.38	0.90		
5215	5230	0.93	0.49		
5230	5250	0.83	0.59		
5250	5270	0.97	0.35		
5270	5290	0.81	0.46		
5290	5310	0.91	0.44		
5310	5330	1.22	0.65		
5330	5350	0.79	0.40		
5350	5370	0.15	0.10		5350
					330' @ 0.08% Cu
5440	5460	0.06			

GEOLOGIC LOG

PROJECT Superior East

Drill Hole A-4 Location _____ Dates Drilled _____

Total Depth _____ Collar Elevation _____ Logged By R.B. Cummings

Depth	DESCRIPTION	ALTERATION & MINERALIZATION
5500		
5550		
5600	5592 Tw. Schist Cgl w/ minor "typical" cgl. Schist Cgl as 5352-5592 but clasts are composed of 90% sc, 5% qtz por. & 5% db. Abundant alteration is present - most is weak but some str alteration w/FeOx → cc & traces of cc occur in sc & qtz por. (qp). "Typical" cgl has dark brn, fine grained gritty & muddy matrix w/poorly sorted, sub-rounded to sub-angular clasts & a Clast:Matrix = 60:40 to 70:30. The main feature which differentiates horizons of "typical" cgl is clast composition. The typical cgl in this case occurs at 5644-56. The clasts are composed of 40% db, 30% sc, 20% sediments & 10% qtz por. (qp). Minor alteration	Traces native Cu & cuprite @ 5649-56 (in "typical" cgl.)
5650		
5700	5687 Tw. Cgl. "Typical" but better packing than most cgl above. Clast:Matrix = 70:30. Matrix dark brn & typical (see above) Clasts 50% db, 30% sc, 10% sediments, 10% qp. Abundant alteration.	Strong native Cu. Some thick sheets on clast borders.
	5707 Tw. Schist cgl. As 5592-5687.	Sparce native Cu.
	5717 Tw. "Typical" cgl as 5687-5707 w/30% sc, 30% db, 30% sediments & 10% qp. Alteration minor. Some light green clay in matrix.	Moderate native Cu. Weak cuprite.
	5736 Tw. Schist cgl. As 5592-5687.	Sparce native Cu.
	5740 Tw. Cgl-typical. As 5687-5707 but only minor alteration of clasts.	Strong native Cu. Sparce cuprite.
5750		
	5783 Tw. Schist cgl. As 5592-5687	Sparce native Cu.
5800	5800 Tw. Cgl-typical. As 5740-83.	Strong native Cu.
	5813 Tw. Schist cgl. Matrix fine grained, dark reddish brn, gritty & muddy. Clasts sub-rounded to sub-angular (not tabular & angular as schist cgl above this point), up to 6" in size, well packed, & composed of 90% sc, & 10% db & qp. Abundant alteration in clasts w/some strong qtz-sericite & some strong cc. Clast:Matrix = 80:20.	Strong native Cu.
5850		
5900		
	5923 Tw. Schist cgl. Matrix fine grained, dark reddish-brn, gritty & muddy. Clasts sub-rounded to sub-angular, up to 8", composed of 85% sc, 10% db & 5% qp. Abundant alteration of clasts. Clast:Matrix = 70:30. Toward base 6004-6019 matrix become dark maroon in color & sc content drops to 75% of clasts.	Traces of native Cu. Some Cu occurs w/ light green clay.
5950		
6000		

ASSAY RESULTS

From	To	Cu %	Weighted Ave. % Cu
5520	5540	0.05	
			300' @ 0.08% Cu
5630	5640	0.03	
5640	5650	0.27	
5650	5660	0.65	
5660	5670	0.04	
5670	5680	0.04	
5680	5700	1.42	5680
5700	5710	0.77	
5710	5720	0.57	
5720	5730	1.18	
5730	5740	0.13	
5740	5750	0.75	
5750	5760	0.25	
5760	5770	1.40	
5770	5780	1.40	
5780	5790	0.62	130' @ 0.86% Cu
5790	5800	0.06	
5800	5810	1.23	
5810	5820	0.27	
5820	5830	0.09	
5830	5840	0.03	
5840	5850	0.03	
5850	5860	0.04	
5860	5870	0.07	5810
5870	5880	0.03	
5880	5890	0.03	
5890	5900	0.04	
5900	5910	0.16	
5910	5920	0.06	160' @ 0.16% Cu
5920	5930	0.08	
5930	5940	1.07	
5940	5950	0.14	
5950	5960	0.16	
5960	5970	0.25	
5970	5980	0.47	5970
5980	5990	0.63	
5990	6000	0.13	

GEOLOGIC LOG

PROJECT Superior East

Drill Hole A-4 Location _____ Dates Drilled _____

Total Depth _____ Collar Elevation _____ Logged By R.B. Cummings

Depth	DESCRIPTION	ALTERATION & MINERALIZATION
6000		
	6019 Tw. Cgl-typical w/some muddy sections in matrix. Clasts - 50% db, 20% sc, 20% sediments (mostly brn mudstone) 10% qp & dark aphanitic andesitic basalt(?). Alteration minor to common. Note: this is the first major occurrence of mudstone clasts	Strong native Cu. Some very strong occurrences on clast borders and in mudstone. Some greenish clay.
	6041 Tw Schist cgl. Matrix fine grained, dark maroon, gritty to shaley. Clasts well sorted, sub-rounded to sub-angular & 90% sc & 10% db. Alteration abundant. Clast:Matrix + 80:20.	Sparce native Cu.
6050	6068 Tw. Poorly sorted cgl. Matrix fine grained, brn, gritty & very muddy (str muddy nature of the matrix may be due to the presence of mudstone or shale clasts). Clasts sub-rounded to sub-angular up to 8", & composed of 40% db, 30% sc, 20% mudstone or shale (including minor qtzite & ls.) & 10% qp & andesite. Alteration in clasts is minor to common. Clast:Matrix = 70:30.	Strong native Cu. Very strong on fractures in mudstone or shale clasts. Some greenish clay w/Cu.
6100		
	6129 Tw. Poorly sorted cgl. Matrix, fine grained, gray-brn to gray, gritty & muddy (not strongly muddy as above). Clasts similar to above but 50% db, 25% sc, 15% sediments & 10% qp & ~~andesite. Alteration of clasts minor but some strong. Clast:Matrix - 70:30 to 60:40.~~ Bedding 10°-15°.	Traces of native Cu.
6150		
6200		
	6245 Tw. Poorly sorted cgl. Matrix as above but color changes to reddish-brn from 6330-39. Clasts sub-rounded to sub-angular up to 8" & composed of 30% db, 30% sc, 30% sediments (including mudstone, qtzite & ls.) & 10% qp. Alteration is common esp. in qtzite & sc. Clast:Matrix = 60:40 to 70:30. Bedding 15° - 20° @ 6252-6278.	Trace to moderate native Cu.
6250		
6300		
	6339 Contact - irregular. Transported FeOx 6337-39. ESCABROSA LIMESTONE (Me). lt. to dark gray, fine to medium grained & slightly dolomitic in spots. ~~Strongly fractured & brecciated. Fractures generally steep. Brecciation produced~~ angular clasts of ls in a reddish to lt. grn matrix filling spaces between larger fractured blocks. Matrix is reddish & greenish sheared clay material. Clast:Matrix = 95:5.	Moderate to str. native Cu in clay-rich matrix. Traces of py in ls. Traces of malachite in ls & matrix. minor white clacite filling fractures.
6300	6386 Me. Brn shale-mudstone. Very fine grained & clay-rich. Several pods of ls & silicified ls. ~~Strong shearing & steep fracturing. Secondary calcite on steep fractures.~~	Very str. native Cu & cuprite on fractures in pods&w/calcite. Tr.tenorite, malachite.
6400	6396 Me. Ls & dolomitic ls. Lt to dark gray, fine to medium grained ls & dolomitic ls (6423-37). str brecciation. Clasts angular & up to 6". Matrix crushed CO_3 w/clay & FeOx. Clast: Matrix = 90:10. Faults str FeOx, 70° @ 6422-23 & 6437-38.	Very str. chrysocolla w/minor cuprite & tenorite replacing ls @ 6396-6408. Wk. native Cu in Bx matrix.
	6438 Me. Siltstone. Lt gray, fine grained, thinly bedded. Detrital magnetite common. Strongly brecciated. Angular clasts up to 3". Matrix (6% of rock) is crushed rock & FeOx.	Rock recrystallized. Wk native Cu in matrix.
6400	6448 Tw. Poorly sorted cgl. Matrix fine grained, reddish brn & gray brn (6451-60) gritty & muddy. Clasts angular to sub-rounded, up to 36", 60% ls, 20% qp, 15% db & 5% specularite. Alteration common. Bedding 0°-10°. Str shearing. Upper contact-irregular & faulted-sheared. Lower contact-irregular, depositional.	Strong native Cu.
	6484 Me. Limestone - thoroughly replaced by metallic hematite, specularite, & red earthy hematite.	Ls replaced by metallic hematite, specularite.
6500		

ASSAY RESULTS

From	To	Cu %					Weighted Ave. % Cu
6000	6010	0.19					
6010	6020	0.39					
6020	6030	3.81					
6030	6040	1.91					
6040	6050	0.11					
6050	6060	0.04					
6060	6070	0.18					
6070	6080	0.94					170' @ 1.12% Cu
6080	6090	2.15					
6090	6100	1.91					
6100	6110	2.04					
6110	6120	2.38					
6120	6130	1.32					
6130	6140	0.36					
6140	6150	0.19					—6140—
6150	6160	0.29					
6160	6170	0.26					
6170	6180	0.44					
6180	6190	0.60					
6190	6200	0.14					
6200	6210	0.45					
6210	6220	0.76					190' @ 0.35% Cu
6220	6230	0.47					
6230	6240	0.65					
6240	6250	0.38					
6250	6260	0.19					
6260	6270	0.31					
6270	6280	0.36					
6280	6290	0.23					
6290	6300	0.30					
6300	6310	0.26					
6310	6320	0.19					
6320	6330	0.11					
6330	6340	1.05					—6330—
6340	6350	0.68					
6350	6360	1.09					
6360	6370	0.59					
6370	6380	1.06					
6380	6390	0.15	1.17				210' @ 2.14% Cu
6390	6400	13.20	5.47				
6400	6410	8.65	7.72				
6410	6420	0.10					
6420	6430	0.24					
6430	6440	0.57					
6440	6450	1.09					
6450	6460	0.57					
6460	6470	0.84					
6470	6480	0.36					
6480	6490	1.26					
6490	6500	0.72			6490		

GEOLOGIC LOG

PROJECT Superior East

Drill Hole A-4 Location _____ Dates Drilled _____

Total Depth _____ Collar Elevation _____ Logged By R.B. Cummings

Depth	DESCRIPTION	ALTERATION & MINERALIZATION
6500	Minor remnants of strongly silicified ls.	and red earth hematite. Str FeOx→ sulfide in silicified remnants. Wk to str native Cu on steep fractures.
6550	6539 Me. Limestone. Fine grained & lt. colored. Silicified very fine grained (rock may be siltstone). Very str. fracturing (+60°) & brecciation. Mylonitized. Matrix (5% of rock (is red & gritty. Bedding is about 20°.	Trace to wk native Cu.
	6563 FAULT ZONE. Complex zone w/included Me, Tqm & pЄpi. See detailed description below.	Str. chalcocite 6571-75 (cemented fault gouge).
	6580 PINAL SCHIST (as root pendant) & Tqmp. Sc is dark gray, fine grained, biotite-chlorite-sericite sc. Schistosity 40°-60°. Tqmp is med grained & gray in color w/phenocrysts (80% of rock) of plag. qtz (some as eyes) biotite & K-spar. Gdmass.is gray aphanitic. Tqm intrudes sc as thin dikes and assimilates sc. Str fracturing(steep) & some fault bx as 6587-88 & 6610-45°	Wk silicification & chloritization of sc. Wk argillization of Tqmp. Minor irregular qtz veinlets. Wk py, cpy & Mo. disseminated & w/qtz veinlets (mostly in sc) str cpy in qtz vein @ 6605.
6600	6610 TERTIARY QUARTZ MONZONITE PORPHYRY.(Tqmp) gray, med. grained porphyry. Pehnocrysts (80% of rock) are plagioclase 75%, Qtz-15%, (Some good "eyes" esp below 6654) Biotite 5-10% (crowded around other grains) & K-spar 5%. Groundmass (20% of rock) is gray & aphanitic.	Wk to moderate argillization of plag. Wk chloritization of biotite. Wk thin qtz veinlets. Salmon colored "Limonite dusting" is associated w/qtz veinlets & stains qtz & plagioclase. Dusting is str below fault at 6644. Traces of py, cpy, mo & specularite along fractures & qtz veinlets. Only minor dissemination.
6650	6664 T.D. Strong fracturing 45-90°. Fractures are often coated w/chlorite. Faults with shearing & cemented fault gouge at 6636-38 (25°-45°); 1/4" granulated sericite & sulfides at 6644 (45°).	
6700		

EXPANDED DESCRIPTION OF THE INTERVAL 6563-6580

Fault zone with included Me, pЄpi & Tqmp. 6563-65 - Ls Bx similar to above with str FeOx & cataclastic texture (20-70°). 6565-66 strly sheared & welded chloritic zone (30°). 6566-71 replaced ls as 6484-6539.6571-75 cemented fault gouge w/clasts of sc & cc(4-6%). Cataclastic texture- 30°-90°. Contacts: upper-65°; lower-50°. 6575-80 sheared Tqm (& pЄpi?) w/ gouge. Rounded clasts w/sheared seams of chlorite - flat to steep in dip.

ASSAY RESULTS

From	To	Cu %		Mo %	Au & Ag		Weighted Avg. % Cu
6500	6510	1.16			Composite		
6510	6520	0.69			.003 oz/ton		
6520	6530	0.28			Au, 0.13 oz/		
6530	6540	2.55			ton Ag		
6540	6550	0.09			6540		—6540—
6550	6560	0.47					30' @
6560	6570	0.07					0.21% Cu
6570	6580	1.58					—6570—
6580	6590	0.14		.0044	6580		—6580—
6590	6600	0.20		.0122			
6600	6610	0.81		.0045	Composite		
6610	6620	0.05		.0026	.002 oz/ton		84' @
6620	6630	0.04		.0018	Au, 0.10 oz/		0.16% Cu
6630	6640	0.03		.0023	Ton Ag		
6640	6650	0.04		.0012			
6650	6660	0.05		.0040			
6660	6664	0.05		.0023	6664		—6664—

TAB

4

GEOLOGIC LOG

PROJECT Superior East
SE1/4, NW1/4, Sec. 28

Drill Hole A-5 Location T 1 S, R 13 E Dates Drilled Rotary 7/28/71-8/28/71

Total Depth 3145 Collar Elevation 4020 Logged By R. B. Cummings

Depth SURFACE	DESCRIPTION	ALTERATION & MINERALIZATION
	DACITE (Td). Welded ash flow tuff. Abundant fine to med. grained phenocrysts of qtz, feldspar, & biotite in a lt. colored aphanitic groundmass. Lithic clasts & pumice fragments are also common. Color is as follows: 0 to 625 - gray 625 to 1857 - orange ~~1857 to 2159 - brown~~ 2159 to 2274 - cream Black vitrophyre occurs w/the brn dacite from 2099-2159. The cream colored tuff from 2159-2274 is the basal non-welded unit. It is fine grained to very fine grained w/ composition as above.	NOTE: All dips or angles of inclination referred to in this log were measured from a plane at right angles to the axis of the core. The stratigraphic column on the left side of the page is meant to be a graphical representation. Dipping features (contact, etc.) are shown in their true vertical position on the right side of the column.
50		
100		
Column Condensed		
2200		NOTE: A-2 was drilled to a depth of 3145 by rotary mud drilling. This log is based on rotary cuttings.
2250		
2274	EARLIER VOLCANICS (Tev). Andesitic basalt & crystal tuff. Andesitic basalt is very fine grained & dark gray to black in color. Crystal tuff is lt. gray to lt. green in color & fine grained. Predominant crystal fragments are qtz & biotite w/greenish altered feldspar (?). Crystal tuff occurs mainly from 2490-2600 but also as thin beds within the andesitic basalt.	Minor chalcedony.
2300		
2350		
Column Condensed		
2550		
2600		
2600	WHITETAIL CONGLOMERATE (Tw). Mudstone, fine grained, brown to reddish brn in color & tuffaceous in part. Probably some thin cgl beds in this interval.	Sparce native copper.
2650		
2700		

GEOLOGIC LOG

PROJECT Superior East

Drill Hole A-5 Location _____ Dates Drilled _____

Total Depth _____ Collar Elevation _____ Logged By R. B. Cummings

Depth	DESCRIPTION	ALTERATION & MINERALIZATION
2700		
2950		
3000	2999 Tw. Conglomerate. Matrix is fine grained brn, mudstone as 2600-2999. Clasts make up 30% to 60% of the rock. Clasts are mostly schist (and Tqm?) & traces of db. Alteration is abundant in sc (qtz-sericite & silicification).	Sparce native Cu in clasts.
3050		
3100		
3150	3145 T.D.	

Column Condensed

TAB

5

GEOLOGIC LOG

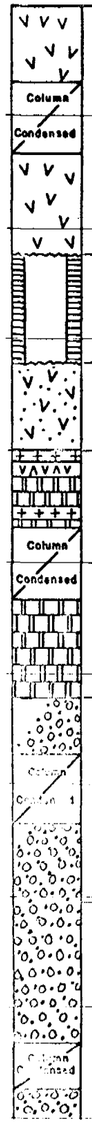
PROJECT Superior East

Page 1 of 4

Drill Hole DCA-1A | Location NW1/4 NE1/4, Sec. 3, T 1 S, R 13 E | Dates Drilled Rotary: 5-18-64 to 6-26-64; Core: 11-17-71 to 2-9-72

Total Depth 5813 | Collar Elevation 4760 | Logged By R. P. Cummings

Depth SURFACE



450 500 550 2,200 4,000 4,050 4,200

DESCRIPTION

Dacite (Td)

NOTE: All dips or angles of inclination referred to in this log were measured from a plane at right angles to the axis of the core. The stratagraphic column on the left side of the page is meant to be a graphical representation. Dipping features (contacts, ~~etc.) are shown in their true vertical position on the right~~ side of the column.

460 Td. Vitrophyre

520 Td. Tuff. Dirty white felsite

~~550 EARLIER VOLCANICS (Tev) Felsite, glass, some dacite(?) and andesite in lower portions.~~

2210 WHITETAIL CONGLOMERATE (Tw) Conglomerate containing sandstone, quartzite, siltstone, granite, limestone, andesite, basalt, and gneiss.

NOTE: From surface to 4002' the hole is a 9" rotary hole which was drilled for Superior Oil and Miami Copper in 1964. The portion of this log to 4002' is reinterpreted from their records.

4002 Tw Poorly sorted conglomerate. Matrix - light greenish brown to brown colored, slightly limy well cemented, gritty sand. Contains abundant fine diabase fragments, with minor biotite and magnetite grains. Fragments - subrounded to subangular, poorly sorted and up to 16" in diameter. Bedding - 20°-25° @ 4100'. Fragment:Matrix = 60:40. Composition - 70% diabase, 15% quartzite, and Barnes Conglomerate, and 15% light to dark gray limestone (all unmineralized).

ALTERATION & MINERALIZATION

Numerous thin calcite-heulandite veinlets filling open spaces. Wk. brecciation in veinlets. Dip 60°-90°. 1' calcite vein @ 4166-67.

ASSAY RESULTS

From	To	Cu ppm	Zn ppm	CaO %	MgO %	total Fe %	SiO_2 %
4002	4020	44	245				
4100	4120	53	285				

GEOLOGIC LOG

PROJECT Superior East

Drill Hole DCA-1A Location _____ Dates Drilled _____

Total Depth 5813 Collar Elevation _____ Logged By R.B. Cummings

Depth	DESCRIPTION	ALTERATION & MINERALIZATION
4,200		
4,250	4247 Tw. Poorly sorted conglomerate similar to above but fragment composition is 60% diabase, 20% quartzite and Barnes Conglomerate, and 20% limestone. Minor layers of well sorted cgl. occur in thicknesses of up to 6". These layers contain clasts <1/2" in diameter. Bedding 25°-30°.	As above.
4,300		
	Column Condensed	
4,500		
4,550	4528 Tw. Poorly sorted cgl. Matrix is similar to 4002-4528 but brown color increases gradually. Fragment shape and size as 4002-4528. Fragment composition - 40% diabase, 35% limestone and 25% quartzite (diabase decreases with depth). Minor gritty layers (4549-51, 4553-54, 4557-60). Bedding 30°-50°.	As above.
	4560 Tw. Poorly sorted limestone conglomerate. Matrix is brown to gray, muddy and slightly limy. Fragments - subrounded, up to 8" in diameter and composed of about 95% limestone and chert, < 5% quartzite, and traces of diabase. Well packed - fragment:matrix + 80:20. Numerous thin beds of limy mudstone (4581-89, 4612-17, 4636-37, etc.). Bedding variable 35°-60°. Fault (?) at 4574-77 - 80°. Contact with Naco ls. is steep, irregular and muddy.	As above.
4,600		
4,650		
4,700	4669 Naco Limestone (Pn). Interbedded shaley limestone and minor quantities of limy shale, shale, and mudstone. Shaley limestones are light gray to brown and fine grained, with light gray shale seams and pods. Shale and limy shale are light to dark grey in color and weakly fissile. Reddish mudstone occurs as thin beds near the top of the interval. Slump brecciation is common in shaley limestones below 4690' - shaley material often fills spaces between rounded limestone fragments. Weak development of orange colored chert nodules is common. Thin (up to 5') fossiliferous zones containing fusulinids are common. Bedding - 30°-45°. Occasional minor faulting.	Trace to weak thin wispy veinlets of calcite with minor heulandite in limestone. Moderate calcite veinlets: 4669-84, 4690-96, 4741-75, 4802-42.
4750		
4800		
4850	4842 Pn. Shale and minor limestone. Shale-reddish brn to dark brn, and dirty with knobby	Trace calcite veinlets in shale; wk.

ASSAY RESULTS

From	To	Cu ppm	Zn ppm	CaO%	MgO%	total Fe %	SiO_2 %
4200	4220	55	263				
4300	4320	77	441				
4400	4420	84	640				
4500	4520	49	609				
4600	4620	24	174				
4700	4720	6	92				
4800	4820	7	156				

GEOLOGIC LOG

PROJECT Superior East

Drill Hole DCA-1A Location _____ Dates Drilled _____

Total Depth 5813 Collar Elevation _____ Logged By R.B.Cummings

Depth	DESCRIPTION	ALTERATION & MINERALIZATION
4850	ℙn. Shale and minor limestone. Shale - reddish brown to dark brown, and dirty with knobby fragments of clay and limestone. Not well bedded. Limestone - light gray and fine grained (4867-77 & 4886-96). Good slump bx. - 4867-77. Fusulinids common. Bedding in shale - 50°. Shale well fractured. Shale & ls. faulted - minor displacement.	Trace calcite veinlets in shale; wk. to mod. in lms.
4900	4911 ℙn. Limestone; gray to light gray, fine-grained. Orange to dark gray chert masses and thin beds common. Slump bx strong in places (e.g. 4911-19, 4931-34, 4949-60). Matrix of bx is dark brown shaley material. Bedding 55°. Contacts gradational above and below.	Wk to mod calcite veinlets.
4950	4960 ℙn. Shale and limestone. Shale as 4842-4911 from 4960-64 and red-brown, soft and clay-rich 4976-87. Limestone 4964-76, light gray, fine-grained, str. slump bx w/abundant chert clasts. Str. fractures in shale. Vert. fault 4967-72.	Str. calcite veining in ls.
	4987 ℙn. Basal unit. Soil regolith. Chert clasts in brown shaley matrix. Contact irregular.	
5000	4998 Escabrosa Limestone (Me). Limestone. Top (4998-5003) is brown and medium grained with mud seams - probably from soil regolith above. 5003-5019 is light gray, medium grained, slump bx, minor mud.	Wk to mod. calcite veinlets.
	5019 Me. Dolomitic ls. Dark gray, fine grained, slump bx. Some green and white clay on fractures.	Mod calcite veinlets (str in spots). Replaced beds @ 5026-30, 5033-36, 5060-66 and 5098-5102. These beds show solution bx textures - thin, curved, linear, open cavities with minor drusy dolomite(?) x-tals. The rock is probably replaced by very fine grained silicification.
5050		
5100	5102 Me. Limestone, light gray and med. grained. Minor chert bands <1" thick. Wkly developed stylolites. Minor thin dolomitic bands. Minor greenish clay on fractures. Bedding (?) - 30°.	Wk calcite veinlets
5150		
	5173 Me. Dolomitic ls., gray and fine grained. Minor cherty bands and greenish clay on fractures. Bedding - 30°.	Wk calcite veinlets. Replaced bed 5202-10. As above.
5200	5210 Me. Limestone, light gray, medium grained. Gray to black chert bed @ 5246-47.5.	Sparce to wk calcite veinlets. Wkly. replaced bed 5228-32.
5250	5247 Me. Limestone, light gray and fine grained. Abundant aphanitic circular to oval shaped oolites (?) or fossils (?). (very strong from 5247.5-84). Minor slump bx 5284-5308.	Wk. to mod. calcite veinlets.
5300	5308 Me. Limestone, light gray (5308-34) to gray and fine grained with medium grained granular streaks in upper part. Good slump bx 5308-46 with green clay (5308-34) and brown muddy material (5334-46) in matrix.	Wk. calcite veinlets. Traces FeOx→Py in calcite @ 5337.
5350		

ASSAY RESULTS

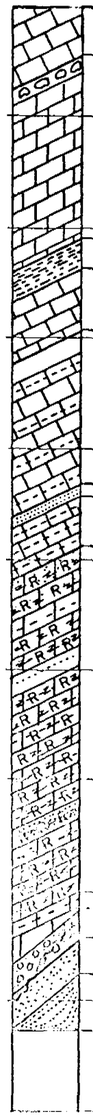
From	To	Cu ppm	Zn ppm	CaO %	MgO %	total Fe %	SiO_2 %
4900	4920	5	123				
5194	5202	31	74	28.1	14.5	0.80	16.9
5202	5210	19	56	30.7	20.8	0.80	3.7
5210	5218	11	37	51.7	1.2	0.35	2.1

GEOLOGIC LOG

PROJECT Superior East

Drill Hole DCA-1A Location _____ Dates Drilled _____

Total Depth 5813 Collar Elevation _____ Logged By P.B. Cummings



Depth	DESCRIPTION	ALTERATION & MINERALIZATION
5350		
5369	Me. Dolomitic ls and ls-chert bx. Dolomitic ls, light gray to gray, fine to medium grained, cherty (5377-84), slump bx with reddish clay matrix (5401-10), and muddy towards base (5433-52) with thin mud streaks. Sedimentary ls-chert bx is light colored ls. and gray, ~~red, and orange chert clasts. (5369-77 & 5384-88). Vert. fault @ 5448. Bedding - 25°.~~ Contact with Martin ls. below is conformable - dip 30°.	Trace to mod calcite veinlets. Well replaced bed 5401-10 as 5098-5102. Wkly replaced @ 5388-5401.
5400		
5450		
5452	Martin Limestone (Dm). Limy shale, light greenish gray to maroon. Bedding - 30°.	
5462	Dm. Fossiliferous ls., fine grained, reddish brown (5462-80) to gray (5480-96). Slump bx with reddish muddy streaks 5480-96. Minor faulting with down-faulted wedges of shale (as 5452-62) at 5466-68 & 5469-73.	Trace to mod (in slump bx) calcite veinlets.
5500		
5496	Dm. ~~Shaley ls. Fine to medium grained gray ls with brown to gray wispy muddy streaks.~~ Dolomitic from 5496-5505. Same slump bx. Sandstone - light red, fine grained and well cemented (5556.5-5557.0). Dark grey limy shale (5557-59). Bedding 20°-35°.	~~Trace to moderate calcite veinlets.~~
5550		
5567	Dm. Sandstone. Buff to pink, fine grained, calcareous cement. Dip - 25°.	Trace calcite veinlets.
5572	Dm. Fossiliferous shaley ls. Gray to dark gray, fine to coarse (5572-75) grained ls with wispy shaley bands. Fossils common.	Moderate calcite veinlets.
5595		
5600		
5595	Martin Limestone (Dm). (From 5595) Dolomitic ls with sandy and shaley portions and minor sandstone. Dolomitic ls is light brown to light green to gray and fine grained. Shaley portion occurs throughout this section. The dol. ls. is sandy from 5595-5614 and 5744-56.5. The sand grains are bluish and frosted. Sandstone is buff to gray in ~~color, fine grained and has calcareous cement. SS. bed occur at 5618-19, 5636-43,~~ 5719-23 and 5756.5-57.5. Minor greenish clay seams are present. Faults (probably with little displacement) @ 5670.5-73.0-45°, 5746-60°, 5753-56-steep, and 5757.5-65°. Bedding 30°-40°.	Sparce to str. calcite veinlets. Str. in replacement zones. Replaced beds as 5098-5102 at 5595-5614, 5619-31 (wk with MnO stain), 5636-43, 5650-64 (some bleaching, red hematite on fractures and traces FeOx → py.), 5664-70.5 and 5673-5719 (with red hematite), and 5719-56.5 (wk with red hematite).
5650		
5700		
5750		
5757.5	Dm. Basal unit. Pebble cgl thinly inter-bedded with argillaceous ss. Clasts; qtz and qtzite, up to 1-1/4", rounded to angular. Matrix red to brn argillaceous sand. Fault @ 5759-70°. Contact conformable.	Trace calcite veinlets.
5768		
5781	Troy Quartzite (p€t). Qtzite, pure to argillaceous, fine grained, brn to gray and pebbly. ~~Minor green clay. Some hematite grains. Brecciated 5778-81. Bedding - 40°.~~	Trace calcite veinlets. ~~Minor wk replacement textures.~~
5800		
5813 TD.	p€t. Inter-bedded argillaceous ss, pebbly qtzite, qtzite and sandy mudstone. Reddish-brown to brown to gray, fine grained. Cement - reddish argillaceous material. Some black chert pebbles. Minor magnetite and hematite grains. Cross bedding common. Bedding 30°-45°.	Wk. replacement textures 5793-5811.

ASSAY RESULTS

From	To	Cu ppm	Zn ppm	CaO %	MgO %	total Fe %	SiO_2 %
5392	5401	18	68	30.5	21.0	0.75	3.0
5401	5410	33	93	31.8	20.0	0.80	2.5
5410	5419	21	47	30.9	22.0	0.60	3.2
5575	5595	42	48	44.2	2.3	0.95	13.7
5595	5605	39	46	20.2	9.9	1.25	36.1
5650	5660	20	53	30.3	19.9	0.90	6.5
5709	5719	37	30	28.1	18.2	0.95	10.8

TAB

Le

GEOLOGIC LOG

PROJECT Superior East

Drill Hole M-1A | Location SW1/4, SW1/4, Sec. 15 T 1 S, R 13 E | Dates Drilled Rotary 9/70-10/70 Core 4/21/71-6/3/71

Total Depth 5322' | Collar Elevation 4500' | Logged By R.B. Cummings

Depth	DESCRIPTION	ALTERATION & MINERALIZATION
SURFACE	DACITE (Td) welded ash flow tuff. Abundant fine to medium grained phenocrysts of quartz, feldspar, and biotite in a light colored aphanitic groundmass. Lithic fragments and pumice fragments also common. Color as follows: 0-355' -white 355-1180'-gray 1180-1420'-red-brown 1420-1575'-yellow-tan	
50		
1550		
1575	Td. As above with black glass.	
1600	1600 Td. Tuff. Similar to 0-1575' but nonwelded or partly welded. Yellow-tan in color.	
1650		
1700		
1750		
1800	1800 Td. Vitrophyre. Black to gray glass with phenocrysts as above.	
1830	Td. Tuff. As 1600-1800'.	
1850		
1890	Rubble	
1900	1900 EARLIER VOLCANICS (Tev) Andesitic basalt. Dark gray to black and very fine grained.	
1950		

GEOLOGIC LOG

PROJECT Superior East

Drill Hole M-1A Location _____ Dates Drilled _____

Total Depth _____ Collar Elevation _____ Logged By R.B. Cummings

Depth	DESCRIPTION	ALTERATION & MINERALIZATION	From	To	ASSAY RESULTS Cu %					Weighted Ave. % Cu
1950	See page 1 NOTE: From the surface to 2400' the hole is a 5-5/8" rotary hole which was drilled for Continental Materials in 1970. This portion of the log is from rotary cuttings.									
2000										
2400	2400 Tev. Very fine grained, dense, dark green to black andesitic basalt. Very well fractured. Shattered 2416-28. Contact with Tw below irregular.	Moderate to strong chlorite on fractures. Minor silica veinlets.								
	2428 WHITETAIL CONGLOMERATE (Tw). Lithic ss and mudstone. SS is fine grained and greenish gray. Clasts are sub-rounded qtz w/subordinate lithic clasts (sc., qm., db., and ls.) and mineral grains (feldspar, biotite and magnetite).	Sparce native Cu in lithic clasts and in matrix.								
2450	2448		2440	2460	0.12					2428
	2460 Cement varies from argillaceous to limy to glauconitic(?). Cement may be tuffaceous. Some pebbles-mostly qm. Mudstone is interbeded with ss. above and in fine grained and reddish brn in color. Bedding 0°-15°.									
	Tw. Cgl. Clasts up to 3", sub-angular, 60% qm, 35% sc., and 5% db, ls, and qtzite. Matrix is reddish brn and gritty-may be tuffaceous in part. Clast: Matrix = 70:30.	Sparce native Cu in clasts, on fractures and in matrix.								
2500	Tw. Lithic ss. Similar to 2428-48. Lithic clasts as ss. above but qtzite and amber colored volcanic jasperoid are also present. Magnetite may makeup 5% (by volume) of the clasts. Pebble sized clasts (up to 5% of total volume) are mostly qtzite.-no qm. Cement similar to 2428-48 but more tuffaceous-	Sparce native Cu in matrix.								
2550	2553 lt. grn. altered ash(?). Reddish brn mudstone layers common (1" thick). Bedding 0°-15°. Contact with below is fault -45°.		2540	2560	0.01					492' @ 0.05% Cu
	Tw. Lithic tuff-water lain. Fine grained lt. green to gray. Clasts are 70-80% of volume and consist assorted lithic & crystal(?) fragments. Lithic clasts include fine grained volcanics (altered by a soft lt. grn. material) volcanic	Sparce native Cu in matrix.								
2600	jasperoid, qtzite, ls & sc. Crystal clasts include qtz, feldspar, biotite and magnetite. Some flattening of volcanic clasts was observed, Matrix is very fine grained, lt. grn, ashy material. Minor reddish brn mudstone seams as above occur. Bedding-flat. Contact with below gradational.									
	2631									
	2640 Tw. Lithic ss interbedded w/minor lithic tuff. SS as 2460-2553. Tuff as 2553-2631.	Sparce native Cu in matrix.	2640	2660	0.03					
2650	Tw. Cgl. Clasts up to 6", sub-angular, 75% qm & 25% sc. Some qm clasts are brecciated. Matrix is reddish-brn, gritty & tuffaceous. Clast:Matrix=60:40.	Sparce native Cu in matrix.								
	2675 Tw. Mudstone interbedded w/minor lithic ss. Mudstone is reddish-brn, finegrained slightly limy and slightly gritty. SS as 2460-2553. Aragonite nodules (as irregular but flattened forms up to 1/2") are present. Bedding-flat.	Sparce native Cu in matrix.								
2700	2711 Tw. Lithic ss interbedded with minor mudstone. As above but ss predominates. Strongly developed aragonite nodules.	Sparce native Cu in matrix.								
	2743 Tw. Shale w/some mudstone & lithic ss. Shale is dark grn to reddish brn, limy & sometimes gritty or muddy. Aragonite nodules are common. They vary in size from 1/16" to 1". Mudstone is brn and fine grained. Lithic ss is fine grained with a tuffaceous matrix & usually as thin beds within shale or mudstone. One thin ls bed at 2743-45 (slump bx & lt. gray). Lt. colored lithic tuff at 2766-68, 2774-75 & 2777-78. Bedding-flat. Vertical fracture with calcite fillings 2819-23.	Sparce native Cu in matrix.	2740	2760	0.02					
2750										
2800										

GEOLOGIC LOG

PROJECT Superior East

Drill Hole M-1A Location _____ Dates Drilled _____

Total Depth _____ Collar Elevation _____ Logged By R.B. Cummings

Depth	DESCRIPTION	ALTERATION & MINERALIZATION	From	To	ASSAY RESULTS Cu %					Weighted Ave. % Cu
2800										
	2822 Tw. Mudstone w/minor shale. Reddish brn to greenish gray, fine grained mudstone. Slightly limy. Some argonite nodules. Definitely tuffaceous from 2889-2906. Shale is greenish gray and limy. Ls bed (slump bx & lt. colored) at 2886-89. Very fine grained, lt. gray, vitric tuff-2903-06. As base of section (2918-20) is a thin cgl w/Tqm (as below) clasts up to 6" in a dark gray grn fine to medium grained tuffaceous matrix. Fractures w/aragonite & calcite fillings present. Bedding-flat.	Sparce native copper - some along bedding planes. In ls. at 2888.8.	2840	2860	0.07					
2850										
2900										
	2920 TERTIARY QTZ. MONZONITE. slide block (Tqm). Slightly porphyritic biotite qtz monzonite. Lt. gray to pink in color. Med. grained. Composition: 55% plagioclase, 20% K-spar (some as phenocrysts up to 1") 20% qtz (mostly as qtz eyes) & 5% biotite. Well brecciated. Brecciation is strongest near top. Rock is shattered from 3052-69. Fragments up to & greater than 1", sub-angular to angular. Matrix is gritty crushed qm-makes up 10% of rock by volume. Open spaces 2953-3069. Some calcite crystals in cavities.	Sparce native copper Traces of FeOx → Py. 2933-3052. Sparce argillic alteration of feldspar. Trace to weak transported FeOx.	2940	2960	0.02					2920
2950										
3000										188' @ ± 0.02% Cu
3050			3040	3060	0.03					
	3069 Tqm. Qtz monzonite as above. Brecciation shows str.effects of shearing. Matrix is more finely crushed. Fragments are subrounded to sub-angular-some rotation has probably occurred. Crushed layers are flat. Fractures 0-45°. Gouge zone 3089-90.	Sparce native copper. Sparce cuprite? Trace to weak transported FeOx								
3100										
	3107.5 WHITETAIL CONGLOMERATE(Tw). Matrix-brn,gritty & muddy. Clasts sub-angular to sub rounded, poorly sorted up to 6" in diameter, 70% schist & fine grained gneiss (sc & gn-both pre-C. Pinal) & 30% qm (as above). Clasts unaltered. Clast: Matrix = 60:40.	Trace native copper in clasts & matrix.								3108
3150	3113 3130 Tw. Cgl. Matrix brick red, gritty, muddy. Clasts sub-angular to sub-rounded poorly sorted 60% sc & gn, 30% qm (as slide block-few altered) & 10% db. Clast:Matrix = 60:40.	Trace native copper in clasts & matrix (in clacite(?) seams @ 3122.5.	3140	3160	0.13					
	3180 TW. Cgl. Matrix dark brn, gritty & muddy. Clasts sub-angular to sub-rounded poorly sorted, up to 8", 65% sc & gn, 25% db, & 10% qm. Clasts:Matrix = 60:40. Minor well sorted, thin, pebble-sized layers. Mudstone 3135-36-bedding 0-10°	Traces of native copper. Best-disseminated in & on borders of db. Also on fractures in db & gn & disseminated in qm & matrix.								262' @ ± 0.09% Cu
3200										
	Tw. Cgl. Matrix dark brn to brn, gritty & muddy. Clasts sub-rounded to sub-angular (slightly more rounded than above), poorly sorted & up to 8". 60% sc & gn, 25% qm (as slide block) & 15% db. Some of the clasts are altered and mineralized up to 4% FeOx → py in some sc, qn & qm clasts. Clast:Matrix= 70:30.	As Above.								
3250			3240	3260	0.03					
3300										

GEOLOGIC LOG

PROJECT Superior East

Drill Hole M-1A Location _____ Dates Drilled _____

Total Depth _____ Collar Elevation _____ Logged By R.B. Cummings

Depth	DESCRIPTION	ALTERATION & MINERALIZATION
3300	3311 Tw. Cgl. Matrix gradually changes to reddish-brn; gritty & muddy. Clasts shaped similar to above. 65% sc & gn, 30% qm & qmp & 5% db. Altered as above. Clast: Matrix + 70:30. NOTE: From 3107.5 to about 3378 most of the qm clasts are very similar to qm from the slide block. Below 3578 fine grained porphyritic qm predominates. The best alteration & mineralization is found in this variety.	Sparce native Cu. Mode of occurrance as above.
3350	3378 Tw. Cgl. Matrix dark gray, gritty & muddy. Clasts sub-rounded to sub-angular poorly sorted, 60% sc & gn, 25% db, & 15% qmp. Qm is mostly altered; some contains cc. as @ 3389. Qm still resembles slide block. Clast:Matris = 60:40.	Traces to weak native Cu. Mode of occurrence as above.
3400	3419 Tw. Cgl. Matrix-dark brn & gritty. Clasts sub-rounded to sub-angular, well packed & well sorted (most clasts 1/2"-2") 90% sc & gn, 10% db - unaltered. Clast: Matrix = 85:15	Sparce native Cu.
3450	3430 Tw. Cgl. Matrix dark gray-brn, gritty & muddy. Clasts sub-rounded to sub-angular & poorly sorted. Well sorted cgl as 3419-30 from 3438-47. Clasts 60% sc & gn, 30% db & 10% qmp. Altered clasts common. Qm w/cc @ 3443. Bedding flat. Clast:Matrix = 60:40.	Traces native Cu.
3500	3494 Tw. Poorly sorted cgl as above but matrix is reddish-brn in color & clasts are 55% sc, & gn, 25% db, & 20% qmp.	Sparce native Cu.
	3504 Tw. Poorly sorted cgl as 3430-94 but clasts 60% sc & gn, 20% db, & 20% qmp. Altered clasts still common.	Trace to weak native Cu.
3550	3543 Tw. Poorly sorted cgl w/reddish-brn gritty, muddy matrix & sub-rounded to sub-angular clasts - 80% sc & gn, 15-20% qm (mostly unmineralized) and 5% db. Clast:Matrix = 60:40.	Sparce native Cu.
3600	3595 Tw. Moderately to well sorted cgl. Reddish-brn to red matrix. Gritty & muddy with str. transported FeOx 3659-81. Clasts sub-rounded to sub-angular, up to 8" in size w/many well packed zones w/clasts 2". 90%-95% sc & 5-10% qm (some altered clasts) Clast:Matrix = 80:20 to 70:30. NOTE: Below 3681 qm similar to the slide block is rare or absent. The intrusive clasts are fine grained qmp as mentioned above. Composition is similar to slide block but phenocrysts of plagioclase (pmk) & K-spar(?) up to 1/4" & qtz eyes are set in a gray aphanitic matrix. Biotite < 4%.	Sparce native Cu. Sparce cuprite? @ 3621 on fractures.
3650	3681 Tw. Poorly sorted cgl. Matrix gray, gritty & muddy. Clasts sub-rounded to sub-angular, up to 8", 60% db, 30% sc & 10% qmp (clasts mostly fresh). Clast: Matrix = 60:40.	Trace native Cu.
3700	3725 Tw. Well sorted cgl. Matrix brn, gritty & muddy. Clasts sub-rounded to sub-angular, 2", well packed, 60% sc, 25% db, 15% qmp (some altered). Clast: Matrix = 70:30.	Sparce native Cu.
3750	3744 Tw. Poorly sorted cgl. Matrix gray, gritty & muddy. Clasts sub-rounded, 60% sc, 30% db, 5% qmp & 5% qtzite. (mostly fresh). Clast:Matrix = 60:40. Bedding 0°-15°. Gray tuffaceous mudstone 3818-19, 3837-38.	Trace native Cu.
3800		

ASSAY RESULTS

From	To	Cu %	Au+Ag oz/ton	Weighted Ave. % Cu
3350	3360	0.04		
3360	3370	0.05		
3370	3380	0.305	-3370-	—3370—
3380	3390	0.348		
3390	3400	0.152		
3400	3410	0.130		
3410	3420	0.100		150' @ 0.154% Cu
3420	3430	0.082		
3430	3440	0.092	Tr Au .02 Ag	
3440	3450	0.110		
3450	3460	0.090		
3460	3470	0.075		
3470	3480	0.130		
3480	3490	0.222		
3490	3500	0.220		
3500	3510	0.140		
3510	3520	0.122	-3520-	—3520—
3540	3560	0.07		
3640	3660	0.03		330' @ ≠ 0.07% Cu
3740	3760	0.11		

GEOLOGIC LOG

PROJECT Superior East

Drill Hole M-1A Location _____ Dates Drilled _____

Total Depth _____ Collar Elevation _____ Logged By R.B. Cummings

Depth	DESCRIPTION	ALTERATION & MINERALIZATION
3800		
3839	Tw. Well sorted cgl. Matrix reddish (w/some transported FeOx), gritty & muddy. Clasts sub-rounded to sub-angular, < 2", well packed, 80% sc, 15% qmp, 5% db. (some alteration). Clast to Matrix = 80:20.	Sparce native Cu.
3850		
3856	Tw. Poorly sorted cgl. Matrix dark gray-brn, gritty & muddy. Clasts sub-rounded to sub-angular, up to 12" in diameter, 65% db, 25-30% ls and qtzite, 5-10% qmp. Clasts are occasionally altered. Some secondary epidote is seen in db. Clast:Matrix = 60:40.	Sparce to trace native copper. Mode of occurrance is as above - as fine grains and small sheets on clasts borders & disseminated in clasts and matrix. Db is still best host. At times Cu occurs with secondary calcite on fractures. Traces of very thin calcite veinlets from 3856-4245. Veinlets in clasts and matrix and on borders of clasts.
3900		
3950	NOTE: A major change occurs @ 3856'. Below this point no sc. clasts were seen and Apache Group and Paleozoic sediments are much more common. Also, secondary epidote is seen in db. Qmp is as described above (see note 3595-3681). In places qmp resembles a volcanic rock.	
4000		
4050		
4100		
4150		
4200		
4250		
4300		

ASSAY RESULTS

From	To	Cu %	Weighted Ave. % Cu
3850	3860	0.16	3850
3860	3870	0.14	
3870	3880	0.09	
3880	3890	0.08	
3890	3900	0.13	
3900	3910	0.11	
3910	3920	0.13	
3920	3930	0.10	190' @ 0.10% Cu
3930	3940	0.07	
3940	3950	0.09	
3950	3960	0.09	
3960	3970	0.10	
3970	3980	0.08	
3980	3990	0.08	
3990	4000	0.11	
4000	4010	0.09	
4010	4020	0.08	
4020	4030	0.06	
4030	4040	0.06	
4040	4060	0.05	4040
4140	4160	0.08	
			858' @ ± 0.08% Cu
4240	4260	0.08	

GEOLOGIC LOG

PROJECT Superior East

Drill Hole M-1A Location _____ Dates Drilled _____

Total Depth _____ Collar Elevation _____ Logged By R.B. Cummings

Depth	DESCRIPTION	ALTERATION & MINERALIZATION	From	To	ASSAY RESULTS Cu %					Weighted Ave. % Cu
4300	4307 Tw. Well sorted cgl. Matrix dark gray-brn, gritty & muddy. Clasts sub-angular to sub-rounded, well packed & generally < 2". Some gritty layers. 50% db, 40% qtzite & ls, & 10% qmp. Some altered clasts (more than above). Clast:Matrix = 80:20.	Sparce to trace native Cu. Mode of occurrance as 3856-4307.	4340	4360	0.11					
4350										
4400	4410 Tw. Poorly sorted cgl. Matrix, dark brn to gray, gritty & muddy, Clasts sub-angular to sub-rounded, up to 14", 45% db, 35% qtzite & ls, & 20% qmp. Altered clasts are abundant (about 50%). Clasts of gossan & altered ls were present. Clast:Matrix = 70:30.	Sparce native Cu. Minor thin calcite veinlets- mainly steep and on clast borders.	4440	4460	0.06					
4450	4473 Tw. Cgl. Good to poor sorting. Matrix as above. Clasts sub-rounded to sub-angular, up to 24" but some gritty & pebbly zones. 60% db, 30% qtzite & ls, & 10% qmp. Altered clasts abundant. Clast:Matrix 70:30.	Sparce to trace native Cu. Minor thin clacite veinlets as above.								
4500	4491 ~~Tw. Poorly sorted cgl. Matrix, brn, gritty & muddy. Clasts sub-angular to sub-rounded & up to 8". 40% db, 35% qtzite & ls, 25% qmp. Altered clasts abundant. Clast:Matrix = 70:30.~~	~~Sparce native Cu.~~ Minor calcite veinlets as above.								
4550	4531 Tw. Cgl. Good to poor sorting. Matrix-brn, gritty & muddy. Clasts sub-angular to sub-rounded & up to 8" but some gritty & pebbly zones. 60% db, 20% qtzite & ~~ls, & 20% qmp. Some altered clasts. Clast:Matrix = 70:30. Bedding -30°.~~	Sparce to trace native Cu. Minor calcite veinlets.	4540	4560	0.05					
4600										858'@ ± 0.08% Cu
4650			4640	4660	0.12					
4700	4685 Tw. Poorly sorted cgl. Matrix-dk. brn, gritty & muddy. Clasts sub-rounded to sub-angular, up to 18", 35% db, 35% qmp, & 30% qtzite & ls. Some altered clasts. Clast:Matrix = 60:40.	Sparce native Cu. Minor calcite veinlets.								
4750	4724 Tw. Poorly sorted cgl. w/interbedded gritty mudstone beds (20%-30% of total volume). Beds up to 2' thick. Matrix dk brn in cgl & reddish-brn in mudstone. Clasts sub-rounded to sub-angular, up to 12" & 40% db, 35% qmp, 25% ls & qtzite (minor). Some altered clasts. Clast:Matrix = 50:50. Bedding 20°.	Sparce to trace native Cu. Minor calcite veinlets.	4740	4760	0.10					
4800	4776 Tw. Poorly sorted cgl w/thin (6") gritty mudstone beds. Matrix is brn to reddish brn, gritty & muddy. Clasts-sub-angular, some good packing, up to 8", & 40% db, 35% qmp & 25% ls & qtzite. Abundant altered clasts 4776-4851. (see next page)	Sparce native Cu. Calcite veinlets (as above) common.								

GEOLOGIC LOG

PROJECT Superior East

Drill Hole M-1A Location _____ Dates Drilled _____

Total Depth _____ Collar Elevation _____ Logged By R. B. Cummings

Depth	DESCRIPTION	ALTERATION & MINERALIZATION	ASSAY RESULTS From	To	Cu %					Weighted Ave. % Cu
5300			5300	5310	Trace					
	5322 T.D. See last page.		5310	5322	Trace					
5350										

GEOLOGIC LOG

PROJECT Superior East

Drill Hole M-1A Location _____ Dates Drilled _____

Total Depth _____ Collar Elevation _____ Logged By R.B. Cummings

Depth	DESCRIPTION	ALTERATION & MINERALIZATION	From	To	ASSAY RESULTS Cu %					Weighted Ave. % Cu
4800	Clast:Matrix = 60:40. Bedding 20-30° from 4776-4870 & 30-60° from 4870-98. Bedding at contact 50-60°. Numerous fractures w/slickensides on bedding planes 4889-98. Contact w/Ps below at 4898 shows fracture or fault as above w/little if any movement.									
4850			4840	4860	0.07					
4900	4898 SUPAI FORMATION (Ps). Sandy limy mudstone. Brownish-red in color. Contains minor fresh biotite. Bedding 30°.	Minor calcite veinlets								4898
	4922 Ps. Lithic ss. Gray, fine grained, muddy & slightly limy. Numerous magnetite grans. Bedding -30°.									
4950	4936 Ps. Limy mudstone. Red to reddish-brn in color (gray-4997-5007) Sandy from 4936-97 & 5024-41. Minor gray-brn lithic ss beds 4973-74, 4982-85. Gray muddy ls 5011-13. Ls. clasts, lt gray and up to 2" - 10% of rock 5021-41. Bedding 25-30°. Numerous fractures at all dips - w/slickensides.		4940	4960	0.08					
5000										
5050	5041 Ps. Lithic ss. Gray to brn, limy & gritty. Numerous lithic clasts 10% by volume near top to 30% at bottom. Clasts 95% ls & 5% db, up to 3" in size. Bedding 30°.		5040	5060	Trace					
5100	5086 Ps. Cgl. Matrix-brn, limy, muddy. Clasts angular to rounded, up to 3", 95% gray ls, 5% qtzite. Clast:Matrix 55:45. Soil Regolith 5103-08. Reddish & muddy-earthy. Some ls clasts. Contact irregular.									
	5108 5114 NACO LIMESTONE (Pn) Rubble zone-broken lt gray ls & gray banded chert. Red muddy material fills spaces between fracments.									
5150	5134 Pn. Muddy ls. Lt gray to gray fine to medium grained ls w/thin wispy seams of gray to red mudstone or muddy ls. Minor thin chert beds & nodules. Wk. slump bx. Bedding 20°.		5140	5160	Trace					
	Pn. Shale w/ls. Shale is maroon in color w/lt grn clay bands & nodules. It Contains minor ls clasts & some chert(as beds). Thin ls beds increase from 5170-73. 5173-86 is buff color very fossiliferous ls - fossil trash. Minor rounded ls clasts & thin red shale seams. Bedding (in sh.)-20-30°. Some steep faults in shale-minor displacement.	Minor calcite veinlets.								
5200	5186 5200 5208 Pn. Chert bed. Dark to lt. gray chert. Some brecciation-sedimentary? Reddish-brn shale 5189-92 & 5193-95. Well broken (faulted?) 5189-90.	Some specularite as fracture fillings at 5186.5, 5187-88, & 5193-94.								
	Pn. Muddy ls. Dark gray, fine grained ls. w/abundant thin gray mud seams - dipping 40°.									
5250	Pn. Ls. Fine to coarse grained. ls. buff to lt. gray to gray (5282-5322) in color. Numerous reddish muddy shale seams w/lt. greenish clay on seam borders. Muddy shale beds (as above) w/ls. clasts @5278-82. and 5292-94. Minor gray chert as beds up to 6" thick, Abundant stylolites 5270-76. Bedding (in muddy shale beds)-irregular 10°-20°.	Sparce py @5214 (in chert) and 5282-5322 (w/thin calcite filled fractures. Numerous steep calcite filled fractures w/some associated light green clay.	5240	5260	Trace					
5300										

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

June 2, 1972

Mr. J. J. Collins
Director of Exploration
New York Office

Native Copper
Superior East Project

Dear Sir:

I believe you will find the attached memorandum by Mr. Graybeal a lucid description of a possible origin of the native copper in the Whitetail conglomerate.

Mr. Graybeal is to be complimented on his keen interest, both on a practical and theoretical basis, in our exploragion programs.

Very truly yours,

W. L. Kurtz

W. L. Kurtz

WLK:lad
Attach.

cc: FTGraybeal
JHCourtright
JDSell
SVFay - w/attach.

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

May 31, 1972

TO: W. L. Kurtz

FROM: F. T. Graybeal

A Model for the Origin of the
Superior East Native Copper Deposit

SUMMARY

It is shown that the native copper in the Whitetail conglomerate in the Superior East area could not have originated by groundwater moving downward through an unsaturated, gravel-filled basin. The preferred origin involves introduction of copper into a lake, isolation of the cupriferous water from the atmosphere, and subsequent precipitation as native copper.

INTRODUCTION

I have been involved in numerous discussions recently concerning the origin of the native copper deposit under the dacite in the Superior East area. These discussions have helped clarify my personal preferences in this regard which are presented forthwith. I am not intimately familiar with all the details of the deposit; however, my incomplete knowledge of all the facts has been supplemented through numerous discussions with J. D. Sell, G. J. Stathis, and R. B. Cummings.

My interpretations are based primarily on the well-established behavior of copper in the supergene environment. This behavior is discussed in some detail by R. M. Garrels and C. L. Christ in their book Solutions, Minerals, and Equilibria. The model I will present will evolve primarily from the Eh-pH diagrams presented by these authors.

THE FACTS

The simplicity of the mineralogy of this deposit and its apparently widespread and uniform distribution, when viewed in gross aspect, suggest that a relatively simple model may be used to explain its origin. The facts which appear most important are as follows:

1) The copper is primarily, although not completely, confined to the basal 1500 ft. within a 4000 ft. section of Whitetail conglomerate.

2) The form of copper in the Whitetail is approximately 90 percent native copper, 10 percent cuprite, and traces of malachite (estimates supplied by R. B. Cummings).

3) The copper is clearly epigenetic as indicated by its occurrence as sheaths around clasts and as disseminated grains in the matrix of the conglomerate.

4) The copper shows no marked preferential distribution around clasts of specific rock type. In particular, copper is not concentrated around limestone clasts.

5) Within the basal 1500 ft. of Whitetail, cuprite is relatively more abundant in the upper portion of this interval as compared to lower portions.

The facts listed above are most apparent from a study of hole A-4, and by not including data from other holes I hope I have not oversimplified the situation. However, data from these other holes, although different to a degree, are generally not in contradiction with data from A-4. In addition, I will not attempt to place the mineralogy of the limestone slide block found in A-4 into the model to be proposed as the time of its emplacement into the sequence is unknown.

THE MODEL

The epigenetic nature of the copper in the Whitetail suggests that the copper was transported to its present position in aqueous solution. The absence of any sulfides suggests that these waters were not of magmatic hydrothermal origin, but, rather were of meteoric character. Therefore, the copper was probably transported by surface waters passing over a copper sulfide deposit, from which the copper was taken into solution during oxidation of the sulfide minerals.

The enrichment of copper in the lower 1500 ft. of the Whitetail basin, and its relative impoverishment above this point could have resulted from several factors. The source area may have been covered at this time, eroded away, or the drainage direction may have changed. For reasons to be explained below I am convinced that the relatively barren upper Whitetail was not an unsaturated gravel section through which cupriferous water passed to be precipitated at greater depth.

The most important feature of the model is the character of the depositional basin. It would appear that there are two possibilities:

1) The basin consisted of permeable gravels into which cupriferous water percolated, much as the intermountane basins in Arizona today.

2) The basin consisted of a lake, perhaps shallow, into which water and clastic material were moving.

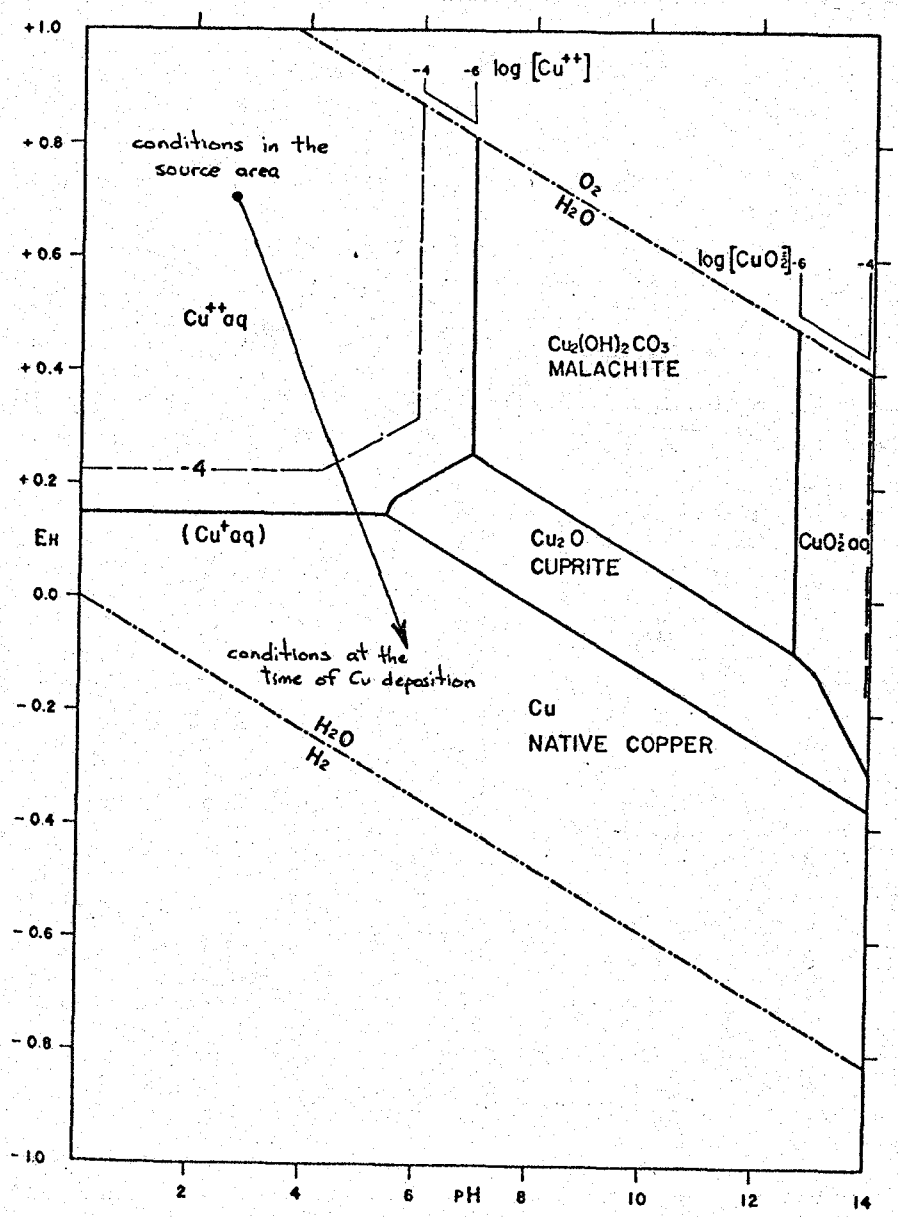
I will now proceed to show that the second choice is more consistent with the facts than the first.

It is important to note that native copper is the most abundant copper mineral present. Cuprite is present in variable amounts and malachite is effectively absent. In the presence of atmospheric amounts of carbon dioxide ($pCO_2 = 10^{-3.5}$) malachite is the stable phase under oxidizing conditions. It can be clearly demonstrated in oxidized copper-bearing skarn deposits that malachite is generally the dominant copper oxide mineral throughout the zone of oxidation. By reference to Figure 1 it is clear that this occurs where the pH is rapidly raised while the Eh is only slowly lowered relative to values found in an oxidizing sulfide deposit.

The absence of malachite in the Whitetail could be interpreted as due to its original formation but later reduction to cuprite assuming it does not exist metastably. However, it should be noted that there is no preferential accumulation of copper around the limestone clasts in the Whitetail. In the Holocene copper deposit described at Ray (Phillips, C.H., et al, 1971, Econ. Geol., p. 495-498) copper was preferentially concentrated around the limestone clasts in the well-drained conglomerate, due to rapid neutralization of water and resulting rapid precipitation of copper as malachite. If this had happened in the Whitetail (movement of cupriferous water through a well-drained conglomerate with limestone clasts) copper should have been preferentially concentrated around these limestone clasts. Later reduction would result in cuprite or native copper rimming these clasts. As mentioned above, copper is no more and perhaps less abundant around the limestone clasts strongly suggesting that movement of water through a well-aerated conglomerate did not occur.

The mere availability of carbonate does not mean that malachite will be formed. Figure 1 shows that malachite is unstable relative to cuprite and native copper under reducing conditions regardless of the pH.

It is also important to note that chrysocolla is absent from the Whitetail conglomerate. Studies of numerous copper-oxide deposits both in caliche-cemented gravels and in limestone suggest that chrysocolla is more stable than malachite at the surface. The stability of chrysocolla under very low pO_2 is well illustrated by its presence in the limestone slide block near the bottom of A-4 where chrysocolla coexists with cuprite and native copper. Thus, if it had been formerly present higher in the Whitetail it undoubtedly would have remained. The absence of chrysocolla in the Whitetail again argues against a model involving downward-moving water in an unsaturated conglomerate.



Stability relations among copper compounds in the system Cu-H_2O-O_2 at 25 °C and 1 atmosphere total pressure. [Courtesy J. Anderson.] $pCO_2 = 10^{-3.5}$

Figure 1. Geochemical evolution of cupriferous water in the Superior East area (after Garrels and Christ).

The problem now involves forming cuprite and native copper with no malachite. Reference to Figure 1 demonstrates that the only way to do this is by rapidly lowering the Eh with only a modest rise in pH. Clearly this cannot be accomplished by moving cupriferous water through a well-drained conglomerate containing limestone clasts, which leaves us with model #2 mentioned previously.

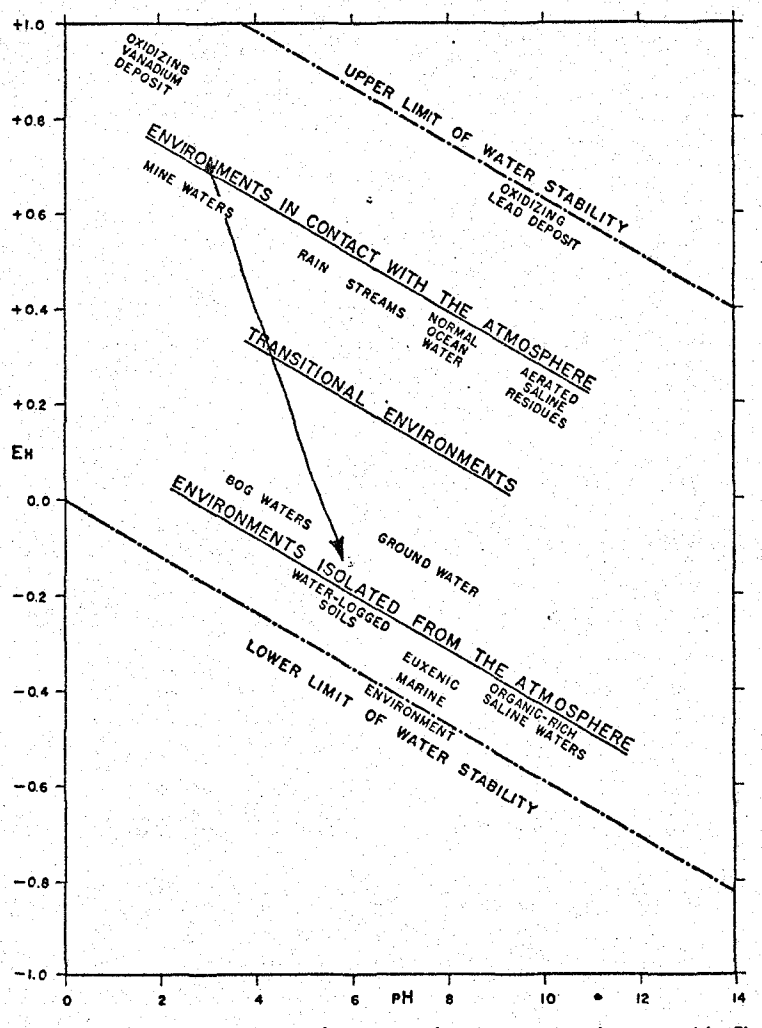
The presence of a small lake or at least a saturated gravel section with the water table at the surface is a reasonable geomorphic phenomenon. Copper-bearing water moving into this environment would be trapped in the interstices of the rapidly depositing Whitetail conglomerate. As the composition of this water changed, in this case due to perhaps a change of drainage direction with new sources of different composition, so too would the composition of the entrapped interstitial water change.

Movement of water into an environment such as this would quickly isolate it from the atmosphere, but would have only minor effect on the pH which would be buffered by the presence of a permanent water table. The change in Eh-pH in such a system is shown by the arrow on Figure 1. The position of some natural environments is shown on Figure 2a. The course plotted in Figure 1 thus starts in the region of slightly acid rain water and moves mostly downward into a region of slightly acid groundwater. Figure 2b shows the distribution of measurements made in natural environments and shows that, although the path shown does not fall in the area of most numerous measurements, it is quite reasonable. The position of the path is mostly on the acid side of the areas of more numerous measurements which is quite compatible with nature of the postulated source of the copper.

The increase of cuprite near the top of the 1500 ft. of well-mineralized conglomerate indicates a relatively more rapid increase in pH relative to decrease in Eh as compared to deposition of native copper. As the appearance of cuprite signals the end of copper mineralization higher in the section, it is reasonable to assume that the source of the copper and water of lower pH was contributing less material to the lake. Thus, the pH of the lake water may have been sufficiently higher to favor the formation of increased amounts of cuprite.

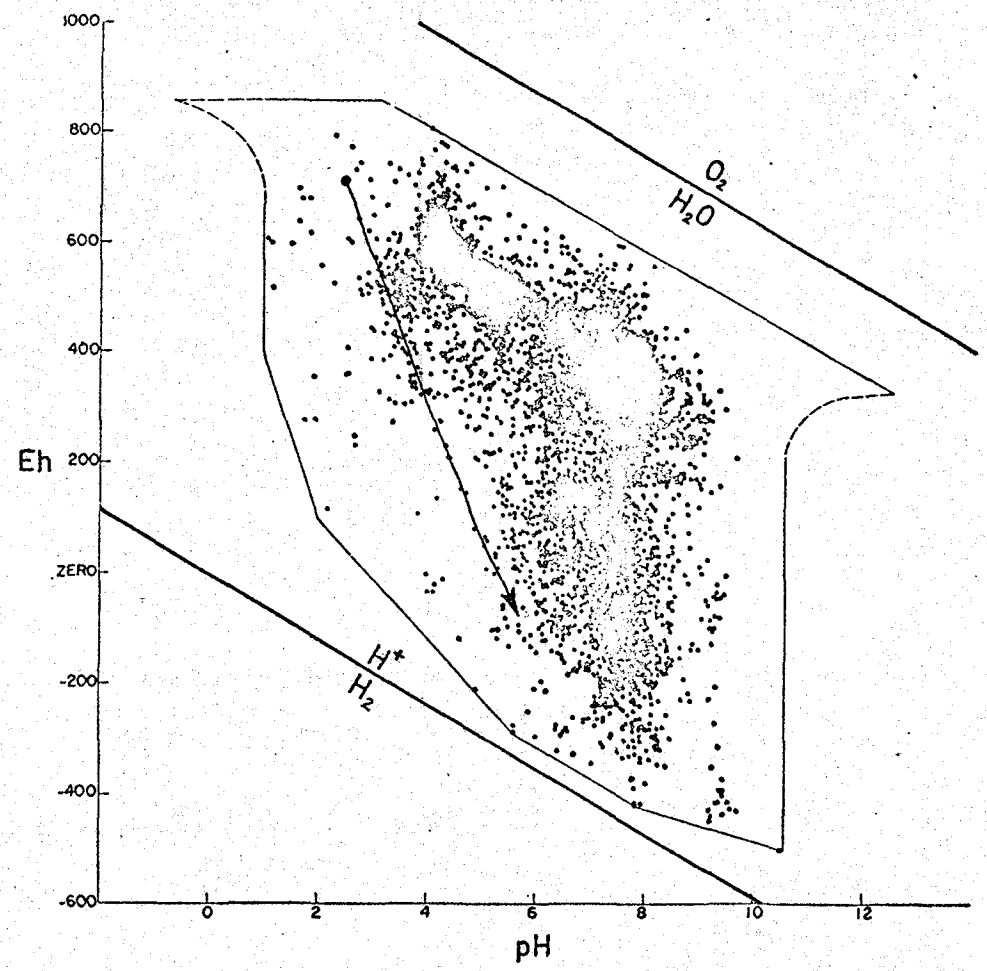
The kinetics of precipitation of the copper are unclear. It may have occurred as soon as the cupriferous water reached deep portions of the lake -- if indeed the lake was ever deep. More probably it happened after deposition of overlying Whitetail and complete isolation from lake water recharged with atmospheric CO_2 through convective overturn of the water. Precipitation of copper may have been initiated by reduction of Cu^{+2} to Cu^{+1} and finally Cu^0 by the decomposition of organic matter in the mudstone clasts which I understand are locally abundant in the Whitetail. In addition

2a



Approximate position of some natural environments as characterized by Eh and pH.

2b



Distribution of Eh-pH measurements of natural aqueous environments. [After Baas Becking *et al.*, *op. cit.*, p. 276.]

Figure 2. Chemical evolution of cuperiferous water in the Superior East area in terms of types of natural environments (after Garrels and Christ).

the limestone clasts may have served to increase the pH of the trapped water after isolation of water from the atmosphere and the buffering action of the overlying lake water.

The problem of the ultimate fate of the water is unsolved and exists whatever model is used. Perhaps it occurred during renewed faulting along the trace of Devils Canyon. In any case, movement of water at this time was probably mostly lateral except along faults or other outlets and, thus, redistribution of copper between different stratigraphic levels of the Whitetail was probably minor. The course taken by the water is of obvious interest as it may have carried some copper which could have been precipitated at some point along its escape route. Such a zone would have obvious exploration interest.

F. T. Graybeal

F. T. Graybeal

FTG:lad

cc: JDSell

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

May 1, 1972

TO: W. L. Kurtz

FROM: G. J. Stathis

Subject: Corocoro Copper Deposit, Bolivia/Superior East Project Area, Arizona

A review of the Entwistle-Gouin article in volume 50, issue #6 of Economic Geology suggested some similarities between the Bolivia deposit and Superior East. The arguments for a sedimentary control of native copper and chalcocite deposition appear to be convincing for the Corocoro deposit. A similar environment of copper deposition is indicated for the Superior East area. It's hard to buy the idea that copper has been remobilized upwards, perhaps from some deep, primary magmatic source as suggested by some for White Pine Michigan copper or heating up of the water saturated Superior East basin by the dacite flow cover as suggested recently by Kraston.

From reading the Corocoro article, I became impressed with the description that the older Ramos sedimentary series is native copper-rich while the Younger Vetas sedimentary series is chalcocite-rich. Therefore, despite the thick column of native copper indicated the the drilling to date at Superior East, one wonders if perhaps future drilling at Superior East might not encounter a change from native copper to substantial intercepts of other copper minerals. Chalcocite will be unlikely, but, barring effects of erosion, perhaps more copper oxides or silicates will be encountered which would reflect changes in the chemistry of the solutions carrying copper from the source area.

Geo. J. Stathis

G. J. Stathis

GJS:sg

cc: JHCourtright
JDSell

TO JDS

FROM W. L. K.

AUG 24 1972

SUBJECT Scp East

DATE / /

MESSAGE

I think it would be in our best interests to complete your summation prior to any reports going out from Stanford or any other quasi-consultant Collins' dreams up!!! See me if you want to discuss contents.

SIGNED Kurt

DATE / /

REPLY

Rediform® 45 472

SEND PARTS 1 AND 3 WITH CARBON INTACT - PART 3 WILL BE RETURNED WITH REPLY

Draft: JDSell -- 8/30/72
Report of August 31, 1972
to W L Kenty

1971-1972 Summation Report
With Recommendations for
Additional Exploration
Superior East Project
Pinal County, Arizona

SUMMARY

Drilling on the Superior East project during 1971-1972 resulted in five completions to premineral bedrock and one hole cased into Whitetail Conglomerate ready for diamond drilling to completion. Holes A-2(A-2W) and A-4 made significant alteration-mineralization discoveries of three types: porphyry copper, limestone replacement, and native copper in conglomerate.

Pervasively altered Tertiary quartz monzonite porphyry and Precambrian Pinal Schist characteristic of a major porphyry copper deposit was discovered in drill hole A-2 and its offset wedge A-2W. As interpreted, a gravity slide block of pervasively altered and mineralized rock, now nearly completely oxidized and leached, which moved from a more central portion of a chalcocite-enriched porphyry deposit was cut in the drilling. Below the slide block fault, secondary chalcocite and primary chalcopyrite and bornite, averaging 0.31% copper, was cut for over six ~~hundred~~ hundred feet before the hole was lost. This underlying unit was also highly, but somewhat variably, altered and the alteration-mineralization characteristics suggest being in the fringe area of a large porphyry copper deposit. Four additional holes are recommended to further delineate this discovery.

A massively replaced limestone unit was intercepted in drill hole A-4. This unit is characteristic of the ore zone mineralization in the limestone replacement deposits at Magma located several miles to the west. The hole intercept was terminated by a fault with weakly mineralized monzonite below. This intercept of favorable limestones and mineralization confirm their

presence and potential for further exploration. Three additional holes are recommended in the favorable area between the drill hole and the Magma workings.

Within the post-mineral Whitetail Conglomerate, a thick section of native copper-bearing conglomerate was intercepted in drill hole A-4. This significant intercept contained three zones, each more than 100 feet thick and averaging in excess of 0.8% copper. The total intercept of 1256 feet average 0.53% copper. Continued evaluation of this potential is recommended through three holes. Two of the three are dual purpose holes designed to test both the conglomerate and the underlying limestone.

DISCUSSION

General

The holes completed during the current program were numbered A-1, A-2(A-2W), A-4, DCA-1A, and M-1A. Hole A-5 is cased for reentry. In addition to the drill hole and monthly reports, Mr. R. B. Cummings has submitted a detailed report on the geology of the 1971-1972 drill holes. Also in progress is a report on the structural-isopach study results based on the drilling and outcrop information.

Attachment A is a plan map of the project area showing the results of the past drilling and the set of cross sections drawn through the area. The cross-sections are submitted as Attachment B-1 through B-3 and portray the geology as now interpreted. Attachment C is the interpreted premineral distribution of rock units and faulting beneath the postmineral cover of dacite and Whitetail Conglomerate. Of special note, on Attachments B and C, is the north-trending Devils Canyon fault structure which limits the eastward extent of preserved Paleozoic limestones capable of containing limestone replacement ore bodies. To the east of the fault, the Paleozoic sediments have been removed by erosion and the basement Precambrian schist and associated diabase exposed.

A significant feature is the southwest-trending nose of the Tertiary Schultze granite and related porphyries. As presently known it contains a secondarily enriched porphyry copper deposit, completely hidden below the cover rocks, and is probably also the major contributor to the localization of the massive limestone replacement deposits to the west. The slightly mineralized intrusive breccia at Magma's No. 9 Shaft is poorly known, but may have some control on mineralization.

Also shown on Attachment ~~D~~ C is the Silver King diorite intrusive and its eastward extent under the dacite cover based on aeromagnetic interpretation. Part of the intrusive complex contained a ~~xx~~ silver deposit mined at the turn of the century.

Three significant alteration-mineralization discoveries have been made; ~~Hole A-2 with~~ 1) porphyry copper type alteration-mineralization in Hole A-2, and ~~and Hole A-4 with~~ 2) limestone replacement mineralization, and 3) native copper in conglomerate in Hole A-4. Each of these discovery types are discussed below.

Porphyry Copper Type

Of foremost importance is the discovery of pervasive alteration and mineralization in schist and porphyry cored in drill hole A-2 and its offset wedge A-2W. Attachment D is an expanded graphic-assay log of the significant portion of drill hole A-2(A-2W). As shown, a gravity slide block was intercepted below the Whitetail Conglomerate. The block was intensely brecciated, altered, and contained up to 5% sulfides previous to oxidation and leaching. The oxidized products show abundant limonite after ~~xxxx~~ sulfide. Minor pyrite and remnant chalcocite was also found in silicified areas. The mineralization is predominantly disseminated with vein filling. Alteration is dominantly argillic with quartz-sericite and abundant silicification. Coarse ~~quartz-~~ grained sericite, of probably secondary origin, is found along major fractures. The

leached block is mainly porphyry with schist inclusions and masses and becomes more brecciated toward the bottom where a low-angled fault was encountered.

It is believed that the upper brecciated and oxidized block has been moved into its position from a more centrally, more intensely altered-mineralized portion of the intrusive porphyry body. This direction of movement is believed to be from the east to west and a half mile distance.

Below the fault, essentially unbrecciated rock (but highly fractured and veined), was encountered with the oxidation effects quickly diminishing and sulfides appearing.

The lower unbrecciated and sulfide mineralized block is predominantly schist cut by aplitic and monzonite dikes, and has abundant silicification along with argillic and quartz-sericite alteration in variable amounts. Chalcocite replacement of chalcopyrite-bornite and films of chalcocite on pyrite occur in the upper part and grade downward into pyrite with chalcopyrite, bornite and minor primary chalcocite with molybdenite. The mineralization is dominatly vein filling with subordinate dissemination occurrence.

From the base of oxidation, shortly below the fault, the 213 feet of secondarily enriched chalcocite copper values averaged 0.37% copper. Below the enriched zone, primary pyrite, chalcopyrite, bornite, and chalcocite mineralization was cored. This recovered zone included 80 feet of 0.31%, 180 feet of 0.13%, and 150 feet of 0.42% copper. The entire thickness of sulfides cored is 623 feet averaging 0.31% copper, with gold, silver, and molybdenum values in minor amounts. The in-place block represents the well altered and mineralized fringe zone of the porphyry copper deposit from which the slide block originated.

The original hole A-2 was lost due to twist-off of rods at 4513 feet. The wedge hole A-2W was initiated to recut the upper block just above the fault and continued down through the sulfide mineralized block below. This was

successfully accomplished to a depth of 4940 feet where the rods became stuck and subsequent work was unable to free them. The hole was abandoned at this depth in values averaging 0.42% copper over the last 150 feet of core with good alteration features. The amount and type of alteration in the block recovered prior to termination of the hole is indicative of that found only around a major porphyry copper deposit.

The potential porphyry target area is shown on Attachment E. The porphyry target extends around the quadrant from northeast to east to southeast to south from drill hole A-2(A-2W). The final extent and orientation of the deposit is to be determined, but half of the potential ground lies outside that wholly controlled by ASARCO at this time. Inspiration controls a large block to the east which ASARCO and Inspiration have under a joint venture project (Rawhide Project) (Attachment F). Fee land is present to the northeast. Recent structural-isopach studies suggest that the eastern portion of the zone outlined may have been exposed to erosional forces during the time of Whitetail deposition, and the remaining area was probably not covered until late in the Whitetail depositional history. Thus, and as shown by the secondary chalcocite in drill hole A-2(A-2W), the zone has the potential of a secondary enrichment cycle of long duration. Of course, the question remains on the rate of erosion in the area versus the rate of chalcocite enrichment, but it has been demonstrated in most of the porphyry deposits in the Southwest that conditions were such during the enrichment cycles that chalcocite enrichment was maintained ahead of the erosional destruction. Late Tertiary to Quaternary times was probably the cycle time of destruction of chalcocite development. At Superior East the porphyry area was covered by a thickness of dacite which prevented any attack on the chalcocite developed. Such preservation is known in the ore bodies of the Miami district and was recently shown in the Miami East drilling where chalcocite was found under a thin eroded section of dacite which was overlain by several thousand feet of

recent valley fill.

A quartz monzonite with schist intrusions was cut in the bottom of hole A-4 and it is a control point on the westward extent of the Schultze Granite and related porphyries. As shown on Attachments A and B, the monzonite of A-4 contained minor Pinal Schist masses and is interpreted to be along the margin of the Schultze granite. The monzonite-schist block is weakly altered and mineralized with pyrite, chalcopyrite, and molybdenite. The 83 feet of monzonite-schist averaged 0.16% copper.

Limestone Replacement Type

Attachment G is an expanded graphic-assay log of the significant intercepts cored in drill hole A-4. An intercept of massively replaced limestone was cored just above the fault contact with the quartz monzonite mentioned previously. The block is thought to be in-place based on projection of known units from the west in Magma's workings. The essentially completed replaced block was replaced with specularite, metallic hematite, and red earth hematite. Some areas of strongly silicified limestone contained iron-oxide filling pseudomorphs after sulfides. Also some native copper was found. Although low (0.81%) copper values were in the replaced unit for the entire 87 feet as intercepted, some ten-foot runs returned values of 1.16%, 1.26%, and 2.55% copper. The block of massively replaced limestone passed downward into less replaced silicified limestone which became progressively brecciated as the large fault structure was encountered.

The type and occurrence of mineralization is identical to that found to the west in the oxidized upper workings of the Magma Copper Company's limestone replacement areas. This type of deposit is presently the major mining and reserve mineralization for Magma at Superior with published reserves of 10.1 million tons of 5.88% copper before dilution.

Above the massively replaced unit and setting between Whitetail Conglomerate units is a brecciated and partly replaced limestone block. The block is interpreted to be a slide block, probably originally from the west, which was emplaced shortly after the initiation of Whitetail Conglomerate deposition. The slide block is slightly altered and slightly dolomitic with some silicification. Primary mineralization is confined to scattered pyrite and one oxidized replaced limestone bed lying below a shale-mudstone unit, as well as mineralization within the shale-mudstone unit. This mineralization here, as well as throughout the entire unit intercept, is abundant secondary mineralization consisting of native copper, malachite, chrysocolla and minor cuprite and tenorite which averaged 3.22% copper over the 109 feet of core.

The slide unit is highly brecciated and the secondary mineralization generally occurs in the breccia fractures and rarely replaced the breccia fragment.

The replacement target (Attachment E) lies between Magma's Number 9 Shaft, now being sunk, and the ASARCO drill hole A-4. A mile and a quarter of the distance (east-west) is Oak Flat Recreational Area (Attachment F) presently closed to mineral entry with a Public Land Order. The withdrawal is a mile in north-south dimension. Magma covers the north, west, and south sides of the withdrawal with mining claims. ASARCO is on the east and also north and south of Magma (Attachment F). The replacement potential is limited on the east by the extent of limestone preserved up to the Devils Canyon fault structure as discussed earlier. Westward the best potential brackets the ASARCO drill hole A-4 and the known replacement deposits of Magma Copper Company. A fully untested potential lies from essentially the Silver King area two miles north of Magma's No. 9 Shaft to the Belmont area two and one-half miles south of the shaft. ASARCO claims and State leases cover some of the area, with Magma and the withdrawn area covering the better potential.

Magma, through Newmont Exploration, is presently building a road for drill sites in the Belmont area.

The ASARCO drill hole A-5 will be deepened to a premineral intercept to test the area eastward from the Silver King intrusive and structural features extending from the Magma mine area.

The ASARCO drill hole M-1A did not penetrate into any significant favorable replacement zones in the Pennsylvanian limestones cored although minor pyrite and specularite was found. The northern ASARCO drill hole, DCA-1A, penetrated the entire thickness of Paleozoic units and found numerous silicified and alteration replaced textured zones, complete with shrinkage-collapse breccia areas and calcite veining throughout the limestone units cut. Only minor zones were found in the Pennsylvanian limestones, but thick sections were found in the underlying Mississippian and Devonian limestone. This hole is far to the north and unrelated to any mineral zone previously discussed. The alteration textures indicate the drill hole is within ~~the~~ an alteration halo effect~~s~~, but present studies are insufficient to determine the ~~xxxx~~ extent to which solutions capable of altering the limestone may have traveled. Only minor iron, zinc, and copper values are associated with the altered zones. Further field studies will be undertaken in the northern area for evaluation purposes.

Native Copper in Conglomerate

A significant discovery in terms of thickness of the intercept and the overall amount of contained copper has been made in Whitetail Conglomerate in drill hole A-4 (Attachment G). The mineralization is native copper and subordinate cuprite, both of which occur as 1) specks, fracture filling, and minor masses within various rock-type clasts in the conglomerate; as 2) sheets and masses along the clast boundary; and as 3) specks and masses randomly scattered throughout the conglomerate matrix.

Native copper, in visible but sparce to trace amounts, has been found in all six ASARCO drill holes, as well as reported in nearly all the other drilling and shafts which have penetrated into the Whitetail Conglomerate. Copper values tested range from 0.02% to 0.11% in relatively thick sections of conglomerate.

The significant section of native copper in drill hole A-4 was cut starting at a distinctive lithic tuff bed containing 1.30% copper, mainly as cuprite, and continuing downward to the limestone units mentioned previously. The significant thick intercept of 1256 feet of conglomerate above the slide block averaged 0.53% copper, while the thin (36 feet) underlying section of conglomerate below the slide block averaged 0.69% copper. The lower conglomerate rests in depositional contact on the limestone below (as does the upper conglomerate section) (Attachment G).

The native copper in conglomerate target (Attachment E) is one which has little precedence in southwestern geology. The thickness and contained copper content indicates a potential of staggering implications. Present studies suggest the richer copper area lies in the basal trough portion of the conglomerate depositional basin. The conglomerate material was rapidly dumped into a continuously subsiding eastward tilting basin which was locally developed along the north-south Devils Canyon fault structure. The probable source area was dominantly from the east with contributions also from the north-east sector and with a minor contribution from western source areas.

Copper is present throughout the basin and has been reported as a curiosity from nearly all holes and shafts drilled through the dacite cover. Native copper has also been reported from drill holes in conglomerate east of the Miami-Inspiration ore bodies of the Miami district. Our only control on the richer portion of the Superior East basin is in ASARCO drill hole A-4 and here the copper appears to be restricted to the units below the distinctive tuff marker bed.

The development of the basin suggests that the north-south faulting in the Devils Canyon area took place soon after the emplacement of the granite-porphyry intrusives and the attendant mineralization. Some movement must have taken place earlier along east-west to southwest-northeast structures as well as the north-south structures as, at Magma, the limestones dip some thirty degrees eastward. This would suggest some ten degrees of tilting prior to mineralization, and some twenty degrees after intense oxidation had been effective at Magma. Perhaps a few to five degrees have taken place contemporaneously or after dacite deposition, as ignimbritic features ~~these~~ in general dip toward the central part of the dacite exposures.

If the tuff unit signals the end to the conditions which accumulated the significant native copper area, then the potential area of accumulation would abut the north-south Devils Canyon fault and wedge out westward as the basin was being tilted and filled. Structural-isopach maps show a potential zone north from A-4 to nearly DCA-1A, but very restrictive in width along the fault. In the area of A-4, structural features were such as to preserve a very wide wedge both to the west of A-4 and to the south as shown on Attachment E. About half of the area, and more of the volume as the wedge increases in thickness to the east, is covered by ASARCO claims or State leases. A majority of the remaining potential is under the Oak Flat Withdrawal with a minor amount under Magma claims (Attachment F).

SP —

FUTURE EXPLORATION

Exploration within the Superior East project area will continue to evaluate the three significant discoveries. Attachment E shows the three areas of interest as an overlay to the land status of Attachment F. Also shown on Attachment E is the proposed drill holes for continued evaluation.

The porphyry target will be more fully delineated by four holes on a 2000-foot grid into the central, higher-grade, portion of the porphyry. The outline and extent of the target area shown ~~is~~ are based on the interpreted alteration-mineralization features developed during the past drilling and the knowledge of the characteristics of the deposits in the Ray and Miami districts. The first hole of this series would be the

easternmost hole which lies on the joint-venture ground of ICC and ASARCO (Rawhide Project). Evaluation of this intercept would guide the direction for further drilling. Based on the interpreted features it can be speculated that the area outlined will contain 300-400 million tons of secondarily enriched chalcocite with a grade in excess of 0.85% copper. The strong mineralization in the fringe in-place intercept further suggests double that tonnage of 0.7% copper in primary mineralization.

It is recommended that the limestone replacement target to the west of A-4 be tested with three additional holes. These holes are within the most favorable structural zone which for the most part underlies the withdrawn Oak Flat recreation area. The replaced and mineralized sections cut by A-4 suggest continuation of high grade values of +6% copper as found at Magma to the west. The proximity of the area to the Schultze granite nose and the intrusive breccia of Magma suggests overall better ground preparation for mineralization with probable more continuous mineralization in thick sections of limestone. Total potential of the area suggests more tonnage than has been currently announced by Magma. As shown on Attachment E, two of these holes will serve the dual purpose of testing the copper-bearing conglomerate which overlies the Paleozoic limestones.

The native copper in conglomerate will be further delimited by the drilling of two of the holes in the suggested replacement target, with a third hole proposed to the south in a State Lease section. The final extent and grade of this discovery may constitute a viable future resource.

SP

LAND STATUS

The land status has been partly mentioned in the above discussions. Attachment F is the basic status while Attachment H gives a more detailed status of the fee land. Basically the ASARCO position is good in the porphyry target area. Recent agreement with Inspiration (ICC) on the Rawhide Project area places most of the project target within the covered ground. However, the northeastern area is covered by Fee land owners as shown on Attachment H. The proposed drill hole on the northeast side will provide the information necessary to evaluate the extent of the zone.

The replacement target area is largely under the Oak Flat recreation withdrawal area. Further evaluation of the target as now known would involve participation within the withdrawn area, although an area of favorable ground lies south of A-4 and eastward to the Devils Canyon fault structure on ground controlled by ASARCO. As shown in cross-section E-E' of Attachment B-1, the depth to the limestone unit becomes progressively less toward the west. Evaluation of the native copper in conglomerate target can largely be done on claims or State Lease land presently controlled by ASARCO, with a segment of the potential under the Oak Flat Withdrawal.

The land claimed by Magma covering the area around Oak Flat would probably be open for joint venture consideration in the event of ASARCO control on the Oak Flat ground.

Attachments

A. Plan of Superior East Project Area with Drilling Results and ~~with~~ Cross-Section Designations

B-1. East-west Cross-Sections

B-2. North-South Cross-Sections

B-3. ASARCO Drill Hole Cross-Sections

C. Plan of Premineral Rock Unit Distribution Below Whitetail Conglomerate

D. Expanded Graphic Log and Assay Groups of Mineralized Blocks in Drill Hole A-2 (A-2W).

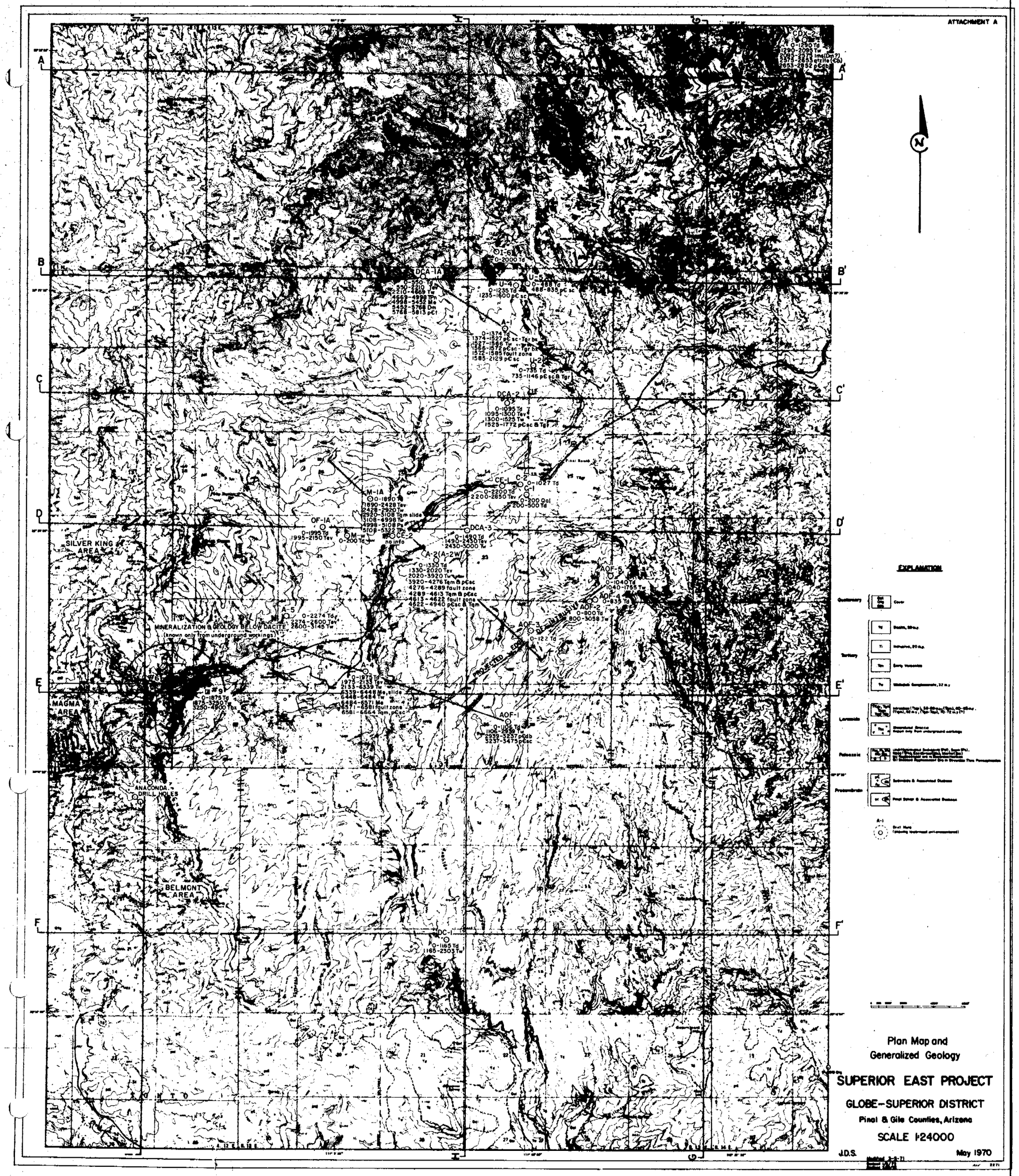
E. Overlay of Target Areas and Proposed Drill Holes, based on previous drill results.

F. Land Status Map of Superior East Project Area.

G. Expanded Graphic Log and Assay Groups of Mineralized Units in Drill Hole A-4.

H. Expanded Land Status Map Showing Ownership of Fee Land and Two Ungatented Lode Claims.

ATTACHMENT A



Plan Map and
Generalized Geology

SUPERIOR EAST PROJECT

GLOBE–SUPERIOR DISTRICT

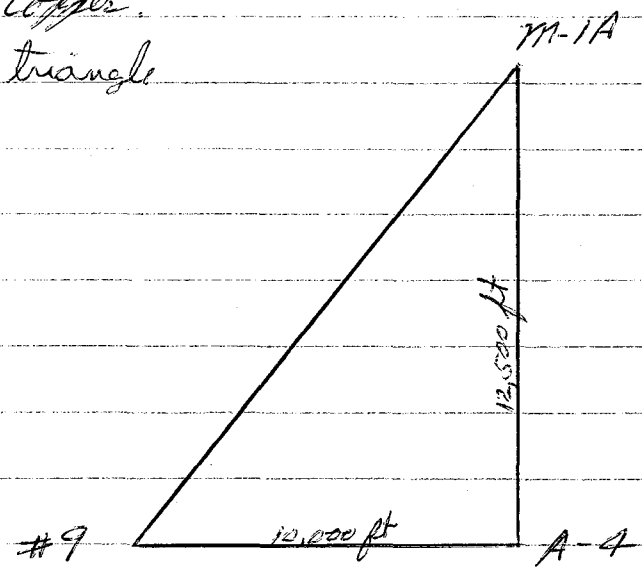
Pinal & Gila Counties, Arizona

SCALE 1:24000

J.D.S. May 1970

Whitetail Copper.

Total triangle



Hole Number	True Thickness	Composite Assay	ft-%
M-1A	2282 ft	@ 0.10% Cu	= 228.20 ft%
A-4	4242 ft	@ 0.25% Cu	= 1060.50 ft%
#9	1375 ft	@ 0.20% Cu	= 275.00 ft%
	7899		1563.70

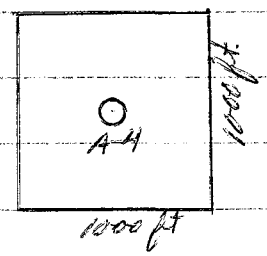
÷3 = 2633 ft ave thickness @ 0.20% Cu

Tonnage $\frac{1/2 \times 10{,}000 \times 12{,}500}{12.0} \times 2633$ = 13+ billion tons material

containing 43+ billion lbs of copper.

Whitetail Copper

1000 ft. square, block around A-4



Tonnage $= \frac{1000 \times 1000 \times 1}{12} = 83{,}000$ tons per foot

with thickness of 240 ft = 69 million tons material

with assay of 0.80 % Cu = 1.1 billions lbs of copper.

~~JHC~~

W. L. K.

SEP 27 1972

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

September 26, 1972

J. H. C.
SEP 28 1972

TO: W. L. Kurtz

FROM: J. D. Sell

Drill Hole A-2
Drilling and Cost Summary
Superior East Project
Pinal County, Arizona

Drill hole A-2 was rotary drilled from the surface to a depth of 4076 feet by Coffey Drilling Company using a Mayhew-3000 and high pressure air. Drilling commenced January 13, 1972 and terminated on February 7, 1972. Four-inch casing was set and cemented in preparation for coring operations.

Coring was commenced by Longyear Drilling Company using a truck mounted (TRK)-44 rig on March 4, 1972 and terminated coring on March 17, 1972 after coring from 4076 feet to 4521 feet, for a total of 445 feet using NQ wireline.

The core barrel stuck at the termination depth and recovery attempts were unsuccessful. The hole was abandoned on April 17, 1972 and a wedge (whipstock) set. (See report on drill hole A-2W for new hole below wedge.)

The hole diameter and depth intervals are as follows:

Hole Size	Depth Interval	Footage
15 inch	0-21 feet	21
8-3/4 inch	21-1863 feet	1842
6-1/4 inch	1863-4076 feet	2213
NQ	4076-4521 feet	445

Casing, etc., remaining in the hole is as follows:

Casing Size	Depth Interval Remaining	Footage
10-3/4 inch	0-21 feet	21
4 inch	0-4019 feet	4019

7"?

Also lost and abandoned were 290 feet of NQ rods and a core barrel in the bottom of the hole.

The cost breakdown of drilling A-2 is as follows:

	Rotary Drilling Cost	Rotary Drilling $/ft.	Core Drilling Cost	Core Drilling $/ft.	Total Cost	Total $/ft.
a) Direct Drilling	$70,102.69	$17.20	$20,804.77	$46.75	$90,907.46	$20.11
b) Site Preparation	4,016.64	0.99	120.00	0.27	4,136.64	0.91
c) Sampling	1,812.20	0.44	5,372.07	12.07	7,184.27	1.59
d) Supervision	1,925.44	0.47	3,936.15	8.85	5,861.59	1.30
Totals	$77,856.97	$19.10	$30,232.99	$67.94	$108,089.96	$23.91

See Drill Hole Summaries report dated October 1, 1971 for explanation of categories.

The high sampling cost during coring was incurred with the use of three full-time samplers for core catching security.

Drilling rate during rotary drilling was 66.8 feet per shift and during coring was 9.9 feet per shift.

James D. Sell

James D. Sell

JDS:lad

cc: HLCrittendon

A-2 + A2W = $25.65 per foot (0-4940')
($23.35 per foot) (0-4940' + 445' (wireline))

W. L. K.

SEP 27 1972

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

September 26, 1972

TO: W. L. Kurtz

FROM: J. D. Sell

Drill Hole A-2W
Drilling and Cost Summary
Superior East Project
Pinal County, Arizona

Drill hole A-2W was started from a wedge (whipstock) set in hole A-2 at a depth of 4230 feet. Coring commenced on April 19, 1972 and terminated on May 18, 1972 at a depth of 4940 feet. A total of 710 feet of NQ was cored for the hole. The hole was drilled by Longyear Drilling Company using the truck mounted (TRK)-44 machine used previously on hole A-2. The hole was terminated and abandoned with the loss of a stuck core barrel and rods.

In addition to the core barrel, 810 feet of NQ rods were lost in the A-2W portion of the hole. Also lost in the upper portion (A-2 area) were 1130 feet of NQ casing (from 2949-4079 feet), 4019 feet of 4-inch casing (from 0-4019 feet), and 21 feet of 10-3/4-inch casing (from 0-21 feet). The last two items were originally left in hole A-2 and remained upon abandonment of hole A-2W.

The cost breakdown of the coring in A-2W is as follows:

	Core Drilling	
	Cost	$/ft.
a) Direct Drilling	$12,797.63	$18.02
b) Site Preparation	160.00	0.23
c) Sampling	4,018.75	5.66
d) Supervision	1,675.16	2.36
Totals	$18,651.54	$26.27

See Drill Hole Summaries report dated October 1, 1971 for explanation of the categories.

Core rate for A-2W was 9.9 feet per shift.

James D. Sell
J. D. Sell

JDS:lad

cc: HLCrittendon

W. L. K.

SEP 27 1972

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

September 26, 1972

TO: W. L. Kurtz

FROM: J. D. Sell

Drill Hole DCA-1A
Drilling and Cost Summary
Superior East Project
Pinal County, Arizona

Drill hole DCA-1A was a reentry into the previously drilled DCA-1 hole of the Miami Copper-Superior Oil joint venture.

ASARCO cleaned the hole with a churn drill and set four-inch stabilized casing to the depth of 4002 feet. Coring with a CP-50 rig using NX wireline commenced on November 17, 1971 and terminated on February 9, 1972 at a depth of 5813 feet, for a total of 1811 cored feet.

No casing was recovered upon termination of the hole.

The cost breakdown of DCA-1A is as follows:

	Clean-out		Core Drilling		Total	
	Cost	$/ft.	Cost	$/ft.	Cost	$/ft.*
a) Direct Drilling	$13,812.77	$3.45	$73,351.62	$40.50	$87,164.39	$48.13
b) Site Preparation	---	-	1,598.56	0.88	1,598.56	0.88
c) Sampling	---	-	609.64	0.34	609.64	0.34
d) Supervision	860.00	0.21	5,531.69	3.05	6,391.69	3.53
Totals	$14,672.77	$3.67	$81,091.51	$44.77	$95,764.28	$52.88*

*Cost per foot based on cored footage.

See Drill Hole Summaries report dated October 1, 1971 for explanation of categories.

Drilling rate during the core drilling averaged 9.8 feet per shift (8 hour)

James D. Sell

James D. Sell

JDS:lad

cc: HLCrittendon

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

June 8, 1973

TO: H. L. Crittendon

FROM: W. L. Kurtz

Drilling Requirements

Over the last several months we have discussed drilling requirements, but have always, for one reason or another, post-poned them. The following schedule should be firm:

BOHME: immediately start rotary hole and drill as deep as funds permit (per instructions of Sell). Set casing for continued drilling after Aug. 14, 1973 with either rotary or diamond drill. Total depth 4,000'?

SUPERIOR EAST-RAWHIDE: a) immediately start rotary hole for Superior East at location north of highway (per instructions of Sell). Depth 3500'+ (core point to be determined by Sell). Continue hole with coring to 5500-6500.

b) start rotary hole after "a", but no later than August 1st. Depth ± 3500' (core point determined by Sell). Continue coring to 5000'±.

THUNDER MOUNTAIN: start diamond drill hole as soon as possible, probably depth 5,000'. Drill access needs to be determined, check with Graybeal for site location and possible road access (perhaps Stone could help).

3R: upon completion of TM hole, move rig to TR-10, clean out, deepen to 5,000'.

SILVER STATE: start air drilling first week July (Whaley to supervise project and Whaley to complete drill roads prior to arrival of Ecklund Drilling Company). You should plan to help kick the drilling off.

You should make strong effort to line up someone capable of handling the deep rotary drilling. If no one available, we could use a 1500 and then diamond drill.

W. L. Kurtz

WLK:lb
cc: JDSell
FTGraybeal
NPWhaley
RBCrist

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

June 29, 1973

TO: W. L. Kurtz

FROM: J. D. Sell

Tops of Units
Holes A-7 and AI-1
Superior East Area
Pinal County, Arizona

Based on adjacent holes and projections, the following units and footages are expected:

		Logged
Drill Hole A-7:		
0-2300	Dacite	0-2100
2300-2650	Early Volcanics	2100-2445
2650-5000	Whitetail	2445-5610
5000-	Premineral	5610 - 2600 (top M-1A top 3B) 3044 (top A-2 top) top BR 3238.

I would expect the volcanic tuff unit in the Whitetail to be somewhere around 4000 4690 feet in depth. (The fault movement and timing of basin filling is unknown at this time and the existence of the marker bed is hypothetical.) Thus, at around 4000 feet of depth would be the projected core point.

Drill Hole AI-1:		
0-1900	Dacite	0-1565 Td 1565-2250 Tev
1900-2200	Whitetail	2260-
2200-	Premineral	

I would think that core point could be anytime after getting into the Whitetail.

James D. Sell

James D. Sell

JDS:lb

cc: HLCrittendon

J. D. Sell

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

July 10, 1973

TO: Harold Stone

FROM: W. L. Kurtz

For the duration of the drilling at Superior East-Rawhide, you will be directly responsible to Mr. Crittendon. By copy of this memorandum, all geologists are hereby notified that Mr. Stone's services may be obtained only upon Mr. Crittendon's approval (i.e., you only contact Mr. Crittendon).

W. L. Kurtz

WLK:lb

cc: All Geologists
HLCrittendon
RBCrist

TAB

KC-1

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

August 6, 1973

FILE MEMORANDUM

Kirby Coryell's State Lease
Drill Hole
Superior East Project Area
Pinal County, Arizona

I have recently come into the factual information concerning Kirby Coryell's drill hole (KC-1) on State Lease Section 9, T2S, R13E. The hole was rotaried to 2370 feet and completed by coring to 3304 feet.

0-1010	Dacite
1010-2917	Whitetail Conglomerate; native copper in last 400 feet.
2917-3304	Naco Limestone; minor pyrite pseudomorphs, manganese and zinc stringers.

Apparently the best interval of native copper was from 2750-2800 feet with a value of 0.09% copper. A sample in the Naco returned 1.5% Zinc and 0.1% Lead. Bedding in the Naco generally dipped 15 to 20 degrees in the core.

James D. Sell

James D. Sell

JDS:lb

Interesting viewpoint but not really very practical unless we use dyna drill and get several hundred feet away.

AMERICAN SMELTING AND REFINING COMPANY
EXPLORATION DEPARTMENT
120 BROADWAY, NEW YORK, N.Y. 10005

W. L. K.

SEP 17 1973

J. H. C.

SEP 17 1973

RECEIVED
SEP 14 1973
S. W. U. S. EXPL. DIV.

T. C. OSBORNE
ASSISTANT DIRECTOR OF EXPLORATION

Air Mail

September 12, 1973

Mr. W. L. Kurtz
Southwestern Division
Tucson Office

Superior East Project and
Rawhide Project
Pinal County, Arizona

Dear Mr. Kurtz:

Mr. Collins has pointed out that we should be prepared to wedge and take additional samples from all holes drilled in connection with the above projects which encounter ore or something close to it if the occurrence is as limestone replacement or enriched chalcocite blanket. I agree, and we will henceforth request a contingent amount in all authorizations which will allow you to undertake such wedging when and if required without requesting additional funds. You should also make sure that the drill crews are always equipped and ready to wedge on short notice as you may request, if that is not already standard practice. I should clarify that we are talking about limestone replacements sulfides and chalcocite mineralization, and not primary porphyry copper mineralization or native copper in the Whitetail. For occurrences of the latter types, an extra sample a few feet away from the original would not be worth the cost in view of the potentially long vertical columns and the general uniformity of grade.

The above is based on the thought that in view of the great depth involved, any ore intersections will in the future have to bear a great responsibility for possible substantial investments, and any intercepts of mineralization of a type apt to be erratic should be reconfirmed at least once or twice by wedging in order to provide a convincing and conservative basis for future decisions.

In line with this, we are requesting an additional $20,000 for your hole A7, as a contingency to be used for possible wedging in case interesting intercepts of limestone replacement ore are encountered.

Very truly yours,

T. C. Osborne

TAB

A-3

AMERICAN SMELTING AND REFINING COMPANY
TUCSON ARIZONA

November 7, 1973

TO: W. L. Kurtz

FROM: J. D. Sell

Daily Drill Data
Drill Hole A-3
Rotary Drilling
Superior East Project
Pinal ~~Gila~~ County, Arizona

Attached is a daily log of the rotary drilling of Hole A-3. The information shown is the date, depth at end of the day, number of hours charged to drilling, and the number of shifts involved (converted to 8-hour shifts), explanation of delays, size of hole, and the geologic formation.

Compiled from this data is a breakdown of the shifts and footage by a) bit size (and essentially depth based on 1000-foot increments), and b) geologic unit.

James D. Sell

James D. Sell

JDS:lb
Attachs.

DRILL HOLE No. A-3 - ROTARY DRILLING WITH AIR-HAMMER
Harness Drilling Company - Failings 1500 DMX with WEJ Compressors

Date	Depth at End of Shift	Footage	Drilling Hours	Drilling Shifts*	Delays	Hole Size	Formation
1973						-0-	-0-
5/21	0	--	-	1-1/2	Moving on location	10" -10-	
5/22	20	20	4	1-1/2	Drilled 8" hole to 20'; reamed 10" hole to 10'; set 8" ID casing to 10-foot and cemented.		
5/23	20	--	-	1-1/4	Welded drill head; repair, clean-up work.		
5/24	243	223	6-1/2	1-1/2	Waiting on hammer; tripping time.		
5/25	518	275	8	1-1/2	Service rig; welding on drilling head.		
5/26	693	175	6-3/4	1-1/2	Tripping; clutch repair.	8"	
5/27	813	110	5	1	Repair master clutch; water at 708'		Dacite
5/28	1038	225	10	1-1/2	Service rig.		
5/29	1038	--	-	1-1/4	Plugged hammer, repair & tripping time.		
5/30	1203	165	9-1/2	1-1/2	Cleaning hole.		
5/31	1218	15	1	1-1/2	Unloading hole; plugged hammer; repair.		
6/01	1428	210	10-1/2	1-1/2	Unloading hole.		
6/02	1428	--	-	-	Saturday; no work.		
6/03	1428	--	-	-	Sunday; no work.		-1430-
6/04	1445	17	1/2	1	Clean up hole; laying down pipe.	-1445-	Whitetail Cgl. -1445-

*Based on 8 hours per shift.
Note: Only ten-feet of 8" ID surface casing in hole.

Drill Hole A-3, Rotary-Air-Hammer
SUPERIOR EAST PROJECT

Drilling Time by Bit Size, including down time:

Bit Size	Depth	Shifts to Depth		Footage	Ft./Shift	Delays
10" & 8"	1445	16-1/2	1445	1445	87.6*	Surface casing; unloading hole; laying down pipe.

*Note: No casing set except 10 feet of surface casing.

Drilling Time by Rock Unit, including down time:

Rock Unit	Depth	Shifts to Depth		Footage	Ft./Shift
Dacite	0-1430	15-1/2	1428	1428	92.1
Whitetail Cgl.	1430-1445	1	1445	17	17.0*
		16-1/2		1445	87.6

*Note: This amount of hole actually drilled in 1/2 hour of on-the-bottom drilling.

TAB

A-6

AMERICAN SMELTING AND REFINING COMPANY
TUCSON ARIZONA

November 7, 1973

Also:
A-6 Discrepancy
1974

TO: W. L. Kurtz

FROM: J. D. Sell

Daily Drill Data
Drill Hole A-6
Rotary Drilling
Superior East Project
Gila County, Arizona

Attached is a daily log of the rotary drilling of Hole A-6. The information shown is the date, depth at end of the day, number of hours charged to drilling, and the number of shifts involved (converted to 8-hour shifts), explanation of delays, size of hole, and the geologic formation.

Compiled from this data is a breakdown of the shifts and footage by a) bit size (and essentially depth based on 1000-foot increments), and b) geologic unit.

James D. Sell

James D. Sell

JDS:lb
Attachs.

DRILL HOLE NO. A-6 - ROTARY DRILLING W/AIR-HAMMER
Harness Drilling Company - Failings 1500 DMX with WEJ Compressors

Date	Depth at End of Day	Footage	Drilling Hours	Drilling Shifts*	Delays	Hole Size	Formation
1973							
6/06	10	10	1-1/2	1-1/2	Set-up on site; drilled 8" hole.	-0-	-0-
6/07	10	--	1-1/2	1-1/2	Reamed to 10", set 10' of ID 8" surf. pipe & cemented.	10" -10-	
6/08	108	98	8-1/2	1-1/2	Welded on drilling head.		
6/09	308	200	8	1-1/4	Service rig.		
6/10	--	--	-	-	Sunday		Dacite
6/11	553	245	9-3/4	1-1/2	Tripping.		
6/12	833	280	10	1-1/2	Making approx. 25 gpm water.	8"	
6/13	1013	180	10	1-1/2			
6/14	1193	180	9-1/4	1-1/2	Tripping.		
6/15	1298	105	8	1-1/2	Trouble unloading hole.		
6/16	1375	77	6-1/2	1	Tripping.	-1375-	-1375-

*Based on 8-hours per shift.

NOTE: Only ten feet of 8" ID surface casing in hole.

Deepening DRILL HOLE A-6 - Rotary-mud Drilling
Copper State Exploration (J.C. Tackett) - Failings DMX Holemaster

Date	Depth at End of Day	Footage	Drilling Hours	Drilling Shifts*	Delays	Hole Size	Formation
1974					(Note: Water level was at 800 feet.)	-1375-	
5/20	1375	0	0	3	6 hrs. rigging up; 12 hrs. mixing mud and lost-circulation material (LCM).		
5/21	1375	0	0	3	24 hrs. blind hole, mix mud & LCM.		Dacite
5/22	1390	15	6	3	18 hrs. recovering circulation, mix mud & LCM.		
5/23	1420	30	20	3	4 hrs. bit change @ 1410 ft.; mix mud & LCM.		
5/24	1440	20	18	3	6 hrs. rd. trip, bit change @ 1428 ft.; mix mud & LCM.		-1475-
5/25	1490	50	20	3	4 hrs. rd. trip; bit change @ 1460 ft.; mix mud & LCM.	5-1/8"	
5/26	1557	67	18	3	4 hrs. rd. trip; bit change @ 1520 ft.; mix mud & LCM; 2 hrs. tripping; bit change @ 1557 ft.		
5/27	1640	83	22	3	2 hrs. tripping in.		Whitetail Cgl.
5/28	1665	25	12	3	4 hrs. tripping for bit change @ 1655 ft; 4-1/2 hrs. conditioning mud for shutdown & tripping out; 3-1/2 hrs. rigging down.		
5/29	1665	0	0	2	15 hrs. rigging down & moving	- 1665-	-1665-

*Based on 8 hours per shift.
NOTE: Only ten feet of 8" ID surface casing in hole.

gwg

ASARCO
Salt Lake Exploration Division

December 12, 1973

J. D. Sell
Tucson, Office

Dear Jim:

First of all my apologies for not getting this to you sooner.

Regarding our conversations of November 27-29th, I have reviewed briefly the drilling reports from the Miami-Superior area and my initial impression is that air drilling through the uppermost 1000' of dacite is preferable to mud drilling in order to minimize problems arising from severe lost circulation zones. The advantages of air drilling below the point at which the intermediate casing string is set are debatable and it is my opinion that mud drilling from this point on would be most efficient in the long run. This is with the assumption that the equipment required for the switchover is readily available on location. The price advantage of rotary drilling over core drilling diminishes below 2000' when the cost of the tertiary casing is added to the rotary cost. It seems probable that attempting to continue rotary drilling to predetermined coring depths below 2000' in spite of difficulties may not result in the least overall cost.

We discussed at length contractors and equipment. I highly recommend that you adjust your timetable so as to coincide with the availability of the contractors with the most applicable equipment.

As far as the problem of buying worn drill rods, some contracts contain a statement to the effect that "... this document constitutes the entire agreement between ASARCO and _____ and no liabilities or conditions are inferred or assumed other than those specified herein." ASARCO representatives executing this sort of contract must be careful to specify all of contractor's obligations but this clause would substitute for the other phrases I suggested while in your office.

It has always been my contention that you cannot write superior performance into a contract. Superior performance can only arise from a contractor with the proper equipment, experience and intent.

It has been a pleasant sojourn for me to once again talk drilling and if I can advise further, please don't hesitate to call on me.

Regards to Marnie, Tom & Mark and hope Kappy is hobbling around O.K.

Very truly yours,

Joe

J. R. WOJCIK

JRW/mb

Dec 1973

AMERICAN SMELTING AND REFINING COMPANY
SOUTHWESTERN EXPLORATION DIVISION
P. O. BOX 5747, TUCSON, ARIZONA 85703

1150 NORTH 7TH AVENUE
TELEPHONE 602-792-3010

Dec. 73

MERRY CHRISTMAS AND HAPPY NEW YEAR

TO ART, DICK, GEORGE, AND ALL THE HELP

FOR THE EXCELLENT WORK OF THE YEAR.

Bill Kurtz
Bob Crist
Jim Sell
Harold Stone

Jan 80

To F T Graybeal
From J D Sell

Project Cost Distribution
July 1, 1978 - ~~Jan. 1, 1980~~ Dec. 31, 1979
Superior East Project
Pinal County, Arizona

A project charges which are ~~is~~ not applicable to drill hole distribution during this period have been separated out as follows:

Rental on Storage-Core Building in Miami, Az.	$1,500.00
Window repair on above storage	103.65
Total	$1,603.65

James D. Sell

cc: N P Whaley.

Feb 80

To F T Graybeal
From: J H Sell

Drill Hole A-11
Core Drilling Costs
Superior East Project
Pinal County, Arizona

Core drilling was initiated from the surface on August 2, 1978, and carried to the terminal depth of 5,175 feet on June 20, 1979. From this date the casing left in the hole ~~temp~~ in the event to do further drilling was rented through January 1980 and this rental fee (3,242.33) has been included in these figures.

Core drilling costs are distributed as follows covering the completed hole to 5,175 feet.

Drilling Charges	$ Cost	$/ft.

← Drilling Charges	$ Cost	$/ft
A. Direct Drilling	$140,331.66	$30.98
B. Site Preparation	16,802.89	3.25
C. Field Administration		
1. Supervision & Geology	9,550.35	1.84
2. Sampling and Assaying	2,429.42	0.47
3. Miscellaneous	603.40	0.12
Drilling Charges Sub-Total	$189,717.72	$36.66
Project Charges:		
D. General Administration	$ 8,780.87	$ 1.70
E. Legal Fees	85.00	0.02
F. Drill Road Access	2,287.26	0.44
G. Claim Work, Surveying	—	—
Project Charges Sub-Total	$ 11,153.13	$ 2.16
Total Expenditures	$200,870.85	$38.82

James W Sell

cc: N P Wholey

AMERICAN SMELTING AND REFINING COMPANY
TUCSON ARIZONA

February 7, 1974

Memorandum for: N. P. Whaley

From: W. L. Kurtz

Drilling Requirements

I have listed below drilling requirements for '74 as I presently view them. As usual, there are a number of question marks.

SUPERIOR EAST

DCA-3 (5-5/8" to current depth of 3,000'): attempt to clean out, case and DD to ±4500' (casing 2-3,000' 3-1/2" ID); Shelton, Boyles.

State 5 - A-3: open hole at 1445' in Whitetail. $12,500 work due by May 30.

State 4 - A-6: open hole at 1358' in dacite. $12,500 work due by June 29.

Decision to be made whether to do work or refile on State 4,5. (If drill holes will need 4" ID casing.)

Assessment work on claims will be fulfilled with drill holes A-7, DCA-3.

CLARK OPTION -- apply work from Rawhide hole AI-1 or else have Cox or Shelton drill shallow hole ($800).

RAWHIDE -- assessment work fulfilled by hole AI-1. No new holes scheduled.

THUNDER MOUNTAIN -- complete hole TM-8; may request additional funds to drill several short (<1000') holes east of TM-8.

MENDOZA OPTION -- $700 in road and drill site work.

3R -- deepen TR-10; drill one new hole (tentatively scheduled for north of TR-10; west of TM-8) by Joy.

CHARLESTON -- DD 10,000' in two holes by Joy.

HARDSHELL -- 2 years assessment work for $15,000 in hammer(?) drilling.

RED HILLS -- complete present hole; decision to be made on $6,300 work due May 29 on section 2.

BOHME -- Boyles DD in the two cased holes.

NW SILVER BELL -- rotary drill 25 location holes; rotary drill 2750' in 3 holes. Shelton? (If premineral bedrock mineralized will case 3-1/2" ID)

RAY WEST -- rotary drill $25,000 in one hole (may have funds to complete one hole to +5,000' by combination rotary-DD). (Case hole 4" ID) Contractor?

SILVER STATE -- air hammer drilling +20,000' (will request funds soon). Ecklund.

SILVER BELL EAST -- apply work from Silver Bell Unit to fulfill assessment work.

COURTLAND-GLEESON -- possible project. Drill 5,000' hole or deepen old hole 1-2000'. Contractor - Joy?

ADDITIONAL DRILLING POSSIBILITIES:
Roskruge -- 1-3 rotary holes; 800-2000'.
Lindsay Canyon -- 1 hole to 5000' combination rotary-DD.
Main Tombstone District -- DD 5,000'.
Geologic Drill Type holes at:
3 areas Papago Reservation (Vaiva Vo, Gu Achi, NE Santa Rosa);
Texas Canyon;
West of Cholla Butte;
Others?

W. L. Kurtz

WLK:lb

cc: JHCourtright
RBCrist
JDSell
FTGraybeal

AMERICAN SMELTING AND REFINING COMPANY
TUCSON ARIZONA

February 12, 1974

Memo To: W. L. Kurtz

From: J. D. Sell

Area	Casing Requirements 1974-75 3-1/2" I.D.	4" I.D.
Superior East Project		
1) North of Hwy, DCA-2(?) Area	---	2500 ft.
2) South of Hwy, DCA-3 Area	2000 ft.	---
3) South of Hwy, S of A1-1, A2 Area	---	2500-3000 ft. (using DMX type)
4) State Sec. 5 (A-3) Back to back	---	2500-3000(?)
5) State Sec. 4 (A-6) Back to back	---	2500-3000(?)
Bohme Project		
1) New Hole ?	---	2500
Rawhide Project		
1) New Hole South ?	---	2500
Ray West		
1) New Hole, north	---	2500-3000(?)
	2000 ft.	17,500 to 21,000 ft.

Casing on Hand:

±100 ft. of 3-1/2" I.D., black (on Bohme AH-4)
±230 ft. of 4" I.D., black (Bohme Corral)
3,780 ft. of 4" I.D., black (SW Pipe & Supply storage to be moved)
±900 ft. of 7" I.D. oil well (North of Oak Flat)

James D. Sell
J. D. Sell

JDS:lb

-KC-1

MJ-1 : Rotary to 2370', cored to 3304'.

0-1010 dacite

1010-2917 Whitetail Congl. : brn, sdy, ms, soft to about 1950; harder, mostly unoxidized cobbles thereafter. Last ±400' native copper present in small amounts, as veinlets in cobbles of altered diabase, disseminations in same, and as coatings on slickensided surfaces of mudstone matrix. Best assay interval: 2750-2800 0.09 % Cu. Cobbles mostly diabase, minor schist, qzite, LS; mudstone common in matrix to the base, though sand also present. One vn qtz cobble and one unidentifiable altered pebble also had native Cu in veinlets.

2917-3304 Naco LS. Bedding generally 15 to 20°. Generally alternating beds, to ±30', of LS & MS. Occasional veinlets of FeOx, near vertical, with pseudomorphs of FeOx after pyrite. Several small concentrations of MnOx; the one assayed contained 1.5 % Zn, 0.1 Pb. Magma geologists consider the beds to be high in the Naco.

Kirby Cowell hol in Stat Section 9, Superior East Proj. Ariz

March 1974

Cleaning Drill Hole DCA-3

Shelton Drilling on February 4-5, 1974 set up and cleaned the old Miami Copper-Superior Oil drill hole DCA-3 (Superior East Project), from surface to 1940 feet, the limit of his rods.

The bulge @ ± 430' was there and apparently straightened or shaved off to permit passage of bit.

Water-mud standing at ± 450 ft.

Mud-sand & gravel bridges of 1-2' thickness were encountered every 20-40 feet down the hole & necessitated drilling them out.

Circulation was partially restored during the clean-out.

Possible reduction of hole size from 5 5/8" to 5" at ± 1200 feet.

Cost $4000.00

Note: Boyles DMX tools cleaned hole to bottom & cased with 3 1/4" flush jointed NX casing.

14 May 1974

To : JD Sell

From : NP Whaley

Fluid Level In Hole A-3
Superior East Project
Pinal County, Arizona

J.C. Tackett of Copper State Exploration Company reports that when they reentered hole A-3 the fluid level was found to be standing at 1010 feet below the surface.

He felt this information would be of interest to you.

N. P. Whaley

TAB

SB Info.

AMERICAN SMELTING AND REFINING COMPANY
TUCSON ARIZONA

August 28, 1974

TO: W. L. Kurtz

FROM: J. D. Sell

Slide Block Information
Superior East Project
Pinal County, Arizona

In response to inquiry on thickness of slide blocks encountered in our drilling, I submit the following table:

Hole Number	Depth Footage	Rock Type	Thickness	Comments*
A-1	1374-1527	p€sc + Tqm	153'	
A-2	3459-3540	Tqm	81'	Based on cuttings
A-2	3920-4289	Tqm + p€sc	369'	Resting on bedrock
A-4	6339-6448	Me	109'	
A-7	3682-3730	Tgr	48'	
M-1A	2920-3108	Tgr	188'	
AI-1	2650-3046	Tgr + p€sc	396'	Resting on slide below
AI-1	3046-3238	p€sc + Tqm	192'	Resting on bedrock
AH-5	987-1710	p€db	723'	Capped by dacite
AH-5	2996-3332	p€dsq + db	336'	

*All blocks have been cored, except as noted, and are covered and rest in Whitetail conglomerate, except as noted.

Mr. K. Coryell's hole, KC-1, penetrated 387 feet of Naco Limestone under Whitetail prior to their termination of the hole. In view that the depth to "bedrock" is shallower than projection and that the old Kerr-McGee hole DC-1 to the south has been deepened by Newmont to a depth below the terminal depth of KC-1 and is yet in Whitetail, suggest the possibility that the K. Coryell hole is within a slide block and is not part of the true basement.

J. D. Sell

JDS:lb

1974

MEMORANDUM

To: W L Kerby

From: J W Sell

Slide Block ~~Prob~~ Problem
Drill Hole A-1 + N-1A
Superior East Project
Pinal-Gila Counties, Arizona

distance →

	DCA-1		U-4	U-5	Dacite
✓ elev.	4760 (4011 deep)		4640 (1600)	4165 (835)	4030
		(300' South)			
distance →		2930'	340'	75'	
		5860	680	150	

	A-1	E	Dacite
700' w/c			
✓	4720'		4475
		1150	
		2300	

	U-2		Dacite-sch	Dacite gn.
1160' E of C	4922 (1144)		4650 4625	4425
1150		540		1015
		1080		2030

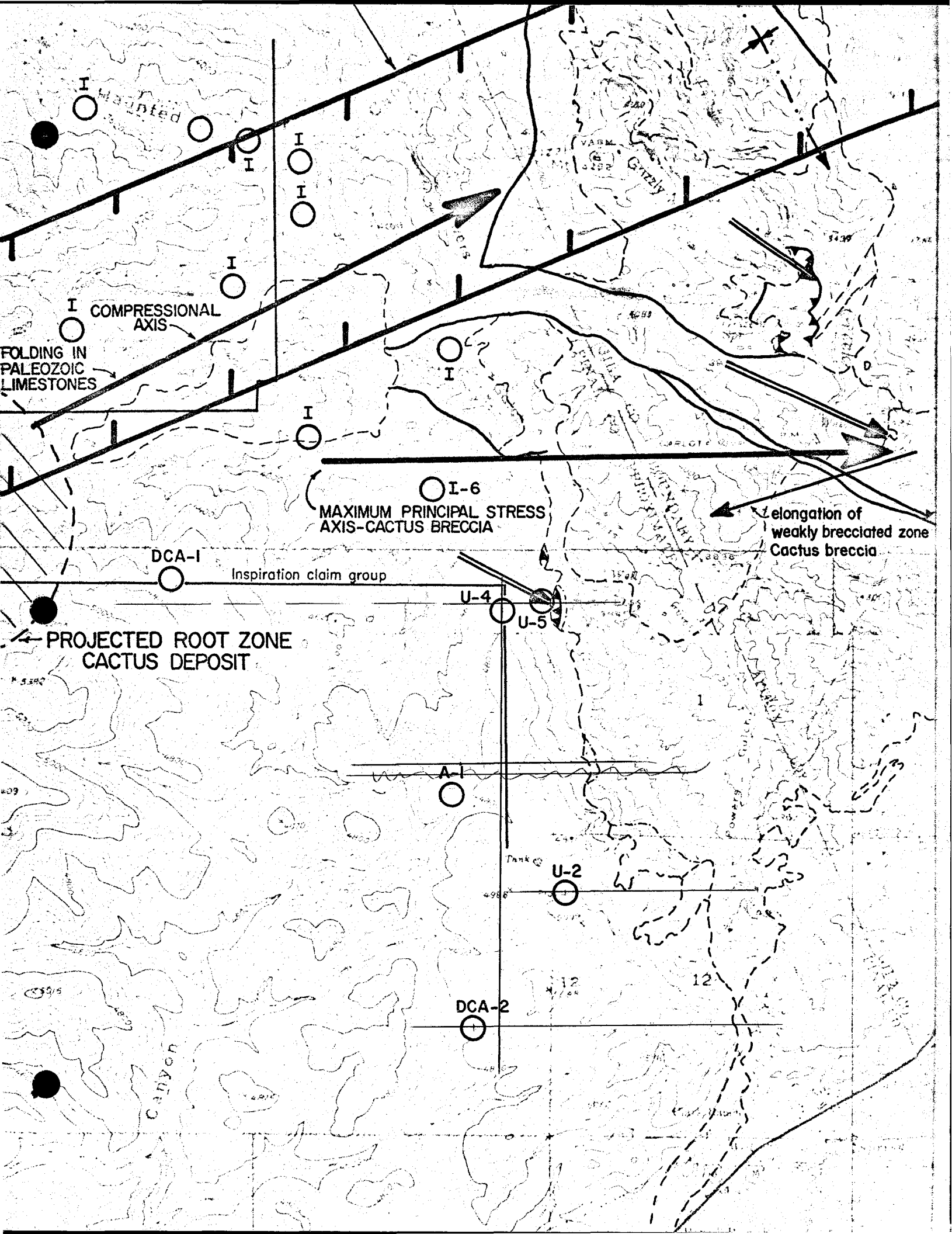
	DCA-2		Dacite-sch	Sc ~~Dac~~-gn.
470' w/c.	4720' (1772) ~~[illegible]~~		4800	4700 ~~4015~~
		~~2300~~	~~2400~~	
		4600	4800	

5000' elev

U-4

1600'

Scale: 1"=500'


COMPRESSIONAL AXIS
FOLDING IN PALEOZOIC LIMESTONES
I-6
MAXIMUM PRINCIPAL STRESS AXIS-CACTUS BRECCIA
elongation of weakly brecciated zone Cactus breccia
DCA-I
Inspiration claim group
U-4
U-5
PROJECTED ROOT ZONE CACTUS DEPOSIT
A-I
U-2
DCA-2
Haunted
Grizzly
Canyon

AMERICAN SMELTING AND REFINING COMPANY
TUCSON ARIZONA

September 11, 1974

Mr. D. E. Crowell
Building

Native Copper

As discussed with you last week, Mr. Sell will provide you with about 20 pounds of assay reject material averaging about 0.9% copper. The copper primarily occurs as native copper in conglomerate. The native copper occurs as thin plates and foils around the pebbles*, as fine disseminations in the fine sand and clay matrix, and a small percentage within the pebbles.

I should like you to determine whether this native copper can be recovered easily and in what quantity.

W.L. Kurtz
W. L. Kurtz/lb

WLK:lb

cc: JHCourtright
JDSell

*In splitting the core and crushing for assay, the plates and foils have fallen away from the pebbles.

Samples # A-4C - 29, 31, 033
submitted Sept. 16, 1974, to T.D. Henderson.
JHC

Coarse reject A-4

5200 →

Zone 5 & 10 ~~5710~~

3 or 4 sacks.

0.9% grade

Tom

5400-5400 —	C 28	(20')	1.47	
	29	(10')	0.77 —	
	30	"	0.57	
	31	"	1.18 —	
	32	"	0.13	0.90 / 3 | 2.70
	33	"	0.75 —	
	34	"	0.25	
	35	"	1.40	
	36	"	1.40	
	37	"	0.62	
	38	"	0.06	
-5810	39	"	1.23	

Sample sacks
Big Pen

JDS-✓

AMERICAN SMELTING AND REFINING COMPANY
ASARCO
MINERAL BENEFICIATION DEPARTMENT
P. O. BOX 5747, TUCSON, ARIZONA 85703

RECEIVED
NOV 6 1974
S. W. U. S. EXPL. DIV.

D. E. CROWELL
DIRECTOR

1150 NORTH 7TH AVENUE
TELEPHONE 602-792-3010

November 5, 1974

Symrna East

W. L. K.
NOV 8 1974

Mr. R. B. Haagensen
Central Research Laboratories
South Plainfield, N. J. 07080

Native Copper Ore

Dear Sir:

I am having sent to you under separate cover approximately five pounds of assay reject native copper ore. This sample should contain about 0.9% copper, which is present primarily as native copper. Some cuprite has also been identified in this ore.

We would like to have a mineralogical examination run on this sample to determine the occurence and size distribution of the copper mineralization present. Also, identification of any other minerals of interest.

Included with this sample will be an assay pulp of the same ore. We would like to have a complete spectrographic analysis run on the same.

Yours truly,

T. D. Henderson Jr.

T. D. Henderson, Jr.

TDH:vh
cc: EMartinez
WLKurtz
DECrowell

~~WLK~~
JAS

W. L. K
NOV 12 1974

Nov. 11, 1974

Art Gleghorn
McPherson Drilling Co.

Art Gleghorn called this AM to say that:

1) All is going well after last cement job. They are now in bedrock at ± 1570 feet. (total depth old hole ± 1772)

2) he has been approached by McPherson drilling (John Godby) (a company he worked with before) & has been offered & has accepted a Field Supervisor job at approx twice the salary as with Baylis, so ± 2000.00 vs 1150.00 per month.

3) Thru this Saturday Nov. 16th will be his last shift

4) Baylis could not match it (the offer) or offer any good thoughts

5) Gleghorn suggested, & Baylis agrees, to place George Behrman (sp) as lead driller.

6). No Baylis comment on who else to be on rig. (Note: Art & George were only drillers since Rudy left on 10/10 of RCA-3A tests). Art had been training his helper Larry to take over one shift & Larry was to work out this week as driller.)

JAS

AMERICAN SMELTING AND REFINING COMPANY
SOUTHWESTERN EXPLORATION DIVISION
P. O. BOX 5747, TUCSON, ARIZONA 85703

1150 NORTH 7TH AVENUE
TELEPHONE 602-792-3010

November 12, 1974

Mr. S. L. Matthews, District Manager
Boyles Bros. Drilling Company
P.O. Box 9910
Phoenix, Arizona 85068

Dear Mr. Matthews:

I do not believe Asarco is responsible for the charges on your invoice SW-207 (i.e., charges we deducted from your invoice SW-182). When a hole is lost under the conditions that DCA-3 was, it is always the responsibility of the drill contractor, at his expense, to get the hole back down to the original depth. We did pay one-half the cost of McCullough's services for cutting the stuck rods, which is really part of the cost of getting back down to original depth.

I am sorry to hear that Mr. Cleghorn is leaving Boyles Bros. We hold him in high regard as a competent driller and foreman.

Very truly yours,

W. L. Kurtz

W. L. Kurtz
Manager of Exploration

WLK:lb

cc: JDSell
NPWhaley

WCK

8:30
11/25/74

NCA-2A
free point at 1100'
BB in Phoenix plan on going thru bit with BX, cleaning hole, cementing, & going back w/ BX to T.D.

JWS

(Harry Lee Henderson
ph. 425-9074 Miami, Ariz.
Boyle Night driller on Lagunas East Proj.
(at Red Rock for Boyle Jan. 13, 1975)

cc to: MPW
JDS

Will Sp Cost file

Drilling Contract
12/5/74

Call to Bud Austin SLC Boyles Bros.

1] Split DCA-3 cement cost 50-50

2] Austin states new contract will be necessary for next hole.
Austin will try to get more experienced driller — states Lee and Rodinski currently tied up (might pay to work on this thru Phx rather than SLC).
He does agree to allow benefit to have more experienced driller on hole

3] Outside services — he prefers to keep as Asarco expense with veto power by Asarco. — otherwise will add into price per foot.

4] Whaley, Kelly, Fell ought to review contract and see what changes we require in new BB contract.

1) Determine cost/foot added for contingencies in outside contractor, cement jobs etc. Rules to say if these not used then price to be adjusted

(over)

Contractor will perform in a diligent & workmanlike fashion and Assessor will not be held liable for losses from causes beyond their control.

gos

ASARCO
Salt Lake Exploration Division

December 12, 1973

J. D. Sell
Tucson, Office

Dear Jim:

First of all my apologies for not getting this to you sooner.

Regarding our conversations of November 27-29th, I have reviewed briefly the drilling reports from the Miami-Superior area and my initial impression is that air drilling through the uppermost 1000' of dacite is preferable to mud drilling in order to minimize problems arising from severe lost circulation zones. The advantages of air drilling below the point at which the intermediate casing string is set are debatable and it is my opinion that mud drilling from this point on would be most efficient in the long run. This is with the assumption that the equipment required for the switchover is readily available on location. The price advantage of rotary drilling over core drilling diminishes below 2000' when the cost of the tertiary casing is added to the rotary cost. It seems probable that attempting to continue rotary drilling to predetermined coring depths below 2000' in spite of difficulties may not result in the least overall cost.

We discussed at length contractors and equipment. I highly recommend that you adjust your timetable so as to coincide with the availability of the contractors with the most applicable equipment.

As far as the problem of buying worn drill rods, some contracts contain a statement to the effect that "... this document constitutes the entire agreement between ASARCO and _____ and no liabilities or conditions are inferred or assumed other than those specified herein." ASARCO representatives executing this sort of contract must be careful to specify all of contractor's obligations but this clause would substitute for the other phrases I suggested while in your office.

It has always been my contention that you cannot write superior performance into a contract. Superior performance can only arise from a contractor with the proper equipment, experience and intent.

It has been a pleasant sojourn for me to once again talk drilling and if I can advise further, please don't hesitate to call on me.

Regards to Marnie, Tom & Mark and hope Kappy is hobbling around O. K.

Very truly yours,

Joe

J. R. WOJCIK

JRW/mb

Continue on good responsible manner particularly on hr rate

Hit WES 250 psi - 400 cfm.
Losing off water & oxygen gone
Mud below.
6¼" full contact bearing bit.
Set up mud tanks (steel) early in system to be ready to convert.

Backfill by oil-mud mixture between 4" & 7" when setting 4"

? on mud program.

~~DOH Excessive rate drilling.~~ ~~CB AI-1~~ See Nov. billing 3 rods

Mike ck CXM Drill Co.
Maybe 2500, 2500 ft.
Tuesday

Asarco will reimburse ___ for replacement of down hole drilling equip rendered unfit for further down drilling use by ~~[illegible]~~ ~~[illegible]~~ wear ~~[illegible]~~ over and above that ~~[illegible]~~ incident to a normal drilling operation. It is expected that conditions in the cased portion of previously drilled holes may cause excessive wear.

Contractor will perform in ___ diligent & workmanlike fashion and Asarco will not be held liable for losses from causes beyond their control.

ASARCO PO 1
REVISED 1/1/58

PURCHASE ORDER

AMERICAN SMELTING AND REFINING CO.
Tucson Office 1150 North 7th Avenue
P. O. Box ~~5795~~ 5747 Tucson, Arizona 85703

DATE: July 3, 1973
ORDER NO.: T-73-340

PLANT JOB NO.:
APPROPRIATION NO.:
REQUISITION NO.:

TO:
BOYLES BROS. DRILLING COMPANY
P. O. Box 9578
Phoenix, Arizona 85020

FINAL DESTINATION — PLEASE NOTE CONSIGNMENT BELOW

DATE REQUIRED AT DESTINATION:

CONSIGNMENT — SELLER WILL SHIP TO

SHIPPING INTERVAL PROMISED | SELLER WILL SHIP BEFORE:

POINT OF SHIPMENT | TERMS

— RENDER BILLS AS PER ATTACHED SHIPPING INSTRUCTIONS —

F. O. B. POINT

SHIP VIA

QUANTITY	UNIT	SPECIFICATIONS	ITEM NO.	UNIT PRICE
		BOYLES BROS. DRILLING COMPANY, hereinafter referred to as CONTRACTOR, will drill exploration holes on ASARCO's projects near Superior, Arizona; the locations and depths of these holes will be specified by ASARCO's representatives at the jobsite. Payment for this work will be made in accordance with CONTRACTOR's letter of proposal dated June 25, 1973, a copy of which is attached to and made a part of this order. Work will commence about July 17, 1973. It is understood that ASARCO will not be charged for delays caused by failure of CONTRACTOR's equipment or personnel. CONTRACTOR's particular attention is called to Clause Eleven (11) on the reverse of this order. The insurance certificates filed in connection with our Purchase Order T-72-550 will suffice if still in force; otherwise, we will require new certificates. Orig: Boyles Bros. Drilling Co. cc: " " " " , for acceptance WLKurtz, HLCrittendon, JDSell, Acctg. Dept., File		ACCEPTED FOR BOYLES BROS. DRILLING COMPANY By: _____ Title

IMPORTANT

Attached Acknowledgment Card must be completed and returned promptly.

PLEASE ENTER OUR ORDER FOR THE ITEMS SPECIFIED ABOVE, SUBJECT TO ALL INSTRUCTIONS AND PROVISIONS ON REVERSE SIDE.

/s/ W. L. Kurtz
Manager of Exploration

DIAMOND CORE DRILLING
DIAMOND DRILLING EQUIPMENT
GROUTING
FOUNDATION TESTING
MINING
QUARRYING
SHAFT SINKING
TUNNEL DRIVING
MINE PLANT DESIGN
AND FABRICATION

BOYLES BROS.
DRILLING COMPANY
CONTRACTORS-ENGINEERS
P. O. Box 9578
10801 North 21st Avenue
PHOENIX, ARIZONA 85020
Phones: Office (602) 944-2741
(602) 944-1731
Res. (602 942-1043

General Offices and Plant
1624 Pioneer Road P. O. Box 58
SALT LAKE CITY, UTAH 84110
Phone (801) 487-3671

BRANCH OFFICES
ARIZONA (PHOENIX)
COLORADO (GOLDEN)
NEVADA (SPARKS)
TENNESSEE (MURFREESBORO)
WASHINGTON (SPOKANE)
MEXICO, D.F.
PERU (LIMA)
CABLE: BOYLESCOP

June 25, 1973

Mr. Howard Crittendon
American Smelting & Refining Company
P. O. Box 5747
Tucson, Arizona 85705

Dear Mr. Crittendon:

For core drilling in the bottom of existing rotary holes near the Bohme Ranch adjacent areas, we submit the following proposal:

1. Mobilization - $ 300.00.

2. Core Drilling

	NCWL 3 15/16	NXWL 3¼		BKWL
1000 - 1500'	11.60	10.35	10.00	
1500 - 2000'	12.10	10.85	10.50	
2000 - 2500'	12.85	11.60	12.00	
2500 - 3000'	14.10	12.85	14.00	
3000 - 3500'	15.60	14.35		
3500 - 4000'		16.10		15.90
4000 - 4500'		18.60		18.40
4500 - 5000'		21.85		21.65
5000 - 5500'		26.35		26.15
5500 - 6000'		30.85		30.65
6000 - 6500'		36.85		36.65

3. Water truck rental will be charged at $325.00 per month, plus .30 cents a mile. Water to be hauled from your source of supply. The cost of the water will be for your account. If extra drivers for water truck are needed, their wages, plus payroll taxes, will be for your account.

4. Suitable roads, drill sites, and sumps will be constructed and maintained by ASARCO, at no cost to Boyles Bros. Drilling Company.

5. The following items will be charged at $32.50 per hour, per two man crew:

   A. Moving drilling equipment between holes.

   B. Delays not the Fault of Boyles Bros. Drilling Company or standby time at your request.

Delays [illegible] be [illegible] per [illegible]

Mr. Howard Crittendon

6. The following items will be charged at $35.00 per hour, per two man crew:
   A. Cementing.
   B. Time spent regaining lost circulation.
   C. Setting and recovering casing.
   D. Setup time on all previously drilled holes, making up strings of rods on reduction of hole or on hole completion.
   E. Breaking down strings of rods on reduction of hole or on hole completion.
   F. Hole survey time.

7. The following materials will be charged for at list price F.O.B. jobsite:
   A. Cement or cement substitutes.
   B. Drilling mud and chemicals.
   C. Casing.
   D. Casing bits or shoes.

8. If the services of any outside drilling service Companies are required, the costs involved will be for your account. The decision to require these services will be discussed and will be mutually agreed upon by Boyles Bros. Drilling Company and ASARCO.

It is our understanding that the holes will be cased to bottom of rotary hole with 4" I.D. pipe. The pipe will be centralized as required and cemented in at the bottom of the hole. If we should encounter any problems in this portion of the hole, the hourly rate of $35.00 per hour will be in effect, plus the cost of any materials and equipment expended until the situation is corrected.

We have a CP50 available to do this work and also qualified people with deep hole experience.

We hope the above proposal meets with your approval and if you should have any questions, or require any information, please contact us at your convenience.

Thank you for giving us the opportunity to bid on your work. We appreciate your business.

Sincerely,

BOYLES BROS. DRILLING COMPANY

S. L. Mathews, District Manager

SLM:jwh
CONTRACTORS LICENSE: 15414
CLASS: A-4

ASARCO PO 1
REVISED 1/1/58

PURCHASE ORDER

AMERICAN SMELTING AND REFINING CO.
Tucson Office 1150 North 7th Avenue
P. O. Box 5747 Tucson, Arizona 85703

DATE: October 30, 1972
ORDER NO.: T-72-550

PLANT JOB NO.:
APPROPRIATION NO.:
REQUISITION NO.:

TO:
Boyles Bros. Drilling Company
P. O. Box 9578
Phoenix, Arizona 85020

FINAL DESTINATION — PLEASE NOTE CONSIGNMENT BELOW

DATE REQUIRED AT DESTINATION:

CONSIGNMENT — SELLER WILL SHIP TO

SHIPPING INTERVAL PROMISED | SELLER WILL SHIP BEFORE:

POINT OF SHIPMENT | TERMS

— RENDER BILLS AS PER ATTACHED SHIPPING INSTRUCTIONS —

F. O. B. POINT

SHIP VIA

QUANTITY	UNIT	SPECIFICATIONS	ITEM NO.	UNIT PRICE
		BOYLES BROS DRILLING COMPANY, hereinafter referred to as CONTRACTOR, will drill exploration holes on ASARCO's Bohme Project near Miami, Arizona, the locations of which will be specified by ASARCO's representatives at the jobsite. Payment for this work will be made in accordance with CONTRACTOR's letter of proposal dated September 25, 1972, a copy of which is attached to and made a part of this order. Work will commence on or about November 6, 1972.		
		It is understood that ASARCO will not be charged for delays caused by failure of CONTRACTOR's equipment or personnel.		
		CONTRACTOR's particular attention is called to Clause Eleven (11) on the reverse of this order. Before entering upon ASARCO's property to perform this work, CONTRACTOR will submit acceptable evidence of compliance with the Workmen's Compensation Laws of the State of Arizona, and, on ASARCO's standard insurance form, acceptable evidence of other required insurance.		
		Orig: Boyles Bros. Drilling Co. cc: " " " ", for acceptance WLKurtz JDSell HLCrittendon Acctg. Dept. File		

ACCEPTED FOR BOYLES BROS. DRILLING COMPANY

By: _____ Title

IMPORTANT

Attached Acknowledgment Card must be completed and returned promptly.

PLEASE ENTER OUR ORDER FOR THE ITEMS SPECIFIED ABOVE, SUBJECT TO ALL INSTRUCTIONS AND PROVISIONS ON REVERSE SIDE.

/s/ W. L. Kurtz
Manager of Exploration

DIAMOND CORE DRILLING
DIAMOND DRILLING EQUIPMENT
GROUTING
FOUNDATION TESTING
MINING
QUARRYING
SHAFT SINKING
TUNNEL DRIVING
MINE PLANT DESIGN
AND FABRICATION

Boyles Bros.
DRILLING COMPANY
CONTRACTORS-ENGINEERS
P. O. Box 9578
10801 North 21st Avenue
PHOENIX, ARIZONA 85020
Phones: Office (602) 944-2741
(602) 944-1731
Res. (602 942-1043

General Offices and Plant
1624 Pioneer Road P. O. Box 58
SALT LAKE CITY, UTAH 84110
Phone (801) 487-3671

BRANCH OFFICES
ARIZONA (PHOENIX)
COLORADO (GOLDEN)
NEVADA (SPARKS)
TENNESSEE (MURFREESBORO)
WASHINGTON (SPOKANE)
MEXICO, D.F.
PERU (LIMA)
CABLE: BOYLESCOP

September 25, 1972

Mr. Howard Crittendon
American Smelting & Refining Company
1150 N. 7th Avenue
P. O. Box 5795
Tucson, Arizona 85703

Dear Mr. Crittendon:

For your core drilling in the bottom of rotary holes near the Bohme Ranch and adjacent areas, we submit the following proposal:

1. Mobilization - $200.00.

2. Core Drilling

	NCWL 3 15/16	NXWL 3	BXWL
1000 - 1500'	11.50	10.25	
1500 - 2000'	12.00	10.75	
2000 - 2500'	12.75	11.50	
2500 - 3000'	14.00	12.75	
3000 - 3500'	15.50	14.25	
3500 - 4000'		16.00	15.80
4000 - 4500'		18.50	18.30
4500 - 5000'		21.75	21.55
5000 - 5500'		26.25	26.05
5500 - 6000'		30.75	30.55
6000 - 6500'		36.75	36.55

3. Water Truck rental will be charged at $325.00 per month, plus .30 cents a mile. Water to be hauled from your source of supply. The cost of the water will be for your account. If extra drivers for water truck is needed, his wages, plus payroll taxes will be for your account.

4. Suitable roads, drill sites, and sumps will be constructed and maintained by ASARCO, at no cost to Boyles Bros. Drilling Company.

5. The following items will be charged at $32.50 per hour, per two man crews.

   A. Moving drilling equipment between holes.

   B. Delays not the fault of Boyles Bros. Drilling Company, or standby time at your request.

September 25, 1972

Mr. Howard Crittendon

6. The following items will be charged at $35.00 per hour, per two man crews.

   A. Cementing.

   B. Time spent regaining lost ciruclation.

   C. Setting and recovering casing.

   D. Making up strings of rods and cleaning hole to core point.

   E. Breaking down strings of rods on reduction of hole or on hole completion.

   F. Hole survey time.

7. The following materials will be charged for at list price F.O.B. jobsite.

   A. Cement.

   B. Drilling mud and chemicals.

   C. Casing.

   D. Casing bits or shoes.

8. If the services of any outside drilling service Companys are required, the cost involved will be for your account. The decision to require these Service Companys will be discussed and mutually agreed upon by Boyles Bros. Drilling Company and ASARCO.

It is our understanding that the holes will be cased to bottom of rotary hole with 4 inch I.D. pipe. The pipe will be centralized as required and cemented in at the bottom of the hole. If we should encounter any problems in this portion of the hole, the hourly rate of $35.00 per hour will be in effect, plus the cost of any materials and equipment expended until the situation is corrected.

We have a CP50 and qualified people available to do this work. We will have to get some of our NC coring equipment out of our Salt Lake plant, so an early reply would be appreciated.

We hope the foregoing proposal meets with your approval.

September 25, 1972

Mr. Howard Crittendon

If you should have any questions or require any information, please contact us at your convenience.

Thank you for giving us the opportunity to bid on your work. We appreciate your business.

Sincerely,

BOYLES BROS. DRILLING COMPANY

S. L. Mathews

S. L. Mathews,
District Manager

SLM:jwh

Contractors License: 15414

Class: A-4

7

AMERICAN SMELTING AND REFINING COMPANY
TUCSON ARIZONA

December 9, 1974

Memorandum for Record

Superior East
Boyles Bros.

I have informed Mr. B. L. Austin that Asarco's Exploration Department would pay one-half of the disputed bill (SW-207, SW-182).

W. L. Kurtz

W. L. Kurtz

WLK:lb

cc: JDSell

Dates of Drilling -- Rotary and Core, Superior East

Drill Hole	Rotary	Core
A-1	April 8 - April 27, 1971	July 14 - August 12, 1971
M-1A	(Previous hole, cased).	April 20 - July 3, 1971
DCA-1A	(Old hole, ± 1 wk to clean & case).	November 16, 1971 - February 9, 1972
A-2	January 12 - February 8, 1972	February 21 - March 17, 1972 April 18 - May 18, 1972 (Wedge).
A-7	August 17 - September 16, 1973	November 27, 1973 - February 9, 1974.
DCA-3A	(Old hole, ± 1 wk to clean & case)	July 1 - October 21, 1974
DCA-2A	(Old hole).	October 23 - December 18, 1974.

Feb 5, 1975

Neumont continues drilling on State Leases to S of Oil Flat.

Lester Cox* just completed MJ-11 to a depth of 805 feet by rigging up two compressors in tandem. Feels he can go to 1200'±. Water flow strong with level at 300 feet. Used some 150 sacks of cement in three attempts to seal off water. Water came in full after drilling some 50 ft below each cement job.

Hole ± in W½ of Sec. 3. NW¼ Capped with pipe & welded # MJ-11 open hole. will reenter?

Road now completed between A-6 area and Hagens Government Spring road. Connected by Guzman Oct-Nov-Dec-Jan.

"Hackett" drilling Co with ± Failing 500 in lower end drilling with pipe at trouble. Was stuck week of Jan 30th. At least 2 holes scheduled

* Note: Cox hit water initially @ 330 ft. and by 540' thought he was making (or pumping) some 30 gals per minute

Had a 750 cfm compressor manifold hooked to 650 cfm for a total of 1300 cfm at 150 psi. Loop injection. (week of Jan. 15).

AMERICAN SMELTING AND REFINING COMPANY
TUCSON ARIZONA

February 21, 1975

Mr. J. V. Desvaux
ASARCO
New York Office

Drilling Contracts

Re: Your letter January 9, 1975

We do not believe it is necessary to write drilling contracts as you suggest. We feel that, with just cause, we can terminate any of our drilling contracts without a "penalty for footage".

W. L. Kurtz

WLK:lb

cc: NPWhaley
JDSell

AMERICAN SMELTING AND REFINING COMPANY
TUCSON ARIZONA

March 7, 1975

FILE MEMORANDUM

Superior East Project
Pinal County, Arizona

Kirby Coryell called. I informed him we were not drilling on the Margarets.

He asked my position on the core. I told him we did not want to show it to him. I suspect he may try legal proceedings to obtain permission to see the core.

W. L. Kurtz

WLK:lb

cc: RBCrist
JDSell

VDS ✓

Inspiration Consolidated Copper Company

P. O. Box 66

INSPIRATION, ARIZONA 85537

Superior East

March 10, 1975

Mr. R. B. Crist
Property Manager
American Smelting and Refining Company
Exploration Department
P. O. Box 5747
Tucson, Arizona 85703

Dear Bob:

Thanks a lot for the topographic map indicating the proposed traverse of Arizona Public Service's 345,000 KV Power Line from Cholla to Saguaro.

We have checked it against our claim map and other data and do not foresee any problems which may develop by construction of it.

I'm sure that a representative from either APS or Salt River Project will sooner or later make contact with Inspiration's land department so respective legalities thereof may be taken care of.

I certainly appreciate your bringing this to my attention which gave us the opportunity to evaluate it.

Best personal regards.

Sincerely yours,

Hugh

Hugh W. Olmstead
Chief Exploration Geologist

HWO/am
cc: Mr. J. G. Kuhn (w/encl.)
Mr. T. J. Montgomery (w/encl.)
Mr. R. G. von Boeck (w/encl.)

Nov '75

file clearing

~~WLK~~
JOS

Tonto Drilling Rates
vs
Others

Tonto has drilled (cored) NQ (NC) from 1940 ft to 2347 ft (407') in 5 days for a 81.4 ft/day average, including downtime in that interval.

This footage is within the Mudstone Unit of the Whitetail and the only other mudstone fusion for NC is 15 days for 478 feet or ~~an~~ 31.8 ft/day average.

Overall previous coring in Whitetail using NC to NX has averaged 52.5 ft/day from depths of 1527 to 6434 feet.

Using the top part averages for holes A-1, A-4, & A-7 the average is 55.5 ft/day.

Thus it would appear that the coring by Tonto may be at an increased rate over the average of the previous drilling.

cc: NBW

* 12hr shifts

Date	Shift*	footage	Hrs Drilling	
9/26/75	N	9	3	(from 1940 to 2347)
27	D	24	7	
27	N	37	12	
28	D	50	9½	
28	N	38	12	
29	D	41	9	
29	N	51	12	
30	D	64	10½	
30	N	73	12	
Oct 1	D	16	3	

5 days.
15 equiv shift
407 feet

$5\overline{)407}$ = 81.4 ft per day

$15\overline{)407}$ = 27.1 ft per shift (8hr equivalent).

Drill Hole	Overall Rates ft/day NC	NX	Whitetail ft/day	Footage Depth
A-1	39.0	—	NC 45.9	(1527-1585)
A-2	—	33.9	None	
A-2W	—	28.7	None	
A-4	—	45.3	NX 47.7	(3593-6484)
			top part NX 61.2	(3593-4000)
A-7	—	52.5	NX 52.2	(3150-5610)
			top part NX 59.4	(3150-3506)
M-1A	30.0	56.7	mudstone NC 31.8	(2422-2920)
			cgl wt NX 59.7	(3108-4898)
DCA-1A	—	29.4	61.8	(4002-4669)
DCA-2A	—	38.8 NX NO BX		
DCA-3A	—	69.5		

Memo of Nov. 8, 1971) Whitetail mudstone NC, 15 days @ 478 ft = 31.8 ft/day in range of 2500-3000'

JDS/NPW

Phone call from H.M.Stone -- 12/1/75
2:05 PM

A-3: Total depth 5983'
Rock change at 5890'; back into conglomerate

Rods gotten from Eagle Mt., CAlifornia; 130' left at site - 500' NX at Cecil's Trucking waiting to be picked up.

Change bit in another 50-60'; 320' so far on bit

3" snow -- some of the water has gone into the mud pit; viscosity of the mud is 34 and they are trying to keep a 40 -- they are working on it now.

Torque is running around 1100 and ~~xxxx~~ that will come down when they get the mud OK again.

1-14-76

FTG:
JDS:
WLK:

TEL CALL FROM CHUCK CROFT'S SECRETARY THIS AM... CANCELING CROFT'S PROPOSED VISIT TO OUR TUCSON OFC TOMORROW MORNING (THUR., 1-15-76).

CROFT WILL PROB'LY BE IN TUCSON ON WED., 1-21-76, BUT WILL CALL ME ON MON MORNING (1-19-76) TO CONFIRM.

PW

1/13/76

WLK/FTG/JDS

Per Norm Whaley:

Chuck Croft of Tonto Drilling will be in this office at 10:00 AM on Thursday, Jan. 15th.

1-20-76

TONTO DRILLING INC.

Items discussed w/ Capt 1/21/76.
He sees all point & bugaus they are to be thought of & stated in next contract. He also felt than on continued drilling in an area that bid prices would drop if conditions (i.e. No "excessive" profit) warranted.

I. SET-UP TIME (w/ EXTRA LABOR)
Capt mentioned that in bidding they figure about 10% of the price of the equipment put with the job as a per month contractors "profitability" For example; the CP-50 cost equipped is ≅ $250,000.00 Thus they would

II. EXTRA LABOR AS ROUTINE THROUGHOUT PROGRAM
expect it to create $25,000.00 per month.
(See back of next sheet).

III. INITIAL CONVERSATIONS, AND CONVERSATIONS UP TO TIME OF MOBILIZATION, DESCRIBED A RIG WHICH COULD BE TOWED IN WITH A WATER TRUCK.

BUT: a) EXPENSIVE UPGRADING OF RD. NEEDED
b) A THIRD-PARTY RENTAL WATER TRUCK.

IV. CHARGE FOR NEW BIT & REAMING SHELL + 10% ON FULL AMT. (CEMENT CORING 1210'-1411' OR 201 FT.)

WHEN: a) BIT CUT 498 FT IN ROCK.
b) SHELL WAS USED THROUGHOUT 1038 FT. OF DRILLING AND CHANGED ONLY THEN BECAUSE HOLE SIZE WAS REDUCED.

(PRORATED CREDIT DOES NOT APPEAR ON FINAL INVOICE (2.5 MOS. LATER).)

V. HOLE CASED WITH HWL RODS RATHER THAN COMMON DD CASING

VI. CHARGE FOR CUTTER & ADAPTER SUB (PURCHASE OF CUTTER?)

After discussion with Chuck Croft of Tonto Drilling, he mentioned part of their bidding scheme. He mentioned that in bidding they figure, as a per month contractors "profitability," a number equal to 10% of the value of the equipment put in the field. (Note: they base all this on the fact that the rig will only work 6 months out of the year).

Thus the CP-50 used in drill hole A-3 was around $250,000.00. Thus they would expect it to create $25,000.00 per month.

Based on A-3 ~~and~~ which was scheduled to ~~go~~ start at ~~from~~ 2000 feet ~~to~~ + go to 5500 ft; and using Boyle Brothers averages of 30 feet per day production average (info he had), 30 ft/day into 3500 ft = 117 days or 4 months.

4 months × $25,000.00/mo = $100,000.00 for the hole.

Using Tonto bid figures:

	Depth.	$/ft	× 500 ft	= Cost
NC	2000-2500	19.95	× 500	= 9,975.00
	2500-3000	21.75	× 500	= 10,875.00
NX	3000-3500	19.75	× 500	= 9,875.00
	3500-4000	23.00	× 500	= 11,500.00
	4000-4500	27.00	× 500	= 13,500.00
	4500-5000	32.00	× 500	= 16,000.00
	5000-5500	39.00	× 500	= 19,500.00
				$91,225.00

Note: based on Tonto's hourly rate of $41.00/hr or $328.00 per shift times 90 shifts per month, the monthly rate would be around $30,000.00.

1-19-76

RBC :
FTG :
WLK :
JDS : ✓

CHUCK CROFT OF TONTO DRILLING INC. CALLED THIS AFTERNOON AND PLANS TO BE IN THE TUCSON OFC. ON WED. MORNING (1-21-76) AT 0930 HRS.

COULD WE CONSIDER MEETING HIM?

NW

1-20-76

SUPERIOR EAST – HOLE A-3
DIAMOND DRILLING BY TONTO DRILLING INC (ROCK: 1940'-6008')
(CEMENT: 1210'-1940')

45-106 EYE-EASE 45-406 20/20 BUFF

	①	②	③	④	⑤	⑥
INVOICE DATE	FOOTAGE INTERVAL	AMT INVOICED	AMT REVISED INVOICE	AMT SPENT IN DRILLING ROCK	FOOTAGE (IN ROCK)	COST/FT.
10-15-75	1210'-1940' 1940'-2331'	$ 17,198.86	$ 16,781.51	$ 8,714.75	391'	$ 22.29
10-29-75	2331'-3381'	23,427.21	22,845.46	22,845.46	1050'	21.76
11-20-75	3381'-4253'	27,018.16	24,403.89	24,403.89	872'	27.99
12-3-75	4253'-5405'	39,749.03	39,749.03	39,749.03	1152'	34.50
12-18-75	5405'-5976'	27,056.00	26,171.50	26,171.50	571'	45.59
SUB TOTALS		$ 134,449.26	$ 129,951.39	$ 121,884.63	4036	$ 30.20
1-7-76	5976'-6008'	$ 22,297.77			32'	
TOTALS		$ 156,747.03			4068'	

DIFFERENCE BETWEEN AMT. ORIGINALLY INVOICED AND AMT PAID AFTER REVISION OF INVOICES

$ 4497.87
$1.11 / FT.
c. 3%

IF WE HAD PAID TONTO INVOICES AS BILLED:

COST F/CORED FOOTAGE IN ROCK = $ 156,747.03 / 4063' = $38.53 / FT.

COST IF FOOTAGE IN CEMENT IS CONSIDERED = $ 156,747.03 / 4798 = $32.67 / FT.

CONSIDERING THE NATURE OF THE PROBLEM INTRODUCED BY THE CEMENT, THESE FIGURES HAVE LITTLE MEANING.

6,000 ft

$250,000

$25,000 per month.

10% of price of equipment per month as contract payments

30) 3500 = 117 = 4 months

30
50
30
200

25
4
$100,000

2000-2500	19.95 × 500 =	9,975.
2500-3000	21.75 × 500 =	10,875.
3 - 35	19.75 × 500 =	9,875
35-40	23.00 × 500 =	11,500
40-45	27.00 × 500 =	13,500
45-5000	32.00 × 500 =	16,000
500-55	39.00 × 500 =	19,500
		91,225

325
× 60
19,680

325
× 90
29,520

WLK

FROM: W. L. KURTZ with file Sup East 1/27/76

To: ~~RBC~~

In discussion with FTG following questions came up:

1) Cont. Copper agreement: can we apply work on State Section 5 to the $50,000 work committment due on Cont Copper agreement? YES
ALL IN EXCESS of the $5,500 required to renew.

2) 1975-76 assessment work – can we apply work from State Section 5 to all of our land holdings (Arizona – Cont Copper)? YES – excess $.

3) Think Rawhide should be done as separate assess work this year? YES – at least it would aid in appearances.

cc. FTG
JDS

ASARCO

Southwestern Exploration Division

February 11, 1976

FILE MEMORANDUM

Superior East Project
Pinal County, Arizona

The four drill sites occupied by Newmont south of Oak Flats have now been abandoned.

Drill hole B-6, in Section 6, was pulling rods and casing on Feb. 10th. Their driller revealed no information other than they would not move to hole B-7 and were "glad this was it." As the driller was there, no chips or other objects were picked up. Approximately 50 operating days have passed since the hole was last checked. Assuming 40 feet per day they could have added 2000 feet to the estimated 1500-foot depth for a total depth of 3500 feet.

Drill hole B-7, in Section 8, was capped after being rotary drilled. Last cuttings from the hole are welded, light brown with orange coloration, dacite. In our hole A-3 such a zone was 800 feet above the base, while in A-7 the zone was 800-1000 feet above the base of the dacite. Thus, it would appear that hole B-7 did not reach very deep. (The rig was broken down at the last visit.)

Drill hole KC-1 was scheduled to go to 5400 feet. Based on 50 days at 40 feet per day, they could have reached that depth from their starting depth of 3300 feet. One dirty core block reads 3858. Numerous chips are available including overcored pieces of Pinal Schist, Dripping Spring Quartzite, and Mescal Limestone. The majority of pieces are fairly large chips (including thin plates of the entire BX cross-section) of limestone (Naco affinity) with pieces of quartzite (probably all three types), diabase (moderate amount), and schist (rare). No porphyry or mineralization was noted in all the chips. Based on the assemblage, it would appear the hole penetrated the Whitetail and terminated in the Naco Limestone. The hole is capped and padlocked.

Drill hole DC-1 had previously been drilled to around 3270 feet in Whitetail. Newmont reentered the hole but abandoned it several weeks ago. The driller is rumored to have said, "They closed us down as we had spent all the money, but we had just gotten the hole cleaned up so we could get to drilling." Thus, they may have gotten only a few hundred feet of new hole. Road conditions were bad and I have not inspected the site for information.

James D. Sell

JDS:lb

Key to KC-1 ~~lock~~ lock

"Best E34"

FROM: W. L. KURTZ

RAWHIDE
6/24/76

TO: FTG

Hugh Olmstead is agreeable to applying the work from Prospect A-8 (approx 1/2 mile south and 3000-3500 feet west of AI-1) for 1976 assessment work on the Rawhide Claims.

cc. TCO
RBC
JDS

JDS

FROM: W. L. KURTZ

TO: FTG

ELDER GROUP
INSPIRATION
6/24/76

Olmstead says they are not ready to joint venture the Elder Grp (north of highway on east edge of ducks plateau).

He wants to wait until the new management (Hudson Bay) sets the policy.

New Inspiration president (a Hudson Bay man) has an exploration background.

cc. JHC/JNS/~~PSG~~ RAK

6/25/76 3 new drill sites being put in and 2 being reclaimed for this summer drilling.

JDS.

ASARCO

Southwestern Exploration Division

JDS

June 28, 1976

TO: N. P. Whaley

FROM: F. T. Graybeal

Revised 1976 Drilling and
Assessment Requirements

By July 20, 1976 the following projects must be organized or active as indicated.

1) Olberg: 3 or 4 rotary holes completed; one 1000-1500 ft. diamond drill hole to collar immediately on completion of rotary holes (assume July 8, 1976); see H. G. Kreis.

2) Santa Cruz: one 2000 ft. rotary hole (SC-31) collared by July 6, 1976 (Shelton only) 800 ft. west of SC-23; see H. G. Kreis; inform Shelton we will probably need more holes before end of July.

3) Rochester: Ecklund drilling by July 19, 1976; see W. L. Kurtz.

4) 3R: drill site construction started or complete; diamond drill either on site or firmly committed to start 5000 ft. hole by Aug. 1, 1976; see F. T. Graybeal.

5) Thunder Mtn.: drill site construction started or firmly committed; diamond drill either on site or firmly committed to start 1000-1500 ft. hole before Aug. 15, 1976; see F. T. Graybeal.

6) Hardshell: drill site construction firmly committed; air-hammer drill contractor firmly committed to start 3-4 holes 300-400 ft. deep before Aug. 15, 1976.

7) Superior East: Bryant started on drill road construction to site A-8; diamond drill scheduled to start one 5000 ft. hole by Aug. 15, 1976; work to apply as Rawhide assessment (road work on Rawhide ground eliminated); see J. D. Sell.

8) Hayden Hill: drill road and site contractor scheduled; Ecklund knows he is to be there by Aug. 16, 1976; see G. J. Stathis.

9) North Star: one 1500 ft. rotary hole (Shelton only) scheduled to start by Aug. 15, 1976; see F. T. Graybeal.

By firmly committed I mean that bids have been received, a contractor has been notified of selection for the job, a specific starting day has been agreed upon, and a purchase order has been written or mailed.

F. T. Graybeal

F. T. Graybeal

FTG:lb

cc: WLKurtz
RBCrist
JDSell
HGKreis
GJStathis

FROM: W. L. KURTZ

Superior East

TO: FTG/JIK/JDS

11/16/76

TCO, a la John Collins, asks: should we make a second (A-B) penetration via a wedged hole? This would be just a 1-2° wedge for a "second assay". Though this is not necessary from a geologic viewpoint in this type deposit TCO points out that it might help the credibility with the miners and management, esp. in this deep a deposit.

Please check cost with Jay of making a wedged hole thru the mineralized intercept.

waste of money to wedge

Superior East

FROM: W. L. KURTZ

TO: ~~FTG~~/JHK/JDS please make the calculation

11/12/76

TCO, a la John Collins,

asks: should we make a second (A-8) penetration via a wedged hole? This would be just a 1-2° wedge for a "second assay". Though this is <u>not</u> necessary from a geologic viewpoint in this type deposit TCO points out that it might help the credibility with the miners and management, esp. in this deep a deposit. (Don't mise them!)

Please check costs with Jay of making a wedged hole thru the mineralized intercept.

(WLK FTG

NPW on file

FROM: F. T. GRAYBEAL

TO: WLK

11/18

Copy JJC

SUPERMORE

I believe you – I want then this with JJC!

However please provide me with cost of wedging to get another sample thru' the "over grade" intercept.

Waste of money to wedge off an initial intersection. Look at core if you don't believe me. No suggestion ever made to wedge SC-23.

If we have to do this sort of thing to establish credibility w/ mines then I suggest we spend money to verbally educate them or find some new ones.

By the time you succeed in educating the operators, managers, Presidents, Chairman of the Board. They will have reached retirement —

In addition to the usual temperature measurements, would advise surveying the hole. — If a deflection is found upon you, then it should be directional, at 180°, if the hole has wandered off course appreciably. JJC

JDS

ASARCO

Southwestern Exploration Division

December 1, 1976

TO: F. T. Graybeal

FROM: N. P. Whaley

Superior East Project
Pinal County, Arizona
Directionally Controlled
Re-drill of a Section:
Hole A-8

I. Basic Factors and Assumptions:

a) BX wedge (1-1/2°): $400.00
b) Joy Mfg. Co. rig time charge: 24.00/hr. ($576.00/24 hr.dy.)

c) Dyna-Drill:
1) Rental (2 dy. min.) $300.00/dy.
2) To-Fr/Longbeach Calif. 10.00/dy.
3) Service fee (operator) 200.00/dy.
$510.00/dy.
4) Bits (w/40'-60'-100'/bit) $200.00-$300.00
5) Advance: 3 ft./hr.±

d) Interval to be redrilled: 3,800' to 4,500' (700'± drilling).
e) Joy Mfg. Co. average advance/24 hr. dy. during initial drilling of the intercept from 3,800' to 4,366' was 33.4'/dy. (say 30'/dy).

II. Using these factors and assumptions, cost estimates for three re-drill options are presented below.

a) Wedging out of the original hole with a single, 1-1/2° unoriented wedge and re-coring a 750 ft. to 800 ft. intercept:

1) Cost of wedge		= $ 400.00
2) Rig time to set (est'd. 4 dys. @ $576.00/dy.)		= $ 2,304.00
3) Coring from 3,750 ft. to 4,500 ft. (750 ft. @ $24.00/ft.)		= $18,000.00
	Sub-total	$20,704.00
4) Assaying		= $ 200.00
5) Overhead		= $ 1,000.00
	Overall Total	$21,904.00

b) Wedging out of the original hole with an oriented, 1-1/2° wedge, coring, and setting additional oriented, 1-1/2° wedges every 75 ft. (minimum interval suggested by Joy Mfg. Co.) throughout the 750 ft. to 800 ft. intercept:

1) Overall total for the first option described above		= $21,904.00
2) Cost of eight additional wedging operations, including orientation fees. 8 x $3,000		= $24,000.00
	Overall Total	$45,900.00

(This is obviously untenable, both economically and mechanically. The technique could be used only with a limited number of oriented wedges.)

c) Wedging out of the original hole with an oriented, 1-1/2° wedge and using the Dyna-Drill to establish a drift and bearing for the re-coring of a 750 ft. to 800 ft. intercept:

1) Original wedging operation with orientation		= $ 3,000.00
2) Use of Dyna-Drill for drilling 100 ft.± intercept above re-core zone to establish drift and bearing:		
2.5 dys. @ $510.00/dy		= $ 1,275.00
2 bits @ $250.00 ea.		= $ 500.00
Orientation charges		= $ 500.00
3) Drilling contractor rig time during operation of Dyna-Drill 2.5 dys. @ $576.00/dy.		= $ 1,440.00
4) Coring 700' @ $24.00/ft.		= $16,800.00
	Sub-total	$23,515.00
5) Assaying		= $ 200.00
6) Overhead		= $ 1,000.00
	Overall Total	$24,715.00

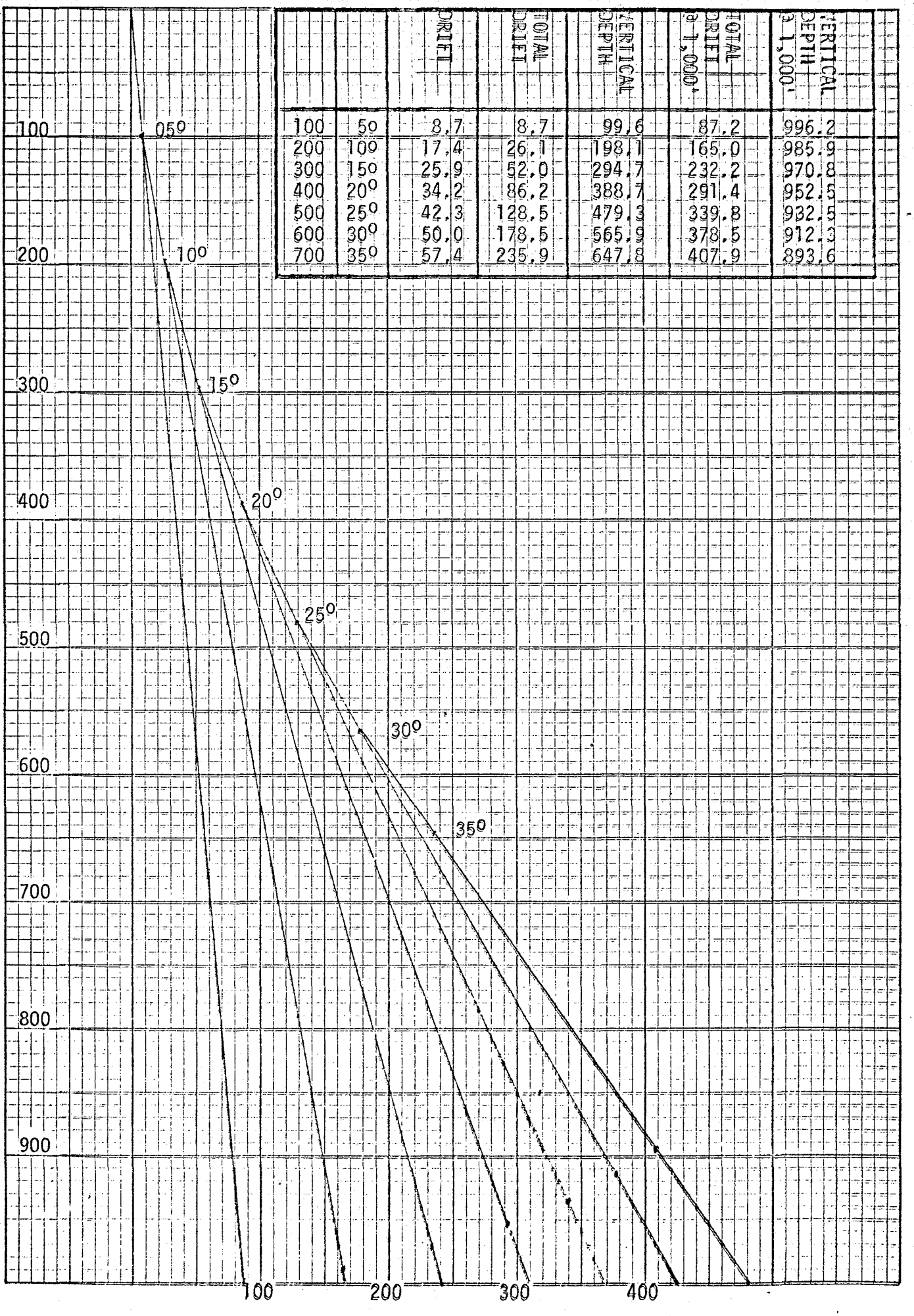
The second and third options contain so many variables that it is rather difficult to assign a reliability factor to them. Any technical or mechanical problems could escalate costs greatly.

N. P. Whaley

N. P. Whaley

NPW:lb

5% BUILD-UP CURVE



		DRIFT	TOTAL DRIFT	VERTICAL DEPTH	TOTAL DRIFT @ 1,000'	VERTICAL DEPTH @ 1,000'
100	5°	8.7	8.7	99.6	87.2	996.2
200	10°	17.4	26.1	198.1	165.0	985.9
300	15°	25.9	52.0	294.7	232.2	970.8
400	20°	34.2	86.2	388.7	291.4	952.5
500	25°	42.3	128.5	479.3	339.8	932.5
600	30°	50.0	178.5	565.9	378.5	912.3
700	35°	57.4	235.9	647.8	407.9	893.6

K+E 10 X 10 TO THE INCH 46 0780
7 X 10 INCHES MADE IN U.S.A.
KEUFFEL & ESSER CO.

ASARCO

Southwestern Exploration Division

February 7, 1977

TO: F. T. Graybeal

FROM: J. D. Sell

Displacement - Devils Canyon Fault
Superior East Project
Pinal County, Arizona

Basin development and age of faulting are important aspects of the Superior East Project.

The breccia at Magma (Tbx on the maps) is a unique rock unit in the area. Hole A-8 found one clast of the breccia at a depth of 2923-2924 in the Whitetail Conglomerate. The clast contained noticeable native copper, as did the surrounding conglomerate, as disconnected, fine disseminated grains. The collar elevation of A-8 is 4685 feet, which places the clast at a present elevation of +1760 feet above sea level.

Magma's No. 9 Shaft collar is 4190 feet in elevation and the top of the breccia was reported at a depth of 3250 feet, giving the top of the breccia an elevation of +950 feet. Based on cross-section reconstruction, a possible westward rise in the pre-Whitetail surface might place the top of the breccia at an elevation of +1400 feet.

As the breccia is unique, there is little doubt that the clast in A-8 was derived from the Magma breccia mass. In the 17,000 feet of separation from #9 Shaft to A-8, and assuming a 5° drainage slope during Whitetail deposition, the breccia clast might have been transported downslope to a point 1300 feet lower. In the A-8 area it would place the clast at near sea-level elevation.

The present Devils Canyon fault trends north-south between No. 9 Shaft and A-8.

With the A-8 clast now at an elevation of +1760 feet, it is likely that the Devils Canyon fault has a movement of this amount since the transport and emplacement of the breccia clast from the No. 9 Shaft area to the A-8 area.

The A-8 clast is presently found some 300 feet above the base of the Whitetail sequence and is above the appreciable native copper found just above the slide block unit in A-8. This narrow copper zone may be the top of the native copper zone as projected from other data.

Implications of post-native copper zone movement on the Devils Canyon fault is important in confirming additional reserves of this type on fully controlled Asarco lands.

James D. Sell

James D. Sell

JDS:lb

ASARCO

Southwestern Exploration Division

April 1, 1977

FILE MEMO

Bornite-High Silver Strike
Dripping Spring Range
Pinal & Gila Counties, Arizona

Rumor of this week is that Inspiration has uncovered, via bulldozer doing assessment work, a chalcocite-bornite vein with high silver values on some claims east of Quintana's Devils Canyon Project holdings. Essex was rumored to have claims nearby.

ICC may drill to test for continuity and depth.

James D. Sell

JDS:lb

later proved to be of very limited extent.

ASARCO

Southwestern Exploration Division

May 20, 1977

TO: F. T. Graybeal

FROM: J. D. Sell

Miami Door Repair
Superior East Project
Pinal-Gila Counties, Az.

On the morning of May 19 I found the side door to the storehouse jammed partially open. I reported it to the Miami police. Mr. G. E. Noland arrived about 9:00 AM and we then forced the door open.

As far as could be determined nothing had been disturbed inside the building. No marks were found on the door. All things considered, Mr. Noland concluded that a vehicle had hit the door with sufficient force to splinter the door and bend the lock mechanism to jam the whole thing.

Stone arrived shortly after Mr. Noland left and he arranged for a contractor to replace the door and lock in the late afternoon.

Although I had previously given the local sheriff's office the telephone numbers etc. in Tucson, Mr. Noland recorded the home phones of FTG, RBC, and myself in case of a night-time emergency. I also stated that in general I stayed at the Copper Hills Motel when in town and they should first check there.

James D. Sell

JDS:lb

ASARCO

Southwestern Exploration Division

June 29, 1977

TO: Geologists

FROM: F. T. Graybeal

Uranium

We now have an expensive, portable gamma ray spectrometer (3 channel scintillometer) for your use. Please run it across all geochemical samples, hand specimens, pulps, and drill core or cuttings which you take in the future. We are not starting an active U_3O_8 program so there is no need to take the instrument into the field. An instruction book is provided and I can show you how to operate it if you wish. The results of your quick scans of rock samples should be noted in a memo or exploration record sheet -- as previously noted by Mr. Courtright.

In the future project geologists should scan all rotary cuttings and drill core for anomalous values and should report his finding in one word (positive or negative). In addition, I plan to have all available rotary and diamond drill samples from previous drill programs, whether from alluvium or bedrock, scanned for anomalous radioactivity. I will keep you informed individually of responsibilities in this regard.

The spectrometer will be kept in Mrs. Bormolini's office. We also have a geiger counter currently in Nevada/California and a second geiger counter available in the Tucson office if you require something for a field exam.

F. T. Graybeal

F. T. Graybeal

FTG:lb

cc: WLKurtz

? What range of values are of interest ?

ASARCO

Southwestern Exploration Division

July 11, 1977

TO: F. T. Graybeal

FROM: J. D. Sell

Clearing of Big Pond
East of hole A-9
Superior East Project
Pinal County, Arizona

With the large loss of water in holes A-8 and A-9 plus limited winter rainfall, the water level in the big pond east of A-9 has been lowered considerably. Mr. Lockhart concurred that additional water could be taken from the pond so that the pond could be cleaned and the dam and spillway revamped and reinforced.

Mr. P. Bryant and crew have completed the cleaning and have pulled some 90 loads of muck (or 1080 cubic feet or 1500 tons, wet) from the pond. The majority is stacked at the A-9 site, with six loads at A-8 site, and a number around the pond area.

The dam crest has been raised 2-3 feet and packed, and it is proposed to install a concrete overflow area whereby the overflow will be about 3 feet below the dam crest. The old spillway has been eroded such that the final overflow was between 4 and 5 feet below the crest.

The new arrangement will afford much more storage in the pond area.

The muck removed will be utilized in road stabilization throughout the project area.

James D. Sell

James D. Sell

JDS:lb

cc: NPWhaley

ASARCO

Southwestern Exploration Division

July 11, 1977

TO: F. T. Graybeal

FROM: J. D. Sell

Proposed Site A-11
Superior East Project
Pinal County, Arizona

The proposed site A-11 will be located 100 to 150 feet west of triangulation point AI-10 and some 500-550 feet in a S45°E direction from hole A-8. The road and site have been flagged and the proposal has been submitted to the Forest Service.

Based on present projections, the proposed A-11 will intercept the flat fault around a depth of 3800 feet. Based on a 300-foot width of the sulfide vein system, the hanging wall will be intercepted around 4800 feet and the footwall at 5400 feet.

James D. Sell

JDS:lb

205/FTG

8/26/77
Superior Exit
S/Branch

Ben Greene called and said that Magma was no longer interested in entering A-6, they plan to work on a contiguous section.

On a recent inspection of the site he noted that our stock tank was full. (Lockheed recently filled it with the submersible pump).

Greene indicated they may request the right to enter next year. He said that if they do, they would contract with (Moss & Weber) our approval for removal of pump & replacement and guarantee no loss of water.

Greene thought the hole was on an ideal location.

-ABC

ASARCO

Southwestern Exploration Division

September 21, 1977

FILE MEMORANDUM

Oak Flat
Superior East Project
Pinal County, Arizona

Mr. T. C. Osborne has received Mr. Crist's memo listing land the U.S. Forest Service would like to acquire and estimated costs of acquisition. The next step will be for him and the New York legal group to study the possible structure of an exchange with the Government, for J. D. Sell to assemble his ideas on what the potential might be under Oak Flat, and then meet to determine the best future course of action. Basic problems in the last step are whether to involve Newmont and how to get both the surface and mineral rights.

F. T. Graybeal

F. T. Graybeal

FTG:lb

cc: WLKurtz
JDSell
RBCrist

TAB

B-5, 6

ASARCO

Southwestern Exploration Division

September 22, 1977

TO: F. T. Graybeal

FROM: J. D. Sell

Newmont Hole B-6
Superior East Project
Pinal County, Arizona

Newmont's drill hole B-6 (my designation) was drilled in the extreme SE corner of Section 6, T2S, R13E, within a few hundred feet of our State Lease Section 5. The hole experienced abundant drilling problems, broken casing, deviated hole, etc., and was ultimately reduced to AX core size.

Inspection of the drill site suggested the hole reached around 3500 feet in total depth. Core chips recovered show Naco, Escabrosa, and Martin limestones plus Precambrian Troy Quartzite, diabase, basalt of the Mescal, and Dripping Spring Quartzite. The most abundant fragments were Troy, then Martin. The least fragments were Dripping Spring and the basalt.

Of importance was the finding of disseminated chalcocite with pyrite in two pieces of Troy. All the other Troy show disseminated oxidized iron and fracture coatings of red-brown hematite. Some of the Martin Limestone was the distinctive recrystallized Magma replacement type but no mineral other than manganese dendrite and spots was noted.

Hole B-6 was the fourth hole along a N60°-70°E trend from the Belmont Mine workings. Our Section 5 blocks Newmont from continuing along that trend but they have drilled three holes along the southern boundary of Section 5 (two of which reached below the Whitetail while the third was reoccupied this month and taken deeper into the Whitetail). Newmont acquired our old State Lease Section 4 where we had drilled Asarco hole A-6 to 1665 feet in Whitetail before we lost the lease. Hole A-6 is on a line N65°E from the Belmont and during the past months Newmont has pressured us in removing the stock water pump from Hole A-6 so that they could deepen the hole. Our denial plus probable time limitations ended when Newmont deepened the hole south of Section 5.

The chips have been sent for geochemical/petrographic analysis.

James D. Sell

James D. Sell

JDS:lb

TAB

B-7

ASARCO

Southwestern Exploration Division

October 4, 1977

FILE MEMORANDUM

Newmont Hole B-7
Superior East Project
Pinal County, Arizona

Newmont's hole B-7 (my designation) located in the SW1/4NE1/4 of Sec. 8, T2S, R13E was reentered by a Joy rig during early September. They spent less than three weeks on site and pulled off during the week of Sept. 15. I visited the site on the 20th and they had just removed the last pipe and cleaned up the site. The work was done to maintain the State Leases and probably amounted to less than ten thousand dollars, or less than 1000 feet of coring. The core size was NX, gauged by the chips and an abandoned core lifter. Three and one-half inch OD pipe was in the hole with a welded cap on the top. As this sized pipe will not fit in an NX hole it is probable that the pipe was run in to the bottom of the previously drilled portion (±1200') with either BX casing below or else open hole to a probable depth of ±2000 feet.

Core chips of Whitetail Conglomerate recovered were approximately as follows:

40% matrix, green-grey arkosic sandy type
60% clasts of: 45% Pinal Schist, 45% diabase, and
10% Escabrosa(?) lms and Bolsa Qtzite.

No native copper or other mineralization was noted. The AARL geochem of the total core chips returned: 73 ppm Cu, 134 ppm Pb, 339 ppm Zn, and 6 Mo, which is compatible to the Whitetail in Asarco hole A-3 to the north (ave. 113 Cu, 57 Pb, 235 Zn, and 4 Mo).

James D. Sell

JDS:lb

ASARCO

Southwestern Exploration Division

October 11, 1977

TO: W. L. Kurtz

FROM: F. T. Graybeal

Section 5, T2S, R13E
Superior East Project
Pinal County, Arizona

Careful work by Mr. Sell, as described on the attached memoranda, revealed that Newmont intersected weak sulfide mineralization in their hole B-6 (our number) which is located on the southwest corner of Section 5, T2S, R13E (see attached map). Section 5 is held by Asarco with all work commitments met until 7/15/79. At this time we must demonstrate that this section is either mineral or non-mineral in character if we wish to hold the ground. Asarco hole A-3 drilled on Section 5 failed to reach pre-mineral rocks and thus is not definitive. Therefore, if we wish to keep the ground additional drilling will be required.

Section 5 lies northeast of the Belmont mine which produced 0.5 million tons averaging 1.0% Cu and 11 oz. Ag. Mineralization in the Belmont area is structurally confined to a northeast-striking zone which extends through Section 5. Newmont has drilled four holes along this trend and recently tried unsuccessfully to bully their way into our hole A-6. The indications are strong that Section 5 contains a good potential for limestone replacement mineralization and that further drilling is required.

Our first step should be to inquire if Newmont will let us examine core from their hole B-6 with the understanding that they can log A-3. This might assist us in locating a site for a new hole on Section 5. Whether or not an exchange is made an additional hole should be drilled. To provide us with sufficient lead time before the Prospecting Permit expires we should drill the hole in 1978.

F. T. Graybeal

F. T. Graybeal

FTG:lb
Atts.

cc: TCOsborne - w/atts.
JDSell - w/o atts.

ASARCO

Southwestern Exploration Division

October 4, 1977

TO: F. T. Graybeal

FROM: J. D. Sell

Geochemical Results
Hole B-6 (Newmont)
Superior East Project
Pinal County, Arizona

The geochemical results from the core chips of Newmont's hole B-6 have been received. In comparing these with other samples in the same units, the following features are suggestive.

1) The Naco chips have more copper than does the shaley lms without any replacement textures but are lower than the mineralized replacement texture collected updip from the Magma ore body. The moly is about the same, while lead is a magnitude lower and zinc is considerably lower.

2) The Escabrosa chips were unreplaced though slightly oxidized and much lower in Cu, Mo, Pb, and Zn values compared to the previous samples.

3) The Martin chips had about the same values as did control sample QC-7 which was lateral to a totally iron replaced bed with high Zn-Pb values and increased Cu-Mo values taken at Queen Creek and south of the Magma workings.

4) The Troy chips appear not to be anomalous but no control sample was from the same formation.

5) The Diabase chips again show a good scavenger effect and show high Cu-Zn values as those in the mineralized diabase at Jewell Hill within the Pinto Valley alteration zone.

Overall, the values are of interest and may indicate weak lateral effects to a massive mineralized zone. If the dark material on the Troy fragments is indeed chalcocite, and since the units were totally to partially oxidized, the chalcocite could be from the downdip migration of copper-rich solutions from the oxidation of the known massive mineralized ore bodies of the Belmont Mine area. Or they could represent weak lateral mineralization, with local enrichment, not related to the Belmont area.

The petrographic samples are not yet available.

James D. Sell

James D. Sell

JDS:lb
Atts.

Phone 889-5787

AMERICAN ANALYTICAL and RESEARCH LABORATORIES

ASSAYERS • CHEMISTS • METALLURGISTS

TUCSON, ARIZONA 85714

SAMPLE SUBMITTED BY ASARCO, INC. DATE Sept. 29, 1977

SAMPLE MARKED	GOLD OZ./TON	SILVER OZ./TON	PPM COPPER	PPM LEAD	PPM ZINC	PPM MOLYBDENUM	Percent Fe
B-6-D			75	372	97	7	1.84
B-6-E			73	458	692	11	1.69
B-6-F			54	66	279	5	1.79
B-6-G			72	208	117	10	2.15
B-6-H			583	124	1679	8	8.50
B-7-A			73	134	339	6	5.43

B-6-D Naco Limestone Chips, unreplaced

B-6-E Escabrosa Limestone Chips, unreplaced, oxidized, some Fe-stain

B-6-F Martin Limestone Chips; partially replaced, oxidized

B-6-G Troy Quartzite chips, oxidized, with Fe pseudomorphs, some Mn; Cu?

B-6-H Diabase chips, weak oxidization & stain; feldspars & magnetite slightly altered.

REGISTERED ASSAYER CERTIFICATE NO. 5512 PETE S. FLORES Date Signed 9/29/77 Arizona U.S.A.

ASSAYER & CHEMIST

CHARGES $ 63.00

INVOICE NO. 15361

To WLK, from JDR. Nov. 28, 1973
Comparative Results, Emission Spectrographic Analysis.

ATTACHMENT B

SEMI-QUANTITATIVE EMISSION SPECTROGRAPHIC ANALYSIS RESULTS

	Sample #	Footage	ppm Cu	ppm Mo	ppm Pb	ppm Zn	ppm Mn	% Fe	% Ca	% Mg	% SiO_2	ppm Ag	ppm Bi	ppm Cd	ppm Sn	Remarks
	A-2C-3	10	700	5	*	*	100	1.5	0.07	0.10	77.2	*	*	*	*	Strong silicification, mixed.
Qtz. Monzonite	A-2C-17	10	3,000	20	*	*	150	5.0	0.01	0.20	73.6	*	*	*	*	Moderate argillic alt., mixed.
	A-4C-124	10	500	40	-	-	-	-	-	-	-	-	-	-	-	Weak argillic (sulfides).
	SC-2	10	100	2	*	*	200	1.5	0.50	0.20	74.7	*	*	*	*	Slight alt. w/FeOx on fractures.
Schultze Granite	AA-1-8	15	10	*	*	*	300	1.5	1.00	0.20	70.2	*	*	*	*	Fresh.
	PR-1	20	7	*	30	*	500	2.0	1.00	0.20	72.2	*	*	*	*	Fresh.
Naco Lms.	QC-1	6	200	5	700	1,500	53,000	2.0	3.00	0.03	76.0	50	*	*	*	Mineralized repl. text.
Middle Repl.	DCA-1A-8	20	6	7	-	*	-	-	-	-	-	-	-	-	-	Shaley Lms., no repl. text.
	DCA-1A-9	20	7	5	-	*	-	-	-	-	-	-	-	-	-	Shaley Lms., no repl. text.
	B-6D		75	7	372	97		1.8								Unreplaced
Naco Lms. Lower Repl.	DCA-1A-10	20	5	7	-	*	-	-	-	-	-	-	-	-	-	Shaley Lms., no repl. text.
	QC-2	10	200	30	2,000	5,000	130,000	2.0	7.00	0.02	37.7	100	*	*	*	Mineralized repl. text.
	QC-9	6	500	100	5,000	5,000	65,000	2.0	15.00	0.20	11.8	100	*	*	*	Vn. struc. w/lateral lms. repl. text.
Escabrosa Lms.	A-4C-95	10	3,000	*	100	3,000	3,000	1.0	-	-	12.8	-	-	-	-	Dolo. lms., bx, w/sec. Cu oxide.
Upper Repl.	A-4C-96	10	5,000	*	50	2,000	3,000	1.0	-	-	20.5	-	-	-	-	Dolo. lms., bx, w/sec. Cu oxide.
	JH-3	15	50	10	1,000	500	5,000	0.5	25.20	5.00	9.0	1.0	*	*	*	Repl. text., minor mineral.
	DCA-1A-12	8	19	13	-	*	-	0.8	30.70	20.80	3.7	-	-	-	-	Repl. texture.
	B-6-E		73	11	458	692		1.7								Unreplaced, oxidized, some Fe-st.
	QC-3	50	70	30	3,000	3,000	200,000	3.0	5.00	0.02	24.5	50	*	*	*	Vein structure w/lateral lms. repl. text.
	QC-4	1	300	20	1,000	7,000	2,000	33.3	5.00	0.10	4.0	1	*	*	10	Total Fe replaced bed.
Escabrosa	QC-5	50	20	*	100	200	1,500	1.0	23.20	5.00	1.8	1	*	*	*	Repl. textured beds on both sides of QC-4.
Lms.	A-4C-111	10	500	15	*	2,000	100	37.3	-	-	36.9	-	-	-	-	Total Fe replacement.
Middle Repl.	JH-2	10	100	3	7,000	2,000	7,000	2.0	24.50	5.00	15.3	2	*	50	*	Weak repl. text. & mineral.
	AH-1-20 & 21	8	52	*	5,400	1,100	9,400	1.3	24.00	0.60	24.8	8	*	*	*	Mineralized repl. text.
	AH-2-17, 18, & 19	12	4	*	*	*	160	0.7	20.50	8.70	7.3	*	*	*	*	Weakly mineralized.
	DCA-1A-15	9	33	9	-	*	-	0.8	31.8	20.00	2.5	-	-	-	-	Repl. text.
Escabrosa Lms.	AH-1-28 thru 31	44	21	*	1,050	520	3,200	0.5	25.10	5.50	5.1	3	*	*	*	Bleached & mineralized repl. text.
Lower Repl.	AH-2-23	34	7	*	*	*	100	0.7	22.40	15.00	4.6	*	*	*	*	Weak repl. text.
Martin Lms.	AH-1-37	17	7	*	200	*	1,000	1.0	10.00	3.00	32.3	*	*	*	*	Weak repl. text.
Middle Repl.	AH-2-27	17	3	*	*	*	500	2.0	23.20	10.00	11.3	*	*	*	*	Weak repl. text.
	DCA-1A-18	10	39	12	-	*	-	1.3	20.20	9.90	36.1	-	-	-	-	Repl. text.
	B-6-F	[illegible]	54	5	66	279		1.8								Partially repl., oxidized
	AH-1-42	8	150	15	1,500	10,000	3,000	10.0	1.00	1.00	44.2	10	20	*	10	Mineralized repl. text.
Martin Lms.	JH-1	5	500	10	1,000	1,500	1,500	15.0	1.00	0.50	77.4	*	*	*	20	Weak repl. mineralization.
Lower Repl.	AH-2-34	9	10	*	100	*	1,000	2.0	15.00	5.00	59.6	*	*	*	*	Weak mineralized repl. text.
O'Carroll	QC-6	5	300	10	1,000	2,000	1,000	33.0	1.50	0.20	37.9	*	20	*	*	Total Fe repl. bed.
	QC-7	12	50	*	50	200	2,000	1.0	26.00	5.00	1.7	1	*	*	*	Repl. text. - Same bed laterally as QC-6.
	DCA-1A-19 & 20	20	28	12	-	*	-	-	29.20	19.10	8.7	-	-	-	-	Weak repl. mineralization.
Bolsa Qtzite	QC-8	15	50	2	*	*	300	5.0	0.10	0.05	90.0	*	*	*	*	Weakly mineralized.
TROY			72	10	208	117		2.2								oxidized w/ Fe pseudo, some Mn, cc?
Dripping Spring Qtzite	AH-2-37	11	20	2	*	*	200	2.0	0.10	0.50	75.7	*	*	*	*	Weakly mineralized.
	Z-4	grab	5	-	*	*	200	1.3	0.30	0.10	major	*	-	-	-	Fresh.
Manitou	Z-3	grab	8	-	30	*	200	1.2	0.30	0.10	major	*	-	-	-	Fresh.
Granite	Z-2	grab	60	-	*	*	100	1.0	0.25	0.10	major	*	-	-	-	Fresh.
	Z-1	grab	5	-	*	*	100	1.2	0.25	0.10	major	*	-	-	-	Fresh.
	A-2C-34	10	3,000	100	*	*	300	2.0	-	-	75.6	-	-	-	-	Wk. to strong argillic w/sulfide.
	A-2W-68	10	5,000	5	*	*	200	3.0	-	-	72.2	-	-	-	-	Qtz. & qtz. sericite w/sulfide.
	SC-1	grab	700	3	*	*	500	3.0	0.20	0.50	68.5	*	*	*	*	Cuttings from Churn Drill (sulfide).
	SR-11	grab	4,300	9	*	*	-	-	-	-	-	-	-	-	-	Moderate FeOx with transported copper
	SR-12	grab	4,500	10	*	*	-	-	-	-	-	-	-	-	-	oxides for SR samples.
Pinal Schist	SR-13-2	10	420	41	50	*	-	-	-	-	-	-	-	-	-	
	SR-13-3	6	3,900	9	44	*	-	-	-	-	-	-	-	-	-	* = Less than 25 ppm Pb, 2000 Zn, 2 Mo.
	SR-13-4	10	1,400	6	36	*	-	-	-	-	-	-	-	-	-	
	SR-15	grab	2,800	2	*	*	-	-	-	-	-	-	-	-	-	- = no result, generally because Cu
	SR-16	grab	4,500	9	*	*	-	-	-	-	-	-	-	-	-	at by wet chem assay

TWLK
From GDS

March 9, 1972
Geochemical Sampling, Below Cowell Area, Miami District

TABLE 1 (cont'd.)

Sample Number	Parts per Million Cu	Pb	Zn	Mo	Rock Type & Comments
Barney Mineralized Zone samples:					
X- 6	2000+	18	54	19	Schist, mineralized, copper oxide
X- 7	1193	23	72	18	Schist, minor mineral'zation
X- 8	287	24	72	11	Schist, minor mineralization
North Barney Schist samples:					
Y- 8	21	24	24	5	Schist, with qtz-tourmaline
Y-10	57	24	59	5	Schist, weak bleaching, hem-epid.
Y-11	68	27	35	9	Schist, pyritic, qtz-tourmaline
Y-12	1270	18	66	9	Schist, copper-mn oxide
North Barney Diabase samples:					
Y- 7	127	35	106	9	Diabase, float over outcrop, wk alt.
Y- 9	100	42	151	7	Diabase, float, weak alteration
Y-21	50	102	355	7	Diabase, red coloration, magnetite alt.
Y-22	30	44	150	7	Diabase, weak alteration
B-6-H	583	124	1479	8	8.5 Fe Weak oxidation & alteration.
Jewell Hill Diabase samples:					
X- 2	615	39	496	16	Diabase, mineralized fractures
X- 4	2000+	1392	2000+	19	Diabase, mineralized & boxworks
Y- 1	270	48	555	14	Diabase, oxidized, Mn-Fe mineralization
Y- 2	1125	34	1008	11	Diabase, Mn-Fe mineralization
Y- 3	217	41	125	9	Diabase, Fe mineralization
Y- 4	621	33	294	9	Diabase, oxidized & mineralized
Y- 5	566	39	107	111	Diabase, minor alt-mineralization
Y- 6	52	43	163	6	Diabase, minor alt-mineralization
South Jewell Hill miscellaneous samples:					
X- 3	188	28	68	12	Granite porphyry cutting diabase
X- 5	106	36	40	25	Schist, red stain in fault sliver
Drill Hole samples:					
"C"	309	35	183	5	Diabase & silicic igneous(?) cuttings
"F"	-100	-	-	-1	Schist, split core runs (average)

Anomalous Samples

High Threshold Samples

10/24/77

FROM: F. T. GRAYBEAL

TO: JDSell

Section 5
NEWMONT
DRILL HOLE

re Superior East, TCOsborne says ok to exchange assays, core recovery, chance to log the hole for our hole A-3 and their hole B-6 (our #). No matter location of B-6, as I assume on their land. This should all be done verbally if possible. If not, I will have to write letter and clear w. New York lawyers.

B-6 SE Corner Sec 6

A-3 NE 1/4 Sec 5, 6005' Stillwater Co.

w/ 5 rotary assay intervals

+ 5-4 core assay intervals

ASARCO

Southwestern Exploration Division

November 15, 1977

TO: F. T. Graybeal

FROM: J. D. Sell

Au-Ag Results
Newmont Drill Holes
Superior East Project
Pinal County, Arizona

Core chips were collected from two drill sites south of Oak Flat.

Drill hole B-5, located 150' south of our State Lease Section 5 (i.e., N Center, N1/2 NE1/4 NW1/4 Section 8, T2S, R13E), contained diabase, Apache Group, and Paleozoic limestone chips. All chips collected were placed in one whole rock sample with the following results:

B-5-WR: 0.003 oz. Au, 0.04 oz. Ag, 402 ppm Cu, 42 ppm Pb, 257 ppm Zn, and 5 ppm Mo.

Two additional samples were collected at drill hole B-6 located very near our SW1/4 of Section 5 (i.e., E1/2 SE1/4 SE1/4 SE1/4 of Sec. 7, T2S, R13E). The core chips were separated into total limestone (L) (mainly Mississippian Escabrosa) and total quartzite (Q) (mainly Precambrian Troy and Minor Dripping Spring). The samples reported the following amounts:

B-6-L: 0.005 oz. Au, 0.09 oz. Ag, 45 ppm Cu, and 6 ppm Mo.; while
B-6-Q: 0.011 oz. Au, 0.81 oz. Ag, 310 ppm Cu, and 7 ppm Mo.

As noted, the quartzite composite contained about double the gold value in either B-5-WR or B-6-L samples while the silver value was highly increased to a significant 0.81 oz. silver per ton.

A more comprehensive geochem report on B-6 individual samples was reported in my memo dated Oct. 4, 1977 but did not have any Au-Ag values. A variation in the values for copper and moly can be noted with the limestone samples being in the same magnitude but the new quartzite sample has more copper than the previous sample (however, I had picked out two pieces of quartzite with possible chalcocite for polished thin section work and this would have diluted the original sample).

No results are presently available on the polished thin sections as they have not been returned by Western Petrographics.

James D. Sell

James D. Sell

JDS:lb
Att.

3441 East Milber

Phone 889-5787

AMERICAN ANALYTICAL and RESEARCH LABORATORIES

ASSAYERS • CHEMISTS • METALLURGISTS

TUCSON, ARIZONA 85714

SAMPLE SUBMITTED BY ASARCO, INC. DATE Nov. 10, 1977

SAMPLE MARKED	GOLD OZ./TON	SILVER OZ./TON	PPM COPPER	PPM LEAD	PPM ZINC	PPM MOLYBDENUM		
B-5-WR	.003	0.04	402	42	257	5		
B-6-L	.005	0.09	45			6		
B-6-Q	.011	0.81	310			7		

CHARGES $ 30.75

INVOICE NO. 15450

REGISTERED ASSAYER CERTIFICATE NO. 6852 ALFRED S. FLORES Date Signed 11/18/77 Arizona U. S. A.

ASSAYER - CHEMIST

Dec 77

FTG

gos

A-10

AX core drilling started in ~~[illegible]~~ on the 10th (Saturday), and as of the end of the 14th (Thursday), they had cored 107 feet at an average rate of slightly less than 27 ft/day. This includes 2 bit ~~[illegible]~~ pulls & the last trip.

The rate since Monday, is, 3 days, going in, plus one bit change, is 34 ft/day.

Yesterday (Thursday AM) they were pulling for a bit change at 4078'.

They will be working this Sunday the 18th, to make up for getting off Monday, the 26th, and so have 9 days plus what they get done on Saturday (I suspect only 1 shift of drilling). Assuming the rate of 34 ft/day × 9 days = 306 + 4078' depth = 4374 depth by the 24th December.

At present only minor gly-sericite bands at 45° subparallel to schistosity is found, with schist being the dominant rock type with many small light brown-cream biotite feldspar porphyry and one zone of black crowded porphyry (A-4 type). The porphyries also contain narrow bands. The bands contain py & minor cc in 1/16" seams & widely scattered, disseminated, & along a few fractures. Estimated grade is between 0.2 & 0.5 and rare of the latter over any 5 foot length.

Of note is the appearance of large 1/4" biotite flakes (seen today) (?)(!) along narrow sericite veins.

3/22/78

FROM: F. T. GRAYBEAL

SUPERIOR EAST

TO: JDSell

You should start thinking about the site for A-11: north of A-8, or down near Rawhide, or elsewhere. When you get your act together let me know and we will review with WLK.

FROM: W. L. KURTZ

Rawhide 9-V-78

TO: ~~FTG~~ JDSell

ok to make letter amendment to ICC-ASARCO agreement changing date to 1 Jun 83 rather than 1 Jun 80.

Everything else remains the same

If successful we will drill A-11 north of A-9, but better get permits for both roads.

FTG.

cc. JDS

FROM: F. T. GRAYBEAL

SUPERIOR E

TO: JDSell

5/3/78

I assume you are planning the next drill hole location so WLK and I can review it before you go to Colorado.

Note: Have ± 47,000.00, enough to complete assessment work on all claims of SE proj.
What will road cost?
Where will hole be at?
Cost of casing & rental?

Chat about Forest Service permit.
Chat about 100 ± thin sections available.

ASARCO

Southwestern Exploration Division

May 1, 1978

TO: F. T. Graybeal

FROM: J. D. Sell

Magma Copper Company
Superior, Arizona
Pinal County, Arizona

At the Pinal Mountain Section, AIME, meeting of April 18, 1978, Mr. Charles Freeman, General Manager of the Superior Division of Magma Copper Company, in the presence of Joe Scheureing (Mine Superintendent), Les Presmyc (sand-fill boss), and Don Peterson (USGS and speaker of the evening), asked me how we were going to joint-venture the Oak Flat area and I replied that it would first have to be taken out of governmental control, and I pointed to Peterson. No further comments were made.

James D. Sell

James D. Sell

JDS:lb

cc: WLKurtz

ASARCO

Southwestern Exploration Division

May 11, 1978

TO: N. P. Whaley

FROM: F. T. Graybeal

Update on drilling projects -- 1978

Nevada-California drilling requirements will all be air-hammer projects as follows:

1) Gold Run N.: must do a minimum of $2200 for assessment; we will complete any partly drilled holes; faint possibility we might drill 3000 ft. in 9 holes; geologist will be P. G. Vikre.

2) Rochester: will do only minimum of $11,400 for assessment; geologist will be P. G. Vikre.

3) Little Gold Hill: will do only minimum of $6600 for assessment; we will complete any partly drilled holes; geologist will be G. J. Stathis.

Drill hole locations will be provided by the geologist who should check with me first. H. M. Stone will be available to supervise all sampling and site preparation for Nevada. He will be staking claims during most of June and will need advance notice as to when the drill will be available. Please make certain that Mr. Stone, Mr. Vikre, and Mr. Stathis are informed as to when the drill will be available for the various projects and that all parties involved know where to contact each other. The projects may be drilled in any order. If possible, Mr. Stone might wish to arrange the road building at Rochester before starting the claim staking.

Arizona drilling requirements will all be diamond drill projects as follows:

1) Three R: will do only minimum of $13,000 for assessment; will need 40° angle hole, NX core is acceptable; will utilize existing road; geologist will be F.T.G.

2) Thunder Mtn: will do only minimum of $16,700 for assessment; will drill vertical NC hole and leave it cased upon completion; will require a new road mostly on Trench patented claims; geologist will be F.T.G.

3) Superior East: will do only minimum of $65,000 for assessment; will drill vertical hole and leave it cased upon completion; will require a new road; geologist will be J. D. Sell and yourself.

The Arizona drilling may start whenever convenient, but before Sept. 1, 1978. If you wish to use a single rig in the Patagonia Mtns. it must start early enough to complete Three R before Sept. 1, 1978. The drill on Thunder Mtn. should be capable of completing all $16,700 using NC size.

F. T. Graybeal

F. T. Graybeal

FTG:lb
cc: PGV, GJS, HMS, RBC, JDS

JDS: Let me know soon if severe deviation and I will see if WLK/TCO will give money to complete a south wedge. 14 March 79

FTG

JDS.

FTG 3/15/79

A box of core (#465) is in my snap case and shows the flat gouge zone separating oxidized material from unoxidized-sulfide material. Also note the 1" slab of cp-bornite "vein" segment at the interface. We are now near 4400 feet and only one small fragment of cp-bn has been note. The mineral below is fine cc or py, mainly disseminated and in +60°-70° dipping qz-ser shear zones. The implication is that the flat fault cut one of the A-9 type bornite veins & transported it along.

Several features in the hole are reviewed.

1) The base of the Tw was some 120' below projection but is no problem on an irregular surface. However, a weak 45° shear zone was found below which may have displaced the irregular surface somewhat.

2) Probably one A-2 ~~type~~ slide block (leached capping) is present in the basement unit.

3) The projection of the basal fault ~~between~~ in hole A-9 between slide block and basement was not found in A-11 where it was projected to, but a flat fault was found at 4040-4085 (250' below projection) which could be the structure. As, below the rock is much less ~~oxidized~~ brecciated and contains good oxidized capping & qz-ser vein structure as noted in A-9.

4) However, the finding of another flat fault structure at the oxidized-sulfide contact as shown

in core box #465 is some 500 feet below original projection and about 120' below oxide-sulfide interface projection. As you recall the oxide-sulfide interface in A-9 was deep inside the unmoved block, but in A-2 was at ± the flat fault contact.

The concern is why the deeper depth to flat fault structure in such a short projection from A-9 — one factor could be a strong deviation of the hole to the north (not found in our previous drilling to these depths), which with a Northerly dip to our structure-surfaces would place the intercept at a deeper depth.

However, if this is true then we would be essentially subparalleling a north-dipping quartz-sulfide zone of A-9 and never reach it (& hence not prove one way or another the true dip of the qs vein zone). If it has not deviated, then we should intercept the qsv zone within 200-400 feet.

Good

Big Mo will survey the hole this weekend to help in planning if a south wedge might be advisable.

The core to date will probably average 0.3-0.5 percent with higher in the qz-sericite zones and lower in the biotite-qz laminae zones as seen in the core below the fault in box #465. This will be split this week end & assays should be back by report time.

Joe

5/21/79

"Mac" McLean, Mech. Super, Mission
ph. 622-4891.

Yes, they have a sump of "waste" oil & we can secure 1-2 barrels of it at any time. (may be out on day sold to buyer)
Prefer we furnish the barrels.
Call in advance.
OK for drill contractor to pick up if notified in advance by Tucson office of contractor & ASARCO.

cc Kent Ro
W. Loveless
6/5/79

Probably needs the same restraint conditions & significance as expressed in the letter covering the mineral potential report
Glen

RECEIVED
JUN 4 1979
S. W. U. S. EXPL. D.W.

wirth associates

June 1, 1979

F. T. G.

Mr. F. T. Graybeal, Director of SW United States Exploration
American Smelting & Refining Co.
1150 N. 7th Avenue
P. O. Box 5747
Tucson, AZ 85703

Dear Mr. Graybeal:

The Salt River Project (SRP) is proposing to construct a hydroelectric pumped storage facility to supply increasing peak load power demands in the SRP service area in the 1990s. Following completion of a detailed site selection study which considered technical, economic and environmental factors, Alchesay Canyon, near Roosevelt Dam, was selected as the preferred site. This site (as indicated on the enclosed map) is located in the Tonto National Forest in eastern Maricopa County. The upper reservoir site would be situated east ot Two Bar Ridge approximately two miles south of Roosevelt Lake. The lower reservoir will utilize Apache Lake and is located approximately 1.2 miles downstream from Roosevelt Dam.

Major project elements associated with the proposed 1000-MW pumped storage project are the power plant and the transmission facilities. Plant facilities include: access tunnel and water tunnel; underground power plant; an upper reservoir, formed by two embarkment dams across Alchesay Canyon; an upper reservoir access road; and the lower reservoir (Apache Lake). The upper and lower reservoirs would be connected by the underground water tunnel. The underground power plant which houses the pump/turbines would be located between the upper and lower reservoirs. The transmission system for the pumped storage facility will be connected to SRP's existing system via a switchyard and new 500kV transmission lines. Enclosed is a project data sheet which briefly synthesizes pertinent information about the proposed project.

The pumped storage concept is similar to a conventional hydroelectric facility in that falling water produces power. When the system's demand for power is high, water is released from an upper reservoir through a power tunnel. The water passes through a turbine which runs a generator in the power plant to produce electricity. When the system demand is low, power is made available from large base load generating stations to turn the turbine in reverse to pump the water from the lower reservoir back up into the upper reservoir. The facility is then ready to be used again for power generation.

Planning and Design • 2701 East Camelback Road • Suite 391, Phoenix, Arizona 85016 • 602-956-9830 • Tlx 66-7397

Home Office: 1739 Grand Avenue, Billings, Montana 59102 • 406-252-1421 • Tlx 319-431

Wirth Associates, Inc. (Phoenix, Arizona) has been retained by SRP to manage the environmental studies that are necessary to meet the Federal Energy Regulatory Commission (FERC) and the Arizona Power Plant and Transmission Line Siting Act licensing requirements. The environmental studies will address the two major elements: the plant site and transmission line corridors. The Phase I transmission environmental study is a regional planning effort which will culminate in the identification of potential corridors for the 500kV transmission lines. The corridors will be located between the plant site and the Coronado/Silverking Transmission Line about 15 miles to the east of the plant site and from the plant site to a substation in Tempe. The Phase II transmission environmental study, leading to the selection of an environmentally preferred alignment, will assess the potential impacts associated with each alternate corridor.

An integral component of the environmental studies is the active solicitation of input from federal, state, regional and local agencies and interest groups through a contact program. The intent of the contact program is to ensure that 1) the most accurate and up-to-date environmental information is utilized in generating the data base; and 2) agency and special interest group concerns are integrated into the study process.

To ensure that all environmental data and/or concerns your agency or organization may have regarding this project, we request that your comments be provided to Wirth Associates by June 30, 1979. In the meantime, if you have any questions, please feel free to contact me at your convenience.

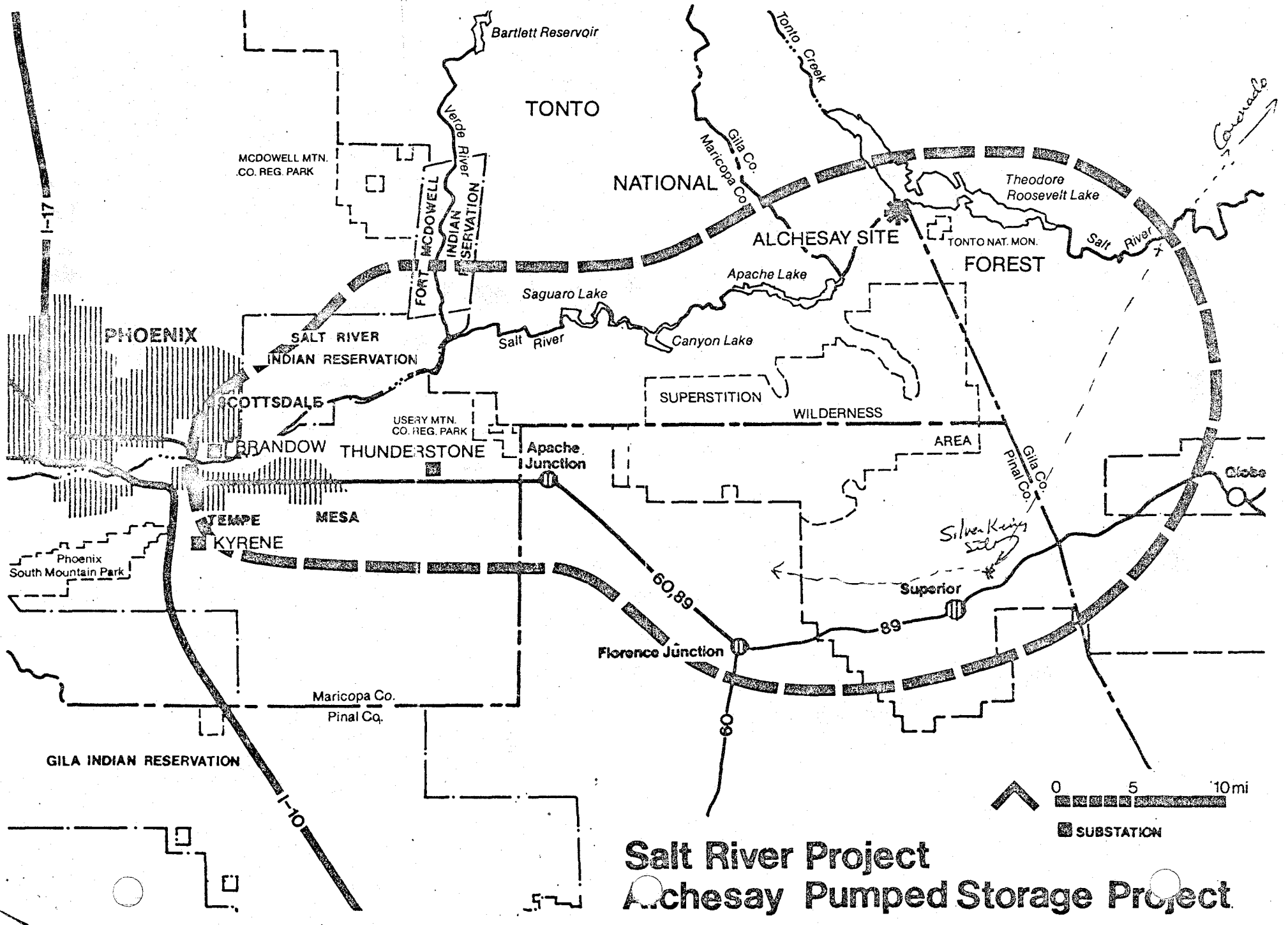
Yours truly,

Curtis A. Miller

Curtis Miller
Assistant Project Manager
Wirth Associates, Inc.

CM/rw

Enclosure



Salt River Project
Alchesay Pumped Storage Project

Preliminary Pumped Storage Project Data Sheet

Size:	1000-MW
Operation:	Daily or Weekly Cycle
Capacity:	12 Hours of Storage (12GWH)
Water Storage:	Approximately 9,500 Acre Feet Active Storage Volume Approximately 12,500 Acre Feet Gross Storage Volume
Type of Power Plant:	Underground
Number & Size of Units:	Two 125-MW and Three 250-MW
Type of Units:	Reversible Francis-type Pump/Turbine Generators
Head:	Max. 1485 Feet Rated Net Min. 1335 Feet Rated Net
Length of Horizontal Tunnel:	6,165 Feet
Diameter of Power Tunnel:	22 ft. 9 in.
Type of Reservoirs:	
Upper:	Concrete-faced rockfill dams, compacted rockfill shells
Lower:	Upper reaches of existing reservoir - Apache Lake
Transmission Facilities:	Primary 500kV transmission line terminating at the Brandow Substation in Tempe, Arizona. Backup system would be two 500kV lines making a loop connection with the Coronado to Silverking 500kV line.

Source: Stone and Webster Engineering Corporation, Alchesay Pumped Storage Project, Phase I Study, Volume I Report, March 1978.

ASARCO

JDS

Exploration Department
Southwestern United States Division
R. B. Crist
Property Manager

June 6, 1979

Mr. Willard Shoecraft
"KIKO"
Patio Park
Globe-Miami Highway
Claypool, Arizona 85532

Dear Mr. Shoecraft:

Enclosed is the information we discussed earlier today regarding the Sutton Summit water basin.

1. map
2. water assays - J.I.Ranch
3. hydrologist report

I mentioned this to Walt Lockhart and told him that I was filling you in on what information we had.

Thank you for calling.

Very sincerely,

R. B. Crist

R. B. Crist.

RBC:jlh
encls as above

c.c. J.D.Sell - Mr. Shoecraft is considering subdividing the north acreage into 48 1-1/2 acre lots (with septic tanks).

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

ASARCO

Southwestern Exploration Division

September 14, 1979

TO: S.R.Davis, J.D.Sell, B.J.Devere, G.J.Stathis, H.G.Kreis, P.G.Vikre, G.W.Pickard, N.P.Whaley

FROM: F.T.Graybeal

DRILLING PROJECTS
4th Quarter 1979

Following is a list of drilling requirements for authorized projects during the 4th Quarter of 1979. N.P.Whaley will obtain a suitable contractor for each new project. The project geologist will be responsible for road and site contractors (with assistance from NPW if needed), supervision of sampling, monthly cost estimates, and monthly progress reports.

Project	Requirements	Start	Geologist
Ventura	Complete V-37	---	FTG
Rochester	Complete drilling; survey all hole collars; deviation surveys of 20 holes	Surveys to start upon completion of drilling	NPW/GWP/ HMS/PGV
Buckskin	Complete current hole, then decide whether to start 2nd hole this year	---	PGV
Superior E.	Dyna-drill wedge out of A-11. Need rig heavier than Joy 22. JDS and NPW work jointly on rig and Dyna-drill contractors	Nov.	JDS
Poston Butte	Diamond drill PB-36 and 37; permeability test in both holes; 24-hour drilling 7-day week for each hole	Oct., or when perm. test equip. is available	HGK
Skyview	Diamond drill SKY-1	When air-hammer work complete -- Oct.	SRD
Santa Cruz	Rotary and diamond drill 6 holes. Need Longyear 44 and DMS capabilities	Oct.	HGK
Florence Pediment	Rotary drill 7500-9000 ft. in 3 holes; need DMX equivalent	Following Santa Cruz rotary	HGK
Stark	1979 drilling uncertain	---	SRD

Project geologists should check with FTG and RBC before starting site work to confirm road building permits and landowner permission have been obtained and with NPW to confirm drill rig starting dates. Site work must be sufficiently advanced by starting date to stay ahead of drills. All new hole locations must be cleared with me. Tony Benavidez will be available for Poston Butte, Santa Cruz, and Florence Pediment. Harold Stone will be available for other projects on a part-time basis after mid-October. John Wood will be available on a limited part-time basis for all projects. If you need the assistance of a geologic technician, please schedule it through Mr. Whaley who will keep me advised.

F. T. Graybeal

F. T. Graybeal

FTG:lb

cc: WLKurtz
RBCrist
HMStone
TCBenavidez

NL Baroid

DRILLING MUD REPORT

REPORT NO. M

DATE Feb 6 1980 DEPTH 2758

API WELL NO.	STATE	COUNTY	WELL	S/T

OPERATOR A.S.A.R. Co.	CONTRACTOR Joy Drlg	RIG NO.
ADDRESS Tucson	ADDRESS Tucson	SPUD DATE
REPORT FOR MR. Jim Sell	REPORT FOR MR. Odell Powers	SECTION, TOWNSHIP, RANGE
WELL NAME AND NO. Superior Project 812	FIELD OR BLOCK NO.	COUNTY, PARISH OR OFFSHORE AREA Gila / STATE OR PROVINCE Az.

OPERATION		CASING	MUD VOLUME (BBL)	CIRCULATION DATA	
PRESENT ACTIVITY Dyna-drlg.		SURFACE IN. at 2560 FT.	HOLE PITS	PUMP SIZE X IN.	ANNULAR VEL. (FT./MIN.) OPPOSITE DP
BIT SIZE (IN.)	NO.	INTERMEDIATE IN. at FT.	TOTAL CIRCULATING VOLUME	PUMP MAKE / MODEL Bean 35	OPPOSITE COLLAR
DRILL PIPE SIZE	TYPE	PRODUCTION OR LINER IN. at FT.	IN STORAGE	BBL/STROKE STROKE/MIN	CIRCULATING PRESSURE PSI
DRILL COLLAR SIZE	LENGTH	MUD TYPE Quickvol-Deptrid		BBL./MIN.	BOTTOMS UP (MIN.) / SYSTEM TOTAL (MIN.)

Sample from ☐ Flowline ☑ Pit
Flowline Tempeture °F

MUD PROPERTIES			
Time Sample Taken	3 PM		
Depth (ft)	2758		
Weight ☑ (ppg) ☐ (lb/cu ft)	8.4		
Mud Gradient (psi/ft)	.437		
Funnel Viscosity (sec/qt) API at °F	31		
Plastic Viscosity cp at °F	5		
Yield Point (lb/100 sq ft)	3		
Gel Strength (lb/100 sq ft) 10 sec/10 min	1 / 2	/	/
pH ☑ Strip ☐ Meter	9.5		
Filtrate API (ml/30 min)	25		
API HP-HT Filtrate (ml/30min) °F	—		
Cake Thickness 32nd in API ☑ HP-HT ☐	<1		
Alkalinity, Mud (P_m)	—		
Alkalinity, Filtrate (P_f/M_f)	.45/1.3	/	/
Salt ☐ ppm ☐ gpg Chloride ☑ ppm ☐ gpg	400		
Calcium ☑ ppm ☐ Gyp (ppb)	80		
Sand Content (% by Vol)	none		
Solids Content (% by Vol)	0.5		
Oil Content (% by Vol)	—		
Water Content (% by Vol)	99.5		
Methylene Blue Capacity (me/ml mud)	—		

EQUIPMENT

	SIZE	HRS/TOUR				SIZE	HRS/TOUR			
Centrifuge						Desilter				
Degasser						Shaker				
Desander						Other				

DAILY COST	CUMULATIVE COST

MUD PROPERTIES SPECIFICATIONS

WEIGHT	VISCOSITY	FILTRATE
<8.6	32-34 sec.	<15 cc

BY AUTHORITY ☐ OPERATOR'S WRITTEN ☐ DRILLING CONTRACTOR ☐ OPERATOR'S REPRESENTATIVE ☐ OTHER

MATERIALS RECOMMENDED

Water Loss too high. Water Flow indicated. Double amount of Deptrid to reduce filtrate. Mud AOK, besides. Dyna-drilling proceeding slow. Will call to find out what might help.

Thank you

THIS COPY TO OIL CO.

THE RECOMMENDATIONS MADE HEREON SHALL NOT BE CONSTRUED AS AUTHORIZING THE INFRINGEMENT OF ANY VALID PATENT, AND ARE MADE WITHOUT ASSUMPTION OF ANY LIABILITY BY N L INDUSTRIES, INC. OR ITS AGENTS, AND ARE STATEMENTS OF OPINION ONLY.

REPRESENTATIVE Tim Wolcott	HOME ADDRESS Tucson	TELEPHONE
MOBILE UNIT 884-5643	WAREHOUSE LOCATION Tucson	TELEPHONE 622-3694

BH 1905 © ABI 11 78 PRINTED IN U.S.A.

JDS

Product Information

QUIK-TROL™
Organic Polymer

General Description
QUIK-TROL™ organic polymer is a white, granular, nonfermenting powder that forms a clear colloidal solution in fresh or salty water.

Recommended Uses
QUIK-TROL™ organic polymer is added to fresh or salty water
1. To stabilize water-sensitive formations that swell, cave, or disintegrate in ordinary drilling fluids.
2. To avoid or overcome problems caused by sticky clays: such as collar-binding, bit-balling, mud rings, booting-off, and so on.
3. To reduce pipe torque and circulating pressure.
4. To eliminate rod vibration.
5. To prepare a solids-free drilling fluid having exceptional hole-stabilizing properties.

QUIK-TROL organic polymer is added to freshwater drilling fluids containing AQUAGEL® gellant or QUIK-GEL® gellant. To beneficiate the bentonite and to improve suspension and wall-building properties.

QUIK-TROL organic polymer is added to gel-foam for air-drilling
1. To provide hole-stabilizing qualities
2. To increase hole-cleaning capabilities

Major Advantages
1. Effectiveness. QUIK-TROL™ organic polymer prevents swelling and disintegration of formation clays, raises viscosity, reduces filtration.
2. Efficiency. QUIK-TROL organic polymer is fully active; only a small quantity is needed.
3. Economy. QUIK-TROL organic polymer saves on transportation costs, storage space, and drilling time and prevents hole problems.
4. Versatility. QUIK-TROL organic polymer works in hard or salty waters and improves several properties of the drilling fluid at one time.
5. Convenience. QUIK-TROL organic polymer is easily mixed and comes in a small, easy-to-handle package.
6. Stability. QUIK-TROL organic polymer does not deteriorate with age, and the moisture-resistant package prevents caking.
7. Environmental Acceptability. QUIK-TROL organic polymer is odorless, colorless, and tasteless in a water solution. It also is not toxic and does not ferment to produce objectionable odors or flavors.

™ QUIK-TROL is a trademark of NL Industries, Inc.
® AQUAGEL, QUIK-GEL, and TORQ-TRIM are registered trademarks of NL Industries, Inc.

2-6-80

JDS :

FOR YOUR INTEREST.

BAROID PRICE LIST $80.70 / 20 LB CASE (AUG. 1, '79)

NW

NL Baroid

NL Baroid/NL Industries, Inc.
P.O. Box 1675, Houston, Texas 77001

1M 9/78 H-S Printed in U.S.A.

Recommended Treatment

	Approximate Amounts of QUIK-TROL™ Organic Polymer		
	lb/100 gal	lb/bbl	kg/m³
	Added to Fresh or Salty* Water		
Stabilize water-sensitive formations	3-5	1.5-2.5	4-7
Stop rod vibration; reduce torque; lower circulating pressure	0.5-1	0.2-0.4	0.6-1
	Added to Mud Made with Fresh or Salty* Water		
Improve performance (better hole cleaning, thinner filter cake, increased hole stability) Extend and beneficiate bentonite	0.5-1.5	0.2-0.6	0.6-1.7
	Added to Injection Liquid in Air/Foam Drilling		
Improve foam performance and hole condition	0.5-1.5	0.2-0.6	0.6-1.7

Method of addition: (1) Slowly through jet mixer or in vortex of high-speed stirrer; (2) if diesel oil is not objectionable, make a slurry of QUIK-TROL organic polymer in diesel oil and add as in method (1); (3) TORQ-TRIM® II lubricant can be used in place of diesel oil.

*Very salty water may require up to twice as much QUIK-TROL™ organic polymer as does fresh water. Preferably mix QUIK-TROL organic polymer in fresh water before adding to very salty water.

Packaging

QUIK-TROL™ organic polymer is packaged in a cardboard box containing ten plastic bags, each holding two pounds (0.9 kg) or organic polymer.

Availability

QUIK-TROL™ organic polymer may be purchased through any NL Baroid Service Center or from the Houston Plant.

™ QUIK-TROL is a trademark of NL Industries, Inc.
® TORQ-TRIM is a registered trademark of NL Industries, Inc.

JDS

ASARCO

Southwestern Exploration Division

March 4, 1980

TO: F. T. Graybeal

FROM: N. P. Whaley

Superior East Project
Pinal County, Arizona
Scheduling of Drills

Your file memorandum of February 28, titled Superior East Project, outlines the near-future scheduling of drilling program operations which we all hope to realize as an adjustment to the unforeseen shutdown of the Dyna-Drill phase. A few points might be clarified and number of potential conflicts understood in the following comments.

Paul Bryant has been kept fully informed of our need for drill sites since the inception of the program in early January. He is well aware of, and fully appreciates, our more critical need for them following the shutdown of the Dyna-Drill phase. His initial timetable became meaningless over the last month and a half when the plateau was subject to the same continued, intermittent heavy rainfall which left much of central Arizona a disaster area. His operations were again stopped yesterday when all of our drill rigs in the Florence-Superior area were once more inaccessible during and after yet another period of heavy rainfall.

The site designated P-6, approximately 0.3 miles south of the stockpond, should be ready for occupancy within the next few days.

The only other site which can be made available in the near future is the location described in Bob Crist's USFS Amendment No. 7. Access to this location will involve the construction of approximately 2600 ft. of road and the completion of a drill pad. You are well aware of the nature of the terrain. I do not feel that it can be completed in less than 2.5-3 weeks.

Joy Manufacturing Company has been made aware of our interest in both the Joy-36, which has been on the Superior East project, and the Joy-22, which is currently drilling on the Florence PDP. You should have copies of two Asarco purchase orders which reflect this understanding, T-642-9 for the Dyna-Drill operations and T-133-0 for the vertical-hole drilling (which rig performs which operation makes no difference to Joy Mfg. Co.).

The execution of the schedule you outline, without conflicts, in your memorandum is contingent upon two factors: 1) the availability of Wayne Craig of Christensen to operate the Dyna-Drill (assuming we are determined to continue the program -- and I feel we should carefully consider whether we are willing to make the commitment); and 2) how soon the Joy-22 in the Florence area is released.

Wayne Craig does not feel that he <u>can</u> make a time-specific commitment in view of the scheduling procedures of his present client.

The release of the Joy-22 in the Florence area is contingent upon our interest in continuing that program -- something which I cannot predict.

These circumstances suggest that it might be difficult to incorporate additional drill rigs (to drill top holes) in the Superior East program. Holding both diamond drills, as you suggest in mentioning the retention of the Joy-36, would seem to be most important to any course the program might take.

N. P Whaley

N. P. Whaley

NPW:lb

cc: RBCrist
JDSell

The release of the Joy-22 in the Florence area is contingent upon our interest in continuing that program -- something which I cannot predict.

These circumstances suggest that it might be difficult to incorporate additional drill rigs (to drill top holes) in the Superior East program. Holding both diamond drills, as you suggest in mentioning the retention of the Joy-36, would seem to be most important to any course the program might take.

N. P Whaley

N. P. Whaley

NPW:lb

cc: RBCrist
JDSell

NPW

As noted before we will keep the diamond drills. If we have to abandon air-hammer plans - so be it! The Flor. Peal rig will do 200-300 ft. in FP-3, then FP-4, then if results justify in FP-5. If major disaster occurs at Sup. East so sites aren't ready we will retain the Flor. Peal diamond drill rig to do some assessment work in Patagonia Mtns. I don't want to do that, but with the amazing scarcity of rigs I don't want to give up any of our drills. Paul Bryant should proceed as rapidly as possible. You should watch the progress of the P-7 road at Superior E. and compare it to the progress of the Flor. Peal. diamond drill work, and let me know if the Superior E. sites will not be ready.

RBC
JDS
WLK

FTG
3/4/80

Talk to - JDS - ~~HGK~~

11/17/80
J I Ranch
So Hon Summit

Willard Slocraft phoned -
He and her son (Superchicken Balloon)
are proceeding with subdivision of old
Apple orchard area - lot size 1½ acre.

They would rather sell the package - ARCO
is not interested.

Slocraft claims that Phillips Petroleum has
claimed all open ground around the Pinal
Mtns & N. of Globe and have inquired
about her So Hon Summit land.

-RBe

ASARCO

Exploration Department
Western USA

January 12, 1981

H. M. Stone
Tucson Office

Last week we discussed some of the items you should be responsible for this winter. The two main ones are listed here (see me if any questions):

3R-Trench: you will be responsible for maintaining liaison with the driller; to consult with drillers and Joy management (Jack Lloyd) with any major drilling problems such as excessive mud costs, excessive cementing, etc., etc.; to prepare the monthly cost estimates; to bring core to Ventura warehouse; to split and deliver to assayer those intervals requested by F.R.Koutz. F.R.Koutz is project geologist and you should consult with him on any problem you may have.

Superior East: ditto above except core goes to Miami warehouse and please bring one box every 50' to Tucson for me to see. G.W.Pickard/ WLK project geologists until J.D.Sell returns from Tintic.

Other jobs will come up, such as possibility of fencing and posting signs around old workings in Patagonia, warehouse maintenance, geochem sampling, etc.

W. L. Kurtz

WLK:lb

cc: FRKoutz
GWPickard
JDSell
RBCrist
NPWhaley

ASARCO

Southwestern Exploration Division

March 5, 1981

TO: W. L. Kurtz

FROM: J. D. Sell

Directional Survey & Temperature Report
Mollen-Hauer Surveying Company
Hole A-14
Superior East Project
Pinal County, Arizona

Attached are copies of the full survey of hole A-14 from surface to 5450' deep. The hole was converted from NX to BX size at 5493' and is presently drilling.

The hole size and rock units are as follows:

Rotary, air-hammer, 4½" casing - Surface-1535; Joy NC core:	1535'	Surface Dacite
		1646'
	to	Earlier Volcanics 2290'
	2891'	Whitetail
Joy NX core	2891'	Conglomerate 3841'
	to	M-1A Type Slide Block 4016'
	5493'	p€ Schist & L. bfp
Joy BX core	5493' & below	

As noted, the main deviation started below 4000' and is well initiated by 4300', while coring NX size. This area is in the top of the bedrock interval in Pinal Schist with oxidation extending to 4113', then some quartz veins and alteration bands to about 4172' and falling off below that point. Schistosity at the upper part is at 20-30° from horizontal with the first steep 70°-90° gouge-shear zone at 4330-4337', followed by a general increase in schistosity dip to 30°-45°. Several steep crushed zones occur farther down and a number of biotite, feldspar, porphyry dikes of less than 20 feet thick occur with generally plus 45° contacts, which are generally crushed and brecciated.

Massive porphyry continues below 5160'.

The temperature range is in the same ball-park as other holes in the area.

James D. Sell

James D. Sell

JDS:lb

Atts.

ANNUAL PROJECT PLANNING SHEET

DISTRICT: Southwest
PROJECT NAME: Superior East
PROJECT NUMBER: 0010
PROJECT SUPERVISOR: J.D.Sell
PROJECT GEOLOGIST: J.D.Sell
PREPARED BY/DATE: JDS/6-3-81

EXPENDITURES

1. Month of _____ $_____
2. Current Year Expenses to Date thru _____ $_____
3. Budget for Current Year 1981 $ 600,000
4. Thru previous year, since project began $2,992,124

TYPE OF PROJECT

	Recon
X	Drilling
	Pre-Development
	Other

COST ESTIMATE & APPROPRIATION REQUEST

		Approvals: Dist. Geol.	Approvals: West. U.S.
Current Yr. Orig. Budget	$600,000	[illegible]	[illegible]
Current Yr. Add. Request @ _____	$		
Current Yr. Add. Request @ _____	$		
New Total	$		

OBJECTIVE: Confirmation and testing of qtz-sulfide vein system (of A-8 type) with two deviation holes, and completion of drill road to south for further testing; by Dec. 31, 1981 at a cost not to exceed $600,000.

Progress for the Month of _____

PLANNED TASKS	RESPONSIBILITY/TIME TO COMPLETE	TARGET DATE	% COMPLETE	PROGRESS TO DATE
1) Split and assay A-14.	JDS & SAC/1 week	6-15-81		
2) Complete drill hole summary of A-13 and A-14.	JDS/3 weeks	7-1-81		
3) Drill A-12, deviation to south, from A-11 hole; to determine dip of previously found vein system (A-9, A-11). Complete drill hole summary.	JDS, TCB, & Joy Drilling & Navi-drill company/ 8-9 months	9-15-81		
4) Start deviated hole to north, from hole A-11, to determine dip of previously found vein system (A-9, A-11).	JDS, TCB, Joy & Navi-drill/3 months	12-31-81		
5) Complete road to the southwest from A-10 pad (3/4 mile).	JDS & P.Bryant Constr./ 6 weeks	12-15-81		
6) Status report for Superior East.	JDS/3 weeks	12-31-81		

June 81

ASARCO

Southwestern Exploration Division

June 18, 1981

TO: W. D. Payne

FROM: J. D. Sell

Oriented Core
Hole A-12
Superior East Project
Pinal County, Arizona

In order to secure a better evaluation on the strike and dip of the quartz-sulfide veins found at Superior East (A-8 type), it was suggested that oriented core be secured from the hole presently being drilled, i.e., hole A-12.

The hole was being directionally controlled using a Navi-drill machine (Christensen Dia-Min Tools, Inc.). The Navi-drill was in use when the oxide-sulfide interface was penetrated and some 47 feet of sulfides were penetrated before the Navi-drill was terminated at a depth of 4217 feet.

The oriented core barrel assembly had been put on "stand-by" several weeks before this point and was immediately asked for from Salt Lake City. However, the core rig resumed coring in order to secure a good hole and to check on the sulfide content while waiting for the assembly and engineer. The hole progressed by conventional coring to a depth of 4343 feet before the orienting assembly was on site.

The oriented core runs and status are as follows:

Core Run	Feet	Status
4343-4347	4	Broken ground; camera misfunction
4347-4352	5	Cleaning hole; no camera
4352-4352½	½	No usable core or picture
4352½-4360	7½	Usable pictures
4360-4365	5	Usable pictures
4365-4375	10	Usable pictures
	32 feet	

The bulk of the mineralization and alteration was above a fault zone (4345'-4349') dipping 70°-80° to core axis. Below are only thin quartz-sulfide veins and a steep schistosity component. Unfortunately the only usable oriented core with pictures is below the fault zone.

Mr. Wally Anderson, orienting core engineer, and Mr. Jonathan S. Hermance, Western Regional Manager, both with Christensen Dia-Min Tools, Inc., secured the core, read the film, and did most of the core readings using a Model 76 Goniometer.

Using representative core, the following points were determined:

Core Footage	Feature	Strike and Dip*
4354	Schistosity	N86°E ; 58°S
4356	Schistosity	N80°E ; 48°S
4356	1/8" qsv	N78°E ; 44°S
4361	1/16" qsv	N84°E ; 38°S
4367**	1/16" qsv	N14°E ; 49°W
4367**	schistosity	N8°E ; 81°W
4369***	1/16" qsv	N87°W ; 30°S
4369***	schistosity	N88°W ; 62°S

Two other qsv were noted in non-oriented core runs and we assumed an east-west striking schistosity to be valid, with a southerly dip. When this was used, the following readings were determined.

4406	1/4" qsv	N56°W ; 36°S
4407	1/4" qsv	N75°W ; 40°S

*Readings have been corrected for declination; true N readings.

**This film reading was judged to be unreliable by Anderson and Hermance.

***Using the film reading at 4369 feet, the same two features of 4367 were re-read with the above results.

The last two determinations (4406 & 4407) are not valid, since the core was not scribed for orientation, but were read for the experience and a means of partial evaluation using the assumptions stated, that is, the schistosity direction and hole bearing. In other areas, any consistent direction such as bedding could be used for the first approximation.

Evaluation of the above data suggests we are dealing with a mineralized system which is trending northeasterly and dipping to the south. Caution must be used as these narrow veins are not the type found in A-8 and may not represent the true direction. In other holes we have noted the smaller veins at essentially right angles to the master veins as now interpreted. It is anticipated that some of the other core will be looked at with the assumption that the schistosity trends east-west. Hole surveys allow the remaining parameters to be calculated.

Costs incurred by Christensen are as follows:

10' Non-magnetic core bbl complete with multishot instruments	$ 525.00
2 - NXBWL Non-magnetic drill rods @ $30.00	60.00
Change over-sub	30.00
Milne Freight Lines (from SLC)	112.66
NXC3 core bit*	699.00
American Airlines Freight (SLC)	33.00
Reaming shell sub (plain)**	57.75
Frontier Air Bill (SLC)	23.00
Service Engineer charges @ $350.00/day	700.00
Service Engineer mileage (200 miles @ $0.55)	110.00
Plus Ariz. Sales Tax where applicable	
Estimated Total	$2,350.41

Average cost per foot as estimated $73.45

*Rebate to Asarco on cut-out of diamonds is to be credited at a future date.

**Reaming shell probably has no salvage value and is unusable on present coring equipment. The shell is being held by W.D.Anderson in the event that further Asarco orienting use may be possible in the near future.

The core orienting log data of the multishot instrument and the film have been placed in the short report - hole survey file of A-12.

James D. Sell

James D. Sell

JDS:lb

SUBJECT
MODEL 76 GONIOMETER OPERATING INSTRUCTIONS

DATE 10/12/77

APPROVED Jon Hernandez

To visually confirm Goniometer settings, the base with the large scale should be aligned with North and placed on a stable level surface.

1. Remove the outer strike and dip direction ring. Select plastic inserts to match the core size.

2. Rotate the core holder to set "Drift Direction" of the hole.

3. Set the hole or "Drift Angle" on the protractor mounted at the side of the core holder.

4. Align the short bent end of the drift angle pointer to the small top scale, with the same reading indicated directly below on the large scale.

5. To position the "Orienting Lug" rotate the double ended pointer over the small top scale to the specified asimuth reading.

6. Place the core in the core holder. Position the Master Scribe on the core in line with the double ended pointer. Clamp the core in position.

   THE CORE IS NOW IN A RELATIVE INSITU POSITION.....

7. Place the outer strike and dip direction ring back in position.

8. Rotate and angle the sighting ring so that it appears to be a parallel extension of the planar feature to be examined.

9. Read the "Strike" of the feature at the appropriate pointer located in a northern quadrant on the base ring.

10. Read "Dip Direction" at the appropriate pointer on the base ring.

11. Read "Dip Angle" on the protractor mounted at the side of the outer strike and dip direction ring.

ASARCO Southwestern Exploration Division

June 26, 1981

To: W. D. Payne

From: J. D. Sell

Goniometer Readings
Superior East Project Core
Pinal County, AZ

After taking the oriented core in hole A-12, which indicated a southerly dip to the mineralized narrow veins, it was discussed that the other holes in the area could also provide some data on the problem (Memo of June 18, 1981).

As the goniometer was available, it was used in the determinations. The basic assumption made was that the schistosity had an east-west strike and a dip to the south. The schistosity readings on the oriented core had an average strike of N 84° E with a southerly dip. The bearing of the hole involved was estimated from the hole surveys available.

In general, only split core was available for the new reading, and a wide diversity in the inclinations of the schistosity was evident. The following observations were made:

Hole Number	Depth	Indicated Dip Direction	Feature Observed In or Adjacent To Schist
A-12	4395	Southerly	one foot qs vein contact
A-12	4556½	88°N	¼" py-cp vein
A-12	4557	Southerly	qtz-sericite band, basal contact
A-12	4598	Southerly	porphyry breccia basal contact
A-8	4252	Southerly	hi-grade vein
A-8	4353	88°N	hi-grade stringer
A-8	4607	Steep South	2" injection of bf porphyry & qtz
A-9	4139	45°N	alteration band contact
A-9	4270	45°S	1/8" cc-bn vein
A-9	4496	Southerly	¼" py-cp vein
A-9	4800	Steep NE	½" py-cp vein
A-10	3965	Steep S	altered band contact (subparallel to schistosity)
A-10	4014	V. Steep NE	aplite contact
A-10	4445	Flattish S	aplite injection
A-11	4391	Steep S	alteration band contact
A-11	4499	Steep S	top bf porphyry contact
A-11	4556	Steep S	alteration and thin mineral vein
A-11	4768	Steep S	alteration cutting steep schistosity
A-13	4083	Vertical	lower bf porphyry contact
A-13	4270	Steep S	bf porphyry contact, near base
A-14	4214	Vertical	intrusive bfp contact
A-14	4360	V. Steep S	bfp-quartz contact
A-14	4433	Steep S	alteration band
A-14	5160	Southerly	porphyry-quartz contact
AI-2	3600	Vertical	leached alteration band subparallel to schistosity

The readings had a component to the west and east of south, but for recording purposes only the dominant direction was recorded.

The study is highly indicative that the mineralization, alteration bands, and the various porphyries all have a dominant dip to the south, although as noted, some dip vertically or steeply north. (Only one, A-9 and 4139 foot depth, indicated a flattish north dip component.)

A note of caution must be made in that no true orientation of the above observations were available. If some of the schistosities are not in the assumed east-west orientations, then the above observations may be subjected to a large and variable correction.

James D. Sell

James D. Sell

JDS:sk
Attach. Core Orienting Log
Model 76 Goniometer Operating Instructions

CORE ORIENTING LOG

Page 1 One of One

WELL INFORMATION

Company: ASARCO Incorporated
Contractor:
Well Name: Superior East Holes
County: Pinal State: Az
Hole Size: Core Barrel:
Formation Name:
Formation Description:

PERFORMANCE

Interval Cored: Finish
Start
Footage Cored:
Remarks: Note: Orientation based on assumption that all schistosity strikes east-west and dips southerly. Split core.

MULTISHOT INSTRUMENT

Make:
Serial No.
Clock Interval: Min.
Station Record By:
Film Read By:

CORRECTIONS

Declination 13 Degrees ☒ East ☐ West

Azimuth Correction for Declination
East Declination ☒ Add to Azimuth
West Declination ☐ Subtract from Azimuth

Reference Groove Correction:
From Above, Groove is Degrees ☐ Right ☐ Left of Orientation Lug.
☐ Right Add to Lug Azimuth
☐ Left Subtract from Lug Azimuth

STATION				Hole DRIFT (from Surveys)			ORIENTATION							DIP, STRIKE			REMARKS
No.	Time Hole Number	Picture No.	Depth (Feet)	Angle	Direction Magnetic	Direction True	Orienting Lug, Magnetic Direction	Orienting Lug, Magnetic Azimuth	Declin. Corr.	Or. Lug Az. True	Reference Groove Corr.	Reference Groove Az. True	Reference Groove Direction True	Dip Dir.	Dip Angle	Strike	
	A-12		4395	14	S20°E	S7°E	Note: These observations made on split core, non-oriented except for the assumption that the schistosity strikes east-west and dips southerly. This point is the equivalent of point #6 on the Model 70 Goniometer Operating Instruction (Attached). All observed features were in contact with schist.									Southerly	One-foot gtz-sulf. vein
	A-12		4556½	14	S20°E	S7E										88°N	¼" py-cp vein
	A-12		4557	14	S20°E	S7E										Southerly	gtz-sericit band, lose
	A-12		4598	14	S20E	S7E										Southerly	Porphyry-bx basal contact
	A-8		4252	2	N22E	N35E										Southerly	Hi-grade vein cotn.
	A-8		4353	3	N13E	N26E										88° N	Hi-grade stringers"
	A-8		4607	5	N5E	N18E										Steep South	Narrow btp-gtz
	A-9		4139	4¾	S69W	S82W										45°N.	alteration band
	A-9		4270	5½	N65W	N52W										45°South	⅛" cc-bn vein
	A-9		4496	9¾	N42W	N29W										Southerly	¼" py-cp vein
	A-9		4800	13¼	N32W	N19W										Steep N	⅛" py-cp vein
	A-10		3965	6¼	S68W	S81W										Steep South	alter band, subparallel slist
	A-10		4014	6½	S70W	S83W										V. Steep N	aplite contact
	A-10		4445	7	S75W	S88W										flattish South	thin aplite dike
	A-11		4391	7	N46W	N33W										Steep South	alter. band, subparallel slist
	A-11		4499	7¾	N40W	N27W										Steep South	top of bt porphyry
	A-11		4556	7½	N42W	N29W										Steep South	alteration + mineral vn.
	A-11		4768	7¾	N39W	N26W										Steep South	alter. cutting steep slist
	A-13		4083	9	N43W	N30W										Vert. to 88S.	Lower btp contact
	A-13		4270	9¼	N38W	N25W										Steep South	btp contact, near base.
	A-14		4214	1	S31W	S44W										Vert. to N.	Intrusive btp cont.
	A-14		4360	1	S80W	N87W										Near Vertical South	btp-gtz contact
	A-14		4433	1½	N80W	N67W										Steep South	alteration band
	A-14		5160	6¾	N47W	N34W										Southerly	Porphyry-gtz contact
	Rawhide Project																
	AI-2		3600	20	N45W	N32W										V. Steep South to Vertical	Leached alteration band subparallel to schistosity
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18

SD255 10-67 R1

CUSTOMER COPY

SUBJECT

MODEL 76 GONIOMETER OPERATING INSTRUCTIONS

DATE 10/12/77

APPROVED Jon Hernandez

To visually confirm Goniometer settings, the base with the large scale should be aligned with North and placed on a stable level surface.

1. Remove the outer strike and dip direction ring. Select plastic inserts to match the core size.

2. Rotate the core holder to set "Drift Direction" of the hole.

3. Set the hole or "Drift Angle" on the protractor mounted at the side of the core holder.

4. Align the short bent end of the drift angle pointer to the small top scale, with the same reading indicated directly below on the large scale.

5. To position the "Orienting Lug" rotate the double ended pointer over the small top scale to the specified asimuth reading.

6. Place the core in the core holder. Position the Master Scribe on the core in line with the double ended pointer. Clamp the core in position.

   THE CORE IS NOW IN A RELATIVE INSITU POSITION.....

7. Place the outer strike and dip direction ring back in position.

8. Rotate and angle the sighting ring so that it appears to be a parallel extension of the planar feature to be examined.

9. Read the "Strike" of the feature at the appropriate pointer located in a northern quadrant on the base ring.

10. Read "Dip Direction" at the appropriate pointer on the base ring.

11. Read "Dip Angle" on the protractor mounted at the side of the outer strike and dip direction ring.

ANNUAL PROJECT PLANNING SHEET

DISTRICT: Southwest
PROJECT NAME: Superior East
PROJECT NUMBER: 0010
PROJECT SUPERVISOR: J.D.Sell
PROJECT GEOLOGIST: J.D.Sell
PREPARED BY/DATE: JDS/6-3-81

EXPENDITURES

1. Month of 7/81 $33,000
2. Current Year Expenses to Date thru 7/81 $363,000
3. Budget for Current Year 1981 $ 600,000
4. Thru previous year, since project began $2,992,124

TYPE OF PROJECT

	Recon
X	Drilling
	Pre-Development
	Other

COST ESTIMATE & APPROPRIATION REQUEST

		Approvals: Dist. Geol.	Approvals: West. U.S.
Current Yr. Orig. Budget	$600,000	[illegible]	[illegible]
Current Yr. Add. Request @ ____	$		
Current Yr. Add. Request @ ____	$		
New Total	$		

OBJECTIVE: Confirmation and testing of qtz-sulfide vein system (of A-8 type) with two deviation holes, and completion of drill road to south for further testing; by Dec. 31, 1981 at a cost not to exceed $600,000.

Progress for the Month of July 1981

PLANNED TASKS	RESPONSIBILITY/TIME TO COMPLETE	TARGET DATE	% COMPLETE	PROGRESS TO DATE
1) Split and assay A-14.	JDS & SAC/1 week	6-15-81	100%	
2) Complete drill hole summary of A-13 and A-14.	JDS/3 weeks	7-1-81	100%	
3) Drill A-12, deviation to south, from A-11 hole; to determine dip of previously found vein system (A-9, A-11). Complete drill hole summary.	JDS, TCB, & Joy Drilling & Navi-drill company/ 8-9 months	9-15-81	Continued Coring	Partially Navi-drilled sulfide zone, plus oriented core study core not split; of core split have weighted average of 456' @ 0.95% copper (ie, total sulfide intercept ±4170-4705 or 535 feet of similar grade. Additional samples below (to 5083) suggest mixed high and low values; probably overall lower than above average. Presently drilling below 5083 to intercept system indicated in A-11.
4) Start deviated hole to north, from hole A-11, to determine dip of previously found vein system (A-9, A-11).	JDS, TCB, Joy & Navi-drill/3 months	12-31-81	See June	
5) Complete road to the southwest from A-10 pad (3/4 mile).	JDS & P.Bryant Constr./ 6 weeks	12-15-81		
6) Status report for Superior East.	JDS/3 weeks	12-31-81		

ASARCO MONTHLY DRILLING SUMMARY

DISTRICT Southwestern US

Project Superior East & Rawhide Project No. EA-0010 EA-0041 State Arizona County Pinal Month July Year 1981 Page 1

Hole No.	Collar location	Bearing	Dip	Footage drilled From	Footage drilled To	Footage drilled Feet	Remarks (significant intersections, geology and/or assay intervals, etc.)
S.E. A-12	Navi-drilled hole from A-8; AzCentral 846,600N; 744,150E	Southerly	8-12°	4666	5085	419	Presently drilling in Pinal Schist. Oxide/sulfide interface cut during Navi-drilling (±4170') has weighted average of 456' @ 0.95% copper to 4705' (535' actual feet including Navi-drill and oriented core which was not sampled and/or split.
S.E. A-13	Az Central 845,800N 775,600E	Vertical			4663 TD		Previously drilled. Best intercept: 3637-4029' or 392' @ 0.67% copper. Graphic log and assay result memo in press and drafting. Pinal Schist and Laramide monzonite bedrock.
S.E. A-14	Az Central 847,200N 773,500E	Vertical			5738 TD		Previously drilled. Sulfide assays start 4096'; have 53' @ 0.53%, then 99' @ 0.25%, then 21' @ 1.20% copper (or 173' @ 0.45%) ending 4269'; interpreted to be lower end of qsv system. T.D. @ 5738'. Graphic log and assay result memo now in press and drafting.
Rawhide AI-2	Az Central 846,500N 777,600E	Vertical			3612 TD		Previously drilled. Best intercept: 2850-3160' or 310' @ 0.37% copper. Graphic log and assay results memo in press and drafting. Pinal Schist bedrock.

WDP - MVK 5266

Note to Lockhart from Ben Greene,
Magma Copper Co drill hole at
Hackberry Canal, JI Ranch. 7/15/81

33' of 7" ID pipe
1430' of 3" ID pipe — water cemented at 130'.
2219' of NX casing.
3020' T.D.

901' of NX drill steel in hole.
97' of AX (?) rod on top of drill steel.

ASARCO

Exploration Department
Southwestern United States Division

July 29, 1981

Mr. Odell Power
Route 1, Box 732
Miami, Arizona 85539

Dear Sir:

As verbally expressed to you on 7/25/81, I would agree that hole A-12 should be reduced from NX to BX to alleviate the hole conditions of the near past and now present. The actual point of reduction and the means, i.e., casing or drilling thru the NX bit, are left as your decision.

At least 300 feet more core, i.e. 5400 feet depth, should be cut, examined, and assayed by Asarco and depending upon the results the hole may be continued to some unspecified point.

Mr. Otto Mollen-hauer has been notified to contact you about a quick survey for our knowledge of the hole. Note also that Mr. Mollen-hauer should be contacted when the terminal depth of the hole is known so that he can make a final survey.

At present, we want also to recore a portion of the hole which was Navi-Drilled. I suggest a wedge be placed around 4100-foot depth and core taken to 4400-foot depth. The wedge orientation is of no consequence. Hopefully the wedge hole will not get back into the old hole. Mr. Mollen-hauer may again be asked to survey the wedge hole before hole A-12 is abandoned, so check for Asarco's decision.

Please notify Dr. W. D. Payne, Manager of SW Exploration, Tucson, ph. 792-3010, as to thoughts, ideas, changes, etc. concerning hole A-12 activities.

Sincerely,

James D. Sell

James D. Sell

JDS:lb

cc: JLloyd, Joy Mgr., Tucson
WLKurtz)
WDPayne)
TCBenavidez

Blind note to WLK & WDP: Mr. Power has been asked to look at the core and if "purple streaks" are noted, i.e. bornite-chalcocite, he is to notify this office.

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

ASARCO

Southwestern Exploration Division

August 5, 1981

RECEIVED
SEP 24 1981
S. W. U. S. EXPL. DIV.

TO: W. D. Payne

FROM: J. D. Sell

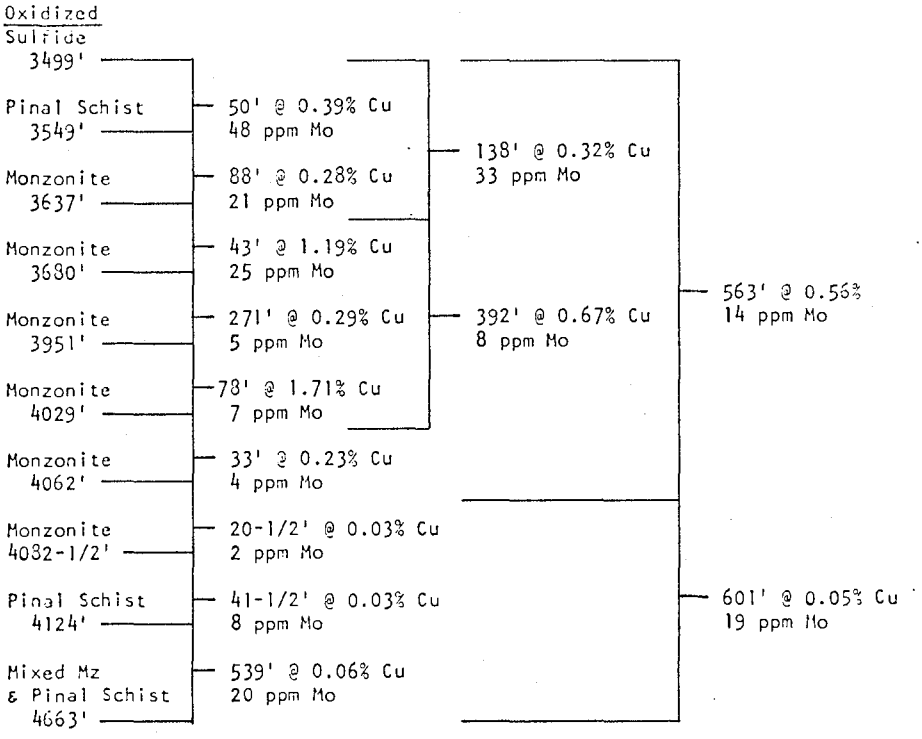
Assay Results
Drill Hole A-13
Superior East Project
Pinal County, Arizona

I hereby attach and report on the assay values from the drill core of hole A-13.

A-13 was drilled as a step-out hole and is located slightly over 1600 feet southeast of drill hole A-8 (the discovery hole in this area). Values determined were copper-moly throughout the hole with scattered gold-silver values.

The oxidized leached capping-sulfide interface was penetrated at a depth of 3499 feet. The bedrock unit is initially Precambrian Pinal Schist and at a depth of 3549 feet Laramide monzonite was encountered. The best values, as chalcocite, some bornite, and chalcopyrite, are found in quartz sulfide veins having a variable selvage of quartz-sericite with disseminated mineralizations.

One grouping of values follows:



As noted above, the best values are in monzonite.

The general pattern of values is similar to that of the A-8 sequence, that is, copper values in steeply dipping quartz-sericite bands cutting the host rock with a better contained zone followed by a sharp drop off of values with depth. This rapid drop off was within the monzonite and remained in the low range as schist and mixed monzonite-schist were encountered.

Initial interpretation of the A-13 intercept is that the mineralized zone cut is composed of several high grade zones within a general moderately mineralized zone of quartz-sericite banding with or without a central and/or border zone of vein or stringer ore minerals and often containing disseminated values of ore minerals.

The zone is interpretated to have a southerly dip and a probable northeasterly strike similar to that interpreted for the A-8 area. The copper to moly ratio, having a value of 400 in the main zone, is comparable to that found in A-8, A-9 and A-11.

The main zone (3637'-4029'; 392') also has a weighted average of 0.12 oz/T. of silver and 0.0008 oz/T. of gold.

Attachments of the rock type-assay number-values and assay sheets are attached.

James D. Sell

James D. Sell

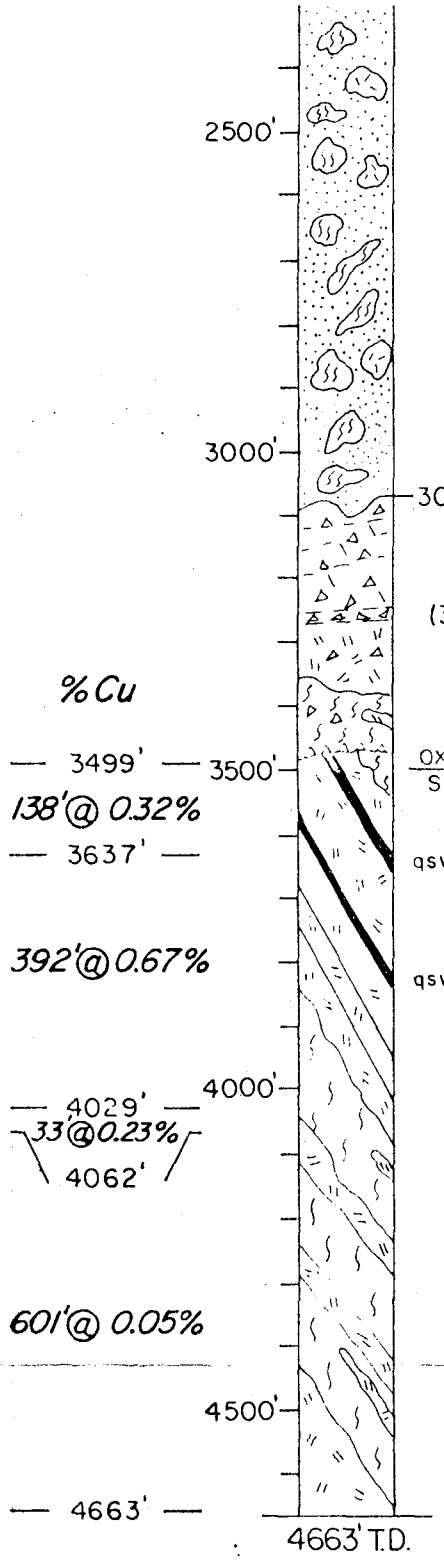
JDS:rr
Atts: Assays
Attachment, Graphic Log & Assay Results, File #2486-Q

UNIT	ASSAY NUMBER	FOOTAGE	FEET	% Cu	Mo PPM	
Pinal Schist	102	3456-3465	9	0.02	20	
"	103	3465-3471	6	0.09	20	
"	104	3471-3487	16	0.03	10	
"	105	3487-3490	3	0.15	10	
"	106	3490-3499	9	0.20	10	
		Oxidized				
		Sulfide				
"		3499-3510	11	0.44	79	
"		3510-3519	9	0.32	49	
"		3519-3529	10	0.38	14	
"		3529-3535	6	0.57	14	
"		3535-3540	5	0.84	66	qsv bx
Pinal Schist		3540-3549	9	0.06	60	
Monzonite		3549-3554	5	0.87	87	qsv
"		3554-3562	8	0.05	10	
"		3562-3564	2	1.00	44	qsv
"		3564-3579	15	0.21	12	
"		3579-3585	6	0.18	50	
"		3585-3589	4	0.64	19	qsv
"		3589-3602	13	0.10	12	
"		3602-3606	4	0.28	24	
"		3606-3618	12	0.42	10	
"		3618-3625	7	0.27	15	
"		3625-3637	12	0.13	19	
"		3637-3650	13	1.62	27	qsv
Monzonite		3650-3660	10	1.24	49	qsv
Monzonite	---	3660-3670	10	0.16	9	bx
"	---	3670-3676	6	1.04	43	qsv bx
"	1	3676-3680	4	2.45	64	qsv
"	2	3680-3690	10	0.32	19	qsv
"	3	3690-3700	10	0.83	9	qsv
"	4	3700-3705	5	0.57	2	
"	5	3705-3715	10	0.03	1	
"	6	3715-3725	10	0.48	2	
"	7	3725-3735	10	0.09	5	
"	8	3735-3749	14	0.08	6	
"	9	3749-3751	2	2.60	9	qsv
"	10	3751-3761	10	0.31	2	
"	11	3761-3771	10	0.05	2	
"	12	3771-3781	10	0.06	1	
"	13	3781-3791	10	0.47	13	
"	14	3791-3800	9	0.08	3	
"	15	3800-3810	10	0.07	4	
"	16	3810-3820	10	0.04	3	
"	17	3820-3830	10	1.37	8	qsv bx
"	18	3830-3840	10	0.16	2	
"	19	3840-3850	10	0.63	3	qsv
"	20	3850-3860	10	0.25	7	
"	21	3860-3870	10	0.07	3	
"	22	3870-3880	10	0.14	1	
Monzonite	23	3880-3890	10	0.12	4	

UNIT	ASSAY NUMBER	FOOTAGE	FEET	% Cu	Mo PPM	
Monzonite	24	3890-3900	10	0.04	3	qv
"	25	3900-3910	10	0.22	10	
"	26	3910-3914	4	0.32	2	qsv
"	27	3914-3919	5	0.53	15	qsv
"	28	3919-3930	11	0.06	10	
"	29	3930-3940	10	0.10	8	
"	30	3940-3951	11	0.40	2	
"	31	3951-3957	6	0.92	2	qsv
"	32	3957-3962-1/2	5-1/2	8.65	23	qsv bx
"	---	3962-1/2-3965	2-1/2	4.00	15	qsv bx
		No core recovered, probably			assigned	
"	33	3965-3975	10	0.57	4	qsv bx
"	34	3975-3983	8	0.65	3	qsv bx
"	35	3983-3987	4	5.20	7	qsv
"	36	3987-3992	5	3.05	6	qsv
"	37	3992-4001	9	0.37	8	
"	38	4001-4006	5	0.96	11	qsv
"	39	4006-4012-1/2	6-1/2	0.77	10	qsv bx
"	40	4012-1/2-4019	6-1/2	0.82	3	qsv
"	41	4019-4029	10	0.45	2	
"	42	4029-4035	6	0.07	2	
"	43	4035-4040	5	0.38	1	
"	---	4040-4048	8	0.39	1	
"	44	4048-4062	14	0.16	8	
"	45	4062-4072	10	0.04	3	
Monzonite	46	4072-4082-1/2	10-1/2	0.03	2	
Pinal Schist	47	4082-1/2-4093	10-1/2	0.03	10	
"	48	4093-4102	9	0.02	12	
"	49	4102-4111	9	0.03	10	
"	50	4111-4124	13	0.05	3	
Monzonite	51	4124-4128	4	0.01	15	
Pinal Schist	52	4128-4137	9	0.03	8	
"	53	4137-4146	9	0.08	5	
"	54	4146-4156	10	0.06	3	qv
"	55	4156-4166	10	0.05	2	qv
"	56	4166-4174	8	0.07	4	
"	57	4174-4177	3	0.23	12	
"	58	4177-4187	10	0.09	10	
"	59	4187-4197	10	0.08	18	
"	60	4197-4202	5	0.02	11	
"	61	4202-4211	9	0.04	5	
"	62	4211-4217	6	0.02	5	
"	63	4217-4224	7	0.10	15	
Pinal Schist	64	4224-4234	10	0.08	35	
Monzonite	65	4234-4241-1/2	7-1/2	0.02	8	
"	66	4241-1/2-4251	9-1/2	0.06	3	
"	67	4251-4260	9	0.42	3	
"	68	4260-4269	9	0.13	6	
Monzonite	69	4269-4275-1/2	6-1/2	0.09	6	

UNIT	ASSAY NUMBER	FOOTAGE	FEET	% Cu	Mo PPM	
Pinal Schist	70	4275-1/2-4284-1/2	9	0.15	4	
"	71	4284-1/2-4293-1/2	9	0.06	9	
"	72	4293-1/2-4303	9-1/2	0.19	12	
"	73	4303-4308-1/2	5-1/2	0.03	2	
"	74	4308-1/2-4316-1/2	8	0.05	1	qv
"	75	4316-1/2-4326	9-1/2	0.04	44	
"	76	4326-4336	10	0.07	42	qv
"	77	4336-4346	10	0.03	74	
"	78	4346-4354	8	0.05	42	
"	79	4354-4360	6	0.05	22	
"	80	4360-4370	10	0.03	15	
"	81	4370-4375	5	0.03	28	
"	82	4375-4385	10	0.02	29	
Pinal Schist	83	4385-4392	7	0.06	9	qv
Monzonite	84	4392-4394-1/2	2-1/2	0.01	21	
Pinal Schist	85	4394-1/2-4398	3-1/2	0.03	17	
"	86	4398-4403	5	0.03	29	
"	87	4403-4411	8	0.01	12	
Pinal Schist	88	4411-4419	8	0.01	26	qv
Monzonite	---	4419-4422-1/2	3-1/2	0.04	38	qv
"		4422-1/2-4431	8-1/2	0.03	16	qv
"		4431-4439	8	0.02	36	
Monzonite		4439-4445-1/2	6-1/2	0.01	9	
Pinal Schist		4445-1/2-4452-1/2	7	0.07	24	
Monzonite		4452-1/2-4462-1/2	10	0.02	102	
Monzonite		4462-1/2-4469-1/2	7	0.03	19	
Pinal Schist		4469-1/2-4476	6-1/2	0.27	25	qv
"		4476-4483	7	0.01	72	qv
"		4483-4487	4	0.06	16	
"		4487-4492	5	0.05	43	
"		4492-4502	10	0.06	11	
"		4502-4504	2	0.05	10	
		Poor core recovery, value assigned				
Pinal Schist		4504-4510	6	0.05	20	
Monzonite		4510-4518	8	0.06	27	
Monzonite		4518-4523	5	0.02	24	
Monzonite		4523-4532	9	0.01	31	

UNIT	ASSAY NUMBER	FOOTAGE	FEET	% Cu	Mo PPM	
Pinal Schist		4532-4538	6	0.02	12	
Pinal Schist		4538-4545	7	0.03	11	
Monzonite	---	4545-4547	2	0.02	14	
Pinal Schist	89	4547-4555	8	0.03	18	qv
"	90	4555-4563	8	0.02	34	
"	91	4563-4573	10	0.02	29	
"	92	4573-4580	7	0.02	15	
"	93	4580-4590	10	0.04	12	qv
"	94	4590-4599	9	0.03	17	
"	95	4599-4609	10	0.02	15	
"	96	4609-4619	10	0.03	12	
"	97	4619-4627	8	0.02	35	qv
"	98	4627-4637	10	0.05	15	
"	99	4637-4647	10	0.03	7	
Pinal Schist	100	4647-4650	3	0.04	51	
Monzonite	101	4650-4654	4	0.04	9	
Monzonite	Not Split	4654-4656 Assay assigned	2	0.04	9	
Monzonite		4656-4663	7	0.04	9	
		No core recovered-assigned T. D.				



2036'-2070' M : 35 %, med. dark brown, reddish cast.
ACP: 65 %; 100 sc

2070'-2285' M : 21 %, green grey to green brown.
ACP: 79 %; 88 sc, 12 db

2285'-2600' M : 15 %, med. brown to green brown.
ACP: 85 %; 70 sc, 28 db, 2 p€ sed.

2600'-3071' M : 20 %, red brown.
ACP: 80 %; 95 sc, 5 db

3071' **A-2 TYPE SLIDE BLOCK** of Pinal Schist cut by high angled qtz-seri bands w/1-2 % hematite limonite w/numerous flattish breccia & gouge zones throughout.

(3242'-3260') Flattish breccia-gouge; possibly basal fault zone.

PINAL SCHIST & MONZONITE, broken brecciated & gougy to 3471; but all cut by variable quartz-sericite-sulfide (or oxidized) bands in overall strong quartz-sericite alteration. Bands & breccia zones generally at steep, + 60° angle to core axis.

OXIDIZED / SULFIDE 3499'

Quartz-sulfide veins & breccias.

% Cu

— 3499' —

138' @ 0.32%

— 3637' —

392' @ 0.67%

— 4029' —

33' @ 0.23%

4062'

601' @ 0.05%

— 4663' —

NOTE : Individual assays are found in Assay Report dated Aug. 5, 1981.

T. 1 S. R. 13 E.

SW 1/4 SW 1/4 SE 1/4 SW 1/4 of Sec. 23

GRAPHIC LOG & ASSAY RESULTS of DRILL HOLE A-13

SUPERIOR EAST PROJECT

ASARCO

Southwestern Exploration Division

August 10, 1981

RECEIVED

SEP 24 1981

S. W. U. S. EXPL. DIV.

TO: W. D. Payne

FROM: J. D. Sell

Assay Results
Drill Hole A-14
Superior East Project
Pinal County, Arizona

Drill hole A-14 was scheduled to be an offset of hole A-8 and located some 700 feet to the northwest. At the time of scheduling, the quartz-sulfide vein system found in A-8 was interpreted to dip to the northwest and, thus, A-14 would test the deep extension of the system.

As the graphic log and assay reports indicate, the typical qsv type alteration and mineralization were found in the oxidized capping. The sulfide zone, 53 feet of 0.53% copper in quartz-sulfide veins and breccia, was cut before the alteration and values diminished to 0.28% copper for ~~125~~ feet, then a 21 foot qsv zone of 1.20% copper, followed below by values less than 0.10% copper.

Scattered sampling was undertaken and the quartz-sericite-mineral bands cut below generally did not average above 0.50% copper in a background of less than 0.10% copper to the hole at 5738 feet. Moly values are around 0.002% Mo, gold around 0.001 oz/T., and silver slightly above 0.02 oz/T.

Subsequent to the drilling of A-14, we have drilled A-12 and taken oriented core in a portion of the hole. The results indicate that the qsv system elements have a north-northeasterly strike and dip to the south. Using an assumption as to the orientation of the schistosity, further studies of core from other holes, including A-14, also suggest a southerly dip to the mineralized structures.

Based on the above, we may interpret that below the basal fault at 4006-4015 feet, the quartz-sulfide vein system was oxidized and leached to the depth of 4096 feet. In the non-oxidized portion, the qsv type was cut to the depth of 4149 feet, before passing into low grade values.

This same sequence of passing from +0.8% copper values into a short zone of ± 0.25%, then into values below 0.10%, has been noted in each of the holes of the area which penetrated a quartz-sulfide system.

To test the qsv system nicked in A-14 it will be necessary to deviate a hole to the south, then attain a near vertical to the north dipping component, and drill through the section of interest.

Attached are the assay-footage sheets with rock type, qsv, and interval notations; the assay sheets; and a graphic log of the hole.

James D. Sell

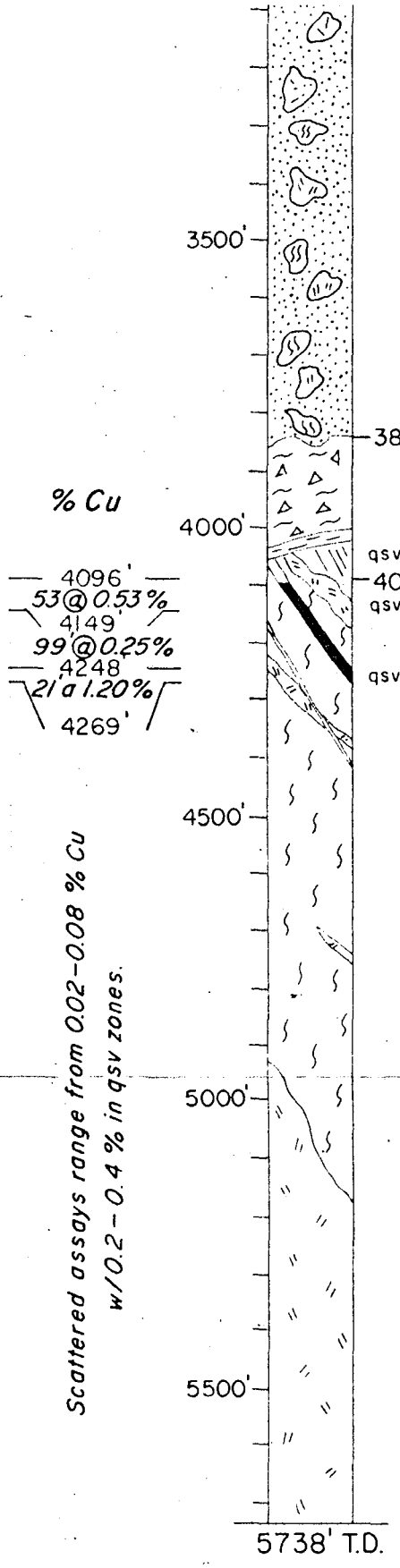
JDS:rr
Atts: Assay Sheets
Graphic Log #2486 - R

UNIT	ASSAY NUMBER	FOOTAGE	FEET	% Cu		
Pi	9	4076-4086	10	0.01		qsv
Pi	10	4086-4096	10	0.08		qs
	Oxidized / Sulfide					
Pi	11	4096-4106	10	0.34		qs
Pi	12	4106-4113	7	0.77		qsv bx
Pi	13	4113-4123	10	0.95		qsv
Pi	14	4123-4130	7	0.34	53' @ 0.53% Cu	qs
Tp	15	4130-4140	10	0.30		qs
Tp	16	4140-4149	9	0.50		qsv
Tp	17	4149-4159	10	0.22		
Tp	18	4159-4166	7	0.09		
Tp	19	4166-4172	6	0.29		
Pi	20	4172-4180	8	0.30		
Pi	21	4180-4190	10	0.22		
Pi	22	4190-4201	11	0.22		qv
Tp	23	4201-4207	6	0.25	99' @ 0.28% Cu	
Tp	24	4207-4213	6	0.27		
Pi	25	4213-4220	7	0.31		
Pi	26	4220-4228	8	0.32		
Tp	27	4228-4232	4	0.22		
Pi	28	4232-4240	8	0.26		
Pi	29	4240-4248	8	0.28		
Tp	30	4248-4252	7	0.82		qs bx
Tp	31	4252-4262	10	0.16	21' @ 1.20% Cu	qs
Tp	32	4262-4269	7	2.90		qsv
Pi	33	4269-4278	9	0.14		
Pi	34	4278-4287	9	0.07		
Pi	35	4287-4296	9	0.07		
Pi	36	4296-4305	9	0.07		
Pi	1	4305-4307	2	0.21	68' @ 0.07% Cu	qsv
Pi	2	4307-4310	3	0.07		
Pi	37	4310-4321	11	0.04		
Pi	38	4321-4329	8	0.05		
Pi	39	4329-4337	8	0.05		
Note: 4337-4373 36' interval was not sampled. Assigned average grade of 0.07 equivalent to interval section.						
Pi	40	4373-4381	8	0.05		
Pi	41	4381-4390	9	0.06	- 35' @ 0.07% Cu	
Pi	42	4390-4400	10	0.07		
Pi	43	4400-4408	8	0.12		qsv
Pi	44	4408-4409	1	2.10		qsv
Pi	45	4409-4414	5	0.34	-6' @ 0.63% Cu	qsv
Pi	46	4414-4420	6	0.03		
Pi	47	4420-4428	8	0.05	-14' @ 0.04% Cu	
Note: 4428-4656 228' interval not sampled. Assigned average grade of 0.05 based on visual inspection.						
Pi	3	4656-4662	6	0.08		
Note: 4662-4698 36' Interval not sampled. Assigned average grade of 0.08 based on visual inspection.						

UNIT	ASSAY NUMBER	FOOTAGE	FEET	% Cu	.	.
Pi	4	4698-4702-1/2	4-1/2	0.26		qsv
Pi	5	4702-1/2-4706	3-1/2	0.21		qsv
Note: 4706-4791 85' Interval not sampled. Assigned average grade of 0.08 based on visual inspection.						
Pi	6	4791-4797	6	0.12		
Note: 4797-4833 36' Interval not sampled. Assigned average grade of 0.05 based on visual inspection.						
Pi	7	4833-4840	7	0.04		
Note: 4840-4881 41' Interval not sampled. Assigned average grade of 0.05 based on visual inspection.						
Pi	8	4881-4886	5	0.08		
Note: 4886-5163 277' Interval not sampled. Assigned average grade of 0.04 based on visual inspection.						
Pi	48	5163-5169	6	0.06		
Tp	49	5169-5177	8	0.03		
Tp	50	5177-5187	10	0.04		
Note: 5187-5373 186' Interval not sampled. Assigned average grade of 0.04 based on visual inspection.						
Tp	51	5373-5383	10	0.04		
Tp	52	5383-5393	10	0.32		qsv bx
Tp	53	5393-5403	10	0.03		
Note: 5403-5688 285' Interval not sampled. Assigned average grade of 0.03 based on visual inspection.						
Tp	54	5688-5698	10	0.02		
Tp	55	5698-5708	10	0.03		
Tp	56	5708-5718	10	0.03		
Tp	57	5718-5728	10	0.02		
Tp	58	5728-5738	10	0.04		

TOTAL DEPTH

Note: Tp = Tertiary porphyry
Pi = Precambrian Pinal Schist



2577'-2728'	ACP: 42 %; 97 sc, 2 db, 1 p€ sed. M: 10 %; dark brown w/ lense of fresh lime-stone @ 2630'
2728'-3000'	ACP: 90 %; 85 sc, 15 db, tr p€ sed. M: 20 %; dark to green brown.
3000'-3487'	ACP: 80 %; 56 sc, 39 db, 5 p€ sed. M: 15 %; med. dark brown.
3487'-3841'	ACP: 85 %; 70 sc, 17 db, 8 p€ gr, 5 Lr. gr. M: 20 %; brick red brown ACP: 80 %; 92 sc, 8 Lr. gr, tr p€ gr.

A-2 TYPE SLIDE BLOCK of Pinal Schist w/ altered bands & some aplite & qfp w/ alteration - mineral. ALL OXIDIZED.

BASAL FAULT ZONE @ 10°-15° (4006'-4015'), gouge - bx.

4096' OXIDIZED / SULFIDE

PINAL SCHIST cut by aplitic porphyry & quartz - feldspar porphyry, all cut by steep dipping quartz - sericite bands containing variable amounts of chalcocite, chalcopyrite, & pyrite, Some hematite bands, pyrite increasing with depth.
1/8" - 1/4" vns & narrow bx zones w/cc end 4149'

Below 5150', secondary K-feldspar & green sericite became noticeable component in schist & bfp, porphyry; quartz-sericite banding with minor mineral became scattered.

A - 14

NOTE: individual assays are found in Assay Report dated Aug. 10, 1981.

T. 1 S. R. 13 E.

N LINE of NW1/4 NE1/4 SE1/4 SE1/4 of Sec. 22

GRAPHIC LOG & ASSAY RESULTS

ANNUAL PROJECT PLANNING SHEET

DISTRICT: Southwest
PROJECT NAME: Superior East
PROJECT NUMBER: 0010
PROJECT SUPERVISOR: J.D.Sell
PROJECT GEOLOGIST: J.D.Sell
PREPARED BY/DATE: JDS/6-3-81

EXPENDITURES

1. Month of 9/81 $42,719
2. Current Year Expenses to Date thru 9/81 $ 416,119
3. Budget for Current Year 1981 $ 600,000
4. Thru previous year, since project began $2,992,124

TYPE OF PROJECT

	Recon
X	Drilling
	Pre-Development
	Other

COST ESTIMATE & APPROPRIATION REQUES

		Approvals Dist. Geol.	Approvals West. U.S.
Current Yr. Orig. Budget	$600,000	[illegible]	[illegible]
Current Yr. Add. Request @ ____	$		
Current Yr. Add. Request @ ____	$		
New Total	$		

OBJECTIVE: Confirmation and testing of qtz-sulfide vein system (of A-8 type) with two deviation holes, and completion of drill road to south for further testing; by Dec. 31, 1981 at a cost not to exceed $600,000.

Progress for the Month of September 1981

PLANNED TASKS	RESPONSIBILITY/TIME TO COMPLETE	TARGET DATE	% COMPLETE	PROGRESS TO DATE
1) Split and assay A-14.	JDS & SAC/1 week	6-15-81	100%	
2) Complete drill hole summary of A-13 and A-14.	JDS/3 weeks	7-1-81	100%	
3) Drill A-12, deviation to south, from A-11 hole; to determine dip of previously found vein system (A-9, A-11). Complete drill hole summary.	JDS, TCB, & Joy Drilling & Navi-drill company/ 8-9 months	9-15-81	Continued Coring	Assay values below 4748' are in range of 0.40 - 0.50% copper with some strongly altered - mineralized zones of 0.80 - 1.00% copper; assays complete to 5083'. Lower values estimated below. Drilling continuing to test for A-11 intercept extension at depth of 5400'.
4) Start deviated hole to north, from hole A-11, to determine dip of previously found vein system (A-9, A-11).	JDS, TCB, Joy & Navi-drill/3 months	12-31-81	See June	
5) Complete road to the southwest from A-10 pad (3/4 mile).	JDS & P.Bryant Constr./ 6 weeks	12-15-81		repair existing road; rub-out
6) ~~Status~~ report for Superior East. (Interim) Progress	JDS/3 weeks	12-31-81		

ASARCO MONTHLY DRILLING SUMMARY

DISTRICT Southwest U.S.

Project Superior East Project No. EA-0010 State Arizona County Pinal Month September Year 1981 Page

Hole No.	Collar location	Bearing	Dip	Footage drilled			Remarks (significant intersections, geology and/or assay intervals, etc.)
				From	To	Feet	
S.E. A-12	Navi-drilled hole from A-8; Az. Central 846, 600 N;744, 150 E.	Southerly	6°	5320'	5477'	157'	Presently drilling in Pinal schist and fine-grained Laramide biotite feldspar porphyry. Average of assays from 4217' to 4748' of 0.94% Cu; 4960'to 4992' @ 0.85% Cu; remainder ± 0.50 or less.

WDP – MVK 526

ANNUAL PROJECT PLANNING SHEET

DISTRICT: Southwest
PROJECT NAME: Superior East
PROJECT NUMBER: 0010
PROJECT SUPERVISOR: J.D.Sell
PROJECT GEOLOGIST: J.D.Sell
PREPARED BY/DATE: JDS/6-3-81

EXPENDITURES

1. Month of October $ 15,750.
2. Current Year Expenses to Date thru 10/81 $ 431,869.
3. Budget for Current Year 1981 $ 600,000
4. Thru previous year, since project began $2,992,124

TYPE OF PROJECT

	Recon
X	Drilling
	Pre-Development
	Other

COST ESTIMATE & APPROPRIATION REQUEST

		Approvals: Dist. Geol.	Approvals: West. U.S.
Current Yr. Orig. Budget	$600,000	[illegible]	[illegible]
Current Yr. Add. Request @ ____	$		
Current Yr. Add. Request @ ____	$		
New Total	$		

OBJECTIVE: Confirmation and testing of qtz-sulfide vein system (of A-8 type) with two deviation holes, and completion of drill road to south for further testing; by Dec. 31, 1981 at a cost not to exceed $600,000.

Progress for the Month of October 1981

PLANNED TASKS	RESPONSIBILITY/TIME TO COMPLETE	TARGET DATE	% COMPLETE	PROGRESS TO DATE
1) Split and assay A-14.	JDS & SAC/1 week	6-15-81	100	
2) Complete drill hole summary of A-13 and A-14.	JDS/3 weeks	7-1-81	100	
3) Drill A-12, deviation to south, from A-11 hole; to determine dip of previously found vein system (A-9, A-11). Complete drill hole summary.	JDS, TCB, & Joy Drilling & Navi-drill company/ 8-9 months	9-15-81	Continued Coring	Hole terminated at 5724' in low grade values; work continuing in cleaning hole to place wedge at ± 4100' to core portion cut by the Navi-drill and oriented core study.
4) Start deviated hole to north, from hole A-11, to determine dip of previously found vein system (A-9, A-11).	JDS, TCB, Joy & Navi-drill/3 months	12-31-81	See June	Note: Upon completion of hole A-12, it is recommended that the rig be moved to hole A-14, recover the rented casing and core to the south either by turn-out using Navi-drill or oriented wedges, to test south portion of GSV system found in hole A-14 just below the oxidized bedrock.
5) Complete road to the southwest from A-10 pad (3/4 mile).	JDS & P.Bryant Constr./ 6 weeks	12-15-81		
6) Status report for Superior East.	JDS/3 weeks	12-31-81		

W D Payne
JOS

Oct. 14, '81

EA-0041
Rawhide AI-2 , 3612 T.D.

April 1, 1980 — Sept 8, 1980 drilling
with 3000' of drillroad & pad built prior
& assaying later.

Total expenditures $132,076.24 ($36.57/ft)

with ± $23,000 being road-site costs.

As of August 1981, have $72,923.76 in authorization.

Best intercept: 3030'-3110' = 80' @ 0.66% Cu, 0.005% Mo.
(partially oxidized).

Intercept: 2850'-3160' = 310' @ 0.37% Cu, 0.005% Mo.
(partially oxidized).

(See Assay Result report to you dated Aug 14, 1981.

ANNUAL PROJECT PLANNING SHEET

DISTRICT: Southwest
PROJECT NAME: Superior East
PROJECT NUMBER: 0010
PROJECT SUPERVISOR: J.D.Sell
PROJECT GEOLOGIST: J.D.Sell
PREPARED BY/DATE: JDS/6-3-81

EXPENDITURES

1. Month of Feb. $ 7,417.00
2. Current Year Expenses to Date thru Feb. $ 45,903
3. Budget for Current Year 19__ $
4. Thru previous year, since project began $3,475,741. (End 1981 fig?)

TYPE OF PROJECT

	Recon
X	Drilling
	Pre-Development
	Other

COST ESTIMATE & APPROPRIATION REQUEST

		Approvals: Dist. Geol.	Approvals: West. U.S.
Current Yr. Orig. Budget	$600,000	[illegible]	[illegible]
Current Yr. Add. Request @ ____	$		
Current Yr. Add. Request @ ____	$		
New Total	$		

OBJECTIVE: Confirmation and testing of qtz-sulfide vein system (of A-8 type) with two deviation holes, and completion of drill road to south for further testing; by Dec. 31, 1981 at a cost not to exceed $600,000.

Progress for the Month of February 1982

(Continuation of 1981--no new funds)

PLANNED TASKS	RESPONSIBILITY/TIME TO COMPLETE	TARGET DATE	% COMPLETE	PROGRESS TO DATE
1) Split and assay A-14.	JDS & SAC/1 week	6-15-81	100	
2) Complete drill hole summary of A-13 and A-14.	JDS/3 weeks	7-1-81	100	
3) Drill A-12, deviation to south, from A-11 hole; to determine dip of previously found vein system (A-9, A-11). Complete drill hole summary.	JDS, TCB, & Joy Drilling & Navi-drill company/ 8-9 months	9-15-81	100	
4) Start deviated hole to north, from hole A-11, to determine dip of previously found vein system (A-9, A-11).	JDS, TCB, Joy & Navi-drill/3 months	12-31-81	Revoked--see June 1981	
5) Complete road to the southwest from A-10 pad (3/4 mile).	JDS & P.Bryant Constr./ 6 weeks	12-15-81	Postponed for Reevaluation	See December 1981
6) Status report for Superior East.	JDS/3 weeks	12-31-81	95	In rough draft form to typist. Review and critique prior to final drafting and typing.

February 82

ANNUAL PROJECT PLANNING SHEET

DISTRICT: Southwest
PROJECT NAME: Superior East
PROJECT NUMBER: 0010
PROJECT SUPERVISOR: J.D.Sell
PROJECT GEOLOGIST: J.D.Sell
PREPARED BY/DATE: JDS/6-3-81

EXPENDITURES

1. Month of Mar. $ 5,953
2. Current Year Expenses to Date thru Mar. $ <18,833>
3. Budget for Current Year 198 $
4. Thru previous year, since project began $ 3,475,741

TYPE OF PROJECT

	Recon
X	Drilling
	Pre-Development
	Other

COST ESTIMATE & APPROPRIATION REQUEST

		Approvals: Dist. Geol.	Approvals: West. U.S.
Current Yr. Orig. Budget	$600,000	[illegible]	[illegible]
Current Yr. Add. Request @ ____	$		
Current Yr. Add. Request @ ____	$		
New Total	$		

OBJECTIVE: Confirmation and testing of qtz-sulfide vein system (of A-8 type) with two deviation holes, and completion of drill road to south for further testing; by Dec. 31, 1981 at a cost not to exceed $600,000.

Progress for the Month of March 1982

PLANNED TASKS	RESPONSIBILITY/TIME TO COMPLETE	TARGET DATE	% COMPLETE	PROGRESS TO DATE
1) Split and assay A-14.	JDS & SAC/1 week	6-15-81	100	
2) Complete drill hole summary of A-13 and A-14.	JDS/3 weeks	7-1-81	100	
3) Drill A-12, deviation to south, from A-11 hole; to determine dip of previously found vein system (A-9, A-11). Complete drill hole summary.	JDS, TCB, & Joy Drilling & Navi-drill company/ 8-9 months	9-15-81	100	
4) Start deviated hole to north, from hole A-11, to determine dip of previously found vein system (A-9, A-11).	JDS, TCB, Joy & Navi-drill/3 months	12-31-81	Revoked--see June 1981	
5) Complete road to the southwest from A-10 pad (3/4 mile).	JDS & P.Bryant Constr./ 6 weeks	12-15-81	Postponed for Reevaluation	See December 1981
6) Status report for Superior East.	JDS/3 weeks	12-31-81	100	Completed report now in drafting for attachments.

March 82

CUSTOMERS PRICE LIST

NL Baroid

GLOBE, ARIZONA

TELEPHONE: 602/425-7049

EFFECTIVE: APR 12, 1982

J.D.S.

xc: HGK
TCB
HMS

BASIC MUD MATERIALS

PRODUCT	PRICE FOB WHSE	PACKAGE	PRODUCT	PRICE FOB WHSE	PACKAGE
AQUAGEL (REGULAR)	9.85	100# BAG	CELLEX (REGULAR)	242.15	50# BAG
AQUAGEL (MARINE)	------	100# BAG	DEXTRID	82.61	50# BAG
BAR-GAIN (BULK)	------	TON	DRISPAC	256.45	50# BAG
BAROID (REGULAR)	10.78	100# BAG	DRISPAC (L.V.)	275.45	50# BAG
BAROID (MARINE)	10.88	100# BAG	IMPERMEX	37.70	50# BAG
BAROID (BULK)	------	TON	ZEOGEL	10.51	50# BAG
CELLEX (H.V.)	248.30	50# BAG	QUIK-GEL	7.43	50# BAG

LOST CIRCULATION MATERIALS

PRODUCT	PRICE FOB WHSE	PACKAGE	PRODUCT	PRICE FOB WHSE	PACKAGE
COTTONSEED HULLS	19.70	100# BAG	KWIK-SEAL	31.69	40# BAG
FIBERTEX	20.23	40# BAG	MICATEX (F,C)	20.47	50# BAG
HY-SEAL	22.60	40# BAG	PLUG-GIT	25.77	40# BAG
JELFLAKE	31.27	25# BAG	WALL-NUT (F,M,C)	23.69	50# BAG

MUD CHEMICALS

PRODUCT	PRICE FOB WHSE	PACKAGE	PRODUCT	PRICE FOB WHSE	PACKAGE
AKTAFLO-S	894.47	55GAL DR	GYPSUM	15.87	100# BAG
ALDACIDE	99.19	50# BAG	K-LIG	39.09	50# BAG
ALUMINUM STEARATE	87.10	25# BAG	LIME	9.18	50# BAG
BARAFLOC	18.14	1# CAN	LOLOSS	195.39	50# BAG
BARAFOS	74.27	50# BAG	PAC-L	271.32	50# BAG
BEN-EX	23.03	2# BAG	PAC-R	252.60	50# BAG
BICARB OF SODA	54.77	100# BAG	POTASSIUM CHLORIDE	29.86	100# BAG
CALCIUM CHLOR-REG.	43.40	100# BAG	POTASSIUM HYDROXIDE	------	100# BAG
CALCIUM CHLOR-H.T.	43.40	80# BAG	Q-BROXIN	46.18	50# BAG
CALCIUM CHLOR-PWD.	------	100# BAG	SALT	11.28	100# BAG
CARBONOX	22.60	50# BAG	SAPP	------	100# BAG
CAUSTIC SODA	49.86	50# BAG	SODA ASH	33.31	100# BAG
CC-16	32.44	50# BAG	SODIUM CHROMATE	------	100# BAG
CON DET	62.65	5GAL CAN	SOLTEX	119.25	50# BAG
CYPAN	168.24	50# BAG	TANNEX	55.65	50# BAG
DESCO	68.65	25# BAG	TORQ-TRIM II	846.19	55GAL DR
DURENEX	92.51	50# BAG	WL-100	177.79	50# BAG
FLOSAL	44.63	50# BAG	XC-POLYMER	578.96	50# BAG
			Mud Gel ~~50#~~	5.13	50# BAG

OIL MUD MATERIALS

PRODUCT	PRICE FOB WHSE	PACKAGE	PRODUCT	PRICE FOB WHSE	PACKAGE
DURATONE	113.64	50# BAG	GELTONE II	85.50	50# BAG
E Z MUL	1002.74	55GAL DR	INVERMUL (LIQUID)	1041.72	55GAL DR
E Z SPOT	1039.99	55GAL DR			

TERMS: Net 30 days. Prices subject to change without notice. TAXES: All applicable taxes will be added to above prices.
MATERIALS RETURNED FOR CREDIT WILL BE SUBJECT TO RESTOCKING CHARGE.

PC-113

NL Baroid/NL Industries, Inc.
P.O. Box 1675, Houston, Texas 77001

PORTA HOUSE, INC.
2349 W. Wetmore Street / Tucson, Arizona 85705 / (602) 888-9774
Telex 330403

April 29, 1982

This is to verify that Mr. H. Stone returned one (1) 8' x 20', Mobile Office Unit, to the Tucson Porta House, Inc. yard on this date at 3:30 p.m. Serial Number 494-23, Unit 2624, 1979 Arizona Mobile.

Judy Morgan
Secretary Porta House, Inc.

H Stone
Harold Stone
ASARCO

SE

A-15

Joy Proposal, Jan-7, 1983 Revised.

Job Unit	Cost + 25%	Cumulative
Mob & Demob.	1000 + 250	= 1,250
NC, Surf. to 500 @ 17.40	8700 + 2175	= 12,125
NC, 500-700 = 200 @ 18.20	3640 + 910	= 16,675
NC Casing 700 @ 9.00	6300 + 1575	= 24,550
NX, 700-1000 = 300 @ 16.70	5010 + 1255	= 30,815
NX, 1000-1500 = 500 @ 17.70	8850 + 2210	= 41,875
NX, 1500-2000 = 500 @ 19.00	9500 + 2375	= 53,750
NX, 2000-2500 = 500 @ 20.70	10,350 + 2590	= 66,690
NX, 2500-3000 = 500 @ 22.90	11,450 + 2860	= 81,000
NX, 3000-3500 = 500 @ 25.70	12,850 + 3215	= 97,065
BX Casing, 3500 x 8.00	—	
BX, 3500-4000 = 500 @ 29.00	14,500 + 3,625	= 129,690 ~~+18,12~~
BX, 4000-4500 = 500 @ 33.30	16,650 + 4,163	= 147,153
BX, 4500-5000 = 500 @ 38.70		
BX, 5000-5500 = 500 @ 45.10		

JOY MANUFACTURING COMPANY
707 BOYD BOULEVARD
P. O. DRAWER 489
LaPORTE, INDIANA 46350
Phone: (219) 362-2191

January 7, 1983

Mr. Jim Sell
ASARCO Incorporated
P. O. Box 5747
Tucson, Arizona 85703

Dear Mr. Sell:

We appreciated receiving the invitation to bid on your Superior East Project. We understand you want to start a new hole from Surface.

Please consider the following:

Mobilization (NC hole to 3,000 feet)	500 $750.00/rig
Demobilization (NC hole to 3,000 feet)	500 $750.00/rig
Extra Road Truck Trips if and when hole reduction is required	$150.00/round trip
Rotary Drilling Through Overburden	$56.00/hour + materials used

70 off →

*Core Drilling	NC Wireline	NX Wireline	BX Wireline
0 to 500 feet	$18.10/ft.	$16.60/ft.	$16.40/ft.
500 to 1000 feet	$18.90/ft.	$17.40/ft.	$17.20/ft.
1000 to 1500 feet	$19.90/ft.	$18.40/ft.	$18.20/ft.
1500 to 2000 feet	$21.20/ft.	$19.70/ft.	$19.50/ft.
2000 to 2500 feet	$22.90/ft.	$21.40/ft.	$21.20/ft.
2500 to 3000 feet	$24.10/ft.	$23.60/ft.	$23.40/ft.
3000 to 3500 feet	-	$26.40/ft.	$26.20/ft.
3500 to 4000 feet	-	$29.90/ft.	$29.70/ft.
4000 to 4500 feet	-	$34.20/ft.	$34.00/ft.
4500 to 5000 feet	-	$39.60/ft.	$39.40/ft.
5000 to 5500 feet	-	-	$45.80/ft.

25%
9,050 + 2263
9450 + 2363
9950 + 2488
10,600 + 2650
48814
casing @ 23,000
72,814
14750
87,564

*Bad Rock Clause at Depths Below 3,500 Ft. - If footage drilled per shift (excluding chargeable time) times the appropriate footage rate drops below $368 per eight-hour shift revenue for five or more consecutive shifts, drilling prices will revert from a per-foot rate to an hourly rate of $46.00 per hour plus bit and other in-hole supplies at actual cost.

no change in drill price
see attached so contract - ±½ lower.

RECEIVED
JAN 10 1983
S. W. U. S. EXPL. DIV.

If Joy should elect to invoke the above bad rock clause, it is understood by both parties that it will be only under conditions of around-the-clock operation by competent drilling crews. ASARCO will be notified by mail or telephone before any hourly charges are accrued under this clause, and ASARCO reserves the right to terminate the drilling at any time after such notification.

Rig Time & Hourly Work

Setting and Pulling Casing and Pipe		$46.00/hour + materials used
Cementing and/or Plugging Drill Holes		$46.00/hour + materials used
Reaming, if necessary		$46.00/hour + materials used
Survey		$46.00/hour + customer supplies instrument
Standby Time for Your Convenience		$30.00/hour
Overtime Premium in Excess of 88 Hours per two-week period		$6.00/man hour

Supplies

Casing Ordered Left in Place	NC	$9.00/foot
	NX	$8.00/foot
	BX	$6.50/foot
Casing Lost through Normal Drilling Operations		At 70% of list price
Diamond Bit Loss in Excess of $2.50/ft.		At Actual Cost
Drilling Mud & Additives		At Jobsite Cost + 20%
Weather-treated Core Boxes which hold ten feet of core		$2.25 each

Water Pumping or Hauling

Water Truck Usage	$600.00/month
Mileage	$.75/mile
Water Truck Driver, if required	$2,000.00/month

The above prices are firm if accepted within 60 days and will remain in effect until 9/25/83.

We understand ASARCO will build and maintain all-weather or passable access roads, level drill sites, dig mud pits and provide water, on surface, free of cost to Joy. We further understand that ASARCO will provide all rights of ingress and egress to all lands that may be required to enable Joy to carry out the specified work.

We reviewed the pricing carefully. We are able to hold the same as in 1981/1982 for on-site work but the limited amount of work to be done does not permit any reduction since mobilization/demobilization figures in significantly as it is less than actual cost.

We would look forward to working with you on this project.

Yours very truly,

JOY MANUFACTURING COMPANY

J. H. Koontz
General Manager
Contract Core Drill Division

JHK/js

T-133-0 2-29-80 NW

JOY MACHINERY COMPANY

707 BOYD BOULEVARD
P. O. DRAWER 489
LaPORTE, INDIANA 46350
Phone: (219) 362-2191

February 21, 1980

Mr. N. P. Whaley
ASARCO Incorporated
P. O. Box 5747
Tucson, AZ 85703

Dear Mr. Whaley:

We appreciated receiving the inquiry to bid on the additional work on your Superior East Project. We understand there are three NC-NX-BX vertical holes going to 6,000 feet. There may be additional work after that. You may elect to have a rotary contractor drill the first 1,500 feet in each hole and set four inch pipe.

Please consider the following:

Mobilization $1,500.00

Demobilization $1,500.00

*Core Drilling	NC Wire Line	NX Wire Line	BX Wire Line
0 to 500 feet	$16.90/ft.	$15.40/ft.	$15.20/ft.
500 to 1000 feet	$17.30/ft.	$15.80/ft.	$15.60/ft.
1000 to 1500 feet	$17.90/ft.	$16.40/ft.	$16.20/ft.
1500 to 2000 feet	$18.80/ft.	$17.30/ft.	$17.10/ft.
2000 to 2500 feet	$20.10/ft.	$18.60/ft.	$18.40/ft.
2500 to 3000 feet	$21.90/ft.	$20.40/ft.	$20.20/ft.
3000 to 3500 feet	-	$22.80/ft.	$22.60/ft.
3500 to 4000 feet	-	$25.90/ft.	$25.70/ft.
4000 to 4500 feet	-	$29.90/ft.	$29.70/ft.
4500 to 5000 feet	-	$35.00/ft.	$34.80/ft.
5000 to 5500 feet	-	-	$41.00/ft.
5500 to 6000 feet	-	-	$48.60/ft.

Setting and Pulling Casing $40.00/hour + materials used

Casing Ordered Left in Place
NC- $9.00/foot
NX- $8.00/foot
BX- $6.50/foot

Joy Proposal, Jan 7, 1983 Revised
TM-14

Job Unit	Cost + 25%	Cumulative	
Mob. & Demob.	1000 + 250	$1250	
NC, 910-1000 = 90 x 18.50	1665 + 415	3330	
NC, 1000-1500 = 500 x 19.20	9600 + 2400	15,330	
NC Casing, 1500 x 9.00	13,500 + 3375	32,205	— NC ↓
NX, 1500-2000 = 500 x ~~19.00~~ 20.00	9500 + 2375	44080	28,205 ~~27,205~~
NX, 2000-2500 = 500 x ~~20.70~~ 22.50	10,350 + 2890	57,320	42,270 ~~40,445~~
NX, 2500-3000 = 500 x 22.90	11,450 + 2860		
NX, 3000-3500 = 500 x 25.70	12,850 + 3215		
NX, 3500-4000 = 500 x 29.20	14,600 + 3650		

JOY MANUFACTURING COMPANY
707 BOYD BOULEVARD
P. O. DRAWER 489
LaPORTE, INDIANA 46350
Phone: (219) 362-2191

January 7, 1983

Mr. Jim Sell
ASARCO, Incorporated
P. O. Box 5746
Tucson, AZ 85703

Dear Mr. Sell:

We appreciated receiving your invitation to bid on your Trench Project near Patagonia. We understand you want to deepen Hole TM-14 from 910 feet.

Please consider the following:

Mobilization (for 3,000-foot NC hole)	500 $750.00/rig
Demobilization (for 3,000-foot NC hole)	500 $750.00/rig
Road Truck Trips to Jobsite from Tucson for hole reductions if and when required	$150.00 each
Overburden Drilling	$60.00/hour + materials used

0.50 dh →

Core Drilling	NC Wireline	NX Wireline	BX Wireline
0 to 500 feet	1980 $17.90/ft.	$16.40/ft.	$16.20/ft.
500 to 1000 feet	1980 $18.70/ft.	$17.20/ft.	$17.00/ft.
1000 to 1500 feet	1980 (1) $19.70/ft.	$18.20/ft.	$18.00/ft.
1500 to 2000 feet	$21.10/ft.	$19.50/ft.	$19.30/ft.
2000 to 2500 feet	(2) $22.70/ft.	$21.20/ft.	$21.00/ft.
2500 to 3000 feet	$24.90/ft.	$23.40/ft.	$23.20/ft.
3000 to 3500 feet	-	$26.20/ft.	$26.00/ft.
3500 to 4000 feet	-	$29.70/ft.	$29.50/ft.
4000 to 4500 feet	-	$34.00/ft.	$33.80/ft.
4500 to 5000 feet	-	$39.40/ft.	$39.20/ft.
5000 to 5500 feet	-	-	$45.60/ft.
5500 to 6000 feet	-	-	$53.10/ft.

RECEIVED
JAN 10 1983
S. W. U. S. EXPL. DIV.

Rig Time & Hourly Work

Setting and Pulling Casing and Pipe	$46.00/hour + materials used
Cementing and/or Plugging Drill Holes	$46.00/hour + materials used
Reaming, if necessary	$46.00/hour + materials used
Survey	$46.00/hour + ASARCO supplies instrument
Standby Time for your Convenience	$30.00/hour
Overtime Premium in Excess of 88 hours per two-week period (if requested)	$6.00/man hour

Supplies

Casing Ordered Left in Place	NC	$9.00/foot
	NX	$8.00/foot
	BX	$7.00/foot
Casing Lost through Normal Drilling Operations		At 70% of list price
Diamond Bit Loss in Excess of $2.50/foot		At Actual Cost
Drilling Mud & Additives		At Jobsite Cost + 20%
Weather-treated Core Boxes which hold ten feet of core		$2.25 each

Water Pumping or Hauling

Water Truck Usage	$600.00/month
Mileage	$.75/mile
Water Truck Driver (if required)	$2,000.00/month

The above prices are firm if accepted within 60 days and will remain in effect until 9/25/83. Our terms are Net 30 Days on monthly progress invoices.

We understand ASARCO will build and maintain all-weather or passable access roads, level drill sites, dig mud pits and provide water, on surface, free of cost to Joy. We further understand that ASARCO will provide all rights of ingress and egress to all lands that may be required to enable Joy to carry out the specified work.

We will look forward to working with you on this project.

Yours very truly,

JOY MANUFACTURING COMPANY

J. H. Koontz
General Manager
Contract Core Drill Division

JHK/js

JDS

ASARCO

Exploration Department
Southwestern United States Division
James D. Sell
Manager

February 15, 1983

Memorandum to all Drill Crews:

Superior East Project

The following personnel are authorized for access to drill rigs, core, sample materials, and related shift reports:

T. C. Benavidez
R. B. Crist
H. G. Kreis
J. D. Sell
J. R. Stringham
H. M. Stone

If you are not acquainted with anyone claiming to be one of the above, please require positive identification such as a driver's license. Do Not Accept Business Cards.

James D. Sell

James D. Sell /cg

JDS/cg

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

May 9, 1983
Superior East — Claims

FROM: W. L. KURTZ

TO: J D Sell
J R Stringham

You should devise a plan that would put each mineral intercept on a separate claim and in additional drilling make every endeavor to have every new mineral intercept on a separate claim.

This will probably entail either amending and/or staking new claims and ought to be done before we make a survey of the claim block (the claims within the main area of interest). Your amending/relocation should take into consideration where your next holes will be drilled.

Main area of interest (you may have other ideas)

East boundary — West edge Rawhide claim block

West boundary — East edge of Sun (Nugget) claims

South boundary — 1,000 feet south of A-13 ?

North boundary — 1,000 feet north of A-2 (2nd) ?

JDS Copy

ASARCO

Southwestern Exploration Division

September 22, 1983

To: T. C. Benavidez

From: J. D. Sell

Water Line
Miami Core House
Superior East Project
Gila County, AZ

It has been brought to my attention that the water bill for the core house at Miami has been continually rising since last April (about the time you and Stone were there).

A call to Miami revealed that a line is broken on the Asarco side of the meter. They were instructed to turn off the meter valve on 9/21/83 which I assume they have done.

Please add the repair of the water line to your list of to-do jobs.

James D. Sell

James D. Sell

JDS/cg

cc: JRStringham

ASARCO Southwestern Exploration Division

SDS

January 5, 1984

File Memorandum

Superior East Project
Pinal County, AZ

On January 2, 1984, I toured the Superior East Project. The road going into A-15 is in fair shape at this date. Some gullies have been washed and need to be filled and leveled prior to moving in a drill rig. I have instructed Mr. Paul Bryant to stack some fill material along the route so that the work can be done rapidly when we are ready.

P. Bryant mentioned that FMC (First Mississippi Corp.) had him do some work south of Superior and east of Smith Ranch where they drilled a number of holes looking for "cement" material. When operating the cemented sand fill at Superior, Magma is a large user of cement and thus FMC thought a market was available. From the highway to Ray, the road work appears to be a revamping of the Norandex area. They apparently drilled for only a short time, both in limestone and schist.

It was also reported that Magma has asked for and received permission to construct a concentrate slurry line from Pinto Valley to the railhead at Superior. I talked with Russ Webster, Chief (and only) geologist and he would not confirm this but did state that with Pinto Valley, it was doubtful that the underground at Superior would ever reopen unless the copper price gets exceptionally high or the grade jumps to 10% copper. Webster has not been drilling since the close-down in 1982 and their final exploration to the north and east did not find sufficient ore or grade to keep the place open. He did state the two veins in the "conglomerate" were of good grade but tonnage is limited. He hinted that he would like to drill for other structures to the south. Russ is presently writing up an ore target shut-down report, starting at the 200 Level and going through the entire mine area from west to east. The zinc exploration, which was in progress for several years prior to shut-down, outlined some 750,000 tons of potentially mineable material.

Sixty-three people are still employed at the Superior Division, including the Chief Engineer and Chief Geologist. They are trying to maintain the water level at just below the 3600 Level and will be dumping water very soon. Walt Martin, Chief Engineer, expressed some concern over this dumping into Queen Creek. Only minimal ventilation and repair work is now in progress to keep the pumping areas available.

When I asked Russ about the Gold Fields entry into Newmont, he replied that it was interesting that they visited Pinto Valley but to his knowledge have not been to Superior!

Magma has also closed the hospital and removed all the equipment.

The merchants of Superior have written a letter to Newmont asking them to state what their plans are for the area, but have not yet received a reply.

James D. Sell

James D. Sell

JDS/cg

cc: WLKurtz

JDS

ASARCO

Southwestern Exploration Division

February 21, 1984

To: T. C. Benavidez
H. M. Stone

From: J. D. Sell

Miami Warehouse

The Accounting Department brought to my attention the fact that our electrical use at the Miami Warehouse jumped to over one hundred dollars. Inspection of the premises indicated the following:

1) The 220 volt heater circuit had not been pulled at the box.

2) The east pigtail was not plugged into the heater but was laying on the floor.

3) The office pigtail was plugged into the heater, with the connection on the floor.

4) The heater had not been turned completely off.

Leaving the circuits on in this old building could be dangerous to its existence. Leaving the pigtail connector on the floor is dangerous as water does leak in during the rainy season and water and electricity do not mix.

Please carefully check the premises when you leave so that these problems are not continued.

James D. Sell

James D. Sell

JDS/cg

JDS

ASARCO

Exploration Department
Southwestern United States Division

February 21, 1984

Department of Water Resources
99 E. Virginia
Phoenix, AZ 85004

Attention: Mr. Roger Kennett

Superior East Project
Tonto National Forest
Pinal County, AZ

Gentlemen:

In compliance with well construction regulations (HB #2228 and as amended in HB #2502), we submit the following "Application for Exploration Drilling Permit":

Name

Southwestern Exploration Division
ASARCO Incorporated
P.O. Box 5747
Tucson, AZ 85703

Location of Drill Site

NE¼ SW¼ Sec. 23, T1S, R13E, GSRB&M
Pinal County, Arizona

Drilling Company

Joy Manufacturing Co. - Drilling Division
750 E. Evans Blvd.
Tucson, AZ 85719 884-5865 -5866

Well Driller's License T-75
(Arizona Contractor's License 261-71)

Number of Drill Holes Under This Project: 1 - (one)

Re-entry of drill hole which was drilled and cased in early 1983. Upon completion surface casing will be capped with a steel plate and drill hole will be available for re-entry.

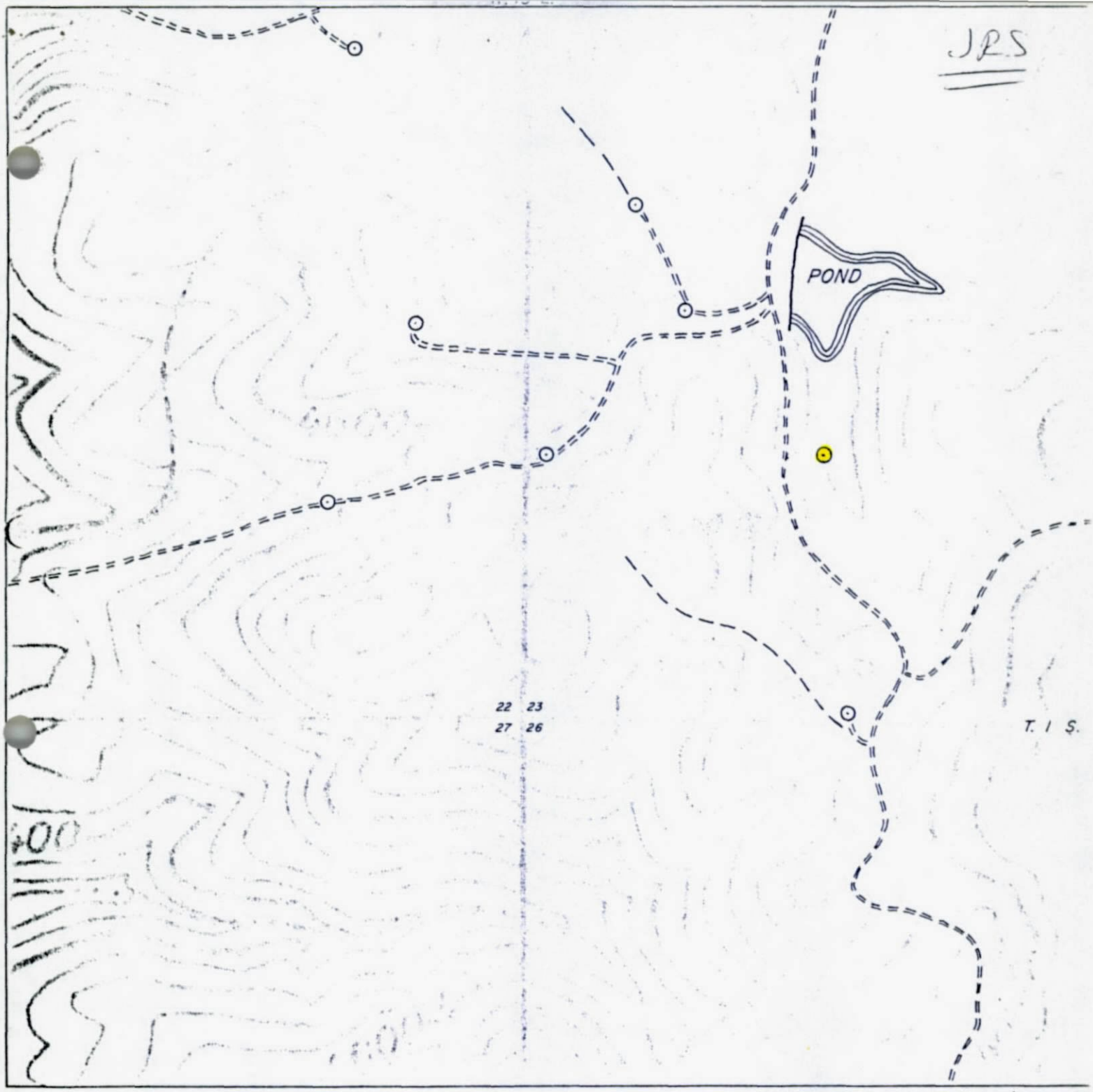
Drilling equipment will consist of a heavy duty truck mounted Joy-22 or Joy-36 using conventional wire-line drill coring barrels. The diameter of the hole will be approximately 3½".

Very truly yours,

J. R. Stringham
Assistant to the
Manager, SWED

JRS:mek
att. map

cc: J. D. Sell
Jack Lloyd - Joy Manuf.



BASE FROM U.S.G.S. SUPERIOR ARIZ. 7.5' QUAD.

EXPLANATION

Existing Roads

Approved Rights-of-way

Proposed Drill Site

NORTH

PLAN OF ASARCO DRILL HOLES

U.S. FOREST SERVICE

PINAL COUNTY, ARIZONA

SCALE: 1" = 500'

J.D. Sell

Jan, 1983

JDS

ASARCO

Southwestern Exploration Division

March 6, 1984

To: H. M. Stone

From: J. D. Sell

Superior East Drilling, EA-0010
Pinal County, AZ

I am asking you to please handle the Superior East drilling. Attached is a copy of the Joy drilling contract to continue hole A-15 at the drill rod cased depth of 2029 feet. Also attached is a copy of the last shift report of 4/8/83 noting that the rods need to be connected up and the bit et al. reamed out before drilling can be started.

You have $80,000 to spend. That includes any invoices from P. Bryant on road clean-up and all Joy charges, including close-down and demobilization.

You should look into securing a multi-shot surveying tool to be used on surveying the hole upon completion (assuming Mollen-Hauer is no longer available). Surveys will be needed on the Superior, Ventura, and Thunder Mountain holes. Naturally this cost would be prorated between the projects.

The hole should be in volcanics for the next several hundred feet and can be laid out on the ground for logging. Skeletonize the hole as you go along. The Whitetail Conglomerate should be below the volcanics and can also be laid out and skeletonized. If noticeable native copper is found then the core should be boxed and put in the Miami warehouse. The base of the Whitetail should be below 3800 feet of depth and the last 50 feet or so of Conglomerate should be boxed as well as all the basement rock of schist and granite.

The Miami warehouse should be straightened out and consolidated while you are watching the drill.

The monthly cost forms and hole completion forms should be submitted to Carol.

H. G. Kreis and I will be logging the hole so be sure to keep Carol advised of the progress.

James D. Sell

James D. Sell/cg

JDS/cg

Attachments

cc: HGKreis (w/o attach)

ASARCO

Exploration Department
Southwestern United States Division

James D. Sell
Manager

March 26, 1984

Memorandum to all Drill Crews:

Superior East Project

The following personnel are authorized for access to drill rigs, core, sample materials, and related shift reports:

T. C. Benavidez
H. G. Kreis
J. D. Sell
J. R. Stringham
H. M. Stone

If you are not acquainted with anyone claiming to be one of the above, please require positive identification such as a driver's license. Do Not Accept Business Cards.

James D. Sell
James D. Sell/cg

JDS/cg

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

± June 15, 1984

Superior East

J D Bell
Tucson Office

Your friend Kirby Cowell ~~Cowpell~~ called requesting information on the drilling. I told him we had hit the Bonanza zone at about 3900 feet and hoped to complete the hole through this zone. ~~Further to~~ I also told him we did not have any assays and would not until you had logged the cost.

JDS - cf

ASARCO

Exploration Department
Southwestern United States Division

CERTIFIED MAIL
RETURN RECEIPT

June 22, 1984

Mrs. Lois A. Burris, Executor
J. R. deCordova Estate
1637 East Catalina Drive
Phoenix, AZ 85016

Lease Agreement
Storage Building
Superior East Project

Dear Mrs. Burris:

Enclosed is a check in the amount of $2,400 as the annual rental for the period from July 1, 1984 through June 30, 1985.

This is in accordance with our Agreement dated May 18, 1976, amended to payments of $200 per month.

Please acknowledge receipt of this letter by returning the extra copy to my attention.

Sincerely yours,

Original Signed By
J. R. STRINGHAM

J. R. Stringham
Assistant to the
Manager, SWED

JRS:mek
enc.

cc: J. D. Sell
A. J. Robles

Received: _____
Lois A. Burris, Executor

Date: _____

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

JDS

ASARCO

Southwestern Exploration Division

July 16, 1984

To: J. R. Stringham

From: J. D. Sell

Best Fit Claims
Superior East Project
Pinal County, AZ

As requested by W. L. Kurtz (memo attached), it is desirable to plot the mineral intercepts at Superior East and make a best fit for a claim block so that as many claims can be validated with the intercepts at hand.

I submit Map 77017-E-1 at a scale of 1" = 200', and a packet of drill hole plans showing the collars and the plus 0.2% mineral intercepts at a scale of approximately 1" = 200'. Also submitted is a list of the drill holes, the depth footage, total mineral footage, and the grade of that mineral footage.

As noted, this "validated claim map" should be completed as soon as possible.

Holes A-4 and A-7 are west of the plan map and have native copper instead of sulfide copper values.

James D. Sell

James D. Sell

JDS/cg

Attachments

cc: WLKurtz (w/o map)

JDSell
7/16/84

Drill Holes, Mineralized Zones

Superior East Project

Hole No.	Depth to Top of Sulfides	Depth to Base of +0.20% Cu	Total Footage	Percent Copper
A-2, -2W	4317	4940	623	0.31
A-4	5080	6540	1460	0.76 Cu°
A-7	4695	5120	425	0.78 Cu°
A-8	3879	4660	781	1.34
A-9	4044	4903	859	0.65
A-10	3953	4249	296	0.29
A-11	4262	5175	913	0.81
A-12	4171	5257	1086	0.62
A-13	3499	4062	563	0.56
A-14	4096	4269	173	0.47
A-15*	3622	4082	460	0.72
AI-2	2850	3160	310	0.37

*Assays below 4082' have not been returned as of 7/13/84.

FILE

ASARCO

Exploration Department

July 5, 1984

TO: J. D. Sell

FROM: W. L. Kurtz

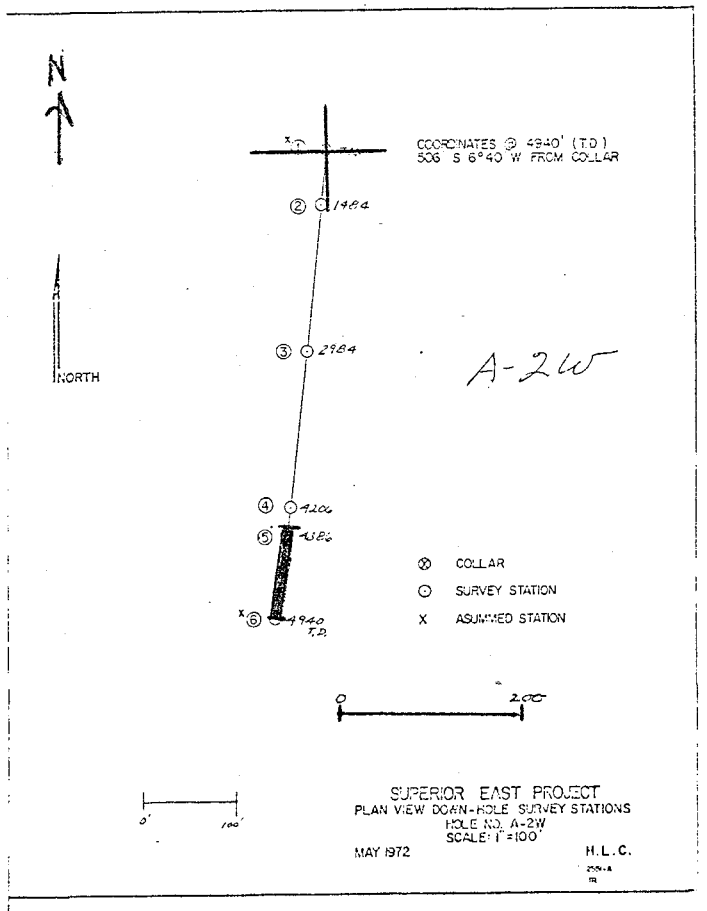
Superior East
Arizona

Some time ago we discussed making a best fit of drill hole intercepts and unpatented lode claims to achieve the greatest number of claims with a valid mineral intercept. I believe Stringham was going to work on this Chinese puzzle and he should complete it by the first of September for Mr. Brown's review. You should show Stringham the ground we are most interested in claiming.

W. L. Kurtz

WLK:mek

cc: R. L. Brown

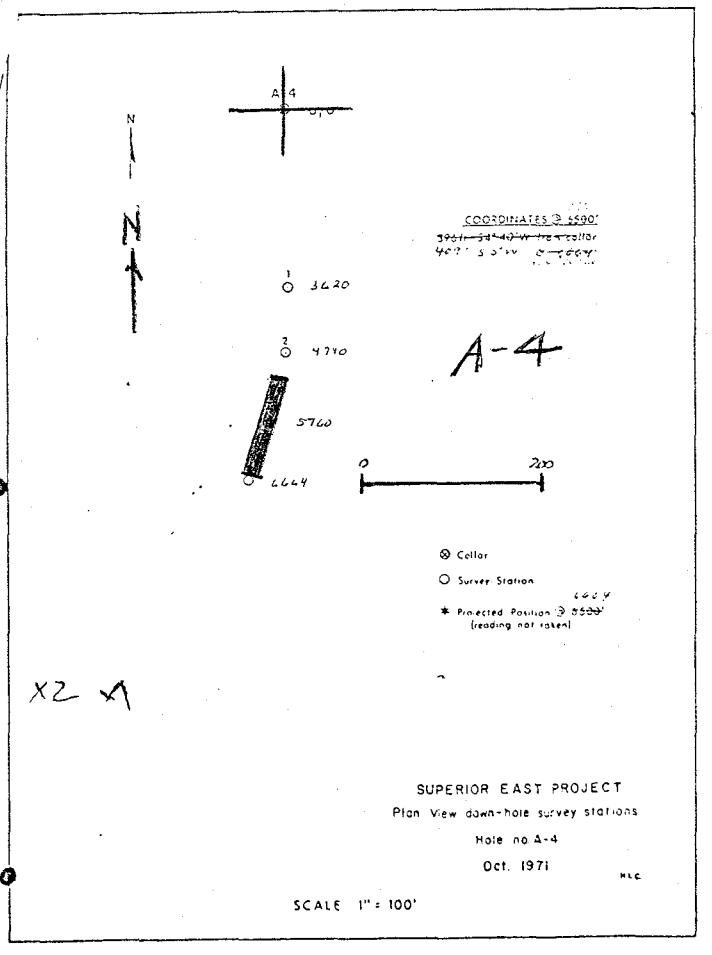


×1 ×2

A-2
A-2W

1" = 200'

≅ 205'


A-4
N
N
COORDINATES @ 5590'
1
3620
2
4790
5760
6664
A-4
0
200
Collar
Survey Station
Projected Position @ 5590'
(reading not taken)
X2 X1
SUPERIOR EAST PROJECT
Plan View down-hole survey stations
Hole no A-4
Oct. 1971
SCALE 1" = 100'

1" = 200'

≡ 205'

A-7

1" = 200'

≅ 180'

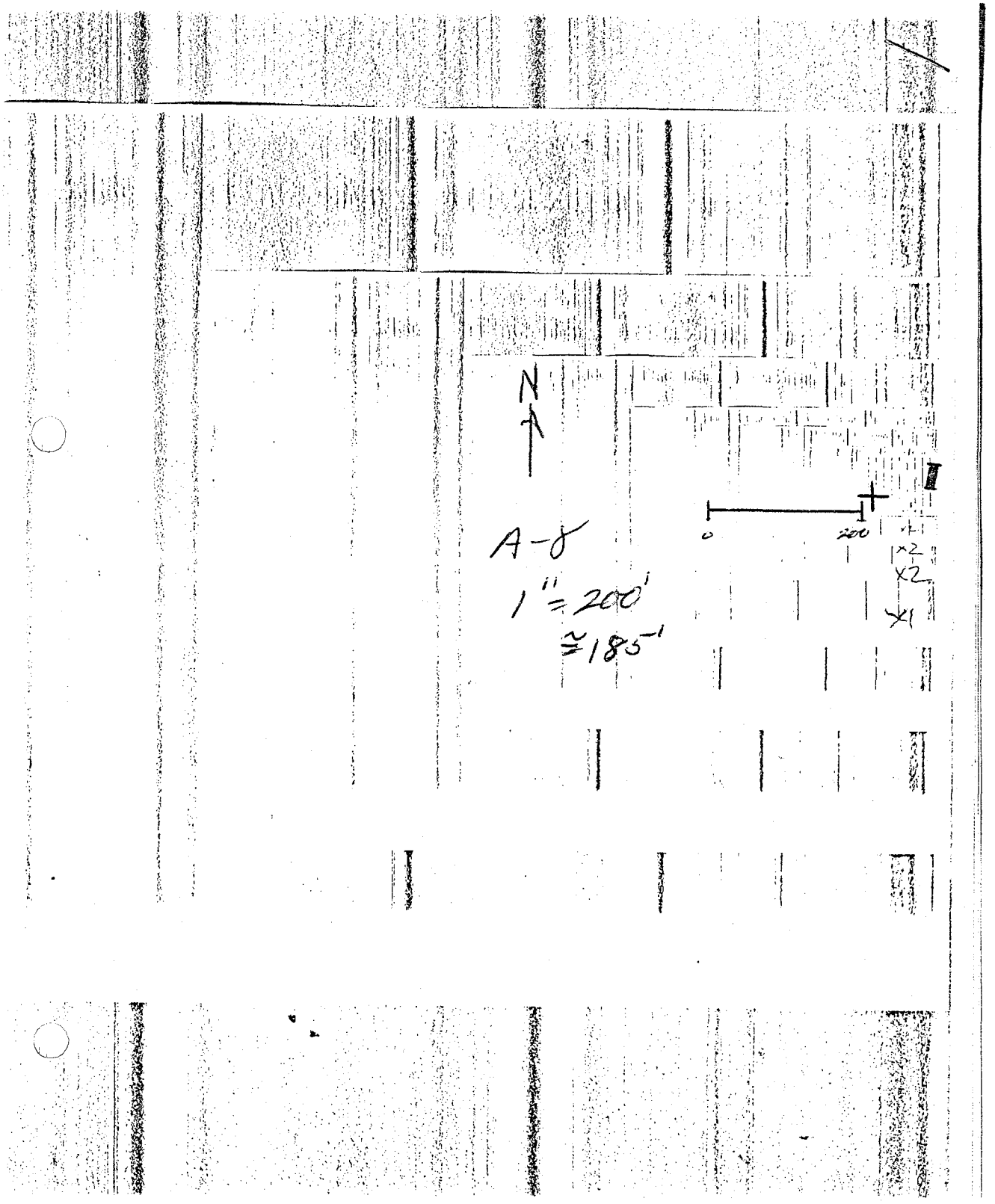
N

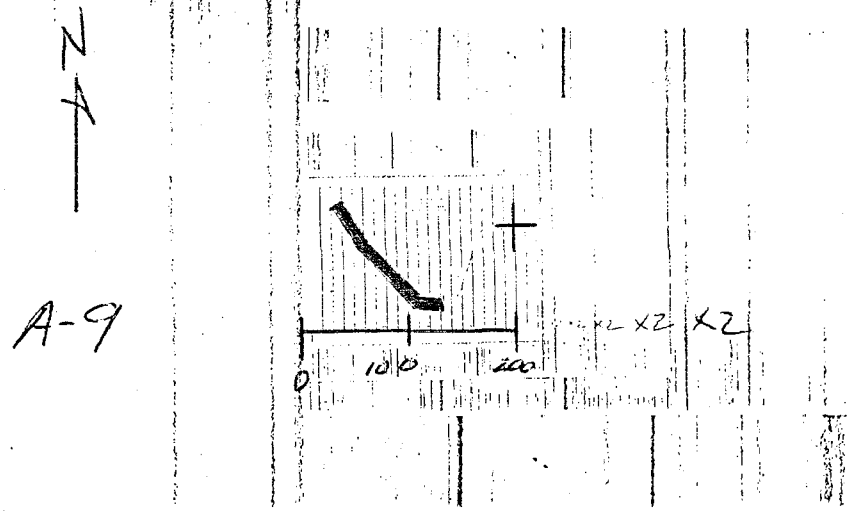
100

0

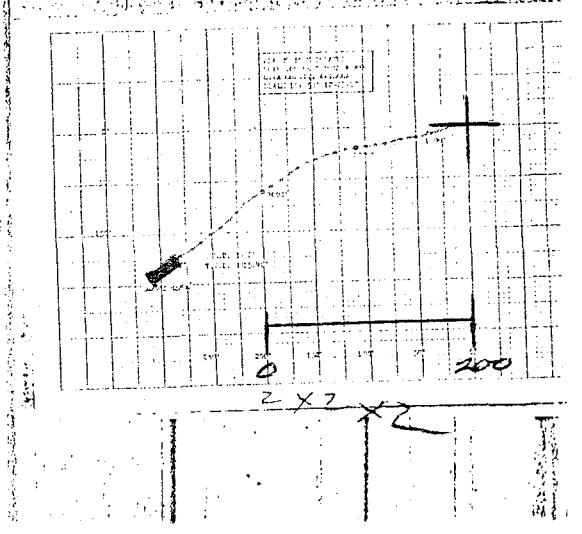
X2

X2 X2


N
0
200
A-8
1" = 200'
≅ 185-1
X2
X2
X1


N
A-9
0
100
200
1" = 200'
≅ 180'

A-10



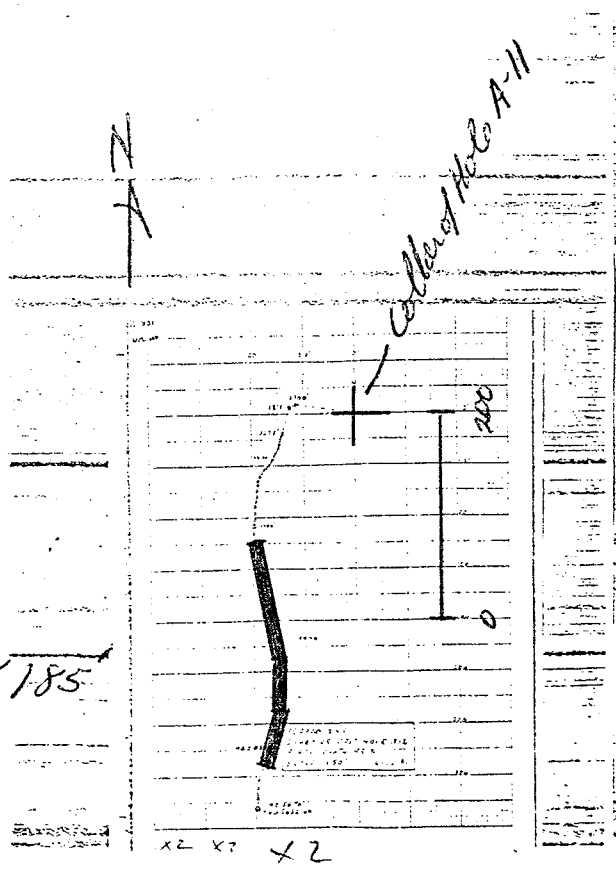
1" = 200' ≅ 215'

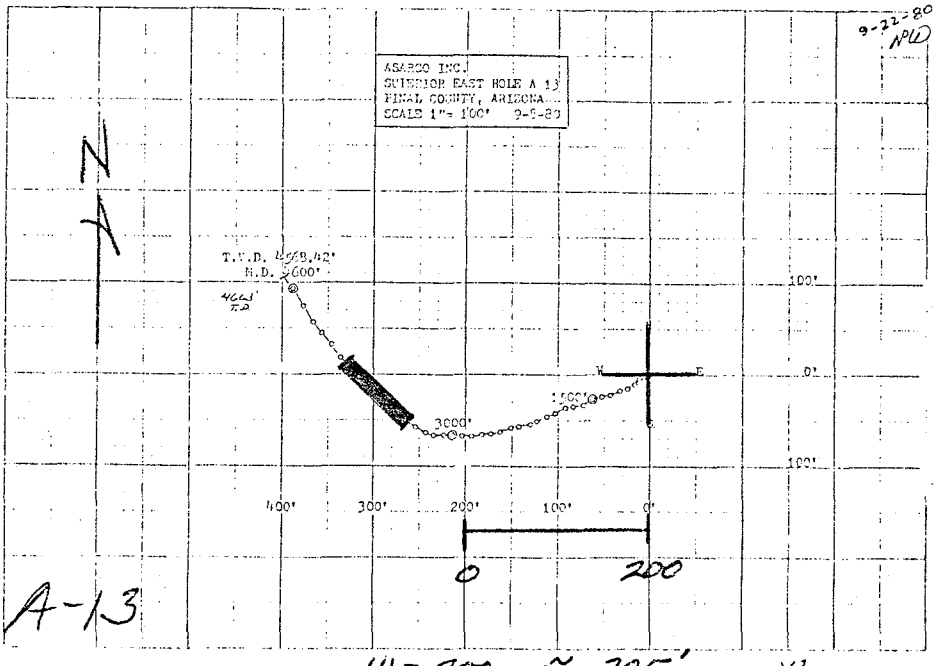
A-11
1" = 200'
1x
2x
3x
0
200
1,000 = 1"

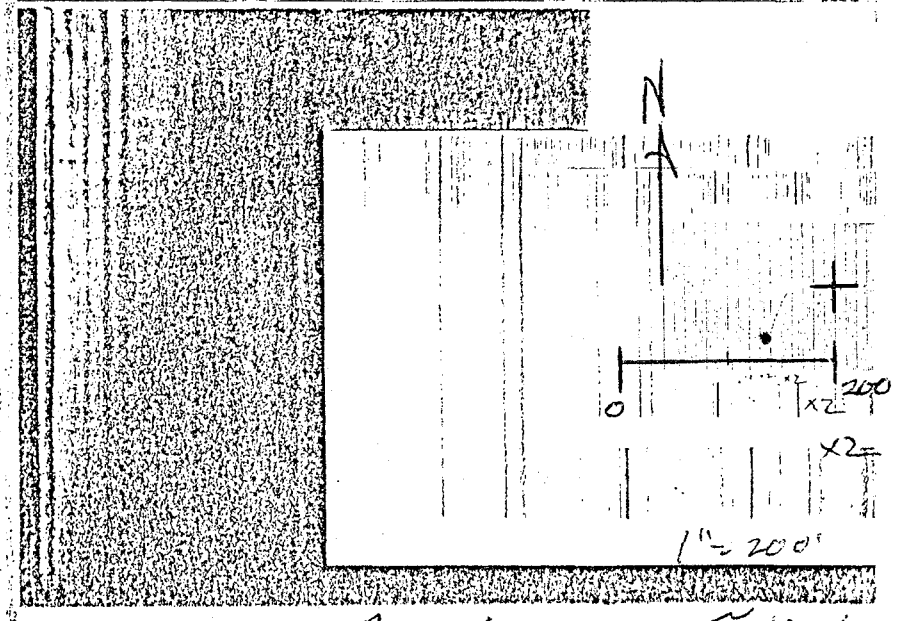
A-12

1" = 200'

≅ 185'

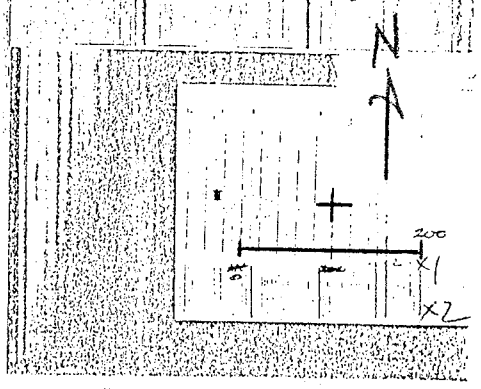


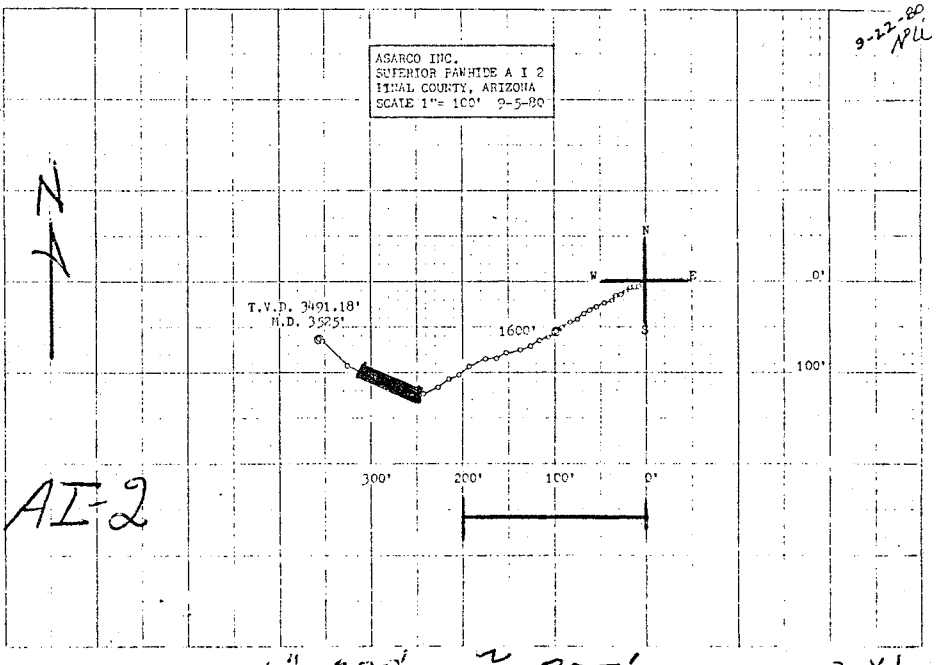

9-22-80
NPLD
ASARCO INC.
SUPERIOR EAST HOLE A 13
PINAL COUNTY, ARIZONA
SCALE 1" = 100' 9-9-80
N
T.V.D. 4668.42'
M.D. 4600'
4600' TD
100'
0'
100'
W
E
3000'
1500'
400'
300'
200'
100'
0'
0
200
A-13
1" = 200 ≅ 205'
X2
X1



A-14

≅ 180'


N
200
X1
X2
X1
A-15
1" = 200'
= 190'


ASARCO INC.
SUPERIOR PANHIDE A I 2
PINAL COUNTY, ARIZONA
SCALE 1"= 100' 9-5-80
9-22-80
N
T.V.D. 3491.18'
M.D. 3525'
1600'
N
W
E
S
0'
100'
300'
200'
100'
0'
AI-2

1" = 200' ≅ 205'

×2 ×1

ASARCO

Southwestern Exploration Division

August 10, 1984

TO: J. D. Sell

FROM: J. R. Stringham

Miami Core Shed Lease

Recommendation

Continue the present arrangement; there seems to be little chance that the property will be sold unless the estate has to be liquidated.

Findings

The real estate market in downtown Miami is stagnant. None of the property seems to have changed hands in years. There seems to be no move, such as reported by Mrs. Burris, to revive the downtown area either. Taylor Realty in Globe had only two listing in the commercial area. One, an empty lot owned by a Florida resident, had no price listed; any offer would be considered. The other, also an empty lot, behind the Safeway store in a residential section, was listed at $12,000. Both have been listed, without offers, for a long time.

The de Cordova property is assessed at a full cash value of $32,845. Of that, $6,357 is allocated to the land and $26,488 to improvements. The building was constructed in 1915. No allowance has been made for the drop in town real estate values, nor for the deterioration of the building. The valuations keep going up. The land ownership is still recorded in the name of the two de Cordova's.

If we were to make an offer for the property, we might consider offering $18,000 to $20,000. It would cost about that amount for us to build a Butler building and move the core. Mrs. Burris might accept such an offer.

J. R. Stringham

JRS:mek

JOY MANUFACTURING COMPANY
707 BOYD BOULEVARD
P. O. DRAWER 489
LaPORTE, INDIANA 46350
Phone: (219) 362-2191

October 4, 1984

Mr. James D. Sell
ASARCO Incorporated
P. O. Box 5747
Tucson, AZ 85703

Dear Jim:

Thanks for your letter of September 28.

I am pleased to enclose the stickers you requested. We are quite proud of the fact that we have 100 years of experience to offer our customers. I hope if we are around for another 100 years that we will still have the pleasure of serving ASARCO.

Yours very truly,

JOY MANUFACTURING COMPANY

Jim Koontz
General Manager
Contract Drill Division

JHK/js

Enclosure

RECEIVED
OCT - 9 1984
EXPLORATION DEPARTMENT

ASARCO

Southwestern Exploration Division

November 13, 1984

FILE MEMO

Water Rights Adjudication
Upper Gila Watershed -
JI Ranch

In response to the attached summons from the Superior Court of Maricopa County, the State Land Department and the Forest Service will register all of the stockponds and wells with that Court.

Dempsy Helms, Hydrologist with the State Land Dept., assured me by phone on Nov. 8, 1984, that the Department would respond. He said that we would receive notice when they were registered.

Dale Flanigan of the Tonto National Forest told me over the phone on November 13, 1984, that the Phoenix hydrologist for the Forest Service would register all of the wells on Forest land. He will make sure that we receive a copy of the registrations.

I will register any stock tanks and wells on our fee land.

J. R. Stringham

JRS:mek
att.
cc: W. L. Kurtz
J. D. Sell
W. E. Lockhart

T.E.S.

S.W. MINING DEPT.

NOV 5 1984

1984 IN THE SUPERIOR COURT OF THE STATE OF ARIZONA
IN AND FOR THE COUNTY OF MARICOPA

NOV 5 1984

IN RE THE GENERAL ADJUDICATION OF ALL RIGHTS TO USE WATER IN THE GILA RIVER SYSTEM AND SOURCE)	No. W-1 (Upper Gila River)
	SUMMONS

TO: ALL WATER CLAIMANTS IN THE UPPER GILA RIVER WATERSHED UPSTREAM FROM ASHURST-HAYDEN DAM EXCLUDING THE SAN PEDRO RIVER WATERSHED

You are hereby summoned and required to appear and to assert any claims to water that you may have in the Upper Gila River Watershed upstream from the Ashurst-Hayden Dam excluding the San Pedro River Watershed, on or before November 1, 1985. Potential claimants for rights to divert water at Ashurst-Hayden Dam are not required to appear and assert such claims pursuant to this Summons. The above action is a general adjudication of rights to use water in the Gila River System and Source in which all rights to use water appropriable under A.R.S. Sec. 45-131 and water subject to claims based upon federal law will be determined pursuant to A.R.S. Sec. 45-251 et seq. A map of the geographic scope of that portion of the general adjudication which is the subject of this Summons is reproduced on the reverse side of this Summons. Pursuant to A.R.S. Sec. 45-254(E), "Any potential claimant properly served who fails to file a statement of claimant in accordance with the requirements of this article shall be barred and estopped from subsequently asserting any rights theretofore acquired upon the river system and source and shall forfeit all rights to the use of water in the river system and source theretofore acquired by him."

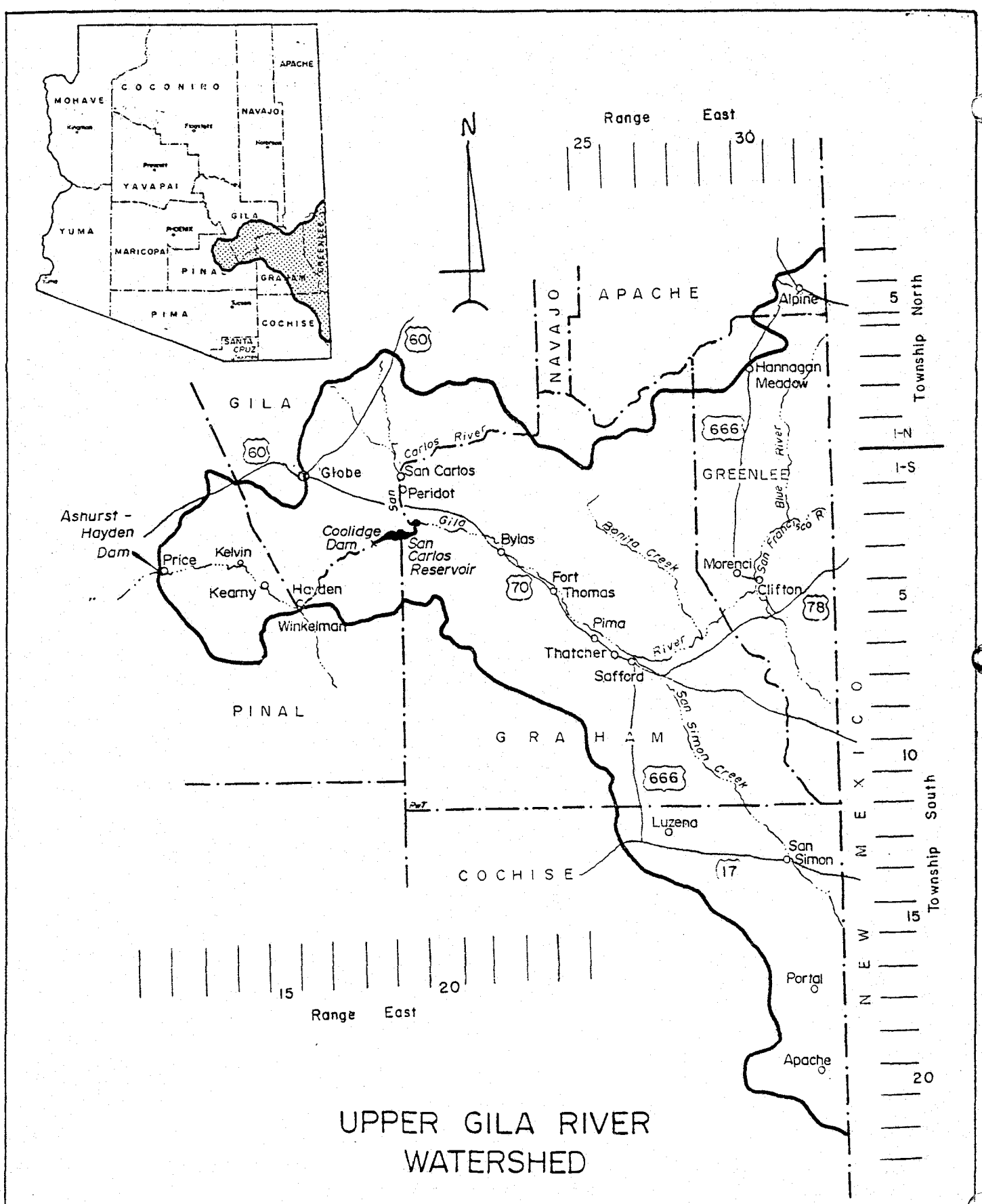
Claims to water rights may be asserted by filing the appropriate court-approved statement of claimant form with the Arizona Department of Water Resources, which pursuant to an order of the Superior Court of Maricopa County, has been authorized to receive claims for the Clerk of the Court. There are four statement of claimant forms that have been approved by this Court for general filing: an irrigation water rights form, a stockpond water rights form, a domestic water rights form, and a form for other water rights. You may obtain whichever forms you need for filing your claim(s) by completing and mailing the enclosed self-addressed, stamped "Statement of Claimant Form Request Card". All groundwater users should inform the Court of their groundwater use on the appropriate court-approved statement of claimant form to defend that use in the event that other claimants assert that the groundwater is either appropriable under A.R.S. Sec. 45-131 or subject to claims based upon federal law.

Unless an extension of time is granted by the Court, all statements of claimants must be filed with the Arizona Department of Water Resources, whose address is 99 East Virginia Avenue, Phoenix, Arizona 85004, on or before November 1, 1985, which shall be deemed a timely presentation of a claim pursuant to A.R.S. Sec. 45-254. The filing fee for an individual is twenty dollars. The filing fee for a corporation, municipal corporation, the state or any political subdivision, or an association or partnership is two cents for every acre-foot of water claimed, or twenty dollars, whichever is greater. The filing fee should be paid by check or money order made payable to the order of the "Arizona Department of Water Resources". No claim will be considered by the Court or the Master unless all filing fees with respect to that claim have been fully paid.

Given under my hand and seal of the Superior Court of the State of Arizona in and for the County of Maricopa this 27 day of September, 1984.

(SEAL)

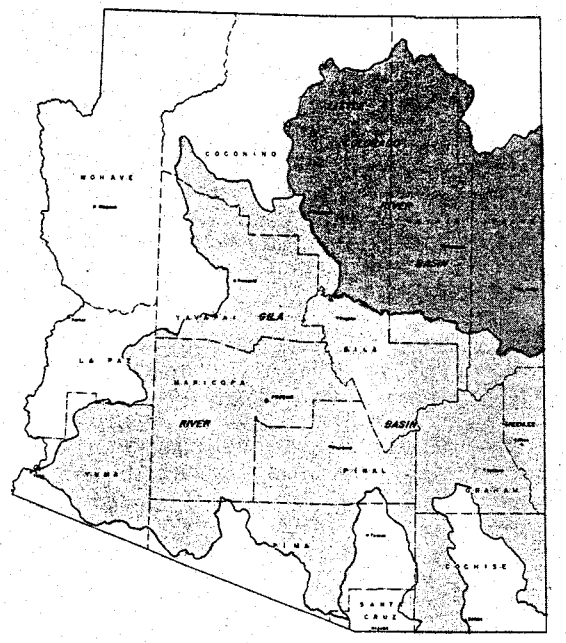
Vivian Knight
Clerk of the Court



UPPER GILA RIVER WATERSHED

Arizona Department of Water Resources

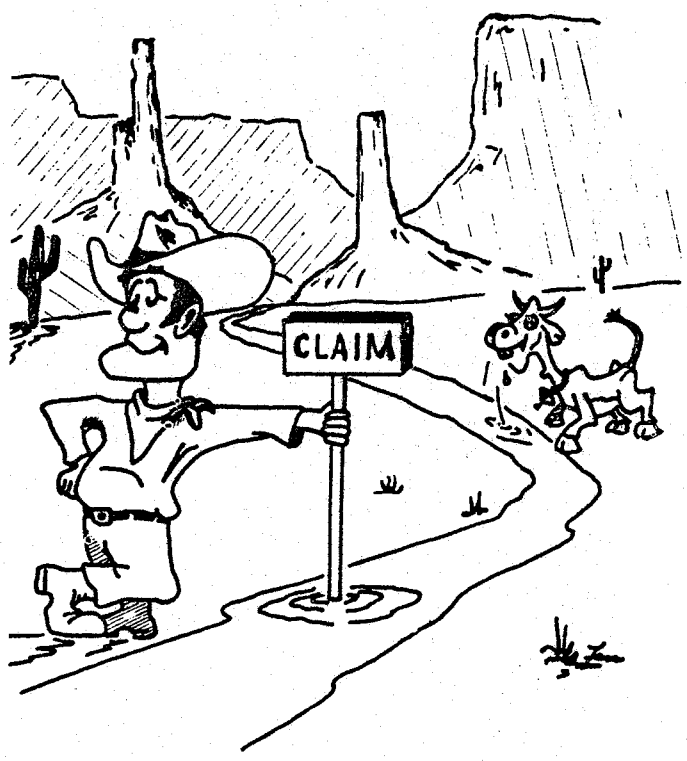
Arizona Department of Water Resources (DWR) will assist the court by tabulating, investigating and verifying claims. Large water users will be contacted by a Department representative. Claimants will have the opportunity to appeal or object. The DWR will also study the amount of water claimed, compare it to the available supply and report the findings to the court. The court will issue a final decree identifying each water-right holder, the priority date, the amount of water that may be used and the terms of its use. This process will take several years to complete.



RIVER BASINS PETITIONED FOR ADJUDICATION

Note: This pamphlet is intended to provide general information. It is not meant to be legal advice.
Published by the Arizona Department of Water Resources,
99 E. Virginia, Phoenix, Arizona 85004.

Adjudicating Arizona's Water Rights



WHAT IS AN ADJUDICATION OF WATER RIGHTS?

An adjudication of water rights is a court determination of the status of all rights to use water from a river system or watershed. The purpose of adjudicating water rights is to protect prior entitlements to withdraw or store water for beneficial use. In Arizona, as in other western states, it is important to protect established water rights because the total claims to water usually far exceed the dependable supplies.

SHOULD A PERSON FILE IF WATER HAS NEVER BEEN USED?

No, the purpose of the adjudication is to confirm existing rights rather than to establish new rights. Arizona water law does **not** provide for reserving water. Filing a claim in the adjudication for a potential future use will **not** establish a right to use water. Therefore, you do not need to file a claim if you have never used water on your property or you do not have a valid water right application, permit, certificate, or decreed allotment that has been maintained in good standing. When you want to develop a source of water on your land, contact the Department of Water Resources at that time to determine the correct filing procedures.

SHOULD A PERSON FILE IF ALL WATER IS RECEIVED FROM A MUNICIPAL WATER SYSTEM, WATER COMPANY, ASSOCIATION, OR IRRIGATION DISTRICT?

No. However the persons may wish to make sure the city, company, association or irrigation district does file on behalf of its water users.

WHO MUST CLAIM THEIR WATER RIGHTS IN THE ADJUDICATION?

If you claim the right to use water from streams, springs, or intermittent runoff, you must file in this adjudication. This is necessary even if you previously filed under the State's 1974 Registration, 1977 Stockpond or 1980 Groundwater Management Acts. You must file a claim in this adjudication even though you may already have a permit, a certificate or a court-decreed right to use surface water. FAILURE TO FILE A CLAIM IN THIS ADJUDICATION COULD SERIOUSLY JEOPARDIZE YOUR CONTINUED USE OF WATER.

SHOULD A PERSON FILE A CLAIM IF WATER IS OBTAINED FROM A WELL?

Yes. Well owners are urged to file for two reasons: 1) Groundwater may be subflow which is subject to appropriation and in many places the court will have to decide which wells withdraw appropriable water and which do not, and 2) federal and Indian water right claims are directed at ground as well as surface water. Even though you may have received a Certificate of a grandfathered groundwater right within one of the four Active Management Areas (Phoenix, Tucson, Pinal or Prescott), you are encouraged to file.

HOW DO I FILE A CLAIM?

Claims are officially entered with the court by completing and returning the court approved Statement of Claimant form to the Department of Water Resources. Filing the Statement of Claimant form constitutes appearance before the court for the purpose of asserting rights to use water. Four different forms are available from the Department of Water Resources.

1. **Domestic Use** — which is to be used by individual home owners and cooperatively owned domestic water supply systems. Public Water laws which govern adjudictaions allow no more than one-half acre of irrigation for each residence to qualify as domestic use. Irrigated areas in excess of one-half acre must be filed on an Irrigation Use form. This is the case even if the use was exempt from filing for a grandfathered right under the Groundwater Management Act.
2. **Stockpond Use** — which applies to ponds or tanks which store not more than 15 acre-feet.
3. **Irrigation Use** — which is to be used by those who irrigate more than one-half acre for crop production or pasture. Water used for golf courses, parks, or aesthetics are not considered in this category.
4. **Other uses** — which applies to everything which is not covered by Domestic Use, Stockpond or Irrigation.

To obtain a Statement of Claimant form, simply fill out the enclosed postcard indicating the type and number of forms you need. Be sure to print your name and address in the space provided on the postcard. For additional forms and information write the Department of Water Resources, 99 E. Virginia, Phoenix, Arizona, 85004, or call us toll-free (in Arizona): 1-800-352-8488. Out of state call 1-602-255-1520.

WHAT DOES IT COST TO FILE A CLAIM?

The filing fee is $20.00 or 2 cents for every acre-foot of water claimed, whichever is greater. The 2 cents option applies only to corporations, municipal corporations, the State of Arizona, associations, partnerships or political subdivisions.

WHAT HAPPENS DURING AN ADJUDICATION?

Water rights adjudications are traditionally conducted in state courts. The United States Congress authorized state courts to determine the relative rights of federal and Indian water claims in comprehensive, basin-wide adjudications.

On the basis of petitions filed by water rights holders, adjudications are now taking place in major watersheds in Arizona. The Little Colorado River System and the Gila River System, including its major tributaries, the Salt, Verde, San Pedro, Lower Santa Cruz and Agua Fria, are being adjudicated.

Each adjudication will be tried in Superior Court. Much of the testimony will be taken by Special Masters who will conduct hearings in areas where claimants reside. The

ASARCO

Southwestern Exploration Division

JDS

December 19, 1984

FILE NOTE

Closure of Continental Minerals
Corporation Exploration Office

Mr. Henry T. Eyrich, Vice President-Mining, suggested that his group, which includes exploration, may be closed out in the near future. Their two big projects -- the Oracle Ridge mine in Arizona, and the Osceola Placer operation in Nevada, have both been closed down and part of the equipment has been sold. This leaves them with only a few exploration projects in the western states.

Apparently, the decision will be finalized before year end.

JDS:mek

James D. Sell

cc: W. L. Kurtz
F. T. Graybeal

JDS

ASARCO

Exploration Department
Southwestern United States Division

October 9, 1985

Mr. Dave Nelson, Forest Hydrologist
Tonto National Forest
P.O. Box 5348
Phoenix, AZ 85010

Water Rights
Devils Canyon Allotment

Dear Mr. Nelson:

I have reviewed the water rights claims that you filed on the Devils Canyon Allotment as detailed in your letter of October 1, 1985. I found a number of discrepancies as to the number, name and priority date in our records. I am enclosing the complete list of stock tanks, springs and wells for both drainages with the Forest Service numbers and priority dates alongside the Arizona State numbers and priority dates. Would you please review these data, try to verify the correctness of one or the other in each case?

Under the stock tank classification, I find we have 7 more tanks registered than you show in the Gila River drainage. We have 3 more in the Salt River drainage for which I have no Forest Service numbers. We do not have Forest Service numbers for one spring and 2 deeded wells in the Gila River drainage; we do not have Forest Service numbers for 3 springs and two horizontal wells in the Salt River drainage. We show 10 wells registered with the State in the Gila River Drainage and two in the Salt River drainage. Additionally, we disagree upon 19 of the priority dates in the Gila River drainage.

In the Gila River drainage, we show only one "Red" tank and one "Hidden" tank. Walt Lockhart, our manager, verifies that only one exists in each place as the other two have silted up and disappeared.

I believe that the Upper Gila adjudication will only cover the stock tanks. We have not been advised about our private rights as yet. Will our registered private water rights have to be adjudicated as well?

Most of our information comes from the printout by the State in November 1979, copy of which is attached. The newer tanks and the drill hole wells have been registered with the State in recent years.

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

Please let me know if you can resolve the differences. Send me any of the Forest Service numbers you might have designated for any of the tanks, springs and wells too. I'm trying to clean up our records on all of the water sources on the private lands and on the grazing leases.

Sincerely yours,

J. R. Stringham
Assistant to the
Manager, SWED

JRS:mek
encs.

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

JI RANCH

Stock Tanks on Forest Service Land

Gila River Drainage

JI No.	F.S. No.	A.S. No.	Name	Priority Date F.S.	Priority Date A.S.
9	23976	65041	East Fork	1967	1949
10	23879	65042	North Fork	1962	1962
13	23878	65043	Basin	1967	1952
17	23892	65044	Trail	1956	1941
22	23885	65045	Headquarters	1959	1960
24	23881	65046	Fishpond	1959	1930
26	23970	65047	Telephone	1961	1961
31		65048	Drill		1974
33	23894	65049	Little Rawhide	1948	1942
35	23895	65050	Iron Flat	1948	1932
38	23893	65051	Middle Mountain	1947	1967
41	23972	65052	Javelina	1956	1960
44	23971	65053	Erosion	1934	1933
45		65054	Pauls		1967
49		65056	Switchback		1949
51		65057	Road		1971
52	23981	65062	Pond	1958	
57	23886	65061	Upper Cox	1957	1944
58	23884	65062	Long Canyon	1957	1946
59	23883	65063	Fenceline	1957	1946
71		65059	Fork		1972
77	23928	65073	Magma	1976	1963
82	23889	65075	Lower EK	1950	1949
85	23868	65076	Red (one only)	1953	1951
86		65077	Rocky		1949
88		65079	Picture Rock		1961
89	23896	65080	Hutton	1948	1947
95	23977(23969)	65081	Hidden (one onlh)	1967	1947
96	23968	65082	Rawhide	1962	1962
97		65083	Craig		1976
101	77046		Kim	1979	
102	77045		Walt	1979	
108	77038		Boundary	1979	
109	77037		Manzanita	1979	
110	77039		Whitetail	1979	
111	77040		Rim	1979	
112	77047		Monte	1979	

Total 37 Stock Tanks on Gila River Drainage

JI RANCH

Stock Tanks on Forest Service Land

Salt River Drainage

JI No.	F.S. No.	A.S. No.	Name	Priority Date F.S.	Priority Date A.S.
7	23880	65039	Powers		1947
8		65040	Cement		1936
48		65055	Horse Pasture		1967
53		65058	Shaft		1951
54	23975	65059	Apache Leap		1931
55	23888	65060	Oak Flat		1931

Total 6 Stock Tanks on Salt River Drainage

Total 43 Stock Tanks on Forest Service Land

One Tank, JI 15, FS 77036, Potluck, approved but not built as yet.

Springs on Forest Service Land

Salt River Drainage

JI No.	F.S. No.	A.S. No.	Name	Priority Date F.S.	Priority Date A.S.
5		24133	Sheepcamp		1909
11		24132	North Fork		1909
15		24137	Pothole		1909
43	77041	24138	Horse		1909

Total 4 Springs on Salt River Drainage

Springs on Forest Service Land

Gila River Drainage

JI No.	F.S. No.	A.S. No.	Name	Priority Date F.S.	Priority Date A.S.
14		24134	Bills		1909

Total 1 Spring on Gila River Drainage

JI RANCH

Wells on Forest Service Lands

Salt River Drainage

JI No.	F.S. No.	A.S. No.	Name	Priority Date F.S.	Priority Date A.S.
113 HW		609683 24135	Javelina		1909
114 HW		609689 24136	Deer		1909

Deeded Wells on Forest Service Lands

Gila River Drainage

JI No.	F.S. No.	A.S. No.	Name	Priority Date F.S.	Priority Date A.S.
JI 92W		609673	Gibson #1		1924
JI 92W		609673	Gibson #2		1924

Deeded Water Rights on Forest Service Land

Gila River Drainage

JI No.	F.S. No.	A.S. No.	Name	Priority Date F.S.	Priority Date A.S.
JI 16			Pump Station		1924
JI 82 (Also on F.S. Inventory)			Lower EK		1927

Drill Holes on Forest Service Land

Gila River Drainage

JI No.	F.S. No.	A.S. No.	Name	Priority Date F.S.	Priority Date A.S.
12		609688			5-27-82
29		609682			"
30		609681			"
32		609679			"
34		609692			"
40		609680			"
46		609677			"
52		609678			"
56		609676			"
72		609675			

Total 10 Drill Holes on F.S. Land, Gila River Drainage

JI RANCH

Drill Holes on Forest Service Land

Salt River Drainage

JI No.	F.S. No.	A.S. No.	Name	Priority Date F.S.	Priority Date A.S.
6		609690			5-27-82
118		609691			5-27-82

Total 2 Drill Holes on Forest Service Land, Salt River Drainage

Total 12 Drill Holes on Forest Service Land

ASARCO

Exploration Department
Southwestern United States Division

November 7, 1985

Mr. L. P. Widner
District Ranger
Forest Service
Rt. 1, Box 33
Globe, AZ 85501

Dear Mr. Widner:

Attached is a map of the roads open on the Devils Canyon Allotment. Some of the drill site roads have been left open to allow us to use the water encountered in them if we need it for stock watering. All of the disturbed sites except the one we prepared this year have been reclaimed and reseeded.

Sincerely yours,

J. R. Stringham
Assistant to the
Manager, SWED

JRS:mek
Att.

cc: J.D. Sell (w/o att.)

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

JDS

ASARCO

Exploration Department
Southwestern United States Division

October 9, 1985

Mr. Dave Nelson, Forest Hydrologist
Tonto National Forest
P.O. Box 5348
Phoenix, AZ 85010

Water Rights
Devils Canyon Allotment

Dear Mr. Nelson:

I have reviewed the water rights claims that you filed on the Devils Canyon Allotment as detailed in your letter of October 1, 1985. I found a number of discrepancies as to the number, name and priority date in our records. I am enclosing the complete list of stock tanks, springs and wells for both drainages with the Forest Service numbers and priority dates alongside the Arizona State numbers and priority dates. Would you please review these data, try to verify the correctness of one or the other in each case?

Under the stock tank classification, I find we have 7 more tanks registered than you show in the Gila River drainage. We have 3 more in the Salt River drainage for which I have no Forest Service numbers. We do not have Forest Service numbers for one spring and 2 deeded wells in the Gila River drainage; we do not have Forest Service numbers for 3 springs and two horizontal wells in the Salt River drainage. We show 10 wells registered with the State in the Gila River Drainage and two in the Salt River drainage. Additionally, we disagree upon 19 of the priority dates in the Gila River drainage.

In the Gila River drainage, we show only one "Red" tank and one "Hidden" tank. Walt Lockhart, our manager, verifies that only one exists in each place as the other two have silted up and disappeared.

I believe that the Upper Gila adjudication will only cover the stock tanks. We have not been advised about our private rights as yet. Will our registered private water rights have to be adjudicated as well?

Most of our information comes from the printout by the State in November 1979, copy of which is attached. The newer tanks and the drill hole wells have been registered with the State in recent years.

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

Please let me know if you can resolve the differences. Send me any of the Forest Service numbers you might have designated for any of the tanks, springs and wells too. I'm trying to clean up our records on all of the water sources on the private lands and on the grazing leases.

Sincerely yours,

J. R. Stringham
Assistant to the
Manager, SWED

JRS:mek
encs.

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

JI RANCH

Stock Tanks on Forest Service Land

Gila River Drainage

JI No.	F.S. No.	A.S. No.	Name	Priority Date F.S.	Priority Date A.S.
9	23976	65041	East Fork	1967	1949
10	23879	65042	North Fork	1962	1962
13	23878	65043	Basin	1967	1952
17	23892	65044	Trail	1956	1941
22	23885	65045	Headquarters	1959	1960
24	23881	65046	Fishpond	1959	1930
26	23970	65047	Telephone	1961	1961
31		65048	Drill		1974
33	23894	65049	Little Rawhide	1948	1942
35	23895	65050	Iron Flat	1948	1932
38	23893	65051	Middle Mountain	1947	1967
41	23972	65052	Javelina	1956	1960
44	23971	65053	Erosion	1934	1933
45		65054	Pauls		1967
49		65056	Switchback		1949
51		65057	Road		1971
52	23981	65062	Pond	1958	
57	23886	65061	Upper Cox	1957	1944
58	23884	65062	Long Canyon	1957	1946
59	23883	65063	Fenceline	1957	1946
71		65059	Fork		1972
77	23928	65073	Magma	1976	1963
82	23889	65075	Lower EK	1950	1949
85	23868	65076	Red (one only)	1953	1951
86		65077	Rocky		1949
88		65079	Picture Rock		1961
89	23896	65080	Hutton	1948	1947
95	23977(23969)	65081	Hidden (one onlh)	1967	1947
96	23968	65082	Rawhide	1962	1962
97		65083	Craig		1976
101	77046		Kim	1979	
102	77045		Walt	1979	
108	77038		Boundary	1979	
109	77037		Manzanita	1979	
110	77039		Whitetail	1979	
111	77040		Rim	1979	
112	77047		Monte	1979	

Total 37 Stock Tanks on Gila River Drainage

JI RANCH

Stock Tanks on Forest Service Land

Salt River Drainage

JI No.	F.S. No.	A.S. No.	Name	Priority Date F.S.	Priority Date A.S.
7	23880	65039	Powers		1947
8		65040	Cement		1936
48		65055	Horse Pasture		1967
53		65058	Shaft		1951
54	23975	65059	Apache Leap		1931
55	23888	65060	Oak Flat		1931

Total 6 Stock Tanks on Salt River Drainage

Total 43 Stock Tanks on Forest Service Land

One Tank, JI 15, FS 77036, Potluck, approved but not built as yet.

Springs on Forest Service Land

Salt River Drainage

JI No.	F.S. No.	A.S. No.	Name	Priority Date F.S.	Priority Date A.S.
5		24133	Sheepcamp		1909
11		24132	North Fork		1909
15		24137	Pothole		1909
43	77041	24138	Horse		1909

Total 4 Springs on Salt River Drainage

Springs on Forest Service Land

Gila River Drainage

JI No.	F.S. No.	A.S. No.	Name	Priority Date F.S.	Priority Date A.S.
14		24134	Bills		1909

Total 1 Spring on Gila River Drainage

JI RANCH

Wells on Forest Service Lands

Salt River Drainage

JI No.	F.S. No.	A.S. No.	Name	Priority Date F.S.	Priority Date A.S.
113 HW		609683 24135	Javelina		1909
114 HW		609689 24136	Deer		1909

Deeded Wells on Forest Service Lands

Gila River Drainage

JI No.	F.S. No.	A.S. No.	Name	Priority Date F.S.	Priority Date A.S.
JI 92W		609673	Gibson #1		1924
JI 92W		609673	Gibson #2		1924

Deeded Water Rights on Forest Service Land

Gila River Drainage

JI No.	F.S. No.	A.S. No.	Name	Priority Date F.S.	Priority Date A.S.
JI 16			Pump Station		1924
JI 82 (Also on F.S. Inventory)			Lower EK		1927

Drill Holes on Forest Service Land

Gila River Drainage

JI No.	F.S. No.	A.S. No.	Name	Priority Date F.S.	Priority Date A.S.
12		609688			5-27-82
29		609682			"
30		609681			"
32		609679			"
34		609692			"
40		609680			"
46		609677			"
52		609678			"
56		609676			"
72		609675			

Total 10 Drill Holes on F.S. Land, Gila River Drainage

JI RANCH

Drill Holes on Forest Service Land

Salt River Drainage

JI No.	F.S. No.	A.S. No.	Name	Priority Date F.S.	Priority Date A.S.
6		609690			5-27-82
118		609691			5-27-82

Total 2 Drill Holes on Forest Service Land, Salt River Drainage

Total 12 Drill Holes on Forest Service Land

ASARCO

Exploration Department
Southwestern United States Division

November 7, 1985

Mr. L. P. Widner
District Ranger
Forest Service
Rt. 1, Box 33
Globe, AZ 85501

Dear Mr. Widner:

Attached is a map of the roads open on the Devils Canyon Allotment. Some of the drill site roads have been left open to allow us to use the water encountered in them if we need it for stock watering. All of the disturbed sites except the one we prepared this year have been reclaimed and reseeded.

Sincerely yours,

J. R. Stringham
Assistant to the
Manager, SWED

JRS:mek
Att.

cc: J.D. Sell (w/o att.)

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