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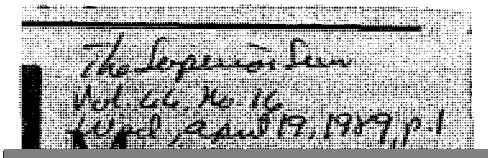
ASU geologist gets Soviet award

Kieffer is 2nd American, 1st woman to win science prize

By Eileen Myers
Tribune writer

Mesa Tribune
Thurs. 7/13/89


The Lexington Law
Vol. 66, No. 16
Aug. 19, 1939, p. 1

[redacted]

tion," Casey said. AZ Daily Star
Sat. June 7, 1980, p. 10-C

ASARCO

Southwestern Exploration Division

JDS Copy

July 7, 1981

Memo to: All Project Geologists/Supervisors

From: W. D. Payne

Subject: Routine Reporting on Drilling Activities and General Geologic Reports for Drilling Projects

Asarco spends a lot of money on drilling, probably a higher proportion of total budget than most, and, in order to insure that a reasonable amount of geologic information gets recorded both as timely information and for posterity, the following reporting guidelines are presented. They proceed from monthly drilling summaries to completed drill hole summaries to annual progress reports and to multi-year status reports.

1) Monthly Drilling Summary (example form attached)

The purpose of these is to provide factual, generally non-interpretive, updates on drilling progress and results during the month. Please fill these in and submit with the project planning sheet. Allow one or two lines per drill hole -- diamond or percussion. Significant intersections might include: patches of notable alteration, zones of low-grade mineralization, vein intercepts, etc. In short, there normally might be 4-6 lines of single space (3 if you use only one section) to report geology pertinent to the reported footage.

If assays are available they should also be reported. If assays are not returned till the following month, then they should be included on the form that subsequent month with the "footage drilled" section to read "previously reported." It is easier if assay data are kept in tabular form; report only significant clusters, but do give general limits on large, low-grade zones.

Be concise and informative. Copies of these will definitely go to the Western Exploration Manager and some will undoubtedly go to NYC. These may be their only interim (vis-a-vis the quarterly reports) source of information.

There is nothing wrong with putting more than one project on a sheet providing they are of reasonably similar geologic cum geographic environment. For example, different project holes being drilled concurrently at the north end of the Patagonia Mtns. could be combined on one sheet, etc.

Bear in mind these are purely information reports. They should take no more than 5-10 minutes per hole per month to complete.

2) Drill Hole Summary

Drill Hole Summaries are not required for rotary or percussion holes, but are mandatory for all surface or underground exploratory holes -- be they wide-spaced, routine exploration, or close-spaced grid-type. The latter would include fan patterns drilled from underground. (What is not included here is "ore confirmation" or "block delineation" type holes which would be drilled by the mining department anyway.)

a) Routine Exploration Holes (Copy for DDH V76-1 appended for review)

Drill hole summaries should be completed as soon as possible after return and review of assay data, thin sections, etc. Ordinarily this would be within about a month after completion of the hole.

The following material should be included in the report:

Heading containing general parameters of the hole (date, depth, deviation, logged by, etc.).

Highlights - To be enumerated and single spaced.

Introduction - General purpose of hole and rationale for its specific location.

Petrology - Tabulation of rock types and brief discussion of anything new or unexpected.

Structure - As applicable.

Alteration - Tabulation (condensing into zones as needed) of alteration from top to bottom. Discuss the mode of alteration, i.e., structure controlled vs. pervasive; type - hydrolitic, potassic, silicic, etc. and the identifying criteria (unless these have been explained in detail in a previous drill summary from the same property.

Mineralization - Present weighted average assay data where continuous mineralization is present. Discuss trace data for rest of hole and how they are thought to fit into the big pattern, i.e., how the Pb-Zn or Mo values fit relative to a supposed Cu system, etc. And, obviously, mention should be made of the nature of mineralization: fracture controlled vs. disseminated, etc.

Interpretation - This will vary from simple and short to long and involved depending on the complexity of the geology and the amount of previous data available. It should briefly integrate all the above sections and come to a rational conclusion.

Recommendations are not needed but may be included. Often, in the case of 1-hole-per-year projects, the addition of this section will render the report acceptable as an annual progress report and thus eliminates the need for a separate one.

Diagrams - If not too inconvenient, a simplified plan map showing topography, geology, hole location(s), deviation, etc. should be appended. In some cases a cross-section might be more apt.

b) Close-spaced, Grid Type Drill Holes

By the time grid drilling rolls around the geologic systems are pretty well understood and the need for abundant comment is minimized.

However, it is still necessary to "reduce" drill log data into form usable for plotting on cross-sections: grade composites, gross alteration patterns, major rock contacts, etc. Accordingly, the same type tabulations as mentioned above should be presented, along with whatever additional explanation is deemed appropriate.

In addition to the heading, highlights, and tabulations (lithology, alteration, mineralization) there should be a brief introduction and a brief conclusion (perhaps interpretation instead, if it is a fringe hole). The report need not be more than 2-4 pages long + map; and most of it would be tabulations.

3) Project Progress Report

At the end of each substantial increment of progress, usually to coincide with the termination of a year-ending field season, a progress report should be written.

It should provide a background for the work done, a logical summary of the results, a set of updated maps and cross-sections to reflect the new information, and recommendations for the following year (or appropriate time/work increment). These reports become the written basis for requesting and justifying additional exploration funds.

There is no reason for these to be particularly long. Something in the 4-6-8 page range should suffice. Please keep any long data sets restricted to appendices. (You may choose to insert a short, single-spaced "Summary and Recommendations" paragraph or two at the outset of the report. If so, keep it very short!) Copies of these reports will be dispersed to a variety of files (incl. NYC?) and to JV partners.

4) Status Reports

These are lengthy, formal reports that, in essence, represent a fait accompli with regard to an exploratory drilling program or subsequent grid drilling.

They are appropriately written before hand-off to the mining department, for final wrap-up of a low-grade system that is being put on the shelf, for a fence-sitter that needs more testing - but with farm-in money, etc.

A lot of money will have been spent, a lot of data gathered, and these reports represent the geologic summation of all that is known. Both progress reports and drill hole summaries can be used as references. Even though they are fairly long (25-40 pages?) they should present generalizations, summaries, and residual queries re aspects of the geology -- rather than a myriad of detail. Procedures should be specified only where appropriate: how mineral inventory or ore reserves were calculated, etc.

The various entities of the report will vary, but normally should include all pertinent aspects of the work done: history, Asarco's approach, geochemistry, geophysics, geology, mineral inventory, and recommendations for further testing. Such testing could be grid drilling by the exploration department or block delineation by the mining people, etc. And obviously a variety of final plan maps and cross-sections will accompany the report. These should be on a scale appropriate for the scope of the project.

Properties which are ready for reports of this type are Hardshell, Santa Cruz (The Lands) [after the '81 drilling?], and perhaps Superior East after the '81 drilling.

For those who would like to peruse a completed status report, check with me in connection with one for the Ventura property. (In fact, in view of the Asarco farm-in there may be a spare one around the office.)

One last comment. For your first writing of a DDH Summary, Progress Report, or Status Report within the guidelines of this memo, would you please provide me with a Xerox copy of the next-to-final draft. I retain the right to make a few editorial comments which should be considered but need not be followed to the letter. After one or two type reports each, we will understand each other's wavelength, which is the object of the exercise.

WDP:lb
Atts.

ASARCO MONTHLY DRILLING SUMMARY

DISTRICT _____

Project _____ Project No. _____ State _____ County _____ Month _____ Year _____ Page _____

Hole No.	Collar location	Bearing	Dip	Footage drilled			Remarks (significant intersections, geology and/or assay intervals, etc.)
				From	To	Feet	

ASARCO MONTHLY DRILLING SUMMARY

DISTRICT _____

Project _____ Project No. _____ State _____ County _____ Month _____ Year _____ Page _____

Hole No.	Collar location	Bearing	Dip	Footage drilled			Remarks (significant intersections, geology and/or assay intervals, etc.)
				From	To	Feet	

WDP - MVK 5266

NORANDA EXPLORATION, INC.
Tucson District

DIAMOND DRILL HOLE SUMMARY
and
Near-Term Recommendations for Ventura Property

DDH # - V 76-1 (0' to 2308') Drill Date - 2-4, 1976

Project/Account - Ventura (0820) Logged By - WDP, JSD

Location - Patagonia, Santa Cruz Co., Arizona Summary By - W. D. Payne

I. INTRODUCTION

The IP, soil geochemistry, surface geologic mapping and diamond drilling that were done at Ventura in 1974 showed that at a depth of about 1000' rested the top of a "porphyry" type copper system which trended northeast and had a 0.1% Cu contour width of 2000' and a 0.2% Cu contour width of about 1200'. The 1975 drilling was designed to test the northeast and southwest extension of this wide zone with the hope that one direction would show an increasing grade trend. In order to not lose sight of the forest for the trees, the holes were located about 1000' distant from existing drill holes.

The first of these, V 75-1, was drilled to the southwest and encountered the top of the system at 990'; it averaged 0.24% Cu to its bottom at 1662'. The location of the northeast hole, V 75-2, was somewhat southeast of where one would have preferred it but due to configuration of the claim boundary there was little choice. This hole collared in Triassic volcanics, proceeded quickly into Jurassic intrusives, went through several hundred feet of moderate alteration, then encountered 700' of strong phyllic alteration, and it bottomed in several hundred feet of weakly altered hornblende granodiorite. It was a most interesting

hole. Alteration was the most intense over a prolonged interval yet encountered in recent drilling, but copper was very weak - albeit in the presence of 5-15% pyrite. The obvious interpretation was that the alteration was coincident with a ruptured contact zone and accordingly the supposed Jurassic age for the granodiorite was seriously in doubt. A chemical analysis showed its composition to be quite similar to the Laramide Patagonia stock; an age date indicated it is Late Cretaceous.

Because V 75-2 was drilled east of the center line of the northeast trending copper system, and because its zone of intense alteration is presumed coincident with the southwest edge of the northwest trending hornblende granodiorite, and because at the approximate intersection of these two there is a rhyolite plug which we had dated and is of Laramide age (62 my), and because the old hole nearest this "triple intersection" (but still 1000' away) was the best that has ever been drilled at Ventura (V 27 bottomed in 600' of 0.56% Cu eq.), it was recommended that a hole be drilled in 1976 to test this apparent optimal location. Once again we were slightly snookered by claim boundaries; the exact location of V 76-1 was within the axis of the copper trend but about 600' southwest of the hornblende granodiorite contact. On the presumption that the latter was dipping to the southwest, this did not present a major concern at the outset of drilling.

V 76-1 was collared on February 12, 1976.

II. DATA FOR V 76-1

1). Petrology

A summary tabulation of rock types intersected in the hole is presented in Table 1.

TABLE 1 - Rock Type Distribution

From	To	Width Drilled	Rock Type
0' -	84'	84'	mixed granophyre and biotite monzonite
-	118	34	biotite quartz monzonite, to locally granophyric granite porphyry
-	163	45	granophyre (G)
-	178	15	biotite quartz monzonite (BQM)
-	219	41	G
-	239	20	granophyric granite porphyry (GGP)
-	265	26	G
-	452	187	BQM
-	461	9	GGP
-	540	79	rhyolite
-	595	55	BQM
-	616	21	fine-grained basic rock (xenolith)
-	657	41	BQM
-	709	52	GGP
-	1135	426	BQM - w/minor G; 6" basic @ 764', 1' @ 923'; big K spars below 1100'.
-	1156	21	G
-	1239	83	GGP
-	1262	23	G
-	1288	26	GGP
-	1315	27	G
-	1434	119	GGP. Grades to -
-	1468	34	BQM
-	1501	33	G
-	1586	85	BQM
-	1601	15	G
-	1635	34	GGP. Grades to -
-	1697	62	BQM
-	1734	37	quartz-eye rhyolite
-	1743	9	BQM
-	1776	33	rhyolite
-	1785	9	G
-	1810	25	GGP. Grades to -
-	1908	98	BQM
-	1962	54	tan, quartz-eye rhyolite
-	2140	178	BQM
2140 -	2308' (EOH)	168'+	porphyry - of unknown affiliation; rock is 2 feldspar, quartz-eye porphyry w/felsic g-mass. Probably Jurassic felsic derivative.

The near surface interval is characterized by an altered mixture of coarse grained biotite monzonite and granophyre, with none of the former present below 84'. This upper section thus represents the contact zone between Jm and the J_{3R} rock group.

The J_{3R} granite clan is present to 2140' and contains minor inclusions of basic rock and narrow dikes (30-80' drilled width) of rhyolite - both the aphanitic and quartz-eye types. As usual, the longer sections of individual J_{3R} units are uniform in texture and composition, but, as noted before, transitions are often gradational when proceeding from granophyre to granophyric granite porphyry or granophyric granite porphyry to biotite quartz monzonite but never between granophyre and biotite quartz monzonite. The granophyre surely crosscuts the biotite quartz monzonite.

The bottom section of the hole encountered a 2-feldspar, quartz-eye porphyry which appears to be massive. As evidenced by the cataclasis present in the overlying biotite quartz monzonite it is a late intrusive into the Jurassic igneous rocks. Preliminary chemical data suggest it is closely allied to the Jurassic Comoro Canyon granite - probably a derivative therefrom - and not the Laramide rhyolites. This distinction is important.

2). Structure

There are two modes of structure present in V 76-1. (One might think of them as the "too early" and the "too late" types.)

There is a zone 80-100' above the bottom porphyry in which the biotite quartz monzonite is strongly micro-fractured and has a gross cataclastic texture. Some of the fractures are filled with seams

of sulphides (eg 2075') but most appear to have healed before significant mineralization took place. At first this fracturing was considered a peripheral effect from the hornblende granodiorite intrusion, and as such was the sole reason we persevered in the hole beyond 2000'. However, once the porphyry was encountered, and when it was evident that the latter was both massive and probably not Laramide, the significance of this structurally-disrupted zone diminished.

All rock units, all alteration zones, and all grade zones have been subjected to a late structural event that is represented by ubiquitous, steep slickensides and locally minor fault gouge. These almost certainly are Basin and Range effects of mid-Tertiary time. They have been noted before at Ventura, but never to the extent seen in V 76-1. Although present in moderate density throughout this hole there are a few intervals where they number 1-4 per foot (1950-2050'). Occasionally they appear to coalesce into post mineral fault-breccia zones, and rarely they occur as 2"-4" clay gouge (eg 80'). We have had a watchful eye on these structures before and have never felt that the composite slippage or offset was significant. Their increased number in this hole however certainly begs the question because their total is surely greater than 500 and perhaps as many as one thousand. Total offset may be as little as a few tens of feet to upwards of many hundreds of feet.

There appears to have been very little structural rupturing adjacent to all but one of the rhyolite dikes.

3). Alteration

From surface down to about 800' the alteration rank is propylitic but contains about 40% combined, structure-controlled, green argillic and phyllic types - an amount much higher than noted before in the upper propylitic zone.

Below 800', and coincident with the onset of the first 0.2% Cu grade interval, the alteration changes to a pattern of wide zones of green argillic, low sericite and phyllic, most of which contain some patches of lower or higher rank. With few exceptions this pattern continues ad nauseum to the bottom, although there does seem to be a decrease in the phyllic type within the final 500'.

In general the grade/alteration correlation is weak. Any correlation on a zone basis (see Table 2) is practically fortuitous, but on a gross basis and on a micro basis it is not. For example, it is only below the upper dominantly propylitic section that continuous, pervasive mineralization is present. And, only in the intensely phyllic altered section between two dikes at 1740' does the grade commence to approach good value: 0.7% Cu with significant additional credits; well developed, high grade quartz-sulphide veins which are present in the interval 1100-1500' invariably have high rank alteration haloes.

4). Mineralization

Weighted average assay data for below 830' are shown on Table 3.

Copper mineralization is entirely structure-controlled above 830' and values vary from 50 to 4000 ppm with an estimated average (based

V 76-1

TABLE 2 - General Alteration Distribution

From	To	Width	Type
0' -	785'	785'	Propylitic with moderate widths of structure controlled green argillic, phyllic
-	915	130	phyllic and green argillic in 5-40' zones
-	990	75	green argillic with few narrow patches propylitic
-	1097	107	phyllic with few narrow patches green argillic
-	1135	38	green argillic with few narrow propylitic patches to 5' wide
-	1335	200	phyllic
-	1532	197	green argillic to weak hi sericite (vis granophyre)
-	1668	136	moderate to strong green argillic with few propylitic patches, local lo-hi sericite.
-	1734	66	weak phyllic
-	1743	9	intense phyllic
-	1810	67	low sericite to green argillic
-	1962	152	zones green argillic and propylitic 20-40' wide
1962 -	2308'	346'	moderate to strong green argillic with occasional patches propylitic, uncommon zones low sericite.

TABLE 3 - Assay Summary

From	To	Width	Cu %	Mo ppm
830'-	909'	79'	0.21	31
909 -	1133	224	0.09	8
1133 -	1625	492	0.20	47
1625 -	1725	100	0.14	30
1725 -	1743	18	0.56	175
1743 -	2064	321	0.10	16
2064 -	2098	34	0.29	389
2098 -	2308	210	0.11	10
TOTALS:				
830'-	2308'	1478'	0.15%	37 ppm

on spot sampling) of about 450 ppm. This upper zone average is much better than encountered in previous holes. The first significant width of 0.2% occurs at a mere 145' down the hole, and this is much higher up than in previous holes.

Other metals of interest pretty much conform to previously established patterns for the Ventura system. Lead is notable in the upper 400'; zinc is weak to 150', strong to 1000', weak to moderate to 1500' and of background to slightly above background below that. The bottom 300-400' average about 30-45 ppm Zn. Molybdenum is roughly correlative with the copper patterns but is nowhere very exciting. Disseminated Mo is about the same, perhaps a bit better, than previous holes but V 76-1 certainly lacked the abundant quartz-moly veins that characterize the near-breccia pipe environs.

Gold is quite scarce throughout but is locally anomalous in some of the upper Cu-Zn veins. One gets the hint that there is very minor gold throughout the deep part of the system, for detectable amounts are noted for most samples in which copper exceeds 0.4%. Notable silver is distributed in a bimodal fashion as is generally the case at Ventura; it is allied with the peripheral lead/zinc and with the interior copper. Vis the latter, silver values are 1-4 ppm with Cu >0.4% and 0.2-0.6 ppm for copper values of 0.1-0.25%.

III. INTERPRETATION

What happened to the anticipated grade? Perhaps more important, in light of the data from this hole, is the question: is it there to be found at all?

The answer to the first is in general terms quite simple. The structurally ruptured contact zone of the hornblende granodiorite was not encountered, and, therefore, no zone for preferred localization of hydrothermal fluids was found. Without this zone - or any other one similar in nature - there was not much of a chance that good grade could - or should - have been encountered. Data from V 75-2 indicated a southwest dip on the hornblende granodiorite contact and accordingly it was anticipated in V 76-1 at 1600-2000'. (Any hole design for higher intersection of this contact would have required a collar location on Asarco ground.)

Obviously, by not having encountered this contact zone at a point coincident within the confines of the Ventura deep system it is impossible to predict what it might be like. One can only hope that a few small examples bear a reasonable similarity. In particular, the case at 1740' where there had been an obvious streaming of fluids up along the footwall of a narrow rhyolite dike to produce intense alteration, 0.7% Cu grade and notable credits of Mo, Au and Ag.

If the contact zone does contain significant mineralization, the chances are good that such a zone might be quite extensive along strike. Further, a majority of this would be on Noranda's ground, as the southwest contact swings northwest and its unexposed top may well continue to the west. There are no drill holes anywhere near this curvilinear contact zone - either on Noranda or Asarco ground.

The Ventura system, as now drilled, is 2500'+ by 1000-2000' wide and seemingly bottomless. A probable 400 million to 1 billion tons of low grade rock are present therein and the mineralized system is still open-ended to the southwest and north-northeast (and possibly to the west-northwest if the north end of the system is swinging that way as current suggestions indicate).

There is no apparent rationale for expecting the grade to increase to the south although the system certainly extends that way. Nor can one expect, for any cogent reason, the grade to increase to the north unless and until it comes up to a decent conduit zone. Only the hornblende granodiorite contact - probably in proximity to the rhyolite - can be expected to produce this effect.

If the Ventura system were an early, deep dry type (what we refer to as "in-batholith mode") then even a good contact zone might not be able to do the job. But the enormous quantities of argillic, low sericite (K-spar still stable), and local phyllic alteration, in addition to abundant added quartz all add up to the strong suggestion that there ought to be a focal point. There are some arguments that mitigate against this, but for the moment they are not of much weight.

IV. RECOMMENDATIONS FOR VENTURA

The system is large, it is complicated, and it is almost resolved. For the completion of the latter, there remain two things to be done.

The extreme eastern portion of the property and the southern 20% have yet to be mapped. Also, there are a number of adits which are in reasonably critical locations that need to be examined and sampled. This may require about three weeks and one week respectively of field work and should be undertaken this summer. Such work is not expected to change the picture very much, but rather to merely complete it.

The north-northeast side of the Ventura deep system ought to be drill tested. It is a reasonably defined target concept and it is probably the last of those on Noranda ground. It is recommended that such

a hole be drilled in January, 1977. This would serve as assessment work for the 1976-1977 assessment year and would hold the ground through August, 1978. (Pending a metallurgical breakthrough?)

This hole can find one of only three things: nothing, low grade or good grade. If the first, then a joint venture partner ought to be called in to drill out the south end - and perhaps the southeast corner IP anomalism in the Patagonia stock rock.

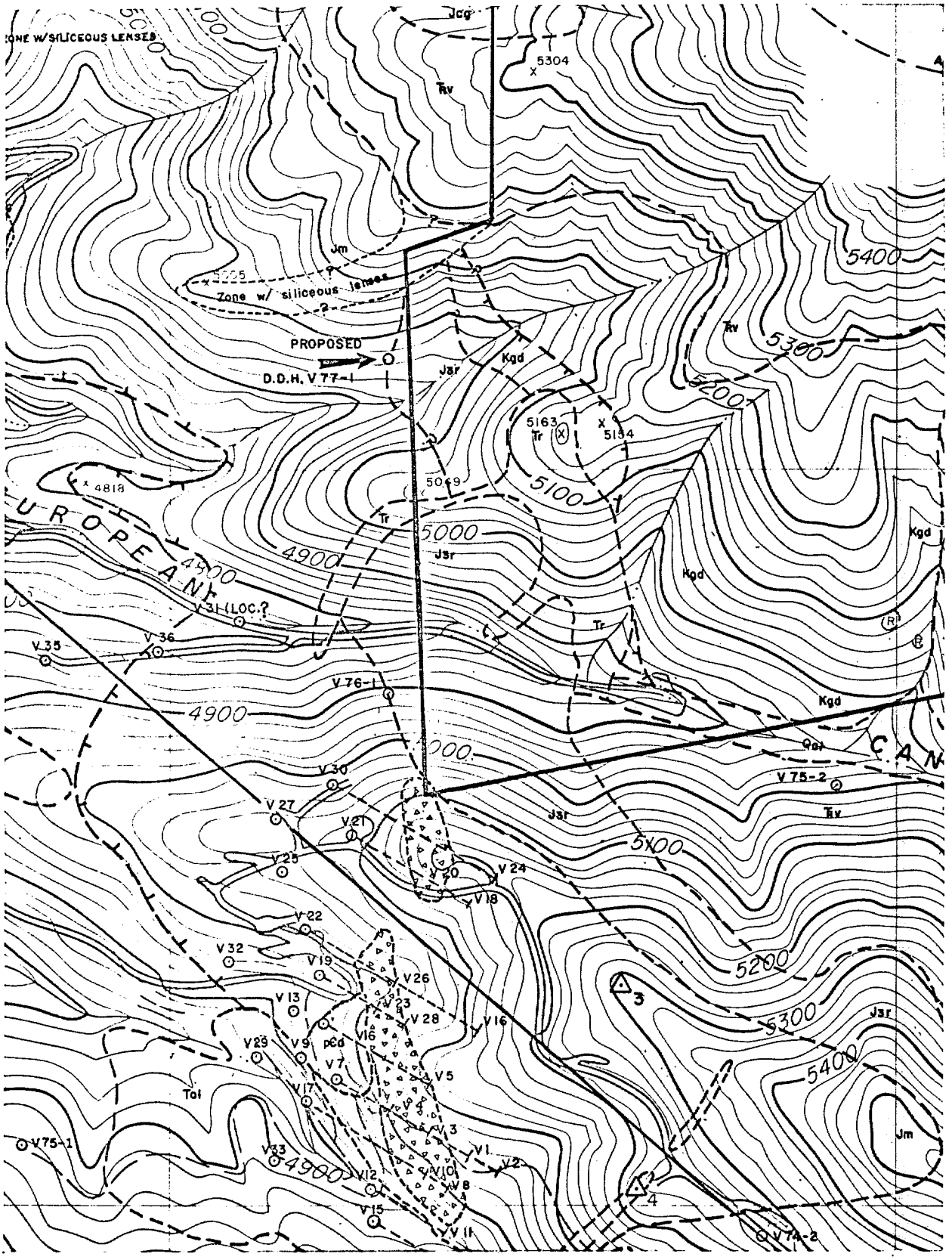
If it is low grade then conceptually a deposit can still be present - but it would have to be on Asarco/Anaconda 3R property and perhaps some arrangement could be made with them, at that point, to test possibilities using our information and their ground. (For example, nothing has been said regarding potential on the northeast side of the hornblende granodiorite, where, upon close scrutiny, the possibilities might be excellent. Or, adjacent to the big plug of quartz-eye rhyolite which is 1000' east of the granodiorite.)

If the proposed hole is of good grade, well, that might mean yet another reprieve for Ventura.

At any rate, the hole ought to get drilled.

E 16000

E 18000



Portion of geologic map for Ventura property. Shown are locations of recent drill holes, proposed V 77-1 drill hole, and general geologic features. Explanation of general units is on following page.

This figure to accompany drill hole summary for DDH V 76-1.

Scale 1"=400'

EXPLANATION

QUATERNARY	Qal	Post Basin & Range valley fill. Unconsolidated boulder and gravel debris
	Tal	Pre Basin & Range valley fill, probably mid Tertiary. Included: Abundant fercrete development in stream channels, deep gruss formation, local wedges of thick sand and gravel
TERTIARY	Tg	Patagonia stock. Biotite hornblende granodiorite. Age 58 (-64?) my: USGS per Simons (1975)
	Tr	Rhyolite; plugs and dikes, generally aphanitic. Locally with phenocrysts of quartz (Q) or Feldspar (F). Often totally silicified (yellow); Age: 62 ± 2.5my: K-Ar whole rock data: Noranda via Geochron Labs 1975
LATE CRETACEOUS	Kgd	Hornblende granodiorite; small apophyses of this unit are often quite hybrid. Age: Hornblende 88 ± 3 m.y., Kspar concentrate 75 ± 3.5 m.y., Noranda via Geochron Labs 1975
JURASSIC	Jfg	Fine grained leucogranite - plugs & dikes; occassionally with enough biotite and plagioclase to be fine grained bqm. Ventura aplites and pegmatites probably related to this unit
	Jcg	Comoro Canyon granite; coarse grained leucogranite to biotite granite / qm. Unit very siliceous in 3 R Canyon. Age 160 ± 20 m.y. Data on zircons per USGS (Simons) 1975
	J3r	3 R Granite Clan { g Granophyre; ggp Granophyric granite porphyry; bqm (Porphyritic) Biotite quartz monzonite; perhaps equivalent to Jcg
	Jm	Coarse grained biotite monzonite (locally syenitic); Age 150 ± 20 my: data on zircons; USGS per Simons 1975
TRIASSIC	Trv	Silicic to intermediate volcanics; intrusive, extrusive, volcaniclastics (often quartzitic)
PRECAMBRIAN	pCd	Xenoliths and large pendants of fine/medium/or coarse grained hornblende diorite. Tabular shaped xenoliths are common and appear to be dikes

AMERICAN SMELTING AND REFINING COMPANY
TUCSON ARIZONA

April 9, 1975

W. L. K.
APR 14 1975

TO: DIVISION SUPERVISORS

EXPLORATION RECORD SHEETS

As mentioned in my memo of 2-21-75, item 27, "Environment," continues to be misconstrued by some. It may in part be due to the format, even though each item is covered in the instruction sheet.

In an attempt to resolve the problem, "Nature of Exposures" has been substituted for "Environment" on the enclosed Exploration Record sheet, which is to be used henceforth.

Also enclosed are "Instructions for Completing ASARCO Exploration Record" which has been revised or expanded as follows:

(14) "No Action," or "Future Reference," or "Further Study" may be an appropriate notation (in the blank space) in some cases. "Technical" should be used for unavailable properties, or mines operated by other companies.

(27) Intensity of weathering, extent of post-mineral cover rocks and soils, outcrop percentage, topographic relief (high or low?).

(31) Enter information as to nature and extent of mineral occurrence, genetic type, ore controls.

Kindly provide each geologist on your staff with a copy of this revised instruction sheet.

J.H. Courtright

JHC:vmh
Enclosures: 2
cc: J.J. Collins w/enclosures

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Revised - April 8, 1975

Instructions for Completing ASARCO Exploration Record

Section I General Indexing
(1) thru (5) Self-explanatory.
(6) (7) If record area is too large to be represented by a single latitude or longitude, area should be bracketed by min. and max. lat. and long.
(8) Completion of this section is optional.
(9) thru (12) Self-explanatory.

Section II Sources of Information
(13) Enter all references by order of importance from which information is drawn in preparing the summary.

Section III Appraisal
(14) "No Action," or "Future Reference," or "Further Study" may be an appropriate notation (in the blank space) in some cases. "Technical" should be used for unavailable properties, or mines operated by other companies.
(15) Check appropriate box for stage of development or fill in blank if choices not appropriate. (More than one check is permissible.)
(16) (17) Enter production and reserve information where available. (18) Total drill holes, all types. (19) Excavations: numberof trenches, pits, adits, shafts.
(20) Check box if spectrographic analyses are attached.
(21) Check box if assays are attached.
(22) Check box if geochem results are attached.

Section IV Geologic Data
(23) Enter name or symbol of metals or commodity known or being sought in the area of interest.
(24) Enter ore minerals mentioned in order of abundance. Abbreviations or full mineral names acceptable.
(25) Enter classification of known or reported host rocks by order of importance.
(26) Enter age of host rocks in blank space immediately below the name of host rock on Line 20.
(27) Intensity of weathering, extent of post-mineral cover rocks and soils, outcrop percentage, topographic relief (high or low?).
(28) Enter alteration types, minerals and/or effects, such as bleaching, coloration, recrystallization, etc.
(29) Enter dimensions of alteration.
(30) Enter brief statement on regional (such as basin-range) and local structure (breccia pipes, folds, faults, etc.).
(31) Enter information as to nature and extent of mineral occurrence, genetic type, ore controls.
(32) Enter age of mineralization - geologic and absolute age if known.
(33) Brief statement as to conclusions and recommendations - use back of sheet to complete statement, or for additional comments as desired.

The Santa Cruz In Situ Copper Mining Research Project

A cooperative project between the U.S. Bureau of Mines and the Santa Cruz Joint Venture.

The Santa Cruz Project is part of a larger Bureau of Mines research program investigating in situ mining methods. Prior to undertaking this project, the Bureau of Mines completed the first phase of a comprehensive laboratory research program and a draft generic design manual on in situ copper mining. The Santa Cruz mining property was chosen by the Bureau of Mines for the test site, in part, because it met the Bureau's physical requirements. These requirements included: size of ore body, depth and grade of mineralization, undisturbed condition and saturation with water.

The Santa Cruz Joint Venture, the owner of the mining property, is a partnership of subsidiaries of ASARCO Incorporated and Freeport-McMoRan Incorporated. ASARCO Santa Cruz, Inc. is managing the project under a cooperative agreement with the Bureau of Mines. The Joint Venture is also sharing in the cost.

The Bureau of Mines share of the project is funded through a special congressional appropriation sponsored by Senator Dennis DeConcini and supported by Congressman Morris K. Udall, Congressman Jim Kolbe and other members of the Arizona delegation and approved by the administration.

All of the results of the research conducted by the Santa Cruz In Situ Mining Research Project will be available to the mining industry and to the public.

In Situ Project Manager
ASARCO Santa Cruz, Inc.
P.O. 5747
Tucson, AZ 85703

The Santa Cruz Project

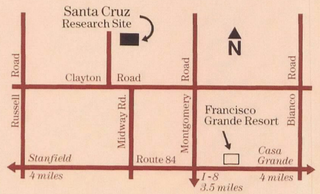
Location & Geology

The research site is located about seven miles west from Casa Grande and about two miles north from Arizona State Highway 84 on agricultural land that has been retired from farming for many years.

The copper deposit, known as the Santa Cruz ore body, extends over an area less than one square mile. The Santa Cruz deposit is separate from the copper deposit at the Sacaton open-pit mine located six miles northeast from the research site.

Test drilling at the project site reveals the upper surface of the barren granitic bedrock to be about 650 feet below the land surface. The copper mineralization occurs within this bedrock below a depth of 1,200 feet.

Basin-fill deposits of sand, gravel and clay overlie the bedrock and are the principal aquifer that supplies groundwater to local wells. The project is designed to protect this aquifer from contamination.



The Research Project

A series of tests using fresh water will be conducted over a period of many months to gain information on the movement of fluids through the ore body. Knowledge of fluid movement is basic to the design of a well field that will control and contain the acid solution used for in situ mining.

Initially, five wells will be drilled to a depth of about 1,880 feet for injection and recovery. The wells will be constructed so no fluids can migrate up the borehole from the injection zone into the basin-fill deposits aquifer.

The four recovery wells will form a square with side dimensions of 127 feet. The fifth well, an injection well, will be drilled at the center of the square and will be 90 feet from each of the four recovery wells. Permeability of the surrounding bedrock will be tested by injecting fresh water into the wells at intervals during construction.

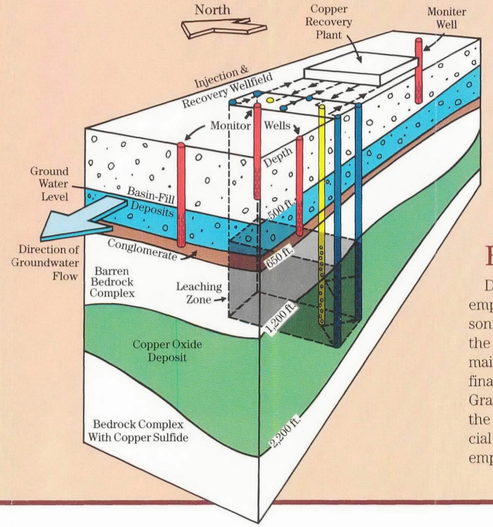
If these tests prove encouraging, a tracer test will be conducted using a solution of water and table salt. The tracer solution will be injected into the well at the center of the square and recovered at the four wells located at the corners. Injection and recovery will occur through perforations in the well casing at depths from 1,500 feet to 1,850 feet below land surface. Pumping from the four recovery wells will be continuous to create a hydrologic barrier that will contain the solution within the injection zone.

If the analysis of this test demonstrates that the solution was contained within the injection zone and was successfully recovered, testing with acid solution will be initiated. Three more wells may be constructed forming a double five spot pattern prior to actual leaching. Injection of dilute acid solutions and recovery of copper bearing solution will not be initiated until all environmental requirements have been met.

Four groundwater monitoring wells located to identify any release of injection solutions into the basin-fill deposits aquifer will be sampled throughout the research period.

Environmental Safeguards

Two sets of environmental requirements must be met before injection of acid solutions can occur; the requirements of the Aquifer Protection Permit from the Arizona Department of Environmental Quality and requirements of the National Environmental Policy Act. In addition, the environmental managers of ASARCO Incorporated, Freeport-Copper Company and the U. S. Bureau of Mines must also give the project their full approval before any injection of acid solutions will occur.



The first phase of the project is designed to yield the information necessary to satisfy the requirements of the responsible state and federal agencies and the managers of the Santa Cruz Joint Venture.

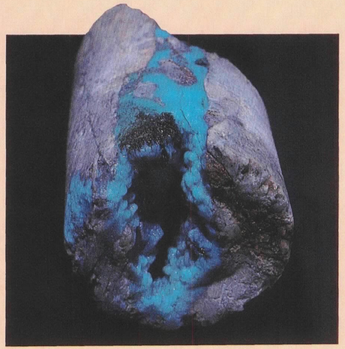
The environmental effects of in situ mining are minimal. Facilities on the land surface consist of wellheads, piping to transport solutions and eventually a solvent extraction/electrowinning plant. Risk of surface subsidence is minimal because very little of the rock in the bedrock leaching zone will be removed and the structure of the rock will not be changed. There will be very little dust or noise. Temporary storage of solutions at the surface will be in ponds lined with an impermeable membrane. Since all solutions are continuously recycled, there is virtually no waste.

Continuous recycling also conserves water. Total water use is estimated not to exceed 10 acre feet per year during the test period and 20 acre feet per year during operation of the pilot plant. Water requirements for a commercial scale operation are estimated not to exceed 1,000 acre feet per year. The Santa Cruz Joint Venture holds Type 1 non-irrigation water rights in excess of these amounts.

Employment

During the test phase of the research project, employment will consist primarily of project personnel. Construction workers will be added during the third year of the project. Plant operators and maintenance personnel will be needed during the final two years of the research program. Local Casa Grande firms will be used as much as possible. If the research program is successful and a commercial scale operation is initiated, the plant will employ up to 120 people.

The Santa Cruz
In Situ Copper Mining
Research Project



A Cooperative Project of
The U.S. Bureau of Mines &
The Santa Cruz Joint Venture –
ASARCO Santa Cruz, Inc.
Freeport Copper Company

In Situ Copper Mining

Drilling at the research site.

In situ mining is a promising new alternative technology for the extraction of valuable metals that cannot be mined by conventional mining methods because of relatively high costs.

The Santa Cruz Project will test the technical, economic and environmental feasibility of this alternative technology on an undisturbed copper oxide ore body. The Santa Cruz Joint Venture expects to pursue a commercial scale operation at this location.

If the demonstration is successful, the technology can be applied to other deeply buried copper oxide deposits of similar type. Many copper deposits that cannot now be mined for economic reasons can be added to the nation's copper resource inventory. This project and other similar projects have the potential to bring new jobs to Arizona and the Casa Grande area and to expand the region's tax base.

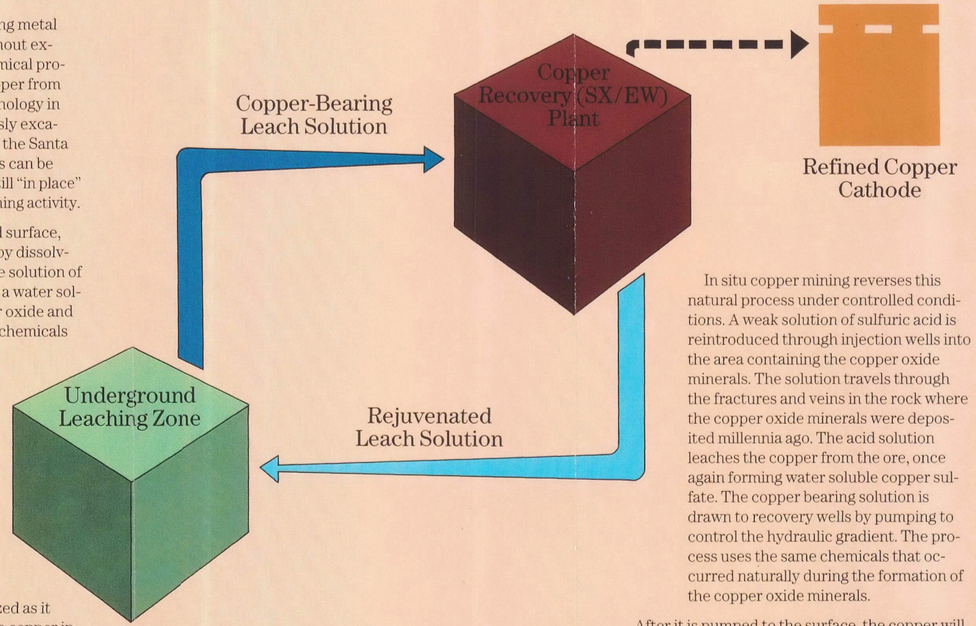
A hydrologist taking water samples.

In situ mining is a method of extracting metal from an ore body "in place", that is, without excavating the ore-bearing rock. The chemical process that will be used to extract the copper from the Santa Cruz ore body is proven technology in general use in heap leaching of previously excavated copper oxide ore. The purpose of the Santa Cruz Project is to show that this process can be used to extract copper from ore that is still "in place" and has not been broken by previous mining activity.

Whether below ground or on the land surface, the process of metal extraction begins by dissolving the copper oxide minerals in a dilute solution of sulfuric acid and water. Copper sulfate, a water soluble compound, is formed when copper oxide and sulfuric acid come in contact. No other chemicals are needed to dissolve the copper.

A similar leaching process occurred naturally millions of years ago when the copper oxide minerals in the Santa Cruz deposit were formed. Geologists tell us that the copper was originally deposited as copper sulfide minerals. Through exposure to air and water, the upper portion of the deposit was gradually oxidized, producing a weak solution of sulfuric acid and copper sulfate.

The acid in the solution was neutralized as it came in contact with alkaline rocks. The copper in the solution then reacted with minerals in the rocks and with chemicals in the solution to form the variety of copper oxide minerals found in the ore body today. Copper sulfide minerals still underlie the copper oxide deposits.



In situ copper mining reverses this natural process under controlled conditions. A weak solution of sulfuric acid is reintroduced through injection wells into the area containing the copper oxide minerals. The solution travels through the fractures and veins in the rock where the copper oxide minerals were deposited millennia ago. The acid solution leaches the copper from the ore, once again forming water soluble copper sulfate. The copper bearing solution is drawn to recovery wells by pumping to control the hydraulic gradient. The process uses the same chemicals that occurred naturally during the formation of the copper oxide minerals.

After it is pumped to the surface, the copper will be removed from the solution through a process called solvent extraction/electrowinning, or SX/EW. The spent acid will be replaced and the rejuvenated solution recycled repeatedly through the buried copper oxide ore.

The Groundwater in the Basin-fill Deposits Aquifer will be Protected Because:

- Several hundred feet of barren granite bedrock separates the basin-fill deposits from the leaching zone. Water moves very slowly through these granitic rocks.
- Injection and recovery wells will be constructed to prevent leakage of solution from the wells into the basin-fill deposits aquifer.
- The well system will be tested with saline tracer solution before injection of acid solution to make sure that the solutions can be controlled and contained in the leach zone. This will insure that the basin-fill deposits aquifer will be protected.
- Monitoring wells in the basin-fill deposits aquifer will continue to demonstrate the reliability of the water quality protection program throughout the life of the project.

CIRCULATE:

~~T. C. BENAVIDEZ~~
~~R. B. CRIST~~
~~R. B. CUMMINGS~~
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~~G. P. STATHIS~~
~~H. M. STONE~~
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ERVICES DIVISION
TH 700 WEST
ITY, UTAH 84119

9, 1974

W. L. K. MAY 21 1974

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

RS, ETC.: S.A. Anzalone
M.P. Barnes
R.L. Brown
B.J. Devere Jr.
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D.D. Harper
W.L. Kurtz
J.J. Merz
J. Sample
R.B. Sprague
K. Whiting

FIELD TEST FOR SECONDARY ZINC MINERALS

Secondary zinc minerals are frequently difficult to recognize in the field. The advent of a simple diagnostic field test is therefore welcome. This test, was described in a recent Canadian paper "Exploration for Lead-Zinc in the Selwyn and Mackenzie Mountains, Yukon and Northwest Territories" by J. Daniel Murphy and W. D. Sinclair, Dept. of Indian and Northern Affairs, which was drawn to my attention by Mr. S. A. Anzalone. It utilizes a light yellow colored solution which turns a distinctive orange-brown on contact with secondary zinc minerals (i.e. zinc carbonate and zinc oxide, etc.). This solution can be readily dispensed from a small plastic "squirt" bottle.

The test solution comprises equal volumes of 3% potassium ferricyanide (in water) 3% oxalic acid (in water) and 0.5% diethylaniline (in an organic solvent such as ethyl alcohol). In view of the poisonous nature of the constituent reagents care must obviously be taken in field handling the solution.

We do not yet have sufficient operating experience with the solution to determine its field operating life.

Presumably the test solution could be best prepared by a geochemical laboratory in your locality.

L. D. James

L. D. JAMES

LDJ:db

cc:J.J.Collins/T.C.Osborne

J. D. Sell

FILE

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

September 23, 1970

MEMO FOR: JJCollins

Heddleston-Anaconda
(Mike Horse)
Lewis and Clark Co,, Mont.

A visit to Heddleston, arranged by Mr. Whiting, was made on September 14, with Bill Salisbury, Russell Smith and Jerry Aiken. Charles Whitcomb, Anaconda geologist, conducted the tour. Some areas were inaccessible because of a recent snow fall, and observations were limited to occasional exposures along drill roadcuts.

Their drill location map showed a drilling pattern extending 5,000' south and 3,000' north of the Blackfoot River with a width of around 2,500'. The denser hole spacing (200') extends about 2,000' south and 2,000' north of the river, indicating dimensions of around 2,000' by 4,000' for the best part of the deposit.

We obtained no specific information as to tonnage and grade. According to the files (Mr. Pollock's memo of 12-23-66 and Mr. Whiting's of 11-2-67) the reserve may approach 200 million tons of open pit ore at 0.50% Cu with minor moly. We were informed that the better moly values occur in the extreme south end of the zone (south of the copper ore body?) and that the overall average is less than 0.01% Mo.

The quartz monzonite porphyry cuts Belt Series sediments forming a body over 7,000' in length and 2,000' to 3,000' in width. On the northwest it crosses for a short distance under Highway 20 near the Mike Horse road junction. Only one drill was operating. It was located around 1,500' southeast of this junction. The core showed very minor chalcocite with essentially pyritic mineralization otherwise in moderately altered monzonite porphyry at about 140' to 170', probably containing less than 0.30% Cu.

Primary sulphides, pyrite-chalcopyrite are pervasive in the quartz-monzonite but reportedly extend only short distances into the sediments. The average sulphide content was stated to be 5% (4% pyrite). Oxidation and leaching extends from a few feet to 100' below the surface. Chalcocite enrichment forms a blanket-like zone which conforms roughly to existing topography. That is, the depth to sulphides from the surface at the Blackfoot River is comparable to depths in the hills to the north and south.

Where exposed in roadcuts, the leached capping consists of monzonite porphyry, laced by quartz veinlets, with pervasive, strong sericite-clay alteration. Residual limonites are moderately abundant and give the rock a medium to pale brown tone. Some yellowish jarosite is present. Dark brown to black limonites, common in the capping over the higher grade enriched deposits of the Southwest, vary from sparse to absent. Post-mineral stresses have produced intense shattering causing the rock to be quite friable and subject to disintegration. Judging by roadcuts, soil with intermingled bedrock fragments varies from 5' to 10' or more in depth and covers essentially the entire zone of alteration-mineralization. No copper oxides or silicates were observed in the leached capping exposures, or in floats derived from the capping.

Outcrops of fresh diorite-gabbro (or diabase) were seen outside the zone of mineralization. Inside the zone, on the slopes south of the Blackfoot, boulders of massive dark brown gossan were observed in a roadcut. The original rock texture was not discernable, however the boulders were presumably derived from the diorite-gabbro sill. We were told that one or more drill holes passed through the gossan into highly pyritized gabbro beneath with no appreciable copper values.

A brief inspection was made of the dump from an adit driven south of the Blackfoot for metallurgical samples. The sulphide "ore" consisted of strongly altered (sericite-clay) monzonite porphyry containing numerous quartz-pyrite-chalcocite veinlets with minor chalcopyrite. Discrete sulphide grains were abundant between veinlets. Molybdenite occurred as thin coatings.

The original exploratory program was carried out with churn drills. Diamond drilling is now employed. Cores are split by diamond saw.

Although relatively low in grade, the deposit closely resembles the enriched porphyry copper type, and its demonstrated existance, along with Butte (Mont.) and Casino (Yukon) invalidates the widely held concept of the past that due to glacial erosion, climate, etc., primary mineralization only is to be found in the North.

The critical factors are the amount of pyrite and degree of alteration. Where the pyrite content is low (say 1.0%, or less) and the alteration weak (reactive gangue) essentially no migration

of copper takes place, such as at Ajo, Arizona. The Bethlehem, B. C. deposit is comparable to Ajo in this respect, but is situated in an area deeply carved by glaciation. I believe a valid assumption is that the rock removed contained no appreciable enrichment. A number of chalcocite blankets no doubt have been destroyed by erosion, however there should be others that remain to be discovered.

J.H. Courtright

J.H. Courtright

JHC/jmm

cc: KWhiting

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

FILE

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

FILE

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

January 6, 1972

Memorandum

TO: W. L. Kurtz

FROM: J. D. Sell

Reserve Figures - Copper
Major Deposits

This memorandum is to upgrade and supplement my memo to W. E. Saegart (June 16, 1971) entitled: Production - Grade - Reserves, Major Mines - Superior East Project Area. The figures, by company, are based on published reports unless otherwise indicated.

Anaconda Company. Sulfide reserves Sept. 1, 1968; World Mining, vol. 4, no. 13, p. 56, December 1968.

Twin Buttes	292,000,000 tons of 0.88%	
Twin Buttes	20,000,000 tons of 0.8% oxide stockpiled	(Verbal)
Eisenhower (Palo Verde)	76,400,000 tons of 0.65%(?)	1962 Mineral Yearbook
Yerington	67,000,000 tons of 0.54%	
Yerington	28,000,000 tons of 0.57% oxide	
Butte, open pit	414,000,000 tons of 0.74%	
Butte, underground	12,500,000 tons of 4.27%	
Cananea	177,000,000 tons of 0.81%	
Cananea (Proposed Pit)	825,000,000 tons of 0.73%	Pay Dirt, Sept. 1971

ASARCO. Prospectus, Jan. 1, 1968.

Mission	113,360,000 tons of 0.68%	
Silver [illegible]		
Oxide Mine	21,140,000 tons of 0.68%	
El Tiro Mine	27,343,000 tons of 0.73%	
Leach Dumps	40,822,000 tons of 0.35%	
San Xavier		
Sulfide	69,076,000 tons of 0.51%	
Oxide	7,292,000 tons of 0.83%	
Sacaton		
Open-pit	22,400,000 tons of 0.86%	sulfide
Underground	14,558,000 tons of 1.36%	sulfide

Bagdad Copper Company - 1969.

Bagdad	46,000,000 tons of 0.69%
"	200,000,000 tons of 0.50%
"	110,000,000 tons of 0.40%

Cities Service Company - December 31, 1968.

Copper Cities	18,000,000 tons of 0.55%
Diamond H	13,000,000 tons of 0.55% sulfide
Diamond H	6,000,000 tons of 0.55% oxide
Pinto Valley	350,000,000 tons of 0.45% (Verbal communication suggests at least twice this amount and possibly three times.)

Miami Mine -- Expansion to NW into Inspiration townsite plus common boundary area with ICC Thorton pit suggests ± 100,000,000 tons at ± 0.5%.

Central zone of Copper Cities - Diamond H altered area is known to contain minor chalcocite and primary values running 0.3-0.35% copper under +300 feet of leached capping. Chalcocite is not sufficient to support stripping at this time. Note in U of A Porphyry Copper Volume, p. 154, reports..... "Recent drilling to the west (of Copper Cities), outside the pit, has shown a significant increase in copper with depth. A thickness of 200 to 300 feet of material averaging +0.4 percent total copper is overlain by 700 to 1000 feet of material averaging about 0.1 percent total copper." Area and thickness of primary suggests +300,000,000 tons of +0.3%.

Also, verbal pit foreman 1969, ore continues under the shallow dipping Drummond fault northeast side of Copper Cities pit. The "barren" hanging wall material will not presently carry the stripping necessary to expose ± 20,000,000 tons of 0.5% in this area.

Miami East. From reported depths and assays of the three companies involved in the faulted offset, it is suggested that Miami's portion may be ± 300,000,000 tons of ± 1.0%. Also verbal, the present Miami feasibility study probably is in the best area and involves some 80,000,000 tons. Underground work is being pushed into this area.

Cactus Area. The area is underlain by a flat fault which cuts off a chalcocite-enriched mineral deposit suggested to be some 15-20,000,000 tons of ± 0.5%. Abundant oxide copper overlies and surrounds the sulfide body. Calculation of the size of altered schist breccia and possible grade suggests some 40,000,000 tons of +0.5% oxide copper in the block controlled by Cities Service.

CONOCO Reported in 1971 Annual Report, p. 27
Florence (Rosa-Butte) "Indicated total ore reserves are about 500 million tons with an average grade slightly above 0.5% copper." Verbal: PB west has 75-100 million tons of oxide @ 0.5%; PB East has 200-250 million tons of oxide @ +0.4% copper.

Duval Corporation. Reserves of January 1, 1968. Mining World, v. 5, no. 3, p. 51, March 1969 and also see Prospectus.

Ithica Peak	54,538,000 tons of 0.49% Cu + 0.044% Mo
Esperanza	41,215,000 tons of 0.45% Cu + 0.032% Mo
Copper Canyon (Nev.)	18,237,000 tons of 0.74% Cu
Copper Basin (Nev.)	3,437,000 tons of 1.43% Cu
Sierrita (1971)	524,000,000 tons of 0.33% Cu + 0.033% Mo

El Paso-Hecla.

Lakeshore	207,000,000 tons of 0.71% oxide
"	241,000,000 tons of 0.7% sulfide
"	24,000,000 tons of 1.69%, tactite sulfide

Homestake Production. Verbal and visual information.

Carlotta	3,600,000 tons of 1.65% Kelly ore (fault zone)
"	5,000,000 tons of 1.03% Carlotta ore (breccia)
"	(based on property boundary and mineral location it is calculated that the Carlotta block contains some 15,000,000 tons of ore.)

Inspiration Consolidated Copper Co. Annual Report for 1970, with reserves to January 1, 1971

Inspiration area	1,507,622,000	pounds	of	recoverable	copper	≅85 million tons of ore
Christmas, underground	567,605,000	"	"	"	"	
Christmas, open-pit	278,122,000	"	"	"	"	
Sanchez	160,917,000	"	"	"	"	

Kennecott Copper Corporation. "Proven" reserves as of January 1, 1971. World Mining, vol. 24, no. 6, p. 48, June 1971.

Ray	736,310,000 tons of 0.82%
Chino	452,307,000 tons of 0.78%
Nevada	63,100,000 tons of 0.79%
Utah	1,773,000,000 tons of 0.71%
Safford	1,000,000,000(?) tons of +0.4%(?) (Not published)

Newmont Mining Company. January 1, 1969. Various sources.

San Manuel	496,800,000 tons of 0.728% sulfide
San Manuel	130,000,000 tons of 0.70% mixed; of which 0.47% is oxide copper
Kalamazoo	565,000,000 tons of 0.72% sulfide
Superior	10,400,000 tons of 5.7%
Vekol	107,000,000 tons of 0.55% Cu + 0.015% Mo

Occidental Minerals. Calculated from drill pattern and published reports indicates some 100,000,000 tons averaging between 0.50 and 1.2% copper as oxide.

Phelps Dodge Corporation. "Economic" ore reserves of January 1, 1971. Prospectus dated June 16, 1971.

Morenci	736,800,000 tons of 0.80%
Metcalf, open-pit	220,600,000 tons of 0.74%
Metcalf, underground	126,700,000 tons of 0.92%
Ajo	138,000,000 tons of 0.70%
Bisbee, open-pit	8,100,000 tons of 0.94%
Bisbee, underground	1,900,000 tons of 5.41%
Safford, underground	250,000,000 tons (probable) of 0.92%
Tyrone	292,200,000 tons of 0.81%

Pima Mining Company. January 1, 1969.

Pima	216,000,000 tons of 0.56%

Ranchers Exploration. Annual report, reserves of January 1, 1971.

Blue Bird	75,000,000 tons of 0.52% (open-ended)
Old Reliable	4,000,000 tons of 0.74%
Big Mike (Nev.)	400,000 tons of 3%(?) in place
Big Mike (Nev.)	300,000 tons of 2%, mixed, in stockpile

James D. Sell

JDS:lad

State District Name	Owner	Operating	Potential	Production 1970 Tons of Leach Cu	Oxide Reserves Grade
ARIZONA Miami Distric					
Inspiration	ICC	X		10,038	Expansion
Miami*	Cities Service	X		7,483	Expansion potential
Ox Hide*	ICC	X		6,720	20-40(?) million @ ± 0.5%, all oxide
Blue Bird*	Ranchers	X		5,930	75 million @ 0.52%
Copper Cities	Cities Service	X		2,246	
Castle Dome	Cities Service	X		467	Operations ceased at end of 1970
Gibson Mine*	Private	X		3 (year 1969)	Oxidized sulfides in shear zone pods; probable limited
Barney*	ICC		X		Reported equivalent to Ox Hide
Miami East	Cities Service		X		100-140(?) million tons @ ± 1% Probably mixed oxide
Van Dyke	Occidental		X		80-100(?) million tons @ ± 1%; Half oxide (?)
Cactus*	Cities Service		X		40(?) million tons @ ±0.7%; Mostly oxide
Carlota*	Homestake Production		X		4-5 million tons @ ± 1.0%; All oxide
Copper Springs	Humble		X(?		
Diamond H	Cities Service	0	X		6 million @ 0.55%

*Leach Operations Only

0 - Past or Anticipated leach production

State District Name	Owner	Operating	Potential	Production 1970 Tons of Leach Cu	Oxide Reserves Grade
ARIZONA Florence District					
Poston Butte West	ASARCO		X		100-175 million tons @ ± 0.6%; Partially drilled
Poston Butte West	Conoco		X		75-100 million tons @ ± 0.5%; Partially drilled
Poston Butte East	Conoco		X		200-250 million tons @ + 0.4% Drilled oxide; Sulfides not included
Red Hill*	Private	X	X		Limited; Expansion drilling in progress
Mineral Butte	Duval		X		40 million tons @ 0.4%(?): Drilled

*Leach Operations Only

O - Past or anticipated leach production

FILE

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

February 9, 1971

FILE MEMORANDUM

Re: Vekol Deposit
Superior Oil & Newmont Mining Companies

Mr. Ben Dickerson, Southwest Manager, Superior Oil Company's Minerals Division, advised me today of the following up-dated ore reserve figures on the Vekol deposit which is jointly owned by Superior Oil and Newmont Mining Company:

> Reserves based on latest drilling are somewhat in excess of 100 million tons grading 0.55% cu, 0.015% mo, and 14¢ per ton combined gold and silver.
>
> Newmont's latest plans call for an initial production rate capacity of 20,000 tons per day. Metallurgical tests indicate a concentrate grade of 27%.

The existing lease with the Papago tribe expires in 1974. Mr. Dickerson indicated that Newmont intends to make an announcement in April of this year concerning the development of the property for production. According to Dickerson, "There is a 95% probability that Newmont will announce their intent to place the property into production."

W. E. Saegart

W. E. Saegart

WES:mw
Route File Copy: W. L. Kurtzweil
J. D. Sell

ASARCO

January 30, 1985

To Asarco Stockholders:

ASARCO Incorporated announced today a restructuring of certain of its operations which will involve the indefinite suspension or permanent closing of some of its plants and mines. An unusual charge of $216 million will be made to fourth quarter 1984 results to reflect the cost of closing or reduction in value of the affected facilities and other assets.

The previously announced shutdown and dismantling of the Tacoma, Washington, copper smelter is now well advanced and the termination of smelting operations is scheduled for March of this year. The costs associated with this process have been at a rate greater than were originally expected, and the unusual fourth quarter charge includes an additional $18-million provision to cover the future related costs.

The Company has also made a $35-million provision in its fourth quarter charge to write off the remaining value of its investment in the Sacaton copper mine in Casa Grande, Arizona. The open-pit portion of this mine was shut down in the first quarter of 1984 due to exhaustion of ore reserves, and at currently forseeable prices completion of development of the underground ore body would not be economic. Asarco has also written off its $11-million investment in the Little River joint venture, a lead-zinc mine in New Brunswick, Canada, in which Asarco has a 25% interest.

The Company has in addition decided to indefinitely suspend operations at its Corpus Christi zinc smelter and electrolytic refinery. A provision of $120 million has been included in the fourth quarter charge to cover the costs associated with this decision. Operations were suspended previously at this plant between October 1982 and February 1984. While the market and price of refined zinc metal have recovered from the recession lows of 1982, the processing fees available for custom smelters like Corpus Christi have remained unsatisfactory due to a combination of market conditions including excess world zinc smelting capacity. High costs for electric power at Corpus Christi have also been a factor.

A $2-million provision has also been made to cover the remaining asset values at the Company's zinc fuming plants at East Helena, Montana, and El Paso, Texas. These facilities, which in the past have provided zinc fume recovered from lead blast furnace slags to the Corpus Christi Plant, have been mothballed since 1982.

Asarco currently produces zinc oxide at plants in Columbus, Ohio, and Hillsboro, Illinois. The Company will remain in the zinc oxide business and continue to operate these plants with zinc concentrates from its Tennessee Mines Division and with purchased slab zinc. The Company will, however, write down by $5 million the book value of these two plants.

During the last two years, Federated Metals Corporation, a wholly owned subsidiary of Asarco, has sold its San Francisco recycling plant and shut down its plants in Whiting, Indiana, and in Trenton and Newark, New Jersey. In the

course of these closures, it has withdrawn from the secondary lead and brass businesses and has restructured its solder business into a 20% interest in a major producer of electronic solders. Federated Metals now plans to relocate its cathodic protection business and its Lone Star Lead Construction Corporation to smaller facilities. The Houston Plant will be closed and the fourth quarter charge includes a $2-million provision to cover the closing costs.

Finally, as a result of continuing weakness of oil and gas markets, the Company has included in its fourth quarter charge a provision of about $23 million to cover a write-down in value of its producing oil and gas properties and undeveloped oil and gas leases.

The Company has reached agreement with its lenders on the necessary loan agreement amendments and waivers to accommodate the restructuring program and its associated write-offs and asset valuation adjustments.

Reductions in the level of both salaried and hourly employment have also been made, and when the facility closures now contemplated are complete, the total number of employees will have been reduced by over 35% during the last three years. Wages of all salaried personnel and fees for directors were reduced effective January 1, 1985. Capital spending has been sharply curtailed for 1985, and the common stock dividend was eliminated during the fourth quarter of 1984.

This restructuring of Asarco's operations will reduce Asarco's 1985 operating costs by more than $60 million. However, a return to profitability will require an improvement in nonferrous metal prices over their current depressed levels.

The adjustments contemplated in this restructuring are part of a process of change now affecting major segments of U.S. industry. United States trade policies, which permit foreign commodity producers unrestricted access to U.S. markets, and fiscal and monetary policies, which have caused an overvaluation of the U.S. dollar, have exposed major segments of basic industry in this country to predatory competitive attacks which constitute neither free trade nor fair commercial dealing. U.S. environmental costs have added to industry's burden. Asarco has been outspoken in the public debate on these issues and has been an active participant in the trade cases and legal proceedings which have opposed such practices. We will continue to do so.

Asarco also has some great strengths. We have made the necessary investments to modernize our facilities. We produce a diversity of essential mineral products on a worldwide basis. Our people are dedicated, and we think comprise the best labor force in the industry. Better times must inevitably follow this difficult period. We plan to continue to be a strong competitor when that day comes, and we believe the steps now being taken will assure that we are.

Sincerely,

Ralph L. Hennebach
Chairman

Richard de J. Osborne
President

ASARCO NEWS
ASARCO Incorporated
180 Maiden Lane
New York, N.Y. 10038

September 29, 1985

FOR IMMEDIATE RELEASE

NEW YORK, N.Y. -- ASARCO Incorporated announced today that M.I.M. Holdings Limited, a major Australian mining company, has agreed to purchase 4,245,800 Asarco common shares owned by Weeks Petroleum Limited for $23.00 per share plus certain expenses. Weeks Petroleum is controlled by Mr. Robert Holmes a Court, an Australian investor. Currently, M.I.M. Holdings owns 6,107,563 Asarco shares. Following the planned purchase, M.I.M. will own 32.4% of Asarco common stock. Asarco, in turn, owns 44% of M.I.M. Holdings stock.

In view of this purchase and the relationship between the two companies that it implies, each company has invited the nomination of two representatives to their respective boards of directors. M.I.M. has nominated Sir Bruce Watson, chairman, and Sir James Foots, an M.I.M. director and former chairman. Asarco does not plan to nominate anyone to the M.I.M. board at the present time although it retains the right to do so at some future time.

Asarco and M.I.M. have entered into standstill agreements with Weeks. Asarco, M.I.M. and Weeks will settle all pending litigation between the parties. Asarco has agreed as part of the

(more)

FOR FURTHER INFORMATION: William K. Murray (212) 510-1810/Donald M. Noyes (212) 510-1613
Public Relations Department, ASARCO Incorporated, 180 Maiden Lane, N.Y. 10038

settlement to reimburse M.I.M. for certain of its expenses. M.I.M. has agreed to limit its holding in Asarco to 33-1/3% for a period of five years, and Asarco has agreed to reduce its holdings in M.I.M. to 40% within three years and not to exceed that level for a period of five years. M.I.M.'s purchase of the Asarco shares is subject to a waiting period under the Hart-Scott-Rodino Act.

Under Asarco's accounting policy, the Company's carrying value of its M.I.M. investment and its shareholders' equity will be reduced by approximately $43 million, representing the Company's pro rata interest in the additional Asarco shares purchased by M.I.M.

# # #

New York, June 23, 1986

MEMORANDUM FOR Messrs: J. C. Balla
J. D. Sell
D. M. Smith, Jr.
P. G. Vikre
D. D. Harper

As you know, the Labor Union contract at the copper-producing units expires on June 30, and negotiations to renew it began two weeks ago. Hopefully an agreement on a new contract will occur. However, the copper units will operate with or without a settlement. If there is no settlement, some or all of our department members will report for work at the Mission Unit and will work there on schedules set by the manager of the Unit, and until released by him.

R. L. Brown

RLB:mr

cc: R. J. Kupsch
W. L. Kurtz

Equity Research

First Boston

Industry:
Metals: Nonferrous

Progress Report
September 16, 1986
MT3075

ASARCO AND PHELPS DODGE PURCHASE KENNECOTT MINES

Investment Recommendation: Buy Both Companies

ASARCO, INCORPORATED (AR)

Price* 9/15/86	Earnings Per Share	P/E Ratios	Div'd Yield	52-Week Price Range
14½	1987E $1.00-2.00(a) 1986E (1.50)(a) 1985A (2.87)	9.7X	—	22⅞—11

(a) Previous estimates: 1987 = $2.50; 1986 = $1.00

Common Shares—32.12 mil.
Market Value—$465.74 mil.
Book Value/Share—$19.11
L.T. Debt as % Total Capital—43.24%
Est. Future EPS 5 Yr. Growth Rate—10.0%

PHELPS DODGE CORPORATION (PD)

Price* 9/15/86	Earnings Per Share	P/E Ratios	Div'd Yield	52-Week Price Range
22	1987E $4.00-6.00 1986E 2.00(a) 1985A 0.61	4.4X 11.0	—	32½—16

* On 9/15/86 the DJIA closed at 1767.6 and the S&P 400 at 257.1.
(a) Previous estimate: 1986 = $3.00.

Common Shares—27.2 mil.
Market Value—$598.4 mil.
Book Value/Share—$33.68
L.T. Debt as % Total Capital—31.99%
Return on Avg. Equity—3.31%
Est. Future EPS 5 Yr. Growth Rate—10.0%

On September 11 an agreement in principle was reached by ASARCO and Phelps Dodge for the purchase of the Ray and Chino Mines, which are part of the Kennecott Copper Mining Company, owned by The Standard Oil Company. We regard these transactions as very positive moves that will benefit both copper producers. We continue to recommend purchase of both securities.

Standard Oil will receive $220 million from the sale of the 100,000-ton annual-capacity Ray, Arizona, mine and smelter to ASARCO, the two-thirds interest it held in the 145,000-ton Chino, New Mexico, mine and smelter, and a sizable copper inventory position. Phelps Dodge indicated it paid $93 million for its interest in Chino; ASARCO did not reveal its purchase price, but we guess that it was less than that paid by Phelps Dodge and that there was close to $50 million in copper inventories sold. The impact on each company is shown in the data boxes.

The Ray acquisition provides ASARCO with 100,000 tons of additional copper output, doubling its U.S. production. The company's sensitivity to a $0.01 change in the copper price goes from $0.11 a share to about $0.16. The Ray smelter has not operated for several years; ASARCO had processed that ore. This acquisition assures the company of that feed, which helps to keep its processing plants full.

We believe the mine was profitable in 1984, 1985, and early 1986, when copper prices were as low as $0.60 a pound, indicating that its costs were around $0.58 a pound. This was before the new labor contract, which reduces labor costs some 30% and would alone account for another $0.04-0.05-a-pound cost reduction, effective for the second half of 1986. There are some further gains in productivity that can be generated as ASARCO implements mining ideas that it has in addition to those being carried out by existing Ray management.

The facilities are in good shape and do not require any significant capital spending. We think the acquisitions will make a positive cash contribution to ASARCO

upon closing and could add $0.50 a share to the high end of our $1.00-2.00 earnings projection for 1987 if the copper price improvement comes about that we expect.

We continue to regard ASARCO as a changing company with some very interesting turnaround potential for 1987 and regard the common stock, convertible preferred (ARpr: 30¾), and the warrants (ASRCW: 5½) as interesting speculations.

Phelps Dodge purchased the two-thirds interest of the Chino mine and smelter owned by Standard Oil; Mitsubishi owns the remaining one-third. Phelps Dodge offered to buy out the one-third interest of the Japanese company but was turned down. The Chino mine has a 145,000-ton capacity and a smelter of the same size. The Chino smelter has been operating, is in excellent shape, and meets current environmental standards. The mine is believed to be profitable at $0.60 copper and should be lower cost as the new labor contract's term takes effect. The additional production increases Phelps Dodge's sensitivity to a $0.01 copper price change, to $0.25 a share from $0.20, keeping the company the most leveraged U.S. copper producer. The Chino smelter is much more important to PD than the Ray smelter is to ASARCO. Phelps Dodge must close its Douglas smelter because of environmental problems by year-end. The addition of the Chino plant puts the company's processing capability into balance with its production. The new mine also provides additional ore to replace the Tyrone facility, which is expected to be depleted in the 1990s and prevents the company from having to spend $300-400 million to develop its Safford property in order to maintain current production levels.

Capital requirements are modest. The plant is regarded as efficient, and there is ore that can be processed through an electrowinning plant. PD plans to build such a plant to obtain 35,000-45,000 tons of additional copper by 1989. This additional output will require $50-60 million in capital expenditure.

Both ASARCO and Phelps Dodge would benefit from this transaction. We think the U.S. copper mining industry will also benefit. Two excellent facilities are being turned over to operators whom we regard as efficient and well disciplined. Costs will be kept at international competitive levels. Both companies will be in better mine-smelter balance, giving them the advantages of integration and making them independent of concentrate and/or smelter problems. In an improving copper market, these acquisitions will enhance the value of both Phelps Dodge and ASARCO, and we continue to recommend purchase of the securities of both companies.

Peter L. Anker
(212) 909-3154

N.B.: The First Boston Corporation has, within the last three years, served as a manager or co-manager of a public offering of securities for Phelps Dodge and The Standard Oil Company (SRD: 45⅞).

ASARCO

Exploration Department
Frederick T. Graybeal
Chief Geologist

January 9, 1987

John M. Guilbert
Professor of Economic Geology
The University of Arizona
Department of Geosciences
Building #77
Tucson, Arizona 85721

Economic Geology Research Funding
University of Arizona

Dear John,

I have read your letter of December 16 regarding funding of research at the University of Arizona, specifically for the economic geology program. I agree it is the best program in the world, particularly in hard rock ores, and products of its graduate program are tops. Having reached the top, no easy accomplishment, you face the difficult task of staying there in the face of rising research costs and declining sources of funding.

You are generally aware of Asarco's support of economic geology research through fellowships and financial support of thesis research. From the period 1970-1985 we funded an average of 6 geology fellowships per year in amounts varying from $1,000-$5,000 per fellowship, one at the University of Arizona. During that same 15-year period, we also provided significant partial or complete financial support for 40 MS and PhD theses, many at the University of Arizona. Certain other companies have similar records of support for economic geology research at the University of Arizona, reflecting clear acknowledgement of your program's contribution to past corporate and individual successes.

Asarco's source of funds for this research was profit from the mining business. There have been no profits since 1983, no dividends paid since late 1984, and our debt at the end of 1985 was $473 million. Lending institutions pay close attention to activities of companies operating in the red and funding of exploration research is not allowed on the list of priorities.

On an individual basis, Asarco employees have not had a raise for nearly 3 years. Our exploration department staff has been reduced by 70% and if current cost reduction measures do not eliminate losses, there will be more reductions. Most of our staff is over 30 years old with 10%+ mortgages

on homes which need new roofs, paint, and heaters; they also own cars with 70,000+ miles and have children in or near college. We all recognize the importance of research, but it's hard to imagine much enthusiasm for individual funding of economic geology research when our jobs are in jeopardy. Why should we fund the education of new students when we may be educating more people than the future will require? What capabilities we do have may be largely directed toward endowment of a research fund established in the name of Harold Courtright and purchase of an acclaimed new textbook on ore deposits.

Turning to another subject, most will agree that the mining industry will survive in the U.S., although not in the same form as in past decades. Structural changes will occur in exploration methodology in ways I can only partly imagine, but certainly will involve fewer companies exploring for a more limited array of targets with focus on shallow ore. Budgets and staffs will be smaller and, as a result, the industry will need fewer exploration geologists.

No doubt your enrollments are down, but natural attrition may not be enough. Your letter does not say to what extent or how your graduate program has cut costs, enrollment, or faculty so that sufficient funds are available to support worthy research. It should still be possible to fund research by top students if you have fewer students to support. Perhaps moving into your new building was a mistake. Perhaps some of the expanded lab space will have to remain shuttered and unoccupied for the time being. Small does not mean low quality, but it does mean more work to insure the admission procedure recognizes and recruits those students with the best research potential--not necessarily the best grade-getters. If you agree the mining business will shrink, plan now; it's easier to phase in reductions than being forced to cut instantly and it's not fair to educate students for jobs which don't exist. Has Geoscience Department financial planning assessed the future for economic geologists? How many will we need and what will your share be?

What sources of funding not mentioned in your letter have you investigated? There are several Third World countries which are modifying their mining laws to encourage exploration. Many of these countries are woefully short of good USGS-style maps of old mining districts. In your capacity as SEG vice president for regional affairs and your travels with the field trip program, you must have become aware of the need for modern geologic studies in these countries. The World Bank and other international lending groups have been

willing to lend for mining development. These countries and their bankers might also be interested in funding low cost, high quality geologic studies conducted by motivated students with modest to no salary requirements under the aegis of the University of Arizona economic geology faculty.

You argue that abandoning exploration research support and cutting enrollment is myopic. My reaction over the past few years is that those with close, but still peripheral ties to the mining industry (their salaries aren't paid with profit from mining) who have voiced an understanding and genuine sympathy with our predicament, have not had the insight which comes with personal involvement to know just how bad things really are. The disbelief which I sense in your letter indicates the ripple effect has now hit the University. The choice between myopia and survival is easy, because an uncertain future is better than no future at all. If we win the fight for survival, we will then assess whether the quality of that survival needs upgrading.

Some of these thoughts are not pleasant and may not be popular. They are not meant to be critical, and I realize your form letter had to be somewhat general in scope. Your program will survive, probably smaller, and we will do what we can to help maintain quality. The above comments are the best we and I can do at the moment.

Very truly yours,

Fred Graybeal

F. T. Graybeal

FTG:mr

cc: Dr. S. R. Titley (w/att.)

bcc: W. L. Kurtz (w/att.)
J. C. Balla "
D. D. Harper "
J. D. Sell "
D. M. Smith "
P. G. Vikre "

ASARCO

Richard de J. Osborne
Chairman and President

October 7, 1987

Dear Fellow Employee:

Last week Asarco completed the sale, announced in mid-September, of 155.6 million shares of MIM Holdings Limited stock, just under 16% of its shares outstanding. We received $381 million from this sale and will continue to hold about 19% of MIM's shares as a long-term investment.

This transaction is an unusually important one for the Company, as it puts its holders of common stock in a position to begin to share in the values we have collectively created in the last two years of hard work, sacrifice and careful planning. We plan to use the proceeds of the transaction to retire our remaining preferred stock and to pay off all of our bank debt. This will reduce our annual interest and preferred dividend requirements by over $30 million, and the Board of Directors has said that it plans to consider resuming payment of a common stock dividend when this program is completed. No common stock dividends have been paid since the third quarter of 1984.

The reduction in ownership of MIM to below 20% will also permit us to shift our accounting for MIM's results from an equity to a cost basis. Under the cost method we will include in future earnings only dividends received from MIM and will no longer be required to record as part of Asarco results the very large foreign currency translation adjustments which have confused investors and masked the real progress that we have made in restoring the Company to financial health.

With costs down and markets for our products improved, the Company's operating results are now solidly in the black. With our balance sheet vastly improved by this transaction, we now have the financial capacity to make new investments. Our spending policies, however, will remain conservative so as to retain and improve upon our position as a low-cost producer. Capital spending to maintain and replace existing plant and equipment will be kept to levels which approximate those of the last three years, which were very low by historical standards. We will add people and expenses and spend additional capital in our existing facilities only for projects which further reduce costs or increase sales volumes or revenues.

We will not go back to doing business the old way. The process of organizational change and cost control which has marked our progress during the last two years will continue as a permanent way of life. We must strive for improvement if we are to remain competitive in the world markets in which we now compete.

Notwithstanding this ongoing policy of tight control over expenditures, we are planning a general increase for salaried employees in January 1988, the first general salary increase since mid-1984. It comes at a time when wage restorations for most hourly employees either have or are being made. The increases for salaried employees will be made using the procedures developed in the new performance management system, which means that salary adjustments will be closely related to individual performance.

We have done a good deal of thinking about where we are going and where new investments should be made. Strategic plans and the steps necessary to implement them are, unfortunately, matters which must be kept confidential. I can say, however, that we have a clear view of our capabilities and do not plan a fundamental change in the character of the Company.

With the improvements made in our earnings, cash flow and balance sheet, we can all breathe a little easier. These past few years have been difficult ones for all of us. I think that every member of the Asarco family can be proud, however, at what we have accomplished together. I wanted to write each one of you and thank you personally for your contribution.

Sincerely,

Richard de J. Osborne