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ASARCO

Southwestern Exploration Division

April 15, 1981

G.P
MAY 1 1 1...
JPS

MINING DE...
APR 4 5 1981
TUCSON

TO: W. L. Kurtz

FROM: F. R. Koutz

Baseline Water Quality Survey-II
Hardshell-Trench Camp Area
Santa Cruz County, Arizona

In February 1980, R. B. Crist suggested that the Exploration Department initiate a background water quality study of the Harshaw Creek watershed to develop baseline data for mining permits and environmental inpact reports in the Hardshell area. The first part of this study was completed in March 1980 (F.R.K. memo to F.T.G., March 11, 1980). Additional sampling was to take place at six month to one year intervals.

On November 6, 1980, Donald Greene of Water Development Corporation and myself collected water samples from ten sites in the Harshaw Creek and Alum Gulch watersheds. Five of these sites had previously been sampled on March 6, 1980. On November 10, I sampled three additional sites, one previously sampled on March 6. These water samples were sent by Mr. Greene to B.C. Laboratories, Bakersfield, California for analyses of a variety of elements as indicated on Table 1. Table 1 also compares these results to the March 6 results, to earlier analyses and to the U. S. Public Health Service Recommended Drinking-Water Standards. (Hem, 1970). Figure 1 shows sampling locations and the attached list gives particulars on each sampling site.

Because of the interest in tailings in the Trench Camp area by Sheila Dean of the U.S. Forest Service, ten tailings or encrustation samples were collected from the area. Ms. Dean is studying acid drainage from abandoned mines and erosion of tailings in the Patagonia Mountains as part of a Masters Thesis in Hydrology at the University of Arizona. The tailings were analysed for 31 elements by emission spectrograph and quantitatively for total sulfur, sulfate and iron by Skyline Labs of Tucson. The composition of these tailings (especially silver) may also be of interest to other Asarco departments. Results are given on Table 2.

The water results from November are not significantly different from March results except for a slight increase in ionic content of November waters due to drier conditions and lower flows. In both the March and November results a general increase in ionic content downstream is shown by the increase in total dissolved solids (TDS) particularly Ca and sulfate.

The higher iron and possibly zinc contents in some November samples, contrasted to March samples, are probably, in part, from lack of filtration of the November batch. Some very fine ($<$ 1 micron) particulate iron and zinc oxides from pipes and tanks may have therefore entered the sample bottles. For this reason silica was not determined on most November samples.

ASARCO

Southwestern Exploration Division

August 11, 1981

TO: F. Michel
T. C. Benevidez
D. Martinez

FROM: F. R. Koutz

1981 Drilling and Field Work
Hardshell Project
Santa Cruz County, Arizona

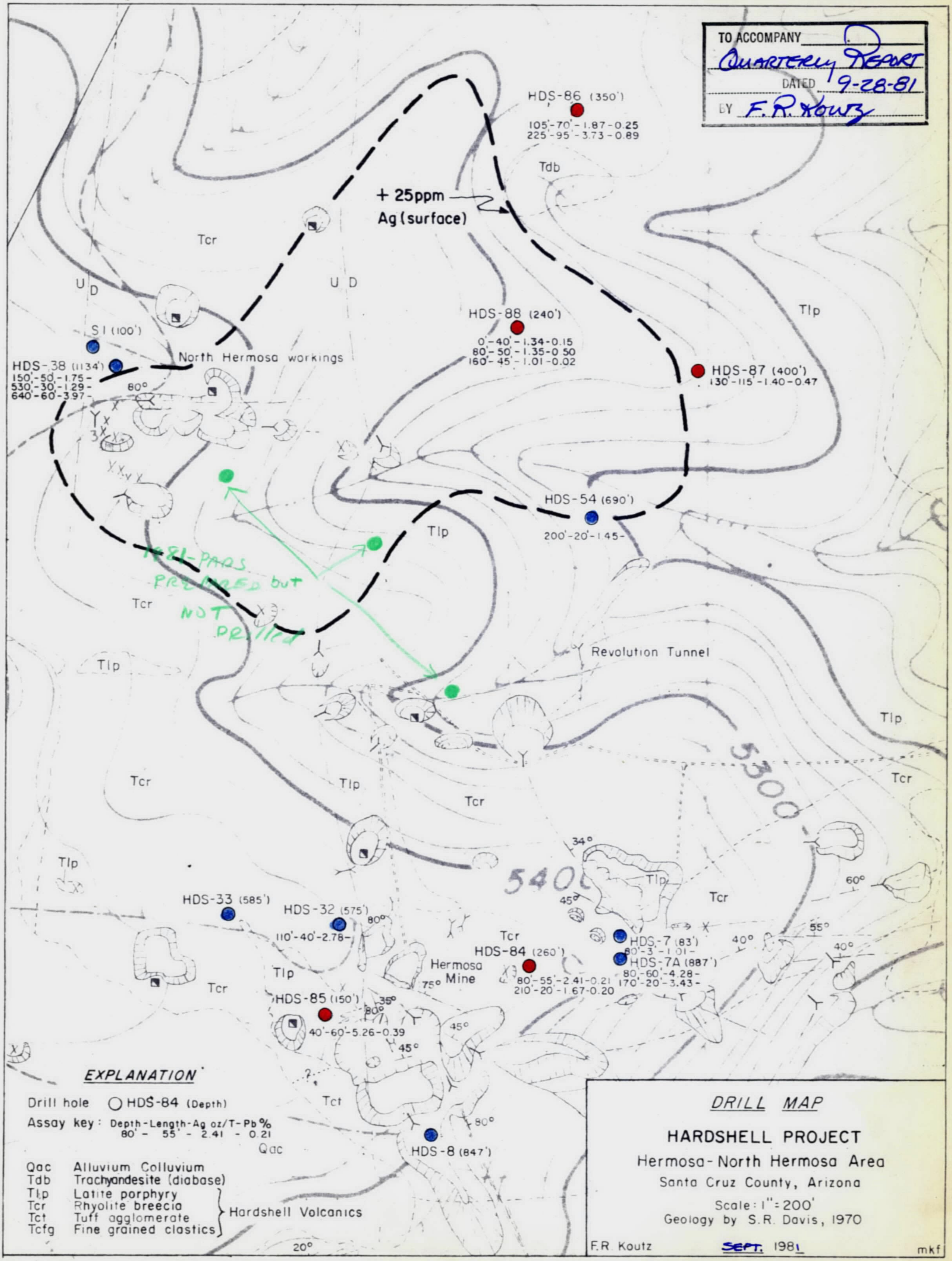
Within the next several weeks we will begin drilling on the Hardshell Project in the Hermosa and North Hermosa Area. T. Benevidez will be in charge of drilling supervision, cost accounting and insuring that adequate samples are taken and vials are made. F. Michel will provide geologic supervision, cutting off holes at assigned depth or extending them if the samples are significantly mineralized (Mn ox., Fe ox., jarosites, etc). Fred will also log all drill chips and compile assay results. D. Martinez will sample, make vials and assist Tony and Fred until school starts and any time available after that. At some time or other, each of you may have to assist the drillers in sampling or making vials.

I have arranged with Richard Arnos of American Analytical to provide 1-2 day turn-around-time on fire Ag-assays of selected batches of cuttings so that we might relocate some of the later holes. Consequently samples that appear significantly mineralized should be marked for priority assay and samples should be delivered to American Analytical at least every other day.

Before and as time permits during drilling, F. Michel will be in charge of mapping and sampling in the accessible workings of the Hermosa Mine. D. Martinez will assist, as will T. Benevidez if it does not interfer with his other duties including the Trench and Superior East Projects. We are particularly interested in the extent of the Hermosa workings, mineralized thicknesses and how much ore might remain in the workings as well as any structural or stratigraphic controls of mineralization. If Hermosa underground work is completed and time permits during drilling, F. Michel will also sample jasperoids in the American Peak-American Mine Area and to the south. You should keep me informed of mapping, sampling and drilling progress daily.

F. R. Koutz

FRK:rr
cc: W. D. Payne



TO ACCOMPANY Quarterly Report
DATED 9-28-81
BY F.R. Koutz
HDS-86 (350')
105'-70'-1.87-0.25
225'-95'-3.73-0.89
Tdb
+ 25ppm
Ag (surface)
Tcr
U D
U D
HDS-88 (240')
0'-40'-1.34-0.15
80'-50'-1.35-0.50
160'-45'-1.01-0.02
S1 (100')
HDS-38 (1134')
150'-50'-1.75-
530'-30'-1.29-
640'-60'-3.97-
North Hermosa workings
80°
HDS-87 (400')
130'-115'-1.40-0.47
Tlp
HDS-54 (690')
200'-20'-1.45-
Tlp
1981-PADS PREPARED but NOT Drilled
Tcr
Tlp
Revolution Tunnel
Tlp
5300
Tcr
Tlp
Tcr
Tcr
Tlp
34°
5400
Tlp
60°
Tcr
45°
HDS-33 (585')
HDS-32 (575')
110'-40'-2.78-
80°
Tcr
HDS-84 (260')
80'-55'-2.41-0.21
210'-20'-1.67-0.20
HDS-7 (83')
80'-3'-1.01-
HDS-7A (887')
80'-60'-4.28-
170'-20'-3.43-
55°
40°
40°
Tlp
Hermosa Mine
75°
Tcr
HDS-85 (150')
40'-60'-5.26-0.39
35°
80°
45°
45°
EXPLANATION
Drill hole ○ HDS-84 (Depth)
Assay key: Depth-Length-Ag oz/T-Pb%
80' - 55' - 2.41 - 0.21
Tct
80°
HDS-8 (847')
Qac
Qac Alluvium Colluvium
Tdb Trachyandesite (diabase)
Tlp Latite porphyry
Tcr Rhyolite breccia
Tct Tuff agglomerate
Tcfg Fine grained clastics
Hardshell Volcanics
20°
DRILL MAP
HARDSHELL PROJECT
Hermosa-North Hermosa Area
Santa Cruz County, Arizona
Scale: 1" = 200'
Geology by S.R. Davis, 1970
F.R. Koutz
SEPT. 1981
mkf

ASARCO

Southwestern Exploration Division

September 14, 1981

TO: W. D. Payne

FROM: F. R. Koutz

Quantitative Drill Hole Log Form
and Logs of HDS-81, 82, 83
(1980 Drilling)
Hardshell Project
Santa Cruz County, Arizona

Large amounts of time have gone into examination of in excess of 28,000 feet of percussion drilling (83 holes) and 3000 feet of diamond drilling (12 holes including deepened hammer-drill holes) at Hardshell. Most written logs of holes up to HDS-52 consist of rough field sheets with the only major comments being the qualitative presence of silica, manganese and iron oxides in mineralized intervals and comments on drilling conditions. Drill-chip specimen boards were prepared on most holes up to HDS-50 and graphic logs with some details of lithology and mineralization are available on holes up to HDS-52. These graphic logs (in N. P. Whaley's files) were partially revised and annotated by S. R. Davis in preparation of sections for his 1970 report.

Since the early 1970's systematic quantitative presentation of drill data has been minimal. Vials of washed, medium- to coarse-grained drill chips on 5 to 10-foot intervals were prepared during drilling of HDS-56 to 83, but systematic logs of these vials are not in the general files. Summaries of the top and bottom of massive silica and Mn-oxide mineralization with silver assays are included in the monthly reports of annual assessment drilling, but these include little quantitative detail.

In 1978 S. R. Davis, N. P. Whaley and myself decided what features in Hardshell vials should and could be logged by binocular microscope to provide data for preparation of new sections and for metallurgy, mine planning and mineral inventory. Davis used this method to log 1978 drilling (HDS:69-76) but his notes were not placed in the general files. Davis planned to have a new logging form drafted and to write an explanatory memo. Unfortunately this was never completed.

As part of my dissertation work I have logged all vials from HDS-56 to 83, most core and many chip boards (HDS-7 to 50) in varying amounts of detail. For HDS-81 to 83 this logging was presented graphically on a memo on gold at Hardshell (9/2/80). The following are written logs of HDS-81 to 83 on a newly designed logging form, explanation of columns used on these logs and a brief discussion of important features that should be looked for in logging HDS vials under the binocular microscope. These logs are 8½" x 11" sepias of the type used to

produce blackline prints on other major Asarco-Tucson projects. This method of logging is fully explained in F. T. Graybeal's memo of January 3, 1973, which should be read in detail as general background. As time permits I will transcribe my logs and what notes I have from other Asarco geologists' logging to these forms.

It is strongly suggested that this form be used for all future logging since the headings of columns are flexible and enough space is provided for quantitative estimates of mineral percentages, as well as for general and specific comments. This form may also be suitable for Hardshell core logging although the larger 11" x 23" forms now in use provide much more space for the detail shown in core.

A future program should involve transferring chip-board data to these logs with necessary relogging. This is especially important since the chip boards are deteriorating from heat and reaction of the glue with Mn-oxides and significant intervals of Hardshell crusher-reject chips were completely composited for metallurgical use with no remaining sample. I also strongly suggest that each box of vials and all chip boards be photographed (35 mm color transparencies) as soon as possible.

F. R. Koutz

FRK:jw
cc: N. P. Whaley
G. W. Pickard
F. A. Michel
General file

HARDSHELL LOGGING FORM EXPLANATION - Sepia - 8½" x 11"

Introduction

This log is for general use on all projects, not necessarily only Hardshell, where the amount of data being quantified does not require use of the larger 11" x 23" form now in use on most projects. The original drafted mylar (2555frk) is stored in the drafting room and sepias can be ordered by the drafting department. 902E sepia works best; "H" or #3 pencil is the right hardness and is easily erased with a white Faber-Castell "Peel-Off Magic Rub" (#1960) eraser (available in the drafting room). A mechanical (0.5 mm) pencil precludes pencil sharpening. Direct sunlight exposure of sepias should be avoided, if possible, and sepias should be stored in the dark. A paper shield over the lower part of the log will protect it somewhat from wet and dirty hands. If a clipboard is used the sepia logs should be trimmed to slightly larger than 8½" x 11" and final trimming of prints can be completed later.

Anyone new to the Hardshell project should read S. R. Davis' (1970) report, Koutz (1977) on Hardshell ore types, and various monthly progress reports to gain familiarity with the project. Koutz (1981) includes details of mineralogy and textures.

Logging Form

An example copy of the drill log is attached. On this copy various suggested headings are filled out, but can be changed with each year's drilling and with depth if necessary. For example, if calcite veins are only prevalent in the bottom of the hole, while say epidote is common in the upper portion, the heading can be changed on later sheets or mid-sheet for the same hole. Logs of HDS-81, 82, and 83 are also attached as examples of the flexibility of this type of log.

MAJOR HEADINGS: Most of this is self-explanatory. Exact coordinates and collar elevations can be added or modified after holes are surveyed in. The "DRILLING INFORMATION" section need only be filled out on the first sheet of the hole. There is usually enough space on the last sheet to add details of casing left in the hole, drilling problems, etc. One of the assay or mineral columns can also be reserved for sample recovery weight, specific gravity, drilling rate or the like. Drillers are usually asked to fill out an Asarco drilling-time log for each interval drilled, including rock characteristics, casing and bit changes and other significant features such as the depth and characteristics of water courses. Note that a one-inch upper margin on the sepia is provided for binding sepias and prints in notebooks and reports. Although this makes an ideal place for marginal or temporary notes, the area should be cleaned up before printing.

DEPTH: At Hardshell it has been customary recently to log and assay on 5' intervals. In many of the earlier holes 5' assays were only used for obvious mineralized intervals with 10' intervals. This led to some ragged cut-offs unless the geologist or geologic technician wereclosely watching drilling - which is generally not necessary at Hardshell except near termination of the holes. There is also no necessity to put all numbers in both the "from" and "to" columns; every fifth interval or so should, however, have both numbers.

Vials to be logged are usually made in 5' intervals or 10' intervals with the upper five feet in the bottom of the vial and lower five feet in the upper portion of the vial. The vials (with remaining space filled with clear water) are placed in core boxes in the order of drilling with the top of the hole in the lower left trough. With use or agitation the two 5' intervals may become homogenized if the vials are not packed tightly, and may be difficult to log individually in old holes (such is the case on much of HDS-81 to 83.

Panned concentrates of each interval may also be placed in the bottom of each vial below unpanned chips. Vials and sample bags should have both the top and bottom of each interval labelled in waterproof marker - in at least two places (top and side of vial; body and yellow tag of sample bag). Earlier samples, pulps and vials may be labelled with only one number, usually the bottom of the interval. This has often led to some confusion. Sample bags should also be prestamped with "ASARCO" in red ink (rubber stamp in warehouse) to reduce confusion with other samples at the assay lab.

ASSAY: Elemental symbols and units (%, oz./T, ppm) should be written at the top of the column. Extra assay columns can be used for composites or averages with appropriate brackets or arrows, or notes such as "T.S." or "P.S." for thin or polished section, respectively, to be prepared. Some Hardshell holes have large amounts of geochemical or other analytical data available for certain intervals. Some of this can be added by dividing any column with a diagonal into two spaces. Notes on analytical methods, reliability and laboratory used can be put in an assay column, above the "ASSAY" heading, or in notes on the last page. If additional assays or analyses are available on samples, a reference note should be made on the original sepia, even if they have already been printed for a report. These steps reduce time spent searching through assay records in later years.

The "MINERALS" section is divided into "Mineralization" and "Alteration" headings with five columns each. (What is mineralization vs. alteration need not be rigid definitions and will not be argued here.)

All minerals are logged in volume percent (of the total rock volume) of the mineral present. Graybeal (1973) prefers to modify original volume percent estimates by later apportioning relative weight percent

of assayed metals between the various minerals present. This may be acceptable for porphyry copper deposits and may be useful for metallurgists, but it destroys original data. At least for Hardshell it is seldom certain where the various elements (Ag, Pb, Zn, Cu, etc.) are distributed. Manganese may also be divided between several mineral phases of different specific gravities in one drill interval. The original estimated volume percent should also not be modified or "fudged" after assays are returned because the difference in estimated and actual percentages may have some significance, for example the assayer may have switched samples and numbers.

In the Hardshell area most of the Ag (and Pb, Zn, Cu) values are contained in "oxide" minerals, specifically the manganese and iron oxides, various sulfate and complex sulf-arsenates. In Mn-poor areas much of the silver is in halides or acanthite occluded in goethite or yellowish iron sulfates or iron-oxide stained clays. Minor amounts of silver, base and semi-metals are associated with relict sulfides and silver (and copper) sulfides may form supergene coatings or fracture fillings on these sulfides. Often the former total sulfide can be estimated from sulfide molds, vugs and boxworks. Former sulfide estimates should be differentiated from actual sulfides remaining by enclosing the former sulfide estimate in parentheses. Former feldspar altered to sericite or clay can also be included in parentheses.

Disseminated vs. vein control often has little meaning in drill chips. Yet it is often important to distinguish between silver-bearing Mn or Fe oxides which coat fractures (or fill veins or veinlets) in the chips versus that which colors or stains clays and sericites or floods the groundmass of host rock. Where this differentiation is noticeable the mineral columns can be split up into disseminated vs. veinlet (D/V) with a diagonal. "Silica" is treated in this way: disseminated (jasperoid) vs. crystalline m.-x.s. veinlets. Some comment on the grain size or massiveness of Mn or Fe oxides can be useful and should be included on the left side of the remarks columns specifically reserved for comments on the individual interval. The fine points as to scale or domain between disseminated vs. vein or veinlet-controlled types of mineralization will be left to Messrs. Graybeal, Vikre and Smith (see Graybeal, 1981a and b).

The use of terms such as "weak," "moderate," "strong," "occasional" and "local" should be avoided as they are extremely subjective and vary among different loggers or between different days. The term "trace (T)" also is somewhat in this category and should be reserved only for such small amounts that are noticeable, but so small that they can not be reasonably quantified. If a mineral (or feature) was looked for, but not noted, a dash should be put in that column for that interval to indicate so. This is better than leaving the space blank as it serves to show later that this mineral has been checked for.

Some difficulty may be experienced distinguishing between goethite and jarosite and between true jarosite and similar appearing yellow to greenish-yellow iron sulfates, sulf-arsenates, antimonates and phosphates. Mimetite-pyromorphite ($Pb_5(AsO_4,PO_4)_3Cl$ is especially common and, unless it can be clearly distinguished, should be lumped with "jarosite." It is good practice to test green to greenish-gray-yellow minerals with a needle as they often turn out to be horn silver (Ag(Br,Cl)).

Pyrite often goes through the oxidation sequence pyrite to jarosite to goethite to hematite, and a review of "Interpretation of Leached Outcrops" by Blanchard (1968) is often helpful in describing oxidation at Hardshell. Silica boxworks after galena and pyrite are particularly noticeable under the binocular microscope as are anglesite/cerussite after galena. The acetic acid-potassium iodide test can be used for these oxide-lead minerals (Jerome, 1950) although coronadite (Pb-MnOx) and other Pb minerals may also give a weak reaction.

"Silica" can be logged several ways. Fine-grained jasperoidal silica is very distinctive. I have usually logged silica as an estimated total SiO_2 analysis of the interval - which is often 90-99% in the massive silica caprock over the main manto, Mn-oxide orebody at Hardshell. Since Hardshell host rocks are mostly of rhyolitic composition (although often strongly argillically altered) original SiO_2 content is 65-75%, but in most cases no attempt has been made to estimate total silica content outside extensively silicified zones. Jasperoid could also be logged as <u>added</u> silica or total SiO_2/coarse-grained quartz, as long as it is clearly defined. The color of the jasperoid and texture (greasy-green and sugary - with microvugs filled with drusy quartz, and the presence of cross-cutting, medium- to coarse-grained quartz veinlets) should be noted as these features give indications of the closeness to mineralization.

Veinlet quartz, medium- to coarse-grained druse in vugs in the ore zone and other quartz veins should be included under "x,g. vein" SiO_2. Quartz bands in the "Ribbon Rock" (flow-banded rhyolite to welded tuff) should also be included in this category, but a marginal note of their presence should be made. "Clay" often includes both true clay and sericite unless they can clearly be distinguished. The differentiation of illite, hydromuscovite, sericite, etc., is best left to the x-ray diffractometer. Most feldspars in the volcanics are now sericite or illite/montmorillonite - often with yellow to red to greenish stains from Fe, Mn or Cu oxides. White supergene clays (usually kaolinite) are commonly found in late veinlets or lining vugs. Iron-oxide stained clay "skins" often with curled mud cracks are often found in vugs in mineralized zones but these seldom are preserved in washed hammer-drill chips. If large amounts of clay are suspected after examining washed vials, the raw samples and the driller's/geologic technician's reports should be checked. Mineralized clay-rich zones are common at breaks in the lithology, in faults and over the massive

silica (red "clay" zone). In some areas, for example at the Hermosa Mine, much of the mineralization appears to be in clay seams and interveinlet blocks may be relatively unaltered and very weakly mineralized.

"K-feldspar" as rhombic adularia is very distinctive and has a close association with mineralization. Fine-grained, pink K-feldspar flooding is also common but often difficult to identify or distinguish from host-rock igneous or "deuteric" K-feldspar flooding or groundmass in the alkali-rich Hardshell rhyolites. Much of the trachyandesite ("diabase") and latite porphyry has a K-feldspar rich groundmass. If alteration vs. rock K-feldspar can be distinguished they should be; otherwise totally visible K-feldspar should be estimated.

"Calcite" is the major mineral in the Concha and much of the Scherrer Formations, which are often mineralized at the base of the main manto. Thin carbonate veinlets (sometimes with Mn-oxide occlusions or "black calcite") are common in the lower main manto and increase with depth toward the Paleozoic carbonate section. Blocks of limestone in the Hardshell volcanics and random calcite veins are locally common in the upper part of the Hardshell section, especially in the Trachyandesite. Miscellaneous minerals would include relict ferromagnesian minerals: biotite, chlorite, hornblende, pyroxene or epidote and magnetite. In less strongly altered/sulfidized parts of the Hardshell area, magnetite is especially common and all vials should be checked for its presence. Alunite (porcellaneous and usually white) is often noticeable as thin veinlets and flooding volcanics but is often difficult to distinguish from fine-grained K-feldspar or weakly argillicly altered host rock. Another sulfate, gypsum, is common near the surface. A large amount of jarosite-alunite related minerals (e.g., hidalgoite-beudanite- $Pb(Al,Fe)_3(SO_4)(AsO_4)(OH)_6$) are not uncommon in mineralized zones at Hardshell but can seldom be distinguished without x-ray diffraction.

The column on the left side of the remarks column is reserved for an abbreviated rock-type symbol or a rock description, often shown vertically. The artistically inclined can also use this column for a graphic log.

Rock types include:

Trachyandesite (diabase)
Amygdaloidal Andesite
Latite Porphyry
Rhyolite Breccia
Tuff Agglomerate or Conglomerate
Fine-grained Tuffaceous Sandstone
Flow-banded Rhyolite to Latite Porphyry
Concha Limestone-Marble (note fossils)
Scherrer Sandstone - quartzite, siltstone, marble, dolomite or hornfels
Massive Silica - Jasperoid
Red Clay Zone
Gouge - Clay
Fill, Dump, Colluvial Material
Main Manto (Mn Oxide and Jasperoid)
Vugs, Cave
Note Position of Water Table.

Under the "REMARKS" section space is provided for general comments, descriptions and notes which should not necessarily be limited to the single line corresponding to that assay or logging interval. In fact this space or the right half or two-thirds should be reserved for a brief description or summary of the salient features of a significant interval of rock larger than the assay interval. Divisions between these major intervals can be based on rock, alteration or mineralization type, or where logging ends for the day if the rock is uniform. The interval described should be clearly identified but the space necessary to describe it does not necessarily have to be confined to the assay interval limits of the top and bottom of the larger interval.

The left third or so of the "REMARKS" section is reserved for comments relating specifically to that assay interval. These may be additional mineralogic or lithologic comments or pertain to drilling - lost circulation, caving, hard rock, water courses or the like. If space remains on the last page of the log this can be used for additional comments.

In addition, at the end of each year's drilling program an explanatory sheet should be attached to each set of drill logs defining each category/mineralization/alteration feature used to head a column, define abbreviations and summarizing significant assay, mineralization, alteration and lithologic intervals. It would also be extremely helpful to photograph, with 35 mm color transparencies, each core-box of vials since any sulfide quickly oxidizes, discoloring the whole vial, and to have an additional record of gross changes in characteristics of each hole. The vials may also dry up with time (even with tight caps) and distinctive features of the chips show up better when wet. Vials should be photographed refilled with water. Abbreviations used in the example log and HDS-81 to 83 are:

Alun = alunite
Angl = anglesite
Bio = biotite
Bk = black
Bx = breccia
Cal = calcite
Chl = chlorite
$CO_3^=$ = carbonate
$Cs^=$ = cerussite
Cv, Cov = covellite
Diss = disseminated
Dk = dark
ep, epid = epidote
f.g. = fine-grained
m.g. = medium-grained
x.g. = coarse-grained
FeOx = iron oxide
Fs = feldspar(s)
Fx = fracture(s)
gg = gouge
gn = galena
gr = green
gy = gray
HBD = hornblende
irrid = irridescent
JAR = jarosite
Jasp = jasperoid
Kfs = potassium feldspar
Ls = limestone
μ = micro
MAT = matrix
mim, mimet = mimetite
MnOx = manganese oxide(s)
Py, Pyr = pyrite
Pyrom = pyromorphite
Q-S = quartz-sericite
Sdy = sandy
Ser = sericite
Spec, Sp = specularite
ss = sandstone
st = stain
str = strong
T,Tr = trace
v = very
vn = vein(let)
w/ = with
wh = white
wk = weak
xtal = crystal

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EXAMPLE

DRILLING INFORMATION

Contractor: Shelton
Date drilled: AUG 8-10, 1981
Hole diameter: 5" - HAMMER (FOAM)
Inclination: 90°

PROJECT: HAROSHELL
HOLE NO. HDS-999
Collar elev. 5608'
Final depth: 485'
Coord. N/~~S~~ 13,485
Coord. E/~~W~~ 8730
Logged by: F.R. KOUTZ
Date logged: AUG 15, 1981

DEPTH from	DEPTH to	int'vl	SKYLINE FIRE ASSAY Ag oz/T	Pb%	Zn%	Mn%	MINERALIZATION: MN-OXIDES	RED HEMAT. / SPECULAR	GOETHITE	JAROSITE	Sulfides	ALTERATION: SILICA / JASPEROID (F.g.) X.g. QTZ VN.	CLAYS (includes SERICITE)	K. Feldspar / EPIDOTE	CALCITE	MISC.	Rock Type	REMARKS SPECIFIC →	← GENERAL →
0	5	5	3.5	↑	↑	↑	2	1/T	3	T (mim.?)	(3 py)	65/2	15	5/T	T on Fx	—	F.ll	-Lp RoBit	⇒ 0-5 Coluvium - Mostly LAT. Porph. TR mimetite
5	10	↑	1.1				1.5	.5/—	2	—	(2 py)	65/1	5	3/T	—	T gyp.	LP	HAMMER	⇒ 5-25 LAT. Porph., Lt. Red, Well Fx with EPIDOTE +
	15		0.8	0.4	0.04	1.3	.5	1/—	T	—	—	65/1	10	6/1	—	—	↑	← 0-5 HBD	clay on Fx, Fs ⇒ clay + SER., Loc. MnOx Dendr on Fx
	20		0.7				T	5/T	2	1	(4 py)	70/5	15	5/—	—	1 ALUN	↓		Most HBD, Biot ⇒ Chl + Musc. Goeth. pseud.
	25		4.2	↓	↓	↓	T+	6/—	5	½ (min)	T py (5 py)	40/T	20 RED	3/—	—	—	LP		AFTER PYR CUBES w/ Fringing Hem.
25	30		21.3	3.5	0.1	1.2	2	8/—	7	1 jar 2 mim.	1 py 6 gn	30/6	35	1/—	—	TR Angl.	?? -VEIN?	Vuggy-PARTIAL CAVE	⇒ 25-33± Vein - Fracture ZONE with relict-stringer
	35		10.1	0.9	0.1	0.7	1	7/T	3	2	T gn 2 py	20/5	20	T/—	—	—	??/Rhy BX		S= (gn+py) oxid. to Angl - CS + mim., STR Fe ox + Mn ox
	40		3.1	↑	↑	↑	½	1/—	3	T	(3 py)	70/1	5	8/—	—	—	Rhy Bx		on Many chips, QTZ is mi/Ky with many Trans. xtals to 2mm
	45		2.0				1	1/—	1	2	1 py (3 py)	60/—	10	5/—	—	—	↑		⇒ 33-60 Rhyol. Bx w/ local strong silicif., strong
	50		2.1	1.4	0.3	1.4	3	1/T	4	1	(7 py)	75/1	8	1/—	—	T gn Cu ox		} STR. SiO_2	Fe ox Flanking Away from MnOx - Fe ox - clay Filled Fx
50	55		5.2				8	1/—	2	1-2 mim.	(1 gn) (2 py)	80/1	3	T	—	Yellow-gr JASP.		)	Bx: Clast/MAT. :: 60:40, Clasts; "Ribbon Rock"; MATRIX
	60		1.1	↓	↓	↓	2	½/—	1	T jar	(1 py)	93/2	2	—	—	grey JASP	↓	← Vuggy (WATER FLOW)	partially welded. Local STR. vfg. Kfs (pink) Flooding
	65																		

THIS SPACE ON LAST PAGE for drilling comments or general hole summary

(81)

DRILLING INFORMATION

Contractor CXM (Price, Utah)
Date drilled 5/25/80
Hole diameter 5"? Hammer (Form)
Inclination 90
10' surf. csg.

PROJECT Hardshell
HOLE NO. HDS 81
Collar elev. ~5400' (map)
Final depth 500'
Coord. N/S ~11,075 (map)
Coord. E/W ~10345
Logged by F. R. Koutz
Date logged 5 JUN 80

DEPTH from	to	int'vl	FIRE ASSAY Au oz/T	MINERALIZATION: Mn Oxide	Hematite	Goethite	Jarosite	Sulfides	ALTERATION: Silica (Tot. SiO_2 / Late QTZ VN)	Clays	K-feldspar	Carbonate	Misc	Rock Type	REMARKS
															VIALS: Homogenized 200-430 - CAN NOT DISTINGUISH 5 FOOT intervals
0	10	10	1.10	—	2	1	—	—	—					CONGLOMERATE / PUMICEOUS	NOTE: If Feox % is ⇒ 0-120: Tuffaceous Conglomerate with
10	20	10	0.68	—	20	—	—	—	—	T, wh VN					underlined: indicates % Local sandy to pumiceous zones
20	30	10	0.42	—	25	T	—	—	—						of chips strongly stained.
30	45	15	0.46	—	3	1	—	—	—						
45	50	5	0.69	—	2	3	—	—	—/5						
50	60	10	0.23	—	25	5	T	(T py)	—	T, gr stain in sec				TUFFACEOUS OR LOCALLY SANDY	T specular.
	70	↑	0.32	—	1	10	—	—	—/3						
	80		0.26	—	T	2	1	T(py)	—						both diesen in sec (old FS)
	90		0.36	—	—	1	T	—	—						
90	100		0.11	—	T	1	—	—	—						
	110		0.20	T	T	3	T	—	—						
	120		0.22	—	3	3	—	—	—/1-3						
	130		1.23	—	10	3	—	—	—					RED CLAY ZONE	µBx crusts of Goeth.-clay. ⇒ 120-155 Red clay zone very clayey, chalky
	140	↓	0.10	—	8	1	—	—	—/1-3						← Grade transition chips with strong hemat. stain. Much of
140	150	10	0.67	—	10	3	—	—	1-3						internal v. fg + not represented in chips
150	155	5	2.64	T	1	5	—	—	75/-						Limon. mostly indeb. - Fringe Hem. w/ µBx (Mud is pink)
	160	↑	0.98	T dissem	T	1	—	—	90/1-5					MASSIVE JASPEROIDAL SILICA	
	165		0.73	T	½	½	—	—	95/3						~153-260: Massive silica zone:
	170		0.70	—	T	1+	T	—	95/5						Lt. to dk gy v. fg QTZ or Jasperoid.
170	175		0.59	T	T	½	T	—	95/-						Local red, yellow, greenish stains from
	180		0.41	—	1 dis	1-2	T+	—	98/1-2						Fe ox + oxid. products. "Greasy green"
	185		0.52	T	1	1	T	—	98/1						color locally common but <1%. Prominent
	190		0.65	T on Fx	T on Fx	1	T	—	95/T						1-2 DK (MnOx stain) QTZ Just above MnOx zone. Staining more
	195		0.55	T	T+	1	—	T py?	95/-				T malach.		3 DK st. QTZ, Py-tooth in cubic vugs or less increases w/ depth.
195	200		0.33	T	1	2	T	—	97/3						T DK st. QTZ.
	205		0.41	T on Fx	—	—	T	—	98/1-2	T wh. clay					200-430: TEN FT VIALS
	210		0.39												
	215		0.40	T	1	3	T	(py)	97/3-5				T? ALUN.		
	220	↓	0.57				Tryeom.								
210	225	5	0.49	T	2	3	T+	—	98/1-2	T wh.					

DRILLING INFORMATION

Contractor
Date drilled
Hole diameter
Inclination

PROJECT HARDSHELL — HOLE NO. HDS-81

Collar elev. — Final depth 500'
Coord. N/S — Coord. E/W.
Logged by FRK — Date logged 5 JUN 80

DEPTH from	to	int'vl	FIRE ASSAY Ag oz/T	Pb %	Zn %		MINERALIZATION: Mn Oxide	Hematite	Goethite	Jarosite	Sulfides	ALTERATION: Total SiO2 / Silica lok Qtz vn	Clays	K-feldspar	Carbonate	Misc.	Rock Type	REMARKS
225	230	5	0.49					SEE		220	-225		INTERVALS		P-1			
	235	↑	0.42				—	1 T spec	2	½ +min	—	95/—	T+ wh. cl				Massive silica	← T+ min. + white clay
	240		0.29			Marker loss												in μ vugs (py)
	245		0.39				T	½ T spec	2	¾	—	93/2	—					1-2% Bk st. QTZ
	250		0.38															
250	255		0.37				—	½	2	1	—	93/3-5	¼			1-3 greasy gr QTZ		~¾% mim. + clay
	260		0.42															Mixed.
	265		0.64	—	—			—	—	—	—	70/1-2	—			5-10 green QTZ		Green stains Blebs / 3% MnOx — ⇒ 260-370: Main MnOxide Manto
	270		3.83	0.35	0.04		1-2											away from goethite / stained QTZ — with former f.s. clastic unit & host
	275		9.75	1.23	0.04		5	3	3	—	—	85/—	1-2					Rock, now mostly jasperoid. % micro-xg
275	280		8.07	1.77	0.07												Main manto	SiO2 incr. with depth & somewhat
	285		10.48	2.01	0.04		4	1	2	½	(py)	80	3 wh.					Goeth. pseudo. (py) — correlates with amounts of MnOx or
	290		9.52	1.56	0.05	+10.22 Ag												metal grade. Generally more of a stain
	295		13.37	1.46	0.08		~15	½	5	—	—	60						MnOx soaks QTZ — rather than massive MnOx (≥5 oz) as in
	300		22.88	1.40	0.23													some other holes in the high-grade core
300	305		19.41	1.63	0.21	13.30 T Au	~20	T	5	T	—	70/5-8						MnOx intergrown w/ — of the main manto.
	310		12.82	1.98	0.11													Goeth.
	315		12.89	2.32	0.13		15-20	½	4	¼	—	70/10				3-4% clear QTZ	Manganese Manto	Sintery MnOx +
	320		10.14	1.69	0.18													soaking of QTZ
	325		8.91	1.65	0.20		15	T	4	T	—	60/15-10						MnOx stains & replaces QTZ. ↓ Zn picks up
325	330		6.56	0.82	0.52													
	335		6.52	0.78	0.83		15	T+	3	T		70/10-15						Sintery MnOx + stain
	340		3.91	0.58	0.88													
	345		4.47	0.51	0.66		10	3	3	—		75/1-3						Hem. Red Jasperoid
	350		3.59	0.55	0.59	5.50 Ag												- Very vuggy
350	355		4.66	1.30	0.94	7.06 Au	10	5	3	—		70/10						Loc. iridescent
	360		4.38	2.62	0.86													Goethite
	365		4.46	2.28	0.88		3	4	2	T / T min		85/3	T					Some cellular Goethite / Sandy-Sugary QTZ.
	370	↓	2.68	0.72	0.59													White clay chips (T)
370	375	5	1.91	0.68	4.96		3	5	1	T		—/1-2			70		LS	LS locally rex'lized. Note Zn picks up below 320!

DRILLING INFORMATION

Contractor
Date drilled
Hole diameter
Inclination

PROJECT HARDSHELL — HOLE NO. HDS-81

Collar elev. — Final depth 500'

Coord. N/S — Coord. E/W.

Logged by FRK. — Date logged 5 JUN 80

DEPTH from	to	int'vl	FIRE ASSAY Ag oz/T	Pb %	Zn %		MINERALIZATION: Mn OXIDES	HEMATITE	GOETHITE	JAROSITE	SULFIDES	ALTERATION: TOT. SiO2 / Lt Qtz Vn SILICA	CLAYS		CARBONATE	MISC	Rock Type	REMARKS
375	380	5	2.14	0.80	3.76		SEE 370-375 in hand / P-2										↑	⇒ 380-500: Limestone (Prob. Concha Fm)
	385	↑	3.23	0.92	2.92		8	½	½	–		–/5			75			Late Qtz. Local v. str MnOx. Almost totally
	390		6.59	0.89	6.24													replacing chips. Higher grade Ag (+Pb-Zn)
	395		9.54	2.24	6.14		60	T	–	–		?/8	2		?			1-2 pink carbonate. Zones show clear relationship to total
	400		5.14	1.68	5.91													Late Qtz veinlets. (Primary) sulfides – now FeOx + minet.
400	405		4.63	1.13	6.06	4.24 Ag No Au	10	1	1	½		?/3			20			3-5 greenish-Bl. Qtz or calc. Minor amount of late v. clear Qtz
	410		3.13	0.70	3.31					T minet.							2	+Tr bright blue stain (paint?) appears to be post-MnOxide
	415		3.69	0.99	4.51		5	T	¼	1		?/10			70			Tr spec? in wh. recxtal LS
	420		2.11	0.65	3.17					T minet					(f.g.)			This hole may be a good candidate
	425		1.41	0.29	1.37	2.04 Ag No Au	2	T	½	T		?/5			80			for deepening by diamond drill to
425	430		1.70	0.35	0.87					T minet.								test LS repl. potential @ depth.
	435		1.02	0.22	0.85		3	T	¼	T+T him.		?/3			85			
	440		1.48	0.21	0.81		2	T+	¼	T		?/5			85			T. Lt. Bl. stain in wh. Qtz + calc. around MnOx
	445		2.95	0.19	2.31													
	450		2.10	0.23	1.32		3	¼	½	T		?/5			80			MnOx in FeinLS.
450	455		1.43	0.31	0.91		2 (stain)	T	1	T		?/5			75			Bright orange → Yellow Fe Ox
	460		4.89	1.03	1.36													
	465		26.30	1.49	2.32	21.19 Ag No Au	3	1	3	¼		?/5			25?			Vuggy with Goeth. hem. fluid.
	470		28.88	2.08	2.82					T him.								Tr. Pink CaCO3?
	475		27.06	2.97	2.98		5	1	5	½	(PY)	?/3			70			Goethite pseud after pyr. Some looks same generation as MnOx
475	480		2.49	3.17	3.03					T him.								T pink calc. vns. – locally forms halo to MnOx stains.
	485		12.19	0.49	0.99		3	T	2	T		?/12			80			T. pink calc.
	490		16.33	1.56	2.35					T him.							↓	
	495	↓	12.82	2.22	2.83		2	¼	1	–		?/1			90		sdy	T pink calc.
495	500	5	0.82	–	–										(Sandy LS)		LS	
TOTAL DEPTH																		

Rock type (written down the column, 380–490): Recrystallized and silicified

– Drilled by CXM Drilling Co. of Price, UT – GD-15W / 250 psi - 600 cfm
– Ag, Pb, Zn Assays by ARL (Au Assays are High!) : Air hammer
SEE 4/14/81 memo FRK → WLK ⇒ Ag-Au ck Assays on Composites by Hunter (Reno) Nov 81

2555 frk

DRILLING INFORMATION

Contractor CXM (Price, Utah)
Date drilled 5/27/80
Hole diameter 5" Hammer (Foam)
Inclination 90°
10' surf csg.

PROJECT Haroshell HOLE NO. HOS-82

Collar elev. ~5395 (map) Final depth 560'
Coord. N/~~S~~ ~10,980 (map) Coord. E/~~W~~ ~10,425
Logged by F.R. Koutz Date logged 5 JUN 80

DEPTH from	to	int'vl	AARL FIRE ASSAY Ag oz/T	MINERALIZATION: Mn Oxides	Hematite	Goethite	Jarosite	Sulfides	ALTERATION: Silica (total SiO2 − x.g. later Si)	Clays	Carbonate	Misc.	Rock Type	% Chips with sandy texture	REMARKS
0	10	10	0.85		T	1			—				Rhyolite Agglomerate ?	10-15	⇒ 0-40 Rhyo! Agglomer.? Some Flow-
10	20	↑	0.64		3	½			—					20	Hem in dissem. dots. Banded Rhyo! Frags ("Ribbon Rock")
	30		0.46		20	4	T		—/1			Green stain ± py		20	↑ T. green Relatively high. Associated with
	40		0.43		1	2	T	T: py T- cov	—			T gr. stain		—	m-f.g. clay. TUFF. Agglom ± sandy interbeds
	50		0.46		1	1	T		—			1-2 gr. stain		—	f.g. ↓ zones
50	60		0.44	T-	1	2			—/1					10	
	70		0.56	T- dendr.	2	3								16-30	⇒ 40-210 Tuff, Agglomerate with local
	80		0.51		3	5								30	str. "sandy" zones. Sdy material
	90		0.51		1	3+								—	m.g. may be f.g. xtal-tuff or Arkose
	100		0.43		2	2			—/+2				Agglomerate Sandy zones	10	f-m.g. (Epiclastic) Matrix to sandy zones
100	110		0.38	T	3	5								—	is f.g. + prob. mostly sericite & clay
	120		0.33		2	3	T							—	Loc. irrid. Bk hem T spec. in QTZ
	130		0.31		2	3-4								10	- Multiple f.g. clastic zones
	140		0.23		¼	1	T							10	m.g.
	150		0.27		¼	1+	T+							—	
150	160		0.28		¼	1	T						Tuff Ag [illegible] with local [illegible]	~40	f.g.
	170		0.41		½	1	½	T py?	—/1-2					—	
	180		0.89	¼	T	1½	½	T py?						20	
	190	↓	1.17	¼	¼	2	½	T py						—	Orange limonite DK red hem after py
	200	10	1.58	T	½	3	¼	T py?						20	T+ specularite
200	205	5	1.69	¼	¼	2	T	T py	—			T+ spec.		—	10' vials below ↑
	210	↑	1.45											—	(0-5' interval refers to 0-40') ↓
	215		0.94	½ 2?	T+	1	T+		35/5			T spec T alun			Black stained QTZ (MnOx+) below 210 ⇒ ~290 Massive Silica zone
	220		0.97												Dk → Lt grey with local str. staining
	225		1.09	¼	½	2	¾	T+ py	90+/-			T+ spec.	Massive Silica		by Fe oxides. Amount spotty but increases
225	230		1.12												with depth - Relict pyr ⇒ jar ⇒ goeth ⇒
	235		1.20	T	¾	2	1	T py?	95+/-			T+ spec.			hem ⇒ spec. Specularite often in
	240		1.28												Former pyrite vugs as blebs.
	245	↓	1.31	—	½	3	1½	T py	85/-			T spec.			
	250	5	0.66												

DRILLING INFORMATION

Contractor
Date drilled
Hole diameter
Inclination

PROJECT Hadoshell (uncertain reading) — HOLE NO. HDS-82

Collar elev. — Final depth 560'
Coord. N/S — Coord. E/W.
Logged by FRK — Date logged 5 JUN 80

← AARL →

DEPTH			FIRE ASSAY			HUNTER	MINERALIZATION					ALTERATION						
from	to	int'vl	Ag oz/T	Pb%	Zn%	comp	Mn OXIDES	HEMATITE	GOETHITE	JAROSITES	SULFIDES	SILICA TOTAL / Xg LATE QTZ VN	CLAYS			MISC.	Rock Type	REMARKS
250	255	5	1.83	1.13	0.01	↑ oz/T	—	1/2	2	1		90+/-				T ALUN.		T green stained sec.-clay
	260	↑	3.75	1.87	0.02												MASSIVE SILICA	
	265		2.77	2.59	0.47	2.77 Ag 0.006 Au (uncertain)		3/4	1 1/2	3/4	T PY	90+/-		T greasy green JASP.				260-300 DK stain (MNOX?)
	270		1.76	0.55	0.01													IN QTZ
	275		1.53	0.23	0.02			1/2	2	1/4	T PY	95/1				T min.? T SPEC.		
275	280		4.74	0.22	0.01	4.47 [illegible] 0.004 (uncertain)												– very gradational – spotty zone into Mn oxide – Rich ORE body.
	285		4.91	0.25	0.01		1/2	1/2	2	T+	—	95/-	wh. 1-2					
	290		5.04	0.38	0.01													⇒ ~280-370: MN oxide zone with mostly
	295		8.80	1.05	0.10		10	1/2	2	T		80/1-2	wh.-mixed w/ MNOX 3					MNOX CRUSTS + LATE QTZ. Jasperoid host-rock, local weak fg
	300		13.65	1.33	0.22	↓												clastic material can be noted (not well
300	305		10.22	1.75	0.26	↑	15	1/2	1 1/2	T	T-py?	70/-	1				Mn OXIDE ZONE (uncertain)	silicified). Local pure white clay with
	310		4.91	1.44	0.27													MnOX + silica: mostly argillized volcanics
	315		6.30	0.51	0.02	13.8 Ag + 3.6 No Au (uncertain)	20	3/4	2	—	—	50/15	3					STILL WEAK porph. Text. where not silicified. Some MnOX – SiO_2
	320		11.33	2.73	0.69													nodules in white clay.
	325		11.61	2.54	0.77		20	T	1 1/2			65/-	1/2	SEV. BRIGHT green flecks paint OR BROCHANT.				– [illegible] late QTZ is clean + forms
325	330		18.79	1.95	0.51													terminated xtals
	335		5.99	2.05	0.50		20	T	2	T		75/5		T PYROM.				– NOTE that higher-grade Ag-Pb zones
	340		8.86	1.74	0.85												[illegible]	correlate w/ higher % Fe oxides
	345		10.50	1.66	0.94		25	T	1	1/4		70/10						MNOX: Sintery CRUSTS
	350		16.25	4.60	0.95	✕												
350	355		12.18	3.90	0.99	↑	35	T	1	T+		60/3						
	360		10.13	3.22	1.27													
	365		6.07	2.15	1.16		15	1/2	2			85/-	T wh.					↑ High Pb
	370		3.62	1.41	0.90													Low Zn
	375		3.23	0.66	1.14	4.24 Ag 0.02 Au	5	1/2	1			20/-					Mostly Sandstone (uncertain)	20% SiO_2 REST fg. seds (SS)
375	380		2.67	0.45	0.86													
	385		2.14	0.27	3.80		2	2	1			10/3						Pink SS, Volcanics [illegible] — ZN picks up
	390		0.89	0.29	5.55													Pb is Low ↓
	395	↓	0.93	0.39	5.60		3	1/2	1			90/-						380-430 Strong Pink Hem. stain
375	400	5	2.47	0.66	4.74	↓											↓	

DRILLING INFORMATION

Contractor

Date drilled

Hole diameter

Inclination

PROJECT Hardshell — HOLE NO. HDS-82

Collar elev. — Final depth 560'

Coord. N/S — Coord. E/W.

Logged by FRK — Date logged 5JUN80

DEPTH from	to	int'vl	FIRE ASSAY (AARL) Ag oz/T	Pb %	Zn %		MINERALIZATION Mn-Oxides	Hematite	Goethite	Jarosite	Sulfides	ALTERATION Silica (f.g. SiO2 — / c.g. late qtz)	Clays			Misc	Rock Type	REMARKS	
400	405	5	1.08	0.33	3.41	↑ 0.2 oz/T 0.76 Ag, T Au	1/4	T	1/2			20/-					↑ Sandstone fairly clean and well rounded	85% clean SS	⇒ 320-500: Sandstone hostrock with
	410		0.79	0.22	4.31														only a few volcanics (maybe cave) -
	415		0.67	0.31	2.67		2-3	1/2	1/2			10/-	1/4					85% clean SS	Generally well-rounded grains with high
	420		1.26	0.43	2.33														porosity - mostly silica cement - some
	425		1.05	0.23	2.74		5-7	3/4	1/2			-	T					80 clean SS	f.g. jasperoid replacement. SS has a
425	430		1.37	0.44	2.47													Some FS ⇒ clay+SER.	light coating of pink ⇒ tan Fe oxides
	435		2.31	0.51	1.50		5	1/2	1/2			- 2	-					5% FS in SS; 85 clean SS	- This is probably PZ sandstone +
	440		1.88	0.25	0.76														NOT f.g. clastic unit because much
	445		0.71	0.07	0.33		7	1/2	1/2			10/5	T					10% Jasp., REST clean SS	too clean. However SS is often poorly
	450		1.53	0.17	0.46	↓													sorted.
450	455		2.07	0.37	1.20	↑ 10.36 oz/T 0.53 : Ag, 0.026 + none : Au	30	1/4	2			-/1	3					SS: Host Rock	SS is probably Schnebly
	460		2.56	0.50	1.83														NOTE THAT SS no matter what Fm.
	465		3.58	0.49	2.11		40	1/2	2	T								Much of MnOx is massive	is often v. good host rock to
	470		10.71	1.14	2.16													~60% SS	Mn-Ag mineralization.
	475		15.80	1.64	2.58		60	1/2	2			10/5						SS soaked w/ MnOx	
475	480		15.41	1.50	2.98														
	485		5.21	0.40	2.70		50	1/2	2			20/-						Massive MnOx + soaking SS	
	490		4.73	0.54	2.46	↓													
	495		1.37	—	—		25	1	1 1/2			30/3						REST SS	
	500		1.04																
500	505		0.98				10	1/2	1								Silicified limestone with interbedded SS (P.)	30% wh. LS. (LS cgl. or Exotic Block)	⇒ 500-560: Mixed sandstone
	510		1.77															REST SS.	and limestone. LS Ltgy with
	515		1.90				5-7	T	3/4			10-15/-							Local c.g. white calcite - sandstone
	520		0.88																is as above - but locally arkosic
	525		1.18				3-5	T+	1 1/2	T		20/-						Loc. wh. calc. Rhombs.; 30 SS REST LS.?	All is more or less stained (soaked)
525	530		2.37				7	1/4	1	T		5/-						20% SS REST Rextal LS	with PK MnOx > FeOx. Mottled
	535	↓	1.34				3	1	1/4			-/1							appearance.
	540	5	0.65																
	545	5	0.43				3	1/4	1			-/3						mostly m.g. SS; clean w/ 5-10% FS (clay)	
	550	5	0.88																
	555	5	0.26				1	1/4	1	T		10/-						massive chips + soak / veins or cave	
555	560 T.D.	5	0.38																

2555 frk

(83)

DRILLING INFORMATION

Contractor: CXM (PRICE, UTAH)
Date drilled: 5/30 - 6/2/80
Hole diameter: 5" ? HAMMER (FOAM)
Inclination: 90°
10' SURF. CSG.

PROJECT: HARDSHELL
HOLE NO.: HDS-83
Collar elev.: ~5470 (MAP)
Final depth: 480'
Coord. N/S: ~11305 (MAP)
Coord. E/W: ~10,395
Logged by: FRKOUTZ
Date logged: 6 JUN 80

DEPTH from	to	int'vl	FIRE ASSAY (AARL) Ag oz/T	MINERALIZATION: Mn OXIDES	HEMATITE	GOETHITE	JAROSITE	SULFIDES	ALTERATION: SILICA (TOTAL SiO2 / XS LATE VN QTZ)	CLAYS		CARBONATE	MISC	ROCK TYPE	REMARKS
0	10	10	0.19		5	1				T. gr. stain in clay					⇒ 0-280: Mostly Tuff Agglomerate with zones of
10	20	↑	0.40	T-	3	½									f.g. clastic sediments (esp. 20-40, 90-155)
	30		0.61		4	1	T							f.g. sed?	with thin zones elsewhere. Variable amounts
	40		0.66		2	2	½								of oxidation (i.e. red Fe Ox stained vs green
	50		0.86		2	2+							T spec.		grey volcanics). Local breccia fragments,
50	60		4.19	½-1	1	2	T								Ribbon rock; and clastics but distinct
	70		1.43		3	1				T gr. stain ser-clay					30% f.g. clay-ser. (green stain) Rhy: Bx zone can not be distinguished
	80		1.18		2	3	T							30-50 fg SS	80-160: mostly gray-green (wk oxid.) although 0-20' has more Bx frag-
	90		1.10		½	½	J			RED clay in vial				mostly fg SS	mostly QTZ + SER.?) ments. / Local strong SiO2
	100		0.77		T	¼-½	T							Bx? SS	lacks strong conchoidal Fx of massive SiO2 flooding
100	110		0.74		¼	1	T								
	120		0.51	T	¼	¾									
	130		0.51		½	T							T spec.		Red → Bk hem on Fx
	140		0.47	T	¾	¾	T								
	150		1.48		1	¼							T spec.		10% fragments (phenocrysts?)
150	160		1.25		1	½								← - - -	Less silicif.
	170		0.71		¼	¼									wk QTZ-SER.
	180		0.34		¼	¼	T			T gr. QTZ SER					phenocrysts or frags repl. by QTZ-SER.
	190	↓	0.27		4	½	T								Pink below
	200	10	0.27		2	¼		Tr py? → hem							mostly gray-green QTZ-SER.
200	205	5	0.19	T	5	1									(10 ft ints)
	210	↑	0.15												(0-5' interval refers to 0-10')
	215		0.12		5	1									
	220		0.18												
	225		0.21	T	4	¼									
225	230		0.30												
	235		0.26	T	2	¼		(py)							Dissem. hem blebs after py
	240		0.23												
	245	↓	0.19		5	1									10-20% f.g. clastics in Tuff Agglom.
245	250	5	0.47												

Vertical notes (90-180, alteration): MOSTLY GREY-GREEN / LOW Fe - SERICITE - QUARTZ
Vertical notes (120-150, rock type): GREY QTZ S...
Vertical notes (170-245, rock type): MOSTLY TUFF AGGLOM. with ... f.g. ...

2555 frk

PAGE 2 OF 3

DRILLING INFORMATION

Contractor
Date drilled
Hole diameter
Inclination

PROJECT *Hardshell* HOLE NO. *HDS-83*

Collar elev. Final depth *480*
Coord. N/S Coord. E/W.
Logged by *FR Koutz* Date logged *6 JUN 84*

DEPTH from	to	int'vl	ASSAY (Fire, AARL) Ag oz/T	Pb %	Zn %		MINERALIZATION Mn Oxides	Hematite	Goethite	Jarosite	Sulfides	ALTERATION Silica / Late x-s QTZ	Clays		Carbonate	Misc	Rock Type	REMARKS
250	255	5	0.14				T	3	2			–/T					Tuff Agglom. & f.g. clastics	M.g. with wh. SER in
	260	↑	0.21															Frags on phenocr. + MATRIX
	265		—				T	3	½									
	270		0.20								1-3 PYR							← PYR in wh.-ser-clay dissem. blebs.
	275		0.15					3-4	½		T+ PY	10/–						Also v.f.g. PYR dissem. in silica — ⇒ 280-285 Transition Zone
275	280		0.14															f.g. clastic + Tuff Agglom.
	285		0.11				T	5	½	—	½ PYR	–/5	3-5 wh chips				f.g.	Most py in f.g. silica w/ wh. SER. Frags on phenocr. + in MATRIX — Increase in Hem. + MUD is
	290		0.22														Clastics	Pyr. is source of HEM. — V. PINK but no distinct upper
	295		1.65				T	2	2	¼	T PY					T. SPEC T pyrom – mim.	?	Part to "Red clay" zone
	300		0.71									90/–						SiO2 Jasp. STARTS @ 295'
300	305		1.08			HUNTER LABS (TREND) COMPOSITES	T	T-¼	¼	T	(PY)	95/–				T SPEC T mim	MASSIVE SILICA CAP ROCK	Mimet. + Jarosite in vugs in QTZ (Py). Spec. Hem dissem in Jasperoid
	310		0.47															
	315		0.51				T.?	T+	¼	2	(PY)	95/5		T CV ?		1% SPEC		Mimet. mixed w/ Hem. "Cuprite" color to some Hem. — ⇒ 295-360 MASSIVE Silica Caprock
	320		0.42													1%– mim		Spec in old pyr. vugs. Some spec. has cov → cu° colored luster — Lt gray to tan v.f.g. SiO2 (Jasperoid)
	325		0.42				T	T	½	1	(PY)	98/5				1 SPEC		Dissem. Mn + pyrom. — with local, late m-x.g. cloudy to clear
325	330		0.63													¼ mim		Late QTZ in old pyr. vugs. — QTZ. Vugs in silica after oxidized pyr.
	335		0.37				T	T-	T	1-2	(Py)	98/5				½ SPEC		MnOx partially assoc. — now filled with late QTZ druse, mimetite
	340		0.36															w/ mimetite — and specularite blades. Amount of x.g. clear
	345		0.46				1-2	—	1	1		95/10				¾ mim		late QTZ increases with depth.
	350		0.83			↓												
350	355		0.70				3	T	1	1¼ (mim.)		85/10				T SPEC		
	360		1.13															
	365		7.16	3.18	0.11	↑	30	T	2			60/5	1-2 wh.			T mim (pyrom)	MAIN MANTO (MnOx-Zn)	360-430' MnOx Massive — ⇒ 360-465: MAIN MnOxide-Rich MANTO
	370		26.05	3.90	0.44													w/ conchoidal Fx — Many chips are massive MnOx (v.x.g.)
	375		23.43	4.10	0.71		70	T	1			30/5						with conchoidal Fx + several periods of cross-
375	380		12.44	2.62	1.06	14.3 + 13.9 Ag (Au)												cutting QTZ + Mn oxides. Mostly x.g. QTZ is
	385		7.55	1.18	1.26		75	¼	2			25/5	a. 1					v. clear + forms terminated xtals and druses
	390		14.30	4.50	0.84													Local late fibers of MnOx in vugs. Amount of
	395	↓	3.57	1.16	1.19		80	T	1			20/10	15					QTZ (x.g.) is clear to cloudy — FeOx corresponds to Ag-Mn-grade. But low
395	400	5	2.82	1.76	0.25	↓												FeOx in general

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DRILLING INFORMATION

Contractor
Date drilled
Hole diameter
Inclination

PROJECT Hardshell HOLE NO. 1405-83

Collar elev. Final depth
Coord. N/S Coord. E/W
Logged by FRK Date logged 6 JUN 80

DEPTH from	to	int'vl	← NAL → FIRE ASSAY Au oz/T	Pb%	Zn%	Mn Oxides	Hematite	Goethite	Jarosite	Sulfides	Silica Late ←QTZ	Clays		Carbonate	MSC	Rock Type	REMARKS
400	405	5	1.98	1.44	0.40	70	T	1/2	T min		30/10						
	410		3.55	1.04	2.35											Pb>Zn Mantle	
	415		7.34	3.20	0.53	60	T	1/2	T		35/15						
	420		4.82	1.38	2.67												
	425		3.18	1.64	1.89	20	1/4	3/4	—		60/5			T wh+ PINK			Rhodochrosite
425	430		2.49	1.22	1.35												
	435		2.66	1.40	1.10	5-10	T	1/2	—		80/5					Mn Oxide Mantle	Some MnOx very Acicular
	440		3.25	1.84	1.46												
	445		3.22	2.04	1.81	30	1/4	1	T min		60/10					Mn Oxide Inter (2nd Pb)	MnOx inter Below 445
	450		4.47	2.48	2.38												
450	455		NSR incl.		in comp.	15	T	1	T		85/5					Mn Oxide Mantle	No Assays QTZ vicinity
	460		2.55	1.24	1.51												stained w/ MnOx - Tr green stain in Fg Grit (base of)
	465		2.63	1.02	1.58	5	1/4	1	T		50/1			30	T min		⇒ 465 - 480 Lt gy to Locally dk gy (unaexted)
	470		0.43	—	—											grey Recital	V.F.g recrystal. + Silicified with Local Fg calc.
	475		0.52			T	—	1/4	—		102/—			80		Ls - Sugary	vn. + a few Zo calc. Rhombs to 2mm. % S.g.
475	480	5	—														is variable. No evidence of Fossils.
TOTAL DEPTH																No Assay	

2555 frk

ASARCO

Southwestern Exploration Division

October 13, 1981

To: F. A. Michel

From: F. R. Koutz

Lithology-Mineralization Summary
Hardshell Project
Santa Cruz County, Arizona

As soon as you have the HDS-84-88 logging and Hermosa work reasonably well finished I would like you to compile a table of all Hardshell drill holes showing the depths and absolute elevations of significant lithologic-mineralization contacts. This table should include North and East Hardshell grid coordinates and collar elevation (the final figures will be available from F. Baker in a week or so). These contacts or elevations should include: total depth, bottom Rhyolite Breccia/top tuff agglomerate, top of red clay zone (if present), top of massive silica caprock (jasperoid), top of main manto-Mn oxide zone, top of limestone and/or sandstone and bottom of Mn oxide zone. Other contacts, if applicable, should be included: bottom of trachyandesite ("diabase"), latite porphyry contacts, limestone conglomerate contacts and elevation of the water table.

Much of this information is already compiled on contoured overlays which I will provide to you. This information should be checked against 1973, 100 scale cross sections, drilling reports and general data in N. P. Whaley's Hardshell files. Original field drill logs will provide some of this data as will the file of graphic logs in Whaley's files.

The Minerals Beneficiation Department is particularly interested in the amount of manganese-silver lower main-manto ore which has a high calcite content which would consume reagents in one possible beneficiation process. Your compilation will be the first step in compiling geologic data for a future mineral/ore-types inventory. The data will also help to plan intermediate-depth drilling to measure the amount of high carbonate, Mn-Ag mineralization.

I also plan to composite and geochem. assay the deepest portions of holes, base of the Mn-oxide zone and/or top of the carbonate section for Mo. As I mentioned to you limestones at Trench and elsewhere show a distinct Mo anomaly in the vicinity of igneous intrusions and breccias related to base metal mineral-

ization. A study of moly zoning will be among the first studies in the attempt to define deep drilling targets for sulfide/ limestone replacement deposits in the roots of the Hardshell manganese oxide system. It is already known that Mo content increases with depth in some HDS-drill holes.

Compilation of this table should only take 2 or 3 days and re-examination of vials, core and chip-boards should be kept to a minimum. Please see me before you start so that we can define criteria for specific contacts.

FRK/sk

cc: W.D.Payne
A.R.Raihl

ASARCO

Southwestern Exploration Division

January 29, 1982

TO: W. D. Payne

FROM: F. R. Koutz

Baseline Water Quality Survey
Hardshell-Trench Camp Area
Santa Cruz Co., Arizona

With this memo I am transmitting through you to the General Files a copy of the results of N.P. Whaley's and S.D. Clark's (Water Development Corporation) water sampling in the Patagonia Mountains. I note no significant changes in water quality at any of the sites from this year's sampling.

I have no specific responses to Mr. Clark's comments to N.P. Whaley (Nov. 17, 1981) at this time except that water supply and quality will be a major consideration in any future mining in the Patagonias, and it is not too early for both of these factors to be considered by both the Mining and the Exploration Departments.

The attached 4 sets of analytical certificates and attached data and letters should be separated from the regular Hardshell/Patagonia section of the general files along with Survey I (3/11/80), Survey II (4/15/81) and possibly Assays on Trench tails (10/09/81) and combined into a Patagonia Mountains "Water/Environmental" file.

This year funds should be set aside for the 4th survey in Oct-Nov., and some attempt be made to include a few more wells nearer to Harshaw/Hardshell. Samples of water outside the Harshaw Creek drainage; e.g., Worlds Fair can probably be dropped.

By copy of this memo I am asking N.P. Whaley to send Hale, Wheeler and Kerr-McGee copies of this year's data from their respective wells, and thank them for their cooperation.

F. R. Koutz

FRK:mek
Att.

cc: N. P. Whaley w/o att.
R. B. Crist w/o att.

Hardshell
NW3

FROM: W. L. KURTZ

TO: G Pickwell

Have you ever updated your original pre reserve calculations with the additional drilling that has been done since your original calculations done for FTC about 4? years ago.

If not would you?

Cl. Tissell

ASARCO

Southwestern Exploration Division

November 18, 1982

To: W. L. Kurtz

From: G. W. Pickard

Hardshell Project
Preliminary Underground
Ore Reserve
Santa Cruz County, AZ

The Hardshell preliminary underground ore reserve compiled in January, 1979 has been updated with the inclusion of hole numbers 77, 79, 80, 81, 82, and 83, drilled during the 1979 and 1980 periods. A comparison of the two ore reserve estimates are as follows:

Lower Manto Ore - 1982

Oz. Ag/Ton Cut-off	Vertical Height	Tons	Oz. Ag/Ton Average Grade
8.0	77'	3,671,000	10.22
7.0	78'	4,677,400	8.92
6.0	88'	5,786,700	8.40
5.0	97'	6,865,500	7.60
4.0	105'	7,858,400	6.91
3.0	101'	8,392,400	6.67
1.5	89'	9,827,300	5.98

Lower Manto Ore - 1979

8.0	70'	3,776,700	10.40
7.0	66'	4,593,400	9.60
6.0	80'	5,720,500	8.64
5.0	89'	6,586,500	7.92
4.0	100'	7,773,000	7.09
3.0	92'	8,192,700	6.89
1.5	86'	9,384,700	6.25

A copy of the worksheets and the polygon map, scale 1" = 100', with drill hole locations accompany this memorandum.

G. W. Pickard

G. W. Pickard

GWP/cg

Attachments

ASARCO

Southwestern Exploration Division

February 25, 1983

To: J. D. Sell

From: F. R. Koutz

1983 Assessment Work
Hardshell Project
Santa Cruz County, AZ

We have 132 unpatented lode claims in our Hardshell Group which need assessment work by September 1, 1983. In July 1981 I believe it was fairly well agreed between W. L. Kurtz, F. T. Graybeal, W. D. Payne and myself that, except for a few definition holes on the margin of the main manto, additional interspaced drilling between known ore holes in the main manto be postponed until a separate appropriation was made available to drill out the orebody for mine-planning/scheduling (development) purposes. Diamond drilling into the carbonate section below the best mineralized portions of the main manto to test for deeper, major limestone replacement mineralization beyond that already known would probably also best be done with a separate appropriation as our annual assessment monies would only allow for 600 feet or so of coring in one or two holes. It was decided for 1981 assessment work to test an area around and to the north of the Hermosa Mine (1000 to 1500' east to southeast of the main manto) where there are significant surface geochem. Ag, Pb, Zn, Cu, Sb, As, Mn and Fe anomalies.

Our 1981-1982 program at Hardshell consisted of five phases:

1. Location and resurvey of all old holes and triangles with correct elevations by Baker, Wood, Broderick, and Martinez. This data was tied in with the new aerial photography in Summer 1982.

2. Surface geochem. sampling (96 samples) with fracture analysis and quantitative alteration mineral estimates by Alpers. This defined the +25 ppm Ag surface anomaly (among others) shown on the attached map.

3. Underground sampling and mapping in the Hermosa Mine by Michel and Martinez (72 samples). This sampling was very encouraging with 37 samples from the vein (5' average thickness) averaging 4.5 oz Ag/T and 0.8% Pb with spotty zones of 10-25 oz Ag/T (1-2% Pb) similar to that mined in 1881-83. Almost all haulage tunnels and crosscuts ran 1-2 oz Ag/T.

4. Hammer drilling (1400') in 5 (150-400' deep) holes of a planned 7-8 hole program. Problems were encountered in getting a contractor

mobilized so TCH-2 drilling was used for 1981 Hardshell assessment work and the September hammer drilling for 1982 assessment work. This drilling was designed to test for disseminations away from high-angle mineralized structures and projected stratiform mineralization at the Hermosa Mine, at Latite Porphyry contacts which show a close association with Hermosa-type mineralization and in the +25 ppm Ag surface anomaly. The drilling was relatively successful with the 1400' of drilling averaging 1.31 oz Ag/T with the 550' of +1 oz Ag material averaging 2.3 oz/T. The drilling would suggest about ½ m.t. of 2-4 oz Ag material over a 50 foot thickness starting at 50-80 feet below the surface. F. Michel's calculations from the underground sampling suggested several hundred thousand tons of 4-5 oz Ag material with 8/1 stripping ratio. The stripped material would include the ½ m.t. of 2-4 oz Ag calculated from drilling.

? - along strike work on FAK

The 3 holes north of the Hermosa Mine encountered greater thicknesses than expected and multiple flows (? - or sills) of Latite Porphyry. Significant intercepts of +1 oz/T silver mineralization are present within the Latite Porphyry encountered but unfortunately the higher-grade portions of the mineralization contain several percent manganese oxides in more fractured zones and are thus more similar to zones directly over the main manganese-oxide manto and massive silica than to the Hermosa ores with lesser manganese and possibly better metallurgy. Some deep (+600-800') drilling may eventually be justified in the North Hermosa area but the carbonate is at least below 1100' depth (e.g. HDS-38). At present additional drilling is justified in the 200-400 foot range to examine fault zones and Latite Porphyry contacts within the +25 ppm Ag surface zone.

5. A metallurgical composite sample (4.26 oz Ag/T, 0.71% Pb) from the Hermosa underground was submitted to the Minerals Beneficiation Department to see if they could improve on the former 50% Ag recovery by cyanidization. In a report of October 30, 1981 T. D. Henderson demonstrated that a 72% Ag extraction could be obtained with a 64 hour leach with 3 lb. NaCN/T solution. The only pretreatment that improved Ag recovery (to 80%) was an SO_2 preleach indicating that roughly 1/3 of the Ag not dissolved by straight cyanidization is tied up with manganese. More Ag is probably tied up with Mn in the mineralization drilled at North Hermosa. However the improvement of silver recoveries suggests that Hermosa-type mineralization, although of low grade in bulk tonnages compared to main manto ores, should be considered in the overall eventual Hardshell beneficiation flow sheet - especially considering up to several million tons of +1 oz Ag Hermosa or "red-clay" type ores overlie the main manto and will have to be stripped.

For 1983 assessment work considering the limited funds available, in spite of such enticing targets, I suggest that we slightly extend and complete the program started in 1981 in the Hermosa-North Hermosa area. The holes

indicated on the attached map should be completed in order until funds are exhausted:

HDS-88 (240' depth): Deepen to 350-400' to test basal Latite Porphyry (LP).
1983-A (400' proposed depth): Test basal LP and N-S Hermosa fault.
1983-B (400'): Same as A but also on extension of N. Hermosa workings.
1983-C (250'): Test Hermosa mineralization downdip of old workings at base of LP.
1983-D (350'): Same as A but to south.
1983-E (250'): Test footwall zone of Hermosa fault near old workings.
1983-F (400'): Reserve site. Test SW edge of 25 ppm Ag anomaly.

The roads and all previous sites are in good condition. Site A is new and will probably have to be built by switching back SW from HDS-86. Site E is on a steep rocky slope and may require minor blasting. Hole E should be about 75' W of the shaft to avoid old workings. Site F at a road intersection should require minimal dozer work. The 1890' of drilling through hole E should be able to be completed at $7/Ft. direct drilling costs ($13,230 total) - a reasonable price this year.

It proved very useful to have F. Michel on site to cut off and log HDS-84 to 88 while sampling at Hermosa and at the American Mine area in 1981. I suggest that a geologist should be available for this year's drilling also. For example holes A & B might be able to be cut off at 350 feet if they do not show significant Mn or Fe oxides or alteration usually associated with Hermosa-type mineralization. The Hermosa underground would also benefit from a minor amount of additional sampling and mapping - particularly in the old workings about 150' SW to SE of site C not shown on the older maps and inaccessible without a 20-foot ladder and a little pick and shovel work.

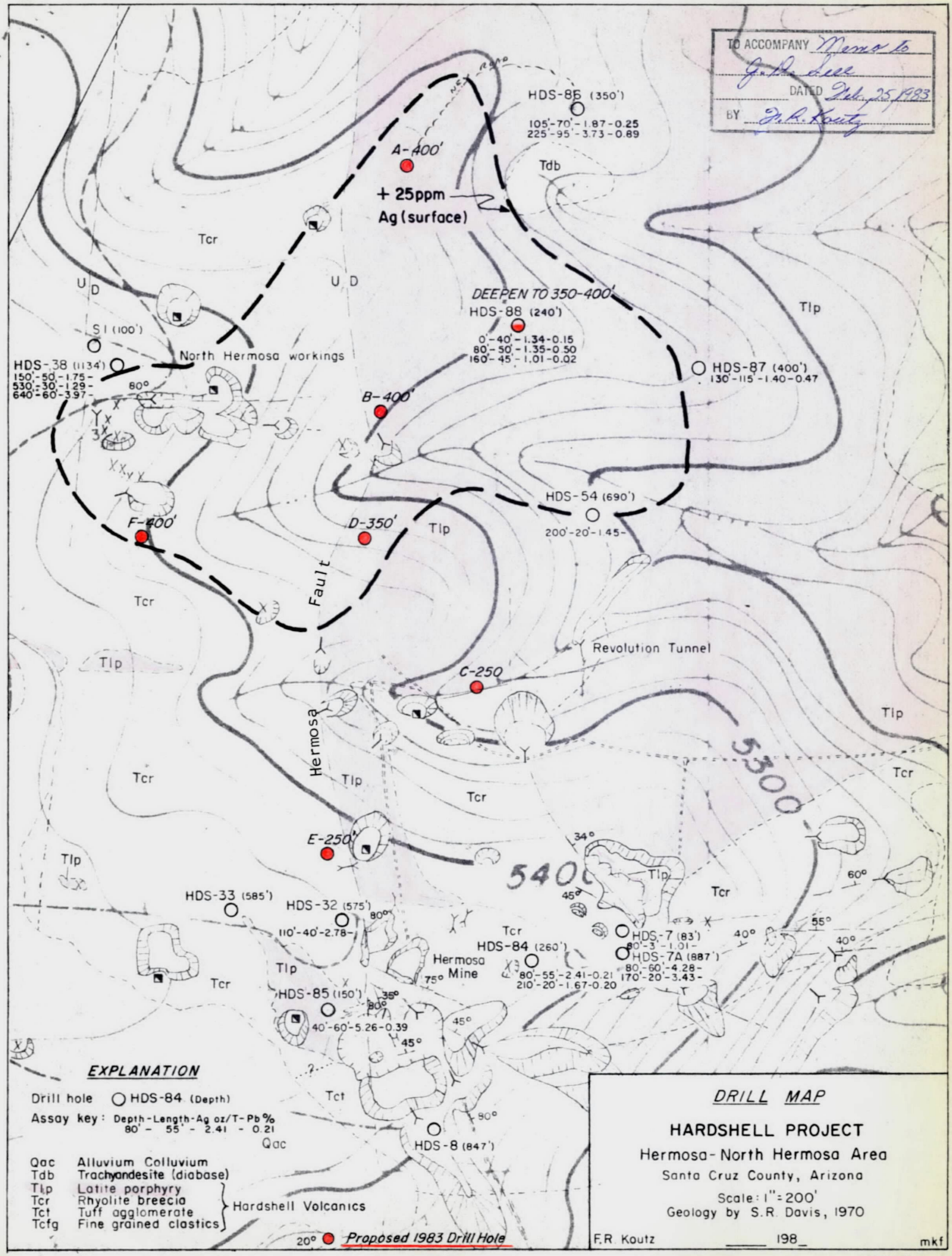
I have briefly discussed this proposed road building/drilling with T. C. Benavidez and I suggest that he might start obtaining bids from contractors and notifying the USFS if the proposed drilling meets with your and New York's approval.

F. R. Koutz

FRK/cg

cc: TCBenavidez

Attachment: mkf #5477


TO ACCOMPANY Memo to J. D. Lee
DATED Feb. 25, 1983
BY F. R. Koutz
HDS-85 (350')
105'-70'-1.87-0.25
225'-95'-3.73-0.89
A-400'
+ 25ppm Ag (surface)
Tdb
Tcr
U D
U D
DEEPEN TO 350-400'
HDS-88 (240')
0'-40'-1.34-0.15
80'-50'-1.35-0.50
160'-45'-1.01-0.02
Tlp
SI (100')
HDS-38 (1134')
150'-50'-1.75-
530'-30'-1.29-
640'-60'-3.97-
North Hermosa workings
80°
HDS-87 (400')
130'-115'-1.40-0.47
B-400'
HDS-54 (690')
200'-20'-1.45-
F-400'
D-350'
Tlp
Fault
Tcr
Revolution Tunnel
C-250'
Hermosa
Tlp
Tcr
5300
Tlp
Tcr
E-250'
34°
5400
Tlp
Tcr
60°
45°
HDS-33 (585')
HDS-32 (575')
110'-40'-2.78-
80°
Tcr
HDS-84 (260')
80'-55'-2.41-0.21
210'-20'-1.67-0.20
HDS-7 (83')
80'-3'-1.01-
HDS-7A (887')
80'-60'-4.28-
170'-20'-3.43-
55°
40°
40°
Hermosa Mine
75°
Tlp
Tcr
HDS-85 (150')
35°
80°
40'-60'-5.26-0.39
45°
45°
?
Tct
80°
HDS-8 (847')
Qac
EXPLANATION
Drill hole HDS-84 (Depth)
Assay key: Depth-Length-Ag oz/T-Pb%
80' - 55' - 2.41 - 0.21
Qac Alluvium Colluvium
Tdb Trachyandesite (diabase)
Tlp Latite porphyry
Tcr Rhyolite breecia
Tct Tuff agglomerate
Tcfg Fine grained clastics
Hardshell Volcanics
20°
Proposed 1983 Drill Hole
DRILL MAP
HARDSHELL PROJECT
Hermosa-North Hermosa Area
Santa Cruz County, Arizona
Scale: 1" = 200'
Geology by S.R. Davis, 1970
F.R. Koutz ____ 198_ mkf

5477

ASARCO

JDS

Exploration Department
Southwestern United States Division

May 31, 1983

Mr. Ken C. Bennett
Executive Assistant
Phelps Dodge Corporation
2600 N. Central Avenue
Phoenix, AZ 85004-3015

1929 Phelps Dodge
Channel Sampling Data
Hardshell Incline Mine
Santa Cruz County, AZ

Dear Mr. Bennett:

As I mentioned to you several weeks ago at La Caridad, Asarco Incorporated is continuing to evaluate the Hardshell property south of Patagonia, AZ. While mapping the Hardshell Incline in 1976-1977 I noted a number (probably +1000) of sample tags labeled: "Phelps Dodge Corp., Copper Queen Branch, Lead Prospecting Dept." over the mine to the 400 level.

In 1976, 1977 and 1978 I corresponded with Mr. Ludden, Mr. Metz and Mr. Richard Graeme concerning the possibility of obtaining sampling data with maps. Mr. Graeme, a number of years before, had noted a file in the Warren Engineering Dept. on the Hardshell Mine as well as a sample map with assays, rolled and stored in a pigeon-holed (80-100 maps), dark, varnished, map case with bad hinges (map index on inside of door) inside the "new" vault. Mr. Graeme indicated that the file and the map might be somewhat hard to find as it was filed under the old P-D system which was superceded by the C. & A. Engineering file system in the early 1930's. The final result of this is that when I contacted Mr. Metz on April 19, 1978 he indicated that he had spent only a few minutes looking for Hardshell data without success. I attached a copy of my correspondence and a copy of Shrader's (USGS Bull. 582) description of the Hardshell Incline.

Since then we have noted in the files of Chief Consolidated Mining Company, Eureka, Utah, which we have under option, September-December 1929 correspondence between A. B. Armstrong, Field Engineer, Copper Queen Branch and G. H. Wigton, Metallurgist of Chief Con, concerning tests on sampled Hardshell ores. These names and dates may be helpful in locating the Hardshell data.

Your Pb-Ag assay data from the Hardshell Incline would be extremely helpful in evaluating the overall Hardshell property although the Incline itself is

a small part of the overall Hardshell mineralized system. Any help you can provide would be greatly appreciated. In addition Mr. M. R. Pawlowski, Small Mines Division Geologist at the Morenci Branch, indicated that Phelps Dodge was quite interested in manganese-silver ores. I would be quite willing to discuss a number of aspects of the Hardshell ore occurrence/ mineralogy with your personnel. I also believe that A. R. Raihl or D. E. Crowell of our Minerals Beneficiation Department in Tucson would be willing to discuss manganese-silver metallurgy.

As I will be out of town a good part of the summer, any questions on the Hardshell Incline data can also be directed to the geologists to whom copies of this letter are sent.

F. R. Koutz
Geologist

FRK/cg

cc: J. D. Sell, Manager, Southwestern Exploration Division
W. L. Kurtz, Manager, Western USA Exploration
S. A. Anzalone, Chief Geologist, Mining Department

phelps dodge Corporation Western Exploration Office, Drawer 1217, Douglas, AZ 85607 • (602) 364-8414

April 12, 1978

Rec'd 17 Apr 78

Mr. Fleetwood R. Koutz
Research Associate
The University of Arizona
Department of Geosciences
Tucson, Arizona 85721

Dear Mr. Koutz:

This will acknowledge your letter of March 28 with further reference to the Copper Queen Branch Phelps Dodge sampling in the Hardshell mine near Patagonia, Arizona.

When Mr. Metz sent your July 29, 1976 letter to me, we searched our files here in Douglas and found nothing that would be useful as I reported to you. We have no way of knowing what might be in the Corporation's offices at Bisbee.

Your request for you or Mr. Graeme to search for this information at the Bisbee offices should be taken up with Mr. Metz who is in charge of the Copper Queen Branch. I am sending a copy of this letter to him as well as a copy of your March 28 letter to me.

Very truly yours,

R. W. Ludden

R. W. Ludden, Jr., Manager
Western Exploration Operations

RWL: s

cc: H. E. Metz w/enclosure
WJW/AMH To Note

300 Park Avenue, New York, NY 10022 • (212) 751-3200

THE UNIVERSITY OF ARIZONA
TUCSON, ARIZONA 85721

DEPARTMENT OF GEOSCIENCES
TEL. (602) 884-1819

March 28, 1978

Mr. R.W. Ludden, Jr., Manager
Western Exploration Office
Phelps Dodge Corporation
Drawer 1217
Douglas, Arizona 85607

Dear Mr. Ludden:

On July 29, 1976, I requested information on the Hardshell Mine, near Patagonia, Arizona. Attached is a copy of my letter and your answer of August 17, 1976, indicating that you could find nothing in your Douglas files.

Since then additional information has come to light. In mapping the Hardshell incline, I noted that there are hundreds of Copper Queen Branch, Lead Prospecting Department tags in the mine and sample numbers go beyond 1000. A copy of one of these tags is attached. Last Spring I also discussed Hardshell mine mineralogy with one of your Engineers, now at Ajo, Richard Graeme. He mentioned that several years before when he was a geologist at Bisbee, he had noted a roll of maps in a specific map cabinet in the vault at Warren containing an assay map of the Hardshell Mine. Since he was very familiar with the old Copper Queen filing system he offered to try to relocate the map(s) and the file report that undoubtedly goes with it and bring it to the company's attention so that a copy might be released to me. Apparently he was not able to obtain permission to do so. A copy of my letter to R. Graeme is attached.

I would like to request to you directly that myself or Mr. Graeme under supervision be given a chance to locate this information. I fully realize that the Bisbee offices have been moved and that it is very time consuming for your personnel to search through 50 year old data. This information would be extremely helpful to me on my dissertation on the Hardshell deposit. The property has been owned by ASARCO for over 30 years and I have been given full access to previous information on the deposit. You can contact Fred Graybeal at ASARCO for further information. Thank you very much for your help.

Very truly yours,

Fleetwood R. Koutz
Research Associate

FRK:me
enclosures
cc: F.T. Graybeal

COPY

June 3, 1977

Richard Graeme
Engineer, Mining Department
New Cornelia Branch
Phelps Dodge Corp.
Ajo, Arizona 85321

Dear Dick:

After our conversation Wednesday, I thought I'd send you copies of last years correspondence on Hardshell With Bisbee-Douglas and of Shraeder's map of the Hardshell which may help you out when and if you get a chance to hunt for the old sampling data. As I mentioned the sampling was probably pre-1940 as the PD tags only go down to the 400 level of the incline which was flooded until 1940 and there are several 100 feet of works on the 500 level which were made during WWII and are not tagged. Before 1940 the mine was held by the Richardson Real Estate, Mining, and Commercial Corp., Patagonia, Arizona and leased out to various parties. There are also some tags, possibly earlier than the PD tags, probably put in by R.T. Mishler, El Tigre Mines, Sonora in about 1927. Howard K. Welch was manager-agent from WWI to 1922 and retained old production data, maps etc. to at least 1940 trying to interest major companies in further exploration-development work.

- Edward Bohlinger, manager

Any help you can give me would be greatly appreciated. I may be in Bisbee over July 4 and will try to look you up then. Thanks much.

Sincerely yours,

Fleetwood R. Houtz

FRK:me
enclosure
4 pages
2 from Shaeder
& 2 PD letters

phelps dodge Corporation Western Exploration Office, Drawer 1217, Douglas, Arizona 85607 • (602) 364-8414

Rec'd 18AUG76 FAK

August 17, 1976

Mr. Fleetwood R. Koutz
Teaching Associate
The University of Arizona
Department of Geosciences
Tucson, Arizona 85721

Dear Mr. Koutz:

Your July 29 letter to Mr. Metz concerning the results of work for Phelps Dodge in the Harshaw district, Santa Cruz County has been referred to me.

The files here contain reports on the World's Fair property dating back to 1912. However, we can find nothing on the Hardshell mine and the reports on the World's Fair are of a preliminary nature. Also, we can find nothing referring to an underground sampling program such as the one suggested by your description of sample tags seen underground at the Hardshell mine.

I'm sorry we don't seem to be able to help with your study.

Very truly yours,

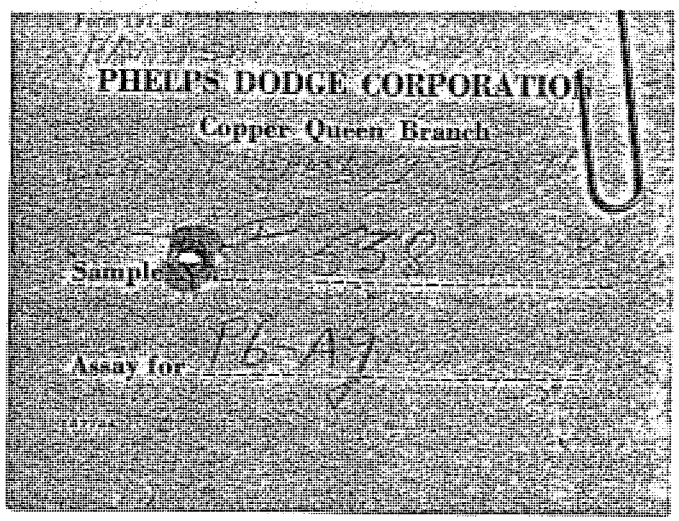
R. W. Ludden

R. W. Ludden, Jr., Manager
Western Exploration Operations

RWL:s

cc: H. E. Metz w/encls.

300 Park Avenue, New York, N. Y. 10022 • (212) 751-3200



July 29, 1976

602-432-3621
Mr. Harry Metz
General Superintendent
Copper Queen Branch
Phelps Dodge Corporation
Bisbee, Arizona 85603

Dear Mr. Metz:

I am beginning a dissertation on manganese silver deposits in the Harshaw District, about 10 miles SE of Patagonia, Arizona in Santa Cruz County. This study is being done under the direction of Prs. S.R. Titley and J.W. Anthony with a grant from ASARCO. While checking the accessibility in the Hardshell mine I noted a large number of sample tags attached to the walls labeled : "Copper Queen Branch, Phelps Dodge Corp., Assay for Pb, Ag " with numbers such as #361,509,587, etc. These tags were located on the 325 level, 325 stopes, and incline. I estimate that these tags were 30 to 50 years old as one tag had "1941" on it. - PROB. OLDER

I would like to know if your office still has material in your files on the Hardshell mine including old maps, reports, or analytical data that could be made available to me. I also understand that Phelps Dodge operated the near-by World's Fair mine in Flux Canyon. Any old material on this mine would also be extremely helpful to my study. None of this information would be published or further disseminated without the express permission of the management of Phelps Dodge. Thank you for your help.

Sincerely Yours,

Fleetwood R. Koutz
Teaching Associate

LEAD PROSPECTING DEPT
CQ BRANCH, PD COOP.
1929

F.K/lk

COPY

occur disseminated sulphides. Beyond the fault, toward the face, the formation is very much broken up and altered rhyolite porphyry comes in. This rock contains widely disseminated pyrite and chalcopyrite, which are concentrated along some of the fissures and are locally coated with chalcocite.

The upper work is located about 600 feet northeast of the lower tunnel and 200 feet higher. It consists mainly of an old 50-foot shaft, 100 feet of drift, and 220 feet of crosscuts and opens a silicified brecciated fault zone 25 feet or more wide in which are shown disseminated pyrite and chalcopyrite, and which is said to average 2 per cent in copper for the entire width. On the south wall there is about 13 inches of quartz containing pyrite, chalcopyrite, and galena, which is said to average 16 per cent in copper, 10 per cent in lead, and 30 ounces to the ton in silver. The zone lies in the altered rhyolite porphyry and is supposed to cross the projection of the lower tunnel about 25 feet beyond the breast of the drift.

In September, 1914, a good body of lead-silver ore was said to have been opened at the 700-foot station in the tunnel.

CHRISTMAS GIFT MINE.

The Christmas Gift mine is half a mile east of the Elevation group and a quarter of a mile west of Harshaw Creek and the United States Geological Survey bench mark 4223, at an elevation of 4,500 feet. It was worked in 1887 by Frank La Monte and is now controlled by the Bland Mining Co., of Kansas City, Mo.

At least two carloads of ore are known to have been shipped from this mine and are reported to have averaged 90 ounces in silver to the ton. The property is opened by three shafts, the west one of which is timbered and is said to be 100 feet deep. The country rock is dark-red to black andesite. It is cut by a fissure that strikes N. 65° W. and dips 87° SW. The ore from the dump is very siliceous and is cream to lemon-yellow in color, apparently from lead carbonate and iron oxide.

HARDSHELL MINE.

Location, history, and production.—The Hardshell mine, one of the most important mines in the district, is about a mile south-southwest of Harshaw, in Hardshell Gulch, at an elevation of about 5,150 feet. The deposit was discovered in 1879 by David Harshaw and José Andrade by observing large bowlders of ore in Hardshell Gulch. In 1880, when but little more than the necessary development work had been done on it, the mine was purchased by the present owner, R. R. Richardson, of Patagonia. The property then consisted of four claims. It now contains 23 claims, aggregating about

400 acres. In 1881–82 Mr. Richardson did 200 feet of work on the Hardshell No. 2 claim, and in the 10 years following he did considerable work in various places on No. 1 claim to find the ledge which was the source of the rich bowlders but was unsuccessful and finally, in 1890, abandoned the property. Later he located two claims, the Hardshell Nos. 1 and 2, the rest of the adjoining country having been at this time located and relocated by various parties. By relocation and purchase he acquired the remainder of the group. Finally, about 1895, he discovered ore on the Hardshell No. 1 by sinking a 40-foot shaft near the present inclined shaft, and continued sinking in the ore body to a depth of 230 feet.

In 1896 Mr. Richardson bonded the property to Mr. Fitzgerald, of the Empire Mining & Milling Co., who sunk the incline to the 400-foot level and took out 4,000 tons of ore, of which about 3,000 tons was shipped to the El Paso smelter and most of the remainder was treated in the Patagonia plant, some shipments being also made to Colorado. This company, which was later known as the Columbia Co., built the smelter at Patagonia mainly for treating the ores from the Hardshell and Flux mines, but the smelter also did custom work. It was a 90-ton plant installed at a cost of $125,000. The plant was operated for about three months, handling about 50 tons of ore a day. The company took out most of its Hardshell ore in 1896 and 1897, after which the property reverted to Mr. Richardson, the owner. He then installed a 50-ton concentrating plant or mill, which, however, handled but a little over 30 tons a day. It was operated from late in 1899 to 1901, about one and one-half years, producing in all about 15,000 tons of ore, including some rich galena ore shipped to the El Paso smelter.

Late in 1905 the Hardshell and Flux mines were bonded to Mr. Heney, of Tucson. In 1906 and 1907 he sunk 100 feet deeper, made the 200-foot crosscut, and sunk the rear 100-foot winze. The winze was all in ore, which he took out. Since 1907 Mr. Heney has held the property by extension of time. Recently this mine, it is said, is being worked on a small scale.

Development and equipment.—The mine is developed by more than 3,000 feet of work, which is concentrated on the Hardshell No. 1 and adjoining Hardshell No. 3 and Camden claims. The workings consist of a 500-foot shaft, inclined 30° (fig. 33), sunk on the vein, 2,000 feet of drift, and several hundred feet of winzes and raises, besides a large amount of irregular stoping, as indicated on the mine map (fig. 34). About the latest work of importance is 250 feet of drifting from the bottom of the incline and a 100-foot winze, inclined 30°, sunk from the 325-foot level. There is also an additional 1,000 feet of work, consisting mainly of shaft and drifts, on the Hardshell No. 3 claim, about half a mile from the mine.

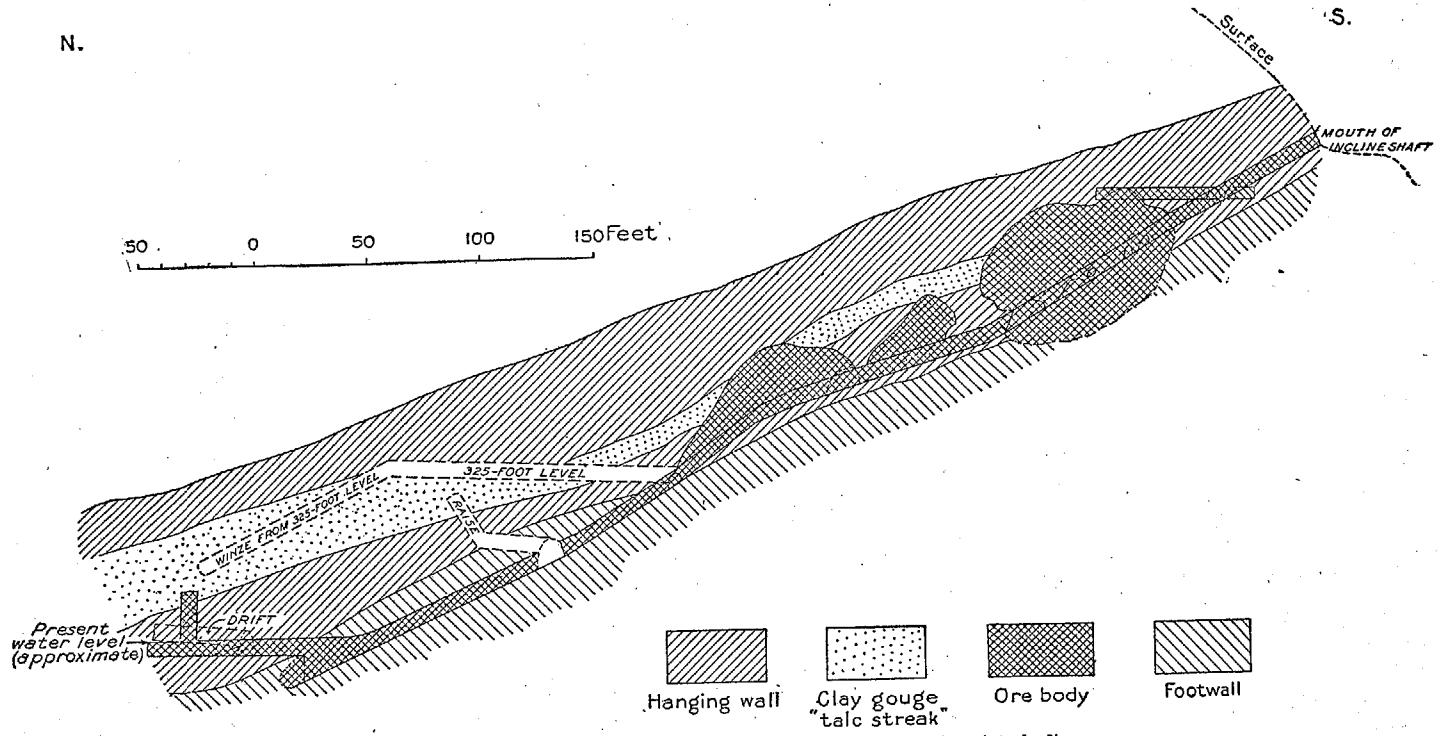


FIGURE 33.—Cross section of Hardshell mine on line of main shaft.

The equipment consists principally of a 40-horsepower steam hoist and a 50-ton concentrating mill. An excellent permanent camp with comfortable adobe buildings is conveniently located on the stage road about half a mile from the mine.

Topography and geology.—The topography is mountainous but not rugged. The mine is opened in the steep north slope of Hardshell Gulch about 60 feet above the gulch and is reached by a wagon road of easy grade.

The prevailing rock at the mine is rhyolite, locally known as porphyry, which, as shown on Plate II (in pocket), connects with the rhyolite area of Red Mountain. It occurs in heavy beds or flows about 3 feet in thickness and contains intercalated beds of quartzite, which it seems to have penetrated as intrusive sheets. The two formations are apparently conformable and dip 30° N. The quartzite also occurs in massive or heavy beds, as seen at the second raise and elsewhere in the deep parts of the mine, and on the east top of Hermosa Hill. It is a fine-grained or dense pale olive-green rock and in places resembles hornstone. It seemingly belongs to the Paleozoic limestone and quartzite series, which, as shown on the map, forms the country rock in American Mountain and the nearer foothills a short distance south of the mine. A little limestone and conglomerate are also reported to have been found in some parts of the mine. Diorite occurs in the gulch below the mine and in the surrounding hills, especially to the north.

The rhyolite is a medium-grained reddish-gray rock having a microfelsitic to glassy groundmass with flow structure in which are a few small phenocrysts and smaller intermediate forms, principally of orthoclase and quartz, with the orthoclase about all altered to sericite or kaolin. Water stands in the shaft at about the 400-foot level, and the mine makes about 200 gallons of water a minute.

Ore deposits.—The deposits occur chiefly in a shear-zone lode of rhyolite, and this rock, altered, partly replaced, and silicified, forms the principal part of the gangue. In a few places the more ferruginous phase seems to replace the quartzite, but as a rule the deposits do not appear to be particularly associated with the quartzite or any of the other sedimentary rocks.

The lode is from 10 to 60 feet wide and averages about 30 feet. It dips about 30° N., conformably with the quartzite and the interbedded rhyolite. On the hanging-wall side is a sheet of light-brown or whitish, more or less consolidated kaolin or clay gouge, which ranges in width from a few feet near the surface to 30 feet in the deep part of the mine, as shown in figure 33, and which seemingly represents a plane of extensive movement. On the footwall, which is hard, impervious rhyolite, there is in many places an intervening veinlike deposit from 1 to 2 feet thick of ferruginous manganese-silver ore that

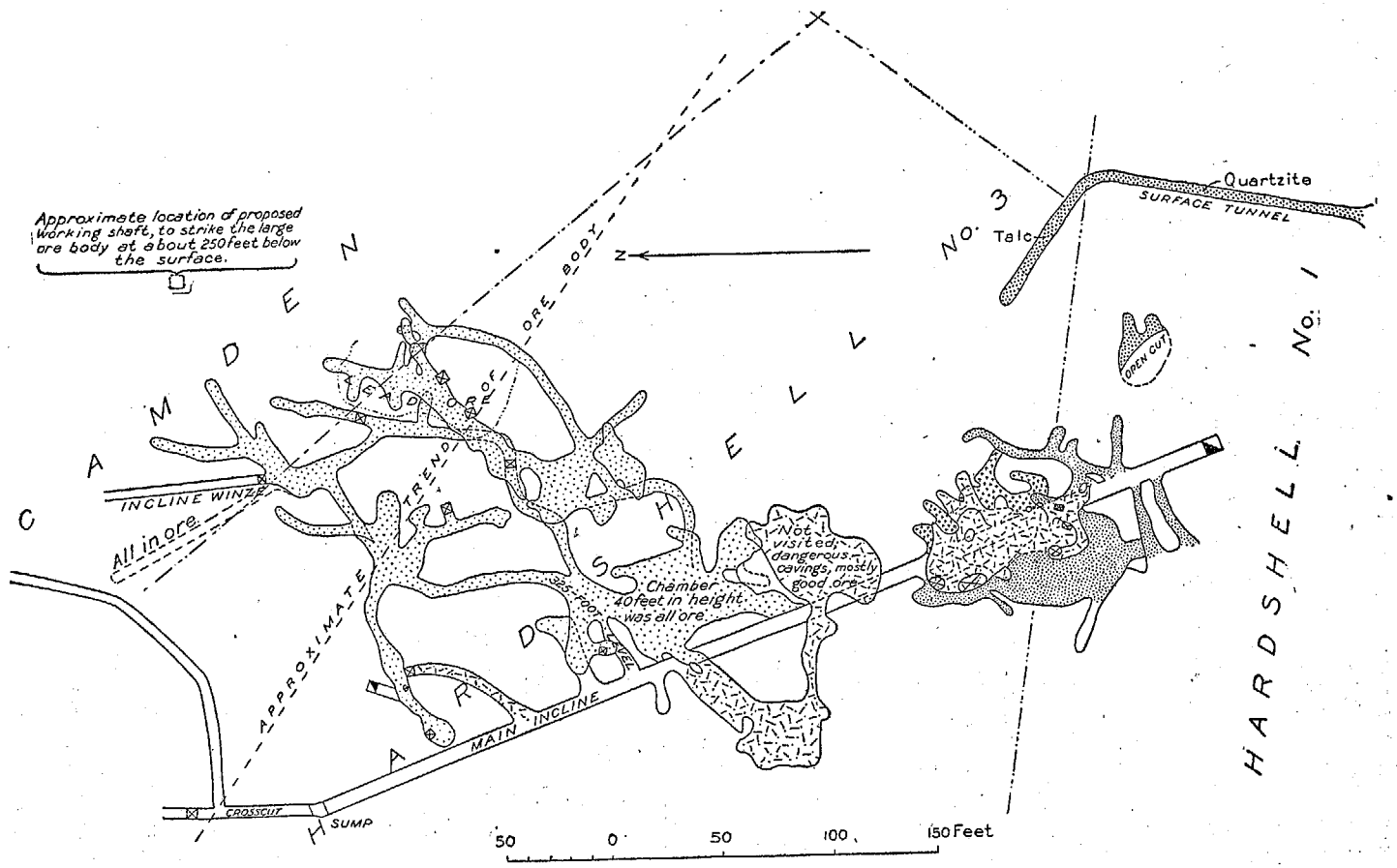


FIGURE 34.—Plan of underground workings, Hardshell mine.

averages, it is said, about 40 per cent in manganese and 15 ounces to the ton in silver and is reported to be a valuable factor as a flux.

In the lode the deposits, as shown in the cross section of the mine (fig. 33), are concentrated in irregular bodies or ore shoots which pitch to the east. The general distribution of the deposits, so far as now exploited in a belt about 300 feet wide along the strike and nearly 600 feet deep on the dip of the vein, is indicated on the level map (fig. 34).

The drift on the lower level, which is mostly in the footwall, has not yet found ore, but the 60-foot winze, whose lower part is but 40 feet east of the drift, is all in ore, which is leached above the water line, 12 feet above the bottom of the winze. An ore body is said to have been encountered in the last drifting in the bottom of the main shaft but could not be satisfactorily examined on account of the rapid influx of water.

About 2,100 tons of ore produced between February 24 and October 11, 1897, averaged, it is said, 15.1 per cent in lead and 7 ounces to the ton in silver. According to the smelter records of the shipments of about 3,000 tons to the El Paso smelter, from March 24, 1898, to January 23, 1905, the shipments in 1900, amounting to about 900 tons, ranged in value from $15 to $30 to the ton and averaged about $24 to the ton, with lead figured at $4 a hundredweight and silver at 62 cents an ounce. Some of these shipments, however, were crude concentrates from the small mill which was operated on the ground. The mill assays of this plant show the ore there treated to have averaged about 9 per cent in lead and 12 ounces to the ton in silver. Though the mill failed to save much of the metal content of the ore, a fair profit was earned. The smelter sheets giving the analyses of the 3,000 tons of ore shipped to El Paso show that the ore contains also about 30 per cent silica, 8 per cent iron, 5 per cent manganese, and 0.4 per cent sulphur.

Considerable ore of concentrating grade, estimated by some at about 100,000 tons, is in sight in the mine. The estimate of one mining engineer is 20,000 tons between the surface and the 200-foot level, and 10,000 tons from the 200-foot to the 325-foot level, besides which there are about 4,000 tons of shipping grade and 5,000 tons in the tailings dump at the mill. The ore in the dump is said to contain about 6 per cent in lead and 6 ounces to the ton in silver.

Besides the Hardshell vein there are several other veins on the property. Among them are what is regarded as the southeasterly extension of the vein worked in the Trench mine, the well-known pioneer producer. An old shaft and surface stope on another vein, on claim No. 2, yielded several carloads of silver ore of shipping grade. Here the vein is chiefly crushed, altered, and mineralized rhyolite. It is 3½ feet in average width and dips 70° N. in fine-grained

quartzite. The ore mineral, like that of the Hermosa mine near by, is principally cerargyrite. On the Camden claim an open cut shows the rhyolite dipping 40° NNW., and it contains a 16-foot body of low-grade silver ore in the red altered oxidized portion. This ore body or bed is also encountered in a cut tunnel driven some 40 or 50 feet farther down the slope to the north.

ALTA MINE.

The Alta mine is one-third of a mile north-northwest of the Hardshell mine, about midway between the Hardshell camp and mine, in the mouth of a southwestern tributary of Hardshell Gulch, at an elevation of about 5,050 feet. It is on open ground and easy of access by a wagon road ascending the gulch by way of Hardshell camp.

The Alta is an old mine. It was worked in 1877 and 1878, the ore being treated in a lixiviation plant at Harshaw. In 1879 a new company opened the mine more extensively, and in 1880 and 1881 this company shipped considerable ore to a small mill called the Boston, on San Pedro River, near Charleston, Ariz., about 3½ miles from Fairbanks and 9 miles from Tombstone. About all the Tombstone ore, it is said, was milled at the Boston mill in those days.

Later other operators shipped a quantity of what is locally known as "lixiviation plumbago" ore at a profit of several thousand dollars. In 1897 the mine was acquired by the present owner, the Melba Mining Co., of New York. It was worked with good results for a year or two but has since lain idle and is now dismantled. It is regarded as a good property, however, and is patented. The mine is opened to a depth of 300 feet or more by shafts and drifts. The size of the dump shows that a large amount of work has been done, probably about 4,000 feet, most of which seems to lie within an area about 150 feet square.

The country rock is the dark-reddish medium-grained quartz diorite or quartz monzonite, and at the mine it is cut by a 20-foot dike of light bluish-gray flow-banded rhyolite breccia, which, as seen in the gulch on the east and in the road, is heavy bedded, dips 40° NNE., and weathers yellowish brown with limonite stain.

Extending over the top of the tank hill to the west of and 100 feet above the mine, the diorite along the footwall side of the dike forms a broad band of silicified croppings which stand up in low relief, suggesting that the faulting that produced the fissure now occupied by the dike was probably normal. Slickensides show also postvein movement.

The deposits are obviously associated in origin with the rhyolite dike and seem to occur in its hanging-wall side or in the adjoining portion of the wall-rock diorite, which is silicified and mineralized

Knight Drilling Company, Inc.

711 E. Laurel Drive - 10 • Casa Grande, Arizona 85222
602-836-7955

SEP 7 1983

ASARCO, Inc.
P.O.Box 5747
Tucson,Az. 85703

September 4,1983
T-24/.3

Invoice for drilling at Hardshell project.

Mobilization and demobilization	$1,144.00
Hole #HDS-88 Re-entry	
5ft. 6 5/8" casing	22.50
240 ft. to 320 ft. 8 hrs @ 115.00	920.00
80	$942.50
Hole #HDS-89	
5½ hrs. stand-by @ 57.50	316.25
5 ft. 6 5/8" Casing	22.50
1 bag Portland cement	7.00
5 gals. foam	85.00
Drilling 0-400 ft.	2,600.00
	$3,030.75
Hole #HDS-90	
5 ft. 6 5/8" Casing	22.50
1 bag Portland cement	7.00
5 gals. foam	85.00
Drilling 0-400 ft.	2,600.00
	$2,714.50
Hole #HDS-91	
5 ft. 6 5/8 Casing	22.50
5 gals. foam	85.00
Drilling 0-400 ft.	2,600.00
	$2,707.50
Total Invoice:	$10,539.25

Thank you,

Wendell Knight

Wendell Knight

9-6-83
OK for Payment
J. C. Barnes
EA-0013

ave cost $8.23/ft.

James A. Sell
OK for payment (early)
9/7/83

FILE

ASARCO PD 1
REVISED 1/1/58

PURCHASE ORDER

ASARCO Incorporated
~~American Smelting And Refining Co~~

TUCSON OFFICE
P. O. BOX 5747

1150 NORTH 7TH AVENUE
TUCSON, ARIZONA 85703

PLANT JOB NO.	
APPROPRIATION NO.	

DATE	August 12, 1983
ORDER NO.	T-244-3
REQUISITION NO.	

To: Knight Drilling Company, Inc.
711 E. Laurel Drive-10
Casa Grande, AZ 85222

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:
F.O.B. POINT	— RENDER BILLS AS PER ATTACHED SHIPPING INSTRUCTIONS —
	SHIP VIA

QUANTITY	UNIT	SPECIFICATIONS	ITEM NO.	UNIT PRICE

Knight Drilling Company, Inc., hereinafter referred to as CONTRACTOR, will drill exploration holes at ASARCO Incorporated's Hardshell Project, Santa Cruz County, Arizona, the location and depth of which will be specified by ASARCO's representative(s) at the jobsite. Payment for work performed will be in accordance with CONTRACTOR's letter of proposal dated 8/10/83, a copy of which is attached hereto and made a part of this order.

CONTRACTOR will provide a drill and water truck complete with crews and accessories, and assume the responsibility for obtaining and delivering all casing, couplings, and accessories required to case hole. ASARCO will be billed by suppliers and pay for all said casing, couplings, and accessories.

Mobilization of CONTRACTOR's equipment will commence on or about August 18, 1983.

It is understood by both parties to this order that CONTRACTOR will perform all work in a diligent and workmanlike manner and in accordance with recognized standard drilling practices. ASARCO will not be charged for delays caused by failure of CONTRACTOR's equipment of 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.

CONTRACTOR will also furnish ASARCO with acceptable evidence that CONTRACTOR holds an appropriate and valid contractor's license issued by the state within which the above project is located.

☞ *IMPORTANT*

Attached Acknowledgment Card must be completed and returned promptly.

Orig: Knight Drilling Company, Inc.
cc: " " " , for acceptance
JDS, ~~TBB~~,
Acctg. Dept., File xc: JES

PLEASE ENTER OUR ORDER FOR THE ITEMS SPECIFIED ABOVE, SUBJECT TO ALL INSTRUCTIONS AND PROVISIONS ON REVERSE SIDE.

/s/ J. R. Stringham
Assistant to Manager

Knight Drilling Company, Inc.

711 E. Laurel Drive - 10 • Casa Grande, Arizona 85222
602-836-7955

Mr. Tony Benavidez
ASARCO,Inc.
P.O.Box 5747
Tucson,Az. 85703

August 10,1983

Dear Sir:

We are pleased to offer the following quotations for drilling four to five holes with a minimum of 1,200 feet, and re-entry of one hole. Approximately ten miles south of Patagonia,Az.

1. Mobilization and demobilization, Casa Grande to jobsite. Lump sum $1,144.00

2. Drilling from surface to five hundred feet. 5" to 5¼" hole. Per foot. 6.50

3. Mud,additives,foaming agents,cement,casing and lost circulation materials,our cost plus 15% F.O.B. jobsite.

4. Re-entry of old hole, $115.00 per hour plus cost of material.

5. Hauling water,no charge, ASARCO,Inc. will pay for the water.

6. Cementing or stabilizing the hole for lost circulation or cave. $57.50 per hour.

7. We will require ASARCO, Inc. to provide suitable roads and locations.

8. Knight Drilling Co.,Inc. will furnish a two man crew, plus one sample catcher.

9. Samples will be taken at five foot intervals.

Sincerely,

Wendell Knight

Wendell Knight

RECEIVED
AUG 12 1983
S. W. U. S. EXPL. DIV.

xc: JDS
TCB
JRS

Hardshell Proj. 7/28/83

EA-0013

8 pat. & 134 unpat claims + 53 new SHELL (for 1984!).

Overspent (July thru)	13,500	
Assessment drilling	13,400	← for drilling
Rd work, Sepew. + Assaying	3,100	
	$30,000	

Tony: Note that you have ±:

for drilling	13,400	
Rd work etc.	3,100	
	16,500	Total expenditure starting Aug 1.

ASARCO

Southwestern Exploration Division

JDS COPY

September 22, 1983

To: F. R. Koutz

From: J. D. Sell

Baseline Water Quality Survey V
Hardshell-Trench Camp Area
Patagonia Mountains
Santa Cruz County, AZ

You should, upon your return from Bull Run, arrange to do the 1983 water sampling continuation program in the Patagonia Mountains.

I understand you should be in Tucson around the third week of October.

Mr. L. Halpenny and Al Cooper will appreciate your early notification of the time so that they can arrange their schedules. Halpenny informs me that early November is a permissible time for the survey.

You should contact the various people who have keys and access rights for permission to continue to collect the water samples.

I presume that BC Laboratories will again handle the analyses with Water Development Corporation to handle the shipment and receipt of the analyses, with a requested copy to Asarco.

James D. Sell

JDS/cg

cc: JRStringham
ACooper (Mission Ph. 791-2920)
LCHalpenny (WatDevCo Ph. 327-7412)

JDS copy

ASARCO

Southwestern Exploration Division

September 28, 1983

To: J. D. Sell

From: T. C. Benavidez

Hardshell Drilling Summary
Santa Cruz County, AZ

The assessment work requirement has been completed on the subject project by deepening one hole (HDS-88) from 240' to 320' (80') and drilling three new holes - HDS-89, HDS-90, and HDS-91.

Knight Drilling Company from Casa Grande, Arizona mobilized a Gardner Denver 14W on August 22 and demobilized on September 2, 1983. Hole depth and size are as follows:

HDS-88	0-5'	6 5/8"	Casing	&	Capped	5'-320'	TD	5 1/8"	bit
HDS-89	"	"	"	"	"	5'-400'	TD	"	"
HDS-90	"	"	"	"	"	"	"	"	"
HDS-91	"	"	"	"	"	"	"	"	"

A summary of the invoiced cost is shown below:

a) Road and Site Work	$ 850.00	$ .66/ft.
b) Drilling and Materials	$10,539.25	$8.23/ft.
Total of a & b	$11,389.25	$8.89/ft.

T. C. Benavidez

T. C. Benavidez /g

TCB/cg

Nov 21, 1983

HARDSTOCK REJECTS

FROM: W. L. KURTZ

TO: FR Kautz

We may want to perform MET tests on specific spots within the ore zone. One way would be to use existing rejects. Do we have enough holes, within the higher grade zone, that would allow us to do this _____ rather than drilling 6" diameter core holes.

cc. JD Sell

Dec 12, 1983

Hardshell
METALLURGY

FROM: W. L. KURTZ.

TO: R L Brown
NY Office

Would you check with Central Research and determine if they can effectively use rotary drill cuttings for the "site-specific" met tests to determine met variations in the mantle. We probably have enough holes to give a reasonably good geographic coverage.

cc T Isel

12/30/84

Relevant Assays

TAS-330

JDS →

Note: NO Ag & only one .006 oz Au

HC1-1 (Relevant hole) 1st MN, Ba, B
2d - NO Pb/Ag Low Cu

PK-5 Texas Gulf hole

(note: high As, Ba, V but little Cu, Pb, Zn, Mo)

Prob. out of A Base-Precious (But only As?) metals zone

- Much but not all of Zn, Ba, Mn)

Probably exotic (Zn+Mn very soluble) As? soluble

Recent/memo on relevant ass by E.O, Mark

PK

SKYLINE LABS, INC.
1775 W. Sahuaro Dr. • P.O. Box 50106
Tucson, Arizona 85703
(602) 622-4836

REPORT OF ANALYSIS

JOB NO. TAJ 330
January 5, 1984
SHIPMENT NO. HOS-E
FLEETWOOD R. KOUTZ
HCH-1-81: 713-714

Felmont - Hardshell East

ASARCO INCORPORATED
Attn: Mr. Fleetwood R. Koutz
Southwestern Exploration
P.O. Box 5747
Tucson, Arizona 85703

Analysis of 14 Core Chip Samples

ITEM	SAMPLE NUMBER	Ag (ppm)	Au (ppm)
1	HCH-1-81: 713-714	<.2	<.02
2	HCH-1-81: 720-721	<.2	<.02
3	HCH-1-81: 737-744	<.2	.19
4	PK-5: 483-491	<.2	<.02
5	PK-5: 505-511	<.2	<.02
6	PK-5: 518-525	<.2	<.02
7	PK-5: 530-545	<.2	<.02
8	PK-5: 550-560	<.2	<.02
9	PK-5: 560-570	<.2	<.02
10	PK-5: 570-590	<.2	<.02
11	PK-5: 590-600	<.2	<.02
12	PK-5: 600-608	<.2	<.02
13	PK-5: 622-626	<.2	<.02
14	PK-5: 635-641	<.2	<.02

cc: Asarco Incorporated
Southwestern Exploration
P.O. Box 5747
Tucson, Arizona 85703
Attn.: Mr. J.D. Sell

REGISTERED ASSAYER
CERTIFICATE NO.
9425
WILLIAM L. LEHMBECK
DATE SIGNED
Arizona
1/10/83

RECEIVED
JAN 13 1984
S. W. U. S. EXPL. DIV.

Charles E. Thompson
Arizona Registered Assayer No. 9427

William L. Lehmbeck
Arizona Registered Assayer No. 9425

James A. Martin
Arizona Registered Assayer No. 11122

SKYLINE LABS, INC.
1775 W. Sahuaro Dr. • P.O. Box 50106
Tucson, Arizona 85703
(602) 622-4836

REPORT OF SPECTROGRAPHIC ANALYSIS

JOB NO. TAJ 330
January 5, 1984
SHIPMENT NO. HOS-E
FLEETWOOD R. KOUTZ
HCH-1-81: 713-714

ASARCO INCORPORATED
Attn: Mr. Fleetwood R. Koutz
Southwestern Exploration
P.O. Box 5747
Tucson, Arizona 85703

Analysis of 14 Core Chip Samples

The attached pages comprise this report of analysis. Values are reported in parts per million (ppm), except where otherwise noted, to the nearest number in the series 1, 1.5, 2, 3, 5, 7, 10, etc. within each order of magnitude. These numbers represent the approximate boundaries and midpoints of arbitrary ranges of concentration differing by the reciprocal of the cube root of ten. The 'accepted' value is considered to be within + or - 1 step of the range reported at the 68 % confidence level and within + or - 2 steps at the 95 % confidence level.

REGISTERED ASSAYER
CERTIFICATE NO.
9425
WILLIAM L.
LEHMBECK
DATE SIGNED
ARIZONA U.S.A.

William L. Lehmbeck
Manager

SKYLINE LABS, INC.
1775 W. Sahuaro Dr. • P.O. Box 50106
Tucson, Arizona 85703
(602) 622-4836

JOB NO. TAJ 330

ITEM NO. SAMPLE NO.
1 = HCH-1-81: 713-714
2 = HCH-1-81: 720-721
3 = HCH-1-81: 737-744
4 = PK-5: 483-491
5 = PK-5: 505-511
6 = PK-5: 518-525
7 = PK-5: 530-545
8 = PK-5: 550-560

ITEM	1	2	3	4	5	6	7	8
ELEMENT								
Fe	3%	2%	5%	5%	5%	5%	1.5%	2%
Ca	.1%	.05%	.02%	.3%	.07%	.02%	.02%	.02%
Mg	.5%	.5%	.15%	.3%	.15%	.15%	.03%	.03%
Ag	<1	<1	<1	<1	<1	<1	<1	<1
As	<500	<500	<500	<500	500	700	2000	2000
B	300	200	150	100	30	70	15	15
Ba	1500	70	200	100	500	500	500	500
Be	7	3	<2	<2	<2	<2	<2	<2
Bi	<10	<10	<10	<10	<10	<10	<10	<10
Cd	<50	<50	<50	<50	<50	<50	<50	<50
Co	150	20	15	<5	<5	<5	<5	<5
Cr	<10	<10	<10	<10	<10	<10	<10	<10
Cu	70	15	50	5	15	15	30	7
Ga	10	10	<10	<10	20	15	10	10
Ge	<20	<20	<20	<20	<20	<20	<20	<20
La	50	30	20	30	50	100	30	<20
Mn	>10000	>10000	>10000	150	150	30	50	20
Mo	<2	<2	<2	<2	7	3	2	2
Nb	20	<20	<20	<20	20	20	<20	<20
Ni	15	5	<5	<5	<5	<5	<5	<5
Pb	20	10	<10	<10	10	15	<10	10
Sb	<100	<100	<100	<100	<100	<100	<100	<100
Sc	<10	<10	<10	<10	10	10	<10	<10
Sn	<10	<10	<10	<10	<10	<10	<10	<10
Sr	<100	<100	<100	700	1000	1500	2000	1500
Ti	5000	5000	5000	5000	7000	10000	5000	5000
V	50	30	30	70	100	100	50	50
W	<50	<50	<50	<50	<50	<50	<50	<50
Y	30	15	10	10	20	20	10	<10
Zn	700	300	500	<200	<200	<200	<200	<200
Zr	200	150	150	150	300	300	150	200

Charles E. Thompson
Arizona Registered Assayer No. 9427

William L. Lehmbeck
Arizona Registered Assayer No. 9425

James A. Martin
Arizona Registered Assayer No. 11122

SKYLINE LABS, INC.
1775 W. Sahuaro Dr. • P.O. Box 50106
Tucson, Arizona 85703
(602) 622-4836

JOB NO. TAJ 330

ITEM NO. SAMPLE NO.
9 = PK-5: 560-570
10 = PK-5: 570-590
11 = PK-5: 590-600
12 = PK-5: 600-608
13 = PK-5: 622-626
14 = PK-5: 635-641

ITEM	9	10	11	12	13	14
ELEMENT						
Fe	2%	2%	5%	5%	3%	5%
Ca	.05%	.05%	.07%	.1%	.2%	.7%
Mg	.03%	.05%	.03%	.05%	.1%	.2%
Ag	<1	<1	<1	<1	<1	<1
As	500	500	1500	1500	<500	<500
B	20	20	30	15	20	15
Ba	700	700	1500	7000	1000	700
Be	<2	<2	2	2	<2	2
Bi	<10	<10	<10	<10	<10	<10
Cd	<50	<50	<50	<50	<50	<50
Co	<5	<5	10	15	<5	30
Cr	<10	<10	<10	<10	<10	<10
Cu	5	7	30	50	20	15
Ga	10	15	10	15	15	15
Ge	<20	<20	<20	<20	<20	<20
La	<20	20	<20	<20	30	30
Mn	50	30	150	100	70	1000
Mo	<2	<2	15	15	<2	2
Nb	<20	<20	20	20	<20	<20
Ni	<5	<5	7	5	<5	7
Pb	<10	<10	<10	10	15	15
Sb	<100	<100	<100	<100	<100	<100
Sc	<10	<10	<10	<10	<10	<10
Sn	<10	<10	<10	<10	<10	<10
Sr	1000	1500	2000	1500	500	200
Ti	7000	7000	5000	5000	5000	5000
V	50	70	100	100	50	70
W	<50	<50	<50	<50	<50	<50
Y	<10	<10	<10	10	20	20
Zn	<200	<200	<200	<200	<200	<200
Zr	200	150	200	200	200	150

Charles E. Thompson
Arizona Registered Assayer No. 9427

William L. Lehmbeck
Arizona Registered Assayer No. 9425

James A. Martin
Arizona Registered Assayer No. 11122

Hardshell Project Spring 1984 Drilling

Hole A, 350' drill site in (last years "D", undrilled)

Hole B, 250' " " " (" " "C", undrilled)

Hole C, 300' new road & site

Hole D, 250' drill site & minimal road (last years "E", undrilled)

Hole E, 400' new road spur off 88 ~~7~~ road

Hole F, 350' new road spur off 88 → 86 road.

1900'

ANACONDA Minerals Company
555 Seventeenth Street
Denver, Colorado 80202
Telephone 303 575 4000

~~Sell~~ Kurtz handle w/copy to go for file.

FILE

Hardshell

January 12, 1984

Mr. W. L. Kurtz
Manager of Western U.S. Division
Exploration Department
American Smelting and Refining Company
P. O. Box 5747
Tucson, Arizona 85703

Dear Mr. Kurtz:

The Domestic Metals Exploration group of Anaconda Minerals Company has recently requested a geological field trip to your Hardshell, Arizona property. Approval was given by Jim Sell, at which time he also tentatively offered the services of Fleetwood Koutz. We would very much like for Mr. Koutz to join our group as trip guide, and would prefer Friday, January 27, 1984 as tour date. Please advise me if January 26 or 28 would be more acceptable.

OK 1/14/ FAK to call & confirm

The Anaconda group will consist of the following people: Lynne Ashton, Jean Dupree, Kevin Hayner, Travis Hudson, Madelyn Millholland, Chris Puchner, Charles Rubin, Carl Steefel, and Bart Stone.

We will appoint a team leader at a later date, who will then make additional contact with Jim Sell to arrange specific trip details. Thank you very much for accommodating Anaconda on this matter.

Sincerely yours,

Richard N. Miller

Richard N. Miller
Senior Geologist

RNM:sak

cc: JCWilson
JSell

RECEIVED
JAN 16 1984
EXPLORATION DEPARTMENT

ASARCO

Exploration Department
Southwestern United States Division

CERTIFIED MAIL
RETURN RECEIPT

January 18, 1984

Bureau of Land Management
Arizona State Office
2400 Valley Bank Center
Phoenix, AZ 85073

Amended Notices of Location
Shell Claims
Harshaw Mining District
Santa Cruz County, AZ

Gentlemen:

In accordance with Section 314 of the Federal Land Policy and Management Act of 1976, enclosed are the following Amended Notices of Location with map as recorded in Santa Cruz County, Arizona.

Name of Claim	Date of Location	Date of Amend.Loc.	Amend.Not.of Loc. Recorded S.C.Co. Book	Page	BLM Serial No.
Shell No. 57	9/28/67	12/20/83	368	248 - 249	A MC 51465
Shell No. 63	"	"	"	250 - 251	51471
Shell No. 65 thru Shell No. 68	"	"	"	252 - 259	51473 thru 51476
Shell 135	6/1/83	12/12/83	"	260 - 261	201239
Shell 136 thru Shell 148	6/2/83	12/12/83	"	262 - 287	201240 thru 201252
Shell 149 thru Shell 154	6/3/83	12/13/83	"	288 - 299	201253 thru 201258
Shell 155 and Shell 156	6/14/83	12/12/83	"	300 - 303	201259 and 201260
Shell 157 thru Shell 163	6/14/83	12/13/83	"	304 - 317	201261 thru 201267
Shell 164 thru Shell 173	6/14/83	12/12/83	"	318 - 337	201268 thru 201277
Shell 174 thru Shell 187	6/15/83	12/13/83	"	338 - 365	201278 thru 201291

Very truly yours,

J. R. Stringham
Assistant to the
Manager, SWED

JRS:mek
encs.

cc: J.D. Sell

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

JDS

ASARCO

Southwestern Exploration Division

February 27, 1984

To: J. R. Stringham

From: J. D. Sell

Shell Claims, Extension
Patagonia District
Santa Cruz County, AZ

FTGraybeal has given permission to stake the available ground south of the Hardshell Mine area, north of the Mowry Mine area, and west of our 1974-83 Shell group (east of the Exxon 1983 group). In other words, fill in the available open ground.

Attached is a copy of FRKoutz' map as he presently understands it.

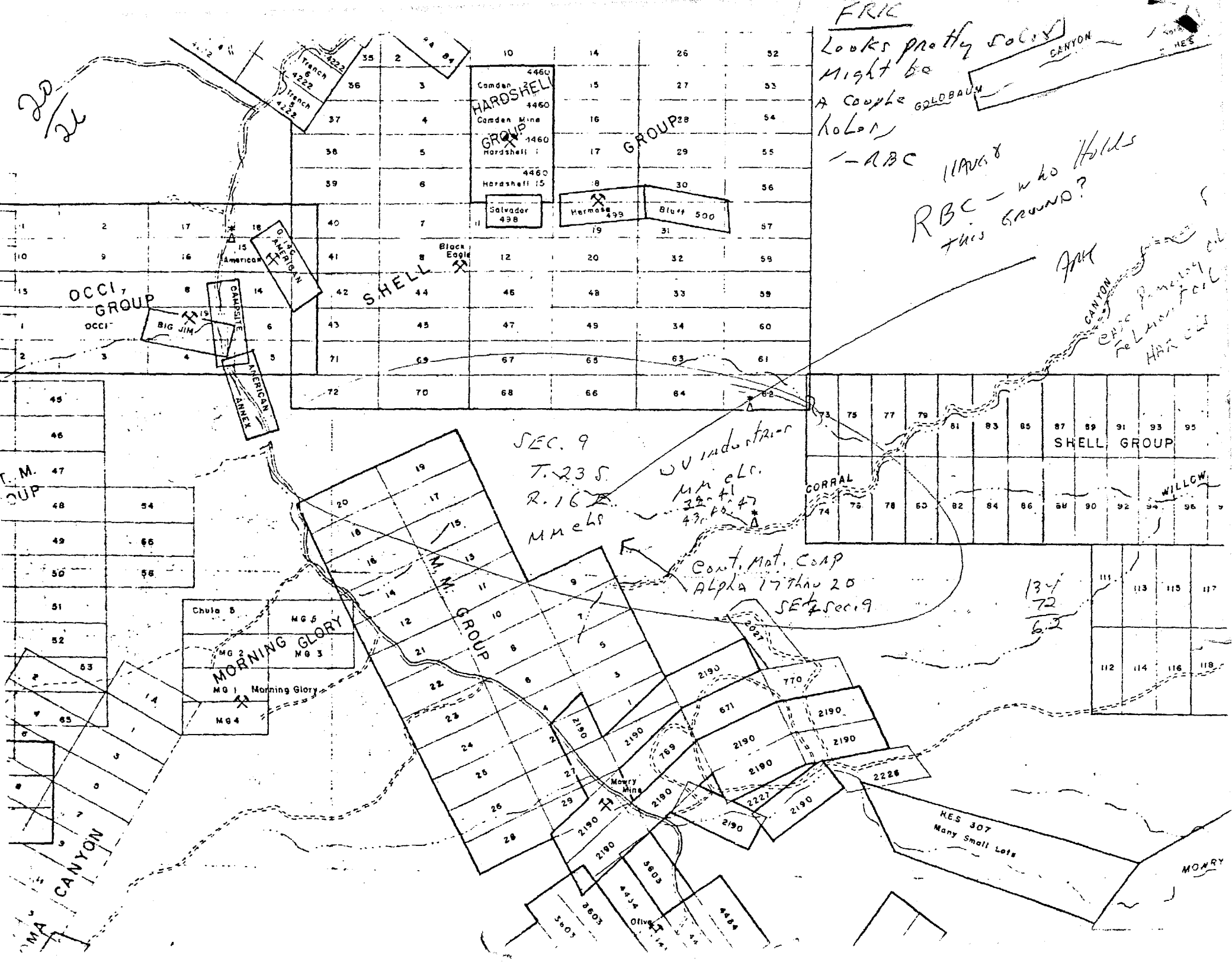
Both TCBenavidez and HMStone are available to help you with this coverage.

James D. Sell

JDS/cg

Attachment

cc: FRKoutz (w/attach)
TCBenavidez "
HMStone "
WLKurtz (w/o attach)


FRC
Looks pretty rocky
Might be
A couple
RBC
GOLDBAUM
CANYON
HARDSHELL GROUP
Camden
Camden Mine
Hardshell
Hardshell 15
Salvador 498
Hermosa 499
Blues 500
Black Eagle
SHELL GROUP
OCCI GROUP
OCCI
BIG JIM
CAMPSITE
AMERICAN
AMERICAN ANNEX
SEC. 9
T. 23 S.
R. 16 E.
MM eLs
Cont. Mat. Corp
Alpha 17 thru 20
SE¼ Sec. 9
M. M. GROUP
MORNING GLORY
Chula 5
MG 5
MG 2
MG 3
MG 1 Morning Glory
MG 4
Morry Mine
HES 307
Many Small Lots
MORRY
CORRAL
WILLOW
CANYON
Trench 6
Trench 5

Request for Drill Targets

ASARCO

Southwestern Exploration Division

JDS

February 28, 1984

To: F. R. Koutz

From: J. D. Sell

Patagonia Area
Santa Cruz County, AZ

We have verbally discussed this subject in general, but I am now asking you specifically to prepare a one-page note on the best drill target in each of the listed greater Patagonia areas.

Areas (listed alphabetically)

Exxon	Shell South
Felmont	Three-R
Hardshell proper	Thunder Mountain
Hermosa	Ventura
Mowry	Other
Shell East	

The report should be completed and submitted by the first week in April and accompanied by a cover letter explaining the priority order for each area in relation to the others. Do not concern yourself with options, work commitments, ownership, or other problems beyond your control--just a positive recommendation of the best target within the area, why it is the best, what you expect to hit, depth to target, etc. I would like a cross-section of each proposed hole-target along with a plan map (all on 8½" x 11" sheet maximum) to accompany each area. The maps-sections can be submitted hand-drafted (readable) if drafting cannot get them out by April.

Do not prolong your report time. If, in the outlying areas, you cannot make a positive drill recommendation then say what you need to do in order to make that recommendation.

James D. Sell

James D. Sell

JDS/cg

cc: WLKurtz

ASARCO

NOTE

Southwestern Exploration Division

JDS copy

September 30, 1983

To: F. R. Koutz

From: J. D. Sell

Greater Patagonias

I realize you are very busy with Hardshell, K-M, Ventura, Felmont, Mogollon, Oatman, W. AZ, et al., et al. However, I ask that you place some serious thinking on the future exploration targets in the Greater Patagonias.

J. D. Sell

JDS/cg

WLK > FRK

Hardshell Project

Paleozoic Chimney-Manto Replacement Target

Residual drill targets at Hardshell were discussed in my memo Geology-Exploration Aspects (June 7, 1983). Additional drilling in and around the Hardshell manto Ag-Mn mineralization will probably be necessary for mine-planning, development or metallurgical purposes. The best remaining exploration target is the Paleozoic carbonate section beneath known mineralization.

Since the earliest days of exploration at Hardshell, mineralization and alteration have been known to continue into the Paleozoic beneath Hardshell Group volcaniclastic and epiclastic rocks. With a few exceptions, and for a variety of reasons, most drilling at Hardshell has stopped after only a few tens of feet of drilling into the Paleozoic as shown on the attached map and section. Only 24 of 60 some holes around and through the manto are around 500 feet deep or greater. Drilling in 1979-80 (HDS-77, 79-83) did however more deeply penetrate the Paleozoic and confirmed that significant thickness & grades of mineralization exist often beneath intervals of lower grade or even clean recrystallized limestone. The root-feeder-chimney zones tend to occur near premineral faults and fault intersections mapped on the surface or encountered in drilling and are usually beneath zones of the highest grade and greatest thickness of mineralization in the supra-Paleozoic section. In many cases these faults also appear to laterally limit thickness of manto-type replacement mineralization.

The Paleozoic under Hardshell dips N to NW at 40° to 10° with dip of the fault blocks probably controlled by differential and rotational movement on the bounding faults. The Paleozoic (Permian to Cambrian) section as encountered on American Peak SSE to Mowry consists of 4600 feet of mainly carbonates. Only the Permian section has been encountered in drilling beneath Hardshell and Trench so far. Although the best limestone replacement-skarn mineralization usually occurs in the lower Paleozoic, significant mineralization at Trench and Hardshell has been encountered in dirty limestone horizons of the Concha, Scherrer and Epitaph Formations.

Drilling of the Paleozoic at Hardshell so far has shown a wide variety of features typical of the alteration/mineralization halos and zoning of major limestone replacement orebodies including bleaching, recrystallization, zebroid textures, dolomitization and development of jasperoid in and away from fracture-fault zones cutting the Paleozoic. Although present mineralization is primarily Ag-Pb-Zn-Cu bearing cryptomelane group minerals, significant amounts of cerussite and willemite occur in carbonate host-rocks. Trace amounts of galena, sphalerite with supergene silver and copper minerals and rhodochrosite and manganoan calcite/dolomite alteration in weakly oxidized, often strongly silicified, sections suggest a sulfide progenitor to present oxide mineralization. Almost all presently known mineralization and drilling is above the present water table at about 4900 feet elevation or about 500 feet below the higher Hardshell surface elevations.

I propose to make a modest test deeper into the Paleozoic for chimney and manto limestone replacement mineralization. I suggest that initially 6 holes be drilled below the thickest and highest grade portion of the manto--generally within the +500 ft.-oz Ag/T and +200 ft.-% Pb and Zn contours and on projections of the Hogan fault zone--the SE extension of the January-Norton fault zone which is the locus of significant high level mineralization at Trench. The holes A-F should be drilled in order initially to 1000 feet and to 1500 feet if encouraging alteration/mineralization is encountered. This would allow testing the favorable Permian section to 500-1000 feet below known mineralization. The exact hole locations are not shown because we may be able to use old drill holes as top holes with casing for this deeper exploration. As an alternative to this drilling, almost of necessity diamond drilling, we might use as top holes any development or metallurgical drilling that takes place over the next several years. Core size should be as large as possible (HQ-NC or 3½"-PQ) and drilled with impregnated bits and experienced crews used to lost circulation and cementing to alleviate many problems previously encountered in diamond drilling at Hardshell.

All things being equal I would prefer the larger number holes to shallower depth rather than 2 or 3 deeper holes because a larger volume of rock is more thoroughly searched and limestone replacement orebodies could be easily hidden between more widely spaced holes. The predicted unoxidized sulfide orebodies below the water table will also probably not have the wide manganese oxide dispersion halo found in oxidized portions of Hardshell mineralization. If we do not find encouraging alteration/mineralization within the first 500 feet of new ground explored we can forego the deep 1000 foot (1500' deep) testing and determine that Hardshell has a distinct lower limit to economic mineralization. Even if not successful the drilling should provide additional hydrologic information helpful in development of the present mineralization.

This is the best limestone replacement target I know of anywhere. Several Asarco exploration managers have said that this is the best limestone replacement target we have or have had in some time. The target needs to be tested before we become locked into any development/production decisions on Hardshell. A rough estimate is that 500' x 6 holes of diamond drilling would cost about $100,000 or $200,000 for 1000 foot depths.

A number of studies, particularly a close alteration-mineralization re-examination of available Paleozoic rocks, especially core, would contribute confidence to drilling plans but I do not believe would significantly move present locations to be drill-tested. More speculatively I believe that igneous intrusives such as satellite stocks or sills from the Patagonia stock probably extend considerably closer to Hardshell than the 6000 feet to the SW to NW where they are now presently known at depth. These intrusions are probably responsible for much of the jasperoid and fracture-controlled alteration/mineralization at and west of Hardshell. Geologic information obtained from even a shallow test of the Paleozoic would certainly contribute development of additional targets west of Hardshell.

Hermosa - North Hermosa Silver Target

In 1981 it was decided to spend annual Hardshell assessment monies evaluating the potential of low-manganese silver mineralization around and to the north of the Hermosa Mine along favorable structure and stratigraphy. Since 1981 we have conducted a surficial geochemical program (96 samples + previous) which defined a +25 ppm Ag anomaly north of Hermosa (in addition to a stronger but contaminated anomaly over the mine). We have conducted a pilot program of underground sampling (73 samples, av. = 3.2 opt Ag) in readily accessible workings of the Hermosa Mine which should possibly have several 100,000 tons of 1-4 oz Ag material remaining underground but with a high (~10/1) stripping ratio. Initial metallurgical tests on the underground samples encouragingly gave 70-80% recovery by straight cyanidization from 4 oz Ag feed with much of the remaining silver probably tied up with manganese oxides. Drilling of 14 holes around the mine and to the north (1981, 1983, 1984) intersected considerable intercepts of 1-2 opt Ag but north of the mine only a few deep intercepts of +2 opt Ag were cut. I believe the drilling results to the north indicate only a minimal potential for extensions of shallow leach-grade silver mineralization. This leaves the immediate Hermosa Mine itself as the only residual target.

The Hermosa Mine has an estimated production of 70,000 at 20 opt Ag. It is clear that much of the material broken averaged about 5 opt and was probably upgraded by sorting. Until this year when extensive underground workings on the north vein were discovered it was not even certain that 40,000 T had been mined. Mineralization generally follows the broken and gougy N-S striking, 70°E dipping zone of the Hermosa fault and a number of lower-angle E-W to NW striking faults which fan or horsetail out of the Hermosa structure. Stratigraphic horizons with minor low-angle faulting are also locally well mineralized but thickness and grade of stratiform mineralization decreases away from the Hermosa fault. It is clear that the highest grade and controlling structures in the mine are higher-angle although the more easily accessible workings give a false impression that mineralization is primarily stratiform.

Any additional drilling should be confined to the immediate vicinity of Hermosa Mine workings and limited to shallow (<200') depths. This drilling might best be done with one of the newer reverse circulation track-drills capable of angle holes and drilling through workings. Immediate targets beside grid-drilling on initially 200 foot centers over known workings include the down-dip extensions of the Hermosa fault-vein north of No. 2 shaft (HDS-97) and extensions of the north vein (40-70°N to NE dip) zone, possibly with angle holes. Some potentially difficult trail building will still be necessary to gain drill access to the slopes north and east of the Hermosa Mine.

This drilling should be accompanied by additional, more closely spaced sampling underground and poorly accessible areas opened up and sampled.

If encouraging results are obtained, a long-hole drilling program both surface and underground could be used to delineate better grade zones. The only remaining "wildcat" target would be an eastward extension of Hermosa mineralization beneath diabase and gravels where a potential N-S high angle fault runs through Hermosa Canyon. This target could be tested as part of a track drill program.

I believe additional metallurgical work should evaluate the heap leach potential of Hermosa mineralization. Previous +1 opt Ag drill intercepts with surface and underground samples should be assayed for Au. The above essentially development drilling should have a lower priority than exploration beneath the Hardshell manto for limestone replacement ores.

in a review of the last batch of samples it appears that only the +3 opt Ag samples cause a jump in the gold value.

Please check & revaluate

Patagonia Drill Target Areas

Exxon: At this time I have little information to add to that in my memo of February 8, 1984 on Exxon's claims except that it appears that the claims have been repapered/amended in March 1984 by Felix Steele of Steele Geographical Services. It has not been confirmed when, where, or if they are drilling but their claims follow the premineral Harshaw Creek fault. We do have data in our files on the USSR&M property (including the Getty-UV JV) which suggests an I.P. target with 0-3% sulfides west of the Mowry Mine toward the Morning Glory Mine. This target may have been tested with 3 "N" series drill holes.

Nice, but where would you drill? Why?

At this time I do not have a specific drill target on Exxon's ground. Such targets could be developed by several days review of USSR&M-UV-Sharon Steel files that we have and that are apparently available for examination at Sharon's Bayard office. I have also not spent more than a few partial days since 1976 examining the area and then only for Paleozoic Bisbee Group and volcanic stratigraphy-lithology with a quick look at the dumps of a few of the old mines. Mineralization/alteration and intrusives would have to be evaluated by 3 or 4 days field examination.

Felmont: I completely reviewed the Felmont submittal in my report of March 7, 1984 (in press at the time of your target request). I have no targets on their ground because of the depth of water-saturated cover, lack of silver values in previous Texas Gulf-Felmont drilling and the presence of better targets elsewhere. I emphasize again that the only value of this ground is for insulating value to future Hardshell operations: as a dump/tailings site or as a potential water source. On this basis the ground should be staked if it comes open in the next few years. Possibly if we do any drilling for eastern extensions of Hermosa (low priority) in the bottom of Hermosa Canyon I may have future recommendations for the Felmont ground. I have asked (February 21, 1984) the SLC Geophysical Office to evaluate the geophysical data in the area and to produce a depth to bedrock map to aid water exploration.

NO interpretive factor in the Felmont data that needs a hole for geology or interpretation

Shell East: (Shell claims 73-134 (1974), 135-187 (1983). These claims were staked for water sources into the San Rafael Valley (Santa Cruz River headwaters). Discussions of the water potential of these areas are included in a 1974 memo in our property files by Halpenny, by 1974 geophysical (gravity) work by Benavidez and Montgomery and in my May 11, 1983 memo on Kerr-McGee Water Well Data. The 1983 Shell claims cover the N-S graben postulated in Montgomery's report and are within ½ mile of Kerr-McGee's Mowry Wash well, SE/4 SW/4 Sec. 17, on patented ground which produced 465 gpm. I have no doubt that with a little geophysical work we could come up with as good a well.

Where to drill the water well?

Shell South: (Shell claims 187-237 (1984)). These claims are being staked for insulating value (tails, dumps, water source) to Hardshell north and east of Mowry and for additional contiguity of previous Shell water claims. They are in part more properly part of a potential Mowry limestone replacement target. In my quick handwritten note of February 20 (later typed February 24) I suggested staking these claims for the above reasons. The claims also cover ground that contains jasperoid-filled faults between jumbled blocks of outcropping Upper Paleozoic carbonates. The north end of this claim group in upper Corral Canyon contains sediments and volcanics which could serve as host rocks and caprocks to Hardshell-type mineralization if feeders such as the Mowry fault or those under Hardshell-Bender-Black Eagle were present. The volcanics do not contain such extreme alteration as over Hardshell proper but they have not been examined, sampled, or mapped in any detail by Asarco. Old USSR&M maps show at least 5 drill holes, probably location holes (100'?), in upper Corral Canyon but we have no data on their results. The claim data (assessment work) filed by UV showed considerable geochemical sampling in the area but the data were barely readable and have disappeared along with my copy of S. R. Davis' 1970 1" = 1000' map of the area with my field notes on it.

The new road (not on maps) from Farrell Spring S and SW to Mowry through limestones has 4-6 drill sites that are 3-4 years old now, some of which showed jasperoid cuttings ± goethite + MnOx scattered around. This recent drilling was probably UV's (or possibly Exxon's--I believe they had an option on the area during Ishung Wu's tenure in Tucson) and is not shown on the 10 year old information we have from UV.

I have no specific drill target picked out for this ground except the area around Farrell Spring shows the most alteration (from my limited visits--mostly for water sampling) and is an obvious target. The area needs to be mapped (200-500 scale) and sampled by Asarco. This should be preceded by a study of UV's work which I believe they would make available to us. You will note some strong structural control of the area on S. R. Davis' 1" = 1000' map--particularly the NE fault zone which to the north downdrops the Corral Canyon sediments and volcanics, extends to the SW across the Harshaw Creek fault and probably controls the drainage along Corral Canyon through Tertiary basinfill gravels to the NE of Farrell Spring. The area is one that might benefit from geophysical work which should start with a review of UV's data.

For the record the University of Arizona Geochronology Lab would like permission to sample and run an Sr/Rb isochron age on the upper Corral Canyon volcanics (Davis' Kvs unit) from which I obtained an 83 m.y. K/Ar (whole rock) age. From work by C. Kluth in the Canelo Hills they suspect that the Corral Canyon sequence is >120 m.y. and the 83 m.y. age is reset. The age of this sequence is critical to a number of interpretations in the Patagonias and I believe that we should cooperate with this work (no analytical cost to Asarco).

Four Metals: This property (some 73 claims) held by Noranda, contains a mineral reserve of 3.1 m.t. @ 0.82% Cu or with lower cutoff 14.7 m.t. @ 0.50 Cu + minor MoS_2 values. (FTG lists reserves at 5 m.t. @ 0.8% Cu, .01 MoS_2, 0.12 opt Ag and 0.15% Pb in his 1972 zoning review of the Patagonias). Sharon Steel-UV had this ground from 1978-1982 and drilled a number of holes which better delimited mineralization and tested deep Cu potential to 3000' (only spotty ore-grade intercepts) but did not appreciably change reserves according to Noranda. We now have all of Noranda's remaining core on the property and some of the drill logs. The Sharon Steel core from 4-Metals is apparently in New Mexico. Apparently the only remaining potential for better grade mineralization is below 3000 feet. I intend to do nothing more than obtain, briefly review, and file Noranda's and possibly UV's data on this project when time permits. The surface alteration around the 4-Metals breccia pipe is considerably weaker than around Sunnyside (3-R/TM) and Red Mountain which suggests that deep potential is less at 4-Metals than these other 2 porphyry copper systems. However I suggest that we run these ideas by our New York expert on 4-Metals and the Patagonias.

so be it

Worlds' Fair (Argentor): I reviewed this property in my memo of March 26, 1984 after examining the limited data available from Eimon et al. and our files. There is little or no potential in the near surface volcanics that would interest more than a small operator or promotor. The potential on the claims is at depth below 3000 feet as Eimon's syndicate realizes. Asarco is the logical choice for them to sell these claims to. The deep limestone replacement potential of the Argentor claims can be fairly well tested from our surrounding TM, Humboldt-Mendoza or January claims in future years without acquiring their ground. At present the claims have no value to us.

but should ASARCO drill that deep hole?
ie, "this is where I would drill a hole" &
what I would find" memo.

To be done:

- Ventura (see April monthly report)
- Mowry
- Alta
- 3R. (NW of TM-14 and Flux)
- Thunder Mountain (Drilling)

} See Trench Area Report of May 14, 1982 (Nothing has changed!)

ASARCO

Exploration Department
Southwestern United States Division

February 28, 1984

Mr. James S. Davis
Staff Hydrologist
Department of Water Resources
99 E. Virginia Ave.
Phoenix, AZ 85004

Hardshell Project
Santa Cruz Co., AZ

Dear Mr. Davis:

We expect to continue drilling on our Hardshell Project between now and August 25, 1984 when our drilling authorization expires. The drilling company has been changed over to:

Drill X Inc.
P.O. Box 277
Chandler Heights, AZ 85227

Well Driller's License #3

Attached are letters of our application, dated August 11, 1983, and your permission to drill, dated August 25, 1983, for your information.

Sincerely yours,

J. R. Stringham
Assistant to the
Manager, SWED

JRS:mek
att.

cc: J. D. Sell
Drill X Inc.

State of Arizona

DEPARTMENT OF WATER RESOURCES

99 E. Virginia Avenue, Phoenix, Arizona 85004

JRS

BRUCE BABBITT, Governor
WESLEY E. STEINER, Director

August 25, 1983

Mr. James D. Sell
Project Manager
ASARCO Inc.
P.O. Box 5747
Tucson, AZ 85703

RE: Hardshell Project

Dear Mr. Sell:

This letter will serve to inform you that we have received the requested information concerning your exploration project. If this letter is available at the drill site for inspection, it will preclude any confusion regarding the project should a field inspection be made.

1. Name of Drilling Contractor and License Number

Knight Drilling Company
711 East Laurel Drive, #10
Casa Grande, Arizona 85222

Department of Water Resources License Number: 02

2. Project Area Location

T23S, R16E, Sections 3, 4, 9 and 10, G&S R B&M (Unsurveyed)

3. Name of Exploration Firm

ASARCO Inc., Southwestern Exploration Division

4. Expiration Date

This authorization to drill expires on August 25, 1984.

I have included a portion of the Lochiel 15-minute topographic map with the project area outlined in red. We are not aware of any hydrologic reports for the area, and the Department has little water level data in the vicinity. It appears that the project area overlies both consolidated rock and alluvial material, and that groundwater could possibly be encountered in the alluvium. If groundwater is encountered, the well shall be cased and capped in accordance with R12-15-811 and 812. If groundwater is not encountered, the well shall be cased, cemented and capped in such a manner so as to prevent contamination of the well bore from the surface. Your abandonment plan should be sufficient, provided the surface casing is securely grouted, either five feet into the first encountered consolidated formation or 20 feet total, whichever is less.

Upon completion of the project, please provide the Department with information regarding the number of holes drilled, the depth to water in each, if encountered, and the actual method of abandonment used.

If you have any questions, please feel free to call.

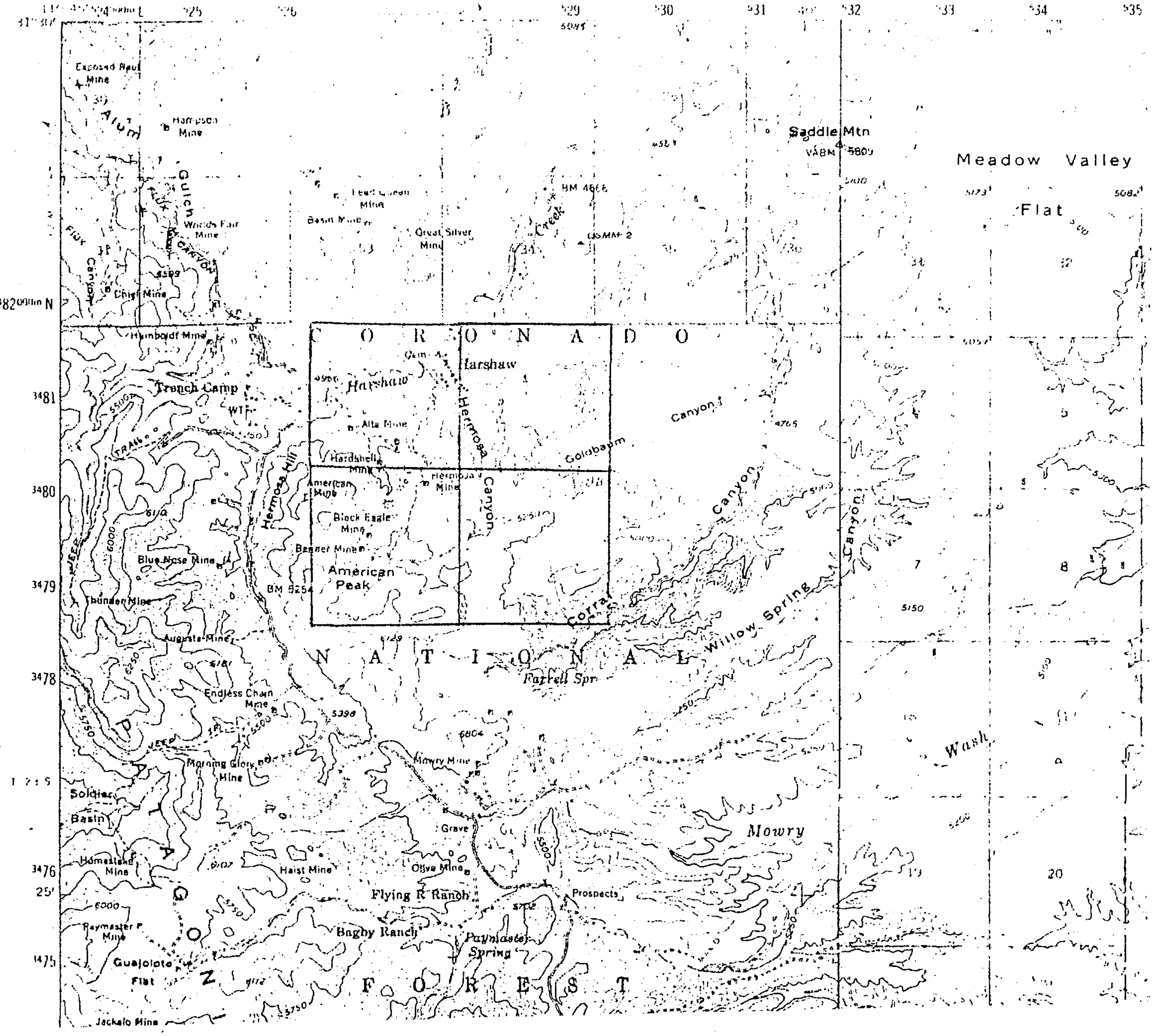
Sincerely,

James S. Davis

James S. Davis
Staff Hydrologist

llk
Enclosures
cc: Knight Drilling Co.

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY



UNITE
DEPARTM

ASARCO

Exploration Department
Southwestern United States Division

August 11, 1983

Department of Water Resources
99 E. Virginia
Phoenix, AZ 85004

Attention: Mr. Roger Kennett

Hardshell Project
Santa Cruz County, Arizona

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

Sections 3, 4, 9 and 10, T23S, R16E
See attached map.

Drilling Company

Knight Drilling Company
711 East Laurel Drive 10
Casa Grande, AZ 85222

Well Driller's License T-2

(Arizona Contractor's License A-4 #55123)

Number of Drill Holes Under This Project: ±5 holes (plus or minus five holes)

Holes will be drilled to a depth between 400 and 600 ft. by percussion drilling. Which holes upon completion will have the surface casing capped with a steel plate and the drilled holes will be available for re-entry.

Drilling equipment will consist of a Failings CF 1500. The diameter of the holes will be approximately $3\frac{1}{2}$".

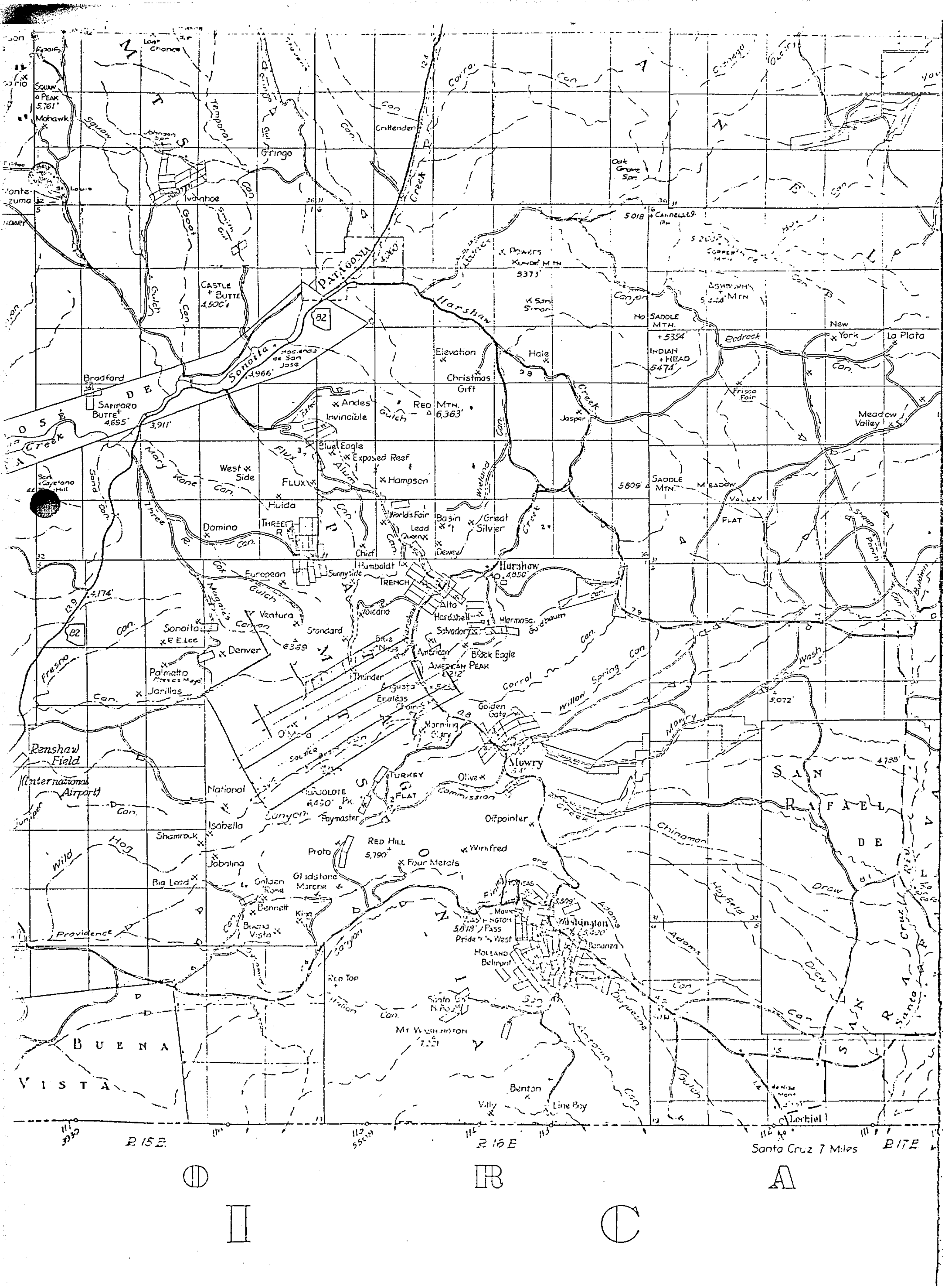
Very truly yours,

James D. Sell

James D. Sell
Manager

JDS:mek
Att.

cc: J. R. Stringham
Wendell H. Knight - Knight Drilling Co.
L. Halpenny


Squaw Peak 5,761'
Mohawk
Monte-zuma
St. Louis
Ivanhoe
Johnson Spr.
Temporal
Gringo
Gringo Gul.
Crittenden
Corral Can.
Oak Grove Spr.
Castle Butte 4,500'
Patagonia
82
Sonoita Creek
Hacienda de San Jose
3,966'
Bradford
Sanford Butte 4695'
3,911'
San Cayetano Hill
Harshaw Creek
Powers
Kunde Mtn 5373
Candelaria Pk.
5 018
Ashburn Mtn
San Simon
No Saddle Mtn. 5354'
Indian Head 5474'
Redrock Can.
New York
La Plata
Frisco Fair
Meadow Valley
Elevation
Christmas Gift
Hale
Jasper
Andes
Invincible
Red Mtn. 6,363'
Alum Gulch
Blue Eagle
Exposed Reef
Hampson
Flux
Flux Can.
West Side
Huida
Three R
Three R. Can.
Mary Kane Can.
Sand Can.
Domino
World's Fair
Lead Queen
Basin
Great Silver
Dewey
Chief
Saddle Mtn.
5609'
Meadow Valley Flat
Humboldt
Sunnyside
European
Trench
Harshaw 4,850'
Alta
Hardshell
Hermosa
Volcano
Ventura
Standard
Sonoita
F. E. Lee
Denver
6359
Blue Nose
American
American Peak 6212'
Black Eagle
Salvador
Palmetto
Jarilias
Fresno Can.
Thunder
Augusta
Endless Chain
Golden Gate
Corral Can.
Willow Spring Can.
Mowry Wash
5,072'
Morning Glory
Mowry
Turkey Flat
Olive
Commission Creek
Renshaw Field (International Airport)
National
Juniper Can.
Isabella
Canyon
Paymaster
Offpointer
Chinaman
San Rafael de la Zanja
Shamrock
Wild Hog
Jabalina
Proto
Red Hill 5,790'
Winifred
Four Metals
Big Lead
Golden Rose
Gladstone
Bennett
King
Buena Vista
Providence
Washington
Washington Pass 5,819'
Pride of the West
Holland
Belmont
Bonanza
Adams Can.
Hayfield Draw
Adams Draw
Santa Cruz River
Red Top
Santo Niño
Mt. Washington 7,221
Duquesne
Buena Vista
Benton
Line Boy
Lochiel
R. 15 E.
R. 16 E.
R. 17 E.
Santa Cruz 7 Miles
O R A
I C

JDS

ASARCO

Southwestern Exploration Division

February 28, 1984

To: T. C. Benavidez

From: J. D. Sell

Hardshell Project
Drill Hole Location Map
Snnta Cruz County, AZ

Please secure a copy of the new Hardshell-Hermosa map (#6022, dam 2-84) at a scale of 1" = 200' and

1) Confirm roads and drill hole locations and numbers;

2) Make necessary corrections and submit to drafting;

3) Plot new (1984) drill hole locations and drill roads when shot in.

James D. Sell

JDS/cg

cc: DAMelhado

ASARCO

Southwestern Exploration Division

JDS

February 29, 1984

To: F. R. Koutz

From: J. D. Sell

Felmont Data
Patagonia Area
Santa Cruz County, AZ

Felmont has inquired about our status on their property in the Patagonias. From what I gather, there is no compelling reason to enter a venture with them.

Taking the current situation, clean up your desk of their material and send it back to them. Place ASARCO copies in the files (this includes all your notes and scraps). When you have time to resurrect the material then you can write up the data. A quick ERS would be in order.

If you feel differently, please inform me.

James D. Sell

JDS/cg

JDS

ASARCO

Exploration Department
Southwestern United States Division
James D. Sell
Manager

February 29, 1984

Lance J. Eklund
Eklund Drilling Company
P. O. Box 666
Carlin, NV 89822

Dear Lance:

Thank you very much for sending us the letter, photos, descriptions, and hourly rates on your various rigs. Your new Drill System M.P.D. 1000AV really looks like quite a set-up. What depth capabilities does it have?

At present I have only a minor amount of rotary type work I need done in southern Arizona - perhaps some five holes at 400-600 feet depth.

I understand you may be bringing the Drill System rig to Arizona on a job and I would be interested in seeing the machine in operation. Could I secure your thoughts on footage rates on the above type job and would it be possible to do the work while you are in the area?

Sincerely,

James D. Sell

JDS/cg

cc: WLKurtz (w/brochure)
TCBenavidez "

State of Arizona

DEPARTMENT OF WATER RESOURCES

99 E. Virginia Avenue, Phoenix, Arizona 85004

BRUCE BABBITT, Governor
WESLEY E. STEINER, Director

March 2, 1984

Mr. J. R. Stringham
ASARCO Inc.
P.O. Box 5747
Tucson, Arizona 85703

Re: Hardshell Project

Dear Mr. Stringham:

This letter will serve to inform you that we have received your letter of February 28, 1984, requesting to change drilling contractors on your exploration project. If this letter is available at the drill site for inspection, it will preclude any confusion regarding the project should a field inspection be made.

1. Name of Drilling Contractor and License Number

   Drill X Inc.
   P.O. Box 277
   Chandler Heights, Arizona 85227

   Department of Water Resources License Number: 03

2. Project Area Location

   T23S, R16E, Sections 3, 4, 9 and 10, G&S R B&M (Unsurveyed)

3. Name of Exploration Firm

   ASARCO Inc., Southwestern Exploration Division

4. Expiration Date

   This authorization to drill expires on August 25, 1984.

xc: JJS
TCB,
cc. File

RECEIVED

MAR - 7 1984

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

I have included a portion of the Lochiel 15-minute topographic map with the project area outlined in red. We are not aware of any hydrologic reports for the area, and the Department has little water level data in the vicinity. It appears that the project area overlies both consolidated rock and alluvial material, and that groundwater could possibliy be encountered in the alluvium. If groundwater is encountered, the well shall be cased and capped in accordance with R12-15-811 and 812. If groundwater is not encountered, the well shall be cased, cemented and capped in such a manner so as to prevent contamination of the well bore from the surface. Your abandonment plan should be sufficient, provided the surface casing is securely grouted, either five feet into the first encountered consolidated formation or 20 feet total, whichever is less.

Upon completion of the project, please provide the Department with information regarding the number of holes drilled, the depth to water in each, if encountered, and the actual method of abandonment used.

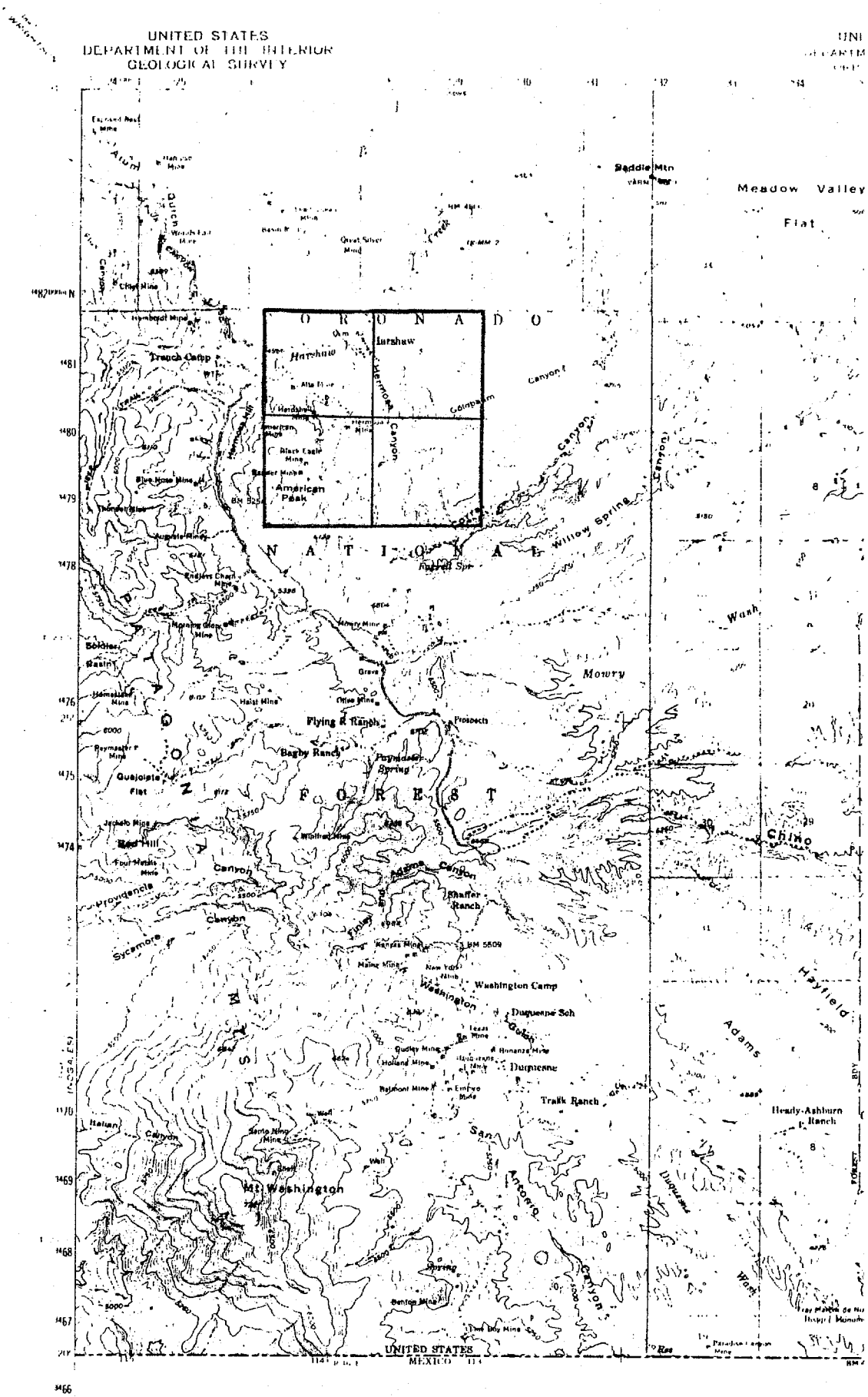
If you have any questions, please feel free to call.

Sincerely,

James S. Davis

James S. Davis
Staff Hydrologist

nh
Encl/
cc: Drill X Inc. (w/out Encl).


UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
Saddle Mtn
Meadow Valley
Flat
Alum
Quinn
Canyon
Creek
Great Silver Mine
Chief Mine
Trench Camp
Hershaw
Hershaw
Mine
Hershaw
Canyon
Hermosa
Columbium
Canyon
Black Eagle Mine
American Mine
Blue Rose Mine
American Peak
BM 5251
Willow Spring
Canyon
Canyon
Canyon
Rattrell Spr
Wash
Soldier Basin
Morning Glory Mine
Grave
Mowry
Homestake Mine
Haist Mine
Ohio Mine
Flying R Ranch
Prospects
Bagby Ranch
Raymaster Spring
Quajolote Flat
Jackass Mine
Four Metals Mine
Providencia Canyon
Providencia Canyon
Sycamore Canyon
Shaffer Ranch
Chino
Washington Camp
Duquesne Sch
Duquesne
Trailk Ranch
Heady-Ashburn Ranch
Adams
Hayfield
Mt Washington
Santa Nina Mine
Spring
Benton Mine
Canyon
Canyon
UNITED STATES
MEXICO
ORONADO
NATIONAL
FOREST

ASARCO

Exploration Department
Southwestern United States Division

CERTIFIED MAIL
RETURN RECEIPT

March 23, 1984

Ms. Mary Lou Sainz
Santa Cruz County Recorder
P.O. Box 1150
Nogales, AZ 85621

Notices of Location
Harshaw Mining District
Santa Cruz County, AZ

Dear Ms. Sainz:

Enclosed for recording in the official records of Santa Cruz County, Arizona are the following Notices of Location for 50 lode claims with maps and a check for $250 as the recording and map fees:

Lode Claims	Location Date
Shell 188 thru Shell 199	3/12/84
Shell 200 thru Shell 207	3/9/84
Shell 208 and Shell 209	3/13/84
Shell 210 thru Shell 229	3/8/84
Shell 230 thru Shell 237	3/7/84

Please return in the enclosed stamped envelope.

Very truly yours,

Original Signed By
J. R. STRINGHAM

J. R. Stringham
Assistant to the
Manager

JRS:mek
encs.

cc: A. J. Robles
J. D. Sell

ASARCO

Exploration Department
Southwestern United States Division
James D. Sell
Manager

March 26, 1984

Memorandum to all Drill Crews:

Ventura Project
Thunder Mountain Project
Hardshell Project

The following personnel are authorized for access to drill rigs, core, sample materials, and related shift reports:

T. C. Benavidez
T. Dalla Vista
F. R. Koutz
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

JDS/cg

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

ASARCO

Exploration Department
Southwestern United States Division

March 27, 1984

Mr. Dennis Brandolino
District Ranger
U. S. Forest Service
RR2, Box 1150
Sierra Vista, AZ 85635

1984 Drilling Plans
Patagonia Mountains
Santa Cruz County, AZ

Dear Mr. Brandolino:

As summarized to you on the phone today and by Tony Benavidez last week in the field we will be starting our 1984 drilling program in the Patagonia Mountains this week. We will be occupying the Ventura Project drill site used last year near the Ventura Mine on the west side of the range for a week or two with a Joy Mfg. diamond drill rig. The rig will then move to our Thunder Mountain Project drill site used last year in Upper Alum Gulch on the east side of the range. The rig will remain at this site for 4 to 6 weeks and should finish by the end of May. No new road work besides removal of boulders and minor grading will be necessary at these sites.

At our Hardshell Project we will be occupying 3 drill sites prepared in previous years and building 3 new sites requiring short spur roads as outlined by Mr. Benavidez. Minor amounts of blasting may be required for several of these spurs. A drill road/site map of Hardshell is attached. You will note that some of this work is on our Hermosa patented claims. The driller at Hardshell will be Drill-X, Inc. using a down-hole hammer rig and work should be completed by the end of April.

We will clean up and reseed new roads and drill sites although some may be used in the future. We will also take our usual precautions against fires.

Mr. Benavidez will be in charge of our field operations and you may contact him, myself or Mr. Stringham, our property manager, if you have any questions. Thanks for your help.

Very truly yours,

Fleetwood R. Koutz
Geologist

FRK/cg

Attachment

cc: JDSell/TCBenavidez/JRStringham (w/o attach)

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

United States Department of Agriculture
Forest Service
Sierra Vista Ranger District
Rural Route 2, Box 1150
Sierra Vista, AZ 85635

Reply to: 2810

Date: April 4, 1984

Rec'd 5/APR 84 copy for JRK TCB original to JAS/JDS property files

Mr. Fleetwood R. Koutz
ASARCO Incorporated
P.O. Box 5747
Tucson, AZ 85703

Dear Mr. Koutz:

The work outlined in your letter of March 27th and discussed by Dennis Brandolino and Tony Benavidez is approved.

You are required to follow all of the standard environmental protection practices which include the following:

a. Keep disturbed area to a minimum when constructing your spur road and drill pads.
b. Contain your mud.
c. Prevent an unsitely mess.
d. Do the normal rehabilitation work, including but not limited to, scarifying the area and reseeding with an approved grass mix.

← TCB says we have to haul it away
← some problems 1983?

We will also have our Fire Prevention Technician inspect your equipment for spark arrestor, shovel, and other necessary fire prevention and suppression equipment.

Upon completion of your operation as outlined, please contact Dennis and he will arrange a date and time with Tony Benavidez to field inspect your projects. Please contact Dennis or myself at 458-0530 if you have any other questions or problems.

Post operation inspection is now.

Sincerely,

Allan L. Hinds

ALLAN L. HINDS
District Ranger

SKYLINE LABS, INC.
1775 W. Sahuaro • P.O. Box 50106
Tucson, Arizona 85703
(602) 622-4836

REPORT OF ANALYSIS

JOB NO. TAJ 350
April 6, 1984
PROJECT NO. ERM-WD
SHIPMENT 1
ERM-WD #1 THRU ERM-WD #14
PAGE 1 OF 1

ASARCO INCORPORATED
Attn: Mr. Fleetwood R. Koutz
Southwestern Exploration
P.O. Box 5747
Tucson, Arizona 85703

Hermosa West Dist

Analysis of 14 Rock Chip Samples

ITEM	SAMPLE NUMBER	FIRE ASSAY Au (oz/t)	Ag (oz/t)	Pb (%)
1	ERM-WD #1	.015	3.25	2.41
2	ERM-WD #2	.005	1.24	1.41
3	ERM-WD #3	.020	1.48	1.26
4	ERM-WD #4	.010	1.39	1.52
5	ERM-WD #5	.005	.78	.48
6	ERM-WD #6	<.005	.26	.06
7	ERM-WD #7	<.005	<.01	.01
8	ERM-WD #8	<.005	.36	.04
9	ERM-WD #9	<.005	1.44	.21
10	ERM-WD #10	.010	.17	.56
11	ERM-WD #11	<.005	.72	.38
12	ERM-WD #12	.005	1.16	1.05
13	ERM-WD #13	<.005	.58	.13
14	ERM-WD #14	<.005	17.56	.78

cc: Asarco Incorporated
Attn.: Mr. James D. Sell
Southwestern Exploration
P.O. Box 5747
Tucson, Arizona 85703

REGISTERED ASSAYER CERTIFICATE NO. 9425 WILLIAM L. LEHMBECK DATE SIGNED Arizona U.S.A.

RECEIVED
APR - 9 1984
S. W. U. S. EXPL. DIV.

ASARCO

Southwestern Exploration Division

JDS

April 9, 1984

F. T. Graybeal
New York Office

Felmont Property
Hardshell (East)
Santa Cruz County, AZ

I submit F. R. Koutz' review and additional note on the Felmont Property. I see no compelling reason to pick up the property from them at this time and question how much should be picked up when any might become available for staking.

James D. Sell

JDS/cg

Attachments

cc: WLKurtz (w/o attach)

WLK agrees (4/11/84)

ASARCO

Exploration Department
Southwestern United States Division

CERTIFIED MAIL
RETURN RECEIPT

April 10, 1984

Bureau of Land Management
Arizona State Office
2400 Valley Bank Center
Phoenix, AZ 85073

Filing of Mining Claim
Notices of Location
Shell Claims
Harshaw Mining District
Santa Cruz County, AZ

Gentlemen:

In accordance with Section 314 of the Federal Land Policy and Management Act of 1976 (43 U.S.C., Sec. 1744), and the regulations thereto, enclosed for filing in your office is a copy of the official record of the Notices of Location with maps for the following 50 lode claims in the Harshaw Mining District, Santa Cruz County, Arizona:

Name of Claim	Date of Location	Recorded in the official records of Santa Cruz Co. Book	Pages
Shell 188 thru Shell 199	3/12/84	373	434 thru 457
Shell 200 " Shell 207	3/9/84	"	458 " 473
Shell 208 " Shell 209	3/13/84	"	474 " 477
Shell 210 " Shell 229	3/8/84	"	478 " 517
Shell 230 " Shell 237	3/7/84	"	518 " 533

A check for $250 is enclosed as your filing fee. Please send receipt and accounting advice in the enclosed envelope.

Very truly yours,

Original Signed By
J. R. STRINGHAM

J. R. Stringham
Assistant to the
Manager, SWED

JRS:mek
encs.

cc: J.D. Sell
A.J. Robles

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

JDS

ASARCO

Southwestern Exploration Division

April 11, 1984

F. T. Graybeal
New York Office

West Drift - Hermosa Mine
Hardshell Project
Santa Cruz County, AZ

Attached is a report on the ongoing work being caught up on the Hardshell area by F. R. Koutz.

Strong FeOx-MnOx seems to be a necessary component for higher grade values.

James D. Sell

JDS/cg

Attachment

cc: WLKurtz (w/o attach)

F.R.Koutz
4/30/84

1984 Hermosa-North Hermosa Drilling

Hardshell Project (1895 Feet Total)

Assay Results ~~To Date~~

1984 Site	Hole No.	Total Depth	Intercept Top	Intercept Bottom	Intercept Feet	Ag (opt)	Pb (%)
B	HDS-92	250'	105	150	45	1.49	0.08
			220	225	5	1.10	0.14
		Mean:	5	250	245	0.57	--
A	HDS-93 (Hole lost - proposed 350')	345'	0	30	30	1.73	<0.01
			85	90	5	1.10	0.13
			100	105	5	1.00	0.10
			205	235	30	1.96	0.37
		Mean:	0	345	345	0.63	--
New	HDS-94	400'	100	125	25	1.72	0.18
			140	160	20	1.08	0.01
			170	175	5	1.10	0.02
			200	210	10	1.10	0.07
			315	330	15	1.29	0.25
		Mean:	5	400	395	0.66	--
F	HDS-95 (Hole lost in gouge - proposed 350')	270'	75	180	105	2.11 (Pb) 0.25	~~Pb Results Below Pending~~
			(90	120	30	3.53) (0.57)	
			210	220	10	1.01 0.92	
			225	230	5	1.10 0.63	
			250	255	5	1.06 0.07	
		Mean:	0	270	270	1.16 —	--
E	HDS-96	400'	0	105	105	3.01 (Pb) 0.23	(2.65 w/o 80-85')
			(80	85	5	10.22)*(0.86)	High MnOx
			125	195	70	2.94 0.34	(1.62 w/o 155-160')
			(155	160	5	20.09)*(0.05)	High MnOx
			210	355	145	2.57 0.35	(1.44 w/o 220-225')
			(220	225	5	34.17) (1.42)	Mod. red hematite
		Mean:	0	400	400	2.38	--
D	HDS-97 (Hole lost in broken rock old workings? - proposed 270')	230'	10	15	5	1.06	0.09
			20	25	5	1.16	0.05
			~~Assays below 60' pending.~~				
			155	180	25	1.25	0.30
			195	200	5	1.38	0.30
			205	220	15	1.23	0.34
			225	230	5	1.10	0.43
		MEAN:	0	230	230	0.58	—

745' = 39.3%

ASARCO

Southwestern Exploration Division

April 30, 1984 Holding for map

To: J. D. Sell

From: F. R. Koutz

Monthly Report
Hardshell Project (EA-0013)
Santa Cruz County, AZ

During April 1895 feet of hammer drilling was completed in 6 holes in the Hermosa-North Hermosa area by Drill-X of Casa Grande, supervised by T. C. Benavidez. This drilling, with road work and assaying, completes 1983-84 assessment work on 196 Shell claims.

A list of +1 opt Ag intervals follows from what assays have been returned. You will note that 3 holes (HDS-93, -95, -97) did not reach their proposed depth because of down-hole conditions. Proposed hole "C" was not drilled because it was judged in the field that the road and site work (including blasting) would be too expensive for the information gained but would still be an excellent site if more extensive drilling is done.

Hole HDS-94 was drilled in place of "C" some 190' N of HDS-86 to follow-up the higher grade intervals (95', 3.7 opt Au) intersected in that hole. All of this year's holes have been surveyed in for use by the Mining Dept.

The results so far received are similar to past years' results and not especially encouraging for having a significant shallow tonnage of leachable 2-4 opt Ag with low MnOx. Although many of the higher grade zones contained significant hematitic clay (fault gouge?) many also contained minor Mn oxides. Only 640 feet of drilling in holes HDS 92-96 was +1 opt Ag (38% of intercepts) but only a few intercepts with the exception of HDS-96 were +2 opt. HDS-96 which intersected 3 +10 opt Ag 5-foot intervals is the best hole of the 14 (4575') drilled in the area since 1981 and averages 2.4 opt Ag over the total 400 feet depth. There is probably enough mineralization to make another, though deeper, and probably more Mn-rich "Hermosa Mine" in the HDS-96 area. However you will note that the Ag average of the total footage drilled around the +25 ppm (0.7 opt) Ag surface is not significantly higher than the surface anomaly except for a few higher grade intervals. It does not appear that there is any significant tonnage of moderate grade Ag material that could be surface-mined and leached. I would therefore recommend that any future drilling in the area be confined to around the shallower Hermosa workings to the south.

T. Dalla Vista and I explored and sampled two areas of the Hermosa Mine not previously accessible. The West Drift of the Revolution Tunnel level (report of April 10, 1984) is essentially as shown on the 1881 map of the mine. Only minor amounts of +5 opt Ag were encountered-associated with high angle faults. Access to the west end of the north vein area (memo in press) was gained by roping down a stope to the surface 120' SSW of HDS-92. The north vein workings are much more extensive than indicated on previous maps and although access to all workings was not obtained, probably between 20-40,000 T of +5 opt Ag was removed from this part of the mine from 6-10', locally 15-20' wide stopes. Mineralization is in high-angle (40-85°) E-W to WNW structure zones and 15 cut samples from a limited area of the workings averaged 5.1 opt Ag, 0.009 opt Au and 1.9% Pb. The rest of the north vein area should also be explored and sampled. It is now clear that most of the stoped mineralization at Hermosa is related to high angle structures rather than stratigraphic horizons.

Because of a number of +0.01 opt Au values obtained from underground sampling at Hermosa and the possibility that Au might contribute significantly to the leach grade of Hermosa mineralization, all +1 opt Ag drill samples had Au reported at the additional cost of 13¢ per sample. Unfortunately most values were around 0.005 Au or less with only a few +0.01 opt Au values. Because of lack of project funds a program to assay for Au previously drilled (206 +1 opt Ag), surface (96 samples) and underground (73 samples) pulps has been postponed. All future sampling at Hermosa and Hardshell should include Au at the time of Ag assay because of the small additional cost and potentially contributing Au values.

Additional work on the Hardshell Project this month included meshing of all Hardshell assay and survey data and production of an up-to-date Preliminary Mineral Inventory on the Mn oxide manto by L. J. Jansen. Tonnage and Ag-Mn grade at various cutoffs follow:

Main Manto Mineralization

Million Tons	Ag-opt	Mn %	Cutoff
19.0	3.78	5.19	1 opt Ag
9.4	6.20	7.27	2 opt Ag
6.8	7.66	8.58	3 opt Ag

Calculation of stripping ratios and other planning is awaiting mining/beneficiation cost data. W. L. Kurtz also made a study this month of low grade mineralization above and marginal to the Mn-oxide rich manto. Reduction roast metallurgical tests are in progress at Central Research.

Proposals for drilling for limestone replacement sulfide mineralization under the manto and a limited exploration program around the Hermosa Mine were made this month. T. C. Benavidez is working on installing a number of corner stakes on the 50 new (Shell 188-237) claims staked north and east of Mowry in March. Exploration proposals for this ground await examination of Sharon Steel data, field examination and sampling.

F. R. Koutz

FRK/cg

Attachment

cc: SAA (w/attach)

ASARCO

Exploration Department
Southwestern United States Division

CERTIFIED MAIL
RETURN RECEIPT

May 4, 1984

Bureau of Land Management
Arizona State Office
2400 Valley Bank Center
Phoenix, AZ 85073

Harshaw Mining District
Santa Cruz County, AZ

Gentlemen:

In reviewing the Notices of Location for the Shell Lode Claims as recorded in the official records of Santa Cruz County, Arizona, with the BLM microfiche Geographic and Claimant Indexes, we have noted the following error in date of location as shown on the microfiche:

Name of Claim	BLM Serial No.	Location Date on Notice of Location	Incorrect Date on BLM Microfiche
Shell 135	AMC 201239	6/1/83	6/2/83

Please correct your records to agree with the Location Notice.

Sincerely yours,

J. R. Stringham
Assistant to the
Manager, SWED

JRS:mek

cc: J. D. Sell

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

CERTIFIED MAIL
RETURN RECEIPT

May 11, 1984

Bureau of Land Management
Arizona State Office
Siete Square Bldg.
3707 North 7th St.
Phoenix, AZ 85014

Harshaw Mining District
Santa Cruz County, AZ

Gentlemen:

In reviewing our Amended Notices of Location for the Shell Lode Claims No. 1 thru 134 located in the Harshaw Mining District, Santa Cruz County, Arizona, with the BLM Microfiche Geographic and Claimant Indexes, we have noted some discrepancies in the locations (SUBDV) shown on the microfiche. These are listed below. Please refer to Document 283, Pages 519 thru 521, "ARS Section 27-210 Mining Claims Existing Prior to September 1978" with plats attached, and to Amended Notices, Document 288, Pages 564 thru 574, for correct locations.

Name of Claim	BLM Serial No.	Location as Shown on Amended Notices & Map*	Incorrect Location Shown on BLM Microfiche*
Shell No. 9	AMC 51417	N2 Section 4	NW Section 4
Shell No. 10	51418	N2 " 4	NW " 4
Shell No. 22	51430	N2 " 4	NE " 4
Shell No. 59	51467	S2 " 3 and	SE " 3 and
		N2 " 10	N2 " 10
Shell No. 81	51489	W2 " 11	S2 " 11
Shell No. 82	51490	SW " 11	S2 " 11
Shell No. 83	51491	W2 " 11	S2 " 11
Shell No. 84	51492	SW " 11	S2 " 11
Shell No. 85	51493	W2 " 11	S2 " 11
Shell No. 86	51494	SW " 11	S2 " 11
Shell No. 87	51495	W2 " 11	S2 " 11
Shell No. 88	51496	SW " 11	S2 " 11
Shell No. 91	51499	E2 " 11	S2 " 11
Shell No. 92	51500	SE " 11	S2 " 11
Shell No. 93	51501	E2 " 11	S2 " 11
Shell No. 94	51502	SE " 11	S2 " 11
Shell No. 95	51503	E2 " 11	S2 " 11

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

Name of Claim	BLM Serial No.	Location as Shown on Amended Notices & Map*	Incorrect Location Shown on BLM Microfiche*
Shell No. 96	AMC 51504	SE Section 11	S2 Section 11
Shell No. 97	51505	E2 " 11	S2 " 11
Shell No. 98	51506	SE " 11	S2 " 11
Shell No. 99	51507	W2 " 12 and E2 " 11	S2 " 12
Shell No. 100	51508	SE " 11 and SW " 12	S2 " 12
Shell No. 101	51509	W2 " 12	S2 " 12
Shell No. 102	51510	SW " 12	S2 " 12
Shell No. 103	51511	All " 12	S2 " 12
Shell No. 105	51513	E2 " 12	S2 " 12
Shell No. 106	51514	SE " 12	S2 " 12
Shell No. 107	51515	E2 " 12	All " 12
Shell No. 108	51516	SE " 12	S2 " 12
Shell No. 109	51517	SW " 7 (T23S,R17E)	SW " 7 (T23S,R17E) and NW " 18 (T23S,R17E)
Shell No. 110	51518	NW " 18(T23S,R17E)& SW " 7 (T23S,R17E)	NW " 18 (T23S,R17E)
Shell No. 119	51527	NE " 14, NW " 13, SE " 11 and SW " 12	N2 " 13
Shell No. 120	51528	NE " 14 and NW " 13	N2 " 13
Shell No. 121	51529	NW " 13 and SW " 12	N2 " 13
Shell No. 122	51530	NW " 13	N2 " 13
Shell No. 123	51531	NW " 13 and SW " 12	N2 " 13
Shell No. 124	51532	NW " 13	N2 " 13
Shell No. 125	51533	N2 " 13 and S2 " 12	N2 " 13
Shell No. 127	51535	NE " 13 and SE " 12	N2 " 13
Shell No. 128	51536	NE " 13	N2 " 13
Shell No. 129	51537	NE " 13, SE " 12 (T23S,R16E)& NW " 18 (T23S,R17E)	E2 " 18 (T23S,R16E)**
Shell No. 130	51538	NE " 13 (T23S,R16E)& SW " 18 (T23S,R17E)	E2 " 18 (T23S,R16E)**
Shell No. 131	51539	NW " 18 " "	E2 " 18 (T23S,R17E)
Shell No. 132	51540	SW " 18 " "	E2 " 18 " "
Shell No. 133	51541	NW " 18 " "	E2 " 18 " "
Shell No. 134	51542	SW " 18 " "	E2 " 18 " "

* Claims are in T23S, R16E except as noted.

** Section 18 is in T23S,R17E.

Please make corrections as indicated. If you have any questions, please don't hesitate to phone.

Very truly yours,

J. R. Stringham
Assistant to the
Manager, SWED

JRS:mek

cc: J. D. Sell

ASARCO

Southwestern Exploration Division

June 25, 1984

To: R. L. Brown

From: J. R. Stringham

Hardshell Zone 3 Ore Reserve

Attached are the several documents which you requested giving information about the Hardshell Project, Zone 3:

1. A surface map showing:

   a. the location of the drill holes from which samples were sent to Central Research;
   b. a horizontal projection of the outer limits of the Zone 3 ore body; and
   c. the section lines for the E-W and N-S vertical projections.

2. An E-W vertical projection with the sampled drill holes marked in blue and the ore outlined in red.

3. A N-S vertical projection with the sampled drill holes marked in blue and the ore outlined in red.

4. A series of E-W sections from the computer with the plus 4 ounce assays marked in red. A cover sheet shows the outline of the ore body projected to an E-W plane.

5. A series of N-S sections from the computer with the plus 4 ounce assays marked in red. A cover sheet shows an outline of the ore body projected to a N-S plane.

6. A series of floor plans from the computer with the plus 4 ounce assays marked in red. A cover sheet shows an outline of the ore body projected to a horizontal plane.

7. A set of computer prints showing silver grades from the holes in the area. The holes from which samples were sent to Central Research are marked in blue brackets.

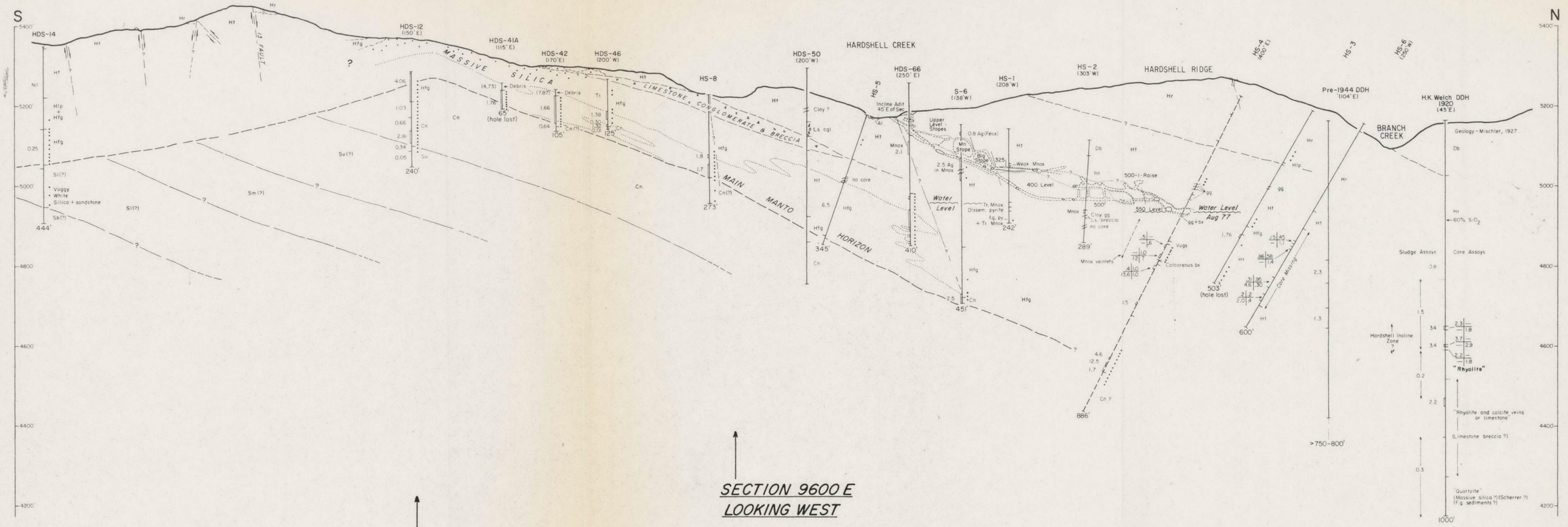
8. A letter with a list of the samples sent to Central Research.

If you need any more information, please call. If I'm not here, Bill Gay who did much of the work on these documents should be able to help you.

J. R. Stringham

JRS:mek
atts.

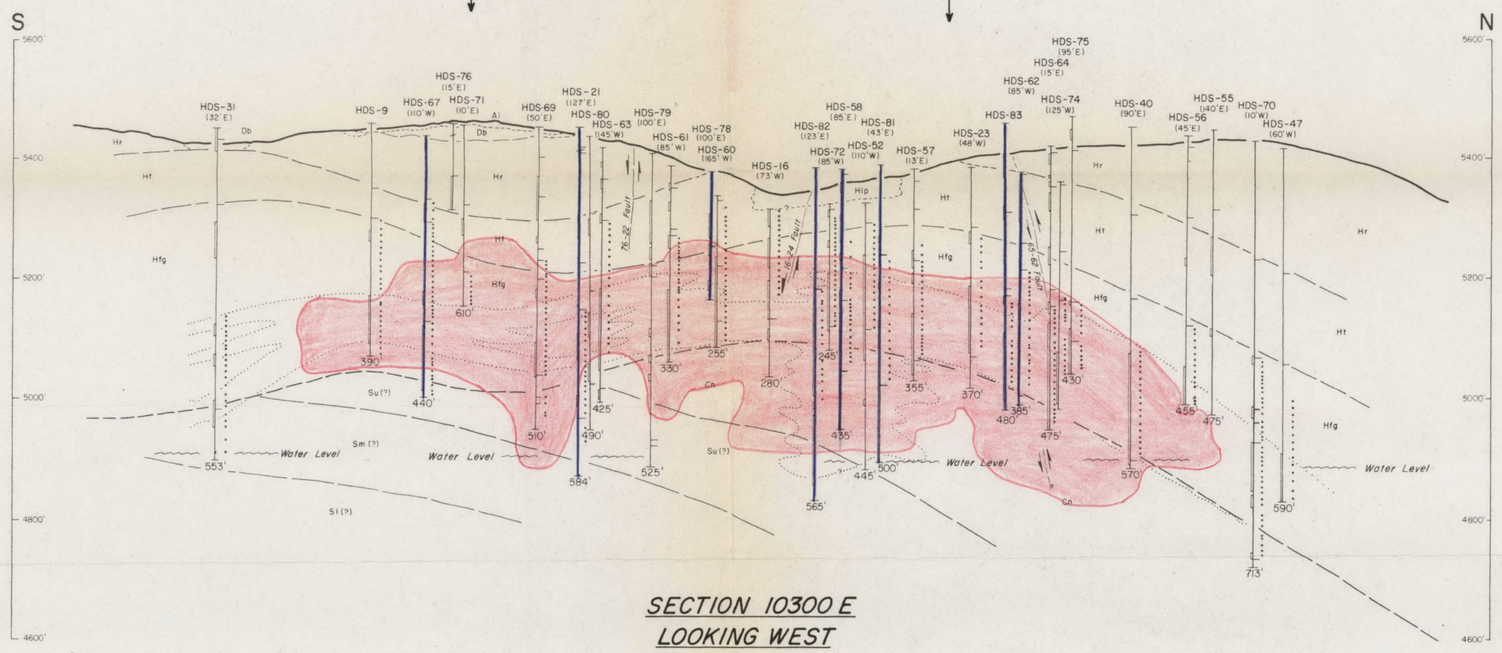
cc: J. D. Sell



SECTION 9600 E
LOOKING WEST

Section 10400 N

Section 11200 N



SECTION 10300 E
LOOKING WEST

BLUE REPRESENTS HOLES FROM WHICH METALLURGICAL SAMPLES WERE SENT TO CENTRAL RESEARCH.

RED - N-S SECTION OF OREBODY (PROPOSED)
ZONE 3

0 100 200 400 600 feet
0 25 50 100 150 meters

EXPLANATION

Quaternary	Al	Alluvium
Cretaceous / HARDSHELL VOLCANICS	Db	Basal trachyandesite of Meadow Valley
	Hlr	Latite porphyry
	Hr	Rhyolite breccia
	Ht	Tuffaceous agglomerate
	Hfg	Fine-grained tuffaceous sediments
Permian	Cn	Concha Limestone
SCHERRER FM.	Su	Upper sandstone
	Sm	Middle silty dolomite
	Sl	Lower sandstone
	Sb	Basal siltstone

Host rock not shown if destroyed
+10% silicification
Contact
4.06 Ag - + 1 oz/ton
Fault zone
Limestone cgl and breccia
gg Gouge
Outline of stoped and mineralized areas (+1 oz Ag/ton)
Pb | Zn / Mn | Ag — Assays in weight % Ag in oz/ton

Geology:
F.R. Koutz, 1980
Revised from
S.R. Davis, 1973

HARDSHELL MANTO
Harshaw District
Santa Cruz County, Arizona

F.R. Koutz, Ph.D. Dissertation, Geosciences, 1981

170,000

168,000

166,000

164,000

873,000

875,000

877,000

879,000

Alta Mine

Welch Shaft

Hermosa Mine

Revolution Tunnel

Bender Mine

Black Eagle Mine

CCC Concrete Tank

HS 1 HS 2 HS 4 HS 5 HS 6 HS 7 HS 8 HS 9

S 1 S 2 S 3 S 4 S 6

HDS 1 HDS 2 HDS 3 HDS 4 HDS 5 HDS 6 HDS 7 HDS 7A HDS 8 HDS 9 HDS 10 HDS 11 HDS 12 HDS 13 HDS 14 HDS 15 HDS 15A HDS 16 HDS 17 HDS 18 HDS 19 HDS 20 HDS 21 HDS 22 HDS 23 HDS 24 HDS 25 HDS 26 HDS 27 HDS 28 HDS 29 HDS 30 HDS 31 HDS 32 HDS 33 HDS 38 HDS 39 HDS 40 HDS 41A HDS 42 HDS 43A HDS 44 HDS 45 HDS 46 HDS 47 HDS 49 HDS 50 HDS 52 HDS 54 HDS 55 HDS 56 HDS 57 HDS 58 HDS 59 HDS 60 HDS 61 HDS 62 HDS 63 HDS 64 HDS 66 HDS 67 HDS 68 HDS 69 HDS 70 HDS 71 HDS 72 HDS 73 HDS 74 HDS 75 HDS 76 HDS 77 HDS 78 HDS 79 HDS 80 HDS 81 HDS 82 HDS 83 HDS 84 HDS 85 HDS 86 HDS 87 HDS 88 HDS 89 HDS 90 HDS 91 HDS 92 HDS 93 HDS 94 HDS 95 HDS 96 HDS 97

SECTION 11,200N

SECTION 10,300E

GENERAL OUTLINE OF (PROPOSED) OREBODY - PLAN VIEW
ZONE 3

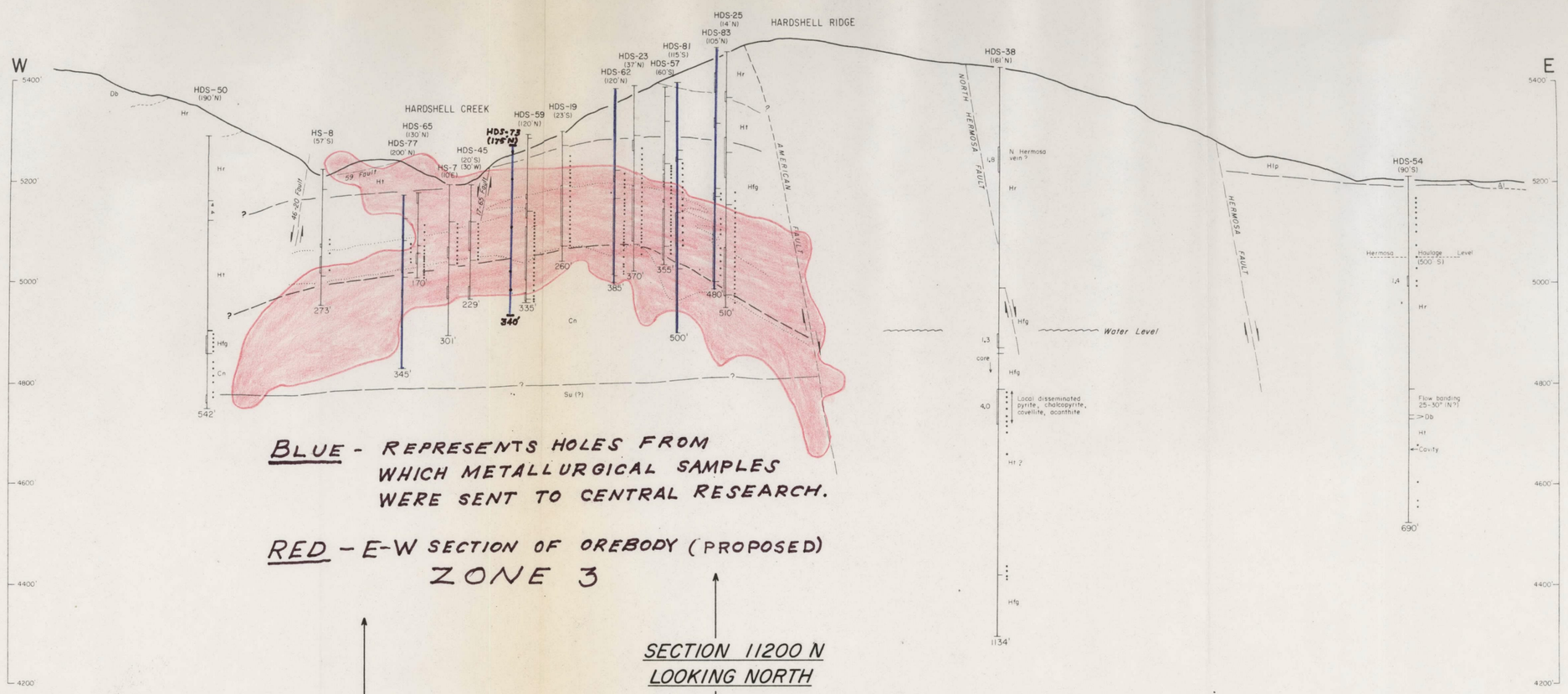
N

HARDSHELL PROJECT
DRILL HOLE LOCATION MAP
SANTA CRUZ COUNTY, ARIZONA

1" = 200' 2-84

REVISED 5-7-84 FRK/DAM

mn 6022 dam 2-84



BLUE - REPRESENTS HOLES FROM WHICH METALLURGICAL SAMPLES WERE SENT TO CENTRAL RESEARCH.

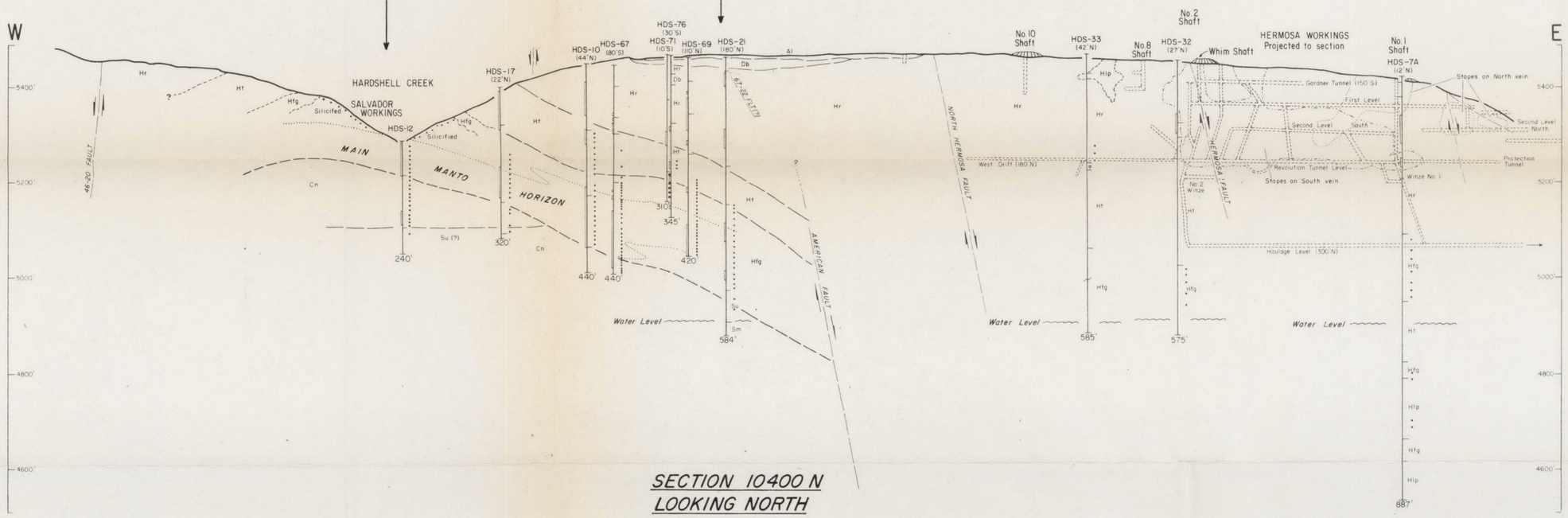
RED - E-W SECTION OF OREBODY (PROPOSED)

ZONE 3

SECTION 11200 N
LOOKING NORTH

Section 10300 E

Section 9600 E



SECTION 10400 N
LOOKING NORTH

EXPLANATION ON N-S SECTIONS

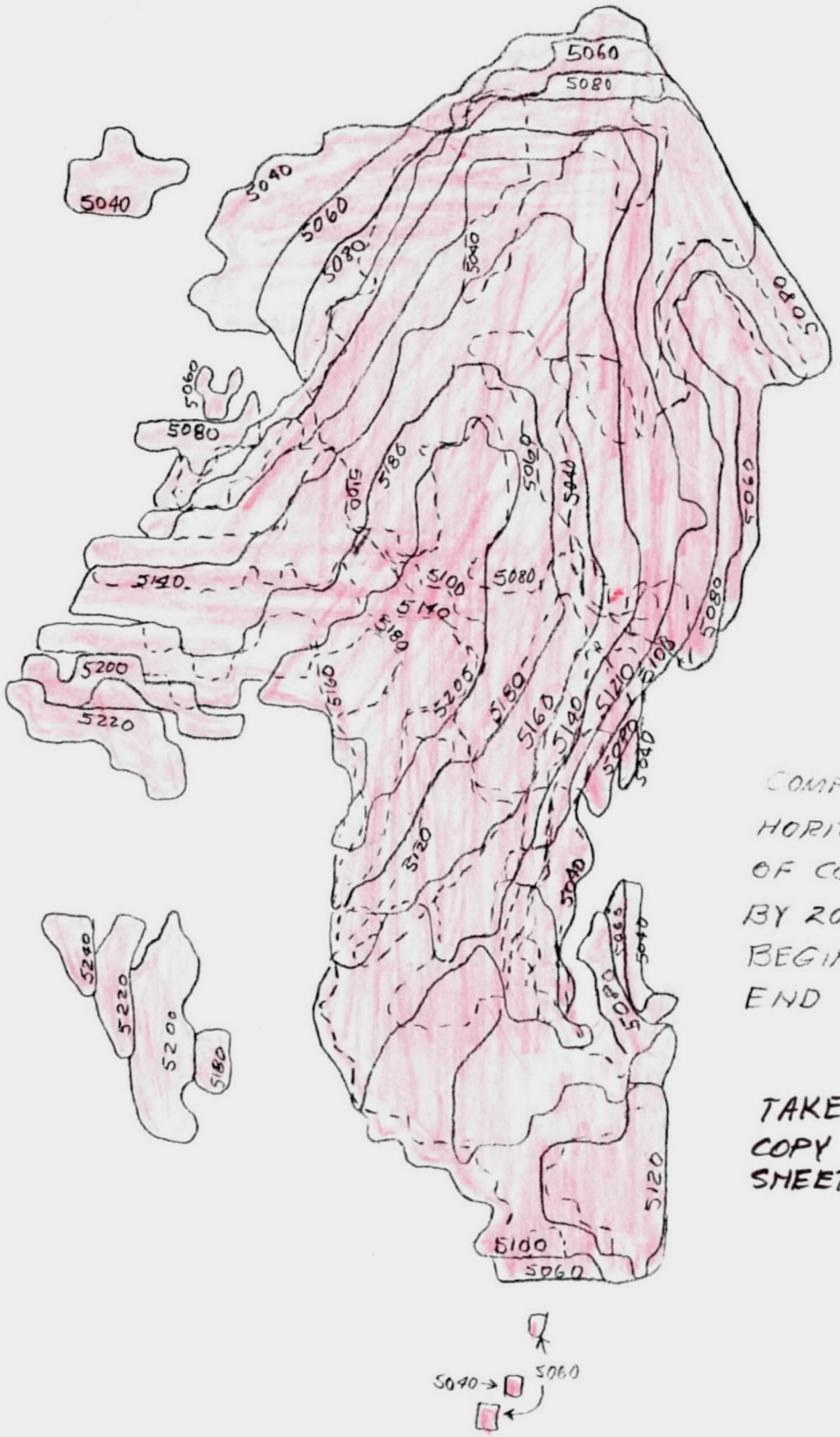
0 100 200 400 600 feet

0 25 50 100 150 meters

HARDSHELL MANTO

Harshaw District
Santa Cruz County, Arizona

F.R. Koutz, Ph.D. Dissertation, Geosciences, 1981

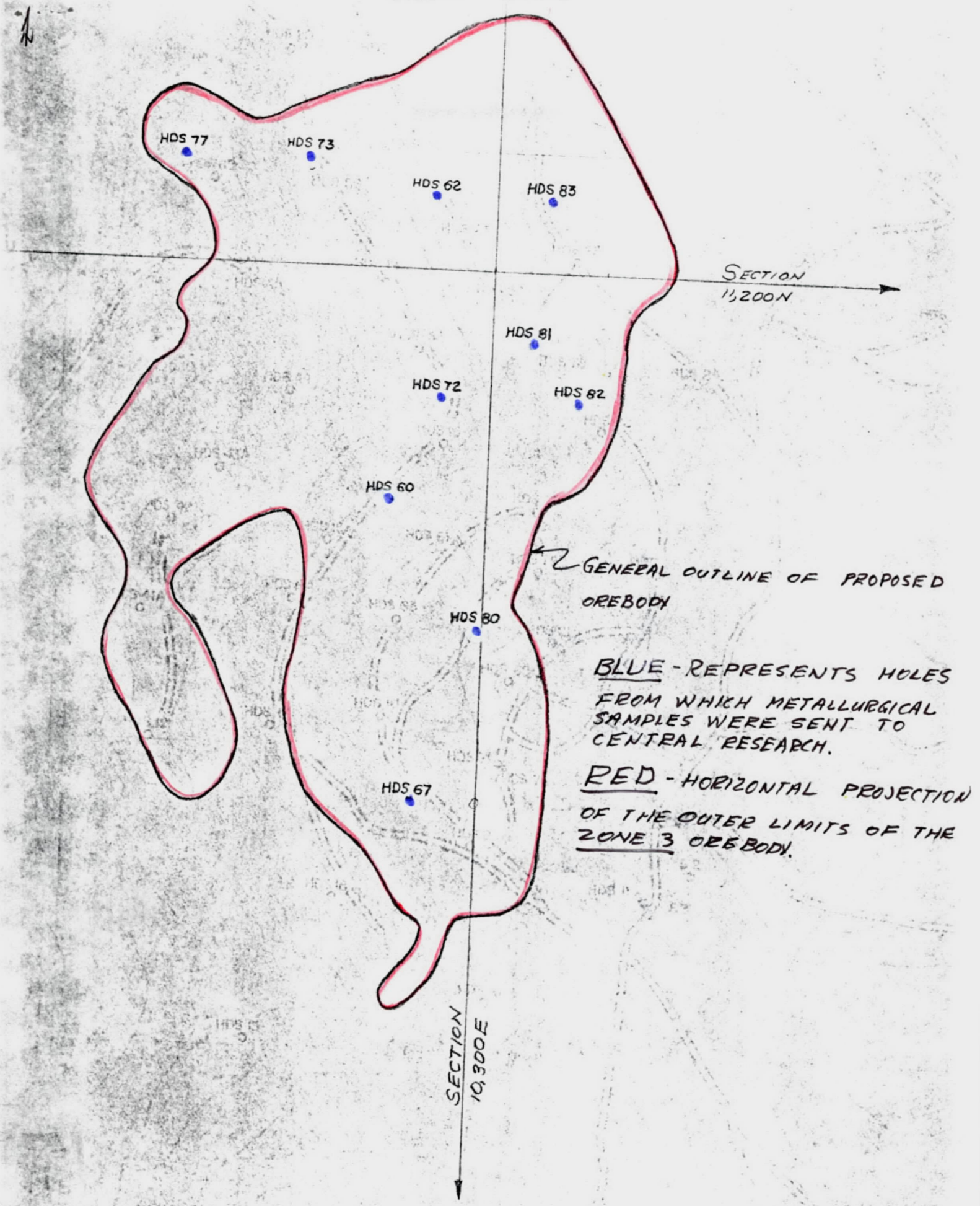


COMPOSITE OF
HORIZONTAL SECTIO
OF COMPUTER SECT
BY 20' ELEVATIONS
BEGIN 1 AT 5260
END 12 AT 5040

TAKEN FROM FILE
COPY COMPUTER
SHEETS 6/7/84 L.J.J.

27860

-876,200



mn 6022 dam 2-84

874800 875800 876800

6000+ 5800+ 5600+ 5400+ 5200+ 5000+ 4800+

COMPOSITE OF 11-100' E-W
COMPUTER SECTIONS
BEGIN 168,200N
END 167,100N

TAKEN FROM FILE COPY
OF COMPUTER SHEETS
6/7/84 L.J.J.

166700

167500

800+

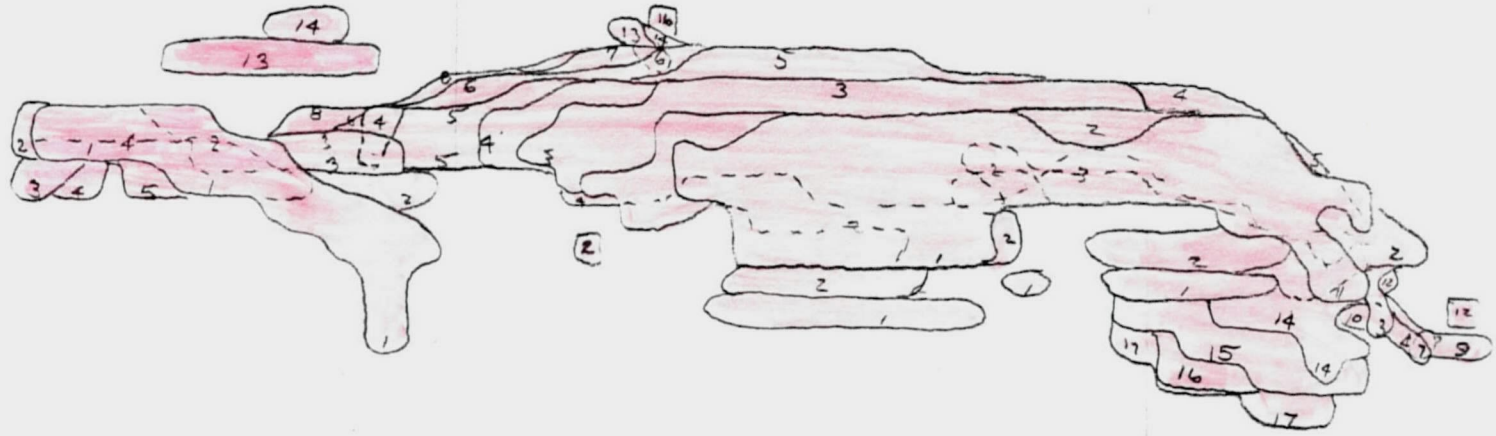
600+

400+

200+

000+

800+



COMPOSITE OF 17-50' N-S
COMPUTER SECTIONS
BEGIN 875,800 E
END 875,000 E

TAKEN FROM FILE COPY
OF COMPUTER SHEETS
6/7/84 L.J.J.

```
LIST DATA                    16
--------- FILE  A ---------   --------- FILE  B ---------

LINE  NAME  FIELDS   FROM  TO   LINE  NAME  FIELDS   FROM  TO

   1  D509     -16      1 412      1  P509     -16      1 356
   2  TOP      -16    413 434      2  C20      -16    357 739
   3  BASE     -16    435 456      3  TAA      -16    740 756
   4  REM      -16    457 628      4  BAA      -16    757 773
   5  T3        16    629 633      5                0      0   0
   6  B3        16    634 638      6                0      0   0
   7  T3I       16    639 643      7                0      0   0
   8  B3I       16    644 648      8                0      0   0
   9  NC20      16    649 675      9                0      0   0

 LOCATE FILE TO LIST ----------------------------------

ENTERED THIS VALUE          9

LOCATED /NC20/ IN FILE (A) WITH   16 FIELDS

 TOUCH FORMAT NUMBER, * TO LIST, ELSE 0 TO KEY FORMAT

ENTERED THIS VALUE          0

 TOUCH HOW MANY, BLOCK FROM START, REL POSITION, OR K
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 LIST BLOCK      649 TO BLOCK      675
ENTER A FORMAT FOR THE ABOVE RECORD OR ? FOR EXPLAN

>>>>> YOUR ANSWER IS:
DRIL

ENTER STARTING FIELD NUMBER,     NUMBER OF FIELDS CONTAINING DRILL NAME OR
OTHER IDENTIFER, AND A 0 THROUGH 5 FOR: 0-NEW PAGE OR 1-5 SKIPPED LINES
MINIMUM AND MAXIMUM RANGE =          0         16

>>>>> YOUR ANSWER IS:

4 2 2

ENTER A FORMAT FOR THE ABOVE RECORD OR ? FOR EXPLAN

>>>>> YOUR ANSWER IS:
HEAD

ENTER THE WIDTH OF EACH COLUMN EVEN THOUGH YOU MAY NOT TITLE IT, EX. IF YOU
WILL DISPLAY UNDER A FORMAT OF (X,3I8,X,2A4,4I5) ENTER: 9 8 8 5 4 5 5 5 5
THIS WILL CAUSE A DISPLAY OF:
*********_________********_____****_____*****_____*****# TO BE PLACED ON SCREEN
UNDER WHICH YOU WILL CENTER THE INDIVIDUAL COLUMN HEADINGS.

>>>>> YOUR ANSWER IS:

3*9 5 4 2*7 8*7 5

ENTER THE TOTAL NUMBER OF TITLE/COLUMN HEADING LINES
MINIMUM AND MAXIMUM RANGE =          1         19

>>>>> YOUR ANSWER IS:

7

ENTER A TITLE/COLUMN HEADING LINE - A '>' IN COL 1 WILL CENTER LINE
*********_________********_____****_______*******_______*******_______*******_______*******_______*******_____

>>>>> YOUR ANSWER IS:
>HARDSHELL PROJECT          MAY 29, 1984

*********_________********_____****_______*******_______*******_______*******_______*******_______*******_____

>>>>> YOUR ANSWER IS:
>ZONE THREE ( MN-LOW CARBONATE ) COMPOSITES

*********_________********_____****_______*******_______*******_______*******_______*******_______*******_____

>>>>> YOUR ANSWER IS:


*********_________********_____****_______*******_______*******_______*******_______*******_______*******_____

>>>>> YOUR ANSWER IS:
                  VERT DIST            ELEV   VERT                  DOWN

*********_________********_____****_______*******_______*******_______*******_______*******_______*******_____

>>>>> YOUR ANSWER IS:
                    BELOW              BASE   THICK                 HOLE

*********_________********_____****_______*******_______*******_______*******_______*******_______*******_____
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>>>>> YOUR ANSWER IS:
  NORTH     EAST  SURFACE  NAME       INTVL  INTVL  FROM     TO    INTVL    AG     MN    SIO2    CAO    AL2O3 ZONE
********_________********_____***_______*******_______*******_______*******_______*******_______*******_____

>>>>> YOUR ANSWER IS:

ENTER THE ACTUAL RECORD FORMAT AS: (1X,3I8,X,2A4,.... )

>>>>> YOUR ANSWER IS:
(3F9.1,X,2A4,5F7.1,5F7.2,F5)
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HARDSHELL PROJECT MAY 29, 1984
ZONE THREE (MN-LOW CARBONATE) COMPOSITES

NORTH	EAST	VERT DIST BELOW SURFACE	NAME	ELEV BASE INTVL	VERT THICK INTVL	FROM	TO	DOWN HOLE INTVL	AG	MN	SIO2	CAO	AL203	ZONE
168088.0	875020.6	0.0	HS5	4980.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
168080.6	875020.6	20.0	HS5	4960.9	20.0	180.0	201.3	21.3	12.15	0.0	0.0	0.0	0.0	3.
168073.4	875020.6	40.0	HS5	4940.9	20.0	201.3	222.6	21.3	3.46	0.0	0.0	0.0	0.0	3.
168066.1	875020.6	60.0	HS5	4920.9	20.0	222.6	243.9	21.3	3.84	0.0	0.0	0.0	0.0	3.
168058.8	875020.6	80.0	HS5	4900.9	20.0	243.9	265.2	21.3	6.21	0.0	0.0	0.0	0.0	3.
168051.6	875020.6	100.0	HS5	4880.9	20.0	265.2	286.4	21.3	4.88	0.0	0.0	0.0	0.0	3.
168044.2	875020.6	120.0	HS5	4860.9	20.0	286.4	307.7	21.3	5.85	0.0	0.0	0.0	0.0	3.
168037.0	875020.6	140.0	HS5	4840.9	20.0	307.7	329.0	21.3	10.03	0.0	0.0	0.0	0.0	3.
168036.7	875020.6	160.0	HS5	4839.9	1.0	329.0	330.0	1.0	0.0	0.0	0.0	0.0	0.0	3.
167807.4	875314.0	0.0	HS7	5071.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
167807.4	875314.0	20.0	HS7	5051.0	20.0	126.0	146.0	20.0	4.04	0.0	0.0	0.0	0.0	3.
167807.4	875314.0	40.0	HS7	5036.0	15.0	146.0	161.0	15.0	8.20	0.0	0.0	0.0	0.0	3.
167755.4	875049.3	0.0	HS8	5088.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
167755.4	875049.3	20.0	HS8	5068.0	20.0	137.0	157.0	20.0	1.15	0.0	0.0	0.0	0.0	3.
167755.4	875049.3	40.0	HS8	5048.0	20.0	157.0	177.0	20.0	0.68	0.0	0.0	0.0	0.0	3.
167755.4	875049.3	60.0	HS8	5028.0	20.0	177.0	197.0	20.0	1.93	0.0	0.0	0.0	0.0	3.
167755.4	875049.3	80.0	HS8	5018.0	10.0	197.0	207.0	10.0	1.68	0.0	0.0	0.0	0.0	3.
168117.7	875231.4	0.0	HS9	4996.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
168117.7	875231.4	20.0	HS9	4976.0	20.0	194.0	214.0	20.0	6.94	0.20	55.90	23.40	0.50	3.
168117.7	875231.4	40.0	HS9	4956.0	20.0	214.0	234.0	20.0	3.85	0.20	55.90	23.40	0.50	3.
168117.7	875231.4	60.0	HS9	4948.0	8.0	234.0	242.0	8.0	0.80	0.20	55.90	23.40	0.50	3.
166844.9	875722.3	0.0	HDS9	5168.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
166844.9	875722.3	20.0	HDS9	5148.0	20.0	290.0	310.0	20.0	2.44	0.05	92.50	0.10	1.15	3.
166844.9	875722.3	40.0	HDS9	5128.0	20.0	310.0	330.0	20.0	6.00	10.35	74.05	0.05	1.50	3.
166844.9	875722.3	60.0	HDS9	5108.0	20.0	330.0	350.0	20.0	12.66	15.25	69.15	0.05	1.95	3.
166844.9	875722.3	80.0	HDS9	5088.0	20.0	350.0	370.0	20.0	4.73	10.75	73.80	0.15	2.40	3.
166844.9	875722.3	100.0	HDS9	5068.0	20.0	370.0	390.0	20.0	0.73	1.60	88.80	0.10	2.00	3.
167055.5	875561.4	0.0	HDS10	5158.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
167055.5	875561.4	20.0	HDS10	5138.0	20.0	290.0	310.0	20.0	4.94	14.70	66.20	0.10	1.75	3.
167055.5	875561.4	40.0	HDS10	5118.0	20.0	310.0	330.0	20.0	4.02	16.70	64.60	0.30	1.50	3.
167055.5	875561.4	60.0	HDS10	5098.0	20.0	330.0	350.0	20.0	6.55	17.90	62.10	0.30	1.75	3.
167055.5	875561.4	80.0	HDS10	5078.0	20.0	350.0	370.0	20.0	3.48	7.80	78.35	0.55	1.20	3.
167055.5	875561.4	100.0	HDS10	5068.0	10.0	370.0	380.0	10.0	8.98	18.60	59.90	0.70	1.60	3.
167010.0	875171.5	0.0	HDS12	5232.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
167010.0	875171.5	20.0	HDS12	5212.0	20.0	50.0	70.0	20.0	8.22	13.50	61.00	0.10	6.90	3.
167010.0	875171.5	40.0	HDS12	5192.0	20.0	70.0	90.0	20.0	1.37	21.47	60.97	0.07	1.92	3.
167010.0	875171.5	60.0	HDS12	5172.0	20.0	90.0	110.0	20.0	1.15	16.00	69.87	0.12	0.92	3.
167010.0	875171.5	80.0	HDS12	5152.0	20.0	110.0	130.0	20.0	0.89	4.47	83.85	0.40	1.02	3.
167010.0	875171.5	100.0	HDS12	5132.0	20.0	130.0	150.0	20.0	0.69	2.90	87.52	0.32	1.02	3.
167010.0	875171.5	120.0	HDS12	5112.0	20.0	150.0	170.0	20.0	3.66	9.90	77.70	0.22	0.70	3.
167010.0	875171.5	140.0	HDS12	5092.0	20.0	170.0	190.0	20.0	0.76	2.87	85.72	0.57	1.65	3.

HARDSHELL PROJECT MAY 29, 1984
ZONE THREE (MN-LOW CARBONATE) COMPOSITES

NORTH	EAST	VERT DIST BELOW SURFACE	NAME	ELEV BASE INTVL	VERT THICK INTVL	FROM	TO	DOWN HOLE INTVL	AG	MN	SIO2	CAO	AL2O3	ZONE
167010.0	875171.5	160.0	HDS12	5087.0	5.0	190.0	195.0	5.0	0.27	1.30	84.90	1.40	2.60	3.
166511.4	875350.3	0.0	HDS13	5052.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
166511.4	875350.3	20.0	HDS13	5052.0	0.0	280.0	280.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
167348.9	875459.6	0.0	HDS15	5232.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
167348.9	875459.6	20.0	HDS15	5212.0	20.0	120.0	140.0	20.0	8.71	10.17	74.10	0.15	2.00	3.
167348.9	875459.6	40.0	HDS15	5192.0	20.0	140.0	160.0	20.0	1.97	4.45	84.55	0.17	1.95	3.
167248.7	875405.4	0.0	HDS15A	5242.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
167248.7	875405.4	20.0	HDS15A	5242.0	0.0	130.0	130.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
167513.8	875651.0	0.0	HDS16	5202.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
167513.8	875651.0	20.0	HDS16	5182.0	20.0	120.0	140.0	20.0	20.73	12.47	71.60	0.03	2.17	3.
167513.8	875651.0	40.0	HDS16	5162.0	20.0	140.0	160.0	20.0	16.85	21.17	59.05	0.10	1.13	3.
167513.8	875651.0	60.0	HDS16	5142.0	20.0	160.0	180.0	20.0	15.40	21.35	49.67	0.22	0.97	3.
167034.0	875377.8	0.0	HDS17	5169.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
167034.0	875377.8	20.0	HDS17	5149.0	20.0	220.0	240.0	20.0	1.31	13.00	51.42	0.22	9.02	3.
166750.6	875491.2	0.0	HDS18	5212.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
166750.6	875491.2	20.0	HDS18	5192.0	20.0	180.0	200.0	20.0	3.30	2.90	87.05	0.05	1.25	3.
166750.6	875491.2	40.0	HDS18	5172.0	20.0	200.0	220.0	20.0	1.15	1.65	89.20	0.05	0.75	3.
166750.6	875491.2	60.0	HDS18	5152.0	20.0	220.0	240.0	20.0	2.30	10.10	77.15	0.07	1.07	3.
166750.6	875491.2	80.0	HDS18	5132.0	20.0	240.0	260.0	20.0	3.86	25.95	42.45	0.07	1.22	3.
166750.6	875491.2	100.0	HDS18	5112.0	20.0	260.0	280.0	20.0	1.02	12.67	69.80	0.10	1.55	3.
166750.6	875491.2	120.0	HDS18	5092.0	20.0	280.0	300.0	20.0	0.33	3.42	85.35	0.17	1.05	3.
166750.6	875491.2	140.0	HDS18	5072.0	20.0	300.0	320.0	20.0	0.57	6.00	80.05	0.32	1.20	3.
166750.6	875491.2	160.0	HDS18	5052.0	20.0	320.0	340.0	20.0	0.53	10.92	71.32	0.70	1.57	3.
166750.6	875491.2	180.0	HDS18	5032.0	20.0	340.0	360.0	20.0	0.15	5.05	76.62	0.80	2.42	3.
166750.6	875491.2	200.0	HDS18	5012.0	20.0	360.0	380.0	20.0	0.12	0.95	83.50	0.25	5.00	3.
167788.2	875536.1	0.0	HDS19	5195.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
167788.2	875536.1	20.0	HDS19	5175.0	20.0	110.0	130.0	20.0	2.99	5.95	92.40	0.03	1.67	3.
167788.2	875536.1	40.0	HDS19	5155.0	20.0	130.0	150.0	20.0	11.55	8.12	79.63	0.03	1.60	3.
167788.2	875536.1	60.0	HDS19	5135.0	20.0	150.0	170.0	20.0	6.13	3.42	87.62	0.03	1.32	3.
167788.2	875536.1	80.0	HDS19	5115.0	20.0	170.0	190.0	20.0	9.86	9.90	78.35	0.03	1.60	3.
167788.2	875536.1	100.0	HDS19	5095.0	20.0	190.0	210.0	20.0	5.26	13.32	73.95	0.03	1.60	3.
167788.2	875536.1	120.0	HDS19	5075.0	20.0	210.0	230.0	20.0	1.47	10.62	75.67	0.12	1.87	3.
168164.4	875366.6	0.0	HDS20	4990.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
168164.4	875366.6	20.0	HDS20	4970.0	20.0	285.0	305.0	20.0	2.44	18.90	59.95	0.05	0.80	3.
168164.4	875366.6	40.0	HDS20	4950.0	20.0	305.0	325.0	20.0	0.82	10.92	76.35	0.13	1.02	3.
168164.4	875366.6	60.0	HDS20	4930.0	20.0	325.0	345.0	20.0	6.46	25.40	52.10	0.17	1.40	3.
168164.4	875366.6	80.0	HDS20	4910.0	20.0	345.0	365.0	20.0	5.67	21.90	56.85	0.20	2.22	3.
168164.4	875366.6	100.0	HDS20	4900.0	10.0	365.0	375.0	10.0	1.40	15.30	66.80	0.20	1.95	3.

HARDSHELL PROJECT MAY 29, 1984
ZONE THREE (MN-LOW CARBONATE) COMPOSITES

NORTH	EAST	VERT DIST BELOW SURFACE	NAME	ELEV BASE INTVL	VERT THICK INTVL	FROM	TO	DOWN HOLE INTVL	AG	MN	SIO2	CAO	AL2O3	ZONE
167191.2	875848.2	0.0	HDS21	4910.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
167191.2	875848.2	20.0	HDS21	4910.0	0.0	550.0	550.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
167545.7	875917.4	0.0	HDS22	5092.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
167545.7	875917.4	20.0	HDS22	5072.0	20.0	320.0	340.0	20.0	3.67	1.47	86.02	0.27	4.10	3.
167545.7	875917.4	40.0	HDS22	5052.0	20.0	340.0	360.0	20.0	5.20	8.52	72.30	0.47	4.40	3.
167545.7	875917.4	60.0	HDS22	5032.0	20.0	360.0	380.0	20.0	3.99	1.67	81.42	0.25	5.87	3.
167545.7	875917.4	80.0	HDS22	5012.0	20.0	380.0	400.0	20.0	3.15	3.20	77.80	0.10	6.22	3.
167545.7	875917.4	100.0	HDS22	4997.0	15.0	400.0	415.0	15.0	2.60	8.63	68.47	0.23	4.83	3.
167850.0	875676.0	0.0	HDS23	5192.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
167850.0	875676.0	20.0	HDS23	5172.0	20.0	200.0	220.0	20.0	15.49	21.15	59.37	0.0	2.17	3.
167850.0	875676.0	40.0	HDS23	5152.0	20.0	220.0	240.0	20.0	23.69	19.52	55.90	0.0	1.77	3.
167850.0	875676.0	60.0	HDS23	5132.0	20.0	240.0	260.0	20.0	16.91	26.07	36.12	0.0	1.12	3.
167850.0	875676.0	80.0	HDS23	5112.0	20.0	260.0	280.0	20.0	4.12	25.50	46.57	0.03	0.60	3.
167850.0	875676.0	100.0	HDS23	5092.0	20.0	280.0	300.0	20.0	2.42	23.37	54.20	0.07	0.63	3.
167850.0	875676.0	120.0	HDS23	5077.0	15.0	300.0	315.0	15.0	1.31	7.13	81.50	0.13	0.70	3.
167628.5	876073.5	0.0	HDS24	4710.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
167628.5	876073.5	20.0	HDS24	4710.0	0.0	759.0	759.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
167825.1	875866.2	0.0	HDS25	5073.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
167825.1	875866.2	20.0	HDS25	5053.0	20.0	395.0	415.0	20.0	4.69	0.0	0.0	0.0	0.0	3.
167825.1	875866.2	40.0	HDS25	5033.0	20.0	415.0	435.0	20.0	9.50	0.0	0.0	0.0	0.0	3.
167825.1	875866.2	60.0	HDS25	5013.0	20.0	435.0	455.0	20.0	3.69	0.0	0.0	0.0	0.0	3.
167825.1	875866.2	80.0	HDS25	4993.0	20.0	455.0	475.0	20.0	2.43	0.0	0.0	0.0	0.0	3.
167825.1	875866.2	100.0	HDS25	4983.0	10.0	475.0	485.0	10.0	1.63	0.0	0.0	0.0	0.0	3.
169147.4	875530.0	0.0	HDS30	4989.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
169147.4	875530.0	20.0	HDS30	4969.0	20.0	360.0	380.0	20.0	1.77	0.0	0.0	0.0	0.0	3.
169147.4	875530.0	40.0	HDS30	4949.0	20.0	380.0	400.0	20.0	2.56	0.0	0.0	0.0	0.0	3.
169147.4	875530.0	60.0	HDS30	4929.0	20.0	400.0	420.0	20.0	1.04	0.0	0.0	0.0	0.0	3.
166585.1	875757.0	0.0	HDS31	4986.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
166585.1	875757.0	20.0	HDS31	4966.0	20.0	456.0	476.0	20.0	5.29	0.0	0.0	0.0	0.0	3.
166585.1	875757.0	40.0	HDS31	4946.0	20.0	476.0	496.0	20.0	1.39	0.0	0.0	0.0	0.0	3.
166585.1	875757.0	60.0	HDS31	4926.0	20.0	496.0	516.0	20.0	0.56	0.0	0.0	0.0	0.0	3.
166585.1	875757.0	80.0	HDS31	4906.0	20.0	516.0	536.0	20.0	0.22	0.0	0.0	0.0	0.0	3.
166585.1	875757.0	100.0	HDS31	4892.0	14.0	536.0	550.0	14.0	0.08	0.0	0.0	0.0	0.0	3.
168121.0	875803.4	0.0	HDS40	5071.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
168121.0	875803.4	20.0	HDS40	5051.0	20.0	400.0	420.0	20.0	24.34	23.60	53.60	0.0	5.80	3.
168121.0	875803.4	40.0	HDS40	5031.0	20.0	420.0	440.0	20.0	4.45	15.90	70.62	0.0	0.97	3.
168121.0	875803.4	60.0	HDS40	5011.0	20.0	440.0	460.0	20.0	6.80	21.27	61.52	0.22	1.00	3.
168121.0	875803.4	80.0	HDS40	4991.0	20.0	460.0	480.0	20.0	0.95	32.00	49.57	0.20	0.57	3.
168121.0	875803.4	100.0	HDS40	4971.0	20.0	480.0	500.0	20.0	4.92	32.00	45.92	0.25	0.62	3.

HARDSHELL PROJECT MAY 29, 1984
ZONE THREE (MN-LOW CARBONATE) COMPOSITES

NORTH	EAST	VERT DIST BELOW SURFACE	NAME	ELEV BASE INTVL	VERT THICK INTVL	FROM	TO	DOWN HOLE INTVL	AG	MN	SIO2	CAO	AL2O3	ZONE
169121.0	875903.4	120.0	HDS40	4951.0	20.0	500.0	520.0	20.0	9.13	33.57	39.70	0.45	0.62	3.
169121.0	875903.4	140.0	HDS40	4931.0	20.0	520.0	540.0	20.0	2.16	32.40	43.22	0.32	0.62	3.
169121.0	875903.4	160.0	HDS40	4911.0	20.0	540.0	560.0	20.0	1.65	27.60	52.62	0.42	0.57	3.
167223.1	875148.8	0.0	HDS41A	5262.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
167223.1	875148.8	20.0	HDS41A	5242.0	20.0	0.0	20.0	20.0	4.66	13.50	68.82	0.25	3.02	3.
167223.1	875148.8	40.0	HDS41A	5222.0	20.0	20.0	40.0	20.0	1.69	14.30	72.22	0.07	1.05	3.
167223.1	875148.8	60.0	HDS41A	5202.0	20.0	40.0	60.0	20.0	1.20	9.47	78.17	0.12	0.95	3.
167223.1	875148.8	80.0	HDS41A	5197.0	5.0	60.0	65.0	5.0	2.65	32.10	44.30	0.10	0.90	3.
167373.4	875196.2	0.0	HDS42	5240.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
167373.4	875196.2	20.0	HDS42	5220.0	20.0	0.0	20.0	20.0	7.31	12.72	70.20	0.07	3.67	3.
167373.4	875196.2	40.0	HDS42	5200.0	20.0	20.0	40.0	20.0	1.82	17.77	66.77	0.05	1.37	3.
167373.4	875196.2	60.0	HDS42	5180.0	20.0	40.0	60.0	20.0	1.69	20.17	63.60	0.07	1.10	3.
167373.4	875196.2	80.0	HDS42	5160.0	20.0	60.0	80.0	20.0	1.45	17.35	68.10	0.10	1.32	3.
167373.4	875196.2	100.0	HDS42	5150.0	10.0	80.0	90.0	10.0	0.90	10.65	75.05	0.10	1.20	3.
167462.7	875275.9	0.0	HDS43A	5180.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
167462.7	875275.9	20.0	HDS43A	5160.0	20.0	55.0	75.0	20.0	11.31	16.95	65.42	0.27	1.22	3.
167462.7	875275.9	40.0	HDS43A	5150.0	10.0	75.0	85.0	10.0	2.96	8.90	79.90	0.15	1.00	3.
167596.7	875389.7	0.0	HDS44	5178.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
167596.7	875389.7	20.0	HDS44	5158.0	20.0	40.0	60.0	20.0	6.92	0.0	0.0	0.0	0.0	3.
167596.7	875389.7	40.0	HDS44	5138.0	20.0	60.0	80.0	20.0	8.44	0.0	0.0	0.0	0.0	3.
167596.7	875389.7	60.0	HDS44	5128.0	10.0	80.0	90.0	10.0	3.03	0.0	0.0	0.0	0.0	3.
167791.8	875319.7	0.0	HDS45	5073.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
167791.8	875319.7	20.0	HDS45	5053.0	20.0	125.0	145.0	20.0	5.56	6.00	84.90	0.05	1.27	3.
167791.8	875319.7	40.0	HDS45	5043.0	10.0	145.0	155.0	10.0	0.44	1.05	91.20	0.10	1.25	3.
167502.3	874822.4	0.0	HDS46	5183.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
167502.3	874822.4	20.0	HDS46	5163.0	20.0	75.0	95.0	20.0	1.14	5.05	71.65	0.27	2.42	3.
167502.3	874822.4	40.0	HDS46	5143.0	20.0	95.0	115.0	20.0	0.46	5.45	83.92	0.15	1.25	3.
167502.3	874822.4	60.0	HDS46	5138.0	5.0	115.0	120.0	5.0	1.32	3.40	85.70	0.30	1.20	3.
168367.0	875662.9	0.0	HDS47	4928.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
168367.0	875662.9	20.0	HDS47	4908.0	20.0	510.0	530.0	20.0	2.29	3.87	84.92	0.10	2.37	3.
168367.0	875662.9	40.0	HDS47	4888.0	20.0	530.0	550.0	20.0	3.28	7.62	81.55	0.07	1.52	3.
168367.0	875662.9	60.0	HDS47	4868.0	20.0	550.0	570.0	20.0	1.84	21.07	62.22	0.10	1.62	3.
168367.0	875662.9	80.0	HDS47	4848.0	20.0	570.0	590.0	20.0	1.85	25.00	56.55	0.10	1.02	3.
169002.1	874822.8	0.0	HDS50	4875.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
169002.1	874822.8	20.0	HDS50	4855.0	20.0	410.0	430.0	20.0	1.36	4.67	82.20	0.80	2.45	3.
169002.1	874822.8	40.0	HDS50	4850.0	5.0	430.0	435.0	5.0	2.20	6.30	75.60	0.50	4.70	3.

HARDSHELL PROJECT MAY 29, 1984
ZONE THREE (MN-LOW CARBONATE) COMPOSITES

NORTH	EAST	VERT DIST BELOW SURFACE	NAME	ELEV BASE INTVL	VERT THICK INTVL	FROM	TO	DOWN HOLE INTVL	AG	MN	SIO2	CAO	AL2O3	ZONE
167671.1	875603.6	0.0	HDS52	5228.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
167671.1	875603.6	20.0	HDS52	5208.0	20.0	90.0	110.0	20.0	5.89	0.0	0.0	0.0	0.0	3.
167671.1	875603.6	40.0	HDS52	5188.0	20.0	110.0	130.0	20.0	7.06	0.0	0.0	0.0	0.0	3.
167671.1	875603.6	60.0	HDS52	5168.0	20.0	130.0	150.0	20.0	14.27	0.0	0.0	0.0	0.0	3.
167671.1	875603.6	80.0	HDS52	5148.0	20.0	150.0	170.0	20.0	19.37	0.0	0.0	0.0	0.0	3.
167671.1	875603.6	100.0	HDS52	5128.0	20.0	170.0	190.0	20.0	11.48	0.0	0.0	0.0	0.0	3.
167671.1	875603.6	120.0	HDS52	5108.0	20.0	190.0	210.0	20.0	14.16	0.0	0.0	0.0	0.0	3.
167671.1	875603.6	140.0	HDS52	5103.0	5.0	210.0	215.0	5.0	8.23	0.0	0.0	0.0	0.0	3.
168205.7	875751.7	0.0	HDS56	5036.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
168205.7	875751.7	20.0	HDS56	5016.0	20.0	420.0	440.0	20.0	6.02	16.92	67.55	0.0	0.72	3.
168205.7	875751.7	40.0	HDS56	5001.0	15.0	440.0	455.0	15.0	4.82	18.90	64.10	0.0	0.50	3.
167751.9	875739.7	0.0	HDS57	5153.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
167751.9	875739.7	20.0	HDS57	5133.0	20.0	245.0	265.0	20.0	36.93	17.65	63.95	0.0	2.27	3.
167751.9	875739.7	40.0	HDS57	5113.0	20.0	265.0	285.0	20.0	6.56	8.67	78.72	0.0	1.22	3.
167751.9	875739.7	60.0	HDS57	5093.0	20.0	285.0	305.0	20.0	1.66	11.90	73.73	0.0	1.20	3.
167751.9	875739.7	80.0	HDS57	5073.0	20.0	305.0	325.0	20.0	1.41	7.45	78.62	0.30	1.30	3.
167751.9	875739.7	100.0	HDS57	5058.0	15.0	325.0	340.0	15.0	1.71	3.13	84.43	0.17	1.47	3.
167640.8	875838.7	0.0	HDS58	5138.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
167640.8	875838.7	20.0	HDS58	5118.0	20.0	275.0	295.0	20.0	4.98	3.72	82.77	0.0	2.75	3.
167640.8	875838.7	40.0	HDS58	5098.0	20.0	295.0	315.0	20.0	9.76	6.67	82.00	0.0	1.55	3.
167640.8	875838.7	60.0	HDS58	5078.0	20.0	315.0	335.0	20.0	6.51	5.60	84.15	0.0	1.22	3.
167640.8	875838.7	80.0	HDS58	5058.0	20.0	335.0	355.0	20.0	12.07	14.02	69.20	0.07	1.45	3.
167640.8	875838.7	100.0	HDS58	5038.0	20.0	355.0	375.0	20.0	11.99	13.47	69.80	0.17	2.05	3.
167640.8	875838.7	120.0	HDS58	5018.0	20.0	375.0	395.0	20.0	25.13	20.27	59.67	0.32	1.20	3.
167640.8	875838.7	140.0	HDS58	4998.0	20.0	395.0	415.0	20.0	17.48	14.75	64.20	0.22	3.65	3.
167640.8	875838.7	160.0	HDS58	4978.0	20.0	415.0	435.0	20.0	2.90	4.20	77.60	0.05	4.92	3.
167921.7	875456.9	0.0	HDS59	5083.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
167921.7	875456.9	20.0	HDS59	5063.0	20.0	210.0	230.0	20.0	9.37	0.0	0.0	0.0	0.0	3.
167921.7	875456.9	40.0	HDS59	5043.0	20.0	230.0	250.0	20.0	15.50	0.0	0.0	0.0	0.0	3.
167921.7	875456.9	60.0	HDS59	5023.0	20.0	250.0	270.0	20.0	3.66	0.0	0.0	0.0	0.0	3.
167921.7	875456.9	80.0	HDS59	5003.0	20.0	270.0	290.0	20.0	1.91	0.0	0.0	0.0	0.0	3.
167921.7	875456.9	100.0	HDS59	4983.0	20.0	290.0	310.0	20.0	0.78	0.0	0.0	0.0	0.0	3.
167921.7	875456.9	120.0	HDS59	4963.0	20.0	310.0	330.0	20.0	1.30	0.0	0.0	0.0	0.0	3.
167921.7	875456.9	140.0	HDS59	4958.0	5.0	330.0	335.0	5.0	0.72	0.0	0.0	0.0	0.0	3.
167420.3	875566.9	0.0	HDS60	5228.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
167420.3	875566.9	20.0	HDS60	5208.0	20.0	120.0	140.0	20.0	8.45	8.80	79.32	0.0	0.85	3.
167420.3	875566.9	40.0	HDS60	5188.0	20.0	140.0	160.0	20.0	4.92	13.90	73.45	0.0	1.12	3.
167420.3	875566.9	60.0	HDS60	5168.0	20.0	160.0	180.0	20.0	7.25	14.95	73.75	0.0	0.70	3.
167420.3	875566.9	80.0	HDS60	5148.0	20.0	180.0	200.0	20.0	3.07	7.45	82.77	0.03	0.80	3.
167420.3	875566.9	100.0	HDS60	5128.0	20.0	200.0	220.0	20.0	4.71	13.05	74.12	0.07	0.75	3.
167420.3	875566.9	120.0	HDS60	5108.0	20.0	220.0	240.0	20.0	3.57	16.37	70.12	0.07	0.75	3.
167420.3	875566.9	140.0	HDS60	5093.0	15.0	240.0	255.0	15.0	3.09	18.63	65.53	0.10	0.63	3.

HARDSHELL PROJECT MAY 29, 1984
ZONE THREE (MN-LOW CARBONATE) COMPOSITES

NORTH	EAST	VERT DIST BELOW SURFACE	NAME	ELEV BASE INTVL	VERT THICK INTVL	FROM	TO	DOWN HOLE INTVL	AG	MN	SIO2	CAO	AL2O3	ZONE
167339.8	875638.9	0.0	HDS61	5182.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
167339.8	875638.9	20.0	HDS61	5162.0	20.0	220.0	240.0	20.0	16.22	6.77	84.10	0.0	0.85	3.
167339.8	875638.9	40.0	HDS61	5142.0	20.0	240.0	260.0	20.0	17.86	16.05	70.02	0.0	0.75	3.
167339.8	875638.9	60.0	HDS61	5122.0	20.0	260.0	280.0	20.0	6.11	10.30	77.60	0.03	0.95	3.
167339.8	875638.9	80.0	HDS61	5102.0	20.0	280.0	300.0	20.0	5.91	19.72	51.30	0.03	0.97	3.
167339.8	875638.9	100.0	HDS61	5082.0	20.0	300.0	320.0	20.0	6.19	17.70	63.40	0.07	0.97	3.
167339.8	875638.9	120.0	HDS61	5072.0	10.0	320.0	330.0	10.0	5.02	13.90	70.00	0.10	1.05	3.
167929.0	875626.5	0.0	HDS62	5167.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
167929.0	875626.5	20.0	HDS62	5147.0	20.0	220.0	240.0	20.0	2.57	3.52	86.35	0.0	1.10	3.
167929.0	875626.5	40.0	HDS62	5127.0	20.0	240.0	260.0	20.0	11.69	16.47	67.97	0.0	1.50	3.
167929.0	875626.5	60.0	HDS62	5107.0	20.0	260.0	280.0	20.0	8.76	20.45	62.52	0.03	1.07	3.
167929.0	875626.5	80.0	HDS62	5087.0	20.0	280.0	300.0	20.0	5.93	13.57	72.20	0.03	0.70	3.
167929.0	875626.5	100.0	HDS62	5067.0	20.0	300.0	320.0	20.0	6.27	7.65	83.50	0.0	0.67	3.
167929.0	875626.5	120.0	HDS62	5047.0	20.0	320.0	340.0	20.0	6.26	7.15	80.70	0.05	0.95	3.
167929.0	875626.5	140.0	HDS62	5027.0	20.0	340.0	360.0	20.0	5.12	9.60	80.60	0.05	0.82	3.
167929.0	875626.5	160.0	HDS62	5007.0	20.0	360.0	380.0	20.0	1.62	7.80	79.22	1.80	0.97	3.
167929.0	875626.5	180.0	HDS62	5002.0	5.0	380.0	385.0	5.0	0.81	1.20	91.60	0.20	1.00	3.
167219.1	875581.2	0.0	HDS63	5180.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
167219.1	875581.2	20.0	HDS63	5160.0	20.0	240.0	260.0	20.0	6.20	4.45	88.32	0.0	0.77	3.
167219.1	875581.2	40.0	HDS63	5140.0	20.0	260.0	280.0	20.0	7.90	7.60	84.22	0.0	0.57	3.
167219.1	875581.2	60.0	HDS63	5120.0	20.0	280.0	300.0	20.0	15.75	10.63	80.20	0.03	0.65	3.
167219.1	875581.2	80.0	HDS63	5100.0	20.0	300.0	320.0	20.0	2.59	4.00	82.12	0.25	1.22	3.
167219.1	875581.2	100.0	HDS63	5080.0	20.0	320.0	340.0	20.0	3.02	9.95	79.07	0.22	0.82	3.
167219.1	875581.2	120.0	HDS63	5060.0	20.0	340.0	360.0	20.0	1.33	12.57	74.92	0.25	0.85	3.
167219.1	875581.2	140.0	HDS63	5040.0	20.0	360.0	380.0	20.0	1.07	7.77	80.97	0.32	0.77	3.
167219.1	875581.2	160.0	HDS63	5020.0	20.0	380.0	400.0	20.0	1.07	8.45	79.80	0.22	1.02	3.
167219.1	875581.2	180.0	HDS63	5010.0	10.0	400.0	410.0	10.0	1.32	16.90	64.85	0.25	1.35	3.
167995.1	875761.6	0.0	HDS64	5173.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
167995.1	875761.6	20.0	HDS64	5153.0	20.0	295.0	315.0	20.0	35.97	15.17	69.77	0.0	1.45	3.
167995.1	875761.6	40.0	HDS64	5133.0	20.0	315.0	335.0	20.0	21.59	26.02	47.87	0.0	1.50	3.
167995.1	875761.6	60.0	HDS64	5113.0	20.0	335.0	355.0	20.0	5.44	22.17	48.05	0.0	1.02	3.
167995.1	875761.6	80.0	HDS64	5093.0	20.0	355.0	375.0	20.0	7.88	19.92	61.40	0.03	1.02	3.
167995.1	875761.6	100.0	HDS64	5073.0	20.0	375.0	395.0	20.0	10.18	21.37	56.10	0.05	1.30	3.
167995.1	875761.6	120.0	HDS64	5053.0	20.0	395.0	415.0	20.0	2.18	21.95	56.47	0.0	1.20	3.
167995.1	875761.6	140.0	HDS64	5033.0	20.0	415.0	435.0	20.0	3.45	23.30	48.25	0.15	1.17	3.
167995.1	875761.6	160.0	HDS64	5013.0	20.0	435.0	455.0	20.0	6.55	14.55	71.25	0.15	0.87	3.
167995.1	875761.6	180.0	HDS64	5003.0	10.0	455.0	465.0	10.0	6.37	21.60	56.45	0.20	1.10	3.
167946.3	875246.3	0.0	HDS65	5059.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
167946.3	875246.3	20.0	HDS65	5039.0	20.0	125.0	145.0	20.0	1.99	7.60	79.38	1.22	1.25	3.
167946.3	875246.3	40.0	HDS65	5019.0	20.0	145.0	165.0	20.0	0.39	1.50	89.85	0.80	1.20	3.
167946.3	875246.3	60.0	HDS65	5014.0	5.0	165.0	170.0	5.0	0.27	1.40	91.50	0.50	1.10	3.
168243.9	875257.1	0.0	HDS66	4920.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
168243.9	875257.1	20.0	HDS66	4900.0	20.0	325.0	345.0	20.0	6.26	18.13	67.92	0.07	0.95	3.

HARDSHELL PROJECT MAY 29, 1984
ZONE THREE (MN-LOW CARBONATE) COMPOSITES

NORTH	EAST	VERT DIST BELOW SURFACE	NAME	ELEV BASE INTVL	VERT THICK INTVL	FROM	TO	DOWN HOLE INTVL	AG	MN	SIO2	CAO	AL2O3	ZONE
168243.9	875257.1	40.0	HDS66	4880.0	20.0	345.0	365.0	20.0	1.98	20.95	64.32	0.07	0.97	3.
168243.9	875257.1	60.0	HDS66	4860.0	20.0	365.0	385.0	20.0	1.11	26.02	56.82	0.12	1.17	3.
168243.9	875257.1	80.0	HDS66	4840.0	20.0	385.0	405.0	20.0	0.61	8.87	77.67	0.22	2.22	3.
168243.9	875257.1	100.0	HDS66	4835.0	5.0	405.0	410.0	5.0	1.09	14.20	67.40	0.50	3.20	3.
166915.5	875615.4	0.0	HDS67	5148.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
166915.5	875615.4	20.0	HDS67	5128.0	20.0	305.0	325.0	20.0	0.88	0.0	0.0	0.0	0.0	3.
166915.5	875615.4	40.0	HDS67	5108.0	20.0	325.0	345.0	20.0	2.30	0.0	0.0	0.0	0.0	3.
166915.5	875615.4	60.0	HDS67	5088.0	20.0	345.0	365.0	20.0	4.38	0.0	0.0	0.0	0.0	3.
166915.5	875615.4	80.0	HDS67	5068.0	20.0	365.0	385.0	20.0	9.33	0.0	0.0	0.0	0.0	3.
166915.5	875615.4	100.0	HDS67	5048.0	20.0	385.0	405.0	20.0	4.78	0.0	0.0	0.0	0.0	3.
166915.5	875615.4	120.0	HDS67	5028.0	20.0	405.0	425.0	20.0	2.85	0.0	0.0	0.0	0.0	3.
166915.5	875615.4	140.0	HDS67	5013.0	15.0	425.0	440.0	15.0	0.82	0.0	0.0	0.0	0.0	3.
167124.1	875773.5	0.0	HDS69	5063.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
167124.1	875773.5	20.0	HDS69	5043.0	20.0	405.0	425.0	20.0	20.64	6.07	77.40	0.20	3.87	3.
167124.1	875773.5	40.0	HDS69	5023.0	20.0	425.0	445.0	20.0	0.86	0.77	81.77	0.45	6.37	3.
167124.1	875773.5	60.0	HDS69	5003.0	20.0	445.0	465.0	20.0	0.91	2.17	74.10	0.45	8.45	3.
167124.1	875773.5	80.0	HDS69	4993.0	10.0	465.0	475.0	10.0	0.73	1.55	77.20	0.45	7.60	3.
168305.7	875722.2	0.0	HDS70	4942.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
168305.7	875722.2	20.0	HDS70	4922.0	20.0	505.0	525.0	20.0	1.02	13.30	74.55	0.37	0.85	3.
168305.7	875722.2	40.0	HDS70	4902.0	20.0	525.0	545.0	20.0	1.23	0.0	0.0	0.0	0.0	3.
168305.7	875722.2	60.0	HDS70	4882.0	20.0	545.0	565.0	20.0	1.40	0.0	0.0	0.0	0.0	3.
168305.7	875722.2	80.0	HDS70	4862.0	20.0	565.0	585.0	20.0	0.92	0.0	0.0	0.0	0.0	3.
168305.7	875722.2	100.0	HDS70	4842.0	20.0	585.0	605.0	20.0	0.97	0.0	0.0	0.0	0.0	3.
168305.7	875722.2	120.0	HDS70	4822.0	20.0	605.0	625.0	20.0	0.93	0.0	0.0	0.0	0.0	3.
168305.7	875722.2	140.0	HDS70	4802.0	20.0	625.0	645.0	20.0	0.38	0.0	0.0	0.0	0.0	3.
168305.7	875722.2	160.0	HDS70	4797.0	5.0	645.0	650.0	5.0	0.20	0.0	0.0	0.0	0.0	3.
167591.6	875643.5	0.0	HDS72	5201.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
167591.6	875643.5	20.0	HDS72	5181.0	20.0	120.0	140.0	20.0	31.80	14.75	63.17	0.07	1.65	3.
167591.6	875643.5	40.0	HDS72	5161.0	20.0	140.0	160.0	20.0	10.75	26.27	47.37	0.03	1.57	3.
167591.6	875643.5	60.0	HDS72	5141.0	20.0	160.0	180.0	20.0	12.66	31.82	34.10	0.07	0.65	3.
167591.6	875643.5	80.0	HDS72	5121.0	20.0	180.0	200.0	20.0	16.55	27.70	45.40	0.10	0.85	3.
167591.6	875643.5	100.0	HDS72	5111.0	10.0	200.0	210.0	10.0	7.25	23.75	57.20	0.10	0.80	3.
167983.3	875412.0	0.0	HDS73	5052.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
167983.3	875412.0	20.0	HDS73	5032.0	20.0	230.0	250.0	20.0	16.36	18.47	61.17	0.10	1.00	3.
167983.3	875412.0	40.0	HDS73	5012.0	20.0	250.0	270.0	20.0	8.82	16.20	64.90	0.12	0.77	3.
167983.3	875412.0	60.0	HDS73	4992.0	20.0	270.0	290.0	20.0	4.33	9.50	78.40	0.10	0.72	3.
167983.3	875412.0	80.0	HDS73	4982.0	10.0	290.0	300.0	10.0	0.74	10.40	74.95	0.95	1.50	3.
167989.1	875590.6	0.0	HDS74	5165.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
167989.1	875590.6	20.0	HDS74	5145.0	20.0	220.0	240.0	20.0	8.77	7.70	75.32	0.0	1.65	3.
167989.1	875590.6	40.0	HDS74	5125.0	20.0	240.0	260.0	20.0	6.30	12.62	70.20	0.05	1.15	3.
167989.1	875590.6	60.0	HDS74	5105.0	20.0	260.0	280.0	20.0	2.29	13.52	70.67	0.05	1.02	3.

HARDSHELL PROJECT MAY 29, 1984
ZONE THREE (MN-LOW CARBONATE) COMPOSITES

NORTH	EAST	VERT DIST BELOW SURFACE	NAME	ELEV BASE INTVL	VERT THICK INTVL	FROM	TO	DOWN HOLE INTVL	AG	MN	SIO2	CAO	AL2O3	ZONE
167989.1	875590.6	80.0	HDS74	5085.0	20.0	280.0	300.0	20.0	1.58	11.75	74.25	0.03	1.10	3.
167989.1	875590.6	100.0	HDS74	5065.0	20.0	300.0	320.0	20.0	2.76	19.35	60.32	0.0	0.92	3.
167989.1	875590.6	120.0	HDS74	5045.0	20.0	320.0	340.0	20.0	2.51	24.95	53.27	0.05	0.62	3.
167989.1	875590.6	140.0	HDS74	5025.0	20.0	340.0	360.0	20.0	4.13	29.92	46.65	0.10	0.60	3.
167989.1	875590.6	160.0	HDS74	5005.0	20.0	360.0	380.0	20.0	1.40	15.88	69.45	0.15	0.63	3.
168010.4	875811.8	0.0	HDS75	5120.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
168010.4	875811.8	20.0	HDS75	5100.0	20.0	350.0	370.0	20.0	15.66	3.62	77.00	0.05	3.07	3.
168010.4	875811.8	40.0	HDS75	5080.0	20.0	370.0	390.0	20.0	56.12	15.47	58.52	3.42	2.20	3.
168010.4	875811.8	60.0	HDS75	5060.0	20.0	390.0	410.0	20.0	4.60	17.07	65.45	0.07	1.55	3.
168010.4	875811.8	80.0	HDS75	5040.0	20.0	410.0	430.0	20.0	3.99	26.20	52.10	0.0	1.10	3.
167983.4	875196.2	0.0	HDS77	5066.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
167983.4	875196.2	20.0	HDS77	5046.0	20.0	115.0	135.0	20.0	12.09	7.42	76.63	0.0	1.17	3.
167983.4	875196.2	40.0	HDS77	5026.0	20.0	135.0	155.0	20.0	2.04	0.67	86.93	0.10	1.00	3.
167309.0	875817.7	0.0	HDS79	5048.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
167309.0	875817.7	20.0	HDS79	5028.0	20.0	370.0	390.0	20.0	1.22	3.25	73.75	1.15	6.38	3.
167204.5	875720.4	0.0	HDS80	5147.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
167204.5	875720.4	20.0	HDS80	5127.0	20.0	295.0	315.0	20.0	2.80	3.15	76.97	0.25	5.35	3.
167204.5	875720.4	40.0	HDS80	5107.0	20.0	315.0	335.0	20.0	1.80	4.25	80.15	0.40	1.97	3.
167204.5	875720.4	60.0	HDS80	5087.0	20.0	335.0	355.0	20.0	0.97	2.70	84.35	0.27	1.10	3.
167204.5	875720.4	80.0	HDS80	5067.0	20.0	355.0	375.0	20.0	0.78	7.50	77.45	0.20	0.92	3.
167204.5	875720.4	100.0	HDS80	5047.0	20.0	375.0	395.0	20.0	6.53	15.25	62.42	0.67	1.38	3.
167204.5	875720.4	120.0	HDS80	5027.0	20.0	395.0	415.0	20.0	1.93	2.55	79.37	1.10	3.07	3.
167204.5	875720.4	140.0	HDS80	5007.0	20.0	415.0	435.0	20.0	0.51	1.12	80.52	0.42	5.05	3.
167685.6	875794.8	0.0	HDS81	5134.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
167685.6	875794.8	20.0	HDS81	5114.0	20.0	270.0	290.0	20.0	9.45	3.85	82.75	0.0	3.63	3.
167685.6	875794.8	40.0	HDS81	5094.0	20.0	290.0	310.0	20.0	17.12	9.77	77.62	0.0	1.80	3.
167685.6	875794.8	60.0	HDS81	5074.0	20.0	310.0	330.0	20.0	9.62	8.17	80.07	0.03	1.17	3.
167685.6	875794.8	80.0	HDS81	5054.0	20.0	330.0	350.0	20.0	4.62	10.90	74.30	0.10	1.35	3.
167685.6	875794.8	100.0	HDS81	5034.0	20.0	350.0	370.0	20.0	4.04	9.60	76.22	0.20	1.42	3.
167587.3	875874.1	0.0	HDS82	5127.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
167587.3	875874.1	20.0	HDS82	5107.0	20.0	290.0	310.0	20.0	9.39	8.35	71.85	0.10	4.35	3.
167587.3	875874.1	40.0	HDS82	5087.0	20.0	310.0	330.0	20.0	12.01	15.25	66.67	0.10	2.50	3.
167587.3	875874.1	60.0	HDS82	5067.0	20.0	330.0	350.0	20.0	10.40	19.42	61.77	0.17	1.25	3.
167587.3	875874.1	80.0	HDS82	5047.0	20.0	350.0	370.0	20.0	8.00	17.22	62.22	0.22	1.17	3.
167587.3	875874.1	100.0	HDS82	5027.0	20.0	370.0	390.0	20.0	2.23	4.75	74.80	1.37	2.67	3.
167587.3	875874.1	120.0	HDS82	5007.0	20.0	390.0	410.0	20.0	1.32	2.15	76.25	0.85	4.52	3.
167587.3	875874.1	140.0	HDS82	4987.0	20.0	410.0	430.0	20.0	1.09	4.07	72.67	0.25	5.80	3.
167587.3	875874.1	160.0	HDS82	4967.0	20.0	430.0	450.0	20.0	1.63	2.95	75.50	0.20	6.82	3.
167587.3	875874.1	180.0	HDS82	4947.0	20.0	450.0	470.0	20.0	4.73	24.30	47.42	0.20	3.72	3.
167587.3	875874.1	200.0	HDS82	4927.0	20.0	470.0	490.0	20.0	10.16	28.47	35.35	0.75	2.45	3.
167587.3	875874.1	220.0	HDS82	4917.0	10.0	490.0	500.0	10.0	1.20	17.40	60.10	0.80	1.50	3.

HARDSHELL PROJECT MAY 29, 1984
ZONE THREE (MN-LOW CARBONATE) COMPOSITES

NORTH	EAST	VERT DIST BELOW SURFACE	NAME	ELEV BASE INTVL	VERT THICK INTVL	FROM	TO	DOWN HOLE INTVL	AG	MN	SIO2	CAO	AL2O3	ZONE
167920.6	875819.9	0.0	HDS83	5127.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.
167920.6	875819.9	20.0	HDS83	5107.0	20.0	355.0	375.0	20.0	14.57	14.87	65.60	0.03	2.50	3.
167920.6	875819.9	40.0	HDS83	5087.0	20.0	375.0	395.0	20.0	9.46	26.27	48.02	0.03	1.15	3.
167920.6	875819.9	60.0	HDS83	5067.0	20.0	395.0	415.0	20.0	3.92	26.30	51.62	0.10	0.77	3.
167920.6	875819.9	80.0	HDS83	5047.0	20.0	415.0	435.0	20.0	3.29	14.12	68.65	0.85	1.20	3.
167920.6	875819.9	100.0	HDS83	5027.0	20.0	435.0	455.0	20.0	3.66	12.83	71.20	0.33	1.83	3.
167920.6	875819.9	120.0	HDS83	5017.0	10.0	455.0	465.0	10.0	2.59	10.25	74.80	0.30	1.65	3.

ASARCO

Exploration Department
Southwestern United States Division
James D. Sell
Manager

February 27, 1984

Dr. M. El Tawil
ASARCO Incorporated
Central Research Department
901 Oak Tree Road
South Plainfield, NJ 07080

Hardshell Metallurgical
Samples - Arizona

Dear Dr. El Tawil:

In accordance with your instructions by telephone (2/27/84) I am shipping the Hardshell metallurgical samples per F. T. Graybeal's letter of 2/21/84.

The shipment, in plastic pails, will be sent to the attention of Engineer Victor Puskar and will be transported by UPS.

Attached is a list of the drill holes, sample footages, approximate pounds, and our silver assay for the interval, along with my letter to R. L. Brown dated 2/8/84.

Additional samples are available from the deposit and can be secured and sent to you. Please give us some lead time if additional sampling is needed.

See you in Tucson soon.

Sincerely,

James D. Sell

JDS/cg
Attachments

cc: Eng. V. Puskar, CRD
RLBrown/FTGraybeal
DECrowell
WLKurtz
FRKoutz
TCBenavidez
HMStone

ASARCO

Southwestern Exploration Division

February 8, 1984

R. L. Brown
New York Office

Rotary Cuttings Rejects
Hardshell Samples
Santa Cruz County, AZ

Rotary cuttings rejects have been separated out for Hardshell drill hole numbers 60, 62, 67, 72, 73, 77, 80, 81, 82, and 83.

The sample interval, weight of sample, and the silver assay for each hole is listed on 4 of the six pages telecopied to you.

The Hardshell drilling map is the fifth page and shows an outline of the +5 ounce silver manto as generally expressed by Pickard on his reserve estimate.

Please advise on the person-place to send these samples which are the first run of the metallurgical research.

Please advise on further samples which are desired for continued research.

Also to be forwarded to Central Research will be a copy of the available SWED assays for these intervals. All samples were assayed for silver but not all for copper, lead, zinc, manganese, and silica.

The Mission Unit X-Ray Fluorescence data being accumulated by Al Raihl is presently available for hole numbers 60, 72, 73, 80, 82, and 83.

James D. Sell

JDS/cg

Hole No.	Footage	Weight (Lbs.)	Assay Ag (opt)
HDS-60	130-135	11	4.14
	135-140	6	6.13
	140-145	10	5.68
	145-150	9	5.62
	150-155	9	3.78
	155-160	4	4.61
	160-165	10	6.03
>	170-175	10½	4.75
	175-180	10	4.55
>	185-190	5	3.22
HDS-62	260-265	7½	3.39
>	285-290	3	4.70
	290-295	3	3.38
	295-300	2	4.74
	300-305	3	6.67
	305-310	5	6.90
	310-315	3	6.82
	315-320	2	4.69
	320-325	5½	6.31
	325-330	2	6.29
	330-335	6	6.91
	335-340	5½	5.55
	340-345	5½	3.81
	345-350	2½	5.20
	350-355	5	6.61
	355-360	5	4.86
HDS-67	380-385	12	6.31

> = gap in sequence.

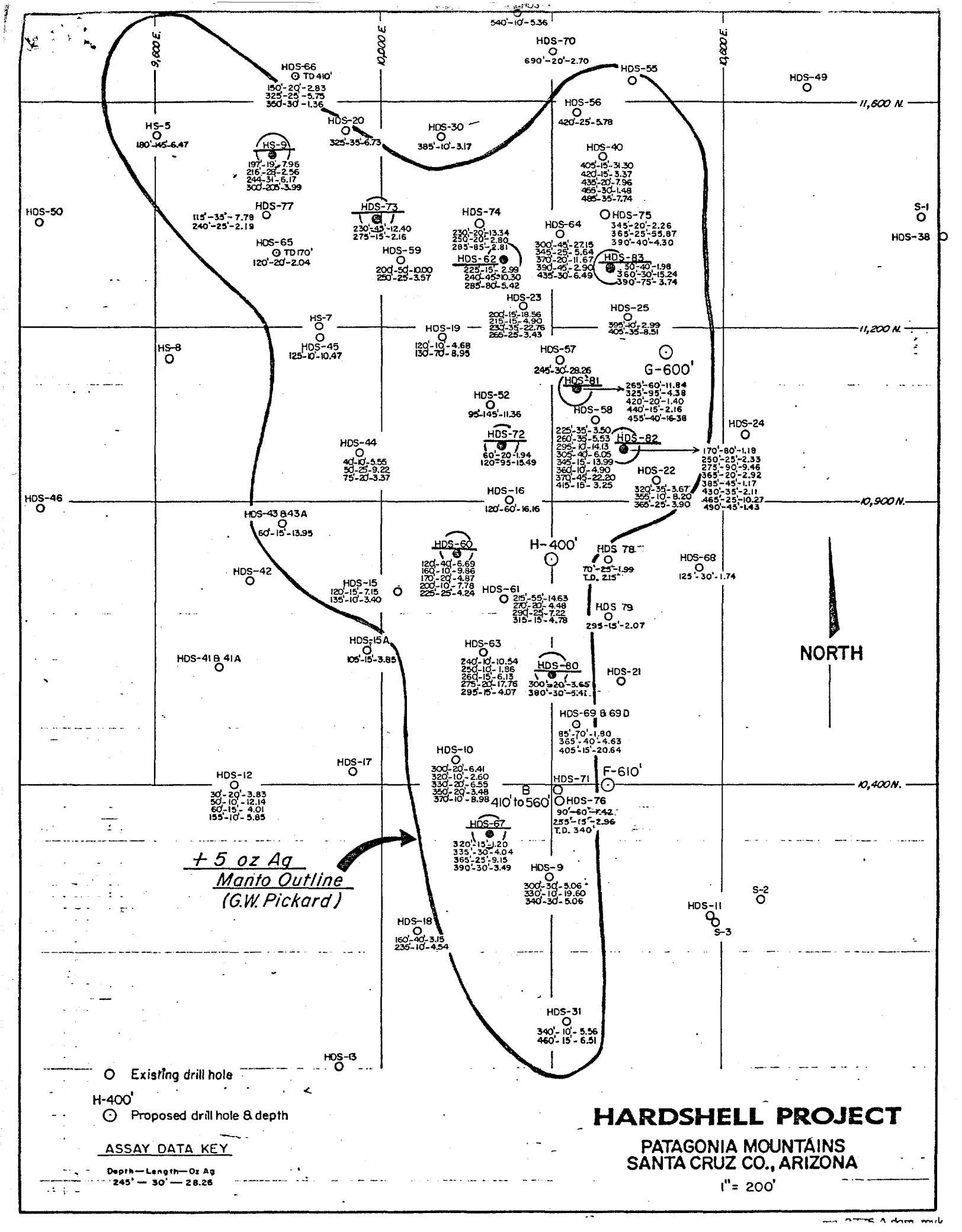
Hole No.	Footage	Weight (Lbs.)	Assay Ag (opt)
HDS-72	120-125	5	62.74
	125-130	5½	52.26
	130-135	3	8.63
	135-140	3	3.57
	140-145	3½	7.94
	145-150	4	9.70
	150-155	2	6.90
	155-160	3	18.46
	160-165	4½	18.08
	165-170	3	15.57
	170-175	8	5.89
	175-180	11	11.11
HDS-73	230-235	5	9.25
	235-240	5	22.22
	240-245	7½	10.75
	245-250	3½	23.22
	250-255	5	12.36
	255-260	6	17.57
	260-265	9	2.64
	265-270	10	2.72
	270-275	9	10.83
	275-280	9½	1.61
HDS-77	120-125	16	27.92
>	145-150	12	2.07
HDS-80	380-385	14	2.04
	385-390	14½	15.15
	390-395	13	8.35
	395-400	13	3.35
	400-405	11½	1.73

Cont. on page 3

> = gap in sequence.

Hole No.	Footage	Weight (Lbs.)	Assay Ag (opt)
HDS-80 Cont.	405-410	10	1.82
	410-415	12½	0.83
	415-420	11	0.86
	420-425	10½	0.68
	425-430	13½	0.30
HDS-81-A	390-395	8	9.54
HDS 81, but no HDS-81-A	395-400	11½	5.14
	400-405	11½	4.63
	405-410	14	3.13
	410-415	12	3.69
	415-420	7	2.11
HDS-81-B	320-325	11	8.91
HDS 81, but no HDS-81-B	325-330	7½	6.56
	330-335	10½	6.52
	335-340	5	3.91
HDS-82 ✓	280-285	12	4.91
	285-290	12	5.04
	290-295	6	8.80
	295-300	5½	13.65
	300-305	9½	10.22
	305-310	9½	4.91
	310-315	11	6.30
	315-320	11½	11.33
	320-325	13	11.61
	325-330	10	18.79
	330-335	11	5.99
	335-340	8	8.86
	340-345	6½	10.50
	345-350	9½	16.25
	350-355	10	12.18
	355-360	6½	10.13
	360-365	8	6.07

Hole No.	Footage	Weight (Lbs.)	Assay Ag (opt)
HDS-83	365-370	10	26.05
	370-375	8	23.93
	375-380	7½	12.44
	380-385	7	7.55
	385-390	13	14.30
	390-395	10	3.57
	395-400	11	2.82
	400-405	4	1.98
	405-410	9½	3.55
	410-415	6½	7.34
	415-420	8	4.83
	420-425	4	3.18



HARDSHELL PROJECT

PATAGONIA MOUNTAINS
SANTA CRUZ CO., ARIZONA

1"= 200'

ASARCO

Exploration Department
Southwestern United States Division

CERTIFIED MAIL
RETURN RECEIPT

June 29, 1984

Ms. Mary Lou G. Sainz
Santa Cruz County Recorder
P.O. Box 1150
Nogales, Arizona 85621

Affidavits of Labor
Santa Cruz County

Dear Ms. Sainz:

Enclosed is Asarco's check of $20.00 as the recording fee for the following Affidavits of Labor which are attached:

Claims	Owner	Project
Shell Group - 187	Asarco	Hardshell
Boot-Flux - 97	Asarco/Anaconda	3-R
Humbolt - 7	Asarco	Trench
TM, Welington, Jessie, ORB, OCCI, et al - 160	Asarco/Kerr-McGee	Thunder Mountain

Please return in the enclosed stamped envelope.

Very truly yours,

Original Signed by
J. R. STRINGHAM

J. R. Stringham
Assistant to the
Manager, SWED

JRS:mek
encs.

cc: J. D. Sell
A. J. Robles

Handshell
'84

AFFIDAVIT OF LABOR PERFORMED
AND IMPROVEMENTS MADE

STATE OF ARIZONA)
) ss
County of Pima)

J. R. Stringham, being first duly sworn, deposes and says that he is a citizen of the United States and more than twenty-one (21) years of age, and resides in Tucson, County of Pima, State of Arizona, and is personally acquainted with the mining claims situated in the Harshaw Mining District, Santa Cruz County, Arizona, the names and books and pages of record in the office of the County Recorder of Santa Cruz County, Arizona, and the Bureau of Land Mangement serial number of the Notices of Location whereof are as set forth in Exhibit A.

That all of said mining claims are owned by ASARCO Incorporated, the mailing address for which is P.O. Box 5747, Tucson, Arizona 85703; that between September 1, 1983 and May 31, 1984, in excess of $20,000 worth of work and improvements were done and performed for the benefit of each of the described claims. Work and improvements consisted of drilling with down-the-hole percussion drill by Drill X Inc., George T. White, Manager, P.O. Box 277, Chandler Heights, Arizona 85227.

Said labor was performed and improvements made at the expense of ASARCO Incorporated for the benefit of each and all of said mining claims (187), comprising said contiguous group as part of a general plan of exploration, improvements and development, and they tend to explore, improve and develop each and all of said mining claims. The amount expended for and the value of said labor and improvements is more than One Hundred Dollars ($100.00) for each of the mining claims, and at least said amount was allocated to each of the mining claims. Said expenditure was made in good faith for the purpose of exploring, improving and developing said contiguous group of mining claims, and was intended as annual labor and improvements for each and all of the described unpatented lode mining claims for the assessment year ending at 12:00 o'clock Meridian, September 1, 1984.

ASARCO Incorporated

By _____
Agent

STATE OF ARIZONA)
) ss
County of Pima)

The foregoing instrument was acknowledged before me this 27th day of June, 1984, by J. R. Stringham.

My commission Expires:

My Commission Expires March 4, 1985

Notary Public

EXHIBIT A
TO AFFIDAVIT OF PERFORMANCE
OF LABOR FOR YEAR
ENDING SEPTEMBER 1, 1984

The following contiguous group of unpatented mining claims are situated in the Harshaw Mining District, Santa Cruz County, Arizona. The Location Notices of which are of record in the office of the County Recorder of Santa Cruz County, Arizona, and the Bureau of Land Management serial numbers are filed at Phoenix, Arizona.

Name of Claim	Docket	Page	BLM Serial No. A MC
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Shell No. 50 thru Shell No. 56	083	413 " 419	51458 " 51464
Shell No. 57	083	420	51465
Shell No. 57 Amend.	368	248 and 249	"
Shell No. 58 thru Shell No. 62	083	421 thru 425	51466 thru 51470
Shell No. 63	083	426	51471
Shell No. 63 Amend.	368	250 and 251	"
Shell No. 64	083	427	51472
Shell No. 65	083	428	51473
Shell No. 65 Amend.	368	252 and 253	"
Shell No. 66	083	429	51474
Shell No. 66 Amend.	368	254 and 255	"
Shell No. 67	083	430	51475
Shell No. 67 Amend.	368	256 and 257	"
Shell No. 68	083	431	51476
Shell No. 68 Amend.	368	258 and 259	"
Shell No. 69 thru Shell No. 72	083	432 thru 435	51477 thru 51480
Shell No. 73 thru Shell No. 110	181	362 " 399	51481 " 51518
Shell No. 111 thru Shell No. 134	181	657 " 680	51519 " 51542
Shell 135	351	627 and 628	201239
Shell 135 Amend.	368	260 " 261	"
Shell 136	351	629 " 630	201240
Shell 136 Amend.	368	262 " 263	"
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Shell 140 Amend.	368	270 " 271	"
Shell 141	351	639 " 640	201245
Shell 141 Amend.	368	272 " 273	"

Name of Claim	Docket	Page	BLM Serial No. A MC
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Shell 148 Amend.	368	286 " 287	"
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Shell 151 Amend.	368	292 " 293	"
Shell 152	351	661 " 662	201256
Shell 152 Amend.	368	294 " 295	"
Shell 153	351	663 " 664	201257
Shell 153 Amend.	368	296 " 297	"
Shell 154	351	665 " 666	201258
Shell 154 Amend.	368	298 " 299	"
Shell 155	351	667 " 668	201259
Shell 155 Amend.	368	300 " 301	"
Shell 156	351	669 " 670	201260
Shell 156 Amend.	368	302 " 303	"
Shell 157	351	671 " 672	201261
Shell 157 Amend.	368	304 " 305	"
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Shell 158 Amend.	368	306 " 307	"
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Shell 172	352	01 " 02	201276
Shell 172 Amend.	368	334 " 335	"
Shell 173	352	03 " 04	201277
Shell 173 Amend.	368	336 " 337	"
Shell 174	352	05 " 06	201278
Shell 174 Amend.	368	338 " 339	"
Shell 175	352	07 " 08	201279
Shell 175 Amend.	368	340 " 341	"
Shell 176	352	09 " 10	201280
Shell 176 Amend.	368	342 " 343	"
Shell 177	352	11 " 12	201281
Shell 177 Amend.	368	344 " 345	"
Shell 178	352	13 " 14	201282
Shell 178 Amend.	368	346 " 347	"
Shell 179	352	15 " 16	201283
Shell 179 Amend.	368	348 " 349	"
Shell 180	352	17 " 18	201284
Shell 180 Amend.	368	350 " 351	"
Shell 181	352	19 " 20	201285
Shell 181 Amend.	368	352 " 353	"
Shell 182	352	21 " 22	201286
Shell 182 Amend.	368	354 " 355	"
Shell 183	352	23 " 24	201287
Shell 183 Amend.	368	356 " 357	"
Shell 184	352	25 " 26	201288
Shell 184 Amend.	368	358 " 359	"
Shell 185	352	27 " 28	201289
Shell 185 Amend.	368	360 " 361	"
Shell 186	352	29 " 30	201290
Shell 186 Amend.	368	362 " 363	"
Shell 187	352	31 " 32	201291
Shell 187 Amend.	368	364 " 365	"

All of said claims are located in Sections 3,4,5,8,9,10,11,12,13 and 14, Township 23 South, Range 16 East, and Sections 7,8,17 and 18, Township 23 South, Range 17 East G&SRB&M.

JDS

ASARCO

Southwestern Exploration Division

July 3, 1984

To: F. R. Koutz

From: J. D. Sell

Hardshell Project

Note from W.L. Kurtz after he read your Monthly Report - Hardshell, April 30, 1984:

> JDS - Suppose sometime this will be put on Sections? So can better "see" the distribution.

Probably should do sections before further recommendation.

W.L. Kurtz's comments after reading your 1984 Drill Coordinate - Hardshell with file copy of assays:

> JDS - Strange memo to attach assays!

and I agree - should have put your "new" drill location map & your best assay list in the same packet.

James D. Sell

James D. Sell

JDS:mek

ASARCO

Exploration Department
Southwestern United States Division

CERTIFIED MAIL
RETURN RECEIPT

July 12, 1984

Mr. Dean Bibles
State Director
Bureau of Land Management
U.S. Department of the Interior
P.O. Box 16563
Phoenix, AZ 85011

Mining Claim Annual Recordation
Hardshell and Trench Group
Santa Cruz County, AZ
A MC Serial Numbers
50226 thru 50232
51409 " 51542
201239 " 201291

Dear Sir:

In accordance with the Federal Land Policy and Management Act (43 CFR, Part 3833.2), enclosed is an exact reproduction of the affidavit of assessment work, with mining claim serial numbers, as recorded in the Santa Cruz County Recorder's office in Docket 379, Pages 87 and 88, and Docket 379, Pages 81 thru 84, for the assessment year ending September 1, 1984.

Please return acknowledgement receipt in the enclosed envelope.

Very truly yours,

J. R. Stringham /mek

J. R. Stringham
Assistant to the
Manager, SWED

JRS:mek
encs.

cc: H.E. Kelshaw (w/encs.)
A.J. Robles (w/encs.)
J.D. Sell (w/encs.)

AFFIDAVIT OF LABOR PERFORMED
AND IMPROVEMENTS MADE

STATE OF ARIZONA)
) ss
County of Pima)

J. R. Stringham, being first duly sworn, deposes and says that he is a citizen of the United States and more than twenty-one (21) years of age, and resides in Tucson, County of Pima, State of Arizona, and is personally acquainted with the mining claims situated in the Harshaw Mining District, Santa Cruz County, Arizona, the names and books and pages of record in the office of the County Recorder of Santa Cruz County, Arizona, and the Bureau of Land Management serial number of the Notices of Location whereof are as follows:

Name of Claim	Book	Page	Docket	Page	BLM Serial No.
South Humbolt	22	4	25	158	A MC 50226
" " Amend.			343	228 and 229	" "
Humbolt	1	627	25	159	" 50227
" Amend.			343	210 and 211	" "
Silverleaf	6	572	25	160	" 50228
" Amend.			343	230 and 231	" "
Good Luck #2	22	7	25	161	" 50229
" " " Amend.			343	208 and 209	" "
Indian Chief	4	309	25	162	" 50230
" " Amend.			343	212 and 213	" "
Monoca	22	161	25	163	" 50231
" Amend.			343	216 and 217	" "
Good Luck	4	300	25	164	" 50232
" " Amend.			343	206 and 207	" "

The above described unpatented lode mining claims are located in Section 32 of Township 22 South, Range 16 East, and Section 5 of Township 23 South, Range 16 East, G&SRB&M.

That all of said mining claims are owned by ASARCO Incorporated, the mailing address for which is P.O. Box 5747, Tucson, Arizona 85703; that between September 1, 1983 and May 31, 1984, in excess of $1,000 worth of work and improvements were done and performed for the benefit of each of the aforementioned claims. Work and improvements consisted of drilling with diamond drill rig by Joy Manufacturing Company, 707 Boyd Blvd., La Porte, Indiana 46350.

Said labor was performed and improvements made at the expense of ASARCO Incorporated for the benefit of each and all of said mining claims comprising said contiguous groups as part of a general plan of exploration, improvements

and development, and they tend to explore, improve and develop each and all of said mining claims. The amount expended for and the value of said labor and improvements is more than One Hundred Dollars ($100.00) for each of the mining claims and at least said amount was allocated to each of the mining claims. Said expenditure was made in good faith for the purpose of exploring, improving and developing said contiguous groups of mining claims, and was intended as annual labor and improvements for each and all of the above-described unpatented lode mining claims for the assessment year ending at 12:00 o'clock Meridian, September 1, 1984.

ASARCO Incorporated

By _____
Agent

STATE OF ARIZONA)
) ss
County of Pima)

The foregoing instrument was acknowledged before me this 27th day of June, 1984, by J. R. Stringham.

_____
Notary Public

My Commission Expires:

My Commission Expires March 4, 1985

FEE NO. 12711

STATE OF ARIZONA, County of Santa Cruz — SS.
I do hereby certify that the within instrument was filed and recorded at the request of ASARCO Inc.
on JUL 2 '84 -10 00 AM Docket No. 379 Page 87-88
Records of Santa Cruz County, Arizona.
WITNESS my hand and official seal the day and year first above written.

COUNTY RECORDER SANTA CRUZ COUNTY STATE OF ARIZONA

MARY LOU G. SAINZ, COUNTY RECORDER
By Barbara J. Soto
Deputy

AFFIDAVIT OF LABOR PERFORMED
AND IMPROVEMENTS MADE

STATE OF ARIZONA)
) ss
County of Pima)

J. R. Stringham, being first duly sworn, deposes and says that he is a citizen of the United States and more than twenty-one (21) years of age, and resides in Tucson, County of Pima, State of Arizona, and is personally acquainted with the mining claims situated in the Harshaw Mining District, Santa Cruz County, Arizona, the names and books and pages of record in the office of the County Recorder of Santa Cruz County, Arizona, and the Bureau of Land Mangement serial number of the Notices of Location whereof are as set forth in Exhibit A.

That all of said mining claims are owned by ASARCO Incorporated, the mailing address for which is P.O. Box 5747, Tucson, Arizona 85703; that between September 1, 1983 and May 31, 1984, in excess of $20,000 worth of work and improvements were done and performed for the benefit of each of the described claims. Work and improvements consisted of drilling with down-the-hole percussion drill by Drill X Inc., George T. White, Manager, P.O. Box 277, Chandler Heights, Arizona 85227.

Said labor was performed and improvements made at the expense of ASARCO Incorporated for the benefit of each and all of said mining claims (187), comprising said contiguous group as part of a general plan of exploration, improvements and development, and they tend to explore, improve and develop each and all of said mining claims. The amount expended for and the value of said labor and improvements is more than One Hundred Dollars ($100.00) for each of the mining claims, and at least said amount was allocated to each of the mining claims. Said expenditure was made in good faith for the purpose of exploring, improving and developing said contiguous group of mining claims, and was intended as annual labor and improvements for each and all of the described unpatented lode mining claims for the assessment year ending at 12:00 o'clock Meridian, September 1, 1984.

ASARCO Incorporated

By _____
Agent

STATE OF ARIZONA)
) ss
County of Pima)

The foregoing instrument was acknowledged before me this 27th day of June, 1984, by J. R. Stringham.

My commission Expires:

My Commission Expires March 4, 1985

Notary Public

EXHIBIT A
TO AFFIDAVIT OF PERFORMANCE
OF LABOR FOR YEAR
ENDING SEPTEMBER 1, 1984

The following contiguous group of unpatented mining claims are situated in the Harshaw Mining District, Santa Cruz County, Arizona. The Location Notices of which are of record in the office of the County Recorder of Santa Cruz County, Arizona, and the Bureau of Land Management serial numbers are filed at Phoenix, Arizona.

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Shell 183	352	23 " 24	201287
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Shell 185	352	27 " 28	201289
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Shell 186	352	29 " 30	201290
Shell 186 Amend.	368	362 " 363	"
Shell 187	352	31 " 32	201291
Shell 187 Amend.	368	364 " 365	"

All of said claims are located in Sections 3,4,5,8,9,10,11,12,13 and 14, Township 23 South, Range 16 East, and Sections 7,8,17 and 18, Township 23 South, Range 17 East G&SRB&M.

FEE NO. 12709

STATE OF ARIZONA, County of Santa Cruz — SS.

I do hereby certify that the within instrument was filed and recorded at the request of ASARCO

on JUL 2 '84 - 10 00 AM Docket No. 379 Page 81-84

Records of Santa Cruz County, Arizona.

WITNESS my hand and official seal the day and year first above written.

COUNTY RECORDER SANTA CRUZ COUNTY STATE OF ARIZONA

MARY LOU G. SAINZ, COUNTY RECORDER

By Barbara J. Soto

ASARCO

Exploration Department
Southwestern United States Division

CERTIFIED MAIL

RETURN RECEIPT

July 27, 1984

Ms. Mary Lou Sainz
Santa Cruz County Recorder
P.O. Box 1150
Nogales, Arizona 85621

Amended Notices of Location
Harshaw Mining District
Santa Cruz County, AZ

Dear Ms. Sainz:

Enclosed is Asarco's check of $55.00 as the recording fee for the enclosed Amended Notices of Location with maps for the following 11 lode claims:

Name of Claim	Owner	Date of Amended Notice of Location
Welington	Kerr-McGee	6/8/84
Lafayette	" "	6/6/84
Bryan	" "	6/8/84
Warren Harding	" "	6/8/84
Roosevelt	" "	6/8/84
South Humbolt	ASARCO Incorp.	6/6/84
Humbolt	" "	6/6/84
Silver Leaf	" "	6/6/84
Good Luck #2	" "	6/6/84
Indian Chief	" "	6/6/84
Monoca	" "	6/6/84

Please return in the enclosed stamped envelope.

Very truly yours,

Original Signed by
J. R. STRINGHAM

JRS:mek
encs.

J. R. Stringham
Assistant to the
Manager, SWED

cc: J. D. Sell
A. J. Robles

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

ASARCO

Exploration Department
Southwestern United States Division

CERTIFIED MAIL
RETURN RECEIPT

August 6, 1984

Bureau of Land Management
Mining Claims Section
Arizona State Office
P.O. Box 16563
Phoenix, AZ 85011

Amended Notices of Location
Harshaw Mining District
Santa Cruz, Arizona

Gentlemen:

In accordance with Section 314 of the Federal Land Policy and Management Act of 1976, enclosed are the following Amended Notices of Location with map as recorded in Santa Cruz County, Arizona.

Name of Claim	Owner	Date of Amended Location	Recorded in Santa Cruz County Book	Page	BLM Serial No.
Welington	Kerr-McGee	6/8/84	380	672 and 673	AMC 33769
Lafayette	" "	6/6/84	"	674 " 675	33770
Bryan	" "	6/8/84	"	676 " 677	33771
Warren Harding	" "	6/8/84	"	678 " 679	33773
Roosevelt	" "	6/8/84	"	680 " 681	33776
South Humbolt	ASARCO Inc.	6/6/84	"	682 " 683	50226
Humbolt	" "	6/6/84	"	684 " 685	50227
Silver Leaf	" "	6/6/84	"	686 " 687	50228
Good Luck #2	" "	6/6/84	"	688 " 689	50229
Indian Chief	" "	6/6/84	"	690 " 691	50230
Monoca	" "	6/6/84	"	692 " 693	50231

Very truly yours,

J. R. Stringham
Assistant to the
Manager, SWED

JRS:mek
encs.

cc: J. D. Sell

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

ASARCO

Exploration Department
Southwestern United States Division

CERTIFIED MAIL
RETURN RECEIPT

August 9, 1984

Bureau of Land Management
Arizona State Office
Mining Claims Section
P.O. Box 16563
Phoenix, AZ 85011

Shell 59, Boot & Flux Claims
Harshaw & Palmetto Mining Dists.
Santa Cruz County, AZ

Gentlemen:

In reviewing our Amended Notice of Location for the subject claims with the BLM Microfiche Geographic and Claimant Indexes, we have noted some discrepancies in the locations on the microfiche. These are listed below. For Shell 59 refer to Document 288, Page 574; for the Boot & Flux claims refer to Document 288, Pages 334 thru 343.

Name of Claim	BLM Serial No.	Location as Shown on Amended Notices & Map	Location as Shown on Shown on BLM Microfiche
Shell No. 59	AMC 51467	S2 Sec. 3 & N2 Sec. 10, T23S, R16E	SW Sec. 3 & N2 Sec. 10, T23S, R16E
Boot 2	AMC 51977	NE Sec. 35, T22S,R15E	E2 Sec. 35, T22S,R15E
Boot 4	51979	NE Sec. 35, T22S,R15E	E2 Sec. 35, T22S,R15E
Boot 9	51984	E2 Sec. 1, T23S,R15E	E2 Sec. 35, T23S,R15E
Boot 10	51985	E2 Sec. 1, T23S,R15E	E2 Sec. 35, T23S,R15E
Boot 17	51992	SE Sec. 26 & NE Sec. 35 T22S,R15E	SW Sec. 26 & NE Sec. 35 T22S,R15E
Boot 38	52013	SE Sec. 25 & NE Sec. 36 T22S,R15E	S2 Sec. 25 & N2 Sec. 36 T22S,R15E
Boot 52	52015	S2 Sec. 31, T22S,R16E N2 Sec. 6, T23S,R16E	S2 Sec. 31, T22S,R16E NW Sec. 6, T22S,R16E
Boot 53	52016	SE Sec. 31, T22S,R16E NE Sec. 6, T23S,R16E	SE Sec. 31, T22S,R16E NE Sec. 6, T22S,R16E

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

Name of Claim	BLM Serial No.	Location as Shown on Amended Notices & Map	Location as Shown on Shown on BLM Microfiche
Boot 73	AMC 52028	SE Sec. 36, T22S,R15E SW Sec. 31, T22S,R16E	SE Sec. 36, T22S,R15E
Boot 88	52043	NE Sec. 1, T23S,R15E NW Sec. 6, T23S,R16E	E2 Sec. 1, T23S,R15E NW Sec. 6, T23S,R16E
Flux 2	52061	SE Sec. 25, T22S,R15E SW Sec. 30, T22S,R16E	SE Sec. 25 & SW Sec. 30, T22S,R16E
Flux 11	52065	SE Sec. 25, NE Sec. 36 T22S,R15E, and SW Sec. 30, NW Sec. 31, T22S,R16E	SE Sec. 25, NE Sec. 36, T22S,R15E, and SW Sec. 30 NW, SE Sec. 31, T22S,R16E
Flux 23	52069	NW Sec. 30, T22S,R16E NE Sec. 25, T22S,R15E	NW Sec. 30, T22S,R16E

Please amend your records to conform with the Amended Notices and maps as submitted and recorded. If you have any questions, please don't hesitate to call.

Very truly yours,

J. R. Stringham
Assistant to the
Manager, SWED

JRS:mek

cc: J. D. Sell

ASARCO

Exploration Department
Southwestern United States Division

CERTIFIED MAIL
RETURN RECEIPT

September 4, 1984

Bureau of Land Management
Mining Claims Section
P.O. Box 16563
Phoenix, AZ 85011

Amended Notices of Location
Harshaw Mining District
Santa Cruz County, AZ

Gentlemen:

In accordance with Section 314 of the Federal Land Policy and Management Act of 1976 (43 U.S.C., Sec. 1744) and the regulations thereto, there is enclosed for filing in your office a copy of the official record of the Amended Notices of Location with maps for the following 7 mining claims in the Harshaw Mining District, Santa Cruz County, Arizona.

Name of Claim	Date of Amend. Notice	Recorded Book	Page	Owner	BLM Serial No.
Calvin Coolidge	8/14/84	382	573 & 574	Kerr-McGee	AMC 33775
Good Luck	8/3/84	"	575 & 576	ASARCO Inc.	50232
Orb #7	8/20/84	"	577 & 578	Kerr-McGee	192265
Orb #8	8/1/84	"	579 & 580	Kerr-McGee	192266
Orb #9	8/1/84	"	581 & 582	Kerr-McGee	192267
Orb #10	8/16/84	"	583 & 584	Kerr-McGee	192268
Boot 107	8/2/84	"	585 & 586	ASARCO Inc.	194596

Very truly yours,

Original Signed By
J. R. STRINGHAM

J. R. Stringham
Assistant to the
Manager, SWED

JRS:mek
encs.

cc: J. D. Sell
A. J. Robles

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

(ARA— copy to RGY DMS JCB JDS (see note below)

ASARCO

Southwestern Mining Department

November 13, 1984

Memo To: Mr. R. J. Kupsch
Mr. W. L. Kurtz/Mr. J. D. Sell
Mr. F. T. Graybeal

The attached Memo is provided for your general information. Obviously, a more complete and thoroughal program will be accomplished in the future, as recommended.

T. E. Scartaccini
General Manager

DFS/mck
encl.

The attached of interest. Prbably my mistake for never having some umpire checks inside of the "ore" intervals. We must keep all assayers honest by enough checks.

Kurtz
Nov 20, 84

ASARCO

S.W. MINING DEPT.
NOV 12 1984
TUCSON

Southwestern Mining Department

T.E.S.
NOV 12 1984

November 8, 1984

FILE MEMO

ASSAY CHECKS
ORIGINAL DRILL HOLE PULPS
HARDSHELL PROJECT

Results of 50 reduction roast-cyanide leach tests on Hardshell drill hole reject samples have been summarized in CRD Report No. 5115, August 30, 1984. It was reported that the calculated head assays averaged approximately 30% higher in Ag than the original 5' drill hole assays. The original assays are from pulverized splits of the 10 to 20 pound samples which were collected during drilling. Samples tested by Central Research are the rejected portions of these samples. Six of the tested rejects were assayed by the El Paso Umpire Laboratory and found to be 28% higher than the original drill hole assays.

The magnitude of this difference has great significance because the original drill hole assays (hereafter called reserve assays) are the basis for mineral inventory and ore reserve calculations. However, since the comparisons mentioned above are between different splits of the same sample, the results are not totally conclusive. In order to verify that the reserve assays actually are systematically low, assay checks of the original pulp samples would be necessary. Accordingly, 15 of the original pulps (the same pulverized split used for the reserve assay) were sent to the El Paso Umpire Laboratory for Umpire assay. All 15 samples represent intervals tested by Central Research.

Results and an assay comparison are shown on Table 1. Overall, the Umpire assays of the 15 samples average 23.2% higher in Ag than the original reserve assays on the same pulps. In only four of the fifteen samples was the Umpire assay below the reserve assay and in only one of these samples was the discrepancy of serious magnitude. By grade range, the Umpire assays are:

1) 2.6% high if the reserve assay is 3.0 to 7.0 oz/ton
2) 50.0 % high if the reserve assay is 7.0 to 11.0 oz/ton
3) 19.9% high if the reserve assay is over 11.0 oz/ton

Generally the higher the Mn the higher the silver but no direct factor

Also shown on Table I are:

1) The calculated head grades for reduction roast tests on the coarse rejects of all 15 samples

2) Central Research (AA) assays on rejects of six of the 15 samples, and

3) Umpire assays on the same six samples.

Results of the above assays are as follows:

1) Calculated heads on the 15 samples are 33.0% higher than the reserve assays

2) AA assays of six reject samples are 31.7% higher than the reserve assays on the corresponding pulps

3) Umpire assays on the same six rejects are 28.1% higher than the corresponding reserve assays

4) The above six Umpire assays are 4.0% higher than Umpire assays on the corresponding original pulp samples

Although the number of samples in this comparison is not large, it is obvious that, for the intervals checked, the reserve assays are systematically low in silver. The samples checked are from holes drilled and assayed in the mid-1970's and 1980. All samples from this period were run by American Analytical Research Lab of Tucson using fire assay. Mr. Arturo Jimenez of the El Paso Umpire Lab claims that fire assay of Hardshell samples can yield a low silver result if the flux is not adjusted to account for the presence of MnO_2 in the sample. This may well be the cause of the discrepancy between the reserve and check assays.

Note!

The percentage of the reserve assays that are influenced by systematic error is unknown. It is possible that the error exists only in those samples assayed during the time period checked in this study.

In the near future, a program will be designed to accomplish the following:

1) Verify the present findings

2) Determine the magnitude and identity of suspect assays

3) Obtain corrected results.

Then, as time and funds permit, the program can be implemented and the discrepancy resolved.

Robert Cummings
R. B. Cummings

RBC/kh

Attach.

cc: DFSkidmore
DECrowell/ARRaihl
MElTawil

TABLE I

HARDSHELL ASSAY COMPARISON

Hole	Interval	Original Pulp Samples: Reserve Assay Ag	Umpire Assay Au	Umpire Assay Ag	Umpire Assay %Dif.*	Coarse Reject Samples: Calculated Head Ag	Calculated Head %Dif.*	CRD - AA Ag	CRD - AA %Dif.*	Umpire Assay Ag	Umpire Assay %Dif.*	Umpire Assay %Dif.**
HDS-83	435-440	3.25	.005	3.20	- 1.5%	3.76	15.7%					
HDS-72	135-140	3.57	.005	4.30	20.4%	5.06	41.7%					
HDS-83	445-450	4.47	.006	4.50	.7%	5.08	13.6%					
HDS-60	145-150	5.62	.011	5.55	- 1.2%	5.99	6.6%	6.25	11.2%	5.55	- 1.2%	0.0%
HDS-60	160-165	6.03	.016	6.20	2.8%	6.72	11.4%	7.13	18.2%	6.55	8.6%	5.6%
HDS-62	305-310	6.90	.009	6.85	- .7%	7.14	3.5%					
HDS-72	140-145	7.94	.005	9.70	22.2%	10.10	27.2%					
HDS-80	390-395	8.35	.004	11.30	35.3%	13.73	64.4%	12.70	52.1%	12.10	44.9%	7.1%
HDS-72	130-135	8.63	.003	9.35	8.3%	10.25	18.8%					
HDS-82	355-360	10.13	.028	22.20	119.2%	22.37	120.8%					
HDS-82	315-320	11.33	.013	19.10	68.6%	17.77	56.8%					
HDS-80	385-390	15.15	.032	22.85	50.8%	26.71	76.3%	25.40	67.7%	24.15	59.4%	5.7%
HDS-82	325-330	18.79	.005	13.35	-29.0%	13.02	-30.7%					
HDS-83	365-370	26.05	.012	28.40	9.0%	32.62	25.2%	30.00	15.2%	30.20	15.9%	6.3%
HDS-77	120-125	27.92	.005	35.35	26.6%	37.95	35.9%	35.90	28.6%	35.60	27.5%	.7%
AVERAGES												
All Samples		10.94	.011	13.48	23.2%	14.55	33.0%					
Reserve Ag 3-7		4.97	.009	5.10	2.6%	5.62	13.1%					
Reserve Ag 7-11		8.76	.010	13.14	50.0%	14.11	61.1%					
Reserve Ag +11		19.85	.013	23.81	19.9%	25.61	29.0%					
Six Samples		14.85	.013	18.28	23.1%	20.62	38.9%	19.56	31.7%	19.02	28.1%	4.0%

NOTE: All assays in troy oz/ton
* % Difference from Reserve Assay pulp sample
** % Difference from Umpire Assay of pulp sample

ANNUAL PROJECT PLANNING SHEET

DISTRICT: Southwestern
PROJECT NAME: Hardshell
PROJECT NUMBER: EA-0013
PROJECT SUPERVISOR: F.R. Koutz
PROJECT GEOLOGIST: F.R. Koutz
PREPARED BY/DATE: FRK 2/23/82

EXPENDITURES

1. Month of MAY $ 1,009
2. Current Year Expenses to Date thru MAY $ 8,501
3. Budget for Current Year May 19 82 $ S.A. approved $26,000
4. Thru previous year, since project began $ 581,074

TYPE OF PROJECT

	Recon
X	Drilling
?	Pre-Development
	Other

COST ESTIMATE & APPROPRIATION REQUEST

		Approval: Dist. Geol.
Current Yr. Orig. Budget	$	
Current Yr. Add. Request @ ____	$	
Current Yr. Add. Request @ ____	$	
New Total	$	

OBJECTIVE: Hold ground for 1982. Attend to a number of unfinished chores re: compilation of Hardshell data.

Progress for the Month of MAY 1982

PLANNED TASKS	RESPONSIBILITY/TIME TO COMPLETE	TARGET DATE	% COMPLETE	PROGRESS TO DATE
1. Complete 1981 surveying report, N.E. & elev. of drill collars + triangles.	F.Baker/J.Wood 2 days	3/1/82	100	TGB/HMS + FRK/JMW panelled holes for aerial photography by McLain, completed May 23.
2. Complete data sheet on elevation contacts, thicknesses - HDS drilling to date.	FAM - 1 week	4/1/82	50%	Initial samples for Mo zoning study returned from Skyline; does not look overly favorable.
3. Complete 1981 Hermosa Area Report				
a. Drilling (HDS 84 to 88)	FRK/FAM - 1 week	8/1/82	50%	
b. Hermosa Underground	FAM/FRK - 1 week	7/1/82	50%	
4. File Assessment work with Santa Cruz County & BLM (HDS-84 to 88).	RBC - 2 days	9/1/82	0%	Could be done anytime
5. Baseline water quality study (annual - 4th sampling).	NPW?/WAT DEVCO 1 week	11/30/82	0%	Need new hydrology consulting company?
6. Hardshell Status Report	FRK/GWP - 3 Months	As time permits (12/82?)	20%	

ANNUAL PROJECT PLANNING SHEET

JDS

DISTRICT: Southwestern
PROJECT NAME: Hardshell
PROJECT NUMBER: EA-0013
PROJECT SUPERVISOR: F.R. Koutz
PROJECT GEOLOGIST: F.R. Koutz
PREPARED BY/DATE: FRK 2/23/82

EXPENDITURES

1. Month of April $ 1,481
2. Current Year Expenses to Date thru April $ 7,577
3. Budget for Current Year 19__ $
4. Thru previous year, since project began $ 581,074

TYPE OF PROJECT

	Recon
X	Drilling
?	Pre-Development
	Other

COST ESTIMATE & APPROPRIATION REQUEST

		Approval Dist. Geol.
Current Yr. Orig. Budget	$	
Current Yr. Add. Request @ ____	$	
Current Yr. Add. Request @ ____	$	
New Total	$	

OBJECTIVE: Hold ground for 1982. Attend to a number of unfinished chores re: compilation of Hardshell data.

Progress for the Month of April '82

PLANNED TASKS	RESPONSIBILITY/TIME TO COMPLETE	TARGET DATE	% COMPLETE	PROGRESS TO DATE
1. Complete 1981 surveying report, N.E. & elev. of drill collars + triangles.	F.Baker/J.Wood 2 days	3/1/82	99%	Baker making table of data. TCB/HMS paneling holes for aerial photography by McLain .
2. Complete data sheet on elevation contacts, thicknesses - HDS drilling to date.	FAM - 1 week	4/1/82	50%	Initial samples for Mo zoning study submitted to Skyline.
3. Complete 1981 Hermosa Area Report				
a. Drilling (HDS 84 to 88)	FRK/FAM - 1 week	8/1/82	50%	
b. Hermosa Underground	FAM/FRK - 1 week	7/1/82	50%	
4. File Assessment work with Santa Cruz County & BLM (HDS-84 to 88).	RBC - 2 days	9/1/82	0%	Could be done anytime
5. Baseline water quality study (annual - 4th sampling).	NPW?/WAT DEVCO 1 week	11/30/82	0%	
6. Hardshell Status Report	FRK/GWP - 3 Months	As time permits (12/82?)	20%	

WDP

ANNUAL PROJECT PLANNING SHEET

DISTRICT: Southwestern
PROJECT NAME: Hardshell
PROJECT NUMBER: EA-0013
PROJECT SUPERVISOR: F.R. Koutz
PROJECT GEOLOGIST: F.R. Koutz
PREPARED BY/DATE: FRK 2/23/82

EXPENDITURES

1. Month of March $ $1,809
2. Current Year Expenses to Date thru March $(19,921)
3. Budget for Current Year 19__ $
4. Thru previous year, since project began $ 581,074

TYPE OF PROJECT

	Recon
X	Drilling
?	Pre-Development
	Other

COST ESTIMATE & APPROPRIATION REQUEST

		Approval Dist. Geol.
Current Yr. Orig. Budget	$	
Current Yr. Add. Request @ ____	$	
Current Yr. Add. Request @ ____	$	
New Total	$	

OBJECTIVE: Hold ground for 1982. Attend to a number of unfinished chores re: compilation of Hardshell data.

Progress for the Month of March '82

PLANNED TASKS	RESPONSIBILITY/TIME TO COMPLETE	TARGET DATE	% COMPLETE	PROGRESS TO DATE
1. Complete 1981 surveying report, N.E. & elev. of drill collars + triangles.	F.Baker/J.Wood 2 days	3/1/82	99%	Baker making table of data.
2. Complete data sheet on elevation contacts, thicknesses - HDS drilling to date.	FAM - 1 week	4/1/82	50%	Will select samples for Mo zoning study in April. FAM can complete with Baker's data.
3. Complete 1981 Hermosa Area Report				
a. Drilling (HDS 84 to 88)	FRK/FAM - 1 week	8/1/82	50%	
b. Hermosa Underground	FAM/FRK - 1 week	7/1/82	50%	
4. File Assessment work with Santa Cruz County & BLM (HDS-84 to 88).	RBC - 2 days	9/1/82	0%	Could be done anytime.
5. Baseline water quality study (annual - 4th sampling).	NPW?/WAT DEVCO 1 week	11/30/82	0%	
6. Hardshell Status Report	FRK/GWP - 3 Months	As time permits (12/82?)	20%	

ANNUAL PROJECT PLANNING SHEET

WDP

DISTRICT: Southwestern
PROJECT NAME: Hardshell
PROJECT NUMBER: EA-0013
PROJECT SUPERVISOR: F.R. Koutz
PROJECT GEOLOGIST: F.R. Koutz
PREPARED BY/DATE: FRK 2/23/82

EXPENDITURES

1 - Month of _____ $_____
2 - Current Year Expenses to Date thru _____ $_____
3 - Budget for Current Year 19__ $_____
4 - Thru previous year, since project began $ 581,074

TYPE OF PROJECT

	Recon
X	Drilling
?	Pre-Development
	Other

COST ESTIMATE & APPROPRIATION REQUEST

		Approval Dist.	Approval Geol.
Current Yr. Orig. Budget	$		
Current Yr. Add. Request @ _____	$		
Current Yr. Add. Request @ _____	$		
New Total	$		

OBJECTIVE: Hold ground for 1982. Attend to a number of unfinished chores re: compilation of Hardshell data.

Progress for the Month of _____

PLANNED TASKS	RESPONSIBILITY/TIME TO COMPLETE	TARGET DATE	% COMPLETE	PROGRESS TO DATE
1. Complete 1981 surveying report, N.E. & elev. of drill collars + triangles.	F.Baker/J.Wood 2 days	3/1/82		
2. Complete data sheet on elevation contacts, thicknesses - HDS drilling to date.	FAM - 1 week	4/1/82		
3. Complete 1981 Hermosa Area Report a. Drilling (HDS 84 to 88) b. Hermosa Underground	 FRK/FAM - 1 week FAM/FRK - 1 week	 8/1/82 7/1/82		
4. File Assessment work with Santa Cruz County & BLM (HDS-84 to 88).	RBC - 2 days	9/1/82		
5. Baseline water quality study (annual - 4th sampling).	NPW?/WAT DEVCO 1 week	11/30/82		
6. Hardshell Status Report	FRK/GWP - 3 Months	As time permits (12/82?)		

ANNUAL PROJECT PLANNING SHEET

DISTRICT: Southwest
PROJECT NAME: Hardshell
PROJECT NUMBER: 0013
PROJECT SUPERVISOR: F.R.Koutz
PROJECT GEOLOGIST: FRK/GWP
PREPARED BY/DATE: FRK/6-2-81

EXPENDITURES

1. Month of 11/81 $625.00
2. Current Year Expenses to Date thru 11/81 $35,048.00
3. Budget for Current Year 1981 $ 20,000
4. Thru previous year, since project began $546,774

TYPE OF PROJECT

	Recon
X	Drilling
?	Pre-Development
	Other

COST ESTIMATE & APPROPRIATION REQUEST

		Approvals: Dist. Geol.	West. U.S.
Current Yr. Orig. Budget	$20,000		
Current Yr. Add. Request @ 8/81	$11,000*		
Current Yr. Add. Request @ ____	$		
New Total	$		

*overrun (1980)

OBJECTIVE: Hold ground by assessment work on Shell claims by drilling for near-surface mineralization in the Hermosa Mine area; complete status report on the Hardshell property.

Progress for the Month of November 1981

PLANNED TASKS	RESPONSIBILITY/TIME TO COMPLETE	TARGET DATE	% COMPLETE	PROGRESS TO DATE
1) Baseline water quality study (annual - third sampling).	FRK/NPW?, WATDEVCO/1 wk.	11-30-81	75	Samples collected by N.P.Whaley and WATDEVCO - being analysed.
2) Survey of HDS drill holes into district grid-transit.	FRK/2 surveyors/1 week	9-1-81	95	F. Baker/D. Broderick: 1 to 2 more field days needed for corrections/checks.
3) Complete new logging form with explanatory memo and examples for Hardshell percussion samples.	FRK/2 says	7-31-81	100	
4) Hermosa Area surface geochem.	CNA/FRK/3 weeks	7-31-81		
a. sampling program			100	To be reported with drill results.
b. report on results: 1981 drilling proposal.			70	
5) Surface drilling program (air trach-hammer) - test for Hermosa-type mineralization;	FRK/NPW?/2 weeks	7-31-81	100	1400'' drilled HDS-84-88; logging completed by F.A. Michel.
			95	UG sampling/mapping by F.A. Michel/D.Y.M. (F.A.M. needs to complete drill & UG report.)
notify USFS.	RBC/FRK/1 day	7-31-81	100	
6) File assessment work with Santa Cruz County and BLM.	RBC/2 days	11-30-81	100	R.B.Crist filed using TCH-2 drilling. Current drilling for 1982 year (see W.L. Kurtz).
7) Jasperoid sampling program - Shell claims south of Hardshell.	FRK/+?/1 week	12-31-81	100	F.A.Michel - completed.
8) Hardshell Status Report.	FRK/GWP/3 months	12-31-81	20	As time permits - revise/augment file data/advise Minerals Benefication Dept.

ASARCO MONTHLY DRILLING SUMMARY

DISTRICT Southwestern U.S.

Project Hardshell | Project No. EA 0013 | State Arizona | County Santa Cruz | Month September | Year 1981 | Page 1/1

Hole No.	HDS-Grid System Collar location (Not Final)	Bearing	Dip	Footage drilled From	To	Feet	Ag oz/T (fire)	Pb%	Remarks (significant intersections, geology and/or assay intervals, etc.) Hammer Drilling: 5" bit by Drill-X, Inc. - Indicates Not Assayed - Assays by AAML
HDS-84	10,381 N. 11,972 E. 5425' Elevation	Vertical		0	80	80	0.51	--	Rock is rhyolite breccia with tuffaceous zones. Higher grade zones correspond with 2 zones in HDS-7A (160 E) of 80' 2.28 oz. (80 - 140') and 20' 3.43 oz. Ag/T (170 - 190').
				80	135	55	2.41	0.21	
				135	240	75	0.66	--	
				210	230	20	1.67	0.02	
				230	260	30	0.45	--	
					TD		1.03 mean		
HDS-85	10,272 N. 11,356 E. 5445' Elevation	Vertical		0	40	40	0.31	--	Rock is Latite porphyry (±) to about 55'. Tuffaceous aggolomerate beyond. The zone 55 - 65' is a distinct vein or structure (21.6 oz. Ag/T, 1.06% Pb) with Fe Ox > Mn Ox.
				40	100	60	5.26	0.39	
				100	120	20	0.91	--	
				120	150	30	0.60	--	
					TD		2.43 mean		
HDS-86	11,808 N. 11,757 E. 5285' Elevation	Vertical		0	105	105	0.48	--	Rock is well fractured Latite porphyry to TD. Mineralized zones are clayey, vuggy with strong hematite stain. Higher grade zones contain minor Mn-Oxide.
				105	175	70	1.87	0.25	
				175	225	50	0.81	--	
				225	320	95	3.73	0.89	
				320	350	30	0.89	--	
					TD		1.72 mean		
HDS-87	11,369 N. 11,972 E. 5260' Elevation	Vertical		0	130	130	0.73	--	Rock is Latite porphyry from 0 - 10', 30 - 230', and 340 - 365'. A fine-grained tuffaceous phase of the Latite was encountered from 10 - 30' with a mixed Latite porphyry between 230 - 340' and tuff from 365 - 400'.
				130	245	115	1.40	0.47	
				245	400	155	0.75	--	
						TD	0.93 mean		
HDS-88	11,441 N. 11,659 E. 5295' Elevation	Vertical		0	40	40	1.34	0.15	Rock is all Latite porphyry. All more or less weakly mineralized with Fe > Mn Oxides.
				40	80	40	0.59	--	
				80	130	50	1.35	0.50	
				130	160	30	0.63	--	
				160	205	45	1.01	0.2	
				205	240	35	0.57	--	
					TD		0.95 mean		NOTE: 1400' total drilling averaged 1.31 oz. Ag/T.

WDP – MVK 5266

ARIZONA GEOLOGICAL SOCIETY FIELD TRIP 8: HARDSHELL SECTION, PM March 21, 1981

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INTRODUCTION AND SUMMARY

Our trip this afternoon will examine the Hardshell deposit, a large, low-grade silver base-metal manganese oxide occurrence on the margins of a zoned, base and precious metal district in the Northern Patagonia Mountains (Figs. 1-2).

We will examine portions of the volcanic stratigraphy, controlling structure, and the mineralized and altered section in Hardshell Canyon as we walk essentially down-section to the outcrop of the upper fringes of the main orebody. If time permits, we will drive to Hardshell Ridge, several hundred feet above Hardshell Canyon, to examine the altered and mineralized volcanics overlying the crest of the main orebody (Figs. 3-5).

Exploration at Hardshell by Asarco has outlined in excess of 6×10^6 tons of near-surface mineralization containing about 5 oz. Ag/T, less than 0.01 oz. Au/T, several percent total Pb and Zn, and about 15% MnO_2. Significant tonnages of lower-grade silver and base-metal mineralization with relatively lower manganese content are found in surrounding stratiform and fracture zones (Table 1).

The main manganese oxide-rich zone forms a blanket-like body or manto up to 200 feet thick over a 2000 by 200 to 1000-foot area and is primarily confined to gently-dipping, Mesozoic pyroclastic and epiclastic tuffs of rhyolite composition. Texturally the manganese and minor iron oxides in the manto form crystalline veinlets, colliform and sooty encrustions which generally replace, fill open space, and are often apparently intergrown with jasperoidal and coarse-grained quartz that, in turn, replaced the volcanics. Massive jasperoid continues in outcrop above the manganese oxide manto as a caprock and is also weakly mineralized. Other apparently similar, parallel, stratiform oxide zones above and marginal to the main manto crop out and contain similar mineral assemblages but also include relict sulfides.

Manganese oxide-rich mineralization, and silicification, locally extend for unknown distances into the underlying Permian limestones and sandstones (Figs. 5 & 6). In outcrop to the southwest of the main manto this mineralization is accompanied by jasperoid breccia and occurs along high-angle faults, fracture zones, and bedding planes in the Paleozoic section. In a broad sense much of the Hardshell mineralization appears to be stratiform, but high-angle fracturing and faulting, apparently related to district-scale structure, appear to exert strong control on the location, lateral extent, and concentration of mineralization within stratiform zones (Figs. 7-8).

This lateral control of mineralization by high-angle structure is particularly evident on structural contour and isopach maps which show that most mineralization is primarily confined to a series of pre-ore horst blocks which must have been active during volcanism. The most favorable horizon for mineralization is where Paleozoic rocks are immediately overlain by fine-grained epiclastic Mesozoic sandstones.

Other favorable horizons directly overlie or are marginal to major fracture or fault zones. We will visit the outcrop of one of these zones, the Hardshell incline. Unfortunately safety considerations and a plague of fleas preclude an underground trip down the incline.

The main manto and Hardshell incline are well zoned (Figs. 8 & 9). A drill hole assay profile shows that the main manto-MnOxide-rich zone has distinct boundaries defined by a number of chemical elements, mineralogical and textural features. The upper part of the manganese oxide zone, the contained manganese oxides, and other ore minerals are Pb-rich, while the lower portion is Zn-rich. Sb shows close correlation with silver, while As is generally concentrated at the margins of the main manto, primarily as mimetite. Cu also closely follows silver and is also relatively high in the limestone root zones of the higher-grade portions of the manto. Manganese oxide is also generally higher in the lower portion of the manto. The top of the MnOxide zone often has a strong silver "kick," suggesting possible supergene enrichment.

The lower portion of the massive silica caprock has a distinctive greasy-green color — caused in part by the oxidation products of sulfides. Increased percentages of clear, coarse-grained quartz veinlets also indicate nearness to main manto mineralization. In the main manto and incline the percentage of coarse-grained, zoned, often terminated, quartz crystals closely correlates with grade of mineralization.

The top of the massive silica is defined by a red "clay" zone with increased percentages of sericite and kaolinite with hematite and goethite after pyrite. The red clay zone is anomalous in silver, copper, and antimony. The altered volcanics over the massive silica are characterized by iron oxides after mainly pyrite, by sericite-illite with local montmorillonite and, distinctively, by rhombic K-feldspar or adularia. Adularia preferentially replaces pumiceous and fracture zones in the Hardshell volcanics and is an excellent guide to bonanza silver halide mineralization at the Hermosa mine (Figs. 4 & 5b) on the SE end of Hardshell Ridge. The K_2O enrichment (and Na_2O depletion) of already alkali-rich rocks is particularly evident on chemical profiles of drill holes over the main manto.

Other guides to mineralization in the Hardshell area include alunite veins, sulfidation of magnetite in the volcanics, an iron oxide color anomaly from the oxidation of pyrite, manganese oxide dendrites, and increased fracturing.

Besides the main manto, there are other stratiform Mn-oxide-rich zones, the most developed of which is the Hardshell incline (Figs. 5A, 10). The Hardshell incline has similar Pb-Zn-Mn zoning to the main manto, but much better defined structural as well as stratigraphic control to the zoning.

The present preferred origin of the silver, base-metal manganese oxides is in situ oxidation, with only minor supergene transport, of a primary assemblage containing manganese sulfide and carbonates, galena, sphalerite, pyrite, chalcopyrite, and silver-bearing sulfosalts similar to that at the Alta and Trench Camp mines. Much of the evidence for the origin of the manganese oxides comes from subsurface data and laboratory studies including detailed mineralogical identification of textures, phases and compositions, metal zoning, isotopic age dating, and fluid inclusion work.

Figure 11 shows some of the manganese oxide mineral structures found at Hardshell — the most common of which is the hollandite group. The hollandite group includes a wide variety of solid solution end members — specifically at Hardshell: cryptomelane-coronadite in which K^+ and Pb^{+2} are contained in the tunnel site of the structure: XMn_8O_{16}. A wide variety of other large cations including Ag^+ also substitute in this site. Recent work has shown that the manganese oxide groups are quite complex and may even be interlayered similar to the illite-montmorillonites. Other important silver-bearing minerals in the Hardshell area are acanthite and silver halides. Table 2 lists all minerals that have been specifically identified from the Hardshell area.

Figure 12 shows fluid inclusion homogenization and freezing temperatures from the Hardshell area. Main stage (pre-manganese oxide) quartz, calcite, and sphalerite range from 400° down to 240°C, uncorrected for pressure, with relatively low salinities. Late-stage (post-Mn oxide) calcite, quartz, and cerussite range from about 180°C down to less than 40°C with very low salinities. These temperatures and salinities with the presence of vapor-rich fluid inclusions above about 340°C would suggest a depth of formation of 1.5-2.0 km in a hydrostatic system. For comparison, stratigraphic evidence suggests at least 1 km of cover over the Hardshell deposit during hypogene mineralization.

Main stage quartz and calcite prior to manganese oxides have similar fluid inclusion temperatures to main stage quartz and sphalerite intergrown with other sulfides. This suggests that the manganese oxides are secondary products of previous minerals. A second thermal event would account for the relatively high post-Mn oxide temperatures.

Support for two distinct thermal events comes from K/Ar dates (Fig. 3) on Hermosa adularia (59 m.y.) formed at about 270°C and on cryptomelane (19 m.y.) from the base of the main manto. The date on the cryptomelane does not suggest the age of the second thermal event, but the 29 and 24 m.y. ages on the Harshaw Tuff suggest that volcanism was active in the Mid-Tertiary. Additional support for Mid-Tertiary oxidation at Hardshell comes from the presence of Hardshell-type manganese-oxide-jasperoid boulders in the "Whitetail-Gila"-type basin-fill conglomerates above the Harshaw Tuff in the headwaters of Harshaw Creek.

FIELD TRIP

NOTE: From a vantage point on Red Mountain, several important tectonic, physiographic, and geologic features will be pointed out. These include the main range of the Patagonia Mountains, NW-trending Alum Gulch controlled by the January-Norton shear zone, the dumps and tailings at the Worlds Fair and Trench Camp mines, Harshaw townsite and Creek, American Peak (45° N-dipping, Permian carbonates and sandstones armored by jasperoid breccias on the summit), Hardshell Creek, drill roads and the faint iron oxide color anomaly on Hardshell Ridge, Hermosa Canyon, the San Rafael Valley, and the Late Tertiary conglomerates being dissected by the headwaters of Harshaw Creek. A brief discussion of circular linear features, possible calderas, and zones of major NW faulting will also take place from this vantage point.

STOP A: (Lunch) Harshaw Townsite. Harshaw had approximately 2000 people in the immediate area 100 years ago, mostly associated with the Hermosa mine and mill, the Trench Camp mines and a wide variety of prospects in the local area. Harshaw was relatively active up until the late 1960's when much of the townsite was cleared. The ASARCO Trench Mill on the hill to the west operated from 1939 to 1964 treating ores from the Trench Camp veins, the Flux mine and custom ores from the Washington Camp-Duquesne area.

Those who wish to wander during lunch can note the thick flows of the basal trachyandesite of Meadow Valley (Simons, 1972) called "diabase" in ASARCO field terminology and the overlying white, biotitic Harshaw Tuff of air-fall and water-laid origin.

An interesting contact in the trachyandesite can be observed on the cliffs above the Harshaw cemetery. A latitic horizon at a flow contact in the trachyandesite contains blocks of andesite and vice-versa.. Such latitic horizons are common in the trachyandesite with a pink groundmass of K-feldspar and finely divided hematite. Amygdaloidal flow-top horizons with strong hematitic alteration are common in the Harshaw area and were a good guide to ore. Ore shoots developed where the fissure-veins of the Trench Camp mines intersected the slightly shallower-dipping trachyandesite flows.

Travel 0.9 mile SW on the Harshaw Creek road to Hardshell Camp. One adobe building remains east of the road. Turn left (east) and proceed about 1200 ft. to the dumps at the Alta Mine. Note how the diabase weathers to cobbles.

STOP B: (Park trucks; proceed on foot from here) Alta Mine Dumps. The Alta vein dips about 40° NNE and was essentially stratiform within the Hardshell rhyolite breccia. The rhyolite is overlain in slight angular unconformity by the trachandesite. An amygdaloidal-hematitic shear zone in the trachyandesite can be traced to the NW into elements of the January-Norton shear zone. Shrader (1915) reported that the Alta vein was 2-3 ft. wide and extended to about 300 ft., but the works had been dismantled by 1905. Production was 3500 tons 35% Pb, 1% Cu, and 10 oz. Ag/T with minor Au (Keith, 1975). A wide variety of sulfides and their oxidation products can be noted in the jarositic dump material including galena, sphalerite with various amount of Fe and Mn, chalcopyrite, tetrahedrite, pyrite, rhodochrosite. Under the microscope, covellite, acanthite, ruby silvers, and embolite can also be noted.

Proceeding up Hardshell Creek, the 30-40° NE dip of the Hardshell rhyolite breccia is obvious. The Mn and Fe oxide staining on shears in the stream cut dies to the SE. Unfortunately the bed of Hardshell Creek is covered with alluvial and reworked dump material from flash floods which covers the trace of the Hogan fault zone (continuous with the Alta and January-Norton fault systems). The creek bed provides a wide variety of mineralization types from mines upstream.

No actual offset on the Hogan fault zone more than a few feet of reverse movement can be demonstrated. However, the juxtaposition of NE-dipping rhyolite to the NE and the similar-dipping diabase to the SW suggests some offset. An unconformity and topography on the top of the rhyolite may account for some of the apparent offset. The dumps of the Hardshell incline and tailings from the oxide mill can be noted along the left side of the canyon. The airshaft of the Hardshell incline is on the left.

STOP C. Hardshell Incline - dumps at the old Engine Room (Incline portal is caved).

The Hardshell incline area was first staked in 1879, but the incline zone was not discovered until 1895 when R. R. Richardson sunk a 40 vertical shaft and ran the incline to 230 level. From 1896-1905 the incline was extended to the 500 level and about 20,000 tons of shipping and milling ore were mined. Sporatic mining from 1905 to 1940 produced several thousand tons of ore including Mn ores during WW I. ASARCO optioned the mine in 1940 in search of sulfide ores to feed the Trench mill. The sulfide ore search was unsuccessful, but about 2500 tons of oxide Pb-Ag ore was produced from 1943-1948. In 1963-64 McFarland, also leasing the Trench mill and Flux mine, produced about 2900 tons of oxide Pb-Ag ore, mostly from below the 500 level. Production has averaged 6% Pb and 8 oz. Ag/T.

In the late 1940's and early 1950's drilling for sulfide ores around the incline led to the discovery of Mn-oxide-Ag mineralization at the Paleozoic/volcanic contact (Fig. 5a). The major drilling project, about 45 holes, that delineated the main manto took place in 1967-68.

The Hardshell incline develops a series of 25-40° north-dipping stratiform zones from a few up to 40 feet thick. The mineralized horizons are arranged in a NE-plunging en echelon fashion and are limited laterally by high-angle, NE-dipping shears parallel to the Hogan zone. Much of the mineralization replaces sandy epiclastic and air-fall tuffaceous zones in the generally well-welded tuffaceous agglomerate. Locally, stockwork-like fracturing within the more competent, welded units are well mineralized and altered. Argillic/illitic alteration — primarily montmorillonite and kaolinite zones, in and around mineralization up to 50 feet thick, are developed and are locally sheared by post-ore movement along bedding planes. Some bedding plane movement and brecciation are pre-ore.

Two main ore types occur in the incline. Footwall ores are Mn-Ag-Zn>Pb-rich and are very similar to main manto ores. Hanging-wall Pb-Ag ores are manganese and zinc-poor (and often iron-rich) and essentially consist of cerussite with minor anglesite, galena, and pyromorphite-mimetite. The dump material contains these and a wide variety of oxidized Pb, Zn, Cu, Mn, Ag minerals listed on Table 2.

Structural contours on the top of massive silica and the manganese-oxide manto underlying the incline show an antiformal surface over the Hogan fault zone, suggesting NW fracture control of mineralization along Hardshell Creek (Figs. 7 and 8).

STOP D. Steam cut across from Hardshell Incline dumps. Hardshell Creek has scoured to bedrock here exposing a volcanic conglomerate with a wide variety of well-rounded clasts in a tuffaceous matrix. Some NW-trending Fe and Mn-oxide filled fractures can also be noted here. The general N to NE dip of the volcanic section, minor flexure of the beds, and high angle faults (some apparently post-mineral) are evident in the immediate area. The volcanics in the stream cut were mapped by Davis (1970) as part of tuffaceous agglomerate/conglomerate unit of the Hardshell (formerly Chief) Volcanics. Actual lithologic units of the Hardshell Volcanics are difficult to trace both laterally and vertically outside the area of close-spaced drilling. Your opinion on the volcanic environment represented by the various units in the Hardshell area is invited. Many have suggested that this is a caldron-margin environment.

Proceeding up Hardshell Creek the massive silica caprock can be noted on the canyon walls to the south and east. Minor old workings are located along high-angle fracture zones and thin stratiform zones south of the incline along the east side of the canyon. Mineralization was primarily Mn-oxides or silver halides associated with adularia and quartz-filled fractures. Only a few of the workings produced more than 100 tons. A wide variety of jasperoid-Mn-oxide textures can be noted in the boulders in the creek bed.

STOP E. Outcrop of unsilicified fine-grained clastic unit of the Hardshell Volcanics. This is at the gradational contact zone with the overlying tuffaceous agglomerate unit. Beds containing breccia fragments are not uncommon in the fine-grained unit. Strong leisegang banding after disseminated pyrite in tuffaceous matrix is common. Elsewhere the fine-grained unit exhibits fluvial cross-bedding. Most of the fine-grained tuffaceous sandstone has been replaced by fine-grained, jasperoidal silica along Hardshell Creek, but the breccia horizons are still locally visible. Proceed up Hardshell Creek.

STOP F. Outcrop of limestone conglomerate unit of Hardshell Volcanics along west side of Hardshell Canyon. Breccia clasts and cobbles of Paleozoic limestone, mostly from the Permian Concha and Scherrer Formations are locally common in the Hardshell Volcanics and are often found throughout the Mesozoic volcanic section of SE Arizona. Beds containing cobbles, usually less than a foot in diameter are most common, but blocks up to several hundred feet long and tens of feet thick can be noted. Limestone conglomerates are most common at or near unconformities in the volcanic section, for example, along the Hardshell incline horizon.

The limestone clasts or cobbles generally make up 70 to 95% of the unit. The matrix consists of well silicified and altered, sometimes welded, volcanics similar to the tuff agglomerate and rhyolite breccia units. The limestone unit as a whole and many of the fragments are locally brecciated, rehealed, and silicified, especially near upper and lower contacts. Higher proportions of volcanic fragments are found near the contacts and often the unit appears to be completely gradational into the enclosing volcanics. The limestone clasts are often marmorized and replaced by fine-grained silica with trace wollastonite. In northwest Alum Gulch at the Flux mine, these limestone blocks in volcanics are mineralized.

The limestone breccias and conglomerates have been well described by Simons and others (1966) and Davis (1970). Possible modes of origin supported by field evidence include fluvial action, landslide-gravity slide blocks, lahars, rafting or dragging by lava, ash or breccia flows or as xenoliths in an eruptive breccia.

Proceeding up Hardshell Canyon down through the jasperoid caprock to the main manto, the canyon narrows. A wide variety of relict textures in the jasperoid can be noted. As the Salvador mine is approached, increased percentages of greasy yellow-green flooding can be noted in the jasperoid, probably caused by finely divided minerals of the jarosite-iron sulfate group. Microscopically the jasperoid becomes coarser grained. The percentage of clear and cloudy quartz veinlets cutting the jasperoid increases and the width of the veinlets increases. All the rock here and in the stream bed is "ore" running in excess of 5 oz. Ag/T.

STOP G. Salvador Mine. This area is the closest outcrop to the upper surface of the main manto and represents leakage of MnOxide mineralization. The most prominent fracturing is E-W, dipping about 35° N and is on trend with fracturing in the Hermosa mine about 2500 feet to the east. Here as elsewhere at Hardshell, low-angle fracturing and shearing may reflect old bedding planes.

About 1000 tons of 30 oz. Ag/T ore were shipped in the 1880's and 2800 tons of 20 oz. Ag/T (2% Pb, 2% Zn, 15% Mn) ore were shipped from 1936-1944. Careful examination of fractures in the Salvador works will reveal drusy quartz-lined vugs with Mn-oxide encrustations and needles, identical to main manto ores intersected in drilling. Trace amounts of pyromorphite-mimetite and cerussite can also be noted.

Farther up the canyon the Black Eagle and Bender mines contain similar mineralization along high-angle fractures and faults between Paleozoic limestones and Hardshell Volcanics and short distances along bedding planes. These faults localized silicification producing jasperoids and jasperoid breccia. Such structures are similar to those beneath the main manto.

Proceed back down Hardshell Canyon to the Alta Mine. If time permits drive up the Branch Creek road past the Welch Shaft sunk in 1920 to 420 ft. in hopes of encountering Hardshell mineralization at depth. High inflows of water prevented extensive development on the 420 level, but fault gouge containing thin stringers of galena and the usual oxidized Hardshell assemblages were encountered. The Welch Shaft served as a water supply to the Trench mill from 1939-1964.

Proceed uphill to the SE crossing a sill or flow of latite porphyry in the Hardshell Rhyolite Breccia and the North Hermosa workings at about 5400' elevation. Note that the plateau along Hardshell Ridge can be projected across to the San Rafael Valley to the east. This area of Hardshell Ridge was probably only thinly covered in Mid-Tertiary time and locally has deep soil development.

STOP H. Park trucks and proceed on foot on drill roads. Thin outliers of "diabase" exposed here are slightly more porphyritic than upper parts of the diabase. This lead Simons (1974) to suggest that these outliers were actually apophyses of a pyroxene monzonite pluton feeding trachyandesite flows. Drilling shows this to be wrong.

We will examine some of the high-angle fracture zones and textures in the rhyolite breccias along the drill roads. Many of the fracture zones are flooded with adularia and quartz; others have a distinct hematitic gouge zone. The exact trace of the American fault against which the main manto terminates is not exposed, but is well defined by drilling. Although many of the north-south, east-side down faults in the area have minor post-mineral movement, most of the movement must be pre-trachyandesite since trachyandesite shows only minor offset. The majority of fault offset may be synchronous with volcanism since volcanic units abruptly thicken and repeat themselves to the east of these faults (Fig. 5b).

These north-south high-angle faults must have strongly limited mineralization to the east since the favorable fine-grained clastic units in the Hardshell Volcanics are only weakly mineralized except for thin zones like the Hermosa Mine. Depth to the Paleozoic in the Hermosa area is in excess of 1200 ft. and could be up to 7-8000 ft., based on the Mesozoic section exposed between Hermosa and Mowry (Figs. 4, 5b).

In summary, most Hardshell mineralization is localized in a series of horst blocks at the southeast end of a major shear-fracture zone (January-Norton) against major north-south offsets. The location of the main manto orebody itself is due to favorable host rocks and the permeability contrast created by the slightly earlier but cogenetic jasperoid caprock.

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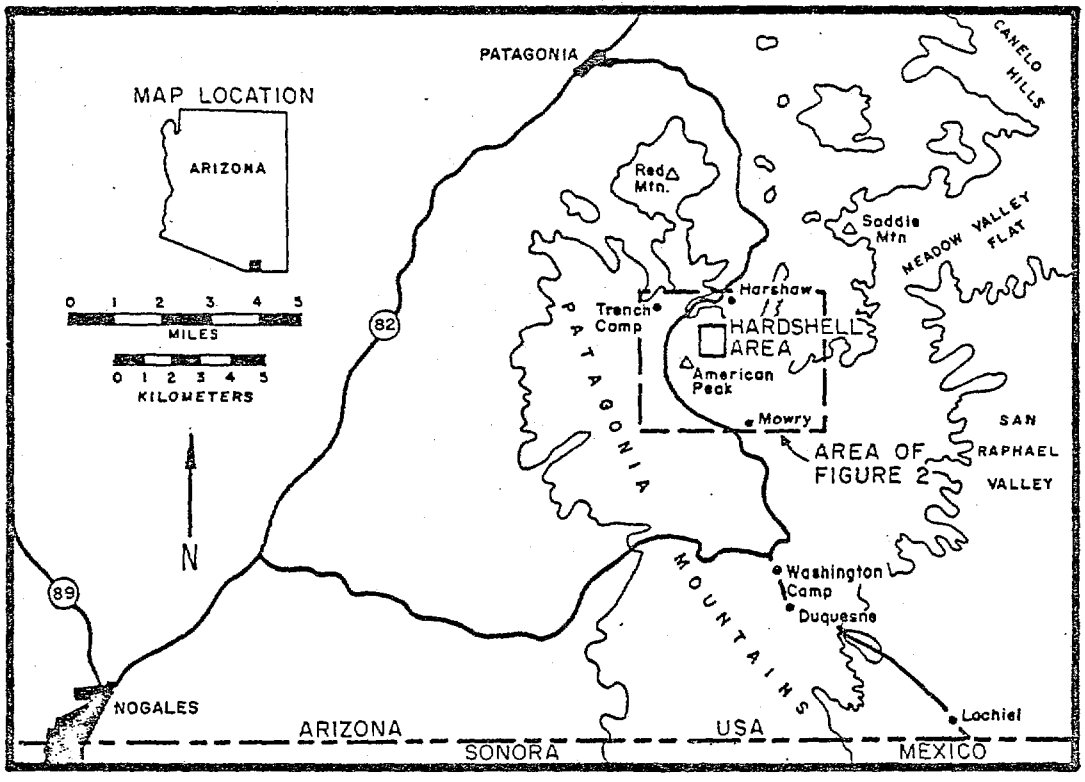


Figure 1. Location of the Patagonia Mountains (5000-ft. contour outline). The areas of Figure 2, the greater Hardshell area, and Figure 4, the immediate Hardshell area, are outlined.

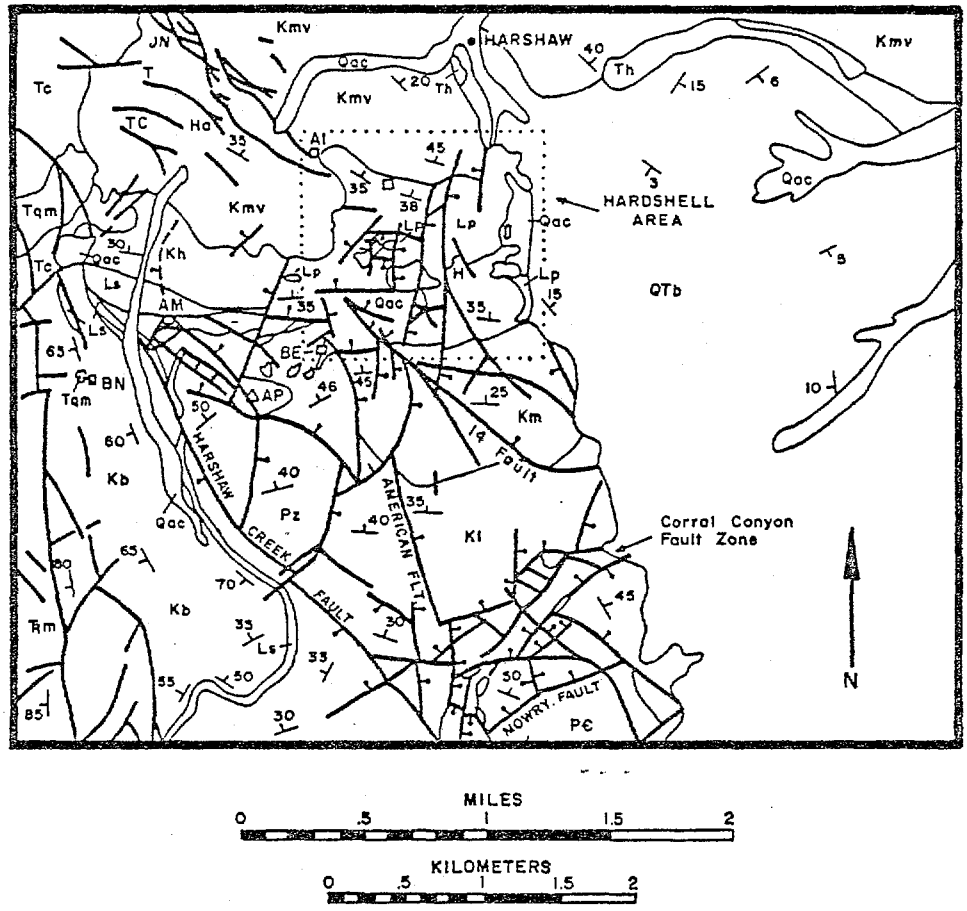


Figure 2. Geologic Map of the Greater Hardshell Area, Harshaw to Mowry, Northeastern Patagonia Mountains. Compiled from Davis (1970), ASARCO file data, Simons (1974) and Baker (1961).

EXPLANATION

- Q_{ac} Quaternary Alluvium and Colluvium.
- QT_b Quaternary-Tertiary Basin-Fill Conglomerates, "Gila"-type.
- T_h Harshaw Tuffs, Calcareous.
- T_{qm} Quartz Monzonite Porphyry Intrusive.
- T_c Chief Volcanics. (TK_v of Simons (1974)).
- K_{cv} Trachyandesite of Meadow Valley. (Simons(1974).
- K_h Hardshell Volcanics, Ash-Flow Tuffs and Breccias; Epiclastic Sediments.
  - lp Latite Porphyry Sills(?).
  - ls Limestone Conglomerate and Breccia.
- K_m Lavas and Ash-Flow Tuffs.
- K_l Volcanics and Sediments in Corral Canyon (Baker(1961); JTa_{vc} of Simons(1974)).
- K_b Bisbee Group Sediments (Siltstones, Conglomerates, Limestones).
  - ls Limestone Marker Bed.
- T_m Lt.Wrightson Formation(?)-Simons(1974). Silicified Rhyolites, Tuffs, Quartzites.
- Pz Paleozoic Sediments, Cambrian to Permian, Predominately Carbonates.
- pC Precambrian Quartz Monzonite and Hornblende Diorite.
- s Massive Silica, Jasperoid, Jasperoid Breccia.
- Shaft
- 35 Attitude of Bedding or Flow Foliation.
- Fault- Ball and Bar on Downthrown Block.

ABBREVIATIONS

A-A	American Fault	BN	Blue Nose Mine
Al	Alta Mine	H	Hermosa Mine and Fault
Am	American Mine	JN	January-Morton Fault
AP	American Peak	M	Mowry Mine and Tenmile
BE	Bender Mine	T	Trench (Hagen) Vein

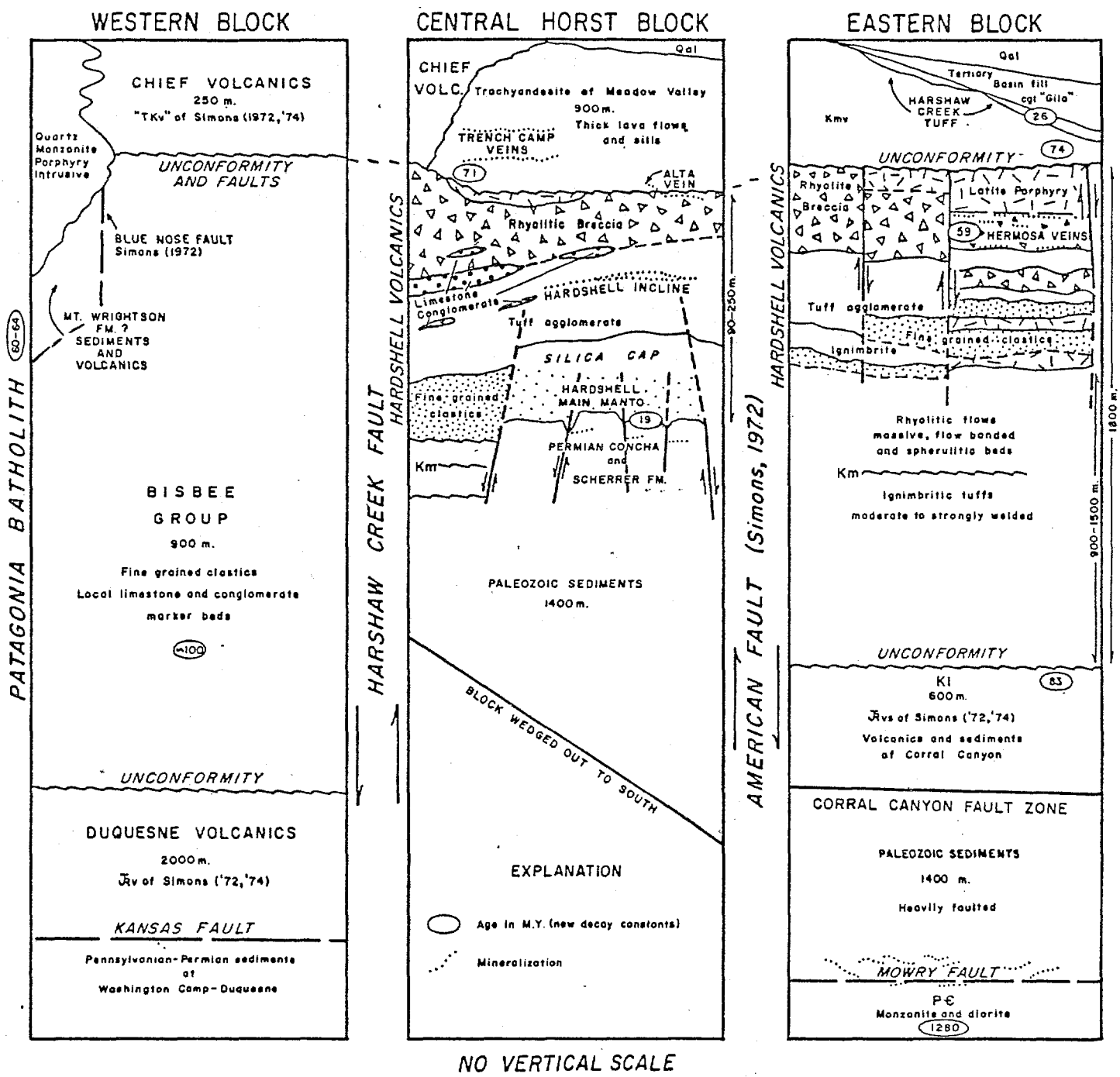
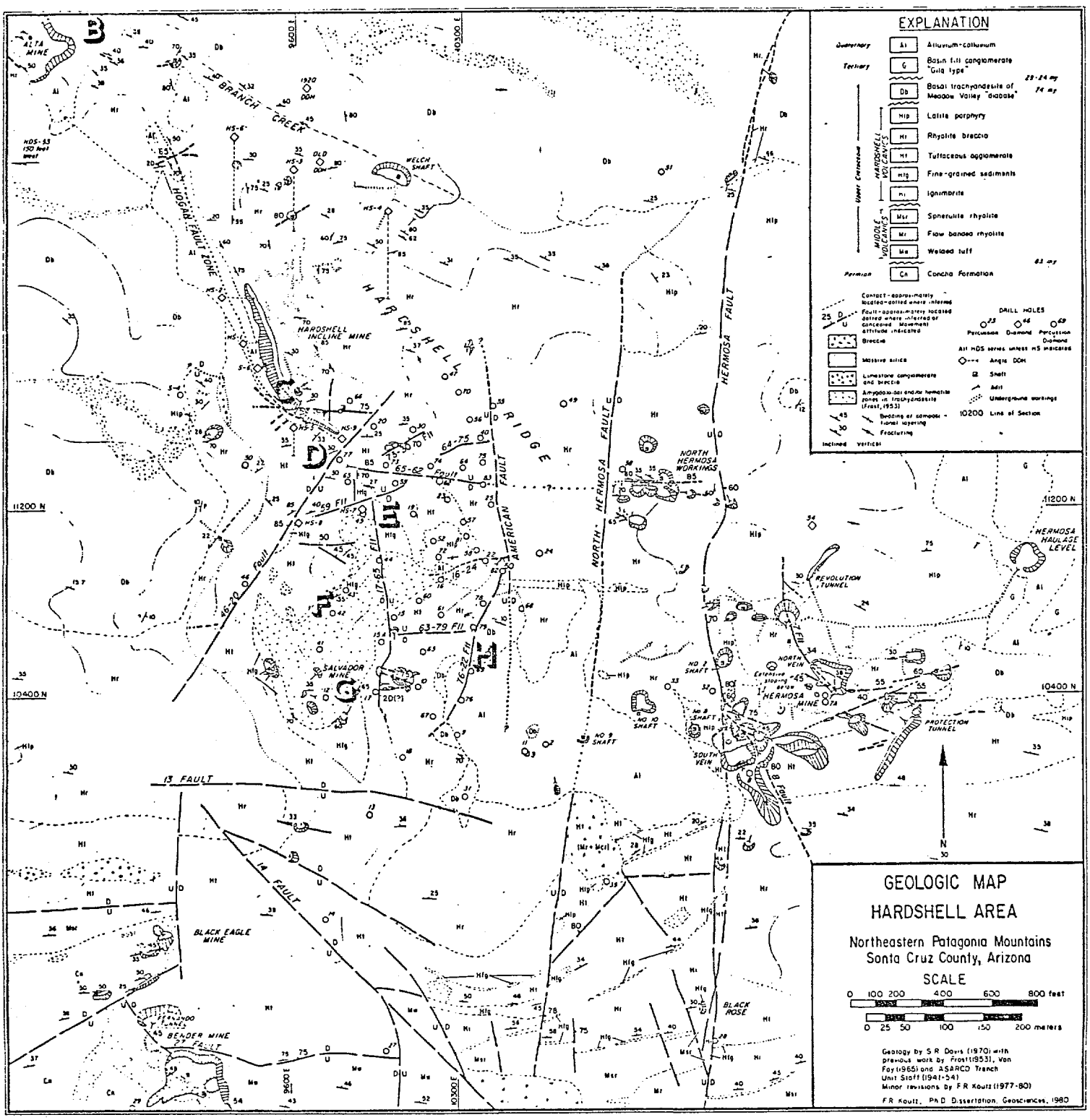


Figure 3. Lithologic Relationships and Tectonic Blocks, Northeastern Patagonia Mountains (in part, after Simons[1972]).

Figure 4. Geologic map of the Hardshell area. We will walk from the Alta Mine dumps (in the NW corner) up the Hogan fault zone to the southeast with major stops at the Hardshell Incline, Ht-Hfg contacts, limestone breccia and conglomerate west of the 17-65 fault, in the massive silica caprock and at the outcrop of the main manto orebody at the Salvador Mine. If time permits we will examine the diabase-rhyolite breccia contacts and alteration in the rhyolite along drill roads on Hardshell Ridge.



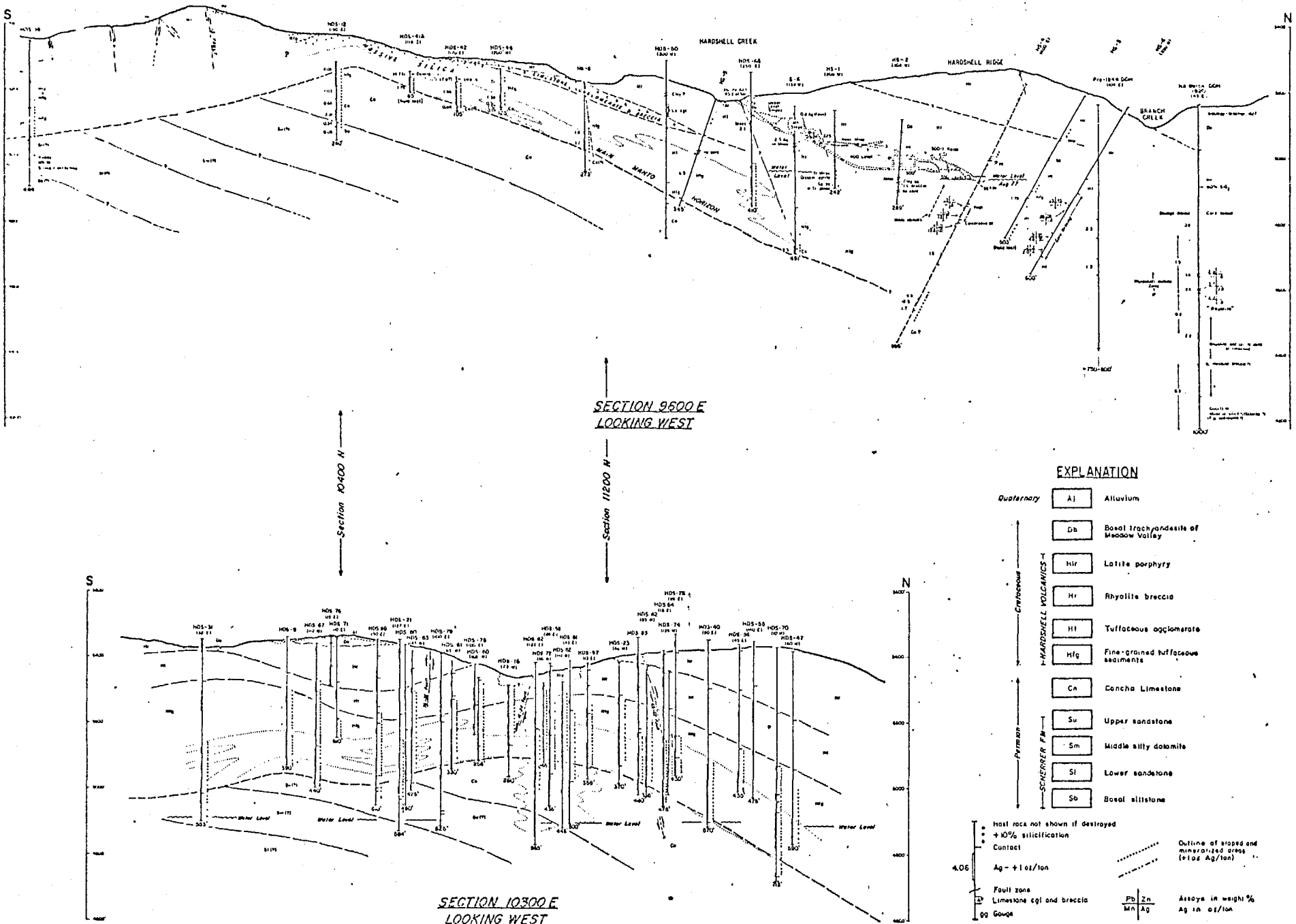


Figure 5a. N-S cross-sections looking west, Hardshell Deposit. Note positions of main manto and Hardshell incline.

HARDSHELL MANTO
Harshaw District
Santa Cruz County, Arizona

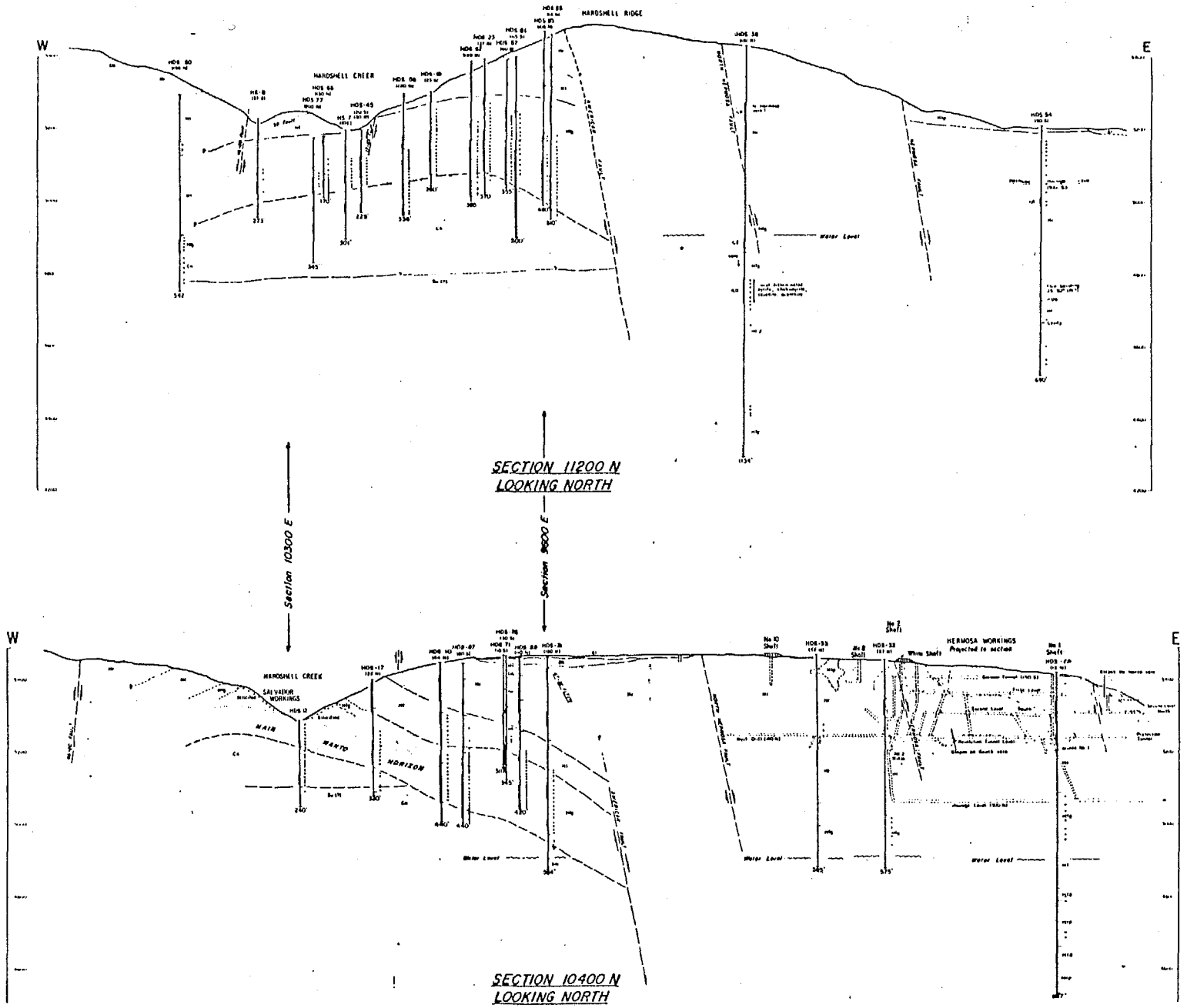


Figure 5b. E-W cross-sections looking north, Hardshell and Hermosa Deposits. Note position of water table.

EXPLANATION ON N-S SECTIONS

0 100 200 400 600 feet

0 25 50 100 150 meters

HARDSHELL MANTO
Harshaw District
Santa Cruz County, Arizona

F.R. Koutz, Ph.D. Dissertation, Geosciences, 1980

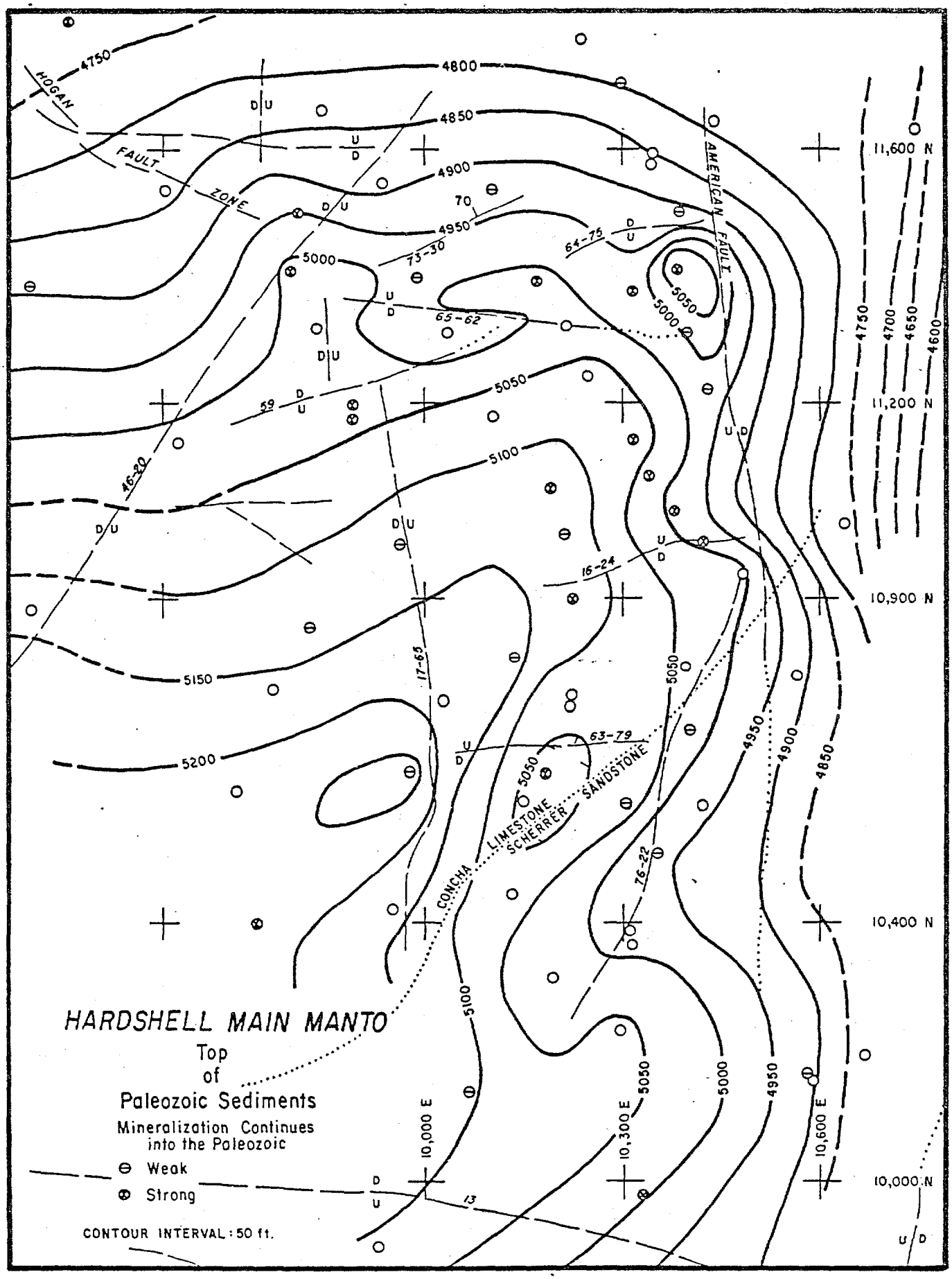
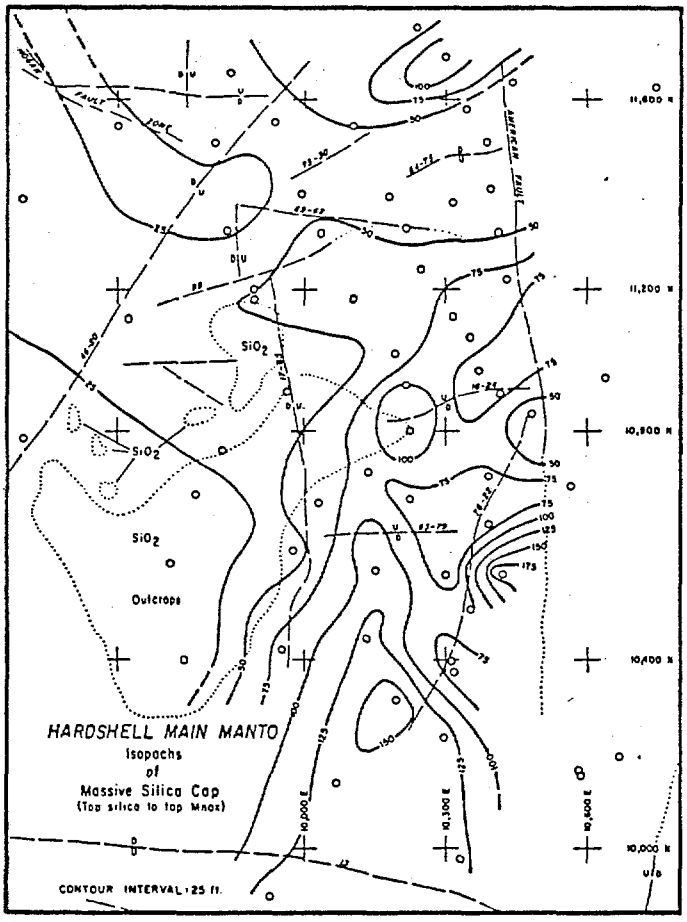
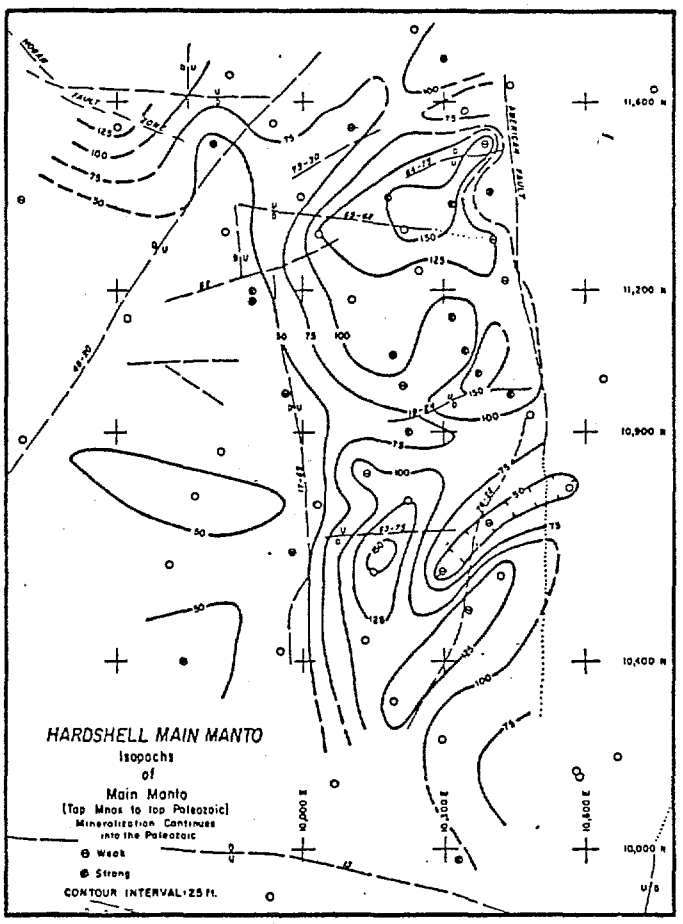
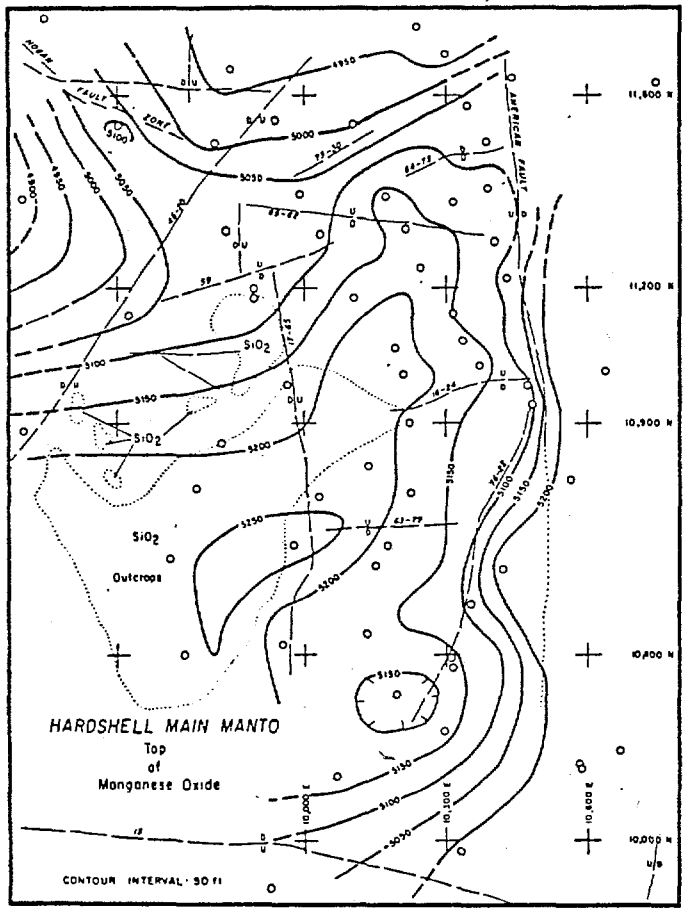


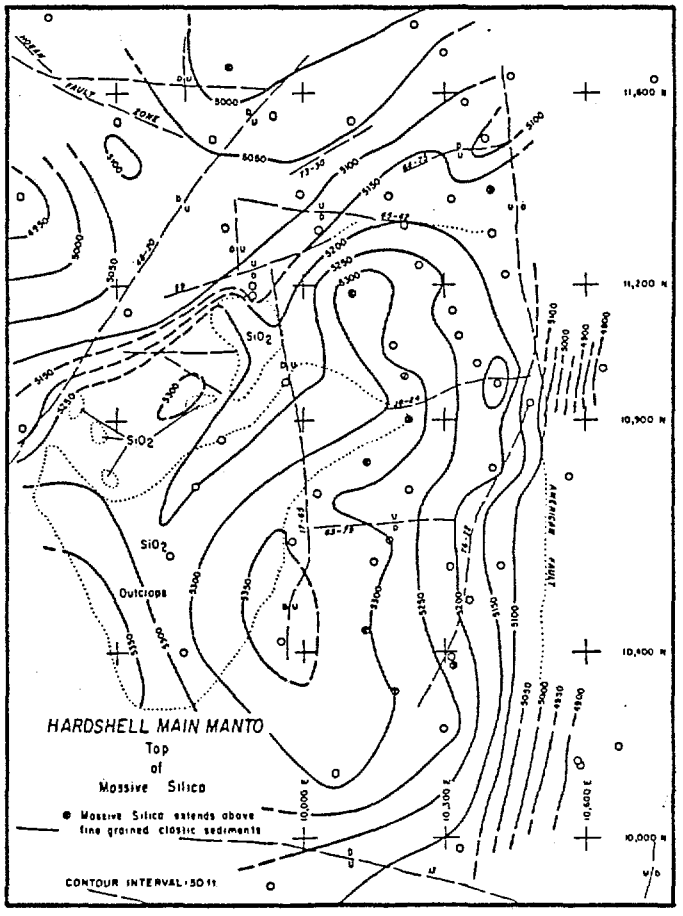
Figure 6. Structure contours on top of Paleozoic. Fault traces are on the outcrop surface and not projected to the Paleozoic.

Figure 7.







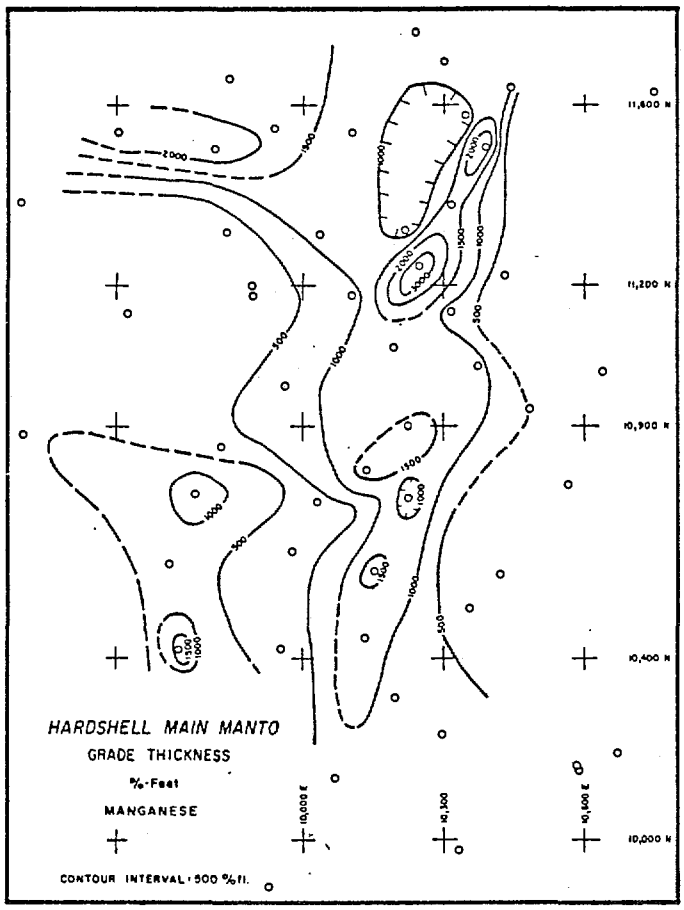


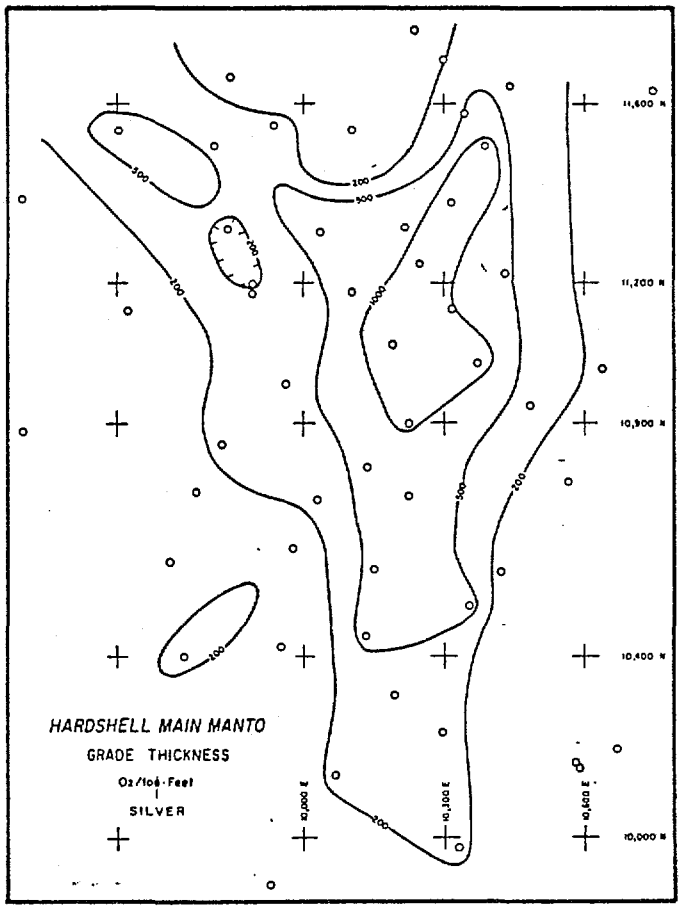
SCALE

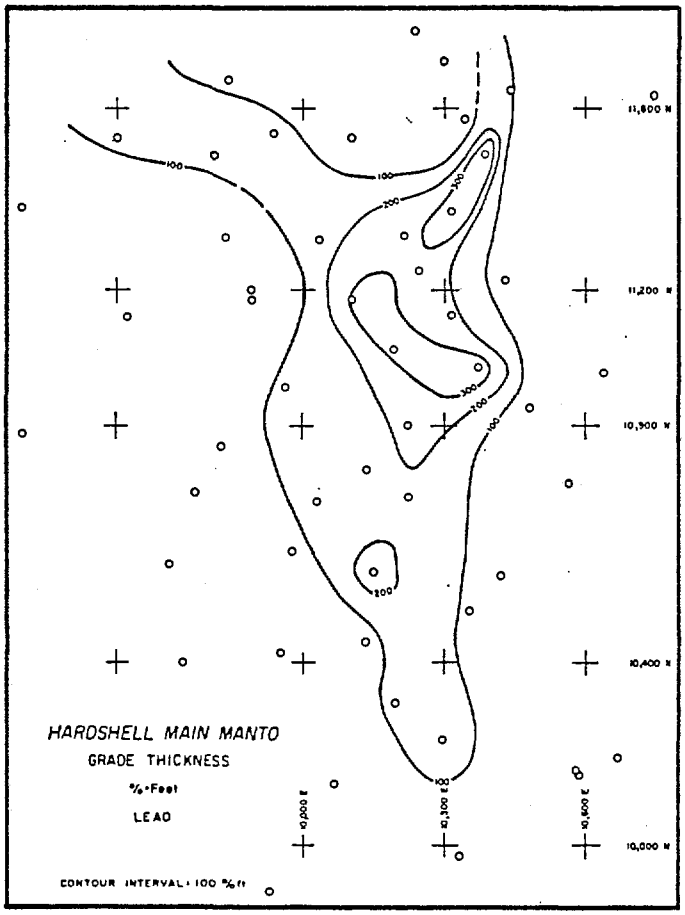
0 25 50 100 150 200 meters

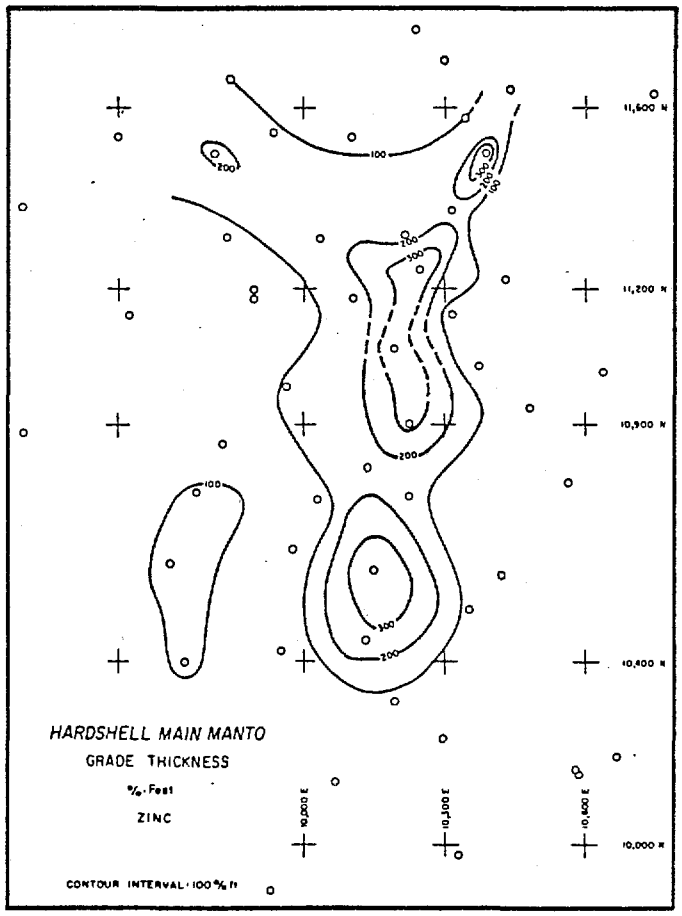
0 100 200 300 400 500 feet

Figure 8.









SCALE

0 25 50 100 150 200 meters

0 100 200 300 400 600 feet

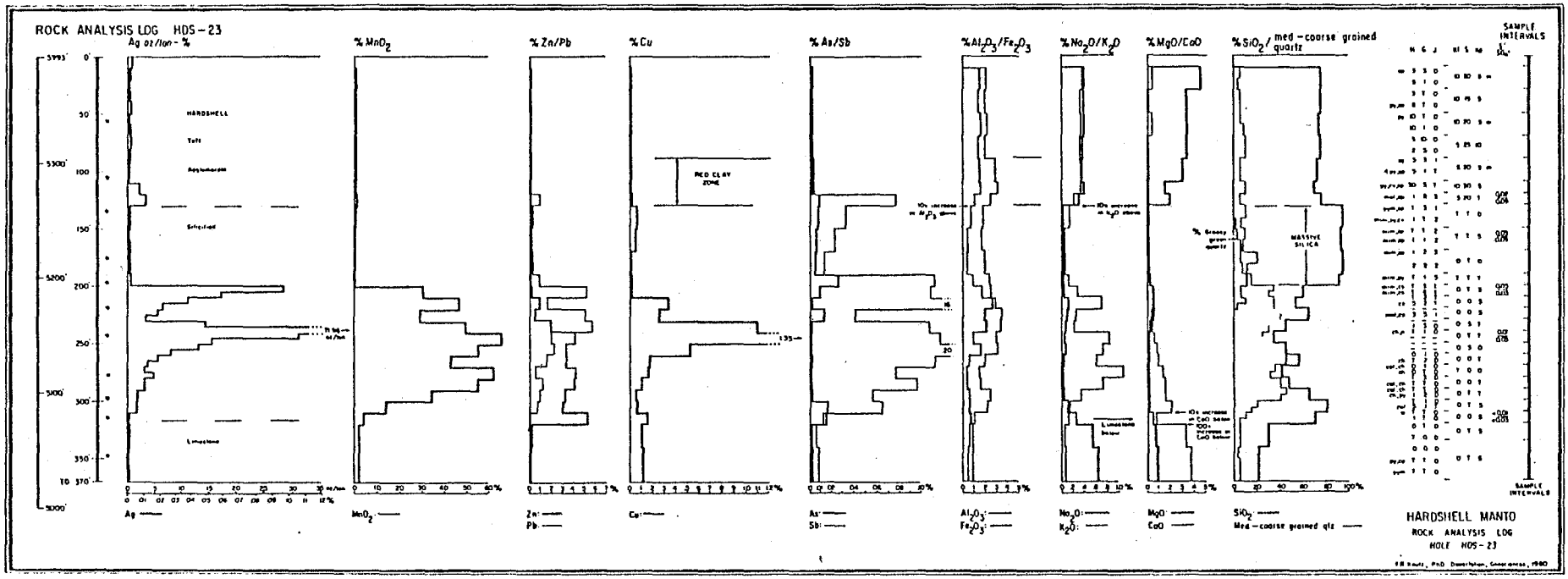
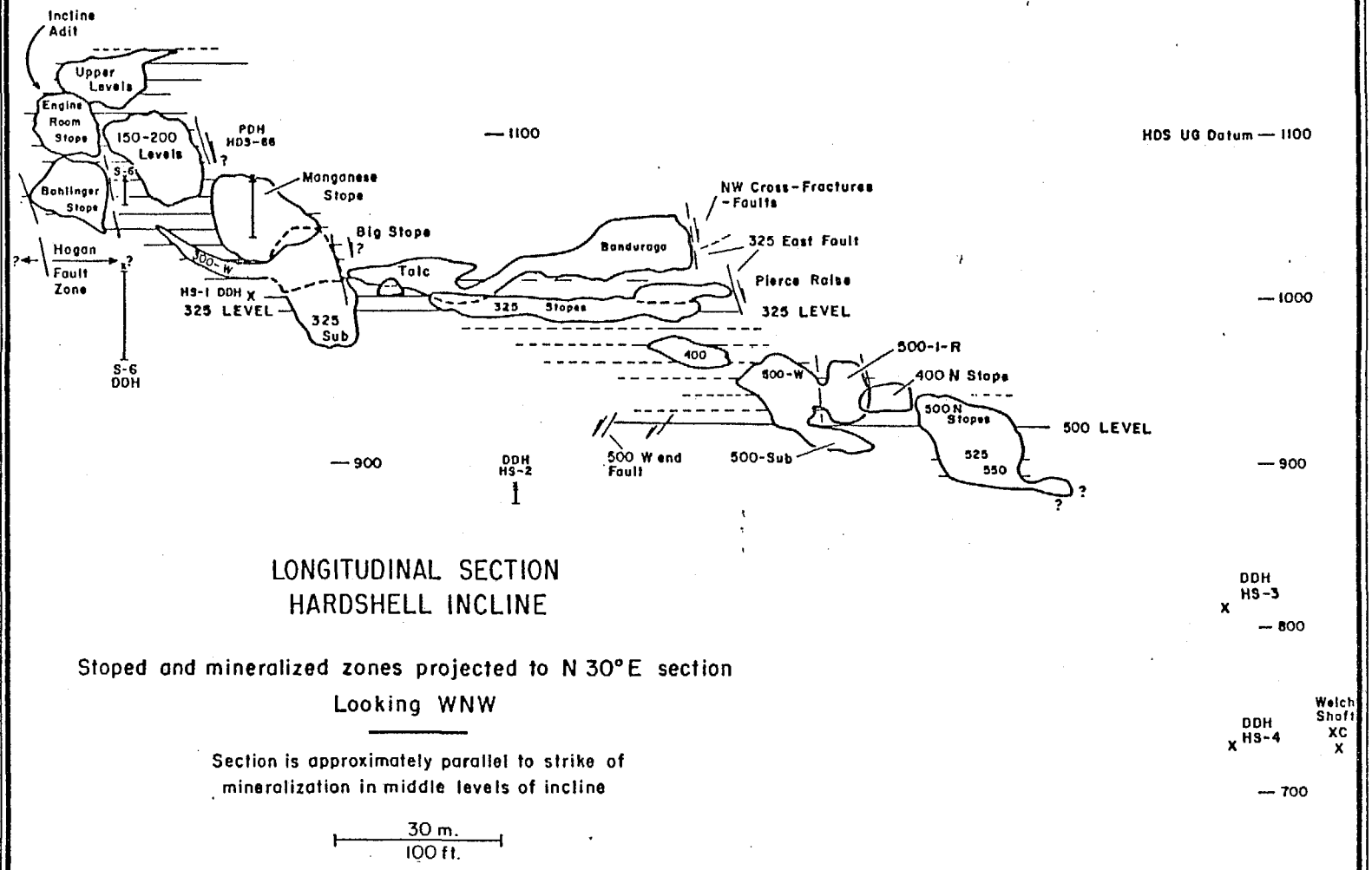


Figure 9. Rock analysis log through one of the higher-grade drill holes through the main manto. Note the positions of change in scale of Al_2O_3, K_2O and CaO.
Abbreviations: H = Hematite, G = Goethite, J = Jarosite, Kf = Potassium-feldspar, S = Sericite, Ka = Kaolinite, m = montmorillonite, py = pyrite, sp = specularite, mal = malachite, cv = covellite, pym = pyromorphite, mim = mimetite, cs = cerussite, ch = chalcophanite, n = nsutite, cal = calcite (late veinlets), w = willemite, cp = chalcopyrite. Mineral estimates in volume percent; less than 1% unless indicated. H & G percentages with dot to right indicate percent of drill chips strongly flooded with hematite or goethite.

Figure 10.



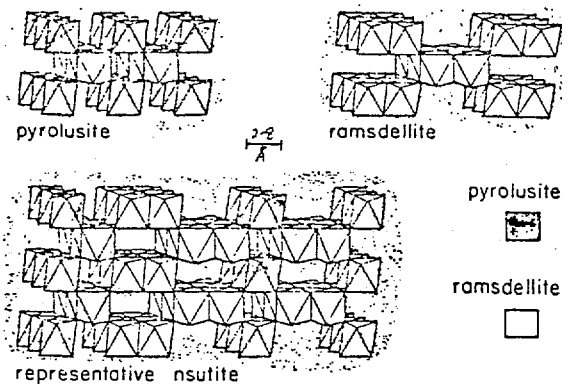
LONGITUDINAL SECTION
HARDSHELL INCLINE

Stoped and mineralized zones projected to N 30°E section

Looking WNW

Section is approximately parallel to strike of mineralization in middle levels of incline

30 m.
100 ft.



Potter & Rossman (1979) Fig. 1. Manganese oxide chain structures, looking approximately down *c* (modified from Clark, 1972, p. 228, 237).

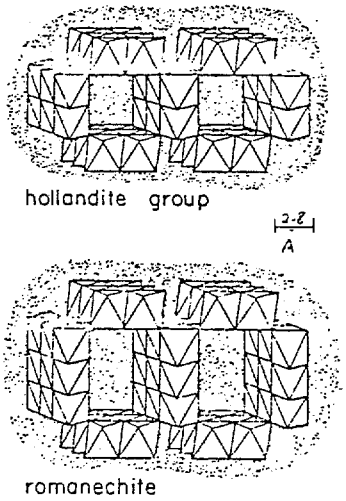
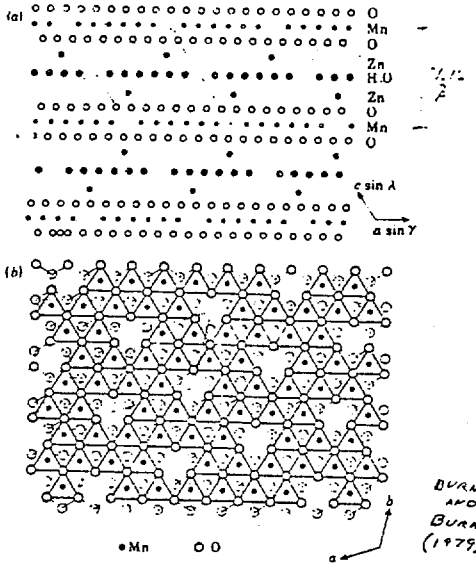


Fig. 8. Manganese oxide channel structures, looking approximately down the channels (modified from Clark, 1972, p. 237). In the hollandite group, Ba, K, Pb, or Na are present in the channels; romanechite channels contain Ba and H_2O. Potter and Rossman (1979)



Burns and Burns (1979)

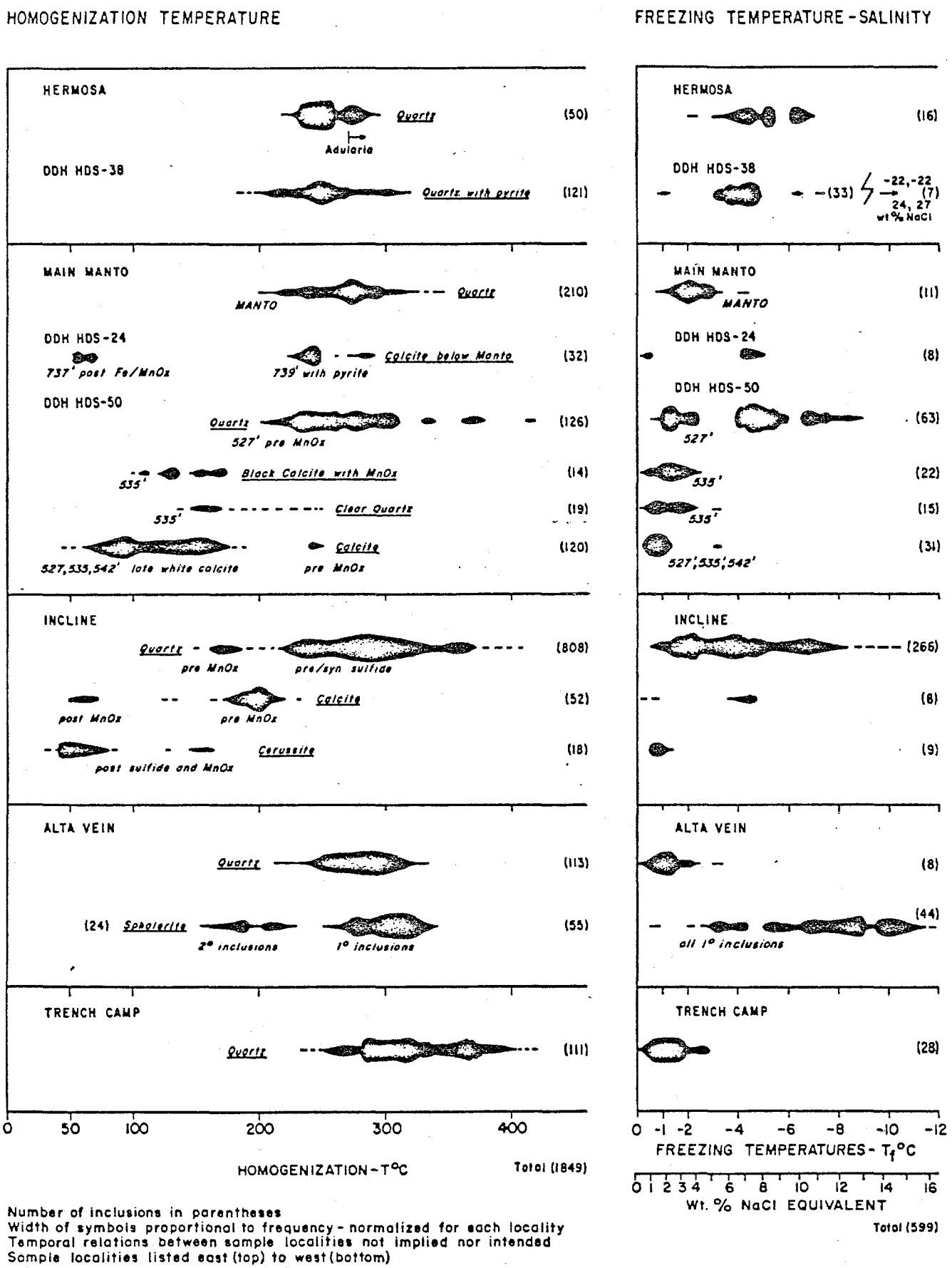
FIGURE 7. The enatcophanite structure (after Waddley 1955). (*a*) Projection along the *b* axis. Vacancies in the Mn layers define the rhombus unit cell. Note that *one out of every seven Mn positions is a vacancy.* (*b*) The edge-shared $[MnO_4]$ layer viewed normal to the basal plane. The vacant octahedral sites at the origin are at the corners of a rhombus outlining the plane of the Mn atoms. Note that each Mn atom is adjacent to a vacancy.

Ag^{+} = 1.26	Mn^{++} = 0.80
Au^{+++} = 1.37	Mn^{+4} = 0.60
Ba^{++} = 1.35	Fe^{++} = 0.76
K^{+} = 1.33	Fe^{+3} = 0.64
Pb^{++} = 1.20	Zn^{++} = 0.74
Sr^{++} = 1.13	Ti^{++} = 0.90
Ca^{++} = 0.99	V^{+3} = 0.74
Na^{+} = 0.95	Sb^{+5} = 0.62
Cu^{++} = 0.96	As^{+5} = 0.47
Cu^{+} = 0.69	Al^{+3} = 0.50
Mg^{++} = 0.65	Si^{+4} = 0.41
	$S^{=}$ = 1.84
Ionic Radii in Å.	Ar^{0} = 1.74

Figure 11. Manganese Oxide Mineral Structures

Figure 12.

HARDSHELL AREA FLUID INCLUSIONS
Summary of Temperature-Salinity Data



Number of inclusions in parentheses
Width of symbols proportional to frequency - normalized for each locality
Temporal relations between sample localities not implied nor intended
Sample localities listed east (top) to west (bottom)

TABLE 1.

APPROXIMATE CHEMICAL COMPOSITION OF HARDSHELL ORE TYPES [1]

	Main Manto Types			Other Stratiform Types		
	Pb/Zn>1	Pb/Zn<1	Massive Silica	Red Clay	Hermosa	Hardshell Incline
oz.Ag	6.7	2.4	1	1.5	4	5.5
oz.Au	0.008	0.005	–[2]	–	–	0.008
%Pb	1.9	0.54	0.25	0.08	0.3	5.5
%Zn	0.44	1.8	0.02	0.01	0.05	2
%Cu	0.12	0.095	0.02	0.014	0.05	0.2
%Mn	8.0	12.4	0.25	0.06	2.	9.
%As	0.019	0.021	0.01	0.006	0.3	0.5
%Sb	0.134	0.068	0.05	0.02	2.	0.4
%Ba	0.15	0.01	0.01	0.05	0.015	0.015
%Cd	0.009	0.01	0.008	0.008	0.008	–
%Bi	0.005	0.005	0.005	0.005	0.005	0.02
%V	0.005	0.005	0.025	0.01	–	0.02
$\%CO_2$	–	0.01-35.	–	–	–	–
%Sulfide	0.03	0.01	0.03	0.3	0.1	0.1
%Sulfate	0.02	0.04	0.05	0.1	0.2	0.1
$\%SiO_2$	77	64(25-90)	94	74	70	55
$\%Al_2O_3$	2	1.2	0.8	15	10	1-20
$\%Fe_2O_3$[3]	2.5	2	2.5	5	5	8
%MgO	0.05	0.15	0.01	0.2	0.2	–
%CaO	0.2	0.01-45.	0.02	0.02	0.1	0.5
$\%Na_2O$	0.08	0.04	0.04	0.5	0.3	–
$\%K_2O$	0.6	1.0	0.1	3.5	5.0	–
$\%TiO_2$	0.02	0.006	0.006	0.15	–	–
Source of data	drill	drill	drill	drill	drill & production	production & underground sampling

1) estimates for ore types, this is not an ore reserve, amounts do not sum to 100% and not weighted for area of influence of drill holes and sampling.

2) – means not analyzed

3) total iron as Fe_2O_3

TABLE 2.

HARDSHELL AREA MINERALOGY-IDENTIFIED

(lower case indicates of lesser importance)

Cryptomelane-Coronadite Group	$(K, Pb, Zn, Cu, Ag, Ba)(Mn^{+2}, Mn^{+4})_8O_{16}$
Romanechite Group	$(K, Pb, Zn, Cu, Ag, Ba)(Mn^{+2}, Mn^{+4})_8O_{16}(OH)_4$
Todorokite Group	$(Pb, Zn, Cu, Mn^{+2})Mn_3^{+4}O_7 \cdot H_2O$
Chalcophanite	$(Zn, Fe, Mn^{+2})Mn_3^{+4}O_7 \cdot 3H_2O$
Nsutite	$(X^{+2}, Mn_y^{+2})Mn_{1-y}^{+4}O_{2-2y}(OH)_{2y}$:y=small X=Cation
birnesite	$(X, Na, Ca)Mn_7O_{14} \cdot 3H_2O$
Pyrolusite	MnO_2

Bromargyrite (Embolite)	$Ag(Br, Cl)$
Acanthite	Ag_2S
Galena	PbS
Sphalerite	$Zn(Mn, Fe)S$
Pyrite	FeS_2
Covellite	CuS
chalcocite	Cu_2S
chalcopyrite	$CuFeS_2$
native silver	Ag
Cerussite	$PbCO_3$
anglesite	$PbSO_4$
Mimetite-Pyromorphite	$Pb_5(AsO_4, PO_4)_3Cl$
descloizite-mottramite	$Pb(Zn, Cu)VO_4(OH)$
vanadinite	$Pb_5(VO_4)_3Cl$
wulfenite	$PbMoO_4$
Willemite	Zn_2SiO_4
bindheimite	$Pb_2Sb_2O_6(O, OH)$
Tetrahedrite-Tennantite	$(Cu, Fe, Zn, Pb, Ag)_{12}(Sb,As)_4S_{13}$
Jarosite	$KFe_3(SO_4)_2(OH)_6$
Plumbojarosite	$PbFe_3(SO_4)_2(OH)_6$
Alunite	$KAl_3(SO_4)_2(OH)_6$
Hidalgoite-Beudanite	$Pb(Al, Fe)_3(SO_4)(AsO_4)(OH)_6$
melanterite	$FeSO_4 \cdot 7H_2O$
copiapite	$(Fe, Mg)Fe_4^{+3}(SO_4)_6(OH)_2 \cdot 20H_2O$
Goethite	$FeO(OH)$
Hematite	Fe_2O_3
Magnetite	Fe_3O_4
native copper	Cu
cuprite	Cu_2O
chrysocolla	$Cu_2H_2Si_2O_5(OH)_4$
Malachite	$Cu_2(CO_3)_3(OH)_2$
azurite	$Cu_3(CO_3)_2(OH)_2$
brochantite	$Cu_4(SO_4)(OH)_6$
atacamite	$Cu_2Cl(OH)_3$
turquoise	$CuAl_6(PO_4)_4(OH)_8 \cdot 5H_2O$
chenevixite	$Cu_2(Fe, Al)_2(AsO_4)_2(OH)_4 \cdot H_2O$
chalcanthite	$CuSO_4 \cdot 5H_2O$
barite	$BaSO_4$
sphene	$CaTiSiO_5$
apatite	$Ca_5(PO_4)_3(F, OH, Cl)$
zircon	$ZrSiO_4$
Gypsum	$CaSO_4 \cdot 2H_2O$
Calcite	$CaCO_3$
Mn-Calcite	$Ca(Mn)CO_3$
Rhodochrosite	$MnCO_3$
siderite	$FeCO_3$
ankerite	$Ca(Fe, Mg, Mn)(CO_3)_2$

Sericite (illite)	$KAl_2Si_3O_{10}(OH)_2$
Montmorillinite Group (including Saponite-Sauconite)	$(Ca/_2, Na)_{0.33}(Mg, Fe, Zn)_3(Si, Al)_4O_{10} \cdot 4H_2O$
Kaolinite	$Al_2SiO_5(OH)_4$
"Allophane"	$Al_2SiO_5 \cdot nH_2O$
Quartz	SiO_2
Sanadine) Orthoclase) Microcline) "Adularia")	$KAlSi_3O_8$
Plagioclase	$NaAlSi_3O_8$-$CaAl_2Si_2O_8$
Chlorite	$(Mg, Fe^{+3}, Fe^{+2}, Mn)(AlSi_3)O_{10}(OH)_3$
Epidote	$Ca_2(Al, Fe^{+3})(SiO_4)_3(OH)$
Biotite	$K(Fe, Mg)_3AlSi_3O_{10}(F, Cl, OH)_2$

ASARCO

New York Office
Office of the Secretary

June 21, 1982

Mr. R. L. Brown, Jr.:

The following is an extract from the minutes of the Advisory Committee meeting held May 19, 1982:

Exploration Appropriation #0013-22
Arizona
Hardshell Project

The Hardshell silver project has incurred an overrun of $22,000 from 1981 assessment drilling and related geological and claim work. A supplemental exploration appropriation for $26,000 is requested to cover the overrun of $22,000 and 1982 maintenance costs of $4,000.

There was approved a supplemental exploration appropriation of $26,000 to cover the cost of an overrun from 1981 assessment drilling and 1982 maintenance costs at the Hardshell Project, Arizona.

F. J. Goldthwait
Assistant Secretary

FJG:dap
Enc.
cc: S. P. McCandless - w/enc.
R. J. O'Keefe - w/enc.
J. D. Sell

xc: FRK
Hardshell File
6/25/82

ASARCO

Southwestern Exploration Division

May 6, 1982

R. L. Brown
Vice President of Exploration
New York Office

Supplemental Exploration
Authorization Request
Hardshell Project, EA-0013
Santa Cruz County, Arizona

Dear Sir:

An accrued overrun of $22,000 for the project was acquired by increased costs in completing the planned assessment holes, assaying, and support costs. Further work is underway for completion of the drilling reports, the Hermosa underground results, further surveying, and on-going claim work at an estimated cost of $4,000. This total of $26,000 is covered in the attached form 302-MB for your approval.

James D. Sell

James D. Sell

JDS/cg

Attachment

cc: WLKurtz (w/attachment)
RBCrist (w/attachment)
CDNewton(w/attachment)
FRKoutz (w/o attachment)

FORM 302-MB (9/79)

New York No. .....

APPLICATION FOR SUPPLEMENTAL EXPLORATION APPROPRIATION

May 6 19 82 Originating Office SWED - Tucson

Application is hereby made for supplemental Appropriation to cover cost, in excess of original estimate, of work authorized by New York.

No. 0013-00 through 0013-21 HARDSHELL PROJECT Santa Cruz County, Arizona

Present total Estimated Cost (Form 302-MA attached)	$ 593,500
Amount previously authorized (date 11/65 thru 8/81)	$ 567,500
Balance for which Authorization is now requested	$ 26,000

ADDITIONAL WORK CONTEMPLATED:

Final drilling reports, Hermosa underground results/report, and on-going claim work.

EXPLANATION OF INCREASED COST:

Overrun of previous budget for completion of hole drilling, assays, support, and on-going geologic and claim work.

Reviewed by ..... ACCT. MGR. OR CHIEF ACCN'T.

Recommended by James D. Sell SUPERVISOR

Approved by ..... CONTROLLER

Account Chargeable to ..... TO BE FILLED IN BY CONTROLLER

Approved by ..... VICE PRESIDENT

Approved by Advisory Committee

..... 19.....

Approved by Board of Directors

..... 19.....

..... SECRETARY

PRINTED IN U.S.A.

ASARCO

New York Office
Office of the Secretary

September 19, 1983

Mr. R. L. Brown, Jr.:

The following is an extract from the minutes of the Advisory Committee meeting held August 17, 1983:

Exploration Appropriation #0013-23
Arizona
Hardshell Project

A $17,000 drilling program has been recommended for the Hardshell silver project to cover 1982-1983 assessment work. Drilling will be done in the vicinity of the Hermosa adit where shallow low-grade silver mineralization has been encountered in previous wide spaced drilling.

In addition, an overrun in the amount of $13,000 was incurred during May and June during the staking of 53 additional mining claims and preparation of various geological reports for review by the Southwestern Mining Department.

Advisory Committee approval of a $30,000 expenditure is requested to cover the overrun and 1983 assessment drilling.

There was approved a supplemental exploration appropriation of $30,000 for assessment drilling and related geological and claim work at the Hardshell Project, Arizona.

F. J. Goldthwait
Assistant Secretary

FJG:jw
Enc.
cc: R. J. O'Keefe - w/enc.
S. P. McCandless - w/enc.

J. D. Sell

xc: AJR
FRK

FORM 302-MB (9/79)

New York No. 0013-23

APPLICATION FOR SUPPLEMENTAL EXPLORATION APPROPRIATION

July 28 19 83 Originating Office SWED - Tucson, AZ

Application is hereby made for supplemental Appropriation to cover cost, in excess of original estimate, of work authorized by New York.

No. EA-0013-00 through EA-0013-22 - HARDSHELL PROJECT, Santa Cruz County, AZ

Present total Estimated Cost	$ 623,500
Amount previously authorized (date 11/65-05/82)	$ 593,500
Balance for which Authorization is now requested	$ 30,000

ADDITIONAL WORK CONTEMPLATED:

Ongoing drilling program in Hermosa area for 1983 assessment drilling and related geological and claim work.

EXPLANATION OF INCREASED COST:

Overrun on previous budget for geological, assaying, and support for ongoing project.

Reviewed by ..... ACCT. MGR. OR CHIEF ACCN'T.

Approved by R. J. O'KEEFE ..... CONTROLLER

Account Chargeable to EXPLORATION EXPENSE
TO BE FILLED IN BY CONTROLLER

Recommended by James D. Sell
J. D. Sell SUPERVISOR

Approved by A. T. Hayhurst
~~VICE PRESIDENT~~

Approved by Advisory Committee

AUG 17 1983 19.....

Approved by Board of Directors

..... 19.....

..... SECRETARY

XC: AJR

PRINTED IN U.S.A.

ASARCO

Southwestern Exploration Division

July 28, 1983

Mr. R. L. Brown
Vice President of Exploration
New York Office

Supplemental Exploration
Appropriation Request
Hardshell Project (EA-0013)
Santa Cruz County, AZ

Dear Sir:

Attached is the SEA request for $30,000 to fulfill the 1983 assessment work on 134 unpatented claims and to cover the previous overrun, mainly incurred by staking 53 additional claims in May and June.

If you approve the above expenditures, please request a Supplemental Appropriation. Attached is a location map and Form 302-MB.

James D. Sell

JDS/cg

Attachments

cc: WLKurtz
JRStringham
AJRobles (Form only)

FORM 302-MB (9/79)

New York No. .....

APPLICATION FOR SUPPLEMENTAL EXPLORATION APPROPRIATION

July 28 19 83 Originating Office SWED - Tucson, AZ

Application is hereby made for supplemental Appropriation to cover cost, in excess of original estimate, of work authorized by New York.

No. EA-0013-00 through EA-0013-22 - HARDSHELL PROJECT, Santa Cruz County, AZ

Present total Estimated Cost	$ 623,500
Amount previously authorized (date 11/65-05/82)	$ 593,500
Balance for which Authorization is now requested	$ 30,000

ADDITIONAL WORK CONTEMPLATED:

Ongoing drilling program in Hermosa area for 1983 assessment drilling and related geological and claim work.

EXPLANATION OF INCREASED COST:

Overrun on previous budget for geological, assaying, and support for ongoing project.

Reviewed by ..... ACC'T. MGR. OR CHIEF ACCN'T.

Recommended by James D. Sell J. D. Sell SUPERVISOR

Approved by ..... CONTROLLER

Account Chargeable to ..... TO BE FILLED IN BY CONTROLLER

Approved by ..... VICE PRESIDENT

Approved by Advisory Committee

..... 19.....

Approved by Board of Directors

..... 19.....

..... SECRETARY

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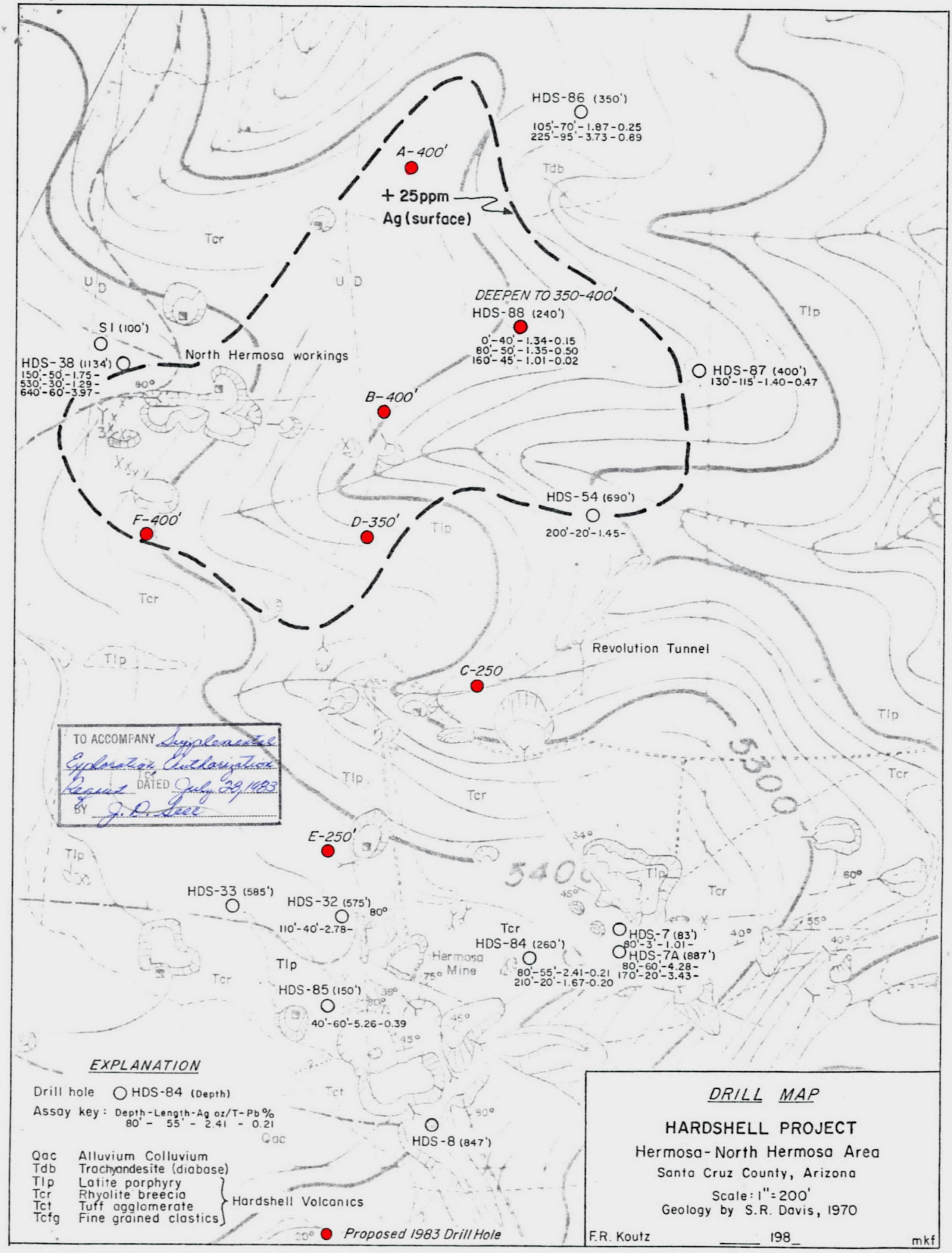
HDS-86 (350')
105'-70'-1.87-0.25
225'-95'-3.73-0.89
A-400'
+ 25ppm
Ag (surface)
Tdb
Tcr
U D
U D
DEEPEN TO 350-400'
HDS-88 (240')
0'-40'-1.34-0.15
80'-50'-1.35-0.50
160'-45'-1.01-0.02
Tlp
SI (100')
HDS-38 (1134')
150'-50'-1.75-
530'-30'-1.29-
640'-60'-3.97-
North Hermosa workings
HDS-87 (400')
130'-115'-1.40-0.47
B-400'
HDS-54 (690')
200'-20'-1.45-
F-400'
D-350'
Tlp
Tcr
Revolution Tunnel
C-250
TO ACCOMPANY Supplemental
Exploration Authorization
Request DATED July 29, 1983
BY J. D. Geer
5300
E-250'
5400
HDS-33 (585')
HDS-32 (575')
110'-40'-2.78-
Tcr
HDS-84 (260')
80'-55'-2.41-0.21
210'-20'-1.67-0.20
HDS-7 (83')
80'-3'-1.01-
HDS-7A (887')
80'-60'-4.28-
170'-20'-3.43-
Hermosa Mine
Tlp
HDS-85 (150')
40'-60'-5.26-0.39
HDS-8 (847')
Tct
Qac
EXPLANATION
Drill hole HDS-84 (Depth)
Assay key: Depth-Length-Ag oz/T-Pb%
80' - 55' - 2.41 - 0.21
Qac Alluvium Colluvium
Tdb Trachyandesite (diabase)
Tlp Latite porphyry
Tcr Rhyolite breecia
Tct Tuff agglomerate
Tcfg Fine grained clastics
Hardshell Volcanics
Proposed 1983 Drill Hole
DRILL MAP
HARDSHELL PROJECT
Hermosa-North Hermosa Area
Santa Cruz County, Arizona
Scale: 1" = 200'
Geology by S.R. Davis, 1970
F.R. Koutz ____ 198_ mkf

5477

JDS cg

ASARCO

Southwestern Exploration Division

February 10, 1984

Mr. R. L. Brown
Vice President of Exploration
New York Office

Supplemental Exploration
Appropriation Request
Hardshell Project (EA-0013)
Santa Cruz County, AZ

Attached is the location map and the Form 302-MB requesting $20,000 to fulfill the yearly assessment work on the 8 patented and 187 unpatented claims of the Hardshell Project.

As noted, we plan to continue to drill in the Hermosa area where shallow, low-manganese silver mineralization has been encountered in previous years' drilling.

If you approve of the above expenditure, please request the Supplemental Appropriation.

James D. Sell

JDS/cg

Attachments

cc: WLKurtz
JRStringham
AJRobles (Form only)

FORM 302-MB (9/79)

New York No. .....

APPLICATION FOR SUPPLEMENTAL EXPLORATION APPROPRIATION

February 10 19 84 Originating Office SWED - Tucson, AZ

Application is hereby made for supplemental Appropriation to cover cost, in excess of original estimate, of work authorized by New York.

No. EA-0013-00 through EA-0013-23, HARDSHELL PROJECT, Santa Cruz Co., AZ

Present total Estimated Cost (Form 302-MA attached)	$ 643,500
Amount previously authorized (date 11/65-07/83)	$ 623,500
Balance for which Authorization is now requested	$ 20,000

ADDITIONAL WORK CONTEMPLATED:

Ongoing drilling program in the Hermosa area for the 1983-1984 assessment year drilling and related geological work.

EXPLANATION OF INCREASED COST:

Ongoing program to expand silver reserve while maintaining claims by assessment work.

Reviewed by A. J. Robbe
ACC'T. MGR. OR CHIEF ACCN'T.

Recommended by James D. Sell
James D. Sell SUPERVISOR

Approved by .....
CONTROLLER

Account Chargeable to .....
TO BE FILLED IN BY CONTROLLER

Approved by .....
VICE PRESIDENT

Approved by Advisory Committee

..... 19.....

Approved by Board of Directors

..... 19.....

.....
SECRETARY

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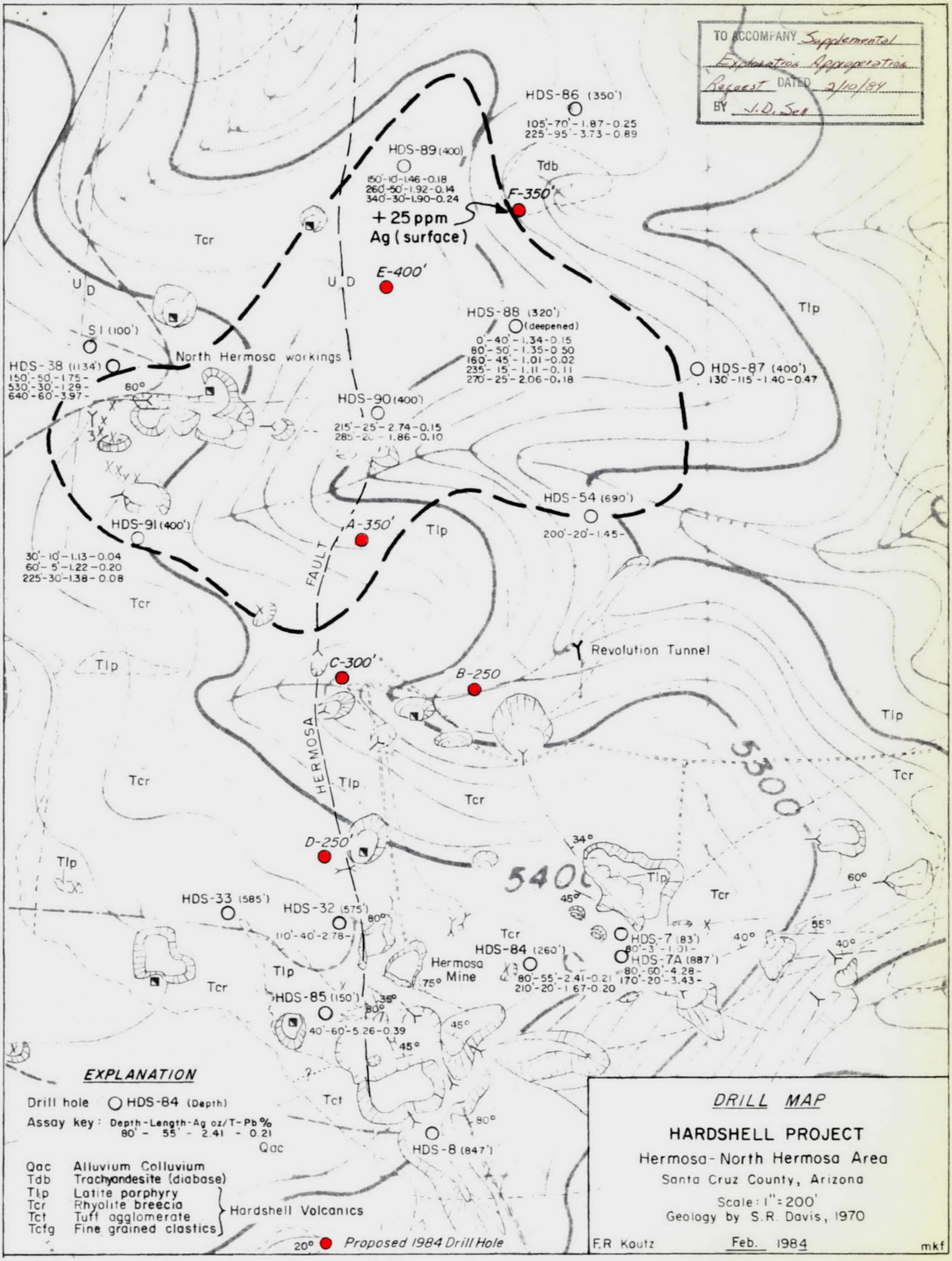
TO ACCOMPANY Supplemental Exploration Appropriation Request DATED 2/10/84
BY J.D. Sell
HDS-86 (350')
105'-70'-1.87-0.25
225'-95'-3.73-0.89
HDS-89 (400')
150'-10'-1.46-0.18
260'-50'-1.92-0.14
340'-30'-1.90-0.24
Tdb
F-350'
+25 ppm Ag (surface)
Tcr
E-400'
U D
U D
HDS-88 (320') (deepened)
0'-40'-1.34-0.15
80'-50'-1.35-0.50
160'-45'-1.01-0.02
235'-15'-1.11-0.11
270'-25'-2.06-0.18
Tlp
S1 (100')
HDS-38 (1134')
150'-50'-1.75-
530'-30'-1.29-
640'-60'-3.97-
North Hermosa workings
60°
HDS-87 (400')
130'-115'-1.40-0.47
HDS-90 (400')
215'-25'-2.74-0.15
285'-20'-1.86-0.10
HDS-54 (690')
200'-20'-1.45-
HDS-91 (400')
30'-10'-1.13-0.04
60'-5'-1.22-0.20
225'-30'-1.38-0.08
A-350'
FAULT
Tlp
Tcr
Revolution Tunnel
C-300'
B-250
HERMOSA
Tlp
Tcr
5300
Tlp
Tcr
D-250'
34°
5400
Tlp
Tcr
60°
45°
HDS-33 (585')
HDS-32 (575')
80°
110'-40'-2.78-
Tcr
HDS-84 (260')
80'-55'-2.41-0.21
210'-20'-1.67-0.20
HDS-7 (83')
80'-3'-1.01-
HDS-7A (887')
80'-60'-4.28-
170'-20'-3.43-
40°
55°
40°
Tlp
Hermosa Mine
75°
Tcr
HDS-85 (150')
35°
80°
40'-60'-5.26-0.39
45°
45°
?
Tct
80°
HDS-8 (847')
Qac
EXPLANATION
Drill hole HDS-84 (Depth)
Assay key: Depth-Length-Ag oz/T-Pb%
80' - 55' - 2.41 - 0.21
Qac Alluvium Colluvium
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Tlp Latite porphyry
Tcr Rhyolite breecia
Tct Tuff agglomerate
Tcfg Fine grained clastics
Hardshell Volcanics
20° Proposed 1984 Drill Hole
DRILL MAP
HARDSHELL PROJECT
Hermosa-North Hermosa Area
Santa Cruz County, Arizona
Scale: 1" = 200'
Geology by S.R. Davis, 1970
F.R Koutz
Feb. 1984
mkf

5477

ASARCO

Southwestern Exploration Division

JDS

September 8, 1987

P.G. Vikre - Reno Office
J.D. Sell - Tucson Office

F.R. Koutz

Mr. Scartaccini requested and I agreed to have Mr. Koutz give Verle Martz a tour of the Patagonia Mountains on Tuesday, September 8. The EPA is going to review the Alta, Hermosa, and Hardshell mines to determine if sampling (at a later date by a different crew) for pollution is necessary.

Martz will accompany the EPA during their trip. It is pretty hard to tour above mines without seeing, from a distance, the Trench mill tails, which should generate more interest than the above mentioned mines.

WLK

W. L. Kurtz

cc: R.L. Brown

ASARCO

Southwestern Exploration Division

September 9, 1987

To: W.L. Kurtz

From: F.R. Koutz

"Environmental" Tour
Asarco Properties
Patagonia Mountains
Santa Cruz County, AZ

On September 8, at your and Mr. Scartaccini's request I gave a geographical/historical/environmental tour of the Hardshell-Trench area to Verle Martz, Chief Environmental Engineer, SWMD, and Al Cooper, Staff Engineer (geologist), Mission Unit. Mr. Cooper has been continuing the background water sampling program started by SWED in the late 1970's. The tour included: the Alta Mine dumps, Hardshell incline portal, dumps and pre-1918 mill tails, up Hardshell Creek to the Salvadore, the Welch Shaft, drill roads over the deposit and Hermosa open cuts.

In the Trench area we visited the #3 tailings pond Harshaw Creek drainage, Trench vein, Josephine Shaft-mill site area (#1 tailings area), Rock (dump) dam in front of #2 tailings and January-Norton vein. The 4 check dams below the #3 dam are intact, although the first check dam is full of tails from the heavily rilled tailings-dam face and the lower 3 check-dams almost full of yellow-orange high Fe-Mn, low pH waters. Rilling of the dam face has been increasing over the last few years. No. 2, 3 and 4 tailings ponds retained low pH water at their upper ends from the recent heavy rains. However, water flow in Harshaw Creek was low. We left via Alum Gulch, briefly visiting artesian DDH TM-11, Worlds Fair Mine, Flux Mine and the heavy pyritic areas in lower Alum Gulch. I gave Mr. Martz a copy of Schrader's 1915 USGS Bulletin 582 on the Patagonias and a copy of my 1984 AGS paper on Hardshell-Hermosa for background.

As a reminder, there are up to several 1000 T of Hardshell Mill oxide Pb-Ag sand tails which might be shipped to the smelters on a break-even basis. I also think the high-pyrite Trench tails might make a good commercial soil amendment such as the "Ironite" tails shipped from the Iron King Mine, Yavapai County. Whether the lead ± arsenic content would prevent the Trench tails being used on edible crops is uncertain. Some 5 years ago Stu Bengson and I had soils tests - assays run on a number of samples from backhoe trenches in the Trench tails completed. If you have no specific objections, when I am back in Tucson I will spend a day or so looking into such uses for the ± 1 million tons of tails at Trench.

FRK:mek

F. R. Koutz

cc: J.D. Sell
V.C. Martz
A. Cooper

JDS

Sal: Darby will be contacting you on this. Thanks for your help. Jim

ASARCO Incorporated

Latin American Exploration Division

FACSIMILE TRANSMISSION

PLEASE DELIVER THE FOLLOWING PAGE(S) TO:

NAME: Mr. Jim D. Sell, Manager, Tucson

LOCATION: Tucson, Exploration DATE: May 26, 1993

TIME: 3:25 pm

SENT BY: DARBY I. FLETCHER
EXPLORATION GEOLOGIST

ASARCO

MAY 28 1993

SW Exploration

MESSAGES: Mr. Sell:

Doug Smith is arranging for 3 or 4 of our Bolivian affiliates to visit and tour a few U.S. deposits and mines, including Hardshell, in late June. I have been given the job of arranging the "nuts-and-bolts" of the tour. For Hardshell, I visited it many years ago, but regrettably I do not remember exactly how to get to it, nor the quality of the access roads. I expect we will be in a van (2WD) instead of a 4WD vehicle, so it is important that we know the quality of the roads in general; has anybody there been to Hardshell in recent months? Also, could you send me a map which will get us to the deposit from Tucson?

I still have Fleet's 1980/1981 vintage "field trip guide" handout, but the maps are so severely reduced as to be illegible. Do any other more usable maps exist which could be sent to me? And any other information which you might be able to provide would be very helpful.

Lastly, wold you and/or anybody else there be interested in going to Hardshell when I come through with the Bolivians (currently scheduled for Monday, June 21)?

Cheers, Darby

TOTAL NUMBER OF PAGES INCLUDING COVER PAGE 1 (this page only)

IF YOU DID NOT RECEIVE ALL PAGES, PLEASE CALL (303) 986-0882

ASARCO Incorporated
274 UNION BOULEVARD • SUITE 450 • LAKEWOOD, COLORADO 80228
PHONE: (303) 986-0882 FAX: (303) 986-0775

United States
Environmental Protection
Agency

Office of Water
(EN-336)

EPA 833-R-92-002
October 1992

Flox

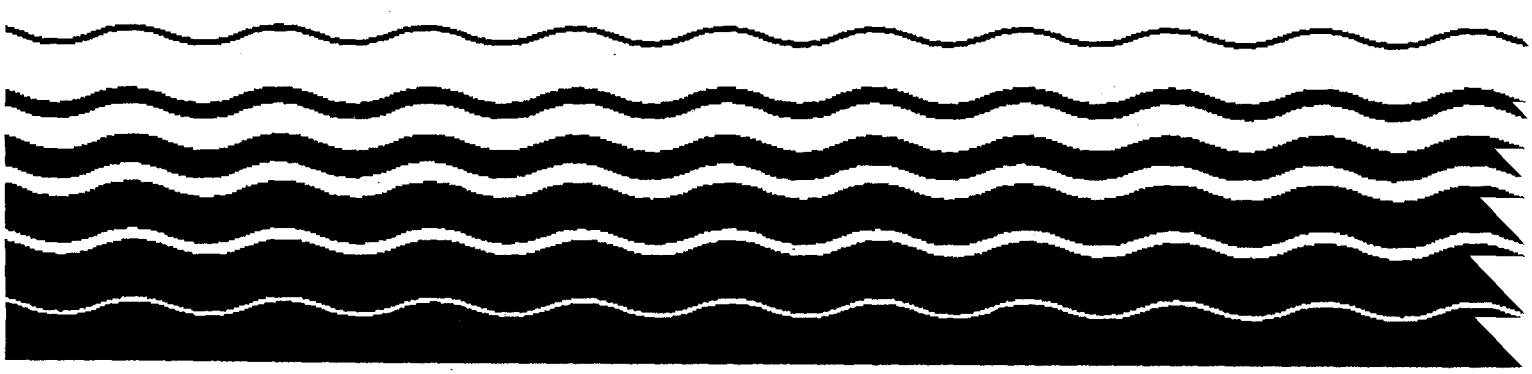
EPA

Storm Water Management For Industrial Activities

Developing Pollution Prevention Plans And Best Management Practices

SUMMARY GUIDANCE

★1992★
THE YEAR OF
CLEAN WATER
Celebration & Commitment



U.S. Environmental Protection Agency
National Pollutant Discharge Elimination System (NPDES)
S T O R M W A T E R G E N E R A L P E R M I T C O V E R A G E N O T I C E

March 5, 1993

Dear Operator:

Your Notice of Intent (NOI) for the facilty noted below has been processed by the U.S. Environmental Protection Agency. This facility is authorized to discharge storm water associated with industrial or construction activity under the terms and conditions imposed by EPA's NPDES storm water general permit issued for use in the state of Arizona. Your facility's NPDES storm water permit number is AZR00A184.

EPA's storm water general permit requires certain storm water pollution prevention and control measures, possible monitoring and reporting, and annual inspections. Among the conditions and requirements of this permit, you must prepare and implement a pollution prevention plan (PPP) that is tailored to your industrial or construction site. Enclosed is a summary guidance document designed to assist you in the development and implementation of your PPP. The summary is organized according to the phases of the pollution prevention planning process. A set of worksheets and an example of a pollution prevention plan are provided for your assistance. As a facility authorized to discharge under this storm water general permit, all terms and conditions must be complied with to maintain coverage and avoid possible penalties.

FACILITY:

Flux
Santa Cruz County
, AZ -
,
, 30, T22S, R16E

OPERATOR:

Asarco Inc-sw Exploration Div
Po Box 5747
Tucson, AZ 85703-0747

If you have general questions concerning the storm water program, or need to obtain a copy of the permit, please call the Storm Water Hotline at (703) 821-4823.

FOREWORD

This booklet provides industrial facilities with summary guidance on the development of storm water pollution prevention plans and identification of appropriate Best Management Practices (BMPs). It provides technical assistance and support to all facilities subject to pollution prevention requirements established under National Pollutant Discharge Elimination System (NPDES) permits for storm water point source discharges.

EPA's storm water program significantly expands the scope and application of the existing NPDES permit system for municipal and industrial process wastewater discharges. It emphasizes pollution prevention and reflects a heavy reliance on BMPs to reduce pollutant loadings and improve water quality. This booklet provides summary guidance in both of these areas.

The document summarized here was issued in support of EPA regulations and policy initiatives involving the development and implementation of a National storm water program. The document itself is Agency guidance only. It does not establish or affect legal rights or obligations. Agency decisions in any particular case will be made applying the laws and regulations on the basis of specific facts when permits are issued or regulations promulgated.

The document and this booklet will be revised and expanded periodically to reflect additional pollution prevention information and data on treatment effectiveness of BMPs. Comments from users will be welcomed. Send comments to U.S. EPA, Office of Wastewater Enforcement and Compliance, 401 M Street, SW, Mail Code EN-336, Washington, DC 20460.

Industrial Guidance Executive Summary

Table of Contents

Industrial Guidance Executive Summary

Table of Contents (Continued)

A Brief Guide to Requirements for Developing and Implementing Pollution Prevention Plans for Industrial Activities

Storm water runoff is part of the natural hydrologic cycle. However, human activities, particularly urbanization, can alter natural drainage patterns and add pollutants to the rainwater and snowmelt that run off the earth's surface and enter our Nation's rivers, lakes, streams, and coastal waters. In fact, recent studies have shown that storm water runoff is a major source of the pollutants that are damaging our sport and commercial fisheries, restricting swimming, and affecting the navigability of many of our Nation's waters.

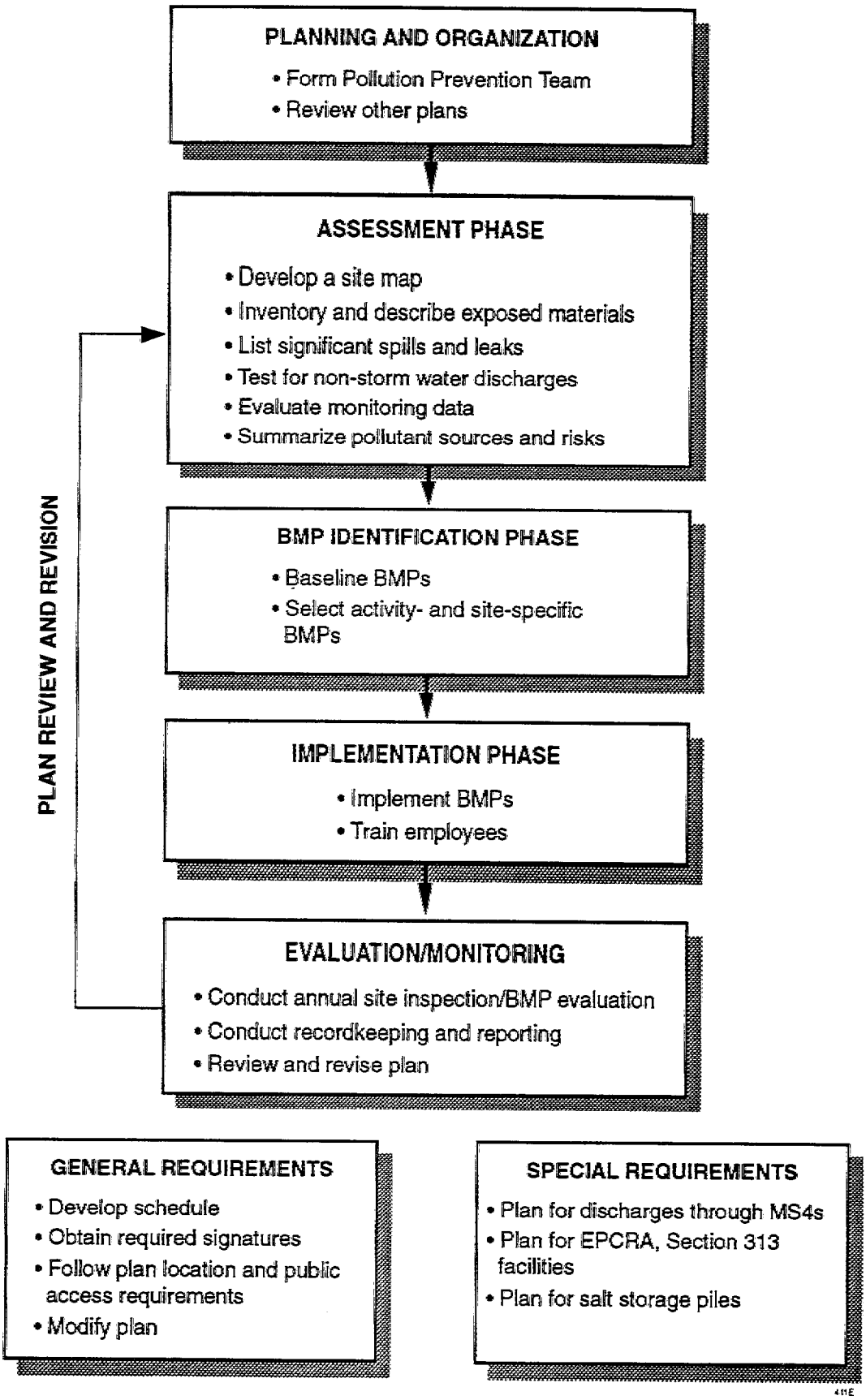
The States and many municipalities have been taking the initiative to manage storm water discharges more effectively. Recognizing the importance of this problem, Congress also directed the U.S. Environmental Protection Agency (EPA) to develop a Federal program under the Clean Water Act to regulate certain high-priority storm water sources. The issuance of storm water discharge permits under the National Pollutant Discharge Elimination System (NPDES) is a major part of the Agency's efforts to restore and maintain the Nation's water quality. Discharges of storm water runoff from industrial facilities must now be covered by an NPDES permit. To deal with the thousands of industrial facilities which are now required to be covered by storm water permits, EPA strongly encourages the use of general permits. Under the NPDES program, a general permit authorizes discharges from a number of sources. To address storm water discharges from industrial facilities located in the States and territories that have not been delegated NPDES permitting authority, EPA issued *NPDES General Permits for Storm Water Discharges Associated with Industrial Activity* in the September 9 and September 25, 1992, Federal Register. (A complete list of these States and territories to which EPA's permits apply may be found on page 16 of this document.)

Under the *NPDES General Permit for Storm Water Discharges Associated with Industrial Activity*, EPA requires the development and implementation of a pollution prevention plan — designed to reduce pollution at the source, before it can cause environmental problems that cost the public and private sectors in terms of lost resources and expensive environmental restoration activities.

Overview of Pollution Prevention Plan Requirements

This guide provides background information on pollution prevention planning requirements for permittees under the general permit. As shown on the chart on the following page, pollution prevention plan requirements provide you with a step-by-step process for ensuring that pollutants are not making their way into the storm water discharges from your site. Specifically, the pollution prevention plan requires that you select and implement Best Management Practices (BMPs). BMPs include schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution in runoff from your site. The five major phases of developing a pollution prevention plan are (1) planning and organization; (2) assessment; (3) BMP selection and plan design; (4) implementation; and (5) evaluation and site inspection. A set of worksheets and a model plan at the end of the document are provided to further clarify pollution prevention plan requirements. All permit holders under EPA's *NPDES General Permit for Storm Water Discharges Associated with Industrial Activity* must meet a number of general requirements. In addition, permittees who are subject to reporting requirements under Section 313 of the Emergency Planning and Community Right-to-Know Act (EPCRA), (also known as Title 3 of the Superfund Amendment and Reauthorization Act [SARA]), will have to meet special requirements under EPA's general permit. These requirements are listed in boxes throughout this guide, and then elaborated upon in the final section.

A more detailed manual on how to develop and implement a pollution prevention plan is available at a modest cost from the National Technical Information Service. The manual, titled *Storm Water Management for Industrial Activities: Developing Pollution Prevention Plans and Best Management Practices*, provides much more specific information than this brief guide. Instructions for ordering the detailed manual and a listing of other references that you may find useful can be found at the end of this guide.



SEVEN PHASES FOR DEVELOPING AND IMPLEMENTING INDUSTRIAL STORM WATER POLLUTION PREVENTION PLANS

PLANNING AND ORGANIZATION PHASE

Before you start putting your Storm Water Pollution Prevention Plan together, there are two steps that will facilitate the development of your plan. These steps are designed to help you organize your staff and make preliminary decisions: (A) decide who will be responsible for developing and implementing your Storm Water Pollution Prevention Plan, and (B) look at other existing environmental facility plans for consistency and overlap.

(A) Forming Your Pollution Prevention Team

As part of developing and implementing your pollution plan, you should (1) designate a specific individual or team who will develop, implement, maintain, and revise your pollution prevention plan, and (2) identify these individuals and describe each person's responsibilities at the site.

Since facilities differ in size and capacity, the number of team members will also vary. Designating one person may be appropriate as long as that individual is qualified to design and implement the plan. The plan should identify those people on site who are most familiar with the facility and its operations; these people, in turn, should provide structure and direction to the storm water management program. In all cases, someone in a senior management position must have overall responsibility for the plan.

The pollution prevention team is responsible for the following:

- **Implementing** all general permit and pollution prevention plan requirements
- **Defining** and agreeing upon an appropriate set of goals for the facility's storm water management program
- **Being aware** of any changes that are made in plant operations to determine whether any changes must be made to the Storm Water Pollution Prevention Plan
- **Maintaining** a clear line of communication with plant management to ensure a cooperative partnership.

Worksheet #1 (located at the end of this guide) is an example of an appropriate form on which to list the team members. To complete this worksheet, list the pollution prevention team members by name, facility position (title), and phone number; include a brief description of each member's specific responsibilities. This list can be directly incorporated into the Storm Water Pollution Prevention Plan, but it should also be displayed or posted within the facility so that other plant employees are aware of who is responsible for storm water management.

(B) Building on Existing Environmental Management Plans

The pollution prevention team also must evaluate existing environmental management plans for consistency and determine which, if any, provisions can be incorporated into the Storm Water Pollution Prevention Plan.

Other related plans may include the Preparedness, Prevention and Contingency Plan (40 CFR Parts 264 and 265), the Spill Control and Countermeasures requirements (40 CFR Part 112), the National Pollutant

Discharge Elimination System Toxic Organic Management Plan (40 CFR Parts 413, 433, and 469), and the Occupational Safety and Health Administration (OSHA) Emergency Action Plan (29 CFR Part 1910).

Although you should build on relevant portions of other environmental plans as appropriate, it is important to note that your Storm Water Pollution Prevention Plan must be a comprehensive, stand-alone document.

ADDITIONAL REQUIREMENTS FOR FACILITIES SUBJECT TO REPORTING UNDER EPCRA, SECTION 313, FOR WATER PRIORITY CHEMICALS—EPCRA contains additional reporting requirements for designated hazardous waste management facilities. EPA's Baseline General Permit contains the following specific requirements for such facilities:

- The team must designate a person who will be accountable for spill prevention at the facility and identify this person in the plan.
- The designated person is responsible for setting up necessary spill emergency procedures and reporting requirements to isolate, contain, and clean up spills and emergency releases of Section 313 water priority chemicals.

ASSESSMENT PHASE

After identifying who is responsible for developing and implementing your plan and organizing your planning process, you should proceed to this next step—a pollutant source assessment. This is where you take a look at your facility and determine what materials or practices are (or may be) a source of contaminants to the storm water running off your site. To complete this phase, you will (A) create a map of the facility site to locate pollutant sources and determine storm water management opportunities, (B) conduct a material inventory, (C) evaluate past spills and leaks, (D) identify non-storm water discharges and illicit connections, (E) collect or evaluate storm water quality data, and (F) summarize the findings of this assessment. To select the most appropriate and effective control measures, consider that potential pollutant sources include areas where materials are handled or stored, outdoor processing areas, loading and unloading areas, and onsite waste management and disposal areas.

(A) Developing a Site Map

A site map is a complete illustration of site features. At a minimum, the site map must include information on the following:

- Discharge points ("outfalls")
- Drainage patterns
- Identification of the types of pollutants likely to be discharged for each drainage area
- Direction of flow
- Surface water bodies, including any proximate stream, river, lake, or other water body receiving storm water discharges from the site
- Structural control measures (physically constructed features used to control storm water flows)
- Locations of significant materials exposed to storm water
- Locations of industrial activities (such as fueling stations, loading and unloading areas, vehicle or equipment maintenance areas, waste disposal areas, storage areas).

Worksheet #2 (located at the end of this guide) provides guidance on completing your site map.

(B) Materials Inventory

Each facility must inventory the types of materials that are handled, stored, or processed onsite. "Significant materials" are of particular concern and are defined as follows:

> **Significant Materials:** *Raw materials; fuels; materials such as solvents, detergents, and plastic pellets; finished materials such as metallic products; raw materials used in food processing or production; hazardous substances designated under section 101(14) of CERCLA; any chemical the facility is required to report pursuant to EPCRA, Section 313; fertilizers; pesticides; and waste products such as ashes, slag, and sludge that have the potential to be released with storm water discharges [40 CFR 122.26(b)(12)].*

To complete the materials inventory, the facility must do two specific tasks:

- List materials that have been exposed to storm water in the past 3 years (focus on areas where materials are stored, processed, transported, or transferred).
- Provide a narrative description of methods and location of storage and disposal areas, materials management practices, treatment practices, and any structural/nonstructural control measures.
  - Structural practices are fixed equipment such as berms, detention ponds, or grassed swales.
  - Nonstructural practices may include regularly scheduled actions such as sweeping or inspections.

Worksheet #3 (located at the end of this guide) will assist you in conducting a material inventory for your Storm Water Pollution Prevention Plan. If any of the significant materials on your site have been exposed to storm water in the 3 years prior to the effective date of your permit, complete **Worksheet #3A** and include it in your plan.

(C) Identifying Past Spills and Leaks

Provide a list of significant spills and leaks of toxic or hazardous that have occurred in the past 3 years. "Significant spills" includes releases in excess of reportable quantities, defined as follows:

> Reportable Quantity (RQ) Discharge: *An RQ release occurs when a quantity of a hazardous substance or oil is spilled or released within a 24-hour period of time and exceeds the RQ level assigned to that substance under CERCLA or the Clean Water Act. These levels or quantities are defined in terms of gallons or pounds. Regulations listing these quantities are contained at 40 CFR 302.4, 40 CFR 117.21 and 40 CFR 110.10.*

Permittees are encouraged to list spills and leaks of nonhazardous materials as well as spills of hazardous materials in their pollution prevention plans.

Worksheet #4 (located at the end of this guide) can help you organize this list of leaks and spills. The areas on your site where significant leaks or spills have occurred are areas on which you should focus very closely when selecting BMPs.

(D) Non-Storm Water Discharges

To certify that your facility has been tested or evaluated for non-storm water discharges, you must:

- Identify potential non-storm water discharges
- Describe the method used and results of any test and/or evaluation for such discharges
- Indicate the location of the onsite drainage points that were checked during the test or evaluation
- Provide the date of the test or evaluation. (If you cannot test or evaluate potential non-storm water discharges, notice must still be made by certification.)

Examples of non-storm water discharges include any water used directly in the manufacturing process (process water), air conditioner condensate, noncontact cooling water, vehicle wash water, or sanitary wastes.

To check for non-storm water discharges, you can use one of the following three common dry weather tests: visual inspection; plant schematic review; and/or dye testing.

Worksheet #5 (located at the end of this guide) will assist you in conducting a non-storm water discharge assessment and certification for outfalls at your site. If you are unable to test and/or provide certification for the presence of non-storm water discharges, please refer to **Worksheet #6**.

(E) Existing Monitoring Data

Where existing storm water sampling data are available, the facility must (1) **provide** a summary of any existing storm water sampling data and (2) **describe** the sample collection procedures used.

(F) Site Evaluation Summary

This step is critical, as it will become the foundation for the rest of the Storm Water Pollution Prevention Plan. Facilities must fulfill the following requirements:

- **Provide** a narrative description of activities with a high potential to contaminate storm water at your site, including those associated with materials loading and unloading, outdoor storage, outdoor manufacturing or processing, onsite waste disposal, and significant dust or particulate generating activities

- **Describe** any pollutants of concern that may be associated with such activities.

Once you have completed the above steps in your pollutant source assessment, you should have enough information to determine which areas, activities, or materials may contribute pollutants to storm water runoff from your site. With this information, you can select the most appropriate BMPs to prevent or control pollutants from these areas.

BMP Selection and Plan Design Phase

Once you have identified and assessed potential and existing sources of storm water contamination at your facility, the next step is to select the proper Best Management Practices (BMPs) that will address these pollutant sources. To satisfy the requirements of this phase, you must provide a narrative description of the BMPs you have selected for your site. At a minimum, your plan must incorporate the following eight "baseline" BMPs: (A) good housekeeping, (B) preventive maintenance, (C) visual inspections, (D) spill prevention and response, (E) sediment and erosion prevention, (F) traditional storm water management practices, (G) other BMPs as appropriate, (H) employee training, and (I) recordkeeping and reporting. A number of these BMPs are discussed below.

(A) Good Housekeeping

Good housekeeping practices are designed to maintain a clean and orderly work environment. Often the most effective first step towards preventing pollution in storm water from industrial sites involves merely using good common sense to improve the facility's basic housekeeping methods. The following are some simple procedures that a facility can consider incorporating into an effective good housekeeping program:

- **Improve** operation and maintenance of industrial machinery and processes.
- **Implement** careful material storage practices.
- **Maintain** up-to-date material inventory.
  - Identify all chemical substances present in the workplace.
  - Label all containers showing name and type of substance, stock number, etc.
- **Schedule** routine cleanup operations.
- **Maintain** well-organized work areas.
- **Train** employees about good housekeeping practices.

(B) Preventive Maintenance

Each permittee must develop a preventive maintenance program that involves inspections and maintenance of storm water management devices and routine inspections of facility operations to detect faulty equipment. Equipment (such as tanks, containers, and drums) should be checked regularly for signs of deterioration.

EPCRA, SECTION 313, FACILITY PREVENTIVE MAINTENANCE INSPECTION REQUIREMENTS—All areas of the facility must be inspected for the following at appropriate intervals as specified in the plan:

- Leaks or conditions that would lead to discharges of Section 313 water priority chemicals
- Conditions that could lead to direct contact of storm water with raw materials, intermediate materials, waste materials or products
- Piping, pumps, storage tanks and bins, pressure vessels, process and material handling equipment, and material bulk storage areas for leaks, wind blowing, corrosion, support or foundation failure, or other deterioration or noncontainment.

(C) Visual Inspections

Regular visual inspections are your means to ensure that all of the elements of the plan are in place and working properly to prevent pollution of storm water runoff from your facility. Consider the following when conducting visual inspections:

- **Designate** qualified, trained plant personnel to regularly inspect the facility's equipment and areas, track results of inspections, make necessary changes, and maintain records of all inspections
- **Ensure** that inspection records note when inspections were done, who conducted the inspection, what areas were inspected, what problems were found, and what steps were taken to correct any problems.

These records should be kept with the plan. EPA's general permit requires that records be kept until at least one year after coverage under the permit expires.

(D) Spill Prevention and Response

Areas where spills are likely to occur and their drainage points must be clearly identified in the storm water pollution prevention plan. You should ensure that employees are aware of response procedures, including material handling and storage requirements. Also ensure that there is access to appropriate spill cleanup equipment.

SPILL PREVENTION PLAN CONSIDERATIONS:

- **Install** leak detection devices.
- **Adopt** good housekeeping practices.
- **Perform** regular visual inspections to identify areas for potential leaks or spills.
- **Recycle, reduce,** and reuse process materials to minimize waste onsite.

SPILL RESPONSE PLAN CONSIDERATIONS:

- Identify a spill response team to implement the spill response plan.
- Identify safety measures.
- Include procedures for notifying appropriate authorities (police, fire, hospital, Publicly Owned Treatment Works [POTW], etc.) in the event of a spill.
- Describe spill containment, diversion, isolation, and cleanup practices.

EPCRA, SECTION 313, FACILITY SPILL PREVENTION AND RESPONSE REQUIREMENTS—When a leak or spill of a Section 313 water priority chemical has occurred, the contaminated soil, material, or debris must be removed promptly and disposed of in accordance with Federal, State, and local requirements and as described in the Storm Water Pollution Prevention Plan. These facilities are also required to designate a person responsible for spill prevention, response, and reporting procedures.

(E) Sediment and Erosion Control

The facility's pollution prevention plan must identify activities that present a potential for significant soil erosion and measures taken to control such erosion. More information on sediment and erosion control BMPs can be found in the reference section of this guide.

(F) Management of Runoff

Permittees must describe existing storm water controls found at the facility and any additional measures that can be implemented to improve the prevention and control of polluted storm water. Examples include: vegetative swales, reuse of collected storm water, infiltration trenches, and detention ponds.

IMPLEMENTATION PHASE

At this point, you have designed your Storm Water Pollution Prevention Plan and the plan has been approved by facility management. Under the implementation phase, you must (A) implement the selected storm water BMPs, and (B) train all employees to carry out the goals of the plan.

(A) Implementing Appropriate Controls

In implementing the plan, a facility will:

- **Develop** a schedule for implementation. For example, your schedule might include a deadline for putting improved housekeeping measures into practice. Some controls may be immediately put into action; others will be phased in.
- **Assign** specific individuals with responsibility for implementing aspects of the plan and/or monitoring implementation.
- **Ensure** that management approves of your implementation schedule and strategy, and schedule regular times for reporting progress to management.

(B) Employee Training

Permittees must develop an employee training program that covers such topics as spill prevention and response, good housekeeping, and material management practices.

The goals of a training program are to teach personnel, at all levels of responsibility, the components and goals of the storm water pollution prevention plan and to create overall sensitivity to storm water pollution prevention concerns. The plan must include a schedule for training programs.

EPCRA, SECTION 313, FACILITY REQUIREMENTS—There are additional training requirements for employees and contractor personnel who work in areas where EPCRA, Section 313, water priority chemicals are used or stored. These individuals must be trained in the following areas, at least once per year:

- Preventive measures, including spill prevention and response and preventive maintenance
- Pollution control laws and regulations
- The facility's Storm Water Pollution Prevention Plan
- Features and operations of the facility that are designed to minimize discharges of Section 313 water priority chemicals, particularly spill prevention procedures.

EVALUATION PHASE

Now that your Storm Water Pollution Prevention Plan has been put to action, you must keep it up-to-date by regularly evaluating the information you collected in the Assessment Phase and the controls you selected in the Plan Design Phase. Specifically, you must (A) conduct site evaluations, (B) keep records of all inspections and reports, and (C) revise the plan as needed.

(A) Annual Site Compliance Evaluation

Qualified personnel must conduct site compliance evaluations at appropriate intervals, but at least once a year (at least once in 3 years for inactive mining sites). As part of your compliance evaluations, you are required to carry out the following:

- **Inspect** storm water drainage areas for evidence of pollutants entering the drainage system.
- **Evaluate** the effectiveness of BMPs (for example, determine if your site cleaner or gauge whether employees are more familiar with good housekeeping measures and spill prevention/response practices).
- **Observe** structural measures, sediment controls, and other storm water BMPs to ensure proper operation.
- **Revise** the plan as needed within 2 weeks of inspection, and implement any necessary changes within 12 weeks of the inspection.
- **Prepare** a report summarizing inspection results and followup actions, identifying the date of inspection and personnel who conducted the inspection.
- **Sign** the report and keep it with the plan.

(B) Recordkeeping and Internal Reporting

Your facility must record and maintain records of spills, leaks, inspections, and maintenance activities for at least one year after the permit expires. For spills and leaks, records should include information such as the date and time of the incident, weather conditions, cause, and resulting environmental problems.

(C) Plan Revisions

Major changes in a facility's design, construction, operation, or maintenance will necessitate changes in that facility's Storm Water Pollution Prevention Plan.

GENERAL REQUIREMENTS

This section provides guidance on some of the administrative requirements related to organizing and developing your Storm Water Pollution Prevention Plan. The guidance covers (A) deadlines for plan development and implementation, (B) required signatures, (C) requirements for plan location and access, and (D) Director-required plan modifications.

(A) Deadlines for Plan Development and Implementation

Schedule for Plan Development and Implementation Part IV.A.		
Type of Facility	**Deadline for Plan Development**	**Deadline for Plan Implementation**
Facilities discharging storm water associated with industrial activity on or before October 1, 1992	April 1, 1993	October 1, 1993
Facilities beginning to discharge storm water after October 1, 1992, but on or before December 31, 1992	60 days after commencement of discharge	60 days after commencement of discharge
Facilities beginning to discharge storm water associated with industrial activity on or after January 1, 1993	48 hours prior to commencement of discharge (upon submittal of NOI)	48 hours prior to commencement of discharge (upon submittal of NOI)
Oil and gas exploration, production, processing, or treatment operations discharging a reportable quantity release in storm water after October 1, 1992	60 days after release	60 days after release
Industrial facilities rejected or denied from the group application process	365 days after date of rejection or denial	545 days after date of rejection or denial
Note: The Director may grant a written extension for plan preparation and compliance for new dischargers (after October 1, 1992) upon showing of good cause.		

(B) Required Signatures

As with the Notice of Intent (NOI), your plan must be signed by an "authorized representative," who is a person at or near the top of your facility's management chain (the president, vice president, or a production manager) who has been delegated the authority to sign and certify this type of document.

EPCRA, Section 313, Facility Plan Certification Requirements—The plan must be reviewed and certified by a Registered Professional Engineer and recertified every 3 years or after the plan is significantly changed. This certification that the plan was prepared in accordance with good engineering practices does not relieve the facility owner or operator of responsibility to prepare and implement the plan, however.

(C) Plan Location and Public Access

Although all plans are required to be maintained onsite, some NPDES storm water permits may require that facilities submit copies of their Storm Water Pollution Prevention Plans to the Director for review. Examine your permit carefully to determine what submittal requirements apply to your facility. Plans and all required records must also be kept at least one year after the permit expires.

(D) Director-Required Plan Modifications

Upon reviewing your plan, the permitting authority may find that it does not meet one or more of the minimum standards established by the pollution prevention plan requirements. In this case, the permitting authority will notify you of the changes that you must make to improve the plan.

SPECIAL REQUIREMENTS

In addition to the minimum "baseline" BMPs discussed in previous sections, facilities may be subject to additional "special" requirements. Not all facilities will have to include these special requirements in their Storm Water Pollution Prevention Plan. Be sure to check your permit closely for these conditions. In particular, EPA's general permit includes special requirements for (A) facilities that discharge storm water through municipal separate storm sewer systems, (B) facilities subject to EPCRA, Section 313, reporting requirements, and (C) facilities with salt storage piles.

(A) Special Requirements for Discharges Through Municipal Separate Storm Sewer Systems

Industrial facilities that discharge storm water through a large or medium municipal separate storm sewer system (serving a population of 100,000 or more) must comply with any applicable conditions established by the municipality's storm water management program. These facilities will be notified by the municipality. Examples of conditions could include additional monitoring requirements and/or additional source control requirements.

(B) Special Requirements for EPCRA, Section 313, Reporting Facilities

In addition to the other special requirements identified in this guide, the following specific control requirements must be practiced in areas where Section 313 water priority chemicals are stored, handled, processed, or transferred:

- Provide containment, drainage control, and/or diversionary structures (prevent or minimize runon by installing curbing, culverting, gutters, sewers, or other controls, and/or prevent or minimize exposure by covering storage piles).
- Prevent discharges from liquid storage areas (store liquid materials in compatible storage containers and/or provide secondary containment designed to hold the volume of the largest storage tank plus precipitation).
- Prevent discharges from material storage areas (install drainage and/or other control measures).
- Prevent discharges from loading/unloading areas (use drip pans and/or implement a strong spill contingency and integrity testing plan).
- Prevent discharges from handling/processing/transferring areas (use covers, guards, overhangs, door skirts and/or conduct visual inspections or leak tests for overhead piping).
- Prevent discharges from all the above areas (use manually activated valves with drainage controls in all areas, and/or equip the plant with a drainage system to return spilled material to the facility).
- Introduce facility security programs to prevent spills (use fencing, lighting, traffic control, and/or secure equipment and buildings).

(C) Special Requirements for Salt Storage Piles

Salt storage piles used for deicing or other commercial purposes must be enclosed or covered to prevent exposure to storm water (except when salt is being added or removed from the pile). Please note that piles do not need to be enclosed or covered where storm water is not discharged to waters of the United Sates. Compliance with this requirement must be met as expeditiously as practicable, but no later than 3 years after the NOI is submitted.

OTHER REFERENCES

In addition to this summary, other documents are available to assist in the preparation and implementation of pollution prevention plans. These documents include the guidance manual Storm Water Management for Industrial Activities, Developing Pollution Prevention Plans and Best Management Practices (EPA 832-R-92-006, September 1992), which is available from the National Technical Information Service (NTIS Order No. PB 922 359 69) at (703) 487-4650.

For any other information and guidance, please call EPA's National Storm Water Hotline at (703) 821-4823. From the Hotline, you may obtain numerous documents, including:

- September 9, 1992, Federal Register (57 FR 41236) - Final NPDES General Permits for Storm Water Discharges Associated with Industrial Activity; Notice

  - Applicability:

    For the States of Alaska, Arizona, Florida, Idaho, Louisiana, Maine, New Hampshire, New Mexico, Oklahoma, South Dakota and Texas; for Indian lands located in Alaska, Arizona, California, Colorado (including the Ute Mountain Reservation in Colorado), Florida (two tribes), Idaho, Maine, Massachusetts, Mississippi, Montana, New Hampshire, Nevada, North Carolina, North Dakota, Utah, Washington and Wyoming; for Federal facilities in Colorado and Washington; for Federal facilities and Indian lands in Louisiana, New Mexico, Texas, and Oklahoma; and for the territories of Johnston Atoll, and Midway and Wake Island.

- September 25, 1992, Federal Register (57 FR 44438) - Final NPDES General Permits for Storm Water Discharges Associated with Industrial Activity; Notice

  - Applicability:

    For the States of Massachusetts and Puerto Rico; for American Samoa and Guam; for Indian lands located in New York; and for Federal facilities in Delaware.

POLLUTION PREVENTION TEAM _____ MEMBER ROSTER	Worksheet #1 Completed by: _____ Title: _____ Date: _____

Leader: _____ Title: _____

Office Phone: _____

Responsibilities:

_____

_____

_____

Members:

(1) _____ Title: _____

Office Phone: _____

Responsibilities:

_____

_____

_____

(2) _____ Title: _____

Office Phone: _____

Responsibilities:

_____

_____

_____

(3) _____ Title: _____

Office Phone: _____

Responsibilities:

_____

_____

_____

(4) _____ Title: _____

Office Phone: _____

Responsibilities:

_____

_____

_____

DEVELOPING A SITE MAP	Worksheet #2 Completed by: _____ Title: _____ Date: _____

Instructions: Draw a map of your site including a footprint of all buildings, structures, paved areas, and parking lots. The information below describes additional elements required by EPA's General Permit.

EPA's General Permit requires that you indicate the following features on your site map:

- All outfalls and storm water discharges
- Drainage areas of each storm water outfall
- Structural storm water pollution control measures, such as:
  - Flow diversion structures
  - Retention/detention ponds
  - Vegetative swales
  - Sediment traps
- Name of receiving waters (or if through a Municipal Separate Storm Sewer System)
- Locations of exposed significant materials
- Locations of past spills and leaks
- Locations of high-risk, waste-generating areas and activities common on industrial sites such as:
  - Fueling stations
  - Vehicle/equipment washing and maintenance areas
  - Area for unloading/loading materials
  - Above-ground tanks for liquid storage
  - Industrial waste management areas (landfills, waste piles, treatment plants, disposal areas)
  - Outside storage areas for raw materials, by-products, and finished products
  - Outside manufacturing areas
  - Other areas of concern (specify:_____)

MATERIAL INVENTORY

Worksheet #3
Completed by: _____
Title: _____
Date: _____

Instructions: List all materials used, stored, or produced onsite. Assess and evaluate these materials for their potential to contribute pollutants to storm water runoff. Also complete Worksheet 3A if the material has been exposed during the last 3 years.

Material	Purpose/Location	Quantity (units)			Quantity Exposed in Last 3 Years	Likelihood of contact with storm water. If yes, describe reason.	Past Significant Spill or Leak	
		Used	Produced	Stored			Yes	No

DESCRIPTION OF EXPOSED SIGNIFICANT MATERIAL

Worksheet #3A
Completed by: _____
Title: _____
Date: _____

Instructions: Based on your material inventory, describe the significant materials that were exposed to storm water during the past three years and/or are currently exposed. For the definition of "significant materials" see page 5 of this summary.

Description of Exposed Significant Material	Period of Exposure	Quantity Exposed (units)	Location (as indicated on the site map)	Method of Storage or Disposal (e.g., pile, drum, tank)	Description of Material Management Practice (e.g., pile covered, drum sealed)

LIST OF SIGNIFICANT SPILLS AND LEAKS

Worksheet #4
Completed by: _____
Title: _____
Date: _____

Directions: Record below all significant spills and significant leaks of toxic or hazardous pollutants that have occurred at the facility in the three years prior to the effective date of the permit.

Definitions: Significant spills include, but are not limited to, releases of oil or hazardous substances in excess of reportable quantities.

1st Year Prior										
				Description				Response Procedure		
Date (month/day/year)	Spill	Leak	Location (as indicated on site map)	Type of Material	Quantity	Source, If Known	Reason	Amount of Material Recovered	Material No Longer Exposed to Storm Water (True/False)	Preventive Measures Taken

2nd Year Prior										
				Description				Response Procedure		
Date (month/day/year)	Spill	Leak	Location (as indicated on site map)	Type of Material	Quantity	Source, If Known	Reason	Amount of Material Recovered	Material No Longer Exposed to Storm Water (True/False)	Preventive Measures Taken

3rd Year Prior										
				Description				Response Procedure		
Date (month/day/year)	Spill	Leak	Location (as indicated on site map)	Type of Material	Quantity	Source, If Known	Reason	Amount of Material Recovered	Material No Longer Exposed to Storm Water (True/False)	Preventive Measures Taken

NON-STORM WATER DISCHARGE ASSESSMENT AND CERTIFICATION	Worksheet #5 Completed by: _____ Title: _____ Date: _____

Date of Test or Evaluation	Outfall Directly Observed During the Test (identify as indicated on the site map)	Method Used to Test or Evaluate Discharge	Describe Results from Test for the Presence of Non-Storm Water Discharge	Identify Potential Significant Sources	Name of Person Who Conducted the Test or Evaluation

CERTIFICATION

I, _____ (responsible corporate official), certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

A. Name & Official Title (type or print)	B. Area Code and Telephone No.
C. Signature	D. Date Signed

NON-STORM WATER DISCHARGE ASSESSMENT AND FAILURE TO CERTIFY NOTIFICATION

Worksheet #6
Completed by: _____
Title: _____
Date: _____

Directions: If you cannot feasibly test or evaluate an outfall, fill in the table below with the appropriate information and sign this form to certify the accuracy of the included information.

List all outfalls not tested or evaluated, describe any potential sources of non-storm water pollution from listed outfalls, and state the reason(s) why certification is not possible. Use the key from your site map to identify each outfall.

Important Notice: A copy of this notification must be signed and submitted to the Director within 180 days of the effective date of this permit.

Identify Outfall Not Tested/Evaluated	Description of Why Certification Is Infeasible	Description of Potential Sources of Non-Storm Water Pollution

CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations, and that such notification has been made to the Director within 180 days of _____ (date permit was issued), the effective date of this permit.

A. Name & Official Title (type or print)	B. Area Code and Telephone No.
C. Signature	D. Date Signed

Double Scoop Ice Cream Company

40 Wonka Drive
Anytown, OK 12345

December 1992

Storm Water Pollution Prevention Plan	
Emergency Contact: **Cheryl Glenn**	Work Phone: **(101) 555-1234**
Title: **Plant Manager**	Emergency Phone: **(101) 555-6929**
Secondary Contact: **Rachel Meyers**	Work Phone: **(101) 555-3923**
Title: **Engineering Supervisor**	Emergency Phone: **(101) 555-6789**
Type of Manufacturer: **Ice Cream Manufacturer**	
Operating Schedule: **8:00 a.m. - 11:30 p.m.**	
Number of Employees: **The plant has 21 employees, including part time staff. Shifts overlap all day.**	
Average Wastewater Discharge: **5,000 gallons per week**	
NPDES Permit Number: **OK1234567**	

POLLUTION PREVENTION TEAM

MEMBER ROSTER

Worksheet #1
Completed by: Cheryl Glenn
Title: Plant Manager
Date: December 12, 1992

Leader: Cheryl Glenn Title: Plant Manager
Office Phone: (101) 555-1234

Responsibilities: Signatory authority; coordinate all stages of plan development and implementation; coordinate employee training program; keep all records and ensure reports are submitted.

Members:

(1) Stephen Michaels Title: Production Supervisor
Office Phone: (101) 555-3923

Responsibilities: Note any process changes; help conduct inspections.

(2) Rachel Meyers Title: Engineering Dept. Supervisor
Office Phone: (101) 555-5870

Responsibilities: Responsible for implementing the Preventive Maintenance program; oversee inspections.

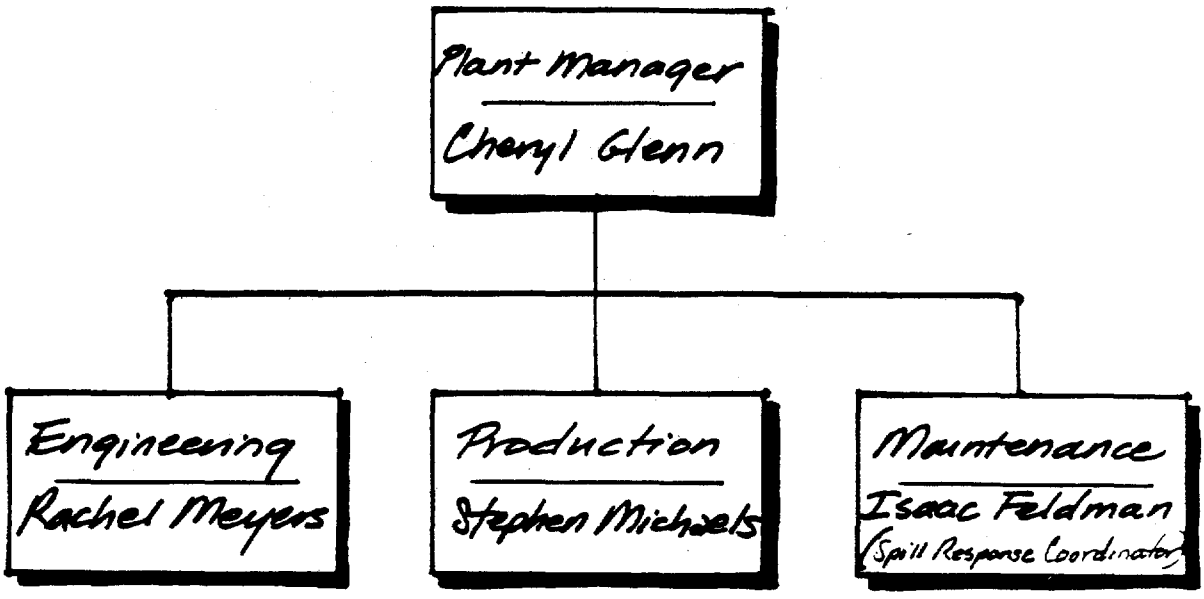
(3) Isaac Feldman Title: Maintenance Dept. Supervisor
Office Phone: (101) 555-0482

Responsibilities: Mr. Feldman is the spill response coordinator; Oversees "good housekeeping."

(4) Group Activities Title:
Office Phone:

Responsibilities: Developing the plan elements, choosing storm water management options.

Pollution Prevention Team Organization Chart



Double Scoop Ice Cream Company

- Storm Water Pollution Prevention Plan
Comparison with SPCC Plan

Double Scoop Ice Cream Plant has an SPCC plan in operation for its aboveground fuel storage tank. Overlaps are noted below:

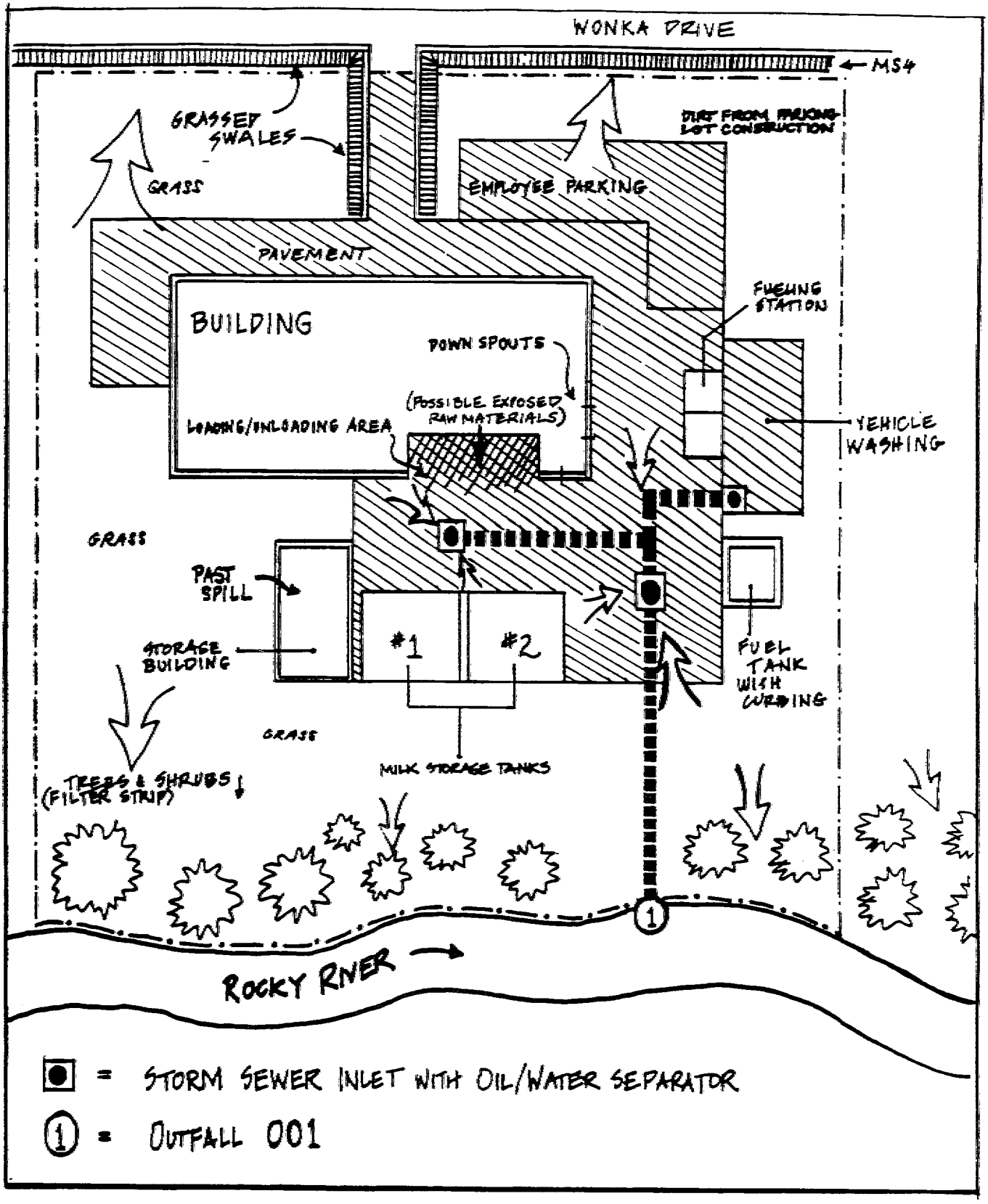
- Isaac Feldman is the SPCC Coordinator and reports directly to Cheryl Glenn. He will be the Storm Water Spill Prevention and Response Coordinator.
- A complete description of potential for oil to contaminate storm water discharges including quantity of oil that could be discharged.
- Curbing around aboveground fuel storage tank identified on site map.
- Expanded SPCC schedules and procedures to include Storm Water Pollution Prevention Plan requirements.
- Incorporated SPCC plan training into storm water training programs on spill prevention and response.
- Relevant portions of the SPCC plan will be included in this plan.

DEVELOPING A SITE MAP	Worksheet #2 Completed by: Cheryl Glenn Title: Plant Manager Date: December 12, 1992

Instructions: Draw a map of your site including a footprint of all buildings, structures, paved areas, and parking lots. The information below describes additional elements required by EPA's General Permit (see example maps in Figures 2.3 and 2.4).

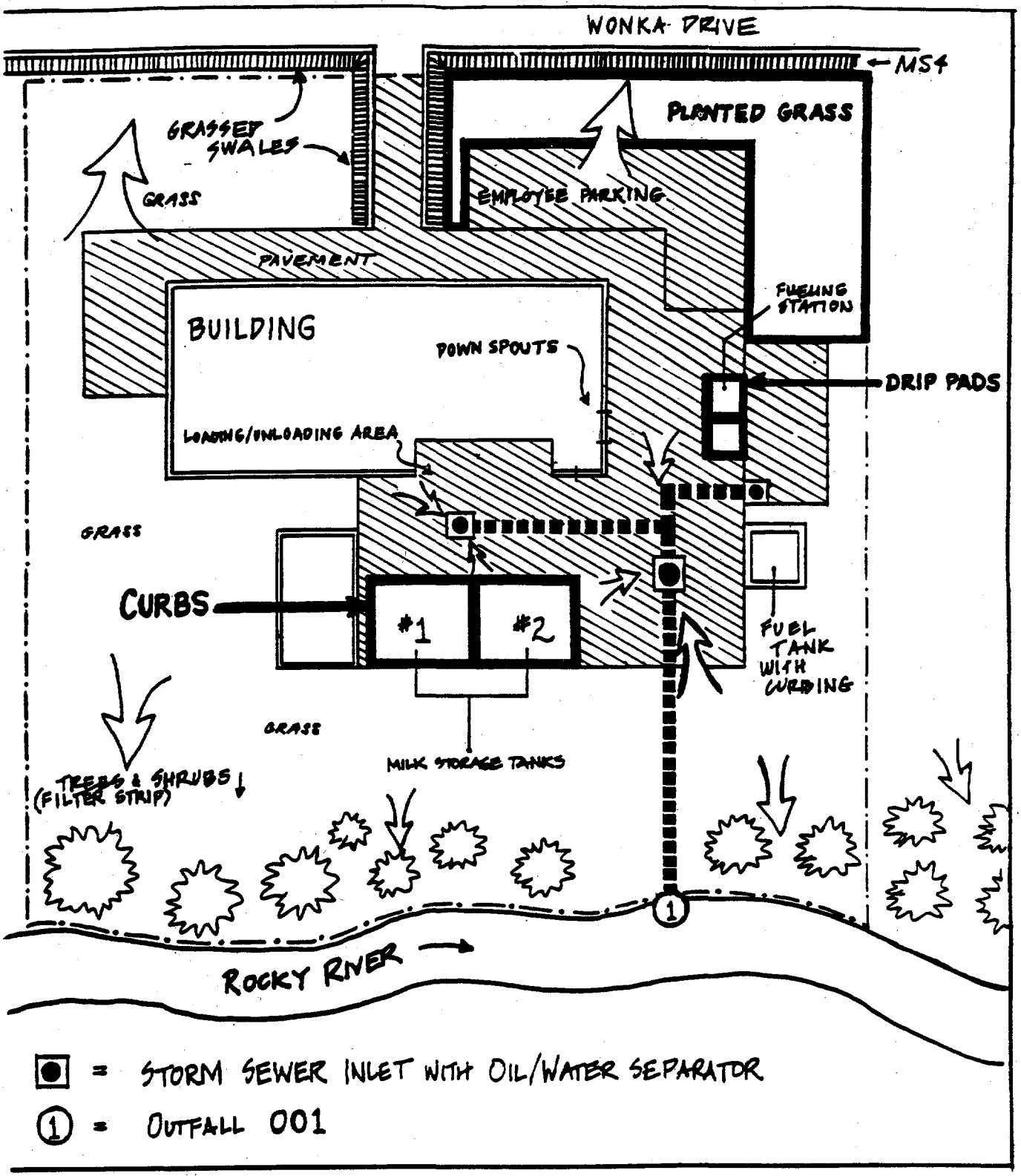
EPA's General Permit requires that you indicate the following features on your site map:

- All outfalls and storm water discharges
- Drainage areas of each storm water outfall
- Structural storm water pollution control measures, such as:
  - Flow diversion structures
  - Retention/detention ponds
  - Vegetative swales
  - Sediment traps
- Name of receiving waters (or if through a Municipal Separate Storm Sewer System)
- Locations of exposed significant materials (see Section 2.2.2)
- Locations of past spills and leaks (see Section 2.2.3)
- Locations of high-risk, waste-generating areas and activities common on industrial sites such as:
  - Fueling stations
  - Vehicle/equipment washing and maintenance areas
  - Area for unloading/loading materials
  - Above-ground tanks for liquid storage
  - Industrial waste management areas (landfills, waste piles, treatment plants, disposal areas)
  - Outside storage areas for raw materials, by-products, and finished products
  - Outside manufacturing areas
  - Other areas of concern (specify:_____)



DOUBLE SCOOP ICE CREAM COMPANY

PRE-BMP SITE MAP
MARCH 1, 1993



DOUBLE SCOOP ICE CREAM COMPANY

POST-BMP SITE MAP
MARCH 1, 1993

MATERIAL INVENTORY

Worksheet #3
Completed by: Cheryl Glenn
Title: Plant Manager
Date: December 12, 1992

Instructions: List all **materials used, stored, or produced onsite. Assess and evaluate these materials for their potential to contribute pollutants to storm water runoff. Also complete Worksheet 3A if the material has been exposed during the last three years.**

Material	Purpose/Location	Quantity (units)			Quantity Exposed in Last 3 Years	Likelihood of contact with storm water. If yes, describe reason.	Past Significant Spill or Leak	
		Used	Produced	Stored			Yes	No
Butter fat Milk Solids Whey solids	truck unloading area during transfer to liquid ingredient storage and milk vat storage.	72,600 gal/wk	—	2,000 gal/wk	NO	Truck loading area outside and possible exposure with ruptured tanks.		✓
Corn Syrup Liquid sugar	Truck unloading area during transfer to sweetener storage.	7,100 gal/wk	—	—	yes	Truck loading area outside with possible exposure as a result of leaking tanks.	✓	
Ice cream	Inside freezers for final product shipping.		35-40,000 Lbs.		NO	NO		✓
Cleansers:								
Granular Chlorshire-O H.D.C.-3R	Dry cleansers in dry storage area (indoors)	400 lb/wk	—	—	NO	Yes. Possible storage exposure during transfer to dry storage area.		✓

Power Spray-R

MATERIAL INVENTORY

Page 2

Worksheet #3
Completed by: Cheryl Glenn
Title: Plant Manager
Date: December 12, 1992

Instructions: List all materials used, stored, or produced onsite. Assess and evaluate these materials for their potential to contribute pollutants to storm water runoff. Also complete Worksheet 3A if the material has been exposed during the last three years.

Material	Purpose/Location	Quantity (units)			Quantity Exposed in Last 3 Years	Likelihood of contact with storm water. If yes, describe reason.	Past Significant Spill or Leak	
		Used	Produced	Stored			Yes	No
Cleansers:								
liquid M.R.S.-200-O Acidize-O Microsan	Cleansers are stored outside under cover.	100 gal/mo	—	—	NO	Yes-if material tanks stored outside.		✓
Fuels:								
gasoline	above ground 750 gallon storage tank	250 gal/mo	—	—	NO	Yes- possible exposure in the event of defective tanks or transfer of materials from tanks to containers		✓
motor oil		20 gal/mo	—	—	NO			✓
soaps detergents		40 gal/mo	—	—	NO			✓

DESCRIPTION OF EXPOSED SIGNIFICANT MATERIAL

Worksheet #3A
Completed by: Cheryl Glenn
Title: Plant Manager
Date: December 12, 1992

Instructions: Based on your material inventory, describe the significant materials that were exposed to storm water during the past three years and/or are currently exposed. For the definition of "significant materials" see Appendix B of the manual.

Description of Exposed Significant Material	Period of Exposure	Quantity Exposed (units)	Location (as indicated on the site map)	Method of Storage or Disposal (e.g., pile, drum, tank)	Description of Material Management Practice (e.g., pile covered, drum sealed)
liquid sugar	1/21/92	10 gal.	Storage building Tank #2	50 gal. tanks (2)	Leak was contained and mopped up. Remainder of liquid sugar transferred to tank that did not have a leaky valve.

LIST OF SIGNIFICANT SPILLS AND LEAKS

Worksheet #4
Completed by: Cheryl Glenn
Title: Plant Manager
Date: December 12, 1992

Directions: Record below all significant spills and significant leaks of toxic or hazardous pollutants that have occurred at the facility in the three years prior to the effective date of the permit.

Definitions: Significant spills include, but are not limited to, releases of oil or hazardous substances in excess of reportable quantities.

1st Year Prior

Date (month/day/year)	Spill	Leak	Location (as indicated on site map)	Description: Type of Material	Description: Quantity	Description: Source, If Known	Description: Reason	Response Procedure: Amount of Material Recovered	Response Procedure: Material No Longer Exposed to Storm Water (True/False)	Preventive Measures Taken
				NONE						

2nd Year Prior

Date (month/day/year)	Spill	Leak	Location (as indicated on site map)	Description: Type of Material	Description: Quantity	Description: Source, If Known	Description: Reason	Response Procedure: Amount of Material Recovered	Response Procedure: Material No Longer Exposed to Storm Water (True/False)	Preventive Measures Taken
1/21/91		✓	STORAGE BLDG.	LIQUID SUGAR	10 gal.	Tank #2	leaky valve	contained and mopped up — transferred	true	installing curbing around tank - to be completed → 3/93

3rd Year Prior

Date (month/day/year)	Spill	Leak	Location (as indicated on site map)	Description: Type of Material	Description: Quantity	Description: Source, If Known	Description: Reason	Response Procedure: Amount of Material Recovered	Response Procedure: Material No Longer Exposed to Storm Water (True/False)	Preventive Measures Taken
				NONE						

NON-STORM WATER DISCHARGE ASSESSMENT AND CERTIFICATION

Worksheet #5
Completed by: Rachel Meyers
Title: Engineering Department Supervisor
Date: 3/1/93

Date of Test or Evaluation	Outfall Directly Observed During the Test (identify as indicated on the site map)	Method Used to Test or Evaluate Discharge	Describe Results from Test for the Presence of Non-Storm Water Discharge	Identify Potential Significant Sources	Name of Person Who Conducted the Test or Evaluation
12/24/92	001	visual inspection	No discharge observed		R. Meyers and S. Goodhope
1/19/93	001	visual inspection	Significant flow; oil	vehicle wash ongoing at time	R. Meyers and S. Goodhope
2/5/93	001	visual inspection	small amount of discharge observed; clear	suspected to be delayed storm water discharge from storm that occurred 2/1/93	R. Meyers and S. Goodhope
	* See details in attached field notebook.				

CERTIFICATION

I, Cheryl Glenn (responsible corporate official), certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

A. Name & Official Title (type or print): Cheryl Glenn

B. Area Code and Telephone No.: (101) 555-1234

C. Signature: Cheryl Glenn

D. Date Signed: 3/2/93

FIELD NOTEBOOK

For non-storm water discharge inspections

INSPECTION TEAM:
R. Meyers
S. Goodhope

Completed by: Rachel Meyers
Date: 12/24/92
Time: 10:50 am

Time since last rain: 42 hours
Quantity of last rain: 0.12 inches
Flow observed: NO

SIGNATURE: Rachel Meyers

Completed by: Rachel Meyers
Date: 1/19/93
Time: 3:20 pm

Time since last rain: 5 days
Quantity of last rain: 0.5 inches
Flow observed: YES
DESCRIPTION: No odor; clear color (soap suds); oily sheen; some sediment.
Temperature: cold (37.5°F)
Volume: collected ten gallons/minute in buckets
Comments: Vehicle wash ongoing at time of inspection. This was the source of the flow.

SIGNATURE: Rachel Meyers

Completed by: Rachel Meyers
Date: 2/5/93
Time: 12:16 pm.

Time since last rain: 96 hours
Quantity of last rain: 2.5 inches
Flow observed: YES
DESCRIPTION: No odor; clear; some sediments; few small pieces of paper (trash)
Temperature: cold (42.3°F)
Volume: Collected one gallon in 5 minutes.
Comments: We suspect that the flow was left over from storm that occurred on 2/1/93 (4 days ago)

SIGNATURE: Rachel Meyers

Double Scoop Ice Cream Company

Site Assessment Inspection

February 10, 1993

Evaluate the site for pollutants.

There are five areas where material handling and storage activities take place.

- The storage building contains tanks of corn syrup, liquid sugar, and the granular cleansers. The tanks were examined for possible leaks. We found that the valve on the liquid sugar tank #2 was faulty and had leaked approximately 10 gallons of liquid sugar. Although this leak occurred on 1/21/92, the faulty valve was not discovered until now. All other tanks are secure. Areas around the tanks were swept clean to determine if leaks or spills were prevalent.

- The milk storage tanks were then examined for leaks or exposure. Upon closer examination, it was found that the number 1 tank was leaking a small amount of milk to the drainage system. This leak may be the reason for the high concentration of biochemical oxygen demand found in the sample taken from the storm water discharge. The tank was temporarily fixed to ensure that no further contamination would result. A replacement tank was ordered on February 6, 1993, and was expected to arrive within 5 business days. The milk storage tanks shall be examined on a daily basis to further prevent possible exposure to the storm water collection system and receiving stream.

- We inspected the fueling station to see if there were any leaks. The general area surrounding the fueling station was clean but we observed that gasoline and motor oil falls during fueling. In accordance with standard operating conditions, facility personnel hose down the area during vehicle washing and the drain is connected to the storm sewer. We detected this connection on 1/19/93 during one of the non-storm water discharge assessment visual inspections. Since this discharge is not allowed under our general permit, we are in the process of submitting a separate permit application specifically for the discharge of vehicle wash water.

- We examined the fueling station which is adjacent to the vehicle washing area. Vehicle washing cleaners are used here and any empty or open containers were removed from the area.

- We next looked at the loading and unloading docks where raw materials and various cleansers are delivered. The transfer of goods from incoming trucks to storage areas is a source of pollution. Although no problems were noticed, the pollution prevention team has developed a spill prevention and response plan to clean up spills quickly and report them if necessary.

- The last area we inspected was the runoff field below the employee parking lot. Here we noticed a significant amount of erosion resulting from recent construction to expand the parking lot.

Describe existing management practices.

Grass was lightly planted around the parking lot after recent construction. The fuel storage tank has curbing around it in accordance with our SPCC plan. Also, the maintenance crew regularly picks up trash and empty containers from around the storage tanks, loading and unloading areas, and the vehicle washing areas. Used oils are collected in containers and taken to a recycling facility. In addition, we installed two oil/water separators at the drains into our underground storm sewer leading to the Rocky River. These separators are indicated on the site map.

Double Scoop Ice Cream Company

Existing Monitoring Data

Although our NPDES permit for process wastewater does not require storm water sampling, we sampled our storm water on one occasion in response to a questionnaire we received from the National Association of Ice Cream Makers. They were collecting information to submit as part of their comments on EPA's proposed general permit.

Date of Sampling	8/30/91
Outfall Sampled	001
Type of Storm	1 inch light rainfall (lasted 2 days)
Type of Samples	Grab samples taken during first hour of flow

Data		
Parameter	**Quantity**	**Sample Type**
BOD	250 mg/l	Grab
TSS	100 mg/l	Grab
pH	7.2 s.u.	Grab
Oil and grease	5.0 mg/l	Grab

Based upon the high concentration of BOD in the storm water samples collected, pollution prevention team is considering possible potential sources of BOD. We will look at storage areas housing butter fat, milk, and whey solids tanks.

Double Scoop Ice Cream Company

Summary of Pollutant Sources

March 5, 1993

Based on the site assessment inspection conducted on 12/1/92, the pollution prevention team identified four potential sources of pollutants:

- Oil and grease stains on the pavement in the fueling area indicate oil and grease may be picked up by storm water draining to the storm sewer. This area drains into the storm sewer leading to the Rocky River.
- Sediment and erosion potential in the field below the employee parking lot because of thinly planted grass.
- Potential for spills or leaks from liquid storage tanks, including the fuel storage tank, based on a spill that occurred on 1/21/92 and the leak that was detected in the milk storage tank. These pollutants would drain into the piped outfall into the Rocky River.
- Use of a toxic cleaning agent may result in a pollution problem if handled improperly.

Double Scoop Ice Cream Company

Description of Storm Water Management Measures Taken Based on Site Assessment Phase

March 5, 1993

These measures correspond to the pollutant sources identified on the preceding page.

Oil and grease from fueling area.

We installed drip pads around the fuel pumps to pick up spilled gas and oil during truck refueling. These will be inspected regularly to make sure they are working well.

Sediment and erosion in the field below the employee parking lot.

We planted grass in this area to reduce potential for erosion.

Leaks/spills from liquid storage tanks.

We are in the process of installing curbing around the outdoor liquid storage tanks that will contain the volume of he largest tank in case a spill should occur. The spill response team has developed procedures to clean up this area should a spill occur. We are incorporating spill response procedures from our SPCC plan.

Toxic cleaning agent.

We have discontinued the use of this agent and are replacing it with a non-toxic cleaning agent.

POLLUTANT SOURCE IDENTIFICATION
(Section 2.2.6)

Worksheet #7
Completed by: Cheryl Glenn
Title: Plant Manager
Date: 3/5/93

Instructions: List all identified storm water pollutant sources and describe existing management practices that address those sources. In the third column, list BMP options that can be incorporated into the plan to address remaining sources of pollutants.

Storm Water Pollutant Sources	Existing Management Practices	Description of New BMP Options
1. Oil and grease on pavement in fueling area	Oil and water separators installed in storm water drain	Install drip pads
2. Erosion in field below employee parking lot	Planted some grass after construction; grassed swales along Wonka Drive	Plant more grass
3. Potential for spills from liquid storage tanks (leak detected in milk tank #1 - past spill on 1/21/92)	Curbing around fuel storage tank (see SPCC plan)	Replace milk tank #1, replace valve on liquid sugar tank #2, install curbing around other outside tanks. Spill prevention response plan, inspect
4. Use of toxic cleaning agent		Use non-toxic cleaning agent
5. Trash in loading/unloading fueling areas	Regular trash pickup (daily) by maintenance crew; collect and recycle used oil.	Train staff in good housekeeping practices.
6.		
7.		
8.		
9.		
10.		

BMP IDENTIFICATION (Section 2.3.1)	Worksheet #7a Completed by: Cheryl Glenn Title: Plant Manager Date: 3/5/93

Instructions: Describe the Best Management Practices that you have selected to include in your plan. For each of the baseline BMPs, describe actions that will be incorporated into facility operations. Also describe any additional BMPs [activity-specific (Chapter 3) and site-specific BMPs (Chapter 4)] that you have selected. Attach additional sheets if necessary.

BMPs	Brief Description of Activities
Good Housekeeping	Collect and recycle used oil; regular trash pick up; train staff in basic clean up procedures (sweeping loading & unloading areas, etc.)
Preventive Maintenance	Daily inspection of outside milk tanks; replace faulty valve on sugar tank #2; replace leaking milk tank #1
Inspections	Daily inspection of outside milk tanks; bi-monthly inspections of drip pads, curbing, loading/unloading areas, grassed areas, drainage system.
Spill Prevention Response	Install curbing around outside liquid storage tanks; fuel tank has curbing; install drip pads at fueling station.
Sediment and Erosion Control	Plant grass around new parking area.
Management of Runoff	Grassed swales along Wonka Drive; (2) oil/water separators in storm drain system
Additional BMPs (Activity-specific and Site-specific)	Order non-toxic cleaning agent.

Double Scoop Ice Cream Company

Employee Training Program

Who:

Line Workers
Maintenance Crew
Shipping and Receiving Crew

When:

Employee meetings held the first Monday of each month to discuss:

- Any environmental/health and safety incidents
- Upcoming training sessions
- Brief reminders on good housekeeping, spill prevention and response procedures, and material handling practices
- Announce any changes to the plan
- Announce any new management practices

In-depth pollution prevention training for new employees

Refresher courses held every 6 months (October and March) addressing:

- Good housekeeping
- Spill prevention and response procedures
- Materials handling and storage

Employee Training Program Topics:

Good Housekeeping

- Review and demonstrate basic cleanup (sweeping and vacuuming) procedures.
- Clearly indicate proper disposal locations.
- Post signs in materials handling areas reminding staff good housekeeping procedures.
- Be sure employees know where routine clean-up equipment located.

Spill Prevention and Response

- Clearly identify potential spill areas and drainage routes
- Familiarize employees with past spill events -- why they happened and the environmental impact (use slides)
- Post warning signs in spill areas with emergency contacts and telephone numbers
- Introduce Isaac Feldman as the Spill Response Coordinator and introduce his "team"
- Drill on spill clean-up procedures
- Post the locations of spill clean-up equipment and the persons responsible for operating the equipment

Materials Handling and Storage

- Be sure employees are aware which materials are hazardous and where those materials are stored
- Point out container labels
- Tell employees to use the oldest materials first
- Explain recycling practices
- Demonstrate how valves are tightly closed and how drums should be sealed
- Show how to fuel vehicles and avoid "topping off"

IMPLEMENTATION
(Section 2.4.1)

Worksheet #8
Completed by: Cheryl Glenn
Title: Plant Manager
Date: 3/30/93

Instructions: Develop a schedule for implementing each BMP. Provide a brief description of each BMP, the steps necessary to implement the BMP (i.e., any construction or design), the schedule for completing those steps (list dates) and the person(s) responsible for implementation.

BMPs	Description of Action(s) Required for Implementation	Scheduled Completion Date(s) for Req'd. Action	Person Responsible for Action	Notes
Good Housekeeping	1. Develop training program	3/10/93	Glenn	
	2. Conduct training	6/1/93	Glenn	
	3.			
Preventive Maintenance	1. Replace valve on sugar tank #2	3/1/93	Feldman	
	2. Install new milk tank #2	2/15/93	Feldman	
	3.			
Inspections	1. Develop inspections schedule	4/1/93	Glenn	
	2.			
	3.			
Spill Prevention and Response	1. Install curbing around milk storage tanks	4/30/93	Meyers	
	2. Install drip pads	4/1/93	Feldman	
	3. Develop / Implement Spill Prevention / Response training	4/1/93 - DEVELOP 6/1/93 - TRAIN	Feldman	
Sediment and Erosion Control	1. Plant grass around parking area	4/15/93	Feldman	
	2.			
	3.			
Management of Runoff	1. BMPs already in place			
	2.			
	3.			
Additional BMPs (facility specific and site-specific)	1. Substitute non-toxic cleaning agent	2/28/93	Michaels	
	2.			
	3.			

EMPLOYEE TRAINING
(Section 2.4.2)

Worksheet #9
Completed by: Cheryl Glenn
Title: Plant Manager
Date: 3/2/93

Instructions: Describe the employee training program for your facility below. The program should, at a minimum, address spill prevention and response, good housekeeping, and material management practices. Provide a schedule for the training program and list the employees who attend training sessions.

Training Topics	Brief Description of Training Program/Materials (e.g., film, newsletter course)	Schedule for Training (list dates)	Attendees
Spill Prevention and Response	locate spill areas by signs; drill spill response procedures; show slides of past spills.	October / March	Maintenance/ shipping & receiving
Good Housekeeping	demonstration; post signs at disposal sites.	October / March	Maintenance/ shipping & receiving
Material Management Practices	introduce hazardous materials labels; discuss recycling.	October / March	Lineworkers/shipping and receiving/maintenance
Other Topics	Environmental/health incidents; Reminders of pollution prevention plan issues.	1st Monday of each month	All employees.

EPA
United States
Environmental Protection Agency
Washington DC 20460
(EN-336)

Official Business
Penalty For Private Use $300

JDS

ASARCO

EXPLORATION DEPARTMENT

JAMES D. SELL
MANAGER

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

May 2, 1994

Santa Cruz County Recorder
P.O. Box 1150
Nogales, AZ 85628

Gentlemen:

Enclosed for recording is the Quit-Claim Deed for 21 unpatented mining claims in the Harshaw and Palmetto Mining Districts, Santa Cruz County, Arizona. Asarco's check in the amount of $8.00, as the recording fee, is enclosed. Please record and return to me in the enclosed stamped envelope.

Very truly yours,

James D. Sell

JDS:mek
encs. Deed & Check
& envelope

cc: G. Van Valkenburg

ASARCO INCORPORATED P.O. BOX 5747 TUCSON, AZ 85703
1150 NORTH 7TH AVENUE (602) 792-3010

QUIT CLAIM DEED

For the consideration of Ten Dollars, and other valuable considerations, ASARCO Incorporated, P.O. Box 5747, Tucson, Arizona 85703, does hereby quit-claim to Kerr-McGee Corporation, all right, title, or interest in the unpatented mining claims situated in the Harshaw and Palmetto Mining Districts, Santa Cruz County, Arizona, described in Exhibit A, attached hereto and made a part hereof.

Date: 4/27/94

ASARCO Incorporated

by: James D. Sell
J.D. Sell, Expl. Mgr., Tucson

State of Arizona)
) ss
County of Pima)

The foregoing instrument was acknowledged before me this 29th day of April, 1994, by J.D. Sell, Expl. Mgr., Tucson, ASARCO Incorporated.

Kathleen M. Horrigan
Notary Public

My commission expires:

My Commission Expires July 6, 1998

EXHIBIT A

The following unpatented mining claims are situated in the Harshaw and Palmetto Mining Districts, Santa Cruz County, Arizona, the name of which and the book and pages of recording of the Location Notices of which, are in the office of the Recorder of Santa Cruz County, and the Bureau of Land Management serial numbers of which are filed in Phoenix, Arizona.

NAME OF CLAIM		RECORDING DATA BOOK	PAGE	BLM SERIAL NO.
South Humbolt		007	360	A MC 50226
" "	Amended	380	682 and 683	"
Humbolt		007	358	A MC 50227
"	Amended	380	684 and 685	"
Silver Leaf		007	364	A MC 50228
" "	Amended	380	686 and 687	"
Good Luck #2		007	366	A MC 50229
" " "	Amended	380	688 and 689	"
Indian Chief		007	368	A MC 50230
" "	Amended	380	690 and 691	"
Monoca		007	362	A MC 50231
"	Amended	380	692 and 693	"
Good Luck		4	300	A MC 50232
" "	Amended	382	575 and 576	"

The above described unpatented lode mining claims are located in Section 32 of Township 22 South, Range 16 East, and Section 5 of Township 23 South, Range 16 East, G&SRB&M.

Boot 52 thru 57		58	421 thru 426	A MC 52015 thru 52020
Boot 77		57	323	A MC 52032
Boot 78		57	324	A MC 52033
Boot 78	Amended	58	431	"
Boot 79		57	325	A MC 52034
Boot 80		57	326	A MC 52035
Boot 80	Amended	69	432	"
Boot 81		57	327	A MC 52036
Boot 103		81	360	A MC 52055
Boot 105		81	363	A MC 52058
Boot 106		81	364	A MC 52059

The above Boot claims are located in Section 36, Township 22 South, Range 15 East, Section 31, Township 22 South, Range 16 East, and Section 6, Township 23 South, Range 16E, G&SRB&M.

ASARCO

MONTH: May 1994

REMITTANCE ADVICE

VENDOR NO. 100821

VOUCHER NO. 050054 004794

4794

ASARCO Incorporated • TUCSON OFFICE • P.O. BOX 5747 • TUCSON, ARIZONA 85703

INVOICE NUMBER	OUR ORDER NO.	CONTROL NO.	INVOICE AMOUNT	DISCOUNT	DEDUCTIONS	NET AMOUNT
QUIT CLAIM DEED	*NONPO	0494253	8.00	.00		8.00
Detach before depositing	TOTALS		8.00	.00		8.00

91-2
1221

ASARCO

ASARCO Incorporated
TUCSON OFFICE • P.O. BOX 5747
TUCSON, ARIZONA 85703

No. 004794

TO: VALLEY NATIONAL BANK OF ARIZONA • DOWNTOWN TUCSON OFFICE • TUCSON, ARIZONA

DATE	NET AMOUNT
05/02/94	$*********8.00

PAY EXACTLY $*********8 DOLLARS 00 CENTS

CASH PROMPTLY
NOT VALID AFTER 90 DAYS

TO THE ORDER OF
SANTA CRUZ COUNTY RECORDER
PO BOX 1150
NOGALES, AZ 85621

AUTHORIZED SIGNATURE

Mildred C. Koeppen
AUTHORIZED SIGNATURE

⑈004794⑈ ⑆122100024⑆ 2000⑈0673⑈

JDS

ASARCO

EXPLORATION DEPARTMENT

JAMES D. SELL
MANAGER

June 1, 1994

Contract Files
New York Office

Thunder Mountain Project
Santa Cruz County, Arizona

For your records enclosed is a copy of the Quit Claim Deed for 21 claims quit-claimed to Kerr-McGee Corp., dated April 29, 1994, which has been entered in the Patagonia Document Book as Document No. 1-QQ.

James D. Sell/mek

James D. Sell

JDS:mek
enc.

cc: F.T. Graybeal - NY

ASARCO INCORPORATED P.O. BOX 5747 TUCSON, AZ 85703
1150 NORTH 7TH AVENUE (602) 792-3010

ASARCO

EXPLORATION DEPARTMENT

JAMES D. SELL
MANAGER

May 11, 1994

Mr. John Alloway
Land-Minerals
Kerr-McGee Corporation
P.O. Box 25861
Oklahoma City, OK 73125

Quit Claim Deed
Harshaw Mining District
Santa Cruz County, AZ

Dear John:

Enclosed is the original Quit Claim Deed for 21 unpatented lode claims located in the Harshaw and Palmetto Mining Districts, Santa Cruz County, Arizona. This was recorded in Santa Cruz County on May 3, 1994, Docket No. 639, Pages 318 and 319.

Sincerely yours,

James D. Sell/mek

JDS:mek
enc.

James D. Sell
Exploration Manager,
Tucson

cc: G. Van Valkenburg
P.J. Maley
D.F. Skidmore

ASARCO INCORPORATED P.O. BOX 5747 TUCSON, AZ 85703
1150 NORTH 7TH AVENUE (602) 792-3010

05/03/94 RECORDER SYSTEM 14:53
SANTA CRUZ COUNTY

FEE NUMBER 943511
DKT./PAGE-TO PG 639/ 318- 319

DATE RECORDED 05/03/94
TIME RECORDED 1:00

FEES PAID:
FILING FEE SUR.CH. POST/HANDL ST.CHG.
5.00 3.00

INSTRUMENT :
DEED TO MINING CLAIM

PAID BY : ASARCO INCORPORATED
CK#004794-$8.00

INSTRUMENT # 943511
OFFICIAL RECORDS OF
SANTA CRUZ COUNTY
IRMA L. PACHECO
COUNTY RECORDER
REQUEST OF :
ASARCO INCORPORATED
DATE: 05/03/94 TIME: 1.00
FEE: 8.00
DOCK 639 PAGE 318 PAGES: 2

QUIT CLAIM DEED

INDEX MICROFILM

DOCK 639 PAGE 318

For the consideration of Ten Dollars, and other valuable considerations, ASARCO Incorporated, P.O. Box 5747, Tucson, Arizona 85703, does hereby quit-claim to Kerr-McGee Corporation, all right, title, or interest in the unpatented mining claims situated in the Harshaw and Palmetto Mining Districts, Santa Cruz County, Arizona, described in Exhibit A, attached hereto and made a part hereof.

Date: 4/27/94

ASARCO Incorporated

by: _____
J.D. Sell, Expl. Mgr., Tucson

State of Arizona)
) ss
County of Pima)

The foregoing instrument was acknowledged before me this 29th day of April, 1994, by J.D. Sell, Expl. Mgr., Tucson, ASARCO Incorporated.

_____
Notary Public

My commission expires:

My Commission Expires July 6, 1998

EXHIBIT A

The following unpatented mining claims are situated in the Harshaw and Palmetto Mining Districts, Santa Cruz County, Arizona, the name of which and the book and pages of recording of the Location Notices of which, are in the office of the Recorder of Santa Cruz County, and the Bureau of Land Management serial numbers of which are filed in Phoenix, Arizona.

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" "	Amended	380	686 and 687	"
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" " "	Amended	380	688 and 689	"
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" "	Amended	380	690 and 691	"
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" "	Amended	382	575 and 576	"

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JDS

ASARCO

EXPLORATION DEPARTMENT

JAMES D. SELL
MANAGER

May 11, 1994

Mr. John Alloway
Land-Minerals
Kerr-McGee Corporation
P.O. Box 25861
Oklahoma City, OK 73125

Assignment and Reimbursement
Humbolt and Boot Claims
Thunder Mountain Project
Santa Cruz County, Arizona

Dear Mr. Alloway:

The termination of the Operating Agreement (as amended) between ASARCO Incorporated and Kerr-McGee Corporation, Thunder Mountain Project, Santa Cruz County, Arizona, was signed and submitted to Kerr-McGee on May 28, 1993.

Asarco at the request of Kerr-McGee paid the annual rental fee for the fiscal years 1993 and 1994 on the 7 "Humbolt" claims in the Harshaw Mining District which were part of the Operating Agreement (as amended) and were jointly owned by Kerr-McGee and Asarco. The fee to be reimbursed to Asarco from Kerr-McGee Corporation.

Asarco at the request of Kerr-McGee paid the annual rental fee for the fiscal years 1993 and 1994 on the 14 Boot claims which were not in the Operating Agreement (as amended). The claims were requested to be transferred to Kerr-McGee. The fee to be reimbursed to Asarco from Kerr-McGee Corporation.

The reimbursement due Asarco from Kerr-McGee Corporation for the annual rental and recording fees is as tabulated:

7 "Humbolt" claims x $200	$1,400
County recording fee	13
14 Boot claims x $200	2,800
County recording fee	13
County recording fee of Quit-Claim Deed	8
Total Due	$4,234

ASARCO INCORPORATED P.O. BOX 5747 TUCSON, AZ 85703
1150 NORTH 7TH AVENUE (602) 792-3010

Copies of the annual rental and recording fees for the two groups of claims, and the original Quit-Claim Deed and recording, are attached.

Sincerely,

James D. Sell

James D. Sell
Expl. Mgr., Tucson

JDS:mek
encs.

cc: G. Van Valkenburg
P.J. Maley
D.F. Skidmore

ASARCO

Copper Operations
Tucson Office

August 25, 1993

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

BUREAU OF LAND MANAGEMENT
Arizona State Office
Attn: Mining Claims Unit
P O Box 16563
Phoenix, AZ 85011

Dear Sir:

Trench Project
Evidence of Payment
Annual Rental Fee Fiscal years 1993 and 1994

This will serve as notice that the owner of the claims/sites intends to continue to hold them as listed and described in Exhibit A.

The annual rental fee of $100.00 for each mining claim and mill site located on or before October 5, 1992, as required under Public Law 102-381 of October 5, 1992, 106 stat. 1374, 1378-79 for fiscal year 1993 and 1994, was mailed to the State Office of the BLM in the form of a check in the amount of $1,400.00 for the claims/sites listed in Exhibit A.

Agent: ASARCO Incorporated
P O Box 5747
Tucson, AZ 85703

Please return the proof of payment receipt to the agent Attn: D. F. Skidmore.

D. F. Skidmore

DFS/kh

Encls.

WHEN RECORDED RETURN TO:

ASARCO Incorporated
P. O. Box 5747
Tucson, AZ 85703

INSTRUMENT # 939392
OFFICIAL RECORDS OF
SANTA CRUZ COUNTY
MARY LOU G. SAINZ
COUNTY RECORDER
REQUEST OF :
ASARCO INCORPORATED
DATE: 12/17/93 TIME: 12.00
FEE: 13.00
DOCK 628 PAGE 923 PAGES: 3

AFFIDAVIT OF LABOR PERFORMED
AND IMPROVEMENTS MADE

INDEXED MICROFILMED

DOCK 628 PAGE 923

STATE OF ARIZONA)
) ss
County of Pima)

David F. Skidmore, being first duly sworn, deposes and says that he is a citizen of the United States and more than twenty-one (21) years of age, and resides in Tucson, County of Pima, State of Arizona, and is personally acquainted with the mining claims situated in the Harshaw Mining District, Santa Cruz County, Arizona, the names and books and pages of record in the office of the County Recorder of Santa Cruz County, Arizona, and the Bureau of Land Management serial number of the Notices of Location whereof are as set forth in Exhibit A.

That all of said mining claims are controlled by ASARCO Incorporated, the mailing address for which is P. O. Box 5747, Tucson, AZ 85703; that between September 1, 1992 and September 1, 1993, in excess of $700.00 worth of work and improvements were done and performed for the benefit of each of the described claims. Work and improvements consisted of:

Annual rental fee of $100.00 for each mining claim as required under Public Law 102-381 of October 5, 1992, 106 stat. 1374, 1378-79. BLM Receipt of payment attached.

Said labor was performed and improvements made at the expense of ASARCO Incorporated for the benefit of each and all of said mining claims (7), comprising said contiguous group as part of a general plan of exploration, each and all of said mining claims. The amount expended for and the value of said labor and improvements is more than One Hundred Dollars ($100.00) for each of the mining claims, and at least said amount was allocated to each of the mining claims. Said expenditure was made in good faith for the purpose of exploring, improving and developing said contiguous group of mining claims, and was intended as annual labor and improvements for each and all of the described unpatented lode mining claims for the assessment year ending at 12:00 o'clock Meridian, September 1, 1993.

ASARCO Incorporated

By _____
David F. Skidmore, Agent

STATE OF ARIZONA)
) ss
County of Pima)

The foregoing instrument was acknowledged before me this 13th day of December, 1993.

My Commission Expires

Notary Public

DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

RECEIPT AND ACCOUNTING ADVICE

NO. 2025757

		05/[illegible]	06/30/93
Subject:	CLAIM RENTAL FEE 1993 & 1994 (7)	2 108 13	1,400.00

Applicant:

ASARCO
BOX 5747
TUCSON AZ 85703

Remitter SAME CK.# [illegible]

Assignor:

DOCK 628 PAGE 924

SERIAL NO.
AMC [illegible], ET AL

REFER TO THE ABOVE CASE SERIAL NUMBER IN ALL CORRESPONDENCE. PLEASE INFORM THIS OFFICE OF ANY CHANGE IN ADDRESS.

NOTE: This notice is a receipt for monies paid the United States. If these monies are for required fees in connection with your application to lease, purchase, enter, or otherwise acquire an interest in public lands or resources, this receipt is not an authorization to utilize the land applied for and it does not convey any right, title, or interest in the land for which application is made.

EXHIBIT A

FISCAL YEARS 1993 - 1994

DOCK 628 PAGE 925

mining claims situated in the Harshaw Mining District, Santa Cruz County, Arizona, the names and books and pages of record in the office of the County Recorder of Santa Cruz County, Arizona, and the Bureau of Land Management serial number of the Notices of Location whereof are as follows:

NAME OF CLAIM	RECORDING DATA BOOK	PAGE	BLM SERIAL NO.
South Humbolt	007	360	A MC 50226
" " Amended	380	682 and 683	"
Humbolt	007	358	A MC 50227
" Amended	380	684 and 685	"
Silver Leaf	007	364	A MC 50228
" " Amended	380	686 and 687	"
Good Luck #2	007	366	A MC 50229
" " " Amended	380	688 and 689	"
Indian Chief	007	368	A MC 50230
" " Amended	380	690 and 691	"
Monoca	007	362	A MC 50231
" Amended	380	692 and 693	"
Good Luck	4	300	A MC 50232
" " Amended	382	575 and 576	"

The above described unpatented lode mining claims are located in Section 32 of Township 22 South, Range 16 East, and Section 5 of Township 23 South, Range 16 East, G&SRB&M.

That all of said mining claims are owned by Kerr-McGee Corporation and ASARCO Incorporated, the mailing address for which is P.O. Box 5747, Tucson, Arizona 85703

PAYMENT

7 mining claims x $200.00 = $1,400.00

AFFIDAVIT OF LABOR PERFORMED
AND IMPROVEMENTS MADE

STATE OF ARIZONA)
) ss
County of Pima)

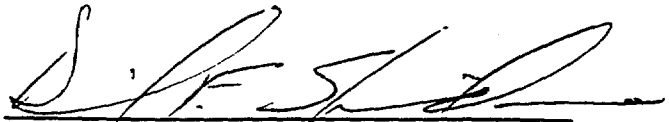
David F. Skidmore, being first duly sworn, deposes and says that he is a citizen of the United States and more than twenty-one (21) years of age, and resides in Tucson, County of Pima, State of Arizona, and is personally acquainted with the mining claims situated in the Harshaw Mining District, Santa Cruz County, Arizona, the names and books and pages of record in the office of the County Recorder of Santa Cruz County, Arizona, and the Bureau of Land Management serial numbers of the Notices of Location whereof are as set forth in Exhibit A.

That all of said mining claims are owned by ASARCO Incorporated, the mailing address for which is P. O. Box 5747, Tucson, AZ 85703; that between September 1, 1992 and September 1, 1993, in excess of $1,400 worth of work and improvements were done and performed for the benefit of each of the described claims. Work and improvements consisted of:

Annual rental fee of $100.00 for each mining claim as required under Public law 102-381 of October 5, 1992, 106 stat. 1374, 1378-79. BLM receipt of payment attached.

Said labor was performed and improvements made at the expense of ASARCO Incorporated for the benefit of each and all of said mining claims (14) comprising said contiguous group as part of a general plan of exploration, improvements and development, and they tend to explore, improve and develop each and all of said mining claims. The amount expended for and the value of said labor and improvements is more than One Hundred Dollars ($100.00) for each of the mining claims, and at least said amount was allocated to each of the mining claims. Said expenditure was made in good faith for the purpose of exploring, improving and developing said contiguous group of mining claims, and was intended as annual labor and improvements for each and all of the described unpatented lode mining claims for the assessment year ending at 12:00 o'clock Meridian, September 1, 1993.

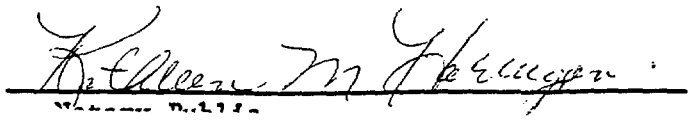
ASARCO Incorporated

By 
David F. Skidmore

STATE OF ARIZONA)
) ss
County of Pima)

The foregoing instrument was acknowledged before me this 13th day of December, 1993 by David F. Skidmore.

My Commission Expires July 9, 1996


Notary Public

orm 1370-41
(arch 1984)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

RECEIPT AND ACCOUNTING ADVICE

NO. 2325936

SM/AZ 08/31/93

bject: CLAIM RENTAL FEE 1993 & 1994 (14) 2 355 13 2,810.00

pplic

ASARCO
P. O. BOX 5747
TUCSON, AZ 85703

SAME - CK #3686

Remitter:

ssignor:

SERIAL NO.
AMC 52015, ET AL

REFER TO THE ABOVE CASE SERIAL NUMBER IN ALL CORRESPONDENCE. PLEASE INFORM THIS OFFICE OF ANY CHANGE IN ADDRESS.

NOTE: This notice is a receipt for monies paid the United States. If these monies are for required fees in connection with your application to lease, purchase, enter, or otherwise acquire an interest in public lands or resources, this receipt is not an authorization to utilize the land applied for and it does not convey any right, title, or interest in the land for which application is made.

EXHIBIT A

FISCAL YEARS 1993 - 1994

the mining claims situated in the Palmetto and Harshaw Mining Districts, Santa Cruz County, Arizona, the names and books and pages of record in the office of the County Recorder of Santa Cruz County, Arizona, and the Bureau of Land Management serial number of the Notices of Location whereof are as follows:

NAME OF CLAIM	RECORDING BOOK	RECORDING PAGE	BLM SERIAL NO.
Boot 52 thru 57	58	421 thru 426	A MC 52015 thru 52020
Boot 77	57	323	52032
Boot 78	57	324	52033
Boot 78 Amended	58	431	"
Boot 79	57	325	52034
Boot 80	57	326	52035
Boot 80 Amended	69	432	"
Boot 81	57	327	52036
Boot 103, 105, 106	81	360, 363, 364	52055, 52058, 52059

All of said claims are located in Sections 36, T22S, R15E; Sections 31, T22S, R16E; and Section 6, T23S, R16E, G&SRB&M.

That all of said mining claims are owned by ASARCO Incorporated the mailing address for which is P.O. Box 5747, Tucson, Arizona 85703

PAYMENT

14 Mining Claims x $200.00 = $2800.00

TR-10.4
(Thunder Mt)

ASARCO

Copper Operations
Tucson Office

December 14, 1993

CERTIFIED MAIL
RETURN RECEIPT REQUESTED
Santa Cruz County Recorder
P. O. Box 1150
Nogales, AZ 85621

Gentlemen:

Enclosed for recording is the Affidavit of Labor Performed and Improvements Made for the assessment year ending September 1, 1993, and our check in the amount of $13.00 as the recording fee.

Please record and return to me at the address listed below.

Very truly yours,

David F. Skidmore

DFS/kh
encls. Affidavit & Check

cc: Voucher

ASARCO Incorporated P. O. Box 5747 Tucson, AZ 85703-0747
1150 North 7th Avenue Phone (602) 798-7732 Fax: (602) 798-7782

ASARCO

EXPLORATION DEPARTMENT

JAMES D. SELL
MANAGER

May 11, 1994

Mr. John Alloway
Land-Minerals
Kerr-McGee Corporation
P.O. Box 25861
Oklahoma City, OK 73125

Quit Claim Deed
Harshaw Mining District
Santa Cruz County, AZ

Dear John:

Enclosed is the original Quit Claim Deed for 21 unpatented lode claims located in the Harshaw and Palmetto Mining Districts, Santa Cruz County, Arizona. This was recorded in Santa Cruz County on May 3, 1994, Docket No. 639, Pages 318 and 319.

Sincerely yours,

James D. Sell/mek

JDS:mek
enc.

James D. Sell
Exploration Manager,
Tucson

cc: G. Van Valkenburg
P.J. Maley
D.F. Skidmore

05/03/94 RECORDER SYSTEM 14:53
SANTA CRUZ COUNTY

FEE NUMBER 943511
DKT./PAGE-TO PG 639/ 318- 319

DATE RECORDED 05/03/94
TIME RECORDED 1:00

INSTRUMENT :
DEED TO MINING CLAIM

FEES PAID:
FILING FEE SUR.CH. POST/HANDL ST.CHG.
5.00 3.00

PAID BY : ASARCO INCORPORATED
CK#004794-$8.00

INSTRUMENT # 943511
OFFICIAL RECORDS OF
SANTA CRUZ COUNTY
IRMA L. PACHECO
COUNTY RECORDER
REQUEST OF :
ASARCO INCORPORATED
DATE: 05/03/94 TIME: 1.00
FEE: 8.00
DOCK 639 PAGE 318 PAGES: 2

QUIT CLAIM DEED

INDEXED MICROFILMED

DOCK 639 PAGE 318

For the consideration of Ten Dollars, and other valuable considerations, ASARCO Incorporated, P.O. Box 5747, Tucson, Arizona 85703, does hereby quit-claim to Kerr-McGee Corporation, all right, title, or interest in the unpatented mining claims situated in the Harshaw and Palmetto Mining Districts, Santa Cruz County, Arizona, described in Exhibit A, attached hereto and made a part hereof.

Date: 4/29/94

ASARCO Incorporated

by: James D. Sell
J.D. Sell, Expl. Mgr., Tucson

State of Arizona)
) ss
County of Pima)

The foregoing instrument was acknowledged before me this 29th day of April, 1994, by J.D. Sell, Expl. Mgr., Tucson, ASARCO Incorporated.

Kathleen M. Horrigan
Notary Public

My commission expires:

My Commission Expires July 6, 1998

EXHIBIT A

The following unpatented mining claims are situated in the Harshaw and Palmetto Mining Districts, Santa Cruz County, Arizona, the name of which and the book and pages of recording of the Location Notices of which, are in the office of the Recorder of Santa Cruz County, and the Bureau of Land Management serial numbers of which are filed in Phoenix, Arizona.

NAME OF CLAIM		RECORDING DATA BOOK	PAGE	BLM SERIAL NO.
South Humbolt		007	360	A MC 50226
" "	Amended	380	682 and 683	"
Humbolt		007	358	A MC 50227
"	Amended	380	684 and 685	"
Silver Leaf		007	364	A MC 50228
" "	Amended	380	686 and 687	"
Good Luck #2		007	366	A MC 50229
" " "	Amended	380	688 and 689	"
Indian Chief		007	368	A MC 50230
" "	Amended	380	690 and 691	"
Monoca		007	362	A MC 50231
"	Amended	380	692 and 693	"
Good Luck		4	300	A MC 50232
" "	Amended	382	575 and 576	"

The above described unpatented lode mining claims are located in Section 32 of Township 22 South, Range 16 East, and Section 5 of Township 23 South, Range 16 East, G&SRB&M.

Boot 52 thru 57		58	421 thru 426	A MC 52015 thru 52020
Boot 77		57	323	A MC 52032
Boot 78		57	324	A MC 52033
Boot 78	Amended	58	431	"
Boot 79		57	325	A MC 52034
Boot 80		57	326	A MC 52035
Boot 80	Amended	69	432	"
Boot 81		57	327	A MC 52036
Boot 103		81	360	A MC 52055
Boot 105		81	363	A MC 52058
Boot 106		81	364	A MC 52059

The above Boot claims are located in Section 36, Township 22 South, Range 15 East, Section 31, Township 22 South, Range 16 East, and Section 6, Township 23 South, Range 16E, G&SRB&M.

ASARCO

JDS

EXPLORATION DEPARTMENT

JAMES D. SELL
MANAGER

June 27, 1994

Mr. John W. Alloway
District Landman
Kerr-McGee Corporation
Kerr-McGee Center
P. O. Box 25861
Oklahoma City, OK 73125

Dear Mr. Alloway:

Corrected Quitclaim Deed

Your letter of June 24, 1994, has been received with the check no. 058195 dated June 21, 1994.

I return to you one signed and notarized copy of the corrected Quitclaim Deed which Kerr-McGee will record and then return a copy to Asarco.

Sincerely,

James D. Sell

James D. Sell
Telephone: (602) 798-7714

JDS:brw
Attachment
cc: G. van Valkenburg
M. A. Miller
D. F. Skidmore
No attach.

JDS

KERR-McGEE CORPORATION
KERR-McGEE CENTER • OKLAHOMA CITY, OKLAHOMA 73125

June 24, 1994

EXPLORATION AND PRODUCTION DIVISION

Writer's Telephone #405/270-3715

RECEIVED
JUN 27 1994
EXPLORATION DEPARTMENT

Mr. James D. Sells
ASARCO INCORPORATED
P.O. Box 5747
Tucson, Arizona 85703

Re: Quit Claim of Lode Claims
Harshaw Mining District
Santa Cruz County, Arizona

Dear Mr. Sells:

Despite Kerr-McGee's request that Asarco pay the rental on the "Humbolt" claims, Kerr-McGee does not desire an assignment of those claims; therefore, we have prepared a Correction Quit Claim Deed for your execution. Please sign and return one notarized original to me. Kerr-McGee will record it and send you a copy.

Also, we enclose Kerr-McGee's check No. 058195 dated June 21, 1994 payable to Asarco, Inc. in the amount of $4,234.00 as reimbursement for annual rental and recording fees.

Thank you for your trouble.

Yours very truly,

KERR-McGEE CORPORATION

John W. Alloway
District Landman

JWA/bg

Attachments

copies to:
G. Van Valkenburg (with check No. 058195)
~~R.G. Mobley~~ M.A. Mills
D.F. Sheldon

CORRECTION QUITCLAIM DEED

WHEREAS: By an instrument dated April 29, 1994 and recorded as Dock 639 Page 318 in the records of Santa Cruz County, Arizona, ASARCO Incorporated (hereinafter referred to as "ASARCO") conveyed an interest in certain unpatented mining claims to Kerr-McGee Corporation (hereinafter referred to as "Kerr-McGee"); and

WHEREAS: Said instrument incorrectly included certain unpatented mining claims not to be conveyed to Kerr-McGee; and

WHEREAS: ASARCO and Kerr-McGee, by this instrument, desire to correct the conveyance so that only the properties intended to be transferred are conveyed.

NOW, THEREFORE: For the consideration of Ten Dollars ($10.00), and other valuable considerations, ASARCO Incorporated, P.O. Box 5747, Tucson, Arizona 85703, does hereby quitclaim to Kerr-McGee Corporation, all right, title, or interest in the unpatented mining claims situated in the Harshaw and Palmetto Mining Districts, Santa Cruz County, Arizona, described in Exhibit A, attached hereto and made part hereof.

Date: 6-27-94

ASARCO Incorporated

By: James W. Lee

KERR-McGEE CORPORATION

By: Bill R. Layton
Bill R. Layton
Attorney-in-Fact

STATE OF ARIZONA)
) SS.
COUNTY OF PIMA)

The foregoing instrument was acknowledged before me this 27th day of June, 1994, by James W. Lee, Mgr. Exploration of ASARCO Incorporated on behalf of the corporation.

Kathleen M. Horrigan
Notary Public

My Commission Expires:

My Commission Expires July 8, 1996

(Seal)

235G/94-0616

STATE OF OKLAHOMA)
) SS.
COUNTY OF OKLAHOMA)

The foregoing instrument was acknowledged before me this 21 day of June, 1994, by Bill R. Layton, Attorney-in-fact of Kerr-McGee Corporation on behalf of the corporation.

Sheryl B. Gotshall
Notary Public

My Commission Expires:

11-13-96
(Seal)

235G/94-0616

EXHIBIT A

The following unpatented mining claims are situated in the Harshaw and Palmetto Mining Districts, Santa Cruz County, Arizona, the name of which and the book and pages of recording of the Location Notices of which, are in the office of the Recorder of Santa Cruz County, and the Bureau of Land Management, serial numbers of which are filed in Phoenix, Arizona.

	Recording Data		BLM
Name of Claim	Book	Page	Serial Number
BOOT 52 THRU 57	58	421 THRU 426	A MC 52015 thru 52020
BOOT 77	57	323	A MC 52032
BOOT 78	57	324	A MC 52033
BOOT 78 AMENDED	58	431	A MC 52033
BOOT 79	57	325	A MC 52034
BOOT 80	57	326	A MC 52035
BOOT 80 AMENDED	69	432	A MC 52035
BOOT 81	57	327	A MC 52036
BOOT 103	81	360	A MC 52055
BOOT 105	81	363	A MC 52058
BOOT 106	81	364	A MC 52059

The above Boot claims are located in Section 36, Township 22 South, Range 15 East, Section 31, Township 22 South, Range 16 East, and Section 6, Township 23 South, Range 16E, G&SRB&M.

J. Sell

ASARCO

Copper Operations
Tucson Office

July 6, 1994

Mr. Jose G. Mendoza and Helen A. Mendoza
P O Box 124
Patagonia, AZ 85624

Humbolt Group
Patagonia Mountains
Santa Cruz County, Arizona

Dear Mr. and Mrs. Mendoza:

ASARCO Incorporated will no longer retain the seven (7) Humbolt claims in the Patagonia Mountains.

Under the Mining Option, you have a 2 1/2% net smelter return on any production from those claims as long as Asarco retains them.

As Asarco will no longer retain these claims, the 2 1/2% NSR will no longer apply to the claims.

Should you desire to retain the claims, Asarco will Quit Claim the seven Humbolt claims as listed in Attachment A, to you.

If you do not desire to retain the claims, please sign and return a copy of this letter.

Asarco will record this document in Santa Cruz County and send a copy to you.

Sincerely,

Mark A. Miller
Landman

MAM/kh

Attach.

ASARCO Incorporated P.O. Box 5747 Tucson, Az 85703-0747
1150 North 7th Avenue Phone (602) 792-3010 Fax (602) 624-3369

We, Jose G. Mendoza and Helen A. Mendoza do not accept the Humbolt Quit Claim Deed.

Jose G. Mendoza

Helen A. Mendoza

cc: DCDixon
JDSell
File

ASARCO

Copper Operations
Tucson Office

July 6, 1994

Mr. Jose G. Mendoza and Helen A. Mendoza
P O Box 124
Patagonia, AZ 85624

Quit Claim Deed
Harshaw Mining District
Santa Cruz County, Arizona

Dear Mr. and Mrs. Mendoza:

Enclosed is the Quit Claim Deed for seven unpatented lode claims located in the Harshaw Mining District, Santa Cruz County, Arizona.

The Quit Claim Deed should be recorded in Santa Cruz County and a copy returned to ASARCO Incorporated.

Sincerely,

Mark A. Miller

We, Jose G. Mendoza and Helen A. Mendoza, do hereby accept the Humbolt Quit Claim Deed.

Jose G. Mendoza

Helen A. Mendoza

ASARCO Incorporated P.O. Box 5747 Tucson, Az 85703-0747
1150 North 7th Avenue Phone (602) 792-3010 Fax (602) 624-3369

QUIT CLAIM DEED

For the consideration of Ten Dollars, and other valuable considerations, ASARCO Incorporated, P. O. Box 5747, Tucson, Arizona 85703, does hereby quit-claim to JOSE G. MENDOZA and HELEN A. MENDOZA, all right, title, or interest in the unpatented mining claims situated in the Harshaw District, Santa Cruz County, Arizona, described in Exhibit A, attached hereto and made a part hereof.

DATE: 7-6-94

ASARCO Incorporated

by: _____
M. A. Miller, Landman,
Copper Operations

STATE OF ARIZONA)
) ss
COUNTY OF PIMA)

The foregoing instrument was acknowledged before me this 7th day of July, 1994, by M. A. Miller, Landman, Copper Operations, ASARCO Incorporated.

_____
Notary Public

My Commission Expires:

My Commission Expires July 6, 1998

EXHIBIT A

The following unpatented mining claims are situated in the Harshaw Mining District, Santa Cruz County, Arizona, the name of which and the book and pages of recording of the Location Notices of which, are in the office of the Recorder of Santa Cruz County, and the Bureau of Land Management serial numbers of which are filed in Phoenix, Arizona.

NAME OF CLAIM	RECORDING BOOK	DATA PAGE	BLM SERIAL NO.
South Humbolt	007	360	A MC 50226
South Humbolt Amended	380	682 & 683	A MC 50226
Humbolt	007	358	A MC 50227
Humbolt Amended	380	684 & 685	A MC 50227
Silver Leaf	007	364	A MC 50228
Silver Leaf Amended	380	686 & 687	A MC 50228
Good Luck # 2	007	366	A MC 50229
Good Luck # 2 Amended	380	688 & 689	A MC 50229
Indian Chief	007	368	A MC 50230
Indian Chief Amended	380	690 & 691	A MC 50230
Monaca	007	362	A MC 50231
Monaca Amended	380	692 & 693	A MC 50231
Good Luck	4	300	A MC 50232
Good Luck Amended	382	575 & 576	A MC 50232

The above described unpatented lode mining claims are located in Section 32 of Township 22 South, Range 16 East, and Section 5 of Township 23 South, Range 16 East, G&SRB&M.