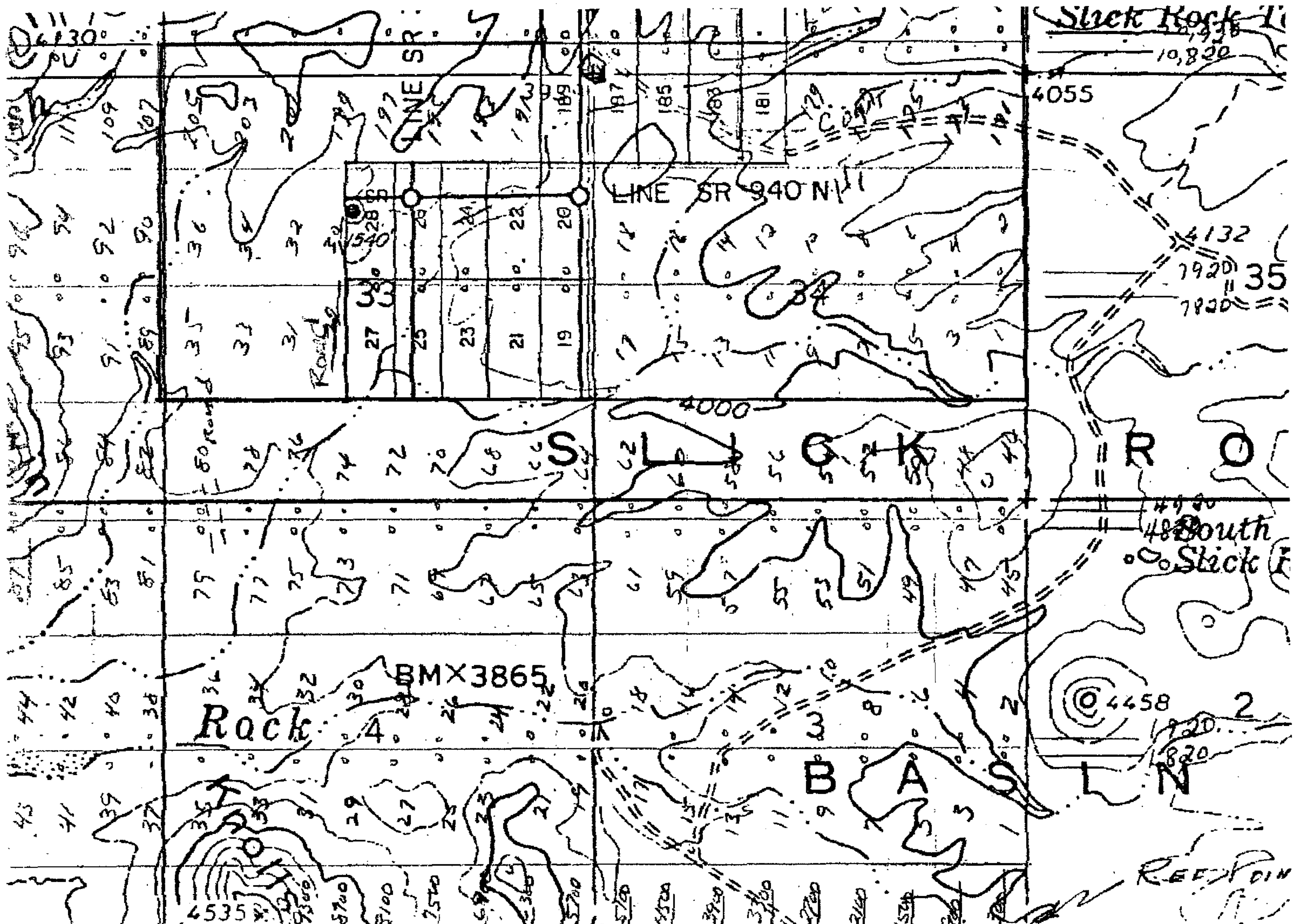
CONTACT INFORMATION
Mining Records Curator
Arizona Geological Survey
416 W. Congress St., Suite 100
Tucson, Arizona 85701
520-770-3500
http://www.azgs.az.gov
inquiries@azgs.az.gov

DOCKET 227 PAGE 5



WESTERN EXPLORATION OFFICE PHELPS DODGE CORPORAT

SLICK ROCK PROJECT
LAND STATUS MAP
GRAHAM COUNTY, ARIZONA

DOCKET 227 PAGE 5

EXHIBIT A

o LOCATION MONUMENT

SCALE	H: 1" = 2000'	CONTOUR INTERVAL:		REVISIONS
	V:	DATE:	BY:	9/28/73 8/7
				10/29/73
SHEET 2 OF 2		DRAWING NO:		FILE: R9-2-3

KRUEGER ENTERPRISES, INC.
GEOCHRON LABORATORIES DIVISION
24 BLACKSTONE STREET • CAMBRIDGE, MA. 02139 • (617)-876-3691

POTASSIUM–ARGON AGE DETERMINATION

REPORT OF ANALYTICAL WORK

Our Sample No. R-4186

Date Received: 28 April 1978

Your Reference: WA-2-1-C

Date Reported: 1 June 1978

Submitted by: L. Clark Arnold
Pillar, Lowell & Assoc.
5115 North Oracle Road
Tucson, ARIZONA 85704

Sample Description & Locality: Volcanic rock. Sample TEV 040, #WA-2-1-C. Crushed rock.

Material Analyzed: Whole rock, -60/+100 mesh. Treated with mixture of HNO_3 and HF to remove alterations.

Ar^{40*}/K^{40} = .001632

AGE = 27.7 ± 1.3 M.Y.

Argon Analyses:

Ar^{40*}, ppm.	Ar^{40*}/ Total Ar^{40}	Ave. Ar^{40*}, ppm.
.004139	.231	.003999
.003858	.151	

Potassium Analyses:

% K	Ave. %K	K^{40}, ppm
2.056	2.008	2.449
1.960		

Constants Used:

$\lambda_\beta = 4.72 \times 10^{-10}$/ year

$\lambda_e = 0.585 \times 10^{-10}$/ year

$K^{40}/K = 1.22 \times 10^{-4}$ g./g.

$$AGE = \frac{1}{\lambda_e + \lambda_\beta} \ln \left[\frac{\lambda_\beta + \lambda_e}{\lambda_e} \times \frac{Ar^{40*}}{K^{40}} + 1 \right]$$

Note: Ar^{40*} refers to radiogenic Ar^{40}.
M.Y. refers to millions of years.

KRUEGER ENTERPRISES, INC.
GEOCHRON LABORATORIES DIVISION

24 BLACKSTONE STREET • CAMBRIDGE, MA. 02139 • (617)-876-3691

POTASSIUM–ARGON AGE DETERMINATION | **REPORT OF ANALYTICAL WORK**

Our Sample No. R-4176

Date Received: 24 April 1978

Your Reference: WA-1-3-C

Date Reported: 1 June 1978

Submitted by: L. Clark Arnold
Pillar, Lowell & Assoc.
5115 North Oracle Road
Tucson, ARIZONA 85704

Sample Description & Locality: Sample TEV 033, #WA-1-3-C. Crushed rock.

1657'-1663'

Material Analyzed: Whole rock, -60/+100 mesh. Treated with mixture of HNO_3 and HF to remove alterations.

Ar^{40*}/K^{40} = .001477

AGE = 25.1 ± 1.2 M.Y.

Argon Analyses:

Ar^{40*}, ppm.	Ar^{40*}/ Total Ar^{40}	Ave. Ar^{40*}, ppm.
.003678	.190	.003566
.003454	.668	

Potassium Analyses:

% K	Ave. %K	K^{40}, ppm
1.992	1.979	2.414
1.966		

Constants Used:

$\lambda_\beta = 4.72 \times 10^{-10}$/ year

$\lambda_e = 0.585 \times 10^{-10}$/ year

$K^{40}/K = 1.22 \times 10^{-4}$ g./g.

$$AGE = \frac{1}{\lambda_e + \lambda_\beta} \ln\left[\frac{\lambda_\beta + \lambda_e}{\lambda_e} \times \frac{Ar^{40*}}{K^{40}} + 1\right]$$

Note: Ar^{40*} refers to radiogenic Ar^{40}.
M.Y. refers to millions of years.

KRUEGER ENTERPRISES, INC.
GEOCHRON LABORATORIES DIVISION
24 BLACKSTONE STREET • CAMBRIDGE, MASSACHUSETTS 02139 • (617) 876-3691

1 June 1978

L. Clark Arnold
Pillar, Lowell & Assoc.
5115 North Oracle Road
Tucson, ARIZONA 85704

Dear Mr. Arnold:

I am enclosing the final written reports on the three rock samples you sent to us for K-Ar age determinations. Enclosed also is the invoice for this work for you to approve and pass along for payment.

All three of analyses had to be done as whole rocks, and all three were sufficiently altered that we had to remove the carbonates and alteration products with a mixture of nitric and hydrofluoric acid. Samples R-4176 and R-4186 were similar mineralogically and similar in their potassium content, and were of nearly equal ages. Sample R-4175 was quite different from the others mineralogically, in potassium content, and also appears to be somewhat older.

If you should have any questions concerning these analyses, please do not hesitate to give me a call.

We look forward to serving you again in the future.

Sincerely,

Harold W. Krueger

Harold W. Krueger
HWK:mhs
encl.

Age determinations
from Whitlock Drill
holes - see CAP
area 64-97

File: Whitlock

KRUEGER ENTERPRISES, INC.
GEOCHRON LABORATORIES DIVISION

24 BLACKSTONE STREET • CAMBRIDGE, MA. 02139 • (617)-876-3691

POTASSIUM–ARGON AGE DETERMINATION | **REPORT OF ANALYTICAL WORK**

Our Sample No. R-4269

Date Received: 12 June 1978

Your Reference: letter of 9 June 1978

Date Reported: 8 August 1978

Submitted by: L. Clark Arnold
Pillar, Lowell & Associates
5115 North Oracle Road
Tucson, ARIZONA 85704

Sample Description & Locality: Andesite. Sample #WR-1.
Mineralized outcrop Ash Peak Mine
Whitlock Project

Material Analyzed: Whole rock, -60/+200 mesh.

Ar^{40*}/K^{40} = .001198

AGE = 20.4 ± .8 M.Y.

Argon Analyses:

Ar^{40*}, ppm.	Ar^{40*}/ Total Ar^{40}	Ave. Ar^{40*}, ppm.
.008522	.638	.008775
.009028	.619	

Potassium Analyses:

% K	Ave. %K	K^{40}, ppm
6.009	6.004	7.324
5.999		

Constants Used:

$\lambda_\beta = 4.72 \times 10^{-10}$/ year

$\lambda_e = 0.585 \times 10^{-10}$/ year

$K^{40}/K = 1.22 \times 10^{-4}$ g./g.

$$AGE = \frac{1}{\lambda_e + \lambda_\beta} \ln \left[\frac{\lambda_\beta + \lambda_e}{\lambda_e} \times \frac{Ar^{40*}}{K^{40}} + 1 \right]$$

Note: Ar^{40*} refers to radiogenic Ar^{40}.
M.Y. refers to millions of years.

Sanchez
Aqueduct
Earven Flat
Canal
Gaging Sta.
Canyon
Brown
Tidwell
GILA
VALLEY
Weir
River
Canal
Gila
Siphon
Fourness Canal
San Jose
Buena Vista
Sanchez Monument
Chic-hil-ti-calli
Pueblo Viejo
(Site)
Substation
Pipeline
Wash
Bennet
Yuma
Brown Jug
Tank
PELONCILLO
MOUNTAINS
Topaz Tank
Heber Tank
Jug Tank
Bridge
Tank
Toll Gate
Rain
Gage
ND-1
ND-2
ND-3
ND-4
EX-1
EX-2
SS6
SS7
SOL 1
SOL 2
SOL 3
SOL 4
SOL 5
SOL 6
SOL 7
SOL 8
SOL 9
SOL 10
SOL 11
SOL 12
SOL 13
SOL 14
SOL 15
SOL 16
SOL 17
SOL 18
Jose

Tol Area
Drill Holes

TO A. D. Wandke
FROM THOMAS W. MITCHAM
DATE 1/8/75

PANGEA RESOURCES, INC.
2002 N. Forbes Blvd., Suite 101
Tucson, Arizona 85705

January 6, 1975

MEMO TO: Thomas W. Mitcham
From: John E. Kinnison
Subject: New Deal (Faulkner-Riebold) claims, drill holes, Graham County, Arizona

According to the arrangement reached with Mike Riebold at our conference December 28, I reviewed the drill core from two holes, at Safford, December 31.

The attached logs, location map, and graphic logs are of these two diamond drill holes (Nos. 3 and 4). Although other holes (Nos. 1 and 2) are shown on Ted Faulkner's claim map, I have not seen samples or core from them. DDH 3 and 4 were drilled at the expense of Riebold, and are stored at Alfred Haralson's farm at Safford, whereas Nos. 1 and 2 were drilled by Faulkner-- who has the samples, if any.

The drill core is poorly stored and difficult of access. The upper half of ND-4 requires complete re-staking before moving any boxes, and so only the upper box of each stack in the upper half was seen. For the most part, my review was limited to spot checking at intervals, due to time limitation imposed by Riebold's conditions of examination.

Important conclusions are:

1. Mineralization in ND-3 could be the pyritic margin or fringe of a zone of copper mineralization, possibly 2000-4000 feet distant.

2. Thickness of post-mineral volcanics is not exactly known, but is not more than the rotary depths (DD-3, 1776'; ND-4, 1080').

3. The Silver Bell formation has been eroded in this area. Apparently the drill holes penetrated the underlying Claflin Ranch formation and the Cretaceous Pinkard formation.

4. Quartz monzonite porphyry in ND-3 lends additional encouragement to the Faulkner ground.

J. E. Kinnison

New Deal Claims
Faulkner-Riebold
DDH-3

Notes on spot logging Dec. 31, 1974; JEK

Core begins at 177'. Only 10'(2690-2700) split.

Footage	Notes
1776	Red brown andesite or latite. A few green-gray andesite frag
1840	Volc.-latite or andesite, finely porph. Red w/ irregular patches of green color-possible large frags?
1960	Same. Green patches are more porphyritic and appear to be frags or inclusions.-- almost looks like cgl, alternating w/ solid red latite.
1970	Same as above
1990	Similar to above, with frags, but color has changed from reddish to green-gray.
2100	Similar to above but more frags. Matrix is tan with volcanic-looking texture.
2210	Agglomerate?, yellow to tan. Py diss, about 2%, in small grains and hairline veinlets. Some hem on edges of veinlets.
2360	Aggl or cgl, gray-green. Vy hard. fine diss py and some hairline stringers. 3% total sulph. No oxid. Some chl & clay alt.
2530	Aggl or cgl, gray-green.. Chl alt and diss py, 1/2%.
2560	Same. Looks like an arkosic cgl. Very dense and hard. 1/2% py, mod. chl.
2660-90	Oxidized. Siltstone or tuff. Lim/py est 2-3%. This section has been split for assay.
2690-2700	Siltstone or tuff, white. 1% diss py.
2710	Same. 1% py. 10" vertical py-qtz vein 1/8" wide. Some oxid.
2740	Siltstone or tuff. 45^c bedding w/py strgs on bd. One 1/16" vert. py vein. 3% total sulph
@ 2748	45^c. thin hem slip.

2748-55	Porphyry? St clay. 3% py diss, first inch below 45° contact is granulated.
2760	Por? odd texture. St clay.
2770	Qtz monz por. Hornblend pheno. No sulph.
2800-2820	Qtz monz por. 2% diss py. Mod clay alt. Texture still looks a bit funny-- more like a very porph volc, but can't tell for sure.
@ 2934	Tight, sharp, healed contact between funny porph. and siltstone below. Probably intrusive contact. Both rocks have 2-3% diss py. Two or three grains possible cpy.
2993	White siltstone above changes to white arkose. 1% py in arkose as fine discrete grains. Rocks gradational, sedimentary contact.
3070	Siltstone or tuff? Fine white matrix w/ little blebs (pheno?) of white (clay) feldspar. thin crenulated rims of py enclose the white feld. Also, bed? dips 45°, marked by silica grains in thin layers, with a crenulated network of py enclosing the area around the grains. Total sulph: 3%.
3210	Fine arkose. St. sericite with 2% py as discrete diss grains.
3450	Siltstone, white. 2% py, diss grains.

Total depth.

New Deal Claims
Faulknew-Riebold
DDH-4

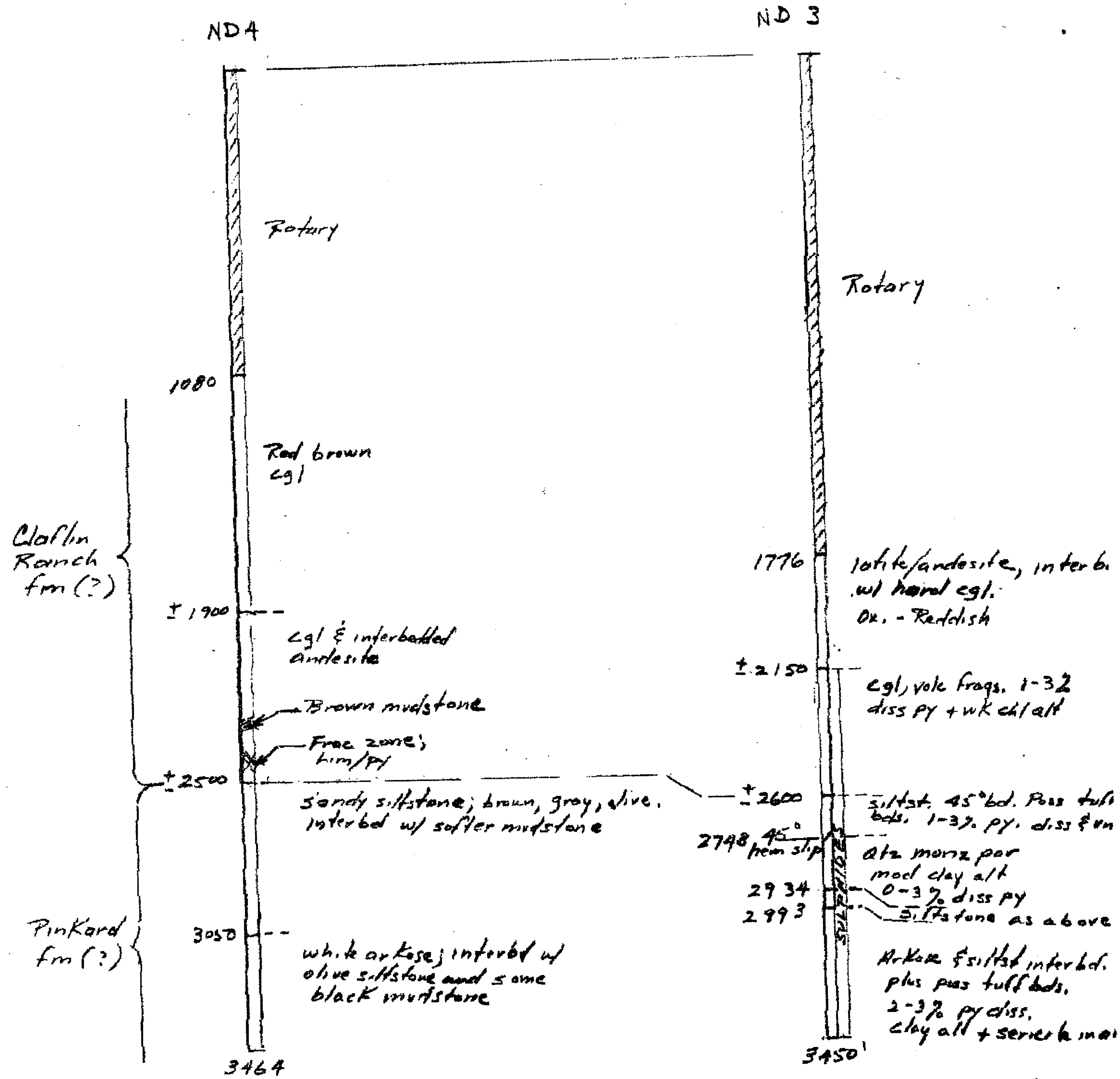
Notes on spot logging Dec. 31, 1974; JEK

Core begins at 1080 ft. None has been split.

Footage	Notes
1080	Red brown cgl. Rounded frags to 4". Red shaly partings. Fairly hard.
1305	Red brown cgl. Arkosic matrix. Hard. Frags of gray-green alt. andesite, hornblend por, monz por.
1464	Same
1640	Red brown cgl.
1820	Brown cgl. Some frags w/ st. chl. looks more like the cgl in ND 3.
1980	Greenish cgl. Frags very well rounded; granules to 4".
2130	Andesite or latite. Brown. Few rounded frags of andesite.
2290	Brown siltstone or mudstone. Mod soft w/ irreg curving fractures or parting planes.
2440	Porphyritic andesite. St fracs, high-angle, w/ soft transported red hematite, probably after pyrite. Chl alt.
Note!	1080-2440 core boxes are in 9 stacks, all leaning badly and ready to fall over. Only the top box of each stack was examined.
2590	Brown sandy siltstone, some hem on thin fracs.
2740	Banded sandy siltstone w/ layers of siltstone/mudstone. Beddings dip 20°. Gray to olive. These beds are essentially hornfels. No sulphide mineralization seen.
2890	Same, with a layer of softer mudstone.
3051	Olive siltstone, then 2 feet nearly black mudstone depositional on arkose, white, very porous-- soaks up water.
3060-3123	Arkose as above alternating with 2 - 5 ft. bands of olive siltstone. At 3121', intraformation cgl of black siltstone.

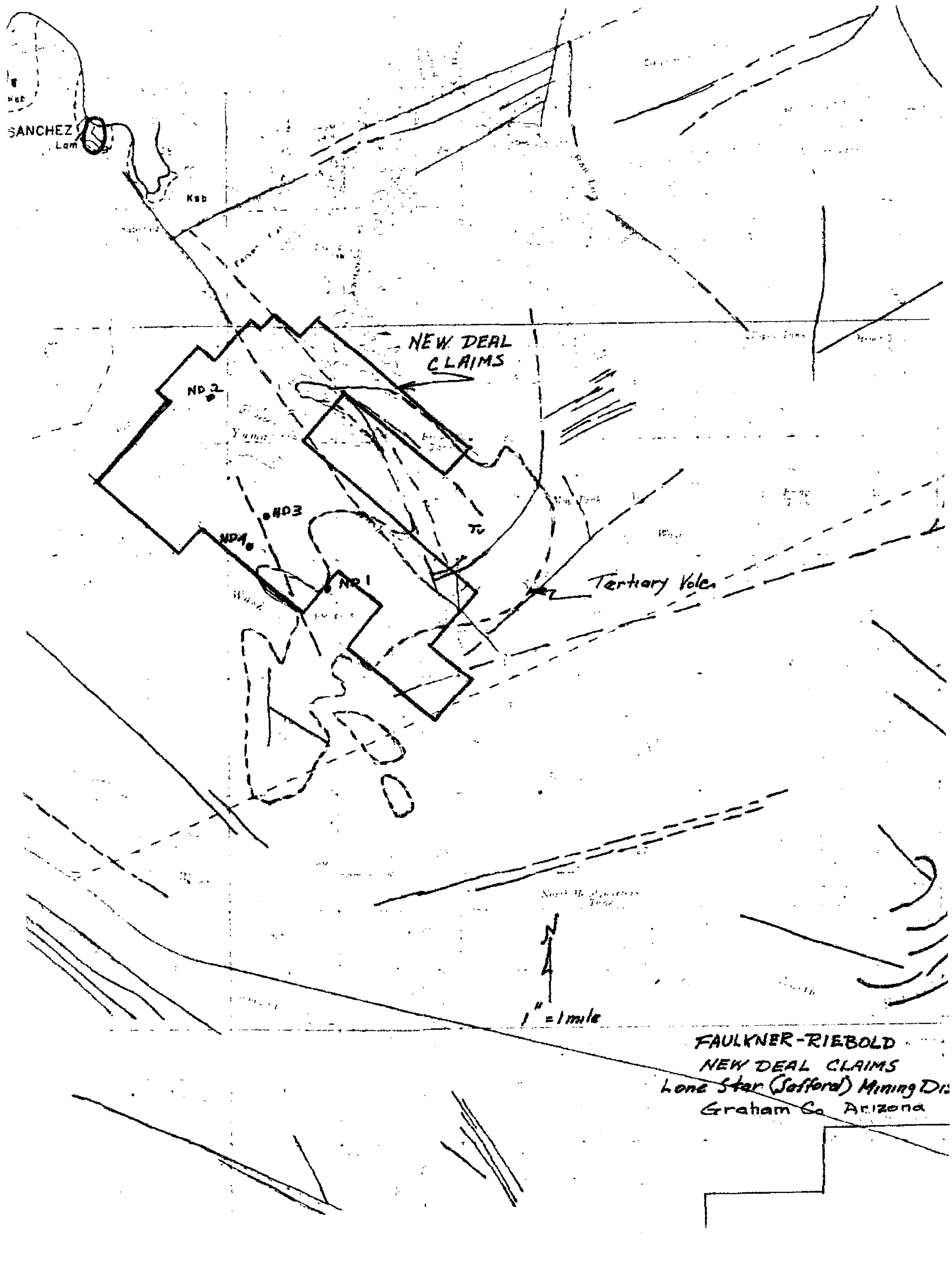
3123-3310	Stack tipper over-- not examined.
3310	Olive brown siltstone
3310-3464	White arkose and olive siltstone, w/some black mudstone.

Total Depth



NEW DEAL CLAIMS
FAULKNER - RIEBOLD

GRAPHIC LOGS
1" = 500'


SANCHEZ
NEW DEAL CLAIMS
ND 2
ND3
ND4
ND 1
Tv
Tertiary Volc.
1" = 1 mile
FAULKNER-RIEBOLD
NEW DEAL CLAIMS
Lone Star (Safford) Mining Di
Graham Co. Arizona

COPPER EXPLORATION DRILL HOLE INFORMATION

For that area of the Safford and Guthrie quadrangles east of Safford and southeast of the Gila River. Compiled from field checks, courthouse records, core logging, and other sources during 1972-1975 by David K. Brummett.

Hole no.	DEPTH	Drilled by	LOCATION	on Claim no.	Geologic Results
ND 1	1508	Faulkner (1964)	S28W, 1300' from NE Cor Sec 18, T7S-R28E.	New Deal 20	pre-ore rock at 1050', no pyrite, slightly altered
ND 2	780	Faulkner (1971)	N25W, 2300' from SW Cor Sec 6, T7S-R28E.	New Deal 84	in pre-ore rock at 700' only slightly altered
ND 3	3479		N43E, 2268' from SW Cor Sec 7, T7S-R28E.	New Deal 6	pyrite, alteration, fractured, intrusives, Cret. sediments, etc.
ND 4	3364		N61E, 1020' from SW Cor Sec 7, T7S-R28E.	New Deal 7	less altered than ND3, two sphalerite veins
Sol 1	2000+	AMAX	N29W, 2500' from SW Cor Sec 19, T7S-R28E.	Sol 121	rumored to have hit bornite at 800'. Ts 0-600, Ka 600-2400 TD. 5-10% py
2 (?)	2000+	AMAX	N4E, 3600' from SW Cor Sec 19, T7S-R28E.	Sol 127	?
3 (?)	2000+	AMAX	N20W, 2600' from SW Cor Sec 19, T7S-R28E.	Sol 124	∓ 80' of 0.60% (chalcanthite)
4 (?)	1800+	AMAX	N31W, 4200' from SW Cor Sec 19, T7S-R28E.	Sol 119	? Ts 0-900 Ka 900-1500, 2-5 TKg 1500-2000 T.D. 2-5% py.
5	3452	AMAX-PD Joint Venture	N55W, 2518' from SW Cor Sec 19, T7S-R28E.	Sol 120	?
6	3075	AMAX-PD	N50°52'W, 4182' from SW Cor Sec 19, T7S-R28E.	Sol 116	? Ts 0-1150 Ka 1150-2200 TD. 2-5% py
7	2200+	"	N78°30'E, 903' from SE Cor Sec 19, T7S-R28E.	Sol 199	pyrite mineralization encountered
8	1800+	"	N18W, 2900' From SW Cor Sec 24, T7S-R27E.	Sol 51	? Ts 0-1500' Ka 1500-2000 TD, 2-5% py.
9	2500+	"	N22W, 5700' from SW Cor Sec 19, T7S-R28E.	Sol 65	?
10	1100+	"	N14W, 2650' from SE Cor Sec 11, T7S-R27E.	Sol 534	some oxide copper at or near TD.
11	1500+	"	N40W, 7000' from SW Cor Sec 19, T7S-R28E.	Sol 57	?
12	1900+	"	N4W, 5300' from SW Cor Sec 19, T7S-R28E.	Sol 71	?

ND 3	3479		N43E, 2268' from SW Cor Sec 7, T7S-R28E.	New Deal 6	pyrite, alteration, fractured, intrusives, Cret. sediments, etc.
ND 4	3364		N61E, 1020' from SW Cor Sec 7, T7S-R28E.	New Deal 7	less altered than ND3, two sphalerite veins
Sol 1	2000+	AMAX	N29W, 2500' from SW Cor Sec 19, T7S-R28E.	Sol 121	rumored to have hit bornite at 800'.
2 (?)	2000+	AMAX	N4E, 3600' from SW Cor Sec 19, T7S-R28E.	Sol 127	?
3 (?)	2000+	AMAX	N20W, 2600' from SW Cor Sec 19, T7S-R28E.	Sol 124	∓ 80' of 0.60% (chalcanthite)
4 (?)	1800+	AMAX	N31W, 4200' from SW Cor Sec 19, T7S-R28E.	Sol 119	?
5	3452	AMAX-PD Joint Venture	N55W, 2518' from SW Cor Sec 19, T7S-R28E.	Sol 120	?
6	3075	AMAX-PD	N50°52'W, 4182' from SW Cor Sec 19, T7S-R28E.	Sol 116	?
7	2200+	"	N78°30'E, 903' from SE Cor Sec 19, T7S-R28E.	Sol 199	pyrite mineralization encountered
8	1800+	"	N18W, 2900' From SW Cor Sec 24, T7S-R27E.	Sol 51	?
9	2500+	"	N22W, 5700' from SW Cor Sec 19, T7S-R28E.	Sol 65	?
10	1100+	"	N14W, 2650' from SE Cor Sec 11, T7S-R27E.	Sol 534	some oxide copper at or near TD.
11	1500+	"	N40W, 7000' from SW Cor Sec 19, T7S-R28E.	Sol 57	?
12	1900+	"	N4W, 5300' from SW Cor Sec 19, T7S-R28E.	Sol 71	?
13	2100+	"	N6E, 1500' from SW Cor Sec 19, T7S-R28E.	Sol 128	
14	1800+	"	N29E, 1700' from SW Cor Sec 18, T7S-R28E.	Sol 22	pyrite mineralization encountered
15	2100+	"	N17W, 2150' from SE Cor Sec 13, T7S-R27E. Dist. may be short.	Sol 15	pyrite mineralization encountered
16	2500+	"	N19W, 4000' from SW Cor Sec 19, T7S-R28E.	Sol 121	?
17	2000' (?)	AMAX-Quintana		Sol 10 ?	?
18	2000' (?)	"		Sol 177	?

Hole No.	DEPTH	Drilled by	LOCATION	on Claim	Geologic Results
SS 1	1000	AMAX-PD	in state sec. 36, T7S-R27E, within 180' of NE Cor.	-	hit Tert. basalt at 650' all in post-ore rock
2	600	"	in state sec. 32, T7S-R28E, within 200 ft. of NW Cor.	-	insignificant depth
3	160	"	in N. Central part of Sec. 36, T7S-R27E.	-	insignificant depth
SS6(?)	420	"	in state sec. 16, T7S-R28E, 80' from SW Cor.	-	hit excess water, cased perferated to 420', potential good water well.
7(?)	1100	"	in state sec. 16, T7S-R28E, 200' from W¼ cor marker	-	still in post-ore basalt at TD (should be close t pre-ore rock)
V 1	1200	Phelps Dodge	about 500' SE of NW cor Sec 9, T8S-R28E.	Verum 20	all post ore rock
V 2	1250	"	about 400' S'ly from NW Cor Sec 21, T8S-R28E.	Verum 58	all post ore rock
SR 1	1264	"	S61W, 3300' from NE Cor Sec 33, T7S-R29E.	Opt 28	~~probably all post-ore~~ ~~no sulfides~~ sp. Py
SR 2	1100	"	N44E, 2000' from SW Cor Sec 27, T7S-R29E.	Opt 184	as above ±250' Tv only
TX-1	848	Faulkner	N22E, 1735' from SW Cor Sec 12, T8S-R28E.	Trendex 107	probably close to pre-ore rock, ~~rig still on hole (4-1-75)~~
EX 1	1800	Exxon	aprox. S45E, 1200' from NW Cor Sec 14, T7S-R28E.	EZ 39	entirely in post-ore ro mostly vuggy basalts
EX 2	2360	Exxon	near center of Sec. 9 T7S-R28E.	EX 36 (?)	entirely in post-ore basalt-same as cropping out at drill site.
Red 1	1000	Inspiration	(?) in E central area of Sec. 20, T7S-R29E.	Red ?	probably all in post-or rock
Red 2	1000	"	(?) probably in W central part of Sec 21, T7S-R29E.	Red ?	probably all in post-or rock.

NP 3

Begin
1776 Red brown andr. or latite w/ a few greengray and frags.

1840 Vol - Post-ore? —
Latite - andesite - finely porph. Red with many patches
of green color.

1960 - Same - green patches are more porph and almost
like mal. - almost cgl. - red hard.
Alternating with solid latite (Red)

1970 - as above

2090 - Same frag - with mal - but red color is gone -
grey to green gray.

2100 - Similar but very fragmental - fine matrix - vole.

2210 - Yellowish or tan aggl. Fugr. diss py + hairline vnlets 2%
Some hem on edges of vnlets.

2360 - Gray green cgl or aggl. Red hard.
fine diss py. Some hair strngr. 3% total sulph. No oxid.
Some chl & clay alt.

2530 - gray-green aggl or cgl. ½ py diss.
chl alt.

2560 - Same - looks like arkose cgl. ½% py. Mod chl.
Vy dense - approaching or is like Cretaceous SR.

Not split

2660-90 Oxidized. Siltstone or tuff. hm/py est 2-3%

split 2700 2690-2700 Siltstone or tuff. white. 1% diss py.

2710 d/o - 1% py. 10" vertical py-qtz vein ⅛" wide.
Some oxid.

2740 Siltstone or tuff. 45° Bd w/ py stringers on Bd.
+ ¼" vert py vein. 3% Sulph

2748 - 45° thin hem slip

2748 - 55 Poss por. St clay 3% py. 1st mch Bx or granulated.

2760 - as above - foamy texture. St clay.

2770 - Abl qtz mon por. No sulph.

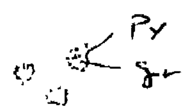
2800-20 Qtz Mon? porp. 2% diss py. - texture "fuzzy". - Just might be qtz latite volc. Mod clay.

@ 2834 - Tight sharp healed cont w/ siltst. and fuzzy porph but hard 2-3% diss py w/ one tr cpy ??

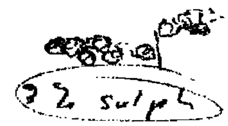
@ 2993 - Siltstone (white)' chgs to white where w/ 1% fine discrete diss py gr. poss cpy minor.

3070 - Tuff? or siltstone Fine white matrix w/ little white (clay) feldspar phenox.

Py tiny white grains



Bed? w/ silic gr and py tiny



+ one 45° 1/4" py vein.

3210 - Fine arkose. Sericite + 2% fine discrete py grains

3450 - Siltstone. wht - 2% diss py gr.

Halverson reports Line
Snowshoe 2700–2800

ND 4

Begin

1305 – Red brown cgl. arkosic matrix. – Hornfel.
frags of grey green alt and, Ksh, hbl por
and Mz por.

1464 – Same

1080 – Red brown cgl – Big Frags ± 4" rounded.
Red shaly partings. Hornfel

1640 – Red brown cgl

1820 – Brown cgl. Some frags st chl. Beginning to Resemble
more like ND 3

1980 – Greenish cgl – Frag very rounded – to 4" down to granule

2130 – Andesite lat.ite. Brown w/ a few rounded and frags.

2290 – Brown siltstone. Mod soft and curving parting planes.

2440 – Porphyritic andesite. St fract – high angle w/
red soft hem. Chl. alt. – evidently mineral.
by Py veins before ox.

2590 – Brown sandy siltstone. Some thin hem frac. Brown

2740 – Banded sandy siltstone w/ siltstone bands. layering 20° dip.
Grey to olive. These silts are essentially a hornfels. No Min.

~~2740~~ 2840 – Same – with a layer of softer mudstone.

@ 3051 – a olive siltstone and flow
nearly black mudstone in depositional
on a arkose. – white very porous – soaks up water

3060 – 3123 – Arkose as above alternating w/ 2 – 5' bands of olive siltstone.
@ 3121 @ an intraformation cgl / black siltstone

Some Below are tippedover –

@ 3310 – Olive Brn silts.

3310 – 5000 TD white ...

PANGEA RESOURCES, INC.

EXPLORATION MANAGERS, GEOLOGIC & MINING CONSULTANTS

2002 N. FORBES BLVD., SUITE 101
TUCSON, ARIZONA 85705
(602) 623-6316

December 31, 1975

MEMO TO: Files

FROM: John E. Kinnison

SUBJECT: Notes: Sol-New Deal Claims Area, SE of Sanches, Safford Mining District
Gila County, AZ

Land status.--Since initiating the Safford district study, we have at various times attempted to discuss terms on the New Deal property, culminating with an interview at Tucson with Riebold who at that time held an option in the Faulkner New Deal group. This meeting, in December, 1974, resulted only in stalemate over the terms. Riebold did, however, make available core for inspection from New Deal drill holes 3 and 4, on which I reported 1-6-75.

According to the Riebold contract, his option expired in July of this year. Faulkner now presumably has legal grounds for clear title, in so far as the Riebold interest clouded it, but Riebold has a quitclaim deed for 1/2 interest in the ground and it may be necessary for Faulkner to go to court to obtain a release from this conveyance.

Ted Faulkner is the principal holder of the New Deal claims, and apparently controls terms for the property. He has, however, conveyed unspecified interests to relatives and friends to raise cash, and a title search will be necessary to determine these conveyances. Faulkner now resides at the Buena Vista Hotel in Safford.

Claim maps prepared for Faulkner by Dave Brummett are placed in our map file. These maps appear to accurately depict the rather large area of claims activity SE of Sanchez.

The Sol group adjoins the New Deal on the west, and is held by Amax. A number of drill holes have been put down by Amax, and by Amax in joint venture with Phelps Dodge, and with Quintana. Claims held privately by a Mr. Whitmore, including the CO, ND 19-28, and Tiffany, adjoin the New Deal on the east. Exxon at one time had an option on this group and drilled at least two holes. To the south and southeast of the New Deal, are the Verum and OPT claims held by Phelps Dodge. Faulkner's Trendex group adjoins the OPT claims on their south side.

During this past fall, I have met with Faulkner on three different occasions to discuss terms for the New Deal group. Faulkner has not been willing to propose any deal in concise terms but has indicated he will not accept a standard mining option with a nominal front-end payment and a nominal purchase price. I do not think we should completely despair of obtaining some type of agreement with him, but there is little doubt that it would be costly--even in comparison with other Safford district options which have been among the most costly in Arizona.

Faulkner may be regarded as a friendly contact in the district who is well informed on general district activity. He has offered to make the New Deal core available for inspection at any time and I would recommend continued contact with him, and a final effort to reach a specific set of terms. It may also be appropriate at this time to contact Whitmore regarding the CO et al. groups.

Geology.--The rocks which crop out in the Sol, New Deal, and CO area consist of flat-lying basalts of the upper sequence, overlain by Gila conglomerate. According to Dave Brummett's log of the rotary section of New Deal holes 3 and 4, a conglomerate underlies this basalt. This is probably the case, for I have found a volcanic pebble conglomerate beneath the basalt in an erosional bank in the Gila River below Earvan flat, 1.5 miles east of Sanchez. A preliminary map in our map file shows the distribution of basalt, and erosional remnants of dissected Gila conglomerate, based on reconnaissance during October and November, 1975.

The drill hole pattern on the Sol group is sufficiently close-spaced to indicate that Amax was obtaining quite a bit of encouragement, but no reference to actual ore intercepts of significance have appeared in rumors around the Safford area. Dave Brummett has compiled a list of these holes, probable depths, and rumors of weak mineralization encountered, which has been placed in our Safford files.

I have scouted the New Deal and Whitmore ground for evidence of holes other than those shown by Faulkner , and have found only one--on the CO group on the common endcenter between CO 14 and 15. The drill sumps and sites have been bulldozed over, and I found only a few very small fragments of epidotized porphyry which may have been derived from this hole. At the site of Exxon 2, in section 9, only basalt cuttings were evident. At the site of New Deal 2, I found a single large piece of core consisting of a porphyry with weak epidote and chlorite, similar to the fragments at the site on CO 14-15.

The site of New Deal 4 is bulldozed over. At New Deal 3, I was able to ob[illegible] diamond drill sludge, and from this panned rather abundant pyrit[illegible] reby confirming that pyritic mineralization was encountered in this ho[illegible]e.

The principal exploration objective to date recognized, consists of a re-occurrence of mineralization along the SE projection of the Sanchez fault zone, which appears to pass through the New Deal and part of the CO groups. The pyritic mineralization in the Cretaceous Pinkard formation, and partly in porphyry, offers a direct lead to exploration on the New Deal group. New Deal 2 and the site at CO 14-15, however, are but weakly mineralized. The spacing of these holes is sufficiently wide to allow room for a Safford-type ore deposit to occur between them. In addition, we may speculate that the Paleozoic section, which could be favorable for replacement or tactite deposits, lies beneath the Pinkard formation at a depth greater than 3,500 feet.

JEK

JEK/nw
Attachments (2)

Circulate

Kennecott Exploration, Inc.

Exploration Services Department

Geophysics Division Operations

May 16

RECEIVED
MAY 21 1975
B. C. M. C.
TUCSON

MEMO TO: G. D. Van Voorhis ✓ J. Ashley
R. C. Babcock, Jr. R. W. Stevenson
H. W. Fleming

FROM: Phillip M. Wright

SUBJECT: The Sol (Amax) Sulfide System, Graham County, Arizona--Report on VIP Work

The attached report by Roger Andrews presents an analysis of one VIP line which we surveyed over the Sol sulfide system, discovered near Safford by Amax. The sulfide system is completely buried beneath 500 to 1,500+ feet of Tertiary lake-bed sediments and volcanic rocks. The discovery was apparently made by IP surveying of a positive gravity anomaly (indicating shallow cover) which runs as a gravity ridge south from the Safford district. Since the discovery, Amax has invited a number of groups to survey a specific line with their equipment. This represented one of the few opportunities we have to compare our equipment with that of others.

A number of points brought up in Roger's report merit further discussion. In 1972 we covered the area surrounding Sol with RIP without detecting an anomaly. At that time it was not possible to place electrodes in the heart of the system because Amax held the ground and was actively exploring. We did, however, have two receiver sites over what is now believed to be portions of the mineralized area (our sketchy knowledge of the size and location of the mineralized area is only by inference from our VIP data and from discussions with Amax geologists during which Amax was quite secretive). There has been much controversial discussion regarding why our RIP did not detect Sol, and the data presented in this report sheds much light on the question.

A glance at Andrews' Figure 6, reproduced here as Figure A, shows that receiver site 33 W from transmitter T 33 can be projected northward to fall between DH 4 and DH 1, which are on our VIP line. Looking at my Figure B we see that the RIP site projects at 15 W of the line. Now with a transmitter site to the east, the RIP value expected from a receiver site in this location would be given roughly by the fourth separation reading of the diagonal on the VIP line which trends down and east from the 5 W - 5 E interval, i.e., a value of 9 mils, as circled. We actually observed

4 mils on the RIP survey. In similar fashion, RIP receiver site 34 SE projects west of DH 6 on the VIP line, and the expected reading from such a site would be given roughly by the fourth separation value on the west trending diagonal from the 35 W - 45 W interval as circled. This value was not read, but surrounding values make a 10-14 mil reading likely. A 9 was actually observed on the RIP survey. My check of RIP data quality shows ±3-4 mils to represent the expected measurement noise level. In addition the dipole-dipole VIP measurements are expected to be about 20 percent higher than the RIP measurements because the VIP data were taken with Mark IV receivers which read higher values than the Mark III receivers used for the RIP work.

Furthermore, Figure C of this cover memo provides a case for comparison with the RIP data. The numbers given are the percentage of intrinsic source response which would be observed from receiver sites situated around transmitters as indicated and for a source body 5,000' x 5,000' in plan, 4,000' thick, and buried 1,000' (top figure) and 2,000' (bottom figure). Because the intrinsic response of Sol is estimated by Andrews to be about 100 mils, the numbers on Figure A can be read as mils of predicted RIP response. These computer models show that it is not sufficient simply to have a receiver site somewhere on the body-- the responsive body must comprise a considerable proportion of the volume between transmitter and receiver, and high amplification in response occurs only when both transmitter and receiver are over the body. This is especially true for deeper bodies, but would not be true for outcropping bodies where either transmitter or receiver in the body is sufficient for detection.

My conclusion from the above analysis is that given the sulfide system as presently known, one would not expect to detect it with the 1972 RIP coverage configuration we were able to obtain at Sol. In fact our "thoroughness of search" study, presented and discussed in Tucson in August 1974, shows that only in the area shaded in blue on Andrews' Figure 6 would we expect to detect the one cubic mile of 50-mil response, which the RIP program sought, for a sulfide system buried between 500 and 1,000 feet to top, as Sol is. Increasing the size of the sulfide system to Sol proportions and intrinsic response aids detection, of course, but does not materially change my conclusion. In this regard, I must disagree with Roger's comment on page 6 that "we do not normally countenance the possibility that two-square mile 50-100 mil sulfide systems can lurk undetected" in holes in our data. We geophysicists do recognize this possibility, and it should also be recognized by others.

A second point for discussion is Roger's words on "residual coupling errors" in our data. That our EM coupling removal procedures do not always remove all of the EM effect is well documented by Gerry Hohmann. In areas where resistivity is very low, like at Sol, total EM coupling is usually very high. In these cases our reduced data may retain some coupling. This residual coupling may be reduced by 1) using more frequencies to obtain a better coupling extrapolation, 2) using lower frequencies, or 3) using a different array. Both (1) and (2) were tried at Sol. We attempted to read 0.0625 Hz data, one frequency step lower than our usual 0.125 Hz low frequency, but were not able to obtain useful data because of high telluric current noise. We were not able to try (3) because Amax restricted our work to a dipole-dipole survey of the one line.

That the MGS IP survey was able to detect the Sol sulfide system in spite of severe coupling is due to the high intrinsic response of the system, which added onto the coupling. MGS may or may not have applied a simple coupling correction such as subtracting theoretical coupling from their data, but it is reasonable to assume that they tried this, for what else could they do with such data? Andrews shows that this coupling removal procedure is reasonably good at Sol, although it does not work well in general. Had they done this they would have obtained a profile which resembles Figure D of this cover memo. Figure D shows a residual anomaly which is dissimilar to our own only on the west end, where coupling becomes large. It is not surprising that such a residual IP indication in the Safford district, however shaky the theoretical grounds for its construction, would be drill tested.

I draw the following conclusions from the present data at Sol:

1. The deposit is detectable with competitor's IP gear because its high intrinsic response adds sufficiently to the severe coupling that it can still be seen;

2. The fact that our RIP survey did not detect the deposit is consistent with known characteristics of the IP technique, and

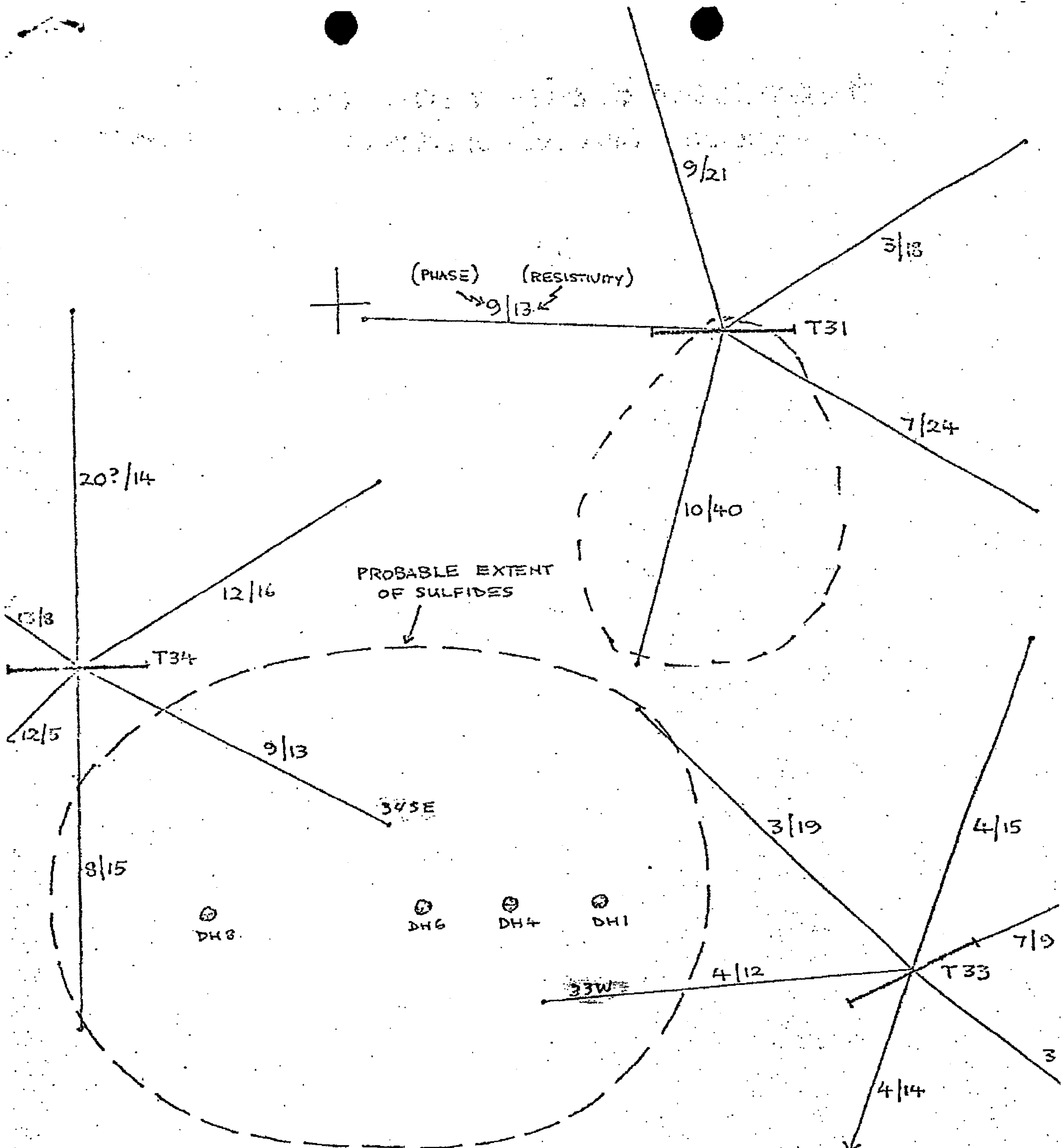
3. Our VIP anomaly shows the best relation to known sulfide distribution of the five sets of IP data to which we have access. Roger's presentation of these other data easily bears this out.

The last point I would like to make is that discussion of differing viewpoints as expressed in this and the companion memo is a natural characteristic of exploration and written documentation of this is a healthy but infrequent occurrence.

Phillip M. Wright

PMW:ss
Enclosures

cc: H. L. Bauer, Jr.   R. K. Andrews



SOL, GRAHAM COUNTY, ARIZO

RIP OVERLAY

Figure A

SCALE 1:24000

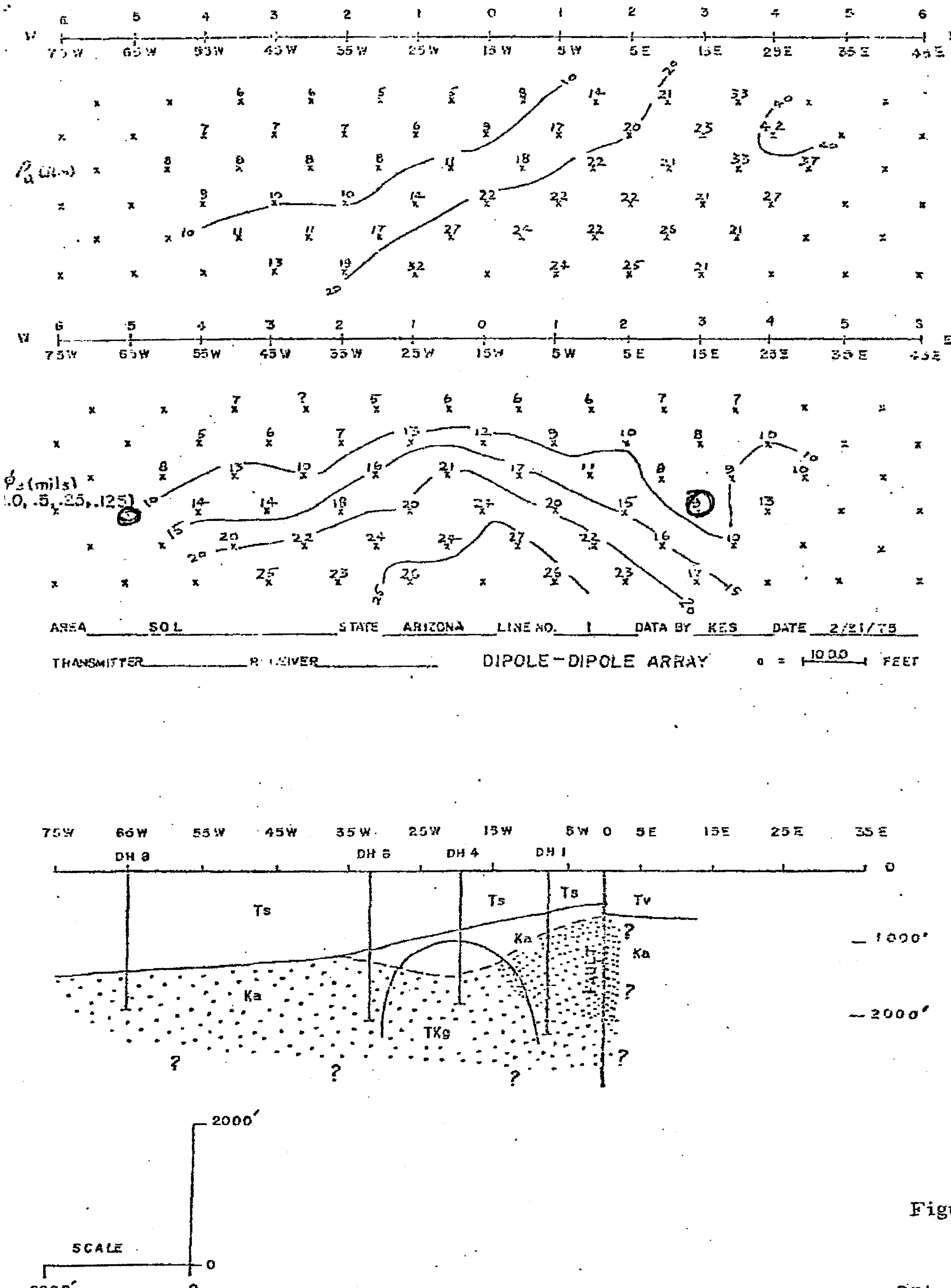
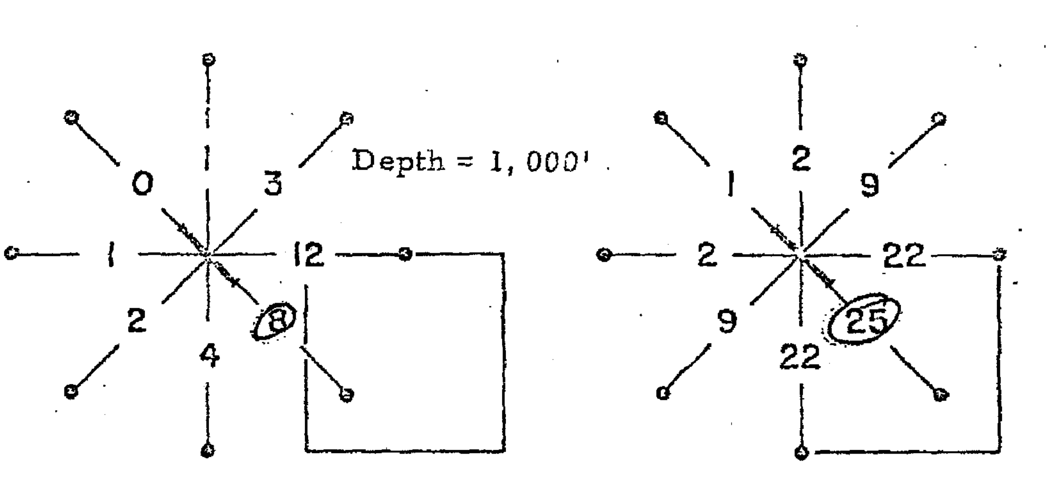
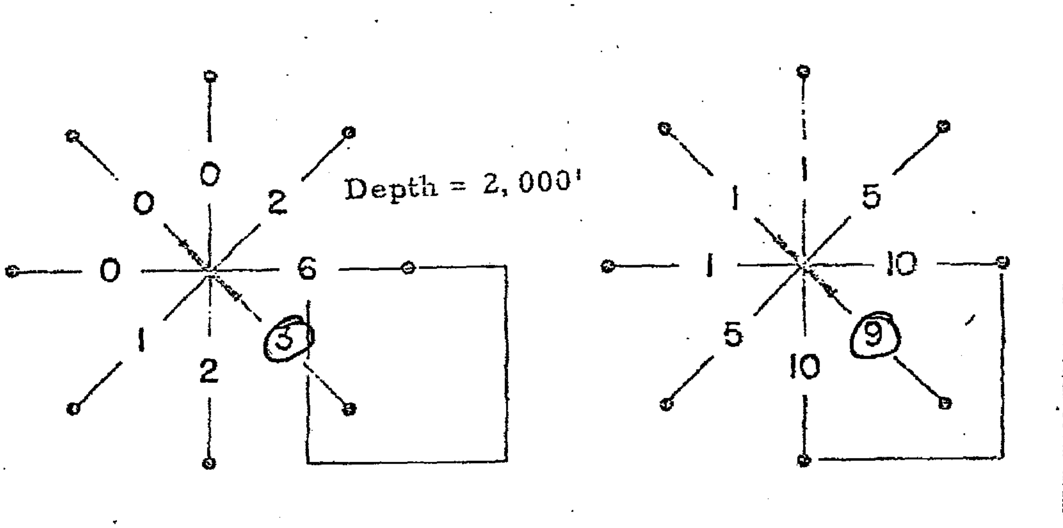


Figure B

SOL
GRAHAM COUNTY, ARIZONA
V.I.P. SECTION



W = L = 5,000'   DE = 4,000'

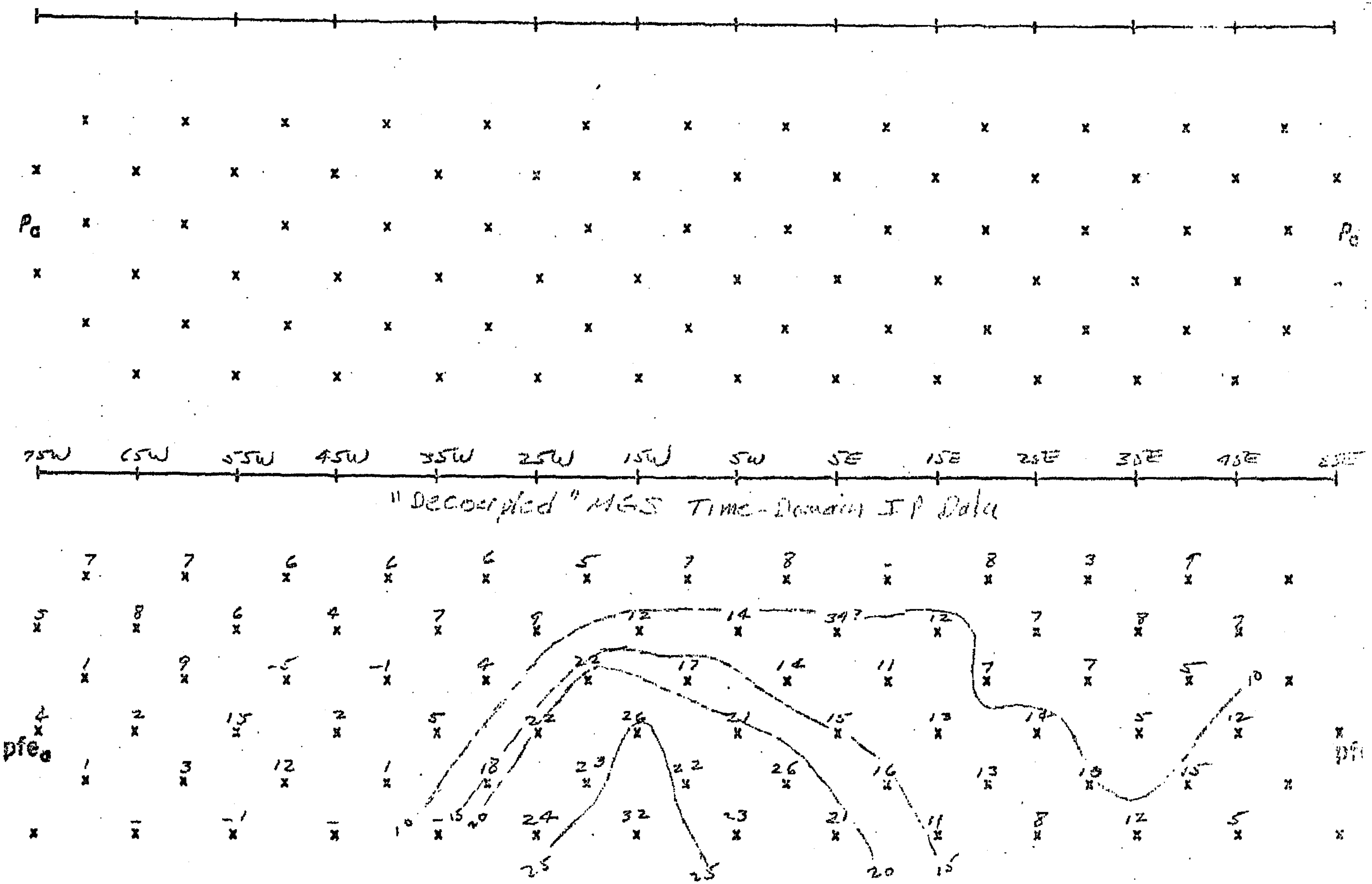


W = L - 5,000' DE = 4,000'

Figure C

KENNECOTT COPPER CORPORATION — EXPLORATION SERVICES — GEOPHYSICS DIVISION
INDUCED POLARIZATION PROFILE WORK SHEET

Figure D



AREA Sol, AZ STATE LINE NO VIP DATA BY MGS DATE 1990

THE SOL (AMAX) SULFIDE SYSTEM,
GRAHAM COUNTY, ARIZONA
REPORT ON VIP WORK

by
R. K. Andrews

May 1975

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

THE SOL (AMAX) SULFIDE SYSTEM,
GRAHAM COUNTY, ARIZONA
REPORT ON VIP WORK

by
R. K. Andrews

May 1975

SUMMARY AND RECOMMENDATIONS

Arrangements were made with Amax to run a VIP line over their Sol sulfide system in February of 1975. Accordingly, we repeated a line that had previously been run by several other mining or contracting companies, using a variety of different IP systems. Amax were interested in comparing our results with those obtained by the other IP systems. We were interested in obtaining data over the Sol system, specifically to assist with our interpretation of IP data from the Goat Well area, located immediately south of Sol, and, more generally, to increase our knowledge of the electrical characteristics of covered sulfide systems.

The Sol sulfide system is located ten miles east of the town of Safford. The system is developed in Cretaceous andesites that are totally covered by 500 to 1,500 feet of Tertiary gravels and volcanics, with the nearest exposed premineral bedrock located about five miles north. Amax discovered the system in 1972 by running conventional time-domain IP over the northern part of a gravity high that extends south from the Safford district. It appears that Sol is one of the few unquestionable IP discoveries in the Southwest, and possibly the only totally covered sulfide system, with no indications in adjacent bedrock, known to occur in Arizona.

The Mark IV VIP system showed a strong, coherent dipole-dipole response up to 20 mils above background despite the existence of highly conductive (5 ohm-meter) cover. Drilling shows that the sulfide system is at minimum 6,000 feet east-west along the IP line. IP indicates that its total east-west extent may exceed two miles. Amax has indicated that the north-south extent of the system is at least one mile. Mineralization apparently does not cut off with depth. Sulfide content within the system is reportedly between 2 and 10 percent by volume. We know little about copper content.

The land situation over the ten square-mile covered area between Sol and Sanchez is presently being compiled. IP is recommended if sufficient open land exists.

INTRODUCTION

The Sol sulfide system was discovered in 1972 when Amax contracted Mining Geophysical Surveys (MGS) of Tucson, to run an IP survey over a pronounced, covered gravity high situated east of Safford, and south of Inspiration's Sanchez property. Some 27 line-miles of in-line dipole-dipole IP was run using Newmont-type time domain equipment. Following discovery of an IP anomaly, Amax staked land, drilled several holes and discovered sulfides at depths between 485 and 1,443 feet. At this point, they joint ventured the property with Phelps Dodge, and several more holes were drilled. At the time of this writing, ten to fifteen holes have been drilled to an average depth of 2,000 feet. Phelps Dodge have now terminated their joint-venture agreement with Amax.

Since the IP anomaly at Sol was discovered in 1972 by MGS, McPhar, Phelps Dodge and Zonge Engineering and Research Organization (ZERO) have run IP over the system. All surveys were carried out along the same line at the request of Amax. In November of 1974, Frank Fritz, the Amax geophysicist in Tucson, presented the results of these surveys at the Society of Exploration Geophysicists convention in Dallas, Texas. According to Fritz, although the different systems gave results that varied significantly in detail, they all effectively defined the same anomaly. Fritz reiterated Amax's invitation to other companies to run over Sol with their IP systems. We felt that we would gain valuable information by so doing, and accordingly a VIP seven-spread was run on February 19th and 20th, 1975. The results of this seven-spread, which form the main subject of this report, were given to Amax, who have indicated their intention to publish a paper that includes our data at some stage in the future.

GEOLOGY

The geology of the Sol system is shown on a section along the IP line provided to us by Amax (Fig. 3, with location map, Fig. 2). This section shows:

i) Cretaceous andesites intruded by a Laramide stock with 2-5 volume percent sulfides within the stock and andesites and a zone of higher sulfides (5-10 percent) in the andesites east of the stock;

ii) Up to 600 feet of oxidation in and around the stock in the eastern part of the system with no oxidation in the andesites in the western part of the system;

iii) The system is totally covered by 500 and 1,500 feet of Tertiary lake bed sediments. At location 0 on the section, these sediments are cut off against Tertiary volcanics by a fault that displaces the andesites only about 100 feet. Amax is mystified by this fault.

Drilling has apparently established no cutoffs to mineralization, either to the north, south, east or west, or with depth. Reasonable horizontal dimensions for the system would be about two miles east-west by at least one mile north-south. The section shown is located in an area where, according to Amax, the system is "effectively two-dimensional" in the IP sense.

THE VIP LINE

The results of our VIP line are shown in Figure 4. This line is plotted in relation to the geologic section first presented in Figure 2. Extrapolated phases are calculated using the least-squares polynominal fit for f = 1.0, 0.5, 0.25 and 0.125.

The Tertiary lake bed sediments that cover the system west of 0 have a resistivity of only about 6 ohm-meters. The decrease in apparent resistivities to the west reflects the thickening of this unit in this direction. Tertiary volcanics exposed east of 0 have resistivities in the 20-50 ohm-meter range. A higher-resistivity layer, dipping west from the volcanic-sediment contact, is apparent in the data, and this is believed to be the higher-resistivity bedrock.

A coherent IP anomaly of up to 27 mils apparent response in a background of about 6 mils is obvious on the IP section. We would qualitatively interpret this anomaly as representing a strongly responsive source, extending westward beyond our data from about 5 E, and shallowest (around 1,000' deep) at about 20 W. This interpretation correlates reasonably closely with the Amax drilling data.

The IP source obviously has some topography on its top surface, and is probably associated with a concealed zone of higher resistivities. Neither of these features are commonly associated with the gravel responses we know about in Arizona. Furthermore, neither the gravels nor volcanics in the area are responsive in outcrop. Finally, the anomaly is associated with a strong gravity high. There is little doubt that we would have identified this anomaly as shown on this one VIP line as a concealed sulfide system.

However, certain problems are inherent in the interpretation of Mark IV IP data in areas of very low resistivities. Chief among these is the fact that the strong electromagnetic coupling effects generated by the conductive ground do not extrapolate to background IP values in the absence of an anomaly using our usual reading frequencies and extrapolation techniques. These residual coupling errors have been investigated by Hohmann (1974).

The calculated residual coupling errors after our usual coupling removal at n = 6 vary from 2 mils on the east end of the Sol line to 9 mils on the west end. Theoretically, this residual coupling should be subtracted from the observed data in order to obtain a coupling-free response. However, these residual coupling errors here are not large enough materially to alter the shape or amplitude of the response.

The correlation between theoretically predicted total coupling and observed coupling at Sol is very close (Fig. 5). Consequently, we are confident that our estimates of coupling errors are fairly accurate.

In an effort to overcome residual coupling errors, measurements were taken at 0.0625 Hz. at Sol. Extrapolations using this low a frequency should be virtually error-free for the Sol resistivity conditions. Unfortunately, noise levels below 0.1 Hz. were very high at the time, and the extrapolated phase values using 0.0625 exhibit a great deal of scatter.

The amplitude of the recorded anomaly at Sol is somewhat larger than might be expected in view of the fact that the system is covered by very low resistivity gravels. This indicates that the intrinsic response of the system must be very high. A layered-earth interpretation of the IP line west of 35 W gives a layer of 5 mils and 6 ohm-meters overlying a layer of 80 mils and 60 ohm-meters, at a depth of 1,300 feet. Residual coupling errors were subtracted from the data before this interpretation was carried out. Layered-earth interpretations normally ascribe minimum intrinsic responses to buried sources, since the sources are never infinite in the horizontal dimension. Consequently, the intrinsic response of Sol might be as high as 100 mils. Some detailed computer modeling of the system would greatly improve our estimates of intrinsic response.

Owing to the resistivity contrast between the cover and the IP source, we are only seeing about 10 percent of the intrinsic IP response of the source at n = 6 on the west end of the line. Were the sulfides weaker or more deeply buried, it is unlikely that they would be IP-detectable in this area.

PREVIOUS RIP WORK

Three RIP sites were read around the Sol system in 1972, using the Mark III receiver (Mackelprang, 1972). The results of this work are shown in Figure 6. Because the land was held by Amax, it was impossible to work directly over the Sol system.

There is no doubt that a RIP transmitter located near the center of the VIP line would have recorded an anomaly on most, if not all, receiver legs. However, transmitter sites located around the edge of the Sol system, with receiver sites located within the system, failed to record a response. This is theoretically conceivable in the light of RIP computer modeling. However, comparatively small 'holes' in our RIP coverage, like the one at Sol, are frequently unavoidable owing to culture or access problems, and we do not normally countenance the possibility that two-square mile 50-100 mil sulfide systems can lurk undetected in these holes. It is also interesting to speculate on whether we would have followed up a noisy RIP anomaly of 25 mils and 15 ohm-meters in this area. Other similar responses in the general area have apparently generated no interest.

COMPARISON WITH OTHER IP SYSTEMS

Figures 7 to 10 show our VIP data plotted against the MGS time-domain data, the P.D. "decoupled" frequency domain data, the McPhar multimode data and the ZERO CR data, respectively. All lines were run with 1,000-foot dipole spacing.

In general, the Mark IV anomaly is significantly more coherent, and more representative of known sulfide distribution at depth, than any other anomaly. Resistivity data for all systems compare very closely, and consequently are not reproduced here.

A brief commentary on the other sets of IP data is appropriate.

1. The MGS Data (Fig. 7)

This was recorded with conventional Newmont-type time domain equipment, with the anomaly contoured in milliseconds (1 millisecond = about .7 milliradian). Of all the IP sections, the MGS section probably correlates best with ours. This, however, is somewhat surprising. Theoretical coupling for the Newmont system approaches 30 milliseconds at n = 6 at Sol, and this is close to the amplitude of the MGS response at that level. My evaluation of the MGS data would probably be that the response was largely caused by electromagnetic coupling. There can be little doubt, however, that MGS and Amax interpreted the data otherwise, since a hole was drilled into the anomaly near 5 W.

2. The P.D. 'Decoupled' Data

Phelps Dodge record IP in the frequency domain with a conventional pfe-reading receiver at f = 3.0 and 0.1 Hz. In conductive areas like Sol, the electromagnetic coupling in the results can be huge (up to 50 pfe). P.D. overcame this problem by subtracting theoretically predicted coupling from the observed data. The results shown in Figure 8 have been thus manipulated. The section shows an anomaly, but one can question the objectivity of the coupling-removal procedure in a case where covered sulfides are known to exist.

3. The McPhar Multimode System

McPhar and Amax selected Sol as an excellent area for a test of the new 'multimode' system. This system is a phase-reading system that removes coupling by extrapolation, which records in milliradians, and which in theory is very similar to our Mark III VIP gear. The multimode results, however, (Fig. 9) show that McPhar, at the time, had some bugs remaining in the system. The scatter in the data is very bad, and this system was rated least coherent of all models tested. Although McPhar defined an anomaly in about the right place, additional McPhar lines in the Goat Well area to the south defined similar responses in areas where we found no anomalies whatsoever.

4. The ZERO Complex Resistivity System

Ken Zonge's results at Sol are shown on Figure 10. The ZERO CR system is a phase-reading system that records phase shift over a very wide range of frequencies. Coupling is removed individually, at each frequency, by means of an undisclosed technique. The results, as shown here, appear to be coupling-free phase values, in milliradians, comparable to our extrapolated phases. Although an anomaly was recorded, it does not correlate very well with known sulfide distribution. The shape of the response indicates that sulfides ought to be about 2,000 feet deep. ZERO were reported to have had trouble reading at Sol, owing to high noise levels. Presumably this is a result of their low transmitter output (2 amps.).

REFERENCES

Hohmann, G. W., 1974, Phase extrapolation for Mark IV Vector IP Data: KEI-GDR&D report, May.

Mackelprang, C. E., 1973, Safford area, Graham County, Arizona--RIP report: KES-GDO report, March.

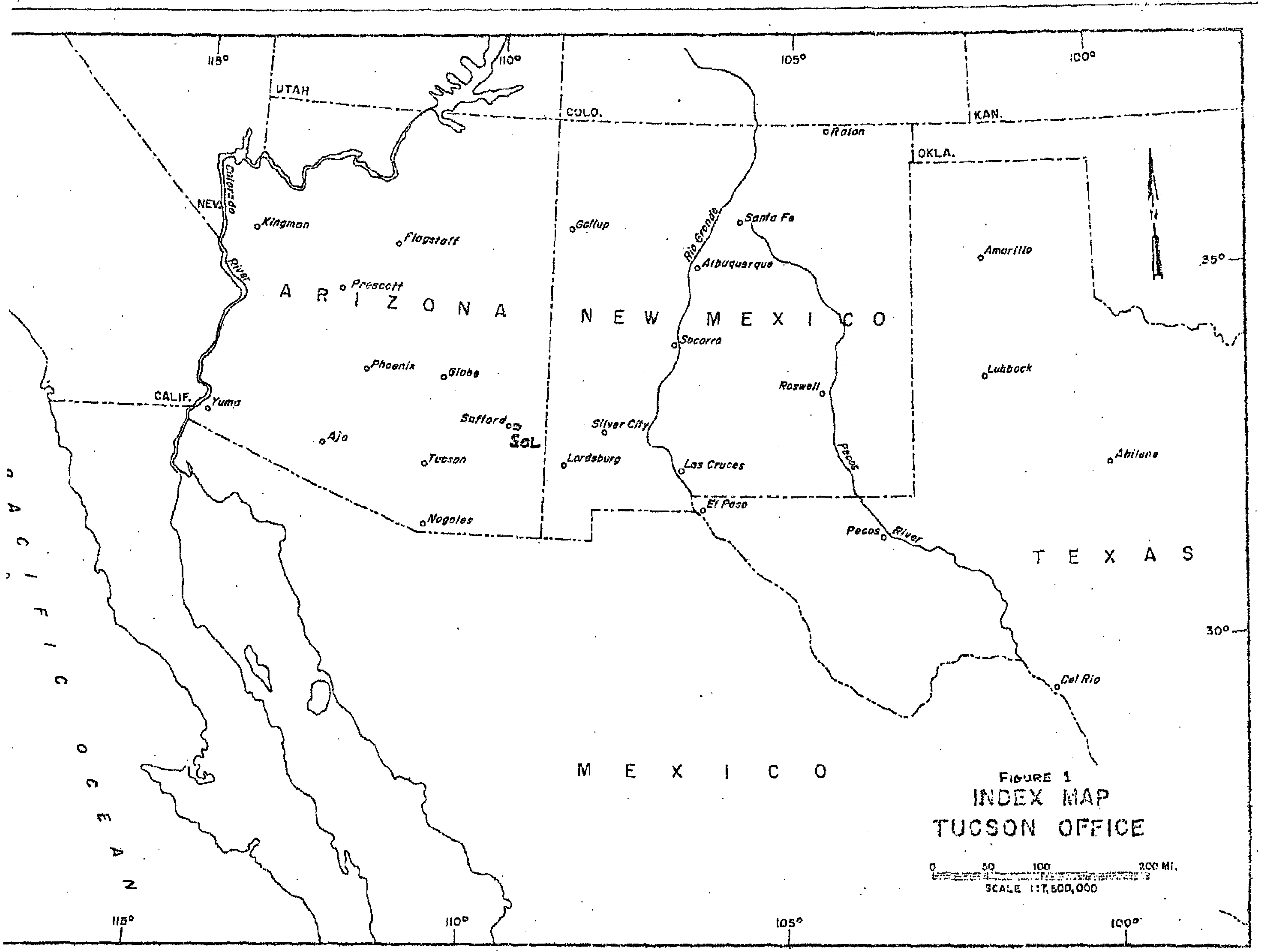
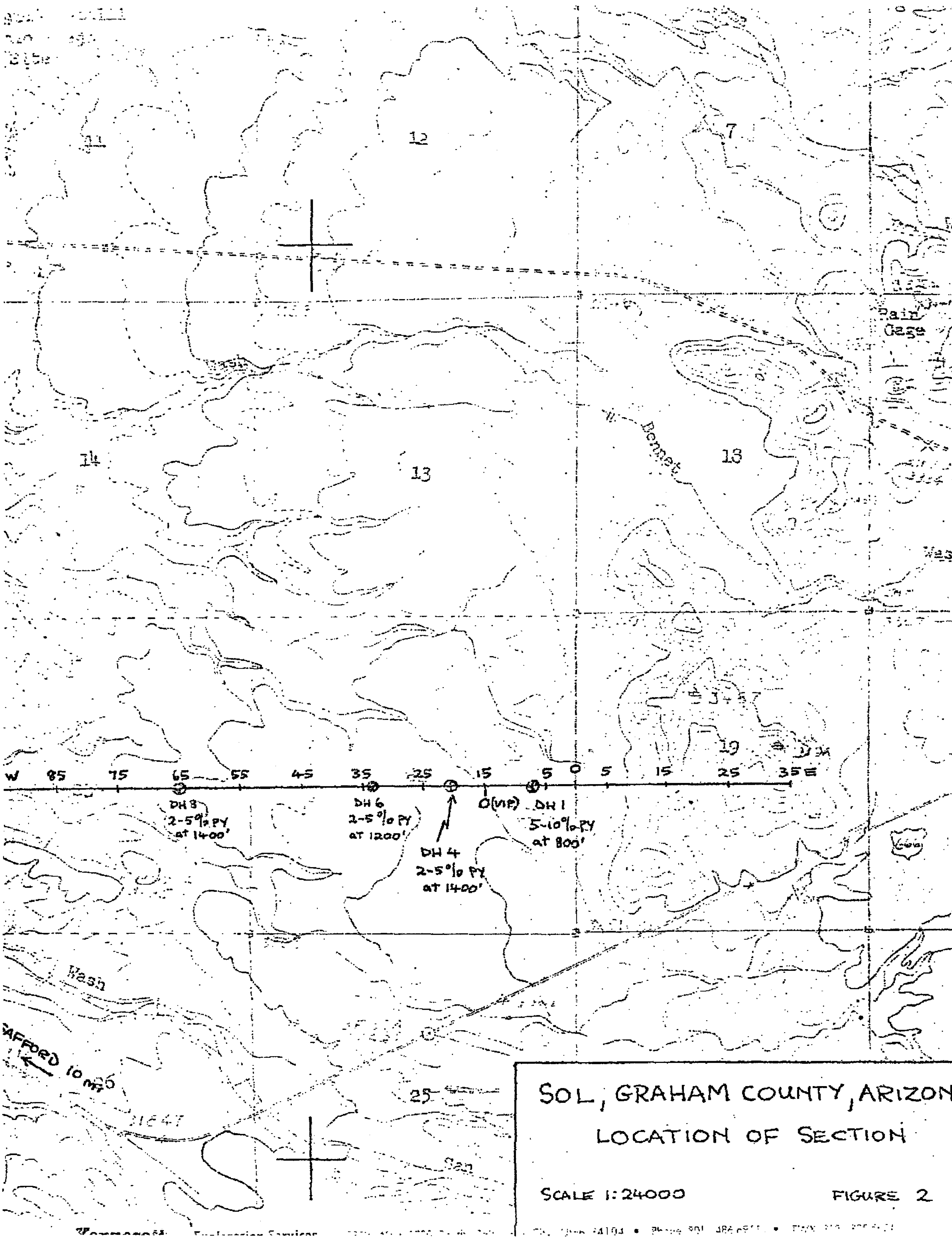


FIGURE 1
INDEX MAP
TUCSON OFFICE

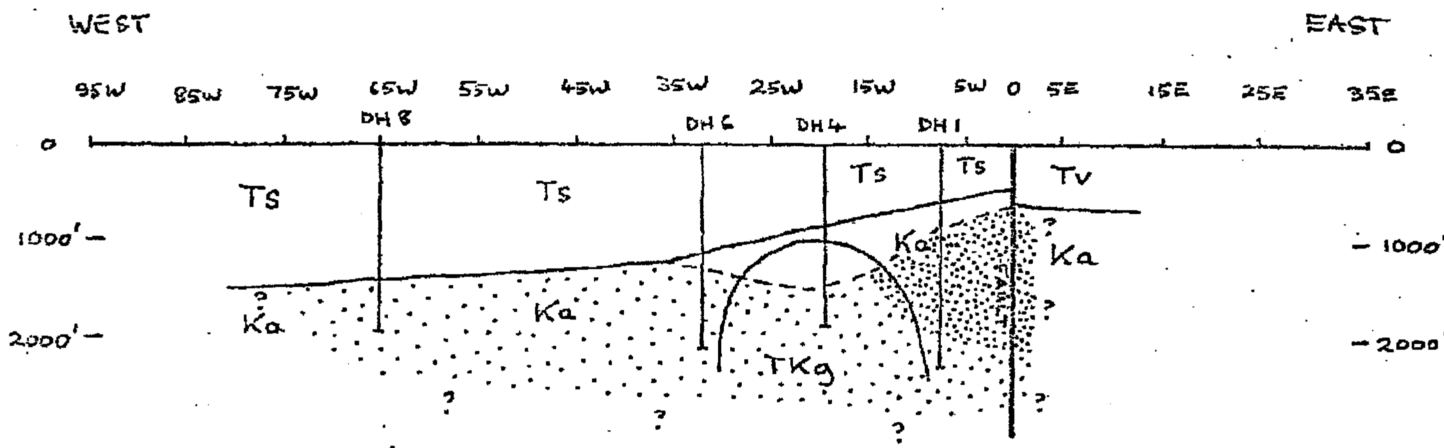


SOL, GRAHAM COUNTY, ARIZON

LOCATION OF SECTION

SCALE 1:24000

FIGURE 2



Ts — Tertiary lake bed sediments

Tv — Tertiary Volcanics

Ka — Cretaceous andesites

TKg — Laramide porphyry

5-10 vol.% pyrite

2-5 vol.% pyrite

Base of oxidation

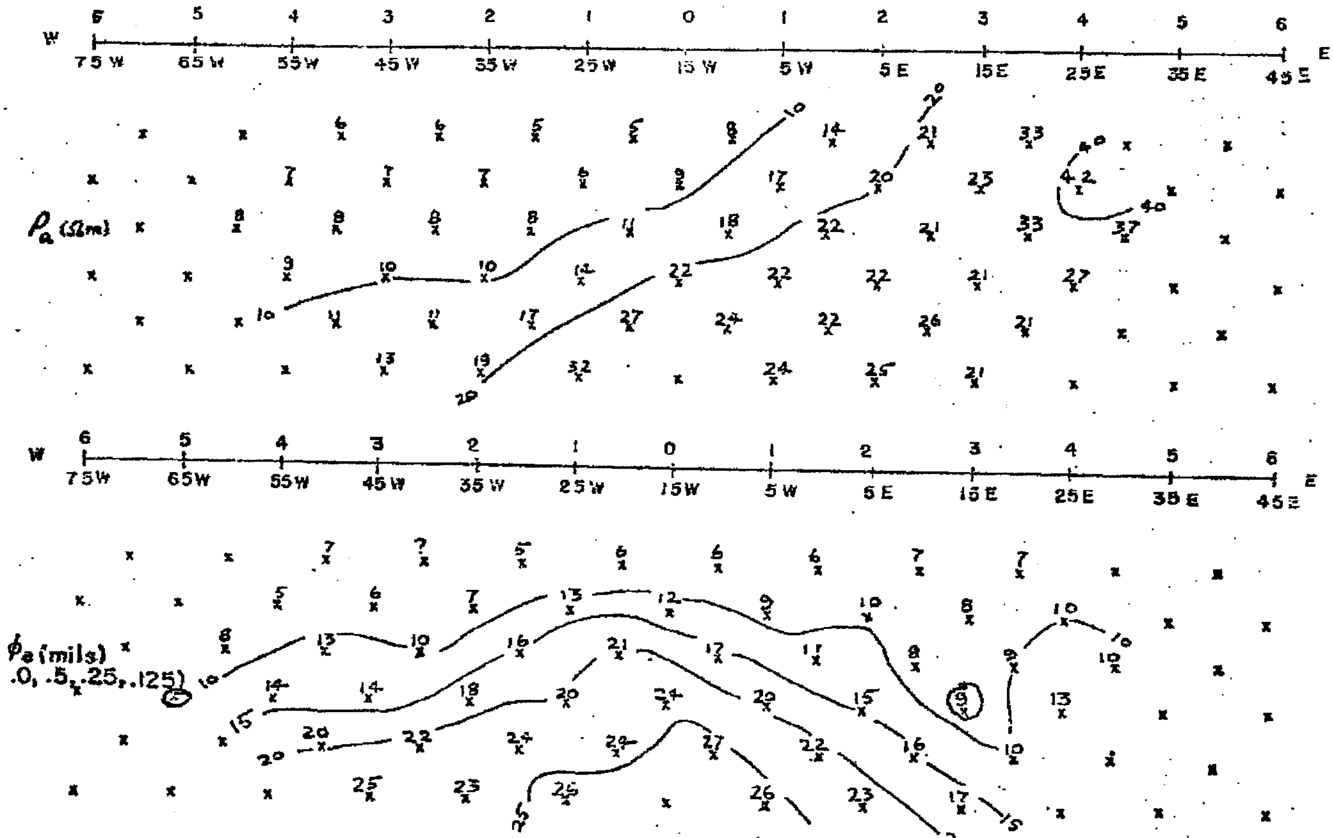
? no cutoff to sulfides.

SOL, GRAHAM COUNTY, ARIZONA
GEOLOGIC SECTION.

SCALE 1 in : 2000 ft. HOR. + VERT.

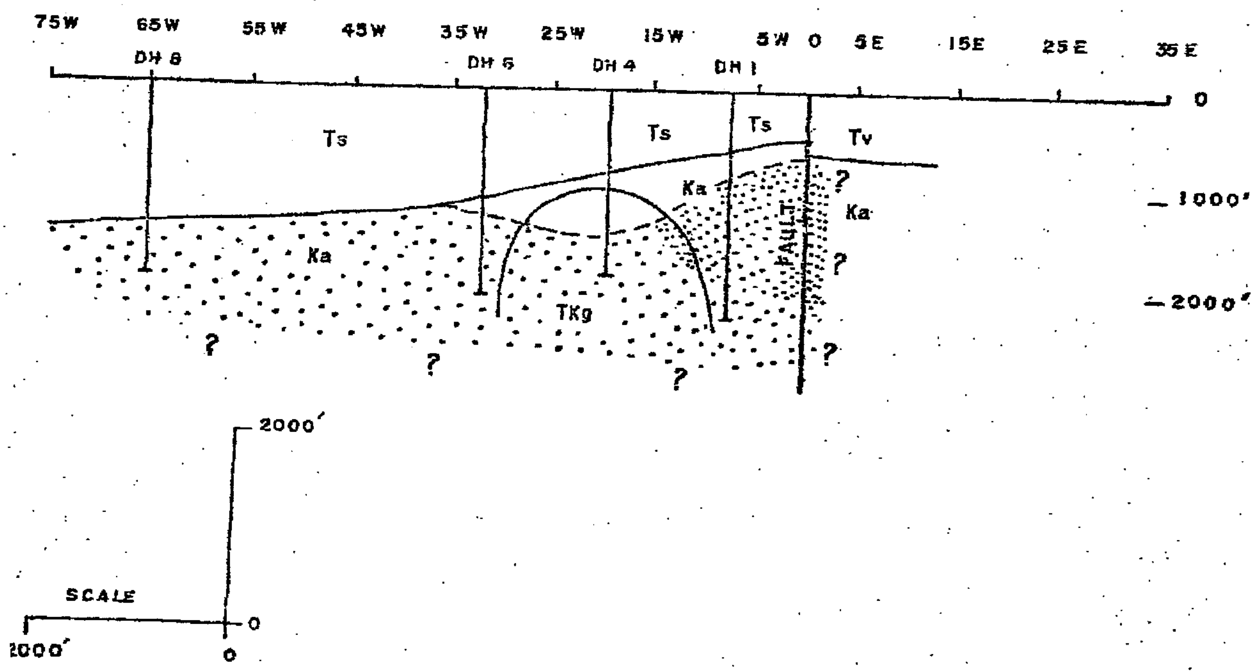
FIGURE 3.

Kennecott Exploration Services 2300 West 1700 South Salt Lake City Utah 84104 • Phone 801 486 6911 • TWX 910 925 5624

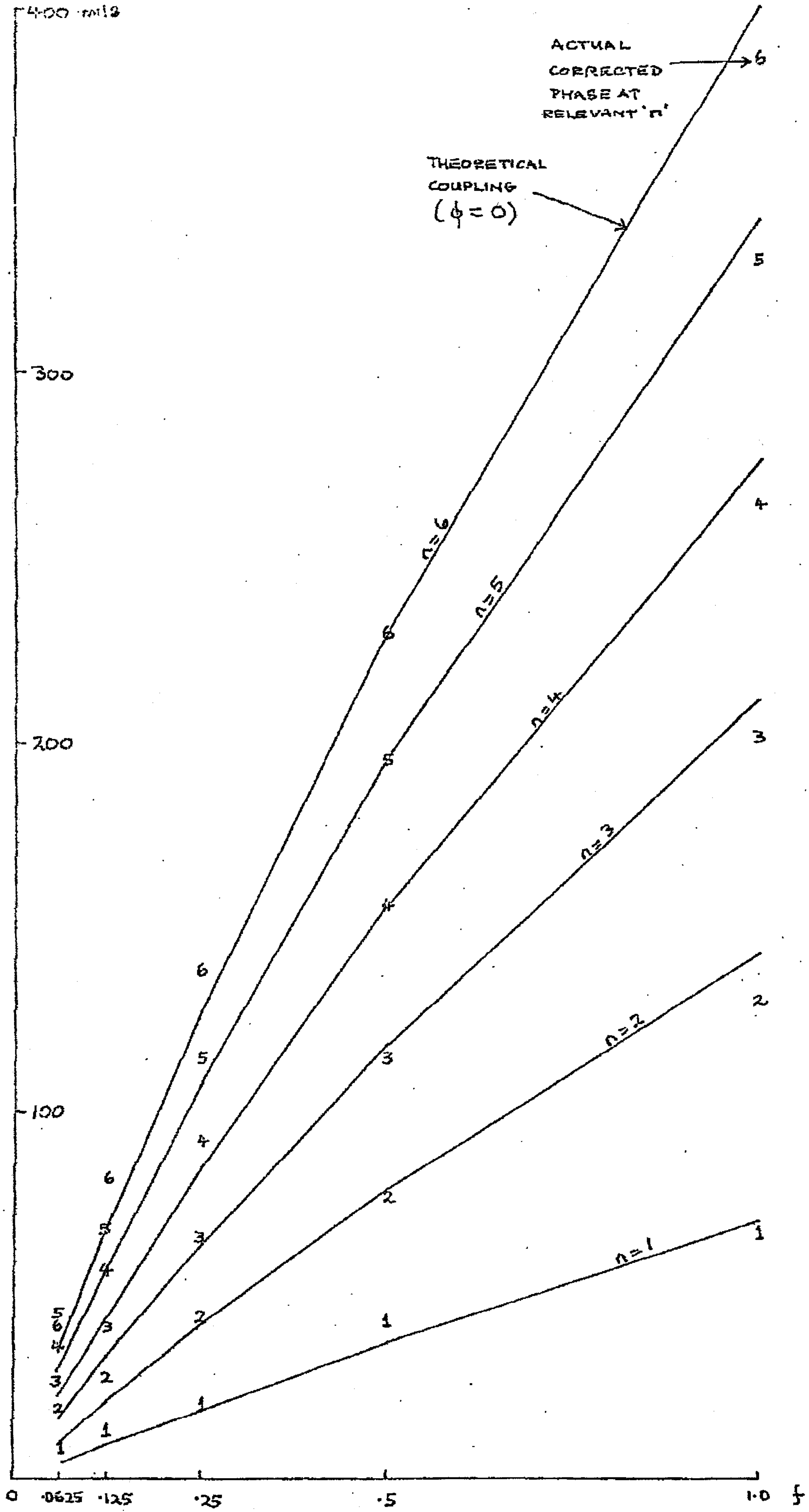


AREA SOL STATE ARIZONA LINE NO. 1 DATA BY KES DATE 2/21/75

TRANSMITTER ________ RECEIVER ________ DIPOLE-DIPOLE ARRAY a = 1000 FEET



SOL
GRAHAM COUNTY, ARIZONA
V.I.P. SECTION



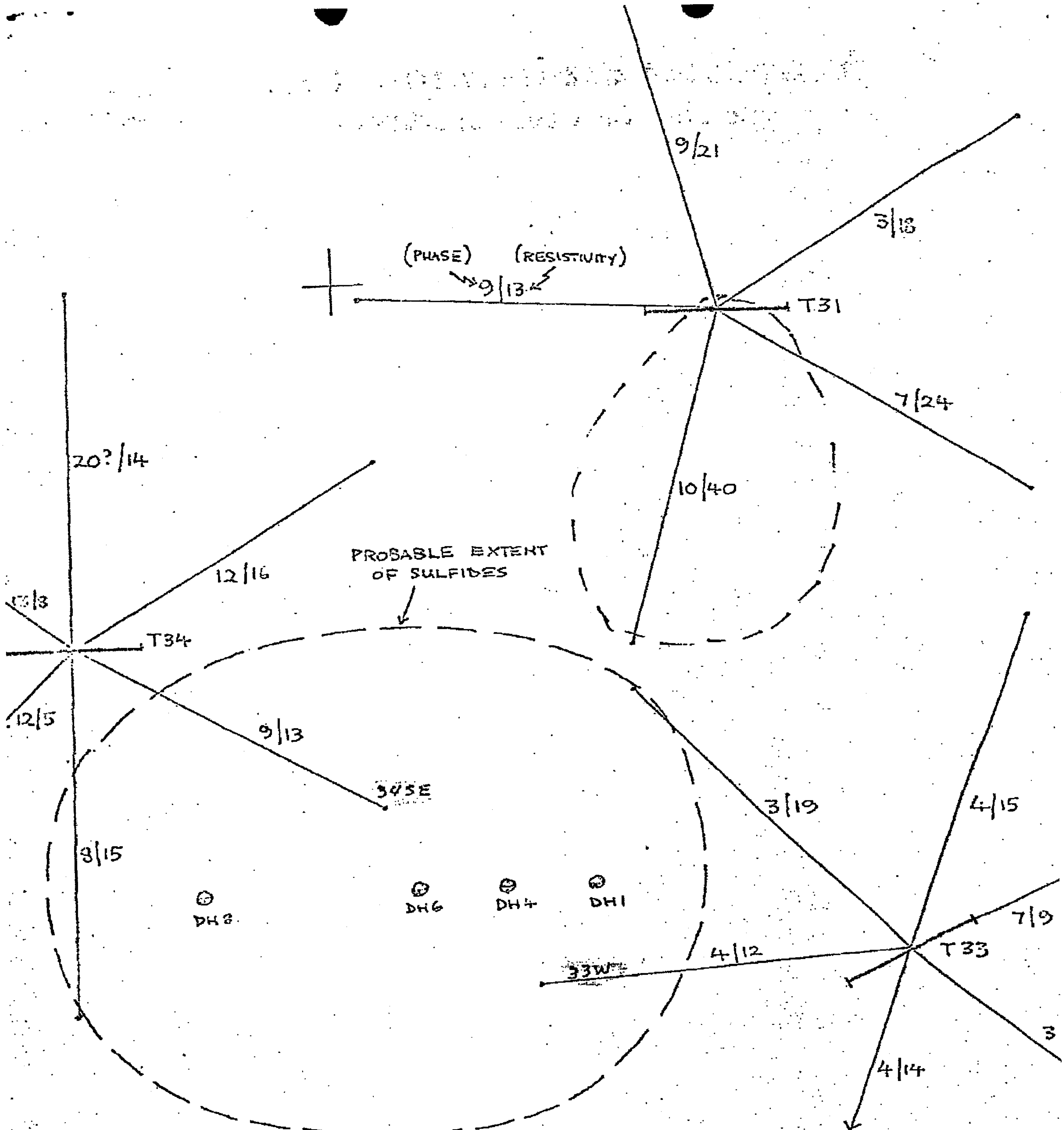
SOL

THEORETICAL VS. OBSERVED COUPLING.

USING WEST HALF OF LINE. THEORETICAL COUPLING BASED ON:

5 ohm-m
1000'.
50 ohm-m

Figure 5.

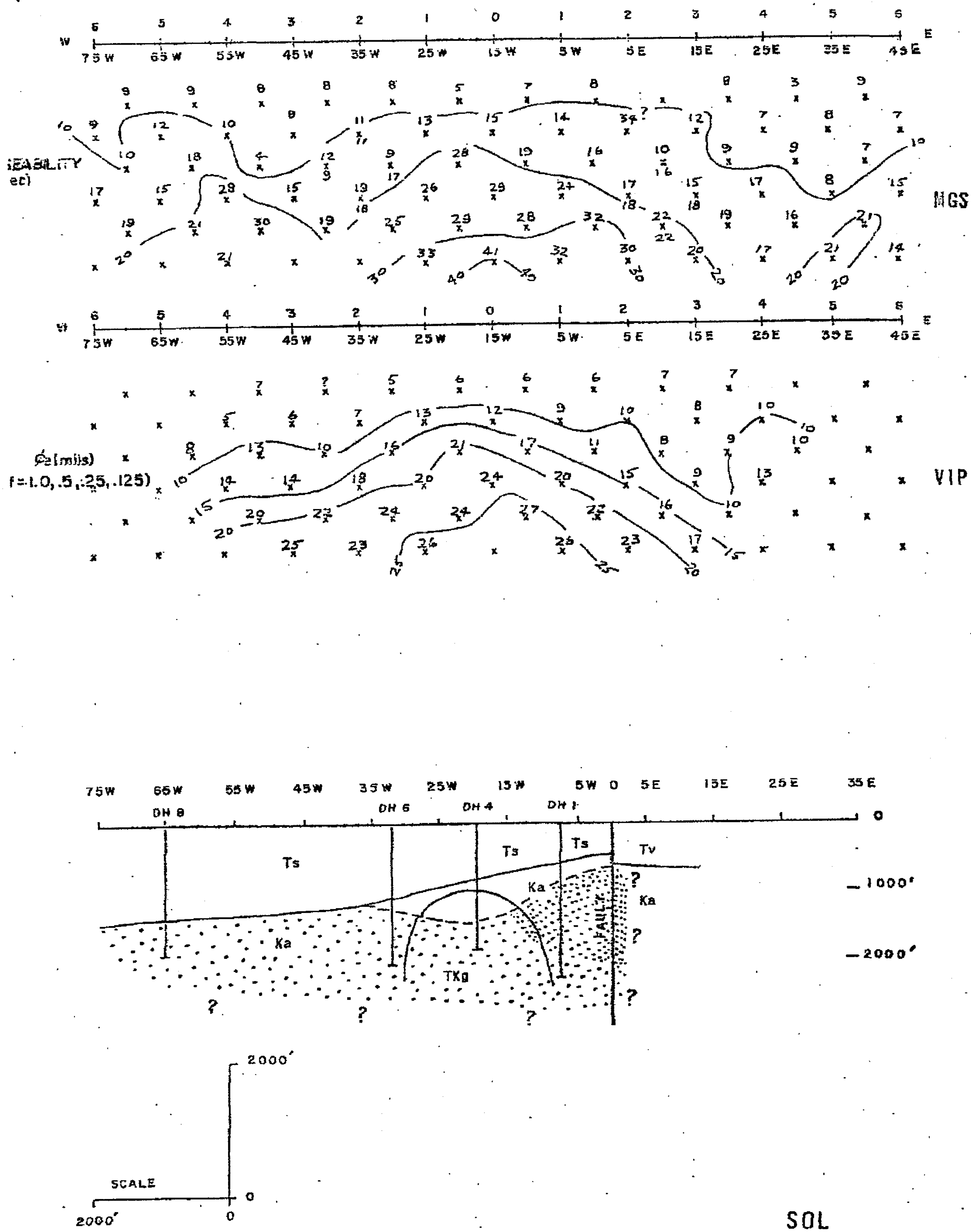


SOL, GRAHAM COUNTY, ARIZO

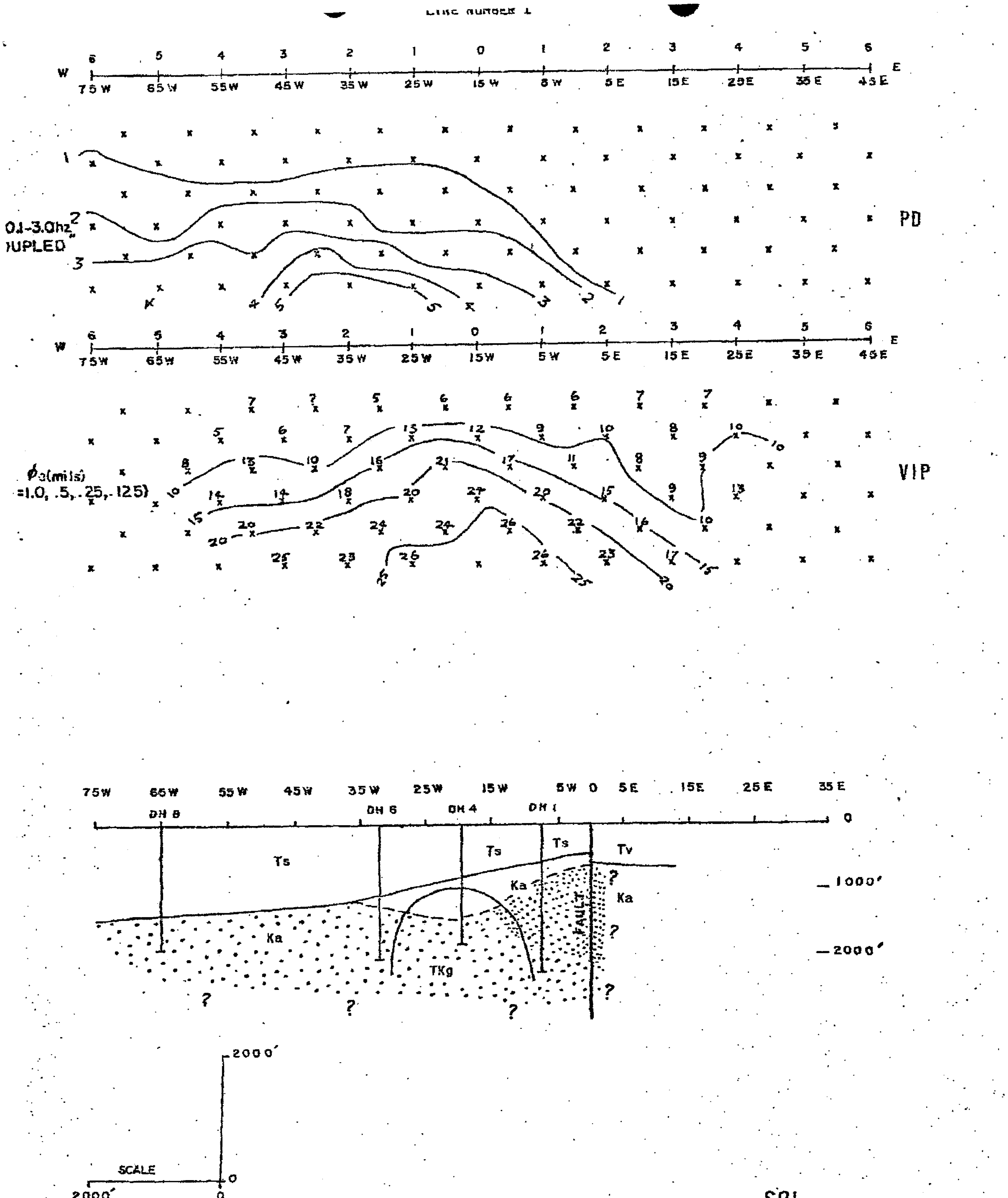
RIP OVERLAY

Figure 6

SCALE 1:24000

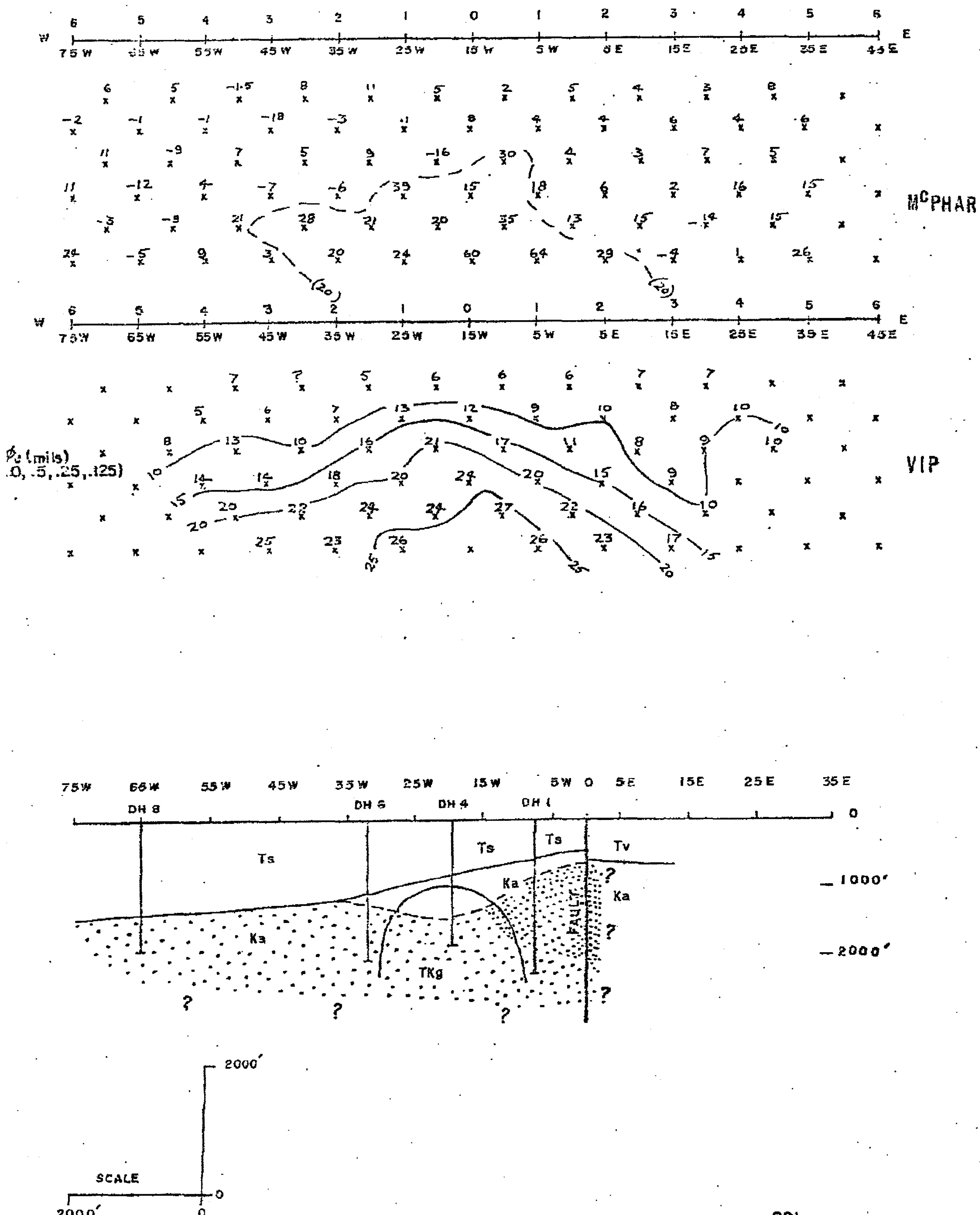


SOL
GRAHAM COUNTY, ARIZONA
MGS TIME-DOMAIN vs. V.I.P. DATA

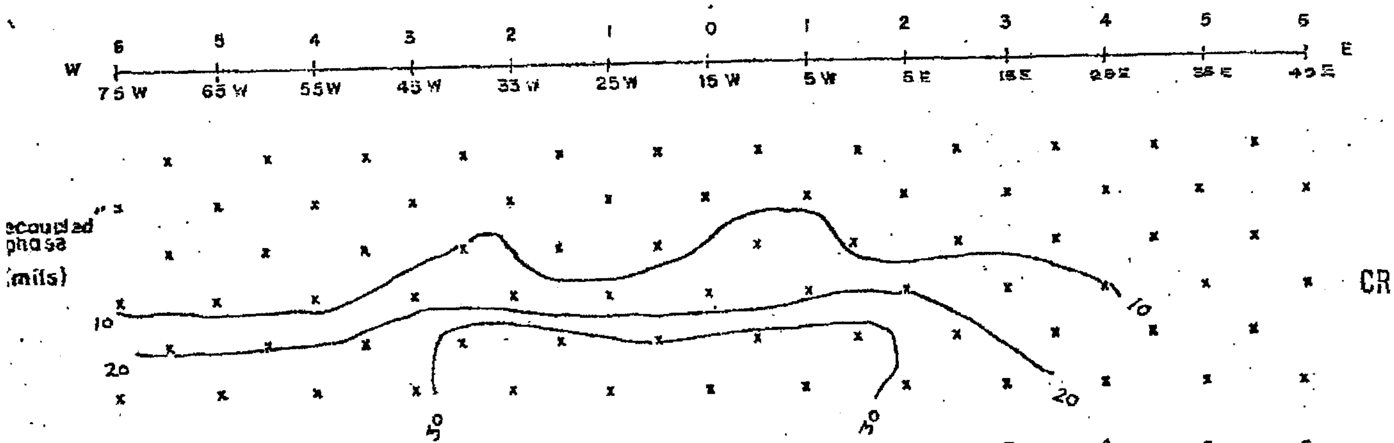


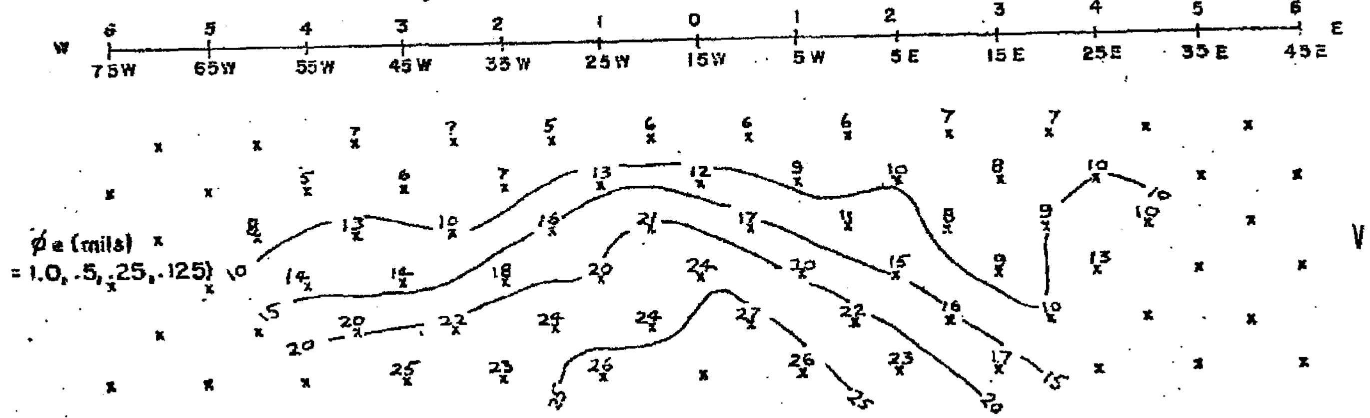
SOL
GRAHAM COUNTY, ARIZONA
P.D. 'DECOUPLED' vs. V.I.P. DATA

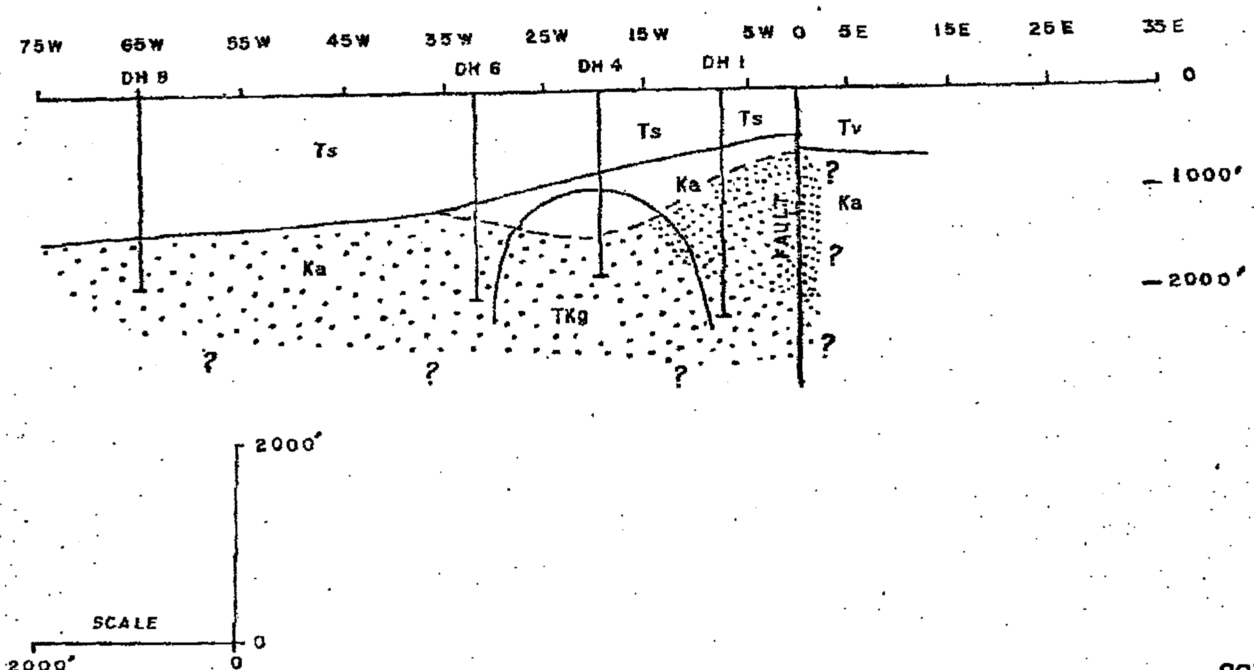
LINE NUMBER 1



SOL
GRAHAM COUNTY, ARIZONA
McPHAR 'MULTIMODE' vs. V.I.P. DATA







SOL
GRAHAM COUNTY, ARIZONA
ZERO 'CR' vs. V.I.P. DATA

Jan. 75

KENNECOTT EXPLORATION, INC.
GEOPHYSICS DIVISION - U.S. OPERATIONS

SURVEY STATISTICS AND COST ESTIMATE (INCLUDING OVERHEAD)

Sol (Amax) Sulfide System
(Project Name and District)
Code No. 04217210

Time Interval From: February 19, 1975 To: February 20, 1975

Lapsed Days 2 Field Days 2 Mob./Demob. Travel Days 0 Expl. Days(1) 2

Geophysical Method	Line Miles or No. of Stations	Percent of Expl. Time	Cost	Cost per Line Mile (Station)	Type of Equip. Used (Model No.'s, etc.)
VIP	3 line-mi.	100%	$1216	$405/li-mi.	Mk IV Rcvr. FT-20 Xmtr.

Personnel Involved Name	Number of Expl. Days	Personnel Involved Name	Number of Expl. Days
Ketchum, K.	2	Andrews, R.	2
Jones, R.	2		
Payne, A.	2		
Sanchez, G.	2		

Estimated Costs

Direct Costs Incurred by GDO

2	TMED (2) Wages @ $55	110
8	NTMED Wages @ $30	240
2	TMED Expenses @ $35	70
8	NTMED Expenses @ $25	200
2	Expl. Days Supplies & Freight @ (3) $70 or $15	140

Total Estimated Direct Costs 760

Total Estimated Costs 1216

Cost Per Exploration Day 608

Indirect Costs Incurred by GDO

Data Analysis, Supervision and Overhead

2	Expl. Days @ $180 or $110 (4)	360

Depreciation on Equipment

trucks @ $12/day each	72
IP gear @ $10/day	20
radios @ $2/day each	4

Other (Computer, Etc.)

Total Estimated Indirect Costs 456

Notes:
(1) Expl. Days = Field Days + Mob. /Demob. Travel Days
(2) TMED - Technical man exploration days, NTMED = Non-technical man exploration
(3) $70/day for an IP crew and $15/day for gravity/magnetic/EM crew
(4) $180/day for an IP crew and $110/day for gravity/magnetic/EM crew

Remarks:

Signed:

Bear Creek Mining Company

Exploration Subsidiary of Kennecott Copper Corporation — Metal Mining Division

Tucson Office

February 16, 1978

Mr. Charles Miller
AMAX Exploration, Inc.
130 South Scott Avenue
Tucson, Arizona 85701

Dear Charles:

Subject: IP Work at Sol Prospect, Arizona

Bear Creek Mining Company conducted three (3) line miles of IP survey at the subject prospect during January 26 through 31, 1978. A five man crew made the survey and the cost of the survey is $1,800.00.

I am enclosing a sketch map showing the IP line and a copy of the IP data.

We appreciate the opportunity to test our equipment on the subject prospect.

Sincerely,

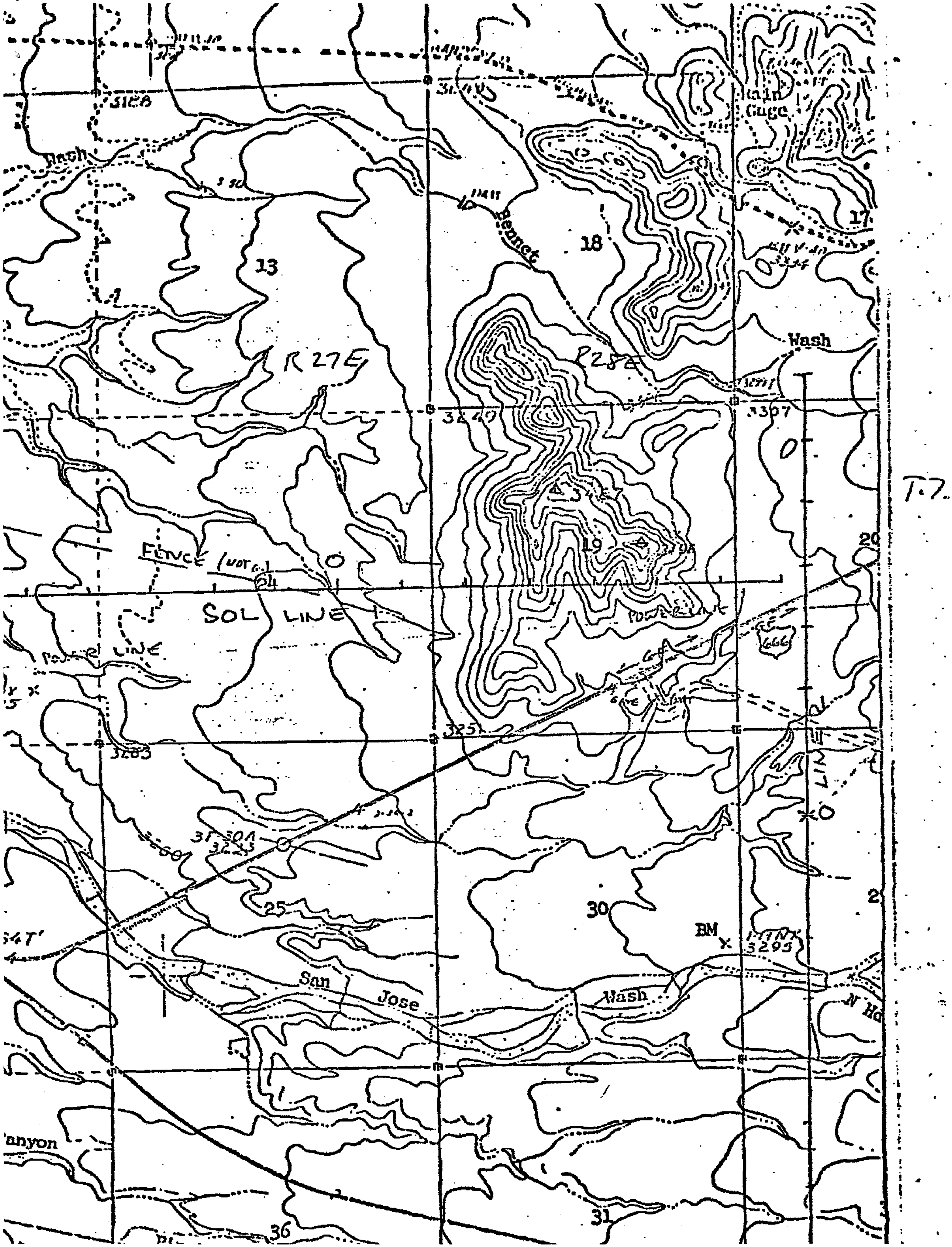
Blaine

F. Blaine Greenhalgh
Landman

FBG:jvb

Enclosures

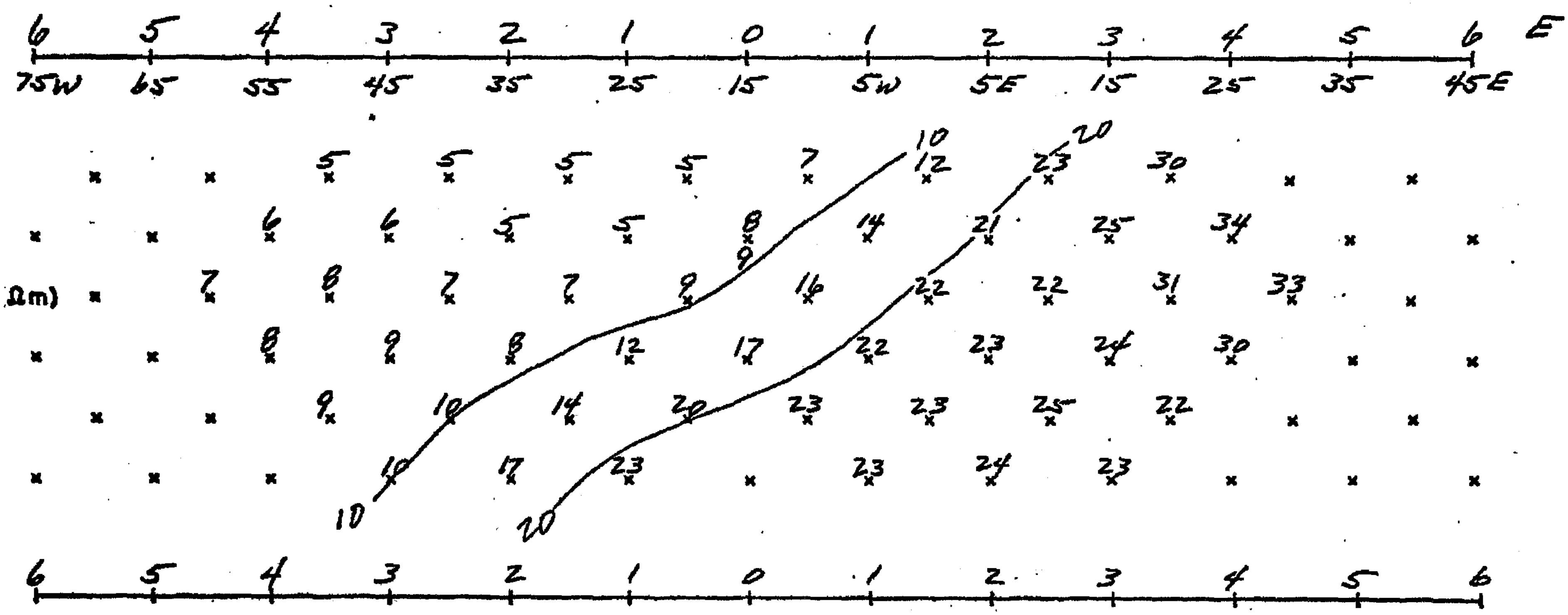
cc: Claron E. Mackelprang

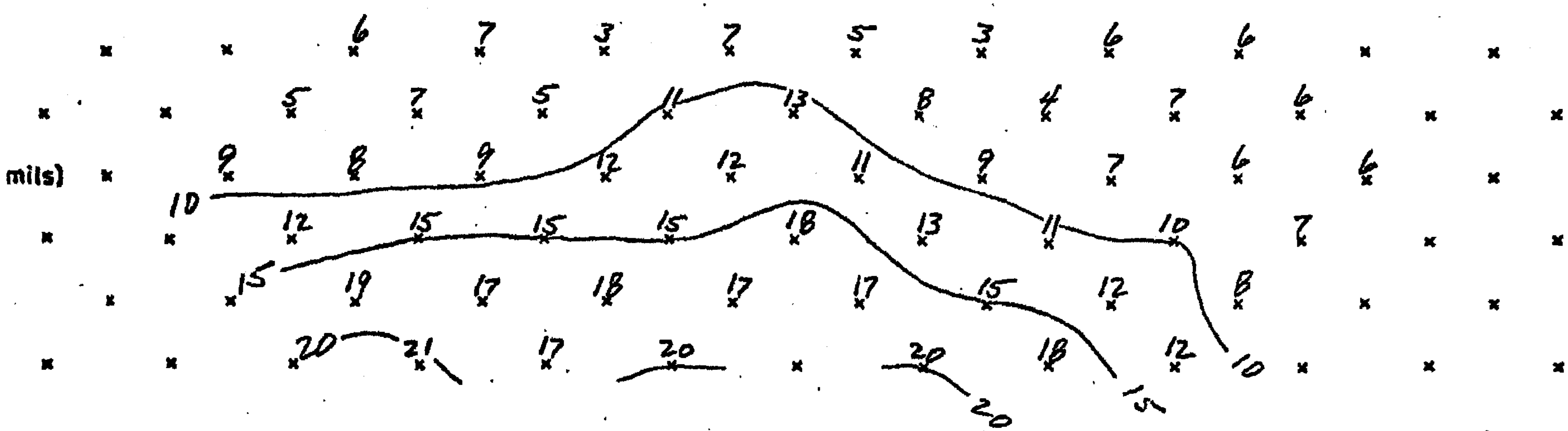


13
18
17
19
20
25
30
31
36
Bennet
Wash
Rain Gage
R 27 E
R 28 E
T. 7.
FENCE
SOL LINE
POWER LINE
San Jose Wash
BM 3295
Canyon
666

BCMC 1978

KENNECOTT EXPLORATION INC. – GEOPHYSICS DIVISION OPERATIONS
VECTOR IP PROFILE WORKSHEET





AREA 501 STATE ARIZONA LINE NO. 1 DATA BY BCMC DATE 2/1/78

Bear Creek Mining Company

Exploration Subsidiary of Kennecott Copper Corporation — Metal Mining Division

Tucson Office

MEMORANDUM

TO: Files DATE: May 4, 1978

FROM: C. E. Mackelprang

SUBJECT: TEST OF MARK IV SQUARE WAVE RECEIVER OVER THE SOL SULFIDE SYSTEM, GRAHAM COUNTY, ARIZONA

Because poor comparison of phase data was obtained on the Safford Northwest prospect between Mark IV sine wave and square wave detection receivers, it was necessary to compare results over known sulfide systems. AMAX's Sol sulfide system was a logical choice in that its phase anomaly was associated with low background apparent resistivities.

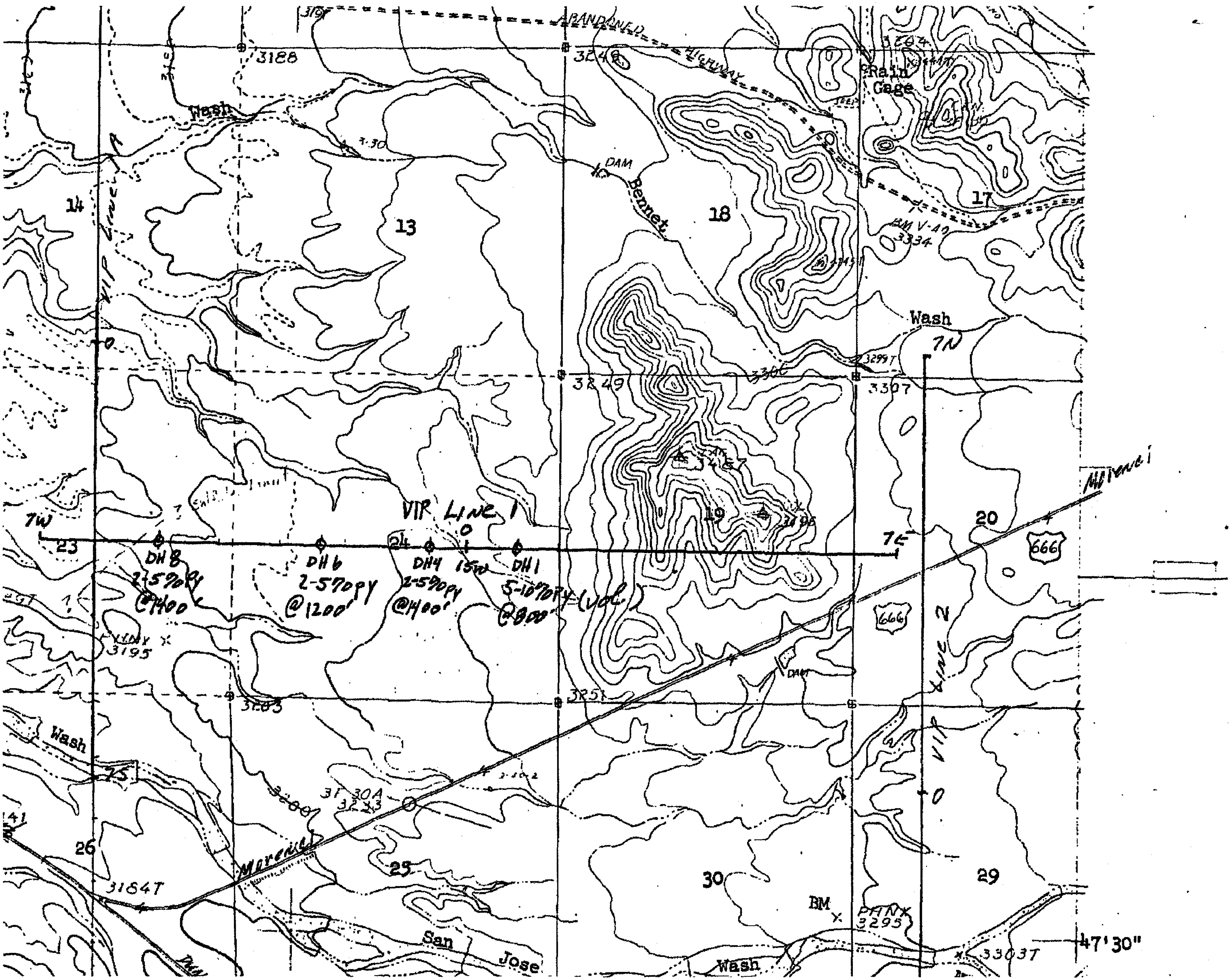
Two lines were repeated, Line 1A north-south outside the AMAX claim block and Line 1 east-west across the sulfide system for which permission was obtained from AMAX. Apparent resistivities are comparable on both lines in data taken with the two receivers. Phase data are not as good. The north end of Line 1A had a deep response upwards of 70 mils using the sine wave detection. This response disappeared when the line was read using a receiver with square wave detection. Only a deep, weak response which appears valid remained beneath Stations 3-4 south.

Line 1, trending east-west, has several drill holes along it with sulfide intercepts recorded. Phase data with both sine and square wave receivers display a coherent anomaly. The square wave data, however, apparently have less inherent noise with increasing n-separation. These data also have a magnitude roughly 80 percent that from the sine wave receiver.

The results obtained with the square wave detection receivers appear much more plausible. Furthermore, the sine wave receivers appear capable of generating "ghost" anomalies. Such certainly has been the case of VIP Line 1A at Sol.

C. E. Mackelprang

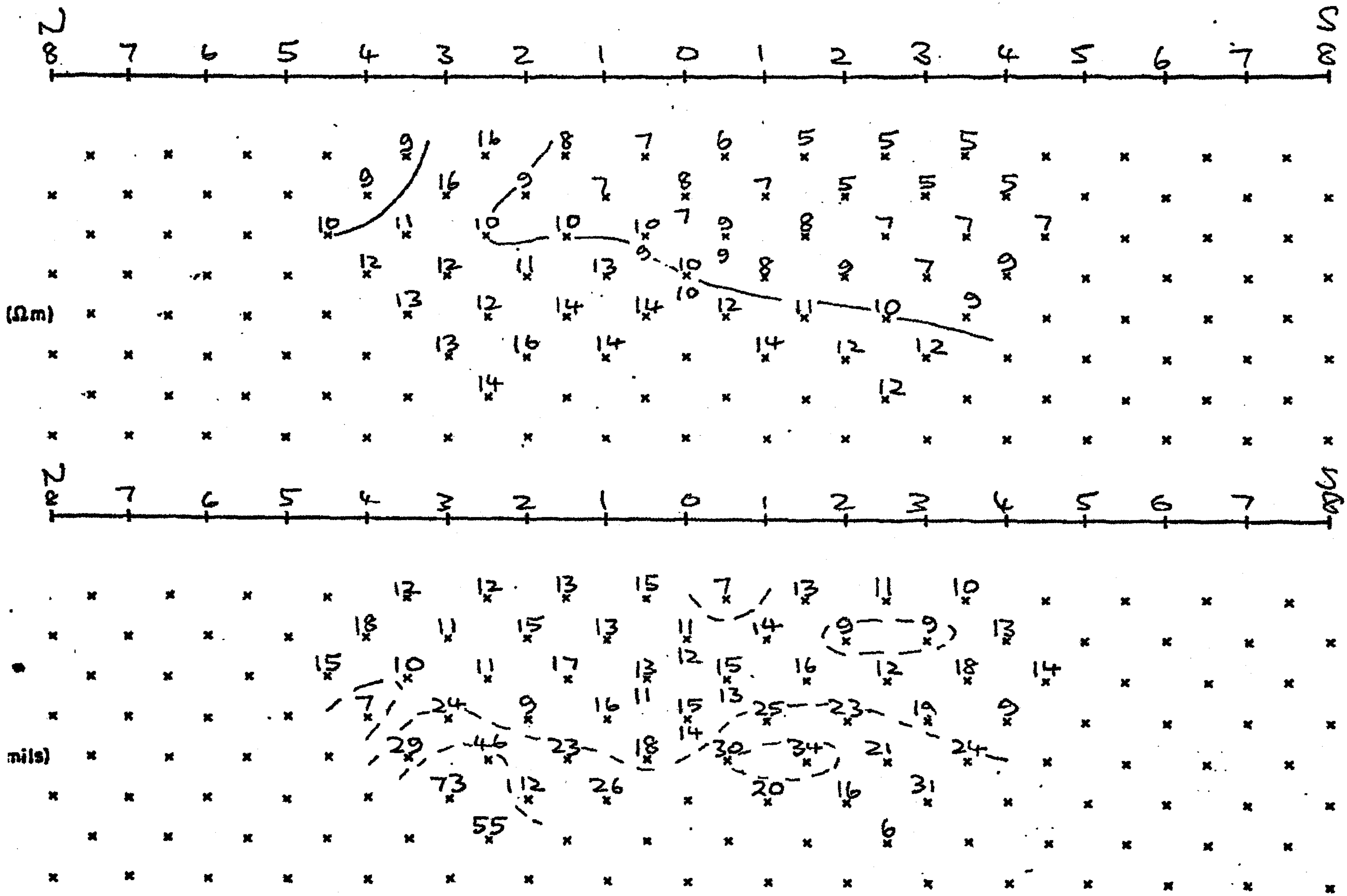
cc: R. K. Andrews



ABANDONED HIGHWAY
3188
3248
Rain Gage
Wash
DAM
Bennet
14
13
18
17
BM V-40 3334
VIP Line A
3249
3307
7N
VIP Line 1
7W
23
24
DH8
2-5%PY
@1400'
DH6
2-5%PY
@1200'
DH4
2-5%PY
@1400'
15W
DH1
5-10%PY (vol.)
@800'
19
3496
7E
20
666
Morenci
VIP Line 2
3195
3183
3251
Wash
3233
26
25
30
29
3184T
Morenci
BM
3295
San Jose Wash
3303T
47'30"

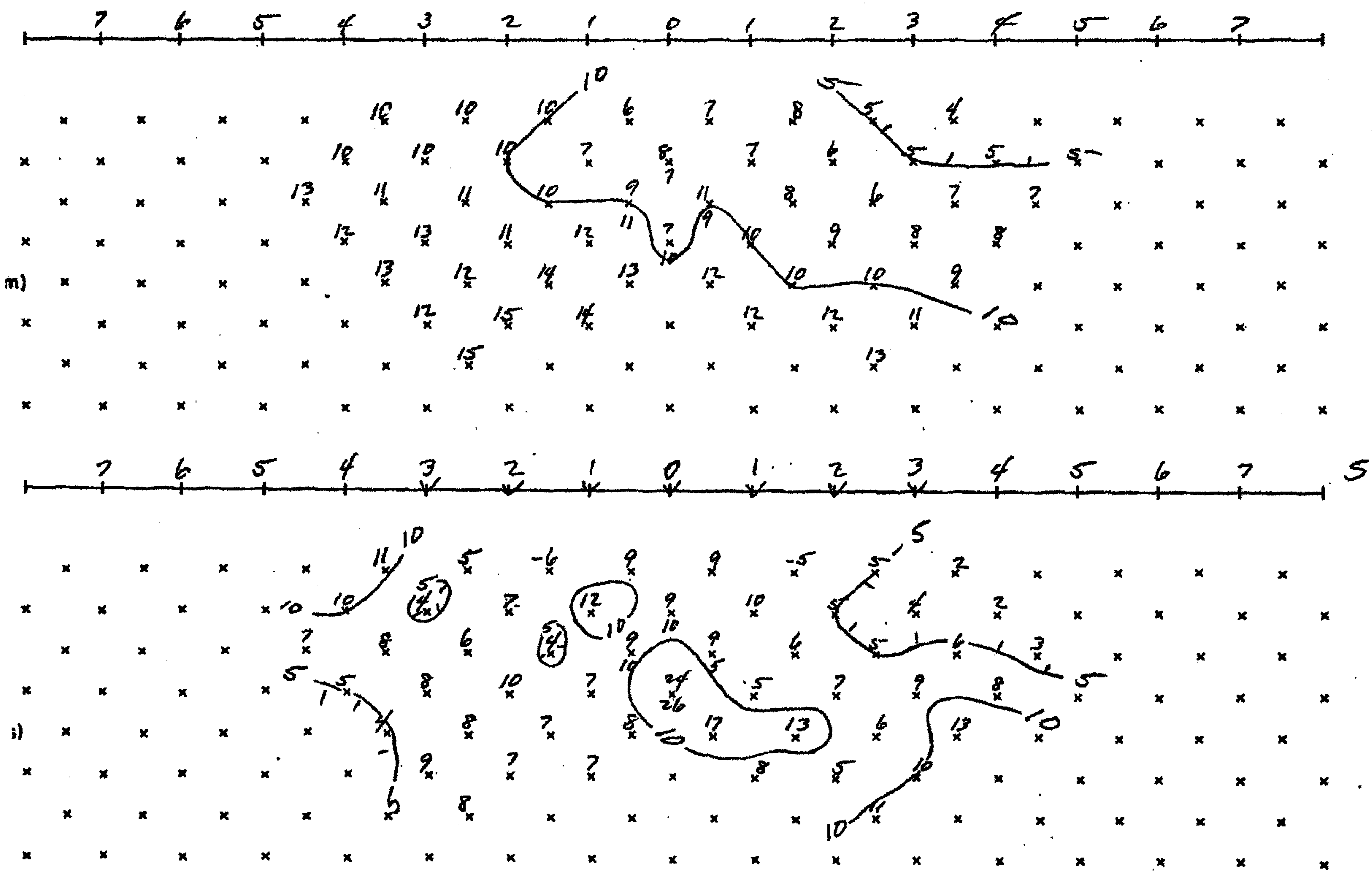
1978

KENNECOTT EXPLORATION INC. – GEOPHYSICS DIVISION OPERATIONS
VECTOR IP PROFILE WORKSHEET



AREA SOL STATE ARIZ LINE NO. 1 A DATA BY RKA DATE 6/20/77

VECTOR IP PROFILE WORKSHEET



AREA SOL STATE ARIZ LINE NO. 1A Repeat DATA BY BF DATE 11/16/77

TRANSMITTER FT-20 RECEIVER MK III #3.1 DIPOLE – DIPOLE ARRAY

GEOLOGY, GEOCHEMISTRY, ALTERATION, AND MASS TRANSFER IN THE SOL PROSPECT, A SUB-ECONOMIC PORPHYRY COPPER-MOLYBDENUM DEPOSIT, SAFFORD DISTRICT, GRAHAM COUNTY, ARIZONA

by

William Vernon Yarter

A Thesis Submitted to the Faculty of the

DEPARTMENT OF GEOSCIENCES

In Partial Fulfillment of the Requirements
For the Degree of

MASTER OF SCIENCE
WITH A MAJOR IN GEOSCIENCES

In the Graduate College

THE UNIVERSITY OF ARIZONA

1 9 8 1

ABSTRACT

Element and mineral gains and losses resulting from alteration in the Sol porphyry copper deposit were studied to determine characteristics that distinguish this subeconomic occurrence from productive, or potentially productive, porphyry copper systems. Time-integrated fluxes of components were analyzed along with fracture abundances, paragenetic relationships, and calculated mineral stabilities to determine the most favorable parts of the system for copper-molybdenum mineralization, and to evaluate the efficiency of transport and depositional mechanisms across the system.

Laramide hornblende quartz monzonite porphyry intruded the sedimentary-volcanic pile at Sol but resulted in no significant copper mineralization. A younger hornblende-biotite diorite porphyry intruded the quartz monzonite and volcanic pile under a modified stress field and resulted in significant copper-molybdenum mineralization. Highest copper values were deposited in quartz monzonite and volcanic sediments adjacent to the diorite porphyry. No high copper values were deposited in the diorite porphyry because the activity of Fe^{+++} and $f(O_2)$ were kept high by the presence of magnetite. Low fracture abundance in the diorite did not provide the permeability necessary for circulating hydrothermal fluids to leach and redistribute the 0.06% average copper values present in the upper portions of the stock. Silica, potassium, sulfur, and molybdenum were added to zones of highest estimated permea-

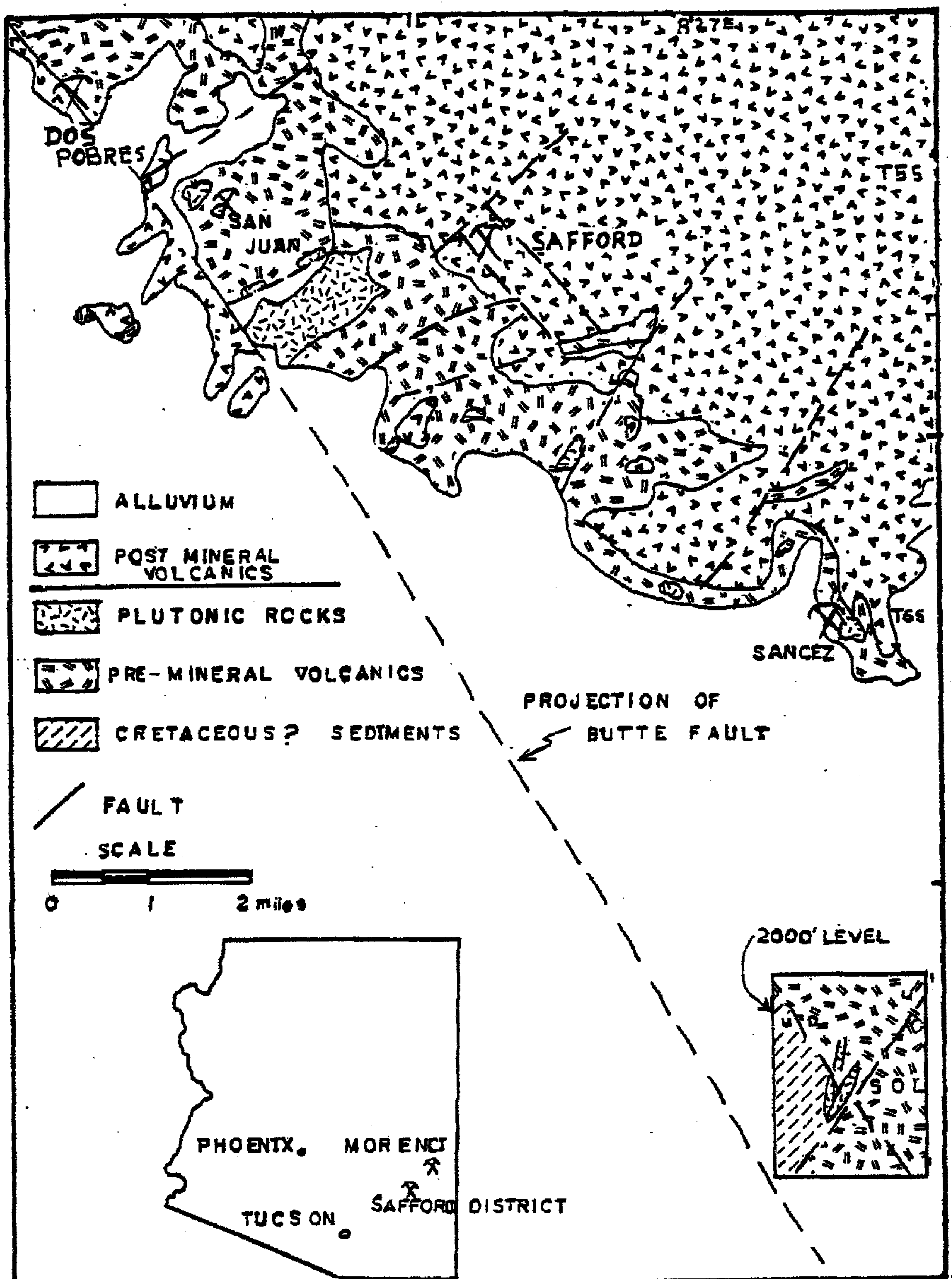


Figure 1. Location of Known Porphyry Copper Deposits and Premineral Outcrop in the Safford District. -- Geology adapted from Dunn, 1978.

Page 2

4 pages Total

Page 3

During the logging procedure, all core not significantly affected by supergene alteration was examined by the author. Mesoscopic study of the core consisted of routine recording of the following data: rock type; volumes of primary and alteration minerals in each ten-foot interval; veinlet paragenesis and paragenetic sequence; the number of mineralized fractures per foot of core; and the dips of any contacts, schlieren, or alignments of phenocrysts in chill zones of the intrusive rocks. Thirty samples of the intrusive rocks were chosen to characterize fresh rock composition and the composition of various alteration assemblages in the intrusive rocks, and to check previous chemical analyses. Bulk and grain density measurements were also carried out on these representative samples, and approximately 110 thin sections were examined to determine the mineralogies of the alteration assemblages, to estimate mineral percentages, and to choose representative mineral samples for analysis with the microprobe.

Chemical, mineralogic, and density data were used to calculate mineral and element gains and losses and porosity in the above-mentioned 30 samples using the Fortran IV program QUANMIN developed by Norton and Koolvard as described in Villas and Norton (1977) and Villas (1975). Mineral and element gains and losses were also calculated for an additional 18 50-foot composite samples which were relatively free of supergene alteration. The mass abundances of