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Phoenix, AZ, 85012
602-771-1601
http://www.azgs.az.gov
inquiries@azgs.az.gov

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4 JAN 1964 GEOEX

January 8, 1964

Mr. Walter E. Heinrichs
Heinrichs Geoexploration Co.
808 West Grant Road
Tucson, Arizona

Dear Walt,

This letter will summarize the results of the petrographic and mineralographic examination of the specimen that was submitted to me for study. These results were reported verbally on December 31, 1963.

The specimen submitted for examination was a piece of drill core that megascopically would be considered a green chlorite schist containing visible disseminated sulfides. The rock is strongly foliated, this foliation aligned along the direction of the drill core rather than across it.

Microscopic examination of thinned and polished sections was made. The rock was too fine-grained to extract clean minerals for X-Ray diffraction or emission spectrographic study. Whole rock X-Ray diffraction was made that essentially verified the results of mineral determination made by the petrographic microscope. Emission Spectrographic study of the whole rock would yield results that would be extremely difficult to interpret if interpretable at all.

Petrographic Examination The rock is foliated, a schist, that consists predominantly of fine-grained quartz, an unknown variety of chlorite and subsidiary amounts of altered (?) feldspar. there are lesser amounts of hornblende and a very fine-grained mineral that has the optical characteristics of andalusite. Both magnetite and pyrite were observed and there is a non-reflecting black opaque mineral that maybe graphite. Some calcite is present as a surface coating. Fine-grained clay minerals have formed (kaolinite?) as a possible alteration product of feldspars. If this is argillic alteration it should be considered as very slight.

The nature of the mineral assemblage and the texture of the rock suggests that the rock is the result of moderate metamorphism of a medium grained to fine grained arkosic sediment. The presence of carbon suggests a euxinic environment with a present day analogy to certain deltaic deposits. The lack of feldspar destruction and the tendency toward an oriented porphyroblastic texture suggest metamorphism of a layered rock.

Pyrite seems to occur exclusively with the black mineral that has been interpreted as graphite. As a consequence, the layering shown by the graphite is reflected by similar layering of the pyrite. This is concordant alignment and indicated, for the pyrite, primary control rather than a secondary control such as fracturing or faulting. Thus the nature of the rock governs the position of mineralization and, with the presence of carbon intimately related to pyrite, governs the site of mineralization.

There are two possible ways to interpret the mineralization, both with substantiated precedent. Carbonaceous material can act as a "precipitant" under low to moderate temperature conditions. Thus, it could act as a precipitant under reducing conditions to provide the proper environment for pyrite formation. This is happening now in certain swamp environments and has happened in the geologic past in the formation of the so-called "bog-iron" deposits of the Appalachians and other locations. If this be the case, then primary control of sulfide mineralization is related to stratigraphy and to a lesser extent recrystallization that might take place during metamorphism.

The other alternative of control would be that of pyrite precipitated by carbon from transient fluids, a process similar to that that may have acted in certain "red-bed" copper deposits or the plateau Uranium deposits. In this case, the carbonaceous material would be indigenous and the pyrite introduced after the rock formed., this in contrast to the first alternative in which the pyrite is part of the sedimentary suite.

On the basis of examination of one specimen, it is difficult to choose between the two alternatives. From the standpoint of exploration, such a distinction is extremely important. If the sulfide is controlled by primary sedimentary features, then study of stratigraphy and depositional environments would be of paramount importance. If the carbonaceous material is a secondary control then a study of stratigraphy and depositional environments (primary rock features) would have to be coupled with study of the primary control (faults joints fractures or such other features that may act as the plumbing system.)

No minerals of major economic importance or of base or precious metals were observed in the rock.

I trust this report presents the type of interpretation that you desired.

My best regards to all at Heinrichs Geoex for the New Year.

Sincerely,

Spencer R. Titley

34
32
5000
B.M.
4898
Poland Jct
5
4
ATCHISON
Roy Spr
TERNUT
MINE
4750

32
34
5000
B M
Poland Jct
4898
5
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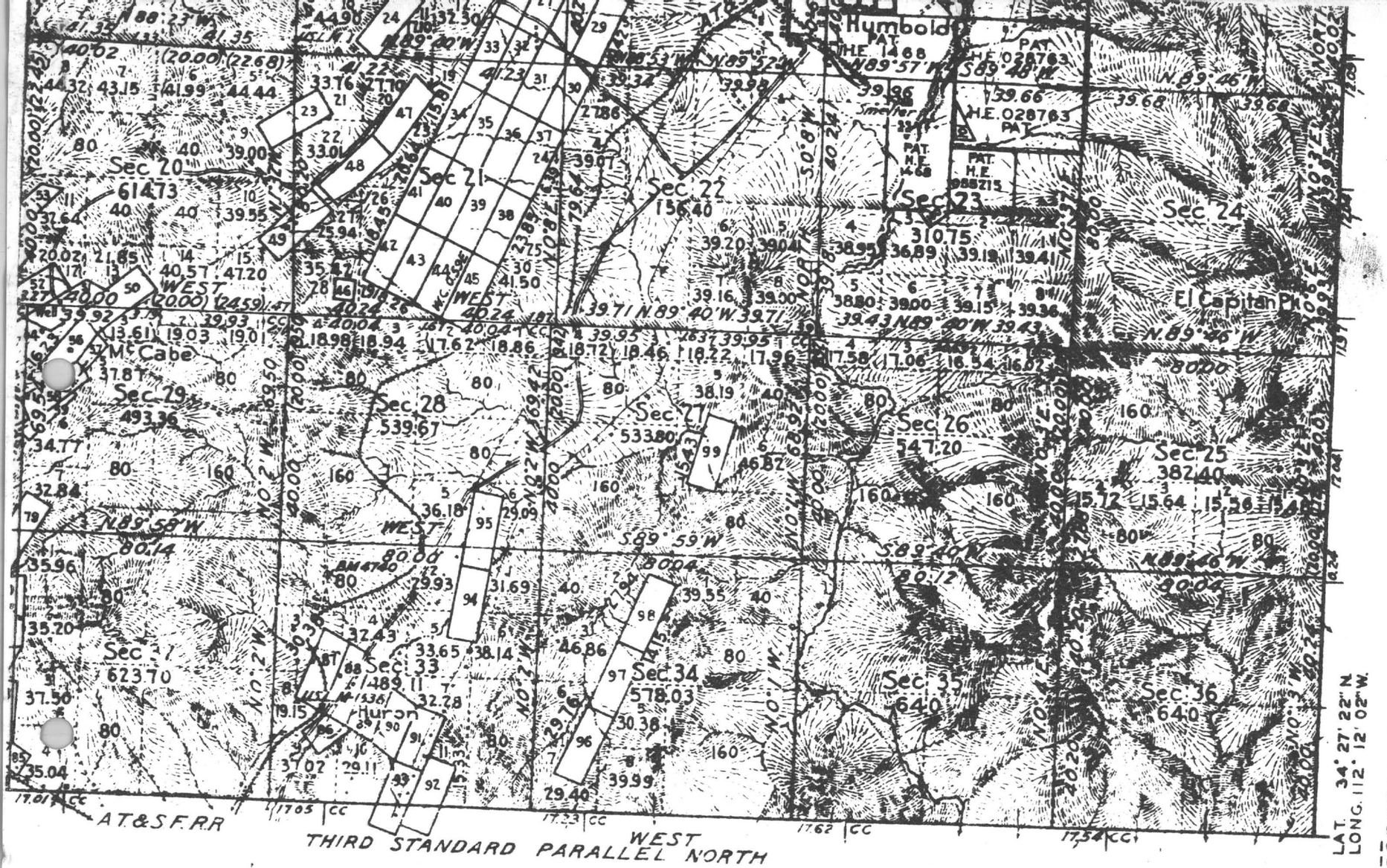
Big
ATCHISON
Roy Spr
TERNUT
MINE
4750



50	JIM CROW NO. 2	1958
51	OLIPHANT	1611
52	KINGSLEY	"
53	LADY ALDE	"
54	FRACTIONAL	"
55	CLEVELAND	"
56	JIM CROW	1268
57	COLUMBUS	1685
58	MC. CABE	1198
59	MONOPOLIST	1242
60	SINK TO RISE	813
61	GLADSTONE	1169
62	EVA	[illegible]
63	GLADSTONE WESTERLY EXTENSION	1160
64	LITTLE KICKER	1498
65	REBEL	1500
66	SUNOL	2084
67	PALO ALTO	"
68	COLUMBIA	"
69	INDEPENDENCE	187[illegible]
70	BETTIE	[illegible]
71	LITTLE JESSIE	[illegible]
72	ELLA	[illegible]
73	ARROYO	[illegible]
74	NEW YEAR	[illegible]
75	OPPORTUNITY	"
76	DIVIDEND	7
77	REPUBLIC NO. 1	177
78	BIG BUG	[illegible]
79	GOPHER	[illegible]
80	SILVERTON	[illegible]
81	YANKE GIRLL	[illegible]
82	INVINCIBLE	"
83	AMERICAN FLAG	"
84	TRINITY	"
85	HENRIETTA MILL SITE	"
86	PRINCES PLACER	163[illegible]
87	MONTEZUMA	3234
88	EAGLE FRACTION	"
89	BRUSHY FLAT	"
90	HURON NO. 2	"
91	SWINDLER	"
92	HURON NO. 1	"
93	VICTOR	"
94	HURON	3454
95	MONTEZUMA	1673
96	CORPORAL	"
97	LONE PINE	1747
98	ADMIRAL	"
99	LITTLE MAY	"
100	AQUA FRIA MILL SITE	1701
101	VICTORY NO. 2 MILL SITE	109
102	MOUNTAIN QUEEN	2022B

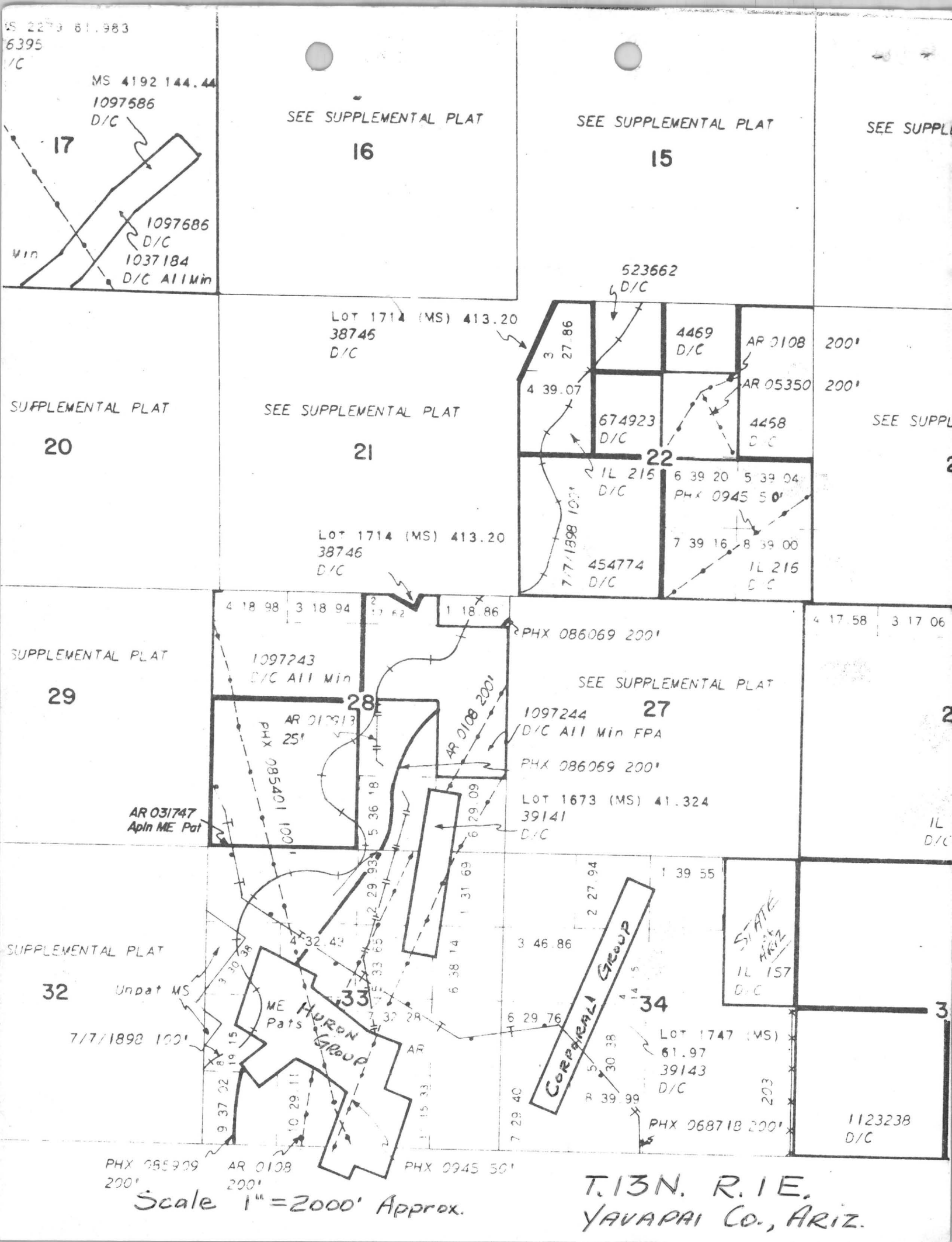
d. 6894.56 Acres (new)

N SURVEYED	COMPLETED
25	Dec. 1, 1925.
25	Nov. 1, 1925.

Office of U.S. Supervisor of Surveys
Denver, Colorado. October 29, 1927
The above plat of Township No. 13 North Range No. 1 East of the Gila and Salt River Meridian, Arizona, is strictly conformable to the field notes of the survey thereof which have been examined and approved

DEPARTMENT OF THE INTERIOR
GENERAL LAND OFFICE
Washington, D.C., March 15, 1928
The survey represented by this plat having been correctly executed in accordance with the requirements of law and the regulations of this office, is hereby accepted.

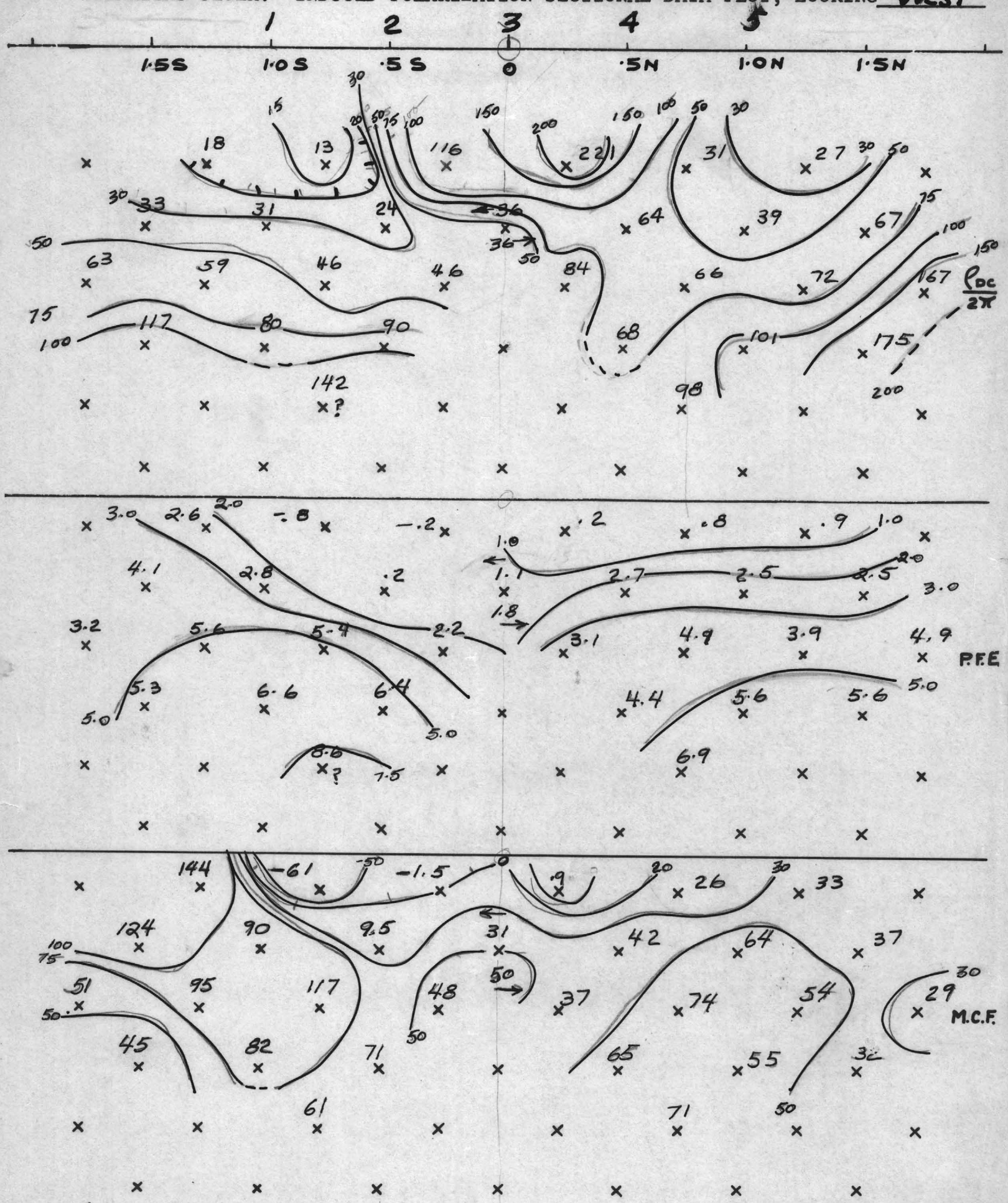
File Copy



Scale 1" = 2000' Approx.

T.13N. R.1E.
YAVAPAI Co., ARIZ.

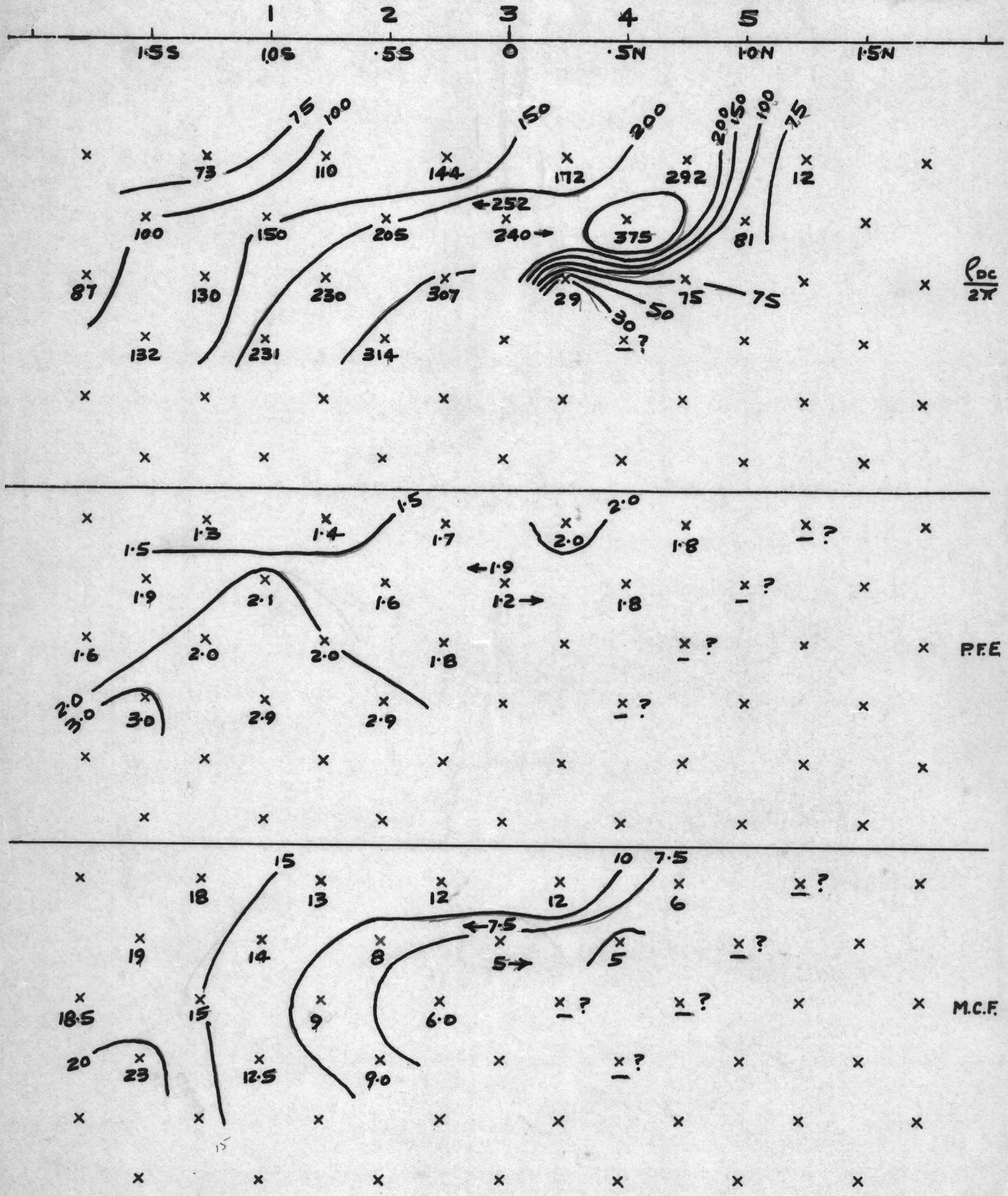
HEINRICHS GEOEX. INDUCED POLARIZATION SECTIONAL DATA PLOT, LOOKING WEST



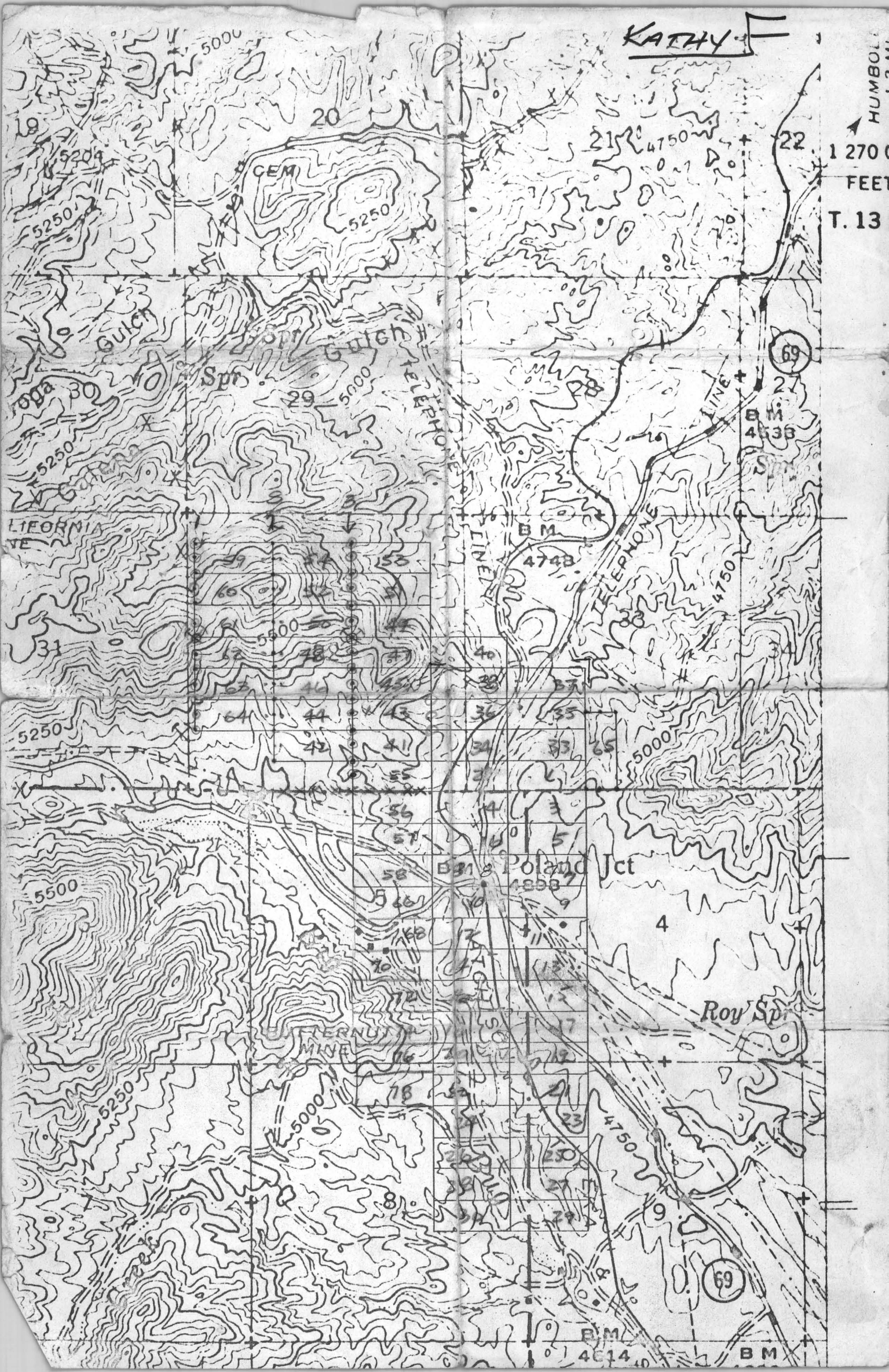
KATHY BUG

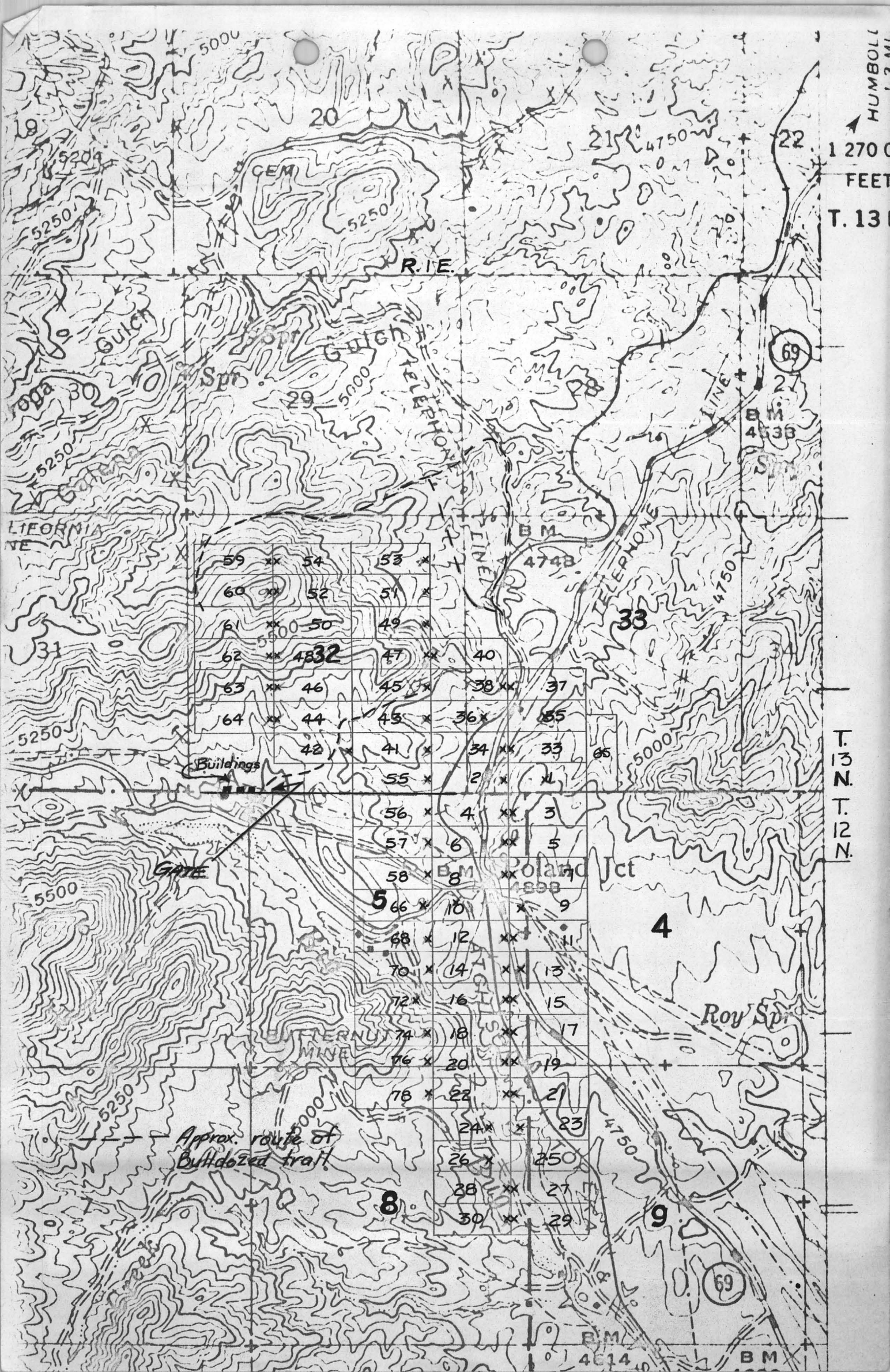
AREA PRESCOTT ARIZ LINE L1 a = 500' SCALE: 500=1" DATE: 9-2-64

HEINRICHS GEOEX. INDUCED POLARIZATION SECTIONAL DATA PLOT, LOOKING WEST

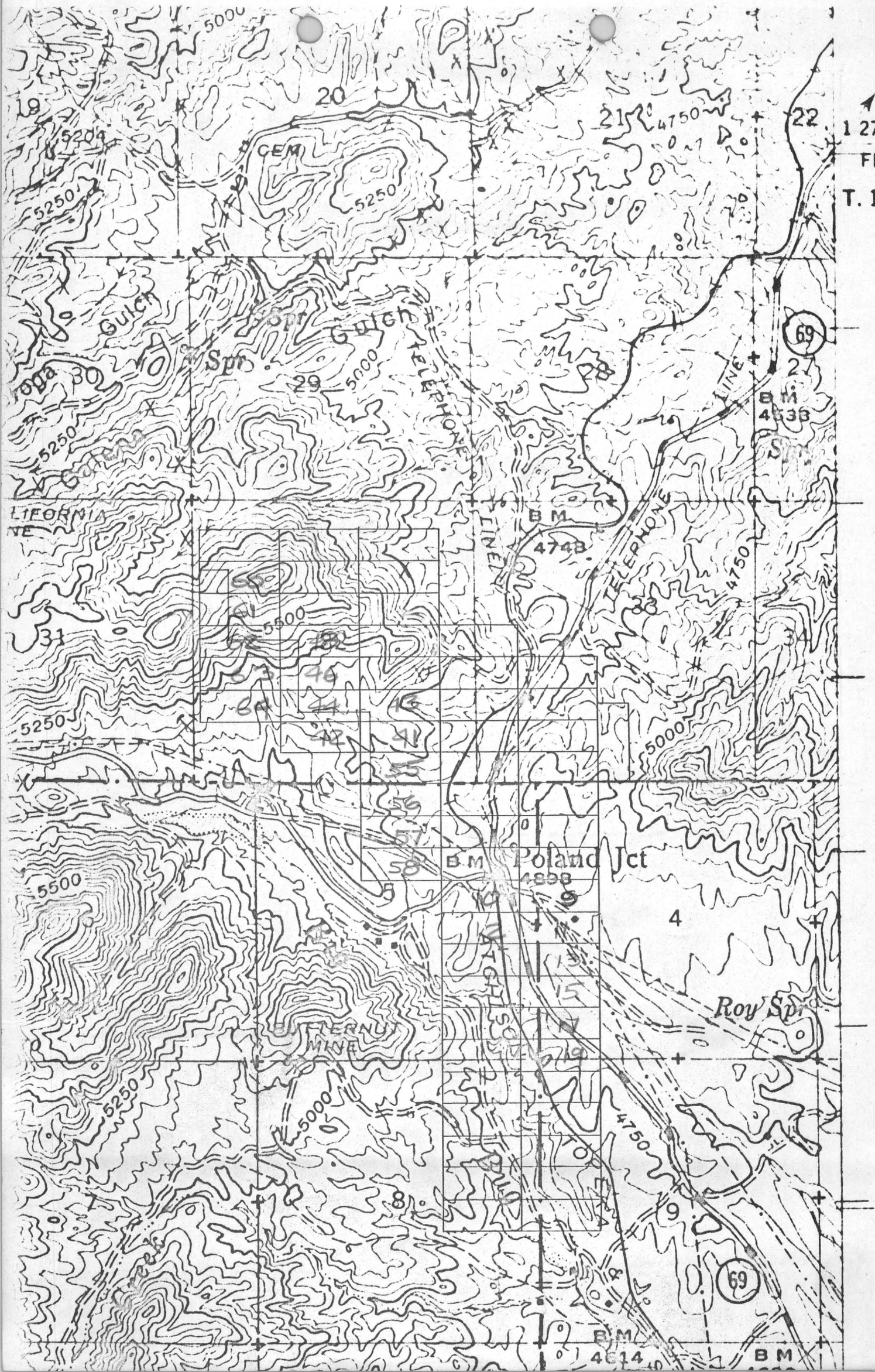


AREA KATHY - BUG LINE 2 a = 500' SCALE: 500' = 1" DATE: 9-1-64

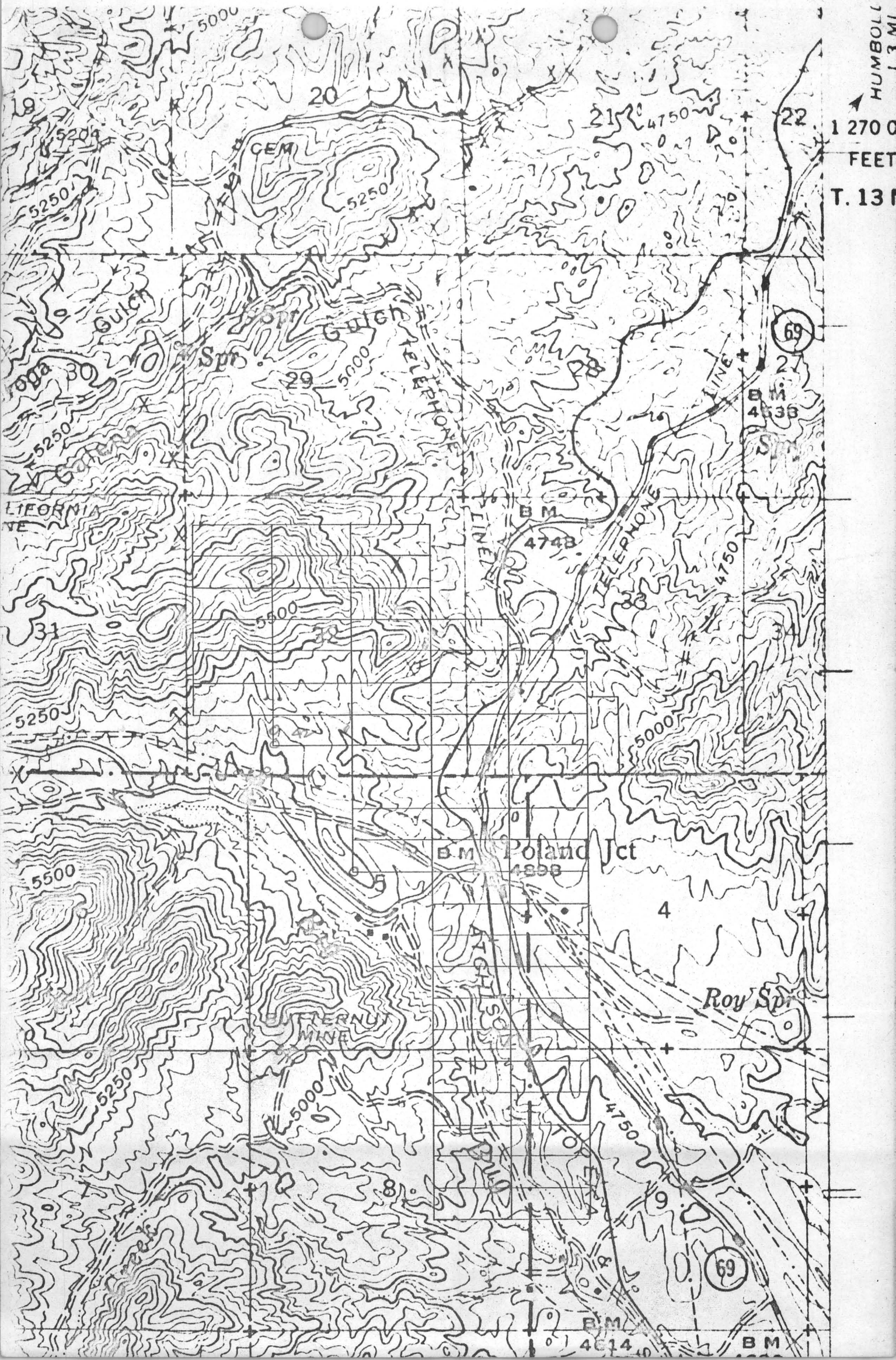

KATHY
HUMBOL
1 270 0
FEET
T. 13
CEM
Gulch
Spr
TELEPHONE LINE
B M
4748
4638
Poland Jct
4898
Roy Spr
BATTERNUT MINE
4614
5000
5250
5500
4750
69



HUMBOLD
1 270 0
FEET
T. 13
R. 1 E.
CEM
Gulch
Spr
TELEPHONE LINE
B M 4748
B M 4638
69
T. 13 N.
T. 12 N.
Buildings
GATE
Poland Jct
Roy Spr
BUTTERNUT MINE
Approx. route of Bulldozed trail
B M 4614
B M



HUMBOLD
1 270 0
FEET
T. 13
CEM
Gulch
Spr
TELEPHONE LINE
B M
4748
4538
Poland Jct
4898
Roy Spr
BUTTERNUT MINE
4614
5000
5250
5500
4750
69



HUMBOLD
1 270 0
FEET
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CEM
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Spr
TELEPHONE
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B M
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Poland Jct
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Roy Spr
BUTTERNUT
MINE
ATCHISON
TOPEKA
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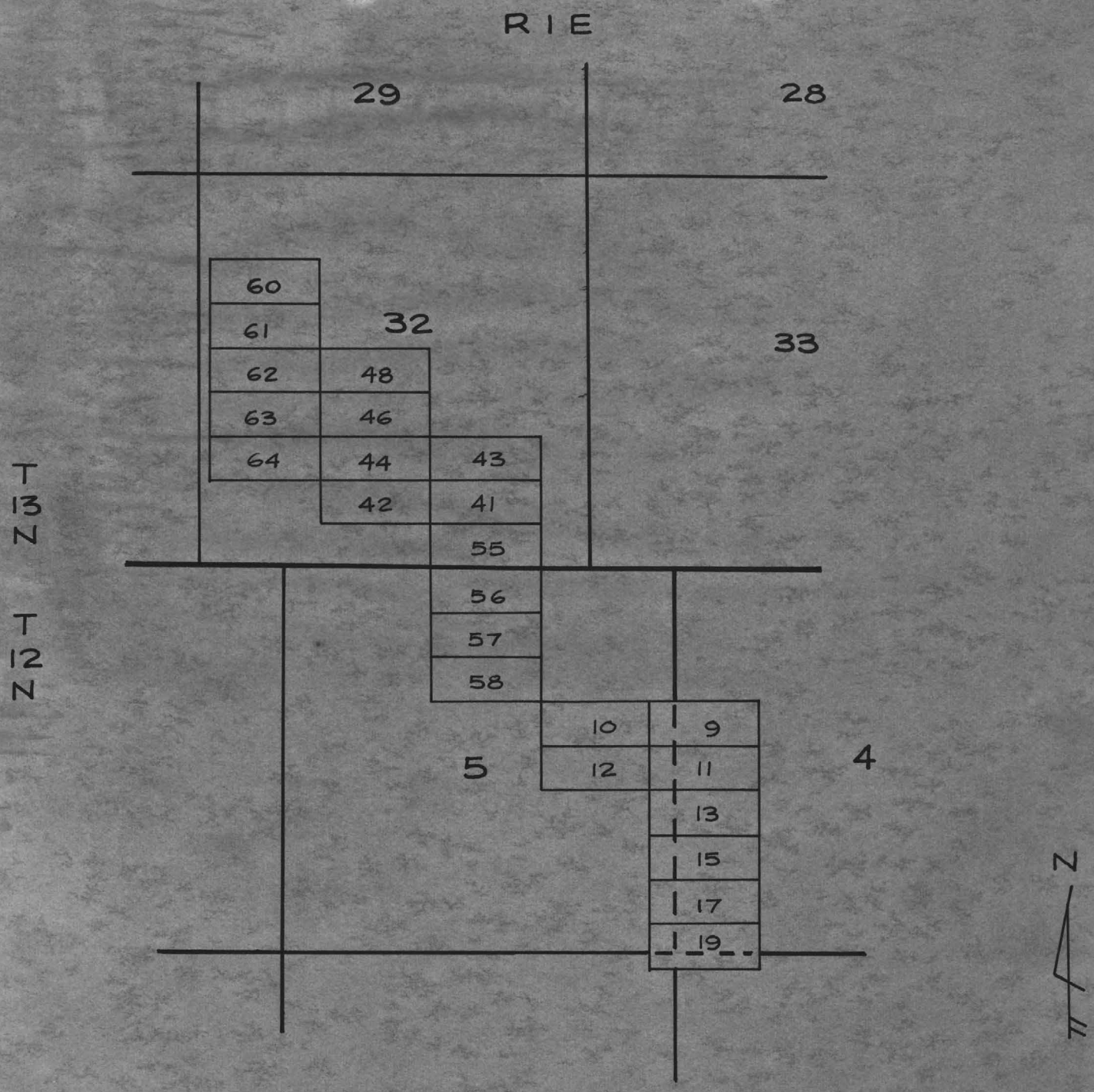


SKETCH MAP

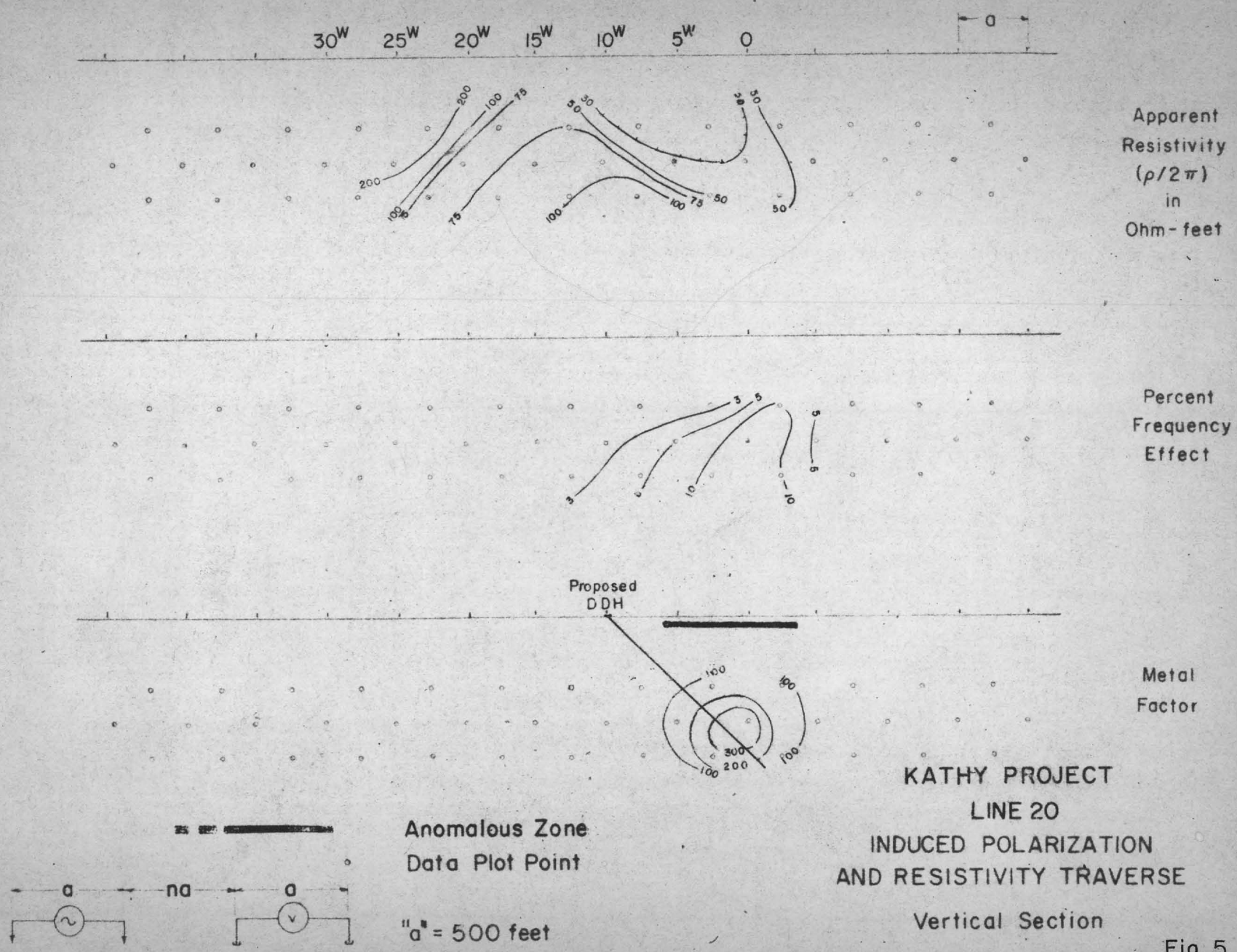
BUG CLAIM GROUP
BIG BUG MINING DISTRICT
YAVAPAI COUNTY, ARIZ.
by
E. GROVER HEINRICHS

Scale: 1" = 2000' approx.
April 1963

8-28-64

Called P.D. –

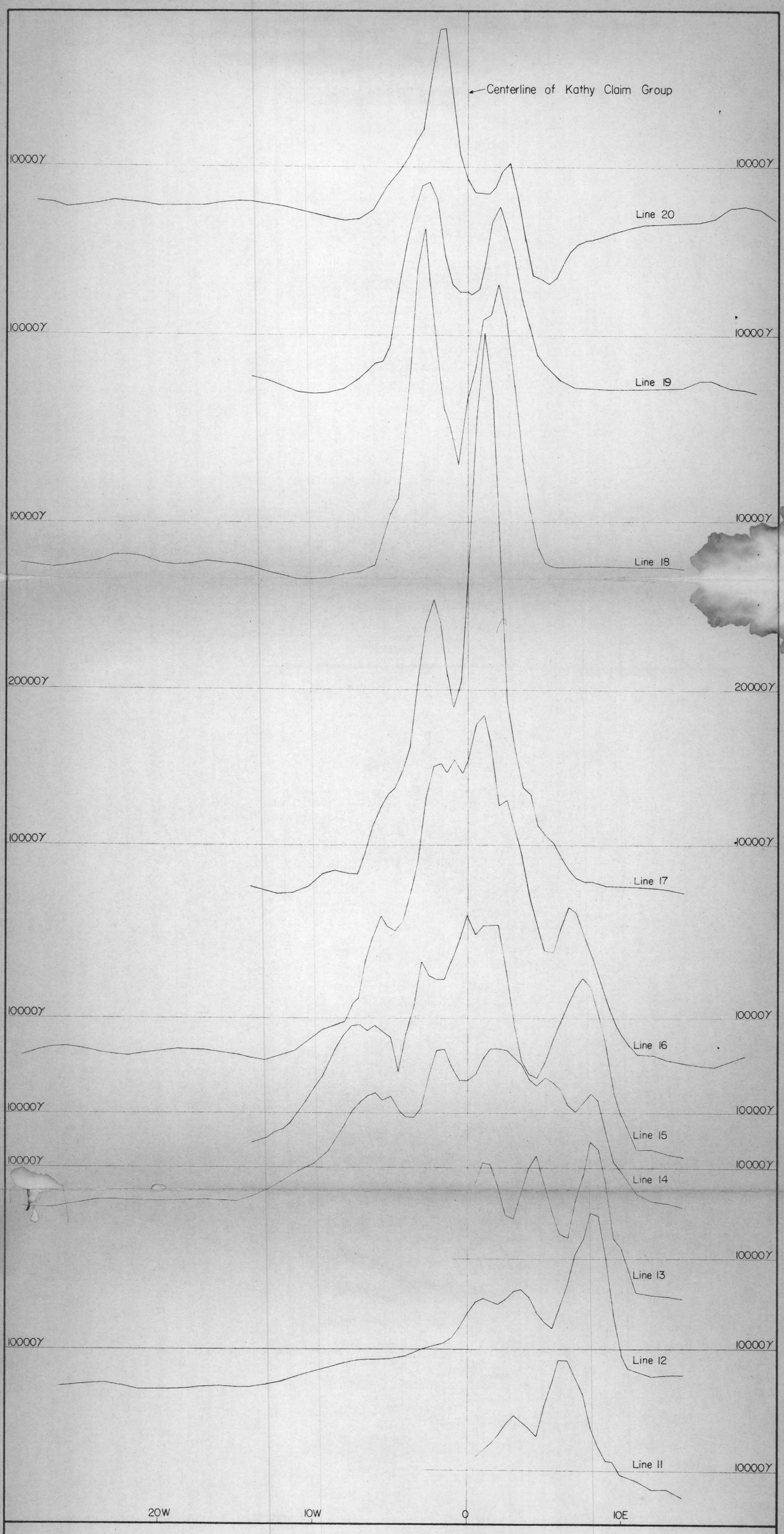
Bob Ludden
said he'd have
sheets mailed
pronto.



KATHY PROJECT
LINE 20
INDUCED POLARIZATION
AND RESISTIVITY TRAVERSE

Vertical Section

Fig. 5



Note: Profiles have been smoothed by the method of three-station averaging.

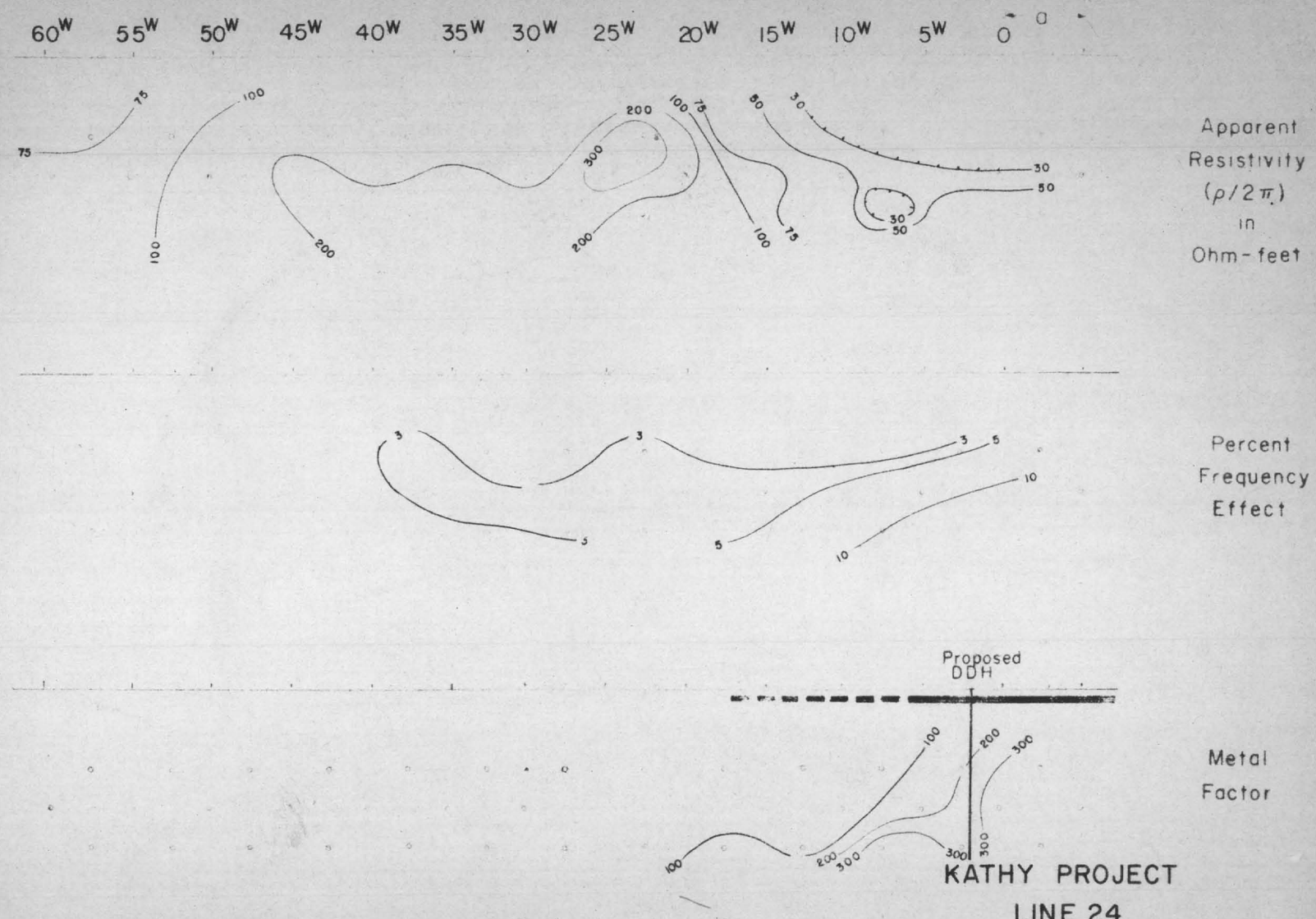
Phelps Dodge Corporation
Geophysical Research and Exploration Department

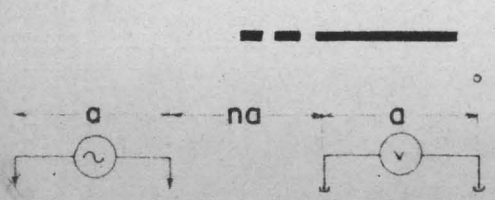
KATHY PROJECT
Magnetic Profiles

Horizontal Scale: 1"=500' Vertical Scale: 1"=5000γ

April, 1963

Fig. 2





Anomalous Zone

Data Plot Point

"a" = 500 feet

KATHY PROJECT

LINE 24

INDUCED POLARIZATION

AND RESISTIVITY TRAVERSE

Vertical Section

Fig. 6

GEOCHEMICAL RESULTS FROM SOIL SAMPLES

KATHY PROJECT, YAVAPAI COUNTY, ARIZONA

SOIL SAMPLE TRAVERSE OVER DDH-K2, 50' SPACING
(Samples listed from west to east as shown on map)

Sample * No.	Copper (ppm) 65 160	Zinc (ppm) 25 55	Lead (ppm) 20 45
K2-20W	95	50	40
K2-19W	105	40	30
K2-18W	85	35	35
K2-17W	90	45	45
K2-16W	75	35	35
K2-15W	85	40	35
K2-14W	95	40	40
K2-13W	90	40	35
K2-12W	100	40	40
K2-11W	75	40	40
K2-10W	85	30	30
K2-9W	70	55	40
K2-8W	105	55	35
K2-7W	65	30	30
K2-6W	95	45	45
K2-5W	90	45	45
K2-4W	110	30	35
K2-3W	160	35	35
K2-2W	100	25	35
K2-1W	70	35	35

* - Sample locations shown on geology map.

SOIL SAMPLE TRAVERSE OVER DDH-K2, 50' SPACING (Cont'd.)

Sample * No.	Copper (ppm) 130 50	Zinc (ppm) 90 25	Lead (ppm) 120 20
K2-1E	100	65	45
K2-2E	50	35	25
K2-3E	60	25	30
K2-4E	120	45	30
K2-5E	85	25	35
K2-6E	120	50	45
K2-7E	95	30	20
K2-8E	130	35	20
K2-9E	120	75	60
K2-10E	85	45	35
K2-11E	100	55	35
K2-12E	115	70	120
K2-13E	110	60	35
K2-14E	80	60	45
K2-15E	105	50	40
K2-16E	90	80	30
K2-17E	65	55	40
K2-18E	75	65	45
K2-19E	75	70	55
K2-20E	50	55	50

* - Sample locations shown on geology map.
Note: Samples determined by colormetric methods Rocky Mountain Geochemical Laboratories, Prescott, Arizona

SOIL SAMPLE TRAVERSE NORTH OF DDH-K1, 200' SPACING

(Samples listed from northwest to southeast as shown on map)

Sample * No.	Copper (ppm) 750 45	Zinc (ppm) 170 10	Lead (ppm) 80 10
K-1	290	105	40
K-2	135	125	25
K-3	150	135	65
K-4	750	170	60
K-5	155	160	80
K-6	110	70	20
K-7	85	75	40
K-8	135	100	50
K-9	140	80	25
K-10	75	45	10
K-11	100	75	15
K-12	190	65	40
K-13	70	30	40
K-14	85	30	35
K-15	60	20	40
K-16	55	10	50
K-17	45	30	45
K-18	80	70	55
K-19	120	25	30
K-20	75	30	40
K-21	210	50	80

* - Sample locations shown on geology map.

SOIL SAMPLE TRAVERSE NORTH OF DDH-K1, 200' SPACING (Cont'd.)

Sample * No.	Copper (ppm) 160 40	Zinc (ppm) 145 30	Lead (ppm) 50 30
K-22	65	40	30
K-23	40	30	35
K-24	160	70	50
K-25	75	145	40
K-26	65	45	45

* - Sample locations shown on geology map.

Note: Samples determined by colormetric methods Rocky Mountain Geochemical Laboratories, Prescott, Arizona

SOIL SAMPLE TRAVERSE DDH-K3 (proposed), 100' SPACING

(Samples listed from east to west as shown on map)

Sample * No.	Copper (ppm) 140 25	Zinc (ppm) 70 10	Lead (ppm) 35 10
K3-10E	25	20	15
K3-9E (missing)			
K3-8E	55	45	15
K3-7E	90	50	20
K3-6E	85	60	35
K3-5E	50	45	30
K3-4E	55	35	20
K3-3E	60	65	30
K3-2E	75	45	20
K3-1E	140	70	15
K3	85	60	25
K3-1W	65	30	20
K3-2W	55	15	25
K3-3W	65	25	30
K3-4W	55	20	15
K3-5W	45	10	10
K3-6W	40	15	15
K3-7W	50	10	25
K3-8W	50	10	30
K3-9W	60	10	15
K3-10W	85	10	30

* - Sample locations shown on geology map.

Note: Samples determined by colormetric methods Rocky Mountain Geochemical Laboratories, Prescott, Arizona

SOUTHERNMOST SOIL SAMPLE TRAVERSE, 200' SPACING

(Samples listed from northwest to southeast as shown on map)

Sample * No.	Copper (ppm) 750 70	Zinc (ppm) 90 25	Lead (ppm) 65 20
B-1	185	55	50
B-2	750	45	20
B-3	160	70	20
B-4	95	45	40
B-5	140	65	45
B-6	140	25	65
B-7	155	55	45
B-8	140	90	50
B-9	140	45	50
B-10	130	60	40
B-11	180	60	30
B-12	120	65	25
B-13	150	70	35
B-14	125	70	40
B-15	145	80	30
B-16	70	80	45
B-17	75	55	30
B-18	110	80	25

* - Sample locations shown on geology map.

Note: Samples determined by colormetric methods Rocky Mountain Geochemical Laboratories, Prescott, Arizona

11/17/89

Statement reminder sent today

re: 10/18/89 statement in $1100 ≅ amt.

M.

LAW OFFICES OF
MOLLOY, JONES & DONAHUE, P. C.

ARIZONA BANK PLAZA
33 NORTH STONE AVENUE, SUITE 2200
P. O. BOX 2268
TUCSON, ARIZONA 85702
TELEPHONE (602) 622-3531
TELECOPIER (602) 624-2816

JOHN F. MOLLOY
STANLEY W. TRACHTA
DONALD S. ROBINSON
MYLES C. STEWART
PETER JOHNSON
MICHAEL J. MEEHAN
PETER VOEVODSKY
SARAH R. SIMMONS
FRED LUYTIES
LARRY D. CLARK
THOMAS W. ROUSE
JEANNETTE K. GEISER
RICHARD S. HUDGINS
DAVID A. McEVOY
KENNETH R. MOELLER
EILEEN W. HOLLOWELL
DEBRA DRECKSEL MILLER
RORY C. HAYS
GEORGE O. KRAUJA
RUSSELL E. JONES
JOHN L. DONAHUE, JR.
RICHARD T. COOLIDGE
ROBERT E. KAUL
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ROY W. KYLE
GARY F. HOWARD
DONALD J. OPPENHEIM
SUSAN G. BOSWELL
D. MICHAEL MANDIG
MARK S. SIFFERMAN
TERRY L. TEDESCO
ARDNER R. CHESHIRE, JR.
JANET C. BOSTWICK
DAVID K. GRAY
C. TIMOTHY WHITE
ANDREA A. LARKIN

THOMAS H. CHILDERS
VICTOR H. VERITY
HERBERT MALLAMO
OF COUNSEL

DON BENNETT MOON
COUNSEL

PHOENIX OFFICE
4041 NORTH CENTRAL
SUITE 2001
PHOENIX, AZ 85012
(602) 263-7784

GREEN VALLEY OFFICE
1151 SO. LA CANADA DRIVE
SUITE 210
GREEN VALLEY, AZ 85614
(602) 648-0822

April 30, 1987

RECEIVED
MAY 14 1987
BOX 5964
TUCSON, AZ. 85703

Mr. Walter E. Heinrichs, Jr.
Heinrichs Geoexploration Co.
P. O. Box 5964
Tucson, Arizona 85703-0964

Re: Arizona Maintenance v. U. S.

Dear Walter:

Enclosed please find a copy of your deposition taken in the above-referenced matter on April 16, 1987. Please review this deposition and make a list of corrections, noting page and line numbers. After you have completed this review, send your list of corrections, if any, to me. You may keep this copy of your deposition for your records.

Yours very truly,

MOLLOY, JONES, & DONAHUE, P.C.

John F. Molloy

JFM:ckk

Enclosure

P. S. Also enclosed is a signature page. After you review the deposition, please sign and return this signature page, along with any corrections you list.

JFM

5/5/87

HEINRICHS GEOEXPLORATION COMPANY

P.O. BOX 5964, TUCSON, ARIZONA 85703, 806 WEST GRANT ROAD, PHONE: (602) 623-0578

John F. Molloy, Esq.
Molloy, Jones & Donahue, P.C.
P.O. Box 2268
Tucson, AZ 85702

Re: Az Maint. v. U.S.
GEOEX#1769

Dear John:

Yours of 30 April 1987 and enclosures are acknowledged.

I have reviewed my deposition taken on 16 April 1987. Corrections are listed on a separate sheet enclosed. The signature page has also been signed and is enclosed as requested.

Truly,

Walter Heinrichs

Encl: 2

Corrections to deposition of Walter Heinrichs taken on 4/16/87 —:

p.5, line 3 – the year 1960, should be 1940.

p.17, lines 9 & 24 – word entry, should be sedimentary.

p.21, line 11 – Mr. Shumann's name is mispelled twice and, this continues consistently throughout rest of deposition.

p.40, lines 13 & 14 – Same as above for line 13, and on line 14 it's: Ackermann (not Ackerman).

p41, line 14 – same

p51, line 11 – the word farcel, should be particle.

p52, line 5 – same as above.

p55, lines 9 & 17 – " " " .

p61, line 19 – the word reflex, should be reflection.

p67, line 16 – the man's name is: Leet (not Leeds).

p69, line 4 – RI 90 would not be pertinent. I believe this is a mistake and should be stricken.

p70, lines 5, 6 & 17 – add another "n" to mens last names.

p71, lines 18, 21 & 24 – " " " to Schuman, so that it reads: Schumann.

fissures in the area of shot hole 2-B have had any impact on possible damage caused by the blast?

A Let's say the effects on the well are similar to the effects that appear at the surface in the fissures, in other words, the same types of phenomenon are probably going on at both places.

So, in that context, there would be a similar relationship, but that they are directly interconnected I wouldn't say is necessarily so.

MS. HOLLOWELL: I don't have anything else.

MR. WHITNEY: That is all.

Can we treat this deposition as continued?

MS. HOLLOWELL: Sure, given that you extended me that courtesy in Denver.

WALTER HEINRICHS

UNITED STATES DISTRICT COURT
DISTRICT OF ARIZONA

ARIZONA MAINTENANCE COMPANY, an Arizona Corporation,	)	
Plaintiff	)	
vs.	)	CIV 86-101 TUC-RMB
UNITED STATES OF AMERICA,	)	
Defendant	)	

April 16, 1987
Tucson, Arizona

DEPOSITION OF:

WALTER HEINRICHS

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APPEARANCES

FOR THE PLAINTIFF:
MOLLOY, JONES, DONAHUE, TRACHTA, CHILDERS & MALLAMO, P.C., by Eileen Hollowell, Esq.

FOR THE DEFENDANT:
James D. Whitney, Assistant U.S. Attorney

BE IT REMEMBERED that pursuant to Notice, the deposition of WALTER HEINRICHS was taken at the offices of the United States Attorney, United Bank Plaza, 120 West Broadway, Tucson, Arizona, before Peter A. Lumia, Certified Shorthand Reporter, a Notary Public in and for the County of Pima, State of Arizona, on the 16th day of April 1987, commencing the hour of 1:00 P.M. on said day.

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2 WALTER HEINRICHS

3 having been first duly sworn, was examined and testified

4 as follows:

5

6 EXAMINATION

7 BY MR. WHITNEY:

8 Q Would you state your name, please?

9 A Walter Heinrichs.

10 Q You are a resident of Tucson?

11 A Yes, I am.

12 Q Where do you reside in Tucson?

13 A 2943 East Chula Vista Drive.

14 Q How long have you lived in Tucson?

15 A Since 1949.

16 Q I see you have brought -- have you brought a

17 resume with you?

18 A I did.

19 Q Could I see it and perhaps we can run briefly

20 through it?

21 A This is your copy, if you'd like it.

22 Q Thank you very much.

23 I will just include this as an exhibit to the

24 deposition.

25 You trained at the Colorado School of Mines?

A Yes.

Q When was that?

A 1936 through 1960.

Q I understand from the affidavit that I have from one of the motions that has been brought by the plaintiff in this case, that you went in the service where you conducted as well as taught seismic blasting, is that correct?

A That is not quite true.

Q Will you tell me what it is, please?

A I taught seismic in my employment as a geophysical engineer with Seismograph Service Corporation and National Geophysical for the first four years after I was out of school.

Q It had nothing to do with the army, then?

A Later on I was in the navy for two and a half years.

Q When you were employed by this company, what areas of seismic testing were you involved in?

A What do you mean?

Q Was it petroleum, did it have to do with petroleum, did it have to do with subsidence?

A It was primarily petroleum exploration.

Q And where was that, principally what part of the world?

1 A Mid continent, Gulf Coast, Rocky Mountains.

2 Q In that capacity I take it you were an

3 employee of a private corporation?

4 A That is correct.

5 Q And they were brought in as consultants by

6 various oil companies?

7 A More precisely as contractors to the

8 petroleum companies.

9 Q Can you name some of the petroleum companies,

10 please?

11 A Continental Oil was one; Atlantic Refining

12 Company was another.

13 Those are the two that I remember most

14 distinctly.

15 Q Would you tell me, please, how you go about

16 your seismic testing insofar as it applys to petroleum?

17 I take it you are looking for bodies of oil?

18 A You are looking for structure, and the

19 seismic method is a method which will help you define

20 subsurface structure that may or may not include

21 accumulations of oil and gas.

22 Q I take it then if we know what a certain

23 structure is, then we know that that structure may or may not

24 contain hydrocarbons?

25 A If you get what we call an anomaly.

Q What is that?

A An anomaly is something that is a little out of the normal, maybe it represents a reversal in the dip, which would perhaps be an accumulation of oil and gas, or it might find a trap.

There are a number of different geologic structures --

Q What would be -- I'm sorry, I didn't let you finish.

A I finished the question.

Q All right.

What do you mean by the use of the word dip?

A That is a geologic term. It is a slope of the formations.

Q It might be a syncline or incline?

A A syncline is usually a low and an anticline is a high.

Q But that would be what you would be looking for?

A The slope would be the dip, or the dip would be the slope.

If you find a reversal in the dip, you may have a petroleum structure.

Q I meant to ask you, when you were in the navy, you did do some work with seismic?

1 A No.

2 Q What did you do in the navy?

3 A In the navy it was all magnetics and

4 geological work, as far as anything that relates to my

5 profession.

6 Q What would that be in aid of in the navy, the

7 magnetics?

8 A We were processing naval petroleum reserves,

9 primarily, and, in particular, naval petroleum reserve number

10 4, which is in northern Alaska.

11 Q Would that define areas for storage of

12 petroleum?

13 A No. It was primarily to evaluate the

14 viability of the petroleum reserve. Do we have producible

15 oil and gas reserves here?

16 Q Was this a portion of Alaska that they have

17 been just developing, Prudhoe Bay?

18 A It is very close to Prudhoe Bay.

19 Prudhoe Bay is a little farther east.

20 It is out of the reserve.

21 It is in the public domain.

22 Q How would this seismic testing -- what would

23 be the components of the seismic testing? A probably better

24 way of putting it is how would one go about seismic testing

25 insofar as, let's say, trying to determine whether there

1 might be the presence of petroleum; how would you set it up?
2 A You would lay out lines and set up geophones
3 and designate shot points, and shoot the shot points and
4 record the data, process the data and plot it.
5 Q Was that a fairly standard way of going about
6 testing to determine whether or not there was petroleum?
7 A Very standard, yes.
8 Q Did you ever do any core drilling?
9 A Yes, occasionally.
10 Q You say occasionally. Was that less popular
11 than the seismic testing?
12 A The decisions would be related mainly between
13 overall costs and the critical nature of the area to be
14 processed; how big an area it is; what is known about the
15 geology; quite a number of different factors involved.
16 Q Which would be -- given a large area -- which
17 would be the cheapest method of proceeding?
18 A Well, generally, some of the force field
19 methods would be the cheapest. Seismic could be a little
20 more expensive than the force field methods.
21 Q What is a force field?
22 A Magnetics or gravity.
23 Customarily they are done first, and if that
24 is not enough, why, you'd be supplemented by or complimented
25 by seismic, and if that is not enough, additional drilling

1 might be done.

2 Q What depths would you -- I know that is a

3 hard question -- it varies, but, in the central area you have

4 described as being Texas and Louisiana, what depths would it

5 be that you would be testing?

6 A To depths of maybe 40 thousand feet,

7 something like that, maximum.

8 Q And what type of charges of dynamite did you

9 have to use with your seismic testing?

10 A It varied considerably.

11 Q It would vary?

12 A From very small to very large.

13 Q What would be the -- what would dictate which

14 was used, whether it was the very small that would be used,

15 or the very large?

16 A A number of things would dictate that. The

17 degree of amplification that the recording equipment

18 provided; how much filtering the recording equipment

19 provided; what the surface formations were like; what

20 artificial noise conditions existed in the area; how close we

21 were to culture; things of this nature would all be part of

22 the equation.

23 These are evolving things.

24 Today we might have equipment that will do

25 one thing, tomorrow we may have equipment to do the same

1 thing much better.

2 Q When was it you did your last seismic

3 testing?

4 Q As a consultant?

5 A As a consultant.

6 A About a year ago.

7 Q Where did you do that, sir?

8 A Up near Tangerine Road, on Interstate 10.

9 Q Right here in Pima County?

10 A Yes.

11 Q And can you tell me please what the purpose

12 of that was?

13 A I really don't know the precise purpose,

14 unfortunately.

15 Q Can you tell me for whom you did it?

16 A I don't remember the company's name, exactly.

17 It was a contracting civil engineering

18 company out of San Francisco, and I assumed this had

19 something to do with the Central Arizona Project in some

20 manner, but what the thread of the correlation is, I have no

21 idea.

22 Q Do you know what it was, or -- I may have

23 asked this question -- what it was that you were seeking --

24 the geological profile?

25 A Primarily that was the objective. The depth

1 to the first layer. The depth of the first layer, the top
2 layer, how deep is it to the next layer.
3 Q Can you tell me what were the variations in
4 your charges when you were doing that testing?
5 A That work involved sledge hammer. There were
6 no explosives used at all.
7 Q You mentioned something before seismic, and I
8 missed it, as being the least expensive. Do you remember we
9 were talking about that?
10 A Well, this gets to be a little
11 hair-splitting.
12 Not any two geologists would necessarily
13 always agree on this, but, generally, magnetics is a little
14 cheaper; gravity is a little more expensive; and, relatively,
15 seismic is a little more expensive than that.
16 Q Where does core drilling fit in?
17 A Well, it depends.
18 Q Again, sir, as I couched my first question, I
19 couched it in terms of a large area.
20 You know, I know that it may be cheaper if we
21 are doing a place like the size of this room.
22 A It depends what your objectives are, of
23 course.
24 Q When you were surveying a large area to
25 determine whether or not there were conditions which might

1 prove out to be, to have oil in it, then would seismic
2 testing have been cheaper than core drilling?
3 A Conceivably it might, yes.
4 Very often there is no core drilling done at
5 all. You go right straight through production drilling, if
6 the seismic data is good enough.
7 Q How would the core drilling aid the seismic
8 testing?
9 A Provide velocity data.
10 Q And which, in turn, would show what?
11 A It would help you process your seismic data
12 better, knowing a velocity distribution, what the velocity
13 distribution was.
14 Often this isn't known too well.
15 Q And the velocity distributions are dictated
16 by what?
17 A The nature of the geologic material involved.
18 In other words, what kind of rocks are we dealing with.
19 Q How would it vary from, let's say, one type
20 of rock to another; where would one have the least velocity,
21 what type of material?
22 A Soil, topsoil, unconsolidated alluvium,
23 gravel, sand.
24 Q Where would be the least velocity?
25 A That would be the least.

1 Q That is the least velocity?
2 A Yes.
3 Q Why would that be?
4 A Because it is the least dense.
5 That is not a rigorous way to answer the
6 question, but in lay terminology that is adequate.
7 Q And what would give you the greatest
8 velocity?
9 A Granite, very hard, highly solidified granite
10 would be a high velocity material.
11 Limestone would be somewhere in between.
12 Q Does velocity play any part in energy, you
13 know, how much energy is distributed from one part to
14 another?
15 A I don't understand the question.
16 Q Well, if one has a great deal of velocity
17 from point A to point B, will the energy being distributed
18 from point A to B be greater?
19 A Not necessarily.
20 Q What would be the variance in that?
21 A What would be --
22 Q -- the variance; why do you say not
23 necessarily?
24 I take it to mean some situations yes, some
25 situations maybe, some situations no.

1 A Yes.

2 I am not sure I am following the gist of your

3 question precisely.

4 Q Okay.

5 My question was that if we take point A and

6 point B, point A being the source of the charge, point B

7 being the point to which the charge is distributed, my

8 question to you was would there be greater energy delivered

9 from point A to point B if the velocity were greater?

10 A No, there would not.

11 Q What would determine how much energy was

12 delivered from point A to point B?

13 A Well --

14 Q Sir, let's deal with blasting, okay?

15 A I know what you are --

16 MS. HOLLOWELL: Just so it is clean for the

17 record, we are discussing a hypothetical question as to point

18 A is the blast point and point B is some arrival point at

19 some non-specified distance?

20 Q That is right, that is right, that is right.

21 A Even though I gave you a categorical no

22 answer in the general sense, it is not entirely predictable,

23 given the parameters that you gave me.

24 There are additional parameters that would

25 have to be considered, such as is it solid material, and is

1 it isotropic and uniform all the way from one to the other,
2 or are there faults involved, or are there not faults
3 involved.
4 Things of this sort would have considerable
5 bearing on what would happen between a shot point and the
6 receiver. All of these things enter into the equation.
7 Q Would there be more energy delivered from
8 point A to point B if it were uniformly unconsolidated
9 alluvium?
10 A Probably a little less energy, relatively
11 speaking, but probably a little more motion for the same
12 given amount of energy.
13 Q How does that occur, the motion?
14 A Pardon?
15 Q How does the motion occur, how -- first of
16 all, what is that phenomenon, the motion?
17 A Well, obviously, when you explode dynamite,
18 you are releasing very suddenly a large amount of energy and
19 that large amount of energy has to be dissipated in some
20 manner. In other words, it just doesn't disappear. It has
21 to go somewhere and it has to be absorbed and distributed,
22 and that is exactly what happens in various forms of
23 transmitted motion.
24 Q How would it dissipate -- would the material
25 somehow --

A It would dissipate gradually and in fundamentally a spherical manner, increasing spheres outward away from the shot point.

Q Would the amount of energy increase the farther one gets from the shot point?

A No.

Q Would the decrease?

A Yes.

Q What if one were dealing with, say, ~~entry~~ sedimentary rock, uniform between point A and point B, given the same amount of energy between those two points. Would that, would the amount of energy delivered to point B be greater than that which was delivered when we had the same uniform type of unconsolidated alluvium?

MS. HOLLOWELL: Just so I am clear on the terms we are using -- these depositions are really hard, because they are so technical -- I am having trouble with the word "energy." Are we defining that to be separate from motion?

MR. WHITNEY: Why don't we leave it with motion.

Q Can you answer the question, sir, with motion -- just asking you, is there any difference between motion, insofar as you know, some ~~entry~~ sedimentary rock, uniform between the two points, and alluvium, unconsolidated alluvium, between the

1 same points?

2 A Let me rephrase your question, if I may.

3 Q Sure, anyway you can. To try enlighten me.

4 A You are trying to make the distinction in

5 terms of motion imparted from point A to point B in two

6 different instances, one in which the material between A and

7 B is a consolidated sediment --

8 Q Yes.

9 A -- and the other instance, where the material

10 is unconsolidated alluvium.

11 Q Yes.

12 A And the question is what would be the

13 difference in motion imparted at point B?

14 Q That is it, exactly.

15 A Everything being --

16 Q You did it better than I.

17 A The difference would be probably greater with

18 the unconsolidated alluvium than it would be with the

19 consolidated material.

20 Q And, again, sir, why would that be?

21 A Because of the inability of the

22 unconsolidated alluvium to absorb and distribute the energy

23 as well as the consolidated material can do it.

24 That is the best way of answering that I can.

25 Q Am I correct then we are into energy, again?

1 A We are talking about motion, now.

2 Q I thought your last -- I thought you spoke of

3 energy, when you wound up.

4 A Motion.

5 Q So, the motion would be greater in the --

6 A -- unconsolidated alluvium.

7 Q -- than it would be with the sedimentary

8 rock?

9 A Correct.

10 Q And what is the reason for that?

11 A Because the unconsolidated material is less

12 able to absorb and distribute energy, there is much more

13 space, air space, between the molecules of material, and so

14 the energy dissipation in effect is taken up by an increase

15 in motion as opposed to a more even distribution through a

16 harder material.

17 Q Mr. Heinrichs, I am going to show you what has

18 been marked Exhibit 2 on deposition and ask you if you

19 recognize that document?

20 A Yes, I do.

21 Q What is it, sir -- I'd like you to refer to

22 it, if you would.

23 A I have got a copy here.

24 It says it is an affidavit.

25 Q And you recognize it and it is your

1 affidavit, is it not?

2 A Yes.

3 Q And it is an affidavit that you executed on

4 the 6th day of April 1987?

5 A I think so.

6 Q All right. It indicates in the affidavit

7 that you examined Arizona Maintenance's well number 2, is

8 that correct?

9 A I don't believe it says that.

10 Q Well, maybe I misread it.

11 I am reading from paragraph 4, now.

12 "I have reviewed the extensive damage which

13 occurred to Arizona Maintenance well number 2."

14 A That is correct.

15 Q I take it then that you did not physically

16 examine the damage that was done, you didn't eyeball it?

17 A I didn't personally see the damage that was

18 done. No.

19 Q What was it that you used in order to come to

20 the conclusion that there was extensive damage on that well?

21 A Testimony of witnesses describing the damage.

22 Q Were those, was the testimony in the nature

23 of statements or depositions, or was it in any way reflected

24 in writing?

25 A It is in part reflected in writing, yes.

1 Q Did you bring that with you, sir?

2 A Yes, I think I did.

3 Q May I see it, please?

4 A It might take me a minute to find it.

5 Q That is all right.

6 A What I am recalling is correspondence between

7 some of the Bureau of Reclamation personnel in these files in

8 which they describe the damage.

9 Q Could you identify what people?

10 A If I remember correctly, I believe it was a

11 Mr. Raymond and Mr. Schuman, or Mr. Schuman and Mr. Raymond.

12 Also, I believe there is a report to the

13 chief geologist from Raymond, and he is quoting Mr. Feldman,

14 apparently.

15 Q So, actually, the source of the knowledge was

16 from Mr. Feldman?

17 A Also Mr. Leonard Halpenny described the

18 damage quite succinctly, if I remember correctly.

19 Q Described it in writing, or orally?

20 A I can't say. I don't know.

21 Q How was it that you received that

22 information, then?

23 A In a meeting at the attorney's office with

24 Mr. Halpenny present and myself present.

25 Q And one of the attorneys who are active in

1 this case for the plaintiff?

2 A Yes.

3 Q Who was that attorney?

4 A I believe it was John Molloy.

5 Q Would you tell me, to the best of your

6 recollection, first, when the meeting took place?

7 A Pardon?

8 Q First when the meeting took place.

9 I am a little adenoidal -- it is the pollen.

10 A Without referring to my files, I would

11 characterize it as approximately a year ago.

12 Q Then in April of 1986?

13 A Something like that. Yes.

14 Q Around that time?

15 A Right.

16 Q And what was said by Mr. Halpenny?

17 MS. HOLLOWELL: Jim, I guess I am having a

18 little bit of difficulty to the extent that this is a meeting

19 between Molloy and two of the experts, and if what you are

20 trying to determine is what he based his knowledge of the

21 damage on, I think that is okay, but anything beyond that is

22 arguably work product.

23 MR. WHITNEY: Yes.

24 Q All I am trying to say is, I am trying to ask

25 you what was the source of the knowledge and what was said

1 only as it pertains to the injuries to Mr. Feldman, or the
2 Arizona Maintenance well.
3 I don't want to know any colloquy between
4 lawyers and anything that the lawyer may have said.
5 A If I remember correctly, the depositions by
6 Mr. Schuman and by Mr. Bartell.
7 MR. WHITNEY: I think it is all right, is it
8 not, to discuss what Mr. Halpenny said, as long as it is not
9 a colloquy between Mr. Halpenny and any of the counsel?
10 MS. HOLLOWELL: To the extent Mr. Heinrichs
11 can remember, and I don't know if he can or not, because you
12 are talking about a year ago and it may be that he remembers
13 better based on listening to Mr. Schuman's testimony.
14 To the extent that he can, that he can recall
15 what Mr. Halpenny described to him about the damage to the
16 well, I don't have any problem with that.
17 Take your time.
18 A Well --
19 MS. HOLLOWELL: I don't want him to guess.
20 A Yes.
21 The best I can offer is that the description
22 as I remember Leonard Halpenny describing it, and that which
23 either Mr. Bartell and or Mr. Schuman described, certainly
24 sounded to me like they were of one and the same subject.
25 Q Okay.

1 A That the descriptions were, to me, identical,
2 verbally.
3 Q And can you tell me what those, how it was
4 described?
5 A It was described as indicating -- these are
6 the government witnesses, in particular -- describing
7 compressional forces were most evident, and by this I assume
8 they were meaning high compressional forces were most
9 evident.
10 Q And from this, based on your expertise, and
11 your years of experience in the field, could you determine
12 where the forces came from, where were they -- vertical,
13 horizontal?
14 A I would visualize tha --
15 MS. HOLLOWELL: Well, wait a second. You are
16 asking him his opinion of what might have been the cause of
17 the damage, just so I am clear?
18 MR. WHITNEY: Yes.
19 Q As I recall the deposition, there was a
20 description of the damage, and I belief it was by Mr. Schumann
21 who had been brought to the scene by Mr. Halpenny, and my
22 recollection is that Mr. Schuman described it as, I believe,
23 again, compressional force, but --
24 A Correct.
25 Q -- but I was just asking this witness, from

1 Mr. Schuman's or Mr. Halpenny's description, and his
2 conclusion that it was compressional, whether it was vertical
3 or horizontal compression that caused the damage.
4 A I would believe, my own opinion, vertical.
5 Q From the top down, or the bottom up?
6 A Correct.
7 Q Now, in terms of seismic testing with
8 dynamite, can you tell me how that would occur, or how you
9 believe it occurred in this case?
10 A I visualize at least two possible scenarios
11 or a combination of two possible scenarios or probable
12 scenarios, and each would be dependent some way on the exact
13 conditions at the well site and around the well itself, in
14 the immediate vicinity.
15 I would include in this the condition of the
16 attachment of the well column and the pump column to the
17 collar of the well.
18 Q That is the part that kind of puts it
19 underground with the surface?
20 A Ordinarily it is the part that all of the
21 material in the well is suspended from.
22 Some wells are cemented in place at depth,
23 and I am not sure about this particular one. I don't recall
24 any mention by anyone of any cementing.
25 Q If it were cemented, would it make a

1 difference in your opinion?

2 A It might. It might make some difference.

3 Q Would you, when you finish your opinion, if I

4 forget, would you tell me what difference it makes, it would

5 make, the cementing?

6 A Well, it would --

7 MS. HOLLOWELL: Well, why don't you -- I

8 think what he is --

9 Q Give me the two scenarios.

10 A The two scenarios are based in part on,

11 again, written testimony, I believe, and depositions that

12 there were, or in one of these two files, which are

13 government files, that sanding had been experienced, and by

14 this I believe they mean the wells had been producing, along

15 with the water, they were producing a certain amount of sand.

16 Q And you took this to have been occurring

17 prior to any seismic testing?

18 A That is my understanding.

19 Q Okay.

20 A Perhaps over some period of time.

21 Q Continue, please, sir.

22 A Obviously, this sand has to come from

23 somewhere, and obviously, the most likely source is from

24 around the well. And in the process of this happening, voids

25 of earth materials, which include the sand, would be removed

1 from around the well, leaving either a total void of nothing
2 but air surrounding the well, or perhaps nothing but water,
3 or a combination of both, and these could be all concentrated
4 in one particular spot near the pump, or they might migrate
5 upward, because the forces of gravity are continual and would
6 be also involved here.
7 Q And it would play some part in the void
8 moving up?
9 A Obviously, you can't repeal the law of
10 gravity. It is always there.
11 Q It is immutable.
12 A Right, and what I visualized happened was
13 things were in a rather sufficiently precarious balance that
14 the motion from the seismic shooting was sufficient to
15 suddenly dislodge material from around the well and cause a
16 total collapse of some kind, which, in turn, dropped the
17 casing, separated it from its collar, and produced the severe
18 compressional damage that was apparently evident.
19 Q Would this occur over a gradual period of
20 time, or would it be a dramatic onset?
21 A It could be either. It could be a
22 combination of those.
23 It could be all suddenly, or it could be a
24 series of things that would be exacerbated by the continual
25 shooting of some farther away, some more or less closer, and

1 so on.

2 I think the primary cause would have been the

3 shot or shots closest to the well site.

4 Q And that has been identified as, and was

5 identified, I believe, in your affidavit, as shot 2-B?

6 A Correct. Plus 2-B.

7 Q What would be the second scenario, sir?

8 A Well, it is really a combination of these two

9 things. The motion imparted by the shot at the shot point

10 that arrived at the well site could be sufficiently intense

11 in terms of total motion, how much movement is involved, that

12 it could have imparted some standing waves into the column

13 which, in turn, might have caused it to separate from its

14 collar. In other words, the collar wouldn't necessarily

15 vibrate the same as the column would vibrate, and especially

16 if the column is at all attached to the ground through the

17 water surrounding it as it would be when you get below the

18 water table, and that that would have caused the separation

19 of the pump column and casing and dropped it to the bottom of

20 the hole.

21 Q Has anyone told you, sir, insofar as what we

22 will call the well number 2 is concerned, whether or not the

23 well was gravel packed?

24 A I don't recall that specific one way or the

25 other.

1 Q Would it make a difference if it were gravel
2 packed?
3 A It might, it might not.
4 Q What would, what part would it play in this --
5 first of all, what is gravel pack?
6 A Well, gravel packing is simply, in the common
7 water well sense, is simply filling the voids around the hole
8 and around the casing with gravel to some degree, either all
9 the way up to the collar, or part way up, or just around the
10 pump, but it varies, depending on whose well it is, and how
11 much they want to spend, and what their objectives are.
12 Q And the gravel packing is for what purpose?
13 A Primarily to collect sand before it gets into
14 the pump column, and act as a filter. Also, to help support
15 the column.
16 Q So that if it was not gravel packed, two
17 things might occur -- you correct me if I am wrong -- A, you
18 might have more sand go in the well, and, B, you might have
19 less support.
20 A I think that is a fair statement.
21 Q These voids migrating upwards, I am a little
22 bit hazy on that.
23 Are you saying that as a result of the soil
24 above falling, filling the void below, that it creates a void
25 above?

1 A I guess I should get you to repeat the
2 question.
3 I think I know what you asked, but I'm not
4 certain.
5 Q Okay.
6 It is my understanding, when we discussed the
7 first scenario of how this well might have been damaged, that
8 you envisioned a situation where the sand had been pumped out
9 leaving a void around the pump casing or column; that as a
10 result of this void, and as a result of the seismic blasting,
11 there may have been a shift of sufficient magnitude to injure
12 the column or the casing.
13 My question -- and I believe you said that
14 the void, because of the laws of gravity, might migrate
15 upward.
16 My question to you then was, was this
17 migration upward created by a collapse in the sand above
18 falling to where now there was no sand and creating above it
19 a void?
20 A I think that is -- it is very difficult to be
21 precise in answering that question.
22 In the first place, the events wouldn't be
23 just one single sudden event, necessarily.
24 It could have been that, but it could also
25 have been just as well a series of events that the

1 culmination of which would be the ultimate and final act of
2 dislodging the casing from its collar and dropping it down.
3 Do you follow what I am saying?
4 It could be either one of those two things.
5 Q Yes.
6 A Now, in connection with the relevancy of
7 gravity is that wherever a void occurs for any reason, the
8 tendency of the material that surrounds the void is for it to
9 arch, because an arch is naturally the strongest structural
10 shape that you can devise, and nature tries to devise it
11 automatically by sloughing off material gravitationally
12 until it reaches an arch.
13 However, if the material is not strong enough
14 to maintain an arch, it can just simply collapse.
15 Now, there could have been one of those, or
16 it could be a series of them, and eventually it could have
17 migrated clear to the surface, which is not uncommon.
18 Q Would all these events be -- you said, I
19 think you spoke in terms of a series of events. Are you --
20 do you feel that they would have occurred by reason of the
21 testing that went on, that took place out there?
22 A They obviously would be enhanced by the
23 testing, obviously. No question about it.
24 Q I take it then they could have taken place as
25 a natural result?

1 A That is a possibility.

2 Q And this compression from a physical

3 standpoint, how would it affect, say, the column?

4 A How would it what?

5 Q How would this falling -- I believe you said,

6 and correct me if I am wrong, I believe you told me that the

7 force to cause the compression would be of a vertical nature.

8 A The vertical forces on the column would be

9 the dropping loose from the collar and eventually a free fall

10 to some constriction point or the bottom of the hole,

11 whichever was reached first, which would have provided the

12 major compressional forces.

13 Q So --

14 MS. HOLLOWELL: Walter, I'm not sure that --

15 either I am misunderstanding Jim's question or you are, which

16 is, I believe -- and, Jim, you correct me if I am wrong --

17 that you are asking him whether or not he believes the

18 compression forces that arrived at the well site were

19 vertical or horizontal?

20 MR. WHITNEY: No, no.

21 I am asking him if the forces that did the

22 damage to the well were vertical or horizontal; and his

23 answer was vertical, because the thing simply dropped, it

24 free fell, and caused a -- would you call it a buckling, or --

25 THE WITNESS: That would be my opinion, yes.

1 MS. HOLLOWELL: But that is a distinct
2 question from whether or not the forces which caused that
3 vertical drop were vertical or horizontal.
4 MR. WHITNEY: Absolutely. No question there.
5 MS. HOLLOWELL: All right. As long as I am
6 tracking along all right.
7 MR. WHITNEY: Okay.
8 Q We were going to go back to the collar. What
9 part would the collar play in this?
10 A The collar would ordinarily be the structural
11 element that holds the pump column and casing in place, in
12 position.
13 Q And if it were cemented, it would be
14 stronger?
15 A Ordinarily it is cement, or sometimes it is a
16 couple of heavy railroad ties, or logs. It can be a
17 combination of things.
18 In this case I understand it was a concrete
19 collar.
20 Q Did you ever see any video tape showing the
21 inside of the well, the damage to it?
22 A No, I did not.
23 Q You have never physically examined the well?
24 A No, I have not.
25 Q Have you identified all the sources from

1 which you have reached the conclusion that there was
2 considerable damage to the well?
3 A Would you like me to summarize by name?
4 Q Yes, if you would, please. Just identify --
5 you have identified, as I understand it, conversations, or at
6 least a viewing by Mr. Schuman with Mr. Halpenny, as I
7 understand it?
8 A Yes.
9 I heard Mr. Schuman's deposition in the
10 attorney's office.
11 I recall Mr. Halpenny's statements.
12 Probably at the same time I recall statements
13 made by the plaintiff, Mr. Feldman.
14 Q As to what he had observed?
15 A And if I am not mistaken, I believe there is
16 a legal document in which he sets forth what he thinks some
17 of his damages were, if I'm not mistaken.
18 Q Do you recall if the damages took place in
19 more than one location of the well?
20 A I don't recall anything specific about damage
21 to anything other than well number 2.
22 That is the only one that I have been
23 personally concerned with.
24 Q And my question insofar as well number 2, did
25 damage occur in more than one area in that well?

A I can't answer that question.

I don't believe --

MS. HOLLOWELL: No. Then don't. Let it go.

A I guess you mean was there damage to the well in more than one place in the well?

Q That is right, sure, underground.

A Well, obviously, if the well separated from the collar, there would be damage there, and if it dropped the whole column to the bottom of the hole, there would be damage there, and that would be two places, simply by simple arithmetic.

So, I guess the answer would have to be yes.

Q Could it occur in three places?

A Conceivably it could have in the middle.

Q It could occur in different components, could it not?

A Yes.

Q The casing, column, or whatever.

A Yes, sure, obviously.

Q Did you look at the hole that this well was in?

A No, I did not.

Q I should have said the well hole.

A Right.

Q You make -- I hate to go back to this, but

1 I'm not clear about it -- you make a statement in your
2 affidavit concerning unconsolidated alluvium. The statement
3 is, "Such material is among the least capable of common earth
4 materials of absorbing and dissipating seismic blasting
5 energy."
6 Is the corollary of that that it is one of
7 the best in transmitting seismic blasting energy?
8 A No.
9 If you change one word --
10 Q What word shall we change?
11 A Seismic blasting motion. There is a
12 distinction between motion and energy.
13 Q And I haven't gotten that straight.
14 Could you -- could we go through it again?
15 A I don't think you have. That is correct.
16 Q Well, can we go through it again, what the
17 distinction is between the two.
18 A Well, energy is the volume and density of the
19 material, and the motion a product of those, and motion is
20 that which leaves out the volume and density of the material
21 involved.
22 In other words, how much movement is there at
23 any given point along the energy train. In other words, you
24 could have this amount of motion, or you can have this amount
25 of motion.

1 Q You are indicating just a slight movement in
2 your hand, or a large swinging motion?
3 A Yes. Motion is motion.
4 Q And how does that affect materials that it
5 might come in contact with?
6 A The more motion, everything else being equal,
7 the more potential for damage.
8 Q And would there be, that material which the
9 motion moves through, would that be affected at all?
10 A The material that it goes through, would that
11 have an effect on the motion?
12 Q Yes?
13 A Yes.
14 Q And would the motion have an effect on the
15 material?
16 A I guess you could say that. It would be a
17 reciprocal effect, yes.
18 Q Your statement also is made as, "Wells, being
19 subsurface structures," on page 3 of your affidavit, "Wells,
20 being subsurface structures, are more susceptible to damage
21 from excessive ground motion caused by blasting than are
22 surface structures such as houses."
23 Can you explain that for me, please?
24 A Do you understand the word "coupling?"
25 Q I do when it comes to railroad cars, but

1 maybe not in this context.

2 A Well, that is a pretty good simile. Railroad

3 cars are either coupled or they are not coupled, and if they

4 are coupled, one will follow the other.

5 If they are uncoupled, they might not follow

6 each other.

7 The fact that the well is in the ground,

8 below surface, and surrounded by materials other than just

9 air, at least in part, ground water, sand, gravels, and so

10 on, that there is an excellent coupling situation between the

11 energy that arrives at the well site through the blasting

12 that was done and is imparted almost completely. In other

13 words, there is very little reflected and bounced off and

14 slides by because the ground itself is moving and it causes

15 the well components to begin to take on, try to take on the

16 same kind of motion.

17 That is the natural thing to happen, and the

18 well, being different material, has a difficult time doing

19 this, because it is composed of iron and steel and tubes as

20 opposed to unconsolidated sand and gravel and clays and so

21 on.

22 Q How did you determine that the material

23 through which this blast traveled, movement traveled, was

24 that, unconsolidated alluvium?

25 A Well, from the experience in the Tucson

1 vicinity in defining the various aquifer basins that exist,
2 and in connection with the Tucson water supply, in my mining
3 exploration efforts, where we are constantly being referred
4 to technical data regarding the materials that are in the
5 surrounding vicinity, and how deep it is to bedrock, and what
6 the bedrock consists of, and that type of thing.
7 Q Did you refer to any of the materials that
8 are furnished, have been furnished, during the course of this
9 lawsuit?
10 A Yes, I did.
11 Q Can you tell me, please, what materials it
12 were that you referred to?
13 A Well --
14 Q I don't mean soil, I mean, you know, written
15 material.
16 A The one that is in the most common context of
17 your question, I guess, would be some profiles relating to an
18 interpretation by Mr. Ackerman in a transmittal to Mr.
19 Schuman, depicting, I believe, his interpretation of the
20 bedrock subsurface and the overlying alluvial material.
21 In addition to that, there are some profiles
22 that show some Bureau of Reclamation drill sites and show the
23 depth of these drill holes in cross section, and indicates
24 there are at least two types of alluvium, as I recall, but
25 the way he described it was unconsolidated versus -- I think

they used the word compressional, in other words, it was already compressed as opposed to that which wasn't compressed.

Q I wonder if you would just go through with me -- it may not be necessary for these to be marked, but if you would go through your notes and materials you brought today and refer to those materials perhaps by date, a letter from whom and to whom it is addressed --

A Okay.

This is a letter dated February 12, 1985, on United States Department of Interior Geological Surveys, mail stop 964, Denver Federal Center, addressed to Mr. Herb Schuman, United States Geological Surveys, Phoenix, Arizona, and signed by Hans D. Ackerman, and accompanying it were two what appear to be computer processed seismic interpretations, one designated SNYD 15, which I believe means Snyder Hill, and the other one, BOP 13, which I think means Bopp Road.

Both of these sections are looking in a northerly direction and note this particular one is marked deposition number 18 exhibit.

Q That shows Bopp 13 and Snyder 15?

A Right.

Q And they are what are kind of a seismic profile which you feel to have been compiled by computer?

A Say again.

Q Which you feel were compiled by computer processing?

A I would assume so, yes.

The notes indicate a zone of cracking or cracks, also indicates different layers of material.

It refers to drill hole T A 44.

Q Can we stop there a moment?

Did you observe, have you seen the logs T A 44; was that one of the things you mentioned as being one of the sources for your opinion?

A No. I have not seen the drill logs from the Bureau of Reclamation drilling.

I have heard casual commentary about the drill results, I believe, in testimony by Herb Schumann, in his deposition, as to the material encountered.

Q Those drill holes, is it your understanding they were made prior to the seismic testing, if you know?

A I don't know. I don't know.

Q Fine, or in aid of the testing?

MS. HOLLOWELL: Again, if you know.

Q If you know.

A I really have no concept of that specific relationship.

Q Okay.

But those logs you did not examine?

1 A No.

2 MS. HOLLOWELL: I believe we just now have

3 them in the office, and neither Mr. Heinrichs nor I have had

4 a chance to go through that.

5 THE WITNESS: Yes. I think we asked for them

6 in the first Interrogatories.

7 Q Sir, when you use the term, when you used the

8 term "dissipation" in the sense of this ground motion, what

9 exactly do you mean; how does it happen?

10 MS. HOLLOWELL: Where are you in his

11 affidavit, Jim?

12 MR. WHITNEY: I am just asking a question.

13 Let's see -- where did it say that -- I am on

14 5 A, and I am at the bottom last three lines. "As a result,

15 energy resulting from the dynamite blast dissipated by a

16 relative increase in motion in the alluvial material."

17 What does the term "dissipate" mean in that

18 context?

19 A Well, let's see if I can think of a suitable

20 simile.

21 I guess it can be commonly philosophized as

22 to what happens to your voice when you utter a sound. Does

23 it go on forever? And you can argue this point yes and no.

24 What actually happens is that the energy that

25 is imparted by the vocal cords onto the gaseous mixture we

1 call air is gradually diminished out in every direction from
2 the point source until it gets totally immeasurable by
3 anything, any ear, or anything that we can build that could
4 measure it, but theoretically it is still continuing.
5 The same with energy from a dynamite blast.
6 It is really sonic energy, just the same as a voice is sonic
7 energy, and it gradually diminishes outward in every
8 direction, and in some cases it deminishes very rapidly,
9 other cases it is diminishing very slowly, and this is
10 dependent on the materials involved.
11 Q In this case it is your opinion that because
12 of the unconsolidated alluvium it was dissipated at a --
13 A It dissipates slower, it takes longer to
14 dissipate because the material is not dense.
15 The material involves a lot of air space, and
16 in the process of trying to be dissipated, it gets all of
17 this material, including the air space, into relatively
18 heavier motion involved, and the motion sops up the energy
19 that is trying to be dissipated as it moves outward from the
20 shot point.
21 Q These movements, are they in a straight
22 plane, or do they tend to go up and down, as well?
23 A It is very complex and the basic answer to
24 the question is yes, they do all of those things.
25 Q Is there any, let's say, is there any

1 difference between the force with which they move, whether it
2 is directly horizontal or up and down?
3 MS. HOLLOWELL: Do you understand the
4 question?
5 A The greatest motion is imparted, as a general
6 rule, by near surface waves.
7 Q The closer you get to the surface?
8 A At the surface is where you may have defined
9 the greatest motion. This is a generalization, now.
10 Q Is the reverse of that the farther down you
11 get, maybe the --
12 A You might get a little less motion as you go
13 deeper, yes.
14 Q What would be the reason for that?
15 A Well, I am not sure I can explain it.
16 Q I can understand the closer to the surface,
17 but I can't understand why it would vary if it were going
18 through the same material the deeper that it got.
19 A Perhaps, and I am strictly guessing here, I
20 don't know that this is necessarily a rigorous correct
21 answer, is that surface material is interfaced with air and
22 air only, whereas the material beneath it is interfaced with
23 rock and rock only. In other words, it is a little different
24 situation at the surface than it is subsurface, just because
25 of the fact we have free air above.

1 Q But it would be interfaced with the same
2 things below the surface no matter what the depth, would it
3 not, provided the material was the same?
4 A If it was homogeneous, that is correct.
5 Q Could this damage to the well have occurred
6 as a result of pumping the sand, since the inception of the
7 well, out to cause these voids and the type of collapse you
8 have described to us --
9 A Is your question --
10 Q -- without the seismic blasting?
11 A -- could the well have been damaged itself,
12 is that what you are saying?
13 Q Yes.
14 A I would think so. That is possible.
15 Q Would this process take some time, from your
16 knowledge of the materials and knowledge of the well itself?
17 MS. HOLLOWELL: What process?
18 Q The process where it would be sanded up,
19 create these voids, and have the collapse which we are
20 speaking of?
21 A I don't think, unless you were conducting
22 quantitative measurements, there would be any way of
23 predicting the time factors involved.
24 In other words --
25 Q It would have to be some period of time,

1 would it not, I mean, just to move that much material?
2 A Probably.
3 Q What was it that made you believe that this,
4 the damage to the well, occurred by reason of the blasting,
5 as opposed to a gradual creation of these voids.
6 A Simply because of the distance the shot was
7 from the well site and the amount of explosive that was
8 allegedly used at the shot point.
9 Q Now, what was the distance that you used in
10 this opinion, sir?
11 A I don't have --
12 Q Let me stop you, before I lose it -- I will
13 forget the question.
14 There was nothing in the description of the
15 damage to the well that you heard or read which would
16 indicate that it was more probable that the damage occurred
17 more probably as a result of the blasting than as the result
18 of a gradual sanding of the well?
19 A Simply the timing of the evidence. In other
20 words, here we have a well that is presumably pumping in some
21 fashion, and then we have a shot, and all of a sudden we have
22 a well that is not pumping at all.
23 The coincidence seems pretty obvious.
24 Q But that would be your only -- it wasn't
25 anything from physical descriptions that you received of the

1 well or the column or the shaft or what have you?

2 A I can't imagine how you could grasp an entity

3 of energy and identify it and say this is the energy that

4 came from that shot, and this is the energy that dislodged

5 the well from its casing. I can't.

6 Q I am not suggesting to be that esoteric, sir.

7 I am much more crude.

8 What I am asking you is there was no shearing

9 or anything that has been described which might indicate a

10 horizontal force which could be attributed only to blasting?

11 A I am not aware of any.

12 Q So, what you are saying is, and you correct

13 me if I am wrong, that the damage to the well, as you

14 understand it, is consistent with either a gradual erosion of

15 the sand surrounding the well, or with this collapse by

16 reason of the seismic blasting?

17 MS. HOLLOWELL: I think that mischaracterizes

18 his testimony.

19 You asked him was it possible that --

20 MR. WHITNEY: I am asking if it is

21 consistent.

22 Q We are not talking about times, or distances,

23 or anything, just the two facts.

24 A To me it is quite consistent.

25 Q All right.

1 Now, let's get to the distances.

2 A Let me go back to your question on shearing.

3 I think there has been some attempt to

4 associate direct shear wave energy which is produced by

5 dynamite blasting and a shearing effect on the pump column.

6 Now, if there was such shearing, I have not

7 been made aware of it. However, I can visualize some

8 shearing between the pump column and the casing and the

9 collar. In other words, you are getting into some pretty

10 fine points of mechanics here as to how they were attached to

11 each other and how they might have separated, and in the

12 process it is very possible that a bolt did in fact shear in

13 the mechanical terminology, but I don't visualize that

14 specific shear energy imparted directly by the blast and

15 directly onto the well casing sheared the casing, or

16 anything like that. I don't visualize that.

17 Q And you are envisioning what you have

18 gathered from the statements and so forth?

19 A I got the impression that someone, and I am

20 not sure who, was trying to visualize that as a possibility,

21 and I think it might have been Mr. Bartell or perhaps Mr.

22 Schuman.

23 Q And you don't --

24 A I don't visualize that.

25 In other words, I would disagree with them.

1 I don't think that that specific type of effect was in fact
2 involved.
3 Q It is -- what we have gotten down to is the
4 collapse of this whole unit by --
5 A Or a series of collapses of a series of
6 units.
7 Q -- at different points in time?
8 A Correct.
9 Q Now, let's get back to the blast itself.
10 You were telling me why you felt that it was
11 the blast as opposed to a gradual eroding of the supporting
12 material around the well that caused the well to collapse, or
13 to lose its support.
14 A That was a question -- it sounded like a
15 statement, to me.
16 Q No, no. It started out as a question, it
17 might have ended up a statement.
18 Can you respond to it?
19 MS. HOLLOWELL: I don't think there is a
20 question.
21 Q Why is it you think this was blasting?
22 We started to get into that, then I
23 interrupted you. It was something about distance.
24 A Well, certainly the amount of explosive
25 allegedly used and the scaled distance that the maps indicate

1 of an eight to nine hundred feet -- Mr. Raymond, in some of
2 his correspondence, I believe in one of these files, said
3 eight hundred feet -- the way the map was drawn that I was
4 given, I scaled it off and it is nine hundred feet -- but, in
5 either case, the alleged 30 pounds of explosives at nine
6 hundred feet is definitely within the realm of potential
7 subsurface structural damage.
8 Q Now, I take it from your affidavit, and,
9 again, I am referring to paragraph C of -- I'm sorry --
10 subparagraph C of paragraph 5 on page 3 -- and in there you
11 make the statement, "The possibility of severe damage from
12 blasting in such alluvial material has been recognized in a
13 number of publications." And you include the United States
14 Bureau of Mines Report 8507.
15 Can you give me, please, did you bring with
16 you those other publications?
17 A I brought that particular one, yes.
18 Q This report 8507, which has been marked as
19 Exhibit 4, I wonder, sir, if you can tell me what chart it
20 was, or charts, that you relied upon in reaching the
21 conclusion that the blast from that distance, the amount of
22 the dynamite charge, caused the damage to the well?
23 MS. HOLLOWELL: If you relied only on charts,
24 that is fine, you can tell him.
25 If you relied on essentially the entire

1 treatise, I think, you know, I don't want you to answer the
2 question too narrowly.
3 A Actually this is the most reliable and most
4 recent rigorous update of the subject of the damage that
5 blasting imparts on various kinds of structures. It is one
6 of a series that date back to, I believe, the early 1940's
7 that have been produced by the United States Bureau of Mines,
8 and they all together relate a series of experiments and
9 studies in trying to quantify this problem.
10 For many years the results indicated in the
11 earlier studies talked about peak parcel velocities of two
12 inch per second or less as probably not imparting very much
13 damage on surface structures and particularly surface
14 structures in ordinary sedimentary rocks.
15 If you were in igneous rocks it would be
16 less.
17 If it was in unconsolidated materials, it
18 would be more.
19 This study, this particular study has
20 indicated that the earlier studies were perhaps somewhat too
21 liberal in a number of particular cases.
22 Q Could you tell me -- summarize.
23 A Its relationship I have highlighted in their
24 abstract, and on two different pages or three different pages
25 here, and I can read you these if you want to put them in the

1 record.

2 Q Yes, please.

3 A It says, "Safe levels of ground vibration

4 from blasting range from point five to two inches per second

5 peak ~~parcel~~ particle velocity for residential type structures."

6 "The damage threshold values are functions of

7 the frequency of the vibration transmitted into the

8 residences, and the type of construction."

9 "Particularly serious are the low frequency

10 vibrations that exist in soft foundation materials and are a

11 result from long blast to residence distances."

12 Q Can we stop there?

13 What do they mean long blast to residence --

14 they mean long in length or duration?

15 A They mean that the distance is not relatively

16 a short distance, in other words, not very close, but out

17 some distance away. In other words, what they have found is

18 that some of this excessive ground motion can continue for

19 very long distances through unconsolidated materials, and if

20 it does, the chance for it to impart considerable damage is

21 enhanced by the simple fact that it is continued to be

22 transmitted.

23 In other words, it goes back to your constant

24 questioning me about what is the precise physical mechanism

25 that allows unconsolidated materials to impart more motion

1 than highly consolidated or very hard materials, and it is
2 part and parcel of the same phenomenon.
3 Now, I can't, I don't understand it well
4 enough to give it to you in hard mathematical and physical
5 terminology. These students could.
6 Q To what type of medium were these studies
7 directed?
8 A These studies were on different kinds of
9 medium. This particular one, this one is all related to
10 quarries, in other words, surface mine blasting, limestone
11 quarries, coal mines, that type of function.
12 Q They would be the more harder material, would
13 they not?
14 A It would be harder material, right.
15 Q Than the unconsolidated alluvium?
16 A Yes.
17 Q That's where those statements are directed
18 at?
19 A They are directed at both. In other words,
20 everything they did, their results were in hard material, but
21 they have attempted to extrapolate from previous data and
22 other work they have done as to what the relative effects
23 would be.
24 The results have changed the criterion from
25 this two inches per second as having been accepted by a

1 number of states and foreign countries as being an a fair
2 general criterion to rely on, to a tenth of an inch per
3 second peak parcel velocity.
4 So, they have changed it 20 times, you see.
5 And this gets into factors that they are
6 bringing in, new factors they find are more relevant all the
7 time, such as frequency. They knew frequency had some
8 effect, but they weren't able to quantify it at first. Now
9 they are better able to do that.
10 And they find that within a certain
11 relatively low range of frequencies the peak parcel velocity
12 can be considerably greater than in the much higher
13 frequencies. Same amount of energy, either way, in other
14 words.
15 Q Would one then carry farther than the other,
16 is that the point of it?
17 A It might carry farther, yes. In other words,
18 you have a combination of factors involved, and depending on
19 exactly what the factor is you are dealing with, why, you may
20 have to cut down considerably on what has been customary to
21 do in the past. In other words, the criteria are becoming
22 more stringent.
23 MS. HOLLOWELL: Jim, I hate to do this, but I
24 have to make a phone call.
25 Can we take a break?

MR. WHITNEY: Sure.

(Whereupon there was a recess.)

Q So, the ground motion is measured in inches, is that correct, sir, ground motion over a certain period of time?

A It can be.

Q Is that what the study is doing here?

A The studies have focused primarily on what they call peak ~~parcel~~ particle velocity.

Q All right. Now you have lost me, how would that work. What does it mean?

A It means how fast is -- what is the acceleration motion of a particular parcel at a particular point, and what is the amount of movement. In other words, they have set up tables and these tables talk about an area of damage potential, less damage potential, greater damage potential, depending on the peak ~~parcel~~ particle velocity at the point of impact.

Q And through these studies they have moved back the places where dynamite should be?

A This particular study moved it back some 20 times in the instances of low frequency unconsolidated material type situations.

Q Are there any standards in the industry as such -- I notice you mention that in your affidavit.

1 A In the seismic industry?

2 Q Yes. I would gather that from your

3 affidavit.

4 A Well, that would be what I would be referring

5 to. It would be the seismic industry, and there are

6 standards, yes.

7 Q Could you tell me where one would find those

8 standards; by standard I mean something that is generally

9 accepted in that realm of activity, seismic industry?

10 A The Bureau of Mines work is probably as

11 standard as anything.

12 Q And that is something that everyone refers

13 to?

14 A Sooner or later, as a rule, yes.

15 Q Those calculations that are made refer to,

16 would refer to general sites, would they not, as opposed to --

17 we wouldn't expect to find them site specific in this

18 particular instance, would we, unless somebody made a study

19 out there on Bopp Road?

20 A I am not sure I understand what you are

21 saying.

22 Q What I am saying is that these standards that

23 are given in this bulletin and in other Bureau of Mines

24 material are general standards.

25 My question is would the standards vary if

one had a specific site?

A It could.

Q And what would be the basis or bases upon which this variance would occur in the site specific?

A The variations that I have repeated several times now, the frequency involved, and the type of material involved, and the type of structure involved. Those are three very fundamental factors.

Q Does that Bureau of Mines study that we have been referring to, does it deal with wells at all, underground surfaces?

A Not specifically, no.

Q Is it mostly designed towards the above-ground structures?

A It was on above-ground structures that they concentrated their effort on, because those are the things that they had the most problem with around the particular mines that they were using as a --

Q Quarries and the like?

A Yes.

Q Where it would be surface to surface kind of, as opposed to --

A That is a fair characterization, yes.

Q Can those figures be extrapolated to subsurface to subsurface?

1 A They have been, yes.

2 Q Can you give me some publication in which

3 that has been done?

4 A This particular one refers to subsurface

5 structures in a general way, or in an indirect way.

6 There is another they are talking about, the

7 time and frequency properties of mining blasts -- this is

8 page 5 -- and the statement is made, thick soil overburden,

9 which is what we are dealing with in the case of Feldman, as

10 well as long absolute as opposed to scaled distances create

11 long duration low frequency wave trains. This increases the

12 response in damage potential of nearby structures.

13 Now, they don't differentiate between surface

14 and subsurface structures. They just say structures.

15 Q So, you are inferring from that that they

16 deal with both?

17 A Correct.

18 Q You attached -- I can't read most of it -- to

19 your, or, it was attached, let's put it that way, a chart

20 called general guidelines, charge size versus offset from

21 various structural classifications, and I have marked that as

22 Exhibit 3, and ask you if you recognize that?

23 A Yes, I do.

24 Q That is what is specifically referred to in

25 your affidavit, is it not?

A I believe so.

Yes. It is in the same paragraph, page 3, chart.

Q This refers to, as I understand your affidavit, somewhere in here, dynamite in the realm of from eleven to fifty pounds, is that correct?

A That is correct. This is in this column here.

Q And what particular area of the country did you refer to?

A The closest one analogous to Arizona, which is the west Texas, northern Mexico, east slope, and the Texas panhandle.

It just happens to be an area where they do seismic work.

Q Would you mark it out for me?

A Pardon?

Q Just put a circle around where you got it.

A Sure.

Q Would there be more movement, I assume there would be, but what would be the difference between the ground movement created by eleven pounds of dynamite and 30 pounds or 50 pounds of dynamite?

A What would be the difference?

Q Yes?

1 A Well, it would be --

2 MS. HOLLOWELL: Are we assuming everything

3 else constant -- it seems an awfully broad question.

4 Q Let's deal with specifics. Let's say the

5 difference between eleven pounds and 50 pounds in

6 unconsolidated alluvium that one would find along Bopp Road

7 in Pima County, Arizona.

8 A It would be approximately five to one.

9 Q Would that have any bearing on the distance

10 that one should set the charge; would it be safer to put a

11 charge containing eleven pounds closer to an underground

12 structure than 50 pounds?

13 A What the charge is indicating is the

14 variations of site specific conditions that you are liable to

15 encounter.

16 Q Can we go into that; would you explain it,

17 please?

18 A It means that in some conditions the distance

19 that is cited for this particular kind of structure and this

20 particular area -- and in this case we are dealing with

21 bedrock, we are not dealing with unconsolidated alluvium --

22 will be a certain distance, and if you want to be on the safe

23 side, you don't want to shoot over eleven pounds at that

24 distance from such a structure without subjecting yourself to

25 the potential of damage to that structure.

1 Now, however, there are conditions where you
2 might shoot as high as 50 pounds and get away with it, if you
3 are lucky. That is all they are telling you there.
4 Q What would those conditions be?
5 A They'd be conditions which are more stringent
6 than the conditions would be at eleven pounds shot.
7 In other words, the alluvium might be less
8 consolidated.
9 Q These areas, west Texas, you know, the
10 panhandle, and so forth, from your experience, you believe to
11 be, of all those areas listed, the most similar to the area
12 around Bopp Road?
13 A I would say most similar to the area around
14 Tucson, Arizona, which would include Bopp Road, of course.
15 Q You mentioned in your previous statement -- I
16 didn't want to interrupt you -- something about bedrock.
17 Now, what did that, where does that come into play?
18 A Most of the seismic shots, where they can,
19 particularly in reflex seismology, you attempt to get below
20 what is called the weathering layer with your shots, and the
21 reason for that is this business of coupling allows you to
22 use less dynamite and get more energy in the process back to
23 the receiver.
24 Q So that the shot would not go up into the
25 air?

1 A That is correct.

2 Q You mentioned also in your affidavit that --

3 I am on page 4, paragraph D -- given the existence of

4 culture. I have heard that expression used, the word

5 "culture."

6 When you used that in your affidavit, what

7 were you referring to?

8 A I had been referring to power lines, pipe

9 lines, subdivisions, ranch houses, trailer courts,

10 residential subdivisions, anything manmade and privately

11 owned.

12 Q And you indicated that when you have the

13 existence of those things, that you should first conduct a

14 test with test blasts with a vibration recorder.

15 A If I were conducting continuous surveys of

16 the sort that the government has been conducting on the

17 Central Arizona Project, I would do that, yes.

18 Q Did you do so when you did the work for -- I

19 have forgotten the name of the company -- which you assumed

20 to be part of the Central Arizona Project?

21 A No, I did not.

22 Q Was there a particular reason for it?

23 A Yes. We weren't using explosives.

24 Q That is right. You told me you used a sledge

25 hammer, was that it?