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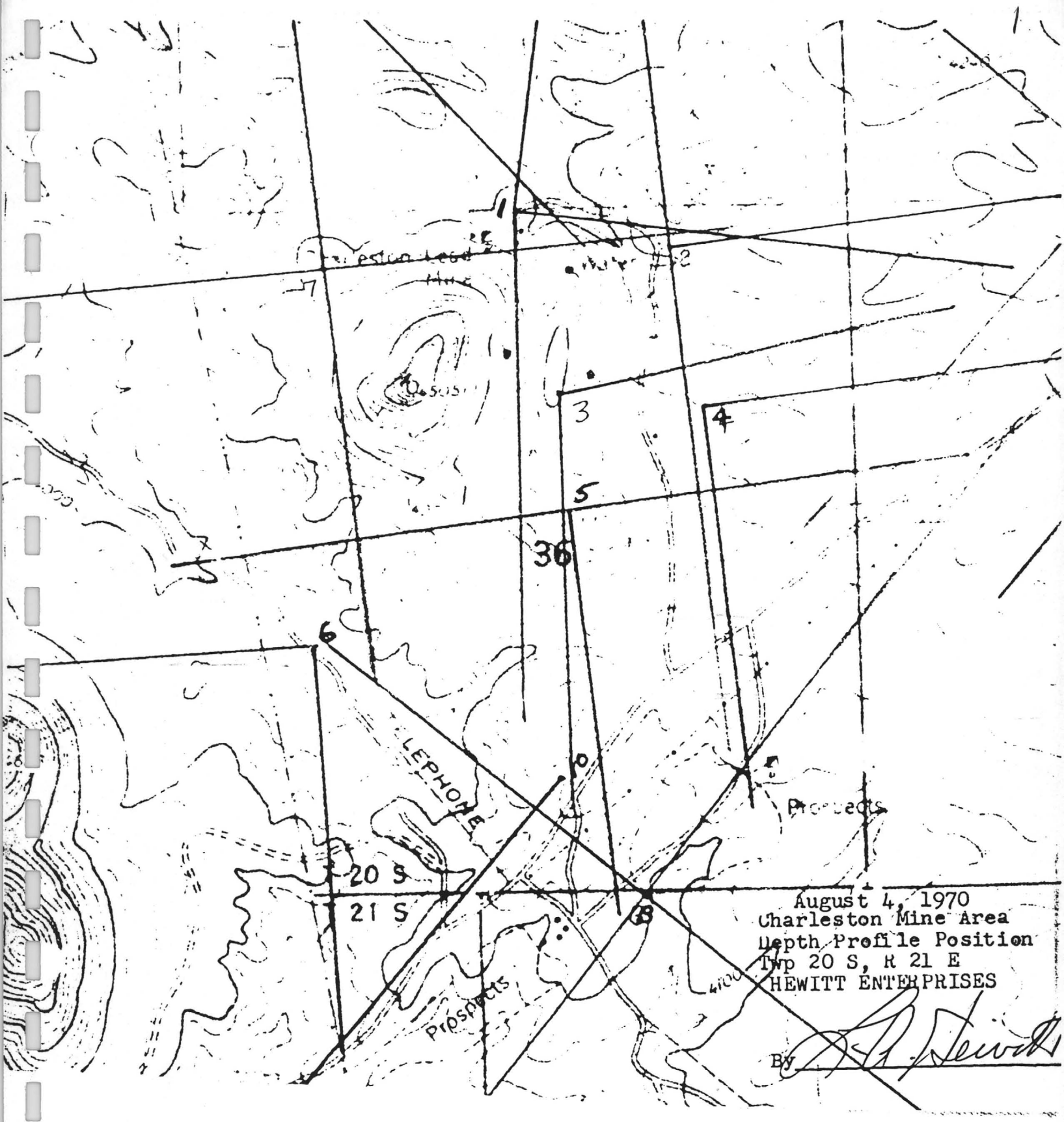
TOMBSTONE MINING DISTRICT
Cochise County, Arizona

Charleston Mine
Geology/Geophysics
(In area of Mutual Interest)
Reports, Correspondence &
Misc.

Tombstone
Block
Reps

HEWITT I.A.
CHARLESTON


1
2
3
4
5
6
7
36
20 S
21 S
LEPHONE
Prospects
Prospects
August 4, 1970
Charleston Mine Area
Depth Profile Position
Twp 20 S, R 21 E
HEWITT ENTERPRISES
By

Bear Creek 2
Inco

REPORT ON I.P. SURVEYS

ON CHARLESTON MINE

January 14, 1970

It is very difficult to draw definite conclusions concerning the cause of the I. P. anomalies in the vicinity of Charleston Mine as very little is known about:

(a) the survey technique
(b) the line direction
(c) the line interval
(d) the spacing of readings
(e) the electrode configuration

and nothing is known about the instrument that was used.

However, if we assume

1. "A" on the 3,200 foot depth (?) map refers to electrode spacing
2. The northeast trending lines on the 1,000 foot depth (?) map are the lines read
3. That the numbers marked on these lines are I. P. readings
4. That the reading interval is the same as the indicated depth (?) and the same as the electrode spacing (as can be inferred from the 1,000 foot depth map)
5. The two surveys were conducted by competent people and/or at the same time

Then the strong anomaly (over 30 units, possibly millisecs) is probably a one reading anomaly and thus suspect. If it is a one reading anomaly, this may explain why lines and readings were not put on the 3,200 foot depth (?) map.

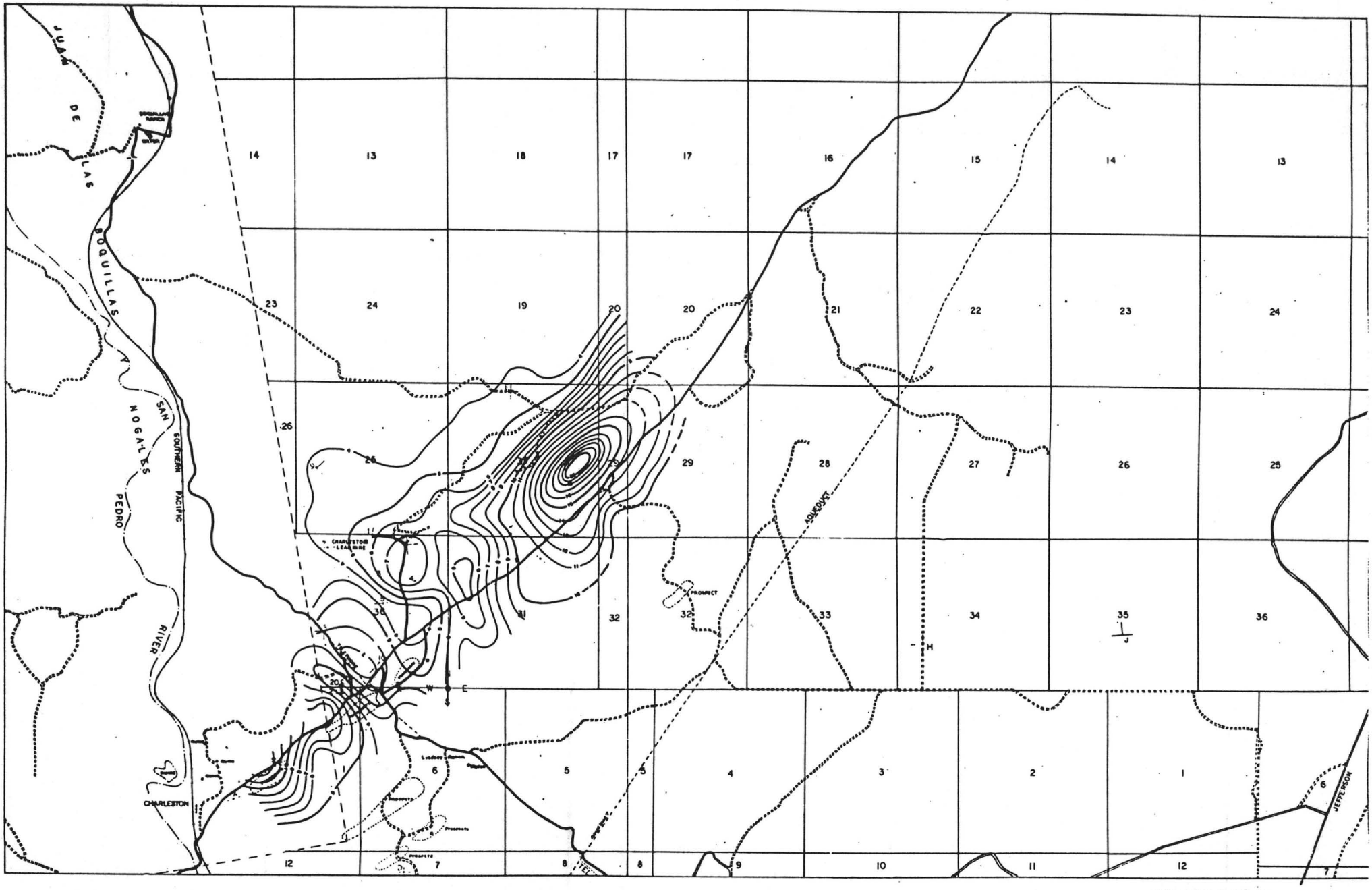
However, if we assume that the strong anomaly on the 3,200 foot depth (?) map is a valid anomaly, it must be caused by something at depth as readings of this magnitude do not occur on the 1,000 foot depth (?) map in the same vicinity.

What is meant by "at depth" in the previous paragraph is related to the instrument, electrode configuration, and electrode separation and thus is very difficult to comment on.

However, I would expect something in the order of 700 feet to 2,000 feet. Again, this conclusion is partly based on the assumption that the lines read in the field are those shown on the 1,000 foot depth (?) map.

If holes two and four were spotted on the basis of the I. P. results, it is surprising that at least one hole is not located in the centre of the anomaly.

The strong I. P. anomaly on the 1,000 foot depth (?) map appears to be a valid anomaly as several anomalous readings are recorded. This anomaly may warrant drilling. Again it is surprising that some of the drilling was not performed in the vicinity of this anomaly, if the drilling program was based, at least in part, on the I. P. results.



TOMBSTONE – CHARLESTON PROJECT
INDUCED POLAPIZATION CONTOURS
"A" = 1000'
SCALE 1" = 1000'

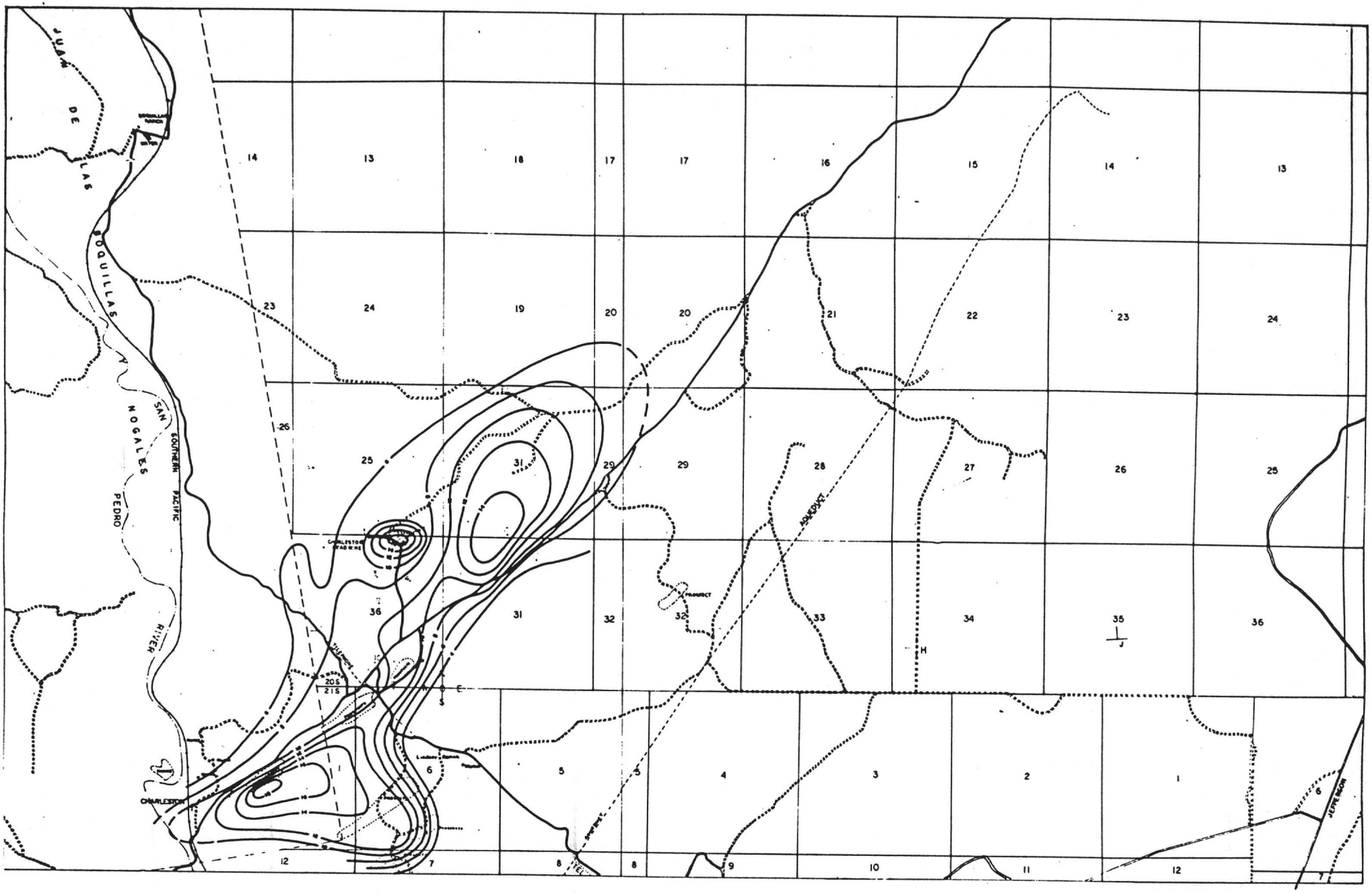
TRUE NORTH
MAGNETIC

SCALE 1:24000 1 2,000

1 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000

4

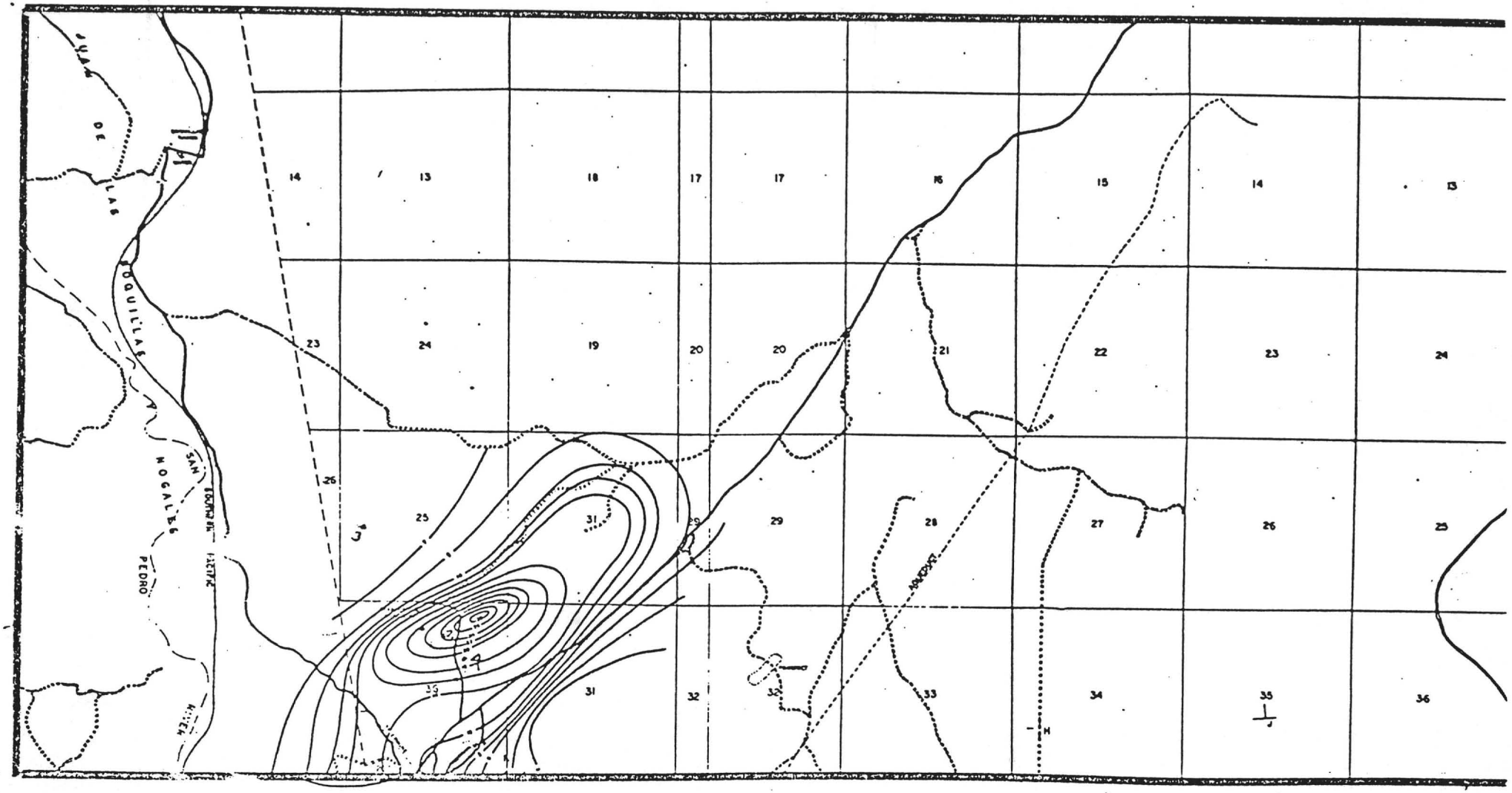


TOMBSTONE – CHARLESTON PROJECT
INDUCED POLARIZATION CONTOURS
"X" = 2000'
SCALE 1" = 1000'

TRUE NORTH
MAGNETIC

SCALE 1:24000
1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000

5

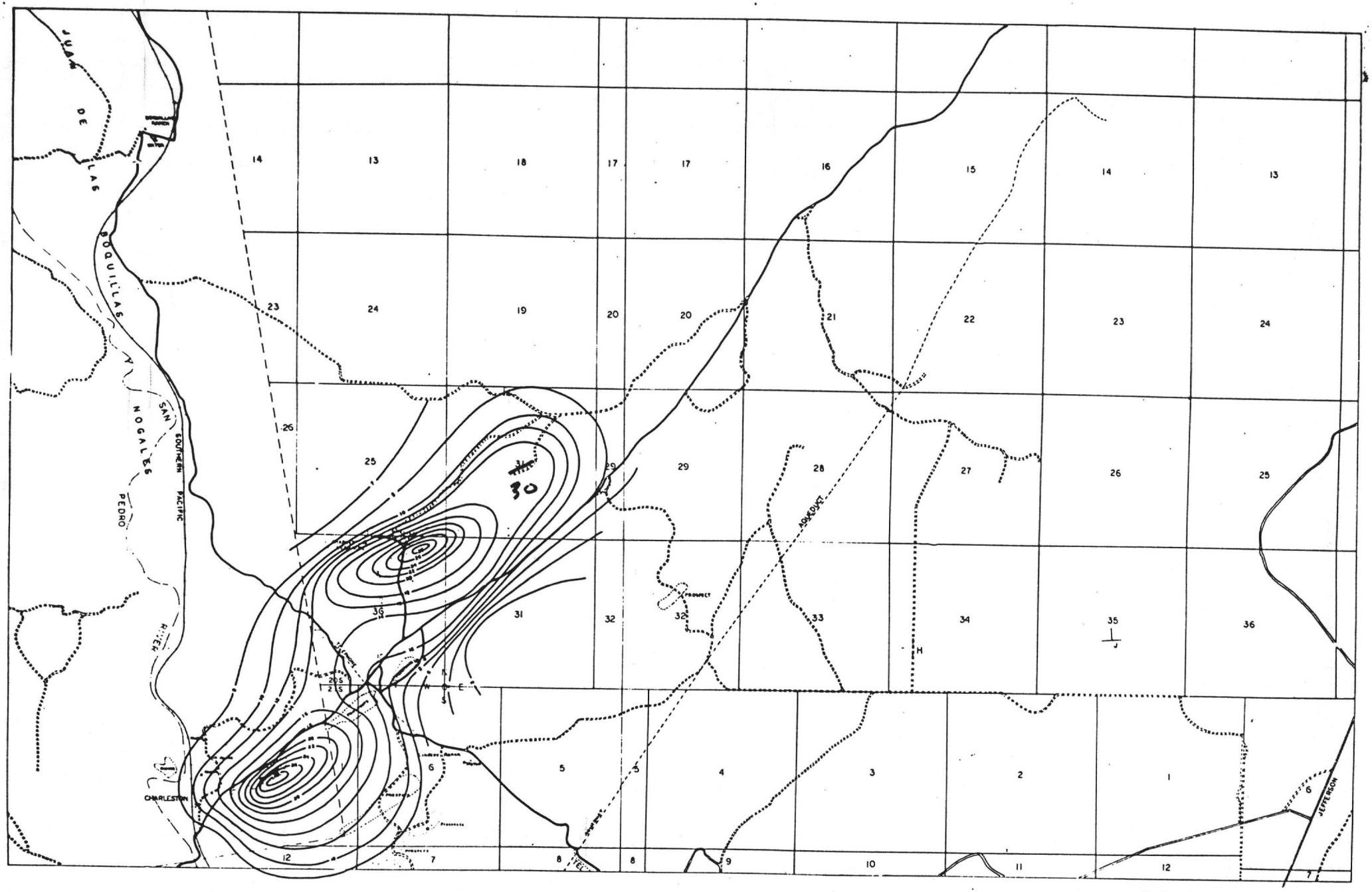


TOMBSTONE - CHARLESTON PROJECT
INDUCED POLARIZATION CONTOURS
"A" = 3200'
SCALE 1" = 1000'

TRUE NORTH
MAGNETIC

SCALE 1:24000

9



TOMBSTONE – CHARLESTON PROJECT
INDUCED POLARIZATION CONTOURS
"A" = 3200'
SCALE 1" = 1000'

TRUE NORTH
13°
MAGNETIC

SCALE 1:24000
1 0 1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000
0

7

RECEIVED
AUG 14 1969
JAMES STEWART COMPANY
PHOENIX, ARIZONA

CHARLESTON MINE AREA

TOMBSTONE, ARIZONA

During May and June, 1969, a geophysical survey was conducted in the Charleston Mine area. This survey was subsequent to an earlier test (note March 11, 1969, tests at Charleston Mine area). In the earlier test, a penetration depth of 1,000 feet was not sufficient to penetrate sulphides believed to lie below this area.

The survey area of interest includes Sections 19, 20, 29, 30, 31 and 32, Township 30 S, Range 22 E; Sections 5 and 6, Township 31 S, Range 22 E; Sections 25 and 36, Township 30 S, Range 21 E; and part of the Boquillas land grant west of Sections 25 and 36.

Generally of interest is a pediment area approximately six miles southwest of Tombstone, Arizona. Several hills rise abruptly from the pediment. One of these hills at the Charleston Mine is called "Gum Drop" locally. The hill is primarily quartz latite and andesite, underlain by older volcanics and metasediments. West of "Gum Drop" lie several more hills within the Boquillas land grant. Earlier mapping by USGS and cursory examination, indicate these hills to be composed of Uncle Sam porphyry. Most of the low lying areas are mapped as volcanics. However, in the mine area some sediments are observed. West of Bronco Hill, to the south, several granodiorite ridges are seen.

From the regional magnetic map, the Charleston Mine area appears to be an embayment of sediments and volcanics between two large intrusive masses. One mass to the east underlying the entire

Tombstone district appears to be granodiorite. The other intrusive mass of granodiorite lies to the west in the San Pedro river valley. This intrusive is exposed in several low mounds west of Bronco Hill. The sedimentary section in the Charleston area may be noted as a magnetic low on the aerial magnetic map. Diamond Drill hole No. 2 shows the sedimentary section to be at least 3000 feet thick near the Charleston mine.

From surface evidence, the rocks noted as Bronco Volcanics, rather than being a distinct member, may in part be a hydrothermally altered meta volcanic. Within this altered area numerous mineralized shear zones, quartz veins, quartz manganese veins and sericite zones are noted. The general trend of these structures is North 45° East. Initial geochemical tests indicate the quartz veins and near vicinity to have abnormally higher values in copper, lead, zinc and silver; whereas, the pyrite and sericite zones contain minor amounts. It would seem that several stages of mineralization and alteration have taken place in the area under investigation. The sericite and pyrite are probably the most recent of any hydrothermal activity in the area and may be the least significant economically.

Drill Hole #2 Analysis

Drill hole #2 gives an excellent analysis of what rocks exist in the sedimentary embayment of interest. From the core log it appears that the altered volcanic section is approximately 800 feet thick. These volcanics are highly altered with many bleached zones, some sericite and silicification. Mineralization with pyrite etc. appears to be minor. No economic minerals of importance seem to be present in the volcanic section.

The sedimentary section from 800 to 3000 feet are primarily bedded quartzites, silt stones, tactites and arkose. Much hydrothermal alteration is present. The bedding plane is approximately 50° to the core axis.

Many sections of interesting mineralization are encountered in drill hole #2, note enclosed log and assays. The following sections are felt to be significant:

1005 - 1008	1850 - 1854
1028 - 1032	2261 - 2272
1175 - 1185	2515 - 2526
1726 - 1737	2947 - 2961

The above sections are noted for their lead, zinc, or copper content or the combination thereof. It is thought to be significant that zoning appears to be prevelant downward. This is based on the increasing copper to lead zinc ratio. An 1820 foot assay for Au and Mo is noted. These values added to the copper or lead zinc would be significant. It is felt that the gold and molybdenum values should exist in the zones herein mentioned. Assays in these sections would be warranted.

Drill Hole #1

At drill hole #1, the volcanic section appears to be about 330 feet thick. The bedding is more nearly 60° average to the core axis. The sedimentary section in this hole is very similar to that in hole #2, except the alteration associated with the mineralization is less intense. Sericite is most abundant. Logs and assays for hole #1 are included in this report.

Geophysical Survey

On the basis of stated preliminary assumptions, induced

polarization and resistivity surveys were conducted in the area of interest. This consisted of two preliminary lines, note L. A. Hewitt report March 11, 1969. Four other traverse lines Tr 1, Tr 2, Tr 3 and Tr 4 were made over the area of interest. These four traverses cover about 70,000 feet, using a nominal depth penetration of less than 1000 feet. Ten depth profiles were also made in the area of interest.

The 1000 foot depth traverses were made primarily to ascertain the general distribution of shallow sulphides. Three anomalies were found which are probably related to sulphides. (A, B, C.) Anomaly A is coincident with a very strong altered and sheared zone in andesite. Abundant sericite is noted along with many fractures containing limonite. filling. The altered zone bears approximately North 45° East. A width of 2000 feet and a length of 3000 feet is probably a good estimate of the anomalous source limits. The depth to sulphides on this anomaly is probably less than 200 feet, 2% sulphide is estimated. Several rock samples over this anomaly suggested that the sulphide mineral is predominately pyrite.

Anomaly B, like A, lies on a strong sheared and altered area striking approximately North 45° East. Like anomaly A, there ia abundant sericite and limonite. The depth to sulphides on this anomaly is estimated to be less than 200 feet also, 1% sulphide is estimated. Associated with the altered zone underlying anomaly B are several quartz veins bordering the south edge of the shear. Copper minerals, principally oxides, are associated with these quartz veins. Geochemical samples over zone B contain anomalous amounts of copper. The copper values probably are associated with copper minerals in the quartz veins, rather than with the pyrite mineralized altered zone.

Anomaly C is a small anomaly at the Charleston Mine. This anomaly appears to be associated with pyrite mineralization seen in the old workings and in drill hole #1.

Ten depth profiles were conducted to determine the presence of sulphides in the sedimentary section below the volcanics. The profiles were made with a two array system in order that maximum depth penetration might be realized. All depth profiles, with the exception of DP3, indicated the presence of polarizable material. It is believed that the predominate effect is related to metallic sulphides, primarily pyrite. After examination of the core and the contained mineralization, it is realized that the curves will not fit theoretical plots for a homogeneous medium. The mineralization is very heterogeneous and therefore field curves are at best a good approximation, as far as depth calculations and sulphide percentages are concerned. The following is a depth estimate and percentage estimate for different probes. The percentages are based on an infinite depth to the bottom of sulphides.

Probe No.	Depth	Percent Sulphides
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#6	800 feet	1% increasing south
#7	700 feet	1 to 2%
#8	200 feet	1% or less, deep section cannot be determined
#9	300 feet or less	less than .3%
#10	500 feet	1%

It appears that section 36 and southwestward is the principle zone of interest. In the area outlined, a deep zone of sulphides seems to be present. It is probable that this deeper zone of sulphide mineralization is confined to a sedimentary section, which has been highly altered and heavily mineralized locally. Though the sulphide percentage estimates seem low, it is of little significance, considering the type of potential ore body that might exist.

It appears from the geologic data, drilling results and geophysics that an area of mineralization has been found. The fact that a large area may be mineralized is of importance. However, we cannot construct a geologic picture sufficiently good to give us specific drilling targets. Based on what we know, it is required that a hole or two be drilled in the area southeast of DDH#2 and possibly southwest. In order that we test this mineralized zone and yet geologically tie to DDH#2, a drill hole is recommended somewhere between Depth Profiles 4 and 5. The hole should be designed to drill at least 1000 to 2000 feet into the mineralized sediments. If indeed DDH#4 encounters economic mineralization it appears a definite pattern be planned to utilize geophysical hole probing to better guide a continued effort. Based on the outcome of DDH#4, it should be considered that holes 1, 2, and 4 be kept open for logging purposes with plastic pipe.

This property is probably typical of a new generation of prospecting in North America. Exploration for new deposits at the depths considered here taxes our present technology to the limit. However, the need for, and possibilities for, new deep seated deposits is high and should be rewarding.

HEWITT ENTERPRISES
by L. A. Hewitt

Update previous rough Draft. 14

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PHOENIX, ARIZONA

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TOMBSTONE, ARIZONA

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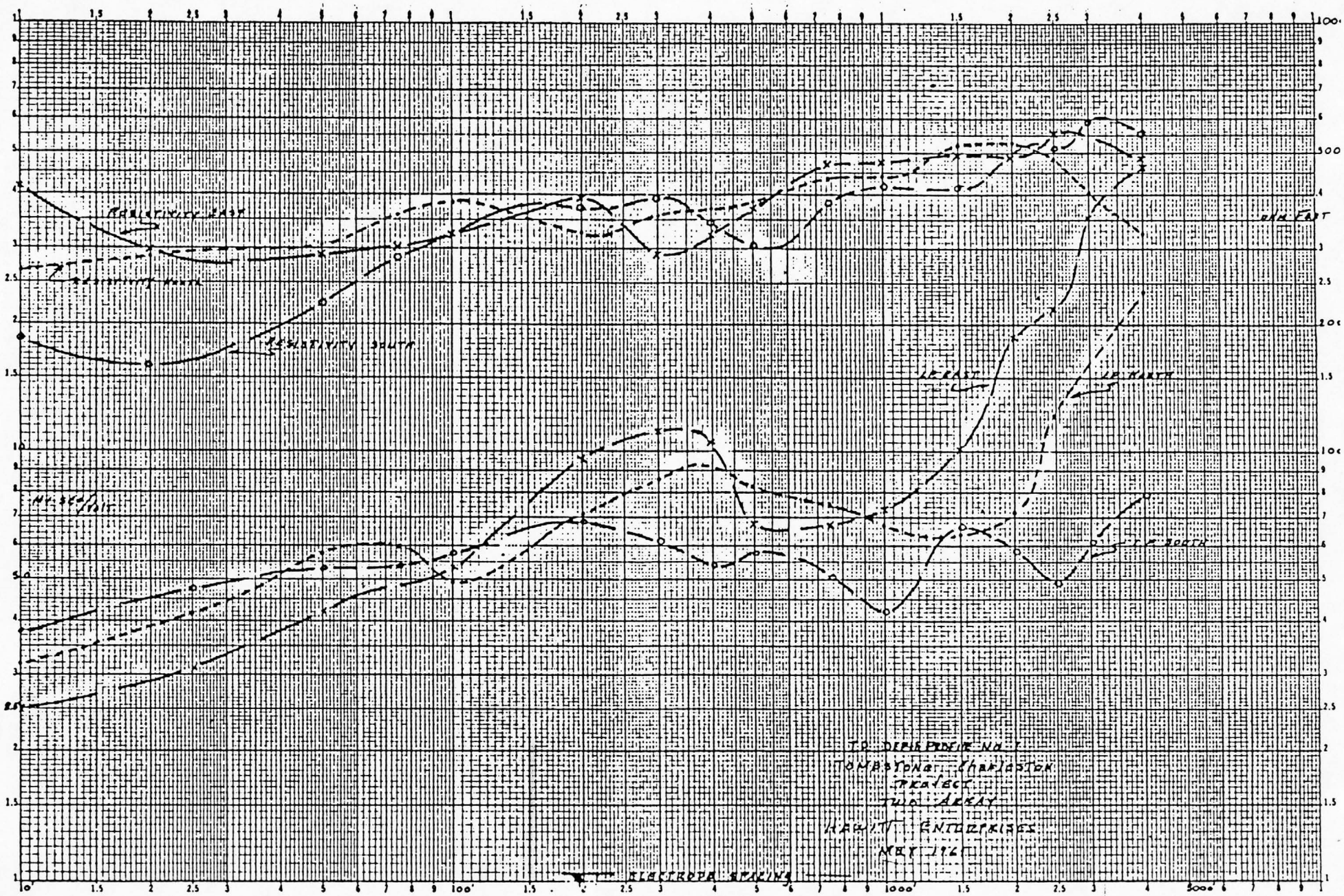

K+E LOGARITHMIC 47 7323 3 CYCLES KEUFFEL & ESSER CO.

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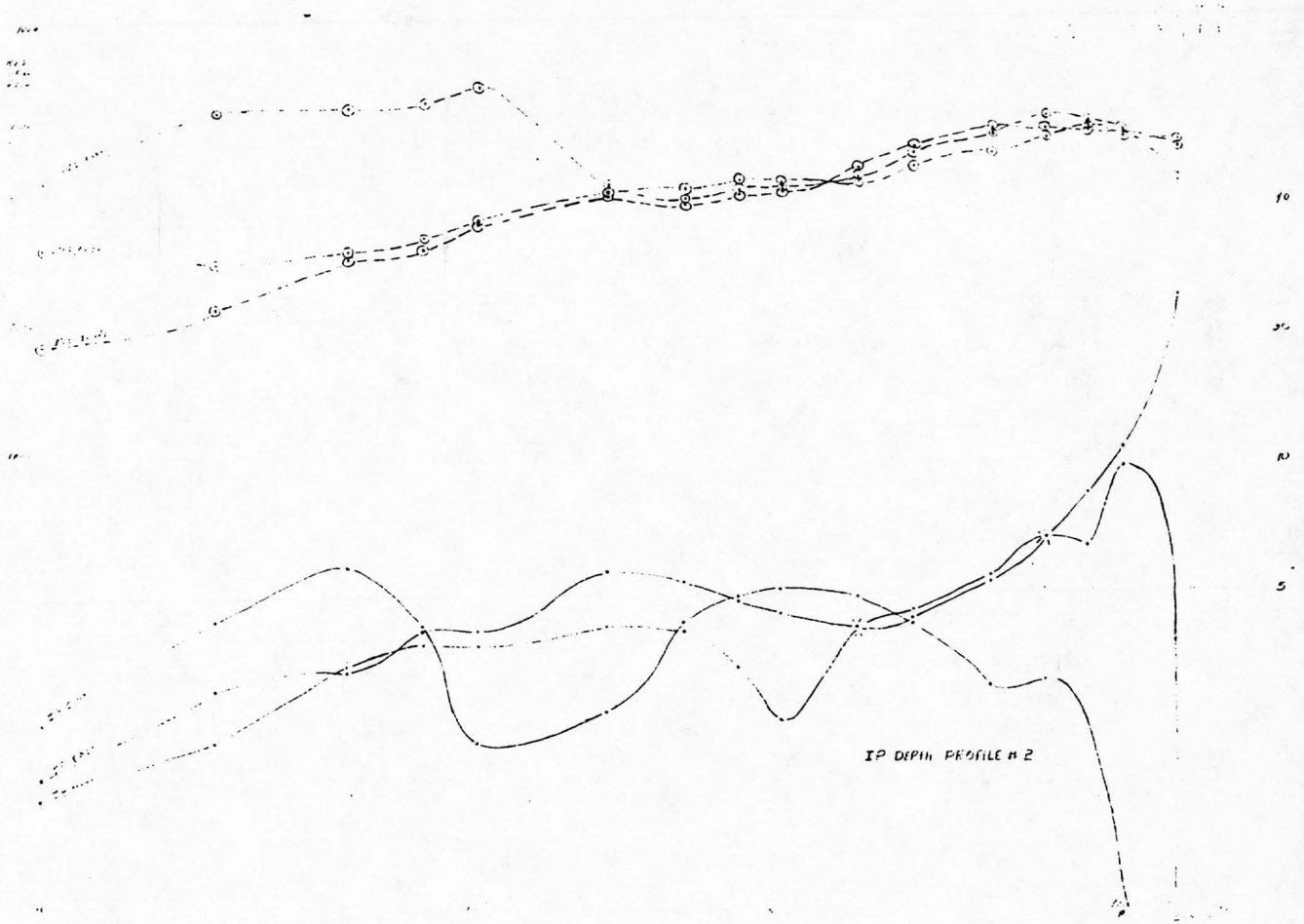

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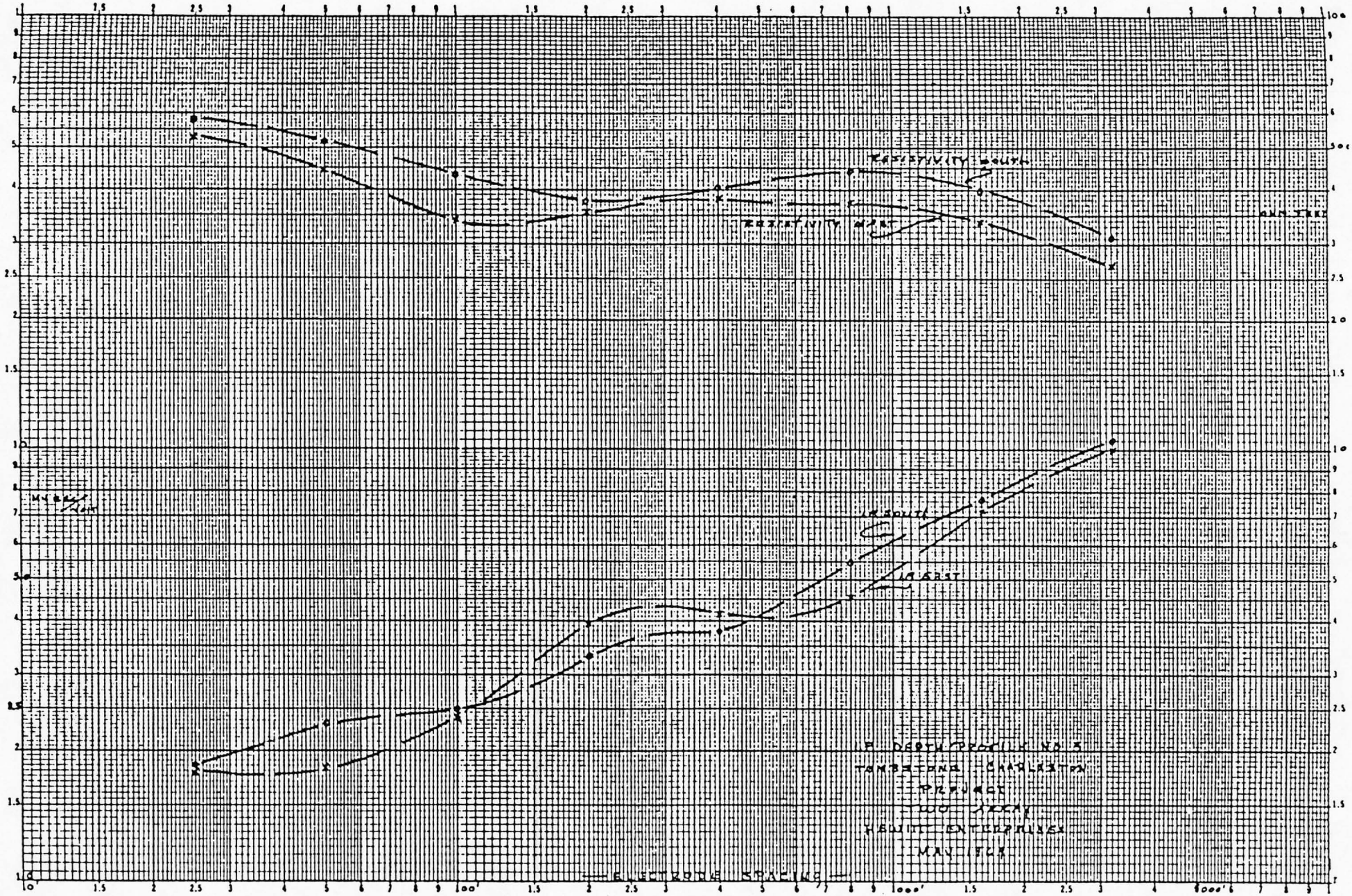

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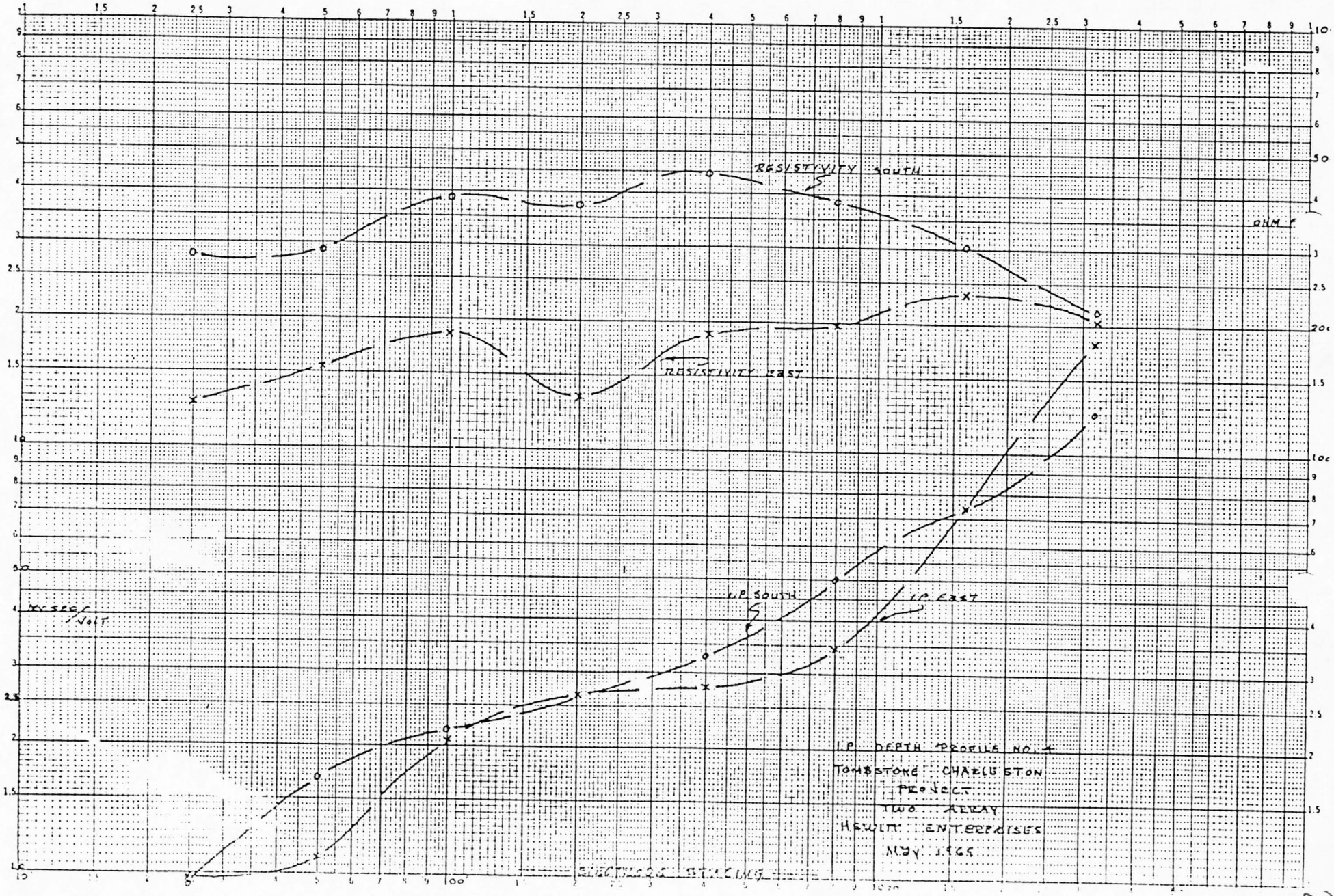
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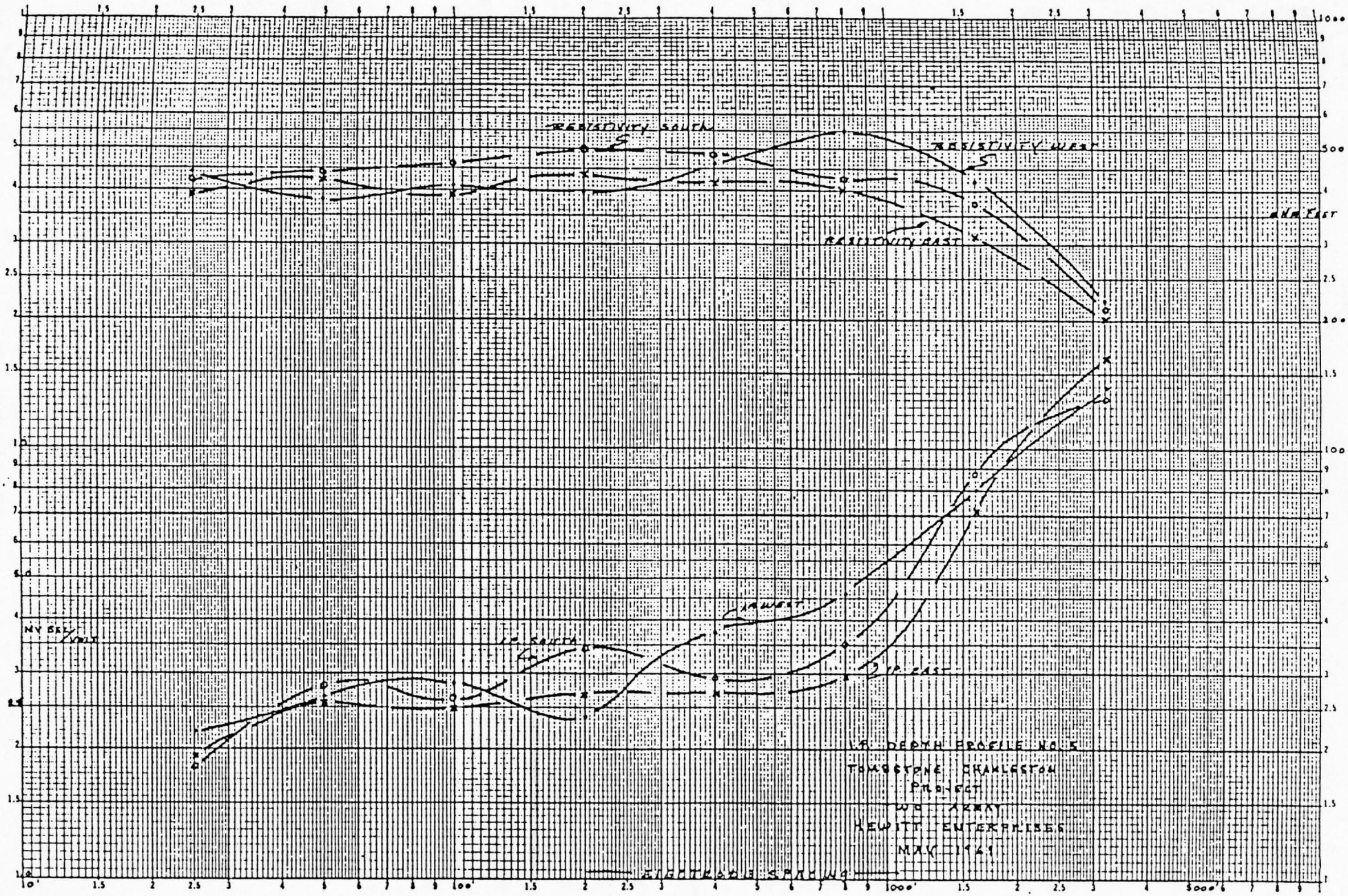
TOMBSTONE CHARLESTON
PROJECT
TWO ARRAY
HEWITT ENTERPRISES
MAY 1965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TOMBSTONE CHARLESTON
PROJECT
W.O. ARMY
HEWITT ENTERPRISES
MAY 1961
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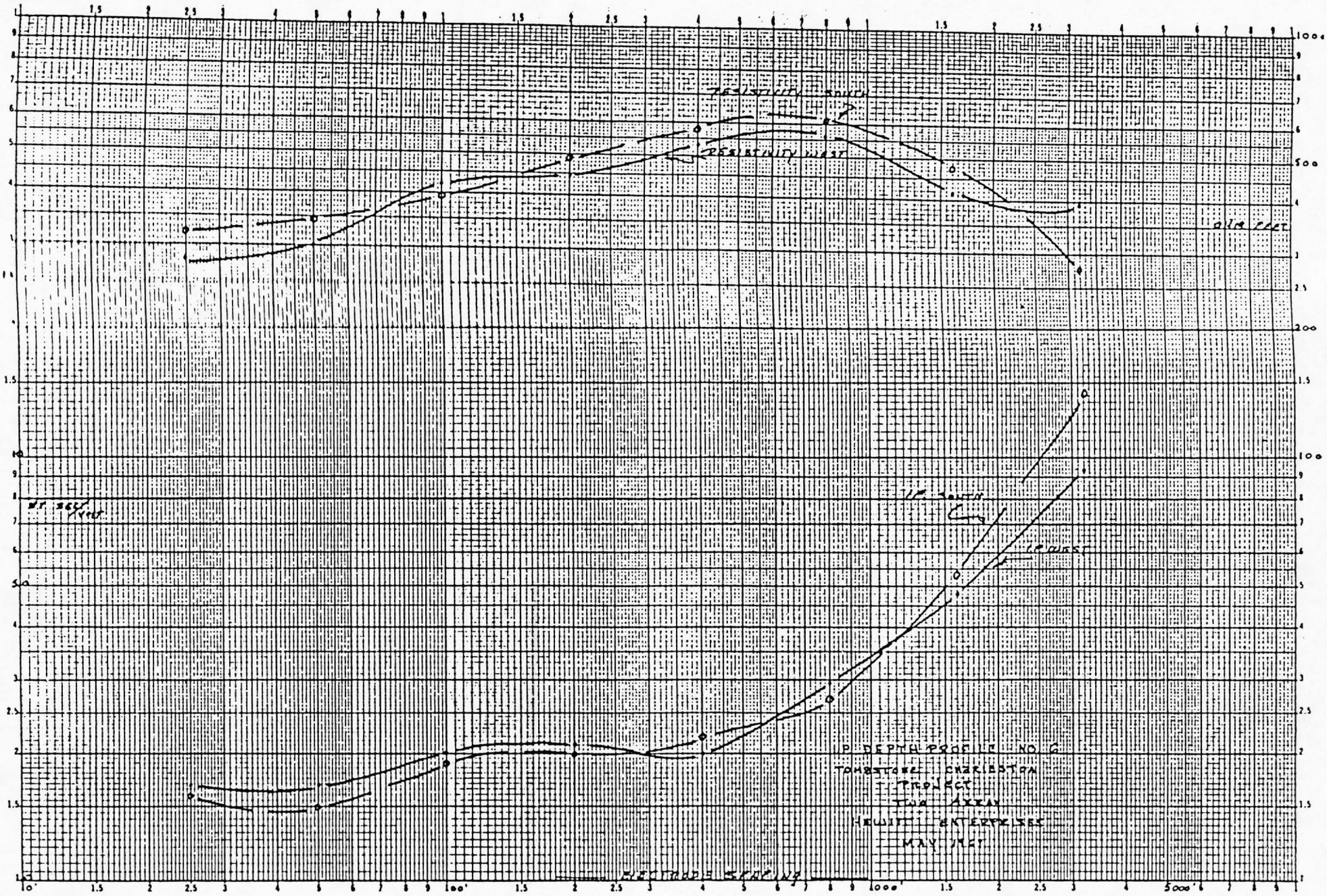
24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PROJECT
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HEWITT ENTERPRISES
MAY 1967
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10'
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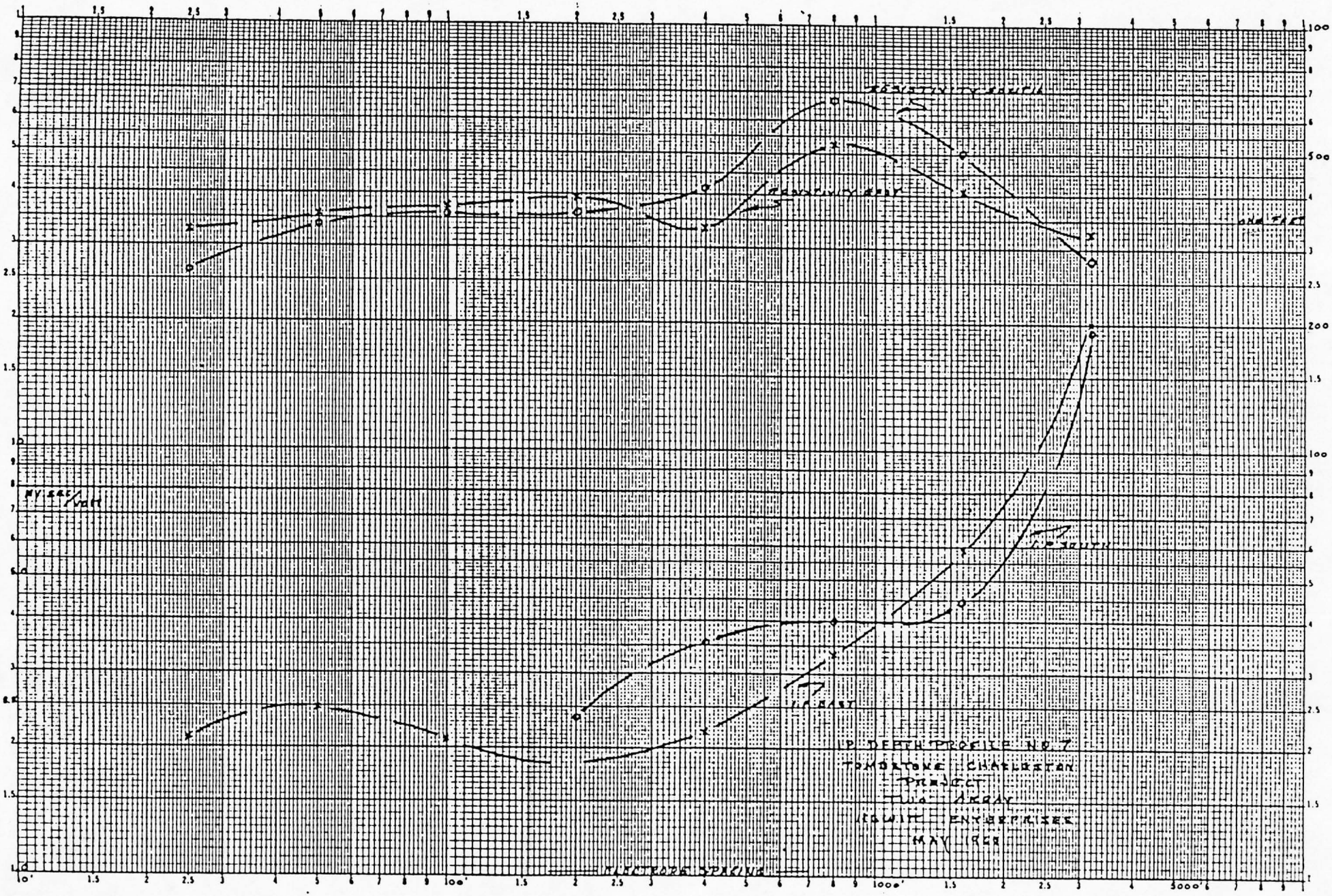
25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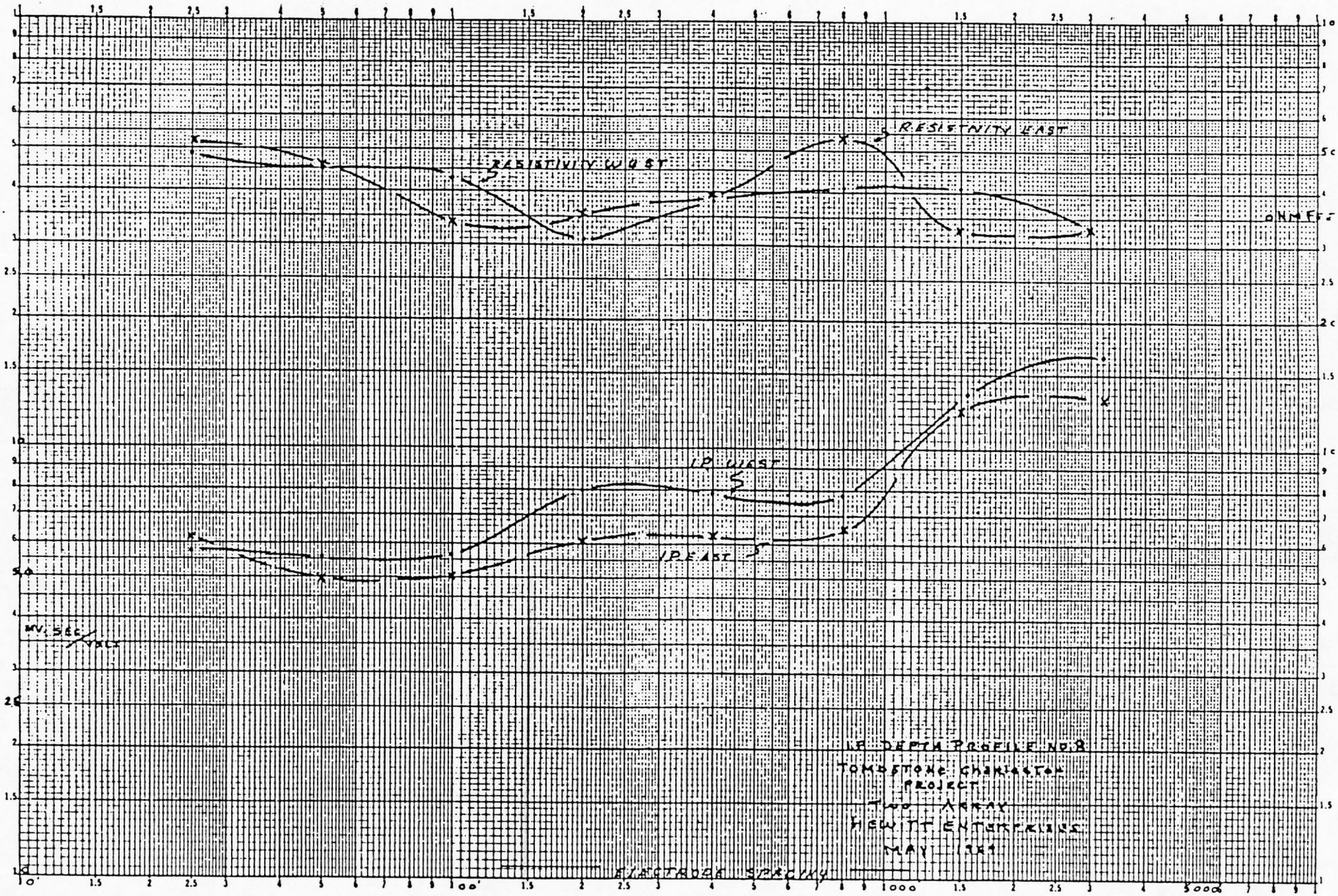
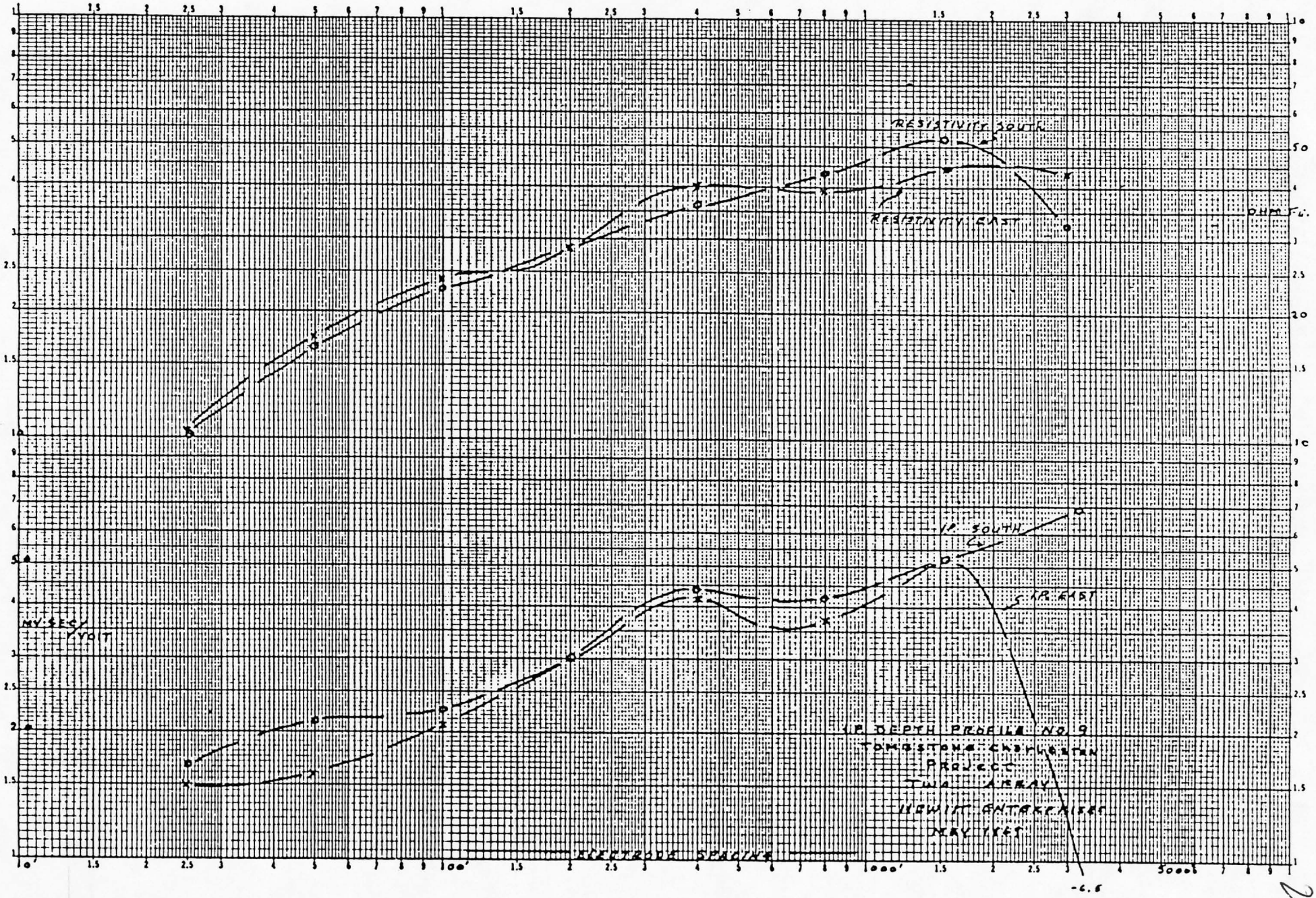
TOMBSTONE CHARLESTON
PROJECT
TUNA ARRAY
ASWIT ENTERPRISES
MAY 1966
ELECTRODE SPACING
10'
100'
1000'
5000'

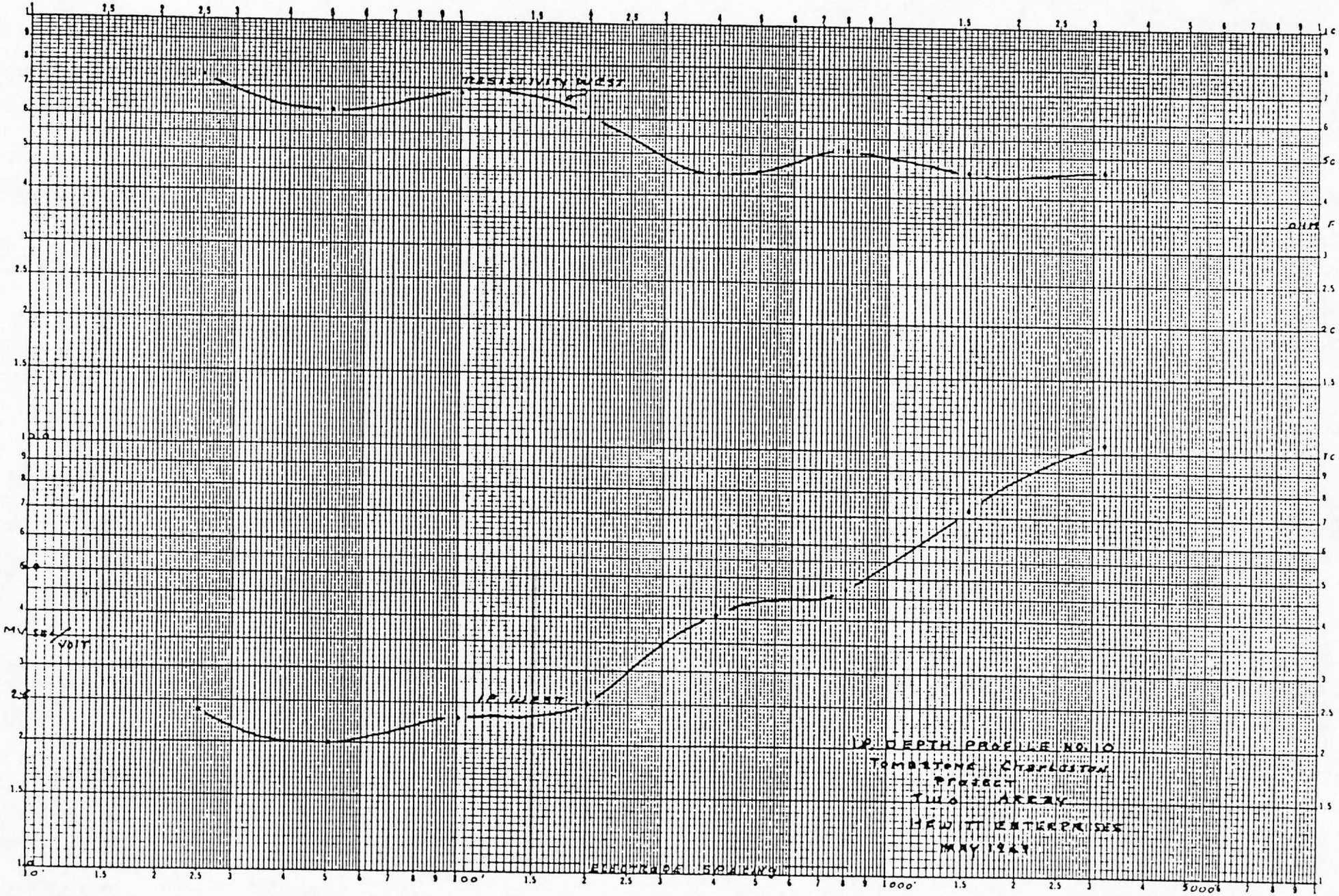


K+E LOGARITHMIC 47 7323 3 X 5 CYCLES KEUFFEL & ESSER CO. MADE IN U.S.A.

27



K+E LOGARITHMIC 47 7323 3 X 5 CYCLES KEUFFEL & ESSER CO.



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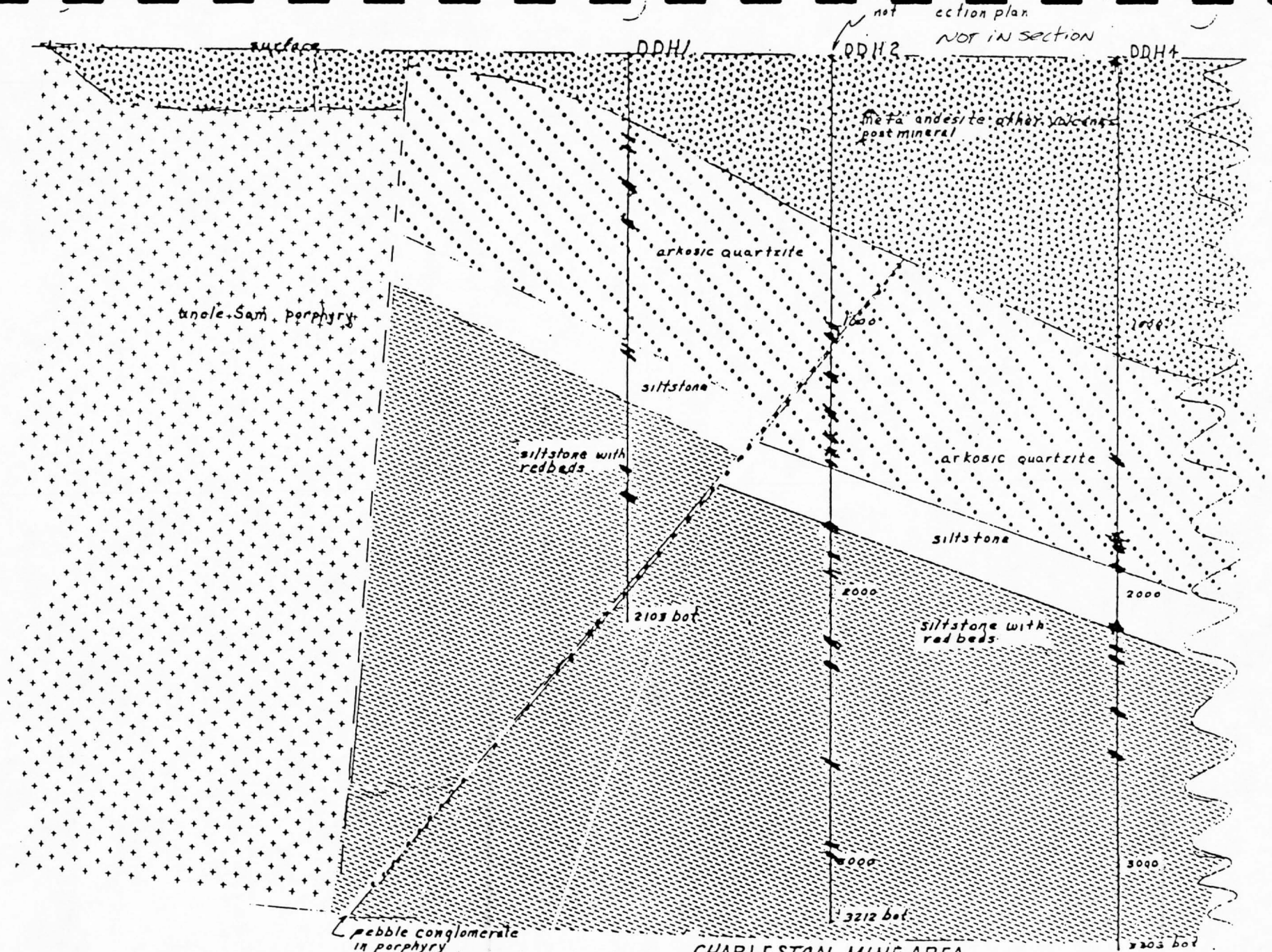
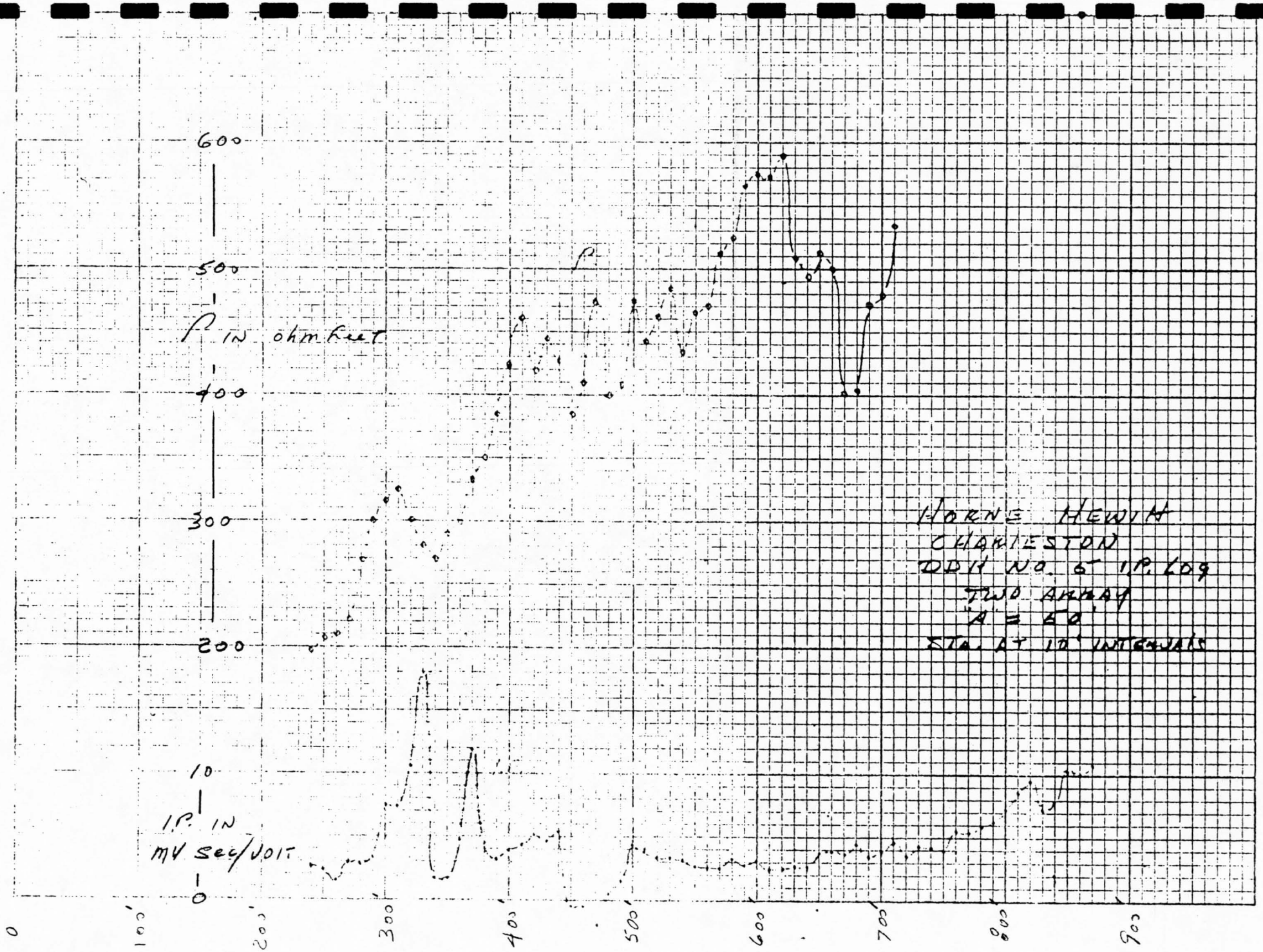
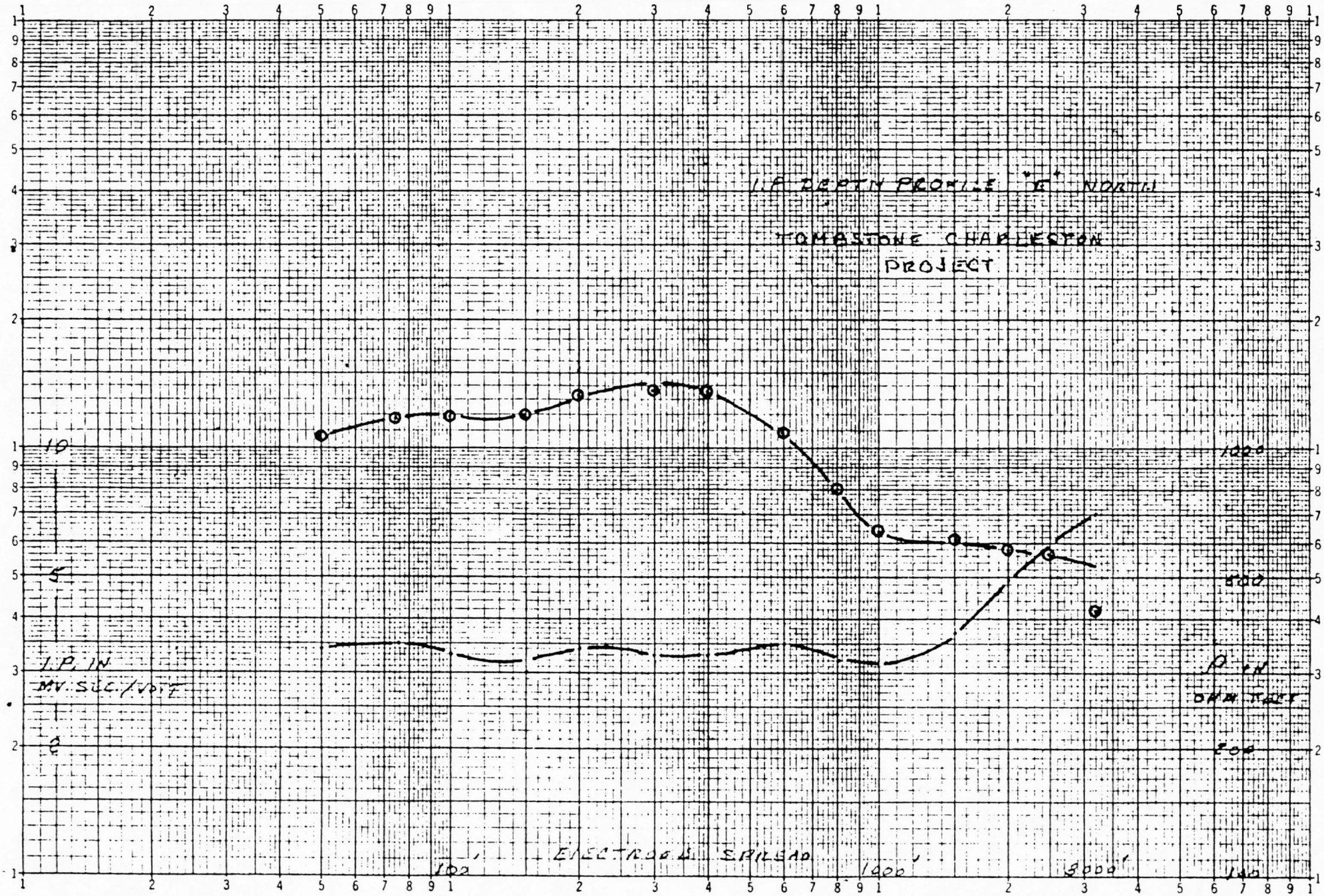


CHARLESTON MINE AREA
very generalized
Proposed section looking NE
scale 1" = 500

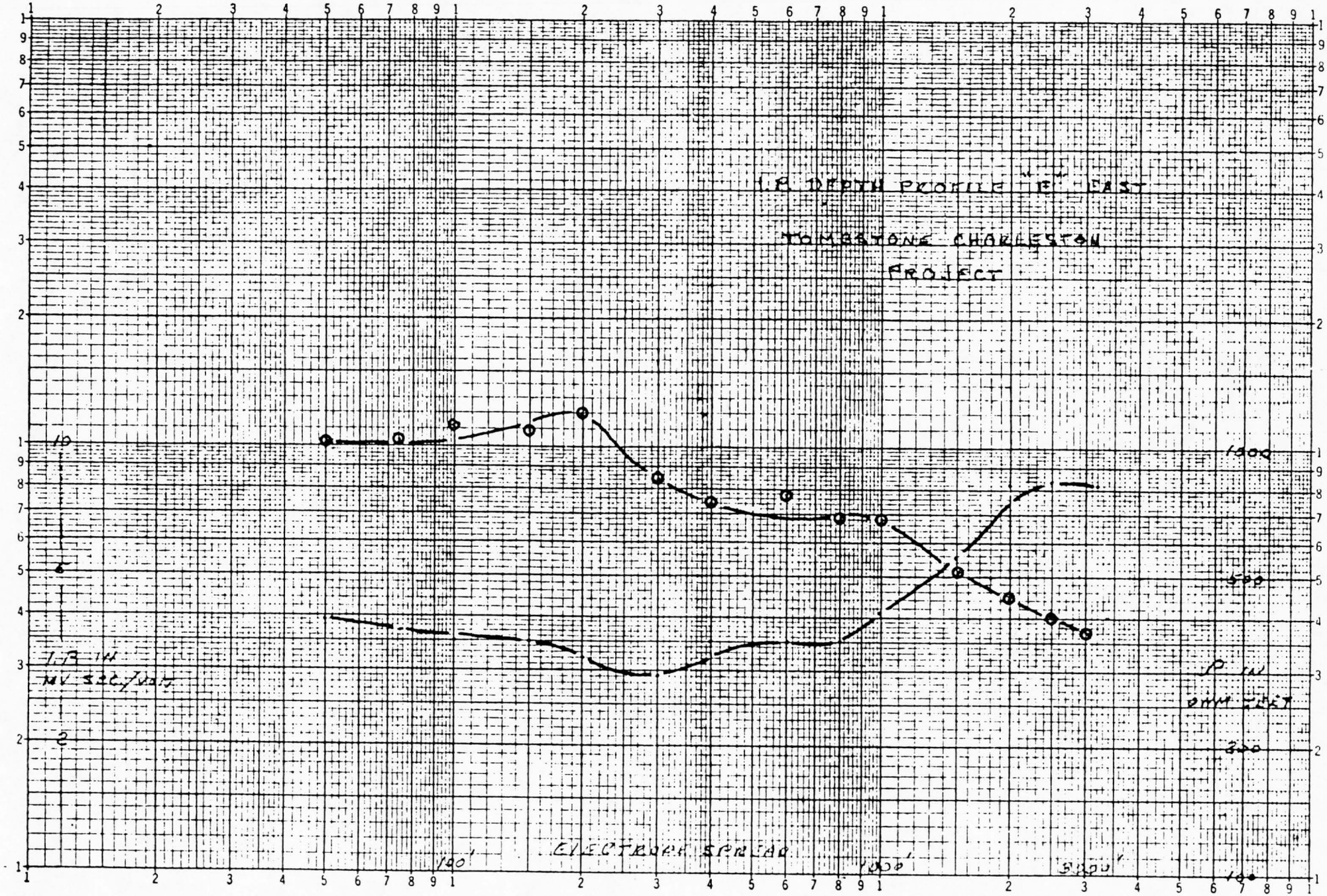
30


600
500
400
300
200
10
0
ρ IN ohm feet
I.P. IN
MV sec/VOLT
ρ
HORNE HEWIT
CHARLESTON
DDH NO. 5 I.P. LOG
TWO ARRAY
"A" = 50'
STA. AT 10' INTERVALS
0
100
200
300
400
500
600
700
800
900

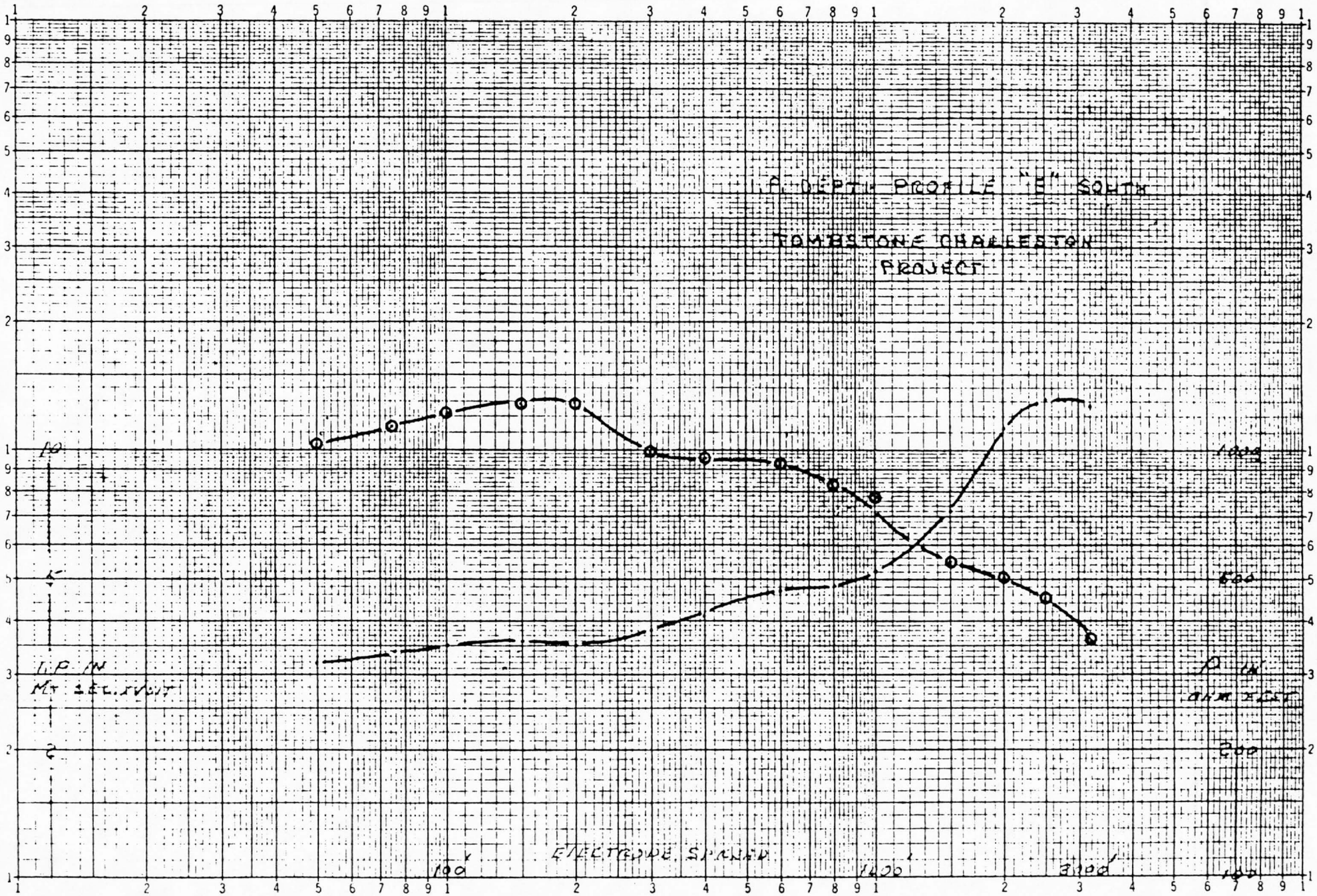
KEUFFEL & ESSER CO.



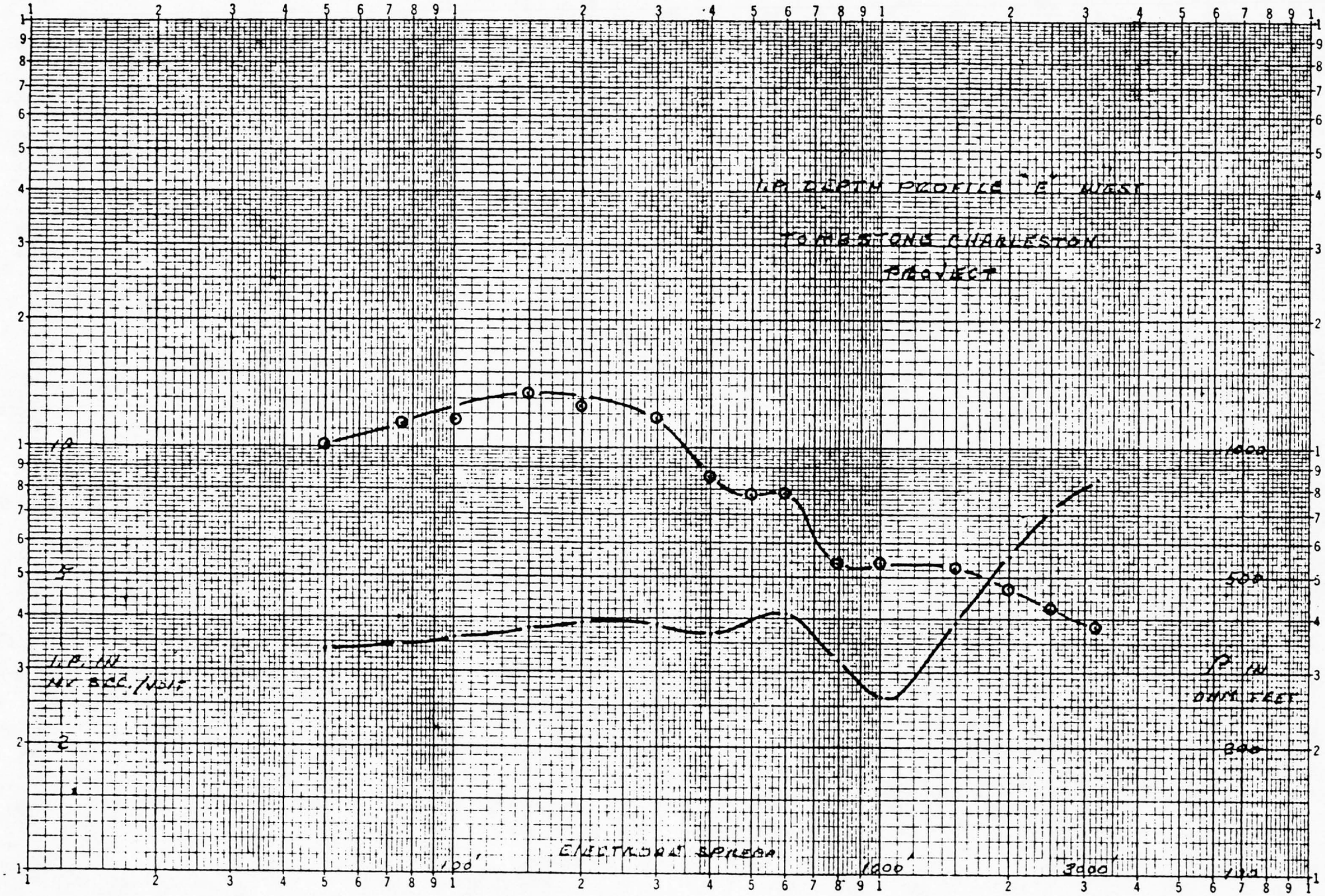
K+E LOGARITHMIC 323
2 X 3 CYCLES MADE IN U.S.A.
KEUFFEL & ESSER CO.



KEUFFEL & ESSER CO.
MADE IN U.S.A.

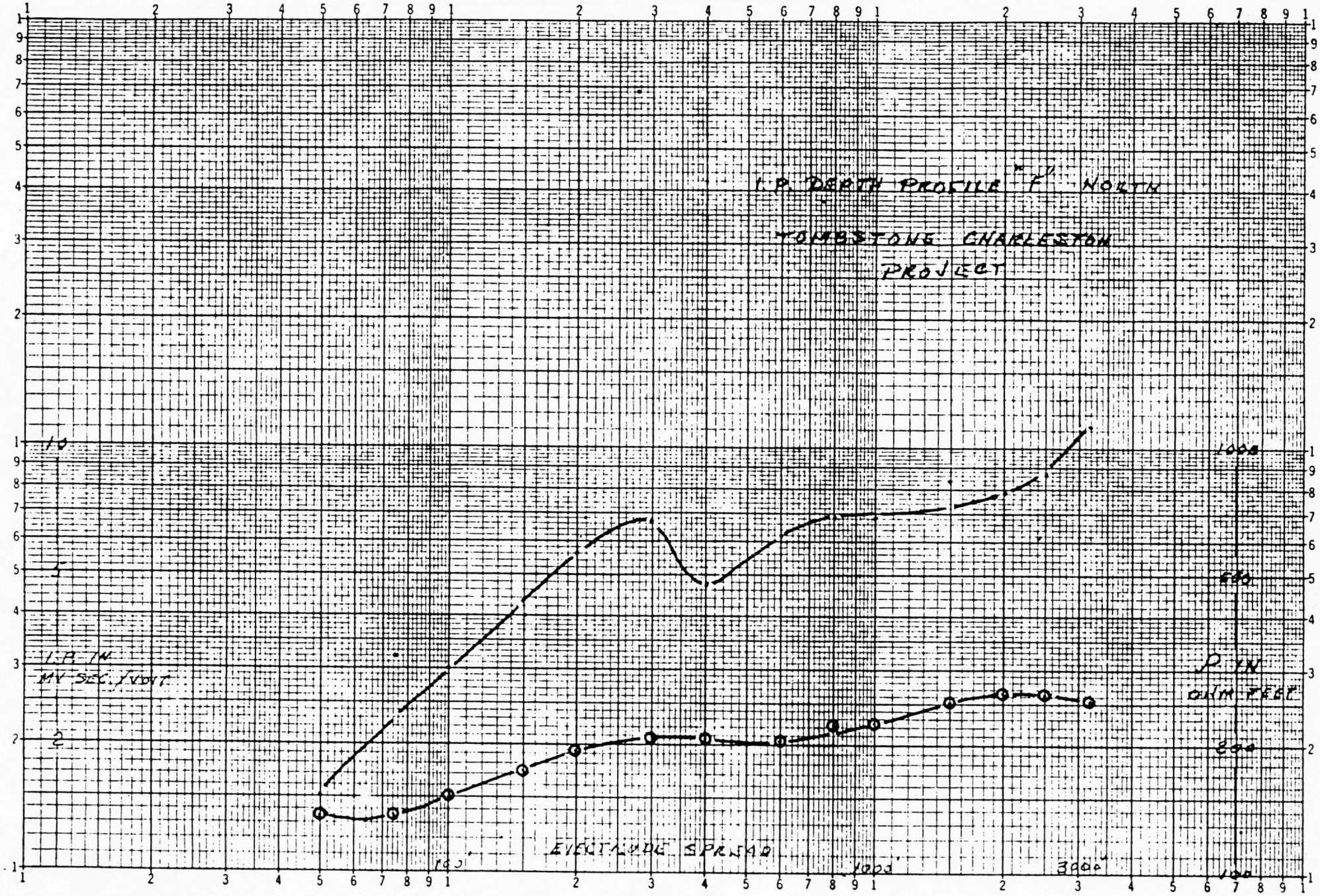


KEUFFEL & ESSER CO.



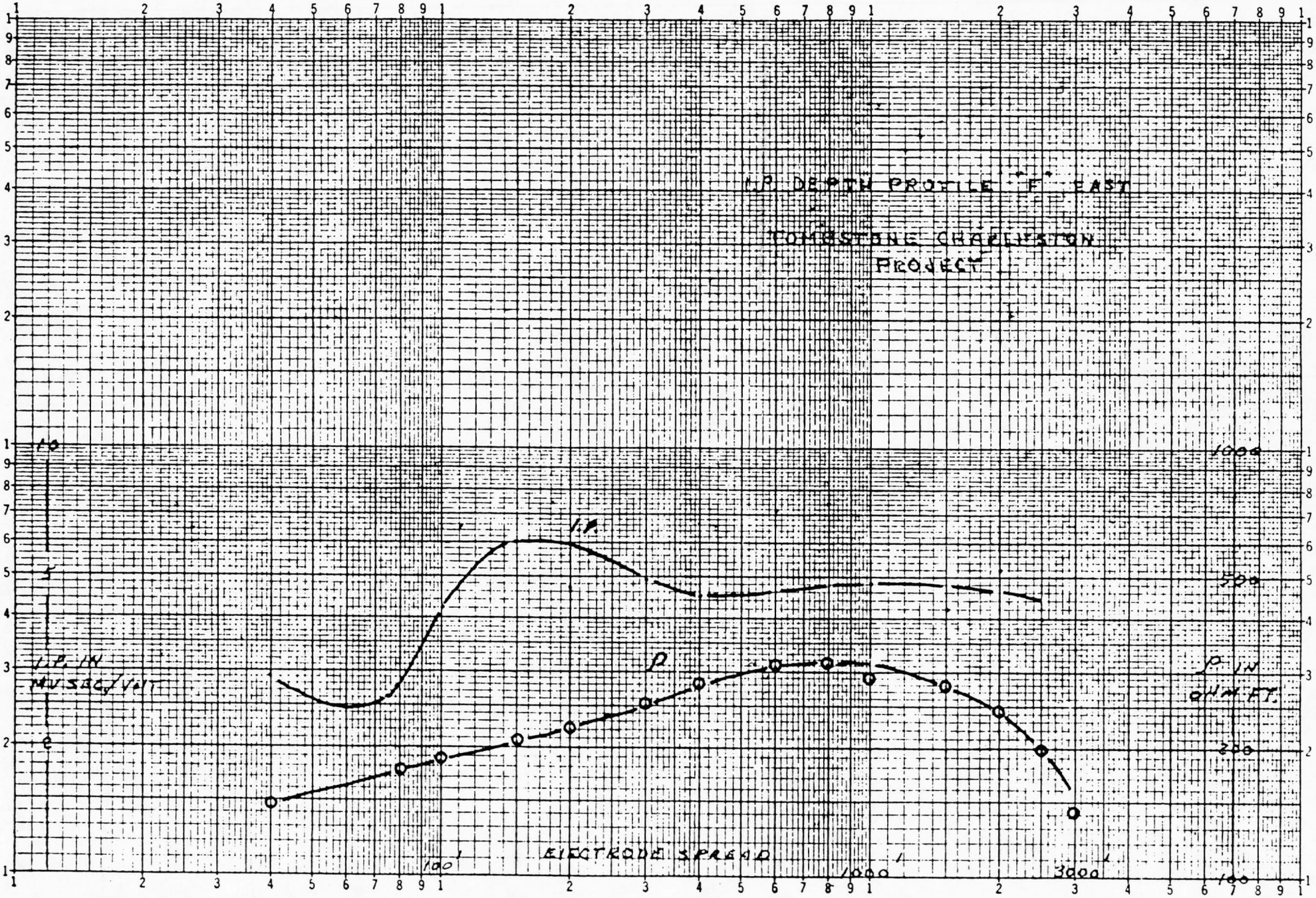
35

K+E LOGARITHMIC 359-323
2 X 3 CYCLES MADE IN U.S.A.
KEUFFEL & ESSER CO.

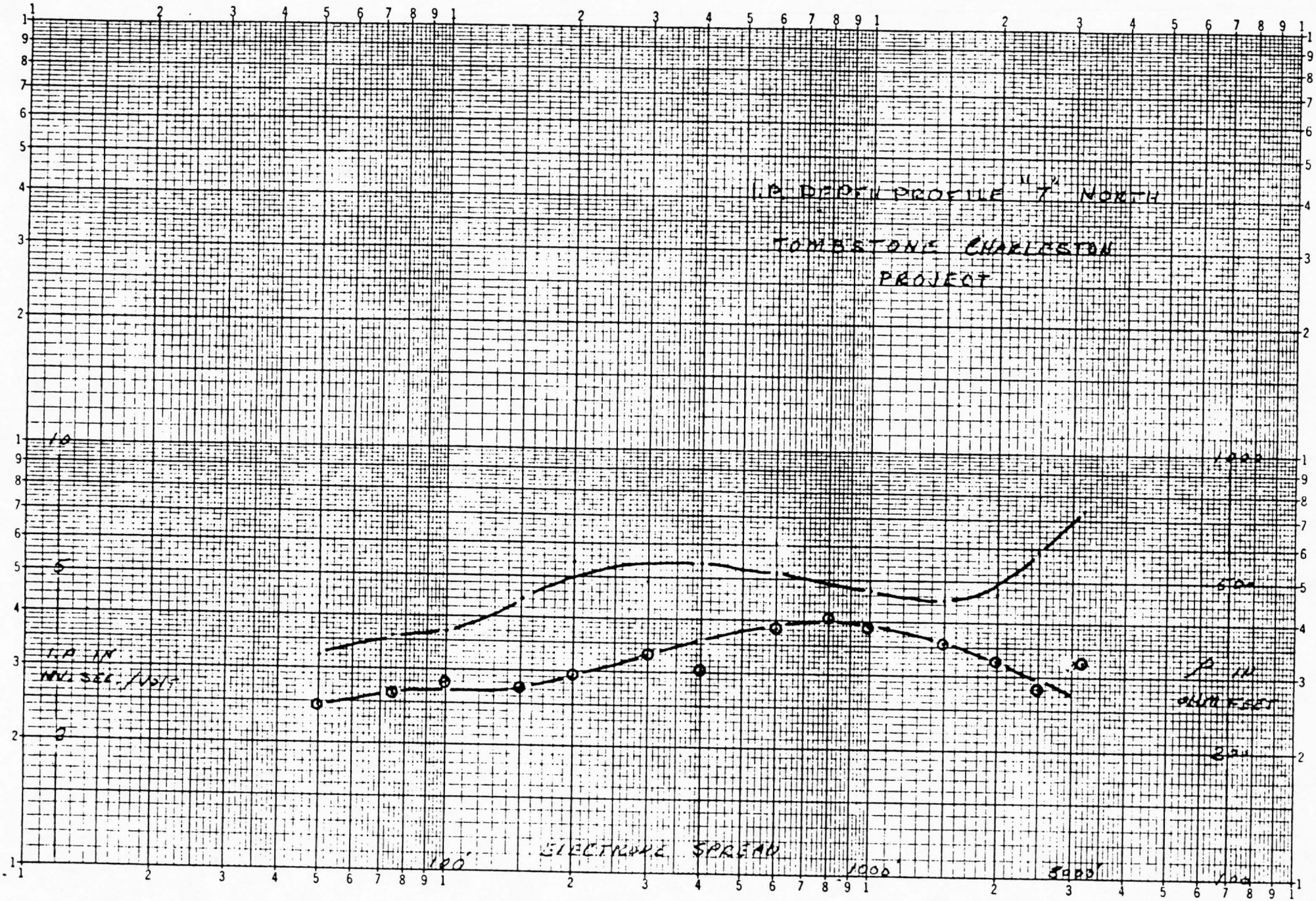


36

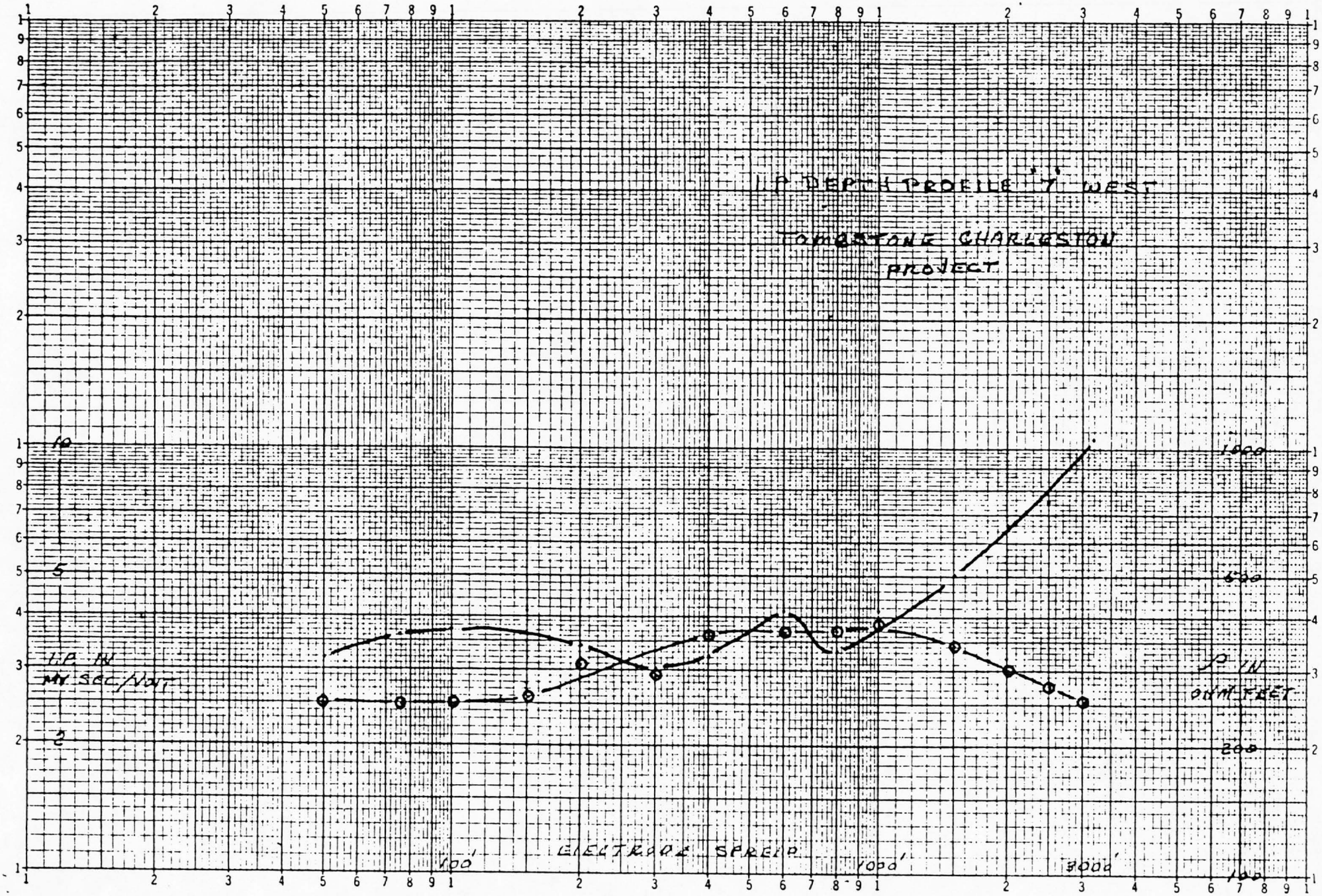
K+E LOGARITHMIC 323
2 X 3 CYCLES MADE IN U.S.A.
KEUFFEL & ESSER CO.



K+E ARITH CYCL 323
KEUFFEL & ESSER CO.



KEUFFEL & ESSER CO



Clarence

40

Hewitt Enterprises Box 978 A Sandy, Utah 84070 801 571-0157

March 11, 1969

RECEIVED
MAR 17 1969
JAMES STEWART COMPANY
PHOENIX, ARIZONA

Mr. M. S. Horne
James Stewart Company
707 Mayer Central Bldg.
3033 North Central Avenue
Phoenix, Arizona 85012

Dear Mr. Horne,

Enclosed please find a preliminary map of the induced polarization traverse lines in the Charleston Mine Area (Tombstone, Arizona.

Two traverse lines were made totaling 22,500 feet. Induced polarization and resistivity data was taken along these traverses. Hewitt Enterprises D. C. Pulse equipment was used. This incorporates a 4-second energizing current and a 0.8 second residual integration of the induced polarization voltage. A Wenner electrode configuration was used with a 1,000 foot depth penetration spread. The resultant resistivity and polarization profiles are plotted in ohm feet and millivolt seconds per volt respectively.

INTERPRETATION

Only two areas of anomalous polarization were found. One between 0 North and 2500 South on line 1 and one centered at 6500 South on line 2. The anomalies in both cases are rather weak. This may be caused by the considerable depth to sulphides. However, no detailed efforts on either anomaly were conducted to determine if this is so.

It is felt that these anomalies do represent mineralization at depth and they do occurr in areas where prospecting for economic minerals has been done.

We believe the induced polarization method is a positive tool for prospecting in this area since no extraneous polarization effects were noted. However, it is felt that in some areas where the mineralization is deep, a modified electrode configuration must be used to insure greater depth of penetration. Further detailed studies would be required before exact drill

target locations could be recommended.

Thank you for the opportunity to be of service.

Sincerely yours,

HEWITT ENTERPRISES

Loyd A. Hewitt

Loyd A. Hewitt

LAH/ikr

cc: Mr. C. A. Cosgrove
James Stewart Company
707 Mayer Central Bldg.
3033 North Central Avenue
Phoenix, Arizona 85012

Mr. H. Clyde Davis
Director, Mineral Development
Brigham Young University
A-362 Smoot Adm. Bldg.
Provo, Utah 84601

Mr. F. McKay Smith
President, Computer Update
72 East 4th South
Salt Lake City, Utah 84111

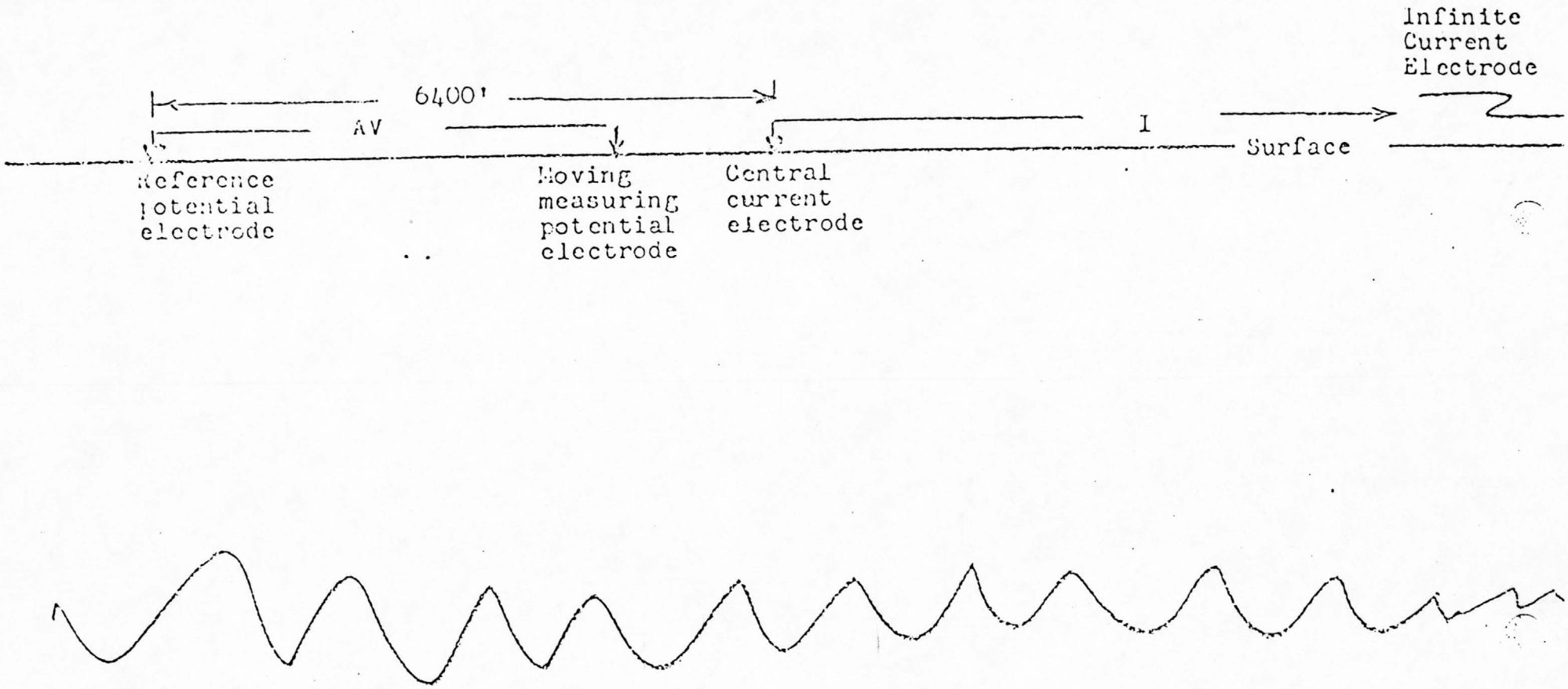
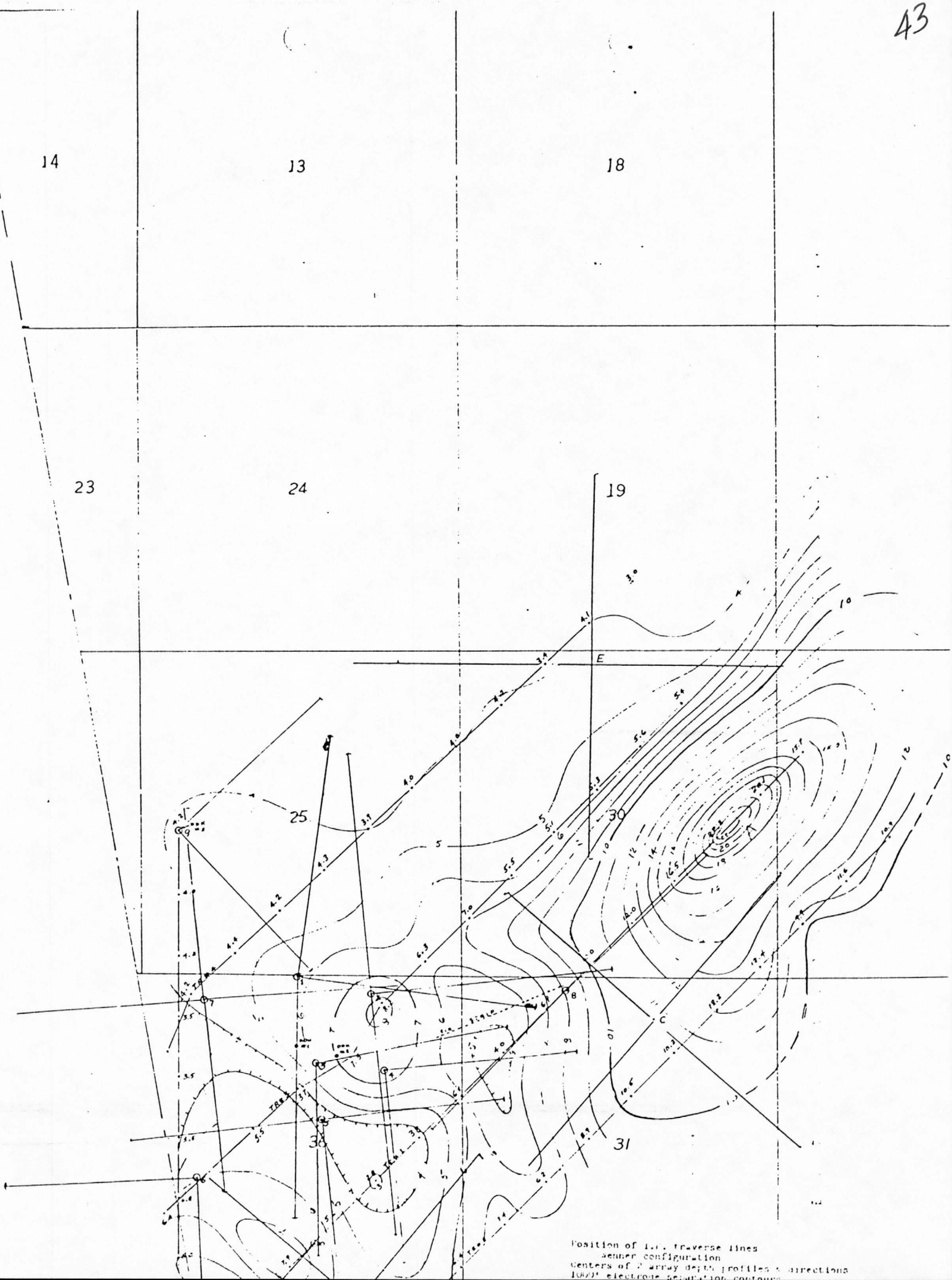


Fig. 1

Modified 2 array electrode configurat



Position of I.P. traverse lines
Wenner configuration
Centers of 2 array depth profiles & directions
100ft electrode separation contours

To MMSH

Hewitt Probes
Nov. 1969
Resistivity

44

I P

Probe A

	North	South	East	West	N	S	E	W
50'	4.6	4.1	5.4	5.0	638	396	403	257
75'	5.6	6.8	6.9	6.5	360	356	367	240
100'	5.1	6.4	8.2	–	335	341	272	–
150'	6.7	8.7	9.1	7.8	249	378	284	247
200'	7.2	10.3	9.2	11.4	269	368	327	261
300'	8.9	15.8	10.5	6.5	261	340	347	317
400'	7.5	10.5	10.8	9.8	293	362	371	315
600'	5.8	8.8	8.2	9.0	366	363	395	344
800'	7.4	7.7	10.5	10.3	396	373	431	313
1000'	10.7	9.0	11.8	10.8	366	383	587	311
1500'	10.0	13.8	15.0	8.1	366	411	539	329
2000'	6.0	13.8	19.1	11.7	363	454	477	335
2500'	10.5	18.5	24.5	20.0	332	425	387	322
3200'	9.7	20.0	30.2	16.4	369	396	349	312

Charleston Mine
Hewitt Probes -
Nov 1969

45

PROBE B.

	IP				Resistivity			
	N	S	E	W	N	S ?	E	W
50	4.2		4.0	5.6	148		173	157
75	4.8		4.2	6.3	164		190	174
100	4.7		4.4	5.5	193		212	179
150	6.5		4.1	5.2	198		251	221
200	2.7		5.7	6.4	244		292	256
300	6.2		5.0	5.0	274		325	277
400	6.2		5.0	5.5	330		331	320
600	4.5		7.3	7.9	305		341	395
800	5.4		6.5	6.5	285		364	391
1000	5.7		5.7	7.1	270		354	403
1500	6.8		7.0	8.6	294		342	420
2000	7.9		10.6	9.7	331		348	400
2500	9.0		11.6	11.3	337		201	381
3200	11.7	4.9	15.3	15.5	300		266	306

To MMSR

Probe C
IP

Charleston Mine
Hewitt Probes
Nov 1965

Resistivity.

46

	N	S.	E	W	N	S	E	W
50	3.9	3.6	5.0	4.5	354	249	296	326
75	4.5	4.5	4.6	5.0	305	295	287	307
100	3.6	5.6	4.4	5.3	269	293	662	294
150	4.5	7.2	5.2	5.3	246	280	268	286
200	5.0	5.5	5.2	3.7	256	300	265	289
300	5.3	5.6	6.4	5.8	265	335	298	299
400	6.2	5.5	6.6	4.9	291	323	294	304
600	5.6	4.6	9.1	8.8	292	376	293	220
800	6.1	5.1	8.3	8.7	280	398	296	313
1000	6.8	4.7	7.2	6.6	254	450	297	296
1500	7.6	3.5	8.8	3.5	290	484	340	256
2000	8.1	3.1	5.7	2.1	262	569	297	241
2500	12.5	–	6.5	2.0	254	650	313	222
3200	15.5	1.7	7.9	0	265	705	295	216

Note

Charleston -

Nov 1969

Probe D

	IP			Resistivity		
	N	E	W	N	E	W
50	2.0	2.2		428	407	
75	3.9	2.0		364	366	
100	3.4	1.8		360	363	
150	3.6	2.2		398	400	
200	3.4	2.1		406	397	
300	4.9	2.1		478	484	
400	4.7	2.6		552	521	
600	4.8	2.7		642	588	
800	6.3	2.6		670	655	
1000	7.1	2.8		825	693	
1500	8.1	2.1		650	704	
2000	11.3 x	1.0		628	650	
2500	10.1	—		635	595	
3200	5.5	—		570	634	

x Influence from "A" ?

12/2/69

Charleston - Geophysics
Work 11/20 - 11/26

Probe E.

	IP				Resistivity			
	N	E	S	W	N	E	S	W
50'	3.4	3.8	3.2	3.3	1065	1021	1030	1020
75'	3.5	3.8	3.4	3.9	1179	1020	1142	1136
100	3.3	3.5	3.5	3.5	1183	1112	1212	1171
150	3.2	3.5	3.6	3.6	1189	1081	1289	1346
200	3.4	3.2	3.5	3.9	1315	1192	1291	1250
300	3.2	2.9	3.8	3.8	1329	839	998	1173
400	3.3	3.5	4.1	3.8	1345	741	959	854
600	3.6	3.5	4.7	4.3	1075	769	921	786
800	3.4	3.5	4.8	3.2	800	677	824	529
1000	3.7	4.1	5.2	3.2	638	671	768	538
1500	3.7	5.5	7.2	3.7	604	504	538	525
2000	4.9	8.2	11.4	5.5	577	442	502	467
2500	5.2	8.3	13.2	7.3	562	389	450	421
3200	7.3	8.2	12.7	9.1	415	375	354	379

Charleston

49

Nov 1969

Probe E

IP

Resistivity

	W	N	E	S	W
50	3.3	3.4	3.8		1020
75	3.9	3.5	3.8		1136
100	3.5	3.3	3.5		1171
150	3.1	3.2	3.5		1341
200	3.9	3.4	3.2		1250
300	3.8	3.2	2.9		1173
400	3.8	3.1	3.5		854
600	4.3	3.4	3.5		786
800	3.2	3.4	3.5		529
1000	3.2	3.7	4.1		538
1500	3.9	3.7	5.5		525
2000	5.5	4.9	8.2		467
2500	7.3	5.2	8.3		421
3200	9.1	7.3	8.2	12.0	379

12-2-69

Charleston – Geophysics

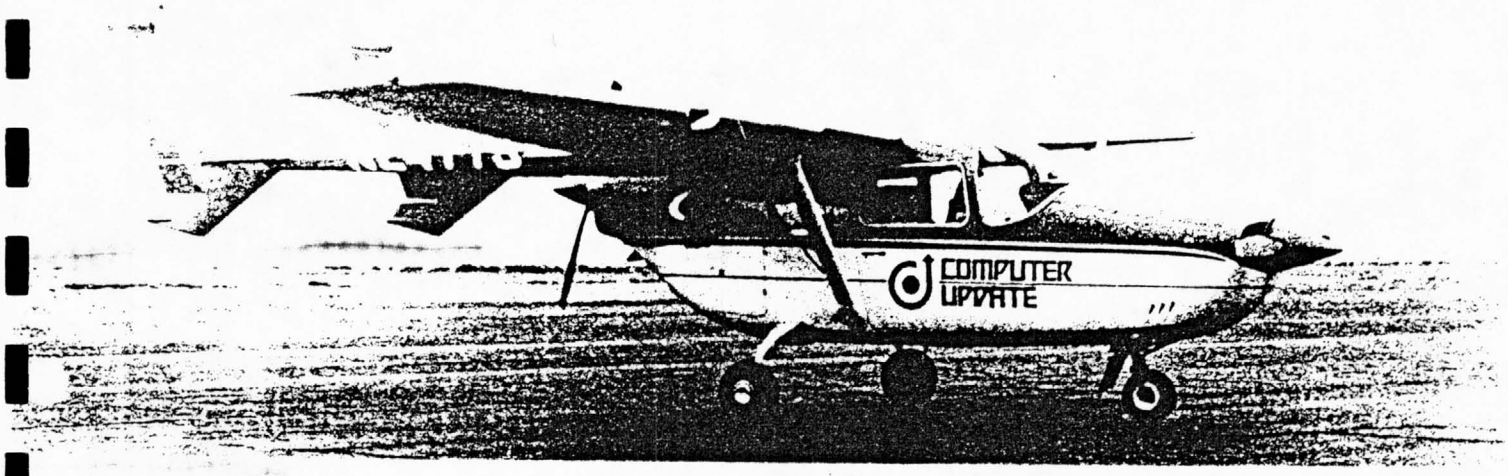
Probe 7

Work done 11/25 & 11/26 /69.

	IP North	IP West	Resistance North	Resistance West
50	3.2	3.2	244	251
75	3.6	3.6	261	254
100	3.7	3.7	261	253
150	4.4	4.1	278	271
200	5.4	3.4	270	310
300	4.9	3.0	295	339
400	5.4	3.2	328	357
600	5.1	4.1		370
800	5.2	3.3		368
1000	4.7	4.3		385
1500	4.5	5.0		338
2000	4.7	6.6		297
2500	5.9	7.5		275
3200	7.3	10.5		254

51

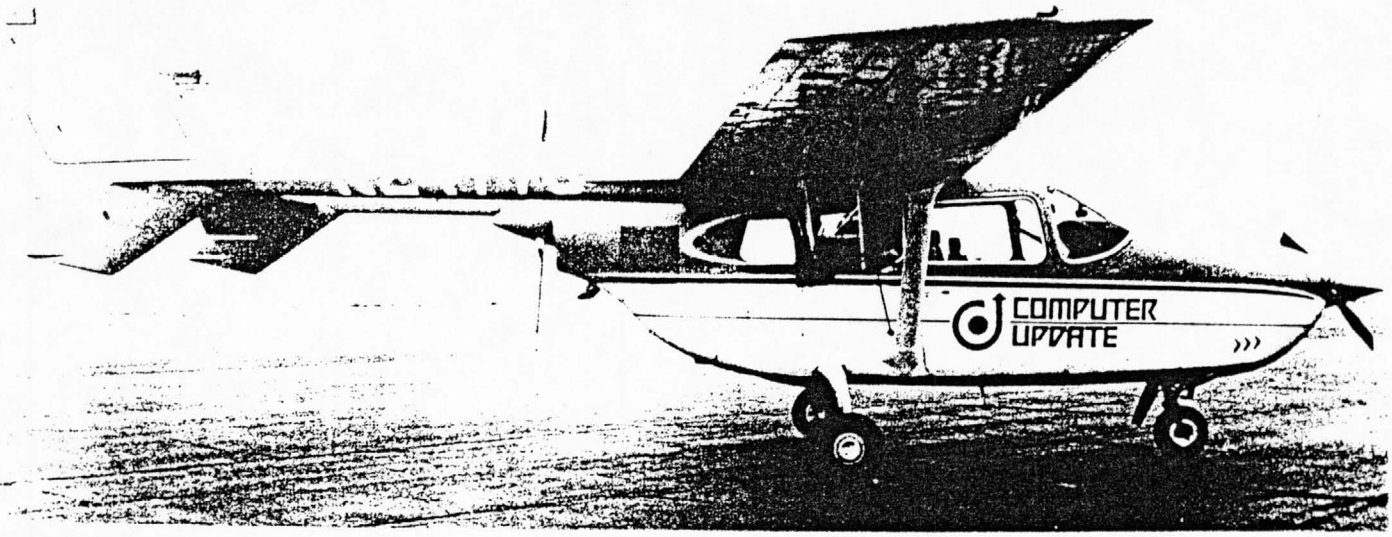
TIME-SHARING COMPUTER GEOPHYSICS AERIAL SURVEYS



COMPUTER UPDATE

AIRBORNE GEOPHYSICAL ACQUISITION AND REDUCTION
SURFACE TO SURFACE CALCULATIONS
PROFILE ANALYSIS OF FIELD GEOPHYSICAL DATA
UPWARD CONTINUATION OF CONSERVATIVE FIELD DATA (MAGNETIC, GRAVITATIONAL, ETC.)
DOWNWARD CONTINUATION OF CONSERVATIVE FIELD DATA (MAGNETIC, GRAVITATIONAL, ETC.)
COMPILATION OF DATA-CURVES FOR INTERPRETATION OF FIELD RESULTS
COMPILATION OF DATA-TABLES FOR INTERPRETATION OF FIELD RESULTS
THEORETICAL AND EMPIRICAL STUDIES WITH RESISTIVITY AND INDUCED POLARIZATION DATA, USING VARIOUS SUB-SURFACE GEOMETRICS AND ELECTRODE ARRAYS
PLOT ROUTINES FOR PROFILE DATA, WITH DERIVATIVES
GRAVITY DATA, WITH HIGHER ORDER ANALYSIS
GRIDDED DATA IN RAW OR DIFFERENTIAL FORM
SOLUTION OF SUBSURFACE PROBLEMS
ANALOG AND DIGITAL PLOTTING
DISPLAYS ON CRT OF ANALOG COMPUTED CONSERVATIVE FIELDS, (MAGNETIC, GRAVITY, ETC.)
CONTOURING DATA (PRINTED ON CALCOMP PLOTTER)
GRID INTERPOLATION AND CONTOURING ROUTINES
DERIVATIVES, HIGHER ORDER POLYNOMIAL SURFACES
SECOND DEGREE MAGNETIC AND GRAVITY CURVES OR TABULATIONS WITH DERIVATIVES
ELECTROMAGNETIC PROSPECTING DATA SOLUTIONS
PROCESSING AND CORRECTING OF RAW FIELD DATA, SUCH AS GRAVITY, SEISMIC, AND MAGNETIC
ANALYSIS OF DISTRIBUTION FOR SEARCH FOR ANOMALOUS PATTERN
SPECTRAL ANALYSIS OF TIME (SCINTILLOMETER)
NOISE ERRADICATION AND FILTERING BY COMMUNICATIONS THEORY TECHNIQUE AND NUMERICAL METHODS
MAP ANALYSIS
BEST-FIT POLYNOMIAL SURFACE METHODS, DERIVATIVES
TERRAIN CORRECTION PROBLEMS, FOR SURFACE AND SUB-SURFACE GRAVITY CORRECTIONS
REGIONAL CORRECTION FOR MAGNETIC AND GRAVITATIONAL MAPS
RESISTIVITY MODEL PLOTTING
HIGHER ORDER EQUATION SOLVING
RESISTIVITY AND I.P. FIELD DATA
TREND SURFACE ANALYSIS
REGIONAL CORRECTIONS OF DATA TAKING INTO ACCOUNT BIAS
DESIGN OF AN OPTIMUM DRILLING GRID
CRITICAL PATH SCHEDULING
LINEAR PROGRAMMING (INCLUDING PERT/COST)
MATHEMATICAL MODEL PROCESS
ENGINEERING APPLICATIONS
COORDINATES OF DRILL DATA
COORDINATES DATA PLOT
COMPOSIT ASSAY
ASSAY PLOT
CONTOUR PLOT OF RANDOM DATA
CONTOUR PLOT OF GRID DATA
INFLUENCE FUNCTIONS FOR ASSAY ANALYSIS
SMOOTH SURFACE INTERPOLATION
SMOOTH SURFACE
POLYGON PLOTTER
POLYGON BLOCK CONVERSION

ORE RESERVE ESTIMATION USING NUMEROUS METHODS (TRIANGULATIONS, POLYGON, STATISTICAL)
FINANCIAL ANALYSIS OF MINES
APPLICATIONS IN MINE DESIGN AND DEVELOPMENT
CALCULATE PIT LIMITS AND PIT EXPANSION
SURVEYING CALCULATIONS
OPTIMIZE PRODUCTION FOR CONTROLLED GRADES
OPTIMUM MINING AND UPGRADING OPERATIONS
OPTIMUM OPEN PIT DESIGN
OPTIMIZE AND CONTROL HAULAGE SYSTEMS
OPTIMUM BENCH HEIGHT
OPTIMUM CUT-OFF GRADE
OPTIMUM PRODUCTION RATE
MAPS OF ORIGINAL DATA SUBDIVIDED INTO EACH BENCH
MAPS OF EVALUATED DATA FOR EACH PRODUCTION BLOCK IN EACH BENCH
STOCKPILE MATERIAL CALCULATION
WASTE-ORE REQUIREMENTS
DRILL HOLE DATA PROCESSING
ORE RESERVES FOR VARIOUS CUT-OFF GRADES BY BENCH
FUTURE DRILLING REQUIREMENTS PLANNING
NUMEROUS PIT SLOPES
NUMEROUS BENCH REFERENCE ELEVATIONS
GRADE REQUIREMENTS TO THE MILL
USE OF GEOLOGICAL DATA FOR ORE RESERVES AND PLANNING
PRODUCTION SCHEDULING
ORE BLENDING AND GRADING
PROCESS CONTROLS
FEASIBILITY STUDIES
ECONOMIC EVALUATION
DESIGN OF CONTROL SYSTEM
CUT AND FILL CALCULATIONS
STATISTICAL AND NUMERICAL [illegible]
MULTIPLE REGRESSION ANALYSIS
MULTIPLE CORRELATION ANALYSIS
SIMPLE LINEAR REGRESSION
QUADRATIC REGRESSION FOR 2 AND 3 INDEPENDENT VARIABLES
QUADRATIC REGRESSION EVALUATION
ANALYSIS OF VARIANCE
QUADRATIC EQUATION CONTOUR PLOT
POLYNOMIAL REGRESSION (X+Y) WITH INTERACTIONS AND EVALUATION
FREQUENCY DISTRIBUTIONS ANALYSIS
GENERAL REGRESSION EVALUATION
REGRESSION WITH STANDARD ERRORS OF FORECASTS
SOLUTION OF SIMULTANEOUS LINEAR EQUATIONS
MATRIX MANIPULATION PACKAGE
LEAST SQUARES POLYNOMIAL CURVE FIT
CURVE FITTING PROGRAM
ORTHOGONAL POLYNOMIALS
EIGENVALUES
LINEAR REGRESSION ANALYSIS OF COMBINATIONS OF VARIABLES
EXPONENTIAL CURVE FITTING PROGRAM
NON-LINEAR CURVE FITTING PROGRAM
TIME SERIES ANALYSIS
FACTOR ANALYSIS
STATISTICAL ANALYSIS OF DATA FOR PATTERN RECOGNITION
AUTOCORRELATION ANALYSIS
STATISTICAL ANALYSIS OF DRILL-HOLE DATA
CHI-SQUARE TEST FOR FIT OF POISSON, NEGATIVE BINOMINAL, LOGARITHMIC, T DISTRIBUTION, LOGNORMAL DISTRIBUTION



COMPUTER UPDATE PROVIDES VALUABLE TOOLS

COMPUTER UPDATE *USES RECOGNIZED PROCEDURES FOR THE PERFORMANCE OF AN AIRBORNE SURVEY AS AIDS TO GEOLOGICAL MAPPING.*
A DETAILED GROUND AIRBORNE SURVEY IS A PERMANENT RECORD OF A SET OF FACTS AND INCREASES IN VALUE AS MORE BECOMES KNOWN ABOUT THE GEOLOGY AND AS NEW TECHNIQUES ARE INCORPORATED BECAUSE THESE FACTS CAN THEN BE EXAMINED IN THE LIGHT OF THE NEW KNOWLEDGE WHICH HAS BEEN BROUGHT FORTH. THE AIRBORNE SURVEY USUALLY CONTAINS MUCH MORE INFORMATION THAN CAN BE EXTRACTED AT THE FIRST INTERPRETATION, AND THROUGH THE USE OF COMPUTER ANALYSIS AND PROGRAMS DESIGNED TO RESTUDY THE DATA WITH DIFFERENT PROGRAMS, IT BECOMES QUICKLY AND ACCURATELY A TOOL FOR FUTURE INTERPRETATION. THE WORK DONE MAY STILL BE AS USEFUL 10, 20 OR 50 YEARS IN THE FUTURE AS IT IS AT THE TIME THE ORIGINAL FACTS ARE RECORDED.
AIRBORNE MAPPING CAN REVEAL MAJOR INFORMATION WHICH IS NOT READILY APPARENT IN EARLY STAGES OF GROUND MAPPING AND WHICH CANNOT BE RECOGNIZED IN THE FIELD.

INFORMATION AND IDEAS PROVIDED BY DIGITAL SURVEYS MAKE MAJOR CONTRIBUTIONS TO MINERAL OR OIL EXPLORATION PROGRAMS. THE INTERPRETATION OF A DIGITAL MAP REQUIRES THE CLOSEST COOPERATION BETWEEN A TEAM OF GEOLOGISTS AND GEOPHYSICISTS.

THE HIGH SENSITIVITY INSTRUMENTS HAVE ALSO NECESSITATED THAT THE SURVEY'S DATA BE DIGITALLY RECORDED IN ORDER TO MAKE FULL USE OF THE HIGHER RESOLUTION AVAILABLE. THIS WILL PERMIT THE COMPILATION OF THE MAPS TO BE AUTOMATED AS MUCH AS POSSIBLE.

AS NEW METHODS COME OUT YOUR INFORMATION WOULD BE IN A FORM INTELLIGIBLE TO THESE NEW METHODS.

AERIAL SURVEYS

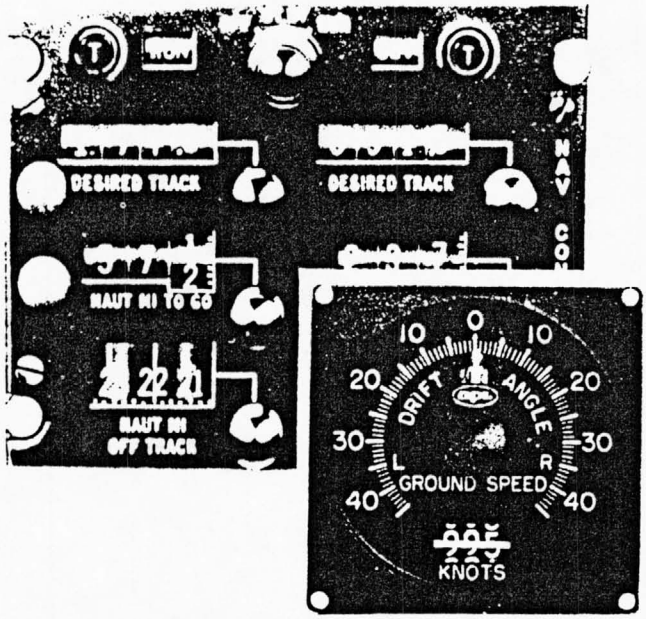
COMPUTER UPDATE'S *AIRBORNE ACQUISITION CONSISTS OF THREE METHODS IN GENERAL.*

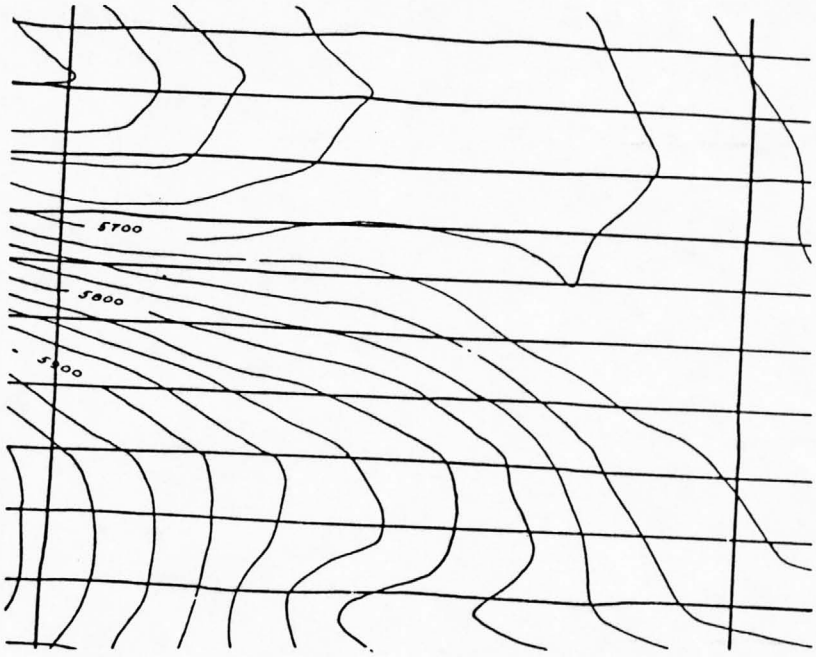
PHASE ONE

AN AIRPLANE EQUIPPED WITH SUCH INSTRUMENTS AS MAGNETOMETER, SCINTELLOMETER, RADAR ALTIMETER, AND A CAMERA FOR STRIP PHOTOGRAPHY. THE OUTPUT OF THESE INSTRUMENTS IS IN ANALOG FORM. IF A MOSAIC IS AVAILABLE OF THE GROUND TO BE FLOWN, THIS IS OBTAINED. IF NOT, ONE IS PREPARED. FLIGHT LINES ARE DRAWN OVER THIS MOSAIC AND CORRECTION TIES ARE DETERMINED. AS THE FIELD IS BEING FLOWN, THE STRIP CAMERA IS RECORDING EXACTLY WHERE THE AIRPLANE IS WITH RESPECT TO THE GROUND. THE CAMERA IS ALSO RECORDING THE NUMBER CORRESPONDING TO OUR INSTRUMENTS' DATA.
FROM THIS POINT PREVIOUS TO THE COMPUTER, LARGE AMOUNTS OF HAND REDUCTION HAS BEEN NECESSARY. **COMPUTER UPDATE** *HAS USED THE COMPUTER AS A TOOL ALONG WITH A DIGITIZER TO SPEED UP THE JOB OF DATA REDUCTION OF FLIGHT INFORMATION. THE OUTCOME IS IN THE FORM OF CONTOURED MAPS.*

PHASE TWO

IN ADDITION TO THE EQUIPMENT IN PHASE ONE WE ADD A RECORDER AND A MULTIPLEXER TO THE EQUIPMENT ON THE PLANE. THIS GIVES US THE INFORMATION IN A FORM READILY AVAILABLE TO THE COMPUTER. WE THEN DIGITIZE OUR GROUND CONTROL AND MERGE THIS WITH THE FLIGHT INFORMATION TO GIVE US OUR COMPUTER OUTPUT OF CONTOURED MAPS. WITH THIS METHOD, WE ALSO HAVE THE CAPABILITY OF CORRECTING, WHILE YET IN THE COMPUTER FOR SUCH THINGS AS ALTITUDE.





PHASE THREE

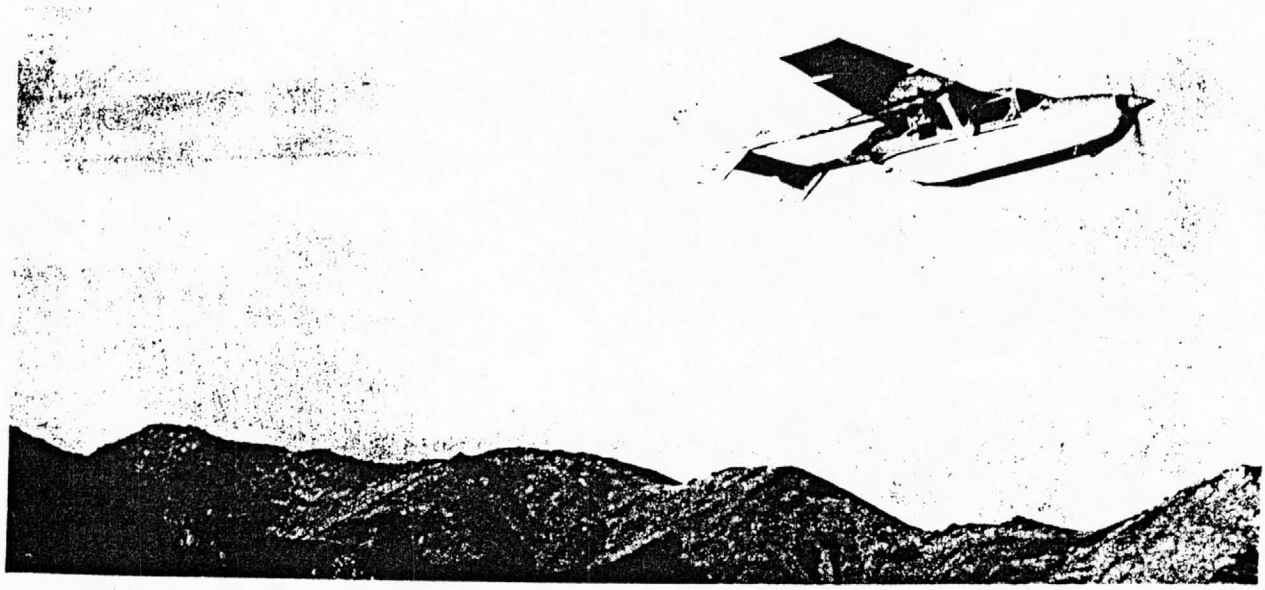
THE ADDITION OF DOPPLER RADAR TO THE EQUIPMENT OF PHASE TWO AND PUTTING THIS INFORMATION ALSO ONTO TAPE GIVES US THE FLEXIBILITY OF KNOWING WHERE THE AIRPLANE IS WITH RESPECT TO A POINT ON THE GROUND. THIS, ALONG WITH SOME CAMERA CONTROL, PROVIDES US WITH AN ALMOST COMPLETELY COMPUTERIZED METHOD OF DATA REDUCTION OF AIRBORNE INFORMATION. PHASE THREE IS VERY FLEXIBLE. WE CAN HANDLE SITUATIONS WHERE OFFSHORE AIRBORNE MEASUREMENTS ARE BEING TAKEN WITHOUT THE USE OF THE MORE EXPENSIVE SHORAN.

COMPUTER UPDATE *HAS SPENT A GREAT DEAL OF TIME AND MONEY WORKING OUT THESE SYSTEMS AND HAS HAD TO SOLVE MANY PROBLEMS SUCH AS NOISE ERRADICATION, AND EXTRANEOUS INFORMATION.*

COMPUTER UPDATE *SUCCESSFULLY DEVELOPS, MONITORS AND EXECUTES THE SYSTEMS NECESSARY FOR QUALITY AIRBORNE DATA ACQUISITION. THROUGH THE USE OF SPECIALLY INSTRUMENTED AIRCRAFT* COMPUTER UPDATE *GIVES ASSURANCE OF THE LATEST RECOGNIZED THEORETICAL STUDIES WHICH ALLOWS* COMPUTER UPDATE *TO MAINTAIN STANDARDS THAT ARE AGGRESSIVE, LEADING TO A RELIABLE REPUTATION AND GROWING TO MEET EVER INCREASING COMPETITIVE DEMANDS. SUCH STANDARDS OF DATA ACQUISITION ALLOW FOR MAXIMUM QUALITY IN DATA REDUCTION AND INTERPRETATION OF SCIENTIFIC AND GEOLOGICAL STUDIES.*
THE DATA ACQUISITION CAPABILITY OF COMPUTER UPDATE *IS AN EXTENSION OF THE APPLICATION OF MATHEMATICAL AND COMPUTER TECHNIQUES FOR THE IMPROVEMENT OF MINERAL, OIL AND WATER EXPLORATION AND AIR POLLUTION. PROPERTY EVALUATION, FUEL EXPLORATION AND ALL AIRBORNE GEOPHYSICAL AND SCIENTIFIC EXPLORATIONS.*

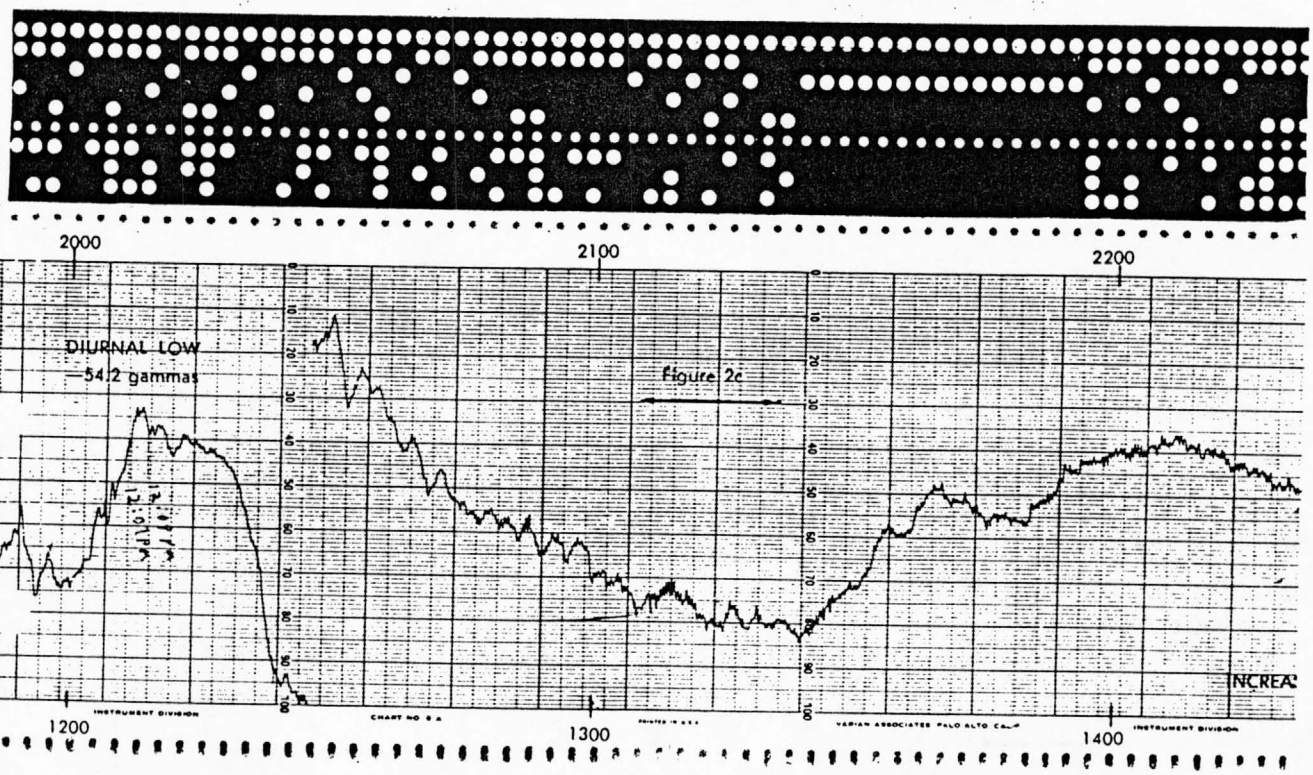
THE NEED FOR HIGHER QUALITY INFORMATION NECESSITATES THE APPLICATION OF COMPUTERS IN ORDER TO MAXIMIZE PROFITS. COMPUTER UPDATE'S *EXTENSIVE AERO SURVEYS RESULT IN A BETTER UNDERSTANDING OF THE STRUCTURE AND ROCK COMPOSITIONS OF THE EARTH'S CRUST. THIS ALLOWS GEOLOGISTS AND GEOPHYSICISTS TO HAVE A BASIS FOR CONFIRMING GEOLOGICAL FEATURES WHICH HERETOFORE HAVE BEEN OBSCURE.*

USE COMPUTER COMPATIBLE METHODS

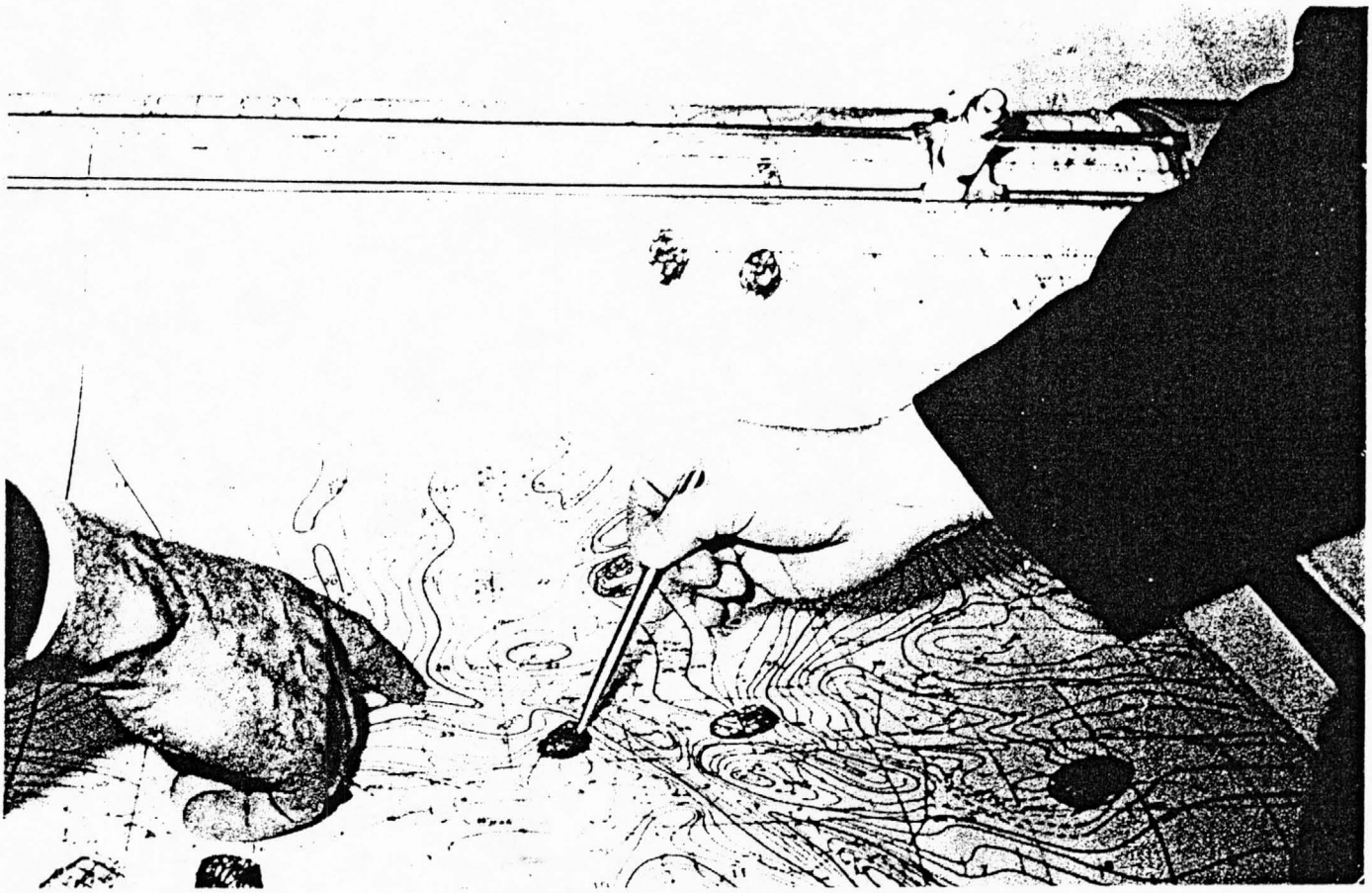


AERO MAGNETIC SURVEYS

IN AERIAL SURVEYING THE MAGNETOMETER IS FLOWN BACK AND FORTH AT A FIXED SPECIFIED ALTITUDE ALONG A SERIES OF PREDETERMINED FLIGHT LINES. THESE ARE GENERALLY CHOSEN TO RUN AT RIGHT ANGLES TO THE MAIN TREND OF GEOLOGICAL FEATURES, AND THEY ARE PARALLEL TO EACH OTHER AT VARYING INTERVALS. AS THE SURVEY PROGRESSES, THE BASE VALUE OF THE MAGNETOMETER MAY DRIFT AND THE EARTH'S FIELD CHANGE IN STRENGTH. ACCORDINGLY THE SURVEYOR ALSO FLIES A NUMBER OF CONTROL LINES ACROSS THE PATTERN, RAPIDLY OBTAINING A SET OF SECOND READINGS AT THE INTERSECTION WITH THE FLIGHT LINES. THESE VALUES ARE USED TO CORRECT FOR DRIFT IN THE INSTRUMENT AND THE FIELD.



DATA TAKEN IN ANALOG AND DIGITAL FORM



GEOPHYSICAL DATA REDUCTION

IN ORDER TO PROPERLY EVALUATE THE FEASIBILITY OF MARGINAL VENTURES, MORE AND MORE INFORMATION MUST BE EXTRACTED FROM AVAILABLE DATA. THIS NEED FOR HIGHER QUALITY INFORMATION NECESSITATES THE APPLICATION OF COMPUTER ORIENTED TECHNIQUES IN ORDER TO MAXIMIZE PROFITS AND MINIMIZE ERROR DUE TO OUTMODED METHODS OF DATA EXTRACTION. THE DATA PROCESSING AND ANALYSIS OF **COMPUTER UPDATE** *IS AN EXTENSION OF THE APPLICATION OF MATHEMATICAL AND COMPUTER TECHNIQUES.*

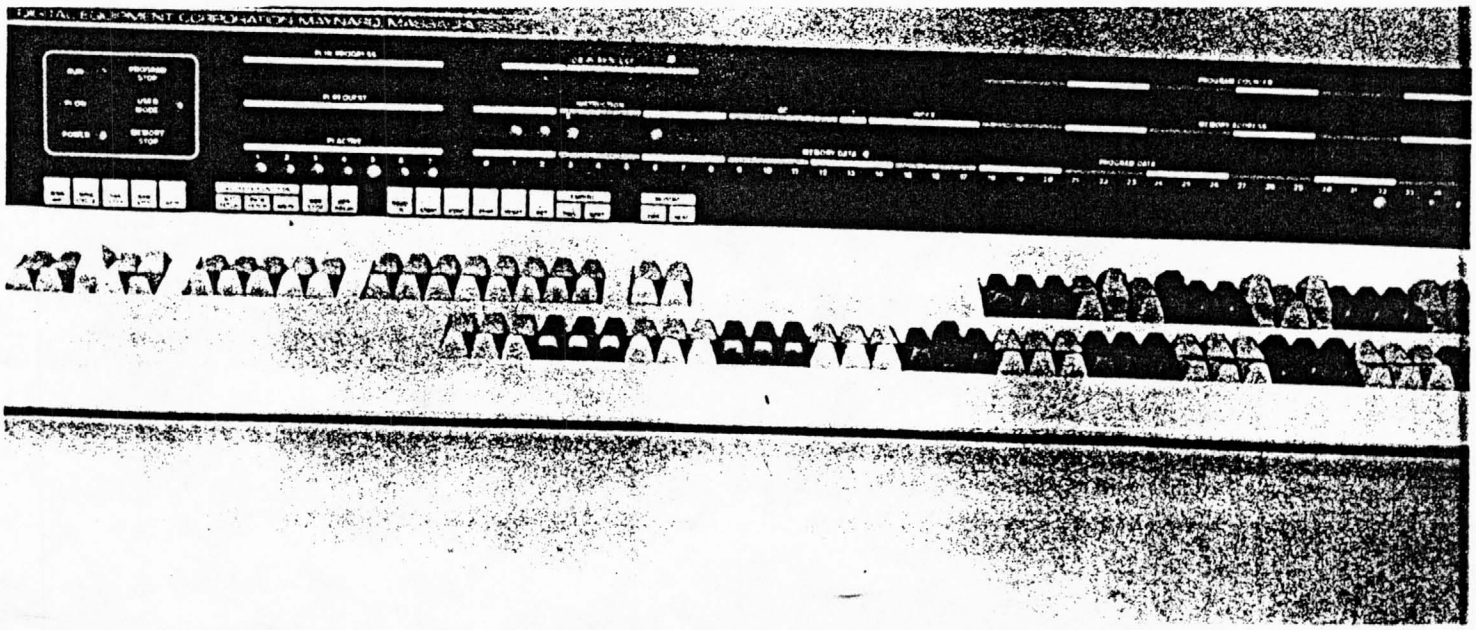
GEOPHYSICAL DATA REDUCTION IS PARTICULARLY AMENABLE TO AUTOMATIC COMPUTATION BECAUSE OF THE QUANTITATIVE NATURE OF THE DATA. RESULTS CAN BE MADE AVAILABLE TO FIELD PERSONNEL OR RESEARCHERS QUICKLY BECAUSE OF THE ACCURACY AND SPEED OF COMPUTERS. FROM DETERMINATION OF THE TYPE OF SOURCE DATA AVAILABLE, **COMPUTER UPDATE** *CAN DETERMINE FROM THE USER'S REQUIREMENTS AND OPERATIONAL PLANS THE PATTERN OF EACH STEP IN DATA TRANSMISSION FROM SOURCE TO ULTIMATE USER. THIS ANALYSIS CAN THEN BE NOTED AND ANALYZED BY THE COMPUTER TO DETERMINE THE PATTERN OF REPORTS AND DATA REDUCTION BY A SYSTEM CAPABLE OF PROCESSING VOLUMES OF INFORMATION SMOOTHLY AND RAPIDLY.*

SAVE TIME AND COSTS

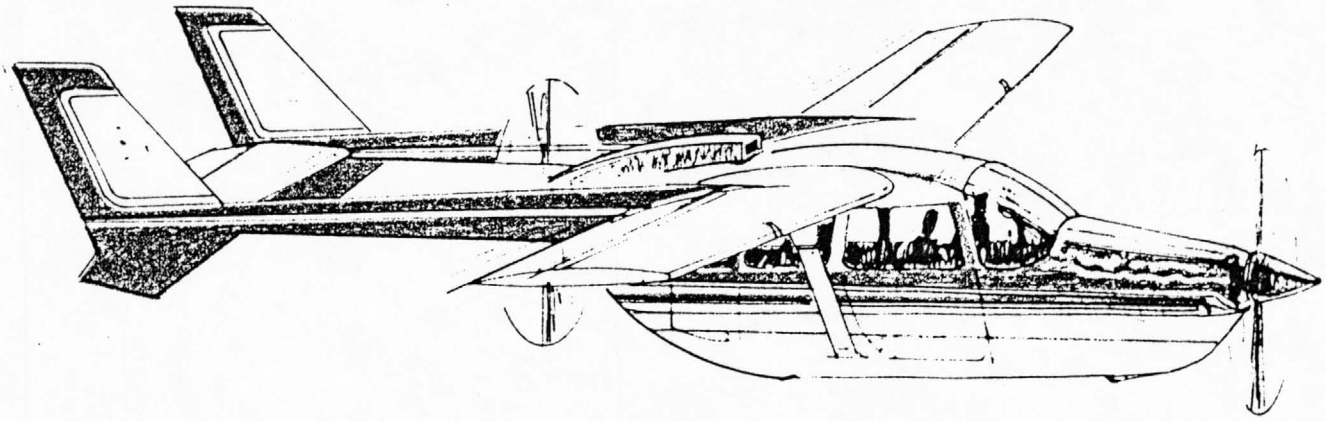
REDUCTION OF EXISTING DATA

UNNUMBERED AMOUNTS HAVE BEEN SPENT BY MANY CORPORATIONS AND INDIVIDUALS FOR GEOPHYSICAL DATA WHICH HAS BEEN PROCESSED INTO CONTOUR MAPS. IT IS NOW POSSIBLE THROUGH SOPHISTICATED, AUTOMATED METHODS TO REDIGITIZE THIS INFORMATION AND EXPOSE IT TO A MORE EXACT SCRUTINY REVEALING EVALUATIONS THAT WERE PREVIOUSLY NOT POSSIBLE BECAUSE OF LIMITED DATA INTERPRETATION.

SOME OF THESE BINDING LIMITATIONS CAN BE REMOVED THROUGH COMPUTER UPDATE'S *EXPANDED KNOWLEDGE OF DATA REDUCTION. NUMERICAL ANALYSES WILL BE AUTHORITATIVELY PERFORMED BY* COMPUTER UPDATE'S *QUALIFIED STAFF IN COMPUTER KNOW–HOW AND WITH THE AID OF A MOST UP–TO–DATE, TIME–SHARING COMPUTER SYSTEM* COMPUTER UPDATE *WILL AFFORD THE OWNER OF THE DATA A DEEPER INSIGHT INTO THE VALUE OF HIS AVAILABLE INFORMATION.*

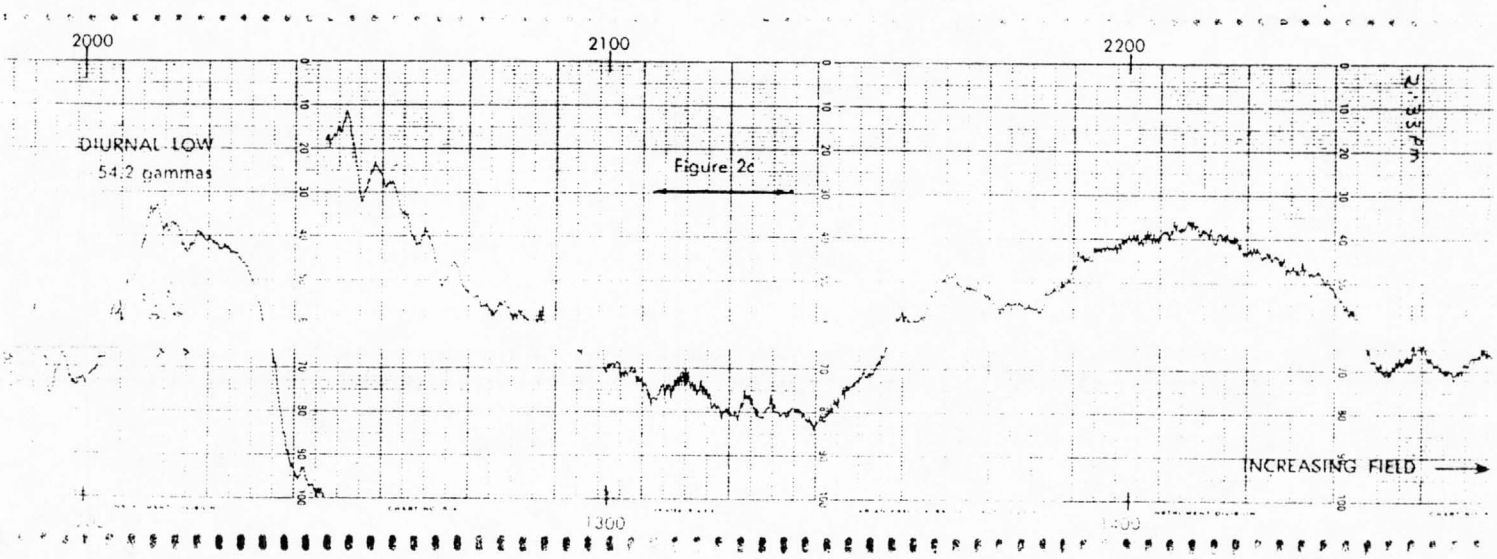


SECOND LOOK AT OLD DATA

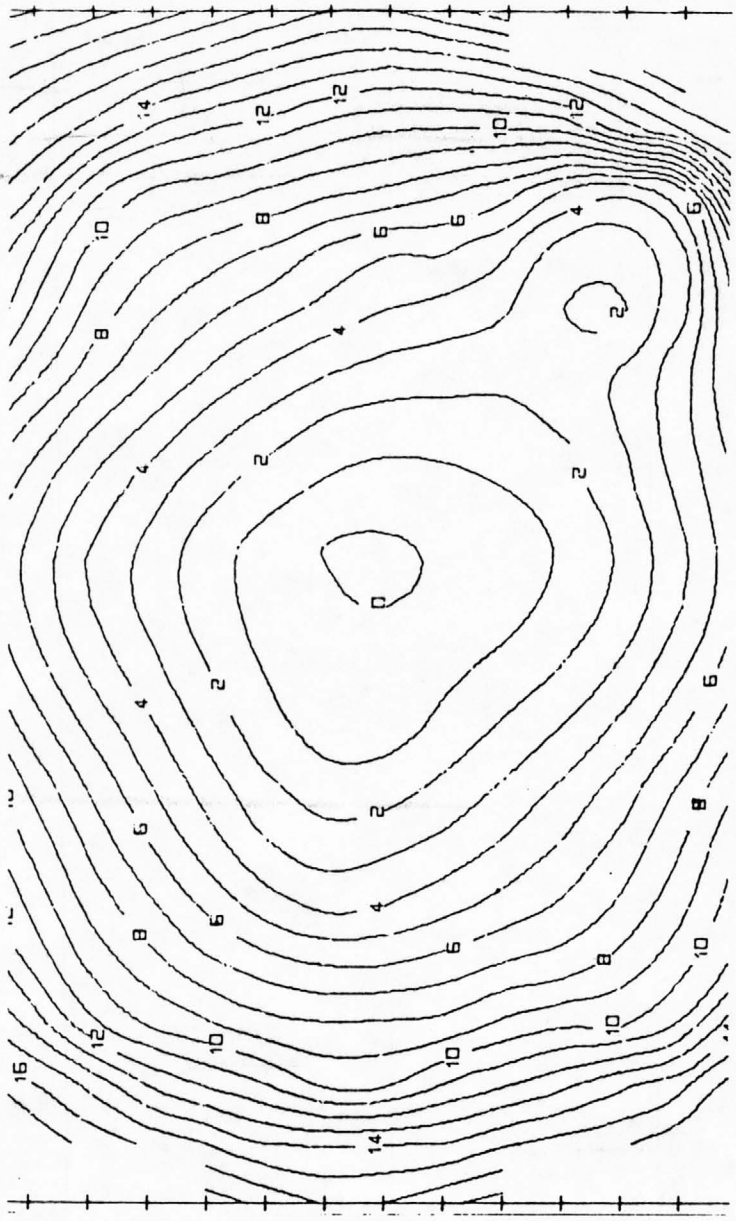


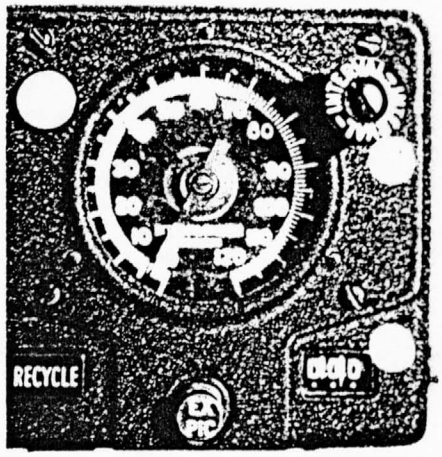
SCINTILLOMETER DATA ACQUISITION

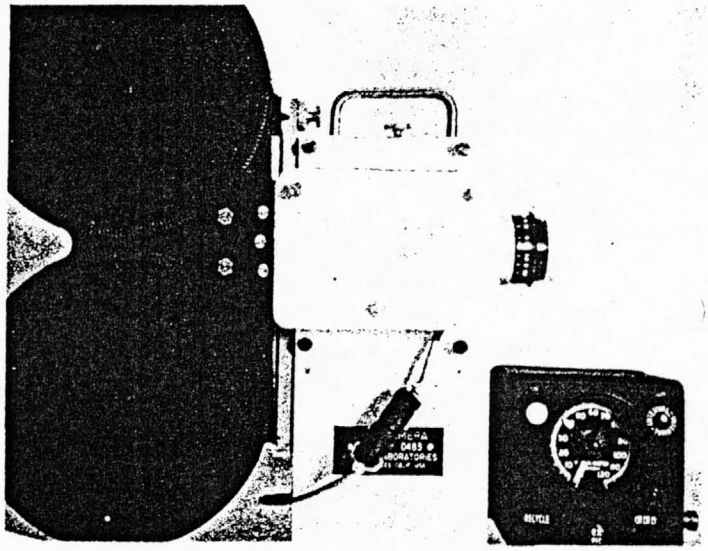
THE SCINTILLOMETER IS FAST BECOMING A TOOL FOR FINDING BOTH MINERALS AND OIL. IN MINERALS IT IS CONCERNED WITH THE RADIO-ACTIVE PROPERTIES OF MINERALS. IN OIL IT IS CONCERNED WITH THE VOIDS OF RADIO-ACTIVE PARTICLES AT THE SURFACE OF THE EARTH. COMPUTER UPDATE *IS PRESENTLY CARRYING OUT RESEARCH WITH THE SCINTILLOMETER SINCE WE EXPECT IT TO BE OF EVER INCREASING IMPORTANCE IN GEOPHYSICS IN GENERAL.*
THE PURPOSE OF CAREFUL AIRBORNE DATA ACQUISITION AND REDUCTION OF THE VARIOUS INSTRUMENTS MENTIONED IS TO PROVIDE A BASIS FOR STUDY AND DECISIONS. THIS NOW WILL GIVE ONE A NECESSARY TOOL TO PROCEED WITH THE MORE ABSOLUTE, BUT MORE EXPENSIVE GROUND WORK. COMPUTER UPDATE, *THROUGH ITS SUBSIDIARIES AND ASSOCIATES CAN OFFER SUCH*



FOUR WINDOWS – POTASSIUM, THORIUM, URANIUM, TOTAL



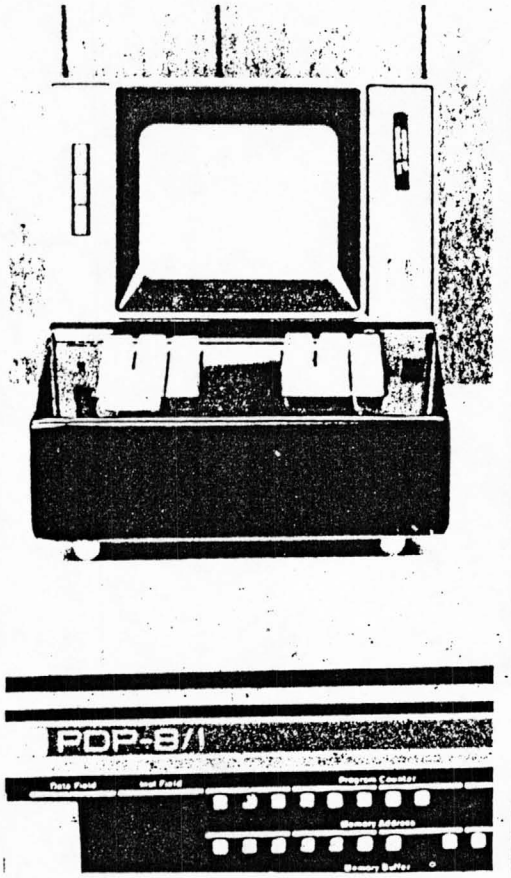


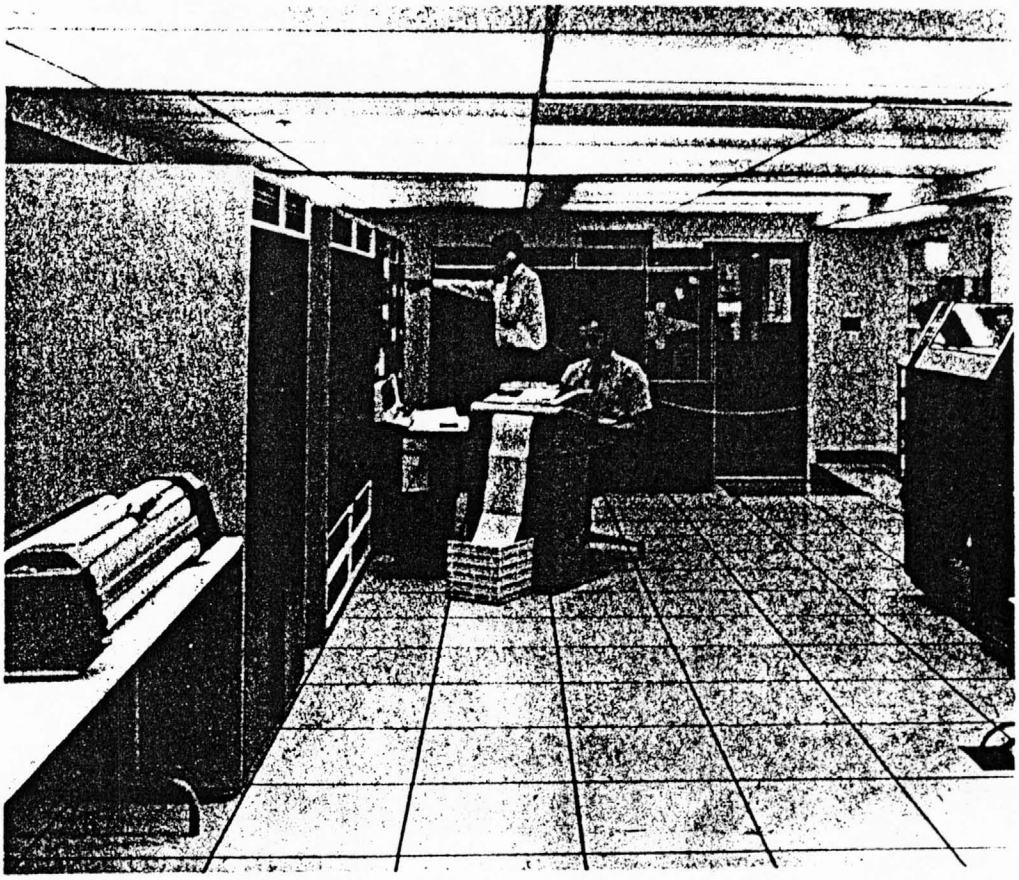


OUTLINE OF SOME COMPUTER UPDATE COMPUTER TECHNIQUES

AUTOMATIC DIGITIZING OF FLIGHT INFORMATION
AUTOMATIC DIGITIZING OF MAPS
COMPUTER REDUCTION OF AIRBORNE DATA
PROFILE PRINTOUTS
ANALOG PLOTTING
DIGITAL PLOTTING
DATA–TABLES
EXPANDING DATA
SHRINKING DATA
STATISTICAL ANALYSIS
ANALYSIS OF DISTRIBUTIONS
PROFILE ANALYSIS
MAP ANALYSIS
POINT TO SURFACE CALCULATIONS
SURFACE TO SURFACE CALCULATIONS
HIGH ORDER EQUATION SOLVING

SQUEEZE MORE INFORMATION OUT OF ORIGINAL DATA

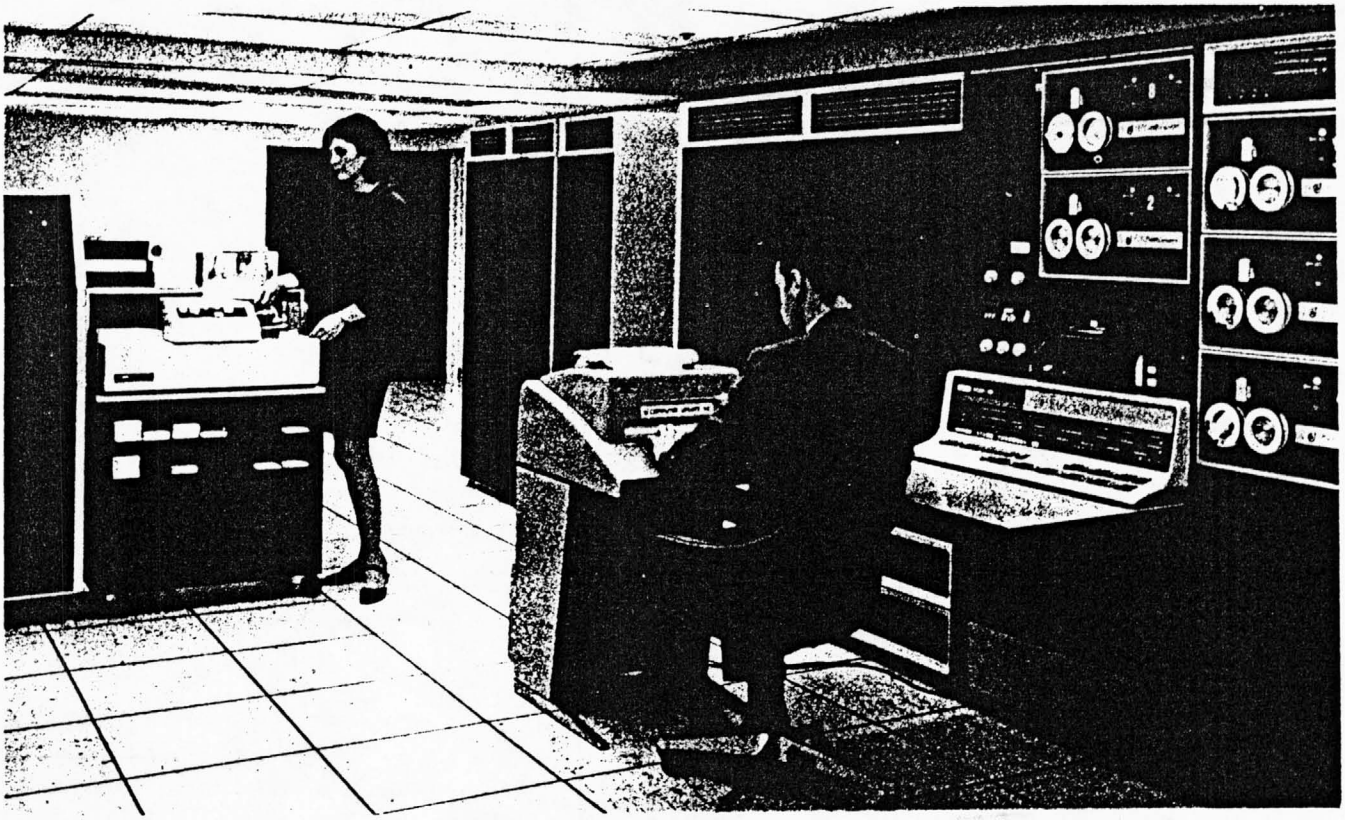




COMPUTER GRAPHICS

TO ASSIST IN EVALUATION OF COLLECTED DATA WE OFFER COMPUTER GRAPHIC SERVICES WHICH PROVIDE A RAPID AND ECONOMIC CORRELATION OF QUANTITATIVE DATA SUCH AS MAGNETIC, GRAVITY, SEISMIC, ALTIMETER, INDUCED POLARIZATION AND OTHER DATA IN THE FORM OF GRID AND CONTOUR MAPS, PROFILES AND COMBINED OVERLAYS AND MANY OTHER FORMS OF GRAPHIC REPRESENTATION OF ACQUIRED DATA. THESE GRAPHICS ARE GENERATED AS NORMAL OUTPUT OF HARDWARE COMPATIBLE CAPABILITIES AND SERVE THE USER IN BETTER UNDERSTANDING THE ACCENTUATION OF GEOPHYSICAL ANOMALIES.

EXTRACT MORE FROM YOUR DATA



GEOPHYSICAL TIME-SHARING

COMPUTER UPDATE *OFFERS, FOR THE FIRST TIME IN THE WESTERN STATES, THE TIME-SHARING ADVANTAGE OF A PDP 10 SYSTEM.* COMPUTER UPDATE *PROVIDES GENERAL PURPOSE TIME-SHARING WITH MULTIPLE CORE SWAPPING.*

COMPUTER UPDATE'S *TIME-SHARING SYSTEM IS VERY MUCH AVAILABLE AND TIME TESTED. WE ARE NOT PROMISING A SYSTEM WHICH WILL BE AVAILABLE, OR A SECOND GENERATION COMPUTER TRYING TO TIME-SHARE; WE ARE TIME-SHARING WITH TIME TESTED SOFTWARE ON A COMPUTER THAT WAS DESIGNED AS A TIME-SHARING COMPUTER.*

WE OFFER A THIRD GENERATION TIME-SHARING SERVICE WITH INTERACTIVE MULTIPLE LANGUAGE ADVANTAGES.

COMPUTER UPDATE'S *PDP 10 SYSTEM IS A MULTIUSER, MULTIPROGRAMMING SYSTEM WHEREIN MULTIPLE INDEPENDENT PROGRAMS SHARE TIME AND MEMORY SPACE. THE PDP SYSTEM IS ESPECIALLY DESIGNED TO ACCOMMODATE CONVERSATIONAL BATCH PROCESSING AND REAL-TIME JOBS CONCURRENTLY.*

HARDWARE-SOFTWARE FLEXIBILITY

COMPUTER UPDATE'S *FULLY INTEGRATED HARDWARE-SOFTWARE ALLOWS FOR OPTIMUM USER FLEXIBILITY.*

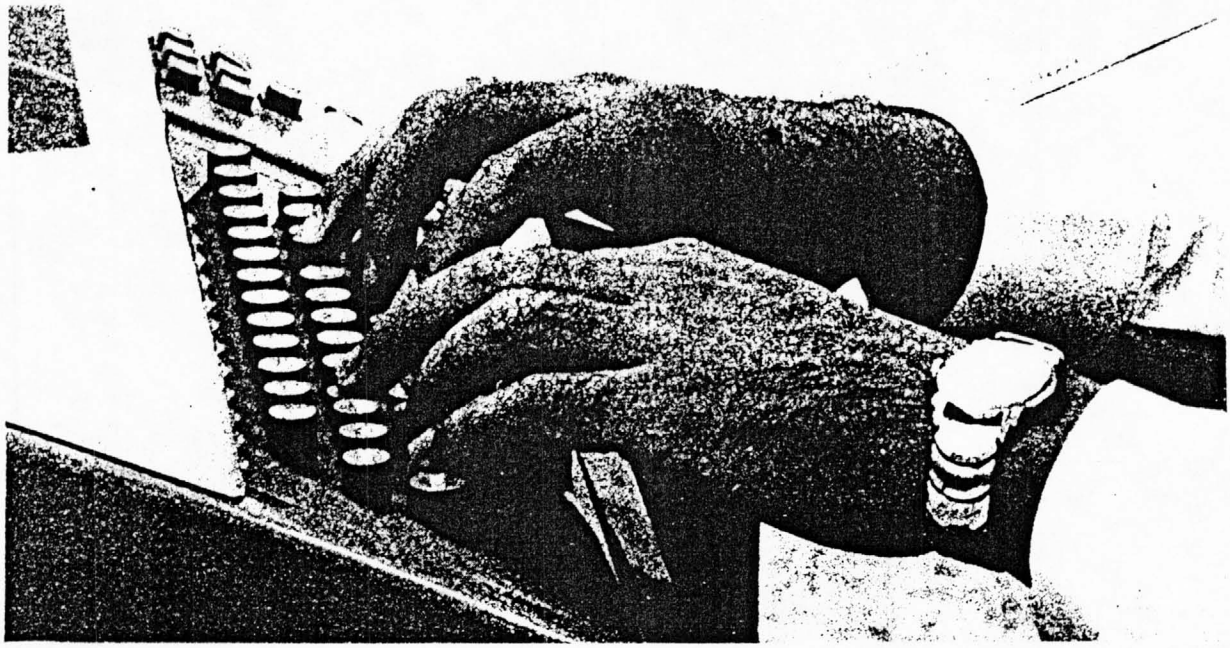
COMPUTER UPDATE *CAN INCORPORATE ANY SET OF PERIPHERAL DEVICES OF A MULTIUSER, MULTIPROGRAMMING CONFIGURATION THROUGH OUR TERMINAL SYSTEMS DIVISION.*

AS A USER YOU ARE NOT LIMITED TO ONE INFLEXIBLE LANGUAGE, BUT YOU MAY CHOOSE FROM OVER SIXTY FULLY INTERACTIVE LANGUAGES.

A SOPHISTICATED INTEGRATED HARDWARE-SOFTWARE SYSTEM GIVES THE USER A COMPLETE SERVICE THAT MEETS THE VARIED DEMANDS OF USER REQUIREMENTS.

COMPUTER UPDATE'S *PDP 10 SYSTEM IS GEARED TO A WIDE RANGE OF APPLICATIONS THAT REQUIRE INTERACTIVE TIME-SHARING SERVICES, CONCURRENT INPUT/OUTPUT AND FAST COMPUTATION.*

TIME-SHARING IS A TOOL, NOT A TOY.



COMPUTER UPDATE TIME-SHARING ADVANTAGES

POWERFUL JOB-ORIENTED TIME-SHARING PERFORMANCE WITH 36-BIT WORDS FOR HIGH SINGLE WORD PRECISION. WITH 366 INSTRUCTIONS MAKING ONE HOUR OF OUR PDP 10 TIME WORTH THREE TO ELEVEN HOURS OF OTHERS' SERVICES. OUR COMPUTER CONTAINS OVER 360 MAJOR INSTRUCTIONS WHICH MAKE THE PROGRAM SHORTER, MAKE PROGRAMS RUN FASTER AND OCCUPY LESS STORAGE.

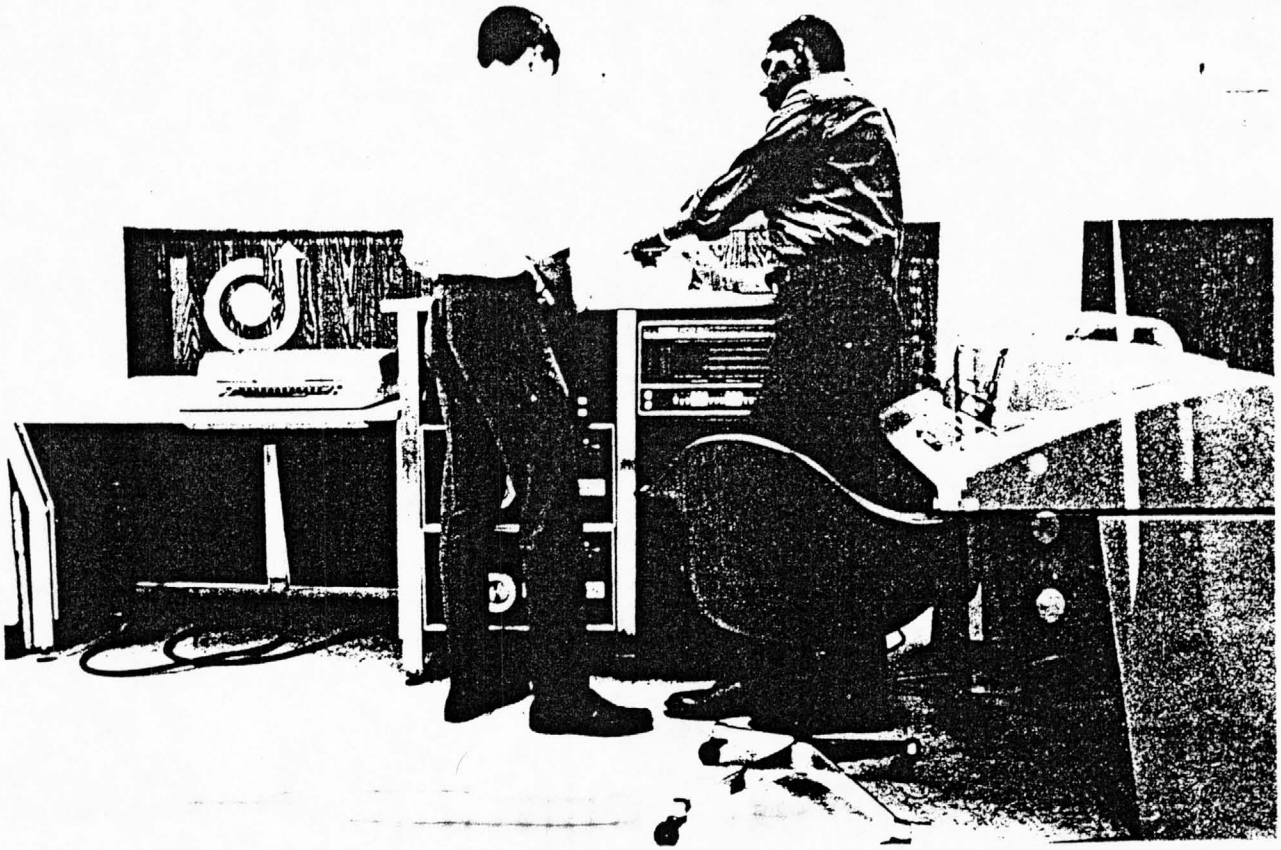
WITH THE POWER OF THE ORDER CODE WE PERFORM PROBLEMS WITH FEWER INSTRUCTIONS BY APPLYING FULL PDP PERFORMANCE. YOU, AS A USER, CAN EXPERIENCE FASTER JOB RESPONSE TIME, MORE CONVENIENT OPERATION AND DIFFERENT CATEGORIES OF TASKS RANGING FROM AN INTERACTIVE "CONVERSATIONAL" MODE TO ENTERING DATA FOR PROCESSING AND FINAL OUTPUT.

ADVANTAGES

- *NO LONG DISTANCE COSTS*
- *SOPHISTICATED I/O SOFTWARE*
- *QUICK TERMINAL RESPONSES*
- *POWERFUL JOB-ORIENTED FEATURES*
- *HIGH-SPEED PROGRAM SWAPPING*

- *32K (36-BIT WORD) EXPANDABLE TO 256K*
- *36-BIT WORDS PROVIDE HIGH ACCURACY SINGLE PRECISION*
- *366 INSTRUCTIONS INCLUDING*
  - *ALL BOOLEAN OPERATIONS*
  - *PROGRAMMED OPERATIONS*
  - *IMMEDIATE OPERATIONS*
  - *FLEXIBLE BYTE MANIPULATION*
- *FLOATING POINT*
- *MULTILEVEL INDIRECT ADDRESSING*
- *MULTILEVEL INDEXING*
- *16 GENERAL PURPOSE REGISTERS*
  - *16 ACCUMULATORS*
  - *15 INDEX REGISTERS*
  - *HIGH SPEED PROGRAM LOOPS*
- *TIME PROVEN SOFTWARE*
  - *OVER 1,000,000 CONSOLE HOURS EXPERIENCE*

YOU ARE AS CLOSE AS YOUR TELEPHONE



SYSTEM PROGRAMS

AID
RESEARCH ORIENTED CONVERSATIONAL LANGUAGE FOR THE SCIENTIST AND ENGINEER. LANGUAGE IS DIRECT AND EASY TO LEARN.

FORTRAN IV
ASA STANDARD SINGLE-PASS COMPILER WITH HIGHLY OPTIMIZED OBJECT CODE. FULLY EXPLOITS OUR POWERFUL INSTRUCTION SET.

MACRO ASSEMBLER
FLEXIBLE DEVICE INDEPENDENT ASSEMBLY LANGUAGE WITH SOPHISTICATED MACRO INSTRUCTION FACILITIES. MACRO HAS MANY SPECIAL DATA GENERATING, CONDITIONAL ASSEMBLY, LISTING AND CONTROL PSEUDO-OPERATIONS.

PIP *(Peripheral Interchange Program)*
TRANSFERS ALPHANUMERIC OR BINARY DATA FROM OR TO ANY I/O DEVICE WITH OPTIONAL EDITING, SEQUENCING, MERGING, AND SYNTAX CHECKING FEATURES.

TECO
PERFORMS SIMPLE EDITING FUNCTIONS AS WELL AS HIGHLY SOPHISTICATED SEARCH, MATCH, AND SUBSTITUTE OPERATIONS. POWERFUL ONE-PASS SYNTAX-DIRECTED COMPILER WHICH ACCEPTS INPUT FROM ANY INPUT DEVICE.

LISP
A GENERAL-PURPOSE PROGRAMMING LANGUAGE WHICH UTILIZES A LIST-STRUCTURE STORAGE SCHEME FOR BOTH PROGRAM AND DATA.
SUITED ESPECIALLY FOR MANIPULATION OF SYMBOLIC QUANTITIES.

DDT *(Dynamic Debugging Technique)*
FAMOUS ON-LINE SYMBOLIC DEBUGGING AID WITH MORE THAN 50 COMMANDS, PERMITTING DYNAMIC INTERACTION WITH RUNNING PROGRAMS.

SCIENCE LIBRARY
MORE THAN 110 LIBRARY ROUTINES INCLUDING DOUBLE PRECISION AND COMPLEX FUNCTIONS.

BASIC
BASIC PROVIDES AN EASY-TO-USE LANGUAGE FOR THE BEGINNING NOVICE AND ALLOWS HIM TO ACCOMPLISH USEFUL WORK EVEN BEFORE HE HAS LEARNED ABOUT THE USEFUL FEATURES OF THE COMPUTER UPDATE *LANGUAGES.*

IMPORTANCE

IN RECOGNITION OF THE MAGNITUDE, SCOPE AND SECURITY ASPECTS OF ALL CONTRACT DATA, **COMPUTER UPDATE** *IS PREPARED TO PLACE RESPONSIBILITY FOR CONTRACT PERFORMANCE AT A TOP LEVEL OF ITS ORGANIZATION. HAVING THE CAPABILITY TO PERFORM IN IMPORTANT PROCUREMENTS,* **COMPUTER UPDATE** *IS PREPARED TO COMMIT THE NECESSARY TECHNICAL RESOURCES TO THE SUCCESSFUL PERFORMANCE ON CONTRACTS.*

COMPUTER UPDATE

72 EAST 4th SOUTH
SALT LAKE CITY, UTAH 84111
(801) 363-4593

T.M.R. I.P.
R.R. BX D AREA

67

REPORT ON THE
INDUCED POLARIZATION SURVEY
ON THE
CAB CLAIM GROUP, TOMBSTONE AREA
COCHISE COUNTY, ARIZONA

Robbers Roost
Bx Area

REPORT ON THE INDUCED POLARIZATION SURVEY ON THE CAB CLAIM GROUP, TOMBSTONE AREA COCHISE COUNTY, ARIZONA

I
INTRODUCTION

At he request of Mr. C. T. Henderson, the reconnaissance induced polarization survey initiated in October 1967, on the CAB Claim Group near Tombstone, Arizona, was continued during October 1968. The property is situated several miles southwest of Tombstone.

The ore potential of this area is expected to be from moderate to considerable depth. The induced polarization and resistivity survey was attempted to assist in locating any zones of mineralization that might be present at depth.

II
PRESENTATION OF RESULTS

The induced polarization and resistivity result is shown on the data plot enclosed with this report.

Three lines were surveyed for the reconnaissance induced polarization survey during the October 1967 effort, however, only LINE NO. 1 and LINE NO. 3 were geophysically surveyed at that time. The present effort includes LINE NO. 2.

LINE NO. 2 500' electrode spacing

Enclosed with this report is a plan map of the CAB Claim Group at a scale of 1:24000. The definite and probable induced polarization anomalies are indicated by solid and broken bars respectively on this plan map. These bars represent the surface projection of the anomalous zones as interpretated from the location of the transmitter and receiver electrodes when the anomalous values were measured.

Since the induced polarization measurement is essentially an averaging process, as are all potential methods, it is frequently difficult to exactly pinpoint the source of an anomaly. Certainly, no anomaly can be located with more accuracy than the spread length; i. e. when using 500' spreads the position of a narrow sulfide body

can only be determined to lie between two stations 500' apart. In order to locate sources at greater depth, larger spreads must be used, with a corresponding increase in the uncertainties of location. Therefore, while the center of the indicated anomaly probably corresponds fairly well with the source, the length of the indicated anomaly along the line should not be taken to represent the exact edges of the anomalous material.

III
DISCUSSION OF RESULTS

The apparent resistivities measured during the reconnaissance survey indicate that the area is structurally quite complex.

Interpretation of the data indicate two definite anomalies, one from 10 N to 5 S, and the other from 32 S to 43 S; also four probable anomalies, one from 54 N to 42 N, another from 20 S to 32 S, and another from 43 S to 49 S, and another from 55 S to 60 S.

LINE NO. 2, correlates fairly well with LINES NOS. 1 and 3, and indicates that the mineraized zones have good lineal continuity.

It should be mentioned that the induced polarization survey lines were run north-south, whereas the suspected trend of possible mineralization was considered to bear northeast to southwest. The north-south bearing was used to assist in defining narrow mineralized zones, if present, as they would be oriented within the geometry of the electrode spread for most effective detection.

IV
CONCLUSIONS AND RECOMMENDATIONS

The reconnaissance induced polarization survey of this area indicated definite and probable anomalies and certainly warrants further investigation.

LINE NO. 2, which was surveyed, correlates fairly well with LINES NOS. 1 and 3, and indicates that the mineralized zones have good lineal continuity.

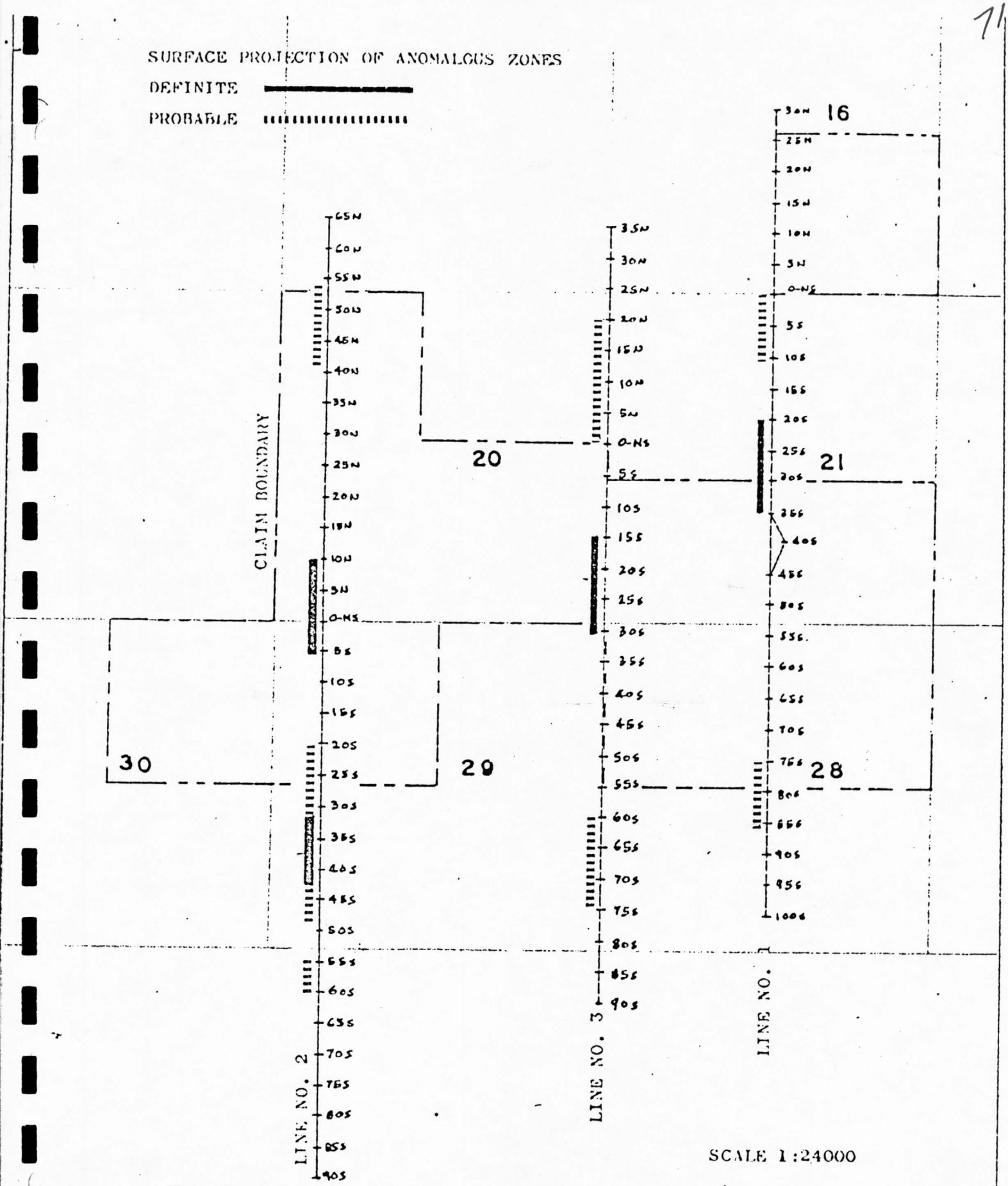
It is strongly recommended that at least one line be surveyed across LINES NOS. 1, 2 and 3, to substantiate the anomalous zones. This should be conducted using 500' dipole lengths.

The definite and probable IP anomalous areas could also be surveyed using 1000' dipole lengths to assist in verifying the data developed by the n-5 and n-6 dipole-dipole separations.

Respectfully submitted,

Nicholas H Carouso

Nicholas H. Carouso 11/4/68



INDUCED POLARIZATION AND RESISTIVITY SURVEY
CAB CLAIM GROUP, TOMBSTONE AREA, COCHISE CTY.-ARIZ.

OCT. 1967, REVISED OCT. 1968

THE INDUCED POLARIZATION METHOD

Induced Polarization as a geophysical measurement refers to the blocking action or polarization of metallic or electronic conductors in a medium of ionic solution conductors.

This electro-chemical phenomenon occurs wherever electrical current is passed through an area which contains electronic conductors such as base metal sulfides. Normally, when current is passed through the ground, as in resistivity measurements, all of the conduction takes place through ions present in the water content of the rock or soil; i. e. by ionic conduction. This is because almost all minerals have a much higher specific resistivity than ground water. The minerals commonly described as "metallic", however, have specific resistivities much lower than ground waters. The induced polarization effect takes place at those interfaces where the mode of conduction changes from ionic in the solutions filling the interstices of the rock to electronic in the metallic minerals present in the rock.

The blocking action or induced polarization described above, which depends upon the chemical energies necessary to allow the ions to give up or receive electrons from the metallic surface, increases with the time that a D. C. current is allowed to flow through the rock; i. e. as ions pile up against the metallic interface the resistance to current flow increases. Eventually, there is enough polarization in the form of excess ions at the interfaces to effectively stop all current flow through the metallic particle. This polarization takes place at each of the infinite number of solution-metal interfaces in a mineralized rock.

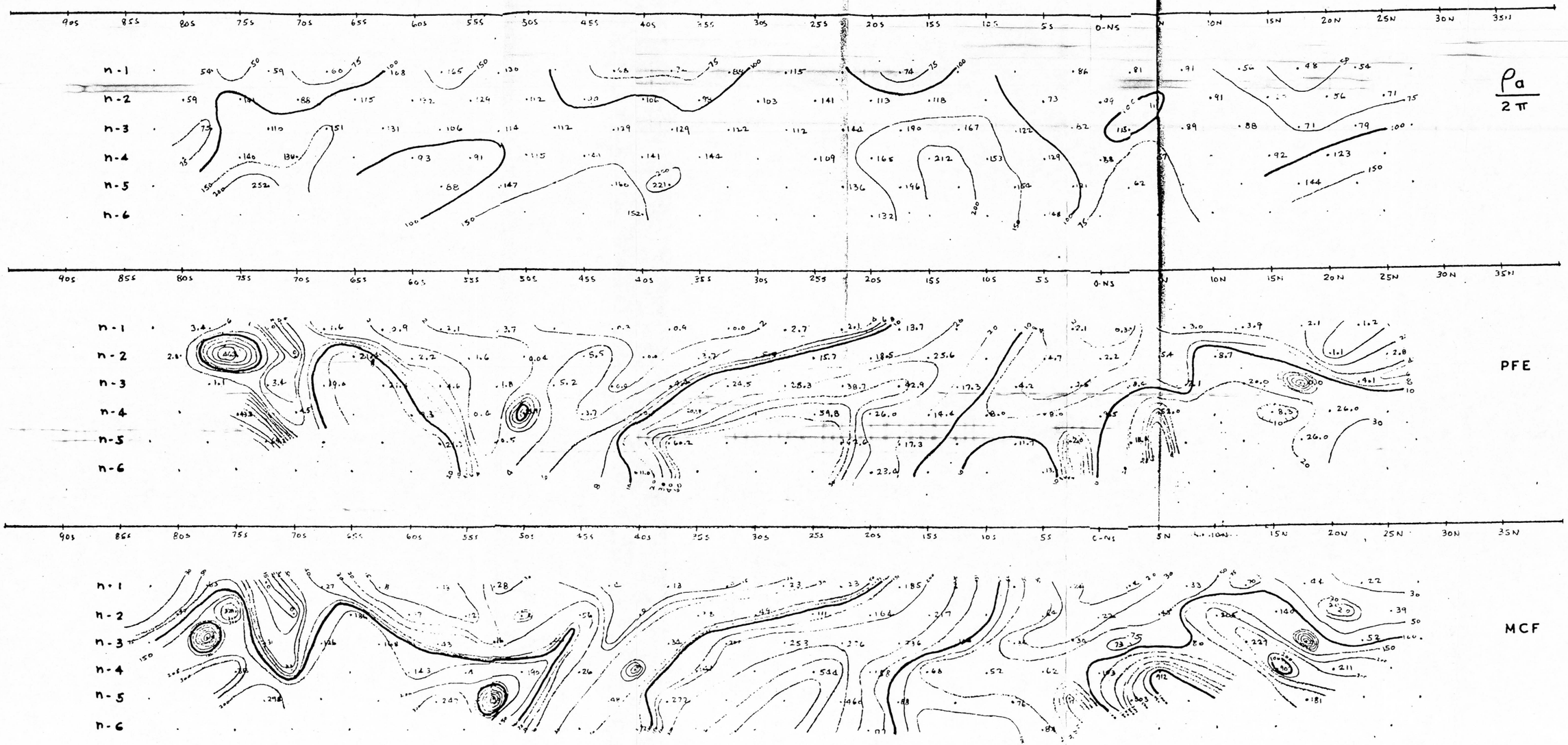
When the D. C. voltage used to create this D. C. current flow is cut off, the Coulomb forces between the charged ions forming the polarization cause them to return to their steady state. This movement of charge creates a small current flow which can be measured on the surface of the ground as a decaying potential difference.

Now if the direction of the current through the system is reversed repeatedly before the polarization occurs, the effective resistivity of the system as a whole will change as the frequency of the switching is changed.

In this induced polarization reconnaissance survey, five equally spaced co-linear current electrodes were placed in the ground by

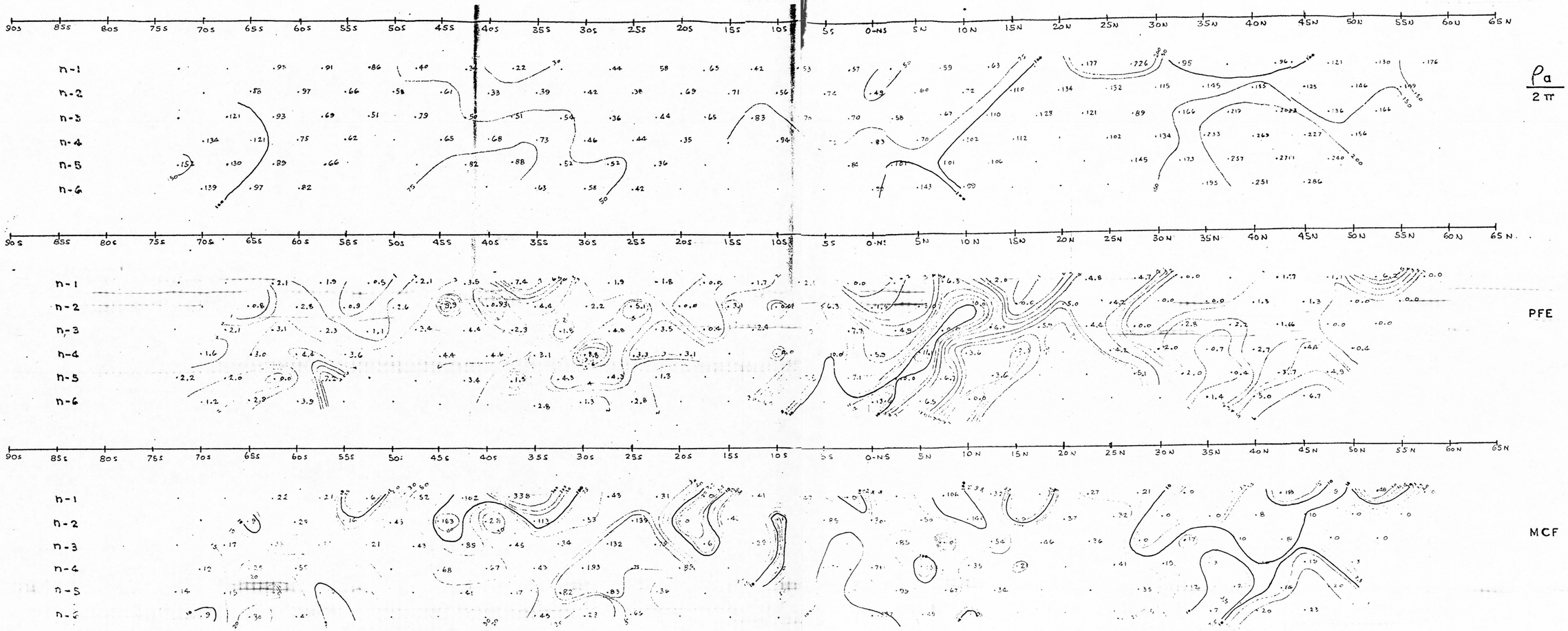
burying aluminum foil in pits wetted with brine. Observations were made in accordance with a symmetrical dipole-dipole configuration where the distance between the receiver or potential electrodes was kept equal to the distance between adjacent electrode pairs. Generally the receiving dipole is separated by one to six dipole units ("n" separation) from the sending dipole. A precisely controlled square wave current was sent through a sending dipole at 0.05 and 3.0 cycles per second from which, at the receiving dipole, a D. C. and an A. C. voltage was measured, respectively. By knowing the geometry involved (the dipole length or spacing and the separation distance between the two receiving-sending dipole pairs), along with the two voltages, an apparent D. C. and an A. C. resistivity was calculated. From these apparent resistivities, their percentage difference was determined, thus giving the Percent Frequency Effect (PFE). A third quantity proportional to PFE and inversely proportional to D. C. resistivity, called Metallic Conduction Factor (MCF) was computed in order to somewhat normalize PFE for variations in ground conductivity purely as a technical interpretational aid.

The IP technique was developed primarily for porphyry type deposits and is perhaps the only reliable means of detecting hidden disseminated sulfides. However, the IP method works just as well or perhaps better on semi-massive to massive sulfides, contrary to some of the earlier thinking, for it gives increased response with increased volume percentage of sulfides.



INDUCED POLARIZATION AND RESISTIVITY SURVEY

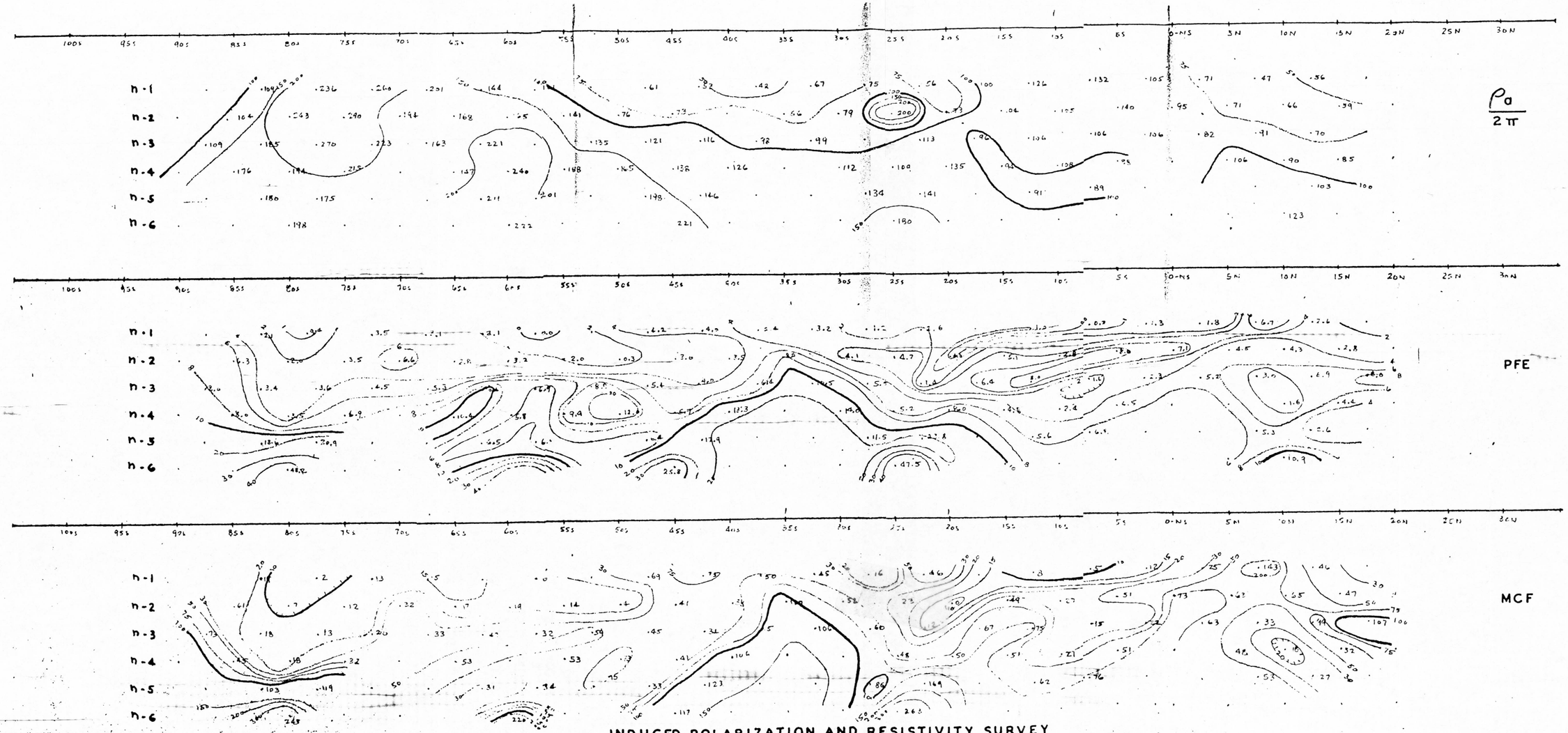
CAB CLAIM GROUP, TOMBSTONE AREA, COCHISE CTY.-ARIZ.



INDUCED POLARIZATION AN[illegible]IVITY SURVEY

CAB CLAIM GROUP, TOMBSTONE [illegible]. COCHISE CTY.-ARIZ.

SCALE- [illegible]/4"= 500' OCT. 1968



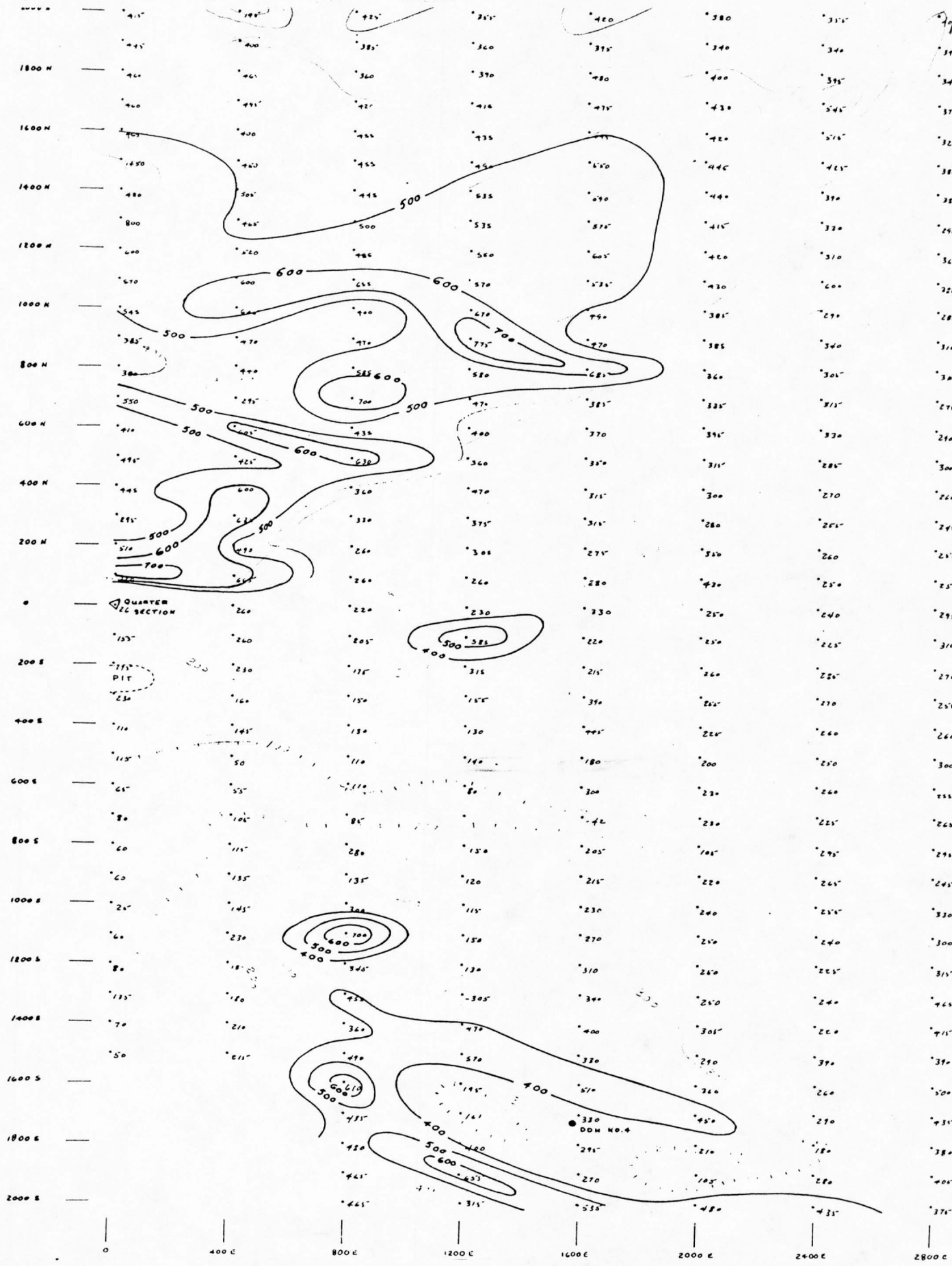
INDUCED POLARIZATION, AND RESISTIVITY SURVEY

CAP CLAIM GROUP TOMBSTONE AREA, COCHISE CTY. - ARIZ.

SCALE - 3/4" = 500'

OCT. 1967

HEWITT MAG.
VERT. INT.

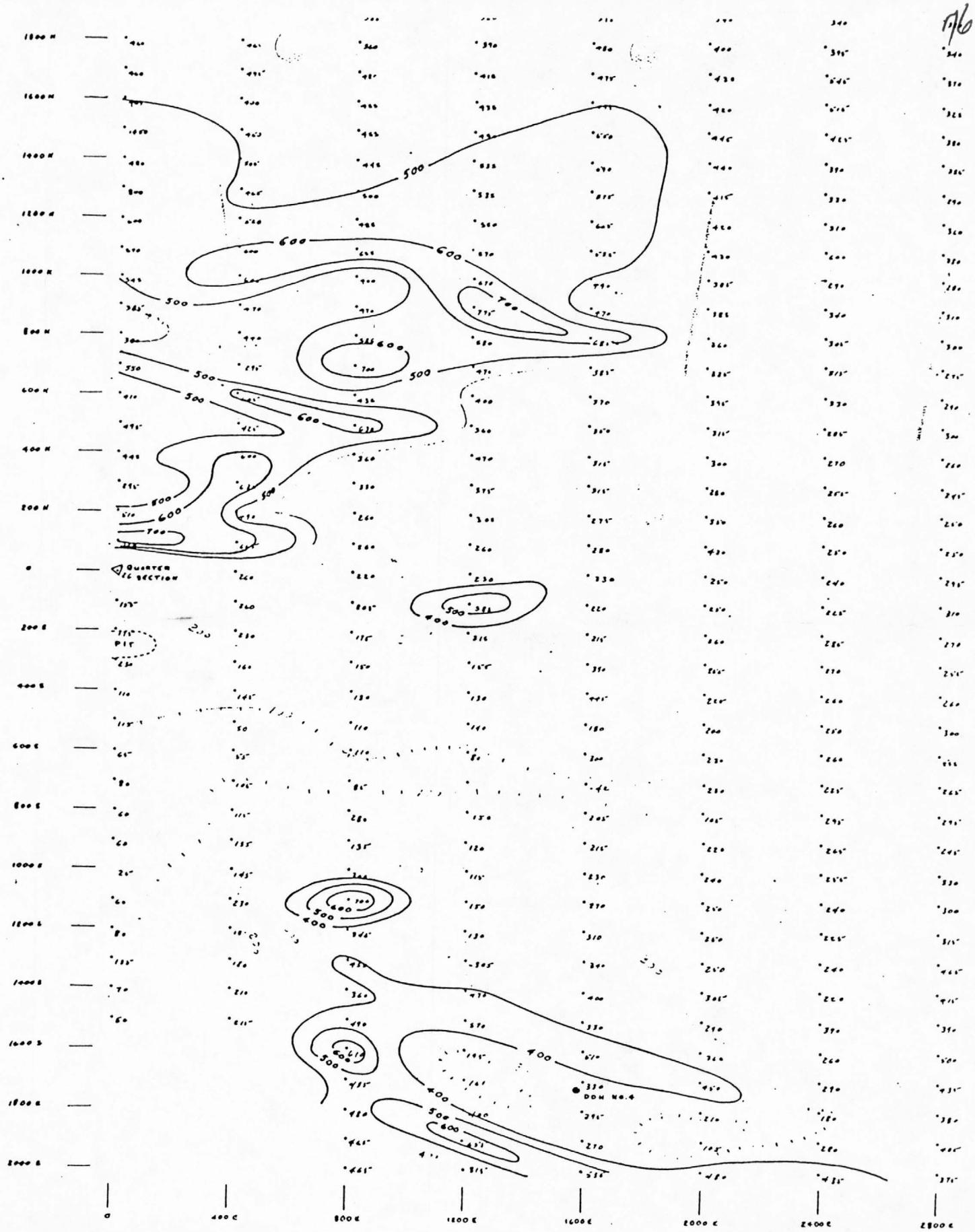


TOMBSTONE CHARLESTON

VERTICAL INTENSITY

MAGNETICS

16 MAY 70

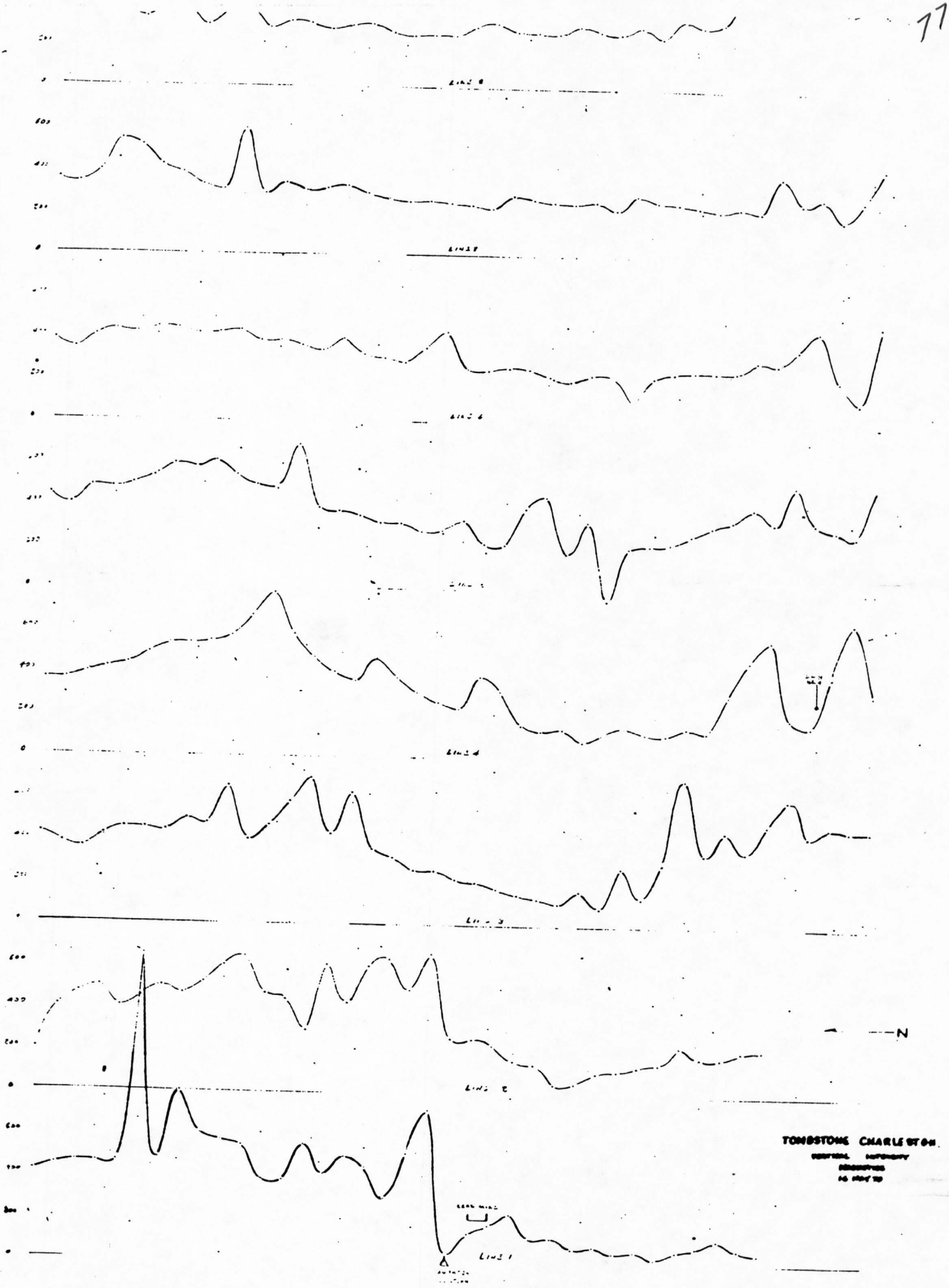


TOMBSTONE CHARLESTON

VERTICAL INTENSITY

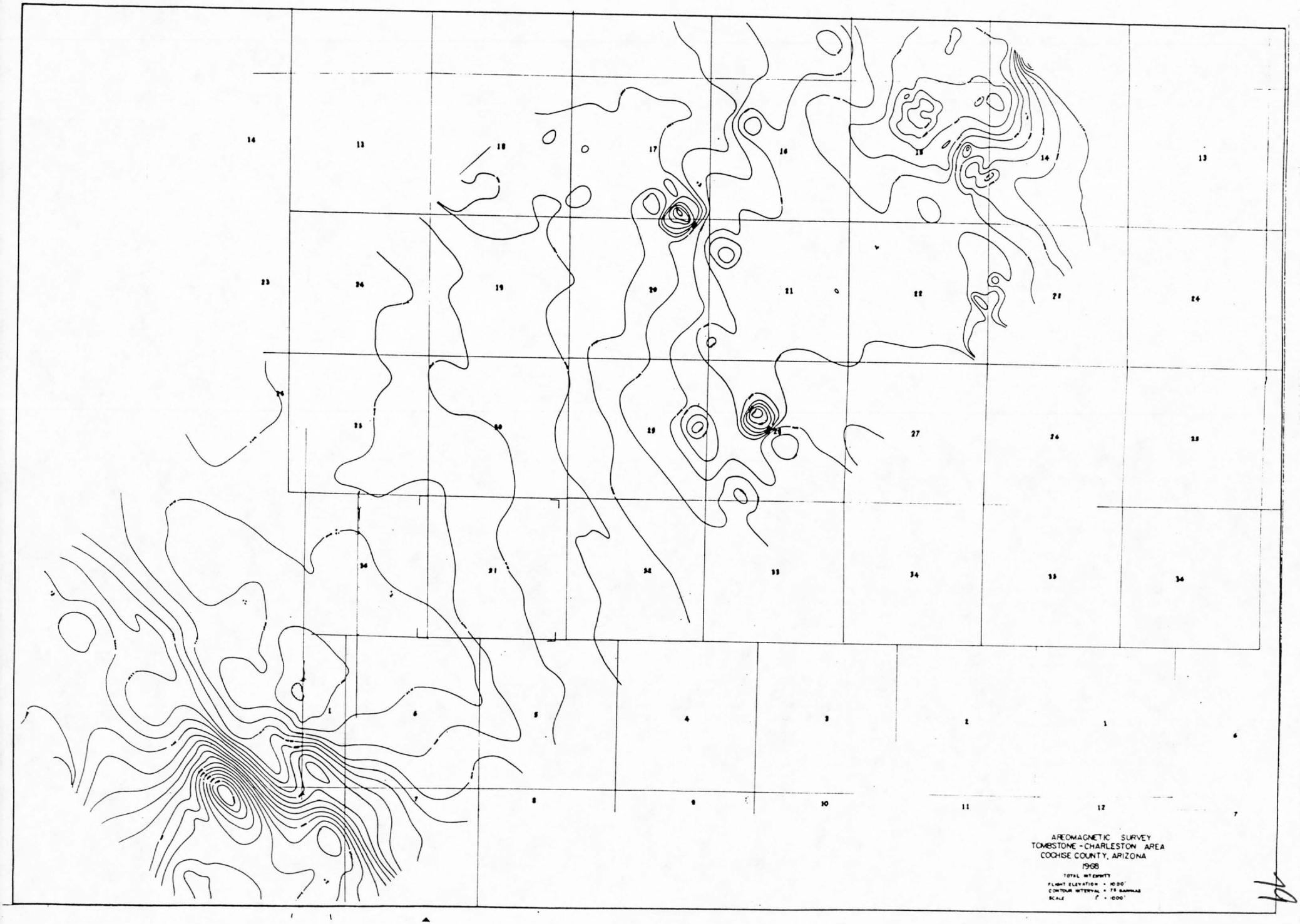
MAGNETICS

16 MAY 70


LINE 8
LINE 7
LINE 6
LINE 5
LINE 4
LINE 3
LINE 2
LINE 1
N
TOMBSTONE CHARLESTON

HEROMAG MIAS

DAUC CONTOUR'S 75


AREOMAGNETIC SURVEY
TOMBSTONE - CHARLESTON AREA
COCHISE COUNTY, ARIZONA
1968
TOTAL INTENSITY
FLIGHT ELEVATION = 10,000'
CONTOUR INTERVAL = 75 GAMMAS
SCALE 1" = 1000'

AREAS OF KNOWN
GEOCHEM SAMPLES

SKYLINE LABS, INC.
Hawley & Hawley, Assayers and Chemists Division
1700 W. Grant Rd., P.O. Box 50106, Tucson, Arizona 85703
(602) 622-4836

Charles E. Thompson
Arizona Registered Assayer No. 9427

William L. Lehmbeck
Arizona Registered Assayer No. 9425

CERTIFICATE OF ANALYSIS

ITEM NO.	SAMPLE IDENTIFICATION	Ag ppm	Cu ppm	Mo ppm
1	1A	<0.2	5	
2	2	0.2	5	
3	3	1 0	5	
4	4	0.6	5	
5	5	<0.2	5	
6	6A	0.2	5	
7	7B	0.6	10	
8	8A	0.2	5	
9	9	0.8	5	2
10	10	700.	550	140
11	11	18.	5	
12	12	1.4	5	
13	13	<0.2	5	
14	14	0.2	5	2
15	15	1.8	5	2
16	16	0.4	5	
17	17	<0.2	5	
18	18	<0.2	5	
19	19	0.4	5	
20	20	14.	5	
21	21	4.2	5	12
22	22A	2.0	5	12

TO:
Mr. C. A Cosgrove
1923 West Osborn Road
Phoenix, Arizona 85016

REMARKS:
Trace analysis

CERTIFIED BY:

DATE REC'D:	DATE COMPL.:	JOB NUMBER:
8/19/74	8/26/74	741625

81

MEMORANDUM

August 12, 1974

To: M. S. Horne

Re: Geochem Survey

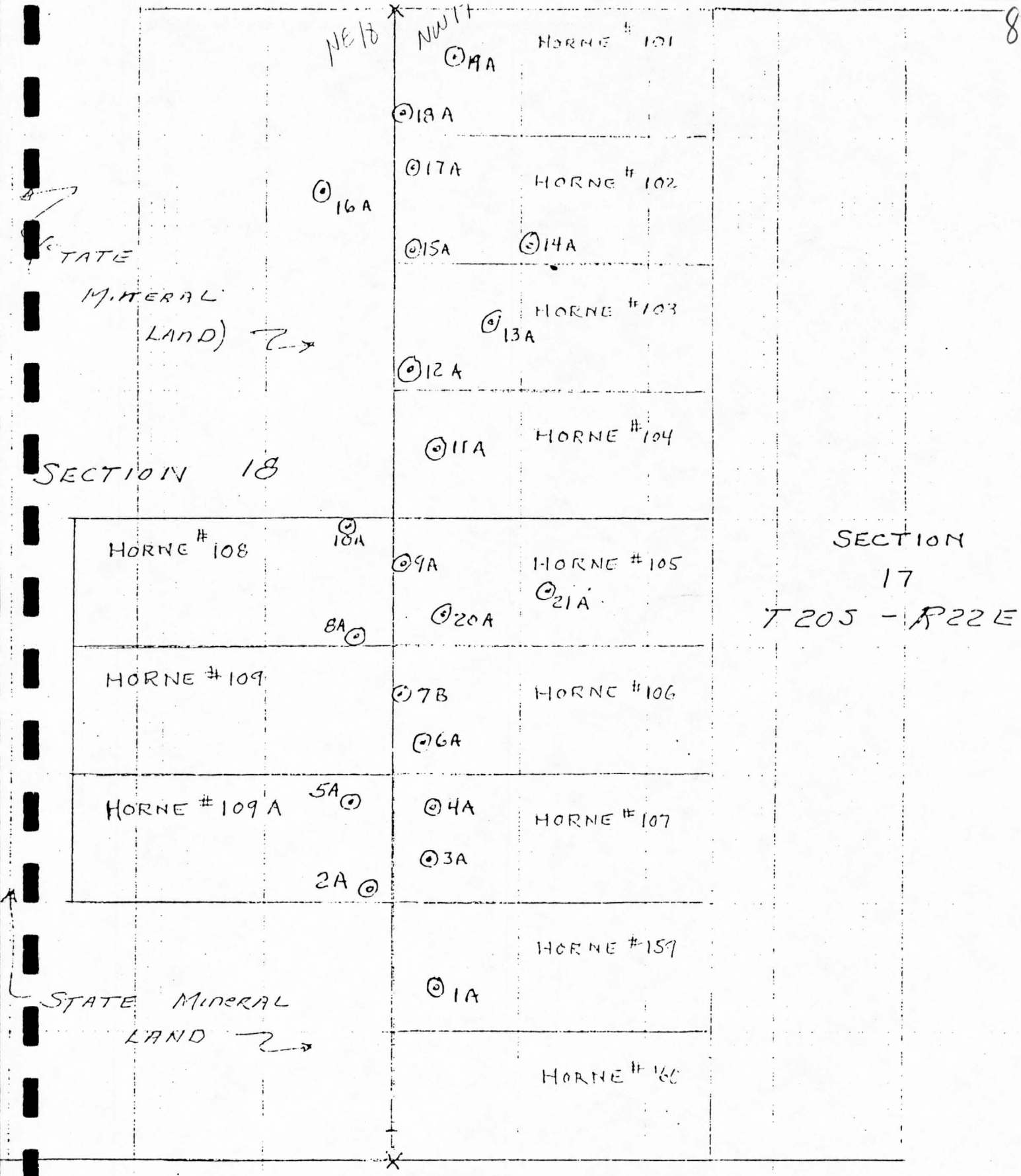
There is attached a copy of the sampling accomplished to date.

I have halted this work pending further discussion with you pertaining to these claims.

C. A. Cosgrove

CAC:vs
Attachment

Firestone



⊙ SAMPLES-GEOCHEM
8-9-74 & 8-10-74

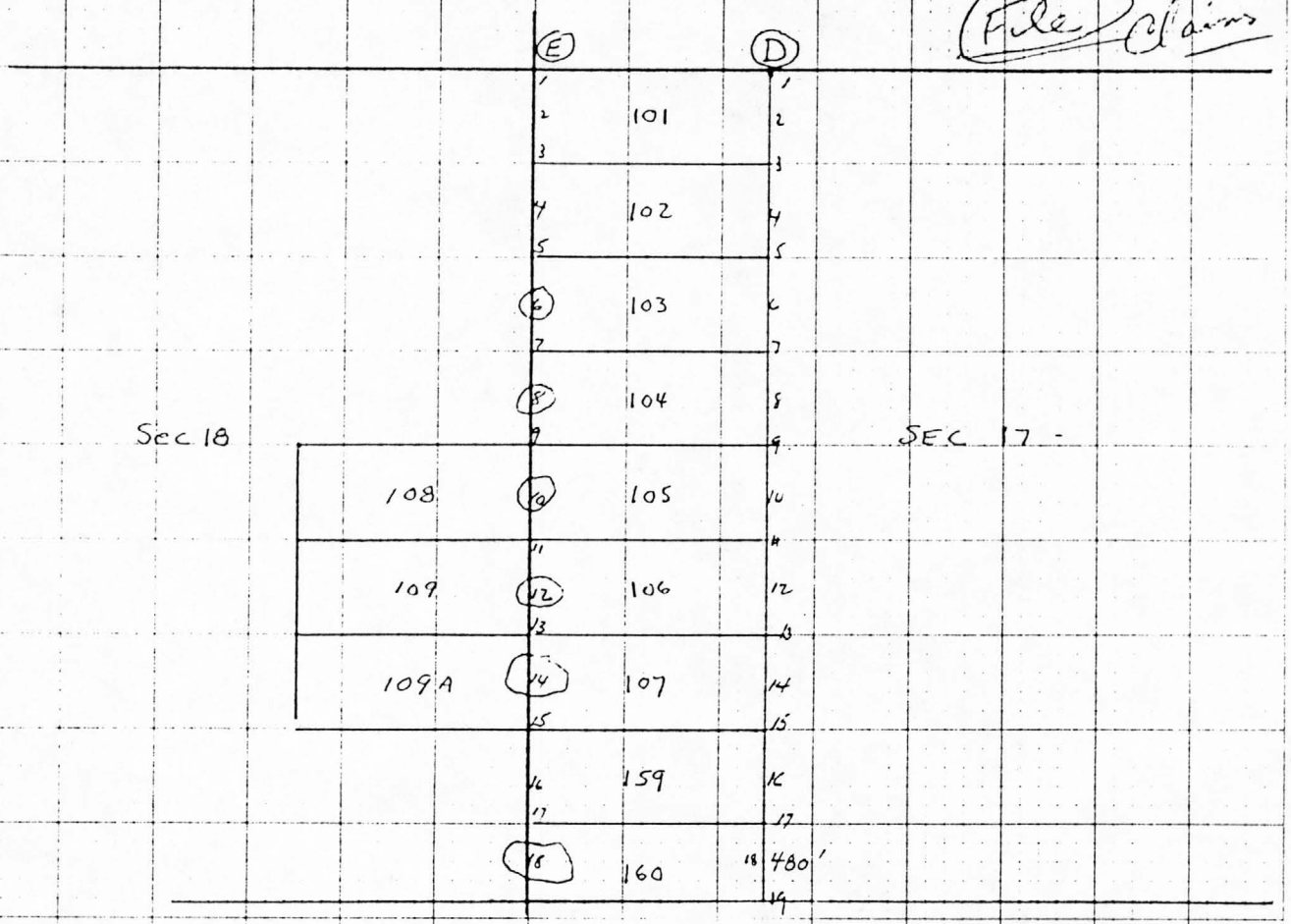
12-280

Condition

T20S R22E

83

File Claims



Offsets

E1 - 60' N (EW Fence)
E2 - 60 South EW Rock Ridge
E11 - South Bank - Sandy Wash
E12 - 500' E of Windmill
D1 48' N Fence
D5 86' N of NNE - SSW Road
D-8 - 65' South of Position South Bank Large Wash
D-9 - 40' South of Position South Bank of Wash.

18 - 106

9 - 107 A

GEOLOGICAL

&

GEOCHEMICAL

STUDY

FOR: M. S. Horne
3033 North Central Avenue
Phoenix, Arizona

August 26, 1974

BY: C. A. Cosgrove, Mining Consultant
Working under supervision of:
H. Clyde Davis, B.S; M.S.
Geologist & Mineral Director

LOCATION

The area covered under this study lies in the west 1/4 of Section 17 T 20 S R 22 E and forms a portion of the west slope of Uncle Sam Hill, about 3 miles southwest of Tombstone. There are 12 claims, 9 of which are in Section 17 and 3 of which are in Section 18. (See claim map appended to this report). These claims are listed as follows:

Horne	#101
Horne	#102
Horne	#103
Horne	#104
Horne	#105
Horne	#106
Horne	#107
Horne	#108
Horne	#109
Horne	#109-A
Horne	#159
Horne	#160

GEOLOGY

This area is covered by an intrusive Latite Porphyry locally known as the Uncle Sam Porphyry. The principal outcrops of this porphyry are on the Uncle Sam Hill, the Three Brothers Hills to the north and west. Similar outcrops are also evident to the south near Charleston.

This porphyry is relatively resistant to erosion thus forming the craggy hills adjacent to the valley pediments. This porphyry has invaded the Bronco Volcanics, the Bisbee Formation, the Colina Limestone and the Epitaph Dolomite. This porphyry is probably younger than all the adjacent rocks except the Schieffelin Granodiorite and the Valley Fill of the San Pedro Trough. This intrusion is undoubtedly of the Tertiary period.

North of Uncle Sam Hill a deep embayment in the contact between the porphyry and the Bisbee formation, which forms the floor of the valley, suggests that the Bisbee underlies the porphyry at a comparatively shallow depth. This has been reported in the State of Maine mine, which penetrate

a considerable body of shale on the bottom level, at an elevation of about 4,300 feet (Butler, Wilson, and Rasor, 1938, p. 101). The floor at this part of the intrusion is therefore probably at a comparatively shallow depth, but farther southeast, near the Tombstone-Charleston road, the exposed contact becomes nearly vertical and cuts the bedding of the country rock at a high angle. Throughout the area between this road and the ridge extending north from Ajax Hill, the porphyry forms highly irregular masses that cut the Bisbee formation without regard to its bedding. A significant feature of this area is the mass of Uncle Sam porphyry following the major fault that farther north separates the Bisbee formation on the west from the Bolsa quartzite on the east. This fault was undoubtedly formed at the time of the major deformation of the Tombstone district. It had a minimum displacement of 5,000 feet and must extend to a considerable depth. The porphyry is frozen to both walls of this fault and has not been notably deformed since its emplacement, showing that the intrusion occurred after the major local orogeny.

A notable feature of the porphyry is the fracture (and strewing out of the resulting fragments) of a large proportion of the phenocrysts.

The groundmass ranges from vitric to microcrystalline, with a maximum grain size of about 0.04 millimeter, though more usually the groundmass crystals do not exceed 0.01 millimeter. Where determinable, the groundmass plagioclase is near An_{30} in composition and is contained, along with chlorite or biotite, in an intergrowth of orthoclase and quartz or glass.

Accessory minerals include magnetite, apatite, zircon, and sphene, but much of the sphene is a product of the alteration of biotite and presumable ilmenite. A few specimens contain rosettes of tourmaline, dichroic in greenish brown and brown. Some of this porphyry is mildly altered, with sericite, epidote, and albite developed in the plagioclase crystals and the mafic minerals altered to chlorite. Calcite is also present in some of the rocks.

CHEMICAL ANALYSIS OF UNCLE SAM PORPHYRY

SiO_2	67.60
Al_2O_3	16.22
Fe_2O_3	2.01
FeO	1.08
MgO	.91
CaO	2.91
Na_2O	3.79
K_2O	3.58
H_2O+	.92
H_2O	.28
TiO_2	.41
P_2O_5	.19
MnO	.10
ZrO_2	--------
O_2	--------

The area under study has been cut by one minor fault or fracture. This bears north 40° east from the center of west line of Section 17. Radiating from this zone are numerous fractures which show filling by secondary mineral solutions - and considerable alteration to the porphyry in proximity to the zone.

A study was made of the high altitude photography by NASA to determine major structural factors effecting the possible implacement of ore bearing solutions. A copy of an enlargement of this photography is attached herewith - This study was considered in the conclusion formed at the end of this report.

GEOCHEMICAL

Following the geological survey and preliminary surface study, it was determined that a geochemical reconnaissance would be the best practical method to locate anomalous mineralized areas for further study and drilling. Surface rock sampling was accomplished in accordance with the sample map attached herewith.

Geochemical results were determined by Skyline Labs, Inc., and are as follows:

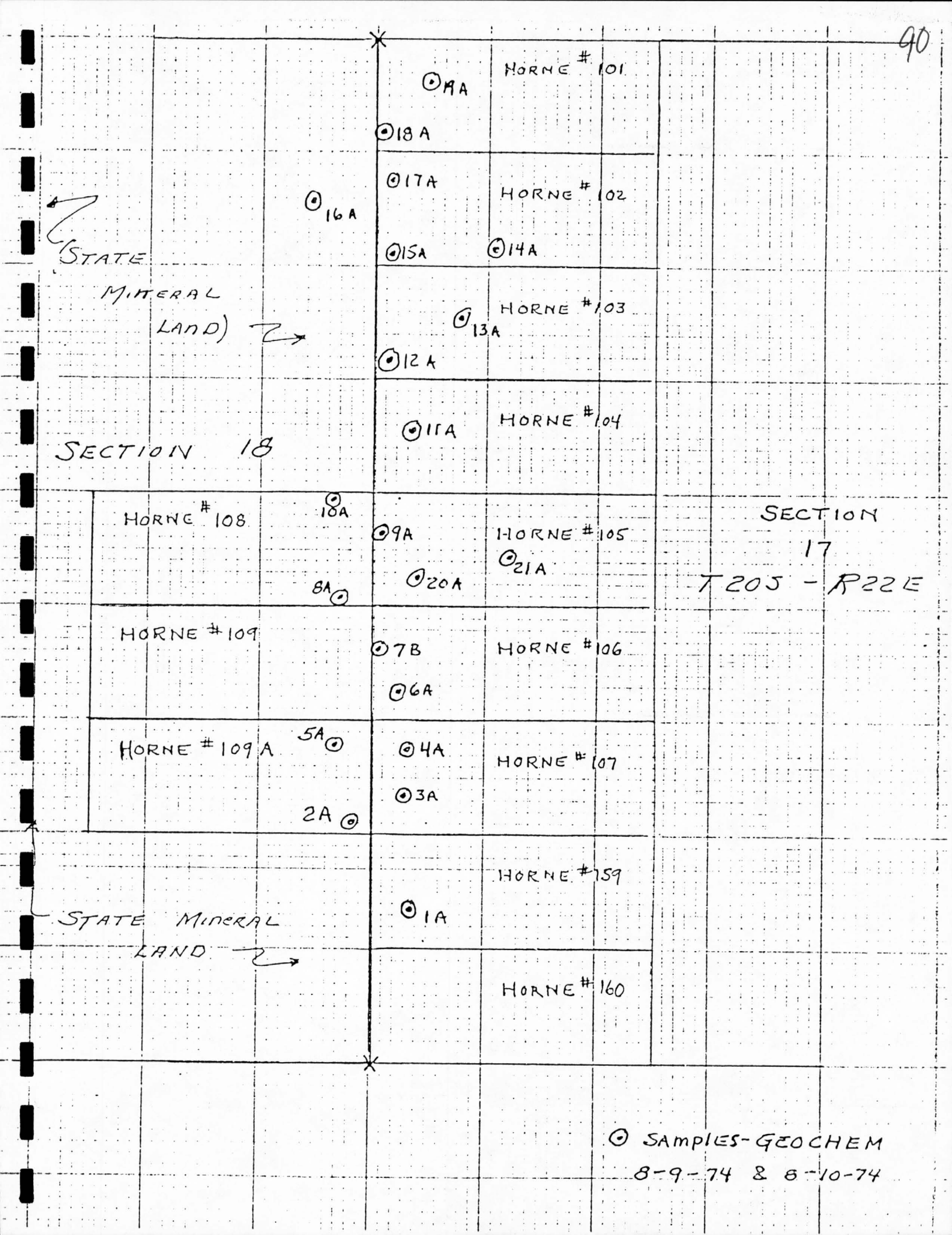
SAMPLE IDENTIFICATION	Ag ppm	Cu ppm	Mo ppm
1A	<0.2	5	
2	0.2	5	
3	1.0	5	
4	0.6	5	
5	<0.2	5	
6A	0.2	5	
7B	0.6	10	
8A	0.2	5	
9	0.8	5	2
10	700.	550	140
11	18.	5	
12	1.4	5	
13	<0.2	5	
14	0.2	5	2
15	1.8	5	2
16	0.4	5	
17	<0.2	5	
18	<0.2	5	
19	0.4	5	
20	14.	5	
21	4.2	5	12
22A	2.0	5	12

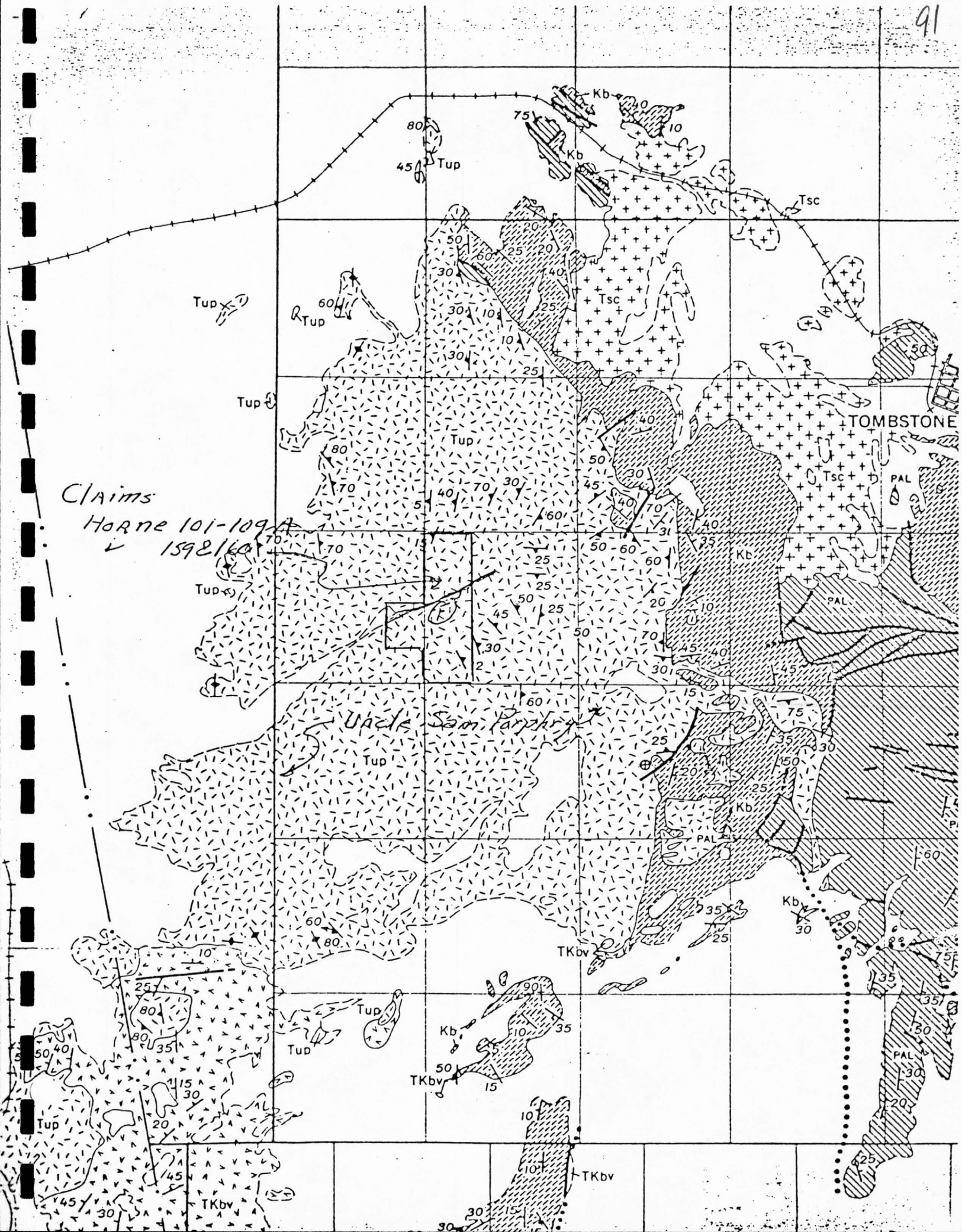
Conclusions: It is evident that two anomalous areas exist which warrant detailed study. It is therefore recommended that an examination program consisting of drilling, testing and studies proceed to delineate mineralized areas. This examination program should be evaluated by feasibility reports as each step is concluded.

This geological examination and research study together with the geochemical sampling was accomplished by C. A. Cosgrove, Mining Consultant, working under the direction and supervision of H. Clyde Davis, B.S; M.S., Geologist and Mineral Director for Brigham Young University.

C. A. Cosgrove,
Mining Consultant

H. Clyde Davis,
Geologist


HORNE # 101
19A
18A
17A
HORNE # 102
16A
15A
14A
STATE MINERAL LAND
HORNE # 103
13A
12A
HORNE # 104
11A
SECTION 18
HORNE # 108
10A
9A
HORNE # 105
21A
20A
8A
SECTION 17
T 20S - R 22E
HORNE # 109
7B
HORNE # 106
6A
HORNE # 109 A
5A
4A
HORNE # 107
3A
2A
HORNE # 159
1A
STATE MINERAL LAND
HORNE # 160
⊙ SAMPLES-GEOCHEM
8-9-74 & 8-10-74


Kb
Tup
Tsc
TOMBSTONE
PAL
Claims
Horne 101-109
1592160
Uncle Sam Parker
TKbv

92

SKYLINE LABS, INC.
Hawley & Hawley, Assayers and Chemists Division
1700 W. Grant Rd., P.O. Box 50106, Tucson, Arizona 85703
(602) 622-4836

CERTIFICATE OF ANALYSIS

Charles E. Thompson
Arizona Registered Assayer No. 9427
William L. Lehmbeck
Arizona Registered Assayer No. 9425

SAMPLE IDENTIFICATION	GOLD ppm	SILVER	COPPER	LEAD	ZINC	MO	Mn ppm		
10 A	0.12						156000		

See Report - Hovne 100-189 A 1598.160 (Jamestown) Trace of report eal

TO:
Mr. C.A. Cosgrove
1923 West Osborn Road
Phoenix, Arizona 85016

REMARKS:
Trace analysis
1 Gold (0.02 ppm) - $2.50
1 Manganese - $2.00

CERTIFIED BY:

CHARGES:
PREPARATION $
ANALYSIS $ 4.50
$ 4.50

DATE REC'D:	DATE COMPL.:	JOB NUMBER:
	9/6/74	741625-A

Check assay for Au and Mn of 110-117

93

SKYLINE LABS, INC.
Hawley & Hawley, Assayers and Chemists Division
1700 W. Grant Rd., P.O. Box 50106, Tucson, Arizona 85703
(602) 622-4836

Charles E. Thompson
Arizona Registered Assayer No. 9427

William L. Lehmbeck
Arizona Registered Assayer No. 9425

CERTIFICATE OF ANALYSIS

ITEM NO.	SAMPLE IDENTIFICATION	Ag ppm	Cu ppm	Mo ppm
1	B - 1	2.6		
2	2	1.2		
3	3	0.2		
4	4	<0.2		
5	5	<0.2		
6	6	7.2		
7	7	3.6		
8	8	0.8		
9	9	<0.2		
10	10	7.4		
11	11	2.8		
12	12	<0.2		
13	13	3.0		
14	14	5.4		
15	15	0.4		
16	B - 16	1.8		
17	2 - 5	2.8	25	14
18	2 - 1-A	1.0	5	
19	2 - H 102 E	<0.2		

Further Study of
Harmon Group - 100-109 A
159-160

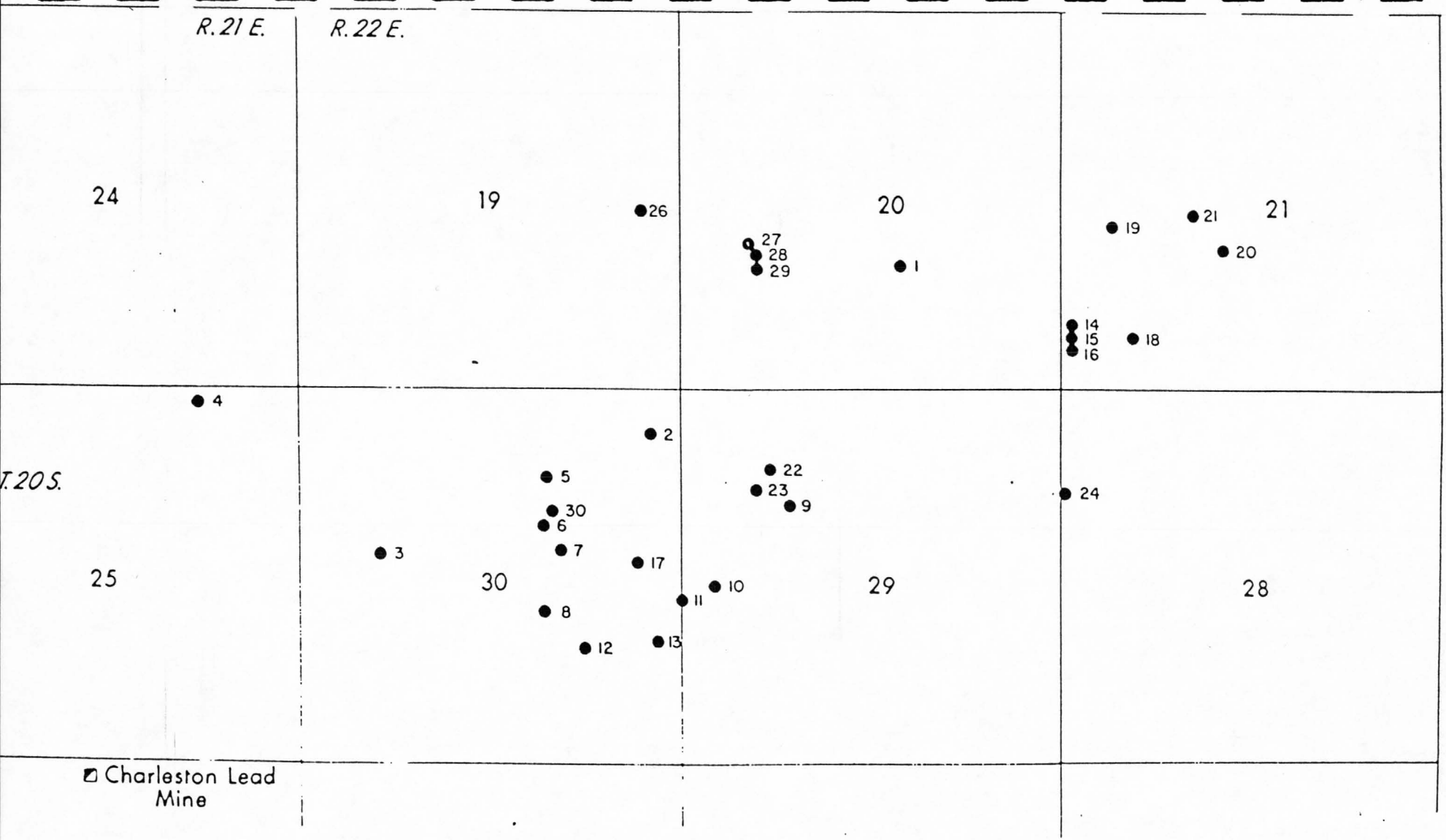
TO:
Mr. C. A. Cosgrove
1923 West Osborn Road
Phoenix, Arizona 85015

cc: Pacific Palisades, California

REMARKS:
Trace analysis

CERTIFIED BY:

DATE REC'D: 9/4/74
DATE COMPL.: 9/10/74
JOB NUMBER: 741777



SAMPLE SITES
GEOCHEMICAL OVERLAY
CHARLESTON MINING DISTRICT
COCHISE CO., ARIZONA

scale 1:24,000 · SEPT, 1973

mn 2650a

94

95

320 East 46th Street

Phone ~~621-0049~~ 889-5759

AMERICAN ANALYTICAL and RESEARCH LABORATORIES

ASSAYERS - CHEMISTS - METALLURGISTS

TUCSON, ARIZONA 85

JUL 2 1973

SAMPLE SUBMITTED BY American Smelting & Refining Co.

DATE June 30, 1973

SAMPLE MARKED	GOLD OZ/TON	SILVER OZ./TON	PPM COPPER	PPM LEAD	PPM ZINC	PPM MOLYBDENUM	PERCENT IRON
TB - 1			20	131	22	25	
TB - 2			48	81	24	25	
TB - 3			161	2000+	71	33	
TB - 4			14	183	8	40	
TB - 5			68	724	666	53	
TB - 6			23	96	17	20	
TB - 7			46	44	34	17	
TB - 8			41	40	18	16	
TB - 9			14	66	8	32	
TB -10			92	44	11	20	
TB -11			35	33	79	17	
TB -12			26	39	9	13	
TB -13			19	65	61	17	
TB -14			11	21	59	22	
TB -15			21	22	57	25	
TB -16			36	18	91	20	

REGISTERED ASSAYER
CERTIFICATE NO. 2357
C. PETER FLORES
Date Signed 6/30/73
Arizona U.S.A.

Invoice # 9411

96

226 East 46th Street

Phone 624-0049

AMERICAN ANALYTICAL and RESEARCH LABORATORIES

ASSAYERS · CHEMISTS · METALLURGISTS

TUCSON, ARIZONA 857

SAMPLE SUBMITTED BY American Smelting & Refining Company

DATE August 29, 1973

SAMPLE MARKED	GOLD OZ./TON	SILVER OZ./TON	PPM COPPER	PPM LEAD	PPM ZINC	PPM MOLYBDENUM	PERCENT IRON	
TB - 17			39	200	24	19		
TB - 18			108	107	49	14		
TB - 19			26	42	25	13		
TB - 20			40	90	30	14		
TB - 21			25	49	57	10		
TB - 22			23	189	21	11		
TB - 23			25	105	17	19		
TB - 24			33	133	50	23		
TB - 25			54	879	29	12		
TB - 26			30	31	63	13		
TB - 27			37	129	61	12		
TB - 28			26	36	69	11		
TB - 29			68	38	107	12		
TB - 30			28	40	80	16		
[redacted]			[redacted]	[redacted]	[redacted]	[redacted]		

8/29/73

Invoice # 9716

I never found anything on this survey

859 East 2730 North
Provo, Utah 84601
August 24, 1971

James Stewart Company
Mayer Central Building
3033 North Central Avenue
Phoenix, Arizona 85012

Attention: Mr. C. A. Cosgrove--Geo-chemical Survey

Dear Mr. Cosgrove:

I have completed a geo-chemical survey on your mining property which is located in the NE 1/4, and E 1/2 NW 1/4 of Section 20 of Township 20 South, Range 22 East of Cochise County, Arizona.

Three lines were run known as A, B, and C with each having nine samples, as indicated on the map and the assay and contour lines on the map enclosed.

This property is located in a good geological environment and the geo-chemical survey indicates mineralized target in depth.

Sincerely,

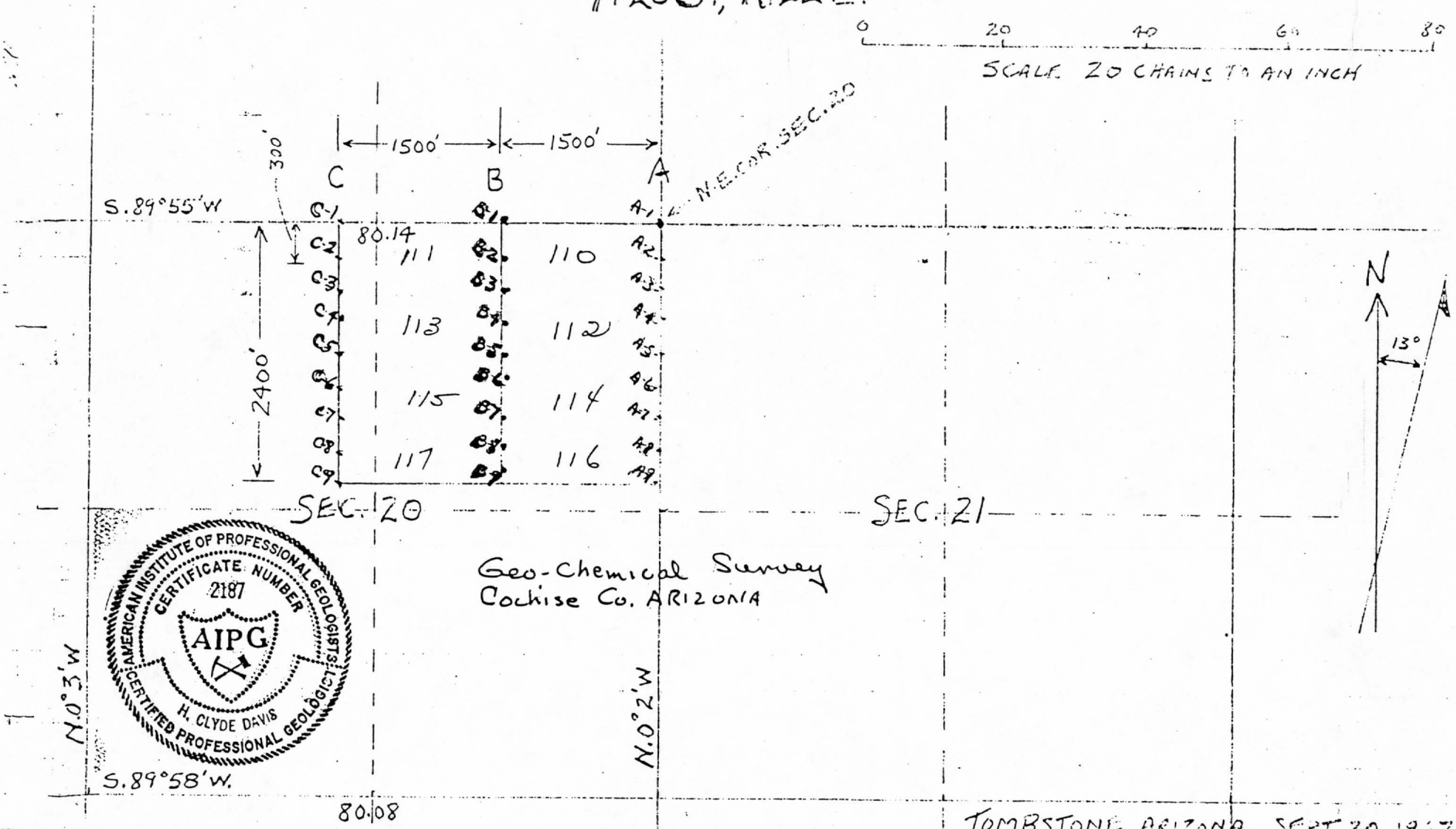
H. Clyde Davis
Consulting Geologist

HCD:pn

Enclosure

Consulting fee: $520.00
Expenses:

T.20S., R.22E.

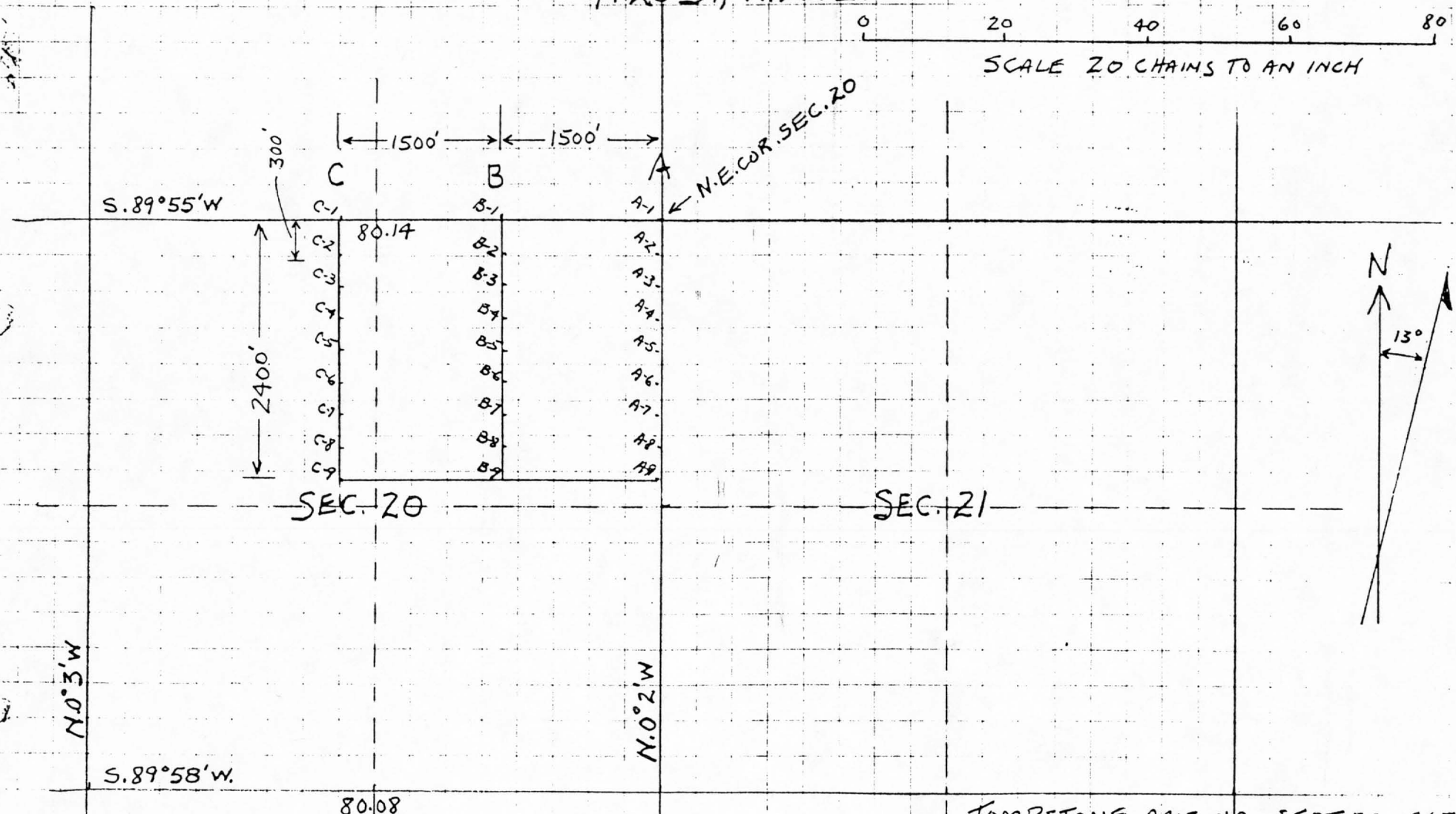


TOMBSTONE, ARIZONA. SEPT. 20, 1967

E: USING FACTORS AS ILLUSTRATED ABOVE AND STARTING AT AN INITIAL POINT BEING THE N.E. CORNER OF SEC. 20, T.20S., R.22E., GILA & SALT RIVER MERIDIAN, ARIZONA, WHICH IS MARKED BY A CAIRN OF ROCKS SURROUNDING AN OBLONG STONE, WITH THIS OBLONG STONE BEARING THREE (3) HORIZONTAL MARKS (≡) ON SOUTH FACE AND FOUR HORIZONTAL MARKS (≡) ON EAST FACE, MEASURE AND INSTALL MONUMENT MARKERS FOR CLARENCE COSGROVE ON LINES SOUTH FROM POINTS A, B & C ON THE NORTH SECTION LINE OF SEC. 20, T.20S., R.22E., AS SHOWN ON FIELD MAP ABOVE.

99

T.20S., R.22E.



TOMBSTONE, ARIZONA. SEPT. 20, 1967

NOTE: USING FACTORS AS ILLUSTRATED ABOVE AND STARTING AT AN INITIAL POINT BEING THE N.E. CORNER OF SEC. 20, T.20S., R.22E., GILA & SALT RIVER MERIDIAN, ARIZONA, WHICH IS MARKED BY A CAIRN OF ROCKS SURROUNDING AN OBLONG STONE, WITH THIS OBLONG STONE BEARING THREE (3) HORIZONTAL MARKS (≡) ON SOUTH FACE AND FOUR HORIZONTAL MARKS (≡) ON EAST FACE, MEASURE AND INSTALL MONUMENT MARKERS FOR CLARENCE COSGROVE ON LINES SOUTH FROM POINTS A, B & C ON THE NORTH SECTION LINE OF SEC. 20, T. 20 S., R. 22 E., AS SHOWN ON FIELD MAP ABOVE.

Chas. W. [illegible]

100

ASSAYERS
CHEMISTS

EL PASO, TEXAS
Box 4

HAWLEY & HAWLEY

W. E. HAWLEY, MANAGER
DOUGLAS, ARIZONA
537 TWELFTH STREET
Box 1060

SHIPPERS REPRESENTATIVES
BULLION BUYERS
ORE BUYERS

WE HEREBY CERTIFY THAT THE FOLLOWING RESULTS WERE OBTAINED FROM SAMPLES OF Charlestown Lead Mines Co.

FICE NO.	MARKED	GOLD OZS.	SILVER OZS.	LEAD PER CENT	COPPER PER CENT	ZINC PER CENT	IRON PER CENT			
46810	#2- L.P.W.	3.90	81.3	13.0						

METAL QUOTATIONS:

$35.00 PER OZ. COPPER _____C PER LB. CHARGES: $ 2.50

SILVER _____PER OZ. _____PER LB. DATE 7/28/51

HAWLEY & HAWLEY

PER W. E. Hawley ASSAYER.

101

HAWLEY & HAWLEY
ASSAYERS AND CHEMISTS, INC.
1802 WEST GRANT ROAD - TELEPHONE MAIN 2-4836 - POST OFFICE BOX 5934
TUCSON, ARIZONA
Registered Assayers

August 14, 1962
Our 48th Year

Mr. Charles Suiter
President, Charleston Mines
5008 West Weldon Avenue
Phoenix 31, Arizona

Dear Mr. Suiter:

In response to your request of August 4, we have made a search of our records and are enclosing copies of the assay report made on your sample received July 28, 1951.

There was an entry for only one L.P.W. sample.

Sincerely,

Harold E. Richard
President

enclosure

Kind personal regards.

UNKNOWN
SEDLIHEN SAMPLES

STATE LAND DEPARTMENT OF THE STATE OF ARIZONA
BEFORE THE STATE LAND COMMISSIONER

104

30 day appeal ? Sept 10

IN THE MATTER OF MINERAL LEASE APPLICATION NO. 11-86254 ON THE STATE LAND DESCRIBED THEREIN.	DECISION AND ORDER
APPLICANT: JAMES STEWART COMPANY	

The files of the Arizona State Land Department (the Department) reflect that:

1. On March 25, 1983, James Stewart Co. filed Mineral Lease Application No. 11-86254, for the State Trust land described therein.

2. Review of said application by the Department's Mineral Section determined that applicant has provided insufficient proof of discovery of a valuable mineral deposit.

The Department, therefore, finds that it is not in the best interest of the State Trust to approve Application No. 11-86254.

IT IS ORDERED THAT Mineral Lease Application No. 11-86254, be and the same, hereby is denied.

This Order is effective immediately.

GIVEN under my hand and the official seal of the Arizona State Land Department this 10th day of August, 1984.

STATE LAND DEPARTMENT SEAL

Robert Lane
STATE LAND COMMISSIONER

Certified No. 389281 James Stewart Company
3033 North Central Avenue, Suite 707
Phoenix, Arizona 85012

Copy to: Russell A. Kolsrud, Attorney General's Office

75/84-85

ROUTING ORDER		INITIALS	DATE ROUTED	ROUTING ORDER		INITIALS	DATE ROUTED
	COMMISSIONER				INFO RESOURCES		
	DEPUTY COMM				SURVEY & MAPNG		
	ADMIN SERVICES				CARTOGPH INFO		
	ACCOUNTING				NATURAL RESOURCES		
	DATA PROCESSING				NRCD		
	SALES ACCOUNTING				RANGE		
	PERSONNEL			1	MINERALS		
	OFFICE SERVICES				HYDROLOGY		
	CONTRACTS & RECDS				FORESTRY		
	LEASING				FORESTY MGMT		
	CASE EXAMINER				FIRE MGMT		
	RECORDS				SHOP PHX DIST OF		
	URBAN & COM DEV				FLAG DIST OFF		
	URBAN PLANNING				PRESCT DIST OFF		
	SELECT & EXCHNGS				TUC DIST OFF		
	APPRAISAL				BOARD OF APPEALS		
	TUCSON OFFICE						

INITIALS ABOVE WITHOUT COMMENT SHALL INDICATE NO FACTS AVAILABLE OR NO CONTRIBUTION WITHIN DISCIPLINE OF ASSIGNMENT TO ALTER OR NEGATE ACTION PROPOSED

103

Mineral Lease APP M-86254

The above mineral lease application was filed March 25, 1983, by the James Stewart Company as a conversion of two prospecting permits, 08-81903 and 08-77664. The minerals of interest are lead, zinc and silver, with minor gold and copper. The parcels involved are located near Charleston, in Cochise County, in Section 36, T. 20 S., R. 21 E. The area covered by the application is 451.77 acres; the rest of Section 36 contains patented claims pertaining to the old Charleston Lead Mine. The property was examined on July 26, 1984.

The 451.77 acres of state land was broken down into 28 claims, the JS group, ranging in size from 1.46 acres to 20.00 acres. The James Stewart Company submitted assays for all but three of the claims; these three were the JS-6, JS-20 and JS-21 claims. Of the remaining 25 claims, only <u>one</u>, JS-19, had an assay that constituted ore-grade material.

The JS-19 sample appears to have been taken from an old shallow mine working on the claim. Using E&MJ's June metal prices, the combined value of the ore runs $165 per ton (in the ground). Principal values are in zinc and silver.

One drill hole--Hole No. 4--on claim JS-14 intersected some good grade mineralization (copper, zinc and silver), but intervals were, for the most part, less than three feet and depths were greater than 1470 feet. Considerably more exploration work is needed to determine whether this mineralization is worth the cost of sinking a shaft to such depths (1478 ft. to 2238 ft.).

The applicant's plan of operations calls only for trenching with a backhoe to locate minerals, and drill new holes and deepen existing ones. This is another way of saying that sufficient reserves have not been developed to date to start a mining operation in the near future (if at all). Trenching and drilling can, and should, be done under the existing prospecting permits (08-81903 has been cancelled, but was refiled as 08-89409).

WHEN IT RELATES TO A MATTER CALLING FOR FINAL ACTION BY THE DEPARTMENT, THIS SHEET SHALL BE KEPT AS A PERMANENT WORK PRODUCT RECORD BY THE DIVISION OF PERMANENT RECORD. WORK PRODUCT IS NOT PUBLIC RECORD.

In summary, the applicant has failed to prove the existence of a valuable mineral deposit or deposits on the state lands under discussion. I recommend that this lease application be denied.

ECS

2389

TOWNSHIP 20 SOUTH, RANGE 21 EAST, OF THE GILA AND SALT RIVER MERIDIAN, ARIZONA

SUPPLEMENTAL PLAT OF SEC. 36

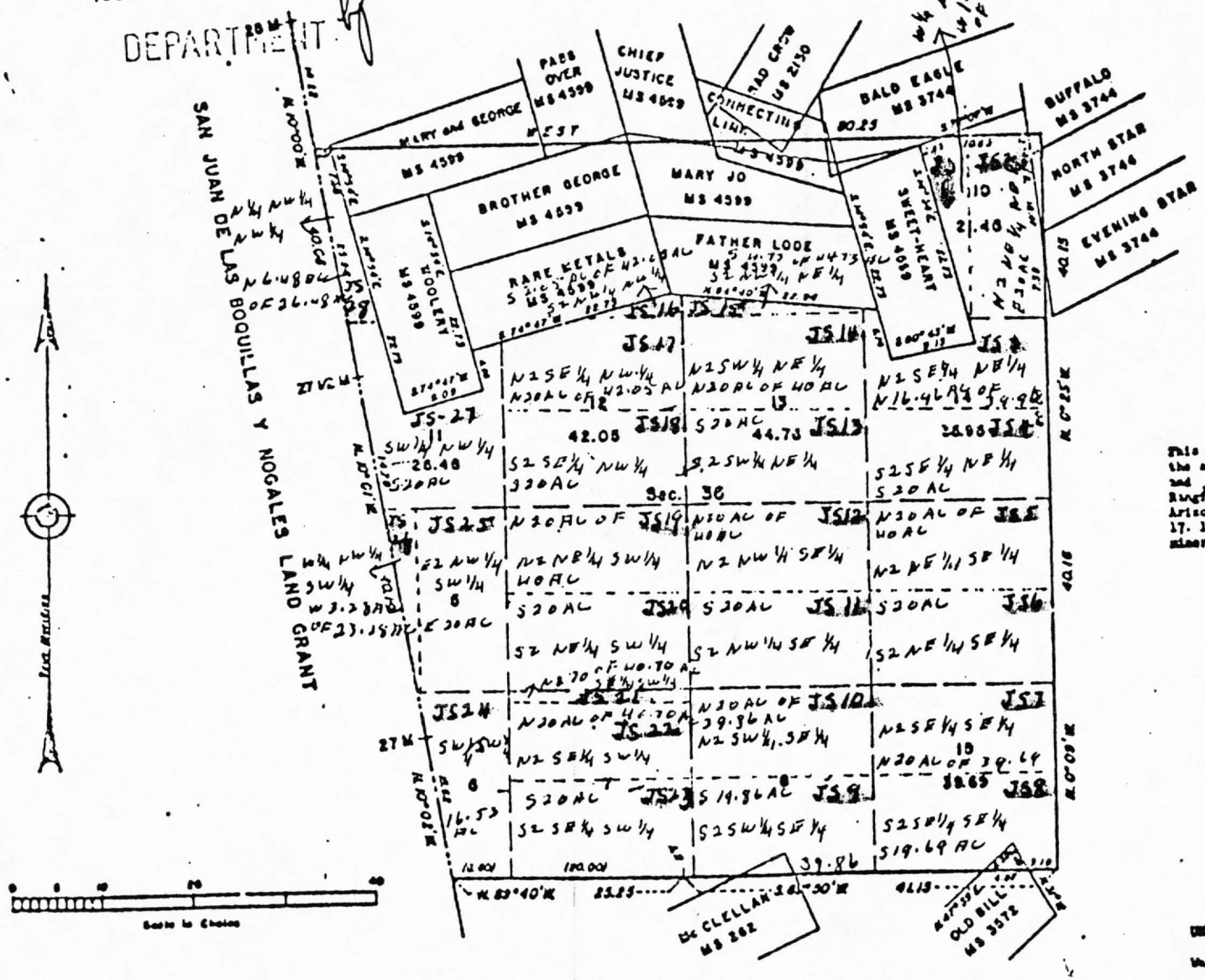
STATE ...

1993 MAR 25 PM 2:51

DEPARTMENT ...

5/655
2-231

OFFICIALLY FILED 9-10-1963



This plat showing amended lottings created by the segregation of Mineral Survey Nos. 3572 and 4599 in section 36, Township 20 South Range 21 East, Gila and Salt River Meridian, Arizona, is based on the plat accepted May 17, 1945 and the record of the approved mineral surveys.

UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
Washington, D.C. July 30, 1963

This plat, showing amended lottings, is based upon the official records, and having been correctly prepared in accordance with the regulations, is hereby accepted.

For the Director

56

DNYANENDRA A. SHAH
ARIZONA REG. NO. 8888

REGISTERED ASSAYER
P. O. BOX 7517
TUCSON, ARIZONA 85725

710 E. EVANS BLVD.
PHONE 602-884-5811
884-5812

06

James Stewart Co.
Suite 707
303 N. Central Ave.
Phoenix, AZ 85012

JOB# 002006
RECEIVED 3/10/83
REPORTED 3/23/83
INVOICE# C 2311

SAMPLE NUMBER	Ag opt	Au ppm	Ag ppm	Zn ppm	Pb ppm	Cu ppm	Mo ppm
JS -						.0224 %	
1		0.08	0.7	20	14	224	8
2		0.12	0.6	16	14	22	8
3		0.10	1.2	38	32	50	2
4		0.10	11.0	226	0.28%	148	2
5		0.18	2.6	18	112	0.33%	2
7		0.44	16.0	400	0.28%	0.27%	14
8		0.64	7.1	222	0.79%	200	84
9		0.10	3.0	216	1.46%	110	60
10		0.08	0.4	16	146	20	4
11		0.12	4.4	294	0.71%	170	2
12		0.10	1.8	12	114	124	38
15		0.08	0.8	28	50	12	2
16		0.09	0.8	26	24	14	2
17		0.06	0.4	10	20	14	4
18		0.06	0.4	12	12	12	4
19	6.11	0.58	>100	8.15%	1.46%	0.81%	44
22		0.10	1.2	384	146	80	1
23		0.08	1.8	300	98	40	2
24		0.06	0.6	104	42	22	<1
25		0.05	0.6	40	30	14	<1
26		0.08	0.6	32	14	12	4
27		0.06	0.4	22	20	30	4
28		0.10	0.8	26	18	12	2

REGISTERED ASSAYER
CERTIFICATE NO.
8888
Dnyanendra
Amrutlal Shah
DATE SIGNED
Arizona U. S. A.

1 ppm = 0.0001% 1 troy oz./ton = 34.286 ppm 1 ppm = 0.0292 troy oz./ton

* Gold and Silver reported in troy oz. per 2,000 lb. ton.

Charleston Mine
Cochise County, Az
Howry Holdings FI150

EXPLANATION

A - Geochemical Sample

6230 108-

RECEIVED
SEP 11 1981

LINDROOS LABORATORIES
P. O. Box 672
Tombstone, AZ 85638

I believe this work was done by WW Stewart on 10-1-77

JAMES STEWART CO.

SOLD TO James Stewart

SHIPPED TO

STREET & NO.

STREET & NO.

CITY

CITY

CUSTOMER'S ORDER	SALESMAN	TERMS	VIA	F.O.B.	DATE

	Ag		Au
Fire Assays			
#1 West side of Wash	.07		Nil
#2 East side of Wash	TR		Nil
#3 Due East of Wash 100 yds	.02		Nil
#4 20 yds N.E. of #3	.04		Nil
#5 20 yds E of #4	.92		TR
#6	.04		Nil
#7	TR		Nil
#8	TR		Nil
#9	TR		Nil
Shaker Tests			
#1 west side of Wash	.03		Nil
#4 20 yds N.E. of #3	.02		Nil
#5 20 yds E. of #4	.24		TR

REDIFORM®
7H 736

INVOICE

S1808 109

SOUTHWESTERN ASSAYERS & CHEMISTS, INC.

WIL WRIGHT
ARIZONA REG. NO. 5875

DNYANENDRA A. SHAH
ARIZONA REG. NO. 8888

REGISTERED ASSAYERS
P. O. BOX 7517
TUCSON, ARIZONA 85725

710 E. EVANS BLVD.
PHONE 602-884-5811
884-5812

Mr. James Stewart Company
Mr. Roger P. Smith
707 Mayer Central Bldg.-3033 N. Central Ave.
Phoenix, Arizona 85012

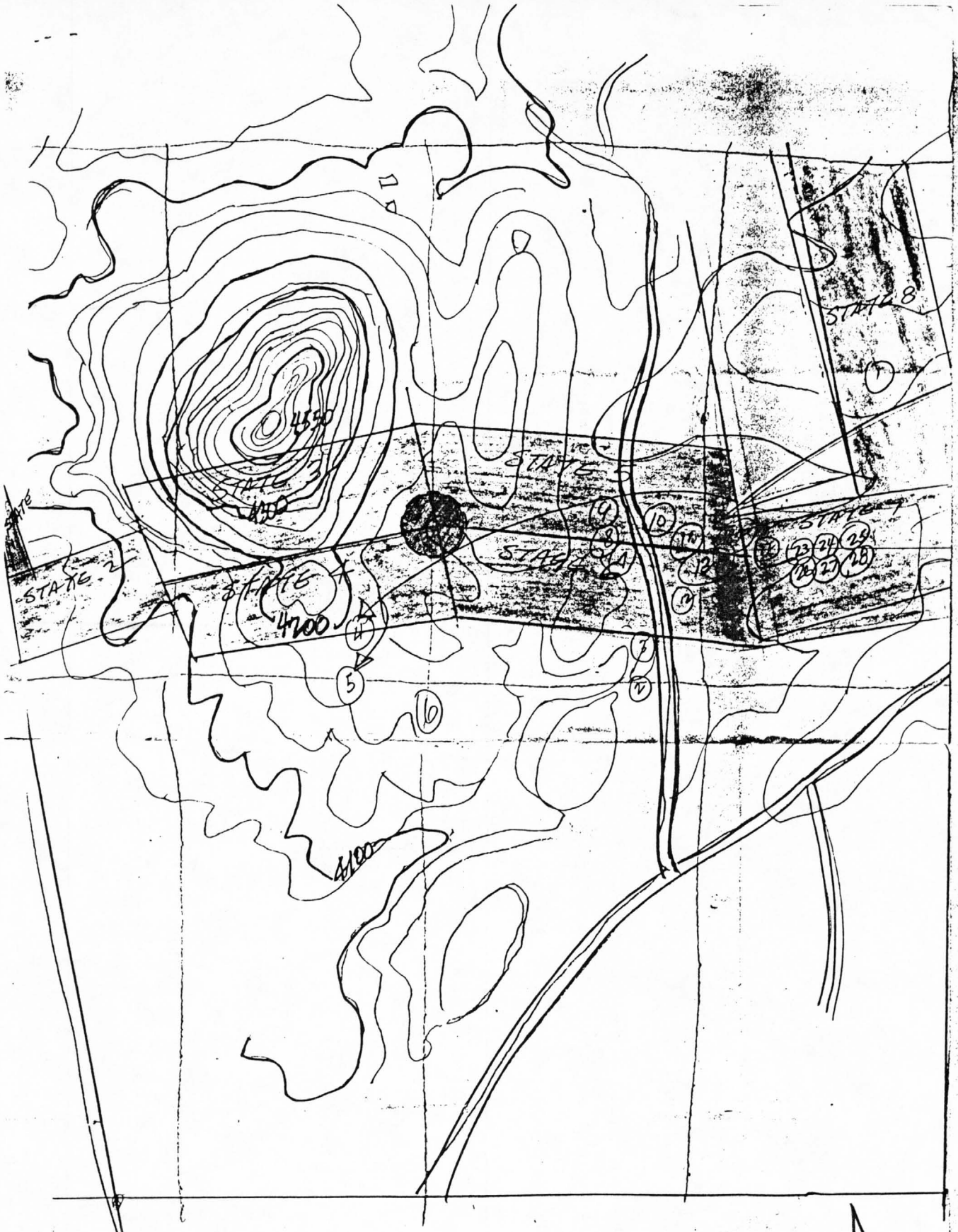
JOB # 024525
RECEIVED 5-14-80
REPORTED 5-21-80

SAMPLE NUMBER	GOLD OZ.*	SILVER ~~oz.~~ PPM	LEAD ppm	COPPER PPM	ZINC %		MOLYBDENUM %
1		< 1	53	60			
2		< 1	26	26			
3		< 1	28	18			
4		< 1	29	19			
5		< 1	28	30			
6		< 1	40	57			
7		< 1	24	34			
8		< 1	24	32			
9		< 1	100	31			
10		< 1	22	21			
11		< 1	18	14			
12		< 1	21	78			
13		< 1	19	22			
14		< 1	23	51			
15		< 1	22	53			
16		< 1	19	29			
17		< 1	50	126			
18		< 1	99	432			
19		< 1	55	276			
20		< 1	27	78			
21		< 1	14	14			
22		< 1	90	16			
23		< 1	49	98			
24		< 1	14	14			
25		< 1	19	200			
26		< 1	95	.52%			
27		< 1	162	.86%			
28		< 1	112	.35%			

REGISTERED ASSAYER CERTIFICATE NO. 8888 Dnyanendra Amrutlal Shah DATE SIGNED 5-21-80 Arizona U.S.A.

1 ppm = 0.0001% 1 troy oz./ton = 34.286 ppm 1 ppm = 0.0292 troy oz./ton

* Gold and Silver reported in troy oz. per 2,000 lb. ton



SECTION 36

TOWNSHIP 20 S. RANGE 22 E.

→ BY CHARLESTON LEAD MINE

74 958

20-26-3

I didn't find any of this material as yet - map found

March 19, 1969

Mr. Loyd A. Hewitt
Hewitt Enterprises
Box 978A
Sandy, Utah 84070

Dear Loyd:

I am enclosing a map of the Charleston-Tombstone Mining District with the locations of approximately 80 samples taken on March 17 and 18 being sent to you under separate cover for purposes of geochemical analysis. As previously discussed, we have not taken any samples in the Talus areas for the fill plain. The areas primarily covered were the more obvious mineralized zones, plus some typical various outcroppings as they occurred. Included also are a few typical samples of the various sectors of the sericite pit, together with an average sample. You will note the fluctuation in mineralization as it occurs.

The parcel being sent to you under separate cover contains physical samples, all numbered consecutively 1 through 74.

If more sampling is needed, please advise.

Yours very truly,

JAMES STEWART COMPANY

C. A. Cosgrove

CAC:ef
Encl.
cc Clyde Davis

112

May 18, 1970

Mr. Loyd A. Hewitt
Hewitt Enterprises
R. D. 1 - Box 978A
Sandy, Utah 84070

Dear Loyd:

We have received assay reports for April 3, April 13, April 15, April 27 and April 29 from American Analytical and Research Laboratories in Tucson. We have no way of identifying these reports. Therefore, as received they are meaningless to us.

It is quite important that we be supplied promptly all geophysical data and that it be properly identified so that it is meaningful. The cooperation of you and your staff in this respect would be very much appreciated.

Very truly yours,

M. S. Horne

MSH:ef

7/25/74

Mr. Cosgrove:

Should this be followed up anymore?

eunice

No file

5/14/70

CAC

Are these for Montezuma --> or where should they be filed?

eunice

I wish I knew where to file them

CAC?

226 East 46th Street

Phone 624-0049

AMERICAN ANALYTICAL and RESEARCH LABORATORIES

ASSAYERS · CHEMISTS · METALLURGISTS

TUCSON, ARIZONA 85713

SAMPLE SUBMITTED BY Hewitt Enterprises

DATE April 15, 1970

SAMPLE MARKED	GOLD OZ / TON	SILVER OZ / TON	PER CENT COPPER	PERCENT LEAD	PERCENT ZINC	PERCENT MOLYBDENUM	PERCENT IRON	
# 2	.008	0.23	0.07					

RECEIVED

MAY 12 1970

JAMES STEWART COMPANY
PHOENIX, ARIZONA

CHARGES $ 5.25

ASSAYER - CHEMIST

226 East 46th Street

Phone 624-0049

114

AMERICAN ANALYTICAL and RESEARCH LABORATORIES

ASSAYERS · CHEMISTS · METALLURGISTS

TUCSON, ARIZONA 85713

SAMPLE SUBMITTED BY Hewitt Enterprises

DATE April 3, 1970

SAMPLE MARKED	GOLD OZ./TON	SILVER OZ./TON	COPPER	PERCENT LEAD	ZINC	PERCENT MOLYBDENUM	PERCENT IRON
PL-16			59		47	5	
PL-17			55		71	10	
PL-18			35		88	7	
PL-19			26		69	12	
PL-20			35		49	10	
PL-21			41		45	3	

RECEIVED

MAY 12 1970

JAMES STEWART COMPANY
PHOENIX, ARIZONA

4/3/70

CHARGES $ 27.00

ASSAYER-CHEMIST

3226 East 46th Street

Phone 624-0049

115

AMERICAN ANALYTICAL and RESEARCH LABORATORIES

ASSAYERS - CHEMISTS - METALLURGISTS

TUCSON, ARIZONA 85713

SAMPLE SUBMITTED BY Hewitt Enterprises

DATE April 3, 1970

SAMPLE MARKED	PPM GOLD	PPM SILVER	PPM COPPER	PERCENT LEAD	PPM ZINC	MOLYBDENUM	PERCENT IRON	
S-1		4.0	34		18	13		
S-2		5.0	41		16	5		
S-3		3.5	15		22	5		
S-4		3.0	29		16	4		
S-5		1.5	30		13	10		
S-6		4.0	18		13	5		
S-7		2.5	25		10	4		
S-8		3.5	32		14	3		
S-9		5.0	30		14	6		

RECEIVED

MAY 12 1970

JAMES STEWART COMPANY
PHOENIX, ARIZONA

REGISTERED ASSAYER
Certificate No. 8882
U.S.A.
FLORES
Tucson, Ariz. U.S.A.

4/3/70

CHARGES $ 54.00

ASSAYER-CHEMIST

East 10th Street

116

Phone 624-0049

AMERICAN ANALYTICAL and RESEARCH LABORATORIES

ASSAYERS · CHEMISTS · METALLURGISTS

TUCSON, ARIZONA 85713

SAMPLE SUBMITTED BY Hewitt Enterprises

DATE April 3, 1970

SAMPLE MARKED	GOLD OZ./TON	SILVER OZ./TON	PPM [redacted] COPPER	PERCENT LEAD	PPM [redacted] ZINC	PPM [redacted] MOLYBDENUM	PERCENT IRON
16			32		28	18	
17			46		18	5	
18			39		19	5	
19			25		24	3	
20			26		15	2	
21			20		24	2	
22			43		35	2	
23			37		14	1	
24			38		16	1	
25			34		16	2	
26			35		13	2	
27			20		32	2	
28			34		17	-1	
29			32		14	1	
30			41		15	4	

RECEIVED

MAY 12 1970

JAMES STEWART COMPANY
PHOENIX, ARIZONA

Geo S. Stewart 4/3/70

CHARGES $ 67.50

ASSAYER-CHEMIST

3426 East 46th Street

Phone 624-0049

117

AMERICAN ANALYTICAL and RESEARCH LABORATORIES

ASSAYERS - CHEMISTS - METALLURGISTS

TUCSON, ARIZONA 85713

SAMPLE SUBMITTED BY Hewitt Enterprise

DATE April 13, 1970

SAMPLE MARKED	GOLD OZ./TON	SILVER OZ./TON	PPM ~~PERCENT~~ COPPER	PERCENT LEAD	PPM ~~PERCENT~~ ZINC	PPM ~~PERCENT~~ MOLYBDENUM	PERCENT IRON	
			39		20	5		

RECEIVED

MAY 12 1970

JAMES STEWART CO.

PHOENIX, ARIZONA

4/13/70

CHARGES $ 4.50

ASSAYER-CHEMIST

3326 East 46th Street

Phone 624-0049

118

AMERICAN ANALYTICAL and RESEARCH LABORATORIES

ASSAYERS · CHEMISTS · METALLURGISTS

TUCSON, ARIZONA 85713

SAMPLE SUBMITTED BY Hewitt Enterprises

DATE April 27, 1970

SAMPLE MARKED	GOLD OZ / TON	SILVER OZ / TON	PER CENT COPPER	PERCENT LEAD	PERCENT ZINC	PERCENT MOLYBDENUM	PERCENT IRON	Percent Ni
D 1-398	Nil	0.02	0.03					.004

RECEIVED

MAY 12 1970

JAMES STEWART COMPANY
PHOENIX, ARIZONA

CHARGES $ 6.25

ASSAYER-CHEMIST

26 East 46th Street Pho 0049

119

AMERICAN ANALYTICAL and RESEARCH LABORATORIES

ASSAYERS - CHEMISTS METAL URGISTS

TUCSON ARIZON 713

SAMPLE SUBMITTED BY Hewitt Enterprises DATE Apr. 2 970

SAMPLE MARKED	GOLD OZ / TON	SILVER OZ / TON	PER CENT COPPER	PERCENT LEAD	PERCENT ZINC	PPM MOLYBDENUM	PERCENT IRON
385	Trace	0.12	0.06	0.06		5	
417	Trace	0.11	0.06	0.08		3	
463	Trace	0.13	0.07	0.08		9	

RECEIVED

MAY 12 1970

JAMES STEWART CO.

PHOENIX, ARIZONA

4/29/70

CHARGES $ 28.50

ASSAYER - CHEMIST

GEOLOGY REPORTS

(COPY)

1 122

REPORT ON THE CHARLESTON LEAD MINE, TOMBSTONE, ARIZONA

The Mary Jo Group of Mining Claims are situated in Section 25 and 36, Township 20 South, Range 21 East of the Gila and Salt River Base and Meridian, eight miles south-west of Tombstone, Arizona and two miles Northerly from Charleston, in the Tombstone Mining District, in Cochise County, Arizona at an elevation of 4100 feet above sea level.

The property is held by possesory title and consists of twelve (12) claims comprising 228 acres more or less.

The country here in general is a quartz-latite porphyry underlain by a quartz-monzonite. The latite in a short depth merges into the monzonite which in spots shows on the surface. The quartz-latite is the porphry phase of the quartz-monzonite.

A zone of shearing developed an east-west course and the minerals are found therein in veinlets, veins and lenses. The rotting and decomposition has caused a slumping and re-arrangement, the lines of shearing being almost obliterated, the veinlets and lenses twisting and crossing the main course of the lode in varying angles.

The reformed minerals arising from the decomposed felspars are sericite and kaolin; the matallic metals and minerals are the sulphides of lead, copper, zinc and iron. The lode also contains some hard ribs or lenses of ~~highly~~ highly siliceous rock oriented with the course of the lode.

Apparently under the footwall of the lode in the approach to No. 5 shaft, a basalt rib or dike is noted and to the north and resting on part of the basalt, a scab of andesite of a green color shows - a remnant of the flow rocks that covered this area at one time.

The metallic minerals - the sulphides of lead, copper, zinc and iron at 20 to 25 feet below the surface, do not show any oxidation effect, except a scarce red stain of iron oxide - this stain was not found on the 100 foot levelof No. 3 shaft; for this reason the sulphides will be readily amenable to selective flotation.

The principal workings are:

Mary Jo Claim - No. 1 shaft 50 ft slope depth at 66 degrees;
No. 2 shaft 100 ft slope depth at 66 degrees;
No. 3 shaft 104 ft slope depth at 65 degrees with an 80 ft crosscut to the south.

Brother George Claim - No. 2 shaft 52 ft slope depth at 66 degrees;
No. 5 shaft 72 ft slope depth with a winze of 20 ft, with 6 ft from collar to surface makes a total depth of 98 ft.

The results from sampling when balanced out, gave results as follows:

Samples 1 to 18 - Lead 6.29%; Copper 0.57%; Zinc 10.94%
19 - Lead 6.18%; Copper 0.52%; Zinc 10.90%

A block of ground extending from 50 ft east of No. 3 (Mary Jo) shaft westerly to a point 100 feet west of No. 7 shaft and depth equal to No. 3 shaft (104 ft) contains 206,000 tons of ore of an indicated value of Gold 0.01 oz; Silver 1.50 oz; Lead 6.18%; Copper 0.524%; Zinc 10.90%.

This block of ore through the owners mill, after freight and smelting charges will yield at present prices, $30.81 per ton of crude ore or $6,000,000.oo out of which to pay mining and milling costs.

However a sectionof the above mentioned ore in shaft No. 5 has somewhat over 5000 tons carrying : Gold 0.oloz; Silver 1.80 oz; Lead 12.78%; Copper 1.41% and Zinc 16.6% - this should yield at present prices, about $42.60 per ton of crude ore or $213,000.oo for the section quoted, increasing daily as the winze is being sunk in increasingly better ore.

As to the other constituents of the ore, the sericite and kaolin, I cannot say except they have considerable economic value and are well worth consideration.

It is highly probable that the mineralization will go to the depth of the quartz-monzonite sill and the mineralization will undoubtedly be there also, what the depth of this sill is I cannot state.

I consider this a very valuable property and improving on depth. I recommend it.

Respectfully,

Jonathan M. Gordon, Mining Engineer
Tombstone, Arizona

September 18 1950.

Original copy of this report on file at mine office.

Hewitt
Enterprises 12415 South 960 East Draper, Utah 84020 801 571-1911 Off. 801 571-0157 Res.

124

THE CHARLESTON MINE PROJECT
DATA COMPELATION
REPORT

August 10, 1970

The Charleston Mine area lies approximately six miles south west of Tombstone, Arizona. The property is reached by the Charleston highway.

In the Charleston Mine area a large zone of mineralization has been discovered. The zone appears to be at least two miles long and 3/4 mile wide. The estimated size of this zone of mineralization is based primarily on deep induced polarization prospecting. Three preliminary drill holes have tested this zone in the immediate vicinity of the old Charleston Lead Mine. All three holes have encountered ore grade mineralization of copper, lead, zinc and silver. These three holes have, in part, covered only a small area within the mineralized zone. A fourth hole, drilled off the mineralized zone, encountered very little mineralization.

The exploration done, to this date on the mineralized zone, suggests an economic mineral deposit to be present. The nature of the ore indicates the operation would be underground, generally along bedding planes. This, ofcourse, is only conjecture needing much better information for a basis of evaluation.

Since a large zone of mineralization appears to exis it is a good possibility that the Charleston deposits are related to a mineralized intrusive monzonite porphyry similar to those of Bisbee, Mission, San Manuel, and others near by.

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In conjunction with the deep mineralization found, the old Charleston Lead Mine itself should not be overlooked. The mineralization in the old Charleston Lead Mine appears to be unrelated to the deeper material. However, this may be due to a time factor and a long series of mineralization periods. The old Charleston Lead Mine may, at depths, contain sufficient reserves of Pb, Zn, Ag, and sericite to be of economic importance.

Further drilling of the mineralized zone is suggested, both to test the ore in the wide spaced holes 1, 2, and 4, and the general area. The drilling is by far the most important next step in exploration.

CLAIMS AREA

For the most part, the zone of mineralization is covered by mineral mining claims and state mineral leases. These properties are controlled by Horne Enterprises, 3033 North Central Avenue, Phoenix, Arizona.

GEOPHYSICS

Three phases of geophysical exploration were conducted in the Charleston area. Preliminary airborne magnetics covered the general area of interest. This was followed by very broad selected geochemical sampling and then induced polarization plus a small amount of ground magnetics.

AIRBORNE MAGNETICS

The general area covered by the magnetic survey is underlain by outcrops of different rock groups, which have a significant susceptibility difference. At the Schieffelin monument and

in the area surrounding, the Schieffelin granodiorite is exposed. Rock samples of this material are fairly magnetic. At the lower end of the Boquillas Land grant, on both sides of the San Pedro River, granodiorite similar to that at the Schieffelin monument is observed. Although in the Boquillas area the rock may be closer to monzonite and is more magnetic. North of the Charleston Mine many outcrops of the Uncle Sam porphyry are observed. This porphyry seems to be andesitic and is surprisingly non-magnetic. Southeast of the Charleston Mine and vicinity, rock outcrops are principally undifferentiated gray and white tuffs with sills and dikes of magnetic andesites and other basic flows. The tuffs are non-magnetic.

From the airborne magnetics the entire Tombstone district appears to be underlain by Schieffelin granodiorite. In most cases this intrusive lies at depths less than 1,000 feet. The intrusive lies as far westward as Section 39, Twp 20 S, R 22 E. A similar intrusive underlies the San Pedro River valley west of the surveyed area. Regional magnetics suggest the San Pedro River intrusive to be far larger in size than the Schieffelin granodiorite.

Between these intrusives lies the Charleston basin. Magnetically the rocks in this basin all appear to be similar. However, the surface geology suggests otherwise. With the abundance of magnetic andesite dikes and sills in the tuffaceous flows it would seem, if the vertical extent of this section were great, there would be some aggregate magnetic effect. Since this is not the case, two choices are possible: the tuffs are underlain at reasonably shallow depths by non-magnetic Uncle Sam porphyry or sediments. Our original interpretation was that sedimentary rocks

underlie the tuffs. This is borne out in drill holes 1, 2 & 4.

The Uncle Sam porphyry is found to be surprisingly uniform magnetically, almost as if it were a sediment rather than an intrusive sill or extrusive flow. This porphyry seems to have very little relationship to other igneous rocks in the area.

SURFACE MAGNETICS

Some of the igneous dikes, especially the andesite porphyries in drill holes 2 and 4, are altered and mineralized. Also they are fairly magnetic. Some surface profiles in the vicinity of the Charleston Mine indicate the possibility of an intrusive dike striking northeastward and paralleling the interpreted major mineralization zone along its north side. The significance of a porphyry mass in this area is not yet known. Additional information from further drilling will undoubtedly shed some light here.

SURFACE GEOLOGY

In the Charleston basin six geologic units may be observed.

1. Schieffelin granodiorite
2. Uncle Sam porphyry
3. Purple volcanics
4. White volcanic tuffs
5. Green to gray volcanics
6. Recent gravels and soils

1. The Schieffelin granodiorite mass underlying the Tombstone district and the San Pedro River valley is thought by this writer to be older than any of the other units observed, except for the cretaceous Bisbee formation. In the San Pedro River valley

the contacts with the volcanic series show the granodiorite to be much weathered before the deposition of the volcanics. It is believed this unit to be older than the volcanics or the Uncle Sam porphyry.

2. The Uncle Sam porphyry is reported to be of Miocene age and, as stated before, the true nature and age of this unit is not known. It is reported that this unit intrudes the white tuffaceous volcanics but this age relationship is doubted. The porphyry covers a large area to the north of Charleston.

3. The purple volcanics vary from purple tuffs to brown argillites and includes agglomerates with some porphyry fragments. In places these rocks appear to have intruded the white tuffs.

4. White volcanic tuffs cover a large portion of the mine area and southwestward. The rock appears to be bleached and altered along shear zones which strike N 45° E. The rock is very hard and a great amount of silica has been introduced.

5. The green to gray volcanics appear much the same as the purple volcanics and are very similar in mineral composition. They are probably the same unit with insufficient iron for a reddish or purple appearance.

SURFACE MINERALOGY

Numerous shears are noted in a zone one and a half miles wide and striking N 45° E, through the Charleston basin. These shears vary from bleached zones with kaolin and sericite to quartz manganese veins. Parallel to the Charleston highway is a shear zone nearly five miles long and 300 feet wide. This zone has much bleaching by hydrothermal solutions and numerous veinlets of

limonite after pyrite. In most places this zone carries very minor traces of copper, with the exception of the southwest end. On the southwest end of this zone quartz veins with minor copper silicates are present.

Near the central part of the suggested Charleston mineralized area, numerous quartz manganese veins are observed. These veins contain larger amounts of copper than the shear zones.

On the north edge of the outlined mineralized zone the Charleston Mine occupies a shear zone in the volcanics. The shear is noted by considerable sericite alteration containing galena, sphalerite and pyrite. This zone appears to be the only one in any way related to the deep mineralization, and that is questionable.

The only relationship of the surface mineralization to the deeper sulphides is that secondary hydrothermal solution from recent or post mineral faulting may have carried minor amounts of mineral through the overlying volcanics. This in part is the reason for giving emphasis to the deeper sulphide zone.

SURFACE GEOCHEMISTRY

In the Charleston basin numerous veins, shears, and altered zones are noted. The great majority of these zones strike N 45° E. As mentioned earlier, three types of mineralized shears are noted. It was felt that these zones, even though they appear to be post mineral, may contain secondary deposition of minerals, especially the quartz manganese veins. Rock sample tests of the three groups indicate anomalous amounts of copper, zinc, and silver in the quartz manganese veins. The mineralized shears with kaolin, limonite, and

bleaching contained the smallest amounts of these elements, only slightly above the fresher volcanic tuffs. These samples though inconclusive do aid in encouraging the possibility of ore mineralization in the underlying subsurface, outlined by the induced polarization.

INDUCED POLARIZATION

Initial tests made on the Charleston basin, using a Wenner configuration with a 1,000 foot electrode spread, indicated nothing of a polarizing nature at depths less than 1,000 feet. Later tests, using this same configuration, suggest that a shallow zone of mineralization exists in the eastern part of the area, Section 30, Twp 20 S, R 22 E. The depth to this zone is estimated to be approximately 185 feet.

With a modified 2 array (note fig. 1) electrode configuration, depth spacings of 3200 feet were attainable. This consisted of placing one current electrode at electrical infinity and the other at the depth station. A reference potential electrode was placed in the direction of the moving potential electrode at 6400 feet from the current energizing electrode. Resistivity and IP readings were made, out from the current electrode, between the reference pot and the moving potential electrode.

Expanders were made in four quadrants, in most cases, depending on accessibility. By doing a sufficient number of these expanders, data was deemed dense enough to contour. Data values were plotted half way between the current electrode and the moving potential electrode for any given depth separation. For example, the IP value would be 10 milliseconds at 1600 feet from the

current center. This value was thus plotted at 800 feet in the direction of the reference pot. The data points were then contoured. Note that contours for 2000 and 3000 feet separations are enclosed. The 2000 and 3000 foot contour maps are from data using the modified 2 array configuration. The 1000 foot electrode separation contour map is based on data from Wenner array traverses as mentioned before. Several typical depth curves are enclosed.

Measurements were made using D.C. power-pulses of 4 seconds at 5 to 6 kw. A .35 second delay was used before an IP integration of 0.8 seconds took place. The D.C. pulse system is repetitious for several cycles to give a good repeatable impressed EMF and IP value. The Hewitt Enterprises system is comparable with the Newmont or Huntex methods.

The induced polarization results indicate that a buried polarizer lies beneath the volcanic cover in the Charleston area. The zone appears to be elongated in a northeast southwest direction, striking approximately N 45° E. It appears that this polarization represents sulphide mineralization, having a width of 3000 feet minimum and at least 2 miles in strike length. An average depth to sulphides is estimated at 1000 feet below the surface. From the results of DD#4 it appears that an average total sulphide percentage for the whole mineralized zone may be approximately 3%.

GEOLOGIC SECTION

The enclosed geologic section is based on drill holes 1, 2, 3, and 4. The principle rocks of the section are post mineral Bronco volcanics, the Bisbee formation sediments and the Uncle Sam porphyry. The contact between the post mineral volcanics and the

underlying sediments is noticeably a basal conglomerate. The Bisbee formation in this area consists of bands of quartzites, arkose, redbeds, argillites and silicified limestones. It is most difficult, if not impossible, to find a marker bed which is identifiable across any two drill holes. The section interpretation is based primarily on the predominance of redbeds or quartzite.

MINERALIZATION

Ore mineralization encountered in the drilling consists of, in order of importance, sphalerite, chalcopyrite, galena, and silver. The mineralization is generally associated with the more arkosic sections of the Bisbee formation. However, in many places mineralization occurs in an andesitic porphyry which seems to be abundant as narrow dikes and sills within the Bisbee formation. The stronger ore sections show considerable sericite and quartz alteration.

Mineralization appears to be disseminated along bedding in most cases, although sections of massive sulphide may form veins.

From the polished sections data enclosed in this report, it appears that several phases of mineralization occurred in this deposit. Pyrite and quartz seem to be the predominant minerals in several of these stages. The polished sample studies suggest the galena and sphalerite are closely associated. The chalcopyrite and silver also appear to be closely related. Since several stages of mineralization seem to be present in the deposit, economic importance may be considerably enhanced.

CONCLUSIONS

Several sections of mineable ore have been encountered in the drilling to date. The reader is referred to the enclosed assay summaries and drill hole logs for an evaluation of the drilling results. Even though many sections of ore grade material were encountered, it is difficult to relate ore in one hole to the next, because of the wide spaced drilling. However, sufficient mineralization has been found to warrant both the use of definitive drilling on shorter hole spacings and general exploration drilling.

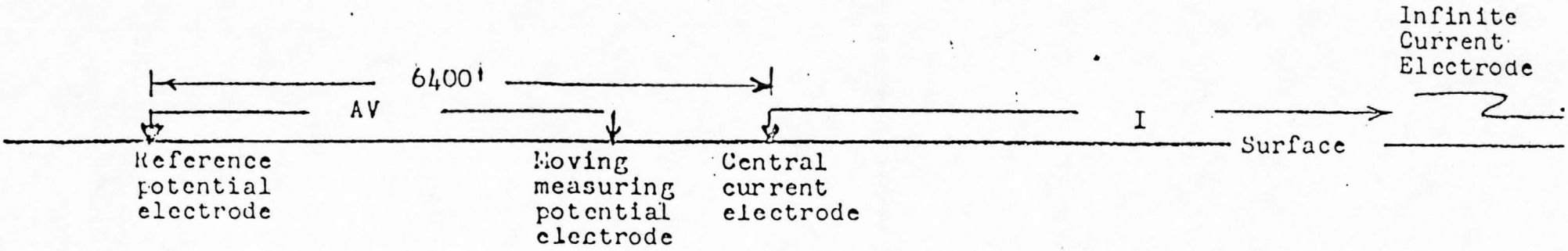
It is important that a very minimum number of holes, within the suggested large mineralized area, have found economic mineralization. It is quite possible that this mineralization lies within the vicinity of a significant porphyry copper deposit.

The geologic environment appears to be favorable to economic mineralization. This, in conjunction with the wide zone of interpreted sulphide mineralization, encourages continued exploration and development. Those familiar with recent mineral discoveries in the southwest will realize that each of them were the result of exploration in situations such as this. We appraise this property to be worthy of a vigorous exploration program.

HEWITT ENTERPRISES

Loyd A. Hewitt

Loyd A. Hewitt



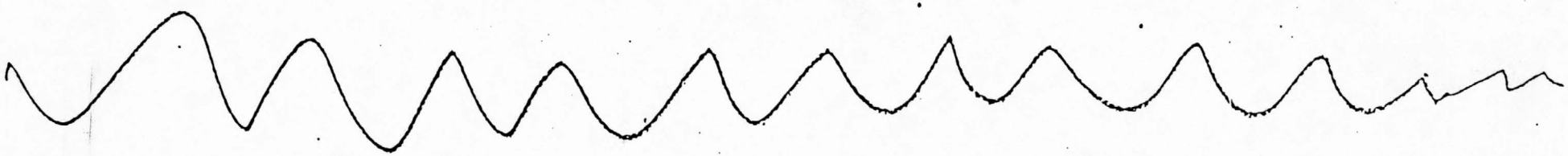
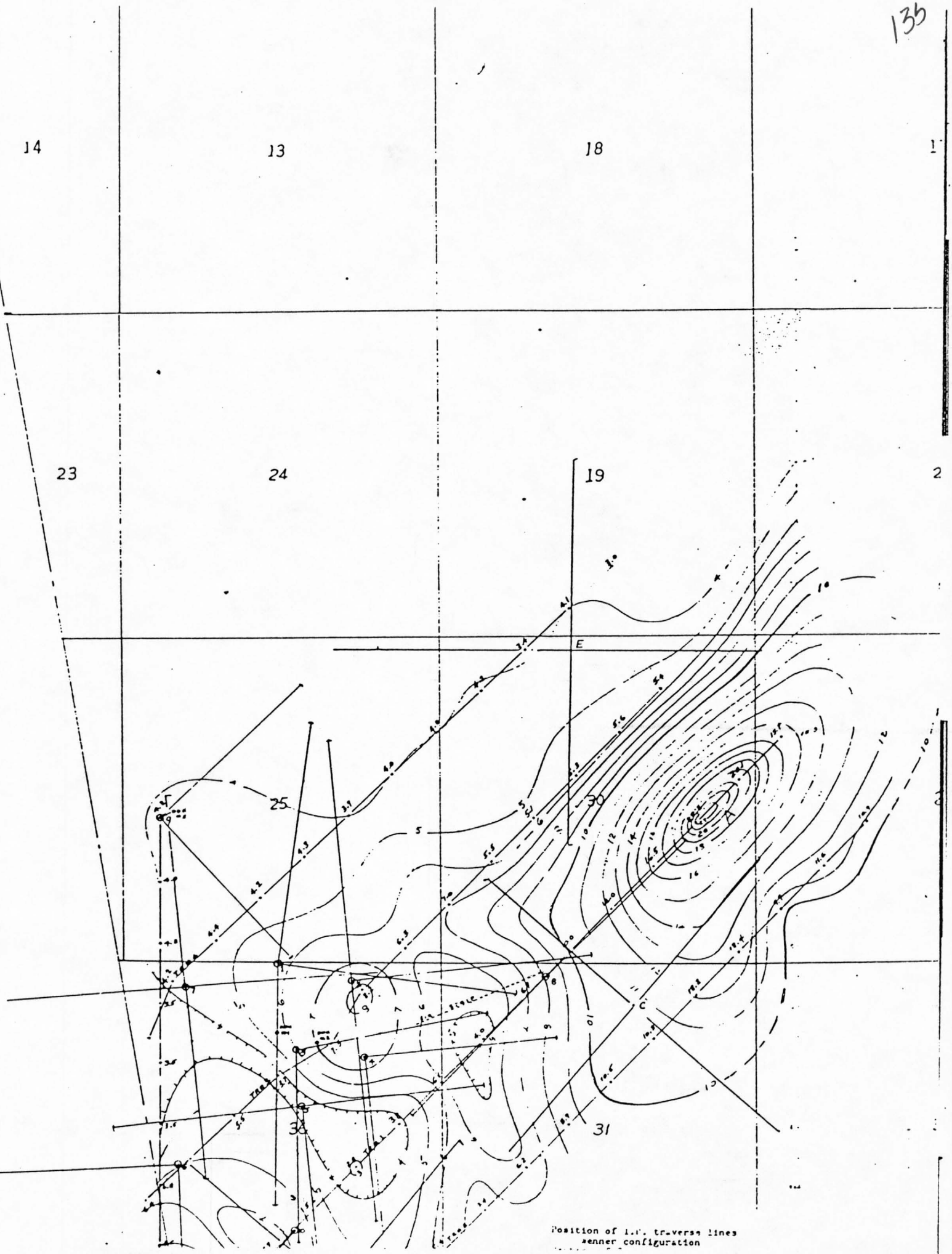
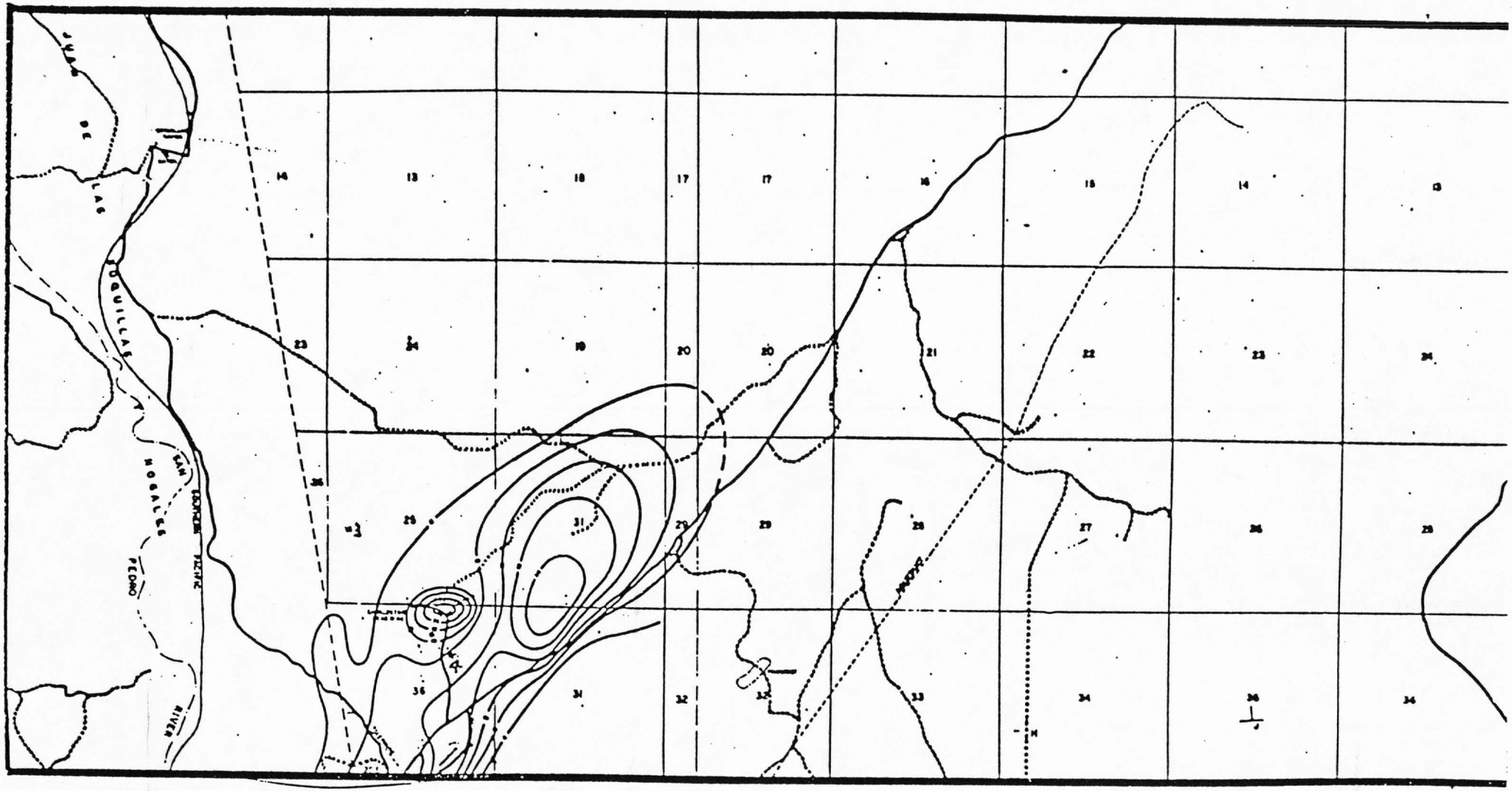


Fig. 1

Modified 2 array electrode configurati



Position of I.P. traverse lines
Wenner configuration



TOMBSTONE - CHARLESTON PROJECT
INDUCED POLARIZATION CONTOURS
SCALE 1" = 2000'
SCALE 1" = 1000'

TRUE NORTH
MAGNETIC

SCALE 1:24000

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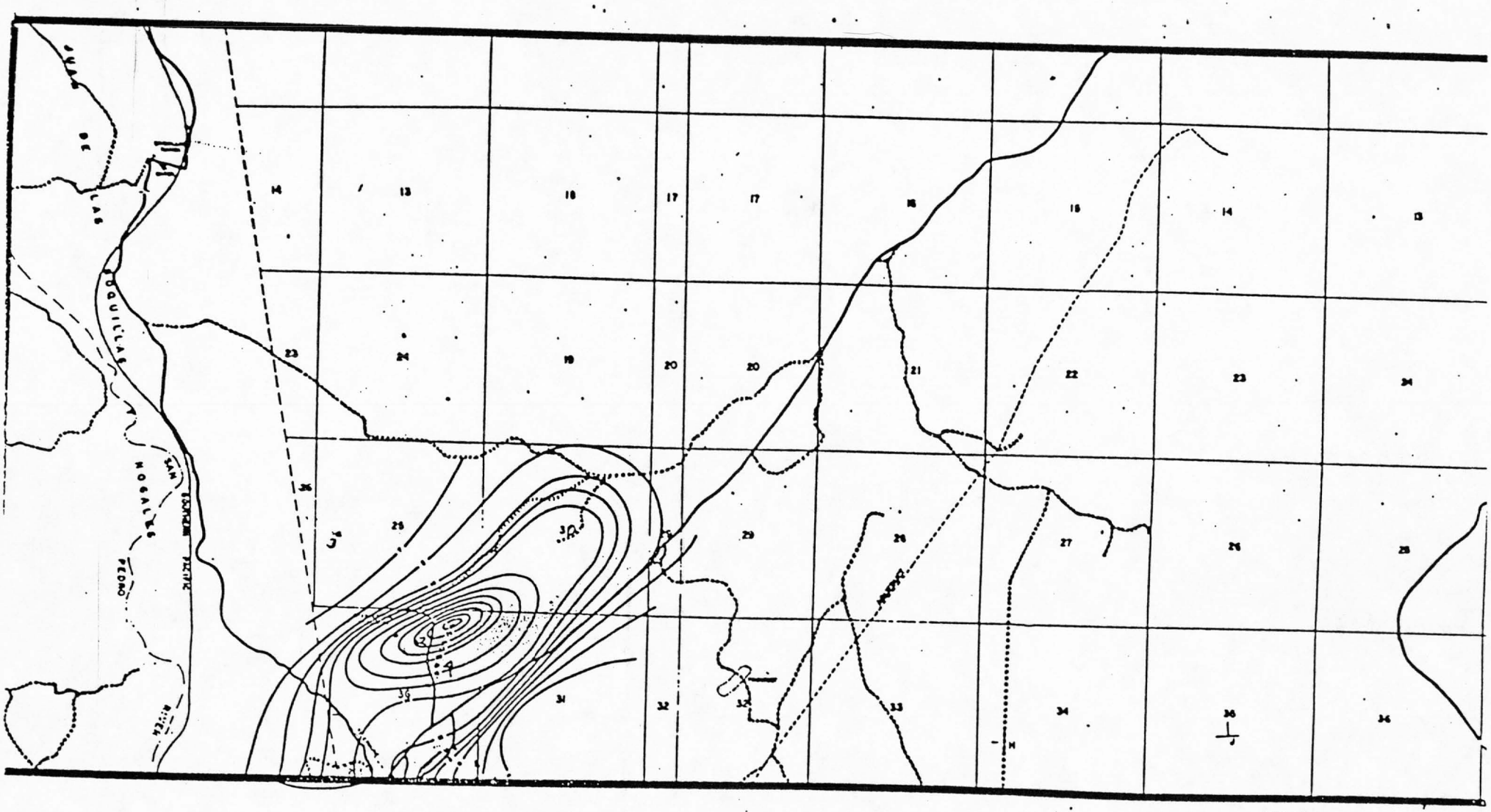

TOMBSTONE – CHARLESTON PROJECT
INDUCED POLARIZATION CONTOURS
"C" = 3200'
SCALE 1" = 1000'

SCALE 1:24000

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3.138

MARY JO GROUP
OF
UNPATENTED MINING CLAIMS IN THE
TOMBSTONE MINING DISTRICT
COCHISE COUNTY, ARIZONA.

The Mary Jo group of mining claims, consists of twelve unpatented claims.

Said group of claims contains approximately 220 acres, two or three of said claims not containing full twenty acres.

These claims were located in 1928, and are on unsurveyed public domain. They are about eight miles south-westerly from Tombstone, and about two miles north-easterly from Charleston.

The main line of the El Paso & Southwestern, or Southern Pacific railroad runs through Charleston, and a spur line runs from Fairbanks to Tombstone.

The claims lie about half a mile from the County highway running from Tombstone to Charleston, thence to Fort Huachuca.

The claims lie on the northerly slope of a lone mountain, part of the claims running to the top of the mountain and others into the flat.

Most of the work done on the property, other than the location work on each claim, has been done on the Mary Jo claim.

What is designated as No. 1 shaft on the Mary Jo was put down on an incline to a depth of fifty feet. From the bottom of this shaft a drift was run south-westerly a distance of about 35 feet, and another drift about 15 feet to connect with No. 2 shaft.

What is designated as No. 2 shaft on the Mary Jo was put down an incline to a depth of 100 feet, and the white clay-like material was encountered at a depth of about 30 feet, and continued down the full depth of the shaft.

Shaft No. 3, on the Mary Jo, now referred to as the main working shaft, is 84 feet deep, on a 55 degree incline, and dips S 20 degrees E. A fifty-one foot drift easterly enters ore the full distance, and the face is still in ore, and a south cross cut at the end of the drift is still in ore at eight feet. An 85 foot drift running southwesterly from the bottom of the shaft enters ore the full distance, with the face still in ore. About 12 inches of the face is massive galena and zinc blended.

As no assay map is available, a record of the assays taken from time to time in the No. 3 shaft on the Mary Jo, after sinking of the shaft was started, to the present faces is herewith set forth. The dates of the assays show that they were taken at intervals as the operations progressed. Neither foot or hanging wall has been exposed, which tends to indicate a good width to the ore zone.

A test run of ore from the No. 3 shaft on the Mary Jo, was made at a nearby mill by gravity concentration, the assays of which are listed. A preliminary flotation test was made, the result of which is also listed. This test was merely to determine if a separation could be made and no attempt was made to secure maximum results, and so no doubt excellent results could be obtained with further experimentation.

In addition to the three shafts mentioned on the Mary Jo, another shaft has been sunk to a depth of ten feet; and an open cut run in a distance of about twenty feet.

Assay of ore encountered at a depth of about ten feet in No. 1 shaft on the Mary Jo ran as follows:

Sample No. 1	Au 0.38 oz.	Ag 49.2 oz.	Cu 20.7%	Pb 3.1%
Sample No. 2	0.12	7.0	9.8	1.0

On the Brother George Claim the discovery shaft was put down to a depth of ten feet. Shaft No. 2 was put down on an incline to a depth of fifty feet. Pockets of Galena and Lead-silver ore were encountered at different depths. Samples of ore taken at a depth of about 30 feet ran:

Sample, Composite	Au 0.09 oz	Ag 21.03 oz	Lead 35.1%
Grown with Galena	.07	14.3	11.33%

Other work on the Brother George consists of a ten foot shaft No. 3 up on the hill, at a contact of an iron vein with a quartz vein; an open cut, No. 4 toward the west end, and some trench work, No. 5 cutting some turquoise and lead stringers.

Assays from No. 3 shaft and drifts on Mary Jo claim:

Date	Oz. Au	Oz Ag	% Pb	% Cu	% Zn
9/25/33	.01	1.6	16.0		5.9
	.01	2.6	25.2		6.8
10/2/33	.01	1.4	10.1		5.5
	.02	4.0	12.5		1.3
10/9/33	.01	3.0	9.1		0.8
	.01	1.0	8.0		30.8
	.01	1.2	13.6		34.7
10/30/33	.01	1.6	13.8		6.2
	.01	1.0	5.0		4.8
11/13/33	.02	0.6	4.5		8.0
	.01	1.2	3.8		3.0
	.01	1.2	3.6		2.8
12/6/33	.01	1.1	5.0		10.1
	.02	2.6	17.1		5.0
12/18/33	.02	2.2	8.5		5.9
	.01	1.0	3.0		4.5
	.01	1.0	2.3		4.6
12/30/33	.02	9.0	4.2		---
2/19/34	.03	1.8	15.3	1.1	12.1
	.03	1.8	2.8	0.3	10.3
12/19/34					
Face, East Drift	.01	0.8	3.8	0.2	8.5
Face, West drift	.02	3.6	6.5	3.5	13.0

Bear Creek Report

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12-16-69

CHARLESTON MINE COCHISE COUNTY, ARIZONA

HISTORY

There is nothing in the records of the Bureau of Mines in Tucson but a few newspaper cuttings. The mine was probably found in the early part of the century. The structure in the open pit was mined from underground workings during the second world war, with an indicated production of 20 tons per day in 1944. A concentrate running 25-30% combined metal (presumably Pb-Zn) was sent to a mill in Bisbee. In 1950, the mine was bought by four Texans, but there is no record of production under this new ownership.

The James Stuart Company, (present owners) bought the property for a reported one quarter million dollars in 1957.

Clark Hughes and Harlowe Jones mined the open pit and the dumps north of the mine which are stated to contain 10,000 tons of ore running 10% combined Pb and Zn, presumably all oxidized. A small mill was built to concentrate the sericite associated with the ore, and $25,000 worth of concentrate was sold to Western Chemical Company for $150 per ton. It was apparently used as a paint filler. C. Cosgrove, Horne's field engineer suggests a new mill to concentrate the sericite could be built for $600,000 and production from such a mill could recapture all the money invested in the property to date. The property was again optioned and five holes at 45° N were drilled to intersect the structure 75' below the bottom of the pit. These are said to have intersected 10' - 20' of sericite.

DEEP DRILLING

Hole #1 was spotted on the basis of geophysics (Air Mag) and to intersect the Charleston mine structure.

Hole #3 is in the middle of the Uncle Sam porphyry stock, at least 1,000' from the nearest contact.

Holes #2 and #4 were stated to have been located on the basis of geophysics (I.P.).

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GEOPHYSICS

An aeromagnetic survey has been flown over the area. There is a magnetic high over the granodiorite stock to the southwest, but very little magnetic relief over the mine area itself. Several ground mag profiles have been run, however, the results are difficult to interpret. The geophysics was carried out by Hewitt Enterprises of Salt Lake City.

Hewitt's equipment, which is a simplified form of the pulse system, had been used previously by Whishaw and found to be somewhat unsatisfactory. Most geophysicists would doubt its ability to record meaningful results from over 2,000' depth.

I.P.

Two contoured I.P. maps accompany this report. There is a very impressive anomaly about 10,000 ft long running NE-SW centered about the mine with values up to 20 milliseconds; about 10 milliseconds would be considered anomalous. This anomaly is stated to represent several per cent sulphide at 2,000' - 2,300' depth.

GEOLOGY

A rough geological map of the mine area, on a blow-up of the 1-24,000 scale 7½ topographic sheet is attached. (Geology 1" - 500').

Five units have been mapped:

1. Uncle Sam Porphyry.
2. Purple Volcanic
3. White Tuff
4. Brown Volcanic
5. Recent Gravel and Overburden

(1) The "Uncle Sam Porphyry", Miocene to Pliocene in age intrudes the white tuff. Two miles southwest of the mine, granodiorite of the same age occurs.

The intrusives associated with the majority of the copper deposits in the southwest are of Laramide age, late Cretaceous to early Tertiary. The mineralizing stock at Bisbee is older Jurassic. This suggests that the Uncle Sam porphyry stock is not the source of the mineralization in the

drill holes. The Charleston Hill and a large area to the north of the mine is Uncle Sam porphyry.

(2) The purple volcanic varies from a tuff resembling a purple argillite to an agglomerate or breccia with porphyry fragments. In part, it is true porphyry with white feldspar phenocrysts. It varies in color from purple to gray-brown. Outcrops can be distinguished from a distance and most areas of this unit have been sketched in. All varieties are assumed to be the same unit, but the contact, in places, appears to be intrusive into the white tuff and the Uncle Sam porphyry and tends to occur near the contact between the two.

The purple porphyry in DD #1 has limey fragments and limey matrix, but this type was not seen on the surface.

Two limestone boulders were noted, but they were probably inclusions weathered from the Uncle Sam porphyry and limestone and conglomerate pebbles were seen in the gravels south of DD #4.

(3) The white tuff covers a large area in the vicinity of the mine. It is a hard, white rock - interbedded and sufficiently altered, so that individual ash particles can no longer be recognized. In some areas, it contains fragments up to 6" across, but more usually, 1" - 2".

(4) The brown volcanic occurs to the south of the mine. It may be the same unit as the purple volcanic but consists of predominantly brown and gray tuff, agglomerate and porphyry. Some of the gray tuff is slightly silty.

Generally, there is no bedding in the volcanics. The few attitudes on the map may be of jointing.

MINERALIZATION

Charleston Lead Mine - Open Pit

The open pit has been sunk on the area of the old underground workings. The plan of the geology is roughly projected to the level of the south end of the pit.

The pit is on an E.W. structure zone of altered rock about 1,000' wide and appears to be on the contact between the Uncle Sam porphyry of the Charleston hill and white tuff to the north.

The west end of the pit shows strong shearing over about 6'. The rest of the zone is highly altered, but comparatively unsheared. The alteration is principally the formation of the sericite in the white tuff, which, in places, is almost completely altered. Pyrite is abundant in parts of the tuff, but no other sulphides were seen. This is presumably the zone from which the lead-zinc ore was mined in the past. Material from the pit has been stockpiled north of the mine (see geology map) which amounts to 10,000 to 15,000 tons stated to run about 10% combined Pb Zn.

Forty five degree holes intersecting the zone 75' below the pit are stated to show 10'-20' of sericite. The trench 1,000' to the west of the pit (see sketch plan) is probably on the same zone. An area on strike to the east, below the water tower, has been stripped by a bulldozer, but the zone appears to have pinched out.

Samples C.P.1 - C.P.7 are from the open pit (see plan of pit). Mineralization in DD holes 1, 3, and 4 occurs between 1,000' and 3,000' below the surface. (See tabulation of significant drill hole intersections based on C. Davis assays). Most of the intersections are in the sedimentary beds, although, in places, porphyry is mineralized.

It is difficult to correlate the mineralization between the holes. The best intersection is in hole #4 1791.5'-1822' 30 - 5' 2.36% Cu. Copper values tend to increase with depth in the vicinity of the mine. The mineralization in the drill holes appears to be unconnected with that in the open pit.

The mineralization is probably in the Bisbee formation (Cretaceous) while the surface rocks are the overlying Bronco Group of late Cretaceous or Tertiary age.

Scattered mineralization occurs over a vertical section of nearly 2,000' and has probably not been bottomed.

Holes #1, #2, and #4 are on the I. P. anomaly, but to the east and south of its center.

CONCLUSIONS

The Charleston Mine structure has not been explored in depth. There is the possibility of economic lead-zinc mineralization and also marketable

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sericite from this structure.

The mineralization in DD holes #1, #2 and #4 is widely scattered in small intersections over 2,000' of section. The best intersection is 30' of 2.3% Cu at 1800'. To prove up an economic tonnage of this type of ore (10,000,000 tons?) would be a very expensive proposition at this depth and with such narrow intersections.

Most copper mineralization in Arizona is associated with intrusive monzonite porphyry bodies. Mineralization spreads out from the porphyry into the intruded rocks, which also, in many cases, constitute ore.

The most attractive possibility at the Charleston property is that the mineralization in holes #1, #2, and #4 may be peripheral to a porphyry copper deposit. Such a deposit may be indicated by the I. P. anomaly centered over the mine area.

It is suggested that the I. P. data be examined by our geophysical department. If there is any doubt about its validity, an arrangement should be made whereby we can check the anomaly on the ground by a different I. P. system. If the anomaly is verified, a drilling program based on the geophysics would be justified.

If it were not verified, the property would be still worth some attention. However, it could then only be explored by a drilling program stepping out from the present drill holes in an effort to find consistent mineralization or the porphyry source. This might prove very expensive and frustrating. The surface geology is of no help, being in a horizon above the mineralization.

A number of the porphyry copper deposits in Arizona have been discovered as a result of the exploration of just such a situation as this. (Pima, Mission, Twin Buttes, VeBol, Lake Shore and possibly others).

End

Q.G. Whishaw
(Ed.) R. E. Wager

HOLE # 1

From		To	Length - Ft.	Pb	Zn	Cu	Ag
1102	-	1106	4	-	-	.5	1.0
1632	-	1636	4	5.6	8.05	-	-

2103 Bottom of Hole

HOLE # 2

1005	-	1008	3	4.88	9.20	.43	-
1028	-	1032	4	.60	5.0	-	-
1726	-	1737	11	.44	3.56	-	-
1858	-	1862	4	.34	.7	-	-
1923	-	-	?	-	14.7	-	-
2261	-	2272	11	-	-	3.30	.70
2640	-	-	?	-	26.2	-	-
2957	-	2961	4	-	-	-	-

3200 Bottom of Hole

HOLE # 3 Nil

HOLE # 4

1478	-	1501	23	.40	1.81	-	-
1791.5	-	1802	10.5	.23	.45	4.95	.5
1810	-	1822	12	.28	.08	1.65	.6
1791.5	-	1822	30.5	-	-	2.36	-
2099	-	2104	5	-	-	.77	-
2230.5	-	2236	5.5	-	-	.67	-

3415 Bottom of Hole

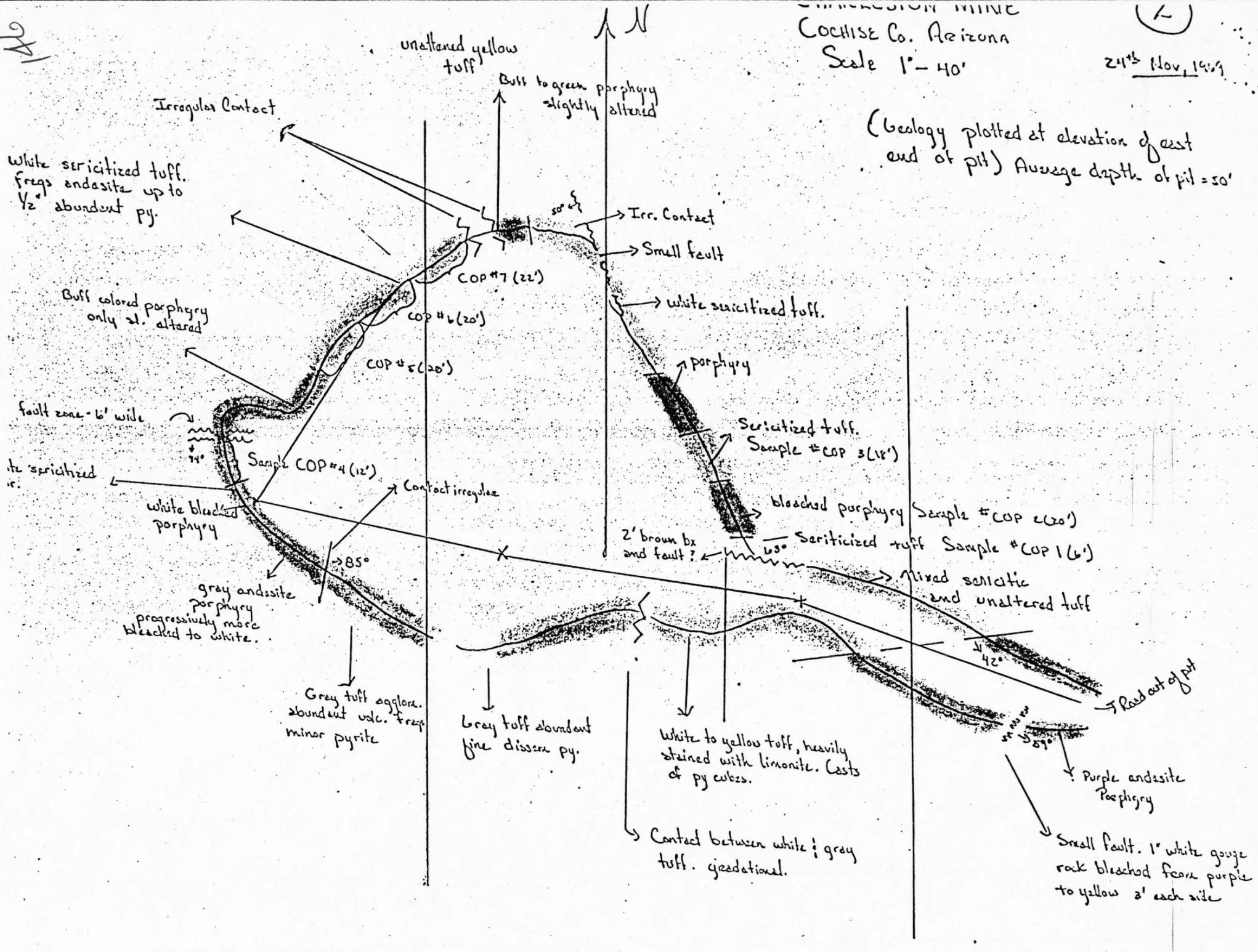
NOTE

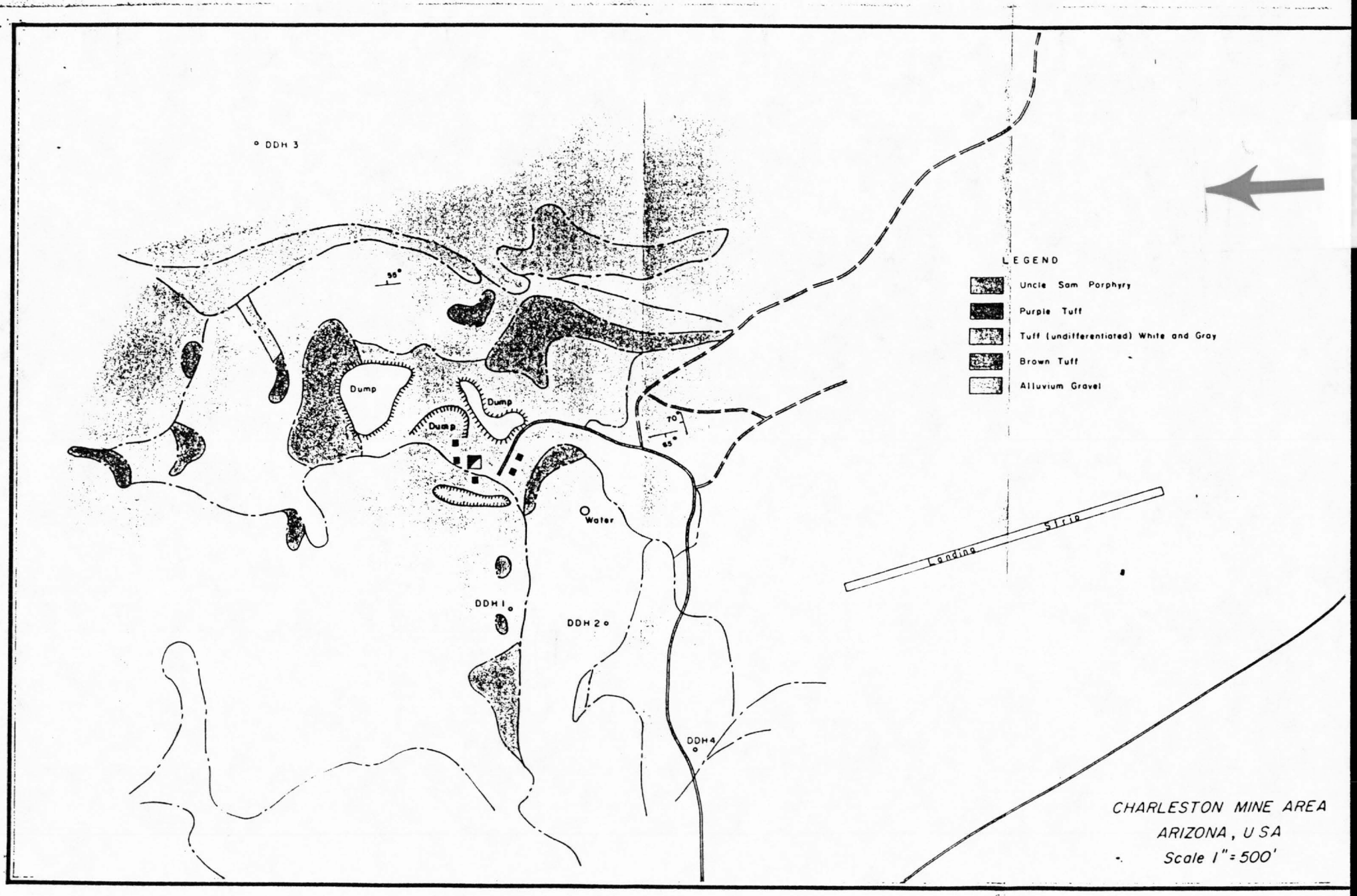
December 16, 1969

CHARLESTON MINE
COCHISE Co. Arizona
Scale 1" – 40'

24th Nov, 1969

(Geology plotted at elevation of east end of pit) Average depth of pit = 50'




DDH 3
55°
Dump
Dump
Dump
70°
65°
Water
DDH 1
DDH 2
DDH 4
Landing Strip
LEGEND
Uncle Sam Porphyry
Purple Tuff
Tuff (undifferentiated) White and Gray
Brown Tuff
Alluvium Gravel
CHARLESTON MINE AREA
ARIZONA, USA
Scale 1" = 500'

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Dr Gaines Report
Perforador A Latina
= Heron Mining Co.

9-10-62

THE CHARLESTON MINE

TOMBSTONE, ARIZONA

LOCATION:- The Charleston mine is about 6½ miles soutwest of Tombstone, Cochise County, Arizona. It is reached from Tombstone by 6.7 miles of graded county road and .75 miles of mine road.

OWNERSHIP:- This mine is owned by Charles Suiter of Phoenix. It has been under lease for several years to the James Stewart Co. The Heron Mining Company has an option to purchase from the James Stewart Co., which also involves taking over the remainder of their obligation to Charles Suiter.

PROPERTY:- There are twelve unpatented mining claims in the Charleston group, located by Suiter, and eight additional claims are included in the contract which were leased by the James Stewart Co. and are on Arizona State lands adjacent to the Suiter group, in section 36, Township 20 South, Range 21 East, Cochise County, Arizona.

HISTORY:- Suiter's twelve original claims were located in 1928. Sporadic attempts to work the lead and zinc ores were made in the thirties, but the first serious mining was done by Suiter in 1949. He had a crude mill and shipped mixed lead and zinc concentrates. He leased the property or gave it under option to several companies, among whom were Nash and Vogel, in 1950, and Ryan Oil Co., in 1952. Both of these companies diamond drilled the property, and Nash and Vogel in addition put down two chrun drill holes. The records kept on Ryan Oil's holeswere so poor as to be of little value, but the Nash and Vogel records were well kept and

of considerable value.

Suiter had worked the mine by underground methods but his costs were high due to the soft, slippery nature of the ore, resulting in heavy ground and much timber consumption. He had six shafts, the deepest being 104 feet deep on a 55º incline, and several hundred feet of levels. The writer visited the Charleston Mine in 1955, but even then many of the workings were inaccessible or dangerous due to caving. In 1953, with the decline in price of lead and zinc, Suiter discontinued his efforts.

In 1956 a Mr. Spencer undertook to develop the property, and started an open pit, removing about 60,000 tons of overburden, exposing the orebody in the bottom of the pit. He only tried to recover the lead and zinc, but due to the low grade of the ore and difficulties he experienced milling it, he abandoned the operation.

In 1957 the James Stewart Company took over the property, and have been trying to operate, at intervals, ever since. They cleaned out the pit and operated the mill, and built and rebuilt several times a plant to recover the sericite. Their operation has been unsuccessful due to technical difficulties and poor management, and they were never able to produce a saleable sericite on a commercial scale.

In 1958 Consolidated Minerals, Inc., purchased several hundred tons of sericite tailings from the tailings pond resulting from the Suiter operation. These tailings were cleaned and purified, producing a very fine white natural sericite, for which a market was developed at prices around $ 100.00 per ton. Cleaning of the sericite was carried out using dry processes, but these processes

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have not been available to any subsequent operator of the property. In 1962 Heron Mining Company core drilled the property, and due to using a larger diameter drill and special precautions to ensure good core recovery, a good idea was obtained for the first time of the structure of the deposit, plus an approximation of the reserves over a limited stretch of the vein.

GEOLOGY:- Two types of igneous rock are revealed on the surface and through the diamond drilling. One is a porphyry, probably intrusive, known as the Uncle Sam Porphyry. This rock constitutes the hill immediately south of the mine, and the enclosing rock of the mine itself. The other rock is fine grained and dark green, and is probably an andesite. It constitutes the foot wall of the vein and is exposed on the surface north, east and west of the mine.

The porphyry, when fresh, is dark green with abundant phenocrysts of feldspar 1mm to 3mm across. Due to alteration and propylitization the appearance of the rock varies widely, ranging in color through grey-green to white, the lightest colored varieties being silicified and largely altered to sericite and probably other clay minerals. In this altered phase, the iron minerals are more or less completely converted to pyrite, which is finely disseminated through the rock.

In places in the drill core, the porphyry appears to have been brecciated and recemented. The contact with the andesite, as seen in the core, is not sharp, but appears to be gradational. Possibly this "andesite" is an intrusive dike into the porphyry, intruded prior to complete solidification of the porphyry. Its color is dark green, sometimes with reddish streaks, and it is

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uniformly fine grained.

Rocks which have been identified by other geologists as "rhyolite", are thought to be nothing more than light colored altered phases of the porphyry. Little or no original quartz was seen in any of the rocks at the mine, although there is some vein quartz associated with the sericite lenses.

Giluly has mapped a major East-West fault which passes through the Charleston mine area. This fault is supposed to be at least one mile long. It is doubtful if any of the holes drilled on the property penetrated this fault, and in the event the fault represents the footwall of the altered zone containing the sericite lenses, then it must be considered that this zone continues somewhat farther to the north, perhaps two or three hundred feet north of the present workings, to where the fault actually is. - Because of thick overburden and wastedumps in this area the underlying geology cannot be seen.

Within the zone of altered porphyry, which is at least 150 feet wide and possibly as much as 400 feet wide, is a narrower zone containing overlapping lenses of sericite. These lenses are scattered through a width of about 120' of the most intensely altered porphyry, and form a mineralized area which is continuous along the strike for al least 600', in which the total thickness of sericite lenses varies between about 10' feet and 30', and with mineable widths varying between 5' and 25', The individual lenses vary from a mere seam up to 17' in thickness, and with a maximum length probably around 150'. The zone of lenses dips about 60° to the south. Evidence from a churn drill hole shows that the sericite lenses continue to al least 305', and there is

reason to believe that at this depth the width of the lens zone and the number of lenses within it are increasing.

The lenses themselves show a sharp contact with the altered porphyry. They consist in pure white fine grained sericite, which by weight constitutes from 25% to 60% of the mass, impregnated with a fine dissemination of minute euhedral pyrite crystals, and often, in addition, galena and sphalerite, which is coarser than the pyrite and may reach a grain size of one inch. Individual samples may assay 30% - 40% combined lead and zinc, and mineable widths of sericite assayed up to 15% combined metals. However, some sericite zones showed no lead and zinc at all. In addition to sericite, pyrite, galena and sphalerite, the sericite lenses contain some fragments of incompletely altered silicate minerals or quartz.

One of the characteristics of the high grade sericite is that when a piece of it is placed in a glass of water, it will quickly disintegrate to a fine slurry, the heavier minerals settling to the bottom.

The altered rock enclosing the sericite lenses also contains much disseminated pyrite and e few percent (8.5% in one sample) of sericite. Iy may contain some lead and zinc, too - the richest sample of this material assayed contained .62% lead and 2.90% zinc. In general, however, the altered wall rock is barren of lead and zinc, and the only commercial concentrations of these metals are confined to the sericite lenses.

Silver is present in some of the ore, but apparently is limited to one or two lenses within any series across the vein. Silver values of 2.4 and 2.8 ounces per ton were found in two lenses having relatively high lead values, but other lenses containing

comparable values of lead showed no silver al all.

EXPLORATION:- Of the holes that produced useful information about the orebody, Nash and Vogel drilled five diamond drill holes and one churn drill hole, and Heron Mining drilled five diamond drill holes.

Nash and Vogel's holes suffered in that they were all vertical, which is a poor angle to investigate a structure dipping 60°. Moreover, since they were seeking only lead and zinc, the sericite, which was the principal object of Heron's exploration, was mentioned only in passing. No assays were made of the sericite, and core recovery was poor precisely in the portions of the holes containing sericite. Robert Teten, their geologist, did an apparently competent job of logging the core they did recover.

Heron Mining's drill holes were all drilled at a dip of 45° to the north, thus intersecting the structure only 15° away from a line normal to it. This means that intersected widths differed by only 3.4% from the true widths. Hole size was mostly NX, although it was necessary to reduce to BX near the bottoms of holes 7 and 10. Drilling mud was used throughout the ore zone, and when it was discovered in hole # 7 that superior recovery of the sericite itself could be accomplished by using diesel oil as a drilling fluid, this procedure was followed whenever sericite was intersected. As a result, the core recovery in sericite was around 90%, and in the altered rock at least 98%.

The experience of the drillers was that after penetrating a sericite lens, when the rods were removed from the hole for a few hours or overnight, the sericite would swell up and squeeze into the hole, filling it. This sericite would have to be

drilled out of the hole again in order to get the rods back down to the bottom of the hole.

The location of the holes drilled is shown on the accompanying map. Nash and Vogel's holes are numbered 1 - 5, and Churn Drill Holes # 1 and # 2. Churn Drill Hole # 1 was abandoned before reaching the ore zone. Heron Mining's holes are numbered # 6 to # 10. Sections of all the holes are also shown, although in the case of # 1 - # 5 the information was rather vague and the results are inferred.

ASSAYING:- Representative pieces of the sericite core were dried and their specific gravity determined, in order to establish the tonnage factor for the sericite. All sericite core was then dried, crushed, quartered, and assayed for lead, zinc and silver. Then portions of each crushed sample were dissolved in water, and the resulting slurry decanted, diluting the remaining sludge and decanting repeatedly until no easily soluble sericite remained in the sample. The resulting sericite suspension was allowed to settle dried, and weighed, giving the percentage sericite content of each core sample.

ORE RESERVE CALCULATION:- In determining which of the sericite intersections constituted mineable ore, the arbitrary factor was used of $ 25.00 per ton combined gross values of the sericite, lead and zinc, over a width of 3 feet, as a minimum. Lead was calculated at 9½ cents per pound, zinc at 11½ cents per pound, and sericite at $ 100.00 per ton, the price at which this product was sold by Consolidated Minerals.

It was assumed that all the blocks of ore extend to a depth of 305 feet, the greatest depth at which a lens of sericite was found in Nash and Vogel's churn drill hole No. 2. The height of the several

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blocks varies according to the amounts removed in the open pit and by underground mining. The orebody was assumed to extend 40' each East and West beyond holes # 7 and # 10 respectively. Since assay data on No. 10 hole was not available at the time of writing this report, a grade of 3% lead, 3.7% zinc, and 36% sericite was assumed, which is the weighted average grade of the other three holes.

RESERVES OF PROBABLE ORE:- Intersection by one drill hole, under these conditions, will not result in a blocked out body of positive ore. However, it is reasonable to call the ore thus blocked as "probable".

Only ore was considered probable which was intersected by the four Heron drill holes which hit sericite. Using as average specific gravity factor of 2.35, equal to 13.7 cubic feet per ton, the following table shows the grade and tonnage blocked out by each of the four holes:

Block No.	Tons	Lead %	Lead Tons	Zinc %	Zinc Tons	Sericite %	Sericite Tons	Gross Value
7	35,000	2.98	1,040	2.04	714	41.25	14,400	$ 1.801,700.00
8	27,100	2.73	740	5.26	1,425	30.8	8,350	1.303,300.00
9	5,100	4.63	236	7.14	364	58.6	2,990	427,500.00
10	19,100	3.00	573	3.70	710	36.0	6,870	959,200.00
	86,300		2,589		3,213		32,610	$ 4.491,700.00

MINING:- Because of the narrowness of the lenses the only feasible way of mining this orebody is by underground methods. The ore itself has no strength, but the wall rock will stand up well for a reasonable period of time. Probably a variation of horizontal cut and fill with timber support, or else of square set stoping, would

work well. The ore is so soft that drilling and blasting in the stopes will be practically negligible, although development headings will require drilling and explosives. Timber costs and filling costs will be high, more than balancing the savings in dynamite. It is thought that mining can be accomplished for around $ 10.00 per ton of ore extracted.

MILLING:- Experience by Consolidated Minerals shows that the sericite can be readily recovered and purified from a cake resulting from the settling and drying of a sericite slurry. This suggests the following flowsheet.

The ore is crushed to minus ¼ inch and agitated with water. The suspended sericite is decanted and sent to dewaterning. The heavy sludge containing all the sulfides is grownd in a ball mill and selectively floated to recover lead and zinc.

The dewatered sericite is dried, pulverized, and treated in the air classifier to remove the very fine particles of pyrite and other grit that may still remain, resulting in a pure, white, fluffly, highly saleable sericite.

Although this sounds simple, the matter of dewatering and drying the sericite is not simple. It passes through or clogs filters, settles with extreme slowness, and does not respond to treatment in cyclones. Batch centrifugal precipitation works well but the apparatus is very expensive. Other methods may work better such as spray drying in a hot air tower. This aspect needs to be investigated.

It is thought that the separation of the lead and zinc concentrates should cost about $ 5.00 per ton of feed, and the treatment of the sericite might cost as much as $ 20.00 per ton of

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sericite, but since this constitutes only 36% of the feed, the overall milling cost works out at $ 12.20 per ton.

ECONOMICS:- With mining costing $ 10.00 per ton and milling $ 12.20, the overall costs are $ 22.20 per ton of ore. Thus, the treatment cost works out to be $ 1,915,000.00 for the 86,300 tons of ore. Considering the gross value to be $ 4.490,000.00, if recovery in the mill es 85% the net recovered value is $ 3.820,000.00. After deducting mining and milling costs, $1.905,000.00 remains. About $ 400,000.00 should be deducted, representing the cost of freight and smelting on the lead and zinc (this is a very rough approximation, based on a gross value of $ 1.050,000.00 for the recovered lead and zinc). This leaves a gross profit before taxes of $ 1.500.000.00. The depletion allowance of 15% will allow $ 600,000.00 of the profit to be put aside. If the remainder is taxed at 50%, there would still remain $ 450,000.00, for a total net profit of $ 1.050,000.00.

POSSIBLE ORE:- The above computation only takes into account the ore present in a strech of the mineralized zone 285' long and 305' deep. There is every reason to expect that this same formation should continue in depth, to double or more the 305'. In addition, it is known that Nash and Vogel intersected 18 feet of sericite (9' true width) in their hole # 2, 340' west of Heron's hole #10. Sericite also visible in an outcrop on the Connecting Links claim, over 1,100' N 75° E of the pit. Obviously, there is plenty of room for exploration, with the promise of multiplying the present reserves by several fold.

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RECOMMENDATIONS:- On the basis of the presently established values and the already developed techniques of treatment, the following steps are recommended for additional exploration and development, prior to constructing a mill and putting the mine into production:

1.- At least three holes should be drilled from the south, designed to test for the continuation of the orebody al a depth of 320' nelow the surface, below the ore already indicated in holes 7, 8, 9, and 10.

2.- Five more holes should be drilled westward along the strike, toward Nash and Vogel's Hole # 2, designed to intersect the ore 150' below the surface.
The total cost of this additional drilling would be about $ 20,000.00.

3.- Test work should be carried out on the sericite, to determine the optimum method of recovery. This should include study of settling rates and methods of drying, and cleaning of test batches of dried sericite with the air classifier. It is believed that $ 5,000.00 would cover sufficient experimental work to lead to a final mill design.

México, D. F., septiembre 10 de 1962.

ASSAY RESULTS - CHARLESTON MINE

HERON MINING CO. DRILL HOLES - 1962

Hole No.	Footage	% Pb	% Zn	% Sericite
7	115-117	.11	Trace	29.5
	120.4-125.8	.02	0.0	59.5
	171-173	1.57	2.94	35.9
	196-197.5	5.15	7.32	25.0
	203-220	3.89	2.12	37.5
8	111-113	.03	0.0	27.0
	154-165	2.15	2.96	31.5
	169-172	2.11	6.50	22.5
	201-206	3.88	10.93	34.5
	206-213	.62	2.90	8.5
	213.4-218	3.27	3.78	30.4
9	138-143	4.63	7.14	58.6
10	156-159			
	165.5-170			
	179-185	(Hit old mine opening. Thickness assumed from old underground data).		

Inco Report? 160

5-2-57

REPORT ON THE CHARLESTON MINE

Tombstone, Arizona

INTRODUCTION

The Charleston property consists of 12 unpatented claims, comprising about 228 acres, situated in Sections 25 & 36 of T. 20 S., R. 21 E. The property lies about eight miles southwest of Tombstone and about one half mile north of the county highway between Tombstone and Charleston.

The claims were located in 1928 and exploration work in the form of sinking three shafts, the deepest to 104 feet, and drifting short distances from these headings, was carried out prior to acquisition of the property, in 1947, by the present major shareholder, C. H. Suiter. Mr. Suiter and several leasers further developed the property and have sporadically operated it, up to the present time.

None of the original shafts are accessible at present because last year a program of open pitting above these workings was abandoned before completion, leaving them buried under a substantial quantity of broken rock. A short distance to the west, however, two shafts about 75 feet apart, called the Brother George No. 2 and No. 5, are connected by a drift on the 70 foot level and a small amount of workings can be inspected on this level.

PRODUCTION

The total production to date from the Charleston property is approximately 3,000 tons, from which 1,340 tons of lead-zinc bulk sulphide concentrate were shipped to the smelter. The arithmetic average of the first 23 of 26 ore shipments which constitutes this tonnage is:

1.45 ozs. Ag. 0.76% Cu. 9.60% Pb. 13.7% Zn.

Neglecting milling losses, the calculated average ~~fro~~ loss the mine run, based on a ratio of concentration of about 2.3 to 1 is:

0.6 ozs. Ag. Cu. 0.3% Pb. 4.2% Zn. 6.0%

It should be noted that the ore was mined somewhat selectively and the true average may be as little as half the above figures, although the ultimate grade will probably lie somewhere between these two extremes.

GEOLOGY

The Charleston mineralization lies in a strong east-west zone of faulting which, in the mine area, cuts through a formation of predominantly andesitic flows and flow-breccia. These rocks are correlated with the lower member of the Bronco formation of late Cretaceous or early Tertiary age. The upper member is variously termed a quartz latite tuff or, for identification in the field,

a rhyolite agglomerate. Outcrops of rhyolite may be found in many places on the property.

The quartz latite tuff member has been estimated from 900 to 2500 feet thick and the underlying andesitic member is considered to be at least 3500 feet thick.

In the Charleston area the Bronco formation has been intruded by a thick sill of quartz latite porphyry. This body, which is known as the Uncle Sam formation, outcrops continuously from about a thousand feet north of the mineralized area to the edge of the Tombstone hills, about four miles to the northeast. There are also numerous smaller irregular masses of this rock in the area, one of which outcrops on the Charleston mine hill, within 200 feet roughly to the south of the main showings.

The intrusion of the Uncle Sam prophyry is believed to have been controlled generally by a thrust fault which was formed during the period of major deformation of the Tombstone district. No additional movement along the thrust is known following the emplacement of the porphyry. The age of the Bronco formation with respect to this thrust faulting is indefinite because thesevolcanic rocks have not been found, as yet, in contact with the fault.

Although the large mass of Uncle Sam porphyry lying northeast of the Charleston mine is relatively flat lying, the contact between it and the Bronco andesite which lies a thousand feet north of the mine fault is steep dipping. Flow banding in the porphyry near the contact is almost vertical, and strikes west to northwest.

The prophyry lying on the hillimmediately south of the mine appears to be laccolithic, as the andesitic member outcrops in a nearly complete ring around it. The north contact of this body appears to be faulted and parallel in strike to the Charleston mine fault; if the contact dips 60 degrees south, as does the main fault 200 feet north, a wide zone of reverse faulting is suggested.

Within this zone of faulting intense hydrothermal alteration of the andesite has taken place, the strongest metamorphism occurring at wider zones of shearing, which are apparently related to zones of northsouth crossfaulting. High temperature solutions emanating along the faults have altered the andesite to clay minerals; this magmatic process is also an indication of lead zinc mineralization.

There appears to be a definite sequence to the wall rock alteration. From almost pure sericite in the centre of the hydrothermal vein the sequence changes from an illite clay (ie. a definite type of mica clay) to a predominantly Kaolin clay, thence in decreasing intensity through Kaolinized andesite, or rhyolite, to a comparatively fresh wall rock. The sericite is most significant because, while being a commercially important by-product, it is also an indicator

of fairly strong lead-zinc mineralization. Minor values in these metals also occur in the Kaolinized wallrock.

The main zone of sericite-lead-zinc mineralization can be traced on surface for a length of 300 feet. The average width along the zone is probably at least 12 feet, and it is likely that the widest portion is in excess of 25 feet. At present, the widest area, in the vicinity of the Mary Jo No. 3 shaft, is partly buried under a pile of broken waste rock and a determination of the width in this area is not possible at present.

On surface the metallic minerals are completely leached but, in the Brother George No. 5 shaft, sulphides are encountered at a depth of about 30 feet. The depth of leaching appears to be somewhat greater where the zone narrows down to a few feet.

The main shear is traceable for about 1200 feet to the west of the main zone of mineralization. There is some oxidation of the adjacent rocks along the fault but at only one other point is any sericite known. This showing is close to a small north-south draw which is believed to contain a cross fault; the mineralized zone is believed to be fairly small although further exposing would be necessary to determine its size. Other interesting zones, which are also believed to be small, lie in parallel zones on both sides of the main body of mineralization.

MINING AND METALLURGY

The original plan for mining the Charleston seemed to be based on the premise that there was a mineable body of ore 400 feet long and up to 150 feet wide. The writer believes, however, that the Kaolinized and weakly mineralized wall rock adjacent to the main sericite zone, which may contain small parallel shoots of ore, is generally of too low tenor for a large scale profitable open pit type of mining. At least this is suggested by the assay results on the churn drill samples which, as previously stated, are incomplete and not too reliable.

At present the property should be regarded as a potential small tonnage underground producer, although a small amount of work cleaning out the broken rock in the pit to verify this, and rule out the open pitting idea, is justified. The chief problem of underground mining would be ground support, especially on those workings below the water table. It is believed that a squareset-fill type of support would be necessary in the stopes and most of the development headings would require close timbering.

The metallurge appears relatively simple, the main uncertainty being the determination of the most suitable method of obtaining the highest possible grade of sericite concentrate. This process might involve using wet cyclones or an electrostatic method; it is understood that Gladding-McBean are separating minor quantities of sericite from Kaolinite with the use of Krebb cyclones.

The clay is easily separated from the sulphides on mixing with water. A clay slurry is formed very simply by agitation and, because the sericite is all minus 325 mesh, separation is easily effected by screening.

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ECONOMIC CONSIDERATIONS

The churn drill hole which is collared 128 feet south of the Mary Jo No. 3 shaft was drilled to a depth of 340 feet; the results of this hole were either withheld from the owner or were carelessly kept, even though difficult drilling conditions prevented acquiring accurate data. Nevertheless, the assays shown on the attached cross section, which were run on the only remaining samples in Mr. Suiter's possession, indicate a zone of significant mineralization at least 12 feet in true width, at a depth of 300 feet below the collar. If the tonnage per vertical foot indicated at surface, ie. about 300 tons plus, is extended down to the horizon of mineralization in the churn drill hole, a total of approximately 100,000 tons is calculated, which can be classed as indicated or probable ore. By assuming that there is a 50 percent chance of this quantity being present, a total of 50,000 tons can be classed as assured ore.

A preliminary analysis of the economics of the Charleston is rather difficult to make for a number of reasons; the value of the sericite product is unknown, the cost of mining is difficult to estimate, the anticipated grade of Pb. Zn. is slightly uncertain, and water seepage or flows in the zone below the water table will undoubtedly affect the mining adverely, although to what degree, is unknown at present.

The following is a quesstimate of the net value of the ore, taking into consideration the mainy uncertainties associated with the calculations. The grade of ore mined in the past by selective mining ran:

0.6 ozs. Ag. 4.2% Pb. 6.0% Zn.

I believe that a 50% dilution factor of these grade should be made to allow for standard mining dilution and for mining the zone full width without any selection. Thus the calculated grade for the mill heads is:

0.4 ozs. Ag. 2.8% Pb. 4.0% Zn.

Allowing for milling losses, freight and smelter charges, the net value per ton of the base metals is calculated to be $10.50 from the following:

80%	of the gross silver value	@ 90¢/oz.	=	$0.30
60%	" " " lead "	@ 15½¢/lb.	=	5.10
50%	" " " zinc "	@ 13½¢/lb.	=	5.40
		TOTAL		$10.80

The by-product sericite from the former milling operation on the Charleston has been marketed through the Ari-Zonalite Co. of Phoenix for a reported price of $20 per ton. It is understood that this company can market 20 tons of sericite per day and may possibly be able to handle 1,000 tons per month. A 40 percent sericite content for the mineable zone is believed to be very conservative. Thus at $20 per ton for the cleaned sericite, the value of the crude ore per ton would be at least $8.

Thus the minimum value per ton is believed to be $18.80. The average sericite content could possibly run 60 percent or higher which would add materially to net value.

It sould be stated that some mining may be possible in the walls of the main zone as well as in parallel shoots, even though the prospect of mining the whole by open pitting does not appear too good. Any mining in the walls, of course would result in a lower grade mine run, and larger tonnage.

The cost of operating the Charleston is a little difficult to predict because the ground conditions are so abnormal. However, the following figures, arrived at after discussion with E. A. Scholz, are believed to be reasonably close.

Mining and Timbering	$9.00 per ton
Development	1.00
Milling	4.00
Overhead and Miscellaneous	2.00
	$16.00 per ton

Thus the profit margin works out at $2.80 per ton which, if anything, may be a little on the conservative side. The estimate is, however, entirely contingent upon the value of the sericite, which is arrived at by negotiation and contract. A cleaned sericite might command a price of $30 to $40 per ton, which could change the picture considerably, although there are no doubt many uncertainties associated with these prices. All calculations have been made on the basis that at least a 100 ton milling plant would be set up on the property, if feasible.

Using the minimum profit figure, the net operating profit on the indicated ore amounts to $280,000. This sum falls short of amortizing the property payments and capital expenditures. Payments call for $3500 down, $5,000 in three months, $2,000 in six months, and monthly payments of $2,000 thereafter during the remainder of the first year, with the total price being $300,000. A rough estimate of the capital expenditure necessary to put the property into production on a 100 ton basis is, say, $200,000. Thus using the minimum profit figure the ore in sight falls some $230,000 short of the break-even point. On a more optimistic basis, which assumes that the sericite could be marketed at an average price of $30 net per ton, the net profit is increased to $4.80 per ton and if, say, 60 percent of the mine run was sericite, instead of the 40 percent figure which was used, the profit would be increased further to a total of $12.80 per ton. In the first example of possible increased return the net operating profit would very closely pay for property payments and capital expenditures, while in the second example, a surplus of $780,000 would be accumulated from the handling of the 100,000 tons of indicated ore. In this latter case, a surplus would be obtained on the assured ore alone.

The above calculations, if northing else, serve to outline the risk of the venture, the difficulty of predicting the profit,

and the importance of knowing more about the value and the marketability of the sericite by-product; the first two of these considerations are more or less dependent on the third. It is likely that a market survey run on sericite would answer many of the questions, however, as an added expense, much testing would be required to ascertain the quality of the product and hence its true value.

Unless the profit margin is high, the property would be of little interest to a fairly large company, based on a 100 ton plant being the most feasible size. The chances of there being a good margin of profit are high enought to warrant investigating the sericite more thoroughly, I believe.

My reluctance to recommend exploration on the property and carry out a market survey is based on the high cost of the initial examination and the reported uncertainties associated with a sericite market as compared with size of the operation. A six month period would probably be necessary to accumulate sufficient date to give a realistic picture of the property's potential. During this period a total of about $35,000 would be required to complete preliminary exploration, as follows:

$3,500	option payment at outset
5,000	" " in three months
1,500	for cleaning out pit sufficient for sampling and estimating tonnage at surface more accurately
15,000	for drilling the zone, or if this is unfeasible, possible a greater sum for underground exploration
10,000	for conducting a market survey
$35,000	TOTAL

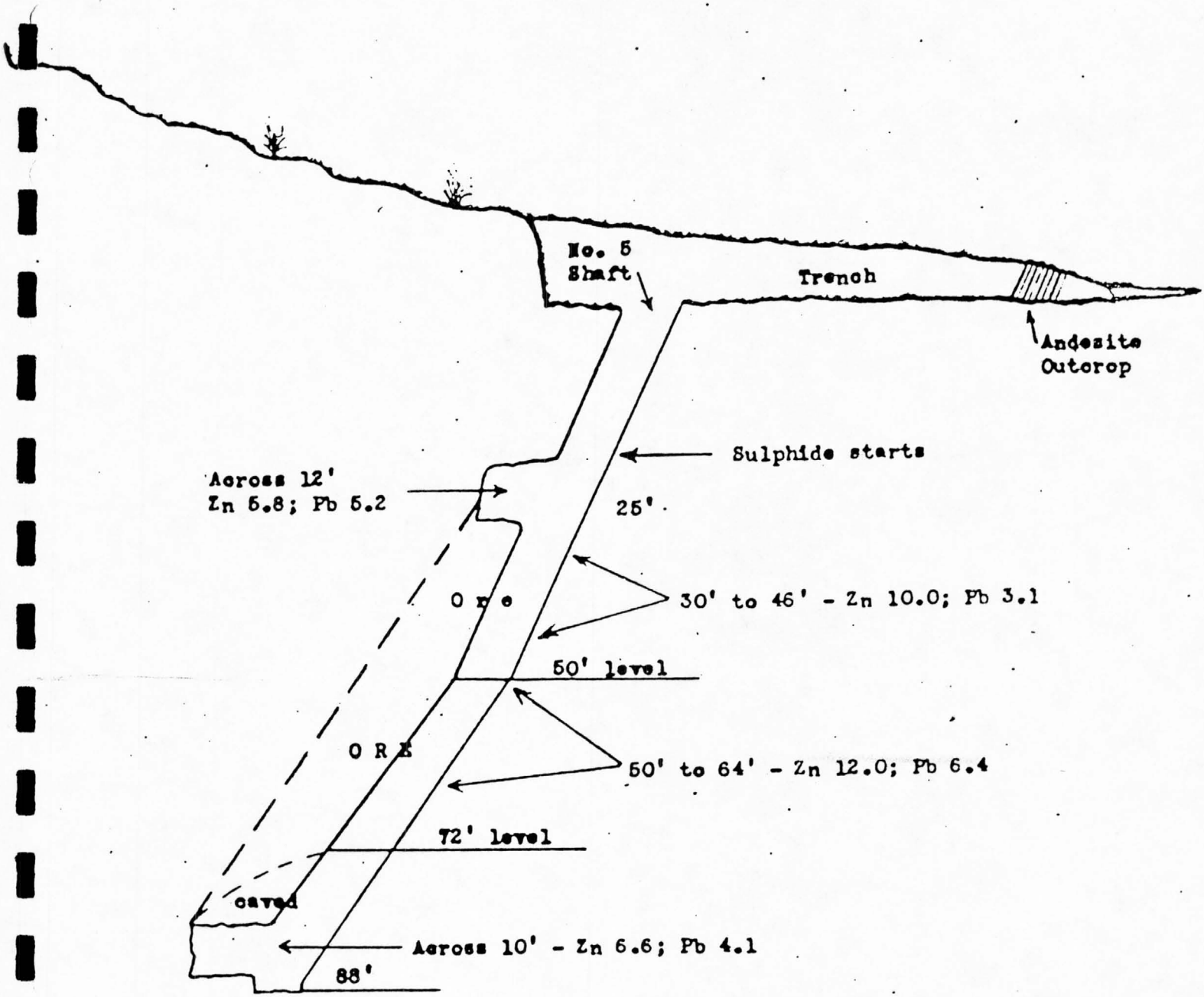
CONCLUSIONS

At present the Ari-Zonalite Company is interested in the property for its sericite content and apparently are able to market a small tonnage. In general their proposal looks better to the owner than what is reasonable for us to offer, because it is based on mining the near surface ore without regard to the development of the property. In withdrawing from a two-week free option period, negotiations were concluded on the note that we might be interested in entering the picture at a later date, perhaps in a sub-agreement with the Ari-Zonalite Co. to explore the larger possibilities while they, or some other small company, were operating on the immediate ore in sight. By this scheme our money would be spent on developing the property rather than being expended on option payments.

Respectfully submitted,

Lawrence Adie

May 2, 1957
Tucson, Arizona



Looking West - Section of No. 5 Shaft
Charleston Lead Mine, Tombstone, Ariz
Scale 1" - 20'0"

167

K.L.

AMERICAN SMELTING AND REFINING COMPANY
SOUTHWESTERN ORE PURCHASING OFFICE
810 VALLEY BANK BUILDING
TUCSON, ARIZONA

REED F. WELCH
MANAGER

May 8, 1951

Mr. Charles H. Suiter, General Manager
Charleston Lead Mines Co.
Tombstone, Arizona

Dear Sir:

Enclosed is Deming mill schedule for ore you are producing at the Charleston Mine, assaying:

Gold oz	Silver oz	Lead %	Copper %	Zinc %
-	1.80	13.80	1.25	21.02

Cars should be consigned to American Smelting and Refining Company, Asarco Mill, New Mexico, with shipping advice and settlement instructions mailed to the Deming office (P.O. Box 998).

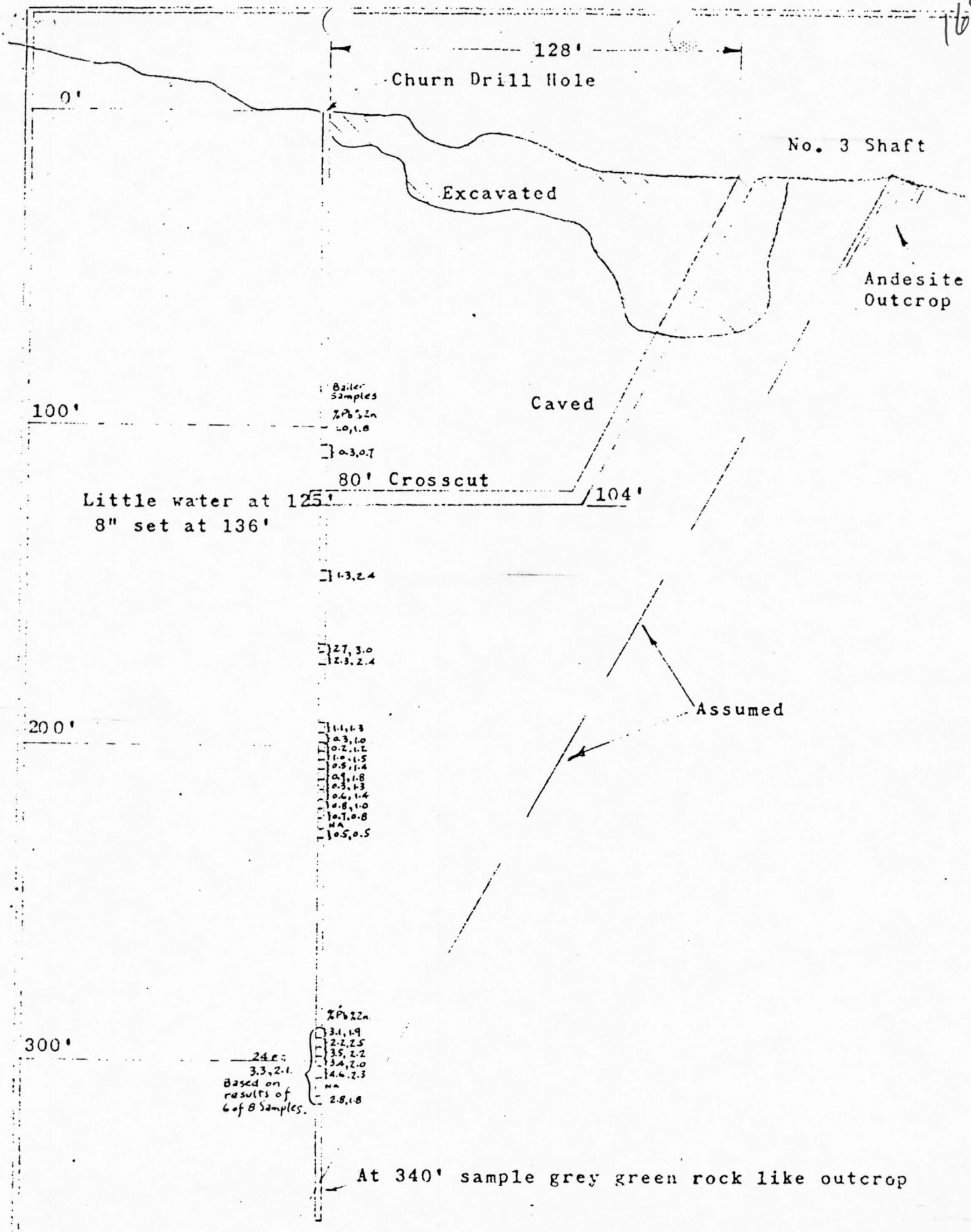
On present metal prices and above-quoted assays the net return after milling would be approximately $60.80 per ton. The freight charge from Tombstone to Asarco Mill on this grade of ore is about $3.50 per ton including tax.

Yours very truly,

Reed F. Welch

REED F. WELCH

Enclosure



American Exploration & Mining Co.
Section Looking West
of Churn Drill Hole and No. 3 shaft
Cha[illegible] "ine, Tombstone, Ariz.
Scale 1" = 40' 0"

2-169

8-25-55

REPORT ON CHARLESTON LEAD MINE.

Pursuant to request I have made an examination of the Charleston Lead Mine for the purpose of determining the feasibility of developing and equipping the property for production, and the expected economics when in production.

The property consists of twelve unpatented mining claims and is located 8 miles southwest of Tombstone, Arizona, and is owned by Mr. Charles H. Suiter of Tombstone.

General Geology.

The terrain consists of a series of volcanic flows, originally rhyolite, latite, monzonite, and allied phases, that have been highly sheared, altered and faulted. A main east-west fault exposes an old and once underlying granodiorite mass on the south which forms a definite hanging-wall for the sheared, altered, and mineralized beds immediately to the north.

A zone some 150 feet wide in these beds, paralleling this main fault, has been invaded by instrusions of mineralizing porphyry causing minor faults, crushing and shearing, and intense hydrothermal action.

This hydrothermal action has been so intense that the rhyolite has been almost completely altered to sericite, and at the same time lead, zinc, copper, and iron sulphides were deposited, together with small amounts of gold and silver. Later volcanic flows of a basaltic type once covered this terrain but have been almost completely eroded away, exposing the above mentioned conditions which were originally formed deep in the earth. Necks or vents of some of these later extrusives appear underground and on the surface.

The hydrothermal actions exhibited here are the strongest I have ever observed anywhere. The sericitization is very complete and extensive.

An area in the above condition, 150 feet or more wide and 400 feet or more long, has been fairly well prospected by one churn drill hole, 340 feet deep, several shafts up to 100 feet, 400 feet of drifts and crosscuts, and best of all the actual mining of some 2600 tons from development work.

The mineralized area however, may be much larger than the dimensions assumed above. To the east the formation is capped but was encountered in a power pole hole. To the west it opens out again after being pinched down by the granite plug. The assumed footwall to the north, an andesite dyke, may only be a false wall, and the mineralization may recur further north where

it is covered with loose gravelly overburden.

A further interesting point is that the instrusive porphyry mineralizers are of the copper producing type, similar to Bisbee. While the copper content of the Charleston is only about .5% some of our best copper ore-bodies in Arizona have a capping or margin low in copper but higher in lead and zinc, and at some depth or location in the Charleston formation there could well be important copper ore-bodies.

History

The mine has been sporadically developed and operated for several years. Before the big drop in the prices of lead and zinc in 1952-3, Mr. Suiter had built a small washing plant and was profitably treating his ore by a very simple washing process, and shipping a crude, mixed, semi-concentrate to custom mills. This operation will be mentioned in more detail further on.

At that time he was obtaining his ore from underground development work. Because of the slick, greasy nature of the sericite, underground workings are difficult to hold and mining expensive. Underground mining should not again be attempted in the sericite zone. The combination of expensive mining and the drop in metal prices shut Mr. Suiter down. It has not been until the last few months that the price of lead and zinc has again risen to change the picture; and there also appears to be a strong and growing market for the sericite as a by-product.

However, the only feasible or economic way to mine the ore-body is by open pit from the surface and as there is some 30 feet of valueless overburden, such an operation requires financing.

Mining Facilities

A commercial high voltage power line crosses the property and ample power can be obtained at regular rates.

Mr. Suiter has obtained his milling water from a shallow dug well. No doubt drilled wells out on the flat would provide ample water for a larger mill.

Seven of the eight miles of road to Tombstone is a good county road, and the one mile of private road is sufficient.

Probable Tonnage

As stated above the possibilities of ore are practically unlimited; but from present development it seems reasonably certain to assume a block of ground 150 feet north and south, by 400 feet east and west, by 125 feet deep below the overburden, would make an open pit. This would amount to 625,000 tons. Deducting 20% for unmineralized "horses" and barren intrusives, some of which could be selectively shovelled and hauled to waste, would leave a net tonnage in such a block of 500,000 tons. It must be understood that such estimate, though reasonably certain because of existing development and nature of the ore occurrence, is still not technically "positive". This matter will be further discussed under the heading of "values".

Metallurgy

The sericite gangue completely disintergrates on contact with water, making a clay slurry with the mineral sulphides freed.

Mr. Suiter's plant consisted only of a drum with blades inside (like a cement mixer) followed by a small classifier. The underflow from the classifier carried 25-30 % combined metallic sulphides and was his shipping product. The overflow from classifier was run through a long trough with partitions and thence to tailing pond. The "heavies" caught by the riffles were added to the shipments.

This simple process achieved over 90% extraction but the sericite was not sufficiently cleaned of iron to be marketable as sericite, and the semi-concentrate still had to be sent to a custom mill for further concentration and the separation of lead and zinc. This was costly as a table below will show.

For a new mill the general flow sheet would be a grizzly but no crusher. A large blade or log washer, followed by an oversize classifier in open circuit. Overflow from classifier to an Humphries spiral and wet cyclones which would glean the last of the metallic sulphides. Underflow from classifier together with concentrate from spiral and cyclones to a small ball mill and thence to differential flotation cells, resulting in clean lead and zinc concentrates which are shipped to smelters.

Values and Economics

Three methods were used to determine an average assay value of the above estimated half million tons. None of these methods, in itself, could

be considered entirely accurate, but when all these methods check each other closely, the overall result should be quite reliable.

(1) The 8" churn drill hole which reached a depth of 340 feet where it cut the andesite footwall.

This hole showed ore from 30 feet of top to bottom, and as it was vertical whereas the orebody dips about 70 degrees, it cut across the ore as well as attaining depth. Log and samples of this hole were taken by Mr. Suiter while drilling, and log is available. I sampled the sump of cuttings.

(2) Sampling of all underground workings per assay map. (Copy of assay map available.)

This sampling was not checked by me but was done by a reliable company, but workings and the visual qualities of the ore were examined by me.

(3) The result of Mr. Suiter's milling of all ore coming from underground work.

In this case I checked the tonnage that such work would have produced.- against the tonnage in the tailings pile - against the ratio of concentration- against the tons of concentrates and their metal content per settlement sheets, file of which is available. All three of these methods produce approximately the same result which is as follows:

Gold - trace; Silver 1.00 oz.; Copper .50%; Lead 4.00%; Zinc 5.50% .

At the present prices of lead (15¢) and zinc (12.5¢) these metals have a net value, FOB mine, after deducting freight, smelter charges, and other "deducts", per unit (1.0% or 20 lbs.) of $1.56 for lead, and $.86 for zinc. Copper would go with the lead and be paid for at about 20¢ per lb., unless there were sufficient quantity to make a separate copper concentrate.

The real value of the above ore, after being reduced to shippable concentrates would therefor be as follows:

Gold (Pay quantity possible)	0.00
Silver 1.00 oz. @ .75	.75
Lead 4% or units @ 1.56	6.24
Copper 10 lbs. @ 20¢	2.00
Zinc 5.50% or units @ .86	4.73
Total	13.72

From this average we should make an across-the-board deduction of 20% for unavoidable dilution and other contingencies, which leaves a value of $11.00 per ton.

While the milling process appears to extract almost 100% of the metals, a general deduction for mill losses of about 10% should be provided, leaving a final net value of $10.00 per ton at present metal prices.

To this should be added anything received for the sericite - see later.

Operating Costs

Operating costs (not including capital costs) will vary greatly according to the efficiency of the setup and the size of the operation. Below are given two tables: one representing the use of Mr. Suiter's past and present setup; and the other representing what should be done with a proper mill for 150 ton daily (24 hrs.) crude ore and 50 tons daily for regrind and flotation. Preliminary stripping is considered as a capital expense and not included in operating costs, but subsequent stripping, on a basis of 1.5 tons (waste) to 1.0 tons (ore) is included in operating costs.

Item	Suiter Mill (50 Tons)	Complete Mill (150 Tons)
Stripping, mining and delivery to mill	.50	.50
Milling	4.00	2.00
Overhead & Miscellaneous..	2.00	1.00
Shipping to custom mill and remilling (Basis: $9.00 per ton for semi-conc'ts.).....	3.00	0.00
Totals	9.50	3.50
Profit on $10.00 per ton crude ore.....	.50	6.50
	10.00	10.00

The above includes no royalty or participating interest to the owner.

It will be noted that in the item of stripping and mining the costs are the same regardless of daily tonnage. This is because I have considered in each case giving a contract to parties properly equipped to excavate and pile behind the mill a considerable tonnage at a time. This would avoid the purchase of much expensive equipment and permit the use of economic heavy equipment. Obviously, in either case, the cost would be approximately the same and

should be done within the figure mentioned.

The above figures show that an over-simplified mill is not practical under present metal prices. However, the present mill, with certain additions, would make an ideal test or pilot plant to obtain positive metallurgical data, before designing a final mill, and to obtain positive average values by mining large samples and milling them.

SERICITE. The sericite angle is intriguing and has extensive possibilities. It is not positive. Sericite is a microscopic sized muscavite mica, an aluminum silicate, with a silky, greasy feel, like talc. The analysis of the Charleston sericite, which corresponds closely with the theoretical (analysis available) is:

SiO_2 - 46.25%; Al_2O_3 - 38.5%; other oxides - 11/8%; Water 4.5%

Sericite has various uses in industry and is in increasing demand. For most uses it must be iron free and Mr. Suiter, with his crude mill, has never been able to remove all the iron. I am quite sure that it can be done.

The market for sericite is one of negotiation and contracts. It is a fact that no user will "talk business" until you have a consistent supply. Once such a supply is established, and a consistent quality proven, one may enter the field through direct sales or brokers. It seems certain that at least a considerable quantity of the sericite from the Charleston ore could be sold at good prices. Approximately 75% of the crude tonnage would be sericite, and such information as is available on prices indicates a value of $10.00 to $30.00 FOB railhead. Its value to the Charleston might surpass that of the metals, but because of some uncertainties I have not included it at all in profit estimates. The pilot plant test runs, recommended below, should definitely establish this feature.

Recommendations

Ordinarily, in a situation such as this, one would first drill a sufficient area to positively determine a tonnage and grade to warrant stripping and opening up a pit, and the building of a suitable mill. But drilling has been found to be difficult and unreliable at the Charleston. As stated above the ore practically dissolves in water; and it is too moist to drill dry. In putting down the above mentioned churn drill hole about 40 feet of the bottom of the hole would fill up over night. Not knowing where such "sloughing off" comes from makes samples unreliable. And the heavy part of cuttings have a way of working into the pores instead of being pumped out. Core drilling produces no core. Seemingly the only successful way to drill would be to follow the bit immediately, or even precede it, with casing - and such would be quite expensive.

It is fortunate in this case that the overburden could be removed from a pit sized area cheaper than same could be drilled.

It is my recommendation therefore that first the overburden be removed from such an area, as is shown on sketch, with a bulldozer. Secondly, that trenches be put across this stripped area with a slusher as deep as possible (probably 25 feet) and that the product from these trenches be used as samples and test material in a pilot plant. Some shallow drilling might be done from these trenches (say 25 feet) to further positively prove justifiable tonnage.

Mr. Suiter's present mill should be augmented by a larger water tank, a Humphries Spiral Classifier, and wet cyclones to obtain ultimate metal extraction and refine the serizite. The product from the slusher trenches should be used as feed for such test work, each trench milled separately to constitute exact sampling.

On completion of such work one should be sure of a justifiable tonnage and detailed metallurgical requirements.

Financial Requirements

Financial plans should be divided into three stages: The first stage would include only the stripping mentioned above and appurtenant expenses. No heavy equipment would be purchased - the work would be contracted or equipment rented. Approximately 30,000 yards should be removed at an estimated cost of 25¢ per yard or $7,500.00; Miscellaneous expense $2,500.00; Total: $10,000.00.

The second stage would consist of the test trenches mentioned, improvement of the mill by the addition of the items mentioned to funaction as a pilot plant, and the test milling of the product from the trenches (approximately 4000 tons); Mining would cost 75¢ per ton ($3,000.00); Mill improvements: $4,000.00; Milling: $16,000.00; Miscellaneous: $2,000.00; or a total of $25,000.00. While the product from the test milling might be shipped and should nearly cover its cost, it would be better to hold it for differential flotation.

The third stage would consist of mining and steckpiling 10,000 tons and complete rebuilding the mill. This is estimated as follows: Mining by shovel: $5,000.00; Mill including flotation: $50,000.00; Miscellaneous: $10,000.00; or a total for stage 3 of $65,000.00. Grand total: $100,000.00.

Not included in the above estimates are any payments that must needs be made to the owner.

It will be noted that in the above plan the first stage which amounts to very little, entails all the risk, and is cheaper than a drilling program. Successive stages are predicated on the success of the preceding stage and would not be entered into unless same were successful.

Before the third stage is entered, which would require the bulk of the financing, all risk would be eliminated, except such risks as are dependent on long term economic changes and the price of metals.

It should be noted that in both operating profits and capital requirements no allowance has been included for payments to or participation by the owner. Mr. Suiter has spent considerable money and has created a very valuable property. We have discussed several types of "deal". I am sure that a reasonable one can be obtained, but the details might best be left open so they can be made to conform to the best interests of both parties.

Conclusion

The economics of the Charleston situation work out for a probable profit of some millions of dollars; and considering the very slight risk and modest financial requirements, the proposition appears to be one of unusual merit.

Respectfully submitted,

CHARLES H. DUNNING

August 25, 1955

REGISTERED MINING ENGINEER
CHARLES H. DUNNING
DEC 21 19
ARIZONA, U.S.A.

CHARLES H. DUNNING
MINING ENGINEER

Record of Shipments of
SEMI-CONCENTRATES
from Charleston Lead Mine.

Lot No	Date	Dry tons	Ag oz.	Cu %	Pb %	Zn %	Mill Returns
1	10/47	125.50	1.30	0.70	7.40	12.7	$1855.70
2	5/48	44.32	1.32	.80	10.20	12.0	1348.97
3	6/48	82.16	1.20	.85	10.60	14.4	2283.18
4	7/48	51.57	1.00	.75	9.40	10.2	1438.91
5	8.48	47.15	1.20	.70	9.40	9.0	1328.24
6	9/48	38.97	1.05	.60	8.90	11.2	1059.33
7	9/48	44.64	1.20	.37	6.90	12.2	1108.00
8	10/48	49.65	1.80	.60	9.70	15.6	1863.74
9	11/48	33.51	1.60	.62	9.90	14.6	1431.90
10	12/48	42.95	1.20	.60	7.30	9.0	1085.61
11	12/48	37.62	1.30	.75	9.10	14.8	1472.74
12	2/49	33.06	1.20	.61	7.20	10.00	927.18
13	3/49	39.74	.80	.40	5.70	8.6	742.61
14	4/49	34.86	.80	.32	5.50	9.5	409.24
15	5/49	41.47	1.40	.55	7.80	12.9	873.15
16	6/49	55.01	3.40	1.25	15.50	22.3	2125.14
17	8/49	38.01	1.70	.75	7.30	11.5	546.93
18	9/49	40.13	1.70	1.06	10.40	15.2	915.28
19	9/50	58.10	1.20	1.05	11.00	15.9	2473.43
20	10/50	70.55	2.28	1.42	17.10	27.3	5326.52
21	10/50	28.90	1.32	.97	10.36	11.5	913.89
22	10/50	32.17	1.80	1.25	13.80	21.0	1854.19
23	6/51	122.04	1.56	.44	7.80	11.8	3825.87
Total		1190.08	33.33	17.41	21826	313.2	37209.75
Average (not weighted)			1.45	.76	9.60	13.7	

Mill extraction approx 90%.
Ratio of concentration about 2.4 into 1.0
Total crude tonnage run, approx 2600.

Average of crude (Calculated)	.68	.35	4.50	6.3

A map is available showing origin of lots. There has no doubt been some selection, but lots are scattered over large area.

Mill returns are after deduction of freight and milling (custom) charges. File of settlement sheets has been examined and is available.

Other methods of obtaining averages are somewhat higher in silver and copper, and lower in lead and zinc than above. Average as stated in report is compiled from all methods. Dollar average would be about the same by either method.

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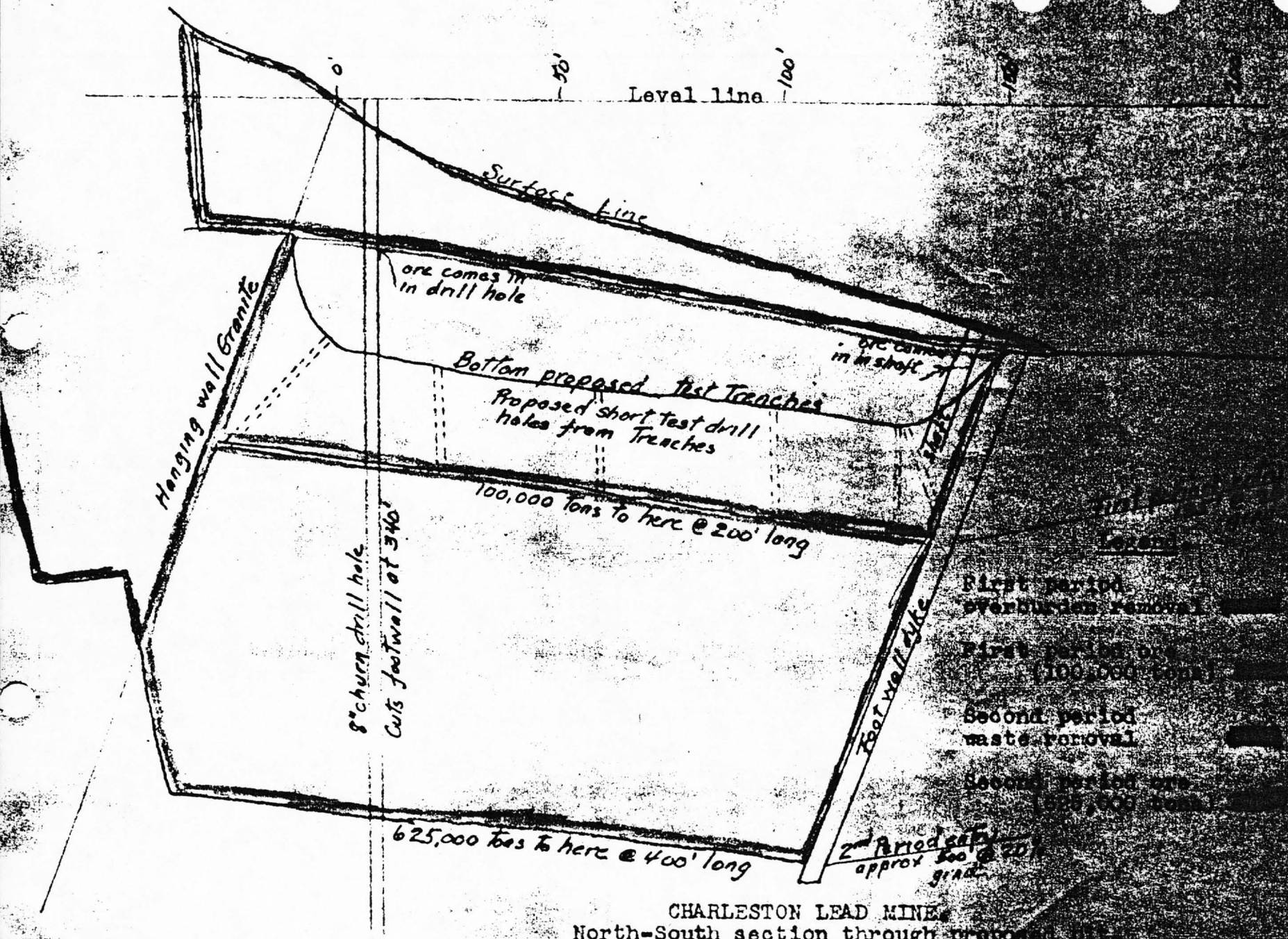
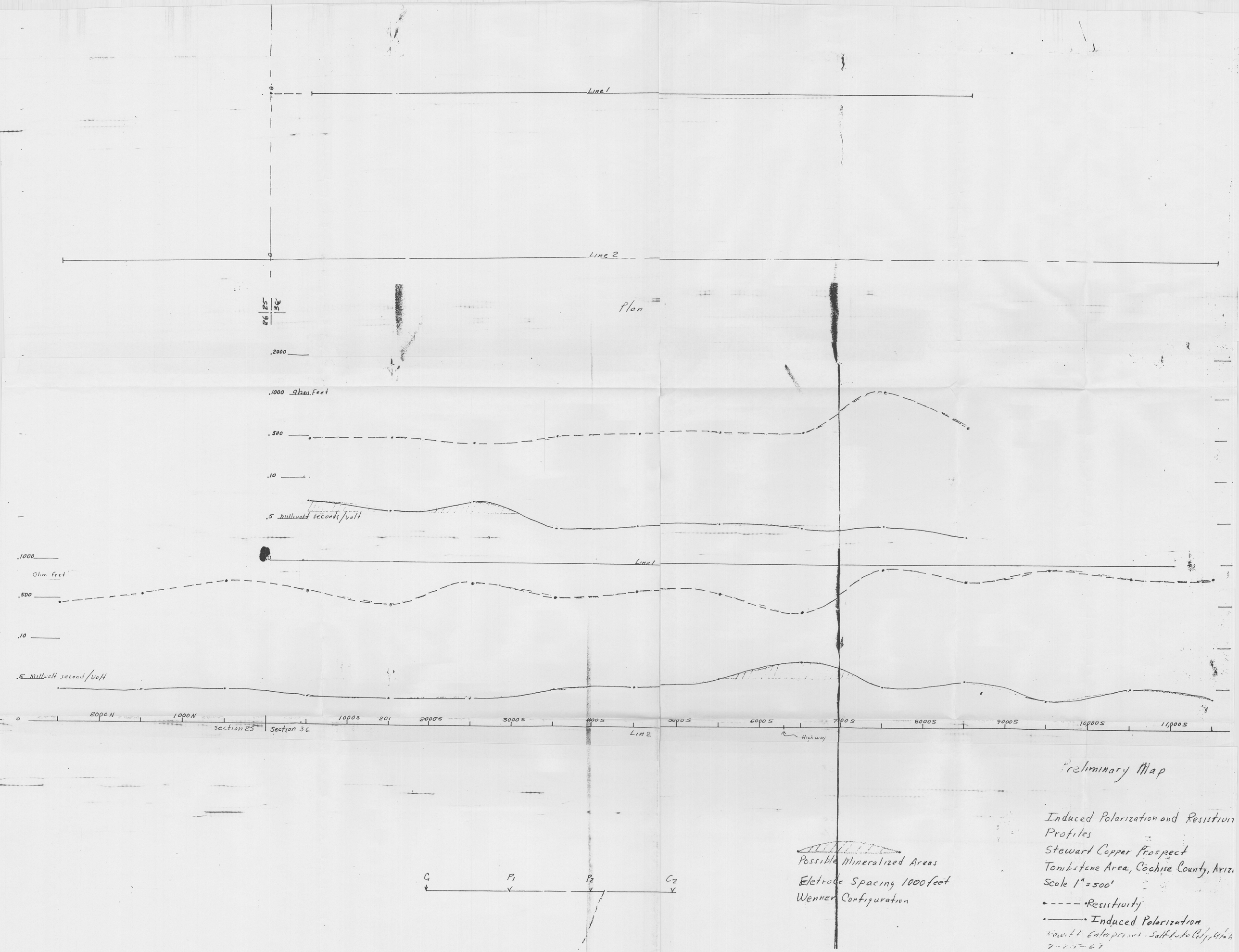
To accompany report, Sept. 1956, by Chas. H. Dunning.



CHARLESTON LEAD MINE.
North-South section through proposed pit.

To accompany report by Chas. F. Dunning.
Scale 1" = 300' Sept. 1955.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8000 S
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C1
P1
P2
C2
Possible Mineralized Areas
Eletrode Spacing 1000 feet
Wenner Configuration
Preliminary Map
Induced Polarization and Resistivity
Profiles
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Induced Polarization
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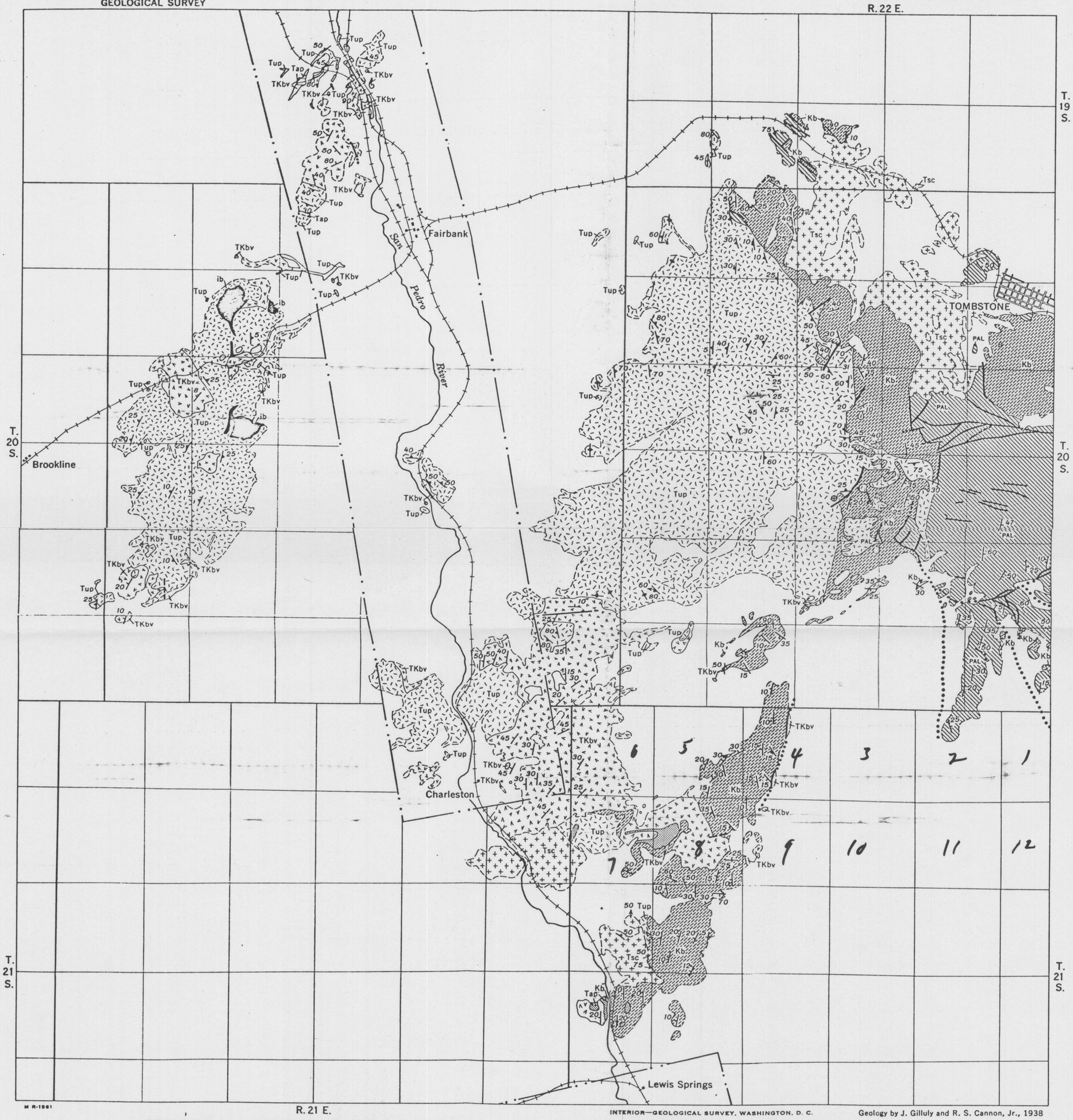

M R-1561

INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D. C.

Geology by J. Gilluly and R. S. Cannon, Jr., 1938

GEOLOGIC MAP SHOWING STRUCTURAL RELATIONS OF THE UNCLE SAM PORPHYRY, COCHISE COUNTY, ARIZONA