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

Mr. J. H. Courtright

J. H. C.

DEC 16 1969

AMERICAN SMELTING AND REFINING COMPANY
SILVER BELL UNIT
Silver Bell, Arizona

December 11, 1969

MEMORANDUM TO: Mr. D. R. Jameson, Superintendent

Subject: GEOLOGIC REPORT FOR NOVEMBER 1969

During November, 1969, 294,000 tons of ore, 46,000 tons of leach, and 765,000 tons of waste material were produced in the El Tiro pit. Eighty-five percent of the ore came from the 2590 (N) bench. Eighty-five percent of the leach material came from the 2630 (M) bench. Sixty-five percent of the waste produced was stripped from the 3035 (B) bench in the East Extension #2 of El Tiro pit.

A very minor amount of ore was mined from the 2700 (H) bench in the West Extension of the Oxide pit.

EL TIRO PIT

2590 (N) Bench:

About equal tonnages of alaskite, hornfels and monzonite were mined during November on 2590. The hornfels occurred as elongate protrusions extending into the pit from the northeast. Monzonite dikes extending from a large monzonite mass to the southwest separated the hornfel protrusions.

The alaskite produced the best ore on 2590. The hornfels produced some ore; but, also contributed to the acid-reactive waste material.

2630 (M) Bench:

All the rock mined on 2630 was a complex mixture of monzonite, dacite, hornfels, marble and tactite rock types. The contacts of the different rock types generally maintained a northeastward strike. Most of the material mined was acid reactive waste or leach ore.

2990 (C) Bench:

Stripping continued on the 2990 bench in the East Extension #2. Approximately two-thirds of the rock mined was monzonite of waste grade. The remainder was tactites, hornfels and marbles of ore grade or with a high content of oxide copper.

3035 (B) Bench:

Stripping continued on 3035 with production of 488,000 tons of waste or overburden. This material consisted of sediments (hornfels, marbles and tactites) cut by a swarm of monzonite dikes trending east to NEE. Six thousand tons of ore were produced from tactites.

El Tiro Slump Zone:

Movement of all traverse points, except B-3, on the slump zone increased slightly over the previous month, to about the same rate obtained during August. This was probably due to the increased rainfall during November. Traverse point B-3, which is on the outer most edge of the 2910 crest, moved 0.20 feet vertically and 0.49 feet horizontally. This latter figure is two to three times the average maximum movement.

NO. 6 WATER WELL

Deepening of #6 water well was started November 19th. The rock type was a very uniform red conglommerate down to about 725 feet. It consisted of detrital quartz, siltstone and igneous sands and gravels dispersed in a red clay matrix. At 725 feet the hardness increased significantly. The only apparent change in the mud was a moderate increase in size of the detrital grains. Average feet drilled per day was approximately 14.

J. W. Cameron

J. W. Cameron
Resident Geologist

JWC:jca

J. H. C.

DEC 4 1969

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

December 4, 1969

TO: J. H. Courtright

FROM: W. G. Farley

Geophysical Surveys
East Silver Bell Area
Pima County, Arizona

On September 5, 1969, a report was submitted to you covering geophysical surveys in the East Silver Bell Area. Attached to that report was a Silver Bell Peak Quadrangle base map with geology after the Arizona Bureau of Mines Pima County Geological Map. Following a review of the East Silver Bell geophysical report, Mr. W. E. Saegart suggested several revisions in the geological base map. Attached to this memo is an updated geological base map of the Silver Bell Area which is to be substituted for the earlier base map. Also attached to this memo is an expanded ASARCO Aeromagnetic Map of the Silver Bell Area.

On the Aeromagnetic Map are also Afmag crossovers from a 1968 McPhar survey which suggest fault locations. Of particular interest are the fault type Afmag anomalies near the Ragged Mt. Fault and the fault type Afmag anomalies over the aeromagnetic low lobe southeast of the Ragged Mt. Fault. These coincident features would tend to confirm the author's earlier interpretation in the September 5, 1969, report suggesting that the aeromagnetic low east of Silver Bell was caused by a southeast extension of the Ragged Mt. Fault Zone having hydrothermal alteration and possibly base metal mineralization.

Another bit of favorable information recently brought forward is an exploration note file by J. D. Sell reporting a shear zone in precambrian granite containing weak alteration and spotty mineralization in the vicinity of the coincident aeromagnetic low lobe and the Afmag crossover. (See attached note file by J. D. Sell.)

At this time additional I.P.-resistivity depth probes are planned for the center of the East Silver Bell Aeromagnetic Low to try and detect sulfides at depth. Also, I.P.-resistivity traverses will be run over the aeromagnetic low lobe in the area reported by Mr. Sell for the detection of possible shallower sulfides. Revision of the author's earlier recommended deep drilling program may follow the additional I.P.-resistivity surveys.

Wayne G. Farley
Wayne G. Farley

WGF/kvs

cc: RJLacy
WESaegart
JDSell


EXPLANATION
QUATERNARY
Qal Valley fill – Sand, silt, gravel
Qb Basalt
TERTIARY
Ts Sandstone, Shale, Conglomerate
Tl-a Latite, andesite
Tl, Tr Latitic, Rhyolitic Intrusives
Post mineralic
Pre mineralic
TKcr Cat Mountain Rhyolite
TKi-al, -d, -gp, -m Intrusives – alaskite (-al), dacite (-d), granodiorite porphyry (-gp), monzonite (-m)
TKa Silver Bell Formation
TKs Claflin Ranch Formation
CRETACEOUS
Ks Amole and Red Beds
CARBONIFEROUS and DEVONIAN
CDl Sandstone, shale, limestone, quartzite
CAMBRIAN
Єt Limestone, quartzite
YOUNGER PRECAMBRIAN to TERTIARY
db Diabase
YOUNGER PRECAMBRIAN
pЄa Apache group
OLDER PRECAMBRIAN
pЄgr Granite, may include some post-pЄ intrusives
pЄp Pinal schist
Contact (Dashed where approximately located)
Concealed Contact
Fault (Dashed where approximately located)
Concealed Fault
Doubtful or probable Fault
Reverse Fault
Alteration and/or Mineralization
Taken from A.G.S. Southern Arizona Guidebook II April, 1959 Fig. 45, pg 212
PAPAGO INDIAN RESERVATION
AGUIRRE VALLEY
Silver Bell
R 6E.
R 7E.
R 8E.
R 9E.
T 11 S
T 12 S
N
SILVER BELL AREA
GEOLOGY and TOPOGRAPHY
of
VACA HILLS and SILVER BELL
QUADRANGLES
SCALE : 1 inch = 1 mile
OCTOBER, 1969
W. G. FARLEY
MKB
2215-A

Mr. J H. Courtright

AMERICAN SMELTING AND REFINING COMPANY
SILVER BELL UNIT
Silver Bell, Arizona

J. H. C.

November 7, 1969

NOV 14 1969

W.E.S.

NOV 17 1969

R. WES
READ AND RETURN
PREPARE ANSWERS HANDLE
FILE INITIALS

MEMORANDUM TO: Mr. D. R. Jameson, Superintendent

Subject: GEOLOGIC REPORT FOR OCTOBER, 1969

Almost all mining during October was carried out in the El Tiro Pit. Mining on the 2590 (N) bench in El Tiro was generally in monzonite; but, alaskite and dacite were also mined. Sediments, hornfels, were encountered for the first time on the 2590 bench in the northeast face. Rock types mined during October on the 2630 (M) bench were a complex interfingering of monzonite, sediments (hornfels, marble, quartzite, and tactites) and dacite. Initial stripping of the 2990 (C) bench in East Extension #2 was in monzonite; but, tactite of ore grade has been encountered. Stripping continued on 3035 (B) bench. Approximately three-fourths of the material mined in El Tiro was leach or waste.

Rock mined on 2700 (H) bench in the Oxide Pit was alaskite of ore grade.

Maximum movement of the El Tiro slump zone continued at a rate slightly less than that for the average maximum movement of the last three months.

J. W. Cameron

J. W. Cameron
Resident Geologist

JWC:jca

Mr. J. H. Courtright

AMERICAN SMELTING AND REFINING COMPANY
SILVER BELL UNIT
Silver Bell, Arizona

October 14, 1969

MR. WES
READ AND RETURN
PREPARE ANSWERS HANDLE
FILE INITIALS

W.E.S.
OCT 21 1969

J. H. C.
OCT 20 1969

MEMORANDUM TO: Mr. D. R Jameson, Superintendent

Subject: QUARTERLY GEOLOGIC REPORT, SILVER BELL, ARIZONA

Most of the mining during the third quarter of 1969 was carried out in the El Tiro Pit. Approximately 10% of the material mined came from the Oxide Pit.

OXIDE PIT

Nearly all of the mining in Oxide Pit during the last quarter was carried out on the 2700 level in the West Extension. The material mined on 2700 was alaskite of ore grade. Lesser amounts were mined from the 2660 level on the north and southwest faces. The rock from 2660 was syenodiorite and sediments. A minor part of the rock mined from 2660 on the north wall was leach ore, the remainder of 2660 material was ore grade. Mining in the West Extension #2, Copper Butte and Wild Hog Butte area, will begin in the next quarter.

EL TIRO PIT

Ore production in El Tiro came from the 2590(N) and 2630(M) benches. Stripping was continued in East Extension #2.

2590(N) Bench

Mining on the 2590 bench was primarily conducted in monzonite; but a substantial amount of alaskite was also mined. About three-fourths of the rock mined was ore grade. Most of the remainder was acid leach material. Sediments were recently encountered on the extremely eastern side of 2590.

2630(M) Bench

Rock types of the material mined on the 2630 bench consisted of dacite porphyry, sediments (hornfels and marble), and monzonite, listed in order of decreasing abundance. Four-fifths of this material was waste, the remainder being sulfide ore and leach ore.

East Extension #2

Stripping continued on the 3035(B) bench in East Extension #2 during the third quarter. Stripping was completed on the 3080(A) bench in Mid September and stripping was started on the 2990(C) bench the last day of September. Rock types were predominantly hornfels with minor marble, tactite and monzonite. The majority of the material was stockpiled for ammonia leach, about 20% was waste.

Slope Stability

Oxide Pit

No new developments were observed in the Oxide Pit slump zone. Loose material continued to dust from the crest and slope areas.

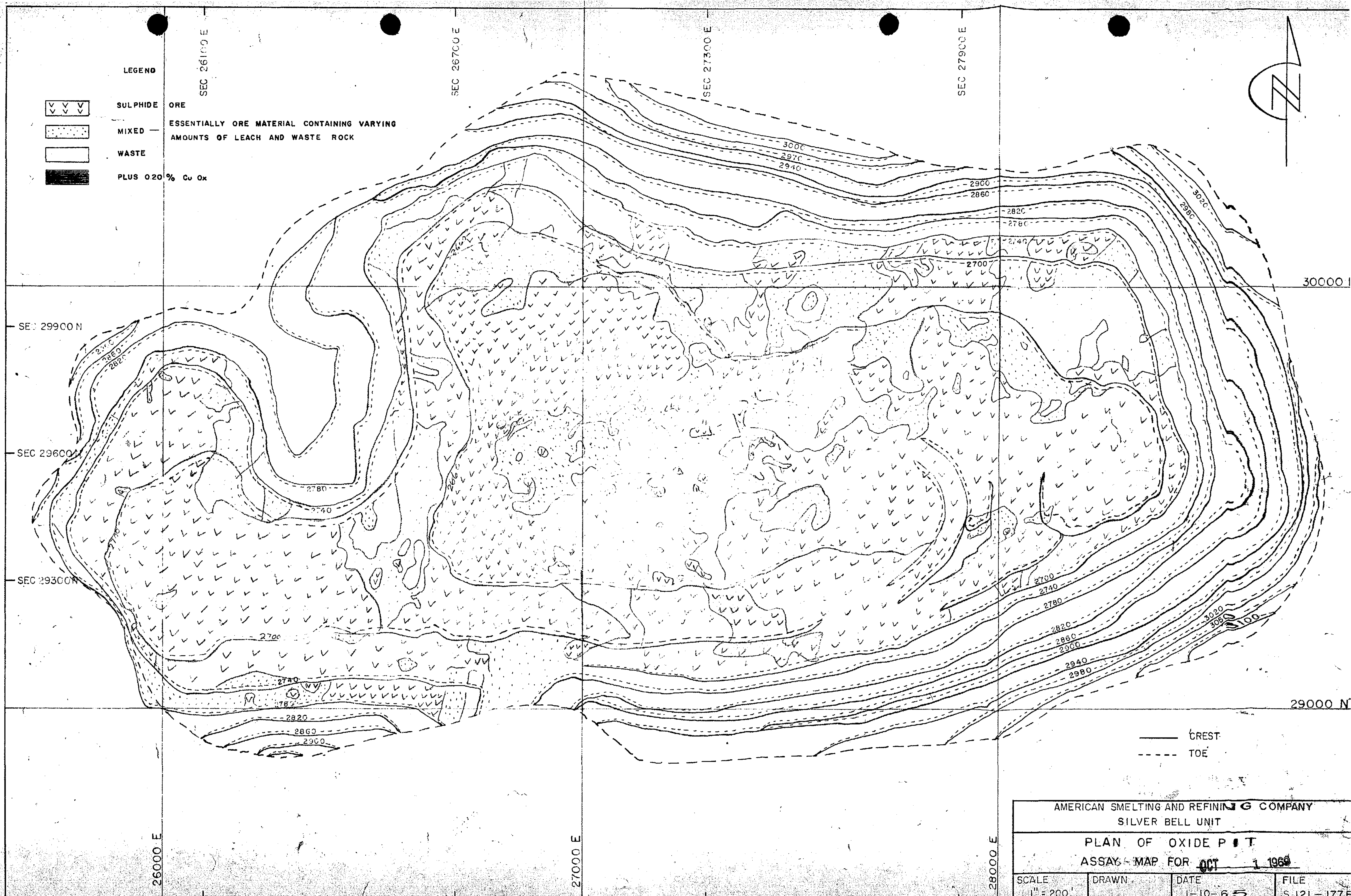
El Tiro Pit

Vertical and horizontal displacements of the El Tiro slump zone continued at rates similar to those for the first two quarters, as illustrated by attachments 5 and 6. Average maximum vertical and horizontal displacements were 0.17 and 0.20 feet per month, respectively.

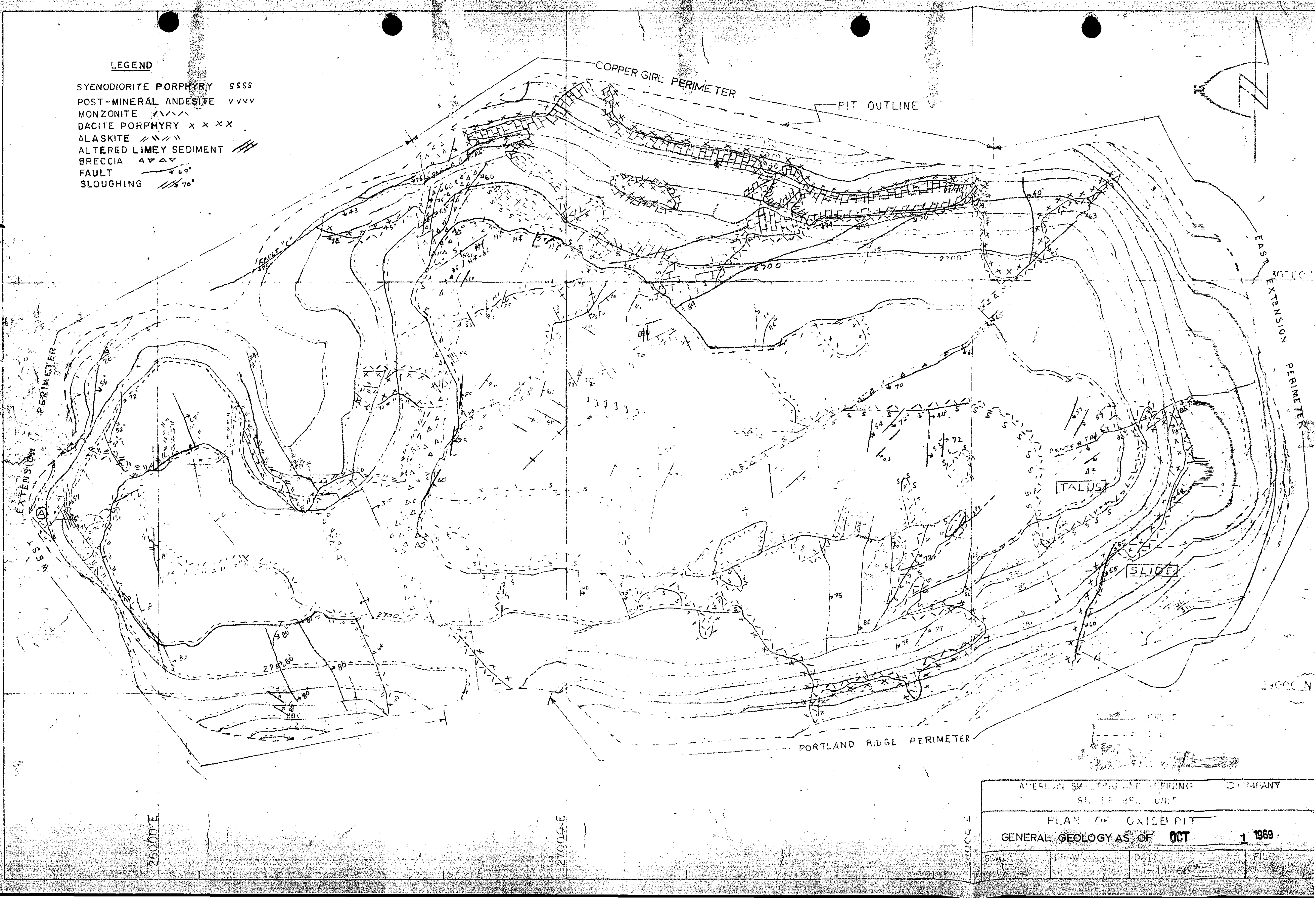
J. W. Cameron

J. W. Cameron
Resident Geologist

JWC:jca

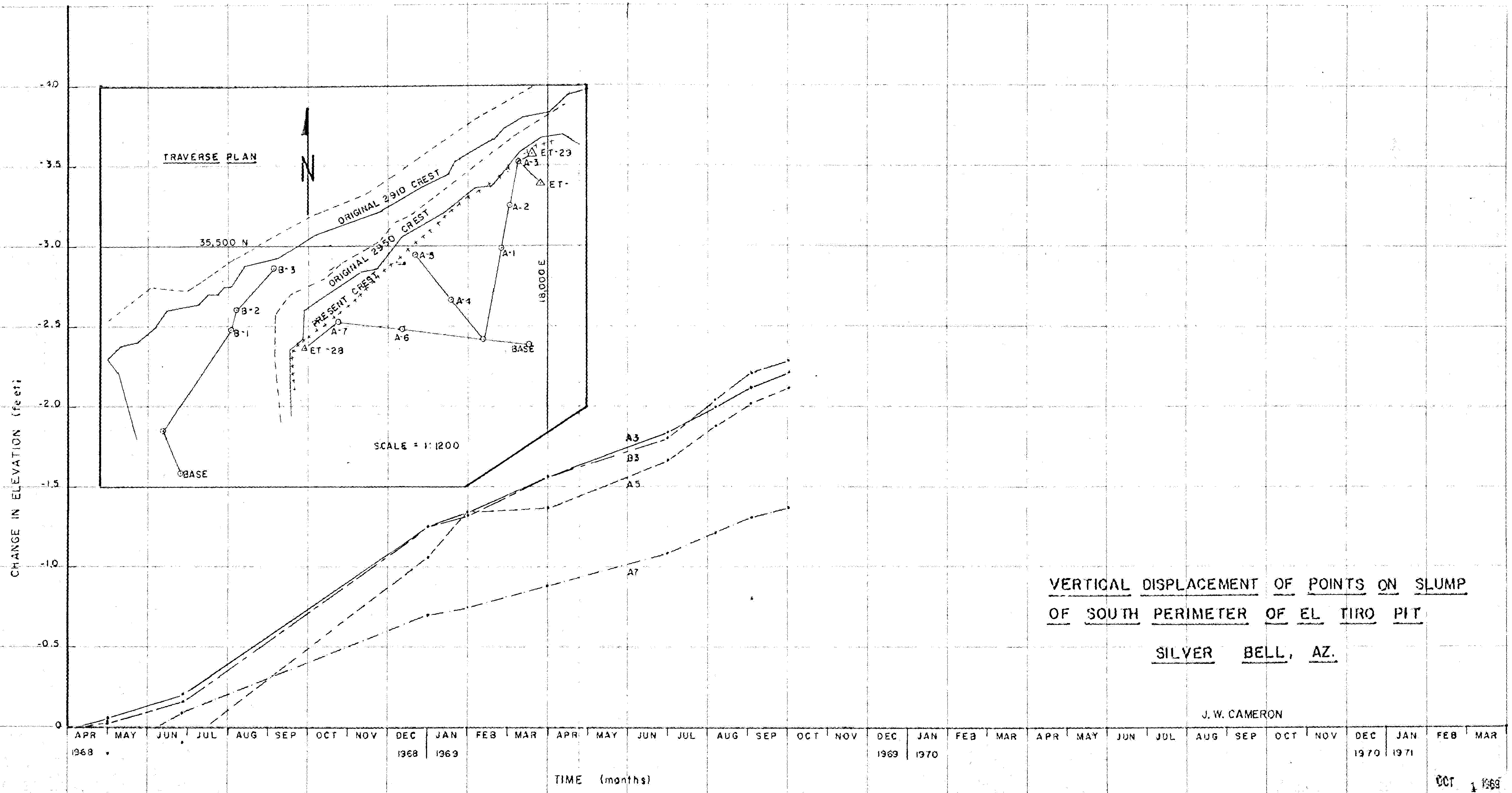


LEGEND
SULPHIDE ORE
MIXED — ESSENTIALLY ORE MATERIAL CONTAINING VARYING AMOUNTS OF LEACH AND WASTE ROCK
WASTE
PLUS 0.20 % Cu Ox
SEC 26100 E
SEC 26700 E
SEC 27300 E
SEC 27900 E
SEC 29900 N
SEC 29600 N
SEC 29300 N
30000 N
29000 N
26000 E
27000 E
28000 E
3000
2970
2940
2900
2860
2820
2780
2740
2700
3020
2980
3050
3100
CREST
TOE
AMERICAN SMELTING AND REFINING COMPANY
SILVER BELL UNIT
PLAN OF OXIDE PIT
ASSAY MAP FOR OCT 1 1969
SCALE 1" = 200'
DRAWN
DATE 1-10-65
FILE S.121 - 177E


LEGEND
SYENODIORITE PORPHYRY SSSS
POST-MINERAL ANDESITE VVVV
MONZONITE
DACITE PORPHYRY X X XX
ALASKITE
ALTERED LIMEY SEDIMENT
BRECCIA
FAULT
SLOUGHING
COPPER GIRL PERIMETER
PIT OUTLINE
FAULT "C"
2700
EAST EXTENSION PERIMETER
WEST EXTENSION PERIMETER
TALUS
SLIDE
PORTLAND RIDGE PERIMETER
25000 E
27000 E
28000 E
GENERAL GEOLOGY AS OF OCT 1 1969
SCALE
DATE
FILE


16000 E
17000 E
18000 E
19000 E
20000 E
37000 N
36000 N
35000 N
LEGEND
CREST
TOE
SULPHIDE ORE
LEACH
WASTE
PLUS 0.20 % Cu Ox
AMERICAN SMELTING AND REFINING CO.
SILVER BELL UNIT
PLAN OF EL TIRO PIT
ASSAY MAP FOR OCT 1 1969
SCALE 1" = 200'
DRAWN HHR
DATE 1-24-68
FILE S-121-206D


16000 E
17000 E
18000 E
19000 E
20000 E
37000 N
36000 N
35000 N
SLIDE AREA
SMALL SLIDE IN PROGRESS
POTENTIAL SLIDE
LEGEND
BENCHES
CREST
TOE
IGNEOUS ROCKS
POST-MINERAL ANDESITE
MONZONITE
SYENODIORITE
DACITE
ALASKITE
ALTERED SEDIMENTARY ROCKS
TACTITE
HORNFELS
QUARTZITE
MARBLE
UNDIFFERENTIATED SEDIMENTS
ALLUVIUM
SYMBOLS
FAULT
BRECCIA
AMERICAN SMELTING AND REFINING CO.
SILVER BELL UNIT
PLAN OF EL TIRO PIT
GEOLOGY FOR
SCALE 1" = 200'
CRAWN HHR
DATE 1-24-68
FILE S-121-206D

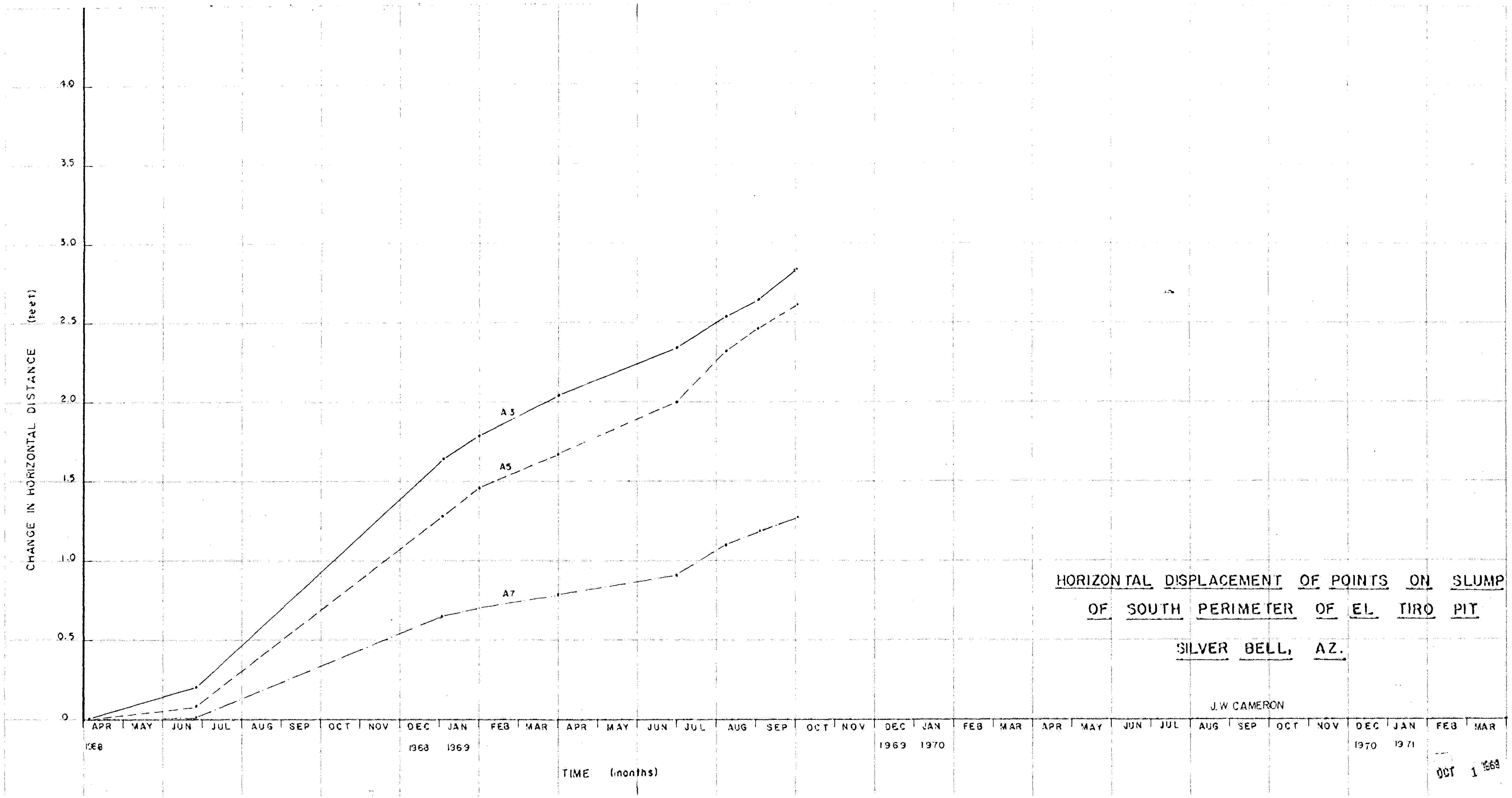


VERTICAL DISPLACEMENT OF POINTS ON SLUMP OF SOUTH PERIMETER OF EL TIRO PIT

SILVER BELL, AZ.

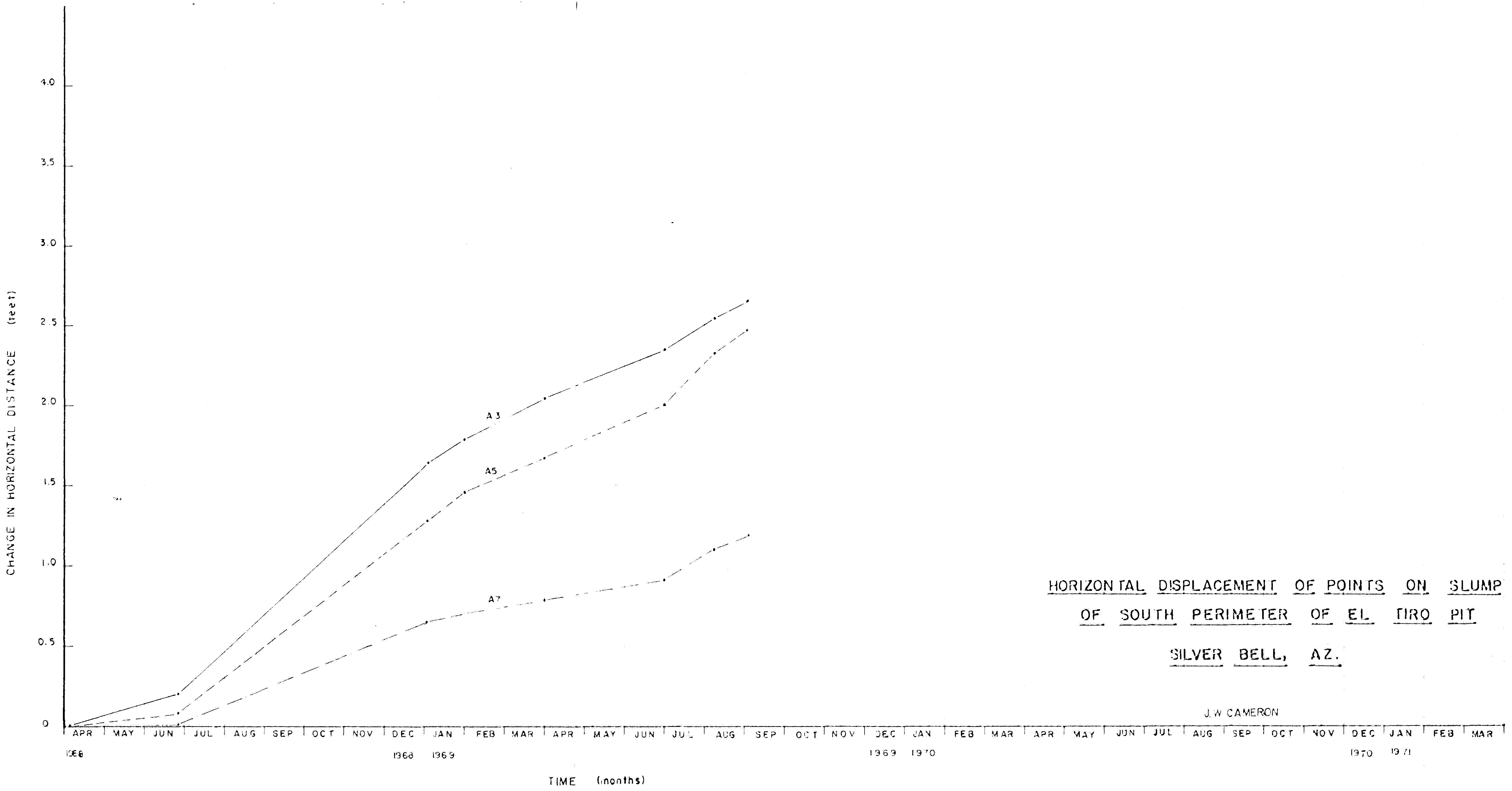
J. W. CAMERON

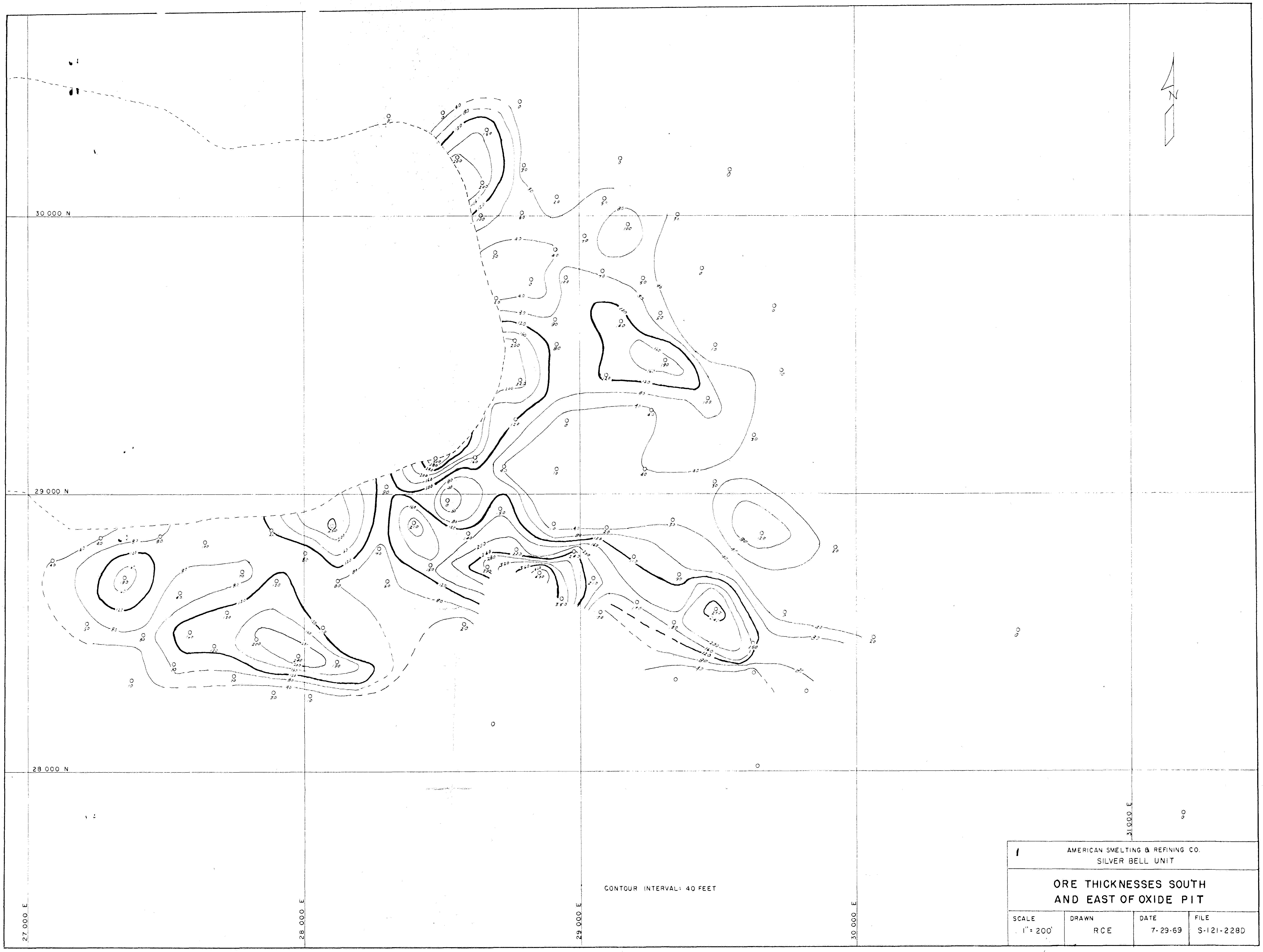
OCT 1 1969



HORIZONTAL DISPLACEMENT OF POINTS ON SLUMP OF SOUTH PERIMETER OF EL TIRO PIT SILVER BELL, AZ.

OCT 1 1969


CHANGE IN HORIZONTAL DISTANCE (feet)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0
A3
A5
A7
APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR
1968 1968 1969 1969 1970 1970 1971
TIME (months)
HORIZONTAL DISPLACEMENT OF POINTS ON SLUMP
OF SOUTH PERIMETER OF EL TIRO PIT
SILVER BELL, AZ.
J.W. CAMERON

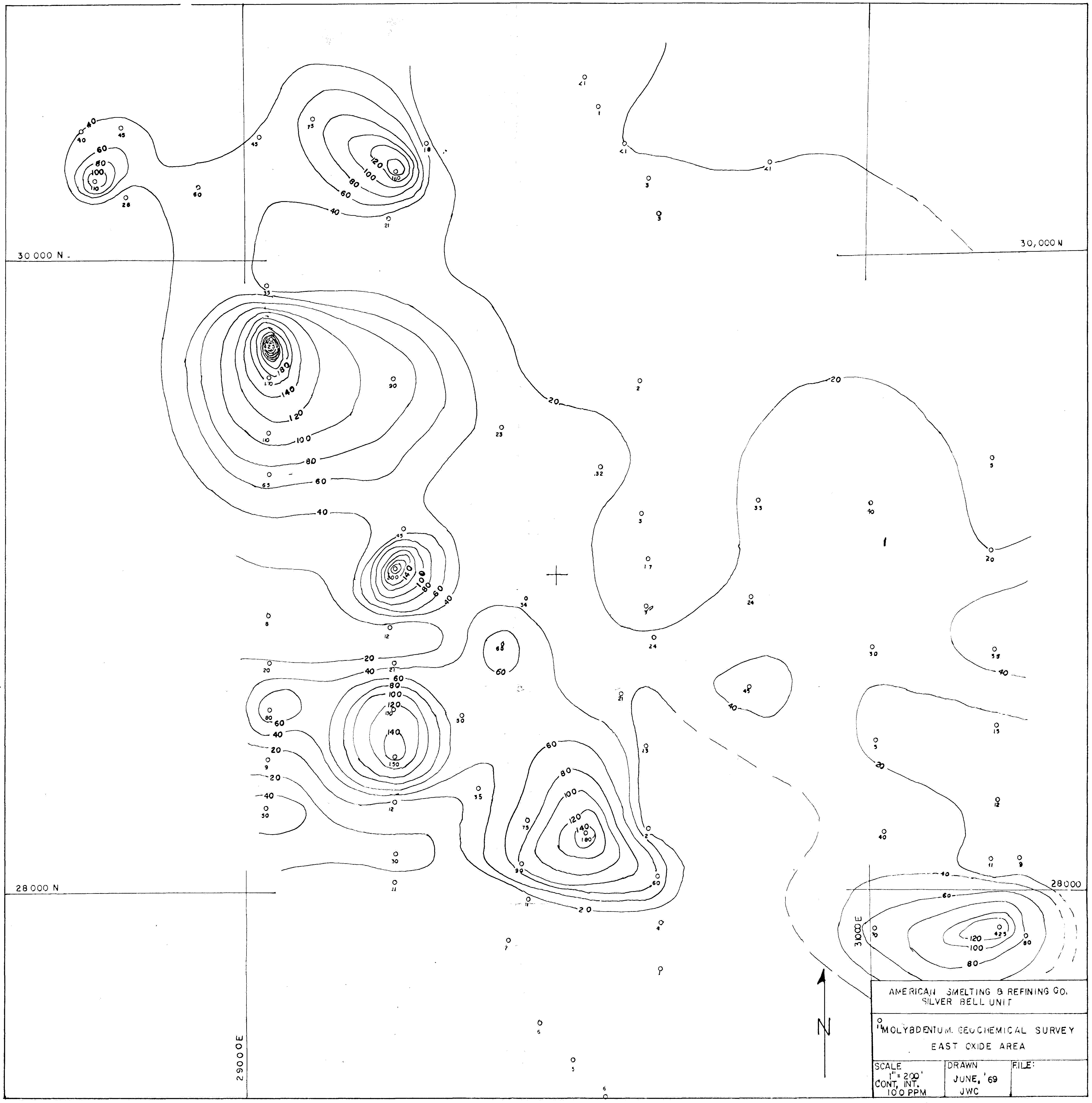


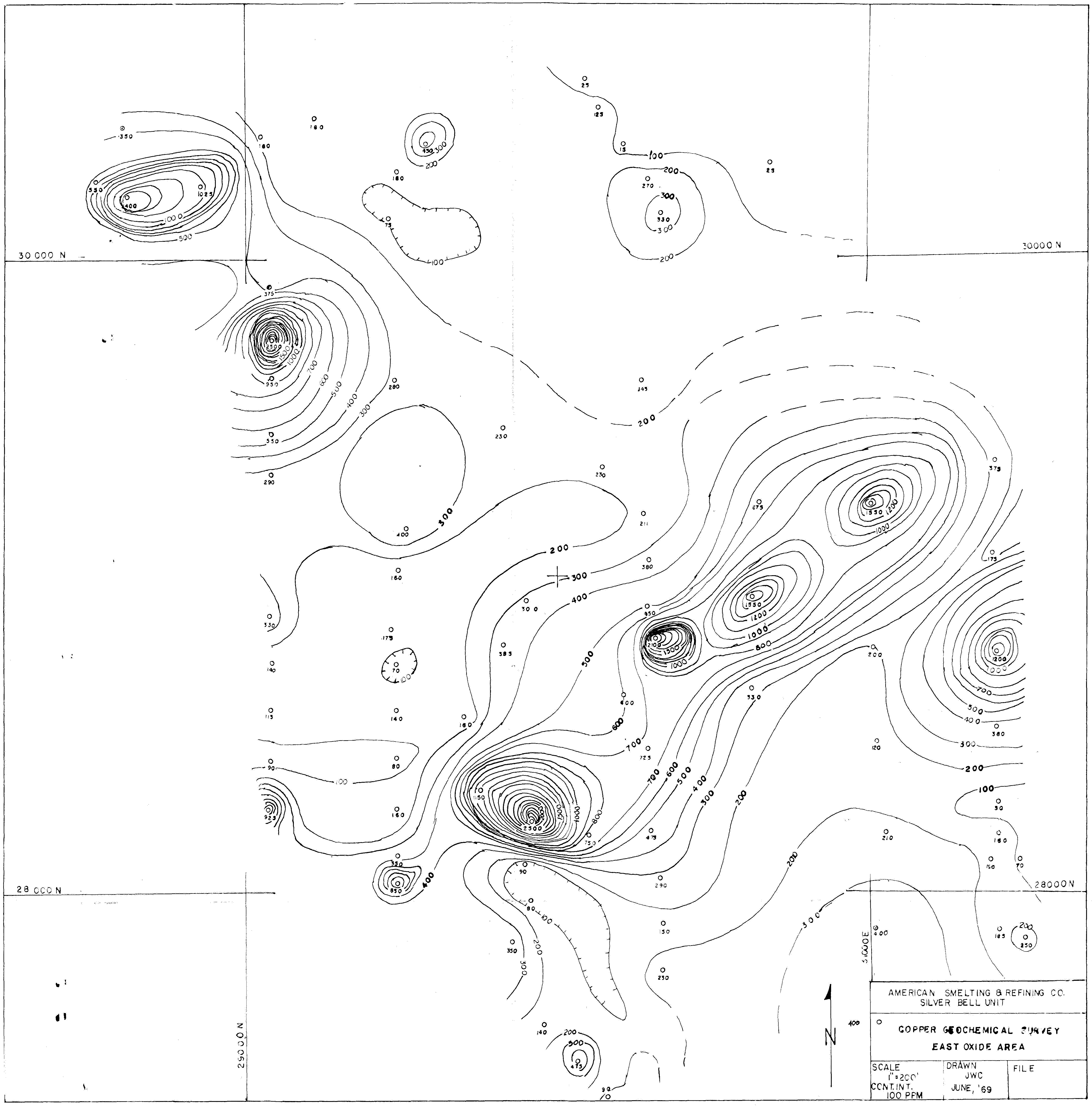
1

AMERICAN SMELTING & REFINING CO.
SILVER BELL UNIT

ORE THICKNESSES SOUTH AND EAST OF OXIDE PIT

SCALE	DRAWN	DATE	FILE
1" = 200'	RCE	7-29-69	S-121-228D


AMERICAN SMELTING & REFINING CO.
SILVER BELL UNIT
MOLYBDENUM GEOCHEMICAL SURVEY
EAST OXIDE AREA
SCALE 1" = 200'
CONT. INT. 100 PPM
DRAWN JUNE, '69
JWC
FILE:
N
30 000 N
30,000 N
28 000 N
28000
29000E
3100E


30 000 N
30000 N
28 000 N
28000 N
29000 N
31000E
N
AMERICAN SMELTING & REFINING CO.
SILVER BELL UNIT
COPPER GEOCHEMICAL SURVEY
EAST OXIDE AREA
SCALE
1"=200'
CONT. INT.
100 PPM
DRAWN
JWC
JUNE, '69
FILE

Mr. J. H. Courtright

J. H. C.

SEP 16 1969

AMERICAN SMELTING AND REFINING COMPANY
SILVER BELL UNIT
Silver Bell, Arizona

September 12, 1969

MEMORANDUM TO: Mr. D. R Jameson, Superintendent

Subject: GEOLOGIC REPORT FOR AUGUST, 1969

OXIDE PIT

Ore production in Oxide pit came from the 2700 (H) bench in the West Extension. Rock type was primarily alaskite, with a minor extent of monzonite. Grade of the rock was variable; but, almost all of the material mined was ore grade.

EL TIRO PIT

Ore production in El Tiro came from the 2590 (N) and 2630 (M) benches.

2590 (N)

Mining on the 2590 bench was carried out primarily in monzonite; but, a substantial proportion of the rock was alaskite. Grade of the 2590 bench was generally less than 0.80% Cu, a large proportion was leach ore and a minor amount was waste.

2630 (M)

Rock types on the 2630 bench consisted of dacite prophyry, sediments (mostly hornfels with a minor amount of mixed marble and tactite) and monzonite. The igneous rocks were entirely leach and waste grades. The sediments were generally ammonia leach grade with several small areas of ore grade material. Due to a larger tonnage of hornfels mined on the 2630 bench, average rock hardness should have been reduced as compared to the previous month.

EL TIRO EAST EXTENSION #2

Stripping continued on the 3075 (A) and 3035 (B) benches in the East Extension #2. Most of the rock was stockpiled as ammonia leach material due to its sedimentary rock type and thorough oxidation.

EL TIRO SLOPE INSTABILITY

The El Tiro Pit south wall slump showed movement at rates similar to that of the past several months. Attachments 1 and 2 show the vertical and horizontal displacements of several gauging stations. The gauging traverses are illustrated on the inset map on attachment #1. Rainfall amounting to 1.97 inches during August has not as yet made a marked increase in the slump rate.

J. W. Cameron
Resident Geologist

JWC:jca

Mr. J. H. Courtright

J. H. C
AUG 26 1969

W.E.S.
AUG 27 1969

AMERICAN SMELTING AND REFINING COMPANY
SILVER BELL UNIT
Silver Bell, Arizona

August 14, 1969

MR. ~~WES~~ ~~FDS~~
READ AND RETURN
PREPARE ANSWERS ✓ HANDLE
FILE INITIALS

MEMORANDUM TO: Mr. D. R. Jameson, Superintendent

Subject: ORE DISTRIBUTION SOUTH AND EAST OF OXIDE PIT

Attachments:

1. Plan of Ore thicknesses south and east of Oxide Pit.
2. Plan of Molybdenum Geochemical Sampling Results.
3. Plan of Copper Geochemical Sampling Results.

The attached maps cover the area south and east of Oxide Pit. Attachment #1 shows the distribution of chalcocite thicknesses and was prepared by contouring the total footage of ore in each diamond drill hole. The geochemical maps were plotted from sampling data taken by Mr. J. A. Briscoe in 1967. There is a good correlation between the 40 foot ore contour and the molybdenum anomallies on attachement #2. The correlation between copper anomallies and ore thickness is more erratic although the ore zone directly east of Oxide Pit is reflected by a 300 ppm copper anomally.

From past studies it has been assumed that a molybdenum anomally reflected more intense primary mineralization and therefore possibly stronger enrichment. An examination of these maps would indicate this is indeed the case. However, an examination of the drill logs shows very little variation in primary copper mineralization between holes with strong and weak enrichment, both average about 0.10%

It appears then that the molybdenum anomallies in this area are more directly related to supergene enrichment than previously thought. This theory is reinforced by DDH F-180 which contained 177 feet of ore. This is one of the few diamond drill holes in which molybdenum has been assayed for continuously. Molybdenum was assayed for from 41.2 to 455.8 feet. The interval from 41.2 to 90.5, in partially oxidized capping, averaged 69 ppm while the remainder of the hole, including the enrichment and primary contained about 20ppm. The molybdenum geochem map shows a value of 80 - 100 ppm for the collar of this hole.

This information although isolated, at least suggests an enrichment of molybdenum at or near the surface of areas overlaying enriched chalcocite ore. Mr. J. W. Cameron has pointed out that primary zone which has now undergone enrichment and leaching was possibly stronger than the primary zone which we presently observe below the enrichment.

It has not been the practice at Silver Bell to assay every core interval for molybdenum so that further detailed information on the vertical distribution of molybdenum is not presently available. However, if a study of the correlation between molybdenum and other sulfides would be of use or importance additional assays could be made of the core in storage.

R. C. Edmiston
R. C. Edmiston
Resident Geologist

RCE:jca

cc: RBMeen
JHCourtright
WTBarlow
JWCameron
File

Aa 16.19.19F J.H.C.

AUG 12 1969

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

July 15, 1969

TO: W. E. Saegart

FROM: W. G. Farley

AVRA VALLEY MAGNETIC ANOMALY
(POSTULATED SILVER BELL EXTENSION)
PIMA COUNTY, ARIZONA

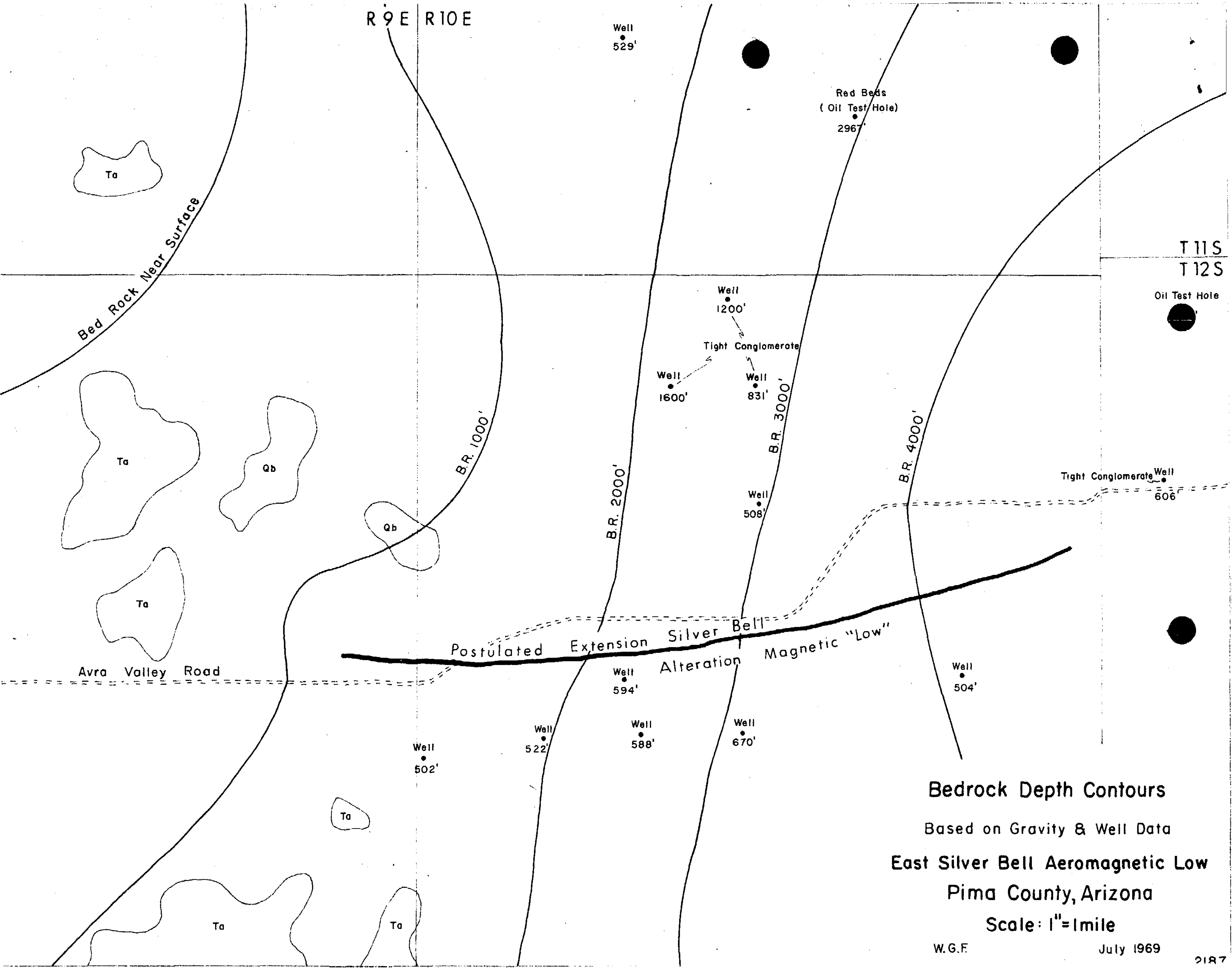
Attached is a map showing calculated depths to bedrock based on Asarco gravity coverage of the Silver Bell Peak Quadrangle and on water well data extracted from the U.S.G.S. Report "An Appraisal of Ground-Water Resources of Avra and Altar Valleys". In the area of the Postulated Extension of the Silver Bell Alteration, Magnetic Low bedrock on the western end is about 1000 feet in depth and on the east end about 4000 feet in depth. An indipendent report by you to Mr. R. B. Meen (Silver Bell Unit Water Feasibility Studies) dated November 25, 1964 shows the same calculated depths to bedrock in this area.

An Asarco ground magnetic survey is nearing completion in the area of the postulated Silver Bell Extension alteration low. A northeast-southwest magnetic anomaly (high-low pair) near the west end of the postulated alteration low calculates out to be coming from a depth of about 1000 feet which correlates with the gravity depth determination. The high-low magnetic anomaly appears similar to the high-low magnetic anomalies that occur in the El Tiro Pit area over tactite copper ore zones. I think that this east Silver Bell high-low magnetic anomaly could also very well be coming from a tactite copper source. The size of the block causing the high-low magnetic anomaly is about 1/4 mile by 1 mile. The bedrock in this area at a calculated depth of 1000 feet is within reach of the Asarco deep penetrating I.P. equipment. Therefore, I plan in the near future to run an I.P. Survey in this area to test for possible sulfide mineralization.

Wayne G. Farley

Wayne G. Farley

WGF:lab
cc: CPPollock &
JJCollins,
JHCourtright,
RJLacy &
CKMoss .



Bedrock Depth Contours

Based on Gravity & Well Data

East Silver Bell Aeromagnetic Low

Pima County, Arizona

Scale: 1" = 1 mile

W.G.F. July 1969

2187

JHC Desk

R. J. L.

JUL 7 1969

GEOPHYSICAL DIVISION

3422 South 700 West
SALT LAKE CITY, UTAH 84119

July 7, 1969

Approved for distribution. R. J. L.

W.E.S. JUL 14 1969

J. H. C. AUG 8 - 1969

MEMORANDUM TO R. J. LACY:

ARVA VALLEY MAGNETIC ANOMALY (POSTULATED SILVER BELL EXTENSION) - ARIZONA

On June 19, I discussed the possible significance of the subject anomaly in a memo to you. Since that time a ground magnetic survey has been underway, and I have had conversation with Wayne Farley, Southwest geophysicist, on the subject.

From an evaluation of gravity and well data, Farley estimates that the eastern end of the anomaly would be coming from an excessive depth, 3000' plus; the western portion, however, might be coming from a depth of 1500' or less. The magnetic data has not as yet been interpreted as to depth figures, but an interpretation should be forthcoming in the near future.

Inasmuch as I expect to be out of the office for the next two weeks, I would like at this time to re-emphasize my interest in the anomaly. I believe the implication of the anomaly justifies our concern in regard to property factors and in regard to follow-up work. In my opinion, there exists a good chance that drilling will eventually be needed and I would recommend that a deep penetration I. P. survey be undertaken in the near future.

CKM:am

C. K. MOSS

cc: C. P. Pollock & J. J. Collins
J. H. Courtright & W. E. Saegart ✓
W. G. Farley

J. H. C.

JUN 26 1969

ASARCO

AMERICAN SMELTING AND REFINING COMPANY
EXPLORATION DEPARTMENT
120 BROADWAY, NEW YORK, N.Y. 10005

MR. WES
READ AND RETURN
PREPARE ANSWERS — HANDLE ✓
FILE — INITIALS

JOHN J. COLLINS
CHIEF GEOLOGIST

Air Mail

June 24, 1969

Mr. J.H. Courtright
Tucson Office

Postulated Extension
Silver Bell Alteration
Magnetic Low

Dear Mr. Courtright:

Regarding Mr. Moss' memorandum on the above subject dated June 19th, copy to you, we will be interested to have your reactions to his recommendation "that ground magnetic profiles be conducted over the "anomaly" to obtain data as to the depth of the source. Following this, gravity measurements or I.P. work might be indicated."

Sincerely yours,

John J. Collins

John J. Collins

CC:RJLacy
CKMoss
cc: WESHEGART

TAS ; RBM

A. H. LINDLEY
MINERAL AND METAL CONSULTANT
112 BRIGHTWOOD AVENUE
WESTFIELD, NEW JERSEY 07090
AREA CODE 201 232-8291

NEW YORK ADDRESS: 595 MADISON AVE., NEW YORK, N. Y. 10022
AREA CODE 212 758-2133

May 16, 1969

Silver Bell

TO WHOM IT MAY CONCERN:

This is to introduce Mr. Ted Hanks, geological consultant, whom I have retained to take surface soil and rock samples over known ore bodies for an independent study we are making on soil chemistry.

We would appreciate the courtesy of allowing him to take a few samples on your property. If desired we will be happy to provide you with the results of our work to determine if there are any abnormal metallic concentrations over an orebody as compared with the cover rock beyond the ore body. We are making this study on a world wide basis.

Sincerely,

A. H. Lindley
A. H. Lindley

AHL:11

Collins phoned that Hennebach has no objections, providing the mining Dept. here approves. They would like to sample over the North El Tiro area.

JHC - 5-26-69

TAS : ok 5-26-69

From: J. J. COLLINS

To: Mr Courtright

cc is going to Mr Snedden

J.H.C.
APR 10 1969

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

RECEIVED
MAR 21 1969
JOHN J. COLLINS

BUILDING 20
DENVER FEDERAL CENTER
DENVER, COLORADO 80225

March 19, 1969

J.H.C.
MAR 28 1969

Mr. John Collins
American Smelting & Refining Company
120 Broadway
New York, N. Y. 10005

Dear Mr. Collins:

Attached is a copy of Kenyon Richard's letter to R. F. Hewlett authorizing the acquisition of sample data from the Silver Bell files.

Dick Hewlett, while he was in school at Tucson, drove over to Silver Bell and made copies of the data from the files in the mine. Data obtained included exploration drill hole assays and blast hole assays from the 2820, 2840 and 2860 benches.

Copies of the report were forwarded to Kenyon Richard, and he told Dick Hewlett that he saw no reason why it could not be published. This was in 1964 when the report was completed.

Sincerely,

Scott

Scott W. Hazen, Jr.
Supvry Mining Engineer
Mine Systems Engineering Group

Attachment

No objection if Mr. Snedden still agrees - CEM

From: J. J. COLLINS ←

MAR 21 1969

To: ~~Mr. Nelson~~

Here is the background.

Still OK ?

AMERICAN SMELTING AND REFINING COMPANY
SOUTHWESTERN EXPLORATION DEPARTMENT
813 VALLEY NATIONAL BLDG., TUCSON, ARIZONA

KENYON RICHARD
CHIEF GEOLOGIST
J. H. COURTRIGHT
ASSISTANT CHIEF GEOLOGIST

November 9, 1961

Mr. R. F. Hewlett
U. S. Department of the Interior
Bureau of Mines
Box 3928, University Station
Tucson, Arizona

Dear Dick:

In reference to your letter of November 8, I have talked with Mr. Snedden and he is agreeable to supplying you with the information on the El Tiro pit.

As I understand it you will need: (1) Maps of all benches which produced ore. These bench maps would show the blast hole assays. (2) Tonnage and grade of ore, waste, and leach produced from each bench. (3) Portions of the logs of exploration drill holes down to the bottom of all material that has been removed. (4) A contour map of the original ground surface.

You will have data which concerns only the material removed by mining. If any of these data, along with the results of your calculations and analyses, are to be published, this Company reserves the right to review the manuscript and make any deletions or changes which it considers necessary.

Copies of this letter and your letter will go to Mr. Jameson. Please get in touch with him in the matter of obtaining the information approximately listed above.

We will be interested in learning from time to time how your analyses are progressing.

Yours very truly,

Kenyon Richard

KENYON RICHARD

KR/z
cc: DRJameson, w/cc RFH letter

Aa-16.14.19

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

February 7, 1969

Mr. R.B. Meen, Manager
Southwestern Mining Department
Building

Silver Bell Unit
Geophysical Surveys

Reference is made to Mr. Jameson's letter of January 31 accompanied by Mr. Edmiston's memo recommending geophysical surveys north of the Oxide Pit and in the area of Cretaceous sediments between the Waterman Mountains and the Oxide Pit.

It is possible that limestone beds more favorable to mineralization may underly the weakly mineralized or barren beds which outcrop north and northwest of the Oxide Pit. Although such beds may not lie within the depth range of detectability by magnetometer or I.P., I agree that a preliminary test is warranted. The surveys should be extended northwesterly to, or beyond, North Butte.

Although the Cretaceous rocks between the Oxide Pit and the Watermans are concealed in a large part by gravels and alluvium, there are a sufficient number of outcrops to indicate that alteration-mineralization is sparse to absent. Accordingly, the chances that copper deposits of important size occur in the limestones at depth beneath the shales and arkoses, are considered remote. I have no objection, however, to a magnetometer survey being carried out over this area.

Mr. Farley should get in touch with Mr. Edmiston to review the information and schedule the surveys.

J.H. Courtright

JHC:lzb

cc: DRJameson
WESaegart
WGFarley, w/copy of DRJ's letter

S-1.1

J. H. C.

FEB 3 1969

AMERICAN SMELTING AND REFINING COMPANY
SILVER BELL UNIT
Silver Bell, Arizona

W.E.S. FEB 6 1969

January 31, 1969

MR. WES, WGF

READ AND RETURN ✓

PREPARE ANSWERS ____ HANDLE ____

FILE ____ INITIALS ____

Mr. R. B. Meen, Manager
Southwestern Mining Department
American Smelting and Refining Company
P. O. Box 5795
Tucson, Arizona 85703

SILVER BELL UNIT
GEOPHYSICAL SURVEY

Dear Sir:

Attached is a copy of a memorandum prepared by Mr. R. C. Edmiston covering a recommended geophysical survey program.

With the new knowledge we are gaining every year about the geology of the Silver Bell area, new targets for exploration have been developed and some have led to the discovery of additional ore for the property. One of the targets not thoroughly tested has been the area between the Oxide Pit and the Waterman Mountains.

In order not to leave any area untested by some means, I would recommend that the aid of the Exploration Department be enlisted to run the magnetic and I. P. surveys. The geophysicists are working in this area at the present time and conceivably could do these surveys after completing their other work.

If you agree or disagree with the recommendation, please advise. If more specific information is required, we will attempt to provide it.

Very truly yours,

Original Signed By
D. R. JAMESON

D. R. JAMESON
Superintendent

DRJ:df

Encl.

cc: JHCourtright
TASnedden

AMERICAN SMELTING AND REFINING COMPANY
SILVER BELL UNIT
Silver Bell, Arizona

January 31, 1969

MEMORANDUM TO: D. R. Jameson, Superintendent

Subject: RECOMMENDED GEOPHYSICAL SURVEYS IN THE OXIDE PIT AREA

In reviewing the exploration program at Silver Bell it appears that not much attention has been given to the possibility of tactite mineralization in the Paleozoic Formations north of Oxide Pit or in the down-dropped block laying between Oxide Pit and the Waterman Mountains. I would like to request the assistance of the Southwest Exploration Department in conducting magnetic and I. P. surveys in this area. A magnetic survey over the graben structure south of the alteration zone and one or two lines of I. P. extending south from Oxide Pit would be useful at this time. Also, we are considering drilling a few test holes in the tactites north of Oxide Pit and a magnetic survey may be useful in selecting the position of these holes.

Any assistance the geophysicists may be able to provide will be greatly appreciated.

R. C. Edmiston
R. C. EDMISTON
Resident Geologist

RCE:df

EXPLORATION NOTE FILE - RECONNAISSANCE

WES J. H. C.

W.E.S. JAN 8 1969

Location: N $\frac{1}{2}$, Sec. 34
T 11S, R9E
Pima, County

Property Red Hill JAN 7 1969
Area Silver Bell Peak Quadrangle
District NE Silver Bell
Mt. Range
State Arizona

Field Check by: James D. Sell

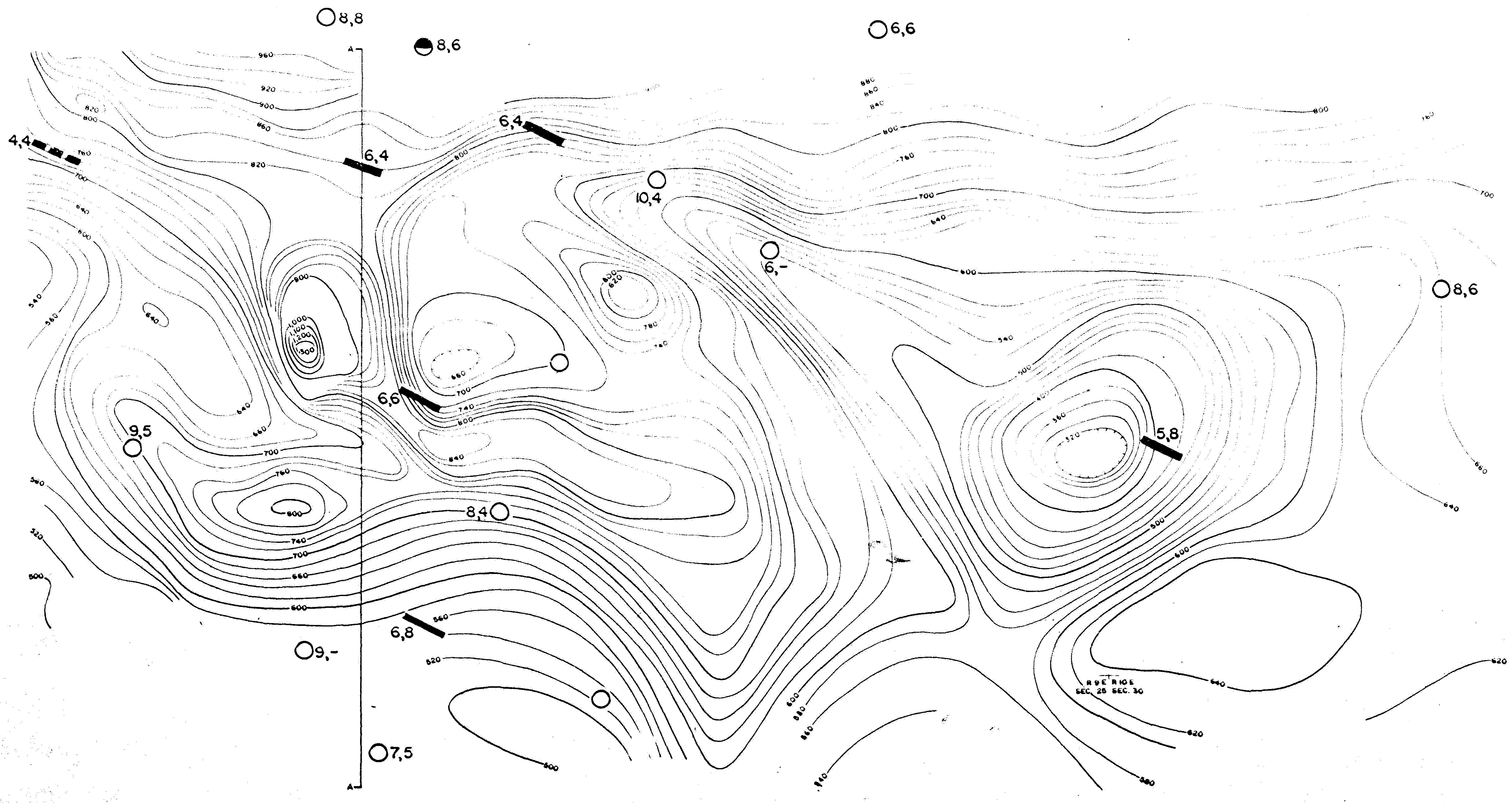
Date January 6, 1969

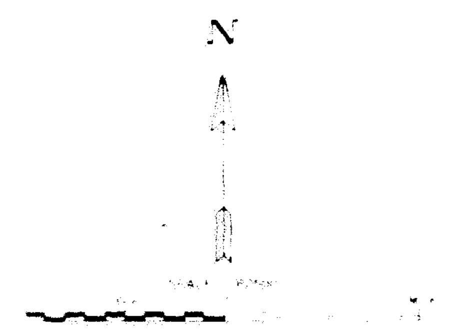
Recommended Company Interest Classification:	Conclusion:
☐ First Order ☐ Second Order ☐ Inactive ☒ None ☐ Technical	The coloration is fresh Precambrian granite with only minor aplite zones. No alteration or mineralization was noted,all other rocks surrounding the hill is either volcanic tuffs and flows or alluvium.

Notes on Recconnaissance: Red Hill is fresh Precambrian granite with only minor aplite zones. The granite covers the main hill and extends outward to the west, north, east and goes under the alluvial cover. On the south contour bulge an andesite feeder system and flows cover the granite and dip off to the south. The andesite also covers eastward. Reconnaissance was continued along the roads and float checked at each wash crossing. Specific hill outcrops were visited in the center of Sec. 3 (T 12S, R9E) and the NW $\frac{1}{4}$, Sec. 4 (T 12S, R9E). All outcrops and float checks showed various volcanic flow rocks with some tuff. The reconn continued northwest along the pipeline road and then cut over to the old Silver Bell Road completing the traverse around Red Hill. Some weakly altered and mineralized granite was found near the center of Sec. 29 (T 11S, R9E) and is reported on a seperate note file.

☐ Map Attached

Date January 6, 1969 By James D. Sell





AMERICAN SMELTING AND REFINING CO.
GEOPHYSICAL DIVISION
SALT LAKE CITY, UTAH

AEROMAGNETIC MAP
SILVER BELL-AVRA VALLEY AREA
PIMA CO., ARIZONA

CONTOUR INTERVAL: 20 GAMMAS

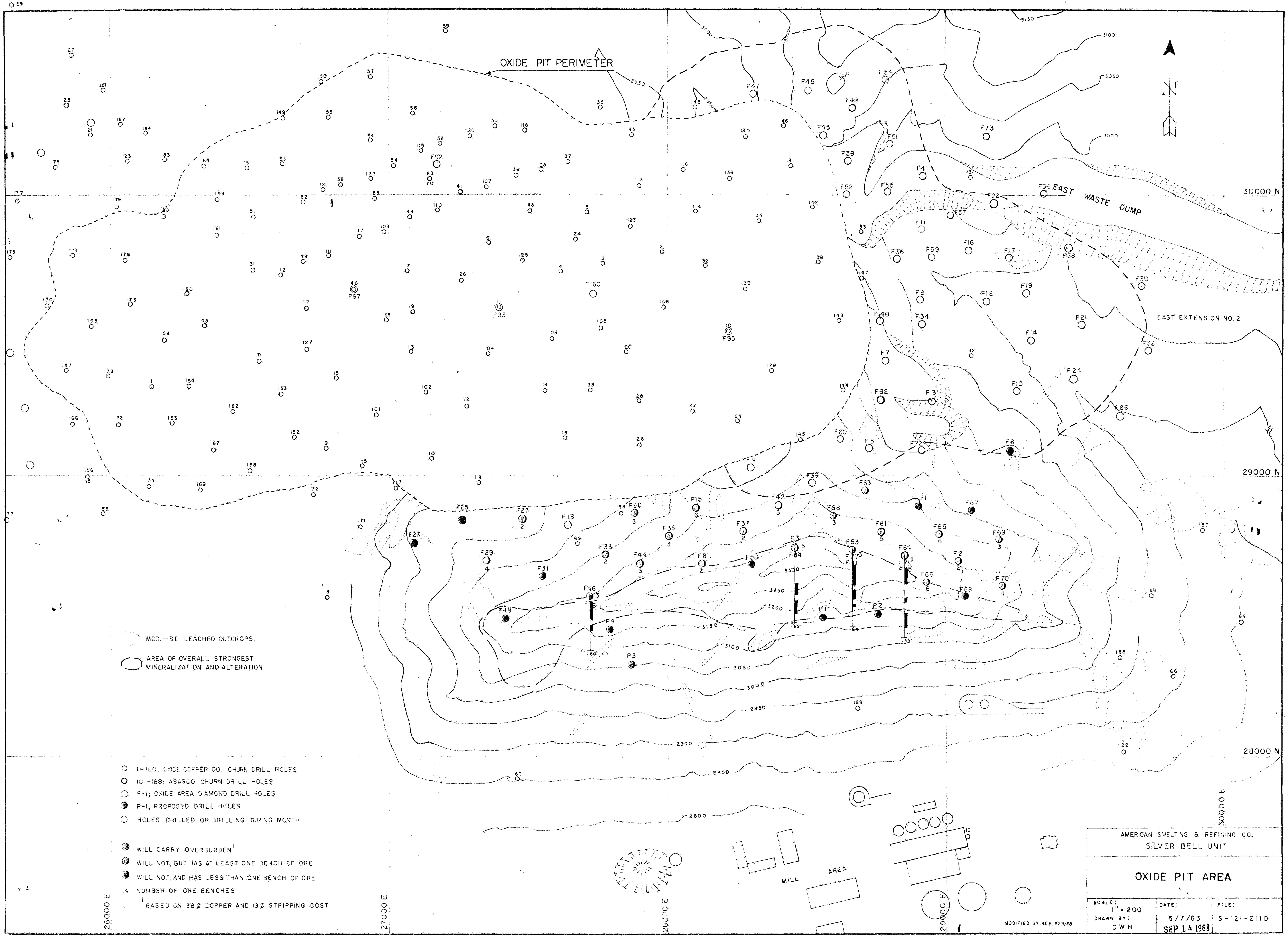
Inst. J. M. Panek • Contoured J. Hafeman • Date: Sept. 1969

32° 20'
111° 15'

32° 20'
111° 30'

AFMAG LEGEND

	LOCAL ANOMALIES	MAJOR "FAULT" TYPE ANOMALIES	DIP ANGLE IN DEGREES 150 Hz	510 Hz
DEFINITE	▬▬	●	12,	6
PROBABLE	▬ ▬ ▬	◒		
POSSIBLE	▬ ▬ ▬	○		


OXIDE PIT PERIMETER
EAST WASTE DUMP
EAST EXTENSION NO. 2
N
30000 N
29000 N
28000 N
26000 E
27000 E
28000 E
29000 E
30000 E
3150
3100
3050
3000
2950
2900
2850
2800
MILL AREA
MOD.—ST. LEACHED OUTCROPS.
AREA OF OVERALL STRONGEST MINERALIZATION AND ALTERATION.
1-100; OXIDE COPPER CO. CHURN DRILL HOLES
101-188; ASARCO CHURN DRILL HOLES
F-1; OXIDE AREA DIAMOND DRILL HOLES
P-1; PROPOSED DRILL HOLES
HOLES DRILLED OR DRILLING DURING MONTH
WILL CARRY OVERBURDEN[1]
WILL NOT, BUT HAS AT LEAST ONE BENCH OF ORE
WILL NOT, AND HAS LESS THAN ONE BENCH OF ORE
4 NUMBER OF ORE BENCHES
[1] BASED ON 38¢ COPPER AND 19¢ STRIPPING COST
MODIFIED BY RCE, 9/9/68
AMERICAN SMELTING & REFINING CO.
SILVER BELL UNIT
OXIDE PIT AREA
SCALE: 1" = 200'
DRAWN BY: CWH
DATE: 5/7/63
SEP 14 1968
FILE: S-121-211D

J. H. C

OCT 9 1968

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

October 9, 1968

MR. WES

READ AND RETURN ✓

PREPARE ANSWERS ____ HANDLE ____

FILE ____ INITIALS ____

W.E.S.

NOV 1 1968

TO: J.H.Courtright

FROM: P.D.Bauer

SILVER BELL MINE

ALTERATION

In the cap rock, alteration is identified by the occurrence of sericite and of live limonite in veins. The more closely spaced veins correspond to stronger alteration. The live limonite is identified by its dark maroon-red color and boxwork. The boxwork developed is indicative of the mineral altered. Chalcopyrite leaves a rectangular boxwork; bornite a triangular boxwork; and pyrite a square boxwork.

If live limonite occurs by itself, it indicates strong mineralization. If it occurs with jarosite, it indicates moderate mineralization, and jarosite occurring by itself indicates poor mineralization.

In the intrusive rock there is a zone of secondary enrichment with a blanket of chalcocite approximately 200' thick. The chalcocite blanket conforms to the present topography. Values taken from core samples in the primary zone of about .2% copper indicated there has been about a 3 fold enrichment, possibly more, in the secondary zone, which yields values of .6-.8%. Secondary enrichments occur only in the intrusive rocks. The only ore in the sediments is primary.

Production amounts to 11,000 ton of ore through the mill per day. A balance is maintained in the amount of ore brought out of the pits with the amount run through the mill. The leaching process is run by a 4-man crew and accounts for about 25% of the total copper production.

STRUCTURE

Major NW trending fault structures with minor NE trending mineralized fissures. The two pits are located at the highest concentration of the fissures. In the strongly altered areas these fissures or veinlets occur at about 4-6 per foot.

ROCK TYPES

The intrusive igneous rock types in altered areas are alaskite, quartz monzonite, and syenodiorite. Tactites are located along the contact between intrusive and sediments. There is also a dacite porphyry in the altered zone.

MISSION MINE

The ore at Mission Mine is primary chalcopyrite and is disseminated through the quartz monzonite, argillite and conglomerate. The conglomerate however, has been completely mined away. In the center of the pit is a barren marble unit which will be left in place and mined around.

There is no leaching process at Mission Mine, but they are stock piling ore with less than.4% copper, for the future. Unlike Silver Bell Mine, there is no recovery of molybdenite. The Mission Mine runs about 30,000 tons of ore, that runs from .4 to 3+% copper, through its mill daily.

Paul Bauer

P.D. Bauer

PDB:lzb

Mr. J. H. Courtright

S-1.1

AMERICAN SMELTING AND REFINING COMPANY
SILVER BELL UNIT
Silver Bell, Arizona

September 12, 1968

WES

W.E.S. SEP 17 1968

J. H. C SEP 17 1968

MEMORANDUM TO: Mr. D. R. Jameson, Superintendent

Subject: PROPOSED DIAMOND DRILLING FOR THE SOUTH SLOPE OF PORTLAND RIDGE.

SUMMARY AND RECOMMENDATIONS

A re-evaluation of the ore potential of Portland Ridge by Mr. R. A. Barnes, Chief Mining Engineer and the writer shows that additional drilling on the south slope of Portland Ridge is desirable at this time. Accordingly, four initial holes are proposed at a cost of about $20,000.00.

PREVIOUS WORK

Between January, 1964, and April, 1966, a total of 78 diamond drill holes were drilled around the east end of Oxide Pit. Results of this drilling led to a planned extension east from Oxide Pit. The extension and original diamond drill holes are shown on the accompanying map. After the completion of about 35 vertical holes it appeared that ore grade mineralization continued south under the ridge line, an area too precipitous to be drilled vertically. Therefore, Mr. C. W. Haynes, former resident geologist, drilled six angle holes on a bearing due south under the ridge. The horizontal projection of some of these angle holes is plotted on the accompanying map. Ore grade (+0.40% Cu) intercepts are indicated by a wide line, the trace of the hole by a narrow line. (The southern limit of ore mineralization as seen in these projections is due to the hole penetrating below the enriched zone, rather than encountering an east-west cut off of mineralization.) In a report of April 22, 1966, Mr. Haynes summarized this drilling as follows:

> "To the south under Portland Ridge, the chalcocite appeared to finger out more gradually. A number of angle holes were drilled on Due South bearings from the northern crest of Portland Ridge, but the mineralization was not completely outlined. If, or when, Portland Ridge is mined a few more holes should be planned to be drilled to find the definite edges."

The map also shows a previous drill site, 123, part way up the south slope of Portland Ridge. This site was evidently drilled by a diamond drill in the late 1940's, but no record of this hole can be found at Silver Bell. It is assumed that no significant mineralization was found in this hole.

NEW ANALYSIS OF PREVIOUS RESULTS

In past months Mr. Robert A. Barnes and the writer have discussed a re-appraisal of the results of the Portland Ridge drilling. Recently, Mr. Barnes re-examined the drill logs to determine which holes contained enough ore to warrant stripping at today's prices and costs. The figures used are those which have recently been applied to drilling in the El Tiro area. The stripping cost used was $.19 per ton while the price of copper used was $.38 per ton. Those holes which would carry the overburden at these figures have been colored red on the map and the number of benches of ore written below the hole location. The map shows that between 27,700 E and 28,000 E there are about three benches of ore which have not been tested south of the ridge line. Between 28,400 E and 29,000 E there are five to eight benches of ore for which no southern limit has been established. Approximately 4.5 million tons of proven ore, for which no grade has been calculated, lay under Portland Ridge which have not been included in any planned extension of Oxide Pit.

PROPOSED DRILLING

In an effort to establish the southern boundary of ore grade mineralization three additional diamond drill holes are recommended. These are, P-1 and P-2 and either P-3 or P-4. P-1, P-2 and P-3 are all accessible from the south while P-4 can only be occupied by moving south from the site of F-46. If either P-3 or P-4 intercept enough ore to warrant stripping then the other will have to be drilled. If P-1 and/or P-2 are successful additional holes will be recommended. All holes have a planned depth of 500 feet.

PROCEDURE AND CONSTRUCTION

All four holes will require a skid-mounted drill. Proposed locations have been examined in the field by the Boyles Bros. foreman, Mr. Bryce Robinson, who considers them feasible for drill rig set-ups. For economy and safety it is recommended that a bulldozer be employed for one shift to blaze a trail from the site of diamond drill hole 123 to the sites P-2 and P-1, as shown, and from an undetermined location to site P-3. Site P-4 will require a small amount of blasting and cat work to be accessible from site F-46. P-4 can not be reached from P-3, and the converse is also true due to steep outcrops between the two sites. Water will be pumped to the sites from the base of the south slope. This procedure is similar to that successfully applied on Mt. Expectation where rugged toppgraphy was also encountered.

COST

The average direct drilling cost for the drilling done on Mt. Expectation with a skid-mounted drill was about $10.00 per foot. Average direct drilling cost with truck-mounted drills varies from $7.00 to $8.00 per foot. The difference between the rates is that the contractor is paid $10.60 per crew per hour while moving the drill and other equipment into place. It is felt that blazing a trail and preparing level sites with a cat will reduce the time spent on each move by about 30 crew hours, saving the Company approximately $318.00 minus about two hours cat time per hole. This would lower average direct drilling costs to about $9.25 per foot. The following estimation is made using the latter figure:

Site P-1, P-2 and P-3:

Total footage -	1,500.00	
Cost per foot -	9.25	
Total direct cost -	13,875.00	$ 13,875.00
Track Dozer time -	8 Hrs.	
Approx. cost per hour	10.00	
Total	80.00	80.00
		$ 13,955.00

Site P-4:

Total footage -	500.00	
Cost per foot -	9.25	
Total direct cost -	4,625.00	
		$ 4,625.00
Drilling and Blasting -		150.00
Track Dozer cost -		80.00
		$ 4,855.00
Miscellaneous Supplies:		400.00
GRAND TOTAL		$ 19,210.00

CONCLUSION

This study shows that it is possible to place vertical diamond drill holes on the south slope of Portland Ridge using the same techniques that were applied on Mt. Expectation. There are several advantages to performing this work at the present time. One advantage is that most of the personnel involved in the Mt. Expectation drilling are still working in the drilling program. Another and more compelling factor is that if enough ore exists to warrant mining, it would be more profitable to include it in the currently planned extension than to mine it separately at a later date.

The success of this program, if undertaken, will require the fullest cooperation of all segments of the Mining Department, the Chief Mining Engineer, the Drill Foreman and the geologists.

RC Edmiston

R. C. Edmiston
Resident Geologist

RCE:jca

cc: RBMeen
JHCourtright
WCWaidler
RABarnes
File

J. H. C.

AUG 27 1968

W.E.S.
SEP 12 1968

AMERICAN SMELTING AND REFINING COMPANY
SILVER BELL UNIT
Silver Bell, Arizona

August 26, 1968

MR. WES
READ AND RETURN
PREPARE ANSWERS ___ HANDLE ___
FILE ___ INITIALS ___

Mr. J. H. Courtright, Chief Geologist
Southwestern Mining Department
American Smelting and Refining Company
P. O. Box 5795
Tucson, Arizona 58703

SILVER BELL UNIT
GEOLOGIC MAPPING

Dear Sir:

Attached is a memorandum prepared by Mr. R. C. Edmiston, Resident Geologist, outlining in general his approach to mapping and recording the geology of the Silver Bell area. This is in response to Mr. Briscoe's memorandum of May 16, 1968.

If you have any recommendations on Mr. Edmiston's proposals, please offer them at this time so that he may proceed with this work as time allows. I believe the geology should be mapped and recorded in a manner similar to your approved methods using the scale, symbols, and colors in general used in your department. You, also, may have another approach that could eliminate any duplications of effort.

Your recommendations would be appreciated.

Very truly yours,

D. R. Jameson

D. R. JAMESON
Superintendent

DRJ:jca

cc: RCEdmiston
RBMeen
JABriscoe
BNWatson

AMERICAN SMELTING AND REFINING COMPANY
SILVER BELL UNIT
Silver Bell, Arizona

August 26, 1968

MEMORANDUM TO: Mr. D. R. Jameson, Superintendent

Subject: GEOLOGIC MAPPING OF AREAS ADJOINING SILVER BELL

Mr. J. A. Briscoe, proposed in his memorandum to Mr. J. H. Courtright of May 16, 1968 that the West Silver Bell Mountains be mapped at a scale of 1 inch = 1 mile or greater in order to verify or negate a postulated extension of the northwest trending zone of alteration.

This would appear to be a logical time to re-evaluate the geology of the entire district as the current round of diamond drilling draws to an end. As such a study should fall within the domain of the resident geologist at Silver Bell, I propose to compile the district geology by the following steps:

1. Transfer existing detailed geology maps to a composite map at a scale of 1 inch = 1 mile.

2. Examine outcrops which have been previously identified (such as the Mt. Lord Ignimbrite, Silver Bell Complex, etc.) in order to standardize mapping.

3. Extend the composite map into surrounding areas with reconnaisance mapping while filling in gaps in the existing maps.

4. Map in larger scale any areas of interest.

The final products of the above work should be an "outcrop" map showing what is clearly visible and an "interpretative" map on which inferred structures are shown. In the course of the above Mr. Briscoe's hypothesis may be evaluated but this will not be done until all information has been gathered in as objective a manner as possible.

Hopefully, such a map of the entire district will be useful to all ASARCO geologists who have worked or may work in the future at Silver Bell.

RC Edmiston
R. C. Edmiston
Resident Geologist

RCE:jca
cc: RBMeen
JHCourtright
JABriscoe
BNWatson

GEOPHYSICAL DIVISION

3422 South 700 West
SALT LAKE CITY, UTAH 84119

JUL 22 1968

J.H.C.
AUG 19 1968

July 19, 1968

W.E.S.
JUL 23 1968

MEMORANDUM TO R. J. LACY:

SILVER BELL UNIT
PROPOSED DIAMOND DRILLING
NORTHWEST SILVER BELL AREA

In his letter to you of July 5, Mr. W. E. Saegart asked whether I would want to comment on the proposed locations of the subject holes.

If these holes were spotted with the simple objective of directly checking the magnetic source then I would move some of the locations to a position which I believe would be closer to the causative material.

Anomaly-wise, I would suggest the following:

Anomaly 4. P-1, as recommended, is well suited to test this anomaly. P-2 and P-3 may well eventually be necessary to test the extent of any mineralization, but additional holes to test the NW-SE trend crossing P-1 would be desirable if results in P-1 are favorable.

Anomaly 5. This anomaly seems to be caused by two rather small magnetic sources lying on opposite sides of the proposed site, P-4. The present site could produce results which would not be as good as the average conditions underlying the anomaly as a whole. A hole 100 feet to the west might well yield better results.

Anomaly 6. Again, to locate the hole more directly over the causative source, I would move the position a short distance. For P-5 a position about 150 feet S60W would be more centrally located with respect to the source.

C. K. Moss

C. K. MOSS

CKM:am

cc: R. B. Meen
J. H. Courtright ✔
D. E. Jameson
R. C. Edminston
R. H. Luning
W. E. Saegart

J.H.C. JUL 8 1968

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

July 5, 1968

Mr. R.J. Lacy
American Smelting and Refining Co.
3422 South 700 West
Salt Lake City, Utah 84119

SILVER BELL UNIT
PROPOSED DIAMOND DRILLING
NORTHWEST SILVER BELL AREA

Dear sir:

I am enclosing a copy of Mr. R.C. Edmiston's drilling proposal of June 22 to test magnetic anomalies obtained last year by Mr. R.H. Luning.

I recall some comments by Mr. C.K. Moss concerning the positioning of holes to test these anomalies. I believe Cal Moss was concerned about the locations of the magnetic sources relative to the amplitude maximum vs gradient maximum for these anomalies.

Perhaps you or Mr. Moss will want to comment further regarding the specific hole locations.

Very truly yours,

W.E. Saegart

W.E. Saegart

WES:lzb
Encl.

cc: RBMeen
JHCourtright
DEJameson
RCEdminston
RHLuning

copied for Mr. Edminston 9/16/68

W.E.S. 83b

JUL 5 1968

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

July 3, 1968

Mr. James Briscoe
ASARCO
1161 N. Tustin Ave., Suite H
Orange, California 92667

Silver Bell Area West
of El Tiro

Dear Sir:

This is a somewhat belated acknowledgment of your memorandum of May 16, 1968, regarding the possible displacement on the fault structure separating the El Tiro area and the West Silver Bell Mountains.

Your conclusion that the west side moves southerly over two miles appears to be well borne out by the evidence presented. Also, I agree that the movement was very likely post-copper mineralization in age.

One important question is, "What was the original (pre-fault) northwest extent of the Silver Bell zone of alteration-mineralization?" Owen Evans' geological map of 1954 shows the zone striking northerly from the El Tiro pit area with the western fringe along the edge of the alluvial cover. This fringe was defined in part by the existence of unaltered rocks found in a few old pits that penetrated the alluvium. Only in one area was there a rather narrow possible continuation to the northwest beneath the alluvium.

However, I agree that the area should be mapped to turn up any evidence, pro or con, that might be useful in evaluating the exploration possibilities to the west. The 800' to 1-inch contact photographs should be used for this work. The data could be later reduced and plotted on 1/2 mile to the inch U.S.G.S. topo sheets.

This work should logically be done by a Silver Bell Unit geologist familiar with the geology of the area. However, no replacement was secured by the Mining Department for Mr. Nuttycombe and Mr. Edmiston is more than fully occupied with the pit mapping and exploration drilling. We have no man available in the Exploration Department at this time but may have at some later date.

Yours very truly,

J. H. Courtright

JHC:lml
cc: TASnedden
RBMeen
DRJameson

Route file copy to WESaegart

WES

J.H.C.

JUN 28 1968

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

May 16, 1968

TO: Mr. J.H. Courtright

FROM: Mr. J.A. Briscoe

Evidence of left-lateral offset between the North Silver Bell and West Silver Bell Mountains
Pima County, Arizona

Summary and Conclusion:

Although the North Silver Bell and the West Silver Bell Mountains are separated topographically the similarity of the geology of the two ranges suggest they are genetically related. They are separated topographically by a northeast trending basin and range type fault(s) which passes through the valley west of the B S & K (Atlas) mine, probably near the old Silver Bell cemetery. For convenience, this fault is called the Cemetery fault in this report.

Several northwest trending linear features are present in the North Silver Bell Mountains, these being:

1. the Ragged Mountain Fault
2. the linear intrusive-extrusive outcrop of the Mount Lord ignimbrite and
3. the Silver Bell alteration zone

Two of these features--the Ragged Mountain fault and the linear intrusive--extrusive outcrop of the Mt. Lord ignimbrite--can be identified in the West Silver Bell Mountains. These features aren't aligned with the same features exposed in the North Silver Bells, however, but appear to be offset to the southwest two and one half to three miles along the Cemetery fault.

When the Ragged Mountain fault in the West Silver Bells is realigned with the fault in the North Silver Bells the linear outcrops of the Mount Lord ignimbrite in both ranges also fall in alignment (see overlay Plate 1). In addition, the weak northwest trending zone of alteration in the El Tiro Hills in the West Silver Bells comes close to aligning with the Silver Bell alteration zone. It is therefore proposed that the El Tiro alteration zone exposed in the West Silver Bell Mountains is actually an offset portion of the northern end of the Silver Bell alteration zone!

Exploration for the extension of the Silver Bell alteration zone beyond the Atlas mine area should therefore be concentrated in the alluvium covered area southeast of the El Tiro Hills mine of the West Silver Bell mountains, rather than in the area northwest of the Atlas Mine as has been done without success in the past.

EVIDENCE OF LEFT LATERAL OFFSET BETWEEN THE NORTH SILVER BELL MOUNTAINS AND THE WEST SILVER BELL MOUNTAINS, PIMA COUNTY, ARIZONA

Linear Features Common to the North Silver Bell and West Silver Bell Mountains.

A comparison of the geology of the North Silver Bell and West Silver Bell mountains shows that, although they are topographically separated into two ranges, they are genetically related and are composed of approximately the same rock types.

Two major linear geologic features are present in both ranges, which is also indicative of their similarity. These are:

1. the elongate intrusive/extrusive outcrop of the Mt. Lord ignimbrite, and its equivalent in the West Silver Bells. 2. the major fault separating the upthrown Precambrian basement rocks on the north from the Paleozoic through Laramide sequence of sedimentary-volcanic rocks on the down-thrown south side. In the North Silver Bell mountains, this fault is known as the Ragged Mountain Fault. The same structure exists in the West Silver Bell mountains but is un-named.

A third major linear feature is exposed in the North Silver Bell mountains--the Silver Bell alteration zone. The zone is exposed throughout its length in the mountains but dips under the alluvium in the south after weakening and loosing economic mineralization. It can be picked up by geophysics for a short distance before it fades and is lost. The zone to the north of El Tiro pit widens and weakens in intensity of mineralization. Beyond the latitude of the Atlas mine, the structure bends slightly westward, and shearing trends east-west, the zone itself appearing to narrow somewhat as it plunges beneath the alluvium filled valley between the North Silver Bell and West Silver Bell mountains.

This valley between the two mountain ranges is defined by a range-front fault(s). Since this fault(s) passes near the old Silver Bell cemetery it will be called the Cemetery fault for convenience. The Cemetery fault or strands of the fault appear to form the western boundry of the North Silver Bell mountains, Picacho Peak, and the Picacho mountains, to the north. The approximate locus of this fault, as indicated by gravity surveys is shown in Plate 1.

Drilling in the valley, to intersect the northwestern extension of the Silver Bell alteration zone, preformed by ASARCO and others, has only encountered deep alluvium and Tertiary or Quaternary volcanics.

Plate 1 is a sketch map of the Silver Bell mountain area showing the various features described above.

Left-Lateral Movement

As can easily be seen from Plate 1, the linear outcrop of Mount Lord ignimbrite and the Ragged Mt. fault, is truncated by the northeast trending Cemetery fault. When these structures are again seen in the West Silver Bells, they are several miles southeast of their projected locations. This strongly suggests left-lateral movement along the Cemetery fault.

Assuming that the Ragged Mountain fault was a continuous, rather linear feature prior to the left-lateral displacement, the overlay for Plate 1, which re-aligns the two segments of the Ragged Mt. fault was constructed.

It can be seen from this overlay, that when the two segments of the Ragged Mt. Fault are aligned the ignimbrite outcrops of the West Silver Bells fall along the projection of the igimbrite outcrops in the North Silver Bells.

The basins to the southwest of both ranges, (indicated by gravity surveys) and the two ridges of Paleozoic sediments represented by Ka Kohl and Koht Kohl Hills appear to fall in alignment also. Since these features are probably Tertiary or even younger, it suggests the left-lateral movement on the Cemetery fault is fairly recent.

When the northwest trending zone of alteration exposed in the El Tiro Hills in the West Silver Bell mountains, which is covered at either end by alluvium, is moved back to its original(?) position, (see overlay Plate 1), it appears that it may actually be the displaced northern end of the Silver Bell alteration zone. This alignment is not nearly so exact as that of the ignimbrite but it still appears to have some validity. The inferred portion (dotted on the overlay, Plate 1) of the El Tiro alteration is located by the author to fall under cover along the south edge of the West Silver Bell mountains, because no alteration is known to occur in the exposed portion of the range, and yet drawn to correspond roughly to the westerly projection of the Silver Bell alteration zone. This projected locus is purely hypothetical, but was drawn to correspond most closely to the geology previously plotted on Plate 1.

If my inferrences regarding the left-lateral displacement of the West Silver Bell mountains in relation to the North Silver Bell mountains are valid, then exploration for the extension of the Silver Bell alteration zone has been located too far to the north, and exploration beneath the alluvium southeastward along the projection of the El Tiro alteration zone might be more fruitful.

Suggestions for Further Work.

The ideas described above are hypothetical at present. There are no geologic maps of the entire West Silver Bell mountains with adequate detail to compare to geology of the North Silver Bell mountains. The geology of the West Silver Bells plotted on Plate 1 was from my memory of several field trips in the area and therefore is not exact...

The West Silver Bell mountains could therefore be mapped on a scale of 1 inch= 1 mile or greater. The geology could then be more closely compared to that of the North Silver Bells to determine whether the idea of left-lateral offset is really valid. Also several questions, such as whether the alaskite and dacite also exist in the West Silver Bells, could be answered.

If the hypothesis of left-lateral offset appears valid, after this more detailed mapping is complete, then further exploration along the southeastern covered portion of the El Tiro hills alteration zone (the offset portion of the Silver Bell alteration zone) may be indicated.

James A. Briscoe

James A. Briscoe

cc: JHC w/att
WES w/att
DR Jameson w/att
R Edmisten w/att
BN Watson w/att

PLATE 1

EXPLANATION FOR
SKETCH MAP SHOWING THE STRUCTURAL RELATIONSHIP OF THE SILVER BELL AND WEST SILVER BELL MOUNTAINS

Valley fill, outcrop not everywhere shown, but assume that only steep topography is outcrop unless otherwise noted.

Zone of hydrothermal alteration

Mt. Lord ignimbrite

Dacite porphyry

Cretaceous sediments

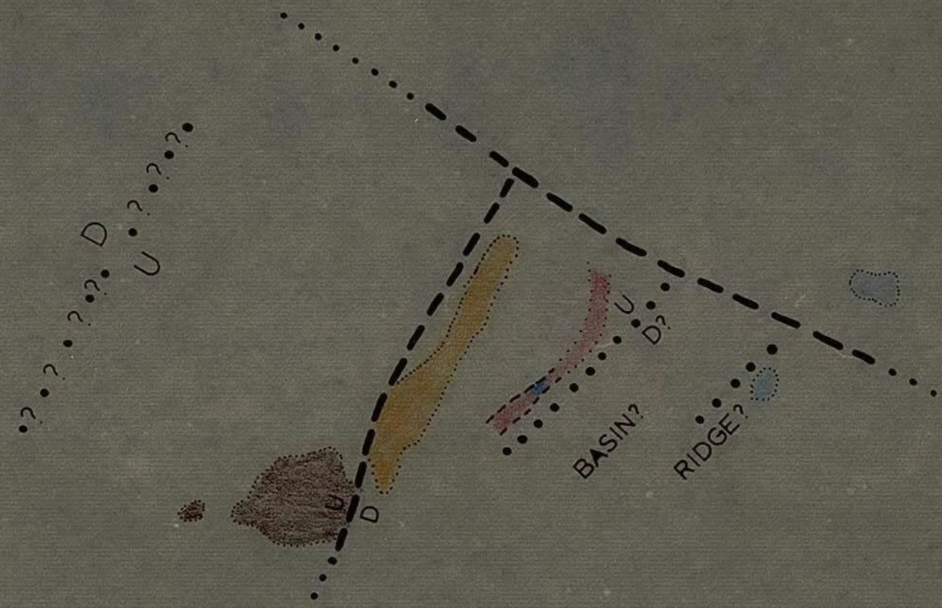
Paleozoic sediments

Precambrian Oracle type granite

Fault -- indicated only by geophysics(gravimetric data), mainly Basin & Range faults of Recent(?) age.

Fault -- not exposed but based on geologic evidence.

Fault -- exposed.


D
U
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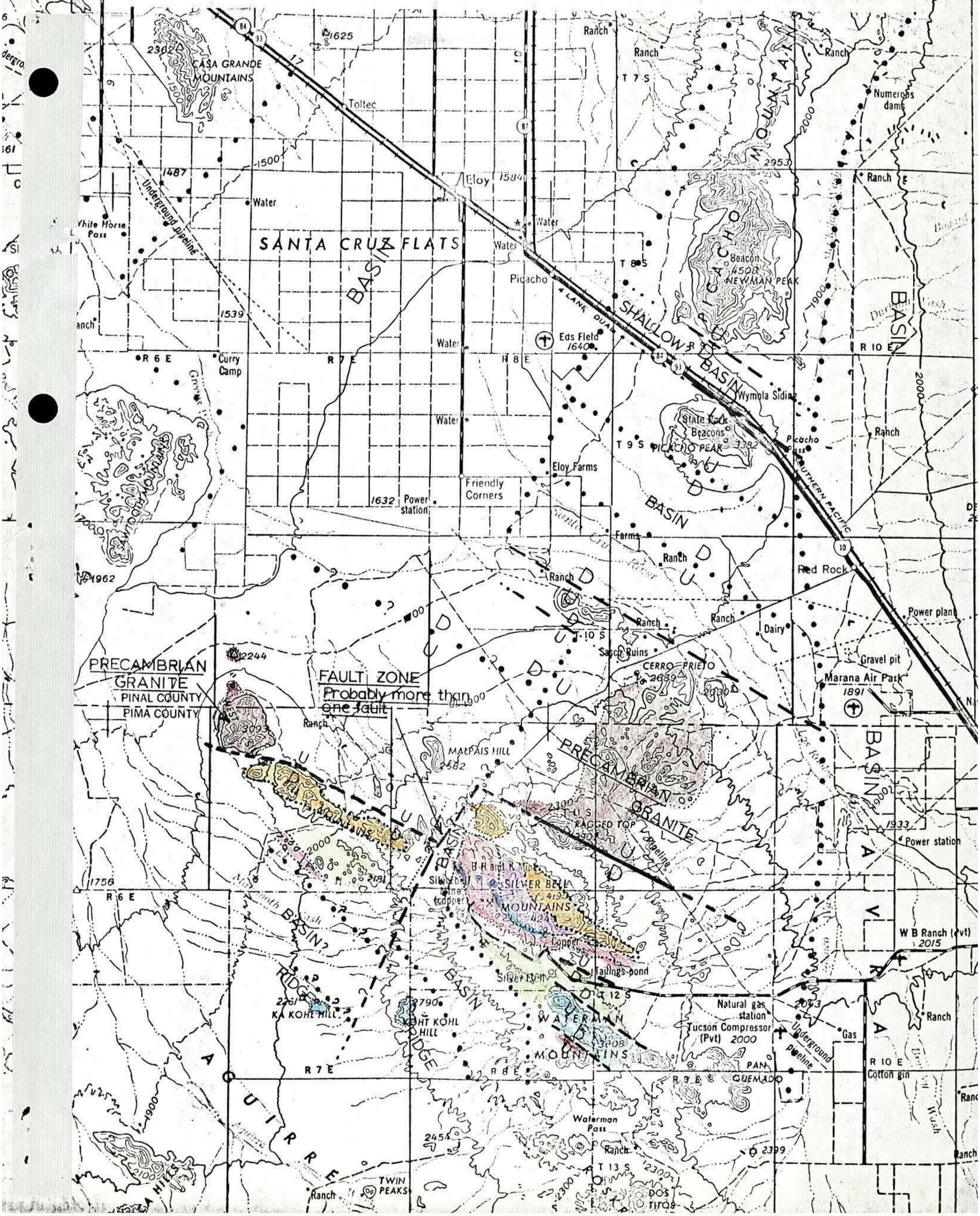
D?
BASIN?
RIDGE?
U
D

SKETCH MAP SHOWING THE STRUCTURAL RELATIONSHIP OF THE SILVER BELL AND WEST SILVER BELL MOUNTAINS



AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

June 27, 1968

Memorandum for Mr. T. A. Snedden:

Silver Bell District
Exploration

During the past few years essentially all the known potential ore-bearing areas in the Silver Bell District have been tested by drilling with the exception of the Danube adit area west of the Oxide pit where drilling has been in progress for the past month.

Prior to terminating the drilling program at Silver Bell, I believe a few deep holes should be put down to explore for possible ore grade primary mineralization at depth beneath the two centers of more intense alteration-mineralization, the Oxide and El Tiro areas.

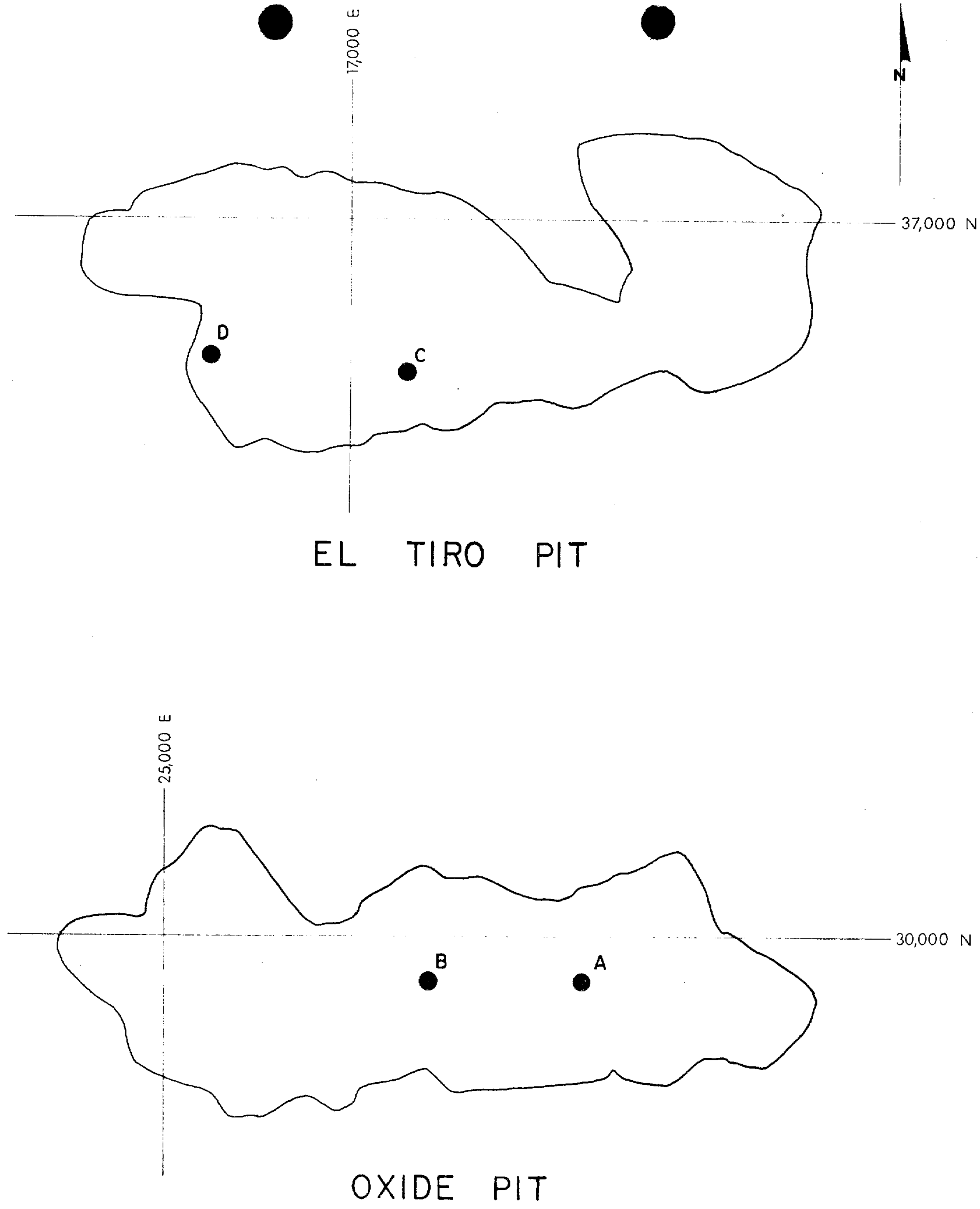
The results of recent alteration studies at Chino and other porphyry copper deposits demonstrate that the better primary copper mineralization usually occurs with potassium feldspar alteration and relative sparse pyrite. Sericitic alteration with less chalcopyrite but strong pyrite tends to form a halo around the low pyrite-high chalcopyrite zone. It is possible that this zoning pattern also exists in the vertical range; that is, the pyrite-sericite halo may coalesce upward, forming a cap over the stronger chalcopyrite mineralization. Thus, in areas where erosion has not been too deep, low grade pyritic mineralization may be underlain by ore-grade primary copper. If, on the other hand, erosion has cut deep into the primary zone, we may be now looking at the roots and should expect copper mineralization to diminish with depth.

In the oxide pit the primary mineralization (.3 to .4% copper) is pyritic with sericite-clay alteration; at El Tiro the primary (.2 to .4% copper) is less pyritic with both sericite and potassium feldspar alteration.

On the attached sketch are shown the proposed locations for two holes in each pit. These positions may be adjusted to minimize interference with mining operations. All four holes should be drilled to 1500'. Continuation of any one hole to a greater depth would depend upon encountering an increase in the primary copper grade in the first 1500'. The maximum depth contemplated should be around 3000'.

J. H. Courtright
J. H. Courtright

JHC:lmi
encl.
cc: JJCollins, w/encl. RBMeen, w/encl.
DRJameson "
WESaegart "



Map Showing Location
of
Proposed Deep Diamond Drill Holes

SILVER BELL
ARIZONA

Scale: 1" = 1,000

J.H.C.

June 1968

JHC —
I am not familiar
with this prospect.
I have commented
by side notes on ~~certain~~
points in Edmistons memo.
JER

J. E. K.

JUL 10 1968

Please return to
JHC before filing
JER

S-10.5

J.E.K.
JUL 10 1968

J.H.C.
JUN 24 1968

AMERICAN SMELTING AND REFINING COMPANY
SILVER BELL UNIT
Silver Bell, Arizona

June 22, 1968

MR. WES, JEK, JRW
READ AND RETURN
PREPARE ANSWERS HANDLE
FILE INITIALS

W.E.S.
JUL 5 1968
J. R. W.
JUL 15 1968

Mr. R. B. Mason, Manager
Southwestern Mining Department
American Smelting and Refining Company
P.O. Box 5795
Tucson, Arizona 85703

SILVER BELL UNIT
MINING ACTIVITY -
EL TIRO AREA

Dear Sir:

Attached for your file and information is a memo by R. C. Edmiston, Resident Geologist, noting renewed mining activity immediately west of El Tiro waste dumps. The mining is being done on the old Gordon Claims. Gordon, as you may remember, tried a very small leaching operation back in the early 1960's and was not able to make it pay.

The area has been turned down by ASARCO geologists and from time to time has been investigated by diamond drilling and sampling by various other groups. In fact, I believe a car or two of non-sulphide copper ore was shipped to the Inspiration Smelter. I did not hear the outcome of this shipment but assume it did not pay as no more shipments were made.

Very truly yours,

Original Signed By
D. R. JAMESON

D. R. JAMESON
Superintendent

DRJ:dms

Attach.

cc: TASnedden w/attach.
JHCourtright "
RCEdmiston wo/attach.

AMERICAN SMELTING AND REFINING COMPANY
SILVER BELL UNIT
Silver Bell, Arizona

June 21, 1968

This is not clear to me. I assume Bob means the Cu values are in bedrock, beginning at the base of alluvium and extending an unknown distance below. JER

MEMORANDUM TO: Mr. D. R. Jameson, Superintendent

Subject: RENEWED ACTIVITY ON CLAIMS ADJACENT TO ASARCO'S CLAIMS WEST OF EL TIRO PIT.

Activity on the Magonigal group of claims, approximately three fourths of a mile west of El Tiro Pit was renewed in May, 1968. At present a large caterpillar (D-8 or D-9) and a wagon drill are being employed to strip overburden and drill shallow holes. I visited this prospect June 20 and collected several rock samples while being shown around by the individual conducting the work. It appears that there is a large shallow blanket of non-sulfides extending from alluvial material down into bedrock. This does not necessarily mean that the alluvium, coming from the direction of El Tiro Pit, was the source of all the mineralization. *If Cu is exotic, where did it come from? JER*

The rocks noted at this prospect are as follows:

1. Alaskite. A rock similar to the alaskite found within El Tiro Pit only containing biotite and being finer grained.

No Cu in samples 1, 2, 3 JER.

2. A dark fine dike rock with some visible mafics.

3. An andesite dike corresponding to the post-mineral andesites found within the zone of alteration.

4. Alluvium containing stratified non-sulfides. *Cu in the alluvium. Is it exotic replacement or detrital grains? Where is the source? JER*

The following information was volunteered by the individual in charge and may or may not be accurate.

1. The deposit extends 3,000 feet in a northwest direction, currently only the top 100-150 feet are being drilled.

2. The claims have been acquired by Canadian interests and a Canadian geologist is in charge.

3. This geologist has studied the published papers on Silver Bell and has attempted to project the NE trending shears from El Tiro to this prospect. (one NW trending fault has been uncovered in a trench.)

4. Geochemical sampling was carried out over the area.

5. The Blue Bird operation is being studied and the Blue Bird group may be invited to join in.

6. The Canadian geologist recognizes the possibilities of a disseminated deposit and may conduct deep drilling after delineating the non-sulfide orebody.

what is Asarcos interpretation? JEK

7. A zone of celestite is supposed to overlay the best non-sulfide values. (The samples of "Celestite" I was shown are highly acid and reactive and look like calcite. Although the operator claimed to have been acid testing the celestite and finding it unreactive.)

R C Edmiston

R. C. Edmiston
Resident Geologist

RCE:jce

cc: RBMean
TASnedden
JHCourtright w/samples.

AMERICAN SMELTING AND REFINING COMPANY
SILVER BELL UNIT
Silver Bell, Arizona

June 22, 1968

Mr. R. B. Meen, Manager
Southwestern Mining Department
American Smelting and Refining Company
P.O. Box 5795
Tucson, Arizona 85703

SILVER BELL UNIT
PROPOSED DIAMOND DRILLING
NORTHWEST SILVER BELL AREA

Dear Sir:

Attached is a memo by R. C. Edmiston, Resident Geologist, outlining diamond drilling to prospect magnetic anomalies located by R. H. Luning in his surveys done in February 1967 and November 1967.

Mr. Luning's report apparently was distributed to Messrs. N. R. Nuttycombe, J. H. Courtright, W. E. Salgart and W. G. Farley. Perhaps Mr. Courtright could furnish you and Mr. Snedden copies for your files.

I agree with Mr. Edmiston that we should test the areas as he has suggested and we are working toward that end now.

Very truly yours,

Original Signed By
D. R. JAMESON

D. R. JAMESON
Superintendent

DRJ:dms

Attach.

cc: TASnedden w/encl.
JHCourtright w/encl.
RCEdmiston w/o encl.

AMERICAN SMELTING AND REFINING COMPANY
SILVER BELL UNIT
Silver Bell, Arizona

June 22, 1968

MEMORANDUM TO: Mr. D. R. Jameson, Superintendent

Subject: PROPOSED DRILLING OF MAGNETIC ANOMALIES, NORTHWEST SILVER BELL AREA

Attached is a copy of Mr. R. H. Luning's report of March 1968 describing seven magnetic anomalies in the area northwest of El Tiro Pit. I agree with Mr. Luning that anomalies number 4, 5 and 6 are large enough to be of interest at this time and recommend the drilling of five diamond drills to a depth of about 600 feet, at a cost of approximately $30,000, to check for sedimentary ore beneath these anomalies. The location of these planned holes as well as the location of all the drill holes in the area and the magnetic anomalies is shown on the attached map. In addition, holes which have penetrated sufficient sedimentary ore to warrant stripping are colored orange, while holes which have penetrated only weakly mineralized sediments are colored purple. (Holes which have not encountered sediments have not been colored on this map.)

Three holes are planned for anomaly number four as this is the largest anomaly and also because DDH No. D234 encountered sedimentary ore at a depth of 502.7 ft. just south of this anomaly. Mr. Luning correctly points out that this anomaly should be drilled first. However, these holes will have to be drilled by a skid mounted drill and it may be that the other two, which can be reached by a truck mounted drill, will be drilled first due to equipment availability.

R. C. Edmiston
Resident Geologist

RCE:dms

Attach.

cc: TASnedden w/o encl.
RBMeen " "
JHCourtright w/o encl.
RHLuning " "

EL PASO ORE TESTING AND ASSAY LABORATORY

El Paso, Texas
May 31, 1968
J. H. C.

JUN 3 1968

Mr. S. A. Anzalone
Denver Office - Exploration Department
American Smelting and Refining Company
5303 East Evans Ave.
Denver, Colorado 80222

Referring to your letter of March 7, 1968 to Mr. G. W. Bossard, we have made the determinations of uranium in the Quiruvilca Unit and Silver Bell Unit precipitation plant feed solutions. Both of these samples contained less than 1.0 ppm. of uranium. The result for the Quiruvilca Unit sample has been reported to Messrs. Williams, Maitrejean, and Marcus under separate cover.

T. D. Henderson, Jr.

cc JJ Collins
JH Courtright ✓
DR Jameson
GW Bossard
DE Crowell
V Kudryk

UPDATING THE GEOLOGY AND STRUCTURAL ORE CONTROLS

AT SILVER BELL, ARIZONA

J.H.C.
JUL 5 1968

by Barry N. Watson
ASARCO Geologist

A talk to be presented to the Mining Geology Division of the Arizona Section of A.I.M.E. on May 20, 1968.

One of the more complete stratigraphic sections in southern Arizona can be pieced together in the Silver Bell area. Much of the geology has been worked out by ASARCO geologists, while a few important areas have been mapped by students as thesis problems. Other portions of the Silver Bell area have yet to be mapped in any kind of detail, and some of this yet-uncharted geology could well be critical to a better understanding of the complex Mesozoic and Cenozoic stratigraphy.

It is my strong belief that a knowledge of certain of the stratigraphic units in the Silver Bell area--their lithologic characters and structural settings--would be of considerable help to field geologists dealing with similar phenomena elsewhere in southern Arizona. Parts of the Silver Bell stratigraphic section are accessible only by washes or somewhat obscure truck trails, and other portions of the section are on, or readily reachable only by passage through, private property owned by ASARCO.

In the following, I will attempt to briefly describe the geologic history of the Silver Bell area, with particular emphasis on the Mesozoic Era. My knowledge of the area has been greatly enhanced through field excursions and conversations with Harold Courtright, Kenyon Richard, Jim Briscoe, Craig Clarke, Chuck Haynes, Nick Nuttycombe, Joy Merz, Fred Graybeal and Dr. Willard Lacy. I must take, however, the responsibility for the interpretations drawn herein.

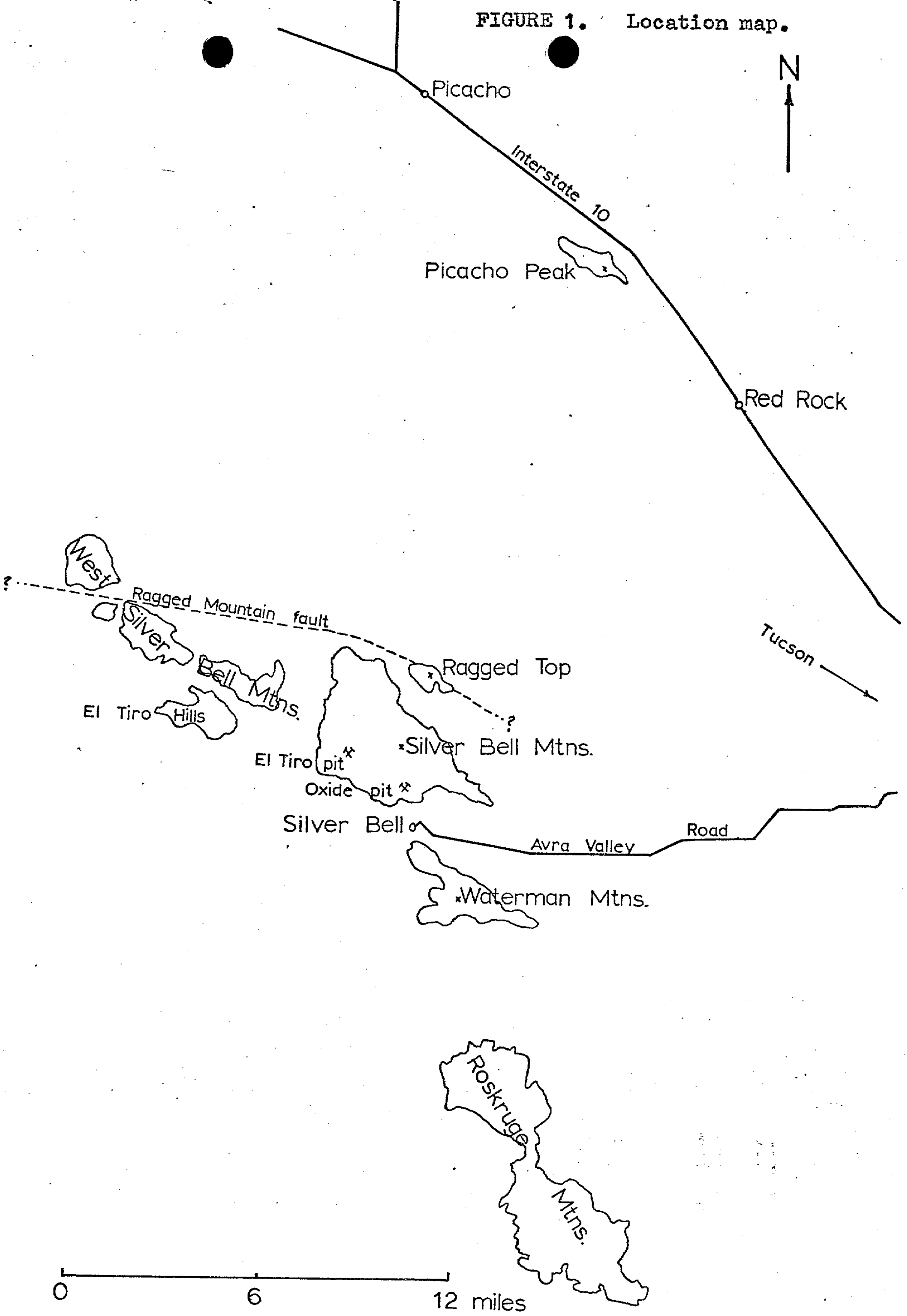
Figure 1 is a location map showing the principal topographic features mentioned below. Figure 2 is my diagrammatic representation of the Silver Bell stratigraphic column.

PRECAMBRIAN

Pinal Schist

The only outcrop of the basement Pinal Schist known to the author in the Silver Bell vicinity straddles the El Paso Natural Gas pipeline road about two miles east of Ragged Top. Relationships with other rock units are obscured by cover, except on the south where the schist is bounded by a mid-Tertiary dike filling the major WNW-trending Ragged Mountain fault.

FIGURE 1. Location map.



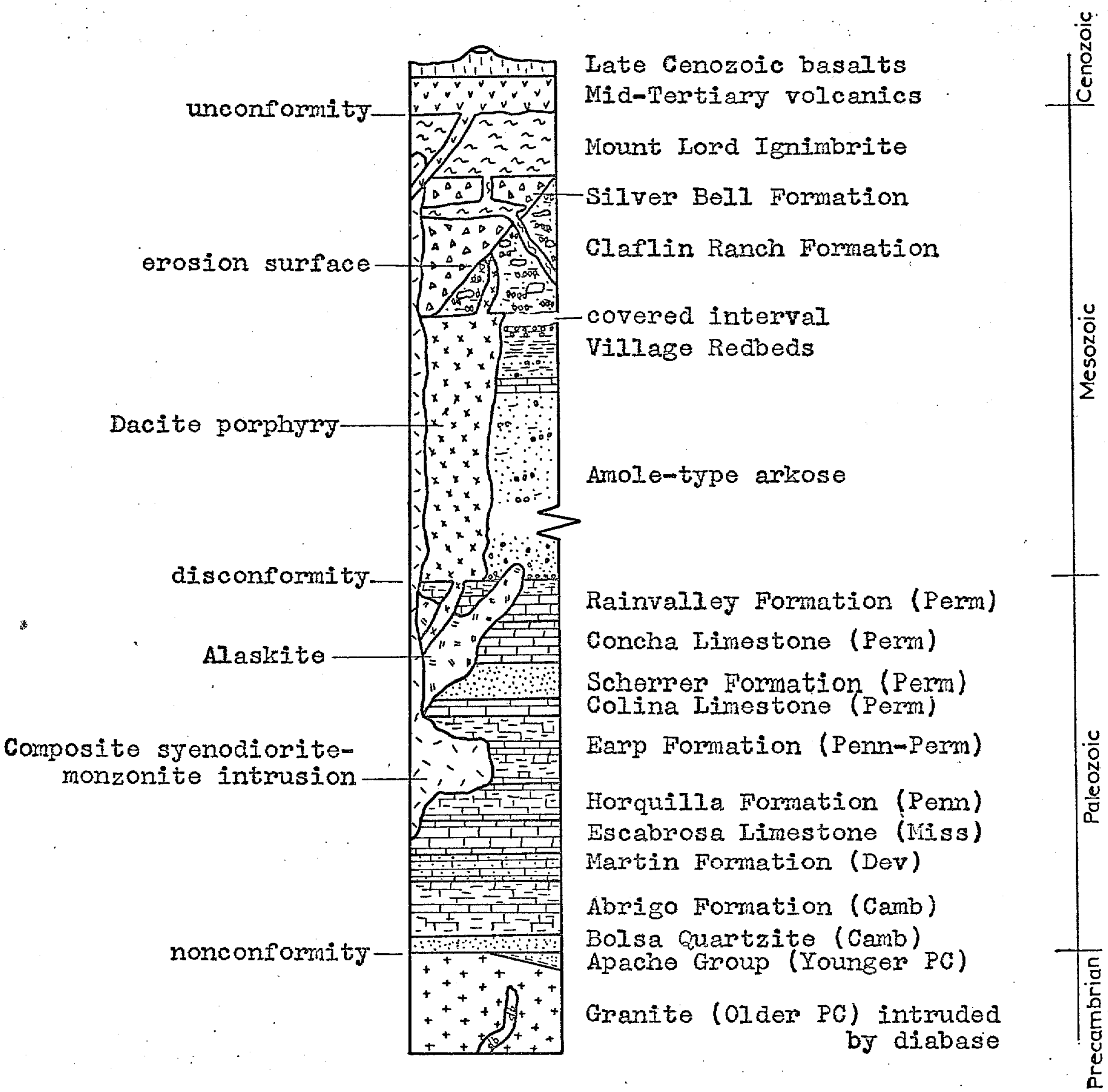


FIGURE 2. Diagrammatic geologic column of the Silver Bell area. Maximum known thicknesses for Paleozoic and Mesozoic rocks are shown. Scale of column: 1"=2000'.

Many fragments (ranging up to boulder size) of Pinal-like schist are seen in Cretaceous sediments just south of Ragged Top, indicating the presence of a considerable area of that schist at the surface in the near vicinity during the Laramide igneous activity.

Granite

A coarse-grained granite is found extensively to the north of the Ragged Mountain fault. Large and numerous quartz grains--frequently.25 inch in diameter--are set among pinkish crystals of feldspar and clumps and books of biotite. In many places orthoclase porphyroblasts up to an inch in length are common. This granite megascopically resembles the Precambrian Oracle granite seen near the town of Oracle.

Paleozoic sediments in the Waterman Mountains southeast of Silver Bell are also underlain by porphyroblastic granite.

Apache Group

Younger Precambrian Apache Group metasediments lie on granite just northeast of Ragged Top. Locally more than 200 feet thick, these south-dipping beds are sharply cut off to the south by the Ragged Top intrusive which wells up along the Ragged Mountain fault. The Apache Group stratigraphy here is not well worked out, but it appears as if a few tens of feet of probable Pioneer Formation (mixed sandy and shaly beds) are overlain by 2-3 feet of Barnes Conglomerate, which is in turn overlain by thin-to moderately thick-bedded quartzites of the Dripping Springs Quartzite.

Apache Group metasediments are missing in the Waterman Mountains where McClymonds (1957) notes Cambrian Bolsa Quartzite to conformably overlie basement granite.

Diabase

Well-altered diabase of possible Precambrian age irregularly intrudes the granite on the northern slopes of Ragged Top. As it is found only within granite, it's relative age cannot be stated with certainty. The principal period of Precambrian diabase intrusion in southern and central Arizona is post-Apache Group.

PALEOZOIC ERA

The Paleozoic stratigraphy of the Waterman Mountains has been deciphered by McClymonds (1957) and Ruff (1951) who mapped a well-faulted pile of limestones, quartzites, siltstones, and shales amounting to a thickness of 4,400+ feet. In the Silver Bell Mountains, Paleozoic stratigraphy was unravelled by Kingsbury, Entwistle and Schmitt in 1941 in a private report to the American Smelting and Refining Co. Merz (1967) undertook the difficult study of the altered and mineralized Paleozoic sediments on Union Ridge east of ASARCO's El Tiro pit. The alteration and mineralization of these Union Ridge sediments will be described in the next paper this morning.

The Paleozoic section in the Silver Bell Mountains is well faulted, locally intensely altered, and generally inundated by various Laramide intrusive units. Although each of the Paleozoic periods represented in the Waterman Mountains also show in the Silver Bell range, the section in the latter is obviously incomplete. A brief tabulation of units with thickness estimates is presented below:

Permian quartzites, limestones, shales..	550 ft. approx.
Pennsylvanian Horquilla Limestone.......	220 ft. max.
Mississippian Escabrosa Limestone.......	275 ft. max.
Devonian Martin Formation..............	300 ft. max.
Cambrian Abrigo Formation..............	430 ft. max.
Cambrian Bolsa Quartzite...............	230 ft. min.
Total.....	2,005± ft.

In the El Tiro Hills section of the West Silver Bell Mountains, Clarke (1965) mapped 1,200+ feet of uppermost Permian sediments. Approximately 300 feet of quartzites and dolomitic limestones belonging to the Scherrer Formation are overlain by ±420 feet of Concha Formation Limestone and ±550 feet of Rainvalley Formation limestone and argillite. These Permian rocks protrude from alluvial cover and are overlain by Mesozoic sediments.

MESOZOIC ERA

Amole-type arkose

A clearly exposed contact between Mesozoic and Paleozoic sediments is found in the El Tiro Hills where Clarke (1965) has mapped an estimated 5,000+ feet of probable Cretaceous Amole-type sediments overlying Permian Rainvalley rocks. The basal Amole-type units, lying on a disconformity, is a massive arkosic conglomerate containing rounded quartzite cobbles up to several inches in diameter. This unit of the Cretaceous (?) is several feet thick; the remainder is generally more thinly bedded.

Hayes and Drewes (1968) consider the Amole Arkose of the Tucson Mountains to be more or less a time-equivalent of the lower Middle Cretaceous Bisbee Group sediments. If the Amole-type materials in the El Tiro Hills can be considered correlative with the Amole Arkose, then Clarke's basal quartzite pebble conglomerate qualifies as a far-western equivalent of the basal Bisbee Glance Conglomerate. The presence of Cretaceous (?) beds lying disconformably on the uppermost Permian Rainvalley certainly suggests that the Silver Bell area did not experience, at least locally, the degree of structural unrest manifested farther to the east.

Another interpretation suggested by the near-conformable nature of the Paleozoic-Mesozoic contact related to recent U.S. Geological Survey recognition of Triassic sediments in southern Arizona. Possibly the hiatus between Permian and Mesozoic deposition is not as great as might be thought, and the lowermost Amole-type sediments are of Triassic age?

A few tuffaceous beds are scattered through the Amole-type arkoses, indicating periodic volcanic activity in the general region. Red-colored shales and conglomerates are found here and there through the sequence and are most prevalent in the upper portions. A 20-30-foot thick sandy limestone occurs near the top of the exposed older Cretaceous beds.

The Amole-type sediments are overlain in angular unconformity by interbedded tuffs and coarse clastic sediments of the Claflin Ranch-type. A similar mid-to late Cretaceous unconformity has been noted elsewhere across southeastern Arizona. It is felt that this unconformity reflects initial upheaval related to Laramide deformation.

Amole-type arkoses, conglomerates and sandstones also crop out in the valley between the Waterman and Silver Bell Mountains. Immediately overlying the arkoses near the southeast corner of the older Silver Bell tailings dam is a limestone unit probably exceeding 200 feet in thickness. Donald Bryant of the University of Arizona was able to identify recrystalized pelecypods here as of definite Cretaceous age. Outside of the Bisbee Group Mural Limestone, this localized unit is probably the thickest Cretaceous limestone known in southcentral Arizona.

Village Redbeds and red conglomerates

A sequence of red-colored clastics is found overlying the limestone unit and Amole-type arkoses south of the Silver Bell tailings dams. These clastics, which also underlie Silver Bell village, are locally several hundreds of feet thick, but faulting and alluvial cover prevent thickness determinations. The author originally considered this unit to be an equivalent of the Recreation Redbeds of the Tucson Mountains. However, detailed mapping plus radiometric age-dating have recently proven the Recreation Redbeds to be of pre-Amole age, and evidence is now overwhelming that red coloration represents restricted environmental conditions that could, and do, appear at various times throughout the Mesozoic. Consequently, I am here designating the Cretaceous redbeds and red conglomerates near the Silver Bell townsite the "Village Redbeds".

In places redbeds and light-colored Amole-type arkoses are found interbedded, suggesting a somewhat gradual transition from the Amole to the Village environment. Several hundred feet of red silts, sands and arkoses occur in the lower portions of the Village Redbeds and are seen to grade upward to red conglomerates. At first these conglomerates contain only sedimentary detritus. Higher in the sequence igneous materials begin to appear, however, and in the uppermost known portions the red conglomerate consists almost entirely of purple andesitic fragments set in a detrital matrix. Deformation of an ancient Silver Bell landscape and a gradual increase in volcanic activity is readily evidenced in the continuing deposition of the redbeds and red conglomerates. Thus the transition from normal Cretaceous subaerial sedimentation to coarse and rapid Laramide accumulation is not always marked by an obvious stratigraphic break.

The Village red conglomerates are cut off by a major WNW-trending fault in the tailing pond area, and their relation to overlying units is not presently known.

Claflin Ranch Formation

The Claflin Ranch Formation is something of a catch-all term, and the rocks it represents are not limited to any one specific time of deposition. The formation represents a type of sedimentation associated with a terrane undergoing volcanic upheaval and rapid erosional deformation. Thus, in the Silver Bell Mountains where Richard and Courtright first used the name (1960), the conglomerates, mudflows, landslide blocks, aeolian tuffs, water-lain tuffs and pyroclastic layers included within the Claflin Ranch Formation have ambiguous relationships with associated volcanic units. They are pre-dacite and post-dacite, pre-Silver Bell andesite and post-Silver Bell andesite. In the West Silver Bell Mountains Claflin-like conglomerates are interbedded with pyroclastics and overlie earlier Cretaceous sediments by angular unconformity.

The thickest continuous Claflin Ranch sequence in the Silver Bell Mountains--approximately 1800 feet--occurs southwest of Ragged Top. This accumulation is, at least in good part, pre-dacite porphyry (the earliest of the Laramide volcanic and sub-volcanic rocks in the Silver Bell range). Coarse, greenish clastic materials megascopically identical with parts of the Claflin Ranch Formation are found as a matrix of the Tucson Mountain Chaos in the Tucson Mountains. Claflin Ranch-type rocks also are seen in roadcuts north of Sonoita along Arizona State Highway 83.

It seems reasonable to expect that the Claflin Ranch-type of surface accumulation of detrital and volcanic debris might be found throughout southern Arizona wherever Laramide volcanic piles exist. Such depositional sequences--seemingly thickest in earlier Laramide time--would run the gamut from fairly thin-bedded sands to chaotic masses of landslide-block accumulations.

Alaskite

Richard and Courtright (1966), in accounting for the WNW-striking zone of alteration at Silver Bell, conclude that "indirect evidence suggests a fault representing a line of profound structural weakness existed in this position prior to the advent of Laramide intrusive activity." This line is referred to as the "major structure." They go on to note that this major structure "was largely obliterated by the Laramide intrusive bodies, but it effected a degree of control on their emplacement, as evidenced by their shapes and positions."

The first indication of activity along the Silver Bell fault zone came in early Laramide time with the intrusion of a coarsely granitoid alaskite along the southwest side of the major structure. This alaskite, which contains a very low ferromagnesian mineral content, intrudes Paleozoic sediments and Cretaceous Amole-type arkoses in the El Tiro area. Aplite dikes are found through the alaskite, and, locally, fine-grained border phases of alaskite are found in contact with other rock units.

The alaskite is one of the principal hosts for the later porphyry copper mineralization. This coarse-grained felsic rock locally shows high chalcopyrite-to-pyrite ratios.

Dacite porphyry

The dacite porphyry is a sub-volcanic rock characterized by numerous rounded or triangular quartz "eyes" set in a very fine-grained matrix. Orthoclase and sanidine phenocrysts, vague but consistent flow structure, and up to 20% of xenoliths are also commonly seen. Chemically, the dacite porphyry is more accurately a quartz latite porphyry.

The dacite occurs extensively northeast of the major structure in the form of sills and dikes within Paleozoic and Mesozoic sediments. The largest body of the porphyry--a sill ± 3,400 feet thick--occupies the stratigraphic interval in the Silver Bell range proper where Amole-type arkose should occur. This sill is floored by Paleozoic sediments and roofed by an 1800-foot sequence of Claflin Ranch materials. The dacite-Claflin Ranch contact is gradational over several feet, but dikes of dacite porphyry are found locally in the overlying Claflin Ranch beds.

An explosive history for the dacite porphyry is strongly suggested by the numerous xenoliths, the large fragments of quartz, and the shards of former glass in the matrix. The nature of the rock is believed to reflect an emplacement by fluidization in the following manner:

The gas-and fragment-charged dacite porphyry magma (actually quartz latite in composition, suggesting greater viscosity and more explosive potential) rose along the Silver Bell fault zone into Paleozoic strata. The higher the porphyry magma ascended, the more the confining pressure decreased, causing exsolution of gases and thus lending an explosive and dilative nature to the intrusive material.

Its extension to the southwest blocked by the large body of alaskite, the dacite porphyry welled up, sending small dikes and sills northeastward into the Paleozoic beds. Damp Amole-type Cretaceous (?) sediments were reached and more gas evolved. The magmatic material, expanding constantly, spread laterally to the northeast in the weak Cretaceous (?) sediments. Dilation occurred, as did the incorporation of fragments broken by churning gas action.

The dacite porphyry probably surfaced in one or more places, venting gases as it did. Gas also escaped laterally through the just-formed sill and vertically into overlying Claflin Ranch sediments. The heat and vapor action altered the immediately overlying quartzo-felspathic clastic sediments, giving rise to the gradational contact seen today.

The dacite porphyry was a poor host rock for porphyry copper mineralization because of its flinty, "tight" nature.

Silver Bell Formation

The Silver Bell Formation (Richard and Courtright, 1960) consists of laharic, autobrecciated, and intrusive andesitic to dacitic breccias, andesitic to dacitic flows, and andesitic intrusions. These materials overlie Claflin Ranch sediments and dacite porphyry in the Silver Bell Mountains. The rugged nature of the basal Silver Bell contact and the fact that it locally lies on unroofed dacite porphyry points to a period of rapid uplift and erosion following intrusion of the dacite porphyry sills.

Purplish Silver Bell-type breccias are seen to be interlayered in places with overlying Mount Lord Ignimbrite. Such a transition from andesitic activity to more felsic and explosive volcanism is seen throughout the world and is commonplace in the Laramide rocks of southern Arizona and southwestern New Mexico.

It is believed that the Silver Bell Formation is roughly correlative with the Demetrie Formation of the Sierrita Mountains, the Picacho Peak volcanics (Briscoe, 1967), the Owl Head volcanics, and that portion of the Cloudburst Formation north and east of the San Manuel mine.

Mount Lord Ignimbrite

A welded ignimbrite lithologically similar to, and stratigraphically a time-equivalent of, the Cat Mountain Rhyolite of the Tucson Mountains overlies the Silver Bell Formation in the Silver Bell Mountains. This quartz latitic ignimbrite is up to 800 feet thick, including an 80-foot thick cap of lithic vitric tuff. As Silver Bell Peak was formerly known to residents of the area as "Mount Lord" and since the peak is composed of the pyroclastic unit, the name "Mount Lord Ignimbrite" has been given to this Cat Mountain-type unit.

Intrusive ignimbrites--genetically related to the Mount Lord Ignimbrite, and megascopically and petrographically identical with it--occur as dikes and sills in the underlying Silver Bell Formation and dacite porphyry. These feeder materials once en route to the surface spread along bedding and formational contacts, apparently when vents became choked.

The Cat Mountain Rhyolite of the Tucson Mountains evinces an average age of 68 million years (Damon, 1968), and it is felt that the Mount Lord Ignimbrite is of similar age.

Syenodiorite porphyry

The syenodiorite porphyry is an early and somewhat extensive pyroxene-bearing phase of the composite intrusive thought to be related to the copper mineralization at Silver Bell. Later phases of this composite intrusive are monzonitic and quartz monzonitic. The syenodiorite porphyry is found principally in the southeastern portion of the Silver Bell Mountains. It occurs as massive bodies in Oxide pit (where it was previously called both "andesite" and "dacite") and east of Oxide pit along the major structure, and is found as east-trending dikes north of Oxide pit in the mountain range.

The syenodiorite porphyry is the best host rock in Oxide pit. It shows the highest primary copper sulfide content of any of the igenous rocks at Silver Bell and has allowed precipitation of a substantial chalcocite blanket.

Only occasional dikes of syenodiorite porphyry are seen in El Tiro pit.

Monzonite porphyry

The later monzonitic and quartz monzonitic phases of the composite intrusion are found as massive bodies scattered along the major structure. They occur also as generally east-trending dikes in the mountain range to the northeast of the major structure.

The principal porphyry copper mineralization followed emplacement of the monzonite porphyry, and a zone of alteration was superimposed on the major structure. K-Ar age-dating (Mauger, Damon and Giletti, 1965) has shown that the solidification of the monzonite porphyry and the subsequent hydrothermal alteration occurred at approximately 65 million years and within a short enough time span so that, considering the limits of error of the age-dates, the two events are radiometrically indistinguishable. I do not mean to imply here that the Silver Bell deposits are to any great extent syngenetic as has been suggested recently (Mauger, 1966). It may be that a small amount of chalcopyrite became trapped as discrete grains in the monzonite magma at the time of solidification. The great preponderance of copper mineralization, however, was emplaced in the various host rocks through veins, veinlets, and hairline fractures with values diffusing into wallrocks, possibly with the aid of a certain amount of igneous rock recrystallization.

It is interesting to note that both the Oxide and El Tiro orebodies occur at structural intersections (see Figure 3). Oxide pit is located at the junction of the WNW-trending major structure with an ENE-trending swarm of syenodiorite and monzonite porphyry dikes. Similarly, El Tiro pit exists at the junction of the major structure with a northeast-trending swarm of monzonite porphyry dikes.

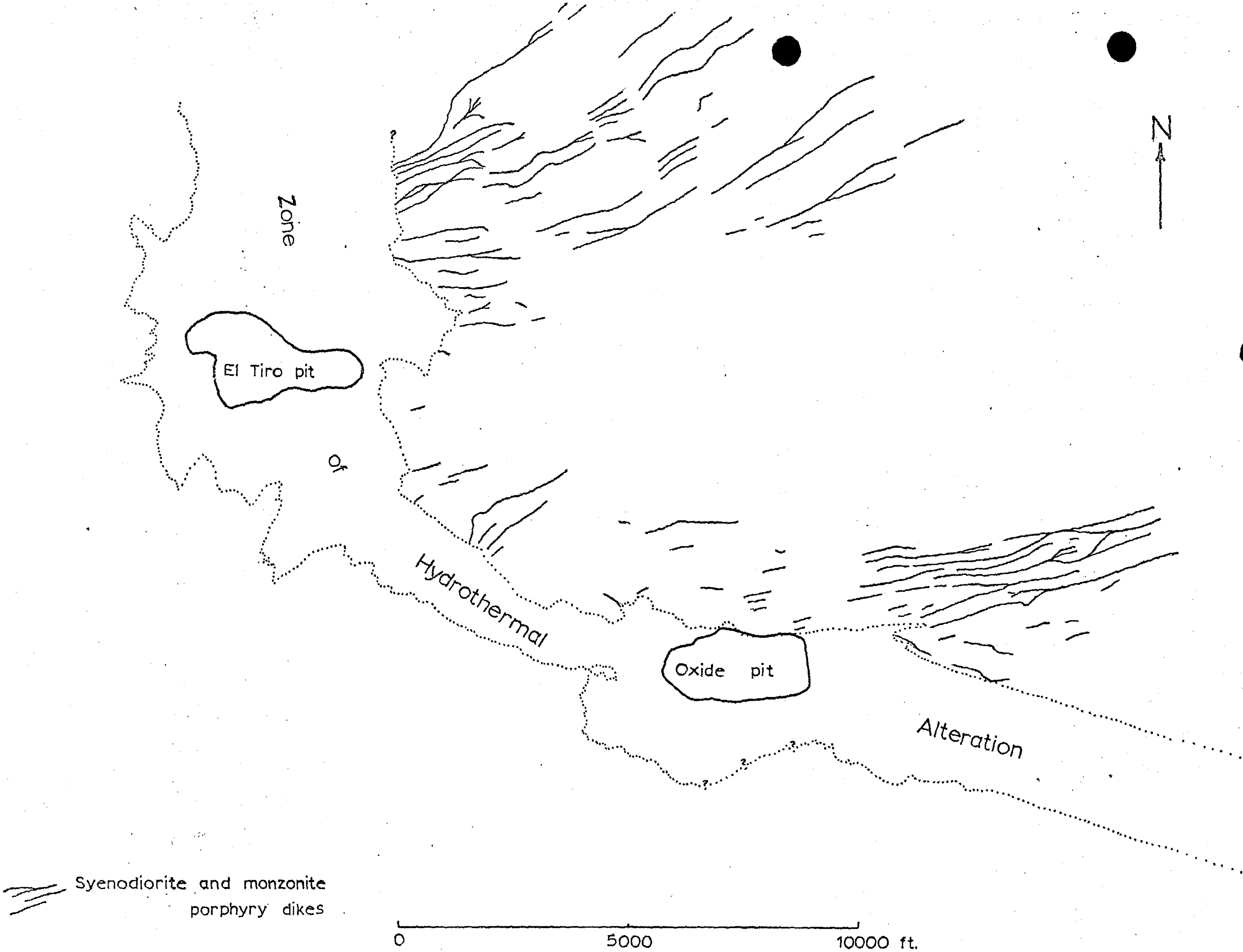


FIGURE 3. Dike swarms related to mineralization at Silver Bell

B. Watson

CENOZOIC ERA

It is preferred here to set the Mesozoic-Cenozoic time boundary at 63 million years as defined by Folinsbee, Baadsgaard, and Lipson (1961). This allows the Silver Bell mineralization to fall at the end of the Cretaceous Period.

Regional northeasterly tilting of 20°-30° occurred sometime between the emplacement of the composite Laramide intrusion and the mid-Tertiary volcanism. It probably was a result of late Laramide upheaval. This tilting, shown by the present orientation of Laramide depositional units, appears to have taken place by rotation of WNW-elongate, fault-bounded blocks in the Silver Bell area.

The mineralized rocks at Silver Bell were exposed to weathering and probably supergene enrichment in early Tertiary time. This is strongly suggested 3 miles east of Oxide pit where pieces of leached capping were found in a conglomerate immediately underlying an andesite flow dated at 28 million years (Damon and Mauger, 1966). A mid-Tertiary period of rhyolitic to andesitic volcanism evinced widely over southern Arizona probably covered and thus preserved the Silver Bell mineralization. This mineralization has been exhumed in more recent times and is presently undergoing destruction through weathering processes.

North-northwest-trending quartz latite porphyry and andesite porphyry dikes of the mid-Tertiary volcanic epoch cut all earlier rock units in the Silver Bell Mountains. The quartz latite dikes have a strangely discontinuous line of outcrop which is caused not by faulting, as has been previously suggested by Schmitt (1941), but by intrusion into a very broken and faulted terrane. A few of the andesite porphyry dikes are conspicuous in El Tiro pit where they are locally collectors of green copper oxide.

The Ragged Top Latite Porphyry dated at 25±1.0 million years (Mauger, Damon and Giletti, 1965) intruded the prominent Ragged Mountain fault which had dropped Laramide rocks on the south some 5,000-7,000 feet against Precambrian granite. Andesitic and rhyolitic flows of probably similar age are seen several miles west of Ragged Top in the northeastern part of the West Silver Bell Mountains.

A late and minor lead-silver-copper mineralization is found in the Silver Bell range. North-trending epithermal veins carrying galena, native silver and cerargyrite with a barite-quartz-calcite-fluorite gangue were mined in the early days. Copper stain is seen on the old dumps. This later period of mineralization has been superimposed very locally on the porphyry copper deposits to the south. On the other hand, a mid-Tertiary quartz latite porphyry dike cuts one of the epithermal veins, thus establishing a general minimum date to this mineralization.

Quaternary-Tertiary basalt cones and flows are found north of the Ragged Mountain fault.

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AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

JHC file

May 16, 1968

J.H.C.
AUG 22 1968

TO: Mr. J.H. Courtright

FROM: Mr. J.A. Briscoe

Evidence of left-lateral offset between the North Silver Bell and West Silver Bell Mountains Pima County, Arizona

Summary and Conclusion:

Although the North Silver Bell and the West Silver Bell Mountains are separated topographically the similarity of the geology of the two ranges suggest they are genetically related. They are separated topographically by a northeast trending basin and range type fault(s) which passes through the valley west of the B S & K (Atlas) mine, probably near the old Silver Bell cemetery. For convenience, this fault is called the Cemetery fault in this report.

Several northwest trending linear features are present in the North Silver Bell Mountains, these being:

1. the Ragged Mountain Fault
2. the linear intrusive-extrusive outcrop of the Mount Lord ignimbrite and
3. the Silver Bell alteration zone

Two of these features--the Ragged Mountain fault and the linear intrusive--extrusive outcrop of the Mt. Lord ignimbrite--can be identified in the West Silver Bell Mountains. These features aren't aligned with the same features exposed in the North Silver Bells, however, but appear to be offset to the southwest two and one half to three miles along the Cemetery fault.

When the Ragged Mountain fault in the West Silver Bells is realigned with the fault in the North Silver Bells the linear outcrops of the Mount Lord ignimbrite in both ranges also fall in alignment (see overlay Plate 1). In addition, the weak northwest trending zone of alteration in the El Tiro Hills in the West Silver Bells comes close to aligning with the Silver Bell alteration zone. It is therefore proposed that the El Tiro alteration zone exposed in the West Silver Bell Mountains is actually an offset portion of the northern end of the Silver Bell alteration zone!

Exploration for the extension of the Silver Bell alteration zone beyond the Atlas mine area should therefore be concentrated in the alluvium covered area southeast of the El Tiro Hills mine of the West Silver Bell mountains, rather than in the area northwest of the Atlas Mine as has been done without success in the past.

EVIDENCE OF LEFT LATERAL OFFSET BETWEEN THE NORTH SILVER BELL MOUNTAINS AND THE WEST SILVER BELL MOUNTAINS, PIMA COUNTY, ARIZONA

Linear Features Common to the North Silver Bell and West Silver Bell Mountains.

A comparison of the geology of the North Silver Bell and West Silver Bell mountains shows that, although they are topographically separated into two ranges, they are genetically related and are composed of approximately the same rock types.

Two major linear geologic features are present in both ranges, which is also indicative of their similarity. These are:

1. the elongate intrusive/extrusive outcrop of the Mt. Lord ignimbrite, and its equivalent in the West Silver Bells. 2. the major fault separating the upthrown Precambrian basement rocks on the north from the Paleozoic through Laramide sequence of sedimentary-volcanic rocks on the down-thrown south side. In the North Silver Bell mountains, this fault is known as the Ragged Mountain Fault. The same structure exists in the West Silver Bell mountains but is un-named.

A third major linear feature is exposed in the North Silver Bell mountains--the Silver Bell alteration zone. The zone is exposed throughout its length in the mountains but dips under the alluvium in the south after weakening and loosing economic mineralization. It can be picked up by geophysics for a short distance before it fades and is lost. The zone to the north of El Tiro pit widens and weakens in intensity of mineralization. Beyond the latitude of the Atlas mine, the structure bends slightly westward, and shearing trends east-west, the zone itself appearing to narrow somewhat as it plunges beneath the alluvium filled valley between the North Silver Bell and West Silver Bell mountains.

This valley between the two mountain ranges is defined by a range-front fault(s). Since this fault(s) passes near the old Silver Bell cemetery it will be called the Cemetery fault for convenience. The Cemetery fault or strands of the fault appear to form the western boundry of the North Silver Bell mountains, Picacho Peak, and the Picacho mountains, to the north. The approximate locus of this fault, as indicated by gravity surveys is shown in Plate 1.

Drilling in the valley, to intersect the northwestern extension of the Silver Bell alteration zone, preformed by ASARCO and others, has only encountered deep alluvium and Tertiary or Quaternary volcanics.

Plate 1 is a sketch map of the Silver Bell mountain area showing the various features described above.

Left-Lateral Movement

As can easily be seen from Plate 1, the linear outcrop of Mount Lord ignimbrite and the Ragged Mt. fault, is truncated by the northeast trending Cemetery fault. When these structures are again seen in the West Silver Bells, they are several miles southeast of their projected locations. This strongly suggests left-lateral movement along the Cemetery fault.

Assuming that the Ragged Mountain fault was a continuous, rather linear feature prior to the left-lateral displacement, the overlay for Plate 1, which re-aligns the two segments of the Ragged Mt. fault was constructed.

It can be seen from this overlay, that when the two segments of the Ragged Mt. Fault are aligned the ignimbrite outcrops of the West Silver Bells fall along the projection of the igimbrite outcrops in the North Silver Bells.

The basins to the southwest of both ranges, (indicated by gravity surveys) and the two ridges of Paleozoic sediments represented by Ka Kohl and Koht Kohl Hills appear to fall in alignment also. Since these features are probably Tertiary or even younger, it suggests the left-lateral movement on the Cemetery fault is fairly recent.

When the northwest trending zone of alteration exposed in the El Tiro Hills in the West Silver Bell mountains, which is covered at either end by alluvium, is moved back to its original(?) position, (see overlay Plate 1), it appears that it may actually be the displaced northern end of the Silver Bell alteration zone. This alignment is not nearly so exact as that of the ignimbrite but it still appears to have some validity. The inferred portion (dotted on the overlay, Plate 1) of the El Tiro alteration is located by the author to fall under cover along the south edge of the West Silver Bell mountains, because no alteration is known to occur in the exposed portion of the range, and yet drawn to correspond roughly to the westerly projection of the Silver Bell alteration zone. This projected locus is purely hypothetical, but was drawn to correspond most closely to the geology previously plotted on Plate 1.

If my inferrences regarding the left-lateral displacement of the West Silver Bell mountains in relation to the North Silver Bell mountains are valid, then exploration for the extension of the Silver Bell alteration zone has been located too far to the north, and exploration beneath the alluvium southeastward along the projection of the El Tiro alteration zone might be more fruitful.

Suggestions for Further Work.

The ideas described above are hypothetical at present. There are no geologic maps of the entire West Silver Bell mountains with adequate detail to compare to geology of the North Silver Bell mountains. The geology of the West Silver Bells plotted on Plate 1 was from my memory of several field trips in the area and therefore is not exact...

The West Silver Bell mountains could therefore be mapped on a scale of 1 inch= 1 mile or greater. The geology could then be more closely compared to that of the North Silver Bells to determine whether the idea of left-lateral offset is really valid. Also several questions, such as whether the alaskite and dacite also exist in the West Silver Bells, could be answered.

If the hypothesis of left-lateral offset appears valid, after this more detailed mapping is complete, then further exploration along the southeastern covered portion of the El Tiro hills alteration zone (the offset portion of the Silver Bell alteration zone) may be indicated.

James A. Briscoe

cc: JHC w/att
WES w/att
DR Jameson w/att
R Edmisten w/att
BN Watson w/att

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

May 15, 1968

MR. W.E.S.

READ AND RETURN

PREPARE ANSWERS HANDLE

FILE ✓ INITIALS

W.E.S. JUL 5 1968

J. H. C.

JUL 1 1968

Mr. Bob Edmiston
Resident Geologist
Silver Bell Unit
ASARCO
Silver Bell, ~~Arizona~~

Dear ~~Bob~~:

Regarding our conversation last week as to the origin and the meaning of the terms tactite and hornfels, these terms were first used and defined by Steve Von Faye in his April 11, 1960 report on the Imperial area. These definitions can be found on page 9 of that report and are as follows:

> "Hornfels-a fine textured rock consisting of varied proportions of lime silicates such as diopside, epidote, chlorite, feldspar, and quartz along with occasional garnet. It is derived from shales or thin-bedded argilaceous limestones and from mudstones or siltstones.
>
> Tactite- is a medium textured rock composed of a number of lime silicate minerals with predominant garnet.
>
> GARNET ~~Granet~~ Rock- represents a replacement of limestone by massive granular garnet."

Steve also related these various alteration phases to intensity of alteration and noted that "Marble would indicate weak alteration, hornfels indicating weak to strong, and tactite and garnet indicating strong alteration."

Most importantly he noted that "garnet rock and the various hornfel tactite types reflect different stratigraphic units in a broad sense, however, locally they are mingled with individual units."

Considering Steve's definition of hornfels and tactite and marble as relating to different original sedimentary rock type, I think it is important to keep delineating these various units in the pit mapping. I do agree, however, that the differentiation between the garnet rich hornfels and tactite has been arbitrary in many places. Your idea of standardization of these terms is certainly a good one. Maybe this could be done by collecting representative samples of each rock type and filing them for future reference. With these type samples on file, future geologists at the unit would always be able to relate the terms hornfels and tactite to a specific alteration facies or mapable unit.

Hope these observations will be of some help to you in your new job as Resident Geologist (Congratulations by the way).

Say hello to all the guys in the office. Be seeing you in a few days.

Sincerely,

Jim Briscoe

JB:ir
cc: JH Courtright

WES, BAW /S-1.1 JAB

MR. JAB

READ AND RETURN

PREPARE ANSWERS ____ HANDLE ____

FILE ____ INITIALS ____

J. H. C.

MAR 7 1968

AMERICAN SMELTING AND REFINING COMPANY
SILVER BELL UNIT
Silver Bell, Arizona

March 6, 1968

W.E.S.
MAR 13 1968

Mr. R. B. Meen, Manager
Southwestern Mining Department
American Smelting and Refining Company
P.O. Box 5795
Tucson, Arizona 85703

<u>SILVER BELL UNIT</u>
<u>PROPOSED DEEP DRILLING IN NORTH EL TIRO HILL AREA</u>

Dear Sir:

Attached is a report by N. R. Nuttycombe summarizing the available knowledge of the geology and mineralization near the Daisy Shaft and in particular what he calls the North El Tiro Hill area.

It has been the contention of the geologists that there are sediments underlying the igneous rocks in El Tiro and in places these sediments could be mineralized sufficiently to be considered ore. Four diamond drill holes northwest of the Daisy Shaft bear this out. Churn drill holes east and northeast of the Daisy Shaft indicated that the sediments continued under the alaskite to the south, however, the holes were too shallow to prove that the mineralization continued.

I agree with Mr. Nuttycombe's proposed drilling program to test for ore mineralization in the sediments, however, I would like Mr. Harold Courtright's comments and your approval before going any deeper into the project.

Very truly yours,

Original Signed By
D. R. JAMESON

D. R. JAMESON
Superintendent

DRJ:dms

Attach.

cc: TASnedden w/attach.
JHCourtright w/attach.

AMERICAN SMELTING AND REFINING COMPANY
SILVER BELL UNIT
Silver Bell, Arizona

February 21, 1968

MEMORANDUM TO: Mr. D. R. Jameson, Superintendent

Subject: EVALUATION OF SEDIMENTARY ORE POSSIBILITIES IN THE NORTH EL TIRO HILL AREA, SILVER BELL, ARIZONA

PURPOSE

The purpose of this report is to compile all the information that is now available on the North El Tiro Hill area and using this information as a basis recommend additional deep drilling considered necessary for a complete and satisfactory evaulation of deep sedimentary ore in the area.

INTRODUCTION

In the Spring of 1967 outcrop examination and geochemical sampling of the area west of North El Tiro Hill indicated that there was a possibility of an economic chalcocite zone underlying the area. At the same time Jim Briscoe recognized the possibility that Paleozoic sedimentary rocks might underlie the alaskite throughout the area. In April of 1967 drilling was started to test both possibilities. The drilling done has been adequate for evaulating the chalcocite zone, but inadequate for a conclusive evaluation of the sediments. The existance of underlying sediments has been proven and although they are deep they are locally well mineralized. The lateral extent and continuity of the sediments and mineralization now needs to be more thoroughly tested.

SUMMARY AND RECOMMENDATIONS

Recent diamond drilling has shown that the sediments which outcrop on Sediment Ridge in the North El Tiro Hill area extend south under the alaskite of West Daisy Hill. Earlier churn drilling carried out over North El Tiro Hill and Daisy Drainage indicate that the sediments also continue into these areas, but apparently become more siliceous and less limey. The sequence is apparently a very steep dipping, slightly overturned and downdropped fault block of lower Paleozoic sediments.

Four diamond drill holes penetrated the alaskite of West Daisy Hill and encountered strongly altered and well mineralized (Appendix B) limey sediments. The earlier churn drill holes in the area of Daisy Drainage and North El Tiro Hill were all too shallow to provide much useful information on the nature and extent of the sediments and the mineralization in them.

The known ore grade mineralization in the sediments underlying West Daisy Hill is reflected by a magnetic anomaly over the area. Another magnetic anomaly lies over North El Tiro Hill, but this one has not been satisfactorily tested.

Between these two areas the magnetics do not seem to indicate that the mineralization is continuous.

"In-Hole" induced Polarization survey information does not seem to indicate a continuation of the mineralization eastward and under North El Tiro Hill, but this should not be given too much weight. There was only one hole close to this area which was tested and the technique as a whole is quite experimental.

In spite of what appears to be discouraging evidence I recommend that further tests of this area be carried out at this time. Since North El Tiro Hill is definitely going to be mined for its chalcocite at some time in the future it would certainly be advantageous to know early if there exist a continuous zone of economically mineralized sediments at depth. Early planning and design would be necessary for the most economic exploitation should it exist.

I have chosen three old churn drill holes - 198E, 200E, and 216E for cleaning out and re-entry with a diamond drill and a fourth site to be located near the site of 214E. This hole would be drilled from the surface with a diamond drill. Each of these holes would be taken down to the 1800' elevation. If any three of these holes hit substantial thickness and grade of material to make them appear economic interspaced drilling would then pursue. If two adjacent holes hit very strong mineralization it is conceivable that more drilling might again be needed. If three of the holes reach the 1800' elevation without encountering what appeared to be economic mineralization the area can then be satisfactorily written off as far as open pit mining is concerned.

This proposed drilling would require approximately 2,725' of drilling at a cost of approximately $26,000.

LOCATION AND NAMES

The North El Tiro Hill area will be that area which falls between the coordinates 37,100N and 38,900N and 14,700E and 16,300E (Atts. 1 & 3).

The south flowing central drainage along which lie the Kurtz and Daisy Shafts will be referred to in this report as the Daisy Drainage. The hill on the east side of this drainage shall be North El Tiro Hill and the alaskite hill on the west side West Daisy Hill. The northwest trending ridge of outcropping sediments just north of West Daisy Hill will be referred to as Sediment Ridge.

GEOLOGY

The geology of the area covered in this report was mapped by H. Schmitt, H. M. Kingsbury, L. P. Entwistle and W. C. Waidler in 1941 (Att. 1) and by Stephan Von Fay in 1960 (Att. 2).

Igneous Rocks

The igneous rocks of the area from oldest to youngest are - alaskite, dacite porphyry, syenodiorite porphyry, biotite quartz monzonite porphyry and post mineral andesite. These are the typical rocks of Silver Bell and fit earlier descriptions.

Sedimentary Rocks

Paleozic (?) sedimentary rocks outcrop on Sediment Ridge and were encountered beneath the alaskite of West Daisy Hill and the alaskite and dacite of North El Tiro Hill.

The west slope of Sediment Ridge is composed mainly of a medium to coarse crystalline marble which was probably derived from a massive, thin bedded limestone. Lenses of chart are fairly common in sections of the marble as are zones of calcium silicate hornfels. This marble probably represents around 200' of section. A very fine to fine grained clean white quartzite bed, 15'-25' thick, crops out along the top and controls the direction of elongation of the ridge. On the east side of the ridge are some irregularly positioned (faulted) blocks of very fine grained hornfels which were probably originally weakly limey, siliceous siltstones.

The sediments encountered below the alaskite of West Daisy Hill are thoroughly altered to calcium silicate hornfels, tactites and chloritic hornfels. The sediments from which these products were derived were probably the same as are represented on Sediment Ridge. The sediments encountered in drill holes beneath Daisy Drainage and North El Tiro Hill (Atts. 3&4, and Appendix B) in general are very fine grained, dense and siliceous hornfels and very fine grained quartzites (?). These were probably derived from limey siliceous siltstones and quartzites.

Correlations

About one weeks time was spent in the field examining stratigraphic sections in the Waterman mountains and some of the weakly altered sequences of sediments in the Silver Bell area. At this time I have no concrete evidence to prove a correlation, but the North El Tiro Hill area sediments appear to be most similar to those which Joy Merz called Lower and Middle Abrigo and Arthur W. Ruff called Lower and Upper Cochise.

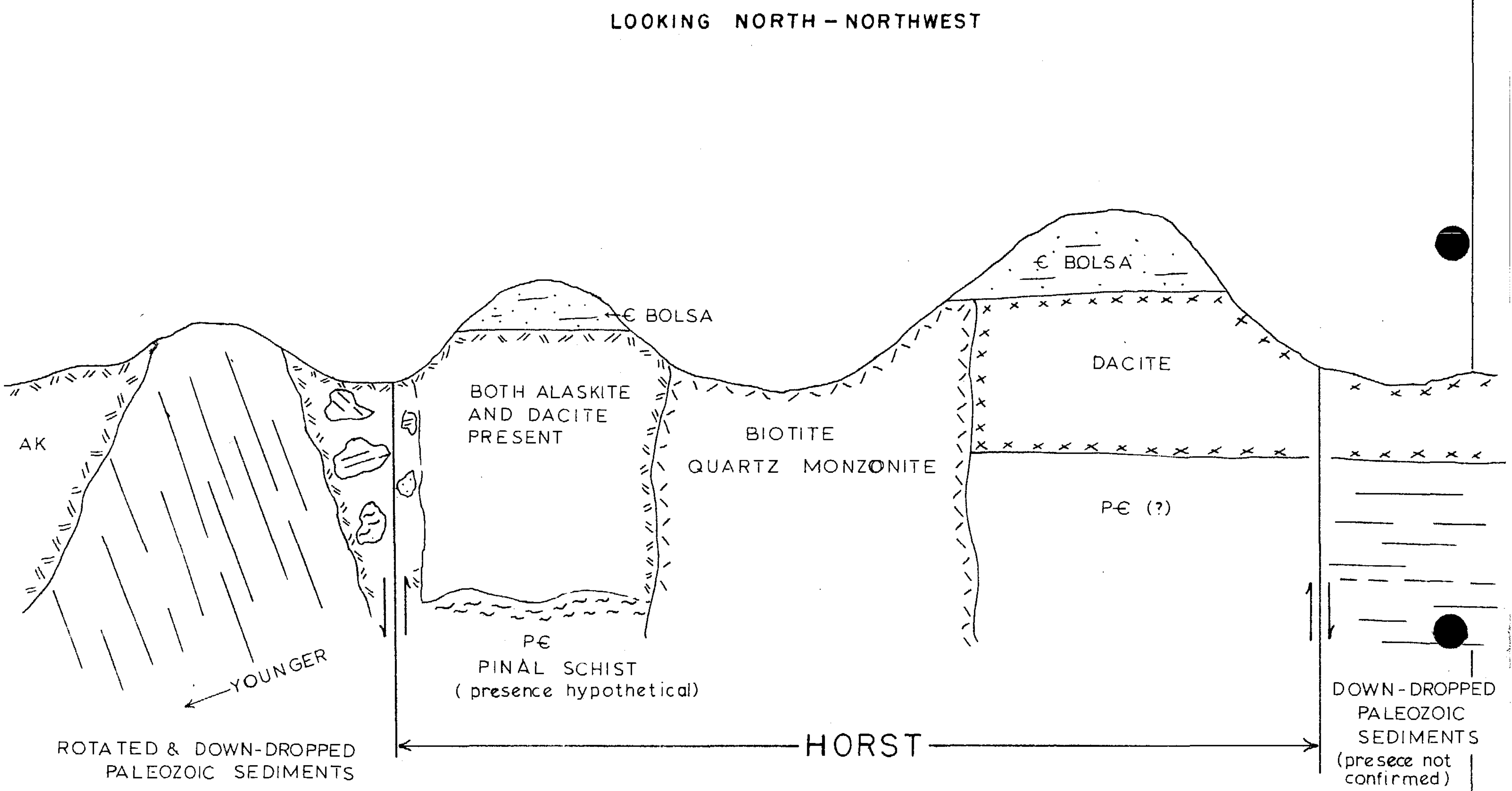
The Upper Cochise measured and described by Ruff in the Waterman mountains consisted of 239' of thin bedded limestones with occassional chart and silty lenses. For the Lower Cochise he measured 288' of limey quartzites and limey shales.

If the sediments of the North El Tiro Hill area are slightly overturned, as I believe, the marbles exposed on the western flank of Sediment Ridge are possibly Upper Cochise and the fine grained siliceous hornfels and quartzites on its east slope and intercepted in drill holes in the Daisy Drainage and west slope of North El Tiro Hill are possibly Lower Cochise.

Structure

When examining the geologic map of the North Silver Bell area (Atts. 1&2) one sees a discontinuous line of limey shaley and quartzitic sediments extending from the North El Tiro Hill area to the Atlas (B.S.&K.) mine area. There are only a few bedding symbols plotted and these indicate a somewhat irratic arrangement of altitudes. For the Sediment Ridge area there are locally anomalous altitudes which result from complex faulting of the area, but on the whole these units have an approximate N 25° W strike and 70° E dip. The sediments of the Atlas mine area were for the most part unmapped by Schmitt's group and Von Fay did not record any bedding for them. There is, however, a map of the Atlas Mine area by Thomas Mitcham (1953) which does show bedding symbols. This map indicates a rather shallow approximate 40° east dip for the western side and it gradually increases eastward to approximately 70° near the igneous contact.

East of the discontinuous line of sediments is a broad central zone with peaks capped by quartzite. Joy Merz correlated this quartzite with the Cambrian Bolsa. He gave a N 45° W strike and 45° south dip for the quartzite on Quartzite Peak and concluded that the altered sediments of Union Ridge to the south are Cambrian Abrigo and that they lie conformably upon the Bolsa.



CONCEPTUAL CROSSECTION OF NORTH SILVER BELL AREA

NO SCALE

Fig. 1

When the east boundary of the sediments of Quartzite Peak and Union Ridge is examined it is seen to form a rather straight line. This feature when considered with other evidence* which indicates that the dacite to the east is underlain by limestones, seems to indicate a pre-dacite fault existed in that area.

The 70° east dip of the Sediment Ridge sequence and the fact that those sediments are elevationally lower than the quartzites of the central zone indicate that a strong fault bounded the central zone on the west also. The units of Sediment Ridge seem to have been down-dropped and rotated counter clockwise (looking north) into a slightly overtruned position. The shallow dips in the Atlas (B.S.&K.) mine area may be evidence against this type of movement or those beds might themselves be more fully overturned.

Figure 1 is a concepted cross-section across the North Silver Bell area. The two major boundary faults and initial horst-like structure could possibly have occured at the time of and in response to the emplacement of the alaskite. The Sediment Ridge Sequence appears to have floundered in the rising alaskite magma and blocks of fault debris were engulfed by it in the vicinity of North El Tiro Hill. The dacite porphyry was emplaced following the alaskite. Although there is no evidence, the dacite may have been introduced beneath the quartzite of the Central Zone, formed a sill like mass and bouyed the quartzite up enhancing the "horst" appearance. East of Quartzite Peak the dacite may have surfaced and may have it's base upon downdropped Paleozoic sediments.

Alteration and Mineralization

The alteration and mineralization of the sedimentary rocks of the North El Tiro Hill area is typical of that seen in the Union and Page hills areas. Limestones have been altered to marbles, tactites and hornfels. The different products are the result of different degrees of intensity of metamorphism-metasomatism, amount and type of impurities present in the original rock, and proximity to deep and persistant fractures and faults. The more strongly altered and mineralized portions of the limestone are composed mainly of porous garnet tactite, diopside and wallastanite. The more silty and siliceous rocks have been altered to variably chloritic and argillaceous diopside hornfels.

Diamond drill holes D-218, D-219, D-241 and D-258 (Sects. 37,730N; 37,886N; 38,042N) which were drilled on the West Daisy Hill all hit well mineralized sediments. The sediments were strongly altered in the manner described above and derived their copper values from chalcopyrite. The mineralization was moderately fracture controlled, but was well disseminated and locally pervasive where the rock had been altered to a porous tactite or was highly chloritic. The chalcopyrite had pyrite, magnetite and sphalerite associated with it. The volume of the pyrite, on the average, was less than the chalcopyrite. The magnetite was very fine grained and present in varying amounts. The sphalerite was minor, but commonly appeared to be in solid solution with the chalcopyrite.

The more dense and siliceous hornfels which were encountered in drill holes D-222, 217E and 203E had very low total sulfide and copper content. In general the well mineralized ore-bearing sediments had an average total sulfide content of approximately 5% while the dense non ore-bearing material ran only about 1-1/2%.

* The existance of the limestone below the dacite is indicated on the assay log for the 1910 churn drill hole #38 which went to 606'.

GEOPHYSICS

Magnetics

Due to the association of magnetite with chalcopyrite in the ore-bearing sediments a ground magnetic survey was conducted. Mr. R. H. Luning carried out the survey using a proton procession magnetometer. Readings were taken every 100' on a square grid pattern from 37,000N on the south to 41,00N on the north and from 14,000E on the west to 17,000E on the east. Mr. Luning is preparing a report on this area at this time. Att. 5 is that portion of his map which covers the North El Tiro Hill area which is of prime concern at this time.

In the northern hemisphere an anomalous condition such as would result from a buried magnetic sphere would be expressed by a "coupled" high-low configuration with the low occuring to the north. The source of such an anomaly would be expected intermediate to the high and low. On our map the lows lie more east than north of the highs. This deviation may be explained by the fact that the sources for our anomalies are steep dipping tabular bodies with north-south elongations. The range between the high and low will be a function of the depth of burial of the source and the amount of magnetic material present.

Four main anomalous areas - A', B, C and D are labeled in the North El Tiro Hill area (Att. 5). Except for the A' the letters are picked to be the same as used by Van Blaricom for "I.P." anomalies (Att. 6) similarly located.

Anomaly (C) which is centered at 15,500E and 37,800N is the least symmetrical of the four. The east lying low is dimensionally much smaller than the associated high. The range between the high and low of this anomaly is 140 gammas. As it turns out (C) is the only one of the anomalies which has truly been tested with drill holes. This anomaly which lies over West Daisy Hill is caused by well mineralized sediments beneath the alaskite as verified by diamond drill holes D-241, D-258, D-219 and D-218.

Anomaly (A') is centered around 38,000N and 16,000E. It is at least 500' long and open on the south and has a general north-south trend. The northern portion of the anomaly has a 160 gamma range and the south a 200 gamma range between the high and low. Drill holes 200E, 206E, 206E, 209E and 215E all have been drilled between the "coupled" high-low, but do not provide a good test of it. All but 215E were stopped soon after entering sediments. Despite this fact 209E was the only hole which did not encounter any +0.4% copper intervals in sediments. Hole 215E hit sediments at 195' and these were well mineralized all the way to the bottom of the hole at 430'.

Anomaly (B) is centered at 15,500E and 38,400N. It is about 250' long and has a 260 gamma range. This anomaly occurs over a quartzite block which peaks through surrounding dacite (Att. 1&2). This anomaly, although well defined, is too small to be of much interest.

Anomaly (D) centered near 38,800N and 14,800E is elongate in a northwest-southeast direction. It is symmetrical and has a high-low range of 340 gamma. Although it is far from a valid test of the anomaly, hole D-234 which lie at its south end did hit good ore in sediments.

The evidence we have from this area as well as the Imperial area of El Tiro pit indicates that ore grade copper mineralization in sediments will be reflected in surface magnetics. Those drill holes which have penetrated sediments in areas other than between "coupled" high-lows are seen to lack copper.

On the basis of magnetics deeper drilling needs to be done in the area of (A') and an area 250' by 500' of potentially good copper ore is indicated in the area of (D).

Induced Polarization

In addition to magnetics it was thought that "In-Hole" Induced Polarization would be helpful in determining the continuity and configuration of the known ore zone and possibly in picking new drilling targets. Due to the general pervasiveness of pyrite through most of the sediments it was decided that only a "Directional" survey would be applicable and that the continuity and configuration of the ore zone would not be resolvable.

A "Directional I.P." survey was conducted using 12 drill holes - 217E, D-218, D-219, D-222, D-224, D-228, D-232, D-234, D-241, D-242, D-258 and D-269. Unfortunately 217E was the only one of these holes that had been drilled on North El Tiro Hill, the area where we most need information.

Detailed results of the survey are available in a report by R. Van Blaricom of the Geophysical Division. In general Mr. Van Blaricom concluded that there were two zones of interest (Atts. 6&7)*. Zone (1) (Att. 6) has three separate areas of interest; area (A) lies north of 217E; area (B) lies north of D-222; area (C) lies south of D-218 and east of D-219. Zone (2) contains only area (D) and runs from D-228 on the south to north of D-232.

The results of this survey show only a fair correlation with the magnetics. The anomaly north of D-228 is not reflected in the magnetics and neither is anomaly (A) north of 217E. "I.P." anomaly (C) is smaller than the corresponding magnetic anomaly and does not cover all of the known ore in that area. If the magnetics are correct I would also have expected D-234 to show a major anomaly to the north. Area (B) seems to be the only real good correlation. If anything the "IN-Hole" Directional "I.P." results may indicate that you can not reliably use a hole which is in an ore zone to detect other large ore masses at a distance, but only the small scale variation in the immediate area.

* Atts. 6 & 7 are plots showing directions of responses from particular drill holes and the elevation through which they were recorded. The "major" anomalies would be due to a large body some distance from the hole; "minor" anomalies represent small bodies, 100' or less in diameter, close to the hole.

N. R. Nuttycombe

N. R. Nuttycombe

NRN:jca

APPENDIX A

Explanation of Maps and Cross Sections:

Att. 1. Geologic map based on work done by Harrison Schmitt, H. M. Kingsbury, L. P. Entwistle and W. C. Waidler and accompanied their report "Geology and Ore Deposits of Silver Bell", 1941. The apparent additions to this map were made by the author. North El Tiro Area is outlined.

Att. 2. Geologic map concerned primarily with sedimentary rocks of the Sediment Ridge area and the Atlas Mine area. The geology was mapped by Stephan Von Fay and the map accompanied his 1960 report on the Imperial Area. Additions to the map by author.

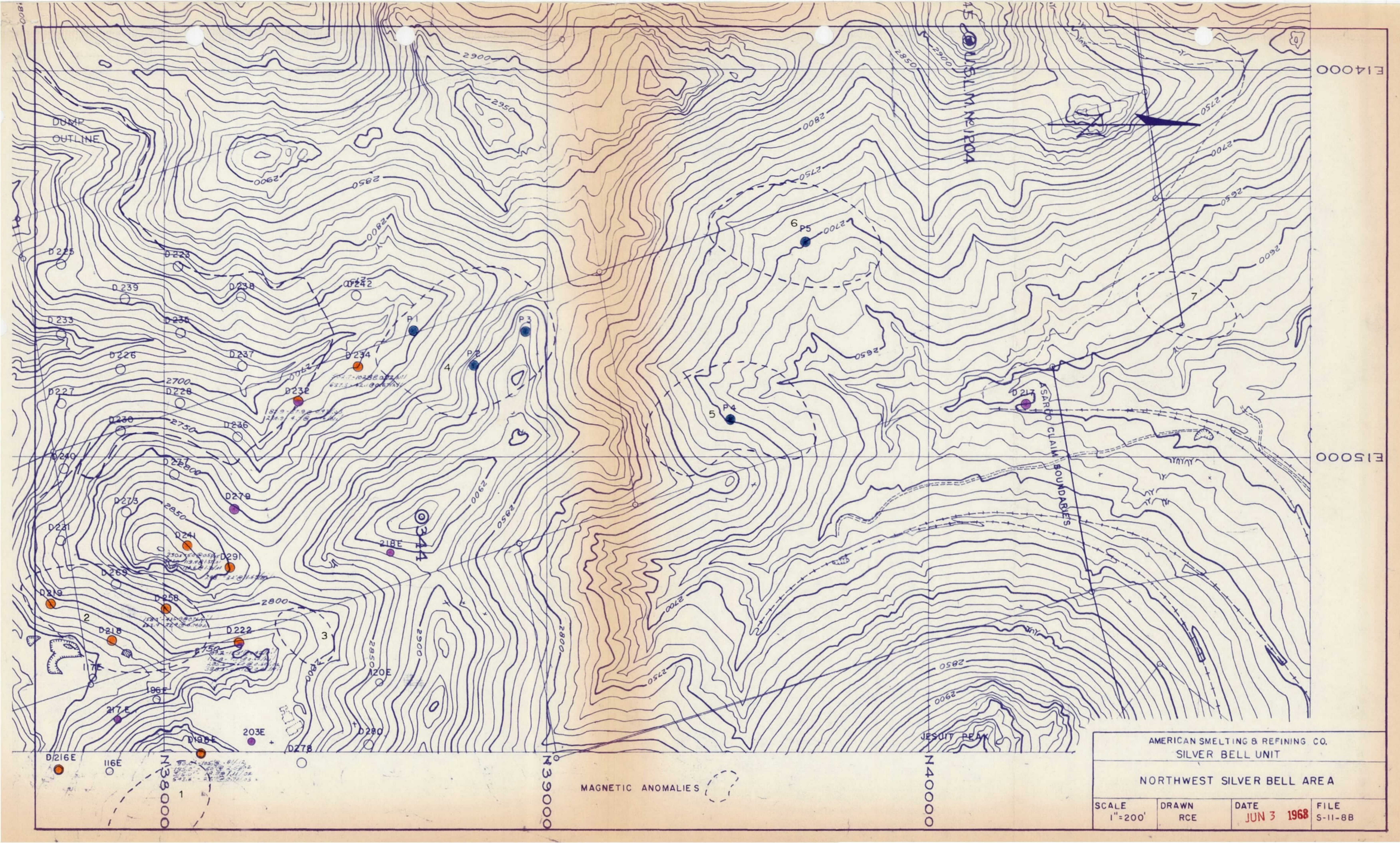
Att. 3. Surface Topography of North El Tiro Hill area. Topographic features are named and those drill holes which encountered sediments are plotted. Sites proposed for additional drilling also plotted.

Att. 4. Position and Interpreted Configuration of Sedimentary Rocks. Compiled from drill hole results. Drill holes which encountered sediments as well as sites proposed for additional drilling plotted.

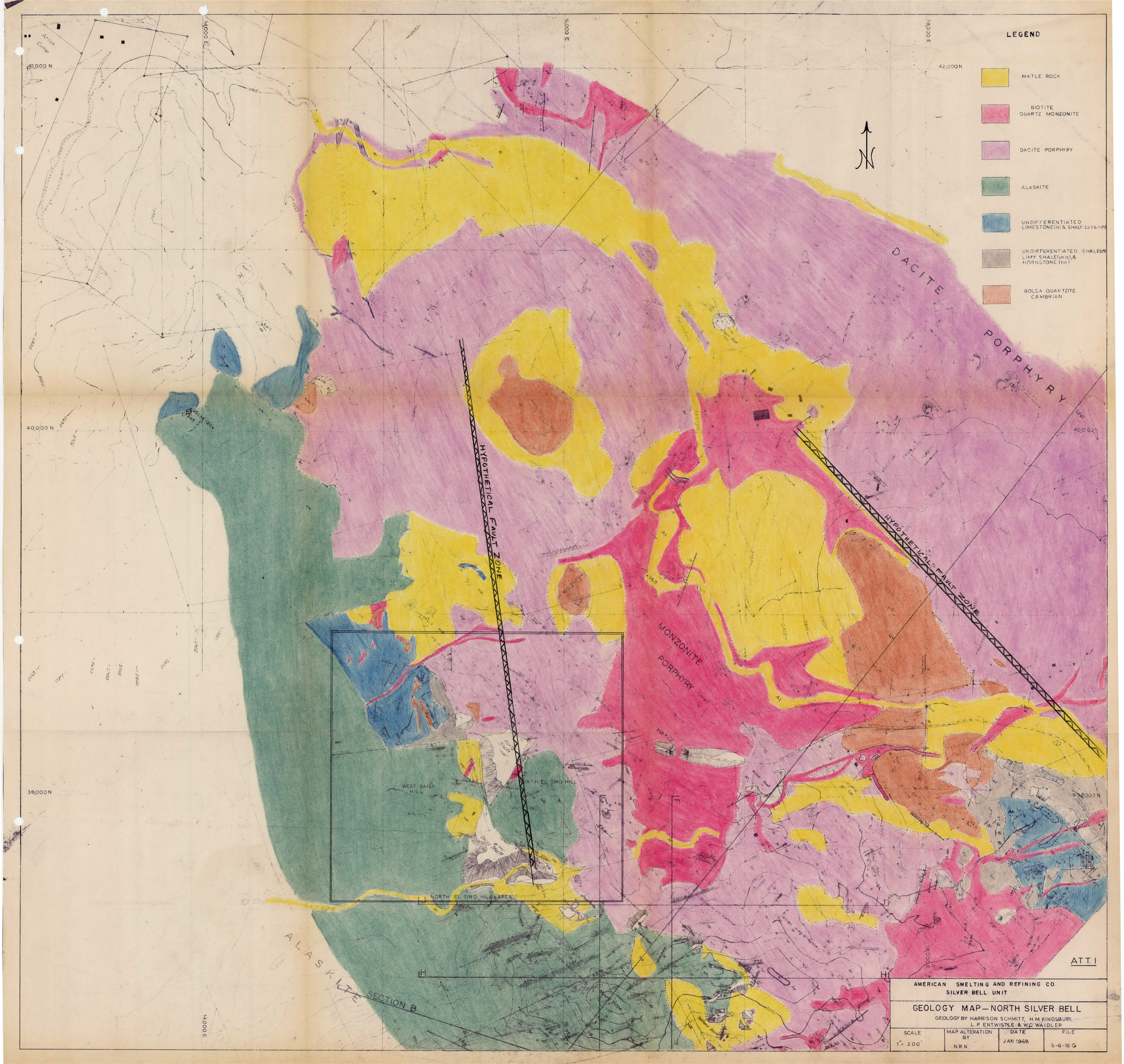
Att. 5. Ground Magnetic Survey - North El Tiro Area, Silver Bell, Arizona. Survey by R. H. Luning.

Att. 6. Plot of "MajorTrends" of sulfide anomalies based on "In-Hole" Induced Polarization results. Taken from R. Van Blaricom's report - "Silver Bell I.P. Drill Hole Logging" (1968).

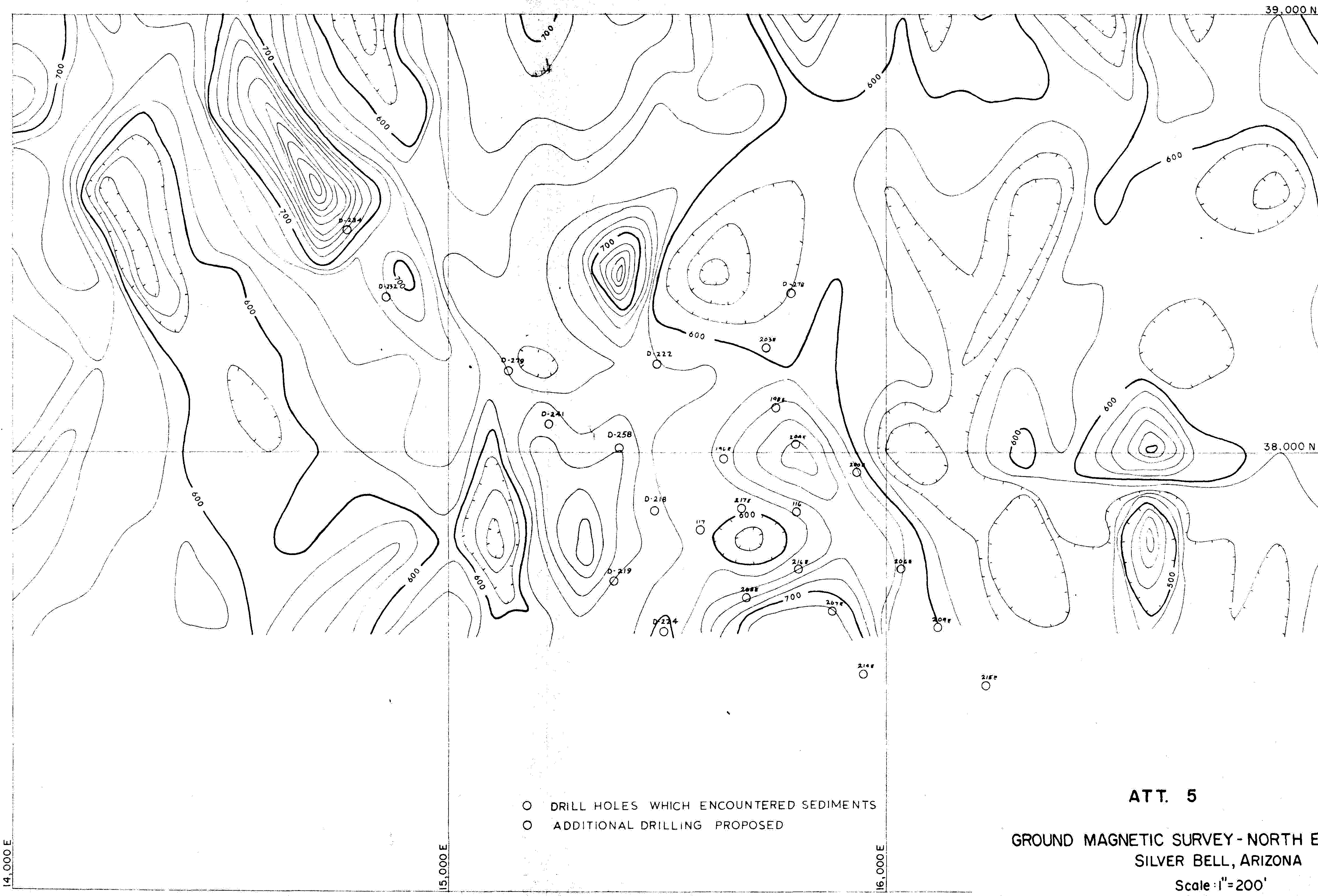
Att. 7. Plot "Minor" sulfide anomalies based on "In-Hole" Induced Polarization results. Reference as above.



AMERICAN SMELTING & REFINING CO.
SILVER BELL UNIT
NORTHWEST SILVER BELL AREA
SCALE 1"=200'
DRAWN RCE
DATE JUN 3 1968
FILE S-11-8B
MAGNETIC ANOMALIES
DUMP OUTLINE
ASARCO CLAIM BOUNDARIES
JESUIT PEAK
U.S.L.M. No 1204
E14000
E15000
N38000
N39000
N40000


LEGEND
MATLE ROCK
BIOTITE QUARTZ MONZONITE
DACITE PORPHYRY
ALASKITE
UNDIFFERENTIATED LIMESTONE(ls) & SHALY Ls (ls-sh)
UNDIFFERENTIATED SHALE(sh) LIMY SHALE(sh-ls), & HORNSTONE (hn)
BOLSA QUARTZITE CAMBRIAN
DACITE PORPHYRY
MONZONITE PORPHYRY (mp)
HYPOTHETICAL FAULT ZONE
HYPOTHETICAL FAULT ZONE
ALASKITE
WEST DAISY HILL
NORTH EL TIRO HILL
NORTH EL TIRO HILL AREA
SECTION B
42,000 N
40,000 N
38,000 N
14000 E
16000 E
18000 E
ATT. I
AMERICAN SMELTING AND REFINING CO.
SILVER BELL UNIT
GEOLOGY MAP—NORTH SILVER BELL
GEOLOGY BY HARRISON SCHMITT, H.M. KINGSBURY, L.P. ENTWISTLE & W.C. WAIDLER
SCALE 1" = 200'
MAP ALTERATION BY N.R.N.
DATE JAN 1968
FILE S-6-16 G


ATLAS CAMP
ATLAS MINE
bx text after shears
Prob outline of bx
U.S.L.M. No 1204
HYPOTHETICAL FAULT ZONE
KURTZ SHAFT
41,000 N
40,000 N
39,000 N
12,000 E
13,000 E
14,000 E
15,000 E
ASARCO Property Line
Drill Hole No. 67
N
Rock Outcrops Other Than Tactite
Tactite Outcrop
Surface Evidence of Strong Sulphide Mineralization
Surface Evidence of Moderate Sulphide Mineralization
Mineralized Fissure
Fault
Breccia
Tt Tactite
Hf Hornfels
Qtz Quartzite
Ls Limestone
Ak Alaskite
Mp Monzonite
Dp Dacite
Rx Recrystallized
And Andesite
ATT. 2
ASARCO
ATLAS AREA
Silver Bell District, Pima County, Arizona
SCALE 1" = 200'
Geology by Stephen Von Fay
December, 1959
1442-1



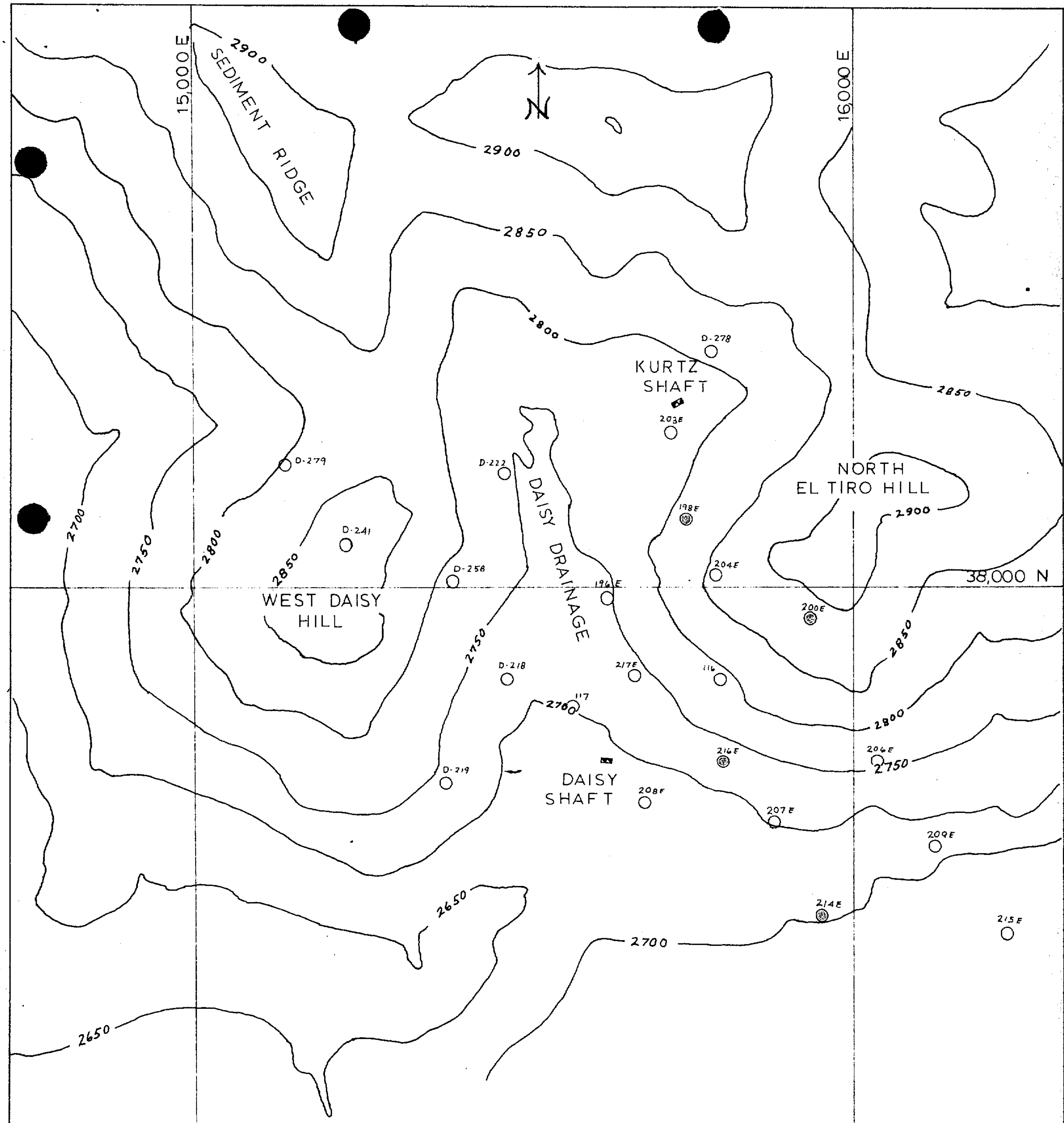
NOTE - Add 50,000 gammas for total intensity.

ATT. 5

GROUND MAGNETIC SURVEY - NORTH EL TIRO AREA
SILVER BELL, ARIZONA

Scale: 1" = 200'
Contour Interval: 20 Gammas

R.H.L. Dec. 1967

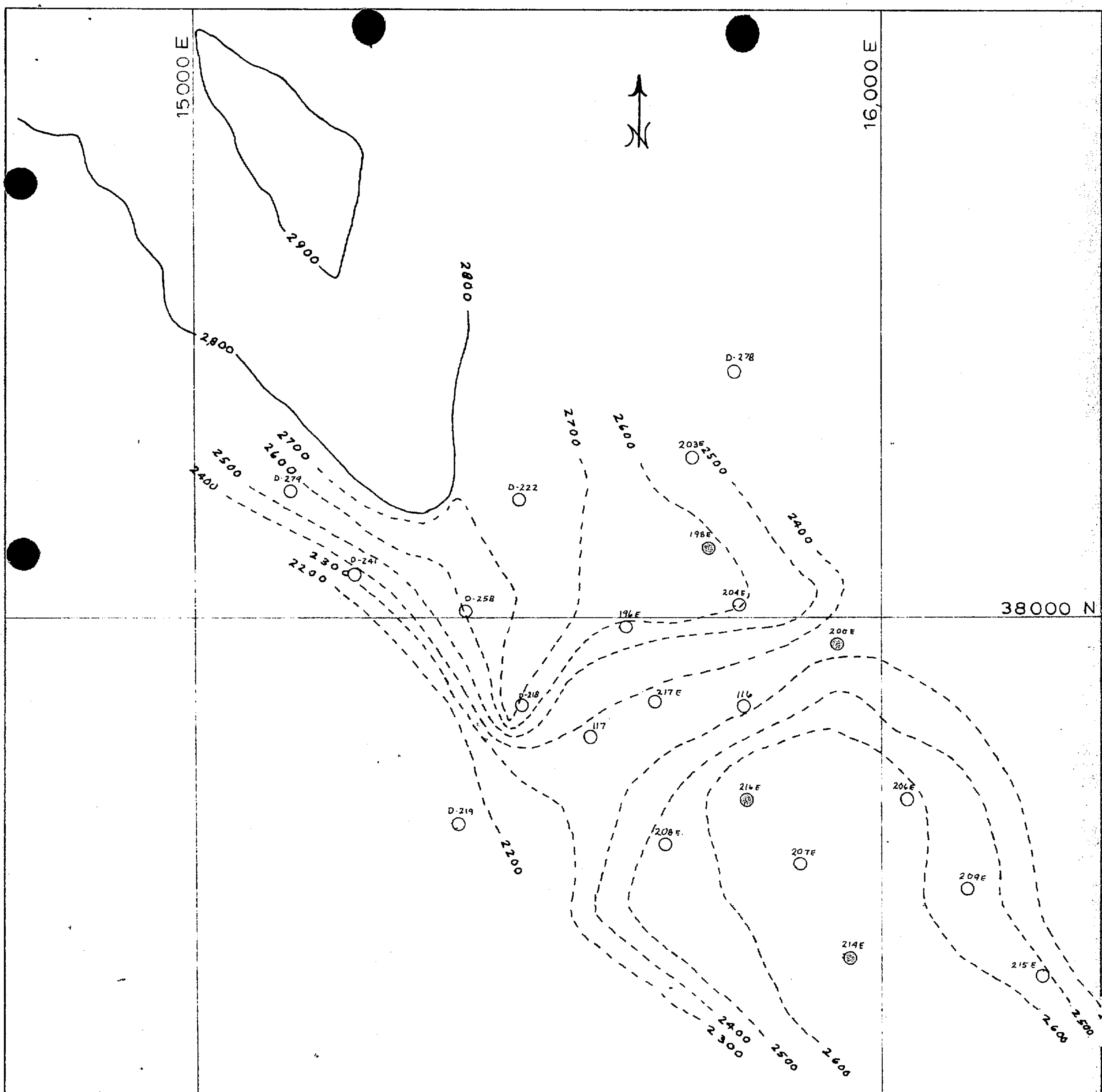


ATT. 3

SURFACE TOPOGRAPHY OF NORTH EL TIRO HILL AREA

○ DRILL HOLES WITH SEDIMENTS
◉ PROPOSED ADDITIONAL DRILLING

CONTOUR INTERVAL 50'
SCALE 1"=200'



ATT. 4

POSITION AND INTERPRETED CONFIGURATION OF SEDIMENTARY ROCKS.

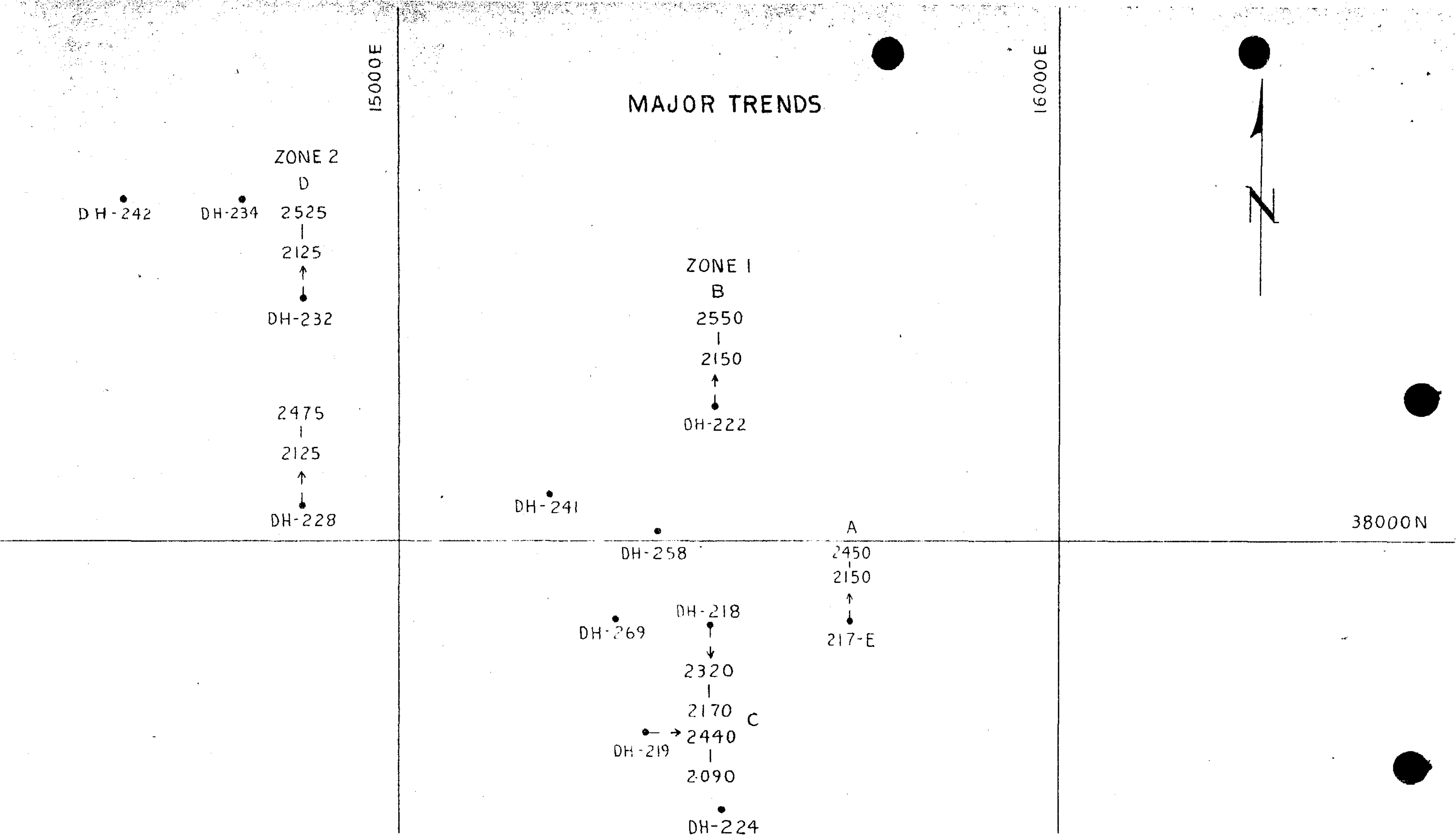
——— OUTCROP CONTOUR

⊛ ADDITIONAL DRILLING PROPOSED

- - - - - SUBSURFACE CONTOUR

○ DRILL HOLES WITH SEDIMENTS

CONTOUR INTERVAL 100′
SCALE 1″= 200′



ATT. 6

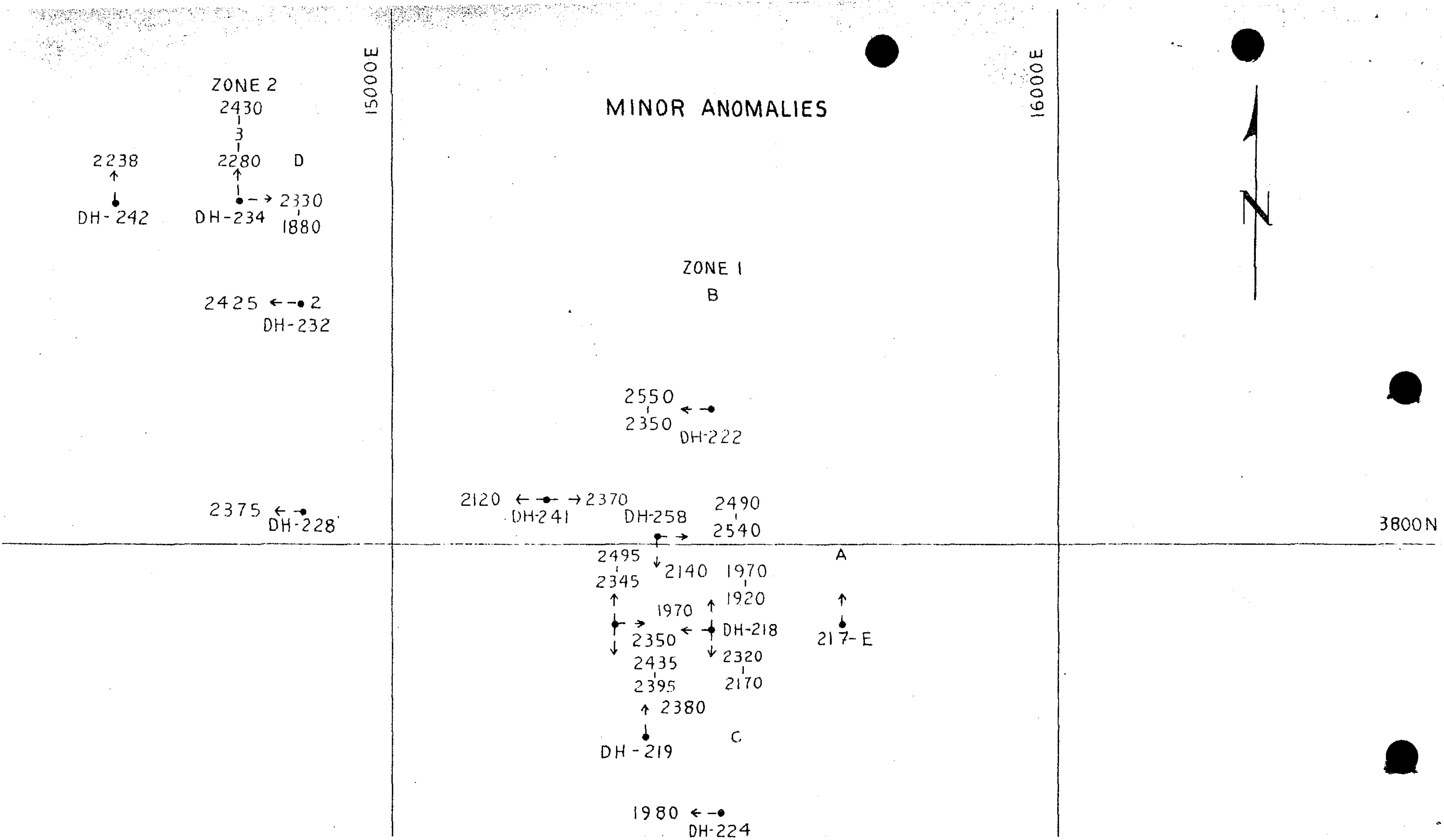
ASARCO

SILVER BELL UNIT

DAISY SHAFT-NORTH ELTIRO HILL AREA

SCALE 1" = 200'

BY R. VAN BLARICOM



ATT. 7

ASARCO

SILVER BELL UNIT

DAISY SHAFT NORTH EL TIRO HILL AREA

SCALE 1" = 200'

BY R. VAN BLARICOM

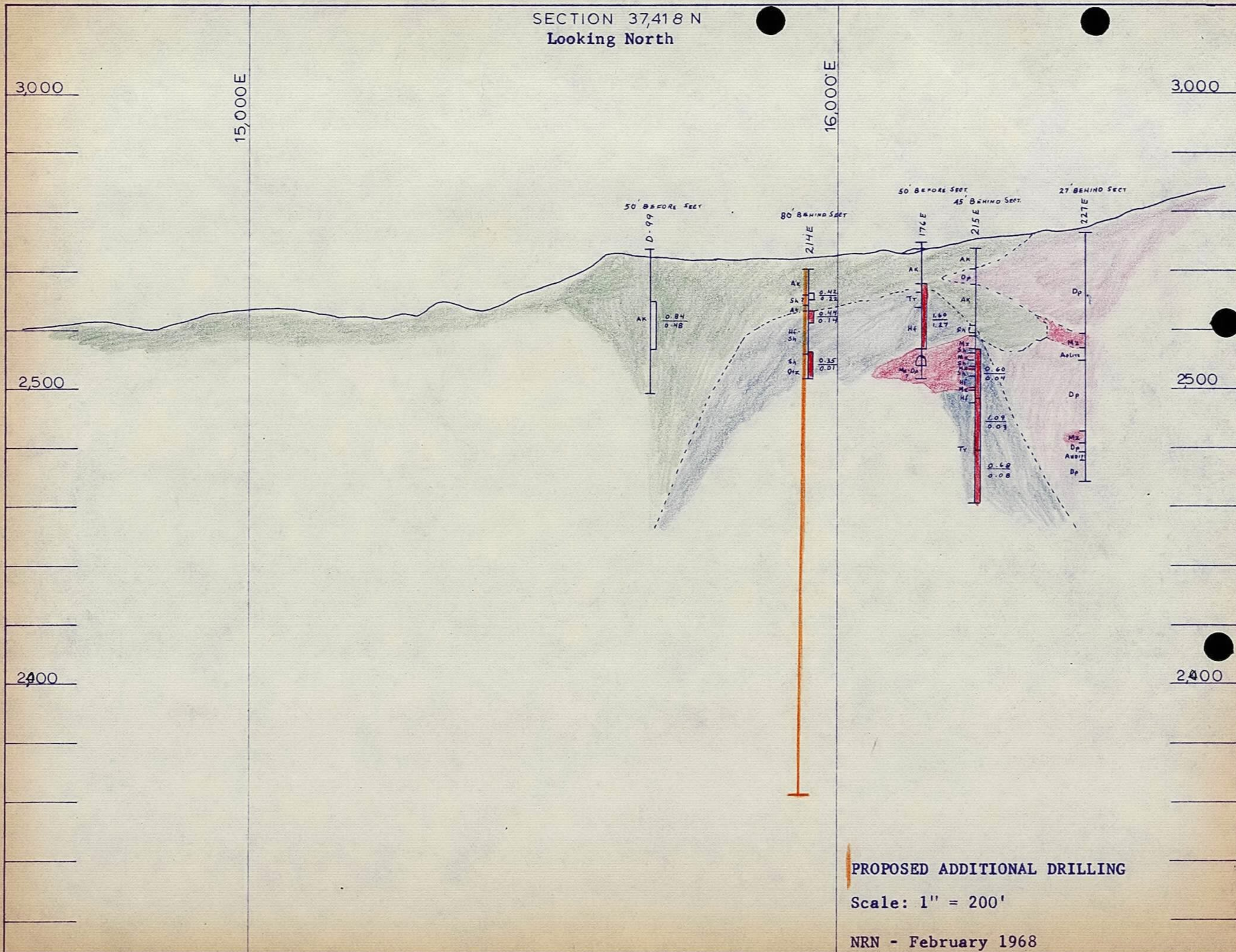
APPENDIX B

1. East-West geologic cross section based on surface and drill hole information.

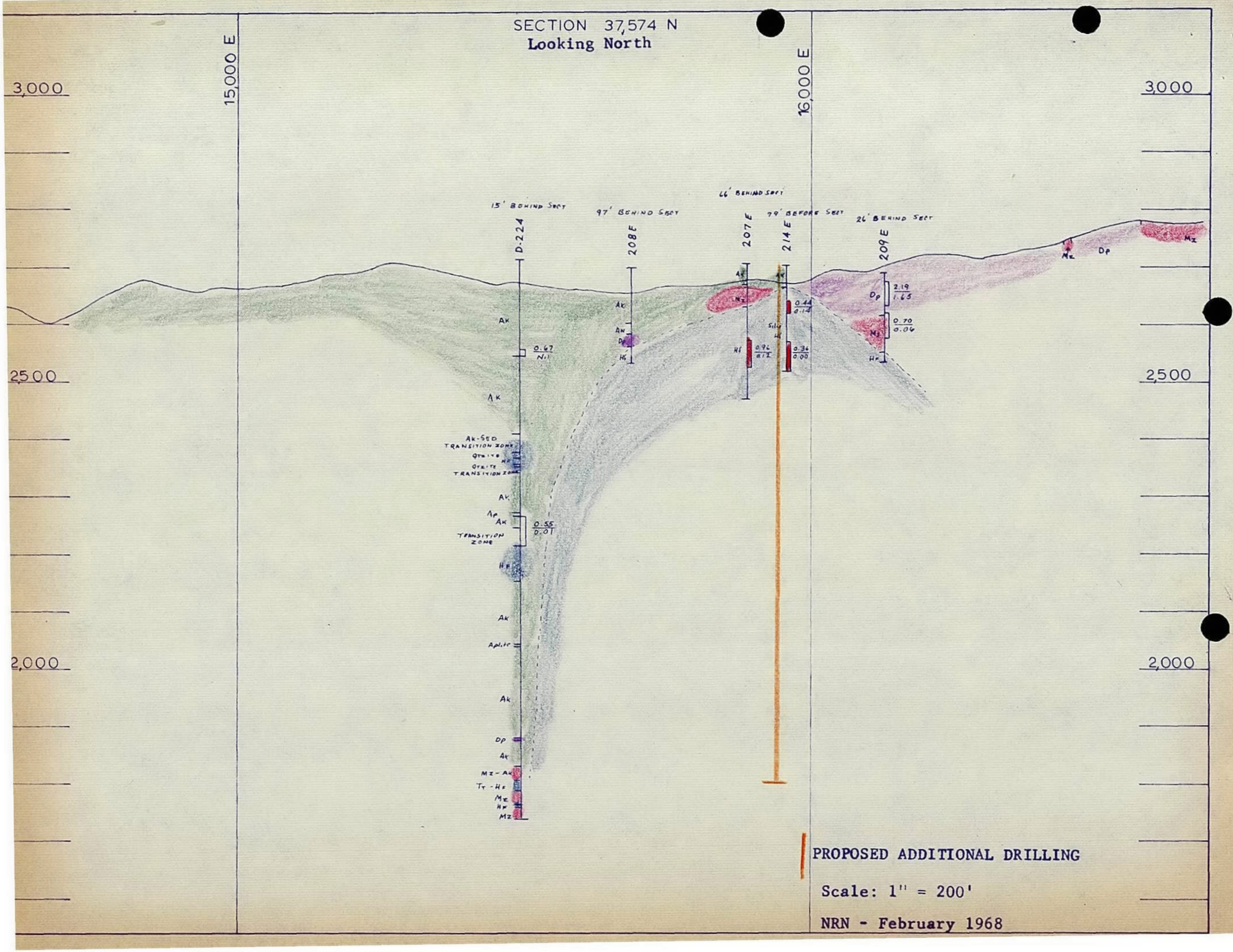
2. Assay information on ore intervals for those holes which penetrated sediments under West Daisy Hill, Holes #D-218, D-219, D-241 and D-258.

	+0.40% Copper Lenses			
Hole No.	Depth to Top	Thick-ness	Avg. % Cu Total	N.S.
D-218	29.0	43.6	0.97	0.67
	72.6	27.1	0.55	0.11
	138.1	40.1	0.78	0.01
	206.7	33.0	0.95	0.61
	253.4	14.6	0.65	0.01
	285.0	36.6	0.66	0.01
	392.7	78.5	0.71	Nil
	506.6	33.5	0.80	Nil
	566.8	73.9	0.88	Nil
D-219	77.6	19.3	0.46	0.01
	544.2	127.3	1.16	Nil
	687.0	23.4	0.88	Nil
	735.3	183.6	1.25	Nil
D-241	601.0	119.4	1.37	0.01
	755.3	134.6	1.30	0.01
D-258	158.3	68.6	1.12	Nil
	248.0	51.6	0.78	0.02
	336.5	248.7	0.80	0.01
	663.9	53.3	0.53	0.02
	886.0	18.1	1.39	0.01
	992.8	19.0	1.70	0.01

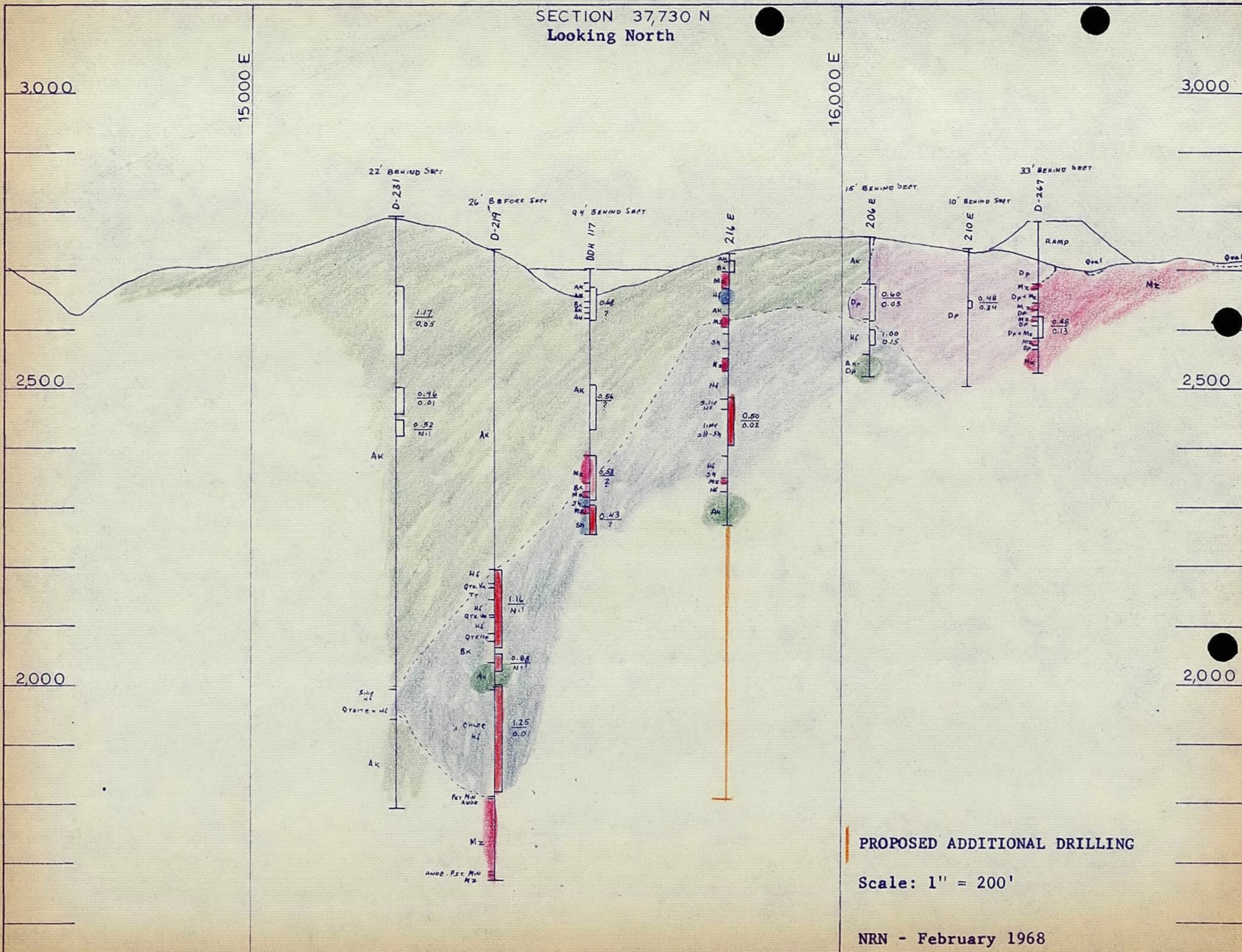
- - - - -



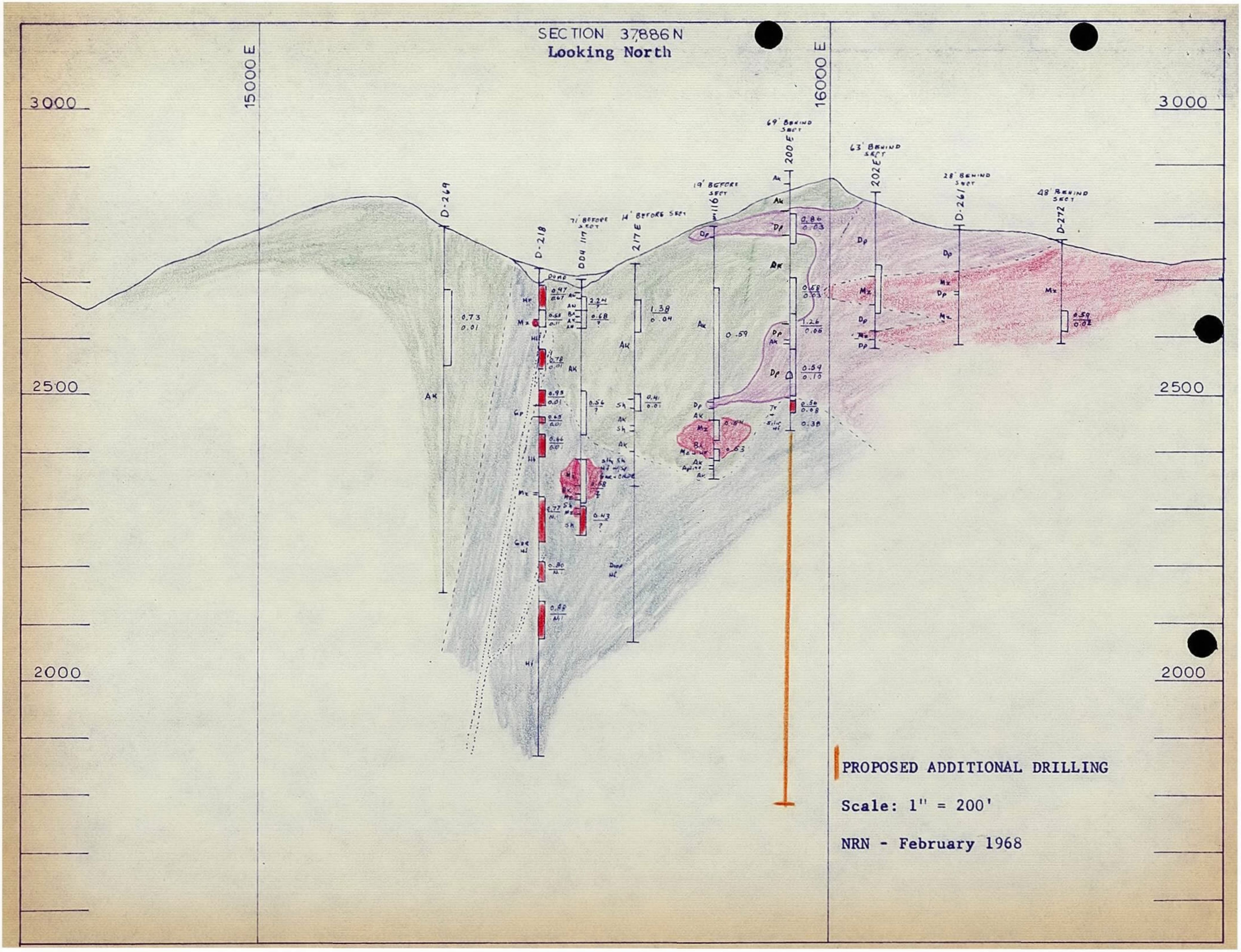
SECTION 37,418 N
Looking North
15,000E
16,000E
3,000
2,500
2,400
50' BEFORE SECT
D-99
AK
0.84
0.48
80' BEHIND SECT
214E
AK
Sh?
0.42
0.22
0.44
0.14
Sh
Qtz
0.35
0.01
50' BEFORE SECT
176E
AK
Tr
Hf
1.60
1.27
45' BEHIND SECT.
215E
AK
Dp
AK
Sh
Mz
Sh
Hf
Tr
0.60
0.04
1.09
0.03
0.68
0.08
27' BEHIND SECT
227E
Dp
Mz
Aplite
Dp
Mz
Dp
Dp
PROPOSED ADDITIONAL DRILLING
Scale: 1" = 200'
NRN - February 1968



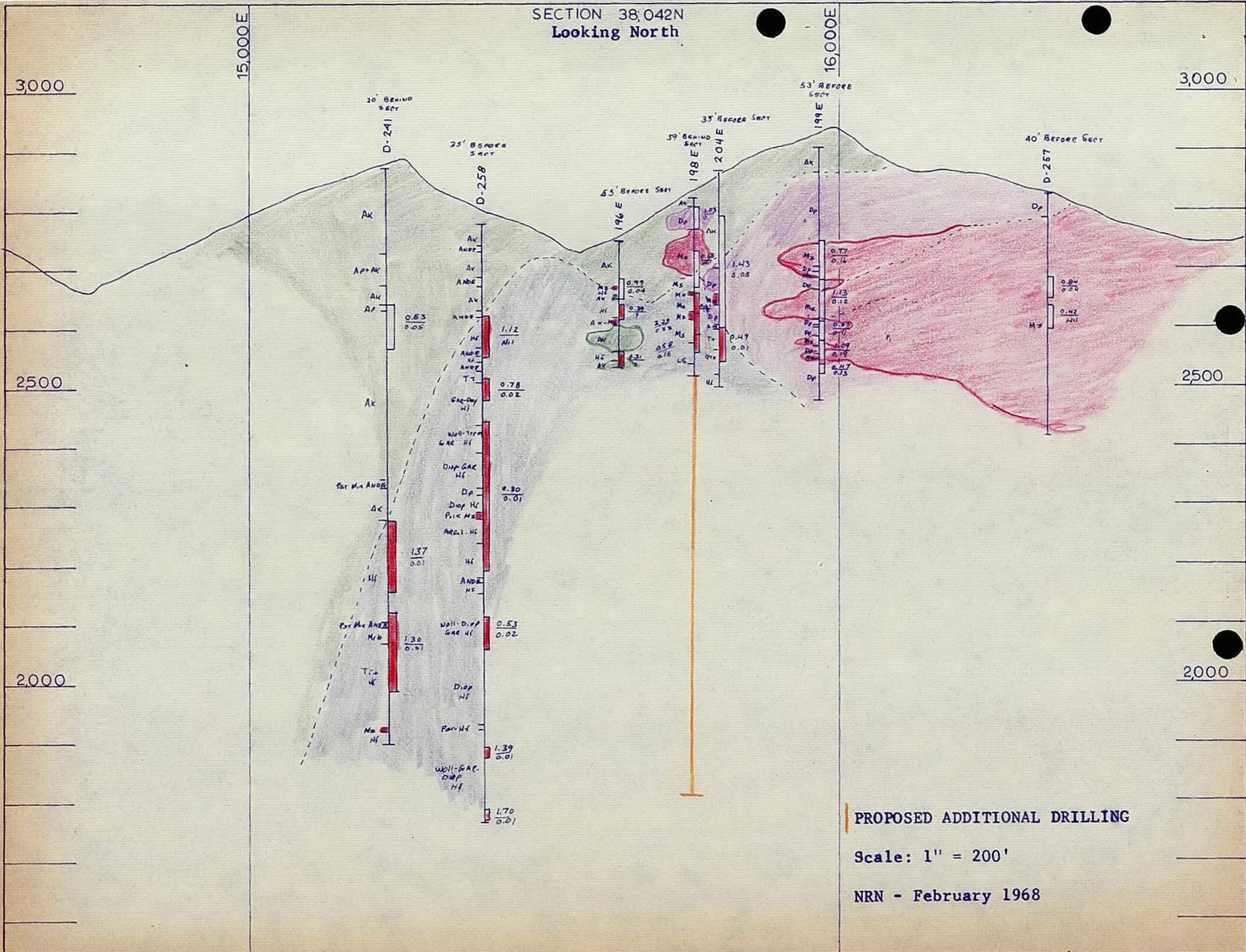
SECTION 37,574 N
Looking North
15,000 E
16,000 E
3,000
2500
2,500
2,000
15' BEHIND SECT
97' BEHIND SECT
66' BEHIND SECT
79' BEFORE SECT
26' BEHIND SECT
D-224
208E
207E
214E
209E
Ak
Dp
Hf
Mz
0.67
0.55
0.01
0.96
0.44
0.14
0.36
0.00
2.19
1.65
0.70
0.06
Ak-SED
TRANSITION ZONE
TRANSITION ZONE
Aplite
Mz-Ak
Tr-Hf
PROPOSED ADDITIONAL DRILLING
Scale: 1" = 200'
NRN - February 1968

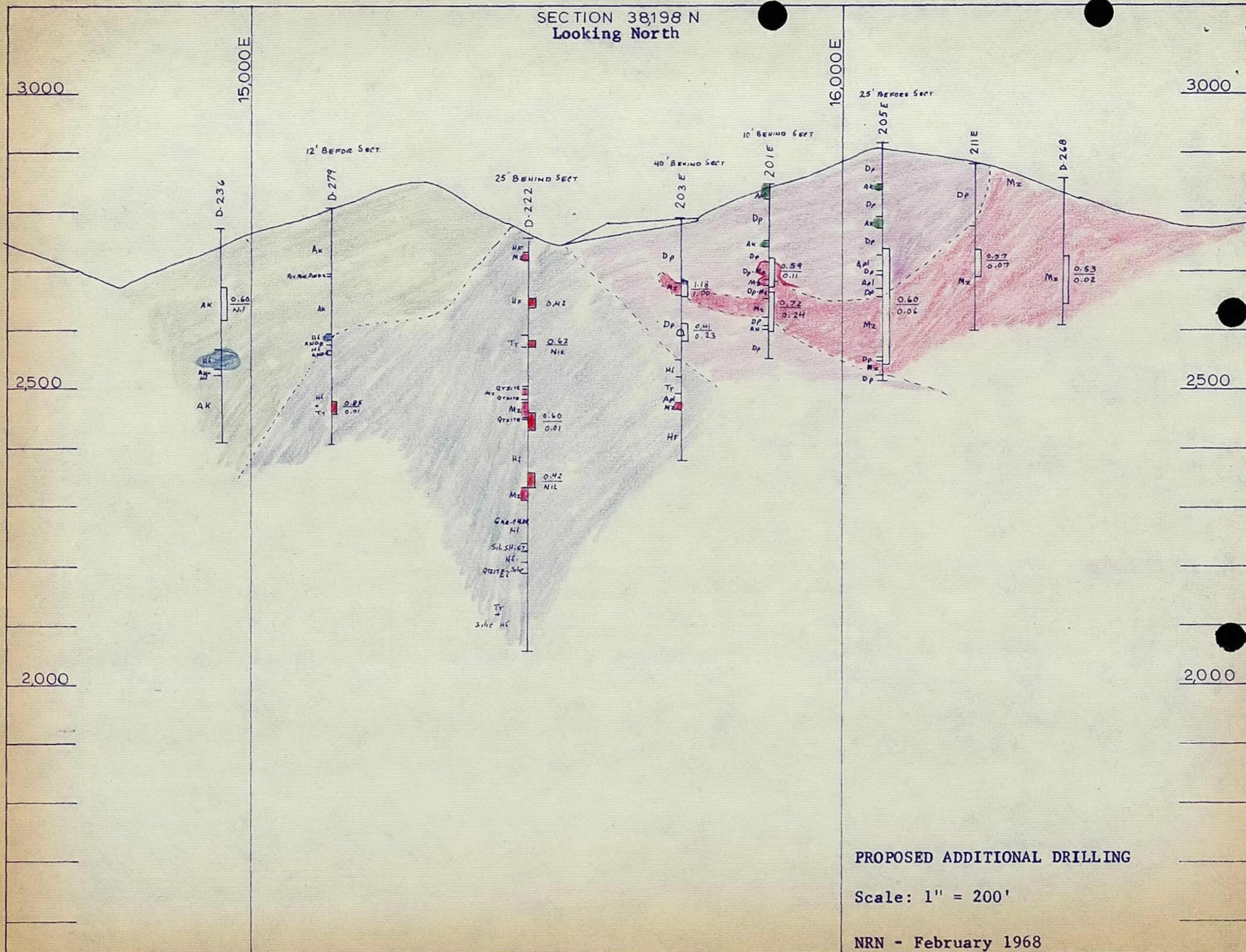


SECTION 37,730 N
Looking North
15000 E
16,000 E
3,000
2,500
2,000
22' BEHIND SECT
D-231
26' BEFORE SECT
D-219
94' BEHIND SECT
DDH 117
216 E
15' BEHIND SECT
206 E
10' BEHIND SECT
210 E
33' BEHIND SECT
D-267
RAMP
Qoal
Mz
Dp
Ak
Hf
PROPOSED ADDITIONAL DRILLING
Scale: 1" = 200'
NRN - February 1968



SECTION 37,886 N
Looking North
15000 E
16000 E
3000
3000
2500
2500
2000
2000
D-269
D-218
71' BEFORE SECT
DDH 117
14' BEFORE SECT
217 E
19' BEFORE SECT
116
69' BEHIND SECT
200 E
63' BEHIND SECT
202 E
28' BEHIND SECT
D-261
48' BEHIND SECT
D-272
0.73
0.01
1.38
0.04
0.59
0.86
0.03
0.68
0.03
1.26
0.06
0.59
0.10
0.56
0.08
0.38
0.63
0.59
0.02
AK
Dp
Mx
PROPOSED ADDITIONAL DRILLING
Scale: 1" = 200'
NRN - February 1968


SECTION 38,042N
Looking North
15,000E
16,000E
3,000
2500
2,000
D-241
D-258
196E
198E
204E
199E
D-257
PROPOSED ADDITIONAL DRILLING
Scale: 1" = 200'
NRN - February 1968


SECTION 38,198 N
Looking North
15,000E
16,000E
3000
2,500
2,000
D-236
D-279
D-222
203 E
201 E
205 E
211 E
D-268
12' BEFOR SECT.
25' BEHIND SECT.
40' BEHIND SECT
10' BEHIND SECT
25' BEFORE SECT
PROPOSED ADDITIONAL DRILLING
Scale: 1" = 200'
NRN - February 1968

Silver Bell (Imperial)
JHC Sec'ys file

September 11, 1968

Mr. S. T. Claflin
Box 5423
Tucson, Arizona 85703

Dear Mr. Claflin:

Enclosed is the northern portion of a map prepared by Mr. B. N. Watson during 1962-63 as part of his work in earning a Doctor's degree in geology at the University of Arizona.

You will note your Ranch headquarters situated near the lower right-hand corner. The best exposures of the Claflin Ranch formation occur approximately 1-1/2 miles west-northwest of your Ranch house. The beds of coarse sandstone and fine-to-coarse conglomerate dip northerly and aggregate several thousand feet in thickness.

Also enclosed is a reprint of an article by Kenyon Richard and myself which was in the Arizona Geological Society Digest, Vol. III, March, 1960. The occurrence of the Claflin Ranch and Silver Bell formations are briefly described on page 1. These formations are correlated with occurrences in many other parts of the Southwest on subsequent pages.

Yours very truly,

JHC:lml

J. H. Courtright

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AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

J. H. C.

MAY 24 1968

May 24, 1968

Messrs: D. R. Jameson - Silver Bell Unit
P. A. Lewis - Mission Unit

Metallurgy

EL PASO LABORATORY - GRAVITY CONCENTRATION

A Humphrey Spiral Concentrator laboratory unit has been purchased for use at the El Paso Ore Testing Laboratory. It is our intention to use this unit to investigate the feasibility of recovering by-product minerals by simple gravity concentration from mill tailings.

As part of this program we would like to have approximately 500 lbs of final tailing composite from both Mission and Silver Bell shipped to the El Paso Laboratory. It is desired that this material be taken over a calendar month period, preferably the month of June. The material should be broken through 10 mesh but mixing will be done at El Paso. Your cooperation in this matter will be appreciated.

Yours truly,

G. W. Bossard

G. W. BOSSARD
Milling Engineer

GWB/mg

cc: RBMeen
VKudryk
TDHenderson
JHCourtright

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

February 8, 1968

Very good!

J. H. C.

MR. WES FEB 7 1968

READ AND RETURN

PREPARE ANSWERS HANDLE

FILE ✓ INITIALS

W.E.S.
FEB 20 1968

TO: J. H. Courtright

FROM: R. B. Cummings

Resume of Tour of the Silver Bell District

On January 3, 1968, Charles Zimmerman and myself were given a tour of the Silver Bell ore bodies and the general area by Nick Nuttycombe and Bob Edmiston.

Geology of the Silver Bell Deposit A large variety of rocks are exposed in the Silver Bell district. They range in age from Precambrian to recent and include Paleozoic and Cretaceous sediments, Tertiary sediments and volcanics (pre-mineral), Laramide intrusives (including alaskite, dacite porphyry, andesite porphyry, monzonite, and syenodiorite), and post-mineral dikes. The deposit was probably not covered. The nearest post-mineral cover is three miles away.

Two ore bodies are present at Silver Bell (Oxide pit and El Tiro pit). They are about two and one half miles apart and are both located on a major west-northwest structural trend. It is indicated that this trend represents a large displacement fault seperating Cretaceous rocks on the southwest from Paleozoic sediments. This line has been destroyed by, and has influenced the intrusion of, Laramide rocks.

A set of northeast fractures has been the major localizing factor in mineralization. These mineralized fractures vary in thickness from a fraction of an inch to several inches. Their spacing varys from several inches to several feet. About 1,000 feet northeast of Union Ridge there is a breccia pipe containing high pyrite but little copper.

Propylitic, argillic, and quartz-sericite alteration types are present in the intrusive rocks of the Silver Bell District. The quartz-sericite is the most intense alteration and is more closely associated with ore grade mineralization. Specimens show that quartz and sulfides have been introduced in the fractures and are now represented by a veinlet. Adjacent to this on either side is fine-grained sericite. Argillic alteration is found grading into the sericite. The Paleozoic sediments on the northeast side of the major trend have been altered to a siliceous garnet-tactite.

The alteration zone is over five miles in length and from 1,000 to 5,000 feet in width. Its boundry may be either gradational or sharp (especially in the lime-rich sediments). The zone parallels the major structure. It trends west-northwest between the two pits and swings north at El Tiro. The alteration zone ends approximately one and one half miles north of El Tiro and fades out to the east-southeast of Oxide.

Hypogene metallization occurs in the form of Pyrite, chalcopyrite, and minor amounts of molybdenite. The majority of the mineralization occurs in thin quartz-sulfide veins but some does occur in discrete grains. The syenodiorite contains the best hypogene values and more mineralization (as compared to other hosts) in the form of disseminated grains. The alaskite and monzonite are approximately equal in hypogene values but the alaskite contains mostly veins while the monzonite also contains some disseminated values. The dacite makes a poor host. The total sulfide content is about five percent and the pyrite to chalcopyrite ratio is 4:1. In the sediments (garnet tactite) numerous irregular pods and veins of pyrite and chalcopyrite are the common occurence.

Supergene mineralization occurs in the form of chalcocite replacing other sulfides. The preference for host rocks is essentially the same as the hypogene mineralization. The thickness of the blanket varies from 100 to 200 feet.

Minor amounts of copper carbonates and silicates are present in the deposit. The leached capping over the best ore contained essentially none but the outer, less intensely altered areas do have some of these copper minerals. The former base of oxidation is now about 100 feet below the surface. This surface is deeper in the sediments. Oxidation products are also more abundant in the sediments. They include copper pitch and copper silicates.

The grade of the primary mineralization at Silver Bell is about 0.2% to 0.3% copper. In the El Tiro pit the supergene ore mined to date has averaged about 0.75% copper while at the Oxide pit it is 0.9% copper. The non-sulfide copper content of the ore is about 0.15%. This is all post-mine. The molybdenum content is 0.02%.

The leached capping over the chalcocite zone is about 100 feet in thickness. It is quite conspicuous in appearance because of the quality and abundance of "live" limonite. The capping takes on a stripped appearance with the dark limonite after chalcocite veinlet surrounded by quartz, sericite, and finally a red hemetitestained argillic material. There is little doubt that a chalcocite blanket at one time existed in the place of the capping.

It is known that at least one period of secondary enrichment occured prior to 27.9 million years ago. This is evidenced by a dated basalt flow which partially covers a conglomerate containing pebbles of leached capping.

The base of oxidation is usually quite sharp and seldom of a gradational nature. The surface is quite irregular due to post-enrichment faults and rock pemeability variations. This surface parallels the modern topography quite well. This means that when the modern surface was forming the climate was quite wet and a reshaping of the base of oxidation took place. Is it possible that some enrichment took place at this time? At the present time the water table is at great depth and the whole deposit is in a condition of oxidation.

The capping over the mineralized limey sediments is quite difficult to evaluate. In places chalcopyrite is left in the outcrop, but in most cases the only evidence of mineralization is open boxworks and the presence of copper pitch and green copper stain.

this is a dangerous relationship since Mo content is not related to the degree of Cu enrichment W.E.S.

A useful geochemical guide has been the presence of anomalous molybdenum values over the ore bodies. In rock samples, 20 ppm Molybdenum is considered to be anomalous and usually indicates the presence of, at least a 40 foot thickness of 0.4% copper.

Mining began in the Silver Bell district in 1865 when oxide copper ores containing some lead and silver were mined. In the early part of the twentieth century, exploration was carried out with churn-drills for low grade possibilities. In the late 1940's and early 1950's, a drilling program by A.S.A.R.C.O. confirmed the existence of the two ore bodies. Leached outcrop studies were very important in this last phase of the exploration. Production began in 1954.

<u>Operations at Silver Bell</u> Transportation of ore and waste is done by 35, 50, and 65 ton trucks. The final pit slope is 1:1. The waste to ore ratio is 1.1:1 at Oxide and 3.9:1 at El Tiro. This figure will be reduced at El Tiro because a large stripping program has just been completed. The operating cutoff is 0.4% copper but this is reduced to 0.35% at times. Exploration drilling is done on a 360 foot triangular grid, but this is reduced to 180 feet in areas of specific interest. The core recovery is usually greater than 90%.

The mill capacity varies from 11,000 to 12,000 tons per day. The recovery is 82%. This poor recovery is due in part to post-mine oxidation and the fine-grained nature of the chalcocite. The leaching operation has produced approximately five million pounds of copper to date.

Robert Cummings

Robert Cummings

RBC:ir