EDMOND F. LAWRENCE
MINING GEOLOGIST
TELEPHONE 747-3333
P. O. BOX 8044
UNIVERSITY STATION
RENO, NEVADA 89507

September 24, 1971

To: Mr. Roscoe Smith
Office of Minerals Exploration
United States Geological Survey
Menlo Park, California

Re: OME-6854

Subject: Recommendations for further Induced Polorization (IP) surveys over the Good Hope area, Elko County, Nevada.

It has been recommended that the proposed exploration program for disseminated silver deposits at Good Hope, Nevada, be modified to include further induced polorization (IP) surveys in an effort to further delineate the IP anomalies. These additional IP surveys should give additional data for use in selecting the most favorable sites for drilling under the proposed drilling program. These surveys should precede and be in addition to the previously recommended drilling program. Mr. Alexander von Hafften has reviewed these proposals and they meet with his approval.

It is hereby proposed that six (6) additional lines, approximately 4,500 feet long, be run parallel to the traverses previously surveyed by Richard Knox and shown on Plate 1 of the original application. These traverses should be made at approximately 200 feet on each side of lines A, B, and F.

Two bids have been submitted by McPhar Geophysics and by Heinrichs Geoexploration Company. The bid by Heinrichs Geoexploration Company appears to be the most favorable. Mr. Richard Knox is now associated with Heinrichs, and could be most helpful if assigned to the surveys.

If the Heinrichs bid is accepted, the cost of six (6) lines of 4,500 feet each would cost between $2,950.00 and $5,000.00 depending on mobilization charges and availability of crews. McPhar Geophysics' bid would also be less than $5,000.00 for these proposed lines. The modified estimated cost of the project would be increased to $24,957.00.

Each bid was based on six (6) lines of 4,500 feet in length, with 300-foot dipole spacing.

RECEIVED
OCT - 1 1971
OFFICE OF MINERALS EXPLORATION
U.S. GEOLOGICAL SURVEY
MENLO PARK, CALIF.

GREAT BASIN EXPLORATION COMPANY
3898 WASHINGTON STREET
SAN FRANCISCO, CALIFORNIA 94118

October 25, 1971

Mr. Roscoe Smith
Office of Mineral Exploration
United States Geological Survey
345 Middlefield Road
Menlo Park, California

RE: OME-6854

Dear Mr. Smith:

You will find enclosed the following:

1. Five (5) executed copies of the "Lien and Subordination Agreements" from Allied Properties dated October 21, 1971.

2. A balance sheet as of December 31, 1970 for the Great Basin Exploration Company.

3. A bid from Manuel Vega of the Vega Construction and Trucking Company dated October 15, 1971 with respect to the cost of bulldozer work at the Good Hope property.

As soon as I receive the bid from the Damele Brothers Construction Company of Pine Valley, Nevada I will forward it to you: I expect it early this week.

Kindly let me know if you need any additional information.

Very truly yours,

Alexander von Hafften

AVH:CAI

Enclosures

RECEIVED
OCT 26 1971
OFFICE OF MINERALS EXPLORATION
U.S. GEOLOGICAL SURVEY
MENLO PARK, CALIF.

STATEMENT

DAMELE BROS. CONSTRUCTION
Hay Ranch
CARLIN, NEVADA 89822

Phone 754-6897

DATE
October 23, 1971
NUMBER

RECEIVED
OCT 27 1971
OFFICE OF MINERALS EXPLORATION
U.S. GEOLOGICAL SURVEY
MENLO PARK, CALIF.

MR. ALEXANDER VON HAFTTEN
3898 Washington St.
San Francisco, Calif. 94118

TERMS

PLEASE DETACH AND RETURN WITH YOUR REMITTANCE $ _____

DATE	CHARGES AND CREDITS	BALANCE	
	BALANCE FORWARD		
	Please find enclosed our bid for work on the Good Hope property North of Elko.		
	14A D8 Cat with Angle Dozer and Hydraulic Rippers $30 Per Hour.		
12.5 mi. one way	Transportation of Cat $1 Per Mile one way.		
	According to Ed Lawrence it would be between 18-24 hour job. Being such a small job and so far away the rates are higher.		
	On any job within the State over $2,000. we charge $25 per hour for the Dozer and there is no Transportation charge.		
	Our Business Procedure requires that we have the first 8 hours or $240 as a deposit.		

DAMELE BROS. CONSTRUCTION

Thank You

PAY LAST AMOUNT IN THIS COLUMN

PHONE 738-5381

VEGA CONSTRUCTION AND TRUCKING

EXCAVATING CONTRACTOR

514 SO. 4TH ST. P. O. BOX 1142
ELKO, NEVADA 89801

Oct. 15, 1971

Alexander Haphin
3898 Washington St.
SanFrancisco, California 94118

Dear Sir;

In regads to our telephone conversation last night you ask if I would send you some prices on the hourly rates of my Catipillers.

The D7 rental is $ 20.00 per Hr. and I will charge $ 100.00 to haul it to the ~~Ranch~~. Mine

The D8 rental will be $ 35.00 per Hr. and the feright will be $ 150.00 to haul it to the ~~Ranch~~. Mine

Very Truly
Manuel Vega

GREAT BASIN EXPLORATION COMPANY
(A Sole Proprietorship)
San Francisco, California

BALANCE SHEET
AS OF DECEMBER 31, 1970
(Unaudited)

BARLOW, DAVIS & WOOD
CERTIFIED PUBLIC ACCOUNTANTS
ONE CALIFORNIA STREET
SAN FRANCISCO, CALIFORNIA 94111

WM. P. BARLOW, C. P. A.
H. VANNOY DAVIS, C. P. A.
THOMAS S. WOOD, C. P. A.
JOSEPH E. A. SAUER, C. P. A.
DAN L. SHEHI, C. P. A.
WM. P. BARLOW, JR., C. P. A.
MICHAEL FOWLER, C. P. A.

BARLOW, DAVIS & WOOD
CERTIFIED PUBLIC ACCOUNTANTS

ONE CALIFORNIA STREET
SAN FRANCISCO 94111
(415) 391-3350

Disclaimer of Opinion

The accompanying balance sheet of Great Basin Exploration Company for the year ended December 31, 1970 was not audited by us and accordingly we do not express an opinion on it.

Barlow, Davis & Wood

May 28, 1971

GREAT BASIN EXPLORATION COMPANY
(A Sole Proprietorship)
BALANCE SHEET
AS OF DECEMBER 31, 1970
(Unaudited)

ASSETS

Cash		$ 42
Mining claims located in Nevada, at cost:		
Talapoosh	$ 2,107	
Aurora	988	
Golden Arrow	235	
Olympic	872	
Good Hope	1,548	
Jessup	256	
Rosebud	200	6,206
Total assets		$ 6,248

PROPRIETOR'S EQUITY

A. Von Hafften capital balance as of December 31, 1970	$ 6,248

BARLOW, DAVIS & WOOD

GREAT BASIN EXPLORATION COMPANY
(A Sole Proprietorship)
NOTES TO BALANCE SHEET
AS OF DECEMBER 31, 1970
(Unaudited)

Note 1: Contingent Assets and Liabilities

The Company owns a lease on mining claims adjacent to the Good Hope claims. To maintain the lease they must perform annual assessment work which costs a minimum of $2,000 per year.

DESCRIPTION OF GOOD HOPE SAMPLES
(All from T.41N., R.49E., MDM)

Sample Number & Total Value*	Location (See Geol. Map)	Description
AL-02-41-49-1 $23.10/ton	Just E. of center of E½ of Sec. 2; at pit 35' E. of vert. shaft.	Selected sample of quartz vein two feet wide with visible sulfide crystals.
AL-02-41-49-2 $16.68/ton	SE¼ofSE¼ of Sec. 2; at caved shaft.	Pieces of vein quartz from dark dump
AL-09-41-49-1 $1.03/ton	Near center of SE¼of NW¼ of Sec. 9.	Sample of old waste dump from caved shaft; rusty, silicified rhyolite & chert.
AL-09-41-49-2 $0.53/ton	(same as above)	Pieces of vein quartz from old dump.
AL-09-41-49-3 $0.17	Just E. of Chino Crk. in W½ofNW¼ofSE¼ of Sec. 9.	Vein quartz float from wide fault zone in altered andesite.
AL-09-41-49-4 $0.90	West trench in N½ofNW¼ ofNE¼ of Sec. 9.	Vein quartz pieces from trench dump.
AL-09-41-49-5 $0.73	East trench & nearby pit in N½ofNW¼ofNE¼ of Sec. 9.	Pieces of vein quartz from pit and trench dump.
AL-09-41-49-6 $61.79	"Central" area main dump just west of shaft with water @ 40'; near center of W½ofNE¼ of Sec. 9.	Pieces of vein quartz from old dump.
AL-09-41-49-7 $8.10	(same as above)	Composite sample of old waste dump taken at several places with shovel.
AL-09-41-49-8 $14.71	Dumps from two caved shafts in NE¼of...¼of NW¼ of Sec. 9; at "West" area, north workings.	Pieces of vein quartz from old dumps.
AL-09-41-49-9 $0.00	(same as above; at pit)	Limestone from Eastern Assemblage rocks of lower plate of Roberts Thrust.
AL-09-41-49-10 $0.00	N½ofNE¼ of Sec. 9	Bright green altered andesite float.
AL-16-41-49-1 $33.18	Buckeye & Ohio mine in E½ofNE¼ofSW¼ of Sec.16.	Selected vein quartz from old ore bin.

* @ $1.29/oz

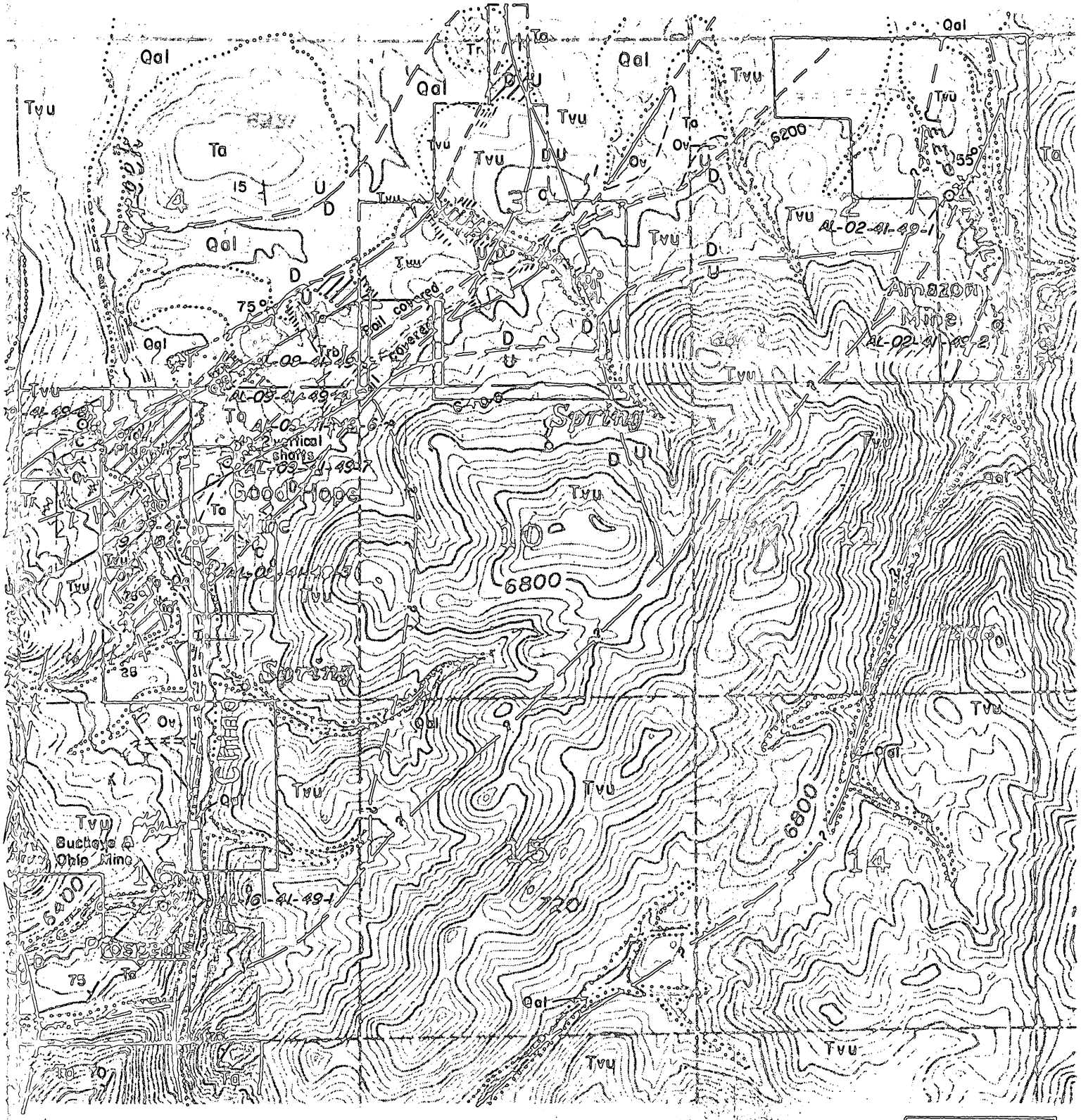
Description of Good Hope Samples (continued)

Sample Number & Total Value*	Location (See Geol. Map)	Description
AL-09-41-49-11 $2.09	SE$\frac{1}{4}$ of NW$\frac{1}{4}$ of Sec. 9	Composite sample of old waste dump taken at several places.
AL-09-41-49-12 $2.92	NE$\frac{1}{4}$ of NW$\frac{1}{4}$ of NW$\frac{1}{4}$ of Sec. 9	Composite sample of old waste dump taken at several places.
AL-16-41-49-2 $5.23	E$\frac{1}{2}$ of NE$\frac{1}{4}$ of SW$\frac{1}{4}$ of Sec. 16	Composite sample of old waste dump taken at several places.

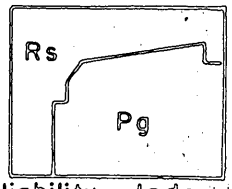
* @ $1.29/oz.

ROPERTIES — AREAL ECONOMIC GEOLOGY —

R. 49 E.



Topographic Base: U.S. Geological Survey Sheets
Mt. Blitzen Quadrangle, 1956



2000 Feet

CONTOUR INTERVAL: 40 FEET

Reliability Index
Rs... Reconnaissance
Pg... Photo geolog

1142 HOWARD STREET • SAN FRANCISCO, CALIFORNIA
UNDERHILL 3-8575

REPORT OF ASSAY

Submitted by Mr. William A. Oesterling
1131 Westwood Street
Redwood City, California

Date July 18, 1966

Sample of Ore

LABORATORY NO. 6151

MARK	GOLD, PER TON OF 2,000 LBS.		SILVER, PER TON OF 2,000 LBS.		Copper %	Antimony %
	TROY OUNCES	VALUE AT $35.00 OZ.	TROY OUNCES	VALUE @ $1.29/oz		
AL-02-41-49-1	0.02	0.70	17.37	22.40		
AL-02-41-49-2	0.015	0.52	12.53	16.16		
AL-09-41-49-1	0.005	0.17	0.67	0.86		
AL-09-41-49-2	0.005	0.17	0.28	0.36		
AL-09-41-49-3	0.005	0.17	Trace			
AL-09-41-49-4	0.02	0.70	0.16	0.20		
AL-09-41-49-5	0.015	0.52	0.17	0.21		
AL-09-41-49-6	0.025	0.87	47.23	60.92		
AL-09-41-49-7	0.005	0.17	6.15	7.93	0.012	
AL-09-41-49-8	0.015	0.52	11.00	14.19	0.002	
AL-09-41-49-9	Trace		Trace			
AL-09-41-49-10					0.001	
AL-16-41-49-1	0.035	1.22	24.78	31.96		0.96*
AL-35-44-52-1	Trace		0.13	0.16		Not applicable to this report
AL-35-44-52-2	Trace		Trace		0.032	
AL-36-44-52-1	Trace		Trace			
AL-36-44-52-2	Trace		Trace			

* Arsenic present

METALLURGICAL LABORATORIE

By [signature]

Geological Report

GOOD HOPE MINING DISTRICT

Elko County, Nevada

by

Anthony L. Payne

August, 1967

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Plate I.	Geologic Map of the Good Hope mining district	(appended)

GOOD HOPE MINING DISTRICT

Elko County, Nevada

INTRODUCTION

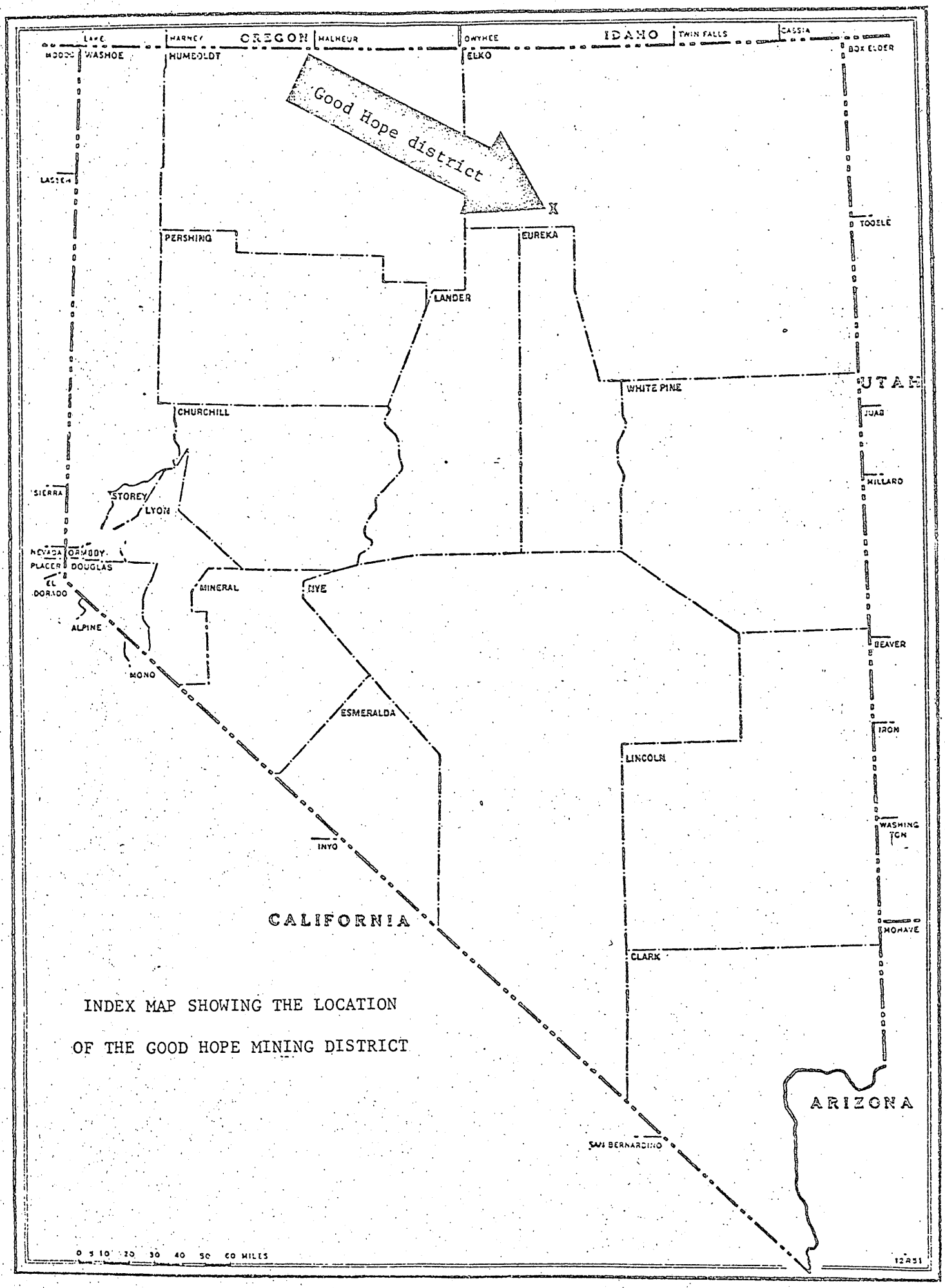
The Good Hope mining district is one of 27 precious metal* districts which were soil sampled during 1964 in a program of geochemical reconnaissance by Great Basin Exploration Company, of Reno, Nevada. This field and laboratory investigation was based on the premise that arsenic is a reliable guide to precious metal mineralization in epithermal veins in Tertiary volcanics of the Basin and Range Province. The concepts and methods employed in this study are described in detail in a report by the writer dated July, 1967 (Please see reference list appended to report).

The present report summarizes the results of reconnaissance and detailed geochemical work, describes the geology of the area, and sets forth specific exploration recommendations.

LOCATION

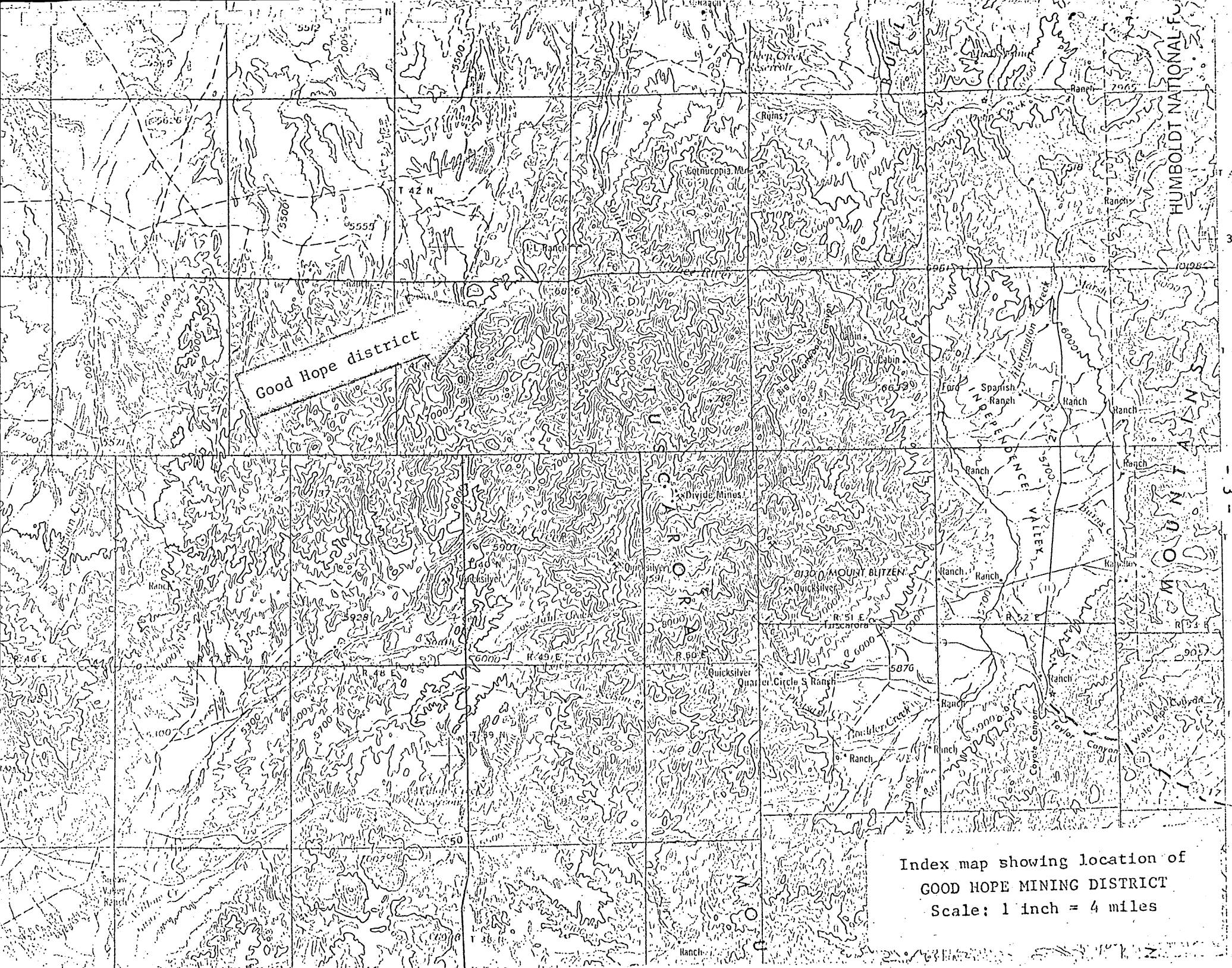
The Good Hope mining district is at the northern base of the Tuscarora Mountains, in north-central T. 41 N., R. 49 E., in Elko County, Nevada.

*Note: To avoid the somewhat tedious and artificial terminology that has developed over the years with reference to gold, silver, gold-silver, and silver-gold deposits (see Ferguson, 1929), the term "precious metal" will be used in this report to denote a mine that produces gold and/or silver.

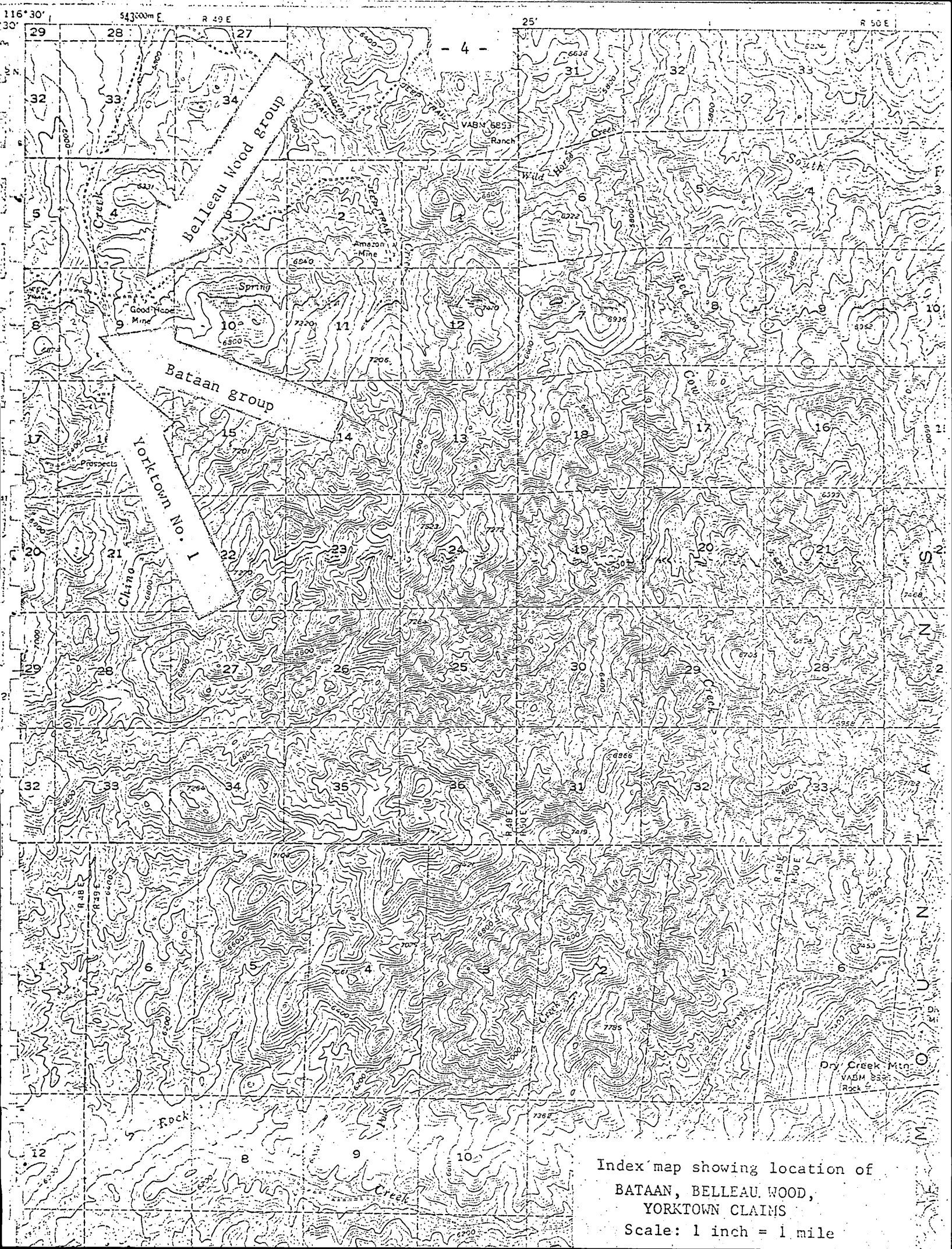


INDEX MAP SHOWING THE LOCATION

OF THE GOOD HOPE MINING DISTRICT



Index map showing location of
GOOD HOPE MINING DISTRICT
Scale: 1 inch = 4 miles



Index map showing location of
BATAAN, BELLEAU WOOD,
YORKTOWN CLAIMS
Scale: 1 inch = 1 mile

Chino Creek, a minor tributary of the South Fork of the Owyhee River, flows through the district. The topography is moderately subdued and rounded, and the entire region is utilized as open range by the Allied Livestock Company. Allied has constructed a shearing pen and operates a temporary camp in north-central Section 9, at an elevation of just under 6000 ft. This pen and camp can be seen in the central foreground of Figure 4 (on the following page) photographic view of Good Hope Mine, taken eastward from northwest Section 9 across Chino Creek.

Good Hope is 16 miles airline northwest of Tuscarora, and can best be reached by driving north from Elko on State Highways 51 and 11 past the Jack Creek Ranch to Deep Creek, where the pavement ends. Four miles on a good gravel road past Deep Creek (on State Highway 11), a dirt road turns to the west 22 miles, passing the I-L Ranch to a point just east of the Wolf Creek Ranch, thence southeast 3 miles over a rough jeep trail to the shearing pen at the mouth of Chino Creek Canyon, in the north-central Good Hope mining district.

An alternate access to the district, from the west, is via Golconda, Midas, and Squaw Valley. The pass in T. 40 N., R. 47 E. over the Tuscarora Mountains is impassable much of the year.

SITUATION

The climate of the area is not typical of Nevada. Because of the northerly latitudes and higher elevation of the area low mean annual temperatures and relatively high rainfall have combined to form a good, deep soil and the major stream courses flow water during much of the year. Springs are common, and enough grass is available to support cattle

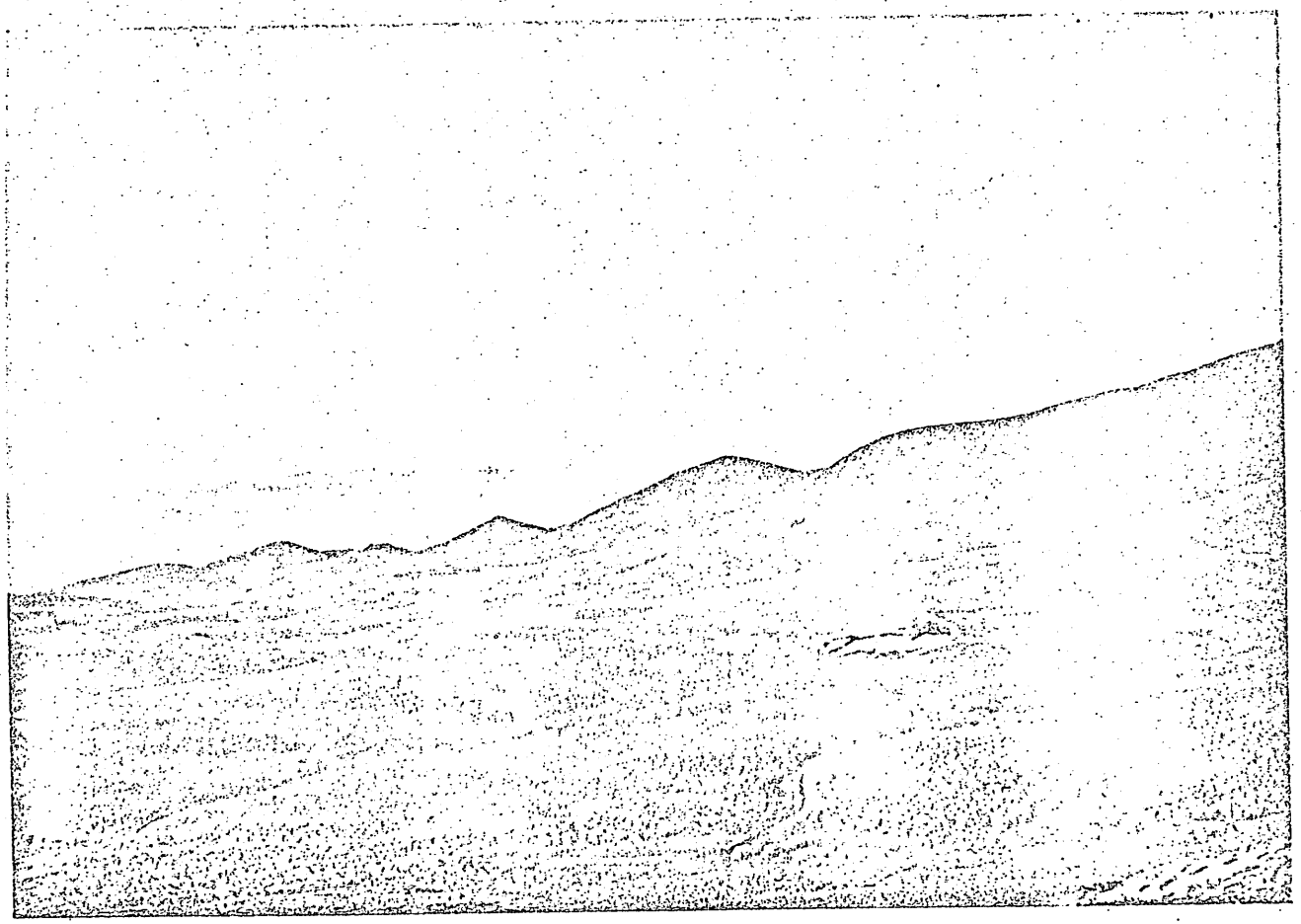


Figure 4. VIEW OF GOOD HOPE MINE (taken eastward from northwest Section 9 across Chino Creek)

grazing all summer. There are no trees in the mineralized areas, but higher up on the slopes of the Tuscarora Mountains, aspen groves can be found in protected small pockets and basins.

Because of the condition of the roads, work may be hindered during the winter and early spring season. The region has been completely snow-bound a number of times during the past decade.

No timber is suitable for saw lumber. Adequate water is available for mining and milling. The district is far from electrical lines, and the only inhabitants of the region are engaged in sheep and cattle ranching, principally as conducted by the Allied Livestock Company, who control most of the land in the region.

HISTORY OF THE DISTRICT

The Good Hope mining district was discovered in 1878 (Lincoln, 1923, p. 46). The principal mines were the Buckeye and Ohio, the Snyder, and the Page and Kelley. During the early eighties, these properties produced about $100,000 in silver (Emmons, 1910, p. 65-66). During the 1920's, a small shipment of silver ore was made from the Midnight mine (Mineral Resources Yearbook, 1921, p. 381). Of these various properties, only the Buckeye and Ohio has been positively identified on the ground. This mine, in central Section 16, is the most extensively developed property in the district, consisting of a 300 ft. adit, with several winzes, many raises, and a number of stopes through to the surface. Since the drastic fall in price of silver during the late 1920's, there has been no activity in the district. The most recent published reference to the area (Granger, et. al., 1957, p. 72-73) contains only a digest of the references cited above.

In the general region of the Good Hope mine, much attention has recently been focused on old precious metal districts, of whatever type, because of Newmont Mining Company's discovery of a major open-pit gold mine in an old precious metal district having a very small past production record. This new mine, the Carlin, is reported to contain more than 10 million tons of ore averaging better than $12 per ton in gold. The gold is so finely dispersed in the ore that earlier prospectors were unable to detect its presence by panning.

The Carlin mine lies 35 miles a little east of due south of Good Hope. The property is fully developed and in production as one of the largest producers of precious metal in the United States.

PROPERTY OWNERSHIP

No mining claims have ever been patented in the Good Hope mining district. At the time of Great Basin Exploration Company's first interest in the area, the land ownership consisted of U. S. public domain, a few Stock Raising Homesteads, and various tracts that had been patented to the State of Nevada and subsequently passed into private ownership. Allied Livestock Company has over the years purchased all of the various private lands. The situation at the time of Great Basin Exploration Company's entry into the district is portrayed on Figure 5 on the following page. An explanation of the tract symbols is as follows:

Symbol	Description	Status
A	NE¼ and SE¼ Sec. 4; E½ of SE¼ and NE¼ Sec. 9; NW¼ and SW¼ Sec. 10	Public Land.
B-1	W½ of SW¼ Sec. 4 NW¼ of NW¼ Sec. 9	State Selection Lieu Lands-Act of June 16, 1880. Patent No. 8274 Altube, July 16, 1916.

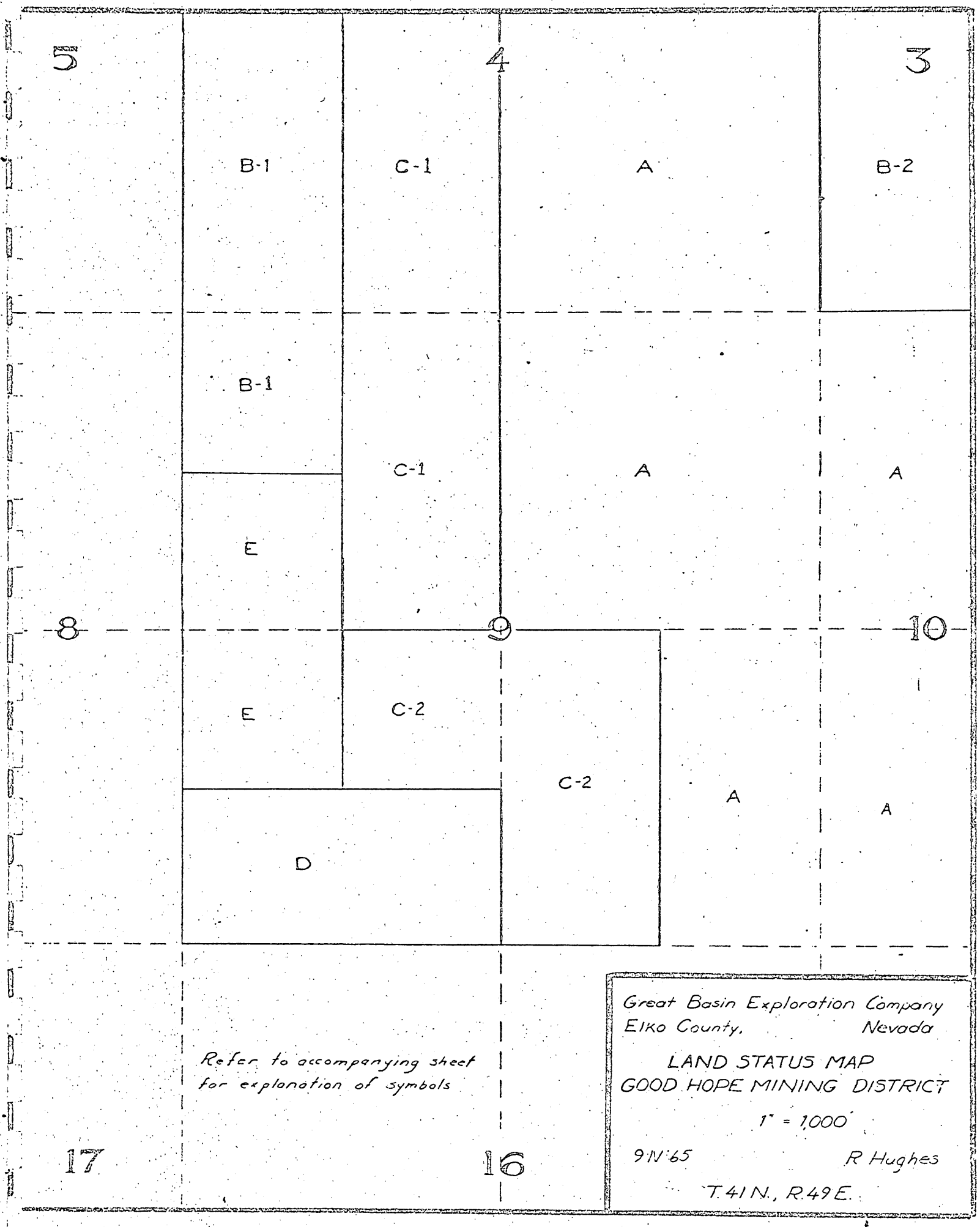

5
4
3
B-1
C-1
A
B-2
B-1
C-1
A
A
E
8
9
10
E
C-2
C-2
A
A
D
Refer to accompanying sheet for explanation of symbols
17
16
Great Basin Exploration Company
Elko County, Nevada
LAND STATUS MAP
GOOD HOPE MINING DISTRICT
1" = 1,000'
9 IV 65
R Hughes
T. 41 N., R. 49 E.

Figure 5

B-2	S½ of SW¼ and NW¼ of SW¼ Sec. 3	State Selection Lieu Lands. Patent No. 5236 Parkinson June 3, 1904
C-1	E½ of SW¼ Sec. 4 E½ of NW¼ Sec. 9	State Selection Education Grant Acts of July 4, 1886, June 8, 1868 Patent No. 955 Perrin, October 21, 1875
C-2	NE¼ of SW¼ and W½ of SE¼ Sec. 9	State Selection Education Grant Acts of July 4, 1886, July 8, 1868 Patent No. 1400 Frazer, April 1, 1880
D	S½ of SW¼ Sec. 9	Stock Raising Homestead Patent April 6, 1922
E	SW¼ of NW¼ and NW¼ of SW¼ Sec. 9	Stock Raising Homestead Patent November 12, 1925

In consultation with Reno attorney Howard Gray, it was decided to stake claims over the former State lands, because of the Nevada Statute permitting prospecting and development of unfenced, undeveloped lands. The following claims were staked in 1965, covering the area of prime interest as indicated by geochemical work (for details see later section of report):

Bataan Nos. 1 through 4, inclusive
Belleau Wood Nos. 1 through 5, inclusive
Yorktown No. 1

These claims are shown on the claim plat, Figure 6, on the following page. Also shown are three additional claims; Bataan No. 5, Bataan No. 6, and Yorktown No. 2, which were staked this year.

Immediately after Great Basin Exploration Company staked the initial claims, two individuals staked around the block, to the north and northwest. Northwest of the Bataan group, J. D. Murdock of Winnemucca staked the Ruby Silver group on May 25, 1965. He has not perfected his locations, nor has he done the annual labor that is due. Along the north-central

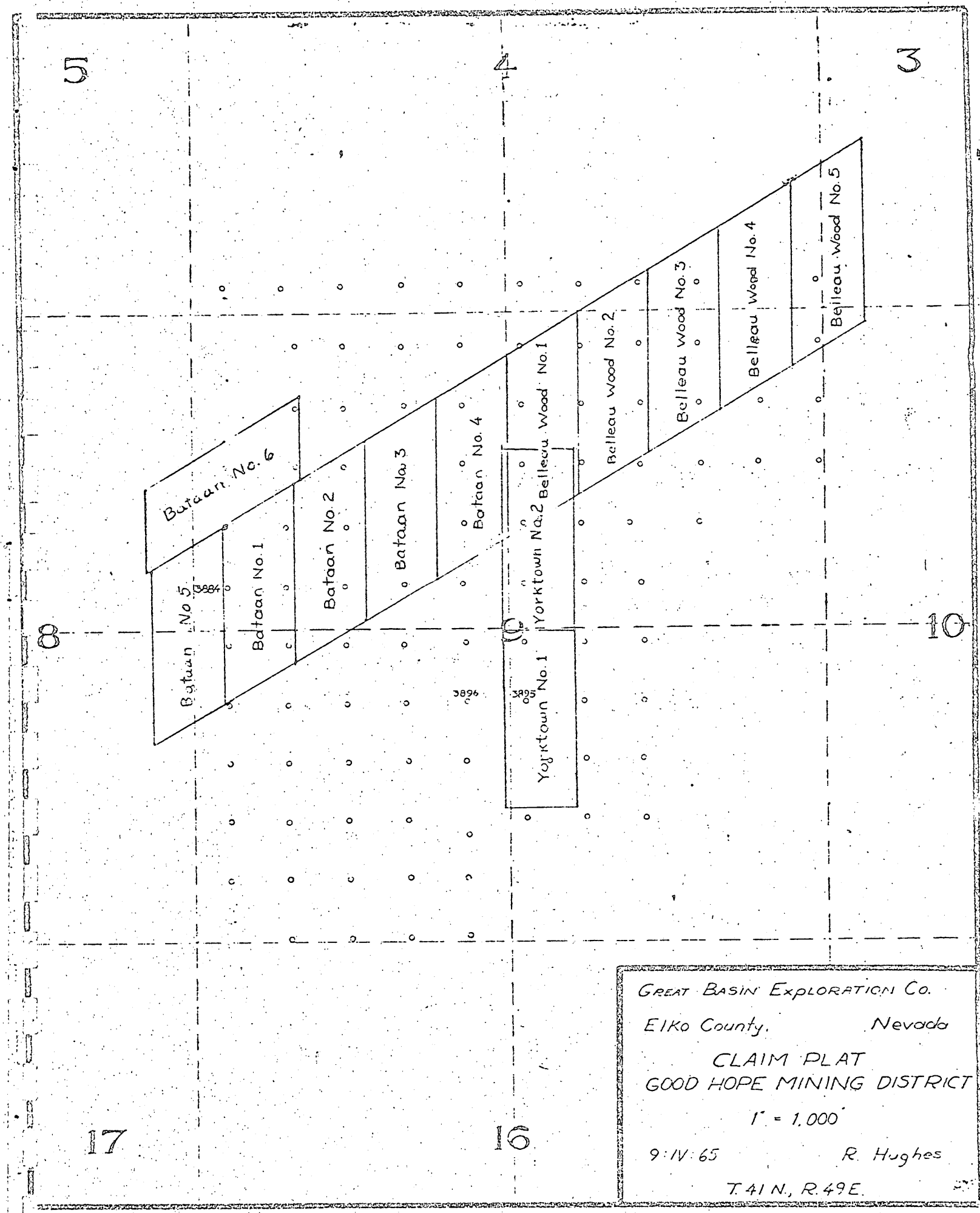

5
4
3
8
9
10
17
16
Bataan No. 6
Bataan No. 5
Bataan No. 1
Bataan No. 2
Bataan No. 3
Bataan No. 4
Belleau Wood No. 1
Yorktown No. 2
Yorktown No. 1
Belleau Wood No. 2
Belleau Wood No. 3
Belleau Wood No. 4
Belleau Wood No. 5
3884
3896
3895
GREAT BASIN EXPLORATION CO.
Elko County. Nevada
CLAIM PLAT
GOOD HOPE MINING DISTRICT
1" = 1,000'
9:IV:65
R. Hughes
T. 41 N., R. 49 E.

Figure 6

portion of the Bataan-Belleau Wood group, Charles B. Welch of Battle Mountain staked the Silver Virgin group on June 27, 1965. He has perfected the locations and has performed his annual labor, for the assessment year closing September 1, 1967.

After staking the original claims, Great Basin Exploration Company contacted Allied Livestock and attempted to come to terms with them on all of their ground thought to be of interest. They apparently consulted with the Southern Pacific and quoted the railroad's relatively unreasonable terms. Once alerted to activity in the area, Allied Livestock retained Wm. H. Hisle of Reno to stake all of the open ground around Great Basin's original holdings. This was done during 1966. When Great Basin filed the affidavit of annual labor for the assessment year ending September 1, 1966, Hisle contacted Great Basin, proposing that a deal be negotiated between the two companies, and that the prospect be presented to a major mining company for exploration. Nothing has come of this suggestion, for Allied's terms were once again thought to be unreasonable.

It is certain that any claims staked by Allied over the Silver Virgin ground are invalid, and that open fractions now exist where the claims do not coincide. There are likely other intervening locators, and the property situation has become complicated enough to require a complete study and search of the county records in Elko before any kind of negotiation can be undertaken with one company to take over the properties in their entirety.

GEOLOGY

General

No modern geologic investigations have been made in the vicinity of the Good Hope Mine, since the reconnaissance work of Emmons (1910, p. 65-66).

To the east, a recent report by Decker (1962) summarizes the geology of the Bull Run area. To the south, the detailed work of Nolan (1936) is the nearest area described geologically. To the southwest, the work of Rott (1931) at Midas is the only study that is close enough to be helpful. The regional work of Roberts and others (1958) provides an invaluable background for correlation with large scale geologic features of the northern Basin and Range Province. These various studies provide a rather good geologic framework, without which many of the details observed at Good Hope would be difficult, it not impossible, to interpret.

Immediately to the north of Good Hope, the relatively subdued flat plain has been given the unlikely name Owyhee Desert. The streams of the region join the Owyhee River, which in turn empties into the Snake, one of the principal tributaries of the Columbia River. This broad surface is actually a portion of the southernmost Columbia Plateau, the relatively recent lava flow that covers all of eastern Oregon and a good share of the surrounding area. The rocks of the Columbia Plateau consist of a series of young intermediate to basic eruptive rocks, and a variety of interbedded fluvial and lacustrine sediments. No epigenetic ore deposits are known to occur in this sequence, and no further mention will be made of these younger, post-ore rocks.

The main mass of the Tuscarora Range consists of a sequence of rhyolitic flows, which have been eroded away at a number of places to expose underlying Paleozoic sedimentary rocks or Tertiary granitic intrusives. At the mining camps of Tuscarora, Cornucopia, Good Hope, and Falcon (Rock Creek) the rhyolite is reportedly cut by bodies of intrusive andesite

(Emmons, 1910, p. 58). All of the ore in the above-named districts comes from silver-bearing fissures of the Tertiary group, and are in andesite or in rhyolite near intruding andesite. The nearest mine producing from the older underlying sedimentary rocks is the Carlin Gold Mine.

Sedimentary rocks

As can be seen on Plate I, Geologic Map of the Good Hope Mining District (appended to this report), two erosional windows cut through the Tertiary volcanics, exposing black chert and shale, and marine limestone of probable Paleozoic age. One such exposure is at the southeast corner of the Yorktown No. 2 claim, the other is at the north end of the Bataan No. 2 claim. It is likely that these Paleozoic exposures are much larger than shown on the map, for the Quaternary slope wash over much of the surrounding area contains unusually large amounts of black chert. As will be described below in more detail, these rocks are probably in thrust relationship, and the black shale and chert represent siliceous facies Ordovician thrust westward along the Roberts Mountain overthrust over marine carbonates of probable Silurian or Devonian age.

Siliceous facies (upper plate) Ordovician.--Although no fossils were found, it is quite probable that these rocks are much the same as Decker's (1962, Plate I) "western assemblage", east of Good Hope some 20 miles.

> ".....dark gray, brown, and black cherts and siliceous argillites; also light gray quartzite and minor limestone members; meta-volcanics in the Trail Creek and Jack Creek areas....."

Likewise, the Paleozoic quartzite mapped by Nolan (1936) under volcanics of the Tuscarora district is probably an Ordovician or older silceous facies, upper plate unit.

In the Rock Creek district (Falcon Mine), there is a sequence of upper plate siliceous rocks, and a large mass of granitic rock is reported at the head of Willow Creek nearby.

Although Roberts, et. al. (1958, Figure 4) show many upper plate exposures in the region surrounding the Good Hope district, no lower plate carbonate rocks have been recognized anywhere much closer than Carlin. However, the Good Hope district is well within Roberts' inferred thrust zone, and knowledge of this new window area will be greeted with enthusiasm by regional geologists. It will provide just that much more control to establish the continuous nature of the Roberts Mountain thrust. Roberts (1958, p. 2832) recognizes two siliceous facies Ordovician formations, the Vinini and the Valmy. The two formational names are a result of independent geologic work at the two type localities. Actually, they are difficult to distinguish in individual outcrop, and it is quite likely that they are at least in part equivalent to each other. In general the Valmy contains more quartzite and gives way eastward to thinner and finer-grained rocks of the Vinini. The lower part of the Vinini includes quartzite, limestone, and calcareous sandstone, and shaly sediments with minor amounts of andesitic lava flows and tuffs. The Upper Vinini is composed of bedded chert and black organic shale. The lower part of the Valmy contains a large proportion of quartzite, and much greenstone. For the purposes of this report, no formation name will be used, and the upper plate rocks will simply be referred to as siliceous facies Ordovician.

Carbonate facies (lower plate) Silurian-Devonian.--No fossils were collected from the carbonate rocks exposed in the small erosional windows of the Roberts Mountain thrust. The limestone is clean, thin-bedded, gray, and

finely-crystalline, and contains no obvious fossils. Chert nodules are lacking, and the over-all impression gained is that it might be somewhere in the range of the Roberts Mountain, Lone Mountain, Nevada, or Devil's Gate formations. No closer assignment can be made at this time. The entire Good Hope district is probably underlain at relatively shallow depth by this rock, and there is a possibility that low-grade gold mineralization of the Carlin type might occur in calcareous rocks under the thrust. The Roberts Mountains limestone appears to be particulary receptive to this type of mineralization, for reasons that are set forth in more detail below.

Volcanic rocks.--A variety of andesitic to rhyolitic flows, flow breccias, and tuffs comprises the main bedrock at the surface of the Good Hope district. Because of the intense local alteration, and the large amount of slope wash and surface cover, it was not possible to distinguish between these various flow units. They are shown on the map under the symbol Tv-Tertiary volcanics. From place to place, various flow structure attitudes can be seen preserved in the croppings, and it would appear that the flows have been moderately deformed, faulted to a considerable extent, and locally they are extensively altered by the hydrothermal solutions accompanying mineralization. It is believed that these flows can be no younger than late Miocene or early Pliocene.

Intrusive rocks.--Although older "Laramide" granitic intrusives have been reported immediately to the south in the Rock Creek area, no such older igneous rocks have been found cropping out in the Good Hope district. However, there are a number of andesitic dikes cutting through both Paleozoic sediments and Tertiary volcanics, and it is possible that a

considerable protion of the andesite of the district is intrusive into the entire Good Hope sequence. Emmons (1910, p. 32, 46) suggests that the mineralization of all of the silver districts in the region is related to andesitic intrusive activity. A wide variety of textures and compositions is observed in the Good Hope andesites, and it would be necessary to expose the rocks in trenches, and to obtain subsurface samples by drilling before detailed microscopic work could be expected to unravel the interrelationships.

ORE DEPOSITS

The mineralization at Good Hope is in general similar to the veins of the surrounding silver camps, of which Tuscarora is by far the most important producer.

According to Emmons (1910, p. 65) the ore is composed of quartz, pyrite, arsenopyrite, freibergite, stibnite, and dark ruby silver. The rhyolitic walls of the veins are extensively pyritized in a propylitic form of alteration, and local sericitization and argillization near veins is observed.

The lodes are found in sheeted zones in rhyolite flow breccia, although altered andesite may also form the vein walls in a few places. Masses of highly altered and silicified wall rock are found here and there as inclusions in the veins. The veins in general appear to strike NNE and NE, with moderate to steep dips to the west. A secondary stage of late barren quartz is suspected.

Terrace gravels.--There are several well-developed terraces in the district, and it is probable that at least three more mature erosion surfaces were

developed in the district. One or more of these earlier stages of erosion may be as old as Pleistocene. No attempt has been made to date the surfaces. The general poor outcrops and lack of good topographic control discourages detailed analysis of the problem. At least one of the surfaces was of considerable regional extent, for well-rounded boulders of rocks entirely foreign to the district are found scattered through the gravel. Several of the planar surfaces project out on the Owhyee Plain to the north, and small flat-topped mesas are suggestive of continuations of the terraces. It is likely that the present Chino Creek is eroding down through the most recent of a series of older erosional plains cut into the north flank of the Tuscarora Mountains. The broad terrace just a few feet above the present stream floor indicates that the rejuvenation of the stream is cyclical, or that there have been pauses in the mechanism responsible for the change in erosion cycle. Climate change may be responsible for the terrace features observed.

Correct interpretation of these geomorphologic features is a matter of considerable economic importance, for it appears that most of the mineralization has not been greatly affected by surficial oxidation. A relatively high water table has kept oxidation from attacking the sulphide minerals of the veins and the pyrite of the altered volcanic wall rocks. This is a rather unusual situation in Nevada, where the upper portions of the veins are usually thoroughly oxidized and leached. Two practical considerations immediately suggest themselves; (1) one should be cautious of geochemical comparisons between this and more thoroughly oxidized districts, although there is no reason to suspect any difficulty yet, and, (2) geophysical methods based upon the electrical, magnetic, or other

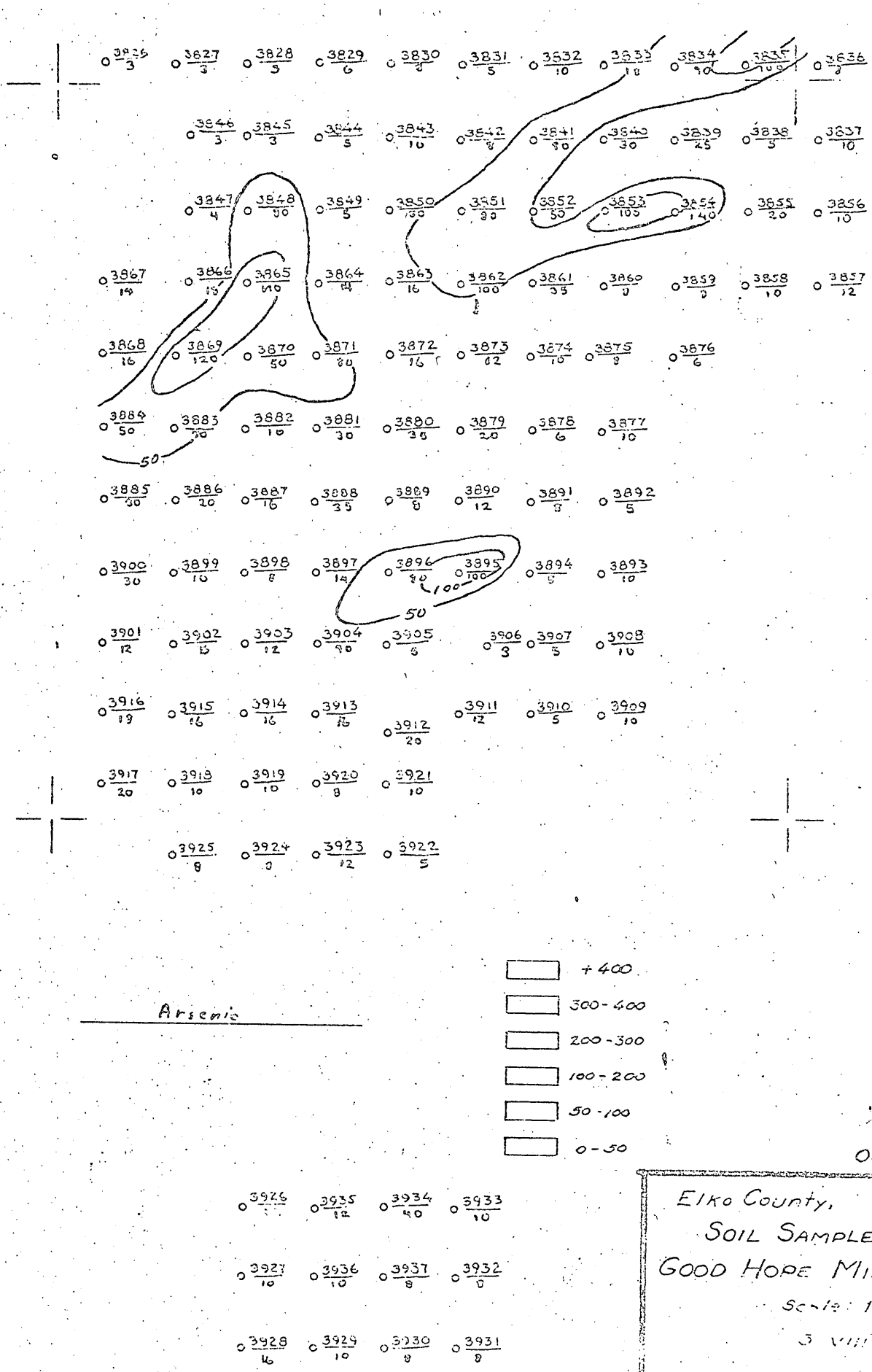
character of sulphide ore minerals might be expected to yield more definitive results here than in the typical Nevada district where the sulphides are irregularly destroyed by oxidation to unpredictable depths.

Alluvium

As erosion cuts down through each of the above-described terrace surfaces, there is a tendency for gravel to be washed out over the bedrock surfaces cut beneath. The result is an unusual amount of slope wash, which conceals outcrops and makes working with float very difficult, for the gravel rock types are usually quite varied and often completely extraneous to the district. Were it not for this relationship, the geologic map would show much more detail and much more would be known of structural relationships.

GEOCHEMISTRY

The original interest in Good Hope was the apparent similarity to Tuscarora and a number of other precious metal mining districts in the region. The district was selected for reconnaissance soil sampling to see if the geochemical behavior of arsenic might help pin-point exploration targets. One hundred and twelve samples were collected in July, 1964. These samples were for the most part in the north central portion of the district. A small number of samples were collected over the Buckeye and Ohio mine at the south end of the district. Relationships are shown on Figure 7 on the following page. Two distinct anomalies were obtained, one extending across the district from southwest to northeast, with a gap where the stream gravels of Chino Creek overly the bedrock and mask



Elko County, Nevada

SOIL SAMPLE OVERLAY

GOOD HOPE MINING DISTRICT

Scale: 1" = 1,000'

3 VIII 64

Sampled 26 & 27 VII 64

By: R. Hughes & R. Luethe

Figure 7

anomalous effects. A second smaller anomaly was detected in the central portion of the district.

Detailed geochemical work resulted in collection of 225 samples in October, 1964. The results are shown on Figure 8 on the following page. Both reconnaissance anomalies were substantiated by the follow-up work, and it was noted that all of the mineralized zones in the district correlate quite well with the geochemical configuration. Prospecting and exploration of these veins was only superficially done, apparently because of the refractory nature of the un-oxidized sulphides encountered.

The suite of detailed samples was sent to Cordero Mining Company in Winnemucca for precise determination of mercury, and the results, which correlate very well with the arsenic values, are portrayed on Figure 9 on page 23. This past winter, the sample suite was sent to Rocky Mountain Geochemical Laboratory in Salt Lake to be run for trace gold and silver by new methods of atomic absorption spectrophotometry. None of the samples showed more than 0.25 ppm gold, but the silver samples showed a pattern somewhat similar to the arsenic and mercury in soil. Experience in the region indicates that gold, if present in the underlying bedrock, is not usually leached from soils forming at the present time. On the other hand, silver appears to leach quite readily, and the soils often show only a small amount of silver as compared to the values that might be obtained at relatively shallow depth. Although the distribution of silver, arsenic, and mercury in soils seems to correspond well with the veins known to be present, and gold appears to be absent, this is not to say that an important gold-bearing deposit could not lie at relatively shallow depth in the tabular, thrust-plane environment of ore deposition.

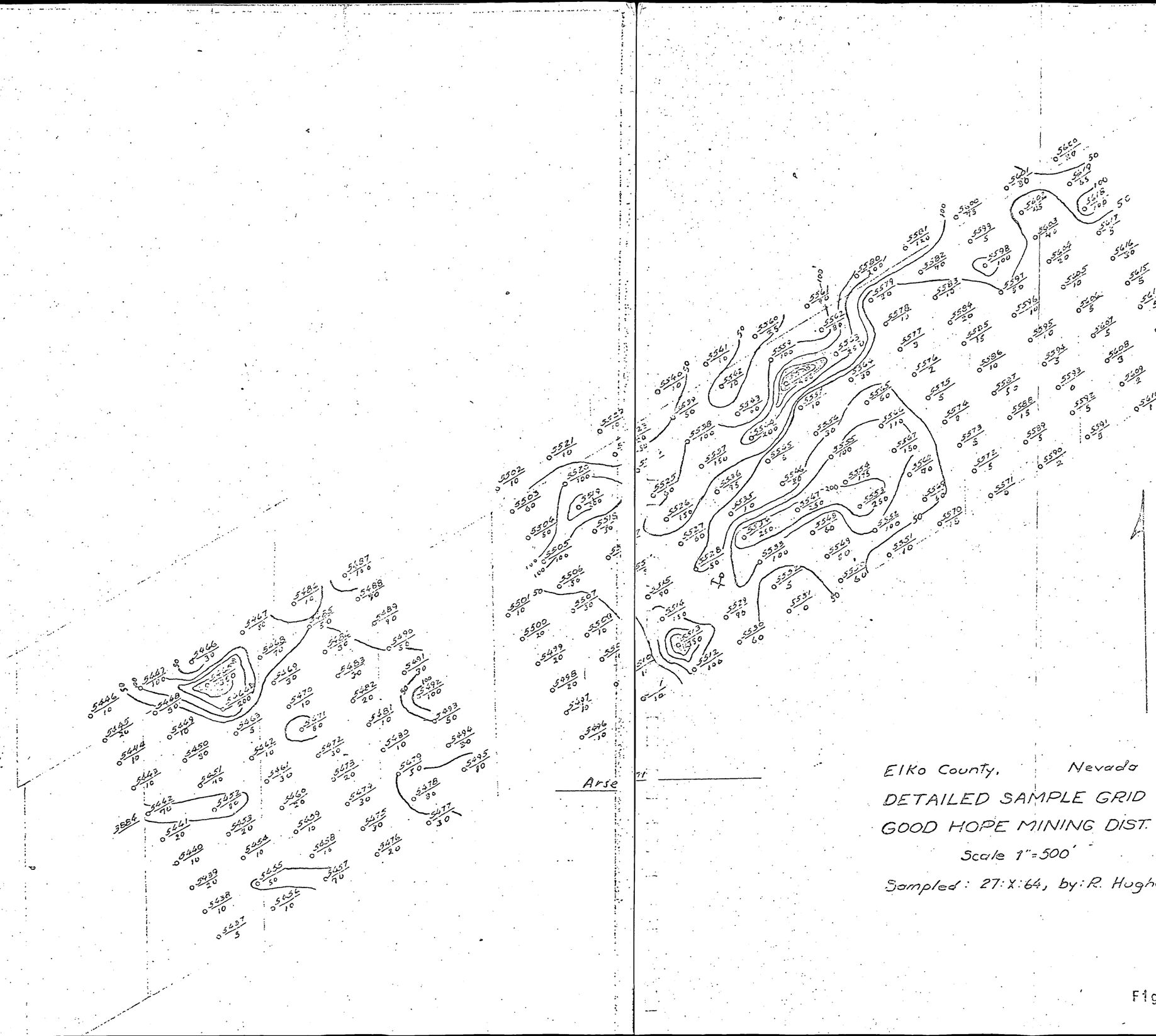
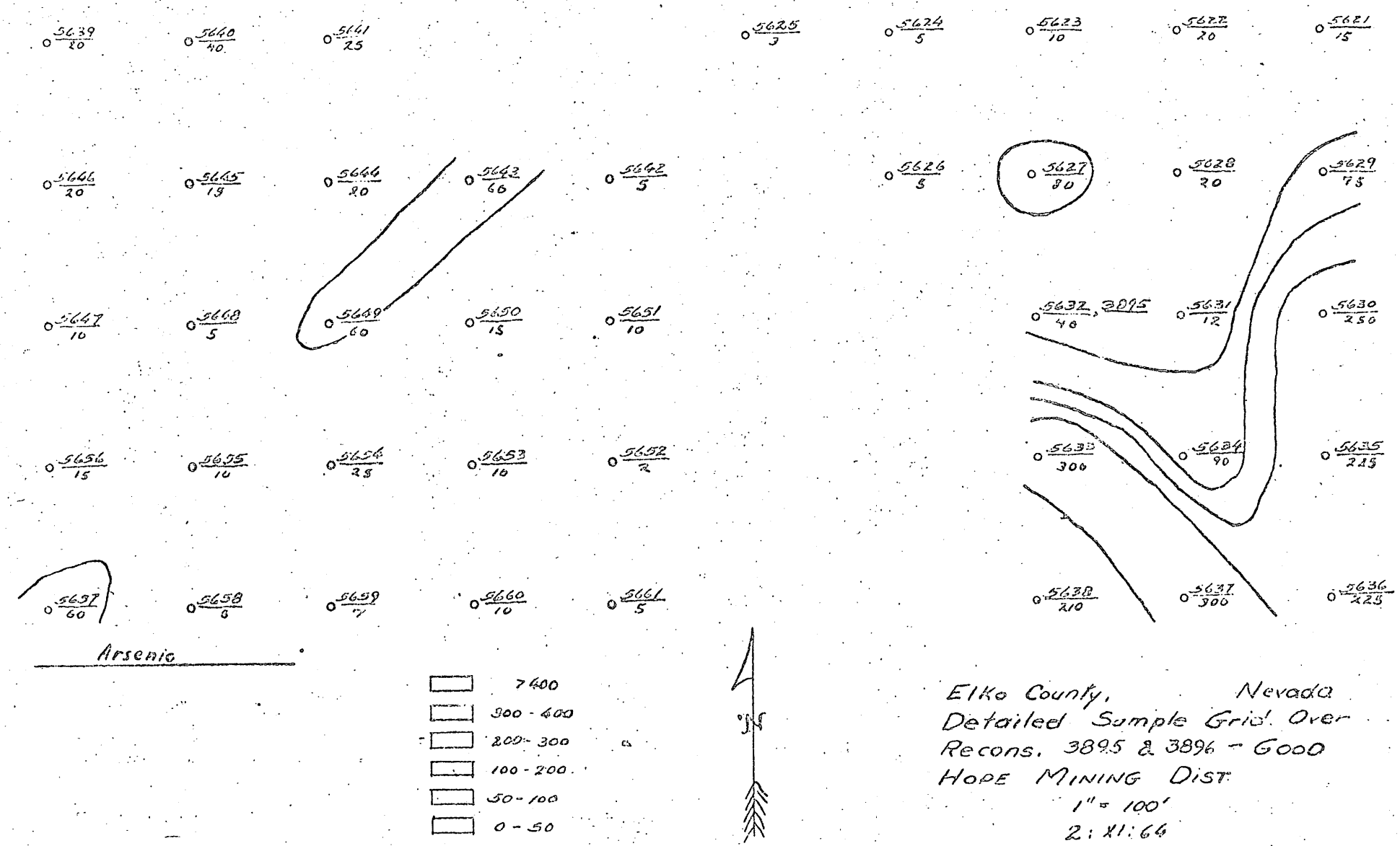

Elko County, Nevada
DETAILED SAMPLE GRID
GOOD HOPE MINING DIST.
Scale 1"=500'
Sampled: 27:X:64, by: R. Hughes

Figure 8



Elko County, Nevada
Detailed Sample Grid Over
Recons. 3895 & 3896 - GOOD
HOPE MINING DIST.
1" = 100'
2:XI:64
Sampled: 28:X:64, by R. Hughes

Figure 8

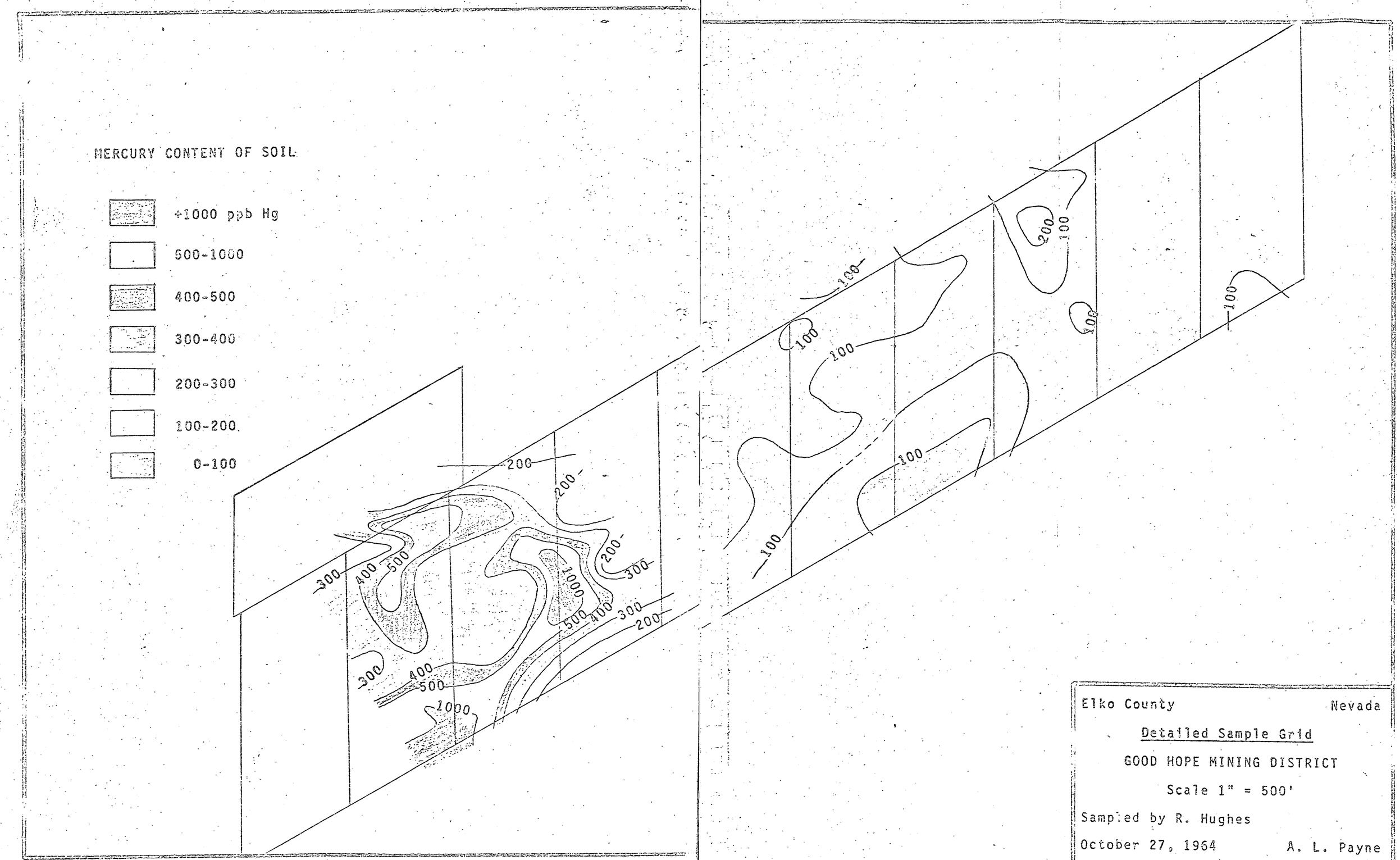

MERCURY CONTENT OF SOIL
+1000 ppb Hg
500-1000
400-500
300-400
200-300
100-200
0-100
Elko County
Nevada
Detailed Sample Grid
GOOD HOPE MINING DISTRICT
Scale 1" = 500'
Sampled by R. Hughes
October 27, 1964
A. L. Payne

Figure 9

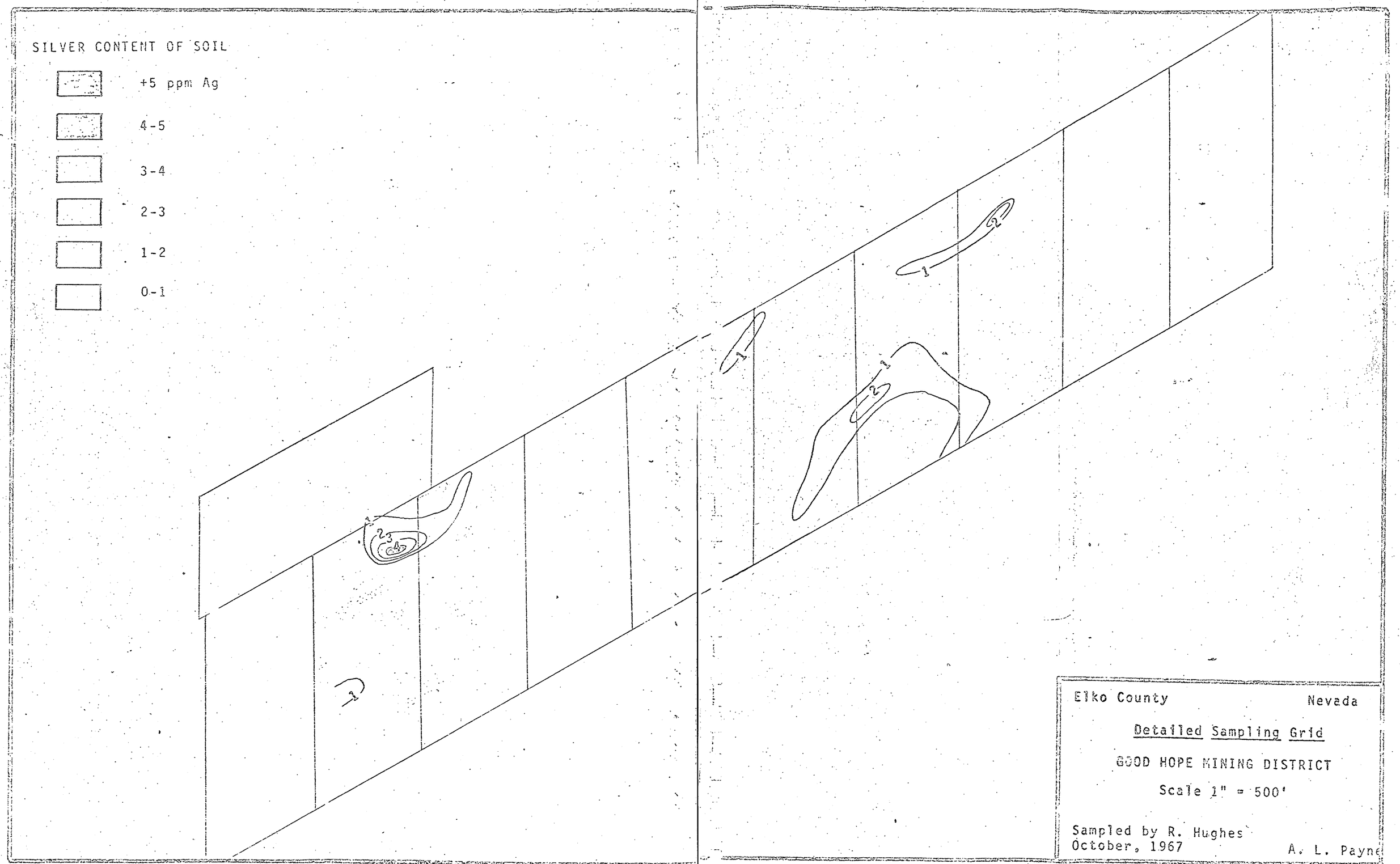

SILVER CONTENT OF SOIL
+5 ppm Ag
4-5
3-4
2-3
1-2
0-1
Elko County
Nevada
Detailed Sampling Grid
GOOD HOPE MINING DISTRICT
Scale 1" = 500'
Sampled by R. Hughes
October, 1967
A. L. Payne

Figure 10

ROCK SAMPLING

Seven rock sample sites are shown on Plate I. These samples represent chips broken from croppings, collected in old prospect pits, etc. Following is a description of the samples and a report of results:

Sample	ppm Arsenic	ppm Gold	ppm Silver	Description
1	400	ND	ND	Fragments of vein quartz on dump
2	180	0.5	9	Fragments of iron-stained quartz
3	+1000	0.6	415	Fragments of vein quartz on dump
4	NA	0.3	35	Limestone wall of vein
5	NA	1.1	380	Fragments of vein quartz
6	NA	0.3	10	Fragments of mineralized shear
7	NA	NA	180	Chip sample of vein

NA = not analyzed ND = None detected

In addition, 20 samples were run for arsenic, gold, and silver. These samples were collected from vertical percussion drill holes drilled at various places on the claim group. Following is a description of the location of the sample, and a report of results (In all cases the sample interval is the last run, in the bottom of the drill hole):

Drill Hole Number	Footage Sampled	ppm Arsenic	ppm Gold	ppm Silver	Location of Hole
1	3-10	15	N.D.	1	375' N 29½°W from DM B.W. No. 4
2	10-20	+1000	0.4	7	124' N 17°E from SWCor B.W. No. 3
3	5-10	+1000	1.4	N.D.	5' North of D.H. #2
4	10-15	30	N.D.	N.D.	225' N 17°E from SWCor B.W. No. 2
5	10-15	10	N.D.	N.D.	10' N 18°W of D.H. #4
6	10-15	55	N.D.	4	10' N 18°W of D.H. #5
7	10-15	115	N.D.	14	10' N 18°W of D.H. #6
8	10-15	15	N.D.	N.D.	10' N 18°W of D.H. #7
9	10-15	+1000	N.D.	N.D.	10' N 18°W of D.H. #8
10	10-15	+1000	0.2	N.D.	10' N 18°W of D.H. #9
11	10-15	520	0.3	N.D.	10' N 18°W of D.H.#10
12	10-15	900	N.D.	N.D.	10' N 18°W of D.H.#11
13	10-15	520	N.D.	N.D.	10' N 18°W of D.H.#12
14	10-15	180	N.D.	N.D.	10' N 18°W of D.H.#13
15	10-15	55	N.D.	N.D.	10' N 18°W of D.H.#14
16	10-15	60	N.D.	N.D.	10' N 18°W of D.H.#15
17	10-12	25	N.D.	N.D.	78' N 29°E from DM Yorktown No. 2
18	15-20	15	N.D.	N.D.	57' N 26°E from DM Yorktown No. 2
19	15-20	65	N.D.	N.D.	150' S 47½°W from DM Bataan No. 6
20	15-20	165	N.D.	N.D.	152' S 56°W from DM Bataan No. 6

It can be readily seen that a correlation exists between the arsenic values and the told values, but that neither the arsenic nor the gold correspond in any way to the silver values. Hole Numbers 1 through 3 were drilled on or near small veins in the northeastern part of the claim group. Holes 4 through 16 were drilled in a "fence" across one of the anomalous vein zones. Holes 17 and 18 were drilled in the cherts and shales of the upper plate just at the edge of the thrust window on the Yorktown No. 2 claim. Holes 19 and 20 were drilled in silicified Tertiary volcanics on the Bataan claims at the northwestern corner of the claim group. All of the holes were drilled as assessment work on a portion of the claims, and it is felt that the information gained, although of indirect scientific value, is inconclusive insofar as direct exploration application is concerned.

EXPLORATION POSSIBILITIES

The original reason for going into the Good Hope district was to determine if relatively high grade veins of precious metal ores, similar to those in the Tuscarora district, might remain undiscovered. The geochemical work, as well as subsequent geologic studies, indicates that there are possibilities along these lines. There has been very little prospecting along the two structures, and deep bulldozer trenching of the most favorable areas, together with shallow angle-hole diamond drilling from the surface, would evaluate these possibilities in the most straightforward manner.

However, the discovery of the two windows in the Roberts Mountain overthrust, with carbonate facies rocks exposed beneath, opens up an entirely new, more important exploration possibility. There is a good chance that the thrust zone underlies much of the northern part of the district at relatively shallow depth. If such is the case, the relatively strong alteration and mineralization of the overlying volcanics suggest reasonable chance for better mineralization controlled by the thrust plane. A substantial low-grade precious metal deposit might occur in or

near this thrust zone. The major unknown factor is the chance for a relatively receptive formation such as the Roberts Mountain limestone to underly the thrust fault. It would be possible to determine this by relatively wide-spaced drill holes from the surface, but the cost of such a program would be too high at this time in comparison with the risks involved.

Because of the shallow oxidation in the district, and the thin alluvial cover, it should be possible to effectively use one of the geophysical methods that depend upon the electrical, magnetic, or other properties of the sulphide minerals associated with any important ore deposit present. The IP method is most often used in situations of this type, and the work might best be done by a reputable contractor such as McPhar of Toronto or Heinrichs of Tucson. If well-defined zones of sulphide mineralization could be delineated by geophysics, even if they represent propylitic zones in the volcanics overlying the Paleozoic basement, it might safely be presumed that these areas would overly the better mineralization at depth. The major difficulty that might be encountered in doing geophysics in this area would be to encounter wide dikes of pyritized andesite cutting through all of the rock, including the Paleozoic limestone and shale beneath the volcanics. Such a relationship might mislead interpretation. A few drill holes at most would provide enough information to re-assess the effect that this might have on the geophysical interpretation.

RECOMMENDATIONS

It is recommended that an IP survey be run over the claim group. Inasmuch as all evidence points to a linear pattern trending about N 55° E,

it would be well to orient the lines across this trend at a high angle. North-south orientation would be satisfactory if this would simplify map control and record keeping. The most detail possible is desired, for the sulphide zones are at very shallow depth, and a relatively small target would be of interest. If geophysics indicates, as all other data has thus far, that narrow vein-like zones are involved, the follow-up exploration drilling should be laid out with the idea of exploring from the anomalies outward, investigating both vein and thrust blanket possibilities at the same time.

If it is not possible to make a deal with Allied Livestock Company, the geophysical work should be done within the claim group only. Favor- [illegible]sults would probably interest one of the major mining companys, in spite of the property difficulties.

If the major company is to be brought in now to do the geophysics and carry on exploration, every effort sho[illegible] made to get together with Allied Livestock Company and the intervening locator(s) who staked claims in the early summer of 1965. Some sort of a "unitization" agreement would be ideal, where all parties would agree beforehand to a specified percentage division of the profits and to a simple external boundary which could be described in terms of metes and bounds. In this manner, it ought to be possible to completely by-pass the more sensitive legal aspects of the subsurface mineral ownership.

Anthony L. Payne

Anthony L. Payne

August, 1967
Reno, Nevada

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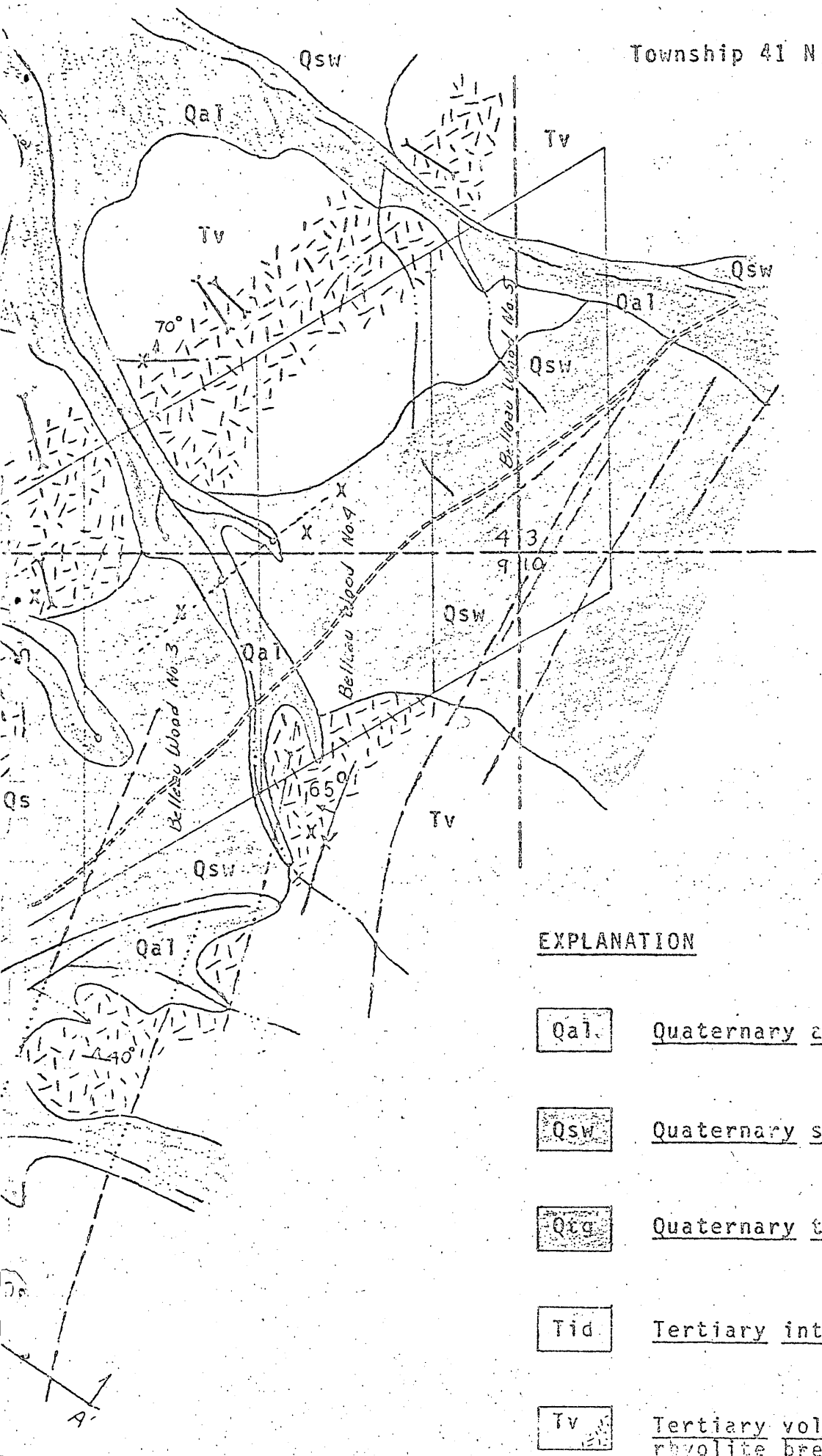
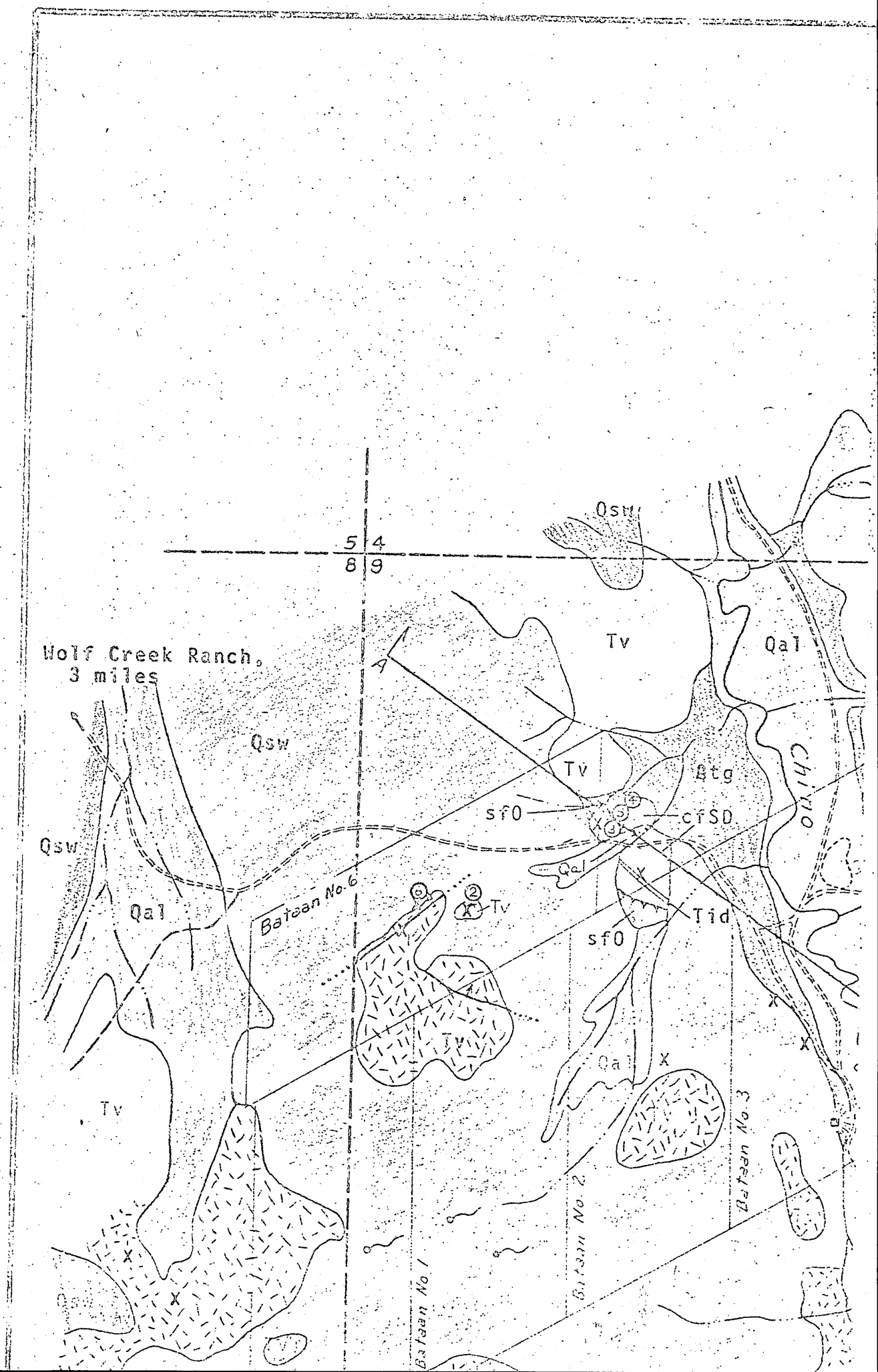
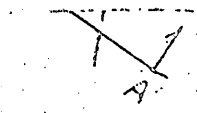


EXPLANATION

Qal.	Quaternary alluvium.
Qsw	Quaternary slope wash, slides.
Qtg	Quaternary terrace gravels.
Tid	Tertiary intrusive dikes.
Tv	Tertiary volcanics. Rhyolite, rhyolite breccia, tuff, andesite.

Tv
Qal
Qsw
Tv
Qsw
5 4
8 9
Tv
Qal
Tv
Qtg
sfO
cfSD
Qal
Tv
Tid
sfO
Tv
Qal
Qal
Tv
Qtg
Tv
Qtg
Qsw
Qal
Qs
Shearing Pen
Bellevue Road
Bellevue Road No. 2
Yorktown No. 2
Bataan No. 6
Bataan No. 1
Bataan No. 2
Bataan No. 3
Chino Creek
cfSD


5 4
8 9
Wolf Creek Ranch,
3 miles
Qsw
Qsw
Qsw
Qal
Qal
Tv
Tv
Tv
Tv
Tv
Btg
sfO
cfSD
Qal
Tid
sfO
Qal
Bataan No. 6
Bataan No. 1
Bataan No. 2
Bataan No. 3
Chino



Tv — Tertiary volcanics. Rhyolite, rhyolite breccia, tuff, andesite. Includes intrusive andesite porphyries which were not mapped separately. Stippled where altered.

sfO — Siliceous facies Ordovician. Black chert and shale of the Vinini-Valmy type.

CfSD — Carbonate facies Silurian-Devonian thin-bedded, fine-grained gray marine limestone.

50° strike & dip of beds

prospect pit

50° Strike & dip of volcanics

trench

vein

spring

thrust

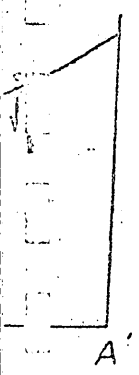
rock sample (see text)

vein

trail

shaft

road



Elko County, Nevada

Great Basin Exploration Co.

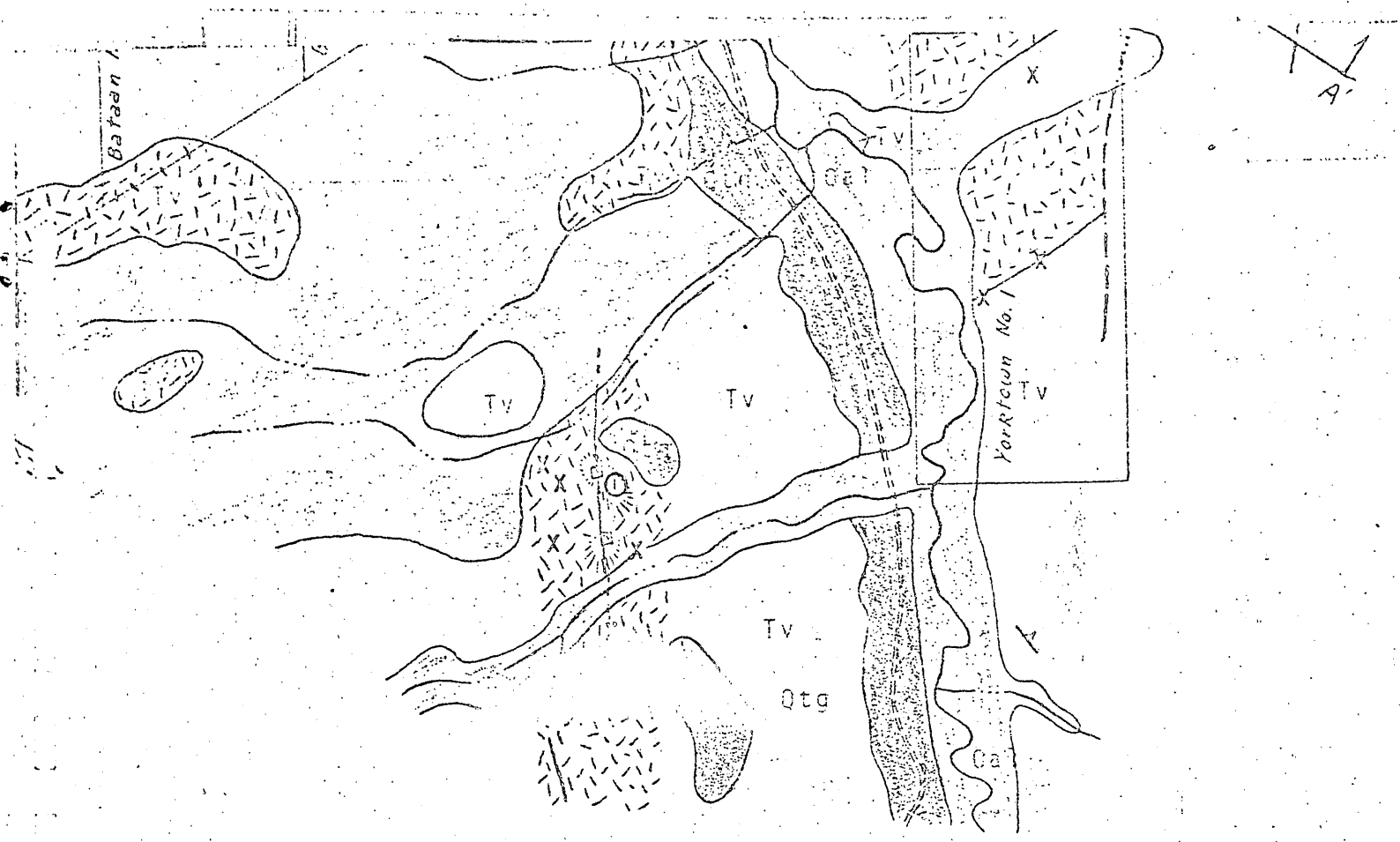
Geologic Map

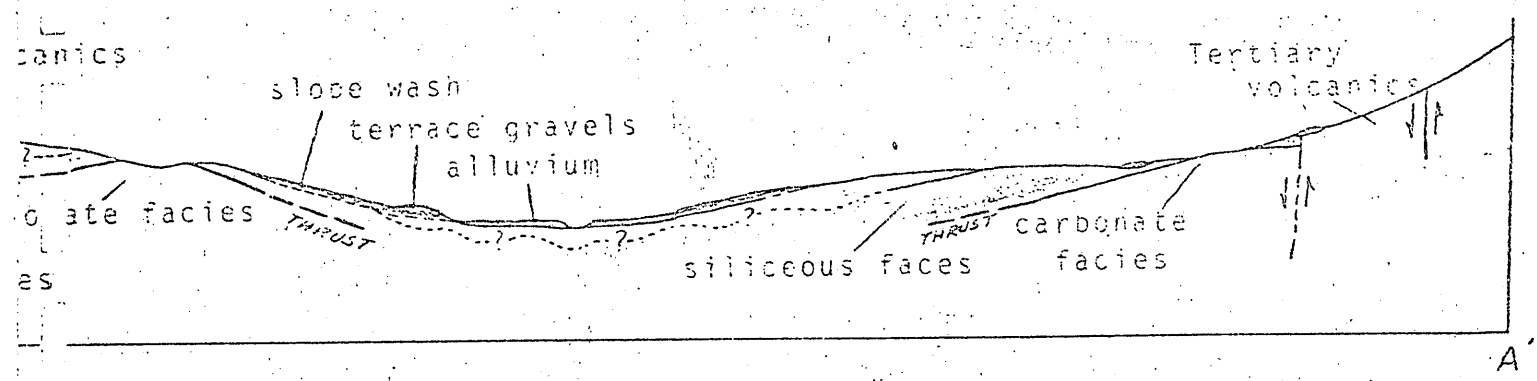
GOOD HOPE MINING DISTRICT

Scale 1" = 500'

July-August, 1967 A. L. Payne

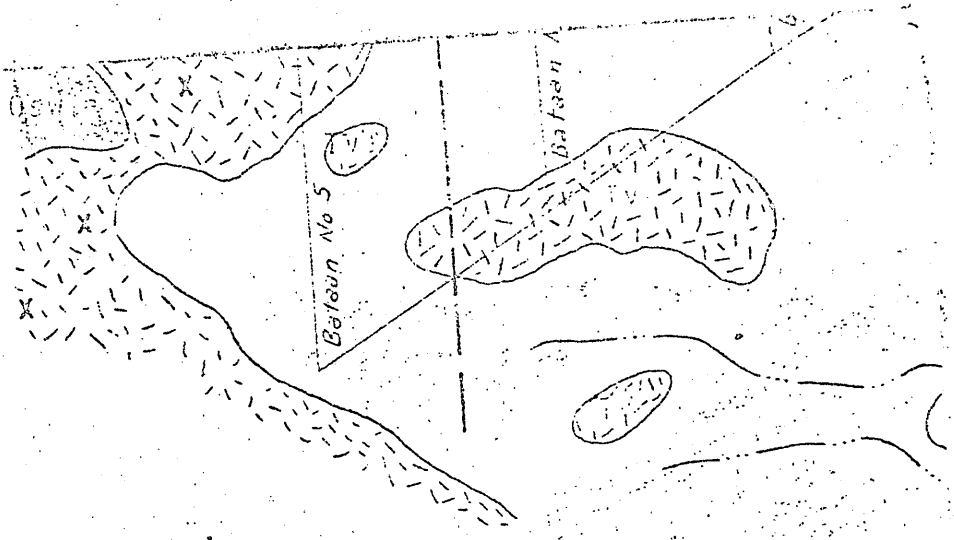
PLATE I

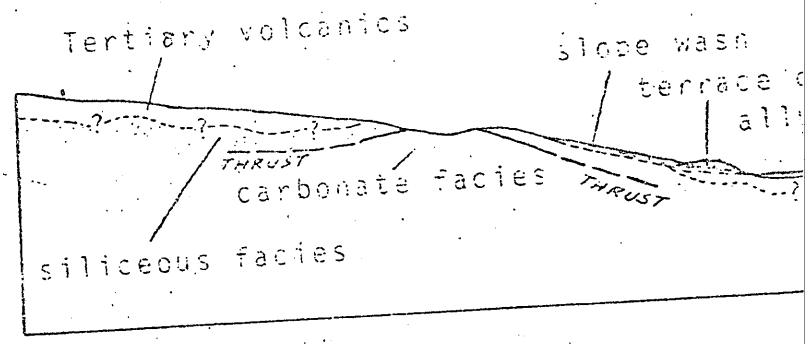




GEOLOGIC SECTION

r pared by Kail Plotter using aerial photographs
a Photos. Inc., June 25, 1967.





A

Planimetric base map prepared by Kail Plotter
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SILVER POTENTIAL OF ALLIED PROPERTIES
IN THE GOOD HOPE MINING DISTRICT
ELKO COUNTY, NEVADA

By: William A. Oesterling

September 18, 1966

ALLIED PROPERTIES
420 Taylor Street
San Francisco, California

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AUTHORS QUALIFICATIONS

SILVER POTENTIAL OF ALLIED PROPERTIES IN THE GOOD HOPE MINING DISTRICT ELKO COUNTY, NEVADA

SUMMARY AND CONCLUSIONS

General

The Good Hope mining district has been largely overlooked by exploration geologists because of its out-of-the-way location and the modest production as recorded in the literature. Superficial mining in the 1870's and 80's produced "over $100,000" in silver from shallow workings, mostly in Tertiary lavas. This work developed only a tiny fraction of one of the most extensive hydrothermally altered and silicified zones the writer has ever seen. The altered zone is at least 11,000 feet long and averages about 1,500 feet wide. Allied Properties holds 1,154 acres of land and mining claims in the district. Six mined areas are located on Allied's holdings, and some 60% of these holdings are on the altered zone.

Exploration Targets

The chances of locating additional ore bodies within the altered lavas are extremely good. However, the most attractive exploration targets are at moderate depths below the lavas in the lower-plate limestones and dolomites of the Roberts Mountains thrust. Large, replacement-type sulfide ore bodies may occur here. Primary targets within this carbonate section are located beneath the mined areas and at the intersections of northeast and northwest trending faults within the altered zone. These and other targets should be delineated by geochemical surveys and geophysical work, especially induced polarization, prior to drilling.

Lower plate "windows" of the Roberts Mountains thrust occur at two places in the district. Upper plate quartzite forms six scattered outcrops. This thrust is widely recognized by exploration geologists to have localized precious-metal and base-metal ore bodies at several major mining districts in northern Nevada.

The Good Hope district lies near the mid point of an apparent metallic mineral belt extending between Mountain City and Midas. Seven mining districts are located within three miles of the axis of this 60-mile-long mineral belt.

Silver Market

Mineral commodity specialists anticipate a sharp increase in the market price for silver at such time as the United States Treasury stops maintaining the current $1.29 per troy ounce price.

INTRODUCTION

Location, Access and Topography

The Good Hope mining district is located in the north-central part of Township 41 North, Range 49 East, Mount Diablo Base and Meridian, northwestern Elko County, Nevada, and is near the mid point of the Mountain City to Midas metallic mineral belt (see Fig. 1). The district is in the northern edge of the Tuscarora Mountains about 96 miles by road northwest of Elko, the county seat. Elko is on U. S. Highway 40 (Freeway 80) and is served by the Southern Pacific and Western Pacific railroads, and by United Airlines. There is a light-plane airstrip at the IL Ranch Headquarters (Allied Properties) about eleven miles northeast of the district.

From Elko, the district is accessible via Nevada Highway 11, 66 miles to end of blacktop at Deep Creek; thence west via graded gravel (Midas road) about 19 miles to the IL Ranch Headquarters which is on the South Fork of Owyhee River; thence west and south on the Midas road five miles to the Chino ("Fourmile") Creek dirt road; thence south six miles to the district. This route is marked in blue line on Fig. 1.

Road access (except Chino Creek road) and regional topography are shown on the McDermitt sheet (Army Map Service) published at 1:250,000 scale by the U. S. Geological Survey in 1959. Detailed topography and access within the district are shown on the Mt. Blitzen quadrangle topographic map published at 1:62,500 by the U. S. Geological Survey in 1956.

History and Production

According to published records, the Good Hope district was discovered in 1878 (Lincoln, 1923, p. 46). However, the Surveyor General's plat of Township 41 North, Range 49 East, MDM shows the Amazon Mining Company and Silver Brick Mining Company were operating along Amazon Creek in 1873 (Fig. 6).

Production records for Elko County for the period 1864 to 1904 are incomplete and inaccurate according to Granger, et al. (1957, p. 20). Emmons (1910, p. 65) indicates the value of silver production from the district was "over $100,000" in the early 1880's, and lists three mines: Buckeye and Ohio, Page and Kelley, and the Snyder. Location of these mines within the district is given by Emmons only for the Buckeye and Ohio. He apparently visited only those mines located along Chino Creek. Lincoln (1923, p. 46) states that the Midnight Mine was producing in 1921, but does not give its location within the district. Emmons (1910, pp. 65-66)

gives a brief account of the geology of that portion of the district he examined, including a description of the adit level of the Buckeye and Ohio mine (Appendix "A").

Judging from the relative sizes of the mine dumps, the Buckeye and Ohio (Allied's George No. 1 mining claim) was the largest of the Good Hope mines; none of the mines was very extensive, however. Most of the workings, as indicated by dump materials, were in altered volcanic rocks, but some of the dumps from mines west of Chino Creek contain altered limestone of the lower-plate of the Roberts Mountains thrust and chert of the upper plate. The old shaft in the NW$\frac{1}{4}$ofNW$\frac{1}{4}$ of Section 9 was collared in limestone. Except for shallow pits and adits, all of the workings are inaccessible. Water stands at about 40 feet in two old shafts, which indicates the sulfide ore bodies are protected from oxidation below this approximate depth.

Emmons (1910, p. 65) reports the ore at the Buckeye and Ohio was composed of "quartz, pyrite, arsenopyrite, freibergite, stibnite and dark ruby silver". Galena was also observed on the dumps by the writer. A sample of selected vein quartz collected by the writer from the old ore bin assayed $33.18 per ton, the values being largely in silver (see sample number A1-16-41-49-1, Appendix "B"). Other samples of vein quartz assayed $14.71 per ton at the dumps in the NE$\frac{1}{4}$ofNW$\frac{1}{4}$ofNW$\frac{1}{4}$ of Section 9, $23.10 at quartz vein near center of E$\frac{1}{2}$ of Section 2, $16.68 at dump in SE$\frac{1}{4}$ofSE$\frac{1}{4}$ of Section 2, $61.79 at dump in W$\frac{1}{2}$ofNE$\frac{1}{4}$ of Section 9. All but the last sample site were on Allied's holdings. Description and assay of all samples is given in Appendix "B".

Apparently most of the workings followed mineralized fault zones striking northeast and northwest. At places, northeast trending veins are offset by northwest faults (see Geologic Map, Fig. 5). Emmons (1910, p. 66) believes the continuation of the main vein at the Buckeye and Ohio will be found south of the workings on the west side of the northwest crossfault.

The remains of two old plants are in the district: a rotary kiln, boilers, and foundations in the SE$\frac{1}{4}$ofNE$\frac{1}{4}$ofNW$\frac{1}{4}$ of Section 9; and a jaw-crusher and foundations between the road and Chino Creek near the west line of the SW$\frac{1}{4}$ofNE$\frac{1}{4}$ of Section 16 (Figs. 2 and 5).

Allied Properties Holdings

Within the Good Hope district, Allied owns 720 acres including mineral rights (colored green on Fig. 2), and holds an additional 434 acres of unpatented mining claims for a total of 1,154 acres. Area covered by these claims is colored purple on Fig. 2. Allied's mining claims are shown on Figs. 3 and 4, and include ten Gyro claims, six Copter claims, two Perry claims, two Bill claims, and one George claim.

About sixty percent of the total acreage held by Allied Properties is underlain by a zone of hydrothermal alteration and silicification favorable for location of deposits of silver bearing minerals. There are six mined areas on Allied's holdings.

The Land Ownership Map (Fig. 2) and the Areal Economic Geology Map (Fig. 5) are based on an enlargement to 1:24,000 scale of a portion of the Mt. Blitzen quadrangle map. The Mt. Blitzen map shows the north tier of Sections of Township 41 North, Range 49 East to be only 4,900 feet long measured from north to south.

However, the U. S. government survey plat of 1873 (Fig. 6) shows this tier of sections to be a standard 80 chains (5,280'). The north line of the township on the Mt. Blitzen sheet appears to be properly located because two of the corners on this line are indicated as "found". Therefore, the south line of the north tier of sections has been moved 380 feet south on Figs. 2 and 5.

The government survey notes for the 1873 survey indicate all section corners within the township to be charred posts set in rock monuments. At the northwest corner of Section 3 as located on the Mt. Blitzen quadrangle map, there is a rock monument but no evidence of the charred post could be found. This is not surprising after some 87 years. No evidence of the west one-quarter corner or southwest corner of Section 3 could be found. The writer ran a stadia survey line south from the northwest corner of Section 3, 5,280 feet to establish the approximate location of the southwest corner. This point was used to survey the location of Allied's 40 acres of land in the SW¼ of SW¼ of Section 3, and the claims as plotted on Figs. 2 and 3.

Summary of Current Investigations

The current investigations of the Good Hope district have included the following phases of work:

(1) A study of published literature and a brief geological reconnaissance survey of Allied Properties holdings in Elko County in late June and early July, 1965. Allied's land in the Good Hope district emerged along with other lands as worthy of detailed study as a result of the reconnaissance survey.

(2) Mineral-title investigation of Allied lands selected during the reconnaissance phase. Title work was by the Title Insurance and Trust Company of Elko, and by Attorney Orville Wilson, Elko. Title reports are on file at the offices of Allied Properties, 420 Taylor Street, San Francisco, California.

(3) Geologic mapping (at 1:24,000 scale) and sampling in

late June and early July, 1966. (There are no published geologic maps of the Good Hope district.)

(4) Location of lode mining claims in early August and early September, 1966.

(5) Geochemical survey in September, 1966. Samples were obtained from the spoil piles at each claim corner post, side-center post, and discovery post. These samples were screened to minus 40 mesh and analyzed for mercury with a Lemaire Type S1 mercury detector. Most of these same samples were also run for silver content by atomic absorption spectrophotometry. Other samples for a continuing geochemical study are being obtained from the discovery trenches on Allied's claims.

Mercury is known to be closely associated with precious metal and base-metal deposits, commonly forming a dispersion "halo" in the soil and rock surrounding these deposits (Hawkes and Webb, pp. 72-73). Sites of anomalously high mercury content or silver content are desirable places to do further exploration such as geophysical work and drilling.

MOUNTAIN CITY TO MIDAS METALLIC MINERAL BELT

Eight historic mining districts, including the Good Hope, form an apparent metallic mineral belt extending for some sixty miles in a northeasterly direction between Midas and Mountain City. Seven of these districts are located within three miles of the axis of the belt as drawn on Fig. 1. Average spacing of mining districts along the belt is about ten miles. The table on the following page, compiled from published literature, summarizes the recorded production and economic geology data for the eight mining districts. (Tuscarora is located 15 miles southeast of the axis of the belt, and is not considered by the writer to be pertinent to the Mountain City to Midas belt.) Total recorded production from the eight districts is $36 million in copper, silver, gold, and minor amounts of lead and zinc. Of this total, the Rio Tinto copper mine at Mountain City produced $21.3.

THE MIDAS TO MOUNTAIN CITY METALLIC MINERAL BELT

Map No.	METALLIC MINING DISTRICT	METALS	MDB&M SEC. T. R. N. E.	RECORDED HISTORY OF PRODUCTION	HOST ROCK	COUNTRY ROCK	STRUCTURAL CONTROL
1	Gold Circle (Midas)	Gold Silver	39 46	1908-49: $4.137 million from 126,726 oz gold & 1,630,268 oz silver	Rhyolite flows and quartz lodes	Tertiary age. Rhyolite, some andesite flows and intrusives	Shear zone 3 miles long by 1 to 1½ mile wide along rhyolite-andesite contact. Faults trend N30-67°W
2	Burner (Burner Hills)	Silver Lead	1 41 47 12	early 1880's-1893: $30,000	quartz-calcite lodes	Tertiary age. andesite	Fault trends N24°E
3	Good Hope	Silver	41 49 (north-central part)	1878-early 1880's $100,000 one shipment in 1921 ($1.274 million total)	Quartz veins	Tertiary age. Leached & pyritized rhyolite flow breccia & andesite	Fault zones trend NE and NNW (Roberts thrust locally exposed)
4	Cornucopia	Silver Gold Copper	18 42 51	1873-82: $1.16 million 1937-40: 10,000 tons ore with 89,600 oz silver & 1,320 oz gold 1870's-1929: prod. unknown	Quartz lodes	Tertiary age. Rhyolite flows intruded by andesite porphyry & quartz porph.	(No info. available on direction of faulting)
5	Lime Mountain (Deep Creek)	Gold Copper Silver	1 42 51	1929-42: $314,692 from 17,258 tons with 7,723 oz gold, 500,000 lbs copper & 23,882 oz silver	Probably silicified limestone	Cambrian age. Porter Peak limestone intruded by dikes & bosses.	Lower plate of thrust fault cut by high-angle fault which trends northerly.
6	Aura (Bull Run, Columbia, Centennial)	Silver Gold Lead	44 52 (So.-cent. & SE part of twp)	1869-1937 (largely 1869-79): $6.0 million from 1.3 million oz silver & 67,260 oz gold	Quartz lodes & silicified limestone	Cambrian to Ordovician age. Limestone, quartzite, phyllite. Mesozoic intrusives	Lower plate of thrust fault cut by numerous high-angle faults. Most mineralized zones trend NW, some NE.
7	Edgemont	Gold Lead Silver Copper Copper	44 52 (SW part of twp)	1900-49: $978,000 from $930,000 (48,500 oz gold) $47,000 (lead-silver) $1,000 (copper)	Quartz veins	Cambrian age. sericitized & pyritized Prospect Mt. quartzite.	Veins trend NE (granitic stock one mile north)
8	Mountain City (Rio Tinto mine largest producer: copper)	Silver Gold	10 45 53	Rio Tinto-1931-38: $21.3 million from 190 million lbs. $1.59 million (silver) $350,000 (gold) $23.2 mil. tot. 1869-1949	For copper: schist & shale For silver: quartz veins	Paleozoic schist & shale covered by Tert. volcanics. Silver: blk, shaly limestone (marble)	Lower plate of thrust fault cut by high-angle faults. Many veins trend NW. Quartz monzonite intrusives nearby.

COMPILED BY: W. A. Oesterling 6-30-65

The mineral belt is parallel to the trend of a major graben (down-faulted block) located southwest of Midas, and is on strike with the north fault of the graben (Fig. 1). The graben is one of the most conspicuous structural features of this portion of Nevada, and the mineral belt is probably genetically related to it through faulting.

GEOLOGIC SETTING

A complex Paleozoic geology is largely masked by Tertiary lavas in this area. No Mesozoic sedimentary rocks are known in this general region, and if ever deposited, have been removed by pre-Tertiary and possibly early Tertiary erosion.

During early Paleozoic times, this region was a part of the vast Cordilleran geosyncline and was the site of marine accumulations of thick deposits of limestone and dolomite with lesser amounts of sandstone. These rocks are known as the Eastern Assemblage. At the same time, a clastic-volcanic assemblage of marine deposits was accumulating in the geosyncline some 100 miles to the west. These rocks, characterized by chert, quartzite, and a few intercalated andesitic lavas, are termed the Western Assemblage. During the Antler orogeny of late Devonian to early Carboniferous time, the Western Assemblage was uplifted, closely folded, and thrust easterly over the Eastern Assemblage. The great thrust which culminated the orogeny is the Roberts Mountains thrust. A detailed account of the complex pre-Tertiary geology of northern Nevada is given in Roberts, et al. (1958), and in Silberling and Roberts (1962).

The Roberts Mountains thrust is recognized to have localized metallic ore deposits at many of northern Nevada's mines. For example, the deposits at the Rio Tinto, Carlin Gold mine, Gold Acres, Bootstrap, and at several mines in the Aura district occur either in the thrust breccia or in the lower plate rocks. Roberts (1964) describes favorable exploration targets in north-central Nevada in "windows" of the Roberts Mountains thrust, and believes they are among the most attractive targets in western United States.

The Tuscarora Mountains in this area are composed largely of greenish-gray to dark gray andesite, and light gray to pink rhyolite and flow breccias. These lavas are several hundred feet thick in the core of the range, but throughout much of the Good Hope district they are thin and have been removed by erosion in several places to expose the Paleozoic rocks. There are half-a-dozen outcrops of the upper plate quartzite (Western Assemblage) of the Roberts Mountains thrust, and two outcrops of the lower plate carbonate rocks (Eastern Assemblage). (See Areal Geologic Map, Fig. 5.)

Basin-and-Range block faulting has displaced the Tertiary lavas and all of the older rocks primarily along northeast trending faults. A secondary, and apparently younger, set of normal faults strikes northwesterly.

HYDROTHERMAL ALTERATION AND MINERALIZATION

The normal-fault fissures were the conduits for hot, mineralizing fluids which the fissures tapped at depth. These hot fluids thoroughly soaked the lavas over large areas and the feldspars of the volcanic rocks have been altered to clay minerals. Silica

was introduced, and the resulting silicification of the lavas is widespread. Locally, quartz veins contain sulfides of silver, antimony, and lead, and compose the "sheeted zones" of Emmons (1910, p. 65). These lodes strike northeasterly along the principal direction of normal faulting, and northwesterly along some of the secondary faults.

In Sections 3, 4, and 9, and extending into Section 8, a very extensive zone of hydrothermal alteration and silicification trends N55°E parallel to a series of normal faults. The topography here is gently rolling for the most part, and slopes northwesterly. The alteration and silicification of andesite is prominently displayed in the banks of the washes, but is largely covered on the broad crests of topographic noses and on the hill tops. From the west edge of the Geologic Map (Fig. 5) to Chino Creek, the altered zone is 3,000 feet long and about 700 to 1,000 feet wide. The zone extends northeasterly from Chino Creek an additional 8,000 feet to the prominent NNW trending fault just east of the quartzite hill and rhyolite hill in Section 3. Along this 8,000 feet, the zone varies from 1,500 feet to more than 2,500 feet in width (see lavendar colored zone on Fig. 5).

Outcrops of Paleozoic rocks within this major zone of alteration and silicification indicate the Roberts Mountains thrust is at shallow to moderate depth beneath the altered andesite. This is also indicated by the abundance of Paleozoic chert fragments mixed with the andesite float throughout most of the altered zone.

EXPLORATION TARGETS

Exploration should be concentrated within the major zone of alteration, with the fundamental aim of locating replacement-type sulfide ore bodies in the lower-plate carbonate rocks of the Roberts Mountains thrust. The most obvious areas for such exploration lie beneath the mined areas. Geochemical surveys and induced polarization surveys should outline additional drilling targets.

Probably the most favorable target area from a geological standpoint is the 40 acres in the NE¼ofNW¼ of Section 9, largely covered by alluvium of Chino Creek. Here, NNW trending faults along Chino Creek intersect the major zone of alteration, and immediately to the west, the Roberts Mountains thrust strikes towards the 40-acre tract. Because this area is covered with transported soil, geochemical surveys would not be useful, but induced polarization would be of value.

Secondary exploration targets are located within the altered lavas with the aim of locating lodes similar to those that have been mined. However, such lodes are probably too small to have any great commercial value at the present price of silver. Of course, these targets as well as the deeper ones will become more attractive with a rise in the market price of silver and base metals.

The Office of Minerals Exploration, administered by the U. S. Geological Survey, has funds available to aid in silver exploration, and will pay 75% of the costs of qualified exploration projects. These funds are recoverable by the government at a 5% royalty on the sale price of minerals produced and sold. If no commercial ores are found, the funds are not repayed.

SILVER MARKET

According to the E&MJ Metal and Mineral Markets, July 18, 1966 issue: "There is no question that the silver price is going to rise, the only question is when. Demand from industry has been snowballing while production has shown very limited growth." (Appendix "C")

The market price of silver from 1955 is summarized by Merrill, et al. (1965, p. 8):

> "As the availability of silver from nonmonetary stocks was the principal stabilizing factor in the market, the price of silver on the New York market from 1955 through November 1961 fluctuated in a narrow range near the Treasury selling price of 91 cents per ounce. After November 1961, when sales of Treasury silver were discontinued, the New York price rose almost at once to about $1.05 an ounce and then continued a rise until June 1963 when it reached $1.293 an ounce, the monetary value of silver. As silver can be obtained from Treasury stocks at the monetary price in exchange of silver certificates (or by melting down silver dollars), this price has become an effective ceiling."
>
> "Reducing the silver content of subsidiary coins would extend the supply of silver for a time but would be only a temporary palliative. A 50-percent reduction, as has been proposed, would permit a rise in the price of silver to $2.76 per ounce, but at this price the intrinsic value of all present subsidiary silver coins would become greater than their face value and they would likely disappear from circulation and be melted down."

Excerpts from Merrill, et al. (1965) and other more recent reports on the silver market are included in Appendix "C".

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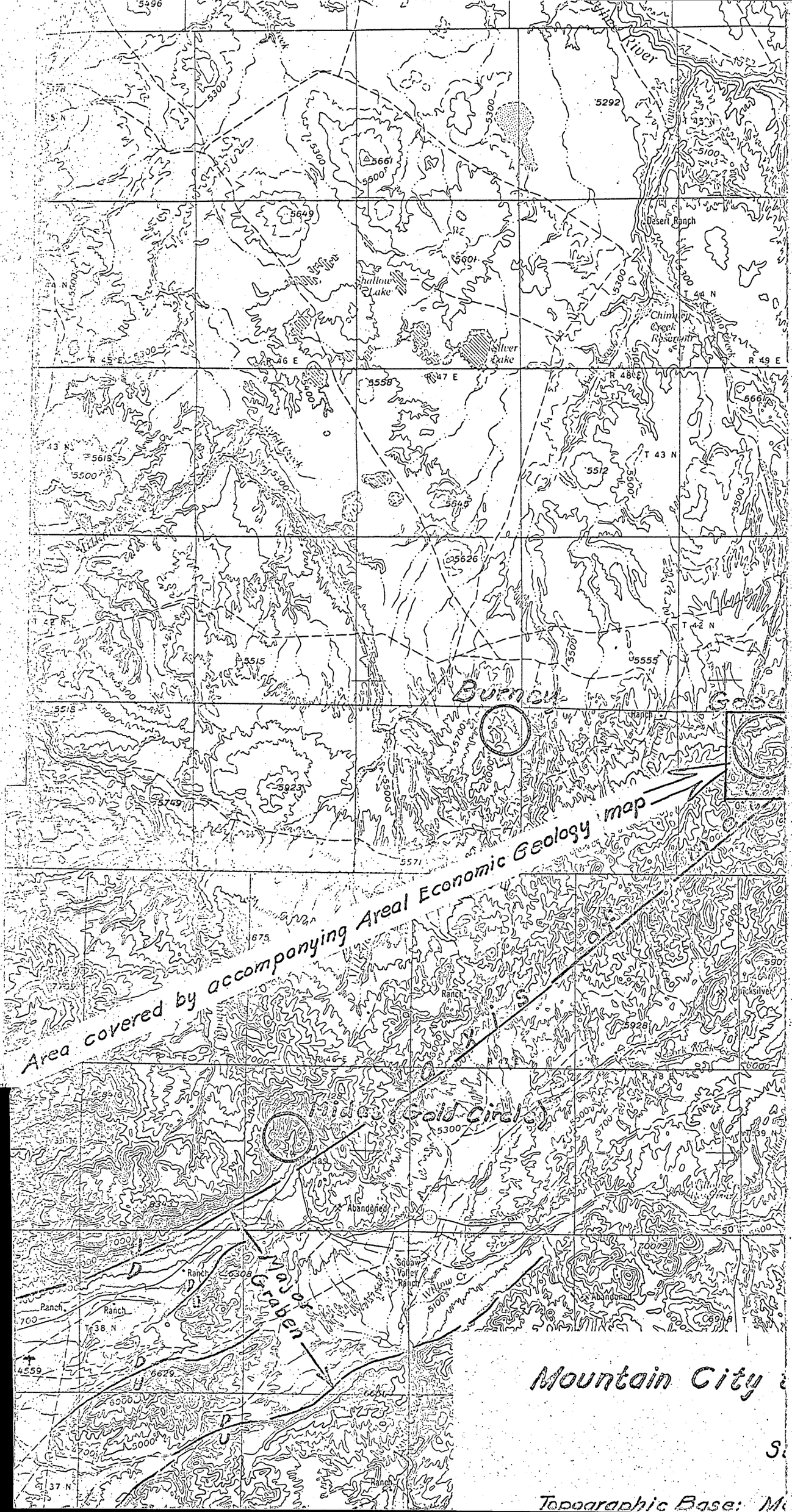
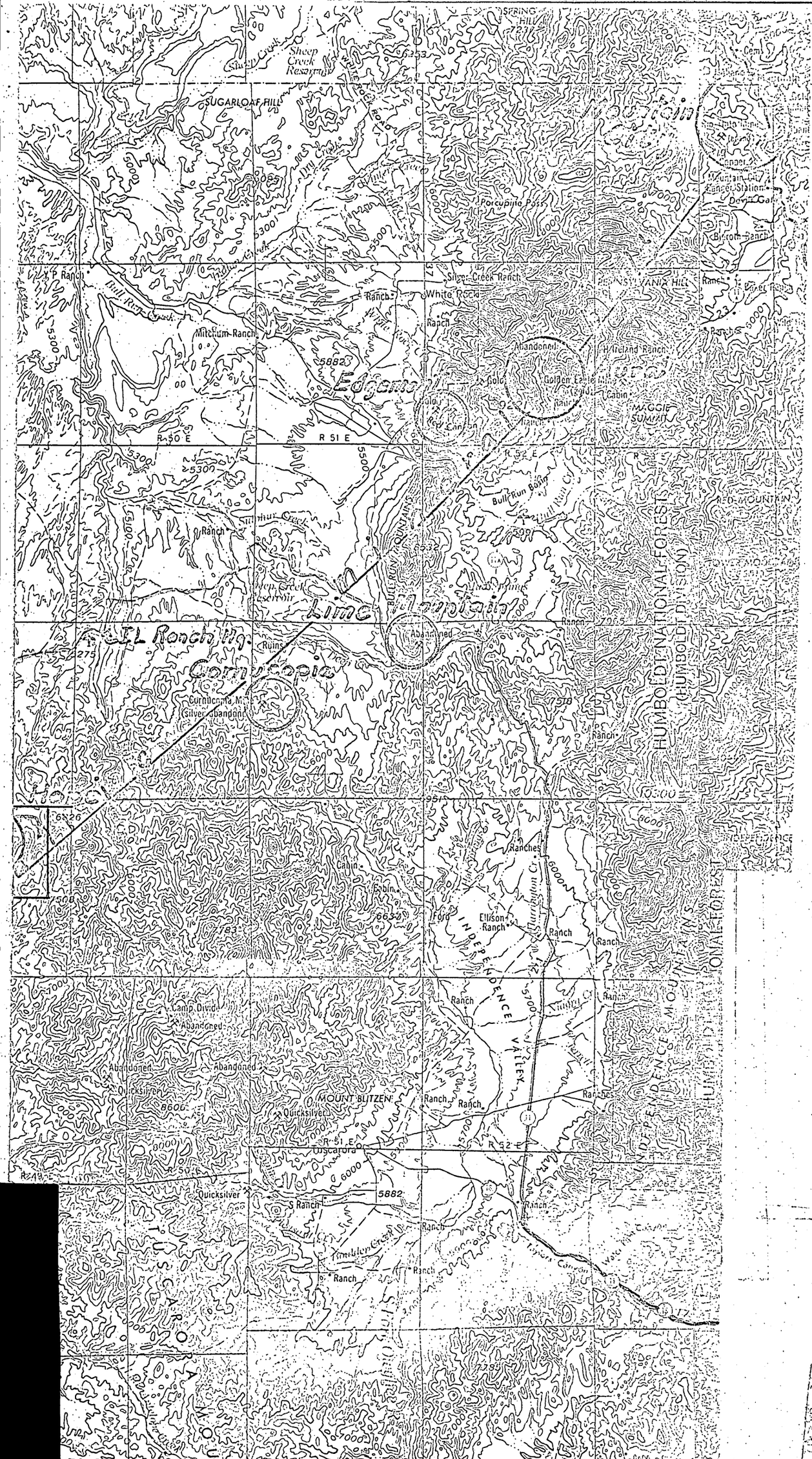
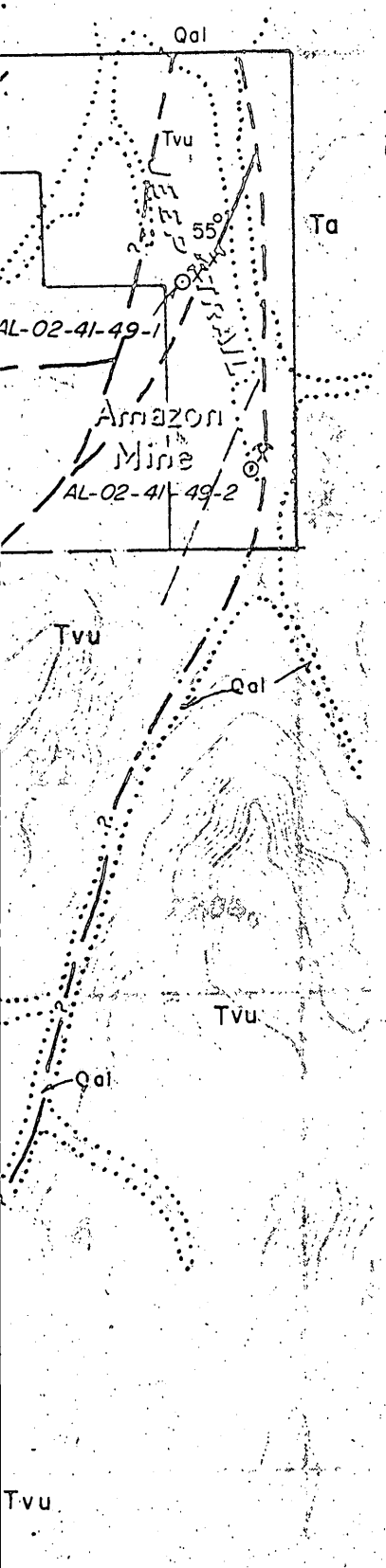

Area covered by accompanying Areal Economic Geology map
Burnett
Gold
Hidden Gold Circle
Major Graben
Mountain City
Topographic Base: M
Desert Ranch
Shallow Lake
Silver Lake
Chimney Creek Reservoir
Willow Cr
Sodaw Valley Ranch
Abandoned
Ranch
Blacksilver
T 43 N
T 42 N
T 38 N
T 37 N
R 45 E
R 46 E
R 47 E
R 48 E
R 49 E



Midas Metallic Mineral Belt

1" = 4 miles

TWP. 41 N. RGE. 49 E. MDM DATE July,
COUNTY ELKO STATE NEVADA



EXPLANATION

QUATERNARY

Pleistocene to Recent

Qal	Alluvium: silt, sand, gravel and boulders in stream and slope wash

TERTIARY

Tertiary

Tvu	Trbf	Rhyolite breccia flow
	Tr	Rhyolite
	Ta	Andesite

Tertiary lavas undiff. (Tvu)

UPPER PLATE OF ROBERTS MOUNTAINS THRUST

PALEOZOIC

Ordovician

Ov	Tvu / Ov	Ordovician Vinini (Valmy) chert and quartzite of Western (eugeosynclinal) Assemblage covered by veneer of Tertiary lavas (Tvu/Ov)
		Vinini chert and quartzite of Western (eugeosynclinal) Assemblage (Ov)

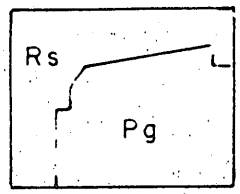
LOWER PLATE OF ROBERTS MOUNTAINS THRUST

THRUST FAULT CONTACT.

C	Paleozoic Carbonate rocks: Limestone and dolomite of Eastern (miogeosynclinal) Assemblage

SYMBOLS

- Mineralized zone: hydrothermally altered lavas, largely replaced by silica with quartz veins containing silver values.
- As above, covered with alluvial deposits
- Silicified Tertiary lavas with quartz veins
- Contact of alluvial deposits
- Formational contacts
- 75° Fault, normal; dashed where inferred or approximate, querried where inferred from topographic expression. Dip as indicated.
- Thrust fault, barbs denote upper plate
- Strike and dip of lava flow
- Mine shaft, vertical
- Adit
- Pit
- Exploration trench
- Allied Properties land
- Allied's unpatented mining claims
- Spl. site and number
- Unpatented mining claims held by Great Basin Exploration Co.



Reliability Index
Rs... Reconnaissance, standard
Pg... Photo geology

Fig 2

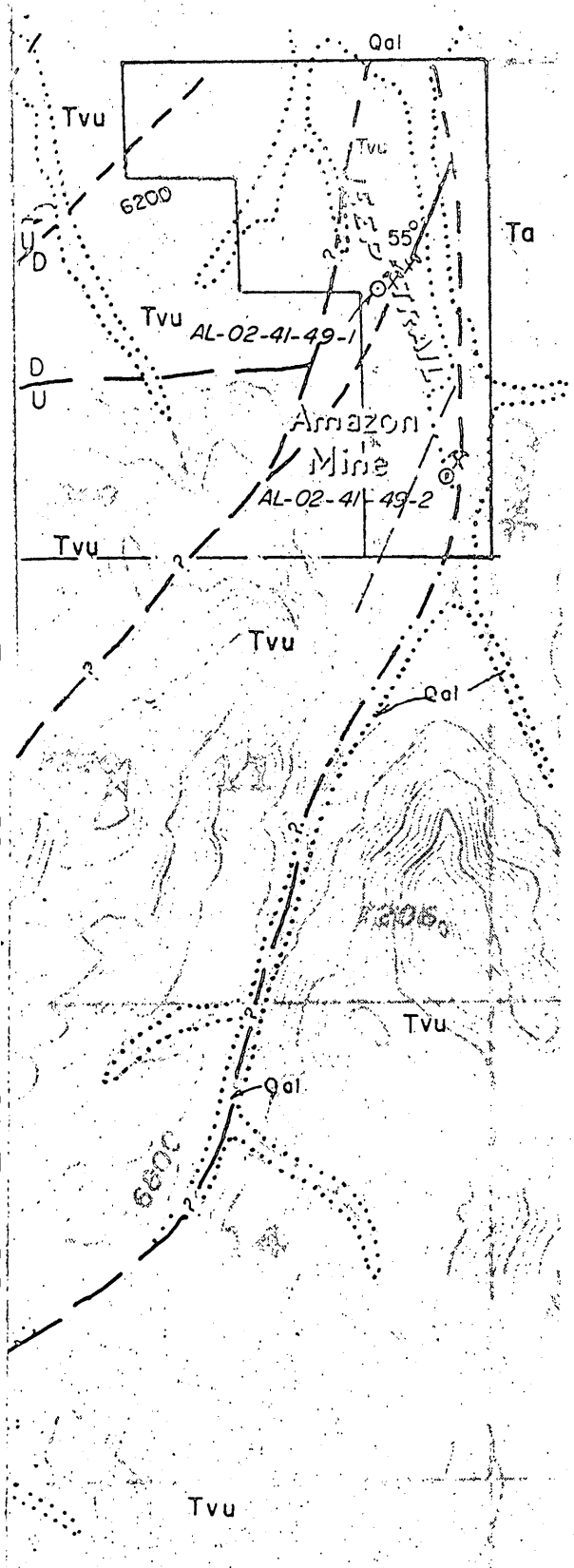
GEOLOGY: Wm. A. Oesterling 1966
DRAWN: Wm. A. Oesterling 1966

DRAFTED: L.W. Temple 1966
Checked: W.A.O. 66 Approved:
Submitted:

DRWG. NO. AL-4149

HIP MAP

TV
CC



Pleistocene to Recent

Qal — Alluvium

Tertiary

Tvu — Trbf, Tr, Ta

Rh
Rh
Ar
Te

UPPER PL

Ordovician

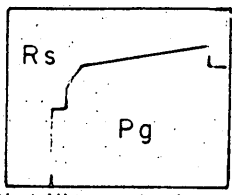
Ov — Tvu / Ov

Or
As
Vi

LOWER PL

C — Paleozo
(miogeos

Mineral
with qu
As abo
Silicifi
Contac
Formati
75° Fault,
where
Thrust
Strike
Mine
Adit
Pit
Explorc
Allied
Allied's
Spl. s
Unpaten
held by
Explorc

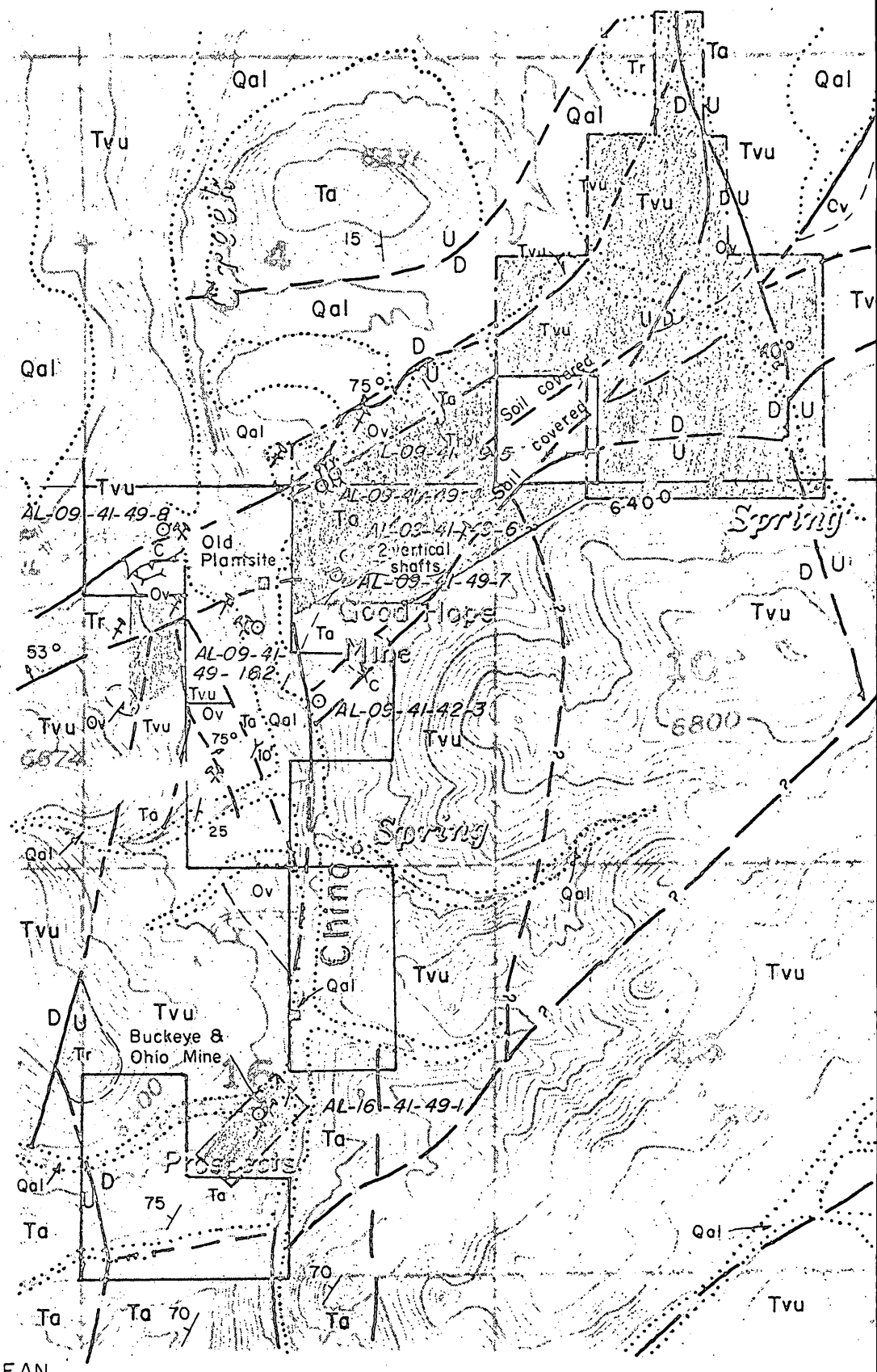


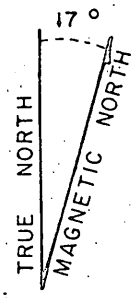
Reliability Index
Rs... Reconnaissance, standard
Pg... Photo geology

ALLIED PROPERTIES — LAND, OWN

R. 49 E.

T. 41 N.





APPROXIMATE MEAN DECLINATION, 1966

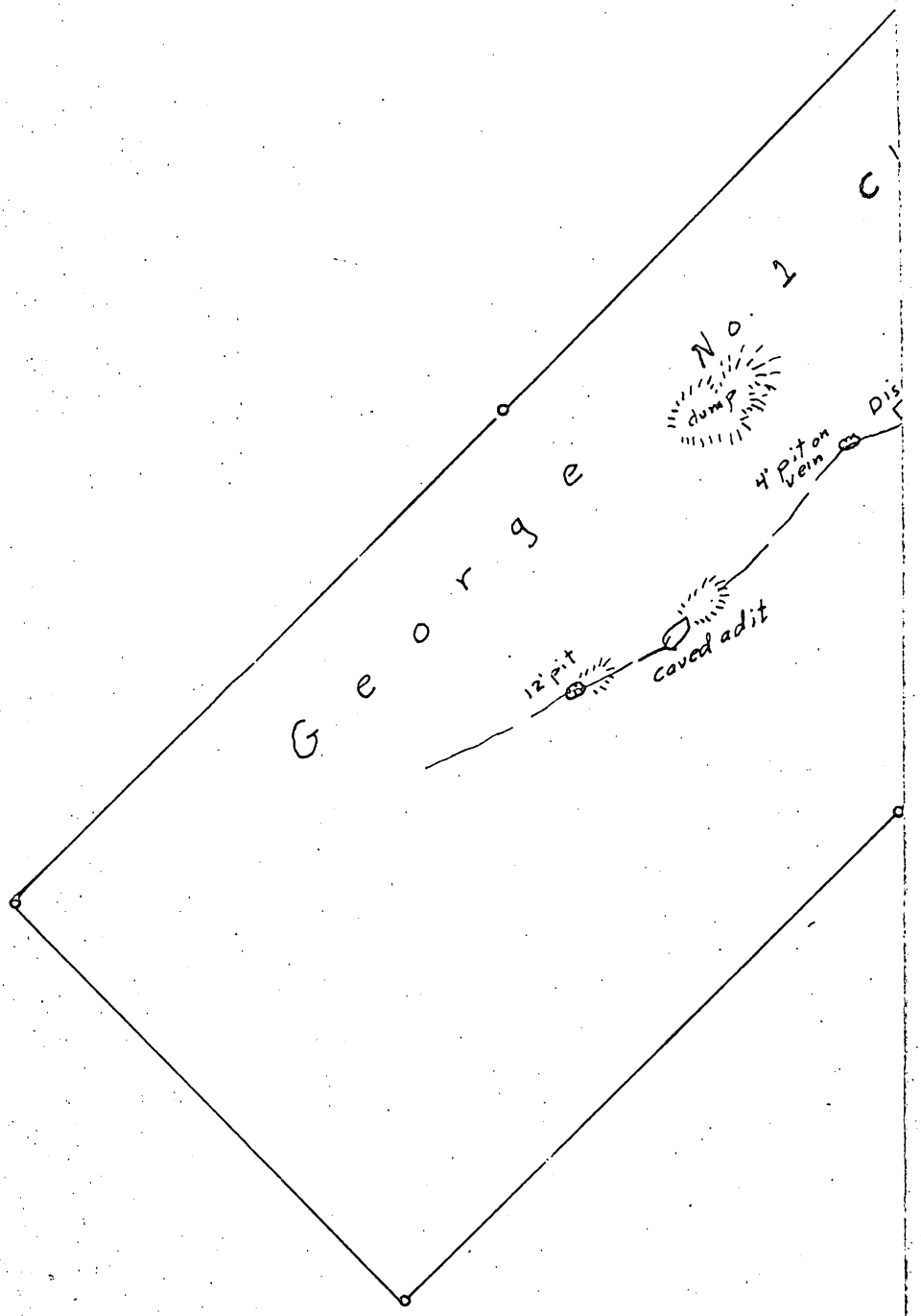
Topographic Base: U.S. Geological Survey Sheets Mt. Blitzen Quadrangle, 1956

SCALE: 1 Inch = 2000 Feet

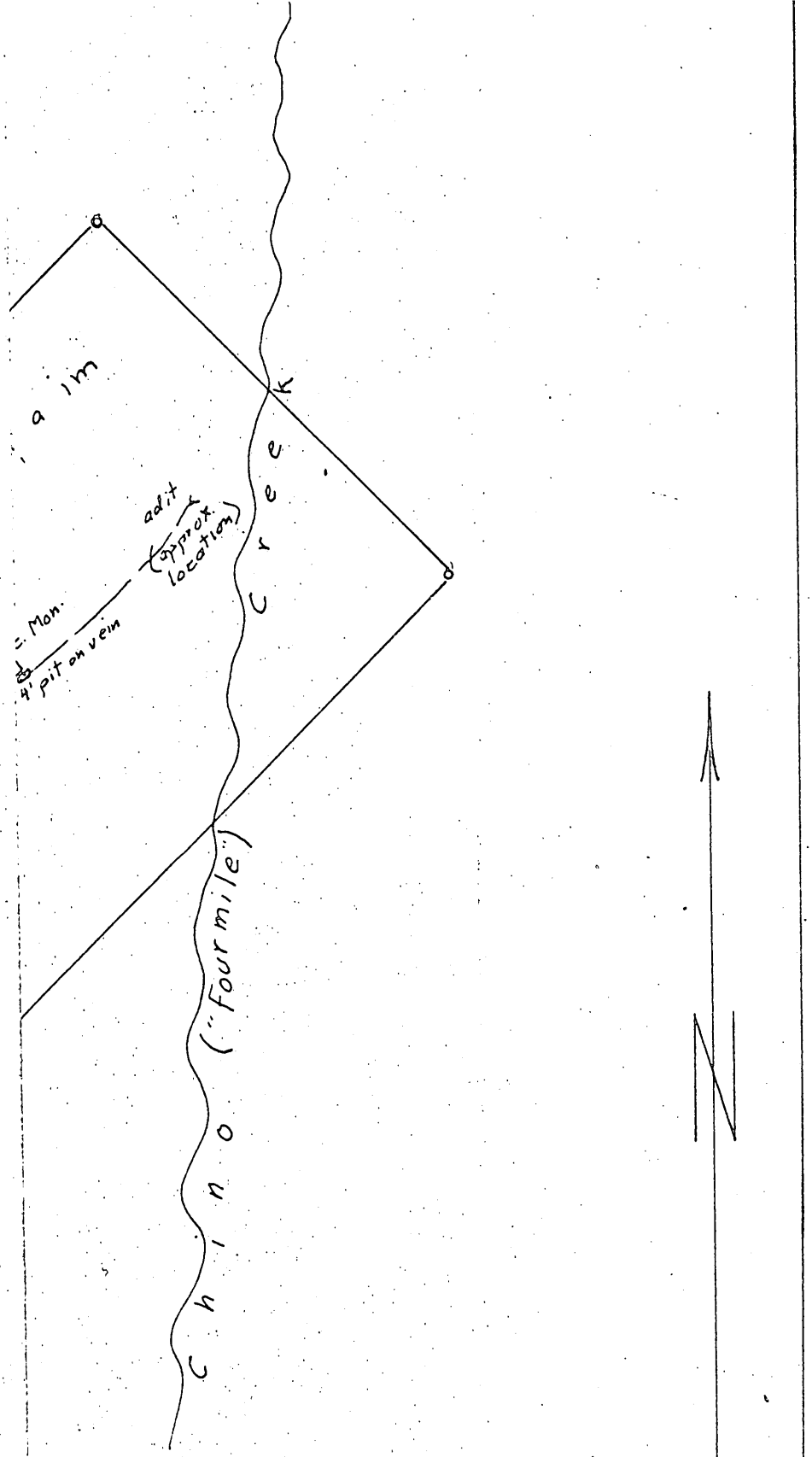
0 1/2 1

SCALE IN MILES

CONTOUR INTERVAL: 40 FEET



George No. 1
old Buckeye
Planetable Surv
By: Wm. A.
Sept. 2,



Claim Covering
Ohio Mine
ey - Scale 1" = 200'
Oesterling
966

Claim is largely in NE¼ of SW¼ of Sec. 16, T41N, R49E, MDM.

TWP. 41 N. RGE. 49 E. MDM DATE July,
COUNTY ELKO STATE NEVADA

EXPLANATION

QUATERNARY

Pleistocene to Recent

Qal	Alluvium: silt, sand, gravel and boulders in stream and slope wash

TERTIARY

Tertiary

Tvu	Trbf	Rhyolite breccia flow
	Tr	Rhyolite
	Ta	Andesite
		Tertiary lavas undiff. (Tvu)

UPPER PLATE OF ROBERTS MOUNTAINS THRUST

PALEOZOIC

Ordovician

Ov	Tvu / Ov	Ordovician Vinini (Valmy) chert and quartzite of Western (eugeosynclinal) Assemblage covered by veneer of Tertiary lavas (Tvu / Ov)
		Vinini chert and quartzite of Western (eugeosynclinal) Assemblage (Ov)

LOWER PLATE OF ROBERTS MOUNTAINS THRUST

THRUST FAULT CONTACT.

C	Paleozoic Carbonate rocks: Limestone and dolomite of Eastern (miogeosynclinal) Assemblage

SYMBOLS

- Mineralized zone: hydrothermally altered lavas, largely replaced by silica with quartz veins containing silver values.
- As above, covered with alluvial deposits
- Silicified Tertiary lavas with quartz veins
- Contact of alluvial deposits
- Formational contacts
- 75° Fault, normal; dashed where inferred or approximate, querried where inferred from topographic expression. Dip as indicated.
- Thrust fault, barbs denote upper plate
- Strike and dip of lava flow
- Mine shaft, vertical
- Adit
- Pit
- Exploration trench
- Allied Properties land
- Allied's unpatented mining claims
- Spl. site and number

Fig. 5

GEOLOGY: Wm. A. Oesterling 1966
DRAWN: Wm. A. Oesterling 1966

DRAFTED: L.W. Temple 1966
Checked: W.A.O. 66 Approved:
Submitted:

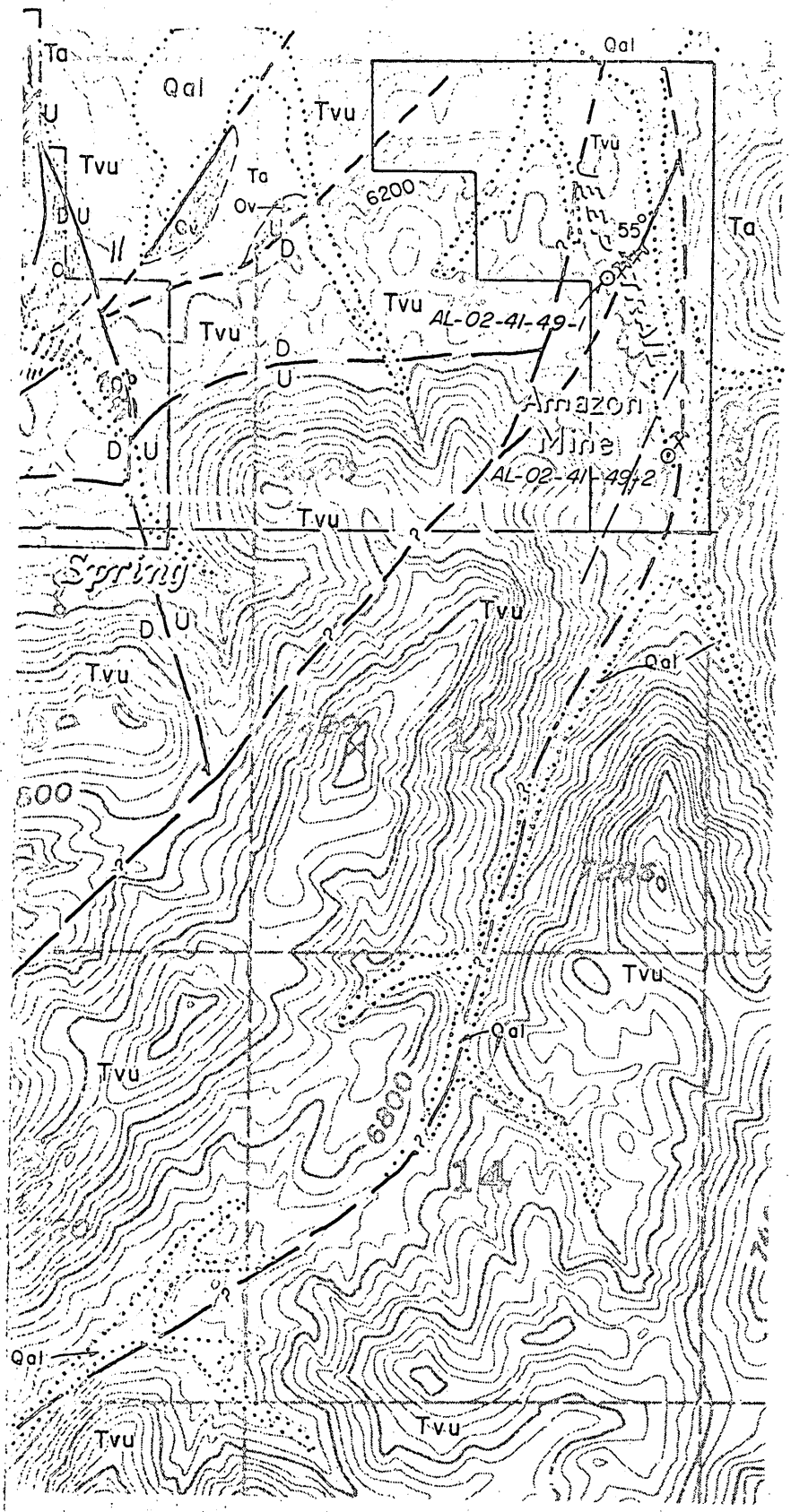
DRWG. NO. AL-4149

standard

— AREAL ECONOMIC GEOLOGY —

TWP. 41 N.
COUNTY

49 E.



Pleistocene to Recent

Qal — Alluvium: silt, sand, gr

Tertiary

Tvu — Trbf: Rhyolite breccia f; Tr: Rhyolite; Ta: Andesite; Tertiary lavas un

UPPER PLATE OF "RO

Ordovician

Ov — Tvu / Ov: Ordovician Vinini (' Assemblage cover; Vinini chert and q

LOWER PLATE OF ROE

THRI

C — Paleozoic Carbonate r (miogeosynclinal) Assem

SY

Mineralized zone: hydrot with quartz veins conte

As above, covered wit

Silicified Tertiary lava

Contact of alluvial c

Formational contacts

75° Fault, normal; dashed where inferred from to

Thrust fault, barbs

Strike and dip of la

Mine shaft, vertical

Adit

Pit

Exploration trench

Allied Properties lanc

Allied's unpatented mi

Spl. site and number

vey Sheets
ngle, 1956

FEET

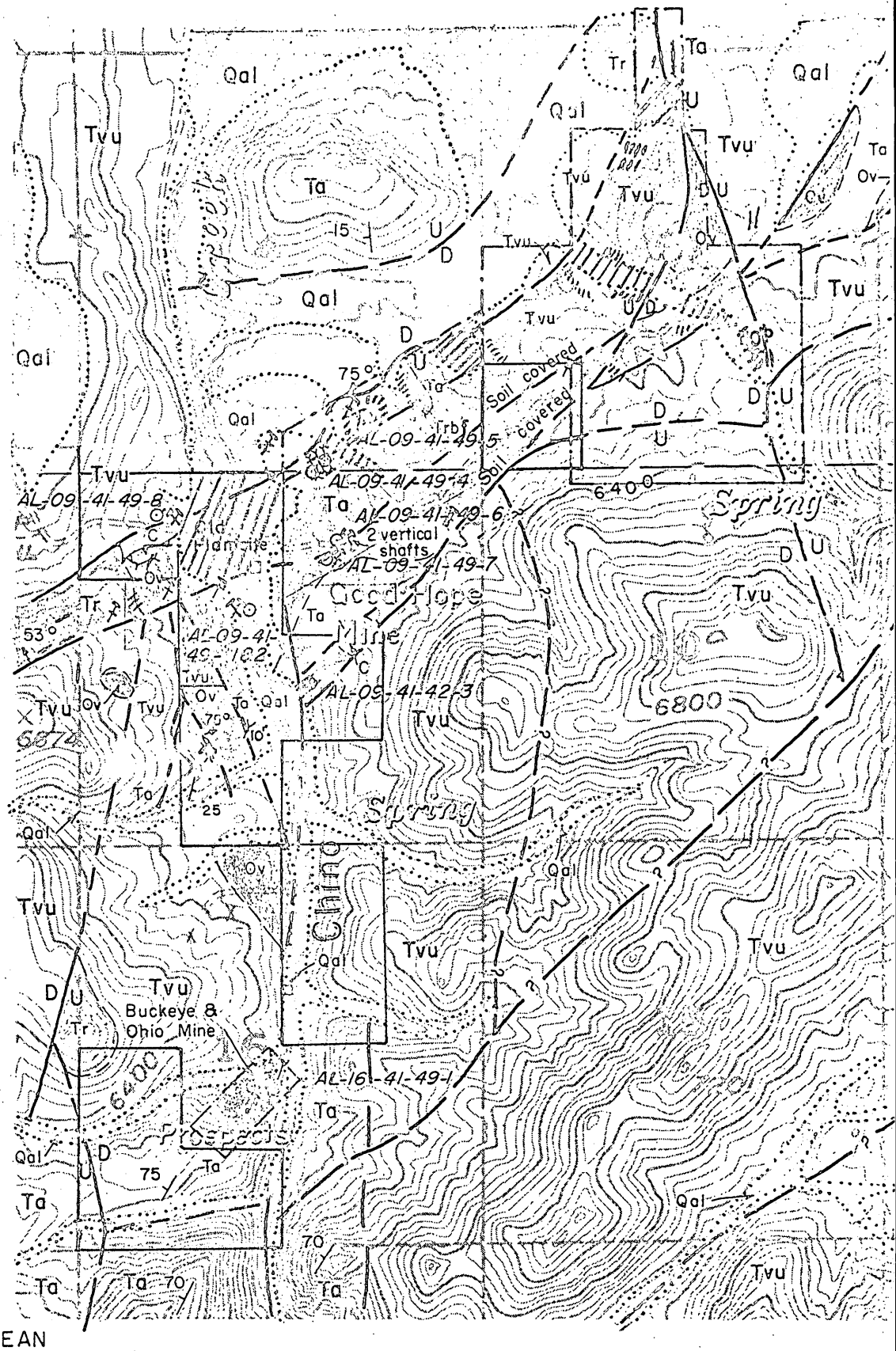
Rs
Pg

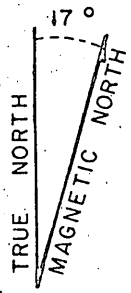
Reliability Index
Rs... Reconnaissance, standard
Pg... Photo geology

ALLIED PROPERTIES — AREAL

R. 49 E.

T. 41 N.





APPROXIMATE MEAN DECLINATION, 1966

Topographic Base: U.S. Geological Survey Sheets Mt. Blitzen Quadrangle, 1956

SCALE: 1 Inch = 2000 Feet

0 1/2 1

SCALE IN MILES

CONTOUR INTERVAL: 40 FEET

GEOCHEMICAL SURVEY FOR SILVER ON ALLIED PROPERTIES' GYRO AND COPTER CLAIMS, GOOD HOPE MINING DISTRICT ELKO COUNTY, NEVADA

Prepared For

ALLIED PROPERTIES
420 Taylor Street
San Francisco, Calif.

By: William A. Oesterling
August 25, 1968

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GEOCHEMICAL SURVEY FOR SILVER ON ALLIED PROPERTIES' GYRO AND COPTER CLAIMS, GOOD HOPE MINING DISTRICT ELKO COUNTY, NEVADA

INTRODUCTION

Purpose.

A geochemical survey involving 1,024 soil samples was conducted within an area of about 300 acres on the Gyro and Copter unpatented mining claims owned by Allied Properties in the Good Hope Mining District, Elko County, Nevada.

Purpose of the geochemical survey was to aid in delineation of exploration targets for two types of potential silver ore bodies described in the writer's September 18, 1966 report on "Silver Potential of Allied Properties in the Good Hope Mining District". These targets, discussed on pages 1 and 11 of that report are:

(1) Replacement type silver ore deposits in the lower-plate carbonate rocks of the Roberts Mountains thrust, primary targets.

(2) Vein ores within the altered Tertiary lavas, which comprise the surface of most of these contiguous claims, as secondary targets.

No geophysical surveys have been conducted on these claims to date.

Geochemical Samples from Three Depths.

Minus 40-mesh samples were obtained at depths of about 3 feet, 1½ feet and six inches as follows:

(1) Sixty samples obtained from discovery trenches A thru G (except C2), approximate locations of which are plotted on the accompanying Geochemical Survey Map. These are the "Letter Prefix" samples in

Report of Analysis, Appendix "A", and average about three feet deep.

(2) Sixty-three samples taken from each claim corner post hole, side-center post hole, and discovery post hole at an average depth of about 1½ feet. These are the "Green Circle" samples reported in Appendix "A", and located by circled numbers on the map.

(3) Nine-hundred-and-one samples taken at approximately six-inch depth at 50-foot spacings along the north-south "Lines" 1 thru 9 along claims side lines, and "Lines" 10 thru 16 along the claims end lines and center lines in an east-west direction. Locations of the individual sample numbers for each Line of samples is shown on the map.

Each of these 1,024 samples was run for silver by atomic absorption spectrophotometry by a commercial laboratory, and the results in parts per million reported in the attached Appendix "A". On the accompanying Geochemical Survey Map, locations of samples containing less than one part per million (ppm) are colored green and are considered to be normal or "background" values. Those containing 1 to 1.9 ppm are colored orange and are interpreted to be of threshold value. Those containing 2 ppm of silver or greater are colored red and the actual values are noted in red; these are interpreted to represent anomalously high amounts of silver possibly indicative of underlying silver ore deposits.

CONCLUSIONS AND RECOMMENDATIONS

Two Anomalous Areas.

Results of the geochemical survey indicate two areas where soil contains up to 10-12 times normal, or background, values:

(1) Samples from discovery trenches on Gyro #1, #2, and #3 claims. This anomaly extends for about one-quarter mile in a northeasterly direction, but determination of total length and configuration awaits further trenching and sampling to the southwest of Trench C and northeast of Trench D, and similar work between these trenches. Silver in amounts ranging up to 10.2 ppm was found in Trench C, to 6.7 ppm in Trench D, and to 10.7 ppm in Trench D1. It must be emphasized that the exact locations of these, and of the other trenches, have not been determined and the locations plotted on the accompanying map are approximations only.

(2) A distinctly anomalous area between the discovery post and the east side-center post of Copter #4, where silver in amounts up to 12.2 ppm were found along a 300-foot distance. The eastern extension of this anomaly is "open", and should be covered by an additional mining claim.

These anomalies may represent leakage of silver to the surface from either of the two types of ore deposits described above.

Increase in Silver Content With Depth.

Results of this survey rather strongly suggest an increase in silver content with depth of sample, and this is apparent over a wide area and from numerous samples:

Statistical Analysis. Of the deepest (3') samples, 80% contain

1 ppm or more of silver, and 26.6% contain 2 ppm or more. Of the intermediate-depth (1½') samples, 76% contain 1 ppm or more, and 6.3% contain 2 ppm or more. Of the shallow (6") samples, 38% contain 1 ppm or more, and 1.7% contain 2 ppm or more.

Depth Within Same Area. With few exceptions, the relatively deep trench samples showed more silver than the nearby, sometimes adjacent, shallower samples. At twenty-one of the claim-post sample sites (1½' depth), soil contained at least 1 ppm of silver in contrast to less than 1 ppm in the nearby surrounding samples from 6-inch depth.

Generalized Pattern Indicated by Claim-Post Samples.

On the Geochemical Survey Map note the east-west center line of Gyro #1 thru #5 and Copter #5 & #6. From this line north, values of 1 ppm or more were found in 34 of 36 samples (94%) at claims posts. South of this line, however, only 12 of 24 samples (48%) contained 1 ppm or more.

Lack of Definitive Pattern for the Shallow Samples.

Although 355 of the 901 shallow (6") samples (38%) contained threshold (1-2ppm)amounts of silver or more, only one definitive pattern is evident from these samples. The generally inconclusive nature of these samples is demonstrated by the anomalous Trench C which is nearly completely "boxed-in" by minus 1 ppm samples in the southern one-half of Gyro #1 claim. Despite the rather high proportion of threshold values in these shallow samples, only six contain 2 ppm or more of silver, and four of these samples are concentrated in the east-central part of Copter #4, and represent the only definitely anomalous area indicated by these samples.

William A. Oestreicher

August 25, 1968

GEOLOGICAL AND GEOPHYSICAL INVESTIGATIONS OF THE GOOD HOPE MINING DISTRICT, ELKO COUNTY, NEVADA

by

Richard Dwayne Knox

August, 1970
University of California, Riverside

GEOLOGICAL AND GEOPHYSICAL INVESTIGATIONS OF THE GOOD HOPE MINING DISTRICT, ELKO COUNTY, NEVADA

by

Richard Dwayne Knox

A thesis submitted in partial satisfaction of the

requirements of a graduate program in Geological Sciences

for the degree of Master of Science

August, 1970

University of California, Riverside

The thesis of Richard Dwayne Knox is approved:

Lewis Cohen

Tsvi Meidav

Committee Chairman

University of California, Riverside

August, 1970

ACKNOWLEDGEMENTS

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It is an honor to acknowledge Professors Tsvi Meidav and Lewis Cohen whose consideration, guidance, and constructive criticisms made completion of this work possible.

I would like to thank Mr. Alexander von Haften of Great Basin Exploration Company for providing for the field expenses and for allowing this study to be done over the Good Hope District.

Dr. Paul Robinson gave much time to aid in the petrographic work. Tentative assignment of the fossils to a Tertiary (Miocene) age and fresh-water habitat is based on opinions given by Professors Michael Murphy and Kenji Konishi, and by E. L. Yochelson and I. G. Sohn of the U.S. Geological Survey. I appreciate the cooperation given by Dr. Robert R. Coats of the U.S. Geological Survey.

The Geonics VLF-EM unit was loaned by Mr. Jack Holloway of the Pacific Mining Corporation, Las Vegas, Nevada.

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Jean C. Denison drafted the illustrations. Karoly Fogassy offered

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The thesis in final form was typed by Carol Besack. The original manuscript was typed by Carol Kendall.

Walter Randall, David Sigurdson, Zekai Nazikoglu, and several other collegues at Riverside have offered helpful suggestions and discussions during the writing of the thesis.

ABSTRACT OF THE THESIS

Geological and Geophysical Investigations

of the Good Hope Mining District,

Elko County, Nevada

by

Richard Dwayne Knox

Master of Science, Graduate Program in Geological Sciences

University of California, Riverside, August 1970

Dr. Edmond F. Lawrence, Chairman

The Good Hope Mining District lies in the Tuscarora Mountains northwest of Elko, Nevada. The surface geology of the district is dominated by Tertiary volcanics: Miocene(?) and Pliocene(?) welded tuffs, Miocene(?) andesite, and Pliocene(?) dacite. Based on its fresh-water gastropod fauna, the district's limestone is tentatively correlated with the Miocene Humboldt Formation. One outcrop of Ordovician Vinini (or Valmy) Formation quartzite was mapped in the northeast corner of the district.

Throughout the district, the Miocene(?) welded tuff was host to intense silicification, argillization, and local sulfide mineralization. Much of this alteration and mineralization is spatially associated with

Miocene(?) andesitic intrusives. Surficial mining in the Miocene(?) welded tuff produced about $100,000 in silver from freibergite and pyrargyrite associated with pyrite, arsenopyrite, and stibnite.

Normal faults, trending northwest, north-northeast, and northeast, and unconformities are the only structural features exposed. Existence of the Roberts Mountains thrust fault in the area was not established.

The current geological-geophysical investigation was initiated to determine the mineralization and lithologic-structural configuration at depth and to determine the applicability of several geophysical methods to exploration in this region.

Magnetics, resistivity-induced polarization, and VLF-electromagnetic surveys were conducted. The magnetics data delineate several buried magnetized bodies, which are postulated to be andesitic intrusives. The resistivity-induced polarization investigation resulted in the suggestion of drill targets. Topographic effects dominate the VLF-electromagnetic responses.

Recommendations are made for the continuation of the geological, geophysical, and geochemical surveys to specific areas on the western and southern periphery of the district.

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Plate | (In Pocket)

I Geologic Map of the Good Hope Mining District, Elko County, Nevada

INTRODUCTION

GENERAL STATEMENT

Modern exploration for economic deposits has become increasingly reliant upon integrated geological, geophysical, and geochemical field studies in localized areas of potential interest. In many areas anomalies in the physical responses or chemical properties of the surface and subsurface have led to the discovery of ore bodies overlooked in purely geological investigations.

In the current work in the Good Hope Mining District, a combined geological and geophysical study was conducted as a follow-up on previous geological and geochemical surveys. Of interest in the present study was the correlation of surface geology with geophysical data obtained from magnetics, very low frequency electromagnetics (VLF-EM), and resistivity-induced polarization (IP) surveys. Magnetic susceptibility measurements on several of the surface rocks helped the correlation of the magnetics data with the lithology.

The complexity of the volcanic geology of the Good Hope District makes the location of subsurface lithologic boundaries unpredictable. The geophysical data reflects these geological complexities as well as possible mineralization of the area.

Geophysical exploration of the Good Hope District was initiated for two reasons. The first was to determine the applicability of each of several geophysical tests to the area and to shed light on the economic potential of the district. The second was to determine, if possible, the subsurface lithologic and structural configurations. Of the two objectives, perhaps the former was best served in that several anomalies

were located by the resistivity-induced polarization data and by the magnetics data. A subsequent drilling program is suggested to decipher the nature of the anomaly sources and to determine their vertical extent.

The second purpose was well served by the magnetic surveys. Several buried andesitic(?) intrusive bodies were suggested by the magnetics profiles. However, major structural features were not interpretable from the data. Perhaps this indicates the lack of extensive tectonic movement in the area during the late Tertiary.

GEOGRAPHY

The Good Hope District lies approximately ninety-five miles (by road) northwest of Elko, Nevada (Figure 1). The area is accessible practically year-round by means of four-wheel-drive vehicles, with the possible exception of those winter periods during which the area is snowbound.

Physically, the district is dominated by the north-south trending valley of Chino Creek which is bound on four sides by hills that rise as much as seven hundred feet above the valley floor. The slopes range from gentle to steep, while the valley-lowland area is characterized by low rolling hills. Much of the area is covered by soil, slope wash, and stream sediments. The vegetation is generally sparse and is primarily sage brush and other desert plants. Small stands of aspen occur in some of the small valleys and protected areas in the higher elevations.

PREVIOUS WORK

The district was first described by Emmons (1910, p. 65, 66) when he mapped the Buckeye and Ohio Mine (Plate I). The area has been

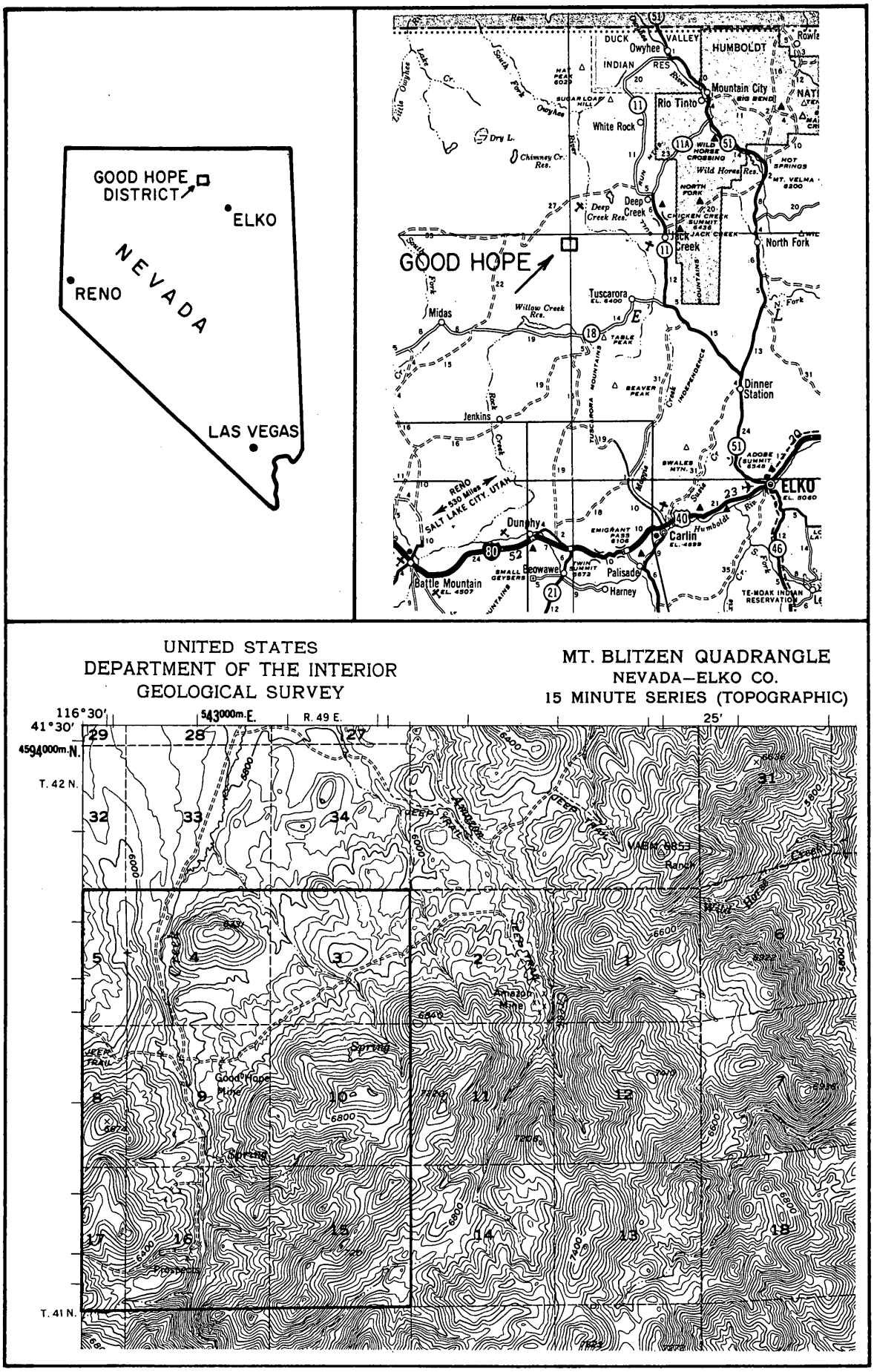


FIGURE 1. INDEX MAP

mentioned in the literature on Nevada (Lincoln, 1923, and Granger and others, 1957). The Buckeye and Ohio Mine was again briefly described and samples assayed by Lawrence (1963). In 1966, a private geological report by Oesterling recommended geochemical surveys and induced polarization studies for the purpose of outlining a drilling program. In the following year, Payne (1967) ran a geochemical survey with analyses for arsenic, mercury, gold, and silver. Further geological and geochemical work was done by Lawrence (1968).

HISTORY OF MINING

Oesterling (1966, p. 3) reports that by 1873 areas along Amazon Creek (Figure 1) were being worked by two groups: the Amazon Mining Company and the Silver Brick Mining Company.

As indicated by Lincoln (1923, p. 46), the Good Hope District was discovered in 1878, and ore was shipped from the area as late as the 1920's. Emmons (1910, p. 65) lists the Buckeye and Ohio, the Snyder, and the Page and Kelley mines as belonging to the Good Hope District. The Buckeye and Ohio Mine was worked from 1882 to 1884.

The ore was processed at a five-stamp mill set up in the Chino Creek valley about one and one-half miles north of the Buckeye and Ohio Mine. A small concentrator was later built about one-quarter mile north of the mine. Total silver production of the area reportedly exceeded $100,000 during the boom in the 1880's (Emmons, 1910, p. 65).

Apparently there had been no significant mining activity nor much specific interest in the area for the fifty years following Emmons' publication. Recently, however, several organizations have begun

seriously examining the district's economic potential.

The external boundaries for the Bataan, Belleau Wood, and Yorktown claim groups belonging to Great Basin Exploration Company are outlined by the N. 60° E. trending parallelogram and the north-south trending rectangle on Plate I. These claims are surrounded by the Gyro, Copter, Perry, Bill, and George groups of unpatented mining claims belonging to Allied Properties of San Francisco, California. The Silver Virgin group located by Charles B. Welch lies to the north of the Belleau Wood group.

ROCK UNITS

INTRODUCTION

The surface geology of the Good Hope District is dominated by Tertiary volcanics and Quaternary alluvium and soil. Many of the areas mapped as Tertiary volcanics are covered by one to six feet of soil and slope wash debris. Therefore, some detail within the volcanics, especially in the Miocene welded tuff unit, may be obscured by the soil coverage and consequently was not mapped.

Very little is known about the original areal distribution and thickness of the units exposed in the Good Hope District. Inference from other work done on welded tuffs (Smith, 1960, p. 150-158) indicates that each of the two tuff units of the area would originally have been a minimum of three hundred to four hundred feet thick. The maximum reasonable thickness for each of these units would be in excess of one thousand feet.

The Tertiary andesites are thought to be primarily intrusive into the older of the two welded tuff units. Geological ages and general correlations within the Tertiary section were inferred from the relationships discussed by workers in neighboring areas. The dacite in the far south is correlated with more extensive dacite flow rock outcrops just west of the map boundary. These seemingly are the youngest rocks of the Tertiary section.

The limestone that outcrops in the north central portions of the district was probably deposited in a restricted basin and is thought to be of Tertiary age. Fossils indicate a fresh-water origin.

Virtually nothing is known about the Paleozoic basement in this area. The lithology and structure are completely concealed by the Tertiary mask, except at one quartzite outcrop in the central part of section 3. The stratigraphic position of this exposure within the Paleozoic section is unknown.

There is a major unconformity between the Paleozoic quartzite and the overlying Tertiary volcanics, and there are several lesser unconformities within the Tertiary section.

PALEOZOIC ROCKS

Vinini (Valmy) Formation

The quartzite unit exposed in the Good Hope District has been assigned to the Vinini Formation, although at this time the unit cannot be definitely correlated with either the Valmy Formation or the Vinini Formation.

Oesterling (1966) and Payne (1967) assumed that the pre-Tertiary quartzite in the Good Hope District is a part of the Ordovician Vinini (or Valmy) Formation. Apparently, this assumption was based on published lithologic descriptions of Paleozoic rocks in surrounding areas.

White quartzite outcrops over an area approximately five hundred feet by one thousand feet and is restricted to the central hill of section 3, T. 41 N., R. 49 E. The vertical exposure is no more than twenty to thirty feet. The base of the formation is covered, and the top is presumed to have been eroded away in this area. No fossils were found in the quartzite. The location of this exposure within the Paleozoic section is not known. No bedding nor foliation is apparent at

this outcrop. However, its angular fracture pattern and its orange-tan color (minor iron oxide staining) are distinctive.

The quartzite is composed of a white, very clean, fine-grained, well-sorted quartz sand with silica cement. There are minor amounts of solution infilling along microfractures and in microcavities. Hydrothermally(?) introduced metallic minerals, possibly pyrite and magnetite, are found as intergranular material in the quartzite. The metallic mineral grains were found to be too minute to be conclusively identified. Small "singly terminated" quartz crystals are found lining many of the small cavities. It is apparent that the quartzite has undergone some alteration and silicification, probably of the hydrothermal type.

Chert and quartzite fragments are found concentrated in great abundances in several small areas. These concentrations were formerly thought to indicate the presence of Paleozoic basement rocks (Vinini or Valmy Formation) under a few feet of soil and slope wash (Oesterling, 1966, and Payne, 1967). However, these fragments appear to have been weathered out of the welded tuff and concentrated mechanically.

As reported by Roberts and others (1958, p. 2832), the Vinini Formation received its name from Merriam and Anderson (1942, p. 1694), who used the name to denote Ordovician age rocks in the Roberts Mountains. The name Valmy Formation was applied to a similar but somewhat different lithology and includes Ordovician rocks "in the Shoshone Range, Battle Mountain, and Sonoma Range" (Roberts and others, 1958, p. 2832).

As described by Roberts and others (1958, p. 2832-33), the Vinini Formation and the Valmy Formation are probably correlative in time but

not in space; there are definite lithologic differences between the units as named. The Valmy Formation is assigned a definite place in Nevada's eugeosynclinal Western Assemblage, while the Vinini Formation appears to belong to a transitional assemblage and contains elements of both the eugeosynclinal and miogeosynclinal environments (Roberts and others, 1958). Both of these formations are part of the allochthonous upper plate of the Roberts Mountains thrust.

The similarities in lithology and age of portions of the Vinini and Valmy Formations to the Eureka Quartzite have been noted in the literature, and it has been suggested that all three formations may have been "supplied from the same source" (Roberts and others, 1958, p. 2851). Identical sources for the Eureka Quartzite and the Valmy Formation have also been suggested (Gilluly and Gates, 1965, p. 16). Since the three units are apparently essentially indistinguishable in isolated outcrops, the possibility remains open for the quartzite exposed in the Good Hope District to be a portion of the Eureka Quartzite. Isopach maps (Webb, 1958, p. 2373) of the Eureka Quartzite indicate that this formation may well have extended as far north as the Good Hope District. The distinction of lithologies could be of vital importance to the question of what the surrounding Paleozoic stratigraphy is and what major structural features underlie the area.

If the Paleozoic rocks belong to the Eureka Quartzite, then the Tertiary volcanics here directly overlie rocks of the carbonate rich Eastern Assemblage. This could have very important implications for the depth to mineralization in the Paleozoic section. In fact, a very shallow depth could be possible if the near surface carbonates were receptive

host rocks during the period of mineralization.

However, with the extremely poor lithologic and stratigraphic control available on the Paleozoic rocks exposed in the district, it is not possible at this time to conclusively state to which formation or to which assemblage these rocks belong.

TERTIARY ROCKS

Miocene(?) Welded Tuff

The lowermost welded tuff exposed in the area is tentatively correlated with reported Miocene rhyolite volcanics in the surrounding areas: Northcentral Nevada (Emmons, 1910, p. 34), Gold Circle-Midas (Rott, 1931, p. 10-11), Tuscarora (Nolan, 1936, p. 18-20), and Bull Run (Decker, 1962, p. 30-31). The Miocene(?) rhyolitic volcanics overlie Ordovician quartzite and are in turn overlain by late-Miocene(?) sediments and Pliocene(?) volcanics. The Miocene(?) andesite is presumably in both intrusive and extrusive relationships with the lower rhyolite unit.

On the basis of the major unconformity separating the rhyolite from the Ordovician quartzite, it is assumed that the basal surface of the welded tuff is irregular. The original thickness is unknown, but it is reasonable to estimate an initial thickness of at least three hundred to four hundred feet (based on Smith, 1960, p. 150-158). These factors make it impossible to estimate geologically the depth to the underlying basement rocks.

This unit, in areas of lesser alteration, is characteristically a light to medium gray, prophyritic, welded tuff. Unaltered sanidine

(2-10%), rounded and embayed quartz (5-10%), zoned and altered plagioclase (0-8%), and minor amounts of biotite and zircon are the common phenocryst minerals of this rock. No unaltered plagioclase was found for compositional determination. There are abundant rock fragments of chert, a few of quartzite, and some of more mafic volcanics. The fragments range in size from 2 mm in diameter to 40 mm in diameter. In this unit, rock fragments make up about 5 percent of the mass, although locally they constitute up to 50 to 60 percent of the rock. The remainder of the rock is devitrified microfelsic groundmass, usually highly silicified and recrystallized. Based on the phenocryst mineralogy, portions of this unit would be classified as quartz latite. For simplicity the term rhyolite will be used to include all compositional variations within the unit.

In the more intensely altered forms of this rock, the plagioclase is totally replaced by clays, and all the mafics are replaced by silica, as is the fine-grained groundmass, but the sanidine and quartz phenocrysts are unaltered. The replaced groundmass is characteristically whitish or pale gray, porcellaneous, and massive.

It is apparent that much of the black chert found as debris on the hillsides is weathering out of the Miocene(?) rhyolitic volcanics. This fragmental material was probably incorporated by the ash flow tuff in either of two ways. The tuff's feeder conduit may have cut through a section of chert, the fragments of which were included during the eruption, or, the flow could have picked up the debris in transit over the earth's surface. In either case the chert that weathers out of the volcanics is now mechanically concentrated in areas of shallow slope.

This idea was suggested by Dr. E. F. Lawrence (personal communication, 1969).

Miocene(?) Andesite

The andesite exposed in the Good Hope District occupies portions of the area of low rolling topography associated with Chino Creek and its tributaries. The unit is loosely correlated with the Miocene andesites exposed elsewhere in northeastern Nevada (Emmons, 1910, p. 32-35; Rott, 1931, p. 11-12; and Nolan, 1936, p. 20-21).

The thicknesses of these bodies are unknown, but it is assumed that they are relatively thin (50 to 200 feet) and relatively discontinuous. The nature of the contacts of andesite with Miocene(?) welded tuff is generally uncertain. A few andesitic bodies, especially those near the Buckeye and Ohio Mine and those near the mine in southcentral section 9, are intrusive into rhyolite. Most of the other bodies could be either surficial flows or shallow sills.

The age relationship between the rhyolite and andesite is not clearly established in the district. Although it is possible that some of the andesitic bodies may be pre-rhyolite flows, there are two factors which suggest that in general they are not. First, the rhyolite-andesite age relationships given by other workers in northeast Nevada indicate that the andesitic activity exclusively postdated the deposition of the Miocene welded tuffs. Second, some of the andesitic bodies are definitely intrusive into the earlier tuffs. No observations indicated that the andesite was earlier than the welded tuff; therefore, it is assumed that all the andesite is younger than the Miocene(?) welded tuff.

The color and mineralogy of the andesites are varied. The color ranges from white phenocrysts in a dark gray groundmass to more uniform shades of red-brown to dark-purplish gray. The principal original phenocryst minerals are plagioclase (An_{40-60}), clinopyroxene with 2V approximately equal to forty degrees, orthopyroxene, hornblende, biotite, and quartz (Table 1). The groundmasses of several specimens are composed largely of clays which may have resulted from alteration of an original glass or an original microcrystalline or cryptocrystalline intergrowth of feldspars. A few of the andesites, with relatively high quartz, biotite, and hornblende percentages, are nearly dacitic in composition.

TABLE 1. Mineralogical ranges within the andesites

Mineral	Range of Percentage of Rock
Plagioclase (An_{40-60})	15-35
Clinopyroxene	2-7
Orthopyroxene	0-3
Hornblende	0-8
Biotite	0-3
Magnetite	2-4
Quartz	0-6
Sanidine	0-5

All of the andesites examined in thin section showed alteration of varying degree. The pyroxenes and amphiboles commonly were totally removed with their outline preserved by iron oxide rims. Some pyroxenes had been replaced by clays. The plagioclase was extensively altered to clays, calcite, and quartz minerals. Occasionally, the feldspars showed only incipient alteration to clays and here generally the extinction angles could be determined. Some of the magnetite has been converted to hematitic material.

Many of the features shown at depths of one hundred to three hundred feet on the geologic cross-sections (Figures 3 through 9) represent interpretations based principally on the magnetics data. Depth control on the andesite lithology is minimal, and none of the geologic cross-sections are to be taken as absolute representations of the lithologic relations at depth. The presence or absence of these inferred intrusive bodies can be conclusively verified only by drilling.

It is herein assumed that the intrusive andesites are directly related to the mineralization of the district. Hydrothermal solutions may have been introduced simultaneously with the intrusion of the andesite, or the intrusives may have provided paths for later transfer of the ore solutions from depth.

Miocene(?) Limestone

There are several small remnants (Plate I) of a late-Miocene(?), fresh-water, lagoonal or lacustrinal limestone. These rocks are perhaps correlative with a portion of the Humboldt Formation. Usage of the name Humboldt Formation has been expanded from King's (1878, p. 434-443)

original limits and now includes major Miocene fresh-water deposits as far north as the Bull Run Mountains (Decker, 1962, p. 26). However, possibly the limestones at Good Hope were deposited in a separate small basin, and these rocks may be of slightly different age than the Humboldt Formation.

The outcrops of Tertiary limestone are small, low-lying, rounded areas with little vertical relief. They are restricted to the lowlands adjacent to Chino Creek. At three outcrops the limestone rests upon the Miocene(?) welded tuff unit. Since the top of the limestone unit has been eroded and the base is generally covered, the thickness at the time of deposition is unknown.

The limestone is faintly bedded and at one point dips about fifteen degrees to the northeast. It is a very-fine-grained, calcium carbonate rock with locally abundant gastropods and ostracods. Minor variations in clastic debris were noted. The outcrop to the east of Chino Creek is slightly siltier than the more shaly outcrops to the west. The most abundant and best preserved fossils were obtained from the eastern outcropping.

Several paleontologists have individually examined fossils obtained from the limestone and all are in agreement that the fossils appear to be relatively modern forms and are most likely of mid- to late- Tertiary age (oral communication, Dr. R. R. Coats, 1969; Dr. M. A. Murphy, 1970; and Dr. Kenji Konishi, 1970). Some of the material collected was examined by U. S. Geological Survey paleontologists, E. L. Yochelson and I. G. Sohn. Their report was inconclusive as to a definite age, but their favored interpretation suggests that the unit is a "post-Paleozoic

non-marine limestone" (Yochelson and Sohn, 1969). The stratigraphic position of the limestone indicates a relatively late-Tertiary fresh-water origin.

Pliocene(?) Welded Tuff

The younger of the two welded tuff units exposed in the district (Plate I) is tentatively correlated with other Pliocene rhyolites in northeast Nevada (Emmons, 1910, p. 35; Rott, 1931, p. 12-13; and Decker, 1962, p. 31-32). This unit often stands topographically above the older volcanics of the area and represents a considerable lithologic thickness (minimum of 600 feet). The areal extent is unknown but within the district this unit occupies about one-third of the surface area. The boundaries suggest that this was a sheet-like mass deposited upon a highly irregular surface. The unit is now exposed on the north, south, and east flanks of the district.

The Pliocene(?) rhyolite is a densely welded ash flow tuff. It is medium gray to dark gray to reddish gray, with a splotchy eutaxitic coloration. Porphyritic and unaltered, the phenocrysts are embayed quartz (4-10%), sanidine (2-10%), zoned and twinned plagioclase of oligoclase to sodic andesine (An_{25-35}) composition (3-8%), biotite (1-4%), and minor amounts of apatite and magnetite. In general, the groundmass is totally devitrified to a gray microfelsic matte, and the eutaxitic texture is generally apparent. Rock fragments make up two to ten percent of the rock. Generally the fragments are small (less than 5 mm in diameter) and are of sedimentary and volcanic origins. Although some specimens from this unit would be classed as quartz

latites on the basis of the phenocryst proportions, the unit here will be referred to as a rhyolite.

A vitrophyric zone of black glass (Plate I) with phenocrysts and abundant fragmental inclusions is exposed in the vicinity of the Buckeye and Ohio Mine. The rhyolite shows a characteristic color gradation from deeper gray to light gray away from the vitrophyre. This color variation is common in unaltered, densely welded, silicic tuffs (Smith, 1960, p. 154). The dense welding apparently promotes devitrification and inhibits vapor phase mineral deposition (Smith, 1960, p. 156). The Pliocene(?) welded tuff is characterized by extensive devitrification, usually only very minor vapor phase mineralization in the devitrified portions, and no apparent vapor phase mineralization near the vitrophyric zone.

The Pliocene(?) welded tuff unconformably overlies all older units exposed in the area. Its relationship to the dacite flows is not definitely determined, but it appears that the tuff is the older of the two. East of Chino Creek, the rhyolite (downthrown side) is in fault contact with andesite (upthrown side).

Pliocene(?) Dacite

The solitary outcrop of Tertiary dacite located west of the Buckeye and Ohio Mine is an erosional remnant of a unit which has much more extensive outcrops west of the map boundary. These flows have not been correlated with any volcanics in nearby areas. The contacts with the underlying units are generally covered.

This dacite is a very distinctive red and gray unit which stands

above the surrounding alteration zone. The gray portions are non-devitrified porphyritic glasses, which perhaps mark the boundaries of adjacent flows. The pink to red portions of the flows are porphyritic and flow banded with a microfelsic groundmass.

Petrographically, the dacite is characterized by having 15 to 25 percent phenocrysts in a glassy or microfelsic groundmass. The phenocryst mineralogy is dominated by twinned and zoned plagioclase (10-15%) of andesine (An_{35-40}) composition. Hornblende and biotite are always present in varying amounts and together compose about 5 to 10 percent of the rock. Small amounts of magnetite (1/2 to 2%), zircon (1%), and quartz (1%) are usually present. No alkali feldspar, pyroxene, nor olivine was observed. The dominance of the groundmass over phenocrysts may cause the chemical composition to be rhyodacitic. The term dacite was used in spite of the low quartz phenocryst percentage for the same reason.

The dacite is definitely younger than both the Miocene(?) rhyolite and the alteration associated with the andesitic intrusives. No portion of the dacite flows is known to have been hydrothermally altered. The age relationship between the Pliocene(?) rhyolite and the dacite is not clear, but since in no place has the rhyolite been seen to lie on top of the dacite and since the dacite is often found topographically above the other, the dacite is assigned slightly younger age than the Pliocene(?) welded tuff.

QUATERNARY

Quaternary Alluvium

The Quaternary alluvium shown on Plate I is composed of several types of unconsolidated materials: soil, slope wash, terrace gravels, and stream sediments. Much of the area mapped as Tertiary volcanics (Plate I) is actually covered by one to six feet of soil and slope wash which obscures details of the lithology and structure.

In several areas terrace gravels are found many feet above the present stream level. Payne (1967, p. 17-18) gives a more thorough description of these terraces. The gravels, which are largely made up of rock types not found in the district, indicate that perhaps one terrace was of "considerable regional extent" (Payne, 1967, p. 18). The sediments in the present channel of Chino Creek are sands and gravels partially derived from relatively coarse-grained crystalline rocks not found in the district.

STRUCTURE

INTRODUCTION

The major structural feature exposed at the surface in the Good Hope District is a series of Tertiary normal faults. These faults have a range of trends from N. 60° E. to N. 60°-70° W. The principal structural trends are northeast, north-northeast, and northwest. Apparently, the major vertical displacements (up to 50 feet) have been localized along the north-northeast and the northeast trends, with the northwest trending faults having smaller throws. At this time, however, the relative importance of each of these trends with regards to andesite emplacement, ore fluid transport, and ore deposition is uncertain. It appears that the deposition of the ore has been localized along the northeast trending structures.

Other workers (Oesterling, 1966, and Payne, 1967) have suggested that the Roberts Mountains thrust fault is exposed in one or two areas within the district, specifically where the limestones outcrop. It has been assumed previously that these limestones were of Paleozoic age, probably Silurian or Devonian. Fossil evidence now indicates that these limestones are most probably of fresh-water origin and of Tertiary age. On this basis, the existence of the surficial expression of a major thrust fault is discounted. However, the possibility remains open for the existence of the thrust fault at some unknown depth of burial. Since the thicknesses of the Miocene(?) volcanics and of the upper plate siliceous rocks are unknown, the depth to the fault zone could be as little as a few feet or as great as several thousand feet. A final

possibility is that the upper plate of the thrust has already been eroded.

UNCONFORMITIES

There are four unconformable contact relationships exposed within the district. These are the following:

1) Ordovician Vinini Formation overlain by Miocene(?) welded tuffs,
2) Miocene(?) welded tuffs (and Miocene(?) andesites) overlain by upper-Miocene(?) limestone,
3) upper-Miocene(?) limestone overlain by Pliocene(?) welded tuffs, and,
4) Quaternary alluvium overlying each of the above units.

The most striking unconformity is that which separates the Vinini Formation from the overlying volcanics. This relationship suggests extensive regional uplift and erosion during some period following the deposition of the Vinini Formation. There are no upper-Paleozoic nor Mesozoic rocks exposed in the district. It is apparent that the presently exposed Vinini Formation stood as part of a hill during Miocene time when the ash flow welded tuffs were extruded. This hill, having a relatively thin overburden of volcanics, has been exhumed and again stands as a hill.

The limestone appears to be lacustrinal or lagoonal in origin, and it has not been hydrothermally altered but lies in contact with altered rhyolite. Since it is assumed that the alteration of the rhyolite is related to the intrusion of the andesite, it is apparent that the limestone is unconformable over the older volcanics. Erosion is indicated

by the juxtaposition of the limestone over a very highly altered zone in the volcanics.

The reasons for suspecting an unconformable relationship between the limestone and the Pliocene(?) rhyolite are the following:

1) deposition and intense welding of the rhyolite in a body of water is unlikely (but plausible),

2) immediate burial of the limestone by the rhyolite would protect the limestone from erosion and one would expect to see the two units in contact; however, the two units are not found in physical contact, and

3) the limestone now seen must have been part of a more continuous carbonate body most of which has now been eroded.

FOLDS

So little of the Paleozoic section is exposed that no structure of any sort was mapped within it. No major or locally continuous folds were discovered within the Tertiary section. All structural deformation in the Tertiary appears to have been by normal faulting.

FAULTS

The details of the structural relationships of the district are not well understood. Most of the faults indicated on Plate I were based on local deformation at the outcrops and correlated on the basis of geomorphology. Some faults were inferred from observation of aerial photographs.

The fault pattern is obscured by the small amount of displacement and the extensive soil and slope wash. No fault appears to have more than about fifty feet of throw along any section of its length, and most

faults appear to have less than twenty to thirty feet vertical displacement. Only one fault on the east side of Chino Creek is known to juxtapose two different rock types (andesite and rhyolite). This fault may have up to fifty feet displacement at various places along its length.

The major fault trends are localized along northeast, north-northeast, and northwest directions. The near surface mineralization explored during the 1880's appears to have at least in part been controlled by the northeast trending faults (Emmons, 1910; Lawrence, 1963; Oesterling, 1966; and Payne, 1967). However, it is not known what role the northwest trending faults have played in the transport of and deposition from the ore-bearing fluids.

Only one fault on the east side of Chino Creek seems to correlate with any magnetic feature. However, this magnetic anomaly may be directly related to the position of the andesite outcrops.

AGE OF THE FAULTING

Pre-Miocene structures are not apparent in the surface geology. The many faults which cut the Miocene(?) rhyolite and andesite were active at least through mid-Miocene time and possibly later. Since several of the major faults of the area affect the Pliocene(?) welded tuffs, it is known that these faults must have been active into the Pliocene.

ECONOMIC GEOLOGY

MINERALIZATION

Disseminated metallic sulfide deposits are developed in silicified fault gauge and breccia zones. The ore minerals reported by Emmons (1910, p. 65) and later researchers are "pyrite, arsenopyrite, freibergite, stibnite, and dark ruby silver." The ruby silver apparently is pyrargyrite. Barite was observed with pyrite on dumps west of the Buckeye and Ohio Mine. A small vein of barite is exposed at the surface a few hundred feet west of hill 6674 in SE 1/4 section 8. The latter occurrence has minute metallic mineral inclusions, possibly pyrite, in the barite crystals.

Lawrence (1963, p. 62) reports that the main vein at the Buckeye and Ohio Mine "strikes N. 10° W. and dips 70° W. and is cut and offset by a cross fault which strikes N. 40° E. and dips 75° NW." The ore minerals at the Buckeye and Ohio Mine generally occur as blebs and pods in veins of quartz and chalcedony. The stibnite is found as "pods up to six inches across, veinlets, rosettes, and single crystals" (Lawrence, 1963, p. 62). It is found with quartz in vugs and is in places altered to yellow and white antimony oxides. The pyrargyrite also occurs in small, rounded pods.

ALTERATION

The Miocene(?) welded tuff is so extensively altered (in varying intensity) that the exposed limits of the alteration zone essentially correspond to the outcrop limits of this unit. The principal alteration processes have been silicification and lesser argillization. The rock

alteration within the Good Hope District appears spatially and temporally to be very closely associated with the andesitic intrusive activity. Several of the most intensely and extensively altered and mineralized zones of the area are in the Miocene(?) welded tuff adjacent to exposed andesite dikes. The Good Hope Mine, the Buckeye and Ohio Mine, and the mine in south-central section 9, have andesite exposed at or near the workings.

GEOPHYSICAL SURVEYS

INTRODUCTION

Magnetic, Very Low Frequency electromagnetic, and resistivity-induced polarization surveys were carried out in the Good Hope District. The results of each of these surveys are discussed below.

The magnetics data are related to the areal distribution of andesitic bodies. The relationship of the magnetics to the zones of mineralization is not conclusively known, however, in general the mines of the area lie in magnetically low and intermediate zones. None seem to be directly associated with the pronounced magnetic highs.

The induced polarization (IP) surveys have produced ambiguous data; however, there are several zones of possible disseminated mineralization within the area. These are the primary IP anomaly areas along lines B, E, and F. Lesser anomalous areas are delineated along lines A and G. Lines C and D appear to have very weak anomalies.

The Very Low Frequency electromagnetic anomalies are apparently responses to topographic effects. Therefore, its usefulness in this area is questionable.

MAGNETIC SURVEYS

A detailed ground magnetic survey was conducted over the major alteration zones of the area. The survey lines were oriented perpendicular to the strike of these mineralized areas (based on Oesterling, 1967, Fig. 5, and Lawrence, 1968, unpublished map). The major lines are labeled on Figure 2 and Plate I (Lines: A,B,C,D,E,F, and G). Other lines were run but are not shown. Station readings were taken on spacings of one

hundred feet on lines A through G, and at one hundred to five hundred feet on each of the other lines. The instrument used was the Varian proton precession magnetometer (Model: M-49A) with sensitivity of $\pm$ 10 gammas.

Diurnal drift corrections were made by the single-magnetometer-single-base-station technique (Parasnis, 1966, p. 34). The time between base station readings was on the order of two hours. The diurnal drift was consistently under twenty gammas per two hour period, and it was generally much less than that value. The data were made relative to an arbitrary base station level of 54,840 gammas. The regional value for the magnetic field intensity was taken as between 54,800 gammas and 54,850 gammas.

After several preliminary plots of the data, it was deemed advisable to smooth the data by an averaging process. This was done to mute the effects of small, very near surface, magnetized bodies of limited horizontal extent. Three equally weighted adjacent points were used for each average:

$$\bar{X}_2 = (X_1 + X_2 + X_3)/3$$

The results of the smoothing are shown in map view on Figure 2 and in profile on Figures 3 through 9, These plots are much less discontinuous than the corresponding ones of the raw data. Many of the small irregularities have been removed. The distribution of the major anomalies was not affected, but the anomaly magnitudes have been decreased.

The data were contoured at a 100-gamma interval as shown on Figure 2. An arbitrary value of 54,000 gammas was subtracted from all field data in order to simplify preparation of the magnetics map. Therefore, the

800-gamma contour corresponds to the total field intensity 54,800-isogamma line.

The Geophysics Specialties magnetic susceptibility bridge (Model: MS-3) was used to determine the susceptibility of crushed representatives of each rock type encountered in the area. The equivalent magnetite content is the volume percent of magnetite needed to produce a specific susceptibility in an otherwise non-magnetic sample. Samples from the Miocene(?) limestone and the intensely altered portion of the alteration zone (Miocene welded tuff) gave the lowest susceptibility readings encountered. The susceptibilities indicated virtually no magnetite present in the samples. The Pliocene(?) welded tuff readings were somewhat higher and indicated about 0.05 percent equivalent magnetite content. The Pliocene(?) dacite susceptibility suggested about 0.5 percent magnetite. The andesite, however, gave equivalent magnetite contents of 1.0 to 3.0 percent. The determination of magnetite content from measured susceptibility was taken from a chart by Parasnis (1962, p. 7). These determinations are admittedly approximate and are used only to give an order to magnitude impression of the lithologic susceptibility contrasts of the area. These values of susceptibility and magnetite content are used to explain the magnetic anomalies of the district entirely in terms of magnetized andesitic bodies.

Interpretation of Magnetic Anomalies

The magnetics data were interpreted by correlation with mapped geology as well as by approximate models for depth determinations. The mapped anomalies were compared to tabulated models (Vacquier and others,

1963). Confirmatory depths were obtained by use of a line of poles approximation applied to the magnetic profiles (Smellie, 1967). Further confirmatory depth estimates were based on other half-width rules techniques (Parasnis, 1966, p. 40-42).

The assumptions upon which the tabulated, prismatic models (Vacquier and others, 1963) are based are the following: (1) the polarization is in the direction of the earth's present field, (2) the vertical extent is "infinite", that is, the body extends downwards to the Curie Point geotherm, (3) the body is flat topped, and (4) the body has vertical planar sides across which there is a sharp and constant magnetic susceptibility contrast (Vacquier and others, 1963, p. 12).

All of the models used in this study were chosen such that the model anomaly most closely fit the pattern of the field data. The magnetic inclination of each model is seventy-five degrees.

The magnetics map is dominated by three prominent anomalous highs. No major magnetite deposits are thought to exist in the district. Therefore, all of the magnetic anomalies are explained on the basis of magnetized andesitic bodies.

The best developed anomaly is centered about one-quarter mile south of the Good Hope Mine. The anomaly extends a minimum of four thousand feet to the northeast from its pinchout near Chino Creek. Its maximum known width is approximately seven hundred to eight hundred feet. This anomaly follows very closely the mapped outcrop pattern of the andesite in this area. Although the match is not exact, it is close enough to suggest a genetic relationship between the andesite and the magnetics. The anomaly may in part be localized by the normal fault in the area.

Comparison with models (Vacquier and others, 1963, models A71 and A73) yields a depth estimate of two hundred to three hundred fifty feet to the top of the anomaly-inducing body. Model A71 is a vertical prism striking N. 45° E. with length equal to eight times its width. Model A73 has an identical orientation but its length is four times its width. Half-width estimates (Parasnis, 1966, p. 40-42, and Smellie, 1967, p. 481-482) indicate depths in the range of two hundred fifty to three hundred sixty feet. The Vacquier method for susceptibility contrast determination gives a value of $2,600 \times 10^{-6}$ to $8,500 \times 10^{-6}$ c.g.s. units for the contrast between this body and the surrounding rocks. A measured susceptibility of the andesite unit, where exposed, was $2,500 \times 10^{-6}$ c.g.s. units. These values correspond to two to three percent magnetite (Parasnis, 1962, p. 7). Thin sections of the andesite indeed show about one to three percent magnetite. The surrounding rocks of the Miocene(?) welded tuff have measured susceptibilities significantly less than 100×10^{-6} c.g.s. units.

The two other major magnetic anomalies of the district are less easily interpreted because they do not closely approximate observed surface geological features. The magnetic anomaly in the vicinity of the Buckeye and Ohio Mine is characterized by a sharp drop on the east side and a more gentle tailing on the west side. This probably represents a westward dipping body or surface. The magnetized parent producing this anomaly is assumed to be an andesitic intrusive. However, the anomaly does not correspond to known outcrops of andesitic material. This fact implies that the rocks exposed at the surface probably have very limited depth extents and that much of the upper portions of these

small bodies have been deeply weathered.

Model approximations for this anomaly (Vacquier and others, 1963, model A71) give depths that range from two hundred fifty to four hundred fifty feet. Model A71 is described above. Depth estimates based on the half-width techniques of Smellie (1967) and Parasnis (1966) range from one hundred feet to four hundred twenty-five feet. The wide variation in these values points up the general imprecision associated with depth calculations based on simple models.

A broad magnetics high is located in the northern portion of section 9. The shape of this anomaly suggests a magnetized body of irregular shape, or the intersection of two or more smaller bodies. Model calculations indicate a range of depths from one hundred feet to one hundred fifty feet to the top of the body. It is thought that this anomaly is also a response to andesitic intrusives. Model A67 (Vacquier and others, 1963) used here strikes N. 90° W., and its length is six times its width.

Discussion of Depth Approximations

The various methods employed above for the depth determinations give maximum expected depths to the top of the magnetized bodies. These methods are generally based on hypothetical, idealized cases and can be applied strictly only in a very limited number of situations. Some of the limiting assumptions that these methods are based on are the following: isolated anomalies, sharp lithologic boundaries, vertical boundaries, constant magnetic susceptibility, flat topography, very simple body geometries, and homogeneous overburdens.

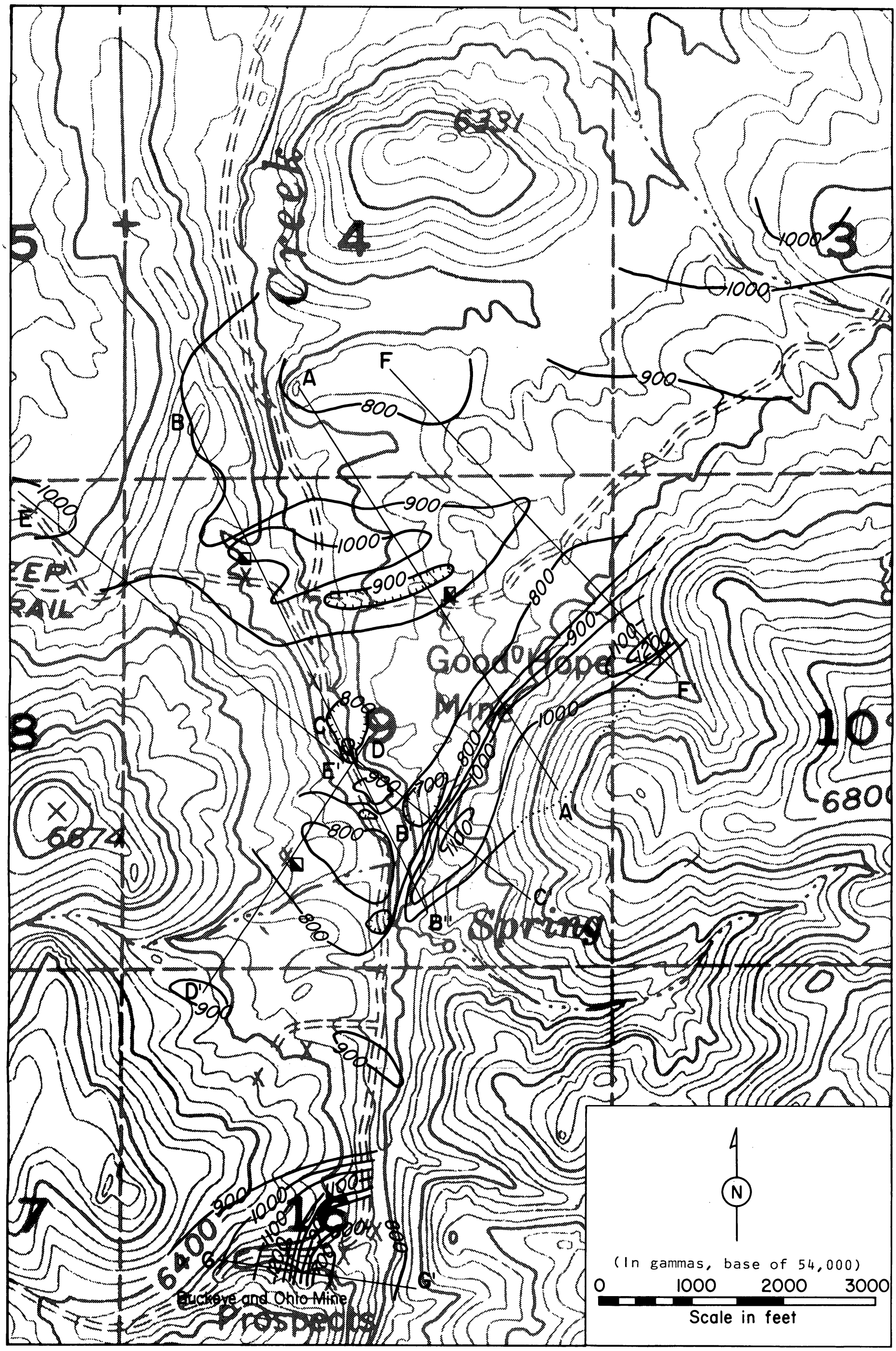


FIGURE 2. TOTAL MAGNETIC FIELD INTENSITY MAP OF THE GOOD HOPE MINING DISTRICT, ELKO COUNTY, NEVADA

Some of the anomalies can be interpreted as implying depths of a few hundred feet to idealized geometrical shapes. However, since these anomalies actually correspond to bodies exposed at the surface, one may postulate several explanations. Those explanations based on deviations from the theoretical boundary conditions set by the models are the following: (1) weathering has severely reduced the magnetite content of the near surface portions of these bodies; (2) the simple depth estimate methods used here do not closely approximate the geological and geographical conditions in the Good Hope District; and (3) the bodies have gently dipping surfaces, which effect anomalies equivalent to deeper steep-sided bodies. However, the possible error introduced by the failure to meet boundary conditions is perhaps overshadowed by the error caused by the smoothing program. This smoothing of the data always broadens anomalies and generally causes the calculated depths to exceed the true depths of burial. These errors may be particularly significant in areas of extreme magnetic gradients associated with very near surface magnetized bodies, as in the Good Hope District. This probably accounts for most of the apparent depth discrepancies.

INDUCED POLARIZATION SURVEYS

In the Good Hope District it was of interest to determine the presence of any relatively thin, tabular, near surface ore bodies that had escaped detection by the early prospectors. Also of interest was the location of any disseminated mineralization at depths greater than had previously been explored. In order to serve both of these purposes in the limited field season, an electrode spacing that might respond to

detail at a relatively large penetration depth was chosen. The intra-electrode spacing used was three hundred feet on lines A through F and two hundred feet on line G. These spacings allowed rapid coverage of a large number of reported mineralized zones with adequate penetration and relatively good detailing of anomalies. The surveys covered the same lines used in the magnetics survey.

A note of caution should preface the discussion of the induced polarization data. None of the IP anomalies are of the order of magnitude that unequivocally implies an ore deposit. Relative to the anomalies obtained over large known deposits (Hallof, 1957, p. 58-65, and Lawrence, 1969, p. 68-87), the Good Hope District anomalies are small in both magnitude and lateral extent. Also, some of the observed anomalies may be responses to the "normal effect" which has been shown to be primarily due to the presence of altered mica and clay minerals in the rock pores (Mayper, 1959, p. 142-158). Mayper's work shows that the IP response is dependent upon the grain size and distribution of the metallic minerals, and under certain circumstances a very small percentage of mineralization can account for a large IP response. So the significance of the Good Hope IP anomalies cannot be known until drilling has provided samples from the anomalous zones.

It is here assumed that the majority of the IP responses are due to metallic (and metallic sulfide) mineralization. However, the intensity and extent of the mineralized zones is completely open to question. Only drilling will calibrate the data and make determination of the economic potential of the district possible.

Terminology and Plotting Technique

The following terminology shall be observed in this paper. The intra-electrode spacing, x, is the distance between the two electrodes of a given dipole. A symmetrical dipole-dipole array was used for all measurements. The dipole spacing, nx, is the distance between the closest current and potential electrodes. In these surveys "n" takes on the values of 1,2,3, and 4.

The following diagrams schematically show these definitions and the data plotting technique (after Hallof, 1957):

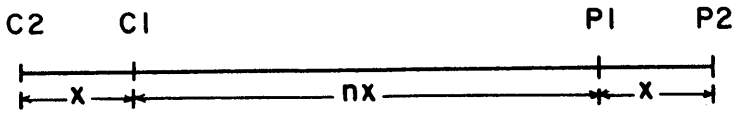


Figure 3i. Electrode Configuration

P1 and P2 are the potential electrodes. C1 and C2 are the current electrodes. The distance between C1 and P1 is the dipole spacing. The plotting points of the apparent resistivity and induced polarization are located at the intersections of lines dipping forty-five degrees (Hallof, 1957, Figure 1). The lines pass through the centers of the dipoles for each of the current and potential dipole locations occupied.

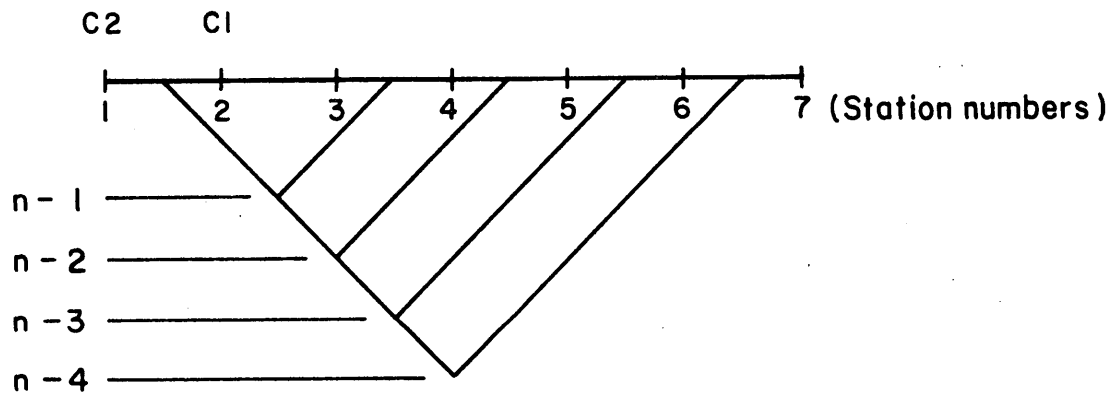


Figure 3ii. Plotting Technique

IP Parameters and Defining Equations

During the IP surveys, the resistivity (in ohm·ft) was determined at 0.3 cps; the percent frequency effect (PFE) was measured at 3.0 cps and 10.0 cps relative to the 0.3 cps reference; and the metal factor (MF) was calculated for 3.0 cps and 10.0 cps relative to the 0.3 cps reference. For simplicity, Figures 3 through 9 show the resistivity and the 10.0 cps values of PFE and MF. The 3.0 cps values for these parameters are appended to the text.

The defining equations for these several factors are the following:

$$\rho_{DC} = K\ (V/I)$$

$$PFE = \frac{\rho_{DC} - \rho_{AC}}{\rho_{AC}} \times 100\%$$

and

$$MF = (PFE/\rho_{DC}) \times 2\pi \times 10^3$$

In the above ρ_{DC} refers to the apparent resistivity measured at 0.3 cps; ρ_{AC} refers to the resistivity measured at 3.0 cps or at 10.0 cps. In the field work ρ_{DC} was calculated from the measured voltage and input current and the calculated geometric factor, K. The derivation of the geometric factor is given in Appendix D. The PFE values were measured and recorded directly in the field.

The Frequency Domain IP Effect

An induced polarization response can be generated by numerous lithologic-petrologic configurations. The two geologically most important anomaly-causing materials are clays and metallic minerals. An IP anomaly induced by clays results from membrane polarization, where the blocking effect is caused by surface ionized portions of the clay particles (Keller and Frischknecht, 1966, p. 446-452).

The IP response to metallics and metallic sulfide minerals is referred to as electrode polarization. This phenomenon is the blocking or capacitive effect of the metallic particles which interrupt the ionic conductor pathways. A mineral-solution interface impedance is developed by the abrupt transition from ionic conduction in the pore fluid to electronic conduction in the metallic particles (Hallof, 1957, p. 10).

A frequency dependent overvoltage develops at each mineral-solution interface. The dependency is such that at higher frequencies the impedance is decreased; therefore, the bulk rock resistivity decreases with increasing frequency of the input current. This inverse frequency dependence is probably a response to shorter transport periods and the resulting smaller voltages developed at the interfaces (Hallof, 1957, p. 11).

Many factors influence the magnitude of the blocking effect: pore size and distribution, permeability, conductivity of the solution, type of mineralization, metallic mineral grain size, amount and distribution of the metallic minerals (Keller and Frischknecht, 1966, p. 444-446). For the purposes of the ensuing discussion, it is assumed that the amount and distribution of metallic minerals is the primary factor in determining the IP anomalies in the Good Hope District.

In general, disseminated deposits of metallic minerals are characterized by an increase in IP response (both PFE and MF) with any increase in the metallic content of the rock. This is based on the increased blocking of the ionic conductor pathways and the resulting increase in the capacitive boundary surface area (Hallof, 1957, p. 10-13). Therefore, in mineralized areas, high values of PFE and MF usually indicate zones of more intense mineralization.

The apparent resistivity is a function of the bulk lithologic and hydrologic properties of a large volume of rock. Low values of resistivity can be caused by changes in any of the following: porosity, permeability, salinity of the pore fluid, rock alteration, weathering, and mineralization (Keller and Frischknecht, 1966, p. 16-33). Metallic minerals produce the overvoltage effect, but they also decrease bulk resistivity by their own low resistivities. Therefore, it is common to find highly mineralized areas having low apparent resistivities. The overall result is that the combination of low measured resistivity, high percent frequency effect, and high metal factor in an area give the best indication of an important disseminated deposit.

RESULTS OF THE INDUCED POLARIZATION

Only the zones of anomalous IP response that look most favorable for drill exploration are discussed. The anomalies observed are considered as if they were responses solely to the metallic mineral content of the rocks. However, without drill data, the results of the IP work are uncalibrated and their geologic-mineralogic implications are uncertain. The possibility remains that many of the high IP responses may be caused by the membrane polarization effect of clays.

Anomalous clay deposits could result from intense argillization within zones of low silicification of the welded tuffs, or from intense argillization within andesitic bodies. Other possibilities exist, but they probably play secondary roles, if present at all.

The anomalous zones have here been divided into two categories: major anomalies and minor anomalies. The discussion begins with the most significantly anomalous lines and proceeds to lesser anomalous lines.

Major Anomalies

Line B (Figure 4)

The pronounced anomalies are located between B1800 and B2700 (Anomaly Bi) and between B3300 and B4500 (Anomaly Bii). A possible, but incompletely explored, anomaly occurs between B600 and B900. Anomaly Bi is well developed in both the PFE and MF plots. The resistivity profile indicates a highly resistive body possibly overlying the potential mineralized zone. The PFE contour distribution suggests either a deep source of the anomaly or else an increase in metal content with depth.

The Bii anomaly suggests a relatively near surface upper limit for

the implied ore body. The shape of the anomaly implies a possible break between upper and lower segments of the body. This area is marked by a resistivity low which may indicate a fault separating the two portions. The resistivity data is otherwise quite nondescript.

It is of interest to note that both anomalies Bi and Bii have anomalous magnetics and geochemical arsenic values (Payne, 1967, Figure 7) associated with them. The arsenic anomalies seem to correspond well with the IP anomalies at depth. The magnetics highs associated with Anomaly Bi are offset a few hundred feet to the north of the highest IP values. The close areal correlation of these three types of anomalies suggests that this area is of prime interest for drilling. The most interesting targets are in the vicinity of B2300 and B3500.

The reference to the geochemical arsenic values is based entirely upon the work done by Payne (1967, Figure 7). His work is not reviewed here, but the results of his arsenic survey are compared with the IP and magnetics data.

Line F (Figure 8)

The three IP anomalies along line F occur between F300 and F1200 (Anomaly Fi), between F1500 and F2700 (Anomaly Fii), and between F2700 and F3600 (Anomaly Fiii). Line F is characterized by several thin anomalous zones, some of which appear to widen at depth. Small arsenic and magnetic anomalies are associated with the upper and lower portions of Fii. Implications of the resistivity data are unclear, although possibly significant resistivity lows are associated with sections of Fi and Fii. Anomaly Fi was not fully explored and the line should be extended to the northwest to check the significance of the IP high.

Two potential drill targets lie in the vicinity of F1800 and F2950. If these two are shown to be significantly mineralized, a supplemental target at F600 is also suggested. The latter target is listed as supplemental because the survey does not delineate its full extent.

Line E (Figure 7)

The anomaly between E2400 and E3600, Ei, has many features in common with Anomaly Bi. The shape and magnitude of the resistivity and PFE of Bi and Ei are very similar. The MF profiles are also comparable but somewhat less convincingly. Although Ei lies in a magnetically flat area, it is associated with the same arsenic high that occurs at Bi. A suggested drilling target lies near E2700.

Minor Anomalies

The anomalies to be discussed below are considered to be of secondary importance. They should be drilled only if justified by data from drilling of the primary targets.

Line A (Figure 3)

Two IP anomalies are delineated on line A. The first, Ai, lies between A3600 and A4000. The second, Aii, lies between A2200 and A2800. Each is smaller and less well developed than those discussed above, but they could be significant if the primary targets prove good. Anomaly Aii has corresponding magnetics and arsenic anomalies. Secondary drill targets are suggested in the vicinity of A2700 and A3900.

Lines C, D, and G (Figures 5, 6, and 9)

There are a few very weak anomalies on each of these lines; however,

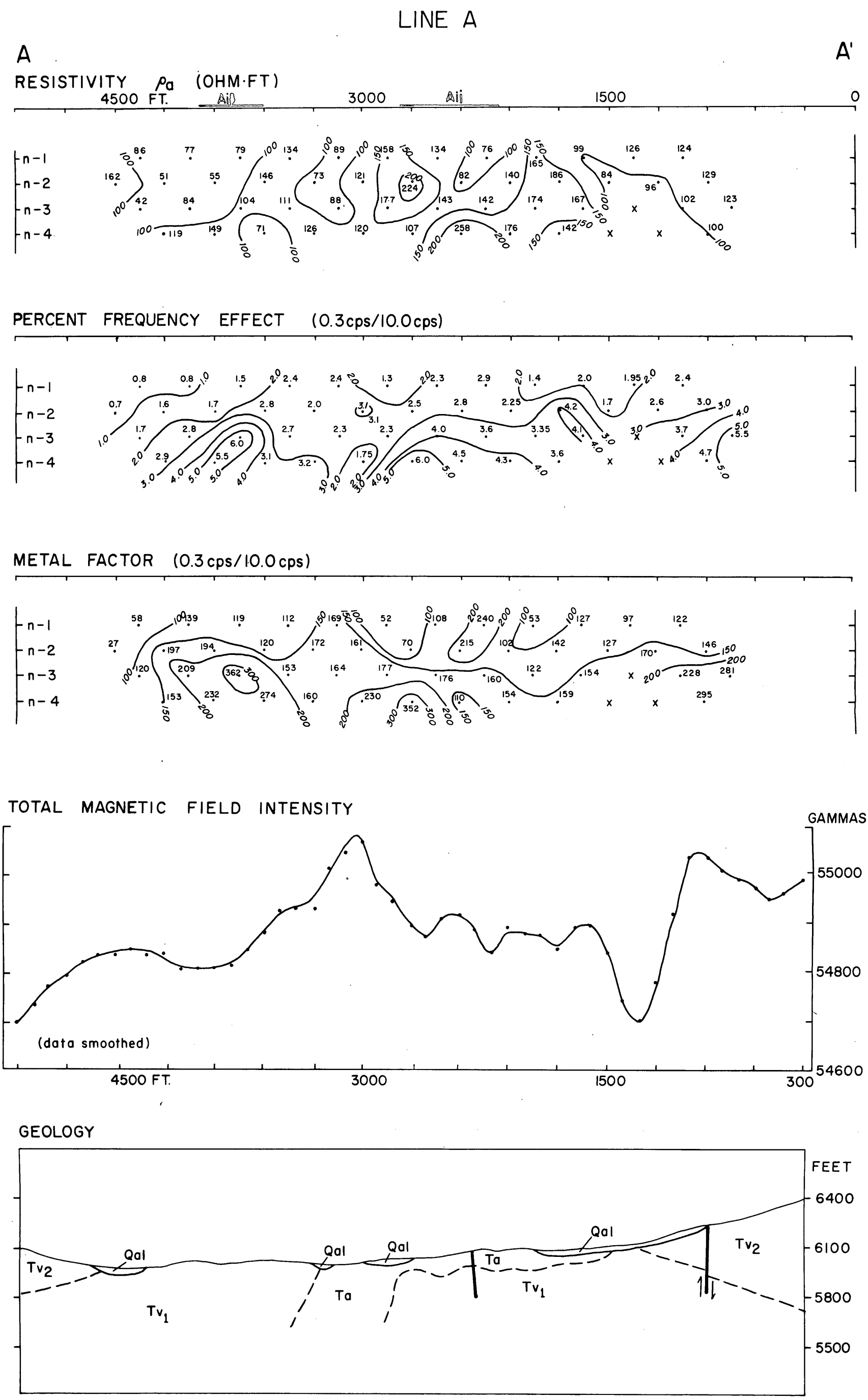


FIGURE 3. GEOLOGICAL AND GEOPHYSICAL PROFILES — LINE A

LINE B

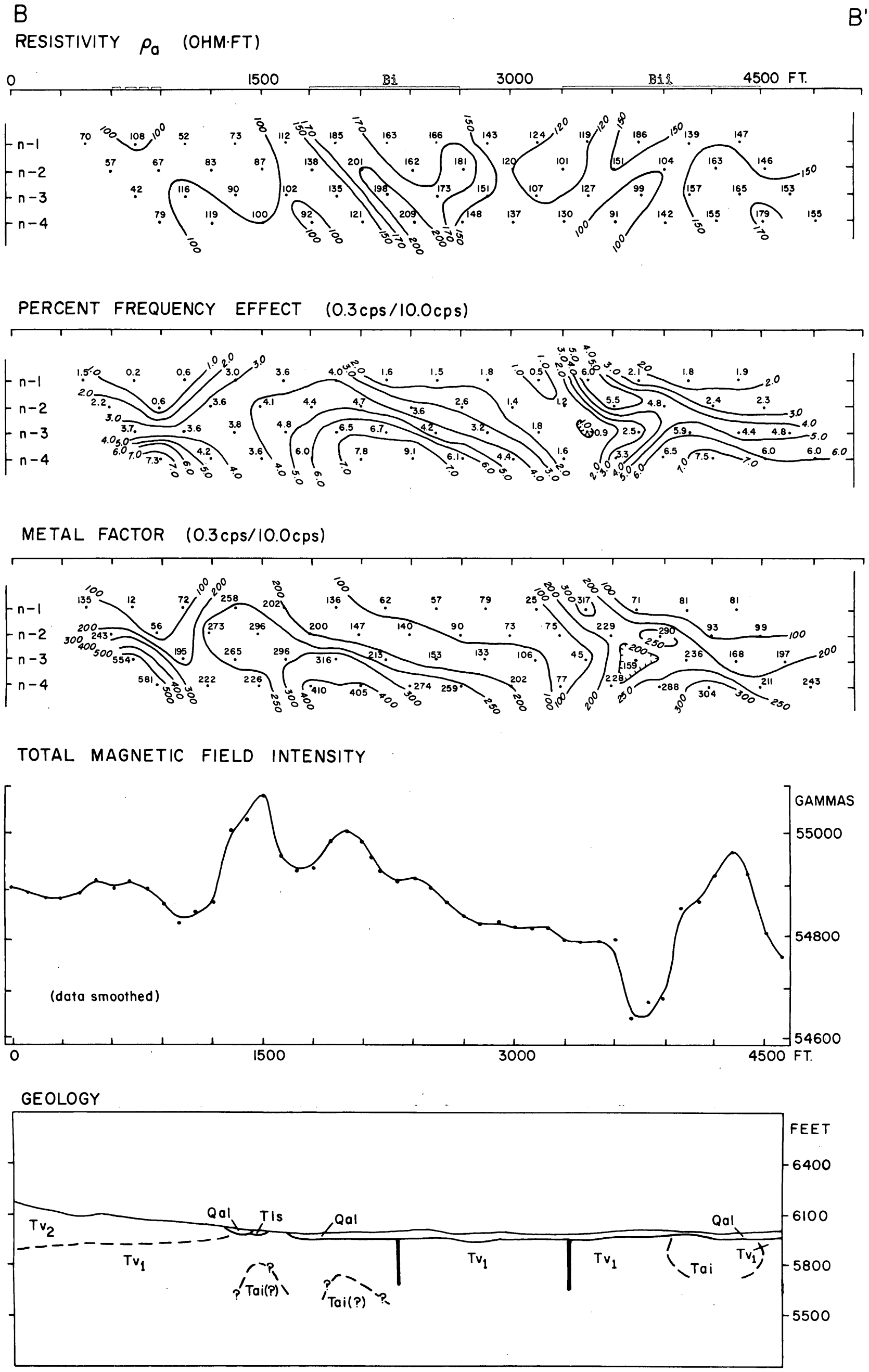


FIGURE 4. GEOLOGICAL AND GEOPHYSICAL PROFILES — LINE B

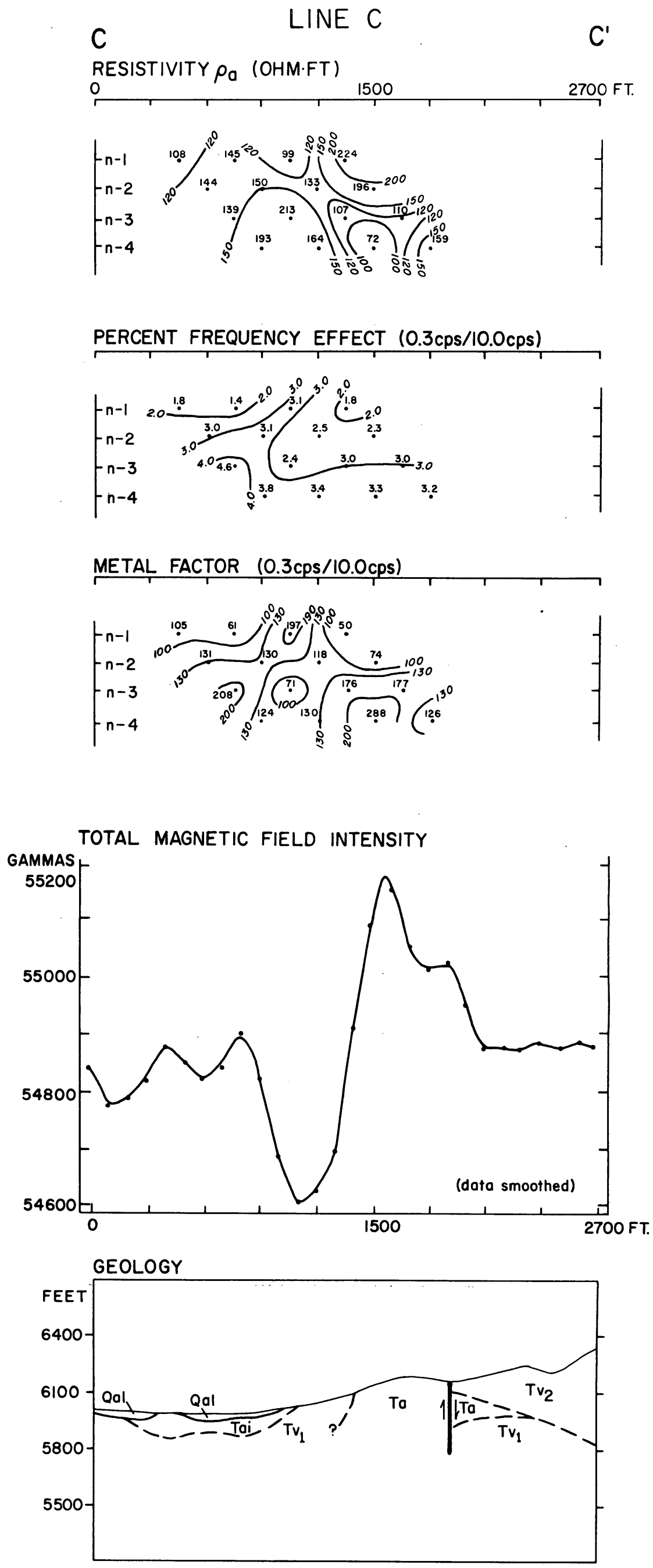


FIGURE 5. GEOLOGICAL AND GEOPHYSICAL PROFILES — LINE C

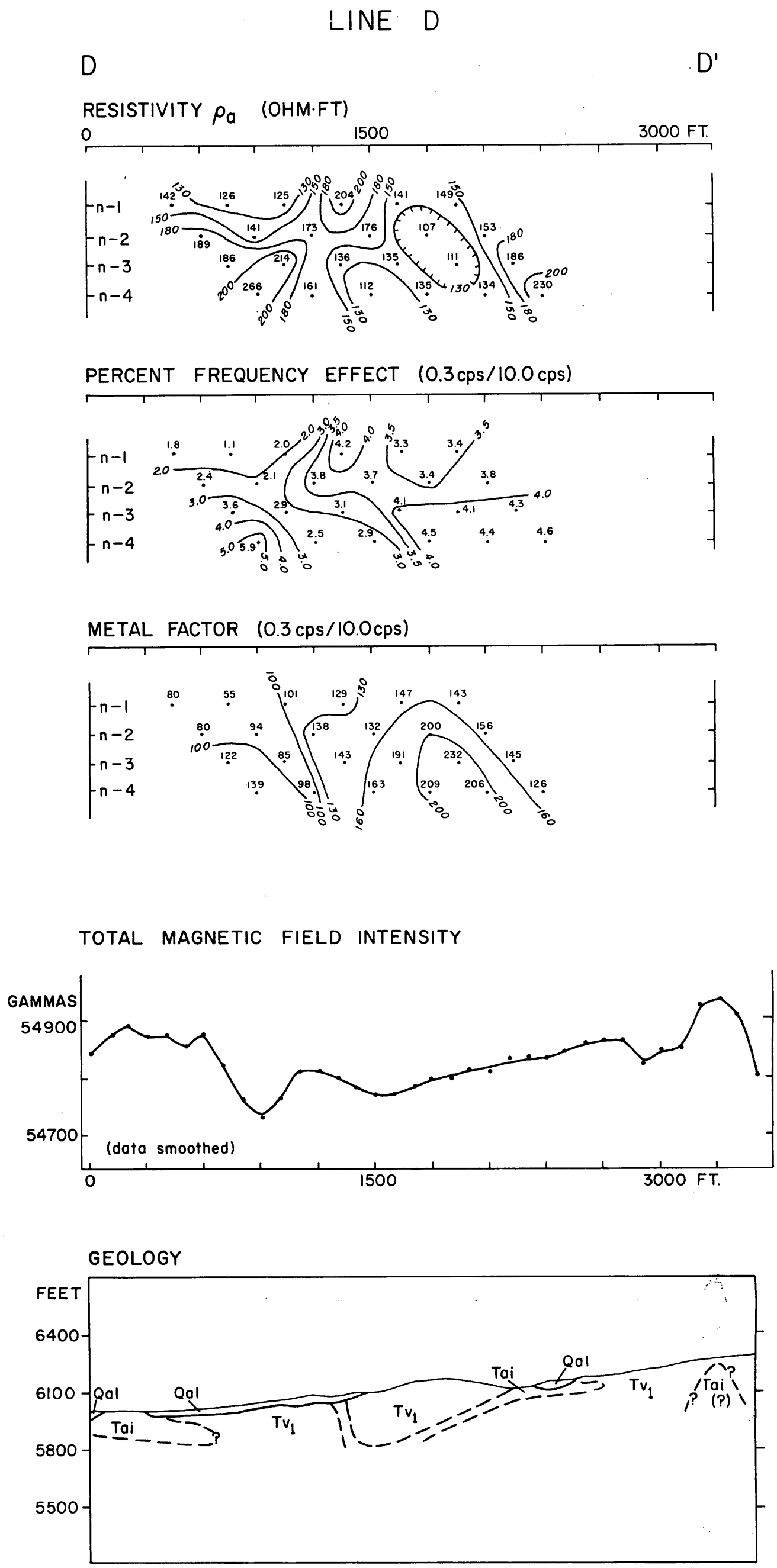
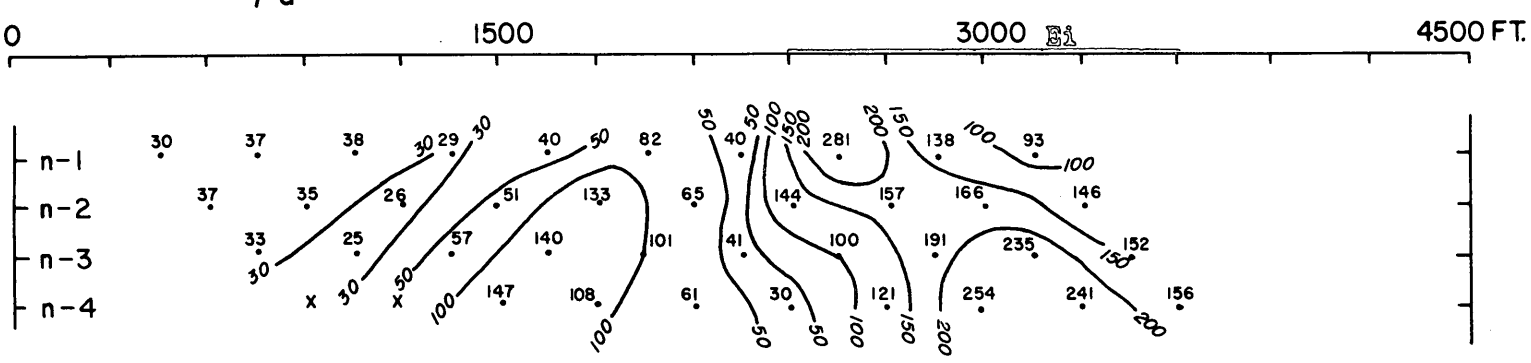


FIGURE 6. GEOLOGICAL AND GEOPHYSICAL PROFILES — LINE D

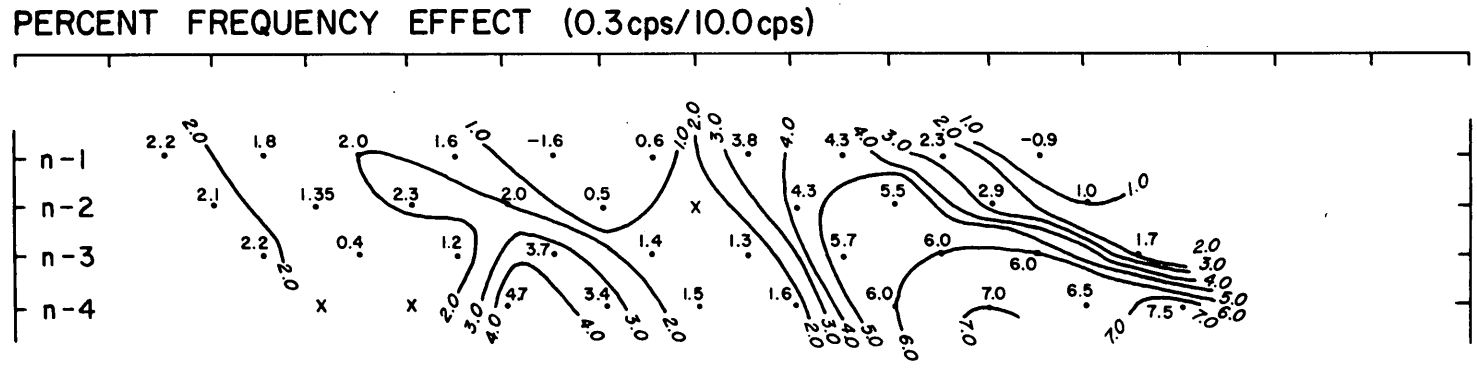
LINE E

E E'

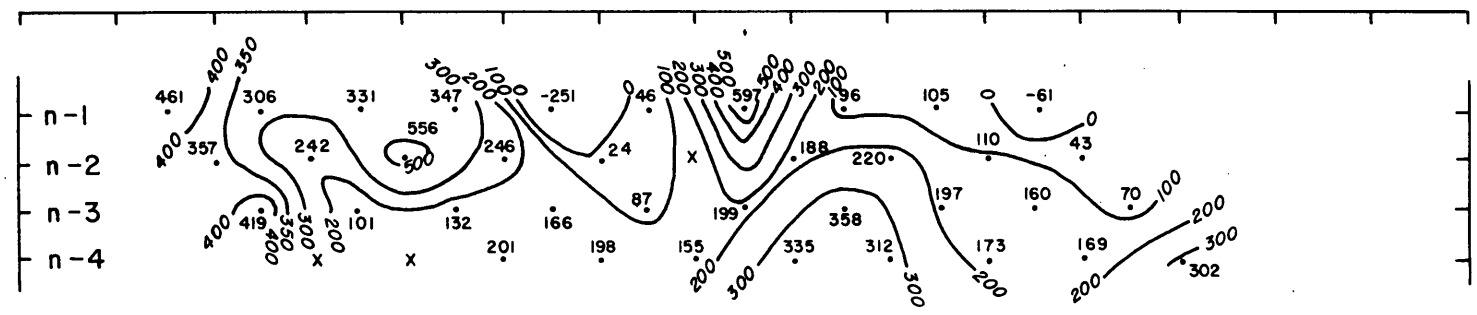
RESISTIVITY ρ_a (OHM·FT)



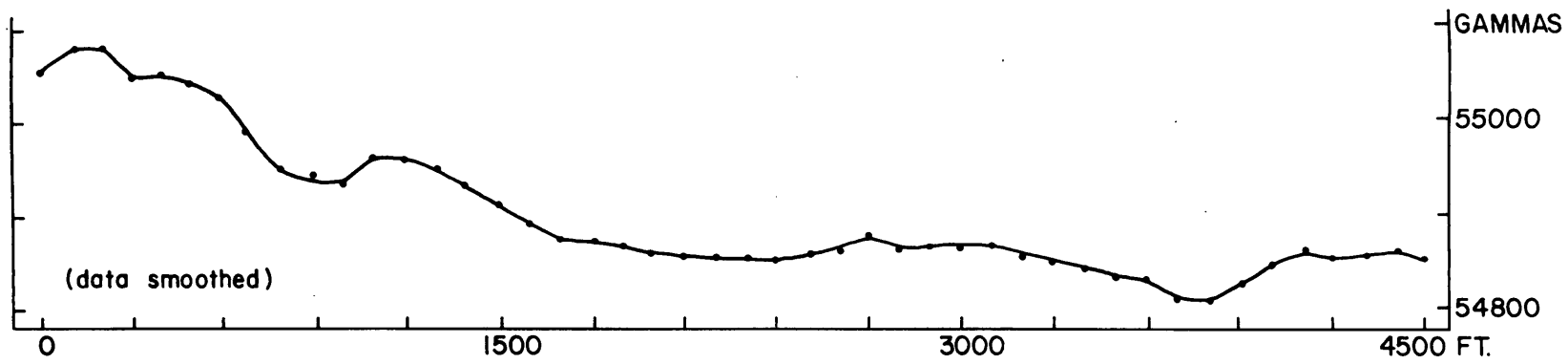
PERCENT FREQUENCY EFFECT (0.3cps/10.0cps)



METAL FACTOR (0.3cps/10.0cps)



TOTAL MAGNETIC FIELD INTENSITY



GEOLOGY

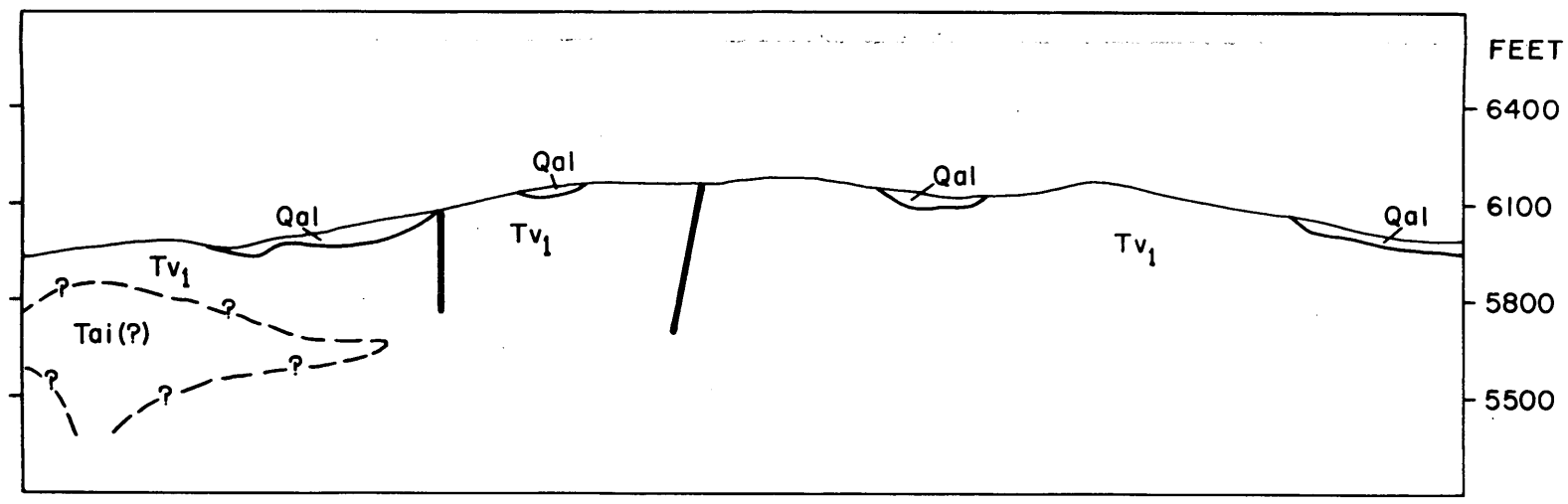


FIGURE 7. GEOLOGICAL AND GEOPHYSICAL PROFILES – LINE E

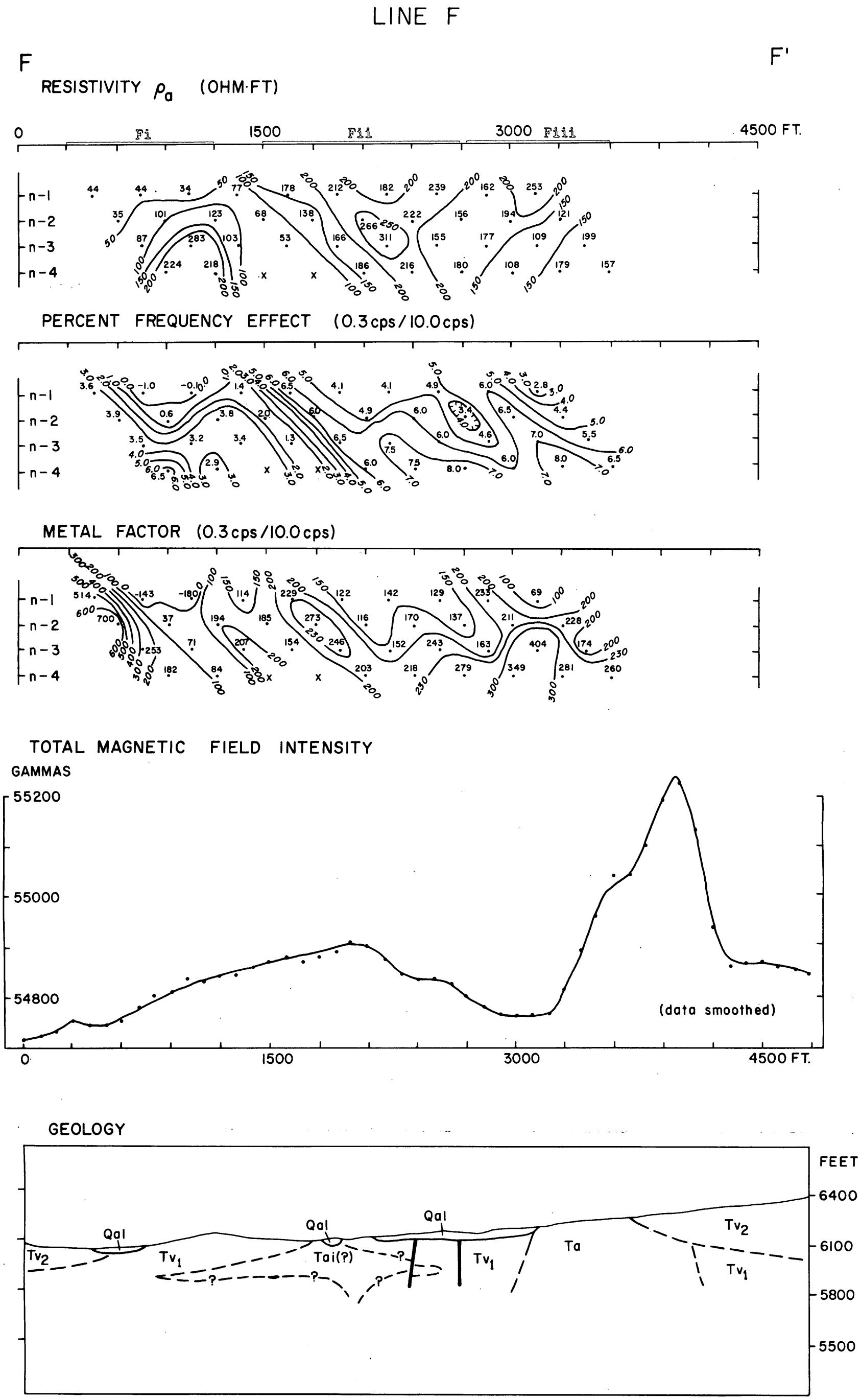


FIGURE 8. GEOLOGICAL AND GEOPHYSICAL PROFILES — LINE F

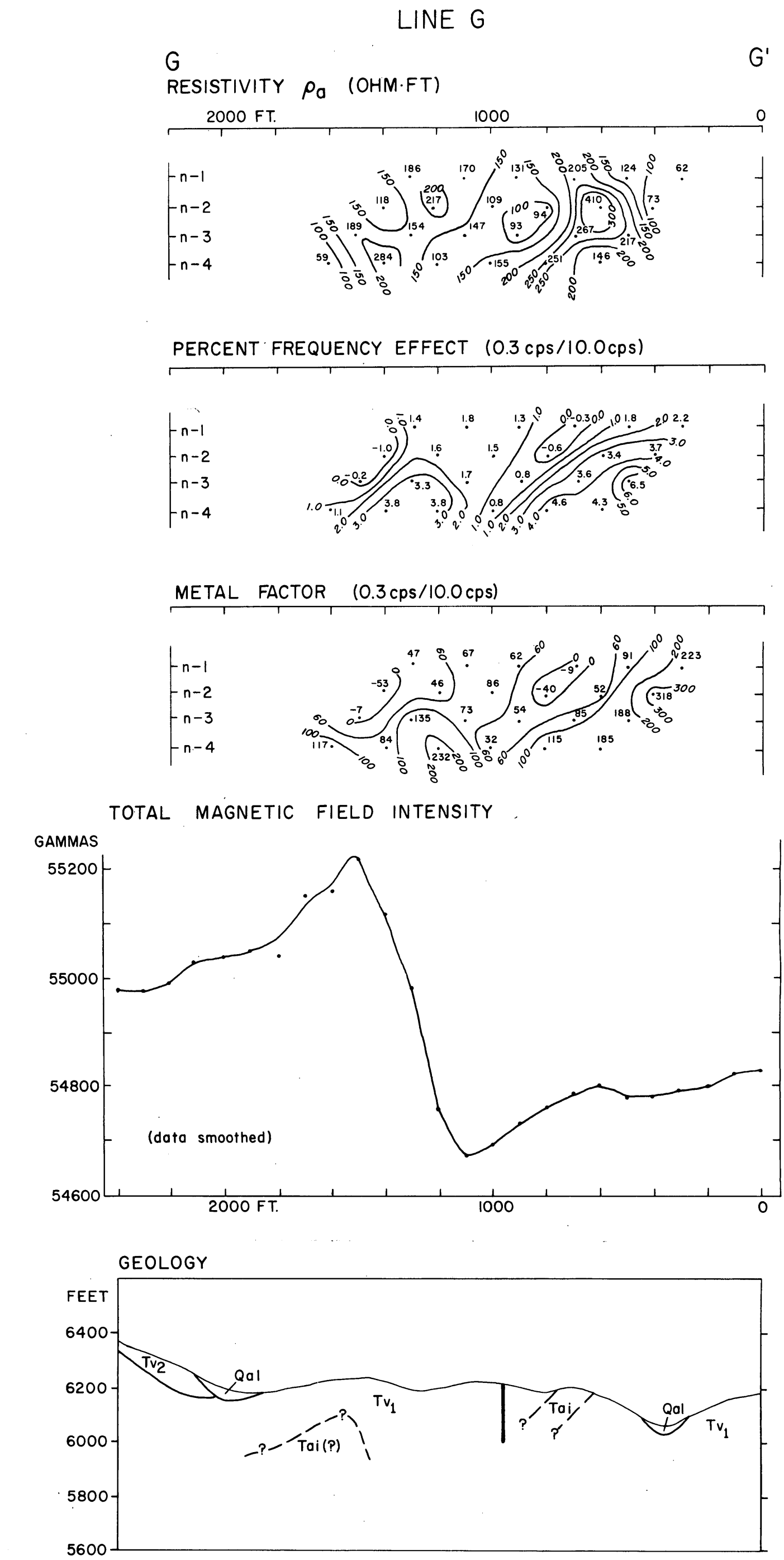


FIGURE 9. GEOLOGICAL AND GEOPHYSICAL PROFILES — LINE G

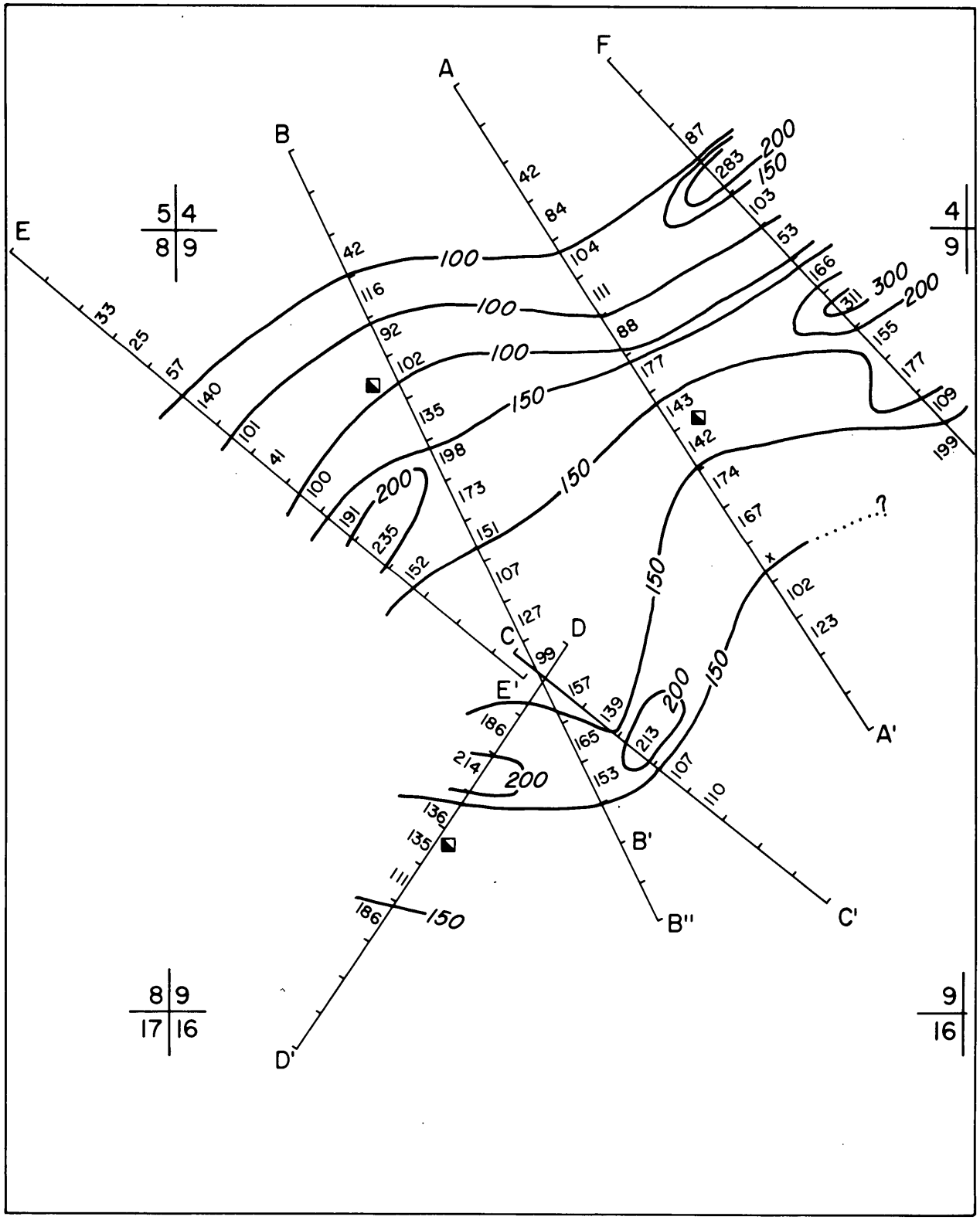


FIG. 10. RESISTIVITY MAP (OHM·FT) n = 3

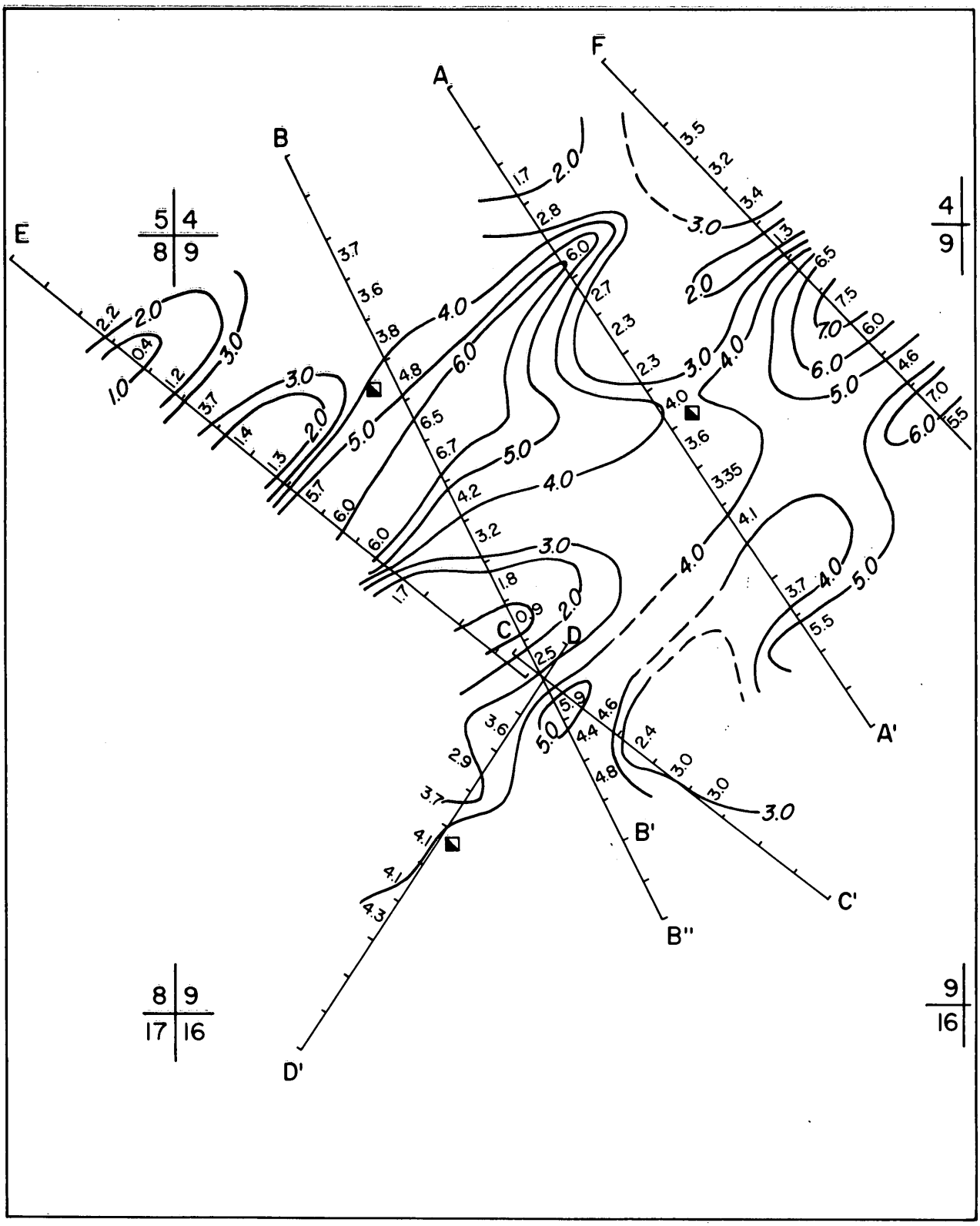


FIG. 11. INDUCED POLARIZATION MAP SHOWING PERCENT FREQUENCY EFFECT (0.3 cps/10.0 cps) n = 3

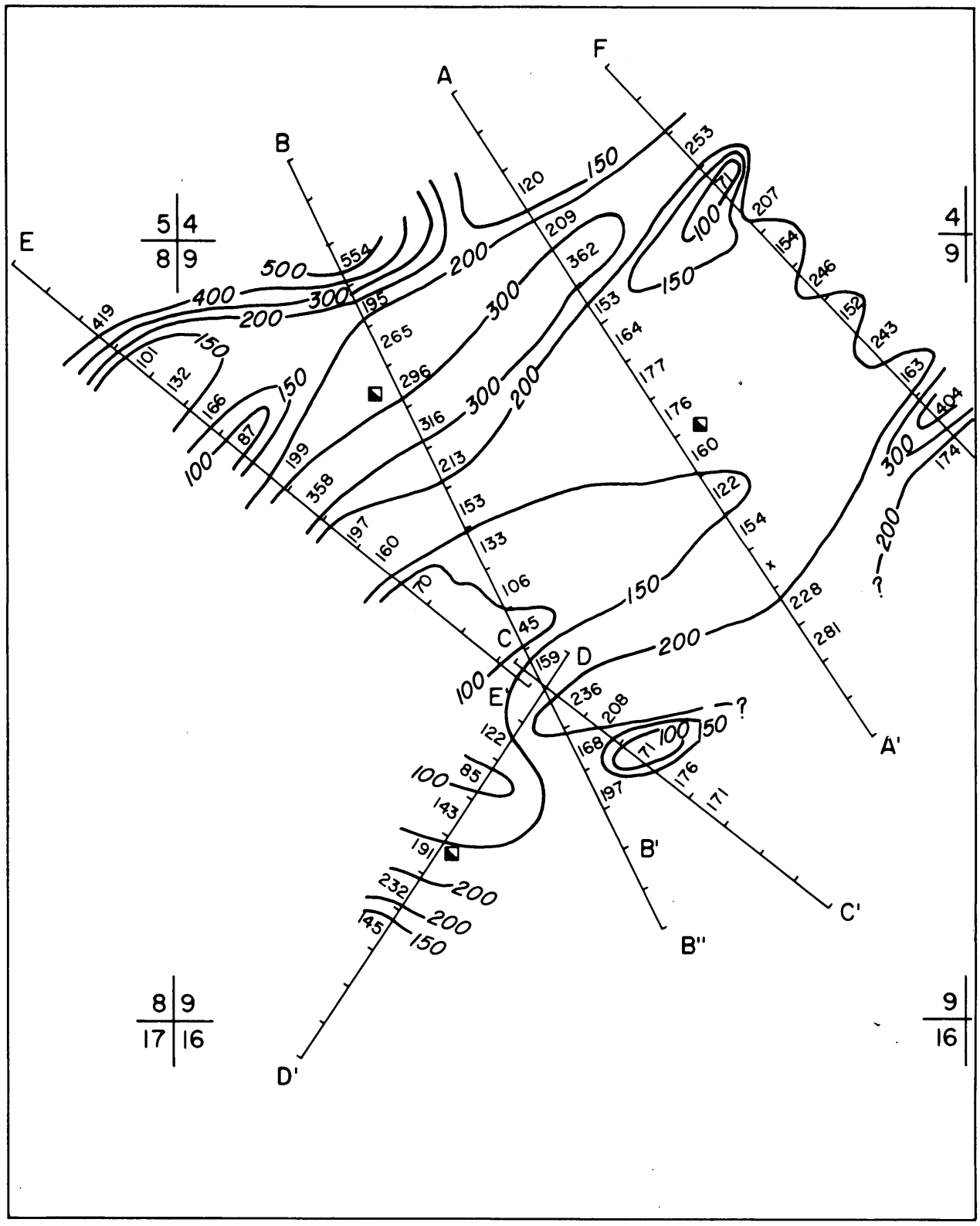


FIG. 12. INDUCED POLARIZATION MAP SHOWING METAL FACTOR (0.3 cps/10.0 cps) n = 3

none warrant drilling at this time. The shape of the eastern end of the line G data suggests that IP work should be extended to the east. A possible drill target may lie to the east of the end of the line G data. The responses along lines C and D suggest very little, if any, mineralization and probably no economic deposits.

INDUCED POLARIZATION MAPS

The series of maps, Figures 10, 11, and 12, show the values of resistivity, PFE, and MF for the dipole spacing of n=3. The maps are the composite of all the profiles given in Figures 3 through 9 for n=3. It appears that a strong northeast-southwest orientation pervades the region. This closely parallels the trends of known mineralization and major faulting mapped in the area. The ultimate significance of this IP orientation is not known, but it appears to add weight to the interpretation that the andesitic intrusives and the mineralization were localized by the northeast-southwest trending Tertiary faults of the area.

VLF-ELECTROMAGNETIC SURVEYS

Introduction

The Geonics Very Low Frequency - electromagnetic instrument was employed over portions of the Good Hope District in search of any zones of conductivity variation. The instrument was used along line A and part of line B. The station spacing was one hundred feet and all readings were taken at magnetics stations. The field procedure is exceedingly simple and is well described by the Geonics VLF-electromagnetic operating manual (Geonics Limited, 1968).

Basic Principles

The energy sources for the VLF receiver are the Naval defense transmitting stations, which use frequencies in the range of fifteen to thirty kilocycles per second. The receiver is tuned to a specific transmitter by inserting the proper frequency response module. The transmitting station is chosen such that "the primary field is parallel to the survey line" (Paterson and Ronka, 1970, p. 10).

The in-phase and quadrature components of the electromagnetic field are determined separately by individual coils arranged perpendicular to each other. The values recorded for the in-phase and quadrature components are functions of the eccentricity and inclination of the VLF polarization ellipse. These two parameters of the ellipse are in turn functions of the distance from the source and the geological configuration beneath the receiver. Variations in the subsurface conductivity register as anomalous VLF responses. The response can be triggered by ore bodies, shear zones, and alteration zones (Paterson and Ronka, 1970).

Topography also can significantly distort the VLF response (Paterson and Ronka, 1970, p. 11, and oral communication, T. Meidav, 1970). A method that corrects for the topographic effect has been suggested by Professor Tsvi Meidav (oral communication, 1970).

Results of the VLF-Electromagnetic Surveys

The profiles for lines A and B are presented as Figures 13 and 14 in Appendix A. The response along each line is remarkably flat with small variations around the zero percent line.

The only area of interest is along line A from A0 to A1000. Here the

in-phase component shows a distinctly anomalous response, while the quadrature component is flat. The anomalous in-phase behavior occurs on a steep hillside, and the anomaly is apparently entirely a topographic effect. This interpretation is based on a nomogram devised by Professor Meidav (1970). This indicates that in the Good Hope District the usefulness of the VLF-electromagnetic unit is questionable.

RECOMMENDATIONS

SUGGESTED DRILL TARGETS

To determine the usefulness of further geophysical work, the IP anomalies should be calibrated by data obtainable from the suggested drill program. The following is a listing of the potential drill targets suggested in the discussion of the IP anomalies. On line B the favorable locations are in the vicinity of B2300 and B3500. The suggested locations along line F occur at F1800 and F2950. Line E shows a single target near E2700. Two secondary targets are at A2700 and A3900.

In addition to the previously suggested sites, one target is suggested by the IP maps (Figures 10, 11, and 12). As the resistivity and PFE maps show, there is a resistivity low associated with the finger-like PFE high just east of the shaft near line B. The suggested target lies about 300 feet due east of B1800. This target roughly corresponds to the edge of the north-central magnetics high (about the one thousand gamma contour).

SUGGESTIONS FOR FURTHER EXPLORATION

Dependent upon the results of a drilling program, extension of the detailed geological, geophysical, and geochemical surveys is recommended in two areas to explore more fully the region's potential. Regional geological mapping is recommended to strengthen the temporal correlations and the interpretation of the stratigraphic sequence. More extensive areal mapping may also point out new areas of interest that should be checked by geochemical and geophysical means.

West of the Buckeye and Ohio Mine along the tributary to Chino Creek are several old mines and prospect pits in the altered rhyolite. It would be of interest to extend the magnetics and IP surveys into this region in order to determine the possible mineralization configuration at depth. The geologic situation is similar to that at the Buckeye and Ohio Mine except that much of the western area is covered by Pliocene(?) dacite flows.

The second area of interest is the barite vein on the west slope of hill 6674 of section 8, T. 41 N., R. 49 E. An extension of the several preceding geochemical surveys to include portions of the alteration zone around this minor barite occurrence would further enrich our knowledge of ore distribution and potential for future production. Possibly IP and magnetics should be used over this occurrence also.

SUMMARY

The geology of the Good Hope District is dominated by Tertiary volcanics: flows, intrusives, and welded tuffs. A portion of the pre-Tertiary basement is exposed in one area, but the pre-Tertiary structural configuration is totally obscured by the volcanic cover. An extensive zone of alteration and mineralization is developed in the Miocene(?) welded tuff and partially in the Miocene(?) andesite.

Several geophysical exploration techniques were applied to the district in order to determine the existence of any unmined continuation of the mineralization and to determine the subsurface lithologic configuration. The magnetics data outlined several possible buried andesitic bodies. Results from the IP surveys suggest a drilling program to determine the nature of the anomaly sources. The VLF-EM responses appear to be totally dominated by the topographic effect.

The future of the Good Hope Mining District cannot be established solely on the basis of the geophysical work described here. A series of drill holes is required to determine the significance of each of the anomalies. The combined geophysical data and drill results should be adequate to conclusively assess the district's potential.

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APPENDIX A:

VLF-ELECTROMAGNETIC DATA LINES A AND B

(FIGURES 13 AND 14)

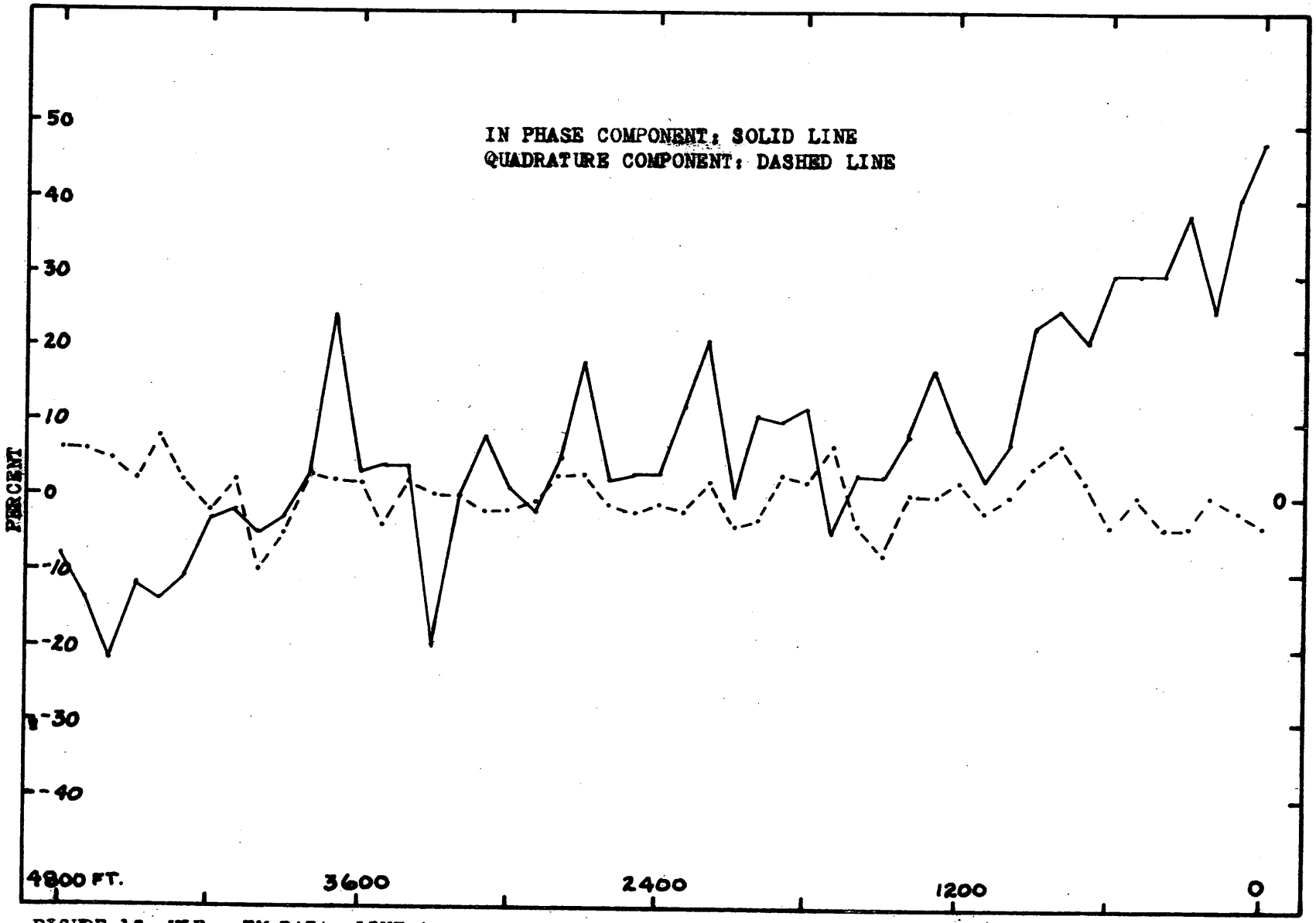


FIGURE 13. VLF - EM DATA: LINE A

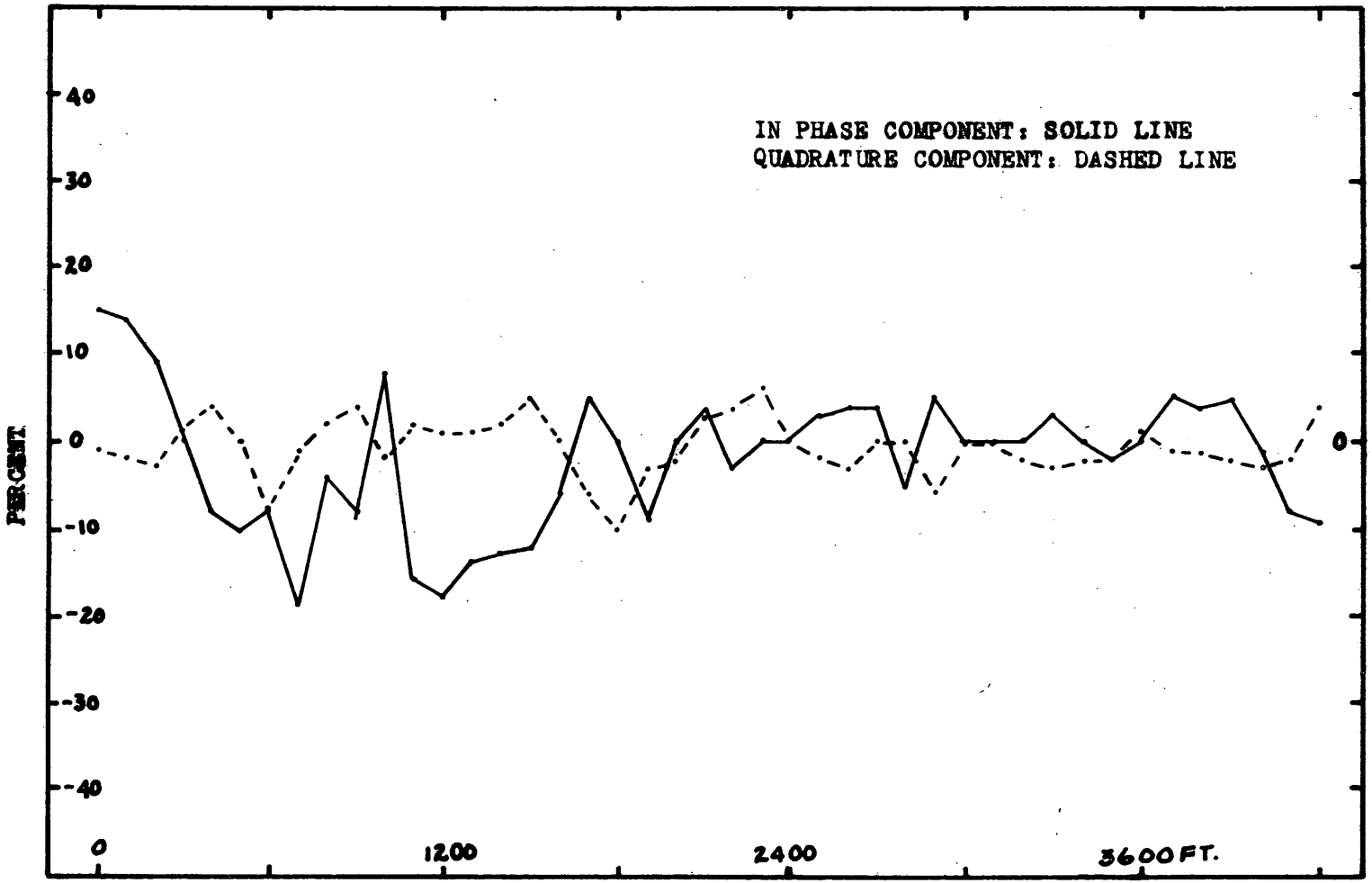


FIGURE 14. VLF - EM DATA: LINE B FROM B-0 TO B-4200

APPENDIX B:

ADDITIONAL MAGNETICS DATA

EXTENSION OF LINE B

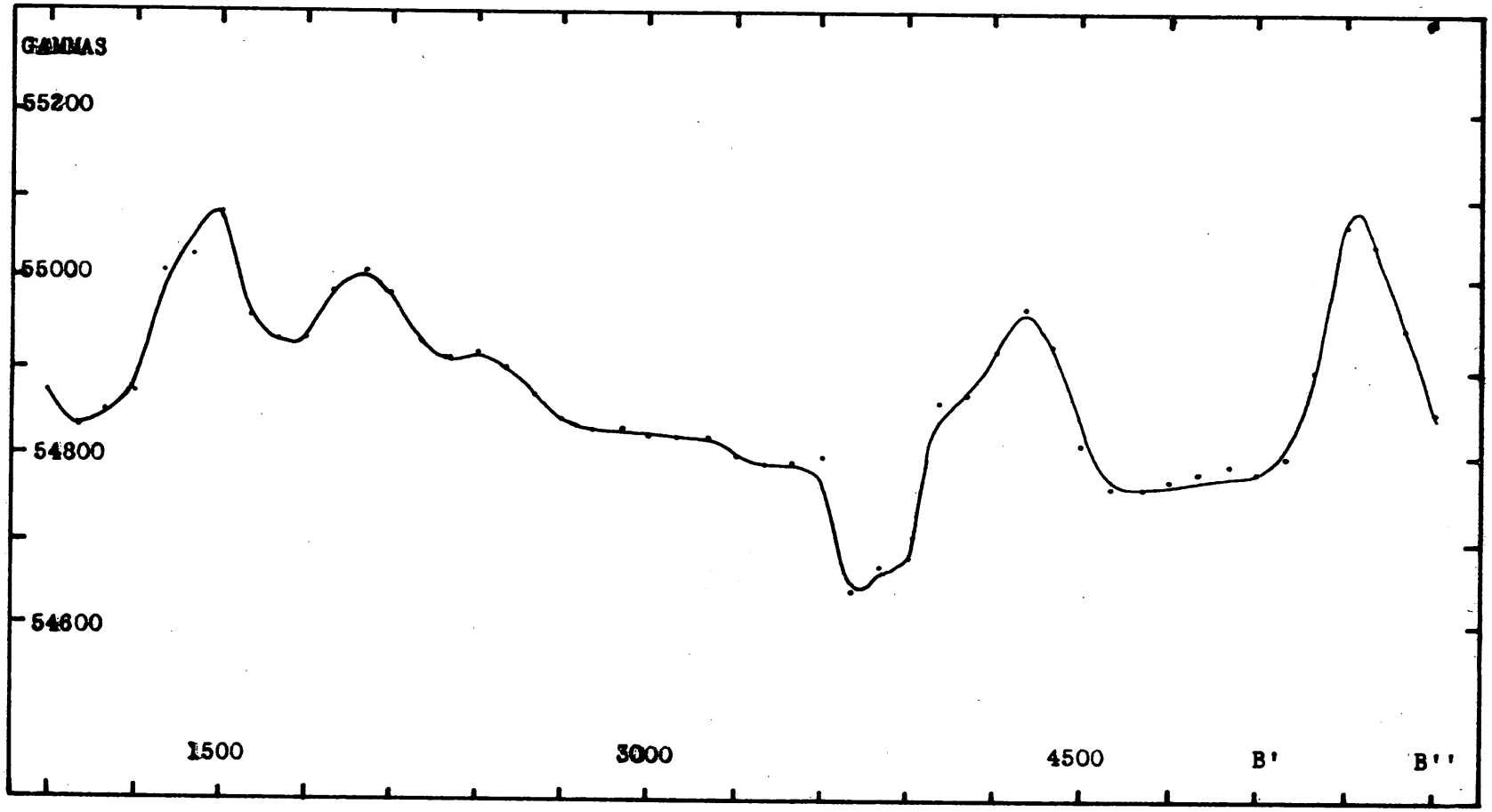


FIGURE . ADDITIONAL DATA: EXTENSION OF LINE B - SHOWING B900 TO B5700=B''

TOTAL MAGNETIC FIELD INTENSITY PROFILE (IN GAMMAS)

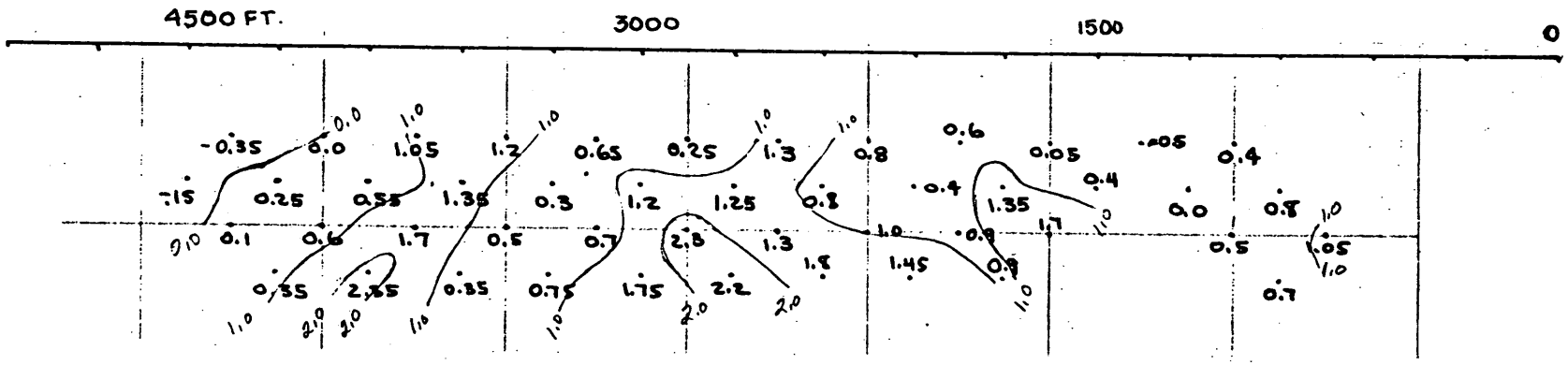
APPENDIX C:

ADDITIONAL INDUCED POLARIZATION DATA

PERCENT FREQUENCY EFFECT AND METAL FACTOR VALUES FOR (0.3 cps / 3.0 cps)

LINES A THROUGH G

PERCENT FREQUENCY EFFECT (0.3 cps / 3.0 cps)



METAL FACTOR (0.3 cps / 3.0 cps)

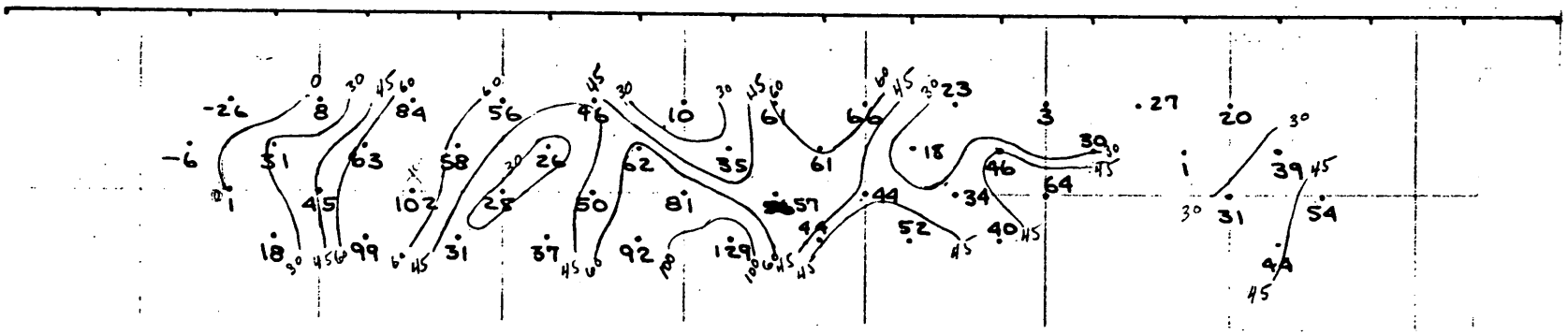
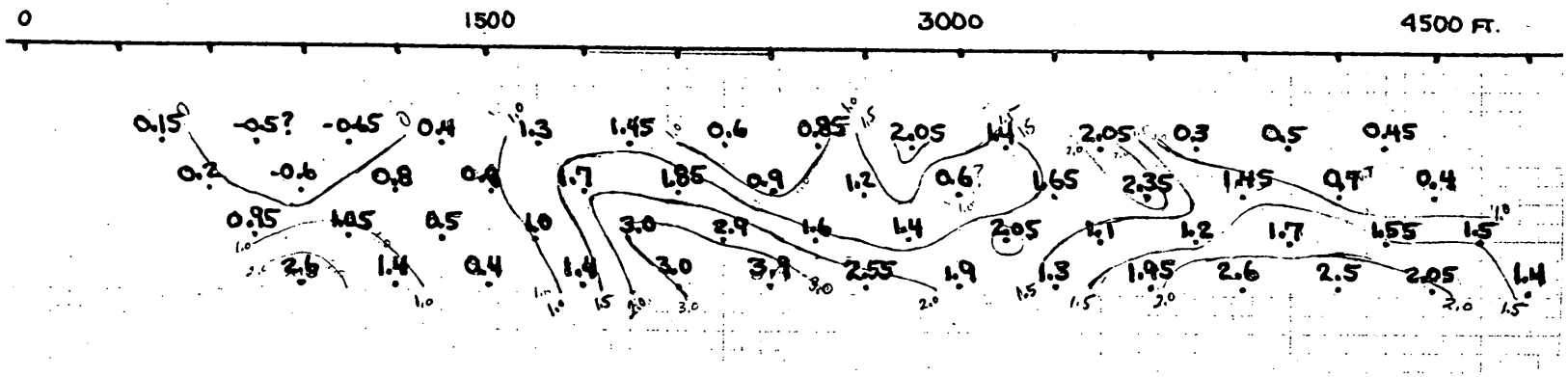


FIGURE 16.
ADDITIONAL DATA: INDUCED POLARIZATION SURVEYS - PERCENT FREQUENCY EFFECT
AND METAL FACTOR (0.3 cps / 3.0 cps) - LINE A

PERCENT FREQUENCY EFFECT (0.3 cps / 3.0 cps)



METAL FACTOR (0.3 cps / 3.0 cps)

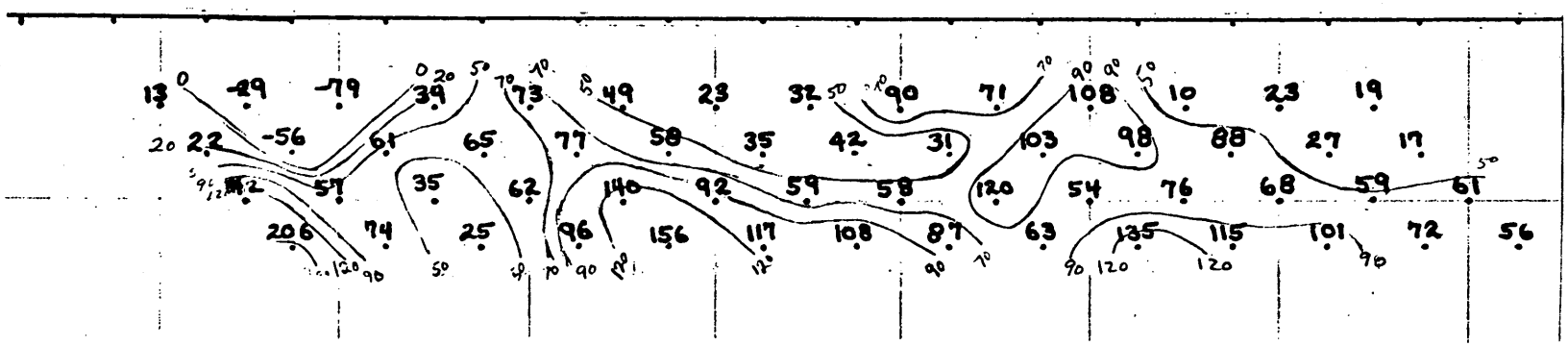
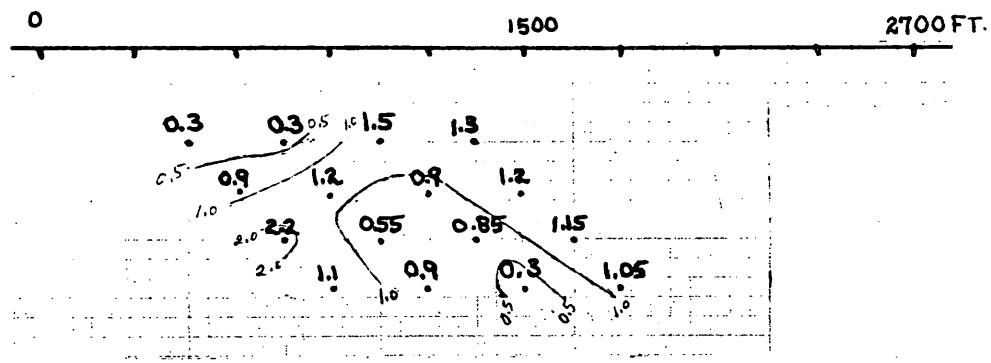


FIGURE 17.
ADDITIONAL DATA: INDUCED POLARIZATION SURVEYS - PERCENT FREQUENCY EFFECT AND METAL FACTOR (0.3 cps / 3.0 cps) - LINE B

PERCENT FREQUENCY EFFECT (0.3 cps / 3.0 cps)



METAL FACTOR (0.3 cps / 3.0 cps)

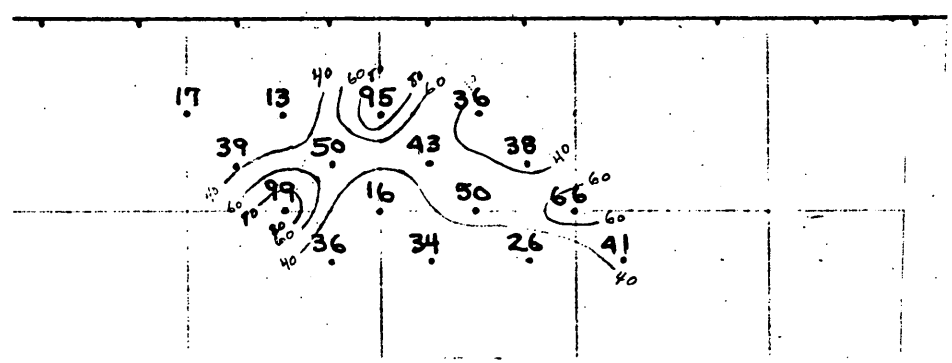
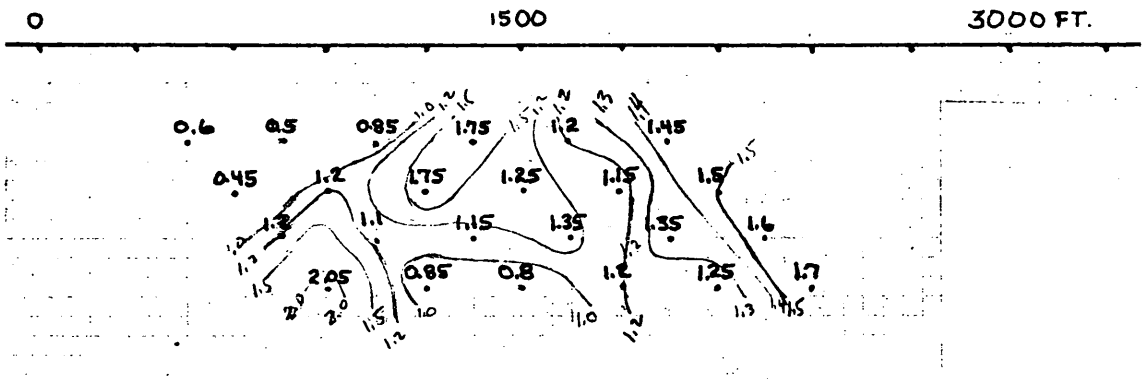


FIGURE 18.

ADDITIONAL DATA: INDUCED POLARIZATION SURVEYS - PERCENT FREQUENCY EFFECT AND METAL FACTOR (0.3 cps / 3.0 cps) - LINE C

PERCENT FREQUENCY EFFECT (0.3 cps / 3.0 cps)



METAL FACTOR (0.3 cps / 3.0 cps)

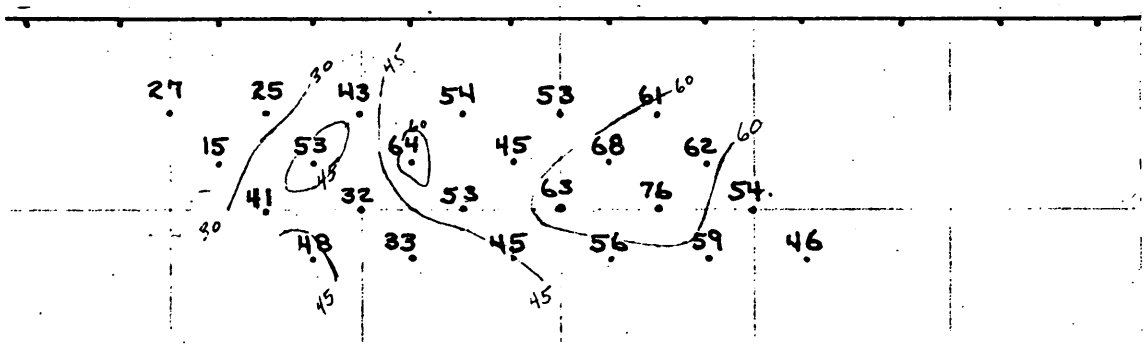
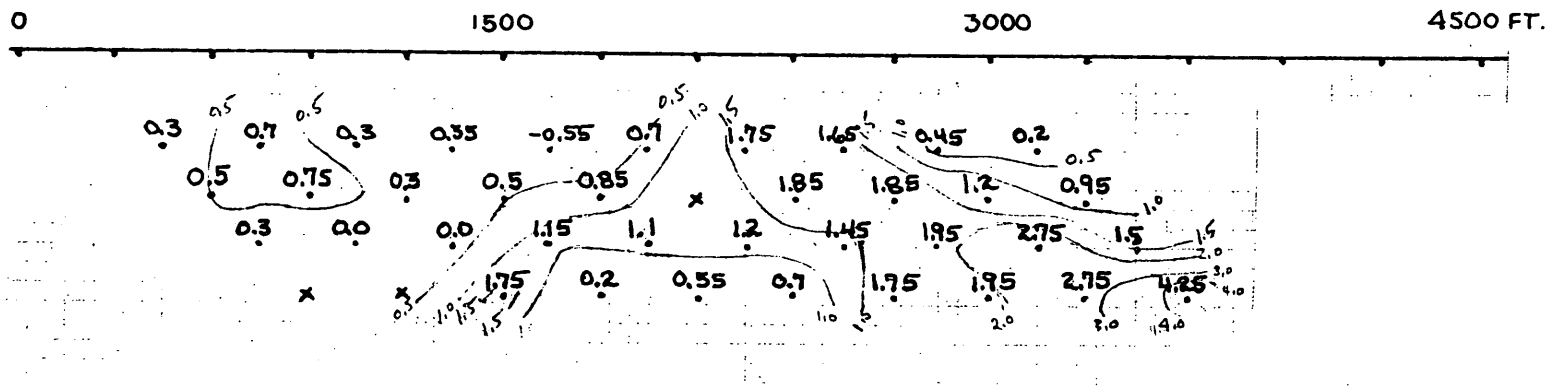


FIGURE 19.
ADDITIONAL DATA: INDUCED POLARIZATION SURVEYS - PERCENT FREQUCNCY EFFECT AND METAL FACTOR (0.3 cps / 3.0 cps) - LINE D

PERCENT FREQUENCY EFFECT (0.3 cps / 3.0 cps)



METAL FACTOR (0.3 cps / 3.0 cps)

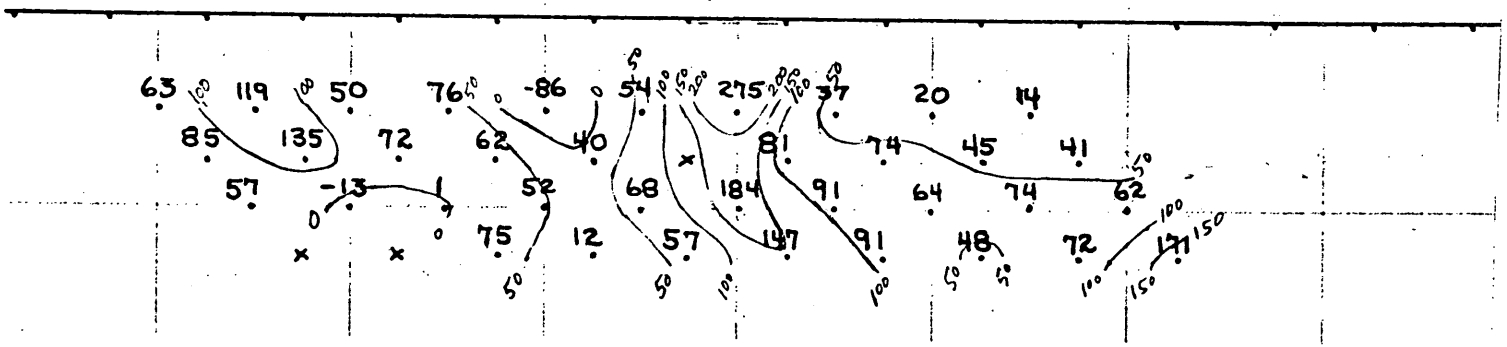
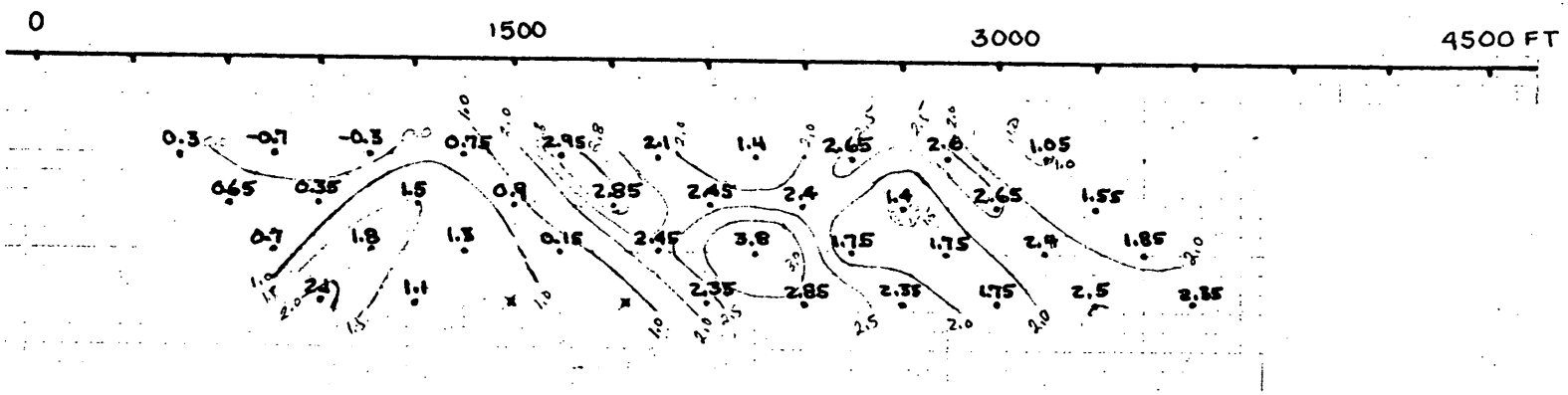


FIGURE 20.
ADDITIONAL DATA: INDUCED POLARIZATION SURVEYS - PERCENT FREQUENCY EFFECT AND METAL FACTOR (0.3 cps / 3.0 cps) - LINE E

PERCENT FREQUENCY EFFECT (0.3 cps / 3.0 cps)



METAL FACTOR (0.3 cps / 3.0 cps)

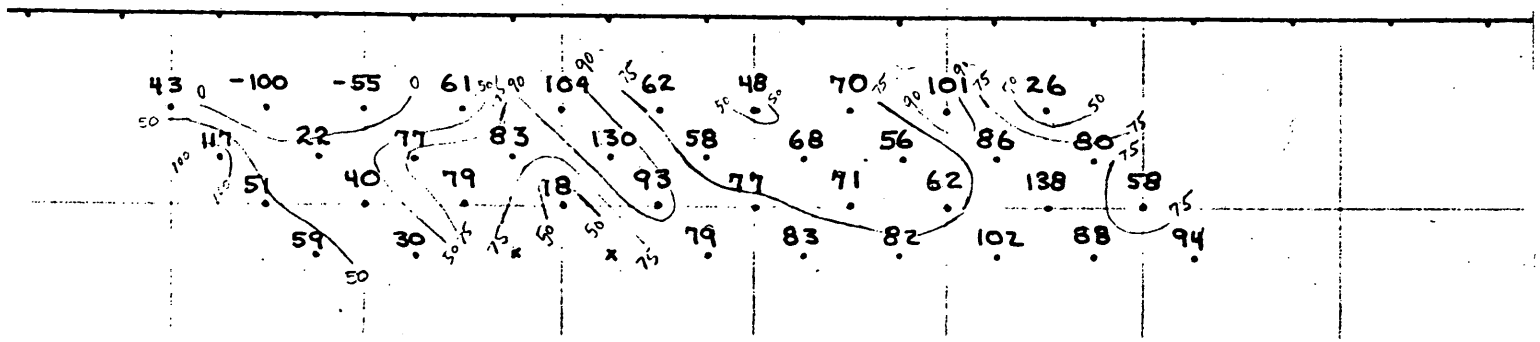
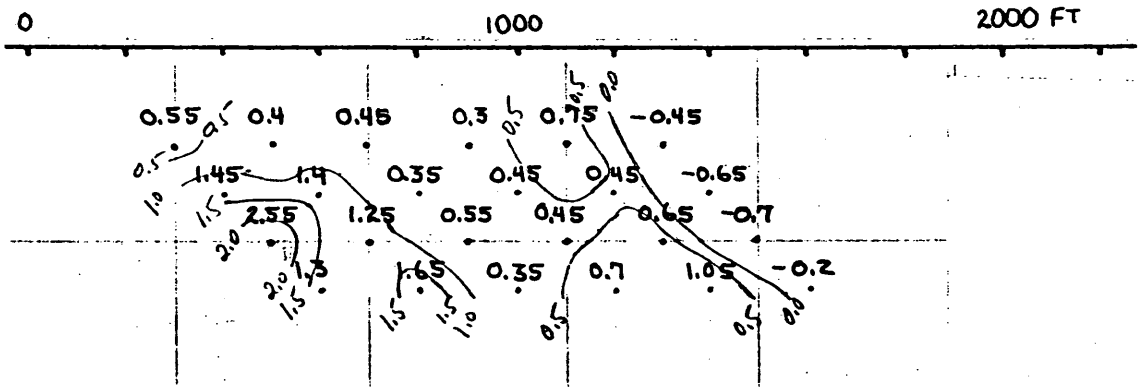


FIGURE 21.
ADDITIONAL DATA: INDUCED POLARIZATION SURVEYS - PERCENT FREQUENCY EFFECT AND METAL FACTOR (0.3 cps / 3.0 cps) - LINE F

PERCENT FREQUENCY EFFECT (0.3 cps / 3.0 cps)



METAL FACTOR (0.3 cps / 3.0 cps)

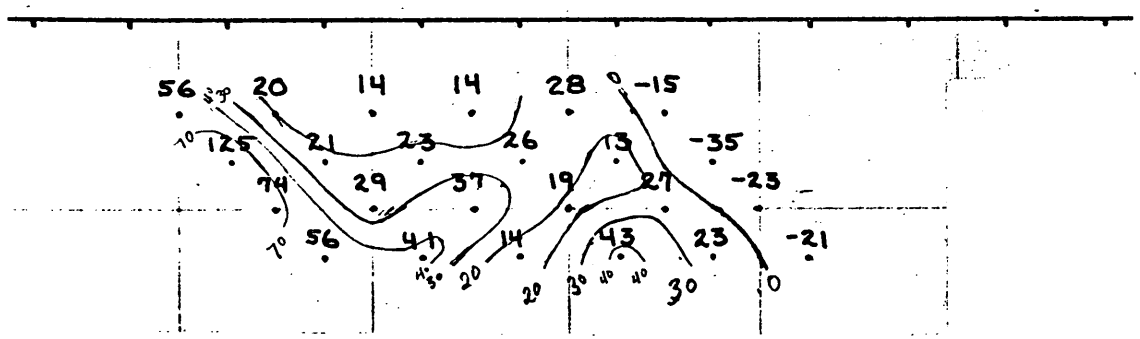


FIGURE 22.
ADDITIONAL DATA: INDUCED POLARIZATION SURVEYS - PERCENT FREQUENCY EFFECT AND METAL FACTOR (0.3 cps / 3.0 cps) - LINE G

APPENDIX D:

CALCULATION OF THE GEOMETRIC FACTOR FOR DIPOLE-DIPOLE ARRAY

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CALCULATION OF THE GEOMETRIC FACTOR FOR DIPOLE-DIPOLE ARRAY

GENERAL EQUATION (Corrected from Keller and Frischknecht, 1966, p.94):

$$\rho_a = 2\pi \frac{V}{I} \left(\frac{1}{\frac{1}{C_1P_1} - \frac{1}{C_1P_2} - \frac{1}{C_2P_1} + \frac{1}{C_2P_2}} \right) \qquad (1)$$

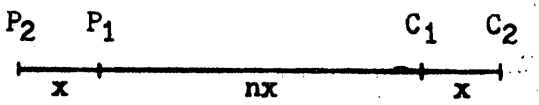
where ρ_a = apparent resistivity

V = potential drop across the potential dipole

I = measured input current at the current dipole

C_1P_2 = distance between the C_1 electrode and the P_2 electrode, measured in feet.

For the dipole-dipole configuration the following is true:



$C_1P_1 = nx$
$C_1P_2 = (n+1)x$

$C_2P_1 = (n+1)x$

$C_2P_2 = (n+2)x$

THEREFORE, from equation 1 the following holds:

$$\rho_a = 2\pi \frac{V}{I} \left[\frac{1}{\frac{1}{nx} - \frac{1}{(n+1)x} - \frac{1}{(n+1)x} + \frac{1}{(n+2)x}} \right] \qquad (2)$$

Equation 2 reduces algebraically to:

$$\rho_a = 2\pi \left[\frac{n(n+1)(n+2)x}{2} \right] \frac{V}{I} \qquad (3)$$

We may define a K such that:

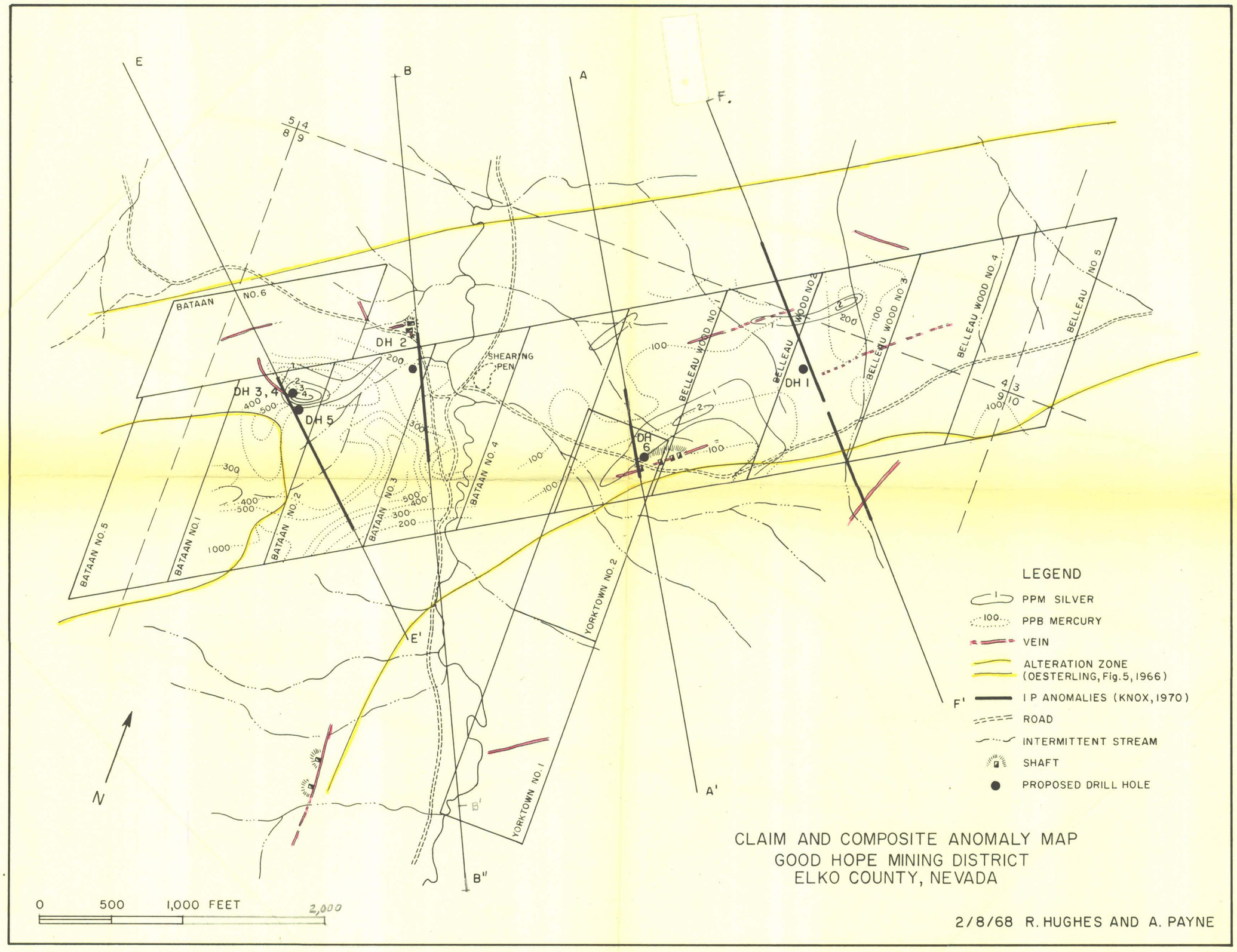
$$K = \pi \cdot n(n+1)(n+2)x$$

It is obvious that K takes on specific values for each electrode spacing. When both x and n are determined, K has a unique value. Equation 2, therefore, reduces to a very simple form when expressed in terms of K :

$$\rho_a = K \frac{V}{I}$$

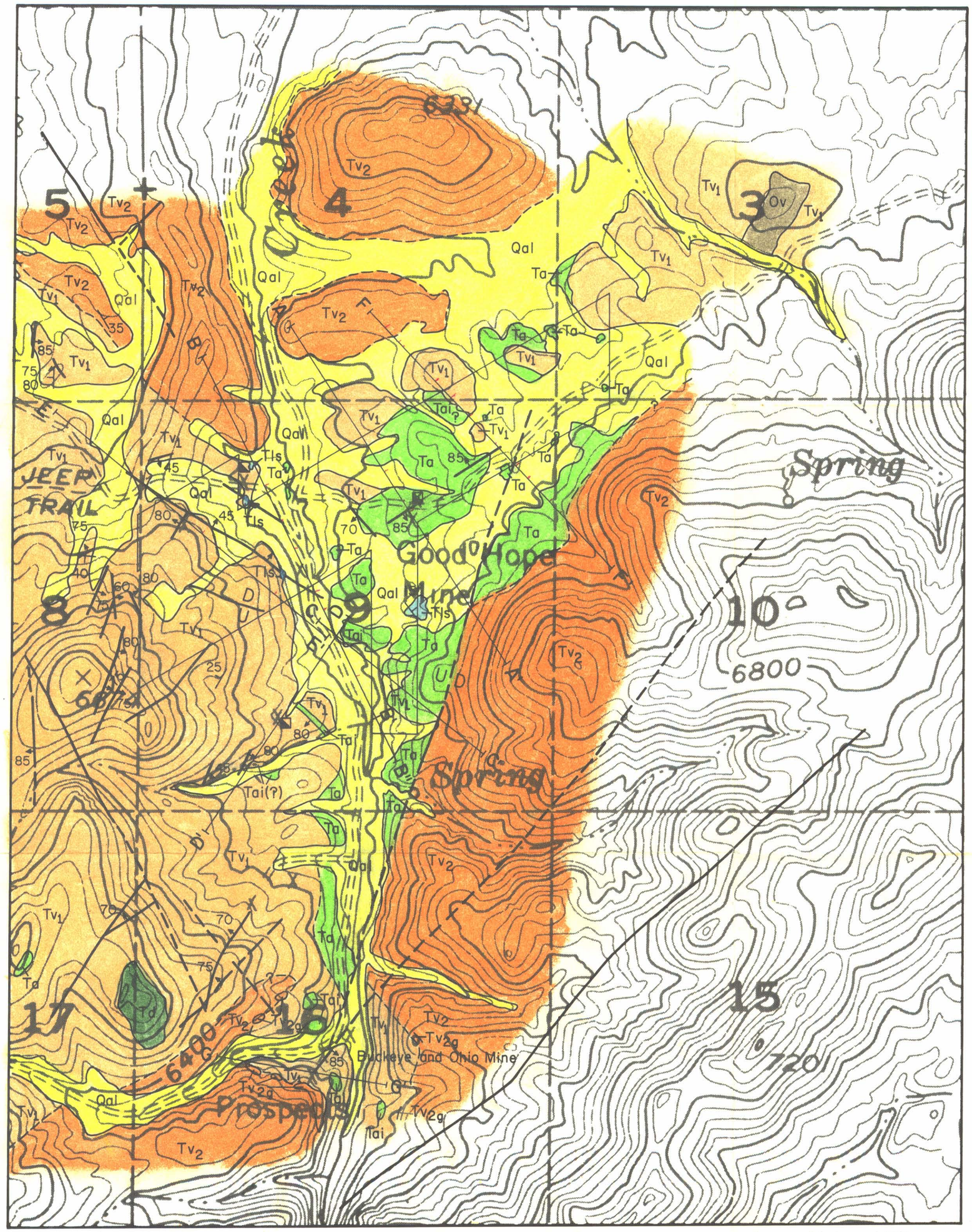
The electrode spacings used in the work in the Good Hope District were 200 and 300 feet. The geometric factor is here tabulated for these electrode spacings and for values of n = 1,2,3, and 4.

n	K (evaluated) x = 200 ft.	x = 300 ft.
1	3770	5655
2	15,080	22,620
3	37,700	56,550
4	75,400	113,100



CLAIM AND COMPOSITE ANOMALY MAP
GOOD HOPE MINING DISTRICT
ELKO COUNTY, NEVADA

2/8/68 R. HUGHES AND A. PAYNE



EXPLANATION

Cenozoic – Quaternary	Qal	ALLUVIUM, stream deposits and slope wash
		UNCONFORMITY
Cenozoic – Tertiary	Td	DACITE to RHYODACITE, red, porphyritic flows
	Tv_2	WELDED TUFFS, rhyolite to quartz latite in composition, probably represents a single cooling unit, Pliocene (?) age, Tv_{2g}, black glass
		UNCONFORMITY
	Tls	LIMESTONE, silty to shaly, gray, freshwater limestone, contains gastropods and ostracods
		UNCONFORMITY
	Ta	ANDESITE, probably flows; Tai, shallow intrusives, dikes and sills, gray to dark brown porphyritic rocks
	Tv_1	WELDED TUFFS, rhyolite to quartz latite in composition, intensely and extensively altered, one or more cooling units, mid-Miocene (?) age
		UNCONFORMITY
Paleozoic – Ordovician	Ov	QUARTZITE, Vinini Fm. or Valmy Fm., white, very clean, quartz sandstone, has undergone alteration and mineralization

CONTACTS, dashed where location is approximate

75 FAULTS, arrow and number show direction of and dip angle of fault plane. Line dashed where location is approximate or concealed

VERTICAL SHAFTS

N

0 1000 2000 3000 Feet

Contour Interval 40 Feet

Geology by R.D. Knox and E.F. Lawrence

PLATE 1. GEOLOGIC MAP OF THE GOOD HOPE MINING DISTRICT, ELKO COUNTY, NEVADA