MME Form 9
Rev. Nov. 65

UNITED STATES
DEPARTMENT OF THE INTERIOR
Geological Survey

OFFICIAL DOCKET FILE Contract No. _____ Docket No. 6864

Application
- [ ] Denied
- [ ] Withdrawn

Contract
- [ ] Terminated - Not Certified
- [ ] Terminated - Certified
- [ ] Cancelled
- [ ] Royalty Agreement

The records contained in this file are marked (x) and arranged in this order:

Folder No. 1:

Left Side

- [ ] Royalty Audits
- [ ] Certification of Discovery
- [ ] Closing Letter
- [ ] Cost Audits
- [ ] Termination Notice or Agreement
- [ ] Recision Notice
- [ ] Assignment of Contract
- [ ] Contract Amendments
- [ ] Contract with all exhibits and annexes
- [ ] Owner's Consent to Lien and Subordination Agreement
- [x] Application and Attachments

Right Side

- [ ] Project Summary (final)
- [ ] Work Completed Analysis (final)
- All other material filed in chronological order including the following reports if checked:
- [ ] Field Team Semiannual Report for Certified Project
- [ ] Final Field Team Report (Tab)
- [ ] Operator's Final Report (Tab)
- [ ] Interim Field Team Reports
- [ ] Operator's monthly reports and all attachments
- [ ] On-site Exam. Report (Tab)
- [ ] Settlement Sheets
- [ ] Drill Logs

Additional Folders:

Left Side

Folders No. _____: Reports
- [ ] Analysis of Semiannual Inspection Reports
- [ ] Project Summary (Interim) by MME Engineers

Right Side

- [ ] Field Team Semiannual Report for Certified Project
- [ ] Field Team Interim Reports
- [ ] Operator's Monthly Reports with Transmittal, Narrative and Maps

Folders No. _____: Maps (Use pocket folder or envelope)

Folders No. _____: Settlement Sheets

Folders No. _____: Drill Logs

Folders No. _____: Royalty Material

72195-65

IN REPLY REFER TO:

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
FEDERAL CENTER, DENVER, COLORADO 80225

Office of Minerals Exploration
Building 53 Room 28

OFFICIAL COPY
O. M. E.
RECEIVED
JAN 19 1972
INITIALS | CODE

January 17, 1972

Memorandum

To: Chief, Office of Minerals Exploration

Through: Assistant Chief, Office of Minerals Exploration

From: Field Officer, Region III

Subject: Application for financial assistance in the Dugway Mining District, Tooele and Utah Counties, Utah by J. Floyd Cannon.

Transmitted herewith is an application to explore six areas in the Dugway mining district by an induced polarization survey and subsequent diamond core drilling for an estimated total cost of $62,120.00.

Our review indicates that the letters of request to the banks appear to be more of a query than an actual request.

The proposed IP survey might be considered prospecting, as they are seeking target areas to be explored. By core drilling, however, the Breccia Hill area is probably a legitimate target area. The areas of proposed drilling are quite scattered, and should probably be concentrated in one or two of the best areas.

The patented claims listed as Stinger and Stinger No. 1 are shown on the claim map as Stringer, rather than Stinger, a typographical error I assume. The Dipper (4337) patented claim is not included on the claim map accompanying the application.

The unpatented Margaret Fraction claim does not appear on the claim map included in the application, however, Exhibit D, the Golconda (Requa) Prospect, shows the Margaret Fraction to lie adjacent to the southeast side line of the Golconda No. 2 (5019) patented claim, and adjacent to the east end line of the Golconda (3572) patented claim.

The history of the district is not one of large production. Most of the deposits were small and none of the past mining went very deep.

Somewhere along the line we get the impression that the veins pinch at depth to almost nothing. May we refer you to U. S. Geological Survey Professional Paper 415 by M. H. Staatz and W. J. Carr on the Geology and Mineral Deposits of the Thomas and Dugway Ranges, Juab and Tooele Counties, Utah, 1964, pages 157, 158, 165 and 166. The application has been reviewed by Mort Staatz and his suggestions and comments are included in the enclosed memorandum dated January 14, 1972.

A total recorded production of 506.68 tons of ore from the Breccia Hill, Bertha Mine, Raymond Claim, and Yellow Jacket Mine produced ore that averaged .036 oz. Au, 2.04 oz. Ag, 10.27% Pb, 1.43% Zn and 1.48% Cu per ton. At current metal prices (1/4/72) this ore would have a gross value of approximately $53.00 per ton, however, some 64 percent of this value is in lead and zinc, which might make its eligibility as a gold-silver-copper ore somewhat questionable, especially if we are dealing with small tonnages, as the production indicates.

In a summary of the proposed exploration work the applicant arrives at a total estimated footage of 3,600 feet for diamond core drilling. This is not correct because the total as shown on page 11 of the application is shown as 4,100 feet.

The applicant's consultant has had a long and successful geological career. He has been affiliated with the Snyder Mining interests in the Utah-Nevada area as well as having consulted of recent date for the Bunker Hill company and others. He has been involved in the supervision of a number of DMEA loan in the past that were concerned with the Combined Metals Reduction Company (DMEA, Docket 86, Contract E-7, and DMEA Docket 1098, Contract E-12-1/2).

J. William Hasler

J. William Hasler,
Field Officer, Region III
Office of Minerals Exploration

Enclosure

United States Department of the Interior
GEOLOGICAL SURVEY
Denver Federal Center
Denver, Colorado 80225

IN REPLY REFER TO:

January 14, 1972

OMPE Region III
RECEIVED
JAN 17 1972
Denver, Colo.

Memorandum

To: William Hasler

From: Mortimer H. Staatz

Subject: Loan application in the Dugway mining district

The Dugway mining district has had a small past production, whose dollar value is not large. Veins are short and the thicknesses are highly variable. High grade assays of various metals are not uncommon, but the ore bodies are commonly not large enough to make a really profitable operation.

Most of the ore in the past has come from fissure veins in either the Prospect Mountain quartzite or from Cambrian and Mississippi carbonates. Most are also either lead-silver or lead-silver-zinc. Copper values are generally of minor importance. Two properties that differ are the Bertha and Metal States. These properties occur in the Bertha and Kellys Hole grabens. As Mr. Requa has pointed out, the district is related to the Buckhorn thrust. The thrust, although lying to the east of these two grabens, has been down dropped into the grabens. Exploration in what is believed to be carbonate rocks just above the thrust has exposed a black cupriferous pyrite ore. Size and extent of these bodies is unknown but could be large. The carbonate rocks just above this thrust presents a worthwhile target for exploration, especially for copper.

Three of the six proposed areas lie in the Bertha graben. The Bertha property exposes a part of this zone and as such appears to be a good place to start. Some lead occurs in the Bertha copper ore and a small high grade lead silver vein is adjacent to this body.

The Breccia Hill area would be my second preference to explore. The well developed siliceous gossan and the high copper, lead, and zinc anomalies mark it as a target that ought to be investigated.

The Golconda property is also in the graben but the relatively narrow lead-silver veins suggest these are more of the fissure type, so common in most of the district. As the property lies in the graben, copper ore might be developed at depth, but the property does not appear to be as likely as the other two properties to ~~develop~~ have a large ore body. ~~as the other two.~~

The Black Dragon, Raymond and Yellow Jacket properties are on fissure

type replacement veins, and although some high grade lead-silver ore may be developed, I don't believe that any substantial reserves are likely to be found. Mr. Requa noted that the Yellow Jacket, which has the largest vein exposure of the three, lies close to the Buckhorn thrust. I would like to point out, however, that it lies below the thrust, and although this area is favorable for small lead-silver fissure-replacement veins, the cupriferous pyrite ores lie above the thrust.

Mr. Requa's report appears to have been carefully done and well thought out. I cannot check his individual assay figures and vein measurements, but they are comparable to the ones I have obtained on veins within the district.

MHStaatz:del

INTERNAL MEDICINE

J. FLOYD CANNON, M. D.
508 EAST SOUTH TEMPLE
SALT LAKE CITY, UTAH 84102

December 3, 1971

Mr. J. William Hasler
Field Officer Region III
Office of Mineral Exploration
Room 28 Building 53
Federal Center
Denver, Colorado 80225

Dear Sir:

Enclosed are two copies of my Application for Financial Assistance in Minerals Exploration.

If there are any questions, don't hesitate to write. If you or any of your associates would like to see the property, just write and I will arrange it.

Sincerely,

J. Floyd Cannon

J. Floyd Cannon, M. D.

JFC:mc

OME Region III
RECEIVED
DEC 6 - 1971
Denver, Colorado

L. K. REQUA
FELT BUILDING
SALT LAKE CITY, UTAH 84111

December 2, 1971

Mr. J. William Hasler
Field Officer, Region III
Office of Minerals Exploration
Building 53 Room 28
Federal Center, Denver
Colorado 80225

Dear Bill:

This is to let you know that I have just completed an O.M.E. application for Dr. J. Floyd Cannon on 83½ claims that he owns at Dugway, Tooele County, Utah. You will be receiving the signed application shortly.

I think well of this proposal and for the money involved a lot of ore could be developed. The Breccia Hill objective is probably the most important. It could be a breccia pipe as well as a part of a bedded deposit on a faulted segment of the Buckhorn thrust fault, which also involves the Golconda and the Bertha objectives.

I am leaving tomorrow for a three weeks trip to Europe, But Dr. Cannon is very well informed on every phase of the projects that I have described.

Dugway is accessible in most winters and generally has a milder climate than Salt Lake, so if you wish to see the property soon it can be arranged. I would be glad to go with you myself after the holidays, but in the meantime Dr. Cannon will gladly answer any questions that you might have.

Your consideration of this application will be greatly appreciated,

Sincerely,

Larry Requa

L. K. Requa

OME Region III
RECEIVED
DEC 7 - 1971
Denver, Colorado

CC: Dr. Cannon

OMB Form 40
Revised Nov. 1971

Approval expires Dec. 1971

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

APPLICATION FOR FINANCIAL ASSISTANCE IN MINERALS EXPLORATION

Pursuant to Public Law 85—701 (72 Stat. 700; 30 U.S.C. 641)

NAME OF APPLICANT *(Full legal name and mailing address as they should appear on contract if one is executed.)*

J. Floyd Cannon
508 East South Temple
Salt Lake City, Utah 84102

APPLICANT DO NOT USE THIS BLOCK

DOCKET NUMBER: 6864

DATE RECEIVED: 1/19/72

REGION: III

DIVISION CODE:

BUSINESS ORGANIZATION *(Check one)*

- INDIVIDUAL [X]
- CORPORATION [ ]
- PARTNERSHIP [ ]
- OTHER *(Specify)* [ ]

STATE IN WHICH FIRM IS ORGANIZED:

LIST CORPORATE OFFICERS OR PARTNERS HERE, IF APPLICABLE

NAME	ADDRESS	TITLE

MINERAL(S) FOR WHICH YOU WISH TO EXPLORE: Gold, Silver, Copper, Lead & Zinc

ESTIMATED COST OF PROJECT: $62,120

PROPERTY NAME	LOCATION COUNTY	STATE
Dugway	Tooele	Utah

GENERAL INSTRUCTIONS

Before filling out this application, please read the *OME Regulations for Obtaining Federal Assistance in Financing Explorations for Mineral Reserves* (30 CFR Chap. II). To assure prompt action, your application must provide all applicable material and information specified on the back of this application form. Avoid unnecessary correspondence and delays by submitting complete and accurate information. *Please submit two copies of this application and all accompanying papers* except as otherwise noted. Place your name and address on each sheet. Each item of information, maps, and reports required as a part of this application is described on the back of this form. Identify each attached statement by the item number to which it applies. If an item does not apply to your application, show the item number on your statement and after it write "not applicable." Maps or sketches should be used to supplement narrative descriptions of the property location and boundaries in item 2, existing mine workings and geology in item 3, and the proposed exploration work in item 5. When this information is not too complex, all of it may be shown on one map or sketch. All documents and other attachments submitted as a part of this application, except those in item 3(g) which you mark to be returned, become the property of the Government and will not be returned to the applicant. Send true copies, *not originals*, of leases, contracts, and other documents which are an essential part of your business records. *File this application with the Department of the Interior, U.S. Geological Survey, Office of Minerals Exploration, Washington, D. C. 20242, or with the nearest OME Field Office.*

CERTIFICATION

The undersigned, whether as an individual, corporate officer, partner, or otherwise, both in his own behalf and acting for the applicant, certifies that the information set forth in this form and accompanying papers is correct and complete, to the best of his knowledge and belief, and that he would not ordinarily undertake the proposed exploration under current conditions and circumstances at his sole expense.

December 1, 1971
DATED

J Floyd Cannon
BY *(Signature)*

Owner
TITLE

A wilfully false statement or certification to any Department or Agency of the United States Government is a criminal offense. U. S. Code, Title 18, Sec. 1001.

INFORMATION REQUIRED WITH THIS APPLICATION

1. Financial Eligibility:

(a) Submit evidence of efforts made within 90 days preceding the filing of this application to obtain credit from your bank of account and at least one other banking institution or other private source of credit. Such evidence shall include (1) true copies of your letters to credit sources which show date of loan request, amount and terms requested, and proposed use of loan funds and (2) true copies of replies from credit sources. If the loan was offered under terms which you consider unreasonable, state why you consider them so.

(b) List names and addresses of affiliated, parent, or controlling companies or organizations and state extent and nature of their interest.

(c) State how you propose to furnish your share of the cost of the exploration work.

2. Applicant's Rights in Land:

(a) State your interest in the land and mineral rights, whether owner, lessee, purchaser under contract, or other. If you are not the owner, submit one true copy of the lease, contract, or other document (with address of owner) under which you control the property. Describe all liens, mortgages, or other encumbrances on the land and state book and page number and official place where recorded.

(b) State the legal description (section, township, and range; metes and bounds; patent number of claims) of the land upon which you wish to explore and all adjacent land which you own or control. Describe any part of the land or workings which should not be subject to Government royalty and liens. If the land consists of unpatented claims, state book and page number for each recorded location notice, including amended locations, and official place where recorded. State all the names by which you know the property.

(c) For all land or mineral rights encumbered or not owned, submit five copies of Lien and Subordination Agreements signed by owner on MME Form 52. If the agreements cannot be obtained, state reasons and whether you can furnish a performance bond.

3. Physical Description:

(a) Describe in detail and illustrate with maps or sketches all mining or exploration operations which you know have been or are being conducted upon the land. Include existing mine workings and all production facilities.

(b) State your interest, if any, in operations described in (a)

(c) State, if you know, the past and current production, supporting your statement with copies of settlement sheets, mine records, or published data if available.

(d) Describe known ore reserves, giving quantities and grades.

(e) Describe by narrative and maps or sketches the geologic features of the property, including ore minerals, geologic formations if known, and type of deposit (vein, bedded, etc.).

(f) If you have sampled the area you propose to explore, show where the samples were taken, describe sampling methods used, and provide copies of assay certificates. State your reasons for expecting to find ore.

(g) Send with your application at least *two* copies of all geologic or engineering reports, assay maps, or technologic information which you have, indicating whether you require their return.

4. Accessibility of Property:

(a) To aid the OME representative who may examine the property state name, address, and telephone number of person who will meet him, give directions for reaching the property; and describe accessibility of property and of any mine workings.

(b) Name the shipping and supply points and state the distances to the property.

5. Exploration Work:

(a) Describe fully the proposed exploration work giving individual footages and sizes of openings *for each item of work*. Use narrative, maps, plans, and sections as necessary. Show location of the proposed work as related to geologic features such as veins, ore-bearing beds, contacts of rock formations, etc. Show also the relation of the proposed work to any existing mine workings and to *land boundaries* or to the closest identifiable corner.

(b) If an access road must be built, show the proposed location on the property map and state the length, type and construction methods proposed.

(c) If an OME contract is executed, state how soon thereafter work would be started and finished. State your anticipated average daily or monthly rate of progress for each type of work.

6. Experience:

State your operating experience and background to conduct this exploration work and also that of the person who will supervise the work.

7. Estimate of Costs:

Furnish detailed estimates of the necessary costs for time and materials *for each item of the work proposed in 5(a)* under the headings listed below with a total for each heading and the estimated total cost of the work. Costs for any work to be performed by an independent contractor should be listed separately under category (a) below. Costs for any work that is not to be performed by an independent contractor should be listed under categories (b) through (g).

(a) Independent contracts. State the total cost of any proposed independent contract for all or any part of the work, and the number of units and the unit cost for each type of work, such as per foot of drilling, per foot of drifting, per hour of bulldozer operations, or per cubic yard of material moved. Cost estimates should be supported by bids from three contractors if possible. (*Note*—If none of the work is to be contracted, write "none" after this item.).

(b) Personal services. The cost of supervision, engineering and geological services, outside consultants, and labor should be itemized by numbers and classes of employees; rates of wages, salaries or fees; and periods of employment. State whether these services are available.

(c) Operating materials and supplies. List items of material and supplies giving quantity and price of each. Include under this heading power, water, and fuel, and units of equipment and tools costing less than $50 each.

(d) Operating equipment. List items of equipment and tools costing $50 or more per unit. Give specifications and indicate how each item is to be acquired—i. e., rented, purchased or provided by the applicant. If rented or purchased, state the estimated rental or purchase price. If furnished by the applicant, state condition and present fair market value.

(e) Initial rehabilitation and repairs. Describe the type and the cost of *initial* rehabilitation or repair of existing buildings, fixtures, installations (exclusive of mine workings), and movable operating equipment now owned by the applicant which will be used in the exploration work.

(f) New buildings, fixtures, installations. Describe each building, fixed improvement, and installation to be purchased, constructed, or installed for the exploration work, stating specifications and cost including labor, materials, and supervision.

(g) Miscellaneous. Describe the type and estimate the cost of repairs and maintenance of the operating equipment listed in 7(d). Do not repeat initial repairs listed in 7(e). Show also the costs of analytical work, accounting, workmen's compensation and employees' liability insurance, payroll taxes, and other required costs that do not fall within the previous categories. [*Note*—The Government will not contribute to costs incurred before the date of the contract, or to costs of or incident to: (1) acquiring, using, or possessing land and any existing improvements, facilities, buildings, installations, and appurtenances, or the depreciation and depletion thereof; (2) general overhead, corporate management, interest and taxes (other than payroll and sales taxes); (3) insurance (other than employees' liability insurance) and (4) damages to persons or property (other than authorized repair to or replacement of equipment or other property used in the work).]

APPLICATION FOR FINANCIAL ASSISTANCE
IN MINERAL EXPLORATION

1. Financial Eligibility
   1.a. Attached herewith are copies of two letters to two Salt Lake City banks asking for financial aid and their refusal thereof:
      1. To First Security Bank
         Request dated Oct. 20, 1971. Refusal dated Oct. 21, 1971.
      2. To Zions First National Bank
         Request dated Oct. 20, 1971. Refusal dated Oct. 21, 1971.
   1.b. The owner of the claims included in this application is J. Floyd Cannon, 508 East South Temple St., Salt Lake City, Utah 84102. There are no other ownerships involved, except as noted in the list of claims.
   1.c. By interesting a third party in financing the owners portion of the project if the OME application is approved.

2. Applicant's Rights in Land
   2.a. By patent title and possessory rights which is an unencumbered ownership.
   2.b. Exhibit A, attached herewith, is a map of the claims involved in this application, as well as some other claims in the district that are owned by the applicant. No complete claim map exists. The claims included in this application are:

Patented Claims	Survey No.
Clingstone	5020
Minor	3229
Holland	2943
Dipper (not included in OME)	4337
Black Warrior	2948
Ensign	5020
Junction	3229
Keynote Eureka	4356
Cloudy Big Four	4356
Golconda No. 1	4355
Golconda	3572
Golconda No. 2	5019
Gonyon	3229
Lead Quartz	3229
Double Out	3229
Stinger — Stringer (No. 2)	3229
Stinger No. 1 - Stringer	3229
La Cigale	4355
Wolverine No. 1	4354
Bertha	4094
Wolverine No. 2	4354
Bertha No. 2	4094
Raymond Mine	3225
Bald Eagle	3225

Patented Claims (cont'd)

Francis (½ undivided interest)	40
Boston	4350
Philadelphia	4350
Black Dragon	3154
Pride of the West	4518
Pride of the West No. 2	4518
Argent	3227
Ophir	3422
Sunday Morning	3223
Croesus	3223
MAMOTH Mammoth	3222
Juno	3222
Revina Juno No. 2	3222
Juno No. 3	3222
Juno No. 4	3222
New State	3222
O. K.	3422
Yellow Jacket	3158
Saddle Rock	3252
Nautilus	3253
Gondola	4356
Copperopolis	4356
Admiral	5712
Bingham	5713
Bingham No. 2	5713
Penant	4319
Bryan No. 1	4319
Free Coinage	4319
Leadville No. 2	4319
Hidden Treasure	4319
Red Metal	5085

Unpatented Claims	Book	Page
Margaret Fraction (see exhibit D)	3G	127
Apex No. 1	48	520
Apex 1A	48	452
Apex 2	48	521
Apex 3	48	522
Apex 4	48	523
Apex 5	48	524
Apex 6	48	525
Apex 7	48	526
Apex 8	48	527
Apex 10	48	529
Apex 11	48	530
Cannon 6	1	446
Cannon 7	1	447
Cannon 8	2	128
Cannon 9	2	129
Cannon 10	1	448

Unpatented (cont'd)	Book	Page
Cannon 11	1	449
Cannon 12	2	130
Cannon 13	1	450
Kennedy 4	48	500
Kennedy 5	48	501
Kennedy 6	48	502
Kennedy 7	48	503
Kennedy 8	48	504
Kennedy 9	48	505
Good Luck 1	48	513
Good Luck 2	48	514
Good Luck 3	48	515

map shows Kennedy 13

As recorded in the records of the County Recorder of Tooele County, Utah.

2.c. Claims are unencumbered except as noted.

3. Physical Description

3.a. The projects of this application are divided into six objectives and are described as follows; (Their location is shown on the Geological Map, Exhibit B.)

3.a.1. Breccia Hill

This is a rounded hill located on the Holland and Black Warrior patented claims. The country rock is all altered limestone which has been mineralized for a length of 800 feet and a width of 400 feet. This mineralized area was the object of a geochemical survey in 1966 as shown on Exhibit C and Exhibits C1, C2, and C3. Good anomalies in copper, lead and zinc were obtained. No drilling has been done, but this area has all of the earmarks of a breccia pipe and could result in a significant discovery if drilled.

3.a.2. Golconda (Requa) Prospect

This is shown on Exhibits C and D. It is an area of altered limestone in which there are several mineralized fissures containing silver, lead, and zinc, with some copper and manganese. In 1955 this area was exposed by bulldozing and samples by L. K. Requa as shown on Exhibit D. The ores are mostly oxidized with some galena. An attempt to drill this area with a rotary rig was made in 1965, but the formation was too hard for a rotary bit. The mineralized area lies in a limestone graben between two quartzite blocks. The surface of this deposit is fairly flat.

3.a.3. Bertha Mine

This deposit is located at the southern end of the Bertha trough, where the two quartzite members come together and pinch out the limestone graben. The ore is cupriferous pyrite in a wide vein (30 ft.) between quartzite walls and dips flatly to the east. It has been explored on dip for a distance of 150 feet on

strike and for 100 feet on dip without limiting the extent of the ore. The only recorded production was in 1956 when Hullinger & McFarland shipped about 400 tons of ore, which will be detailed under production. There are roughly about 400 feet of drifts, cross cuts, and winzes, most of which are believed to be open for inspection.

3.a.4. Black Dragon Prospect

This showing of ore is seen in a single pit eight feet deep. The mineralization occurs in Cambrian limestone and is seen in a zone about six feet wide that shows iron oxides, black manganese and copper sulphides. The mineralization strikes N 30° W and dips 45° NE. In 1960 Requa cut a 3 ft. sample of the sulphides showing copper stain. This one pit is the only known exposure of mineral.

3.a.5. Raymond Claim

The workings on this claim consist of an open pit that is 15 feet square and about twenty feet deep. The country rock is Cambrian limestone and the ore occurs adjacent to a prominent fissure that strikes S 70 W and dips 72° SE. A shaft was sunk for 40 ft. in the bottom of the pit but is now caved. Requa mapped and sampled this showing in 1960, but did not sample an adjacent outcrop of black gossan which was later sampled and found to contain good gold and silver values. Production from the open pit amounts to about 300 tons of lead and zinc ore that was shipped in 1948-50, which will be reported in detail later. For a map of this prospect see Exhibit F.

3.a.6. Yellow Jacket Mine

These workings consist of stopes on a fissure vein and adjacent flat stopes in the limestone that branch out 30 to 40 feet from the fissure. This mineralized zone was mined for about 300 feet along the fissure and bed, but no deeper than 50 feet, in 1925-26, but these workings are now caved and inaccessible. Immediately north of these workings a shaft was sunk on another fissure to an unknown depth, but it also is caved and inaccessible. Production from this property was estimated at 20 cars of ore, some of it high grade silver-lead .

3.b. Owner and lessor

3 c. Production

3.c.1. Breccia Hill - No production

3.c.2. Golconda (Requa) Prospect

Two shipments made 1959 as follows:

Date	Tons	oz Au	oz Ag	%Pb	%Zn	%Cu
8/4/59	13.21	.0125	2.48	21.75	.05	0.5
6/25/59	26.47	.011	1.95	8.5	11.2	0.1

3.c.3. Bertha Mine

In 1955-56, McFarland & Hullinger shipped the following ore from the Bertha to the A.S. & R. smelter at Garfield, Utah, all being sulphide ore.

Date	Tons	oz Au	oz Ag	%Pb	%Zn	%Cu
7/31/55	55.74	.01	.65			2.8
12/30/55	22.35	.125	.825	.2		9.7
1/4/56	82.18	.01	.495	.2	.1	2.10
1/4/56	87.90	.01	.595	.35	.55	1.73

No other shipments have been made from this property.

3.c.4. Black Dragon - No production

3.c.5. Raymond Claim

In 1948-50 several shipments were made to the International Smelter at Tooele as follows: (This was all oxide ore.)

Date	Tons	oz Au	oz Ag	%Pb	%Zn	%Cu
5/10/48	32.375	.045	1.61	13.2	18.6	0.35
10/26/48	12.963	.005	.55	7.2	10.7	0.1
10/26/48	17.114	.01	.64	8.7	8.5	0.1
10/26/48	18.851	.015	.84	8.7	12.3	0.1
10/16/50	22.377	.01	.99	9.8	23.9	0.1
10/20/50	10.814	.005	.7	7.5	11.2	0.15

Smelter settlement sheets are available if needed. No other shipments of ore have been made.

3.c.6. Yellow Jacket Mine

In 1925-26 this property was leased to Huston & Christensen who shipped a number of car lots of ore to the Salt Lake smelters. A few settlement sheets were available and they are summarized herewith, but the greater part of these settlement sheets are lost. Brechon, in 1934, mentioned this property and stated that 20 cars of ore had been shipped, that the ore was lead carbonate and that the workings went no deeper than 50 feet, but exploration should go deeper. In 1964 the following information was obtained from Glenn Burt of the International Smelting & Refining Company. Their records show that the following shipments were received at their Tooele plant.

Date	Tons	oz Au	oz Ag	%Pb	%Zn	%Fe
11/26/26	23.0	.027	3.2	13.5	1.65	39.2
9/2/26	31.0	.09	5.6	17.2	1.6	28.75
8/4/26	27.0	.099	7.55	19.0	1.75	31.75
6/14/26	23.0	.097	3.6	18.3	2.0	28.7

A diligent investigation of all other possible sources of information for records of the remaining shipments failed to turn up any further data, but it is reasonably certain that 20 lots in all were shipped. There has been no production from this property since 1926.

3.d. Ore Reserves

There are no ore reserves that can be calculated except at the Bertha where in 1951 Craig estimated that there were about 20,000 tons of ore that would average about 2½ to 3% copper. The ore mineral is cuperiferous pyrite with a little lead.

3.e. Description of the Geology of the Properties

General Geology:

The general geology of the Dugway district is well described in the U.S.G.S. Professional Paper 415, entitled "Geology and Mineral Deposits of the Thomas and Dugway Ranges, Juab and Tooele Counties, Utah". (1964) by Staatz and Carr. Several of the deposits included in the application are mentioned therein.

It is assumed that anyone reading this application will have access to Professional Paper 415.

Exhibit B, attached herewith, is a general geological map by L. K. Requa (1963) that is very similar to the U.S.G.S mapping, but suggests that in some cases the porphyries are intrusive, rather than flows. In this case mention should be made of the rhyodacite explosion breccia seen near the Yellow Jacket workings, that is mapped by the U.S.G.S as an intrusive and is the only intrusive so mapped by them.

In the last several years more intrusives have been recognized, in the Dugway district.

Nobody has previously recognized the Buckhorn thrust fault as a principal mineralizer, which it most certainly is. Ore has been mined on this thrust at the Ironsides Shaft, which property is not included in this application, but the bleaching and alteration can be traced in a wide band along the course of this thrust for two and a half miles, at least as far as the Yellow Jacket property, where the alteration is the most intense and covers an area that is one half mile square.

The Buckhorn thrust has been itself faulted by later normal faults and this normal faulting has resulted in the formation of two troughs, or grabens, known as the Bertha trough and Kelley's Hole, as shown on Exhibit B. The latter graben is not in the present application, but the former one is included. However the pattern in both structures is the same, i.e. an elongated segment, or keel of limestones resting on the faulted segment of the Buckhorn thrust.

In such keels of limestone ore can and does occur, but the larger ore potential is still untested, but will be tested if this application is approved.

A still larger ore potential is in the thrust along the eastern edge of the district, which zone starts at the Ironsides property and extends southeasterly to the Yellow Jacket property. Parallel strands of the Buckhorn thrust involve the Breccia Hill and Golconda properties.

The remaining projects in this application are the Black Dragon and the Raymond and are not directly associated with the Buckhorn thrust, but are in limestone and out of the quartzite area. No common mineralizer can be suggested here except that these two deposits both have good surface showings.

In 1967-71 the Shell Oil Co. and the AMAX Exploration Co. leased the entire district and did considerable geological mapping and drilling, but confined their efforts to the western half of the district, which is almost all quartzite.

In all they only drilled four holes the deepest of which was 2600 feet and all in quartzite. They did not test the possibilities of the Buckhorn thrust fault, or any of the objectives that are a part of this application.

The Shell - AMAX project was looking for a buried intrusive and failing to find it they canceled their contract in June of the present year.

The most obvious objective that Shell - AMAX missed was that at Breccia Hill where a well sampled geochemical an anomaly had been amply demonstrated. The details of this anomaly are attached herewith as Exhibit C with sheets C1, C2, and C3. The potential of a breccia pipe containing copper, lead, zinc ore is definitely indicated.

Why Shell - AMAX confined themselves entirely to the quartzite cannot be explained. If they were looking for a buried porphyry there is much evidence of such a structure in the area included in this application.

Description of the Individual Properties:

3.e.1. Breccia Hill

Breccia Hill located at the north end of the Bertha trough is a well mineralized hill of Mississippian limestone that shows good anomalous geochemical values of copper, lead and zinc over a distance of 800 feet north-south and 300 feet east-west as shown in Exhibit C and Sheets C1, C2, and C3.

The north and west sides of this structure contains considerable jasper and breccia in a semi-circular form that strongly suggests a breccia pipe.

The geochemical sampling was done in 1966 by Dr. Cannon, the owner, and L. K. Requa. Assays were made by A.S. & R. and the Rocky Mountain Geochemical Corp. The west side of this breccia hill is bounded by a strong fault that strikes north-south and is in itself mineralized. This fault is shown on Exhibit C and may continue, under the alluvium, to the south into the Golcanda area and represents a potentail mineral target.

3.e.2. Golcanda (Requa) Prospect

This property is shown on B, C, and D with the geochemical and surface sampling results. The mineralization consists of a series of northerly striking fissures in Mississippian limestone. This area was exposed and explored in 1955 by L. K. Requa and some shipments were made in 1959.

This limestone is part of the graben previously mentioned in the Bertha trough. The faulted segment of the Buckhorn thrust underlies this keel of limestone. The depth to the thrust can only be estimated, but it is probably in the magnitude of 250 to 300 feet.

In 1963 ASARCO made a preliminary I. P. survey of the Dugway area and their "Depth Probe" here indicated that

there was a sulphide mineralizer at 250 feet.

The surface ores are all oxidized.

In 1964 several rotary holes were drilled in this area, but one on the main silicified outcrop had to be abandoned as the rotary bit would not cut the silicified rock. Hole No. 9 to the south of the main outcrop (see Exhibit C) went to 126 feet in less silicified rock and obtain anomalous assays of copper, lead and zinc at this depth.

A line of geochemical samples taken across the area and noted on Exhibit C and described in ASARCO's letter of Sept. 28, 1965, definitely recommends this area for further study.

Besides the chances for a breccia pipe at Breccia Hill there exists the possibility of a bedded deposit of ore in the deposit of this keel of limestone, between Breccia Hill and the Golconda property that might approximate a length of 2,000 ft., a width of 1,000 ft. With a thickness of 30 ft. this could contain a possible 5,000,000 tons of ore that could be mined in an open pit, in addition to the ore that could be contained in the Breccia Hill pipe.

3.e.3. The Bertha Property

The geology of this deposit is hard to define due to the lack of adequate development, but it has been exposed in part by 300 feet of tunneling and 200 feet of inclined winze.

In 1955 McFarland & Hullinger mined 248.17 tons of cuperiferous pyrite ore as described previously in subheading 3.c. of this paragraph.

This ore occurs between two walls of quartzite about 30 feet apart and in what is presumed to be a footwall strand of the Buckhorn thrust fault.

The development work done so far has not delineated the limits of this ore either on strike or dip and good chances for drifting on ore and sinking on ore exist.

An ASARCO I. P. Depth Probe indicated sulphide ore near the north end of the dump at a depth of 180 feet. For further details of this prospect see Exhibit E which was made by S. E. Craig in 1951.

3.e.4. Black Dragon Prospect

There is little to add to the description already given previously in this paragraph except to state that the three foot sample of sulphides that were sampled in 1960 by Requa assayed 0.01 oz Au, 0.4 oz Ag, 4.98% Cu. This was from a mineralized zone six feet wide showing iron oxides, manganese oxides, and sulphide copper with some malachite. This vein was exposed in a pit 8 ft. deep. The vein strikes N. 30° W, dips 45° NE. Other than the pit mentioned there are no workings on the deposit.

3.e.5. Raymond Prospect

This deposit has also been described previously herein

and there is little to add except to refer to Exhibit F which shows the open pit and the relation to a large black silicified ledge located 200 feet to the west of this open pit. There is a black, siliceous gossan immediately adjacent to the open pit that measures 10 ft. by 20 ft. A general sample of this gossan, taken by Dr. Cannon, assayed .26 oz Au, 10.75 oz Ag, 0.08% Pb. This is a part of the ore structure of the open pit.

3.e.6. Yellow Jacket Workings

The Exhibit G attached herewith is the most complete description of this deposit and is from an old map of J. C. Ingersoll in 1931. There are two mineralized fissures in limestone that were explored in 1925-26. One vertical fissure strikes N 60° W and was explored by a shaft, now caved. There is no information on this shaft, or what it found.

The other fissure strikes northerly and was explored and mined for 300 ft. on strike, as was a flat mineralized bed that branched off this fissure. None of the workings went to more than 50 feet in depth and it is the opinion of several geologists who have seen the property that deeper exploration is well warranted.

The limestones in the area around these workings are intensely altered and bleached with colors of red, yellow, brown and white. This altered area goes south about a half mile and east for the same distance and constitutes the most altered area in Dugway. Within this area there is a rhyodacite porphyry plug that contains much explosion breccia and is undoubtedly a true intrusive.

The Yellow Jacket deposit while not directly on the Buckhorn thrust fault, is less that 500 feet from it and it may, with the alteration area mentioned, be considered a part of the Buckhorn thrust fault structure. This deposit can best be explored by geophysical means, perhaps I. P. to be followed by drilling.

Total production, while complete records do not exist, is believed to have been close to 20 cars of good grade silver-lead carbonate ore.

3.f. Sampling

All of the sampling and assays done in Dugway that are of record and from the early days (circa 1930) were taken by J. C. Ingersoll for Combined Metals Reduction Co., Less Brechon for Utah Copper (Kennecott), and Billingsley and Lyon for Anaconda. Only the results and not the certificates are available.

More recent sampling was done by Hart (ASARCO) and Requa (1950-70) and these results are shown on Exhibits C and D. Some of these assay certificates are available, but not many. Hart's assaying was done by ASARCO laboratory in Salt Lake City. Requa's samples were assayed by Union Assay Office and the Rocky Mountain Geochemical Corporation of Salt Lake City.

Copies of the Raymond shipment settlement sheets are attached as are also the Bertha settlement sheets.

3.g. Copies of the Geological and Engineering Data are contained in Exhibits B to G and are attached herewith.

4. a. Location

The location of the property is shown on the attached Index Map, Scale 1"= 40 miles. The legal description of the district is shown in Exhibit A where the section, township and range are given.

Dugway is 125 miles from Salt Lake City. There is pavement for 63 miles. The next 42 miles is improved county gravel road and the last 20 miles is unimproved dirt road. The property is accessible at most times of the year except during unusually heavy snow storms. However, Dugway has a more mild climate than usually prevails elsewhere in Utah during the winter.

The property may be visited through prior arrangements with Dr. J. Floyd Cannon, the owner whose office is at 508 East South Temple, Salt Lake City, Utah. Phone number is (801) 355-1841, or by contacting L. K. Requa, geologist, 210 Felt Building, Salt Lake City, Utah, Phone 355-9622.

All of the individual properties described at Dugway can be be reached by four wheel drive vehicles except that the Raymond and the Black Dragon now involve about a half mile hike due to a washed out road.

4.b. Supplies

The principal supply point would be Salt Lake City, with perhaps Tooele for groceries and small items of equipment. Railroad shipping points would be at Faust, on the Union Pacific Railroad, near Vernon which would involve an off the highway ore haul of 62 miles.

An alternate shipping point might be at Lynndyl, also on the Union Pacific Railroad, which would involve 23 miles of dirt road to Utah Highway 215 at Topaz Mountain, then over 50 miles of payement to Lynndyl, a total haul of 73 miles. If loading facilities could be arranged, near the Brush Beryllium plant, five miles could be cut off this distance.

5. a. Proposed Exploration Work

The following items of exploration are considered as essential to prove the existence of significant orebodies at Dugway.

5.a.1. An Induced Polarization survey of the Bertha Trough and also of the Raymond - Black Dragon - Yellow Jacket area. The Bertha Trough I. P. Survey should consist of three lines of I. P. stations 500 feet apart and each line being at least 6,000 feet long. The Raymond - Yellow Jacket survey lines should trend NE - SW. It should also consist of three lines 500 feet apart and not less than 5,000 feet long.

5.a.2. The I. P. Survey should be followed by a series of core

holes the location of which will be governed by the I. P. results, but it is expected that the following holes will be needed:

Breccia Hill	3 holes 500 ft. each	1500
Golconda	2 holes 300 ft. each	600
Bertha	2 holes 300 ft. each	600
Black Dragon	2 holes 200 ft. each	400
Raymond	2 holes 200 ft. each	400
Yellow Jacket	2 holes 300 ft. each	600

Being a total of 3,6000 feet of drilling. 4,100'

5.b. Access Roads

No access roads need to be built, but some of the roads, near the individual properties need repair. A bulldozer working for two days could do this job.

At Breccia Hill the drill stations will have to be excavated, but this would involve a couple of days at most. Certainly a week's work with the cat would take care of all these items.

5.c. Time of Execution

After the individual contractors are ready to move onto the ground the time factor should be:

For the induced Polarization Survey - Two weeks

For the core drilling - Four months with one drill.

6. Experience

The owner of the property, Dr. J. Floyd Cannon has had a life time of ownership and experience at Dugway and for the past 20 years has been associated with L. K. Requa, a mining geologist of Salt Lake City who has made various geological investigations and explorations in the Dugway district during this interval of time. In cooperation with Dr. Cannon, Mr. Requa has prepared this application and had previously made most of the maps contained herein.

7. Estimate of Costs

Based on a period of four months for the completion of this project the costs are estimated to be:

7.a.1.	Induced Polarization Survey	$4,000.00	
2.	Bulldozer Work @ $275 per day	1,650.00	2 days identified other 4 days?
3.	Drilling 3,600 ft. of NX core hole @ $10 per foot	36,000.00	? 4100' of drilling
	Other drilling items @ 10%	3,600.00	
4.	Assaying and Core splitting	4,400.00	
5.	Engineering & supervision 4 mos. @ $1,000	4,000.00	
6.	Travel and other expenses	2,000.00	
7.	Mobile Phone Service	270.00	
8.	Trailer rent 4 mos. @ $300 ?	1,200.00	high ?
9.	Contingencies	5,000.00	
	Total Estimated Cost	$62,120.00	

7.b. Personal Services

Included in 7.a.

7.c. Supplies
Contractors will furnish

7.d. Operating Equipment
Covered under 7.a.

7.e. Initial Installations & Repairs
None - Does not apply.

7.f. New Buildings
None - Does not apply.

7.g. Miscellaneous
None - Does not apply.

C E R T I F I C A T E

This is to certify that I, J. Floyd Cannon the applicant for financial assistance in mineral exploration, would not normally undertake the exploration suggested at my sole expense under current conditions and circumstances.

J. Floyd Cannon

J. Floyd Cannon

ZIONS
FIRST NATIONAL BANK
ESTABLISHED 1873
SALT LAKE CITY, UTAH

HEAD OFFICE
One Main Street

October 22, 1971

J. Floyd Cannon, M.D.
508 East South Temple
Salt Lake City, Utah 84102

Dear Dr. Cannon:

In response to your letter of October 20 in which you request a loan for the financing of diamond drilling and geophysical exploration on approximately 60 claims, we regret to inform you that we do not make loans of this type, and especially under the terms as outlined in your letter.

If you have any questions regarding this matter please feel free to call the undersigned at 524-4764.

Yours truly,

Noall J. Bennett
Vice President

fp

October 30, 1971

Mr. Claron Spencer
Zions First National Bank
Salt Lake City, Utah

Dear Sir:

I am the owner of a large number of mining claims in the Dugway Mining District, Tooele County, Utah. From this group of claims I wish to select about 60 of the more promising claims for exploration and development and wish to spend approximately $90,000 in diamond drilling and geophysical exploration.

This is the kind of a project that the federal government might finance through the Office of Mineral Exploration to the extent of 50% to 75% of the above amount, but their first prerequisite is that money from private banks cannot be secured for this purpose. Such a loan can be repaid to the government through a 5% royalty or production in a period of not less than 10 years and not more than 25 years.

If the government certifies that exploration has resulted in the discovery of a commercial ore body, then the loan is repaid out of royalty, but there is no obligation for the owner to ca produce.

If the government does not certify the property for production the property will be free of any government claim for royalty or the lien to secure it's payment. In other words the loan will be liquidated if ore is not found.

Would your bank loan money on such a project and require no repayment if ore is not found?

Your answer will be very much appreciated.

Very truly yours,

J. Floyd Cannon, M. D.

First Security Bank of Utah
NATIONAL ASSOCIATION
MAIN AT FIRST SOUTH OFFICE
SALT LAKE CITY, UTAH

October 21, 1971

J. Floyd Cannon, M. D.
508 East South Temple
Salt Lake City, Utah 84102

Dear Doctor Cannon:

This is in reply to your recent letter concerning the possibility of making a long term loan of $25,000 to $50,000 for the purpose of exploration and development of certain mining claims in Tooele County, Utah.

We regret the necessity of declining a loan such as this because we could not enter into an agreement under which repayment would not be required unless ore is found.

Thank you very much for giving us an opportunity to consider your request.

Yours very truly,

H. F. Aldous

Heber F. Aldous
Vice President

HFA:cg

October 20, 1971

Hobar F. Aldous
First Security Bank
Salt Lake City, Utah

Dear Sir:

I am the owner of a large number of mining claims in the Dugway Mining District, Tooele County, Utah. From this group of claims I wish to select about 60 of the more promising claims for exploration and development and wish to spend approximately $50,000 in diamond drilling and geophysical exploration.

This is the kind of a project that the federal government might finance through the Office of Mineral Exploration the the extent of 50% to 75% of the above amount, but their first prerequisite is that money from private banks cannot be secured for this purpose. Such a loan can be repaid to the government through a 5% royalty on production in a period of not less than 10 years and not more than 25 years.

If the government certifies that exploration has resulted in the discovery of a commercial ore body, then the loan is repaid out of royalty, but there is no obligation for the owner to so produce.

If the government does not certify the property for production the property will be free of any government claim for royalty or the lien to secure it's payment. In other words the loan will be liquidated if ore is not found.

Would your bank loan money on such a project and require no repayment if ore is not found?

Your answer will be very much appreciated.

Very truly yours,

J. Floyd Cannon, M. D.

GEOPHYSICAL DIVISION
3422 South 700 West
Salt Lake City, Utah

September 28, 1965

MEMORANDUM TO R. J. LACY:

GEOCHEMISTRY
DUGWAY MINING DISTRICT
FILE MEMORANDUM

On September 1, 1965, I went with Dr. Cannon to the Dugway Mountains to investigate a new showing of lead in the Bertha Trough area. The mineralization occurs along somewhat parallel fault planes within the down dropped block which forms the trough. These faults are parallel the general strike of the trough. The mineralization occurs within the recemented breccia principally as galena and sphalerite, some oxides and carbonate ores also can be seen. The recementing agent is quartz.

Because of the silicous nature of the breccia, these mineralized zones seem to stand as ribs along the floor of the trough. These zones extend to the north under the Double Ought claims where the Asarco I.P. depth probe was located. This probe gave a response which indicated sulfides at a depth of 80 feet and a directional indication southward. These structures do, in fact, extend southward some 2000 feet and appear to be mineralized over their full extent.

There are four structures mapped by the use of geochemistry with a total width of about 800 feet, as noted from the enclosed profile data and geologic notes.

This new information does explain the I.P. response which was obtained at I.P. depth probe number one.

The enclosed geochemical data was derived from surface rock exposures and soil. There is strong evidence of increasing values at depth. A ten pound sample of this surface material was sent by Dr. Cannon to Bunker Hill for a smelter run. The results of this analysis has not been received as yet. A similar sample was sent to the Anaconda smelter at Tooele, Utah for assay. Anaconda reported 10% lead in the sample (personal communication, Dr. Cannon).

From the results of our analysis reported herein, I am definitely of the opinion that further investigation is warranted.

Respectfully submitted,

D. H. HART

DHH:ao
Enc.

cc: JF. Cannon

GEOLOGIC LOG DATA
DUGWAY MINING DISTRICT

1 - Rock hill top north side Bertha trough.
2 - Soil and rock @ 35' from #1.
3 - Rock - stringer mineralized? 40' from #2.
4 - Soil 40' from #3.
5 - Rock 40' from #4.
6 - Rock 40' from #5.
7a- 40' from #6 - small stringer in pink chalcite.
7 - Soil 45' from #6.
8 - Soil and rock 40' from #7.
9 - Soil 40' from #8.
10 - Soil wash bottom 45' from #9.
11 - Rock middle of road 40' from #10.
12 - Rock dike mineralized 30' from #11.
13 - Soil (side wash) 40' from #12.
14 - Rock wash side 40' from #13.
14 - Rock stringer 40' from #14.
15 - Rock 40' from #14 stringer.
16 - Stringer - 40' from #15
17 - Soil 40' from #16.
17 - Stringer 40' from #17.
Road at 18 - 40' from #17 stringer.

Total width - 795'.

GEOCHEMISTRY
DUGWAY MINING DISTRICT
FILE MEMORANDUM

Sample No.	PARTS PER MILLION Cu	Zn	Pb	Mo	Ni	REMARKS:
1-R	0	108	160	3	6	
2-S	10	64	120	0	2	
3-R	328	5400	3800	0	2	Mineralized stringer*
4-S	0	1720	1480	5	2	
5-R	20	2040	240	0	2	
6-R	0	92	0	3	2	
7-S	0	160	120	3	2	
7a-R	0	44	120	0	2	Stringer in pink calcite
8-R	0	68	1040	0	2	
8-S	20	204	480	0	8	
9-S	0	108	320	0	2	
10-S	60	480	360	0	4	Wash.
11-R	0	172	240	3	2	Middle of road.
12-R	1620	24000	12800	3	2	Largest mineral zone.*
13-S	20	840	840	3	2	Small wash.
14-R	60	9400	7000	0	2	
14-R-St	80	29760	15200	5	2	2nd largest stringer.*
15-R	20	2880	480	0	4	
16-R	0	840	240	5	2	
17-S	20	92	320	0	4	
17-R-St	180	18400	3420	0	2	
Dike 0	250	10000	17600	45	2)	Representative samples
Dike 1	150	12600	11200	57	30)	along strike of 12
Dike 2	220	8000	10000	30	4)	N → S.
H-2-1	20	68	64	3	4)	
H-2-2	40	68	244	0	4)	D.D.H.#2 last two portions.

R - rock
S - soil
St- stringer

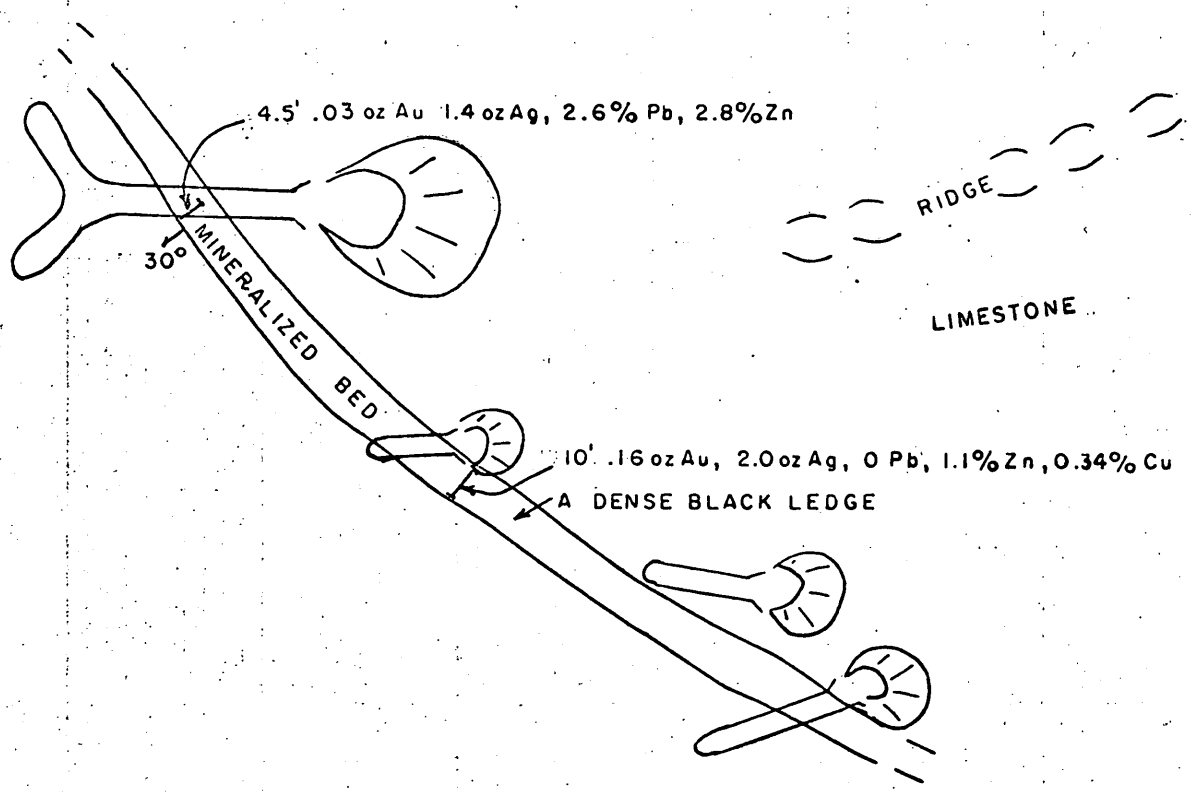
*To be run for silver.

RAYMOND CLAIM

DUGWAY, UTAH

SCALE 1" = 40'

L.K.REQUA SEP. 1960



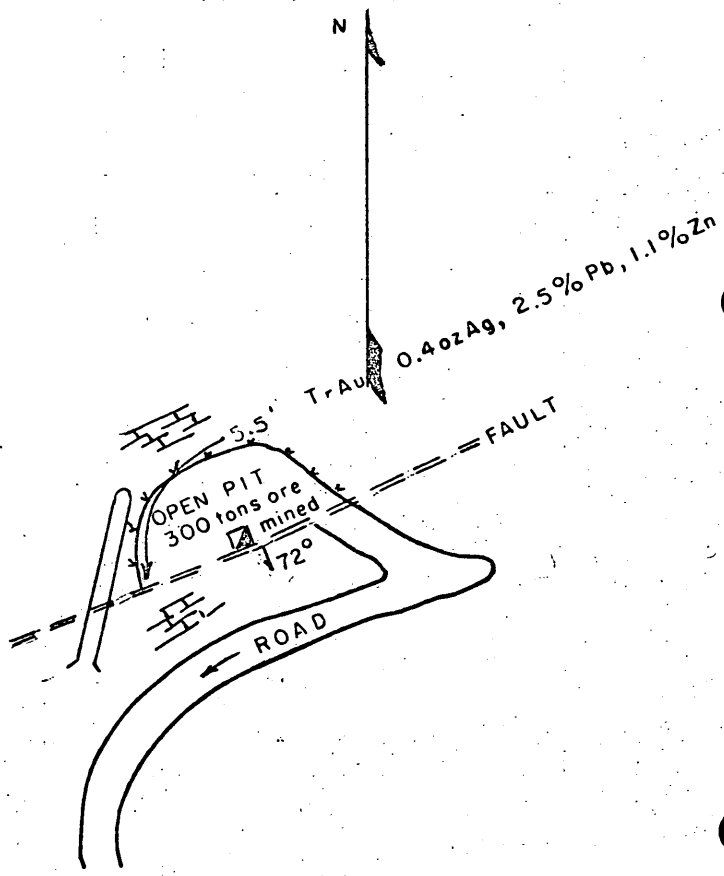


EXHIBIT F

YELLOW JACKET MINE

DUGWAY UTAH

SCALE 1" = 100'

J.C. INGERSOLL 1931

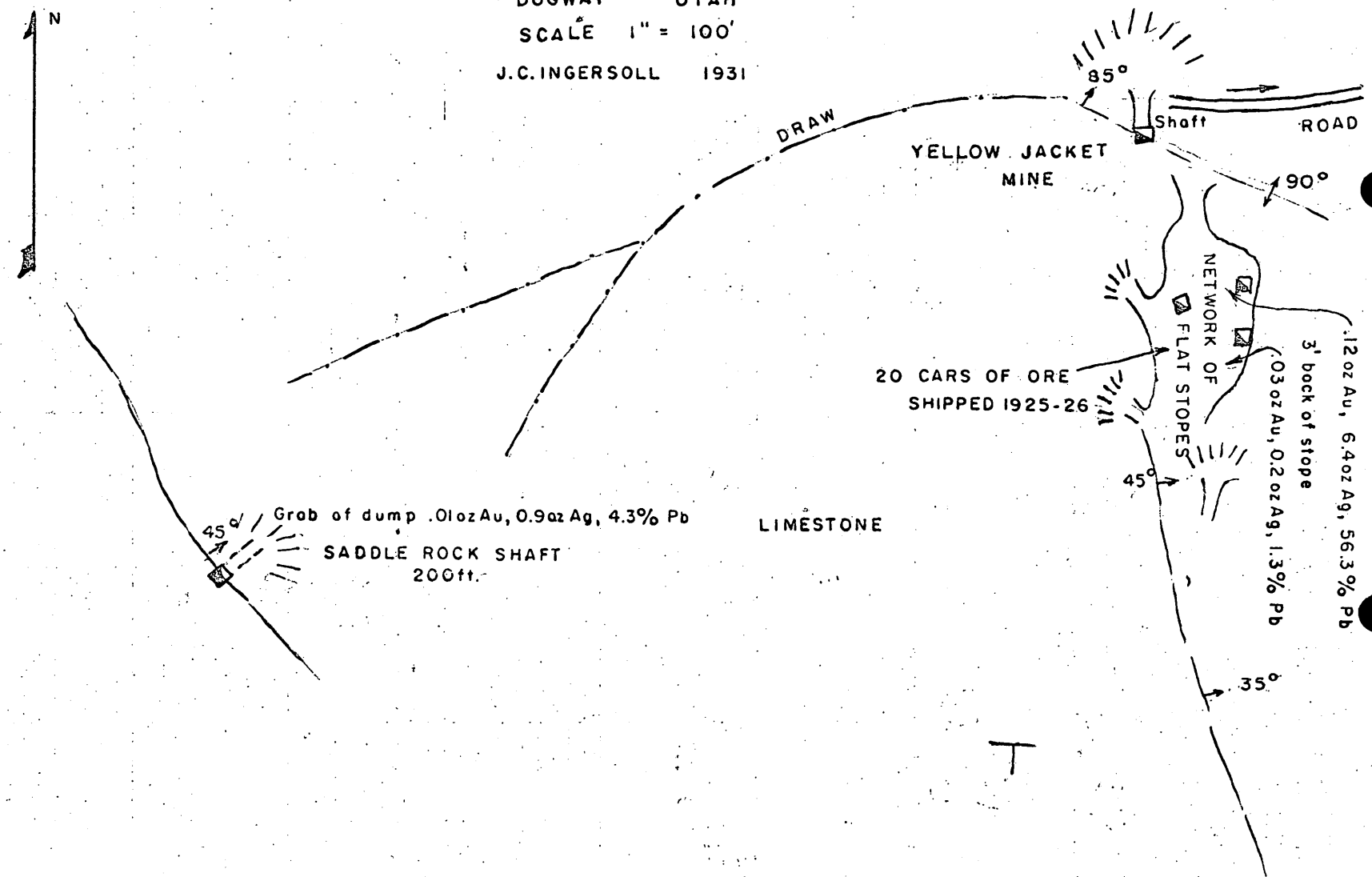


EXHIBIT G

L.K.R.

INTERNATIONAL SMELTING AND REFINING COMPANY
TOOELE PLANT

Bought of Jesse F. Cannon — Salt Lake City, Utah — 10/26/48
Pay Ophir R. Evans, Alma White, & Delmas Maxfield
353 N. 1st West
Mine Raymond — Tooele, Utah — *Shipped from* Dugway, Utah

Received — *Sampled* 10/7 — *By* — *Class* Crude — *Mine Lot* 1 — *Smelter Lot* 5582

ASSAYS	COPPER PER CENT	LEAD PER CENT	ZINC PER CENT	SILVER OZ. PER TON	GOLD OZ. PER TON	INSOLUBLE PER CENT	IRON PER CENT	SULPHUR PER CENT	LIME PER CENT	MANGANESE PER CENT	PER CENT
[illegible] CO.	.1	8.7	12.3	.84	.015	20.4	16.0	.2	1.6		
[illegible] CO.											
[illegible]											
[illegible]		=1.5									
[illegible]		7.2									

E. & M. J. METAL QUOTATIONS

[illegible] (Average for Week Ending)			
[illegible] (Average for Week Ending)	10/6	19	500
[illegible] (Average for Week Ending)	10/6	15	000
[illegible]	10/7	90	000
Gold			

VALUES PER TON

Copper		@		
Lead	90%	@.17593	22	801
Zinc	75%	@.03300	6	089
Silver	.5 Oz.	@.90000		306
Gold		@		
Gross Metal Payment			29	196
Less Treatment			10	345
Net Value Per Ton			18	851

TREATMENT

[illegible]		5	140
Chg lead under 30% @ .10		2	280
Insoluble	% @ .10	7	420
Sulphur	% @	2	040
Zinc	% @ .15	1	845
Iron	% @ .06	11	305
Lime	% @		960
Manganese	% @		
Net Treatment		10	345

INITIAL	CAR NUMBER	WEIGHT
[illegible]		

PAYMENT

48.2305 Dry Tons@ 18.851 Per Ton — 909 19
14.99

Hauling @ $7.00 per wet ton, pay Gene Nicholas, 729 Utah Ave., Tooele, Utah — 372.89
3% Federal tax — 11.19
Vo. 49642 — 384 08

No Royalty

Truck:
Net Freight Weight — 106540
Less Weight of Sacks
Net Weight
Moisture 9.46
Dry Weight — 96451

Freight @ Per Ton (R. R. Value)
Shipped By
Mine Lot
Smelter Lot — Voucher No. 49660
Total — 384 08
Net Proceeds — 525 11

An extra charge made for sampling all lots less than carload. Rates except on contracts for specified time or specified tonnage, subject to change without notice.

No assent, express or implied, by this Company to any breach or waiver of any covenant contained in any agreement shall be deemed a waiver of any succeeding breach of the same.

WS

INTERNATIONAL SMELTING AND REFINING COMPANY
TOOELE PLANT

Willis Smith
Stockton, Utah

Salt Lake City, Utah 10/20/50

Raymond

Shipped from Dugway, Utah

Sampled 10/15 By Class Crude Mine Lot 5 Smelter Lot 1210

	COPPER PER CENT	LEAD PER CENT	ZINC PER CENT	SILVER OZ. PER TON	GOLD OZ. PER TON	INSOLUBLE PER CENT	IRON PER CENT	SULPHUR PER CENT	LIME PER CENT	MANGANESE PER CENT	BA PER CEN
	.15	7.5	11.2	.7	.005	21.6	18.2	.3	.8		
		-1.5									
		6.0									

N. Y. METAL QUOTATIONS		
Price for Week Ending)		
Price for Week Ending)	10/11	16 000
Price for Week Ending)	10/11	17 500

TREATMENT		
Base		5 626
Chg lead under 30% @ .10		2 400
		8 026
Insoluble	% @ .10	2 160
Sulphur	% @	
Zinc	% @ .15	1 680
		11 866
Iron	% @ .06	1 092
Lime	% @	
Manganese	% @	
Net Treatment		10 774

VALUES PER TON		
	@	
90%	@ .14000	15 120
75%	@ .05950	6 468
	@	
	@	
		21 588
		10 774
		10 814

	WEIGHT
Truck	
Weight	127000
Tons	
10.10	
	114173

PAYMENT

57.0865 Dry Tons@ 10.814 Per Ton		617 33
Hauling @ $8.00 per wet ton, pay Roland Smith, Grantsville, Utah 508.00 3% Federal tax 15.24 Vo. 52950	523 24	
Royalty 15% of $94.09 pay Jesse F. Cannon, 1437 Gilmer Drive, City Vo. 52951	14 11	
Freight @ Per Ton (R. R. Value		
Shipped By		
Mine Lot		
Smelter Lot	Total	537 35
Voucher No. 52952	Net Proceeds	79 98

WS

A charge made for sampling all lots less than carload.
Subject to contracts for specified time or specified tonnage.
Subject to change without notice.

No warranty express or implied, by this Company by the acceptance of any covenant contained in any agreement of which this shall be deemed a waiver of any succeeding breach of the same covenant.

INTERNATIONAL SMELTING AND REFINING COMPANY

TOOELE PLANT

Salt Lake City, Utah 5/10/42

Shipper of Jessee F. Cannon
Ray Willis Smith
Raymond ? Stockton, Utah

Shipped from Dugway, Utah

Sampled 4/29 By Class Crude Mine Lot 1 Smelter Lot 4021

COPPER PER CENT	LEAD PER CENT	ZINC PER CENT	SILVER OZ. PER TON	GOLD OZ. PER TON	INSOLUBLE PER CENT	IRON PER CENT	SULPHUR PER CENT	LIME PER CENT	MANGANESE PER CENT	ARSENIC PER CENT
.35	13.2	18.6	1.61	.045	20.2	13.9	.4	3.5		
	1.5									
	11.7									

H. & M. J. METAL QUOTATIONS			
(Average for Week Ending)			
(Average for Week Ending)	4/28	17	500
(Average for Week Ending)	4/28	12	000
	4/29	90	000
		$35	000

VALUES PER TON			
	@		
90%	@ .156445	32	947
95%	@ .02640	7	366
.5 oz.	@ .20000		929
21%	@ 35.000	1	433
Metal Payment		42	745
Treatment		10	370
Value Per Ton		32	375

TREATMENT		
Date		
Chg. Pb under 30% @ .10		4 565
		1 330
Insoluble	% @ .10	6 394
Sulphur	% @	2 020
Zinc	% @ .15	2 790
		[illegible]
Iron	% @ .06	[illegible]
Lime	% @	
Manganese	% @	
Net Treatment		10 370

CAR NUMBER	WEIGHT	PAYMENT		
		13.5855 Dry Tons @ 32.375 Per Ton		439 83
Truck				
	2[illegible]20	Freight @ Per Ton (R. R. [illegible])		
3.72		Shipped By		
	27171	Mine Lot		
		Smelter Lot	Voucher No. 48591	Total Net Proceeds 439 83

[illegible] allowance made for samples or lots less than carload. [illegible] contracts for specified fine or specified ton [illegible] subject to charge without notice. MJS

No assent, express or implied, by this Company to any breach or waiver of any covenant contained in any agreement shall be deemed a waiver of any succeeding breach of the same covenant.

INTERNATIONAL SMELTING AND REFINING COMPANY
TOOELE PLANT

Bought of Jesse F. Cannon — *Salt Lake City, Utah* 10/26/48

Pay Ophir R. Evans, Alma White, & Delmas Maxfield
353 N. 1st West
Tooele, Utah

Mine Raymond — *Shipped from* Dugway, Utah

Received — *Sampled* 10/12 *By* — *Class* Crude — *Mine Lot* 2 — *Smelter Lot* 5617

ASSAYS	COPPER PER CENT	LEAD PER CENT	ZINC PER CENT	SILVER OZ. PER TON	GOLD OZ. PER TON	INSOLUBLE PER CENT	IRON PER CENT	SULPHUR PER CENT	LIME PER CENT	MANGANESE PER CENT	[illegible]
[illegible] & R. CO.	.1	7.2	10.7	.55	.005	22.5	16.6	.3	1.3		
[illegible] CO.											
[illegible]											
		-1.5									
[illegible] MENT		5.7									

E. & M. J. METAL QUOTATIONS

Copper	(Average for Week Ending)		
Lead	(Average for Week Ending)	10/6	19 500
Zinc	(Average for Week Ending)	10/6	15 000
Silver		10/12	90 000
Gold			

VALUES PER TON

Copper		@		
Lead	90%	@ .17593	18	050
Zinc	75%	@ .03300	5	297
Silver	-.5 Oz.	@ .90000		045
Gold		@		
Gross Metal Payment			23	392
Less Treatment			10	429
Net Value Per Ton			12	963

TREATMENT

Base		Smelter
Chg lead under 30% @ .10		2 430
		7 570
Insoluble	% @ .10	2 250
Sulphur	% @	
Zinc	% @ .15	1 605
		11 425
Iron	% @ .06	996
Lime	% @	
Manganese	% @	
Net Treatment		10 429

DATE	CAR NUMBER	WEIGHT

PAYMENT

44.507 Dry Tons@ 12.963 Per Ton		576 94
Hauling @ $7.00 per wet ton, pay Gene Nicholas, 729 Utah Ave., Tooele, Utah 347.48		
3% Federal tax 10.42		
Vo. 49642	357 90	
Royalty 15% of $219.04 pay Jesse F. Cannon, 1437 Gilmer Drive, City Vo. 49661	32 86	
Freight @ Per Ton (R. R. Value)		
Shipped By		
Mine Lot	Total	390 76
Smelter Lot Voucher No. 49660	Net Proceeds	186 18

Truck
Total Freight Weight 99280
Less Weight of Sacks
Net Weight
Moisture 10.34
Net Weight 89014

An extra charge made for sampling all lots less than carload. Rates, except on contracts for specified time or specified tonnage, subject to change without notice.

No assent, express or implied, by this Company to any breach or waiver of any covenant contained in any agreement shall be deemed a waiver of any succeeding breach of the same covenant.

WS

INTERNATIONAL SMELTING AND REFINING COMPANY

TOOELE PLANT

Salt Lake City, Utah

10/26/48

Shipper Jesse F. Cannon
Raymond Zephir R. Evans, Alma White & Dellas Laxfield
353 N. 1st West
Tooele, Utah

Shipped to Dugway, Utah

Received 10/15 By Class Crude Mill Lot 2 Sample No. 5631

Moisture	Lead Per Cent	Zinc Per Cent	Silver Oz. Per Ton	Gold Oz. Per Ton	Insoluble Per Cent	Iron Per Cent	Sulphur Per Cent	Lime Per Cent	Magnesia Per Cent
.1	8.7	8.5	.64	.01	22.8	15.9	.3	.2	.2

-1.3
7.8

METAL QUOTATIONS

(Average for Week Ending)	10/13	19.500
(Average for Week Ending)	10/13	15.000
	10/15	90.000

TREATMENT

Clay lead under 50% @ .10 — 2 290

VALUES PER TON

	@				
90%	@ .17523	22 801	Insoluble	% @ .10	2 280
25%	@ .03300	4 208	Sulphur	% @	
5 Oz.	@ .90000	125	Zinc	% @ .15	1 27
	@				10 27
			Iron	% @ .06	9 54
Metal Payment		27 135	Lime	% @	
Treatment		10 021	Magnesia	% @	
Net Value		17 114	Net Treatment		10 021

Gross Weight	Payment	
49 3265	Dry Tons 17.114 Per Ton	846 17
	Hauling @ $7.00 per wet ton, pay Gene Nicholas, 729 Utah Ave., Tooele, Utah Wet Tons 39.70 3% Federal tax 11.95 Vo. 49642	410 25
	Royalty 15% of $437.92 pay Jesse F. Cannon, 1437 Gilmer Drive, City Vo. 49661	65 69
1.3560	Freight @ Per Ton (R.R. Value)	
	Shipped By	
	Mine Lot	Total 475 [illegible]
38653	Smelter Lot — Voucher No. 49660	Net Proceeds 370 [illegible]

[illegible] made for sampling all lots less than [illegible] No assent, express or implied, to [illegible] contracts for specified time or specified [illegible] or waiver of any covenant contained in [illegible] subject to change without notice. [illegible] deemed a waiver of any succeeding breach [illegible]

Wo.

INTERNATIONAL SMELTING AND REFINING COMPANY
TOOELE PLANT

Bought of Willis Smith
Stockton, Utah

Salt Lake City, Utah
10/16/50

Name Raymond

Shipped from Dugway, Utah

Received Sampled 10/1 By Class Crude Mine Lot Smelter Lot 1149

ASSAYS	COPPER PER CENT	LEAD PER CENT	ZINC PER CENT	SILVER OZ. PER TON	GOLD OZ. PER TON	INSOLUBLE PER CENT	IRON PER CENT	SULPHUR PER CENT	LIME PER CENT	MANGANESE PER CENT	PER CENT
L. S. & R. CO.	.1	9.8	23.9	.99	.01	16.8	12.0	.3	.7		
SMELTING CO.											
OTHER ASSAYS											
		-1.5									
		0.3									

METAL QUOTATIONS

(Average for Week Ending)		
(Average for Week Ending) 9/27	16	000
(Average for Week Ending) 9/27	17	500

VALUES PER TON

Copper @			
19% @ .14000		20	916
5% @ .05850		23	802
@			
@			
		34	718
		12	341
Net Value Per Ton		22	377

TREATMENT

Base		
Chg lead under 30% @ .10	5	626
	2	170
Insoluble % @ .10	7	756
Sulphur % @	1	680
Zinc % @ .15	3	595
Iron % @ .06	13	065
Lime % @		790
Manganese % @		
Net Treatment	12	340

CAR NUMBER	WEIGHT	PAYMENT		
	17.624	Dry Tons @ 22.377 Per Ton		394 37
		Hauling @ $8.00 per wet ton, pay Roland Smith, Grantsville, Utah 153.12		
		3% Federal tax 4.59		
		Vo. 52922	157 71	
		Royalty 15% of $236.66 pay Jesse F. Cannon, 1437 Gilmer Drive, City		
		Vo. 52923	35 50	
196				
38520		Freight @ Per Ton (R. R. Value)		
		Shipped By		
		Mine Lot		
35240		Smelter Lot		
		Total		193 81
		Voucher No. 52924 Net Proceeds		201 16

[illegible] made for sampling all lots less than carload. [illegible] contracts for specified time or specified tonnage without notice.

No assent, express or implied, by this Company to any [illegible] or waiver of any covenant contained in any agreement [illegible] deemed a waiver of any succeeding breach of the same [illegible]

48 REVISED 2500 9-54

AMERICAN SMELTING AND REFINING COMPANY

700 PACIFIC NATIONAL LIFE BUILDING
SALT LAKE CITY, UTAH

F SHIPPER McFARLAND & HULLINGER — GARFIELD PLANT, GARFIELD, UTAH — 195?

S 23 Pinehurst Ave., Tooele, Utah — PLANT LOT 2057

G POINT ST. JOHN, UTAH — SHIPPERS LOT MH-1

IME BERTHA COPPER — COUNTY CLASS CRUDE — SAMPLED BY GARFIELD

REC'D VIA	CAR INITIAL	CAR NUMBER	WEIGHTS GROSS WEIGHT	WEIGHTS CONTAINERS	WEIGHTS NET WET	MOISTURE %	MOISTURE POUNDS	NET DRY WEIGHT
UP	UP	65339			125 260	11.0	13 778	111 482

METAL QUOTATIONS

GOLD	[illegible]	PER OZ.
SILVER	.125	PER OZ.
LEAD	.15	PER LB.
COPPER	.35575	PER LB.

BASED ON WEEK ENDING 7-9 1955

ASSAYS SMELTER	SHIPPER	UMPIRE	SETTLEMENT	PAY CONTENT	PRICE	CREDIT	FRT. VALUE
01	035	03	03	.03	[illegible]	95	
65	7		675	95% - MIN.			
				50%			
28	295		2875	DEDUCT 15# 42.5#	.32275	13 72	455
				GROSS VALUE		14 67	550
				DEDUCTIONS	DEBIT		
118			118	BASE SPECIAL	556		
				EXCESS VAL. OVER $			
				BULLION FRT. TAX	02		
				LABOR			
				TOTAL DEDUCTIONS	558		
				NET VALUE PER DRY TON		9 09	UNDER
				FRT. VALUE PER WET TON	XXX XX	XXX XX	10 00

equired in this material was held under Section 19 of the Provisional
ations of January 30 and 31, 1934, as amended, by the person from
s acquired by us.

DISTRIBUTION OF PROCEEDS

		DEBIT	CREDIT
LUE: 55.741 DRY TONS @ 9.09 PER TON			506 88
NT SAMPLING			
IGHT 62.630 WET TONS @ .78 PER TON PLUS TRANSP. TAX		50 32	
ILING PAY @ 2-00		451 56	
PLING PAY			
AYING PAY CROWDUS & NICHOLS		5 00	
IRE. PAY			
RESENTATION. PAY			
UNT WITHHELD PENDING RECEIPT OF SILVER AFFIDAVIT			
ALTY			

AMERICAN MELTING AND REFINING COMPANY

700 PACIFIC NATIONAL LIFE BUILDING
SALT LAKE CITY, UTAH

McFARLAND & HULLINGER
SHIPPER 60 West Vine St. Box 238
Tooele, Utah

GARFIELD PLANT, GARFIELD, UTAH DEC 30 1955 195

POINT St. John, Utah
AGE Bertha

PLANT LOT 3499
SHIPPERS LOT M+H-3
COUNTY CLASS Crude
SAMPLED BY GARFIELD

CAR INITIAL	CAR NUMBER	WEIGHTS GROSS WEIGHT	CONTAINERS	NET WET	MOISTURE %	MOISTURE POUNDS	NET DRY WEIGHT
Truck				58 140	23 1	13 430	44 710

METAL QUOTATIONS
GOLD 34.9125 PER OZ.
SILVER .90514 PER OZ.
LEAD .155 PER LB.
COPPER .4404 PER LB.

BASED ON WEEK ENDING 12-17 1955

ASSAYS

SMELTER	SHIPPER	UMPIRE	SETTLEMENT
12	13		125
75	90		825
2			2
944	970	970	970
290			290

VALUES PER TON

PAY CONTENT		PRICE	CREDIT	PRT. VALUE
	.125	31.8125	3 98	
95% - MIN.				
50%				
DEDUCT 15#	179#	.4074	72 92	
GROSS VALUE			76 90	
DEDUCTIONS		DEBIT		
BASE		6 75		
EXCESS VAL. OVER $ 20.00		4 00		
BULLION FRT. TAX		07		
LABOR				
TOTAL DEDUCTIONS		10 82		
NET VALUE PER DRY TON			66 08	
FRT. VALUE PER WET TON		XXX XX	XXX XX	

red in this material was held under Section 19 of the Provisional
ns of January 30 and 31, 1934, as amended, by the person from
quired by us.

DISTRIBUTION OF PROCEEDS

		DEBIT	CREDIT
22.355 DRY TONS @ 66.08 PER TON			147722
AMPLING			
29.070 WET TONS @ PER TON PLUS TRANSP. TAX			
PAY McFarland + Hullinger @ 7.78 Box 238, Tooele, Utah		232 94	
G. PAY			
G. PAY			
PAY		5 00	
NTATION. PAY			
WITH PENDING RECEIPT OF SILVER AFFIDAVIT			
Royalty 10% of 123.93			
PAY SHIPPER			1239 28

FORM 206 2M 6-49

INTERNATIONAL SMELTING AND REFINING COMPANY
TOOELE PLANT

Salt Lake City, Utah 1/4/56

Bought of McFarland and Hullinger
Box 238
Tooele, Utah

Mine

Shipped from Dugway, Utah

Received 12/10 Sampled 12/13 By Class Crude Mine Lot 2 Smelter Lot 207

ASSAYS	COPPER PER CENT	LEAD PER CENT	ZINC PER CENT	SILVER OZ. PER TON	GOLD OZ. PER TON	INSOLUBLE PER CENT	IRON PER CENT	SULPHUR PER CENT	LIME PER CENT	MANGANESE PER CENT	PER
I. S. & R. CO.	2.7	Nil	.2	.39	.005	15.0	32.7	27.1	Tr.	.1	.1
MINING CO.	2.65	.4	Nil	.6	.015	14.8	33.0	25.5			
Oxide	.57										
SETTLEMENT	2.105	.2	.1	.495	.01	14.9	32.85	26.3			

E. & M. J. METAL QUOTATIONS		
Copper (Average for Week Ending)	12/7	43 075
Lead (Average for Week Ending)		
Zinc (Average for Week Ending)		
Silver		
Gold		

VALUES PER TON			
Copper 10#	@ .364515	11	701
Lead	@		
Zinc	@		
Silver	@		
Gold	@		
Gross Metal Payment		11	701
Less Treatment		4	750
Net Value Per Ton		6	951

TREATMENT		
Base		4 750
Insoluble	% @	
Sulphur	% @	
Zinc	% @	
Iron	% @	
Lime	% @	
Manganese	% @	
Net Treatment		4 750

INITIAL	CAR NUMBER	WEIGHT
Truck		
Total Freight Weight		180,440
Less Weight of Sacks		
Net Weight		
% Moisture	8.91	
Dry Weight		164,363

PAYMENT

82.1815 Dry Tons@ 6.951 Per Ton		571 24
Crismon and Nichols, Assaying	8 00	
McFarland and Hullinger, Hauling on 180,440# @ 8.00 per ton 721.76		
Less deficit on lot 158.52	563.24	
Voucher # 56747		

Freight @ Per Ton (R. R. Value)

Shipped By McFarland and Hullinger
Mine Lot 2 Crude
Smelter Lot 207 Voucher No.

Total 571 24
Net Proceeds Nil

An extra charge made for sampling all lots less than carload. Rates, except on contracts for specified time or specified tonnage, subject to change without notice.

No assent, express or implied, by this Company to any breach or waiver of any covenant contained in any agreement shall be deemed a waiver of any succeeding breach of the same covenant.

FORM 556 20M 8-45

Rec'd 12/30/63

INTERNATIONAL SMELTING AND REFINING COMPANY

TOOELE PLANT

Salt Lake City, Utah 1/4/56

Bought of McFarland and Hullinger
Box 238
Tooele, Utah

Mine

Shipped from Dugway, Utah

Received 12/8 *Sampled* 12/12 *By* *Class* Crude *Mine Lot* 1 *Smelter Lot* 205

ASSAYS	COPPER PER CENT	LEAD PER CENT	ZINC PER CENT	SILVER OZ. PER TON	GOLD OZ. PER TON	INSOLUBLE PER CENT	IRON PER CENT	SULPHUR PER CENT	LIME PER CENT	MANGANESE PER CENT	PER CENT
I. S. & R. CO.	2.1	Nil	.3	.39	.005	15.7	32.0	24.0	Tr.	.1	.1
MINING CO.	2.3	.7	.8	.8	.015	14.7	33.0	21.4			
Oxide	.47										
SETTLEMENT	1.73	.35	.55	.595	.01	15.2	32.5	22.7			

E. & M. J. METAL QUOTATIONS

Copper (Average for Week Ending)	12/7	43	075
Lead (Average for Week Ending)			
Zinc (Average for Week Ending)			
Silver			
Gold			

VALUES PER TON

Copper 10# @ .364515		8	967
Lead @			
Zinc @			
Silver @			
Gold @			
Gross Metal Payment		8	967
Less Treatment		4	750
Net Value Per Ton		4	217

TREATMENT

Base		4	750
Insoluble	% @		
Sulphur	% @		
Zinc	% @		
Iron	% @		
Lime	% @		
Manganese	% @		
Net Treatment		4	750

INITIAL	CAR NUMBER	WEIGHT
Truck		
Total Freight Weight		194,080
Less Weight of Sacks		
Net Weight		
% Moisture 9.41		
Dry Weight		175,817

PAYMENT

87.9085 Dry Tons@ 4.217 Per Ton		370 71
Crismon and Nichols, Assaying	8 00	
McFarland and Hullinger, Hauling on 194,080# @ 8.00 per ton 776.32		
Less Deficit on lot 413.61	362 71	
Voucher # 56747		
Freight @ Per Ton (U. S. Value		
Shipped By McFarland and Hullinger		
Mine Lot 1 Crude Ore	Total	370 71
Smelter Lot 205 Voucher No.	Net Proceeds	Nil

An extra charge made for sampling all lots less than carload. Rates, except on contracts for specified time or specified tonnage, subject to change without notice.

No assent, express or implied, by this company to any breach or waiver of any covenant or condition in any agreement shall be deemed a waiver of any succeeding breach of the same covenant.

Standard Form No. 65
November 1961
General Services Administration
FPMR (41 CFR) 101-11.6

U.S. Government Messenger Envelope

NAME (OR TITLE) OF ADDRESSEE, AGENCY, ORGANIZATIONAL UNIT, ADDRESS, AND ROOM		NAME (OR TITLE) OF ADDRESSEE, AGENCY, ORGANIZATIONAL UNIT, ADDRESS, AND ROOM	
~~Al Roberts~~ ~~Room 1417A~~	STOP		STOP
~~Rose Foster~~ ~~Bldg 82~~	STOP	~~Clerk Ed Ard~~ ~~Payroll~~	STOP
~~Robert Jones Service & Supply~~ ~~Bldg 25 Int. Affairs~~ ~~Room 1428~~	STOP	~~CHUCK KITTER~~ ~~Rm 1442~~ ~~Internal Bus.~~	STOP
~~J R Strowa~~	STOP	~~Leonard Patten~~ ~~Rm 4222 GSA Bldg.~~	STOP
BUDGET AND FINANCE BRANCH U. S. GEOLOGICAL SURVEY WASHINGTON, D. C. 20242	STOP	4232	STOP
~~Rm 3224 GSA~~	STOP	OME Rm 4460 Interior	STOP
Mr. Upston 2226	STOP		STOP
Mr. Latcher 132 AT	STOP		STOP
Washington Distribution U.S.G.S. Pub.	STOP		STOP
South Pads Street	STOP		STOP

Use other side

Use STOP only when messenger service between Government buildings in Washington, D.C., is required or wherever a STOP system is used. Your mail room has STOP information.

65-107

4989-EWQ
Moes
SDWL

INSTRUCTIONS FOR USE

1. Void Previously Used Block
2. Identify Agency of Addressee
3. Write Clearly
4. Send Surplus Envelopes to Supply Room for Reissue

NAME (OR TITLE) OF ADDRESSEE, AGENCY, ORGANIZATIONAL UNIT, ADDRESS, AND ROOM		NAME (OR TITLE) OF ADDRESSEE, AGENCY, ORGANIZATIONAL UNIT, ADDRESS, AND ROOM	
	STOP		STOP
	STOP		STOP
	STOP		STOP
	STOP		STOP
	STOP		STOP
	STOP		STOP
	STOP		STOP
	STOP		STOP
	STOP		STOP

Use other side first

☆ U. S. GOVERNMENT PRINTING OFFICE: 1966—O—249-909

(notes - 8-14 - 8/15/72
KW)

UNITED STATES
DEPARTMENT OF THE INTERIOR
OFFICE OF MINERALS EXPLORATION
WASHINGTON 25, D.C.

Hasle & Lily - agree that the gets are of sufficient size and have copper average content: Bertha and Rebecca Mtn. and have worth exploring. Hasle rules I.P. survey.

Applicants program shows 2100 ft of drilling on these two targets. Drilling costs $6 Gold + auxiliary costs targets about $30, and would cover the overall program.

Mineral property questions remain, can be cleared up if a program is recommended.

Applicants financial status not specifically detailed, would need fixed documentation if program recommended.

Market for ores not firm. Approx value of the ores appears to be in $23-28/ton range - would not stand much shipping.

Bank letter okay - has he need a record? - He did follow Kirk's instructions.

Copper does form a significant part of ore in selected targets.

Market for ore? still not too good

Financial statement —
still not too specific —

Bertha mine area
and
Breccia Hill area in Bertha trough
and
Raymond claim (east of Bertha mine

Hassler / provisionally
staking Breccia Hill area for core drilling

800 tons of ore

	.036 oz Au	@ 65.00	2.34
	2.04 oz Ag	@ 1.71	3.49
205.4 lbs	10.27 % Pb	0.155	31.84
28.6 lbs	1.43 % Zn	@ 0.18	5.15
29.6 lbs	1.48 % Cu	@ 0.50	14.80
			57.62

Pb + Zn
64.2 %

Au + Ag + Cu
$20.63
35.8 %

Stautz

black cuprous pyrite ore in
(carbonate rocks immediately above
Golconda thrust. Size unknown but
could be significant

Berthe a good target for 1st exploration
by drill 2nd target. subcrop gossan,
geochem anomalies

recommends against yellow jacket.

Claim map - + list

Map ~~includes~~ shows following patented claims as being included in a ME application, but not listed in application:

Keynote
Cloudy
Levine

Following names misspelled on application or map.

List names	Map name
Stinger	Stringer No 2
Stinger No. 1	Stringer No. 1
Mammoth	Mamoth

Unpatented Claim Kennedy 13 shown on map but not listed in application

---

Golconda area
high Pb-Zn — Not recommended

Bertha OK — 246 tons shipped, Cu ore ± 2½ %
Breccia Hill OK — reserves 20,000 tons

MAX D. CRITTENDEN, JR. *U.S. Geological Survey, 345 Middlefield Road, Menlo Park, California 94025*

FREDERICK F. SCHAEFFER *Southern Colorado State College, Pueblo, Colorado 81001*

D. E. TRIMBLE *U.S. Geological Survey, Denver, Colorado 80225*

LEE A. WOODWARD *University of New Mexico, Albuquerque, New Mexico 87106*

Nomenclature and Correlation of Some Upper Precambrian and Basal Cambrian Sequences in Western Utah and Southeastern Idaho

Geological Society of America Bulletin, v. 82, p. 581-602, 8 figs., March 1971

MAX D. CRITTENDEN, JR. *U.S. Geological Survey, 345 Middlefield Road, Menlo Park, California 94025*
FREDERICK E. SCHAEFFER *Southern Colorado State College, Pueblo, Colorado 81001*
D. E. TRIMBLE *U.S. Geological Survey, Denver, Colorado 80225*
LEE A. WOODWARD *University of New Mexico, Albuquerque, New Mexico 87106*

Nomenclature and Correlation of Some Upper Precambrian and Basal Cambrian Sequences in Western Utah and Southeastern Idaho

ABSTRACT

Recent stratigraphic studies in three widely separated localities in southeastern Idaho and western Utah have revealed a startling continuity of both individual rock units and of rock sequences over a distance of some 300 mi parallel to the strike of a late Precambrian and Cambrian depositional trough. Between 15,000 and 25,000 ft of beds were deposited in the axis of the trough, whereas only 1000 to 3300 ft of correlative rocks were laid down on the shelf to the east. In several areas a diamictite is present near the base of the sequence; this is underlain locally and overlain generally by argillites containing lenticular limestones and dolomites; these in turn are succeeded by quartzitic rocks containing a thick grayish-red to maroon unit—the Mutual Formation. In each area the sequence includes, at the top, quartzites typical of the basal Cambrian. Deposition in the basin was essentially continuous from late Precambrian into Cambrian time but was interrupted by uplift and erosion on the shelf. The hinge line of the ancient seaway is inferred to have coincided roughly with the present "Wasatch line," but erosion prior to deposition of the Tintic Quartzite has removed most of the data needed to establish this with certainty.

Rocks in each of the three areas described here in detail are regarded as allochthonous and appear to have been thrust eastward during the Sevier orogeny. A precise reconstruction of the sedimentary basin must therefore await not only additional stratigraphic studies in such areas as the Promontory Range of Utah and the Bannock and Malad Ranges of southern Idaho, but also final resolution of the structural events.

INTRODUCTION

Geologic mapping and stratigraphic studies in three widely separated areas of the northeastern part of the Great Basin have shown that both individual stratigraphic units and gross rock sequences of late Precambrian and Cambrian age exhibit remarkable continuity over the 300-mi distance from southeastern Idaho to central Utah (Fig. 1). The sequences are 15,000 to 25,000 ft thick where most complete and appear to record continuous sedimentation from late Precambrian into Cambrian time. All three areas are within the deformed part of the Sevier orogenic belt and are presumed to have been transported eastward several tens of miles from their original sites of deposition. However, because correlative rocks in shelf sections to the east are thin or absent and the rates of thickening and of original facies change are unknown, the precise amount of telescoping by tectonic transport remains uncertain.

The purpose of this paper is to name, describe, and correlate the thickest and least complicated sections of these rocks, in the hope that the units and sequences defined in these areas can be recognized in other areas where exposures are limited or where structural complexity makes it impossible to work out a complete stratigraphic section.

Authors are listed alphabetically; responsibility is shared jointly for sections on correlation, age, paleogeography, and structure, but is carried individually for stratigraphic description of specific areas.

The rocks of the Pocatello, Idaho, area now assigned to the Precambrian were first described by Anderson (1928) and included in the Cambrian; Ludlum (1942) was the first

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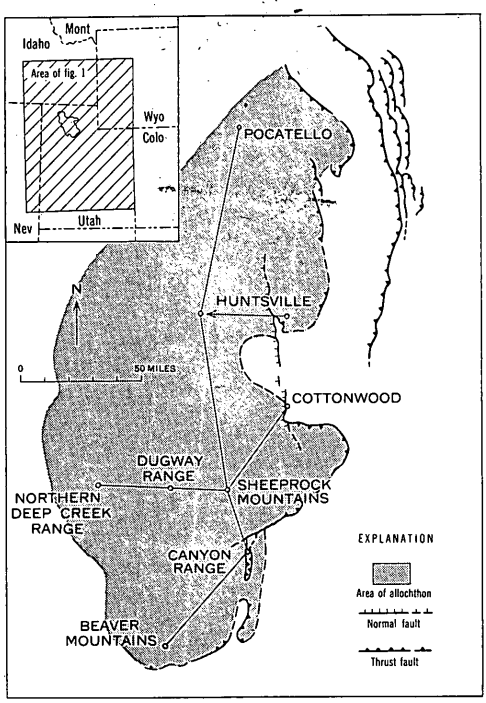

Figure 1. Index map showing location and tectonic setting of stratigraphic sections described.

to recognize that some of them are Precambrian. Similar rocks in the area near Huntsville, Utah, were first recognized by Blackwelder (1910) and were mapped in reconnaissance and described briefly by Eardley (1944). The earliest and most significant synthesis of younger Precambrian rocks in northern Utah was that of Eardley and Hatch (1940); more recent summaries include those of Cohenour (1959) and Condie (1966, 1969). Precambrian rocks in the Beaver Mountains were originally assigned to the Ordovician and Silurian(?) by Butler (*in* Butler and others, 1910, p. 511) because he failed to recognize the thrust fault which separated them from the immediately underlying lower Paleozoic rocks. The presence of a thick Precambrian section in this area was noted by D.M. Lemmon, W. C. Jeffs, and others, during mapping following World War II, and the rocks are assigned to the Precambrian on the geologic map of southwestern Utah (Hintze, 1963).

Stratigraphic studies of the older rocks in the Pocatello area were started in 1961 by F. E. Schaeffer during preparation of a geologic map of Bannock County, Idaho, for the Idaho Bureau of Mines and Geology. Schaeffer was the first to distinguish the major subdivisions within the Precambrian rocks of this area and to recognize that they could be traced over the adjoining parts of southeastern Idaho. These subdivisions were used in mapping the Pocatello and Michaud 15-minute quadrangles by D. E. Trimble from 1962 to 1965 (Trimble and Schaeffer, 1965) and in more recent mapping of the Michaud and Pocatello 15-minute quadrangles.

Geologic mapping at a scale of 1:24,000 in the Huntsville area by Crittenden largely between 1964 and 1966 led to definition of the Huntsville sequence (Crittenden, 1967) in a little-deformed area in the Browns Hole quadrangle. Mapping designed to establish the stratigraphy of the lower diamictite-bearing units is continuing in structurally complex areas near Willard Peak, northwest of Huntsville.

Stratigraphic relations in the shelf area were established during mapping in the Cottonwood district east of Salt Lake City by the U.S. Geological Survey between 1940 and 1960 (Calkins and Butler, 1943; Crittenden, 1965a, 1965b).

Stratigraphic studies in the Beaver Mountains were completed by Woodward during 1966 (Woodward, 1968).

POCATELLO AREA, IDAHO

The rocks of the Pocatello area, southeastern Idaho, appear to be typical of the conformable depositional sequence of upper Precambrian and lowermost Cambrian rocks of the eastern part of the Great Basin. Inasmuch as they constitute the thickest known section of those rocks and because the units defined here can be recognized over a wide area, they may well serve as a standard for much of southeastern Idaho. More than 25,000 ft of dominantly quartzitic rocks, of which more than 20,000 ft probably are Precambrian, underlie Middle Cambrian limestones. Lower Cambrian fossils have not been discovered in this area but were found in correlative rocks in the Portneuf Range (Oriel, 1965). The rocks below the Cambrian carbonates formerly assigned to the Brigham Formation (Anderson, 1928; Ludlum, 1942, 1943) are divided into six formational units, four of which are Precambrian. New names are introduced here for three of these and for the two Cambrian units.

POCATELLO FORMATION

The lowest and oldest rocks in the Pocatello area comprise clastic, volcanic, and carbonate rocks of probable marine origin that were designated the Pocatello Formation by Ludlum (1942). That term is retained here, and the formation is divided into four members, a lower member, mainly argillite; a diamictite[1] member, a volcanic member; and an upper member, also dominantly argillite. The type section of the Pocatello Formation is a composite of those of the individual members, defined below.

The lower member of the Pocatello Formation consists of black, thinly laminated, slaty argillite, phyllitic siltite, and brown quartzite. A thickness of about 700 ft is observed, but the total thickness is uncertain because the base is not exposed. The type section of the lower member is designated as the section from the canyon bottom to near the top of the west slope of a small canyon just north of the Portneuf River, in the S½ sec. 15, and N½ sec. 22, T. 7 S., R. 35 E., about 7 mi southeast of Pocatello (A-B, Fig. 2).

These slaty rocks are overlain conformably by several thousand feet of diamictite-bearing rocks, here named the Scout Mountain Member, with excellent exposures on the summit of and on the ridge approximately 2 mi north and south of Scout Mountain in Tps. 8 and 9 S., R. 35 E., about 15 mi south-southeast of Pocatello (Fig. 2). Owing to severe faulting, a complete section is not present either at the type locality on Scout Mountain, or elsewhere. The reference section for this unit is therefore designated as a composite of three partial sections as follows: (1) from the crest, down the west slope of the ridge immediately northeast of Portneuf in the SW¼ sec. 15, T. 7 S., R. 35 E. (C-C′, Fig. 2); (2) from the base, up the west slope to the crest of the corresponding ridge immediately south of the river, in the W½ sec. 27, T. 7 S., R. 35 E., (C′-C″, Fig. 2); (3) up part of the west slope of the same ridge about a mile south in the NW¼ sec. 34, T. 7 S., R. 35 E. (C″-D, Fig. 2). Sections C-C′ and C′-C″ could not be matched, and an unknown, but probably small, amount of section is believed to be missing. The following is a generalized description of these composite sections. The Scout Mountain Member has at the base 65 ft of limestone, locally recrystallized to dense marble. This is succeeded by 100 ft of medium-grained gray quartzite with much interbedded siltstone at the top. This, in turn, is overlain by the main body of the member, consisting of intercalated diamictite and quartzite. It is several thousand feet thick including the intercalated volcanics (see below). Above this thick unit, but still within the Scout Mountain Member are as much as 1200 ft of quartzite and minor argillite, 150 to 350 ft of cobble conglomerate, an additional 100 to 300 ft of quartzite, an upper bed of diamictite, on the order of 100 ft thick, a distinctive 2-ft bed of laminated dolomite, 100 to 800 ft of quartzite with small amounts of argillite, and a 15-ft bed of limestone, designated the top of the member.

The typical diamictite is a massive dark purplish- to greenish-black rock consisting of pebble- to boulder-size clasts in a voluminous fine-grained matrix characterized by angular sand-size grains. The clasts are rounded to angular, up to 3 ft in diameter, and of diverse lithologies, including quartzite, granite, dolomite or limestone, mafic igneous rocks, and argillite. This rock is believed to be partly of glacial origin because of its massive character, the anomalous angularity of the sand-size grains, the abnormally large ratio of fine matrix to clasts, and the presence of large clasts that are faceted or striated. It is also suspected to be of submarine origin because it is interstratified with several thousand feet of quartzite, and with several thin beds of limestone and dolomite presumed to have been of marine origin.

Metavolcanic rocks, herein designated the Bannock Volcanic Member, form a wedge at least 1000 ft thick that interfingers with the diamictites of the Scout Mountain Member. This volcanic unit was first designated the Bannock Volcanic Formation by Anderson (1928, p. 3), who defined it as including all the exposed rocks below his Black Rock Limestone and inferred that it might be Cambrian. It was later restricted by Ludlum (1942, 1943) to exclude most of the sedimentary rocks and was assigned to the Precambrian. Both volcanic flows and breccias are present; the massive rocks show a wide range of porphyritic textures, and include both vesicular and amygdaloidal types. Fragmental textures ranging from coarse volcanic breccia to

[1] Diamictite: A nonsorted sedimentary rock consisting of sand and/or larger particles in a muddy matrix (modified *from* Flint and others, 1960).

tuff can also be recognized readily, although all are fairly typical "greenstones" showing weak schistosity, and consisting largely of albite, chlorite, epidote, and calcite.

Exposures here designated the type section of the Bannock Volcanic Member are located on the west slopes of Chinks Peak in secs. 32 and 33, T. 6 S., R. 35 E., about 4 mi east-southeast of Pocatello (E-F, Fig. 2).

The upper member of the Pocatello Form-

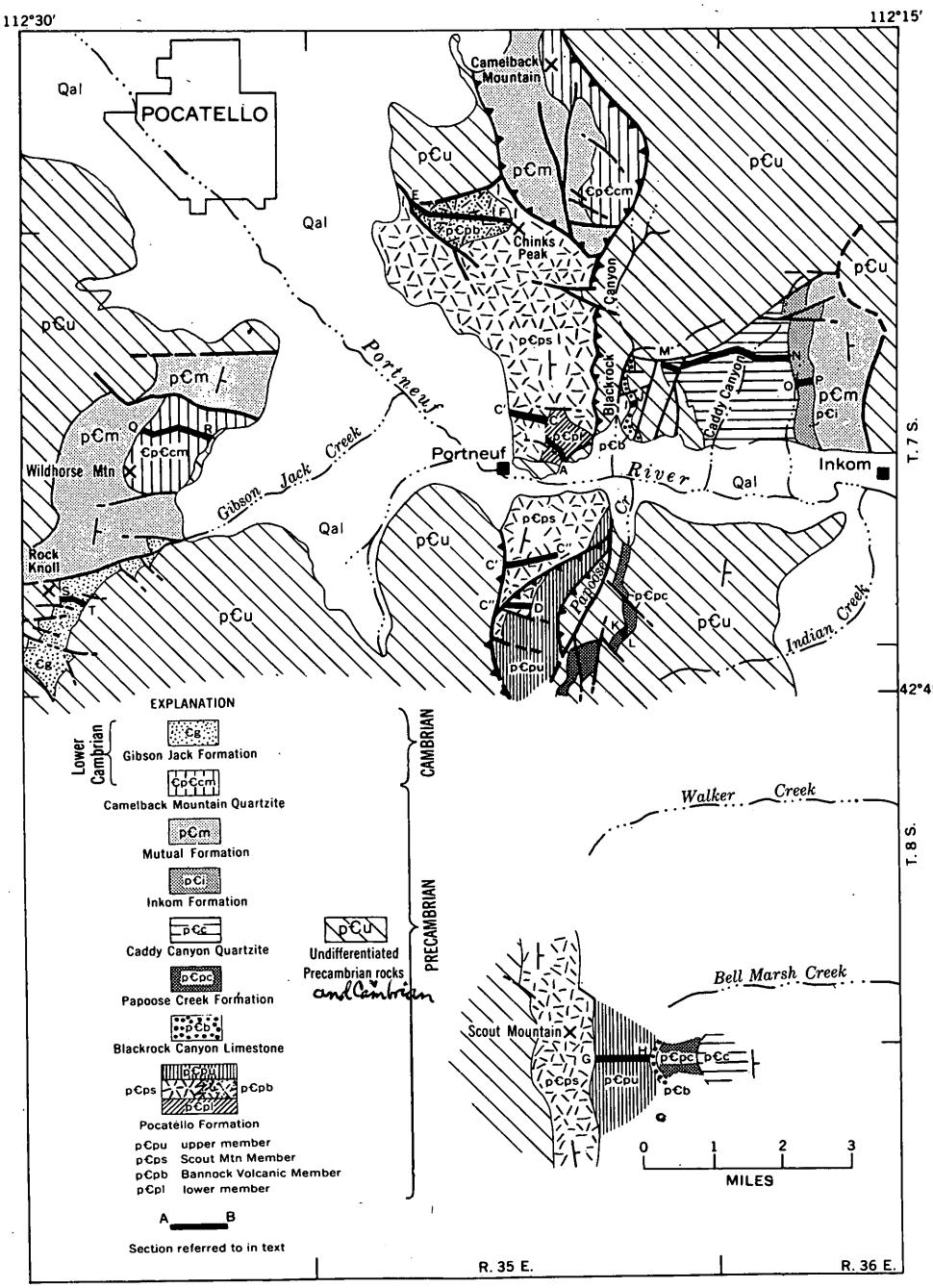

Figure 2. Map of area near Pocatello, Idaho, showing location of type sections for newly described Precambrian and Cambrian units.

tion consists of nearly 2000 ft of black, thinly laminated phyllitic to slaty argillite that contains much interbedded quartzite in the upper half. As thus defined, it corresponds essentially to Ludlum's (1942) "varved slate series." The type section is designated as extending across the top of a narrow saddle about a mile southeast of Scout Mountain in sec. 2, T. 9 S., R. 35 E. (G-H, Fig. 2).

Blackrock Canyon Limestone

The thickest carbonate unit of the Precambrian section in the Pocatello area consists of several hundred feet of fine-grained gray limestone interbedded with quartzite and minor variegated argillite. This limestone unit was originally named the Black Rock Limestone by Anderson (1928, p. 4); it was later designated the Blackrock Limestone by Ludlum (1942, p. 92–93), but is here renamed the Blackrock Canyon Limestone because the name "Blackrock" is preempted. The type section is on the east side of lower Blackrock Canyon in sec. 14, T. 7 S., R. 35 E., about 7.5 mi southeast of Pocatello (I-J, Fig. 2).

Brigham Quartzite of Anderson and Ludlum

The 15,000-ft interval of detrital rocks, consisting mainly of quartzite, between the underlying Blackrock Canyon Limestone and the lowest carbonate rocks of Cambrian age, was assigned to the Brigham Quartzite by both Anderson (1928) and Ludlum (1942). However, the term is not used at Pocatello in this report because this interval is thick and contains several distinctive lithologic units, and because the term has been used in several different ways in adjoining parts of Utah and Idaho (*see* Huntsville area, Utah, this paper). In recent mapping of the Pocatello quadrangle (Trimble, unpub. data), this interval is divided into six new formations; the lower four are believed to be Precambrian, the upper two are presumed to include Cambrian rocks.

Papoose Creek Formation. Overlying the Blackrock Canyon Limestone in the Pocatello area are about 1800 ft of distinctively, irregularly bedded, mottled gray and brown siltite and very fine-grained quartzite, here designated the Papoose Creek Formation. The name is taken from exposures in Papoose Creek, the type locality south of the Portneuf River about 5 mi southeast of Pocatello, Idaho (Fig. 2). The type section (K-L, Fig. 2) is in sec. 35, T. 7 S., R. 35 E., and secs. 2 and 3, T. 8 S., R. 35 E., in the headwaters and just east of the canyon of Papoose Creek where the formation is a little more than 600 ft thick. The Papoose Creek Formation is poorly exposed in most places and must be recognized by float. The beds of siltite or quartzite, commonly 1 to 3 mm thick, form alternating layers of light gray and light to dark brown that are undulating, broken, and slightly offset in many places. This deformation of the bedding is probably penecontemporaneous and characterizes the formation. The lower contact is drawn at the top of the highest carbonate of the underlying Blackrock Canyon Limestone. Locally, the Papoose Creek appears to overlie conformably the Blackrock Canyon Limestone, but great variations in thickness suggest that the contact may be a disconformity. The formation is presumed to be marine.

Caddy Canyon Quartzite. The Papoose Creek Formation is overlain by several thousand feet of vitreous quartzite here named the Caddy Canyon Quartzite. The type section is in Caddy Canyon, north of the Portneuf River in sec. 13, T. 7 S., R. 35 E., and sec. 18, T. 7 S., R. 36 E., about 8 mi southeast of Pocatello (M-N, Fig. 2). The base of the formation is exposed on the west side of a spur west of the mouth of Caddy Canyon in sec. 24, T. 7 S., R. 35 E.; the upper contact is exposed on the ridge east of the canyon in sec. 7, T. 7 S., R. 36 E. The formation is widely exposed as smooth slopes and ledges. The lower part of the Caddy Canyon Quartzite is mostly white- to tan-weathering, light-colored vitreous orthoquartzite that contains some interbedded greenish argillite or siltite. In places, especially in the lowermost part, there are many interbeds, some rather thick, of irregularly bedded, fine-grained quartzite and siltite much like that of the conformably underlying Papoose Creek Formation. The lower contact is placed at the base of the lowermost light-colored quartzite in the transitional sequence between the predominantly silty Papoose Creek Formation and the light-colored orthoquartzite of the Caddy Canyon Quartzite. Somewhat above the middle of the Caddy Canyon, and overlying the light-colored quartzite, there is at many places about 50 ft of dolomite or, less commonly, limestone. Above the dolomite or limestone, the quartzite and argillite beds that constitute

the upper part of the formation commonly are pinkish, purplish, or maroon. In the uppermost few hundred feet of the Caddy Canyon are several interbeds of greenish argillite and siltite.

Inkom Formation. The Caddy Canyon Quartzite is overlain by 800 to 1000 ft (locally as much as 2300 ft) of very fine-grained detrital rocks here named the Inkom Formation. In the Pocatello area these rocks are characteristically greenish, although locally as much as 200 ft of grayish-red or dusty-red argillite is present at the top. The name is taken from the small town of Inkom, Idaho, and the type section is in a small canyon north of the Portneuf River about a mile west. The lower part of the Inkom is mainly greenish phyllite. This grades upward into greenish-gray to light olive-gray argillite or slate, siltite, and very fine-grained quartzite. The unit also contains a few beds of conglomerate or impure micaceous quartzite. The lower contact of the Inkom is placed at the top of the highest quartzite of the Caddy Canyon Quartzite, although some beds of argillite like the Inkom are present below it. The top is placed at the base of massive quartzite ledges of the overlying Mutual Formation and is generally quite sharp.

Mutual Formation. The Inkom Formation is overlain by a massive 3000 ft quartzite unit whose characteristic grayish-red color (5R 4/2)[2] contrasts strongly with that of the underlying greenish argillite. This unit is correlated with the type Mutual Formation southeast of Salt Lake City, Utah (Crittenden and others, 1952) on the basis of its characteristic lithology, color, and position. In the Pocatello area, the quartzites of the Mutual are coarse-grained, pebbly or conglomeratic, and persistently cross-bedded. The color ranges from light grayish-red (5R 5/2) to dark grayish-red (5R 3/2) or purplish-black (5RP 2/1). In addition to quartzite, the unit contains relatively thin but distinctive beds of argillite, one of which is more than 200 ft thick. Most of the argillite is dusky-red to very dark red; locally, it may be olive drab (5Y 5/2) or greenish-gray (5GY 6/1). The basal contact is placed at a conspicuous and abrupt change from argillite to quartzite; in most places greenish-red quartzite overlies the Inkom Formation. The Mutual Formation is present in all of the basin sequences and is the youngest unit that one can be sure is entirely of Precambrian age.

Camelback Mountain Quartzite. The Mutual Formation of the Pocatello area is overlain by as much as 3500 ft of light-colored vitreous orthoquartzite that is lithologically similar to the Cambrian Tintic Quartzite of the Tintic district of Utah and the Prospect Mountain Quartzite (restricted) of the northern part of the Great Basin. This orthoquartzite is here designated the Camelback Mountain Quartzite for exposures on Camelback Mountain east of Pocatello, Idaho (Fig. 2). This section is severely faulted, however, and a section on the east slope of Wild Horse Mountain in secs. 22 and 23, T. 7 S., R. 34 E., about 4.5 mi south-southwest of Pocatello (O-R, Fig. 2) is designated an alternate type section. This formation generally forms smooth slopes. It is composed of thick-bedded to massive, locally cross-bedded, medium-grained vitreous orthoquartzite that weathers white, tan, brown, and brownish-gray. It is mostly white at the base. The Camelback Mountain Quartzite lacks the reddish hues found in older units and contains little argillite or phyllite. The basal contact is conformable and transitional with the underlying Mutual Formation. Locally, the base is marked by a pebble conglomerate, 5 to 15 ft thick, that contains light colored pebbles as much as 1.5 in. in diameter in a pinkish quartzitic matrix. No fossils have been found in the Camelback Mountain Quartzite, but Cambrian fossils occur about 300 ft above the base of the overlying unit. The Camelback Mountain is therefore assigned a Precambrian and Early Cambrian age. It is considered to be of marine origin.

Gibson Jack Formation. The uppermost clastic unit at Pocatello is composed of more than 1000 ft of argillaceous siltstone and shaly argillite with interbeds of quartzite and sandstone that is here named the Gibson Jack Formation. The name is taken from exposures on Gibson Jack Creek south of the Portneuf River about 5 mi south of Pocatello. The type locality is at the head of Gibson Jack Creek in sec. 33, T. 7 S., R. 34 E., about 8 mi south-southwest of Pocatello (S-T,

[2] Numerical designations derived from the Rock Color Chart (Goddard and others, 1948) are given for the Mutual Formation, because color is a distinctive and characterizing feature of this unit. Adjective designations are used throughout the remainder of the report.

Fig. 2). The formation consists of argillaceous siltstone and papery-weathering argillite with minor interbeds of sandstone or quartzite. The lower part is mostly tan, olive, or gray-green; the upper part is mainly pale yellowish-brown. A 100-ft bed of light gray medium-grained quartzite is present about 350 ft above the base and other beds are present near the top. Two or more beds of thin-bedded argillaceous limestone, tens of feet thick, also occur near the top, but they seldom crop out. The basal contact of the Gibson Jack Formation is placed at the base of the first thick siltstone or argillite; although this leaves some argillaceous beds in the underlying Camelback Mountain Quartzite, they are commonly thin.

The upper contact is placed at the base of the first thick limestone or dolomite lithologically equivalent to the Langston or Ute Formations of Walcott (1908b). The only fossil found to date in the Gibson Jack Formation is the Cambrian arthropod *Naroia*, which was found about 300 ft above the base. The only other occurrence of this rare form is in Middle Cambrian rocks in British Columbia (A. R. Palmer, 1968, written commun.), but its actual range is unknown. Therefore, because the Early Cambrian *Olenellus* was reported by Oriel (1965) in beds believed to be equivalent to or slightly higher than the Gibson Jack, this formation is assigned an Early Cambrian age.

HUNTSVILLE AREA, UTAH

General Features

About 13,000 ft of younger Precambrian and basal Cambrian rocks are exposed east and northeast of Huntsville, Utah. This section, which has been divided into seven formational units, should serve as a standard for northwestern Utah as the Pocatello section does for southeastern Idaho.

The existence of a thick section of younger Precambrian rocks near Huntsville was recognized by Blackwelder as early as 1910. Indeed, its presence there and its absence near Ogden, where the basal Cambrian quartzite (Tintic) rests directly on crystalline basement, was the basis for his identification of the Willard thrust. The general character of these rocks and their structural relations were further elaborated by Eardley and Hatch (1940), and Eardley (1944). Although younger Precambrian rocks are present both east and west of Huntsville, the present description will be restricted to the rocks that crop out to the northeast and east (Fig. 3). As a consequence, the lowest units of the more complete section at Pocatello—argillite and the diamictites of the Scout Mountain Member of the Pocatello Formation—are absent from this section. Previous work (Eardley and Hatch, 1940) has shown that diamictites (Fig. 4) are present above the Willard thrust between Willard Peak and Brigham City, and recent mapping by Crittenden indicates that they occur 2000 to 3000 ft below the lowest rocks exposed east of Huntsville, but their exact stratigraphic relations are still being studied.

The sequence of Precambrian and basal Cambrian rocks east of Huntsville will be described briefly, beginning with the oldest and continuing to the base of the carbonate units which here are of Middle Cambrian age. The lowest units are well exposed in the foothills and along the lower reaches of both the South Fork and Middle Fork of the Ogden River east and northeast of Huntsville.

Maple Canyon Formation

The name Maple Canyon Formation is here given to about 1000 to 1500 ft of clastic rocks which are divided into three informal members on the basis of lithology. The name is taken from Maple Canyon about 6 mi east of Huntsville, Utah, and the type locality is near the mouth of the canyon, beginning in the north half of sec. 9, T. 6 N., R. 2 E. (A-B, Fig. 3).

The lowest unit, designated the argillite member, consists of about 500 ft of olive drab to locally gray, thin-bedded, silty argillite or siltstone which contains one or more beds of greenish-gray arkosic sandstone. This unit is exposed at several places along the foothills northwest from Maple Canyon, and in each place it is the lowest unit of Precambrian rocks exposed on this side of the valley. Although the rocks in the Huntsville area as a whole are little metamorphosed, this unit is typically phyllitic and commonly shows small-scale crenulations and folds usually at an angle to the bedding (Fig. 5); locally these rocks show well-defined schistosity.

The middle member of the Maple Canyon Formation is informally designated the green arkose member. It consists of 500 to 1000 ft of relatively thick-bedded, massive, very fine-

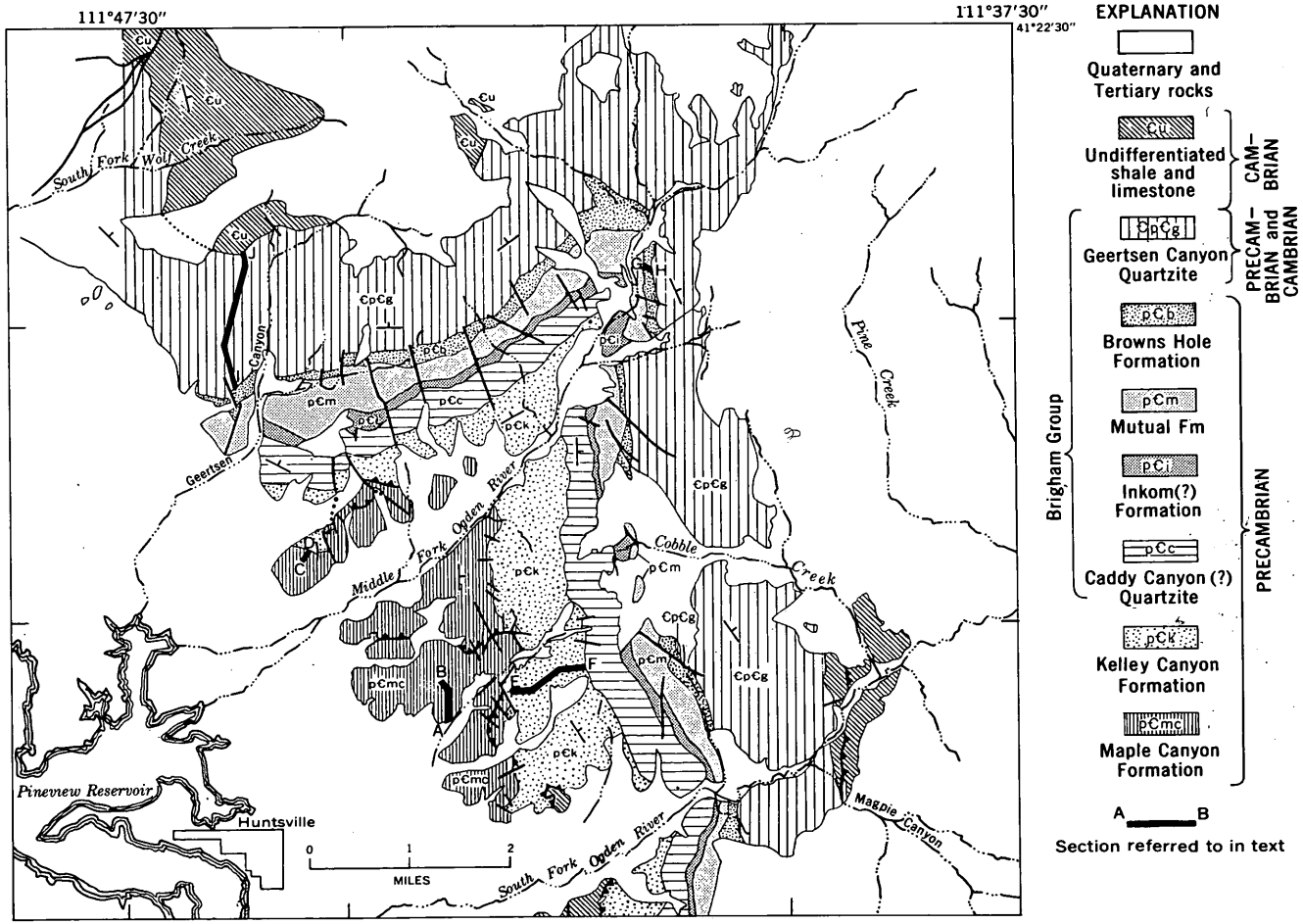

Figure 3. Map of area near Huntsville, Utah, showing location of type sections for newly described Precambrian and Cambrian units.

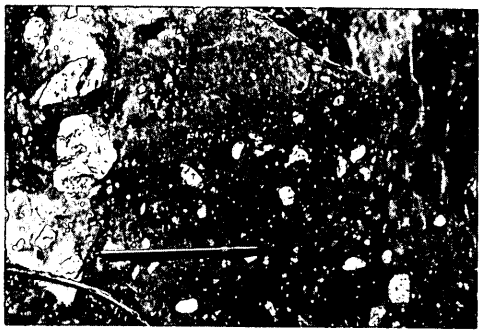

Figure 4. Diamictite consisting of subrounded to subangular clasts of quartzite, granitic rocks, and carbonates in a black fine-grained matrix. Exposures are in Willard thrust sheet north of Willard Peak, Utah.

grained arkosic sandstone. On fresh fractures, this rock is a very pale greenish-gray, but this color is commonly obscured by weathering and, at a distance, the unit forms rounded ledges that are dark gray or brown. Individual beds range from 1 to 2.5 ft in thickness and are separated by thin partings of siltstone or thin-bedded argillite. The more massive beds are distinguished from quartzites in other parts of the section by their remarkably perfect sorting, and by the abundance of K-feldspar, which makes up as much as 40 percent of some stained slabs. As a result of the feldspar content, this unit tends to be less quartzitic in character than other parts of the section. The feldspar content is variable, however, with some areas containing lenticular bodies of well-cemented vitreous and pebbly quartzite as much as 200 ft thick.

Figure 5. Argillite member of Maple Canyon Formation near Huntsville, Utah. Crenulated bedding is nearly vertical, parallel to pen; schistosity dips 30° to left.

The uppermost member of the Maple Canyon Formation is designated the conglomerate member. It consists of two conglomerates or, locally, quartzites and an intervening argillite. The member as a whole ranges from 60 to 500 ft in thickness but in the type area immediately north of Maple Canyon, averages about 200 ft. Much better exposures are present on the top of a rounded hill just north of the mouth of the middle fork of Ogden River (C-D, Fig. 3) and this is designated a reference section for this member. The lowermost conglomerate consists of 50 to 200 ft of white to light gray, conglomeratic quartzite. Clasts range from pebble to small cobble in size and consist mainly of white quartz, or white, gray to pale pink quartzite. Pale green quartzite containing chromian mica (x-ray fluorescence) is a sparse but significant constituent. These distinctive clasts closely resemble the green quartzites near Park Valley in the Raft River Range of Utah (Felix, 1956). Similar clasts are present also in the tillites of Antelope Island and in the Dutch Peak Tillite of Cohenour (1959) in the Sheeprock Mountains of Utah.

The two conglomerates are separated by 10 to 100 ft of olive drab laminated argillite. This unit is not well exposed and commonly must be mapped by its silver-gray-weathering flakes in the soil. The upper part of the conglomerate member commonly consists of a white, coarse-grained rock that ranges from quartzite to conglomerate. In places it is only 50 ft thick and consists entirely of pebble to small cobble conglomerate; in other places it is as much as 200 ft thick and consists almost entirely of quartzite with only a few pebbles at the base. In a few places the matrix, instead of being light colored vitreous quartzite, grades into a dark gray, tan-weathering, friable, impure sandstone or graywacke whose anomalous appearance is vaguely reminiscent of a diamictite. This leads to the suspicion that this clastic member may be correlative with the uppermost thin unit of diamictite in the Scout Mountain Member of the Pocatello Formation, which occupies a corresponding position immediately below laminated dolomites at Pocatello (Fig. 6).

Kelley Canyon Formation

The conglomerate member of the Maple Canyon Formation is overlain by a domi-

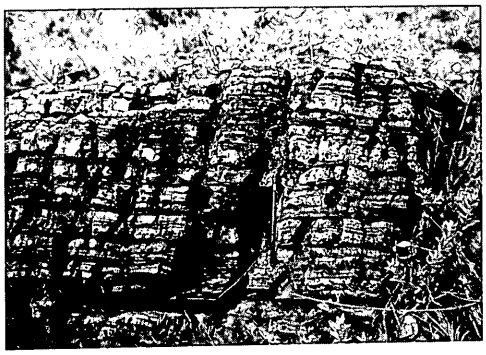

Figure 6. Tan-weathering laminated dolomite at base of Kelley Canyon Formation, near Huntsville, Utah.

nantly argillaceous unit to which the new name Kelley Canyon Formation is here given. The type section is located in the head of Kelley Canyon (E-F, Fig. 3) in the south half of sec. 3, T. 6 N., R. 2 E., about 3.5 mi east of Huntsville. Although argillaceous rocks predominate, the unit contains much interbedded quartzite in the upper portion and grades into the overlying quartzite. The formation is distinctive in that it contains the only limestones and dolomites known within the Precambrian rocks in this area.

The Kelley Canyon Formation begins at the base with a persistent 10-ft bed of thinly laminated, tan-weathering, fine-grained dolomite. The laminae are commonly about 1 mm thick but tend to be cyclic, giving the appearance of bedding 1 to 2 cm thick. Locally, individual laminae consist of chert, giving the rock a distinctive ribbed appearance (Fig. 6). Although the unit is poorly exposed in general, its presence can usually be verified by large and persistent dolomite blocks in the float. The dolomite is overlain by lavender-gray, purplish-gray or olive drab shale and siltstone locally containing thin beds of greenish fine-grained sandstone. Like the argillite at the base of the Maple Canyon Formation, these units are commonly phyllitic.

The middle part of the formation consists of gray to lavender-gray argillite enclosing several lenticular bodies of thin-bedded pinkish-gray silty limestone. The gray color, absence of laminae, and intercalations with shale distinguish these carbonate units from the dolomite at the base of the unit. Although they are not persistent enough to map everywhere, these limestones occur at the same horizon as the Blackrock Canyon Limestone of the Pocatello area, and it is possible that they represent the distal end of a tongue of this formation.

Above the thin-bedded limestones, the argillites of the Kelley Canyon Formation are largely olive drab- or tan-weathering and contain increasing amounts of thin- to medium-bedded quartzite. The top of the formation is poorly defined and cannot always be identified with certainty. In many places, however, it is marked by a zone of very thin-bedded white quartzite (.25 to .75 in. in thickness) with intervening wavy laminae of red-weathering shale and silt.

Brigham Group

History and definition—The term Brigham Formation was first applied by Walcott (1908a, 1908b), to a 2000-ft thickness of massive quartzites and sandstones in the Wasatch Range immediately east of Brigham City, Utah. Unfortunately, he did not give a precise locality or measured section, nor show the unit on a map. More importantly, for problems of the Precambrian, the base was completely undefined. As a consequence, two strongly contrasting usages of the term Brigham have evolved. Most authors working in southern Idaho (for example, Mansfield, 1920, 1927, 1929; Anderson, 1928; Ludlum, 1942, 1943; and Bright, 1960), have used the term Brigham in an inclusive sense for the entire sequence of dominantly quartzitic rocks below the Cambrian carbonates. Another group, working mainly in northern Utah (for example, Eardley and Hatch, 1940; Lochman-Balk, 1955; Williams, 1958; and Stokes, 1963), used the term in a restricted sense for only the uppermost 2000 to 5000 ft of light colored quartzites that were presumed to be Cambrian.

As a result of these persistent conflicts, the term "Brigham" is here raised to group rank, and this term is recommended for use wherever the units here defined or others of formational rank can be recognized. In areas where exposures are inadequate or structural complications are too severe to permit subdivision, the term Brigham Quartzite can be used in an inclusive sense for rocks within the same stratigraphic limits defined below for the Brigham Group. Thus far, these formational units have been recognized by

Trimble near Pocatello, by Schaeffer in much of Bannock County, Idaho, and by Crittenden near Huntsville, Utah. Reconnaissance suggests that at least some of the lithologies characteristic of these units can be distinguished in intervening areas also, as near Preston, Idaho (Bright, 1960). Detailed study of such areas will be required to determine which of the formational units described here are present.

In the Huntsville area, the Brigham Group is here defined as comprising approximately 7000 ft of beds, largely quartzite, in the interval between the top of the Kelley Canyon Formation and the base of the lowest carbonatic or pelitic rocks of Cambrian age. It thus includes the Caddy Canyon(?) Quartzite, Inkom(?), Mutual, and Browns Hole Formations and Geertsen Canyon Quartzite. Two of these units (Caddy Canyon and Inkom) are named elsewhere in this report for rocks in the Pocatello area; the Mutual Formation was described in the Cottonwood area near Salt Lake City (Crittenden and others, 1952); the remaining two units are defined below for the first time.

The best exposed and least faulted section of the Brigham Group in northeastern Utah is on the north wall of the Middle Fork of Ogden River, beginning at the base of the Caddy Canyon(?) Quartzite near the southeast corner of sec. 21, T. 7 N., R. 2 E., and extending northwest to the base of Cambrian limestones exposed near the head of Geertsen Canyon in section 18. This stratigraphic section is here designated the principal reference section for the Brigham Group. Redefinition of the Brigham in terms of this reference section is necessary because reconnaissance mapping at Walcott's presumed type locality along U.S. Highway 89–91, 2 mi east of Brigham City, has shown that the lower 5000 ft of the Brigham Group, as here defined, is cut out by a north-striking fault which places beds near the base of the Geertsen Canyon Quartzite in fault contact with beds near the top of the Kelley Canyon Formation. The newly designated reference section is about 18 mi southeast along the regional strike from the type locality, but the units have already been mapped at 1:24,000 scale over some 12 mi of the intervening distance. Although many normal faults are present in the area between the two sections, there appear to be no significant thrust faults.

Caddy Canyon(?) Quartzite

The lowest formation of the Brigham Group in the Huntsville area is a brown- to tan-weathering, impure quartzite tentatively correlated with the Caddy Canyon Quartzite of the Pocatello area. The lower contact is gradational, the slope-forming argillites of the underlying Kelley Canyon Formation giving way upward through an interval of a few tens of feet, or locally as much as 100 to 200 ft, to cliff-forming quartzite ledges. Near the base, argillite and thin-bedded fine-grained quartzite make up nearly half of the formation; near the top, however, argillaceous rocks are limited to partings a few inches to a few feet thick. Similarly, quartzite ledges near the base are impure and weather to shades of brown, whereas those near the top are increasingly pure, form steep cliffs, and weather light gray or tan. The upper contact is very sharp, and generally is marked by a topographic bench exposing gently wavy bedding surfaces, from which the overlying less resistant shale has been stripped. The Caddy Canyon(?) Quartzite thickens systematically from about 1500 ft in the South Fork of Ogden River to 2500 ft in the area north of Huntsville.

Inkom(?) Formation

Above the massive cliff-forming quartzites is a bench- or slope-forming argillite unit 360 to 450 ft thick. The upper half is dominantly grayish-red; the lower half is olive drab to light green. This unit is tentatively correlated with the Inkom Formation of the Pocatello area on the basis of stratigraphic position and general character. Although the Inkom at its type area is thicker and is dominantly green, the lithology is essentially identical, and the larger proportion of grayish-red rocks here is thought to represent a decrease in the reducing capacity of the environment, suggesting that perhaps the Huntsville section was deposited in shallower water.

Mutual Formation

One of the most distinctive units in the Precambrian rocks of northern Utah is the strikingly colored grayish-red quartzite which can be recognized widely from the Beaver Mountains, Utah, on the south, to Pocatello, Idaho, on the north. This unit was desig-

nated the Mutual Formation by Crittenden and others (1952) in the Cottonwood area near Salt Lake City. It consists dominantly of grayish-red to pale purplish or pale pink coarse-grained, locally pebbly or feldspathic quartzite with abundant cross-bedding. In this area, as in the type locality, it contains local lenticular interbeds of argillite, most of which are the same distinctive grayish-red or pale purplish-red as the surrounding quartzite. Mapping northwest of Huntsville has shown that this unit is intercalated locally with both basalt and rhyolitic tuff.

Browns Hole Formation

The unit here designated by the new name Browns Hole Formation consists of two lithologically distinctive members, a lower member characterized by volcanics and an upper member of terra cotta quartzite. The type section is along the middle fork of Ogden River on slopes northwest of Browns Hole, near the center of sec. 14, T. 7 N., R. 2 E., Browns Hole quadrangle (G-H, Fig. 3). Still better exposures are present high on the north slopes of the middle fork extending along strike about 2 mi southwestward from the northeast corner of section 10 into Geertsen Canyon. This formation has no lithologic counterpart at Pocatello or in the Beaver Mountains.

The volcanic member is a slope-forming unit 182 to 460 ft thick. Although characterized by volcanics, it also includes fine-grained sediments ranging from shale to thin-bedded quartzite. The volcanics observed in greatest abundance are basalt, either gray, massive, and fine-grained, or vesicular and amygdaloidal. In places, black to red scoriaceous rocks of boulder size weather out from the finer matrix. Locally, volcanic fragments show a wide range in composition, and include porphyritic types with stony or vitrophyric-appearing groundmass. Both the massive and fragmental rocks are reworked along strike as rounded cobbles and boulders which diminish in abundance southward and finally give way in the South Fork of the Ogden River to a zone of brown thin-bedded quartzite and argillite containing only traces of volcanic material.

The upper member of the Browns Hole Formation throughout the Huntsville area is a distinctive terra cotta colored, medium- to fine-grained quartzite 100 to 150 ft thick. It is distinguished by its uniformity of grain size, the presence of well rounded, locally frosted grains, and widespread small- to large-scale cross-bedding. Locally, the weathered unit is friable and strongly resembles the Jurassic Nugget Sandstone of the Wasatch Mountains near Salt Lake City. The presence of frosted grains suggests an eolian environment, but bedding features indicate that final deposition may have taken place in shallow water.

The range of Rb/Sr ratios in the basalt is too small to permit adequate whole-rock dating, even though the rocks are remarkably fresh in many places. It is hoped that a combination of this basalt and the rhyolitic tuff discovered recently in the underlying Mutual Formation may provide the necessary range in composition. The age of this unit, like that of all of those below, is presumed to be Precambrian.

Geertsen Canyon Quartzite

The basalt and quartzite of the Browns Hole Formation are overlain with apparent conformity by a very thick, light colored conglomeratic quartzite unit that is here given the new name Geertsen Canyon Quartzite. Rocks with this lithology underlie fossiliferous Cambrian shale or carbonates throughout the intermountain region of western Utah and much of eastern Nevada. In each area, however, a different name has been applied: in Nevada and western Utah they are generally called the Prospect Mountain Quartzite; in central Utah they are commonly referred to as the Tintic Quartzite; in much of northern Utah and southern Idaho, including the Huntsville area, these rocks have been referred to as the Brigham Quartzite. However, because of the conflicting and more inclusive use of the term "Brigham" in much of northeastern Utah and southeastern Idaho, the formation is here given a new name.

The type section of the Geertsen Canyon Quartzite is on the ridge west of Geertsen Canyon, 5 mi north of Huntsville in sections 18 and 19, of T. 7 N., R. 2 E. (I-J, Fig. 3). In this area the formation rests with apparent conformity on the terra cotta quartzite member of the Browns Hole Formation and is overlain with apparent conformity by brown-weathering dolomite of the Langston Dolomite. The total thickness in this area is ap-

proximately 4200 ft, divided into a lower member about 1200 ft thick that is dominantly arkosic, and an upper member about 3000 ft thick that is dominantly quartzitic. The two are separated by a persistent zone of conglomerate lenses.

The lower member of the Geertsen Canyon Quartzite has at the base 300 to 400 ft of very coarse-grained arkose containing fragments of salmon-colored microcline and pale greenish-weathered plagioclase up to a half inch in size; both the grain size and feldspar content diminish upward, however, and the remaining 800 ft or so of this member is white- or tan-weathering quartzite.

The contact between the lower and upper members of the Geertsen Canyon is drawn at a persistent zone of cobble conglomerates. Where best developed, the conglomerate occurs as a single bed 8 to 10 ft thick of 2- to 4-in. clasts mainly of reddish-coated vein quartz or quartzite, occasionally of gray quartzite or red jasper. In many areas, however, conglomerate beds a few feet thick are found throughout a stratigraphic interval 100 to 200 ft thick. The upper member of the Geertsen Canyon Quartzite is typical of basal Cambrian quartzites throughout the intermountain area. It consists predominantly of pale buff to white or pale-pink quartzite locally streaked pale red or pale purple. In general, it is coarse grained with scattered pebbles up to an inch in diameter, particularly along bedding planes, throughout the unit. Locally, at the top of this member is an interval about 375 ft thick in which the quartzites are marked by persistent *Scolithus* and in which the interbedded argillites show abundant fucoidal structures, occasional trilobite tracks, and sparse unidentifiable phosphatic fragments. It seems probable, although not yet demonstrable, that this part of the unit is equivalent to rocks in the Portneuf Range called the "quartzite of Sedgewick Peak" by Oriel (1965), which have yielded an olenellid trilobite, and hence are of Early Cambrian age.

In terms of general position and lithology, the Geertsen Canyon Quartzite is presumed to correlate approximately with the Camelback Mountain Quartzite of Pocatello and with the Prospect Mountain Quartzite (restricted) of the Beaver Mountains. It is assigned a Precambrian and Early(?) Cambrian age.

BEAVER MOUNTAINS, UTAH

About 9000 ft of younger Precambrian and lowermost Cambrian strata are present in the Beaver Mountains (Fig. 1). The uppermost formation is the Prospect Mountain Quartzite (restricted, *of* Woodward, 1968) which generally has been considered to be Lower Cambrian; however, the Precambrian-Cambrian boundary within the Beaver Mountains cannot be located precisely (Woodward, 1968).

Beneath the Prospect Mountain Quartzite (restricted) are seven units, tentatively considered Precambrian; these have been informally numbered 1 through 7, beginning with the oldest. This concordant section is correlated with the younger Precambrian and Cambrian sections near Pocatello and Huntsville on the basis of remarkable lithologic similarities in both individual units and in the over-all sequence (Fig. 7). The following brief descriptions begin at the base; more complete descriptions are given by Woodward (1967).

Unit 1 consists of medium- to coarse-grained, thick-bedded, light gray, cross-bedded quartzite. Although the base of the unit is not exposed, 970 ft were measured. This unit appears to be correlative with the upper part of the upper member of the Pocatello Formation.

Overlying this quartzite unit is about 1300 ft of interbedded quartzite, slate, argillite and marble of unit 2. The lower 500 ft consists of thin-bedded gray quartzite with intercalated red and green slate laminae and thin-bedded quartzose marble. A thin zone of intraformational edge-wise quartzite conglomerate occurs near the top of this sequence. Overlying it is a 25-ft cliff formed by very thick-bedded quartzose calcite marble. Above the cliff-making marble, the unit consists of thinly interbedded tan, olive-green, and greenish-gray slate, argillite, and quartzite with minor quartzose marble that decreases in abundance upward. The marble beds, mostly occurring in the lower part of the unit, probably represent tongues of the Blackrock Canyon Limestone of the Pocatello area. The upper part of unit 2 may be correlative with the Papoose Creek Formation.

Unit 3 consists of 260 ft of quartzite with minor green slate near the top. The lower part of the unit is thick-bedded, medium- to

coarse-grained, whitish and light gray quartzite. About 50 ft below the top of the unit there is an abrupt upward change from light gray quartzite to dark brown quartzite containing subrounded white quartz pebbles up to 2 cm in diameter. The top of the unit is formed by a 15-ft green slate interval and 10 ft of overlying very thick-bedded, medium- to coarse-grained, dark gray quartzite. This unit appears to be lithologically correlative with the much thicker Caddy Canyon Quartzite of the Pocatello region.

Unit 4 consists of 530 ft of olive-green slate and argillite with minor thinly intercalated fine- to medium-grained green quartzite. The quartzite is impure, containing abundant chlorite and sericite matrix. This greenish unit is the lithologic equivalent of the Inkom Formation of the Pocatello area.

Units 5, 6, and 7 of the Beaver Mountains appear to be lithologically correlative with the rocks assigned to the Mutual Formation in the Pocatello and Huntsville areas. Unit 5 contains 760 ft of thick-bedded, reddish-brown, medium-grained to conglomeratic quartzite. Well-rounded white quartz pebbles up to 3 cm in diameter occur sparsely in the lower beds and become more abundant near the top of the unit, forming thin conglomeratic layers. Unit 6 consists of approximately 150 ft of interbedded maroon slate, argillite, and thick-bedded, coarse-grained to gritty quartzite. A composite section of unit 7 measures 1175 ft and is composed of purple conglomeratic quartzite with minor purple and silver slate and argillite laminae. The quartzite is medium- to very coarse-grained and contains abundant but thin gritty and conglomeratic zones with pebbles of white and clear quartz or, rarely, jasper up to 1 cm in diameter. Beds are thin near the base of this unit but become thicker upward.

The purple quartzite of unit 7 is overlain with a concordant but sharp contact by pinkish and tan quartzite characteristic of the Prospect Mountain Quartzite (restricted). This unit consists of thick to very thick-bedded, coarse-grained to conglomeratic quartzite; the lowest beds are poorly sorted and gritty, becoming conglomeratic about 20 ft above the base of the formation. This conglomeratic zone is 20 ft thick and contains pink and tan subrounded quartz pebbles up to 2 cm in diameter. In the succeeding 200 ft, pebble-size clasts are scattered, only locally becoming abundant enough to form thin conglomerate layers. Still higher, pebbles are scarce and the rock is more uniformly coarse grained or gritty. Pink feldspar clasts, principally microcline, are common in the lower part of the formation and constitute up to 10 percent of some specimens. The thickness of the Prospect Mountain Quartzite (restricted) cannot be measured precisely because of faults in the section, but it appears to be at least 4000 ft thick.

OTHER AREAS IN UTAH

Dugway Range

A 12,000-ft sequence of younger Precambrian and basal Cambrian rocks in the Dugway Range, Utah, described by Staatz and Carr (1964), contains rocks equivalent to a large part of the sections previously described at Pocatello, Huntsville, and the Beaver Mountains. Although Staatz and Carr assigned these rocks to the Prospect Mountain Quartzite, which they designated Lower Cambrian, they pointed out (1964, p. 16) that the lower part was probably of Precambrian age. The close lithologic similarity between the rocks in the Dugway Range and those of Pocatello were pointed out to Trimble by W. J. Carr and later confirmed in the field.

The oldest units exposed in the section at Dugway (Fig. 8) are dominantly light colored to pinkish-tan, rusty weathering quartzite interbedded with considerable olive-drab or tan micaceous shale (units 1 through 6 *of* Staatz and Carr, 1964). Except for the presence of a 150-ft pebbly conglomerate (unit 6), this section bears a considerable resemblance to parts of the Caddy Canyon Quartzite of the Pocatello and Huntsville areas and perhaps part of the underlying Kelley Canyon Formation of Huntsville. The succeeding unit at Dugway (unit 7 *of* Staatz and Carr) consists of 600 ft of olive-tan, thinly laminated shale and siltstone which is virtually indistinguishable from the greenish Inkom Formation at Pocatello. This unit in turn is overlain by 1600 ft of coarse-grained "violet" to grayish-red conglomeratic quartzite that resembles in both character and position the Mutual Formation of all three of the areas previously described. The Mutual equivalents at Dugway are overlain by approximately 4500 ft of white or tan quartzite (unit 8 *of* Staatz and Carr, 1964) that appears to be correlative with the Camelback Mountain Quartzite of the Pocatello area, the Geertsen

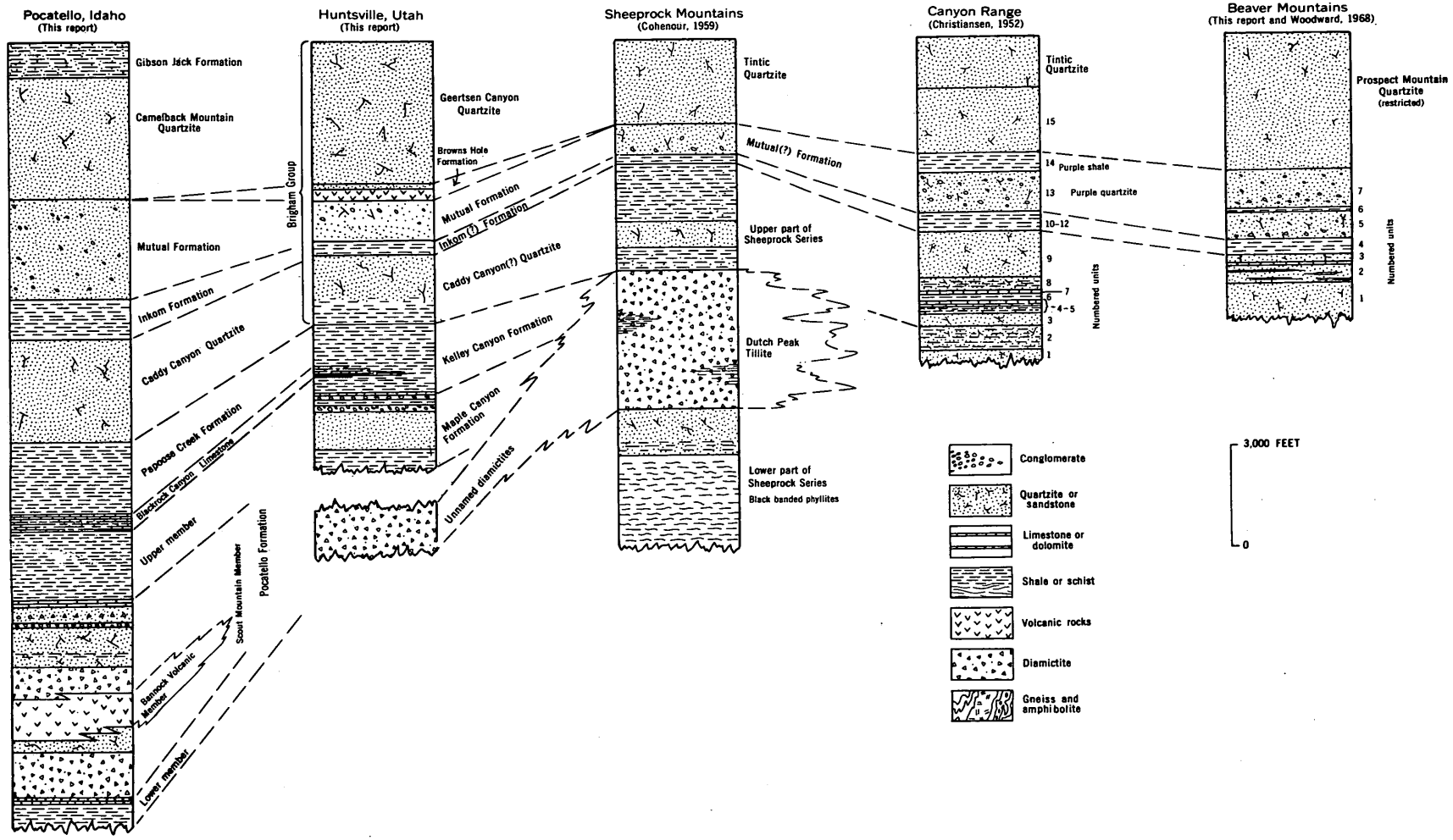

Figure 7. North-south correlation of younger Precambrian and basal Cambrian rocks from Pocatello, Idaho, to Beaver Mountains, Utah.

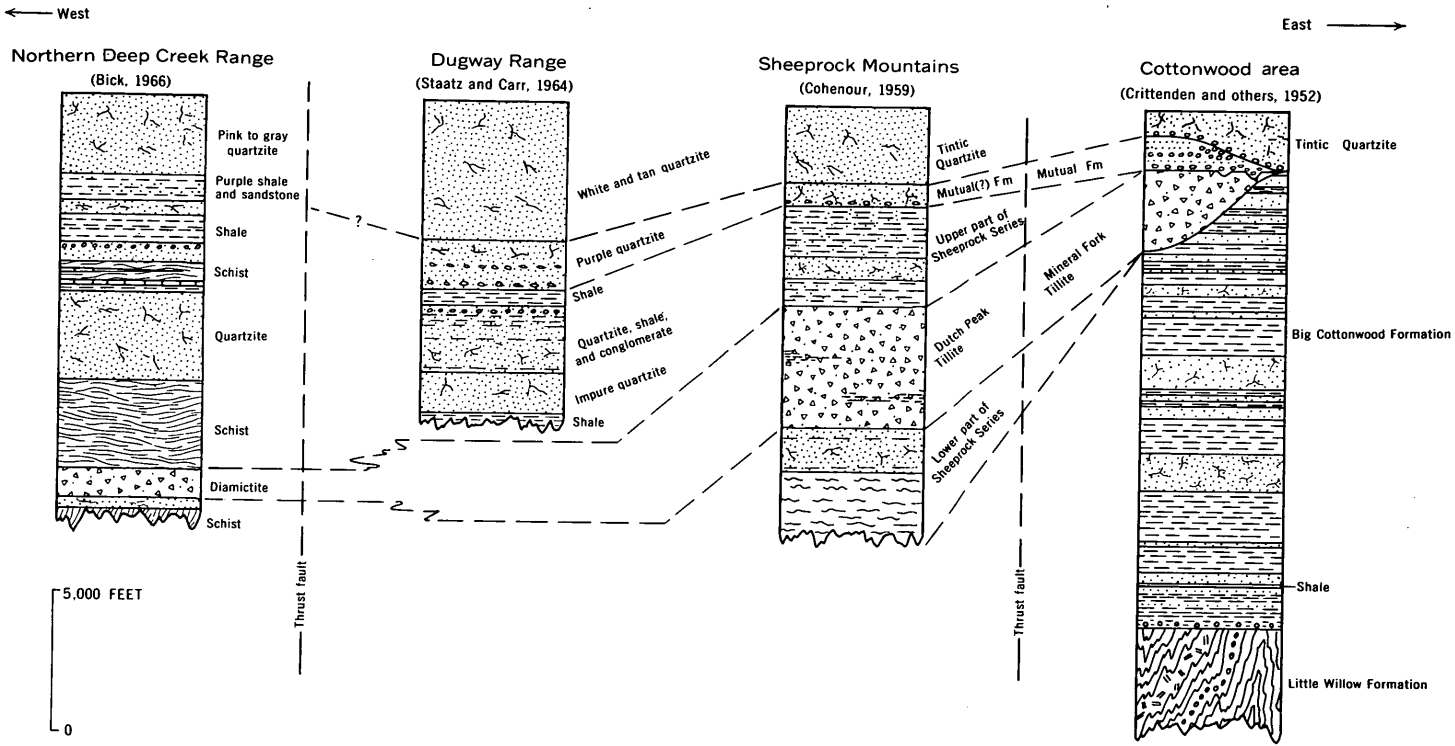

Figure 8. East-west correlation of younger Precambrian and basal Cambrian rocks in western Utah.

Canyon Quartzite of Huntsville, and the Prospect Mountain Quartzite (restricted) in the Beaver Mountains.

Sheeprock Mountains

A 15,000-ft section of younger Precambrian and basal Cambrian rocks described by Cohenour (1959) in the Sheeprock Mountains of central Utah also contains lithologic equivalents of the rocks recognized at Pocatello and Huntsville (Fig. 7). The lower part of the section, designated the Sheeprock Group by Harris (1958, p. 6) and the Sheeprock Series by Cohenour (1959, p. 17), contains a lower "black-banded phyllite" 2690 ft thick that together with about 1470 ft of dark slate, conglomerate, and graywacke, probably is correlative with the lower member of the Pocatello Formation. This is overlain by a diamictite unit, called the Dutch Peak Tillite by Cohenour (1959, p. 19), which correlates in both character and stratigraphic relations with the diamictite-bearing Scout Mountain Member of the Pocatello Formation. More recent mapping in the southern Sheeprock Mountains by H. T. Morris and R. W. Kopf (1968, oral commun.) indicates that diamictites in that area intertongue with normal marine sedimentary rocks as they do at Pocatello. Above the Dutch Peak Tillite is the upper part of the Sheeprock Series, which consists of olive-green or tan shale and a white quartzite. These suggest the lithology of the upper member of the Pocatello Formation and the Papoose Creek Formation at Pocatello and of the Kelley Canyon Formation at Huntsville, although the limestone tongues are apparently absent. The Mutual Formation in the Sheeprock Mountains is thin (900 ft) compared with other trough sections, but this may be local, inasmuch as Groff (1959, p. 25) reports a 3000-ft section on the slopes of Sabie Mountain immediately to the east. A small angular discordance reported by Cohenour at the base of the Mutual shows that the effects of epeirogenic movements that strongly modified the section in the shelf areas to the east (Fig. 8) also were effective locally within the basin. A 2500-ft section of white, pale gray, or tan quartzite, called Tintic Quartzite by Cohenour (1959), appears to be correlative with the Camelback Mountain Quartzite of Pocatello and the Geertsen Canyon Quartzite of Huntsville. As in other parts of the trough (Fig. 7), there is no evidence of a stratigraphic break between the Mutual and Tintic, and sedimentation appears to have been nearly continuous from Precambrian to Cambrian time.

Canyon Range

A 9900-ft section of younger Precambrian rocks described by Christiansen (1952) in the Canyon Range (Fig. 1) also exhibits the same sequence and many of the same units recognized to the north and south (Fig. 7). At the base, Christiansen's units 1 through 3 occupy the stratigraphic position of the upper member of the Pocatello Formation in Idaho; units 4 and 5 may represent a distal tongue of the Blackrock Canyon Limestone of Pocatello and equivalents at Huntsville inasmuch as they resemble it in both character and position. Units 9, 10 through 12, and 13 are correlated, respectively, with the Caddy Canyon Quartzite, Inkom Formation, and Mutual Formation, recognized in the Pocatello, Huntsville, and Beaver sections. Christiansen's unit 15 and the conformably overlying quartzite, which he referred to as the Tintic Quartzite, are the equivalents of the Camelback Mountain Quartzite and Geertsen Canyon Quartzite of southern Idaho and Huntsville, and the Prospect Mountain Quartzite of the Beaver Mountains and probably contain the same continuous record of deposition from Precambrian to Cambrian time.

Antelope Island

The thin but highly significant sequence of younger Precambrian rocks on Antelope Island (Fig. 1) near the eastern edge of Great Salt Lake was described by Eardley and Hatch in 1940. The crystalline basement is overlain by a few tens of feet of diamictite, a thin shale, and a laminated limestone that closely resembles the laminated dolomite immediately above the diamictite in the Pocatello section. This is overlain unconformably by a thick cobble and pebble conglomerate that is typical in every respect of the basal Cambrian throughout all of northern Utah. This unit has been examined repeatedly by one of the authors (Crittenden) and also by R. J. Roberts, H. T. Morris and E. W. Tooker, who agree that Eardley and Hatch's original identification as Tintic Quartzite was correct, and that Larsen's (1957) correlation with the

Mutual Formation (shown also on the Geologic Map of northwestern Utah; *see* Stokes, 1963), is in error.

CORRELATION WITHIN SEDIMENTARY BASIN

The remarkable similarity of both individual stratigraphic units and of rock sequences in a north-south direction is evident from the preceding descriptions. Correlation in this direction (Fig. 7), therefore, presents few problems. The key horizons are: (1) the distinctive and persistent purple to grayish-red quartzite of the Mutual Formation, which characteristically overlies greenish pelitic rocks of the Inkom Formation; (2) the impure silty carbonates of the Blackrock Canyon Limestone, thin equivalents of which reappear at Huntsville, in the Beaver Mountains, and the Canyon Range; (3) a few feet of tan-weathering laminated dolomite that occurs with remarkable persistence just above a thin conglomerate at both Pocatello and Huntsville; and (4) the lithologically distinct and genetically significant diamictites.

The unique character and the probable glacial origin of the diamictites in Utah was recognized near the turn of the century by Blackwelder (1910) and Hintze (1913). These are black boulder-bearing beds containing several unusual lithologies. The most distinctive is a massive rock (Fig. 4) consisting of clasts ranging from boulder to small pebble size in a muddy matrix. It is remarkable for its persistent black color (resulting from an abundance of both carbon and pyrite), faceted and striated cobble-size clasts, anomalously angular character of sand-size fragments, and absence of bedding through many tens of feet. A second characteristic rock is boulder phyllite in which boulder- to cobble-size clasts are spaced at intervals of a few feet to a few hundred feet (one or two per outcrop) in thin-bedded black (carbonaceous) mudstones which have been sheared to phyllite. A third characteristic lithology is medium-bedded, coarse-grained, greenish-gray arkosic quartzite or graywacke. These rocks occur through about 5000 ft of section at Pocatello, are present along strike below the sequence at Huntsville, and intertongue through 4000 ft of beds in the Sheeprock area (Cohenour, 1959). These relations suggest deposition in a subsiding marine trough by glacial tongues, which in some areas dumped till directly, in others yielded ice-rafted clasts, and in many other areas yielded only the reworked or redistributed products of a complex depositional process like that described by Frakes and Crowell (1969, p. 1027–1029) for Paleozoic glaciation in South America.

East-west correlation (Fig. 8) across the assumed trend of the depositional basin can be established with confidence only as far west as the Dugway Range. Farther west, correlation with sections in easternmost Nevada and along the Utah-Nevada line (northern Deep Creek Range, Schell Creek Range, Pilot Range; Fig. 1) have been suggested by Woodward (1968), but variation within individual sections, together with a lack of key beds, makes these correlations much more tenuous than those within the basin.

Correlation eastward from the basin sections of Pocatello and Huntsville to the Cottonwood area, which appears to represent a shelf environment, can be established with considerable confidence (Fig. 8). The basal Cambrian quartzites are identical lithologically but thin from some 4000 ft in the axis of the trough to less than 1000 ft on the shelf. Moreover, the Tintic Quartzite in both the Cottonwood areas and in the autochthon near Ogden appears to represent only the upper member of the Geertsen Canyon Quartzite at Huntsville; the lower member is cut out along the low-angle unconformity. Locally, in the Cottonwood area, the entire Mutual Formation also has been cut out by this unconformity, and the Tintic Quartzite rests directly on the diamictite-bearing rocks, there designated the Mineral Fork Tillite (Crittenden and others, 1952).

A second angular unconformity is locally present in the shelf section at the base of the Mutual Formation. As a result, coarse boulder conglomerate at the base of the Mutual rests directly on the Mineral Fork Tillite—the equivalent of the lower part of the thick basin sequence at Pocatello. The thickness of beds cut out by this unconformity amounts to nearly 10,000 ft.

REGIONAL CORRELATION AND AGE

All of the rocks here described lie within the Big Cottonwood subprovince of younger Precambrian rocks as defined by Condie (1969). However, without detailed mapping

and stratigraphic studies of the kind here reported, correlation both within that subprovince and with adjoining provinces was considered tenuous (Condie, 1969, p. 83 and 86).

Recognizing the unique lithologic character of the diamictites, whether or not they are of glacial origin, it is now possible to subdivide the major younger Precambrian sequences of western North America, even though strict temporal equivalence cannot be demonstrated. Thick prediamictite sequences which may be in part temporal equivalents, include the Purcell Series of British Columbia, the Belt Supergroup of Montana and Idaho, and the Big Cottonwood Formation of Utah. Diamictites are recognized in all or parts of the Toby Conglomerate of British Columbia (Walker, 1926), the Scout Mountain Member of the Pocatello Formation, the Mineral Fork Tillite, and the Dutch Peak Tillite of Cohenour (1959) in Utah (Fig. 3), and the Kingston Peak Formation in southern California (Hewett, 1956, p. 27). Thick post-diamictite sequences include the remainder of the Windermere Group of British Columbia, the Brigham Group and its equivalents here described near Pocatello, Idaho, near Huntsville, and in the Beaver Mountain sections in Utah. Temporal equivalence of the diamictites is strengthened by their close association with volcanic rocks in the Pocatello section (Bannock Volcanic Member), in Washington (Leola Volcanics), and in British Columbia (Irene Volcanics), a relation pointed out by Yates (1968) and others.

The age span of each of the rock sequences described above has not been determined in the eastern Great Basin. The entire sequence is obviously bracketed between the underlying crystalline rocks, which are dated as 2.3 b.y. in the eastern Uinta Mountains (Hansen, 1963, and 1965, p. 31) and 1.6 b.y. in the Farmington area between Salt Lake City and Ogden (Giletti and Gast, 1961) and the basal Cambrian with which the uppermost units are gradational in the basin sections. If the correlations suggested above are valid, the dates established for Belt rocks in Montana, Idaho, and British Columbia (Obradovich and Peterman, 1968) imply that the Big Cottonwood Formation is between 1 to 1.5 b.y. old. The bulk of the rocks in the Pocatello and Huntsville sections should be the same age as the Windermere, that is, between 570 and 700 m.y. (*see* Leech, *in* Lowdon, 1961, p. 6), inasmuch as all three groups of rocks have a diamictite at the base and appear to have been deposited continuously, or at least without detectable tectonic disturbance, into Cambrian time.

PALEOGEOGRAPHY AND TECTONIC RELATIONS

The sequence of rocks at Pocatello, together with that present, although not yet completely mapped, at Huntsville, suggests the following generalized sequence of events in the eastern Great Basin, in very late Precambrian time.

1. Accumulation of a thick series of black argillaceous sediments containing thin tongues of dolomite or limestone which thicken westward. The shoreline during this time probably lay close to the present site of the Wasatch line; the axis of the trough was at least 40 mi farther west, possibly close to the Nevada line. The presence of black (carbonaceous) pyritic mudstones or shales in the lower member of the Pocatello Formation and at Huntsville suggests relatively deep quiet water and euxinic bottom conditions.

2. This depositional basin was invaded periodically from an unknown eastern source by tongues and sheets of ice which deposited diamictites, at times directly from ice, at times by ice-rafting of boulders beyond the glacial limits. Reworking and redeposition by slumping and turbidity currents is also probable (Condie, 1966, 1969). An episode of volcanism intervened in the Pocatello area during this same interval.

3. Normal marine sedimentation then resumed, including the deposition of tongues of carbonate intercalated with silt-size clastics whose green or purple color and scarcity of carbon or pyrite suggests normal rather than euxinic bottom conditions.

4. Gradually, the supply of sand-size debris increased, leading to accumulation of the quartzitic sequences that characterize the Brigham Group. Deposition appears to have been continuous into the Cambrian in parts of the basin, but the presence of volcanics and eolian sands in the Browns Hole Formation of the Huntsville sequence suggests that terrestrial conditions existed, at least temporarily, perhaps representing a slowing in the rate of basin subsidence.

5. The abundant cross-bedding and "pebbled" bedding surfaces that characterize the

upper parts of the Geertsen Canyon Quartzite indicate that shallow water conditions persisted into Cambrian time throughout the area.

Although a complete reconstruction of late Precambrian to Early Cambrian paleogeography is impossible, the preceding framework is sufficient to help clarify certain tectonic relations, particularly in northern Utah. That the thick Precambrian sequences of Huntsville and the northern Wasatch are allochthonous and are derived from the west, was evidently suspected by Blackwelder (Eardley, 1944, p. 849), and was one of two structural alternatives considered by Eardley and Hatch in 1940 (p. 867–872). More recently, Eardley (1968, 1969) has proposed that the Huntsville sequence is autochthonous, having been deposited in a trough on the east side of a late Precambrian uplift, which is marked by the very thin Antelope Island sequence.

The following evidence, drawn from the preceding discussion, is believed by the writers to support the concept of eastward thrusting. (1) The startling similarity of the Huntsville, Pocatello, Sheeprock, and Beaver Mountain sections implies that they all accumulated in the axis of a subsiding trough in which deposition was nearly continuous from Precambrian into Cambrian time: (2) The Antelope Island section, like that in the Cottonwood area near Salt Lake City, indicates intermittent uplift, with the result that only equivalents of the lowermost (diamictite) and uppermost (Tintic Quartzite) parts of the Pocatello and Huntsville sequence is present in these areas. The vastly thicker and more complete Huntsville section must have been deposited well to the west of Antelope Island. Thick sections of younger Precambrian rocks exposed on Promontory Point, Fremont Island, and Little Mountain are believed by Crittenden to be part of the Huntsville sequence, and presumably came from still farther west. (3) Accumulation of the Huntsville sequence at its present location in an embayment *east* of Antelope Island and east of the extensive exposures of the Farmington Canyon Complex in the Ogden area is unlikely because the late Precambrian uplift proposed by Eardley, and recorded by the profound unconformity exposed in those areas, would have yielded abundant conglomerates and coarse gneissic clasts which are conspicuously absent in the Huntsville sequence, and which, had they been present, would have caused this sequence to contrast strongly with the rocks at Pocatello. Similarly, uplift and stripping of the entire Huntsville sequence from the Antelope Island-Farmington area during Early Cambrian should have been recorded by an abundance of Huntsville-type clasts in the Geertsen Canyon Quartzite. These also are conspicuously lacking.

The logical alternative is that thick younger Precambrian sequences were never deposited at Antelope Island, and that the Huntsville sequence has been thrust eastward *over* the Antelope Island section. This conclusion is strongly reinforced by evidence from other parts of the stratigraphic column (Rigo, 1968; Crittenden, 1961; Armstrong, 1968). Although the 40-mi transport of the frontal edges of the thrust plates proposed in 1961 still appears reasonable, stratigraphic and structural relations in areas such as the Raft River Range (Felix, 1956; Compton, 1969) suggest that much greater distances are possible. A more complete reconstruction of the paleogeography of late Precambrian rocks must await solution of these and related structural problems.

ACKNOWLEDGMENTS

It is a pleasure to acknowledge the benefit of discussions of Precambrian stratigraphy and nomenclature with R. A. Bayley, R. R. Compton, W. R. Hansen, R. K. Hose, P. B. King, Hal T. Morris, S. S. Oriel, and C. A. Wallace. We are grateful also to C. A. Anderson, K. C. Condie, A. J. Eardley, and S. S. Oriel, for critical review of the manuscript, and to R. W. Kopf for his painstaking attention to geologic names.

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MANUSCRIPT RECEIVED BY THE SOCIETY MAY 4, 1970

REVISED MANUSCRIPT RECEIVED OCTOBER 21, 1970

PUBLICATION AUTHORIZED BY THE DIRECTOR, U.S. GEOLOGICAL SURVEY

November 4, 1974

Memorandum

To: The File

From: Chief, Office of Minerals Exploration

Subject: OME-6864 (Gold-Silver-Copper)
J. Floyd Cannon
Dugway Property
Tooele County, Utah

The Field Officer notes in his report for October 1974 that there has been no contact with the applicant for months. This office has had no correspondence with the applicant since October 1972. Under these circumstances, and in view of the fact that no new funds are available for contracts this fiscal year, we are removing this application from our active files and will consider it as withdrawn.

Harold Kirkemo

Harold Kirkemo

INTERNAL MEDICINE

J. FLOYD CANNON, M.D.
508 EAST SOUTH TEMPLE
SALT LAKE CITY, UTAH 84102

July, 15, 1973

OME Region III
RECEIVED
JUL 19 1973
Denver, Colorado
OME 6864

Mr. Wm. J. Hassler
U. S. Geological Survey
Federal Center
Denver, Colorado 80225

Dear Mr. Hassler: Just a note to thank you for the infrmation of the applications. DuVal informed me they will give me all the necessary information. Mr. Tafuri spent 22 days outthere. They will advise me of the best targets. They may come in on the project but of course they must get approval from the head office. I will receive the reply this week.

If you get an assay on the samples I should appreciate getting a copy of the results.

I will keep you informed as we progess.

Very truly yours,

J. Floyd Cannon

J. Floyd Cannon

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United States Department of the Interior

GEOLOGICAL SURVEY
Denver Federal Center
Denver, Colorado 80225
Office of Minerals Exploration
Building 53 Room 28

IN REPLY REFER TO:

June 26, 1973

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Memorandum

To: Chief, Office of Minerals Exploration

From: Field Officer, Region III

Subject: OME-6864 (Au, Ag, Cu)
J. Floyd Cannon
Dugway Property
Tooele County, Utah

Attached is a paper: Nomenclature and Correlation of Some Upper Precambrian and Basal Cambrian Sequences in Western Utah and Southeastern Idaho by Max D. Crittenden, Jr. and others. This work is part of the basis upon which AMAX and Duval Corp. are taking a look at the Dugway property. AMAX has penetrated a buried thrust fault, in their deep drilling and they are also looking for a deep occurrence of Cu-Moly, associated with some indicated porphyry type intrusions in the Dugway Mountains.

J. William Hasler

J. William Hasler,
Field Officer, Region III
Office of Minerals Exploration

Enclosure

INTERNAL MEDICINE

J. FLOYD CANNON, M.D.
508 EAST SOUTH TEMPLE
SALT LAKE CITY, UTAH 84102

April 23, 1973

OME Region III
RECEIVED
APR 30 1973
Denver, Colorado

Mr. J. Wm. Hasler, Field Officer, Region III
Office of Mineral Exploration
Building 53 Room 28
Federal Center, Denver
Colorado. 80225

Re: OME - 6864 (gold,silver,copper)
J. Floyd Cannon
Dugway Property
Tooele County, Utah

Dear Mr. Hasler:

As I am sure you are aware, we have had impossible weather conditions at the property at Dugway. The snow continues to be on the mountain but by the first of May we can be sure of seeing the property without difficulty.

Your letter indicated some problems as to the claim names but this is easy to clarify by the statement that I control outright all the patented claims in the district except the Moonlight, Virginia and 50% of the Francis claims. I also have all the unpatented claims making it a solid block. I can further clarify the specific discrepencies mentioned in your letter when you conduct the field examination.

This property has all been surveyed but the map will be available later.

At the time of your inspection of the property you can determine which claims should be included in the exploration project.

I am sure that at the time of your visit all problems can be resolved rapidly and to your satisfaction.

We should be glad to take you out anytime you desire but we feel it would be advantageous to go out after May first as then we can be sure of the conditions at Dugway.

Sincerely,

J. Floyd Cannon

J. Floyd Cannon.

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MME Form 7
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NOV 1 1972

Memorandum

To: Field Officer, Region III

From: Chief, Office of Minerals Exploration

Subject: OME-6864 (Gold-Silver-Copper)
J. Floyd Cannon
Dugway Property
Tooele County, Utah

The applicant's letter of October 19, 1972 responds to questions raised in our letters of October 6 and August 17. By limiting the proposed work to the Bertha Mine area, the applicant would be exploring an eligible target, and this is probably the target with highest geologic probability of success. The recommendation in M. H. Staatz memorandum of January 14, 1972 identifies this area as his first preference of the several potential exploration targets identified by the applicant.

There are several uncertainties in any further consideration of the application, mainly focused on two aspects, economics of the potential ore and specifics of how to explore the restricted target. The applicant's proposal to treat the ore by the cyanide method suggests that he is perhaps overlooking the probable loss of most of his copper values if the ore is only treated for gold and silver recovery through cyanidization. In your opinion, would the potential ore likely to be found in the Bertha Mine area provide an economic incentive in view of existing distant markets and likely feasible ore treatment methods applicable to deposits of expectable dimensions?

If your recommendation on this economic aspect is generally positive, will you assist the applicant in outlining a specific exploration program and revising his application to provide the most information for his effort and expense, and within the economic reality of possible results of such a program, and provide this office with a recommendation of such a revised application.

Minor inconsistencies between the applicant's map and list of claims need to be resolved. These include the Keystone, Cloudy, Revina, and Kennedy #13, which are shown on the map but not listed, and the listed names Stinger, Stinger No. 1, and Mammoth, which are shown on the map as Stringer No. 1, Stringer No. 2, and Mammoth.

Harold Kirkemo

Harold Kirkemo

cc: Director's reading file
Mineral Resources R. Weeks RWeeks:cac 11/1/72
OME reading file 130

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Date	Surname	Code
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MME Form 7
(2/63)

NOV 1 1972

Dr. J. Floyd Cannon
508 East South Temple
Salt Lake City, Utah 84102

Re: OME-6864 (Gold-Silver-Copper)
J. Floyd Cannon
Dugway Property
Tooele County, Utah

Dear Dr. Cannon:

Your letter of October 19, 1972 provides useful suggestions and answers to some of the problems previously identified with regard to your application for exploration assistance. Limiting your exploration program to the Bertha Mine area would focus the work on a geologic target in which the dominant values in the potential ores would be in the eligible materials gold, silver, and copper.

In view of the rather indefinite nature of the actual exploration work that you would now propose, we are referring your file to Mr. J. William Haslerr, Field Officer Region III, Office of Minerals Exploration, U. S. Geological Survey, Denver, Colorado, who will confer with you and/or your consultant, Mr. L. K. Requa, to determine what specific exploration work is presently contemplated and to provide this office with a recommendation on your revised plans.

Mr. Haslerr will contact you to obtain information on your specific plans.

Sincerely yours,

Harold Kirkemo

Harold Kirkemo
Chief, Office of
Minerals Exploration

cc: Director's reading file
Mineral Resources
OME reading file
Region III
R. Weeks

RWeeks:cac 11/1/72

INTERNAL MEDICINE

J. FLOYD CANNON, M. D.
508 EAST SOUTH TEMPLE
SALT LAKE CITY, UTAH 84102

OCT 25 1972

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October 19, 1972

Harold Kirkemo
Chief, Office of Minerals Exploration
U.S. Department of the Interior
Geological Survey
Washington, D.C. 20242

Dear Mr. Kirkemo:

Re: OME-6864 (Gold-Silver-Copper)
Dugway Property
Tooele, Utah

The reply to your letter was delayed by my drilling project of the breccia area. It was done to satisfy the labor requirements on my unpatented claims. Boyles Borthers were very helpful in doing this for me. As yet, I do not have the full reports of the assays.

One area which does warrant a drilling project is in the Bertha mine area, on which the application for loan has been made at the time of the original application.

This area has 0.26 ounces of gold and 10.75 ounces of silver per ton over a considerable area. It is an iron gossan and we would not need a smelter to handle this ore as it could be treated by the cyanide method. If we could get this area drilled to see the extent of the mineralization, it would be helpful in determining the justification for the cyanide mill.

If this application could continue to be considered and you could advise me as to what steps I should now take to obtain this aide, it would be appreciated.

Sincerely,

J. Floyd Cannon

J. Floyd Cannon, M. D.

JFC:mc

Copy to Region III 11/9/72

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OCT 6 1972

AIRMAIL

Dr. J. Floyd Cannon
508 East South Temple
Salt Lake City, Utah 84102

Re: OME-6864 (Gold-Silver-Copper)
J. Floyd Cannon
Dugway Property
Tooele County, Utah

Dear Dr. Cannon:

We have had no reply from you to our letter of August 17, 1972, inquiring about economic factors concerning the Dugway property, and noting that only two of the six prospective exploration targets would be eligible for OME assistance. In view of these factors, we suggested that it may be preferable for you to withdraw the application.

May we have your comments to our questions, and your decision regarding continuance or withdrawal of the application? In the event you decide to withdraw the application, you may reactivate the application at a later date by referring to the present docket number, and submitting information necessary to update and complete the application.

Sincerely yours,

Harold Kirkemo

Harold Kirkemo
Chief, Office of
Minerals Exploration

cc: Director's Reading File
Mineral Resources
OME docket
OME Reading File
OME Region III
Mr. Kirkemo

HKirkemo/gla 10-6-72

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Date	Surname	Code
8-17	Weeks	

Dr. J. Floyd Cannon
508 East South Temple
Salt Lake City, Utah 84102

AUG 17 1972

Re: OME-6864 (Gold-Silver-Copper)
J. Floyd Cannon
Dugway Property
Tooele County, Utah

Dear Dr. Cannon:

We have again reviewed your application for financial assistance to explore the Dugway property, and your letter of July 15, 1972 with accompanying materials.

A careful study of your data together with other information available to us, suggests that only two of the six areas you propose to explore seem to contain prospective exploration targets that would be eligible for OME assistance. Only the Bertha mine and the Breccia Hill areas contain the eligible materials copper, silver, and gold as major values, whereas in each of the other four areas, lead and zinc, which are not eligible for OME assistance, constitute the principal values in the known mineralization and likely targets. However, the production records and sample data furnished indicate that based on current prices the value of the metals in the Bertha mine would average about $23.00 to $28.00 per ton.

Using your stated range of copper content (2.5 to 3.0 percent) in the 20,000 tons of identified ore reserves at the Bertha mine, the metal value ranges from $25.00 to $30.00/ton. Is there evidence to suggest the grade would improve?

In view of the recent closing of the custom smelters in Utah, the marketing of any ores you might discover would require that such ores be valuable enough not only to repay mining costs but also to repay shipping costs to more distant smelters.

In summary, your proposed exploration program contains several objectives that are not eligible for assistance, and in the two areas that apparently contain eligible targets, the indicated grade of the ores

being sought may not be of sufficiently high value to justify exploration under existing metal prices and the distance to potential markets. Do you have plans on how you might develop and market ores from the deposits? If you can demonstrate favorable economics for your potential mine products that are dominently valued for eligible minerals, a modified proposal for exploration of such targets would be given careful consideration. In the absence of such plans, it may be preferable for you to withdraw this application.

Sincerely yours,

Harold Kirkemo

Harold Kirkemo
Chief, Office of
Minerals Exploration

cc: Director's reading file
Minerals Resources
OME reading file
Region III
Mr. Weeks

RWeeks:cac 8/17/72

July 15, 1972

Mr. Harold Kirkemo
Chief, Offie of
Minerals Exploration
U. S. Department of the Interior
Geological Survey
Washington, D. C. 20242

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O. M. E.
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JUL 25 1972
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HK ~~F20~~
Karl Bhatia

Re: OME-6864 (Gold, Silver, Copper)
J. Floyd Cannon
Dugway Property
Tooele County, Utah

Dear Dr. Kirkemo:

During this spring I have contined work on the Dugway Property. I am at the point where significant development is possible. I am enclosing the requested statement to the First Security Bank and their answer.

The shipment records I sent you previously did contain mainly lead and zinc. However, the area of greatest interest to us in further development is the Bertha mine and Breccia Hill area at the mouth of the Bertha trough. Mr. Staats has verified the existence of a substantial deposit of copper and smaller percentages of silver and gold in his report Professional Paper 415 in the Bertha mine. The Breccia Hill area has given very promising surface indications of copper in a geochemical sampling program. I believe you have a copy of this but I am enclosing another copy. Another area, on the claim to the east of the Bertha Mine is called the Raymond which we would also like to drill. The Raymond has a gossan which gave surface assays of 0.26 oz. Au and 10.75 oz. Ag. None of the areas described above have been drilled and we feel it is imperative to drill these areas to justify further development. We will not know whether the value of the ore warrants the added transportation costs until the drilling verifies the extent and value of the ore body at depth.

Under Item 1.c. we state that a share of the cost of the exploration would be furnished by a third party if the OME application is approved. Several companies have told me that they would furnish the remaining part of the development funds if the loan were approved. They would want a percentage of profits in proportion to the amount of money they put into the development. This, in turn, depends on how much money is available from OME.

We have left the amount of drilling rather variable because we have no way of knowing the amount of funds available to OME and specifically to this property. However, we feel that 3,600 feet of drilling is necessary before further development of the property can continue.

If any further information or qualifications are needed please let me know.

Very truly yours,

J. Floyd Cannon

J. Floyd Cannon
1982 Yale Avenue
Salt Lake City, Utah 84108

First Security Bank of Utah
NATIONAL ASSOCIATION
MEMBER FIRST SECURITY CORPORATION SYSTEM OF BANKS
POST OFFICE BOX 720, 405 SOUTH MAIN STREET
SALT LAKE CITY, UTAH 84110

July 5, 1972

J. Floyd Cannon, M.D.
508 East South Temple
Salt Lake City, Utah 84102

Dear Dr. Cannon:

This is in response to your letter concerning request for a loan of $40,000.00 for drilling property in the Dugway, Utah area.

We are sorry to inform you that First Security Bank of Utah, N.A. is not making this type of loan at the present time.

Sincerely yours,

F. R. Lawson
Vice President

FRL:rm

March 6, 1972

Mr. F. R. Lawson, Vice President
First Security Bank of Utah, N. A.
Fourth South Office
Salt Lake City, Utah 84111

Dear Mr. Lawson

This letter is to be deemed a request for a loan from the First Security Bank to J. Floyd Cannon for use in the capacity as owner of patented and unpatented claims in the Dugway Mining District of Utah. The purpose of the loan is to provide funds for exploration and development of these certain mining claims. The amount of money requested is Forty Thousand Dollars ($40,000.00) which will be largely expended for a drilling program on the properties.

If such a loan is granted I would anticipate a pay-out period of ten years, with payment of principal and interest in quarterly installments beginning March 1, 1972 for the interest and January 1, 1973, for the interest and principal combined.

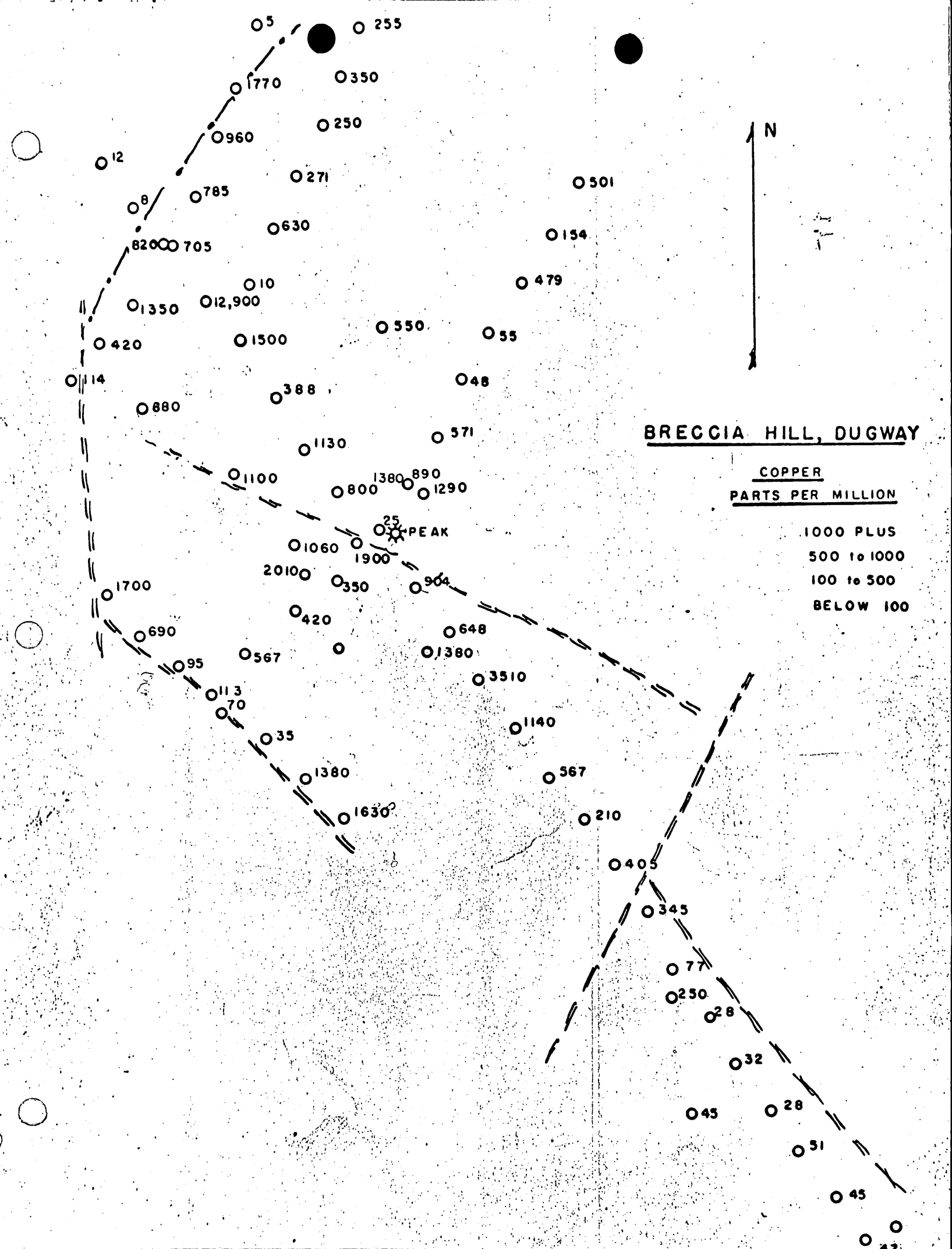
At your request, we shall be pleased to furnish further information regarding the mining properties and the proposed drilling.

Your prompt consideration of this request will be genuinely appreciated.

Very truly yours,

J. Floyd Cannon

J. Floyd Cannon


BRECCIA HILL, DUGWAY
COPPER
PARTS PER MILLION
1000 PLUS
500 to 1000
100 to 500
BELOW 100
N
PEAK
5
255
1770
350
250
960
12
271
501
8
785
630
154
820
705
10
479
1350
12,900
550
55
420
1500
114
388
48
880
571
1130
1100
1380
890
800
1290
25
1060
1900
2010
350
904
1700
420
690
648
567
1380
95
3510
113
70
1140
35
1380
567
1630
210
405
345
77
250
28
32
45
28
51
45

MME Form 7
(2/63)

OFFICIAL FILE COPY

Date	Surname	Code

JUL 27 1972

Airmail

Mr. J. Floyd Cannon
508 East South Temple
Salt Lake City, Utah 84102

Re: OME-6864 (Gold, Silver, Copper)
J. Floyd Cannon
Dugway Property
Tooele County, Utah

Dear Mr. Cannon:

On February 9, 1972, we requested additional information concerning your application for financial assistance to explore the Dugway property, but to date we have not heard from you.

Please let us know if you need additional time to prepare this information. If we do not hear from you within 30 days of the date of this letter, we must assume that you are no longer interested in proceeding with the application, and we shall consider it as having been withdrawn.

Sincerely yours,

Harold Kirkemo

Harold Kirkemo
Chief, Office of
Minerals Exploration

cc: Director's reading file
Mineral Resources
OME reading file
Region III
Mr. Kirkemo

HKirkemo/cac 7-27-72

MME Form 7
(2/63)

OFFICIAL FILE COPY

Date	Surname	Code
2/9/72		120
		220
		120M

FEB 9 1972

AIRMAIL

Mr. J. Floyd Cannon
508 East South Temple
Salt Lake City, Utah 84102

Re: OME-6864 (Gold, Silver, Copper)
J. Floyd Cannon
Dugway property
Tooele County, Utah

Dear Mr. Cannon:

We have completed a preliminary review of your application for financial assistance to explore the Dugway property and offer the following comments.

You are proposing to explore for gold, silver, copper, lead, and zinc, but the shipment records indicate that the major values in eight of the ten shipments for which settlement sheets were submitted were due to the lead and zinc content. The major value in the other shipments probably was due to copper, but the records are not legible or complete. Lead and zinc are not eligible for assistance under the OME program, so we should have evidence that the major values in the proposed exploration targets are due to one or more of the eligible metals on the OME list. Otherwise, we could not give further consideration to the application.

Incidentally, with one or both of your prior sales outlets (Tooele and Garfield plants) closed, are other buyers available and would the value of the ore warrant the added transportation costs?

With respect to your requests for loans from the banks, your offer of repayment only in the event of an ore discovery would not be acceptable to commercial lending institutions, so the negative replies were to be expected. One bank replied further that it did not make loans for minerals exploration. We suggest that you write again to the First Security Bank of Utah and present a specific repayment plan for a specific amount. You did not specify a loan amount or offer a repayment plan to either bank in your first requests.

Under Item 1.c., you state that your share of the cost of the exploration would be furnished by a third party if the OME application is approved. We need assurance that funds sufficient for your share are available before a contract is offered. You should identify the party or parties supplying these funds on your behalf and the terms under which they are offered. If any present or future interests in the property are transferred to these parties, the considerations for such transactions should be described.

You indicate 3600 feet of diamond drilling in your estimate of costs on page 11, but the total footage of the proposed holes is 4100 feet. Some of the expenses listed would not be accepted or included in the event of a contract, but these problems can be resolved later if you can furnish satisfactory information with regard to the above questions.

Budget constraints in FY 1972 restrict the OME program to modest assistance for very few of the more promising proposals. However, we shall be pleased to continue processing your application upon receipt of the required information. This letter should not be construed as a commitment by the Government to grant an exploration contract.

Sincerely yours,

Harold Kirkemo

Harold Kirkemo
Chief, Office of
Minerals Exploration

cc: Director's Reading File
Mineral Resources
OME docket
OME Reading File
OME Region III
Mr. Kirkemo

HKirkemo/gla 2-9-72

January 19, 1972

Mr. J. Floyd Cannon
508 East South Temple
Salt Lake City, Utah 84102

Subject: OME-6864

Dear Mr. Cannon:

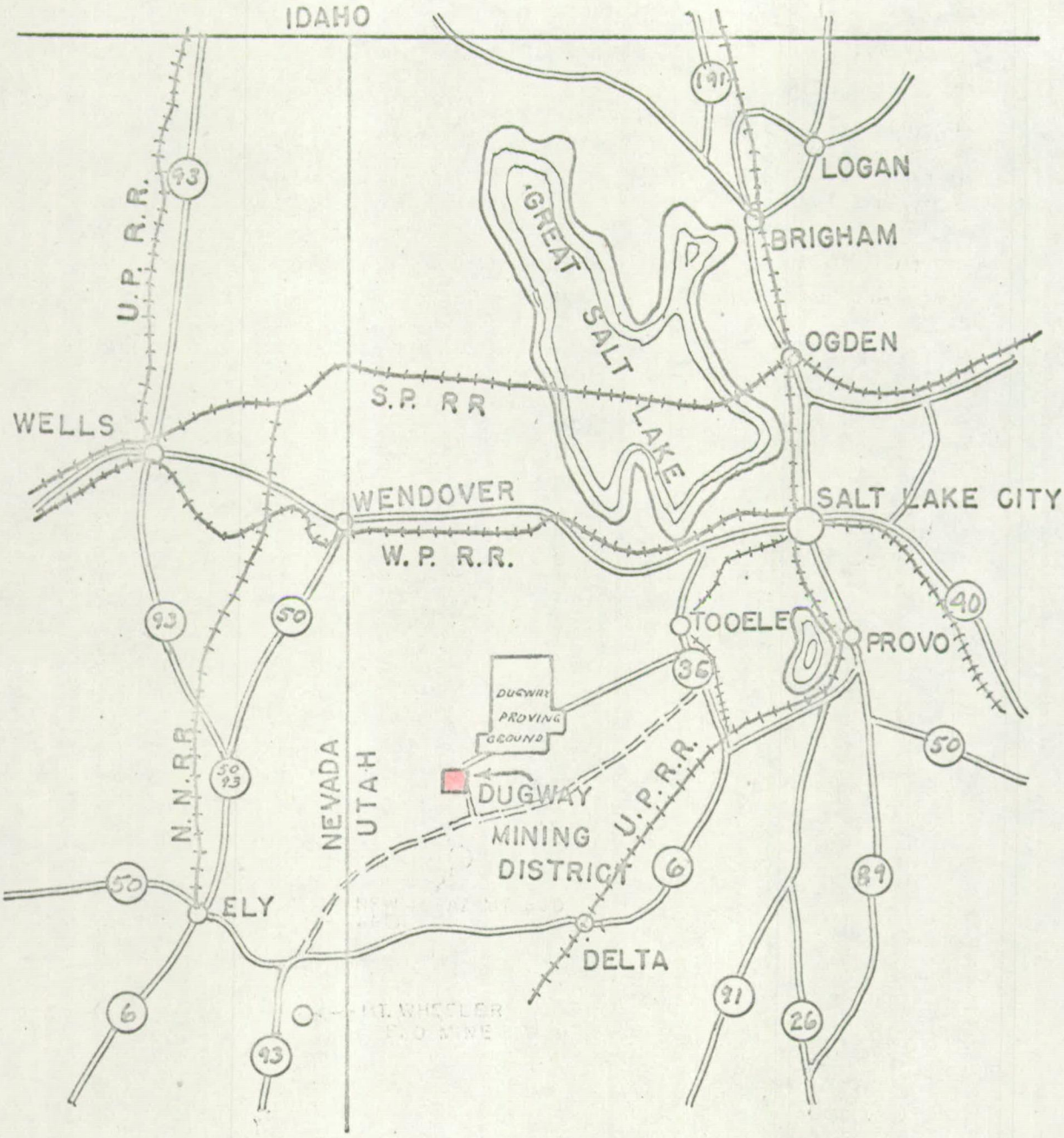
Your application for exploration assistance, dated December 1, 1971, submitted to our office at Denver, Colorado, has been assigned Docket No. OME-6864.

Please identify all future correspondence relating to your application by this docket number.

Sincerely yours,

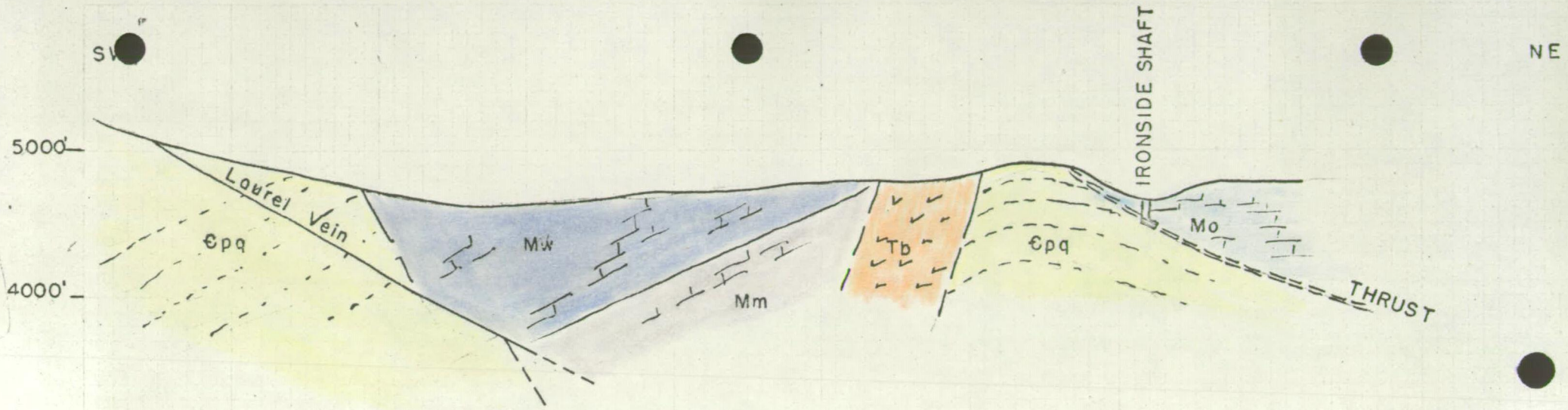
Harold Kirkemo
Chief, Office of
Minerals Exploration

cc: Region III

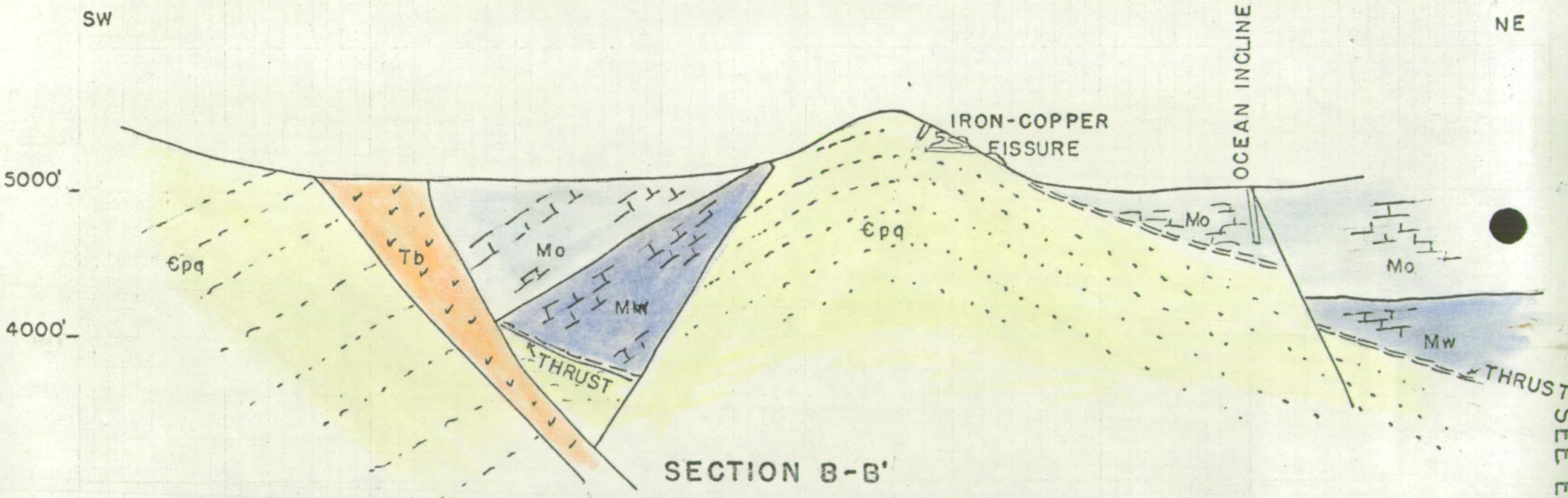


INDEX MAP

SCALE 1" = 40 Mi.

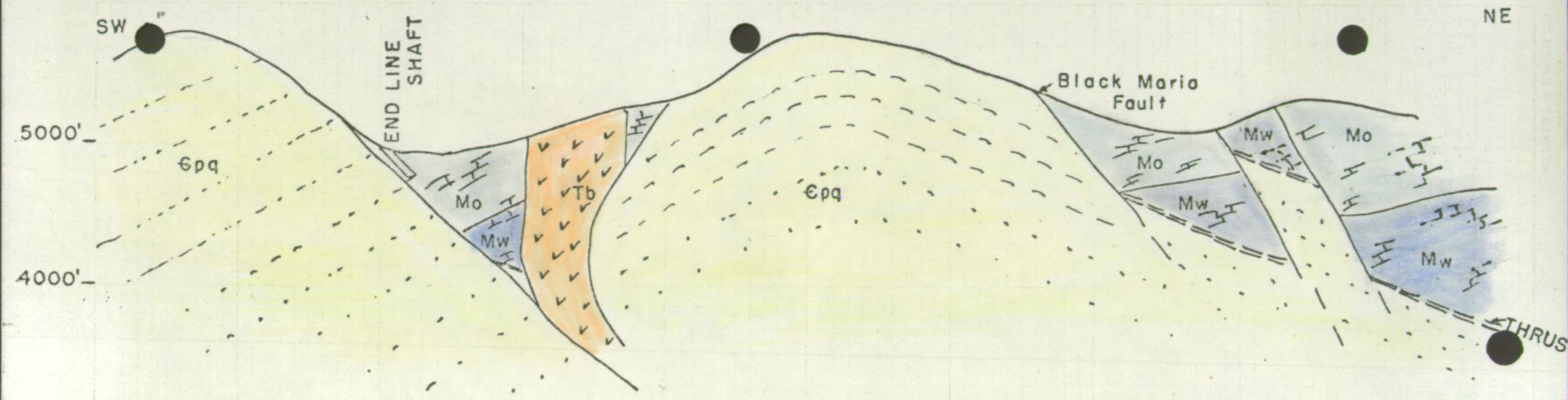


SECTION A-A'

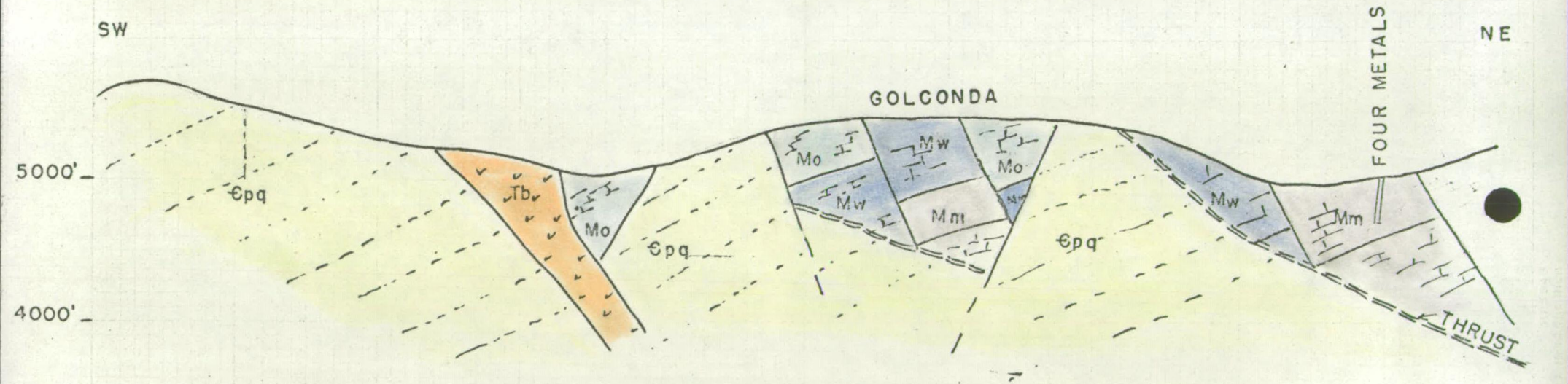


SECTION B-B'

SEE EXHIBIT B

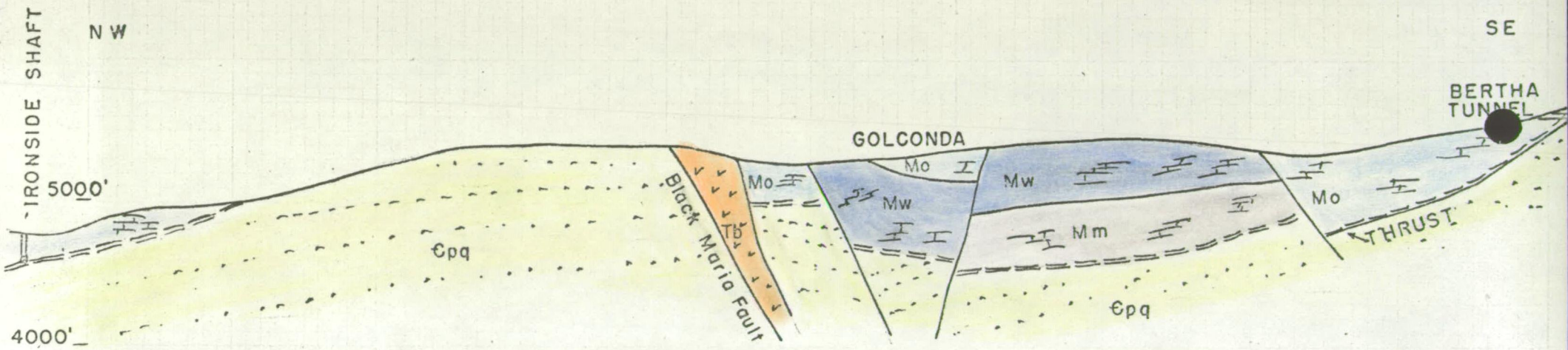


SECTION C-C'



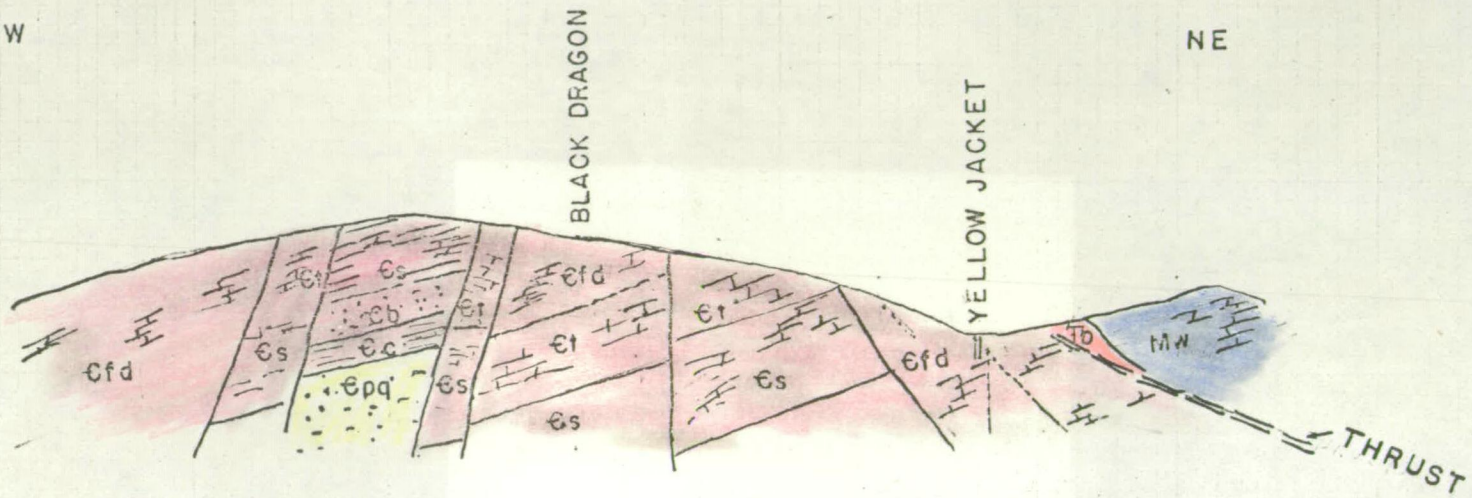
SECTION D-D'

SEE EXHIBIT B



SECTION E-E'

SEE EXHIBIT B

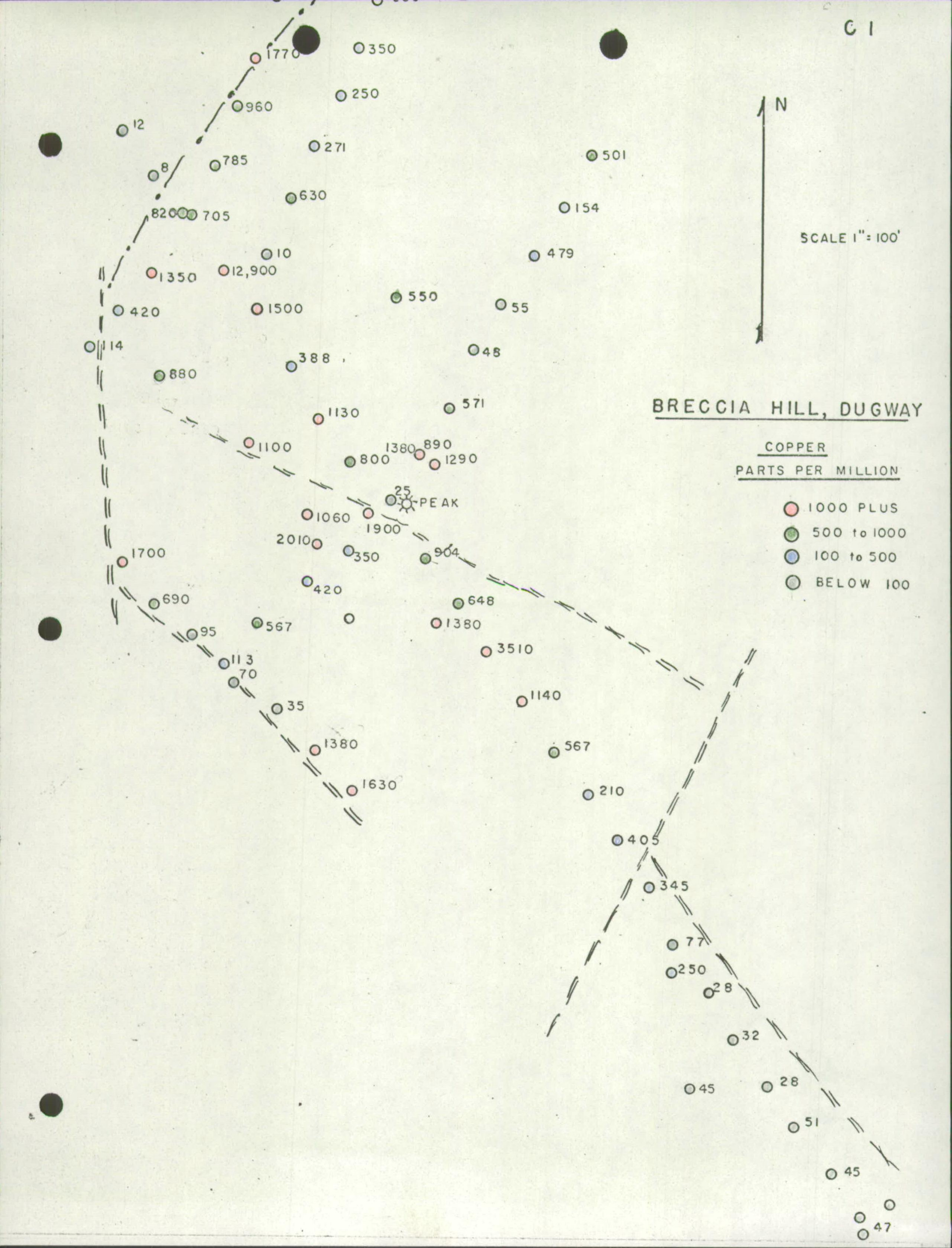


			Thickness
MISSISSIPPIAN	Mw	Woodman Formation	785'
Thrust Fault			
	Єfd	Fandangle Limestone	1,670'
	Єt	Trailer Limestone	385'
CAMBRIAN	Єs	Shadscale Formation	520'
	Єb	Busby Quartzite	160
	Єc	Cabin Shale	140
	Єpq	Prospect Mt. Quartzite	1,000' +
	Tb	Volcanic Breccia	

SECTION F-F'

SEE EXHIBIT B

Fig. 57 (p. 159) in
P. P. 415 gives page size
reproduction of patented claims.


BRECCIA HILL, DUGWAY
COPPER
PARTS PER MILLION
1000 PLUS
500 to 1000
100 to 500
BELOW 100
N
SCALE 1" = 100'
PEAK
1770
350
250
960
12
271
501
785
8
630
154
820
705
10
479
1350
12,900
550
420
1500
55
14
388
48
880
571
1130
1100
1380
890
800
1290
25
1060
1900
2010
350
904
1700
420
690
648
567
1380
95
3510
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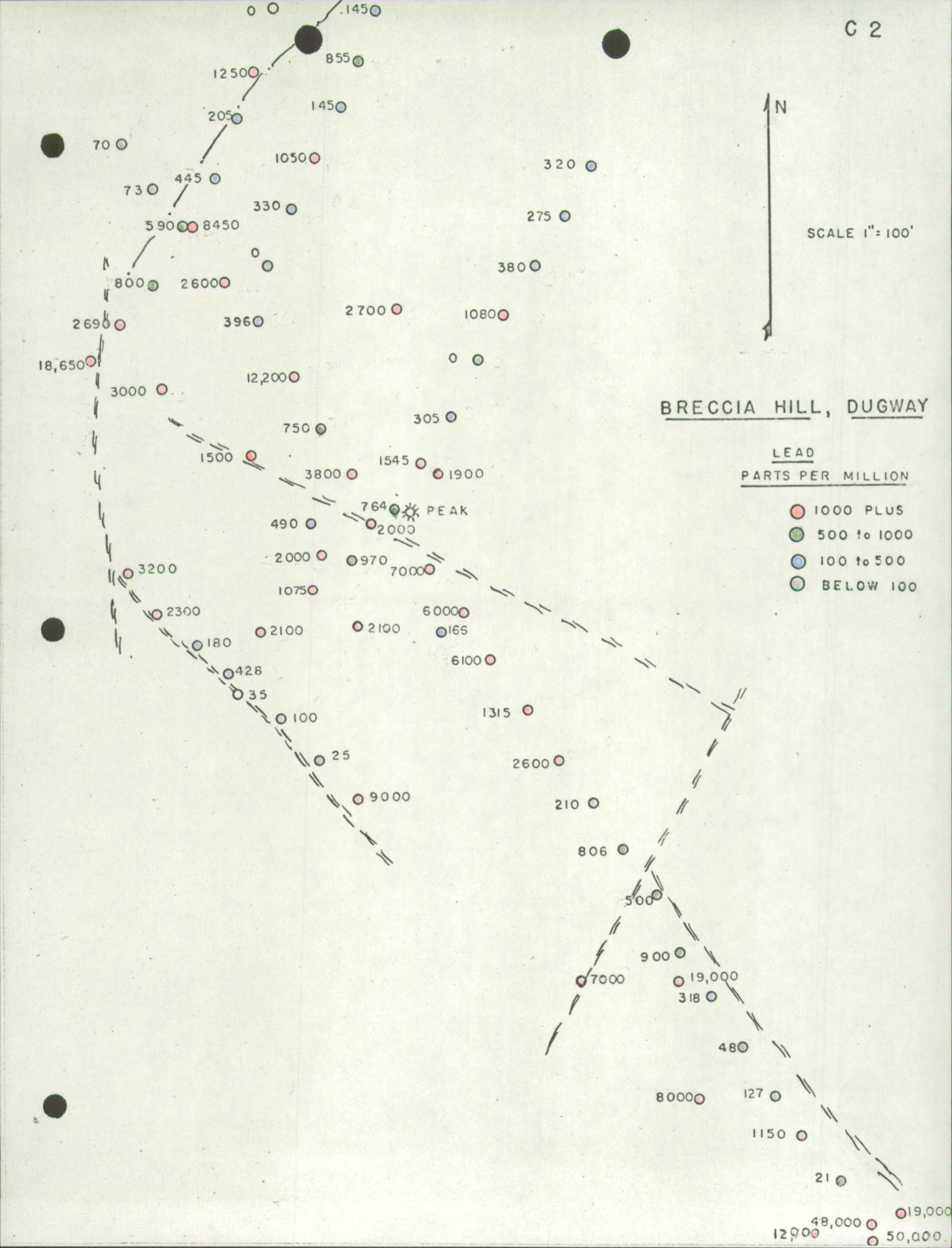
45
28
51
45
47


N
SCALE 1" = 100'
BRECCIA HILL, DUGWAY
LEAD
PARTS PER MILLION
1000 PLUS
500 to 1000
100 to 500
BELOW 100
PEAK
0
145
855
12500
205
145
70
1050
320
445
73
330
275
590
8450
0
380
800
26000
2700
1080
2690
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18,650
12,200
3000
305
750
1500
1545
3800
1900
764
490
2000
2000
970
70000
3200
1075
2300
6000
2100
2100
165
180
6100
428
35
100
1315
25
2600
9000
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19,000
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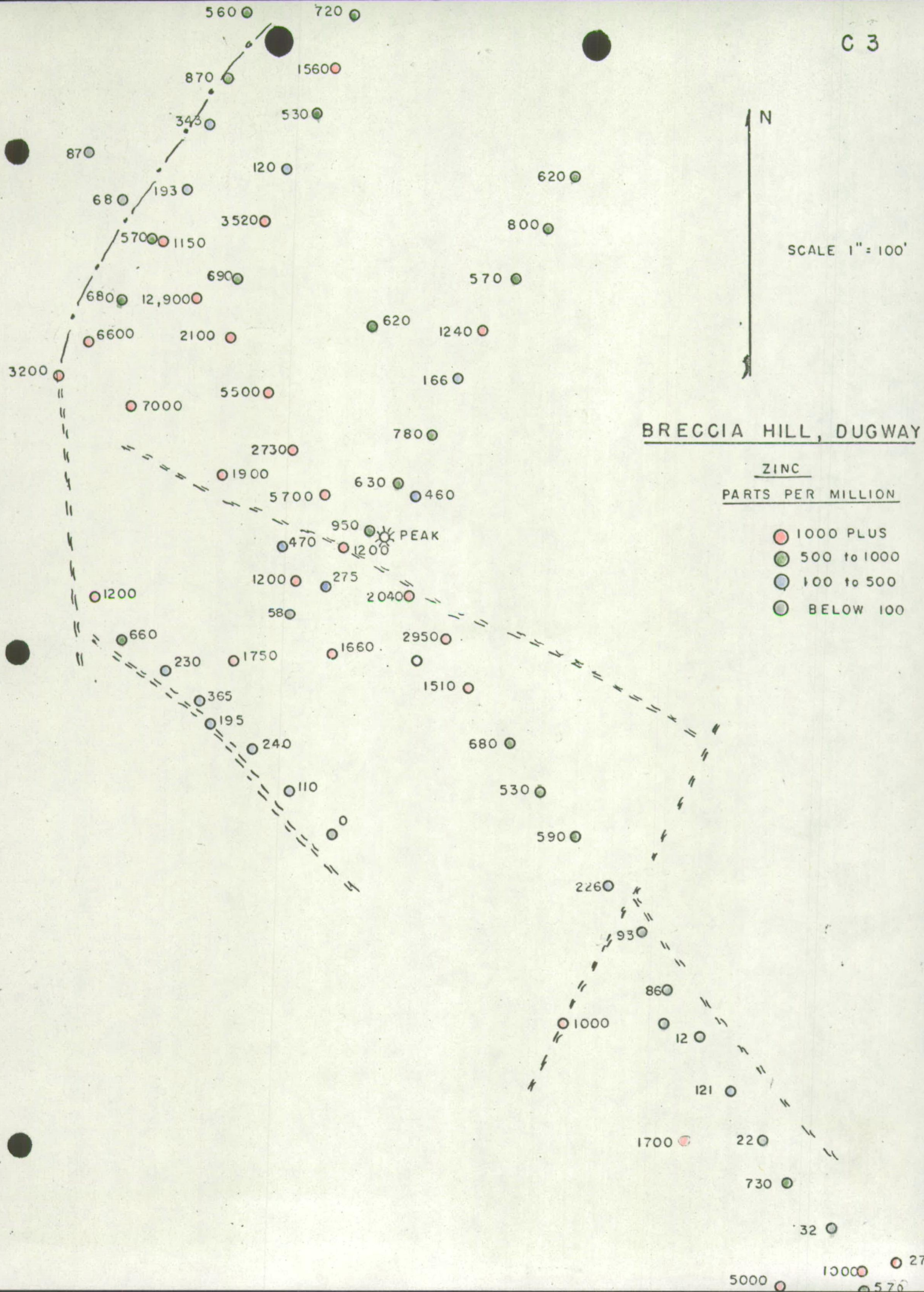
480
8000
127
1150
21
19,000
48,000
12,000
50,000


N
SCALE 1" = 100'
BRECCIA HILL, DUGWAY
ZINC
PARTS PER MILLION
1000 PLUS
500 to 1000
100 to 500
BELOW 100
PEAK
560
720
870
1560
343
530
87
120
620
68
193
3520
800
570
1150
690
570
680
12,900
620
6600
2100
1240
3200
166
5500
7000
780
2730
1900
630
5700
460
950
470
1200
1200
275
1200
2040
58
660
2950
230
1750
1660
1510
365
195
240
680
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590
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1000
12
121
1700
22
730
32
2700
10000
5000
570

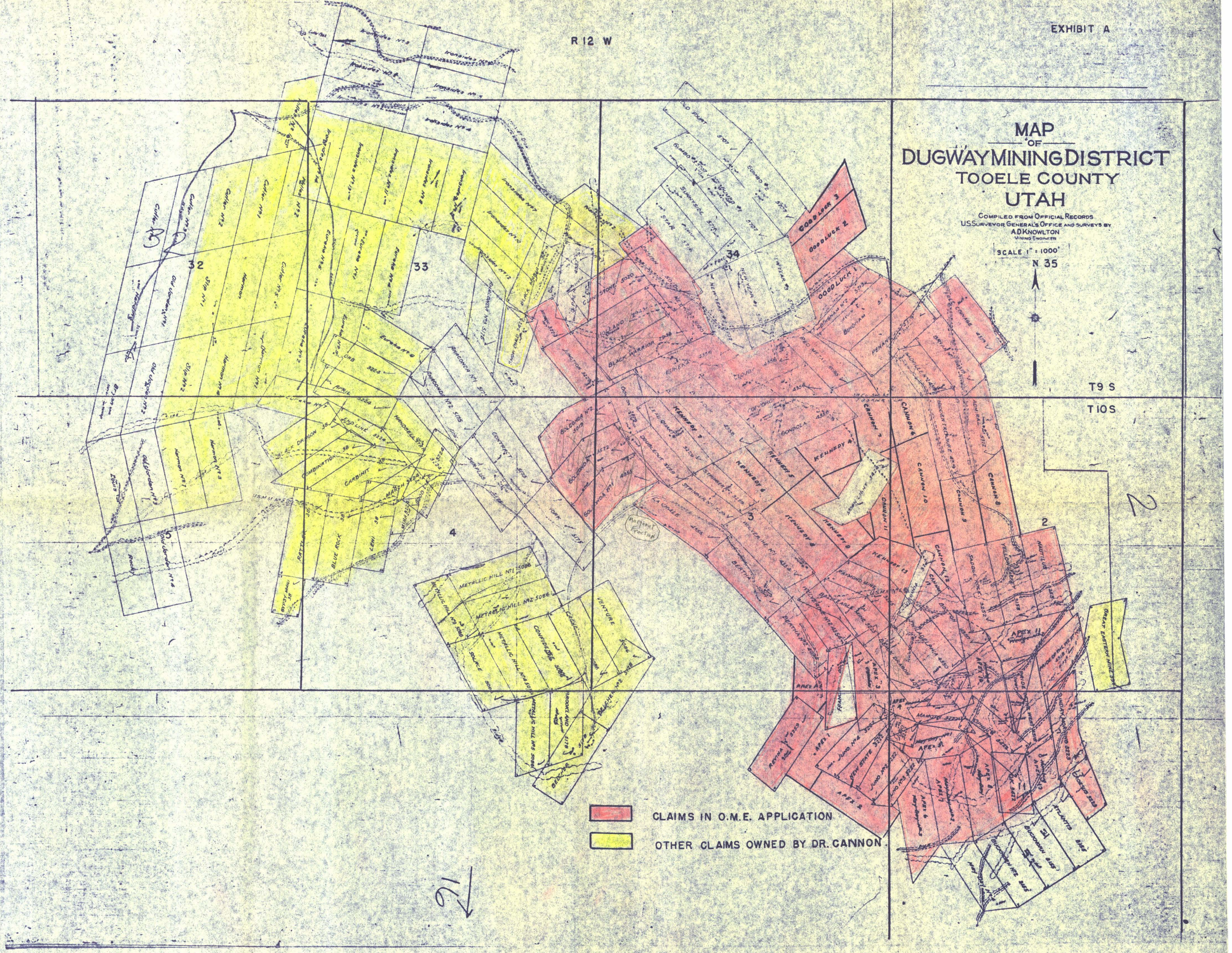
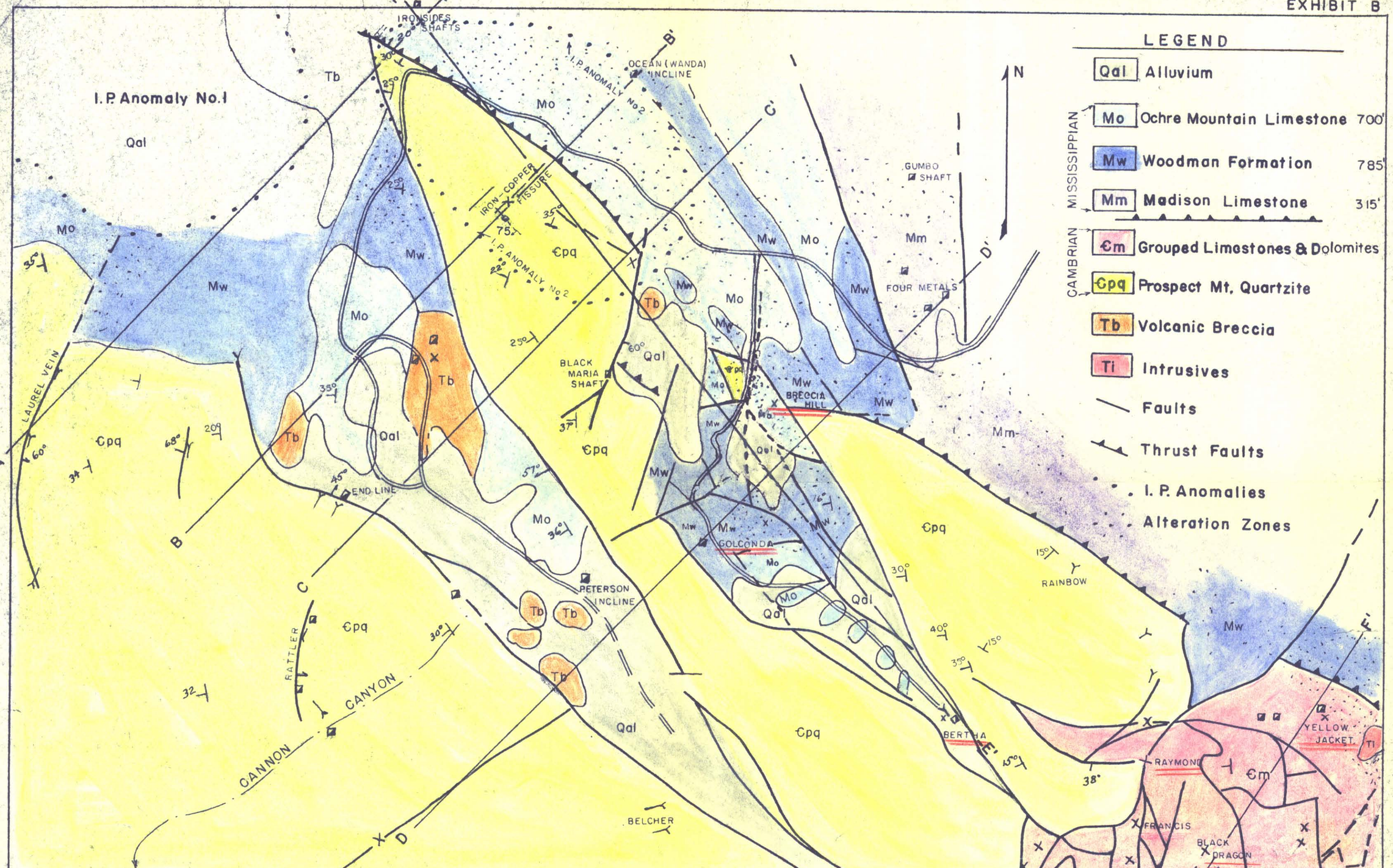


EXHIBIT A
R 12 W
MAP OF DUGWAY MINING DISTRICT
TOOELE COUNTY
UTAH
COMPILED FROM OFFICIAL RECORDS
U.S. SURVEYOR GENERAL'S OFFICE AND SURVEYS BY
A.D. KNOWLTON
MINING ENGINEER
SCALE 1" = 1000'
N 35
T9 S
T10 S
32
33
34
4
3
2
5
CLAIMS IN O.M.E. APPLICATION
OTHER CLAIMS OWNED BY DR. CANNON.
GOOD LUCK 3
GOOD LUCK 2
GOOD LUCK 1
FREE COINAGE
BLACK WARRIOR
HOLLAND
JUNCTION
GOLCONDA No. 2
KENNEDY 4
KENNEDY 5
KENNEDY 6
KENNEDY 7
KENNEDY 8
CANNON 6
CANNON 7
CANNON 8
CANNON 9
CANNON 10
CANNON 11
CANNON 12
NAUTILUS
GREAT EASTERN MINE
ATLANTIS
BUCKHORN
APEX 2
JUNO No. 4
NEW STATE
METALLIC HILL No. 1 5086
METALLIC HILL No. 2 5086
CONFIDENCE
VENTURE
BELCHER
SOLACE
CONTRACT
SURPLUS
YORK
ANACONDA No. 1
ANACONDA No. 2
BLACK DRAGON
COMBINATION
CARBINIT
END LINE
RATTLER
BLUE ROCK
LEHI
OLD FOURT
GUMBO
SUNNYSIDE
STAR
NEW YEAR

EXHIBIT B



REFERENCES	REVISIONS	WORK			
		DRAWN	L.K.R.	12/5/63	GEOLOGY & CROSS SECTIONS
		TRACED			
		CHECKED			
		APPROVED			

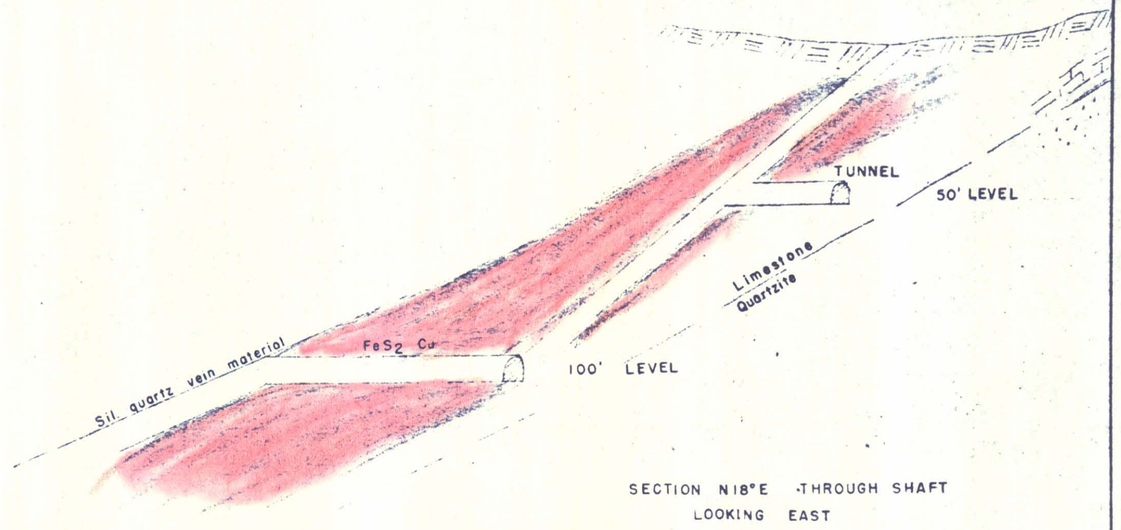
PLANT

DUGWAY DISTRICT, TOOLE CO., UTAH
AFTER USGS, ASARCO & REQUA

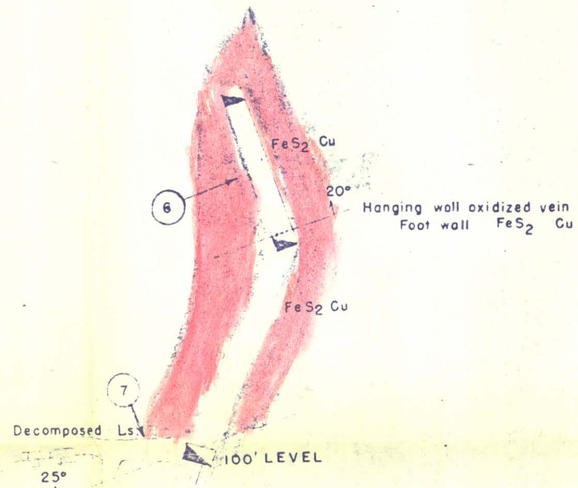
SCALE 1" = 1000'

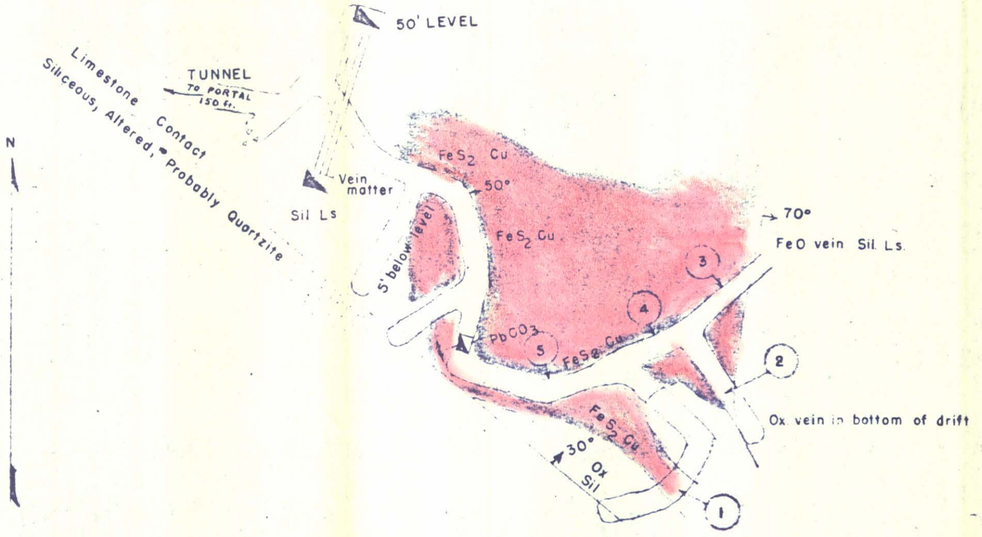
B-

CESCO - 1000H



SECTION N18°E THROUGH SHAFT
LOOKING EAST





ASSAYS

NUMBER	Au oz	Ag oz	Pb %	Cu %
1	.005	.82	2.0	0.3
2	Tr	.58	1.6	3.4
3	.01	.71	1.2	3.8
4	.005	.74	1.2	3.6
5	.015	.51	1.3	3.0
6	.04	.54	1.4	2.3
7	0	Tr	1.2	0

REVISIONS	REVISIONS	REFERENCES	WORK	
			DRAWN S. E. GRAIG	1/18/51
			TRACED	
			CHECKED	
			APPROVED	

PLANT

BERTHA COPPER
DUGWAY UTAH

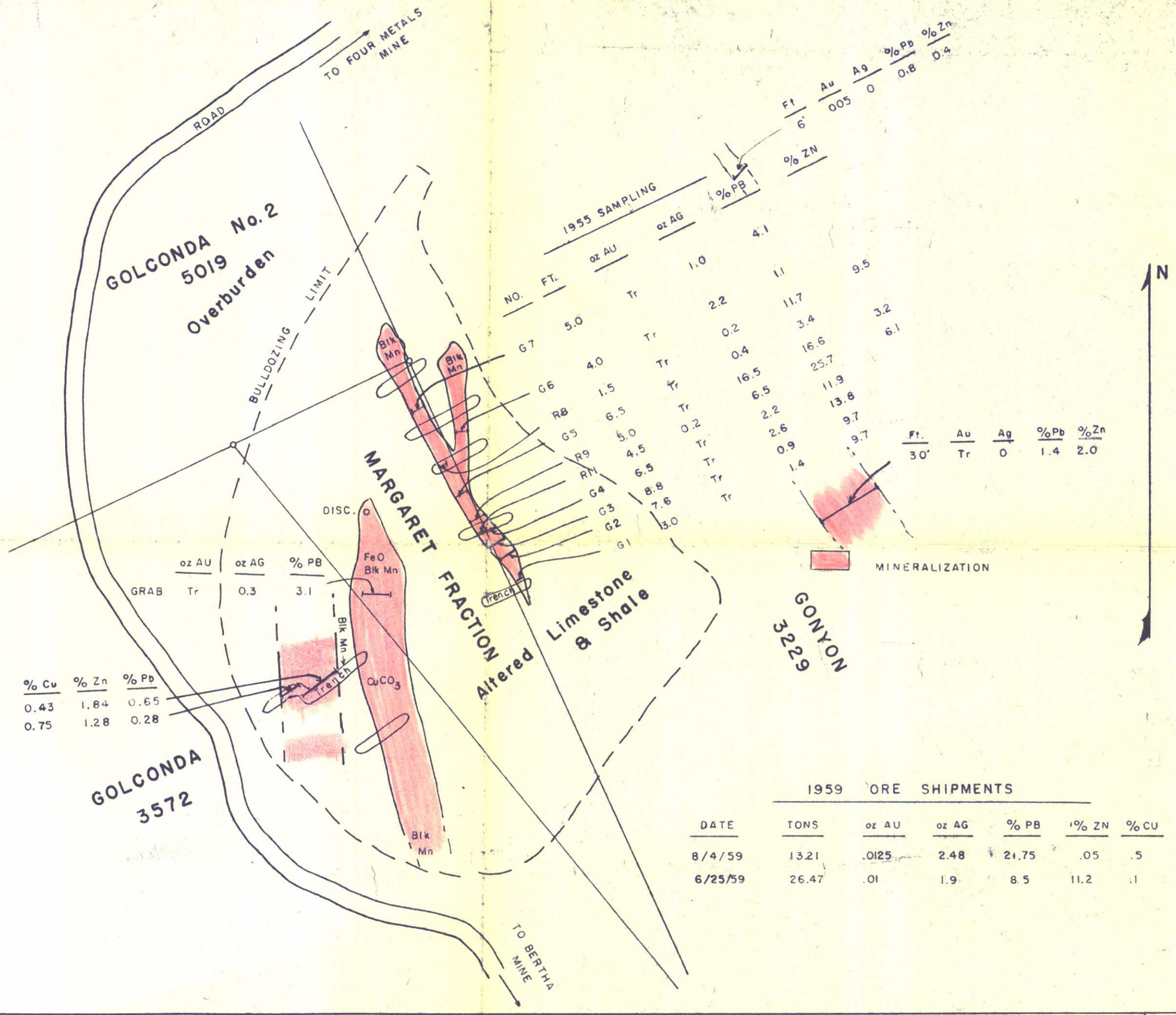
SCALE 1" = 20'

C-

CESCO-1000H

EXHIBIT D

Dugway Mining District
J. Floyd Cannon, Owner



1959 ORE SHIPMENTS

DATE	TONS	oz AU	oz AG	% PB	% ZN	% CU
8/4/59	13.21	.0125	2.48	21.75	.05	.5
6/25/59	26.47	.01	1.9	8.5	11.2	.1

REFERENCES	REVISIONS	WORK			
	L.K.R. 1964	DRAWN L.K.R.	1955	DUGWAY MINING DISTRICT TOOELE COUNTY, UTAH	PLANT
	L.K.R. 1966	TRACED			
		CHECKED			
		APPROVED			

GOLCONDA (REQUA) PROSPECT

SCALE 1" = 40'

B-

CESCO - 1000H

EXHIBIT C

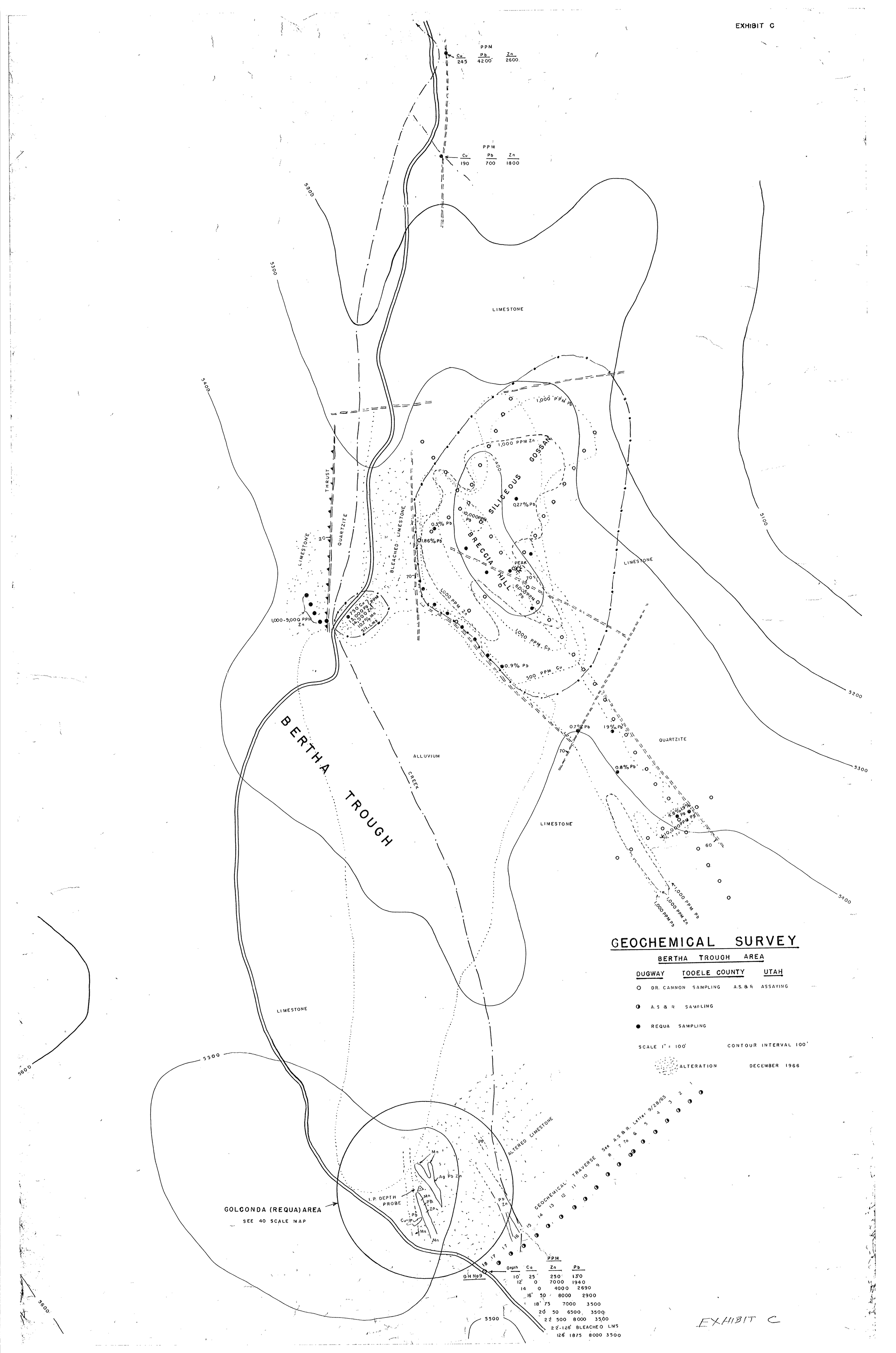


EXHIBIT C