DOCKET COPY

NOTICE OF TERMINATION OF EXPLORATION PROJECT CONTRACT, UNDER THE TERMS OF THE CONTRACT, BEFORE THE COMPLETION OF THE WORK

To: Mathis and Mathis
P. O. Box 452
Silver City, New Mexico

Original (or Gov't. copy) surnamed by:
AEKane 3/19/53
Rubin

Operator under Exploration Project Contract Idm-E458, Docket No. DMA 1549X, dated October 23, 1952

The United States of America, acting through the Department of the Interior, Defense Minerals Exploration Administration, under the terms of the above-mentioned contract, hereby terminates the contract on the following grounds:

In the opinion of the Government, you have failed to prosecute operations pursuant to the terms of the contract.

Upon the receipt of this notice, as provided in said contract, you are required to dispose of any remaining materials, supplies, facilities, buildings, fixtures, equipment, or other items, in which the Government has an interest, for the joint account of yourself and the Government; and to render to the Government a full and final accounting of your operations under the contract and of your expenditures of money on account thereof.

Any work prosecuted or costs incurred by you after the receipt of this notice shall be for your sole account, except for (a) such necessary and reasonable costs and expenses as may be incurred in preserving and disposing of any facilities, buildings, fixtures, equipment, or other items, to the cost of which the Government has contributed and in which the Government has an equity, and (b) the costs of any reports, accounts, and winding-up and settlement actions provided for in the contract.

Dated this 6th day of March, 1953.

UNITED STATES OF AMERICA

By W. H. King
W. H. King
Executive Officer, DMEA
Region IV

Entry Forthcoming

MF-200 (A)
(February 1952)

DEPARTMENT OF THE INTERIOR
Defense Minerals Administration
RECEIVED
OCT 15 1952

DOCKET No. DMEA 1549X

COMMODITY Zinc, Lead

Idm-E458

UNITED STATES OF AMERICA
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS EXPLORATION ADMINISTRATION

EXPLORATION PROJECT CONTRACT[1]
(Short Form)

IT IS AGREED this 23rd day of October, 1952, between the United States of America, acting through the Department of the Interior, Defense Minerals Exploration Administration, hereinafter called the "Government," and[2] a partnership consisting of R. W. Mathis and Lettie Mae Mathis, doing business as Mathis and Mathis, P. O. Box 452, Silver City, New Mexico

hereinafter called the "Operator," as follows:

ARTICLE 1. *Authority for contract.*—This agreement is entered into under the authority of the Defense Production Act of 1950, as amended, pursuant to DMEA Order 1 entitled "Government Aid in Defense Exploration Projects."

ARTICLE 2. *Operator's property rights.*—With respect to that certain land situated in the State of New Mexico, County of Grant, described as follows:[3] The following patented mining claims: Lafayette, Manilla, Alpha, Omega, Florida, Caribou, Atlas, all No. 1211; Bauxite No. 1497; Calcite, Quartzite, Rocker, all No. 1489; Maverick, No. 1580; Opher, Tunnelaite, No. 1490; Klondyke, No. 1583

the Operator represents and undertakes:[4]

(a) ~~[illegible] possess [illegible] possession and [illegible] only to the following [illegible] of encumbrances as to each of which the subordination agreement of the holder is attached:~~

Landlord's Subordination Agreement

(b) That the Operator is a lessee, in possession and entitled to possession, and the ~~Owner's Consent to Lien~~ is attached.

The Operator shall devote the land and all existing improvements, facilities, buildings, installations, and appurtenances to the purposes of the exploration project without any allowance for the use, rental value, depreciation, depletion, or other cost of acquiring, owning, or holding possession thereof.

ARTICLE 3. *Exploration project.*—The Operator, within sixty (60) days from the date of this contract shall commence work on a project of exploration for[5] Zinc, Lead

in or upon the described land; and shall bring the project to completion within a period of twelve (12) months from the date of this contract. The work to be performed is more fully described in Exhibit "A" attached hereto, which, with any maps or drawings thereto attached, are made a part of this contract. The Government will contribute to the cost of this work as hereafter provided. The work shall be performed by the Operator or by independent contractor or contractors efficiently, expertly, in a workmanlike manner, in accordance with good mining standards and State regulations for health and safety and for workmen's compensation and employers' liability insurance, with suitable and adequate equipment, materials, and labor, to bring the project to completion within the time fixed. The Government shall have the right to enter and observe and inspect the work at all reasonable times, and the Operator shall provide the Government with all available means for doing so. The Government may consult with and advise the Operator on all phases of the work.

ARTICLE 4. *Costs of the project.*—The agreed, estimated costs of performing the work, expressed in terms of units of work to be performed (per foot of drifting, per foot of drilling, per cubic yard of material to be moved, etc.) are set forth in Exhibit "A," attached hereto. The Government will pay fifty (50) percent of these agreed, estimated costs, as they accrue, for units of work actually performed that conform with the description or specifications for the work set forth in this contract, in an aggregate total amount not in excess of $ 14,200.00, which is fifty (50) percent of $ 28,400.00, the agreed, estimated total cost of the project in which the Government will participate: *Provided,* That until the Operator's final report and final accounting have been rendered to the Government and any final check or auditing required by the Government has been made, and a final settlement of the contract has been made, the Government may withhold from the last voucher or vouchers such sums as it sees fit not in excess of ten (10) percent of the maximum total which the Government might have been called upon to pay under the terms of the contract. The Government may, as it sees fit, make payments direct to the Operator's independent contractors, if any, for the account of the Operator, rather than to the Operator.

ARTICLE 5. *Reports, accounts, audits.*—(a) *Progress reports.* The Operator shall provide the Government with monthly reports of units of work performed under the contract, in quintuplicate (five copies), upon forms provided by the Government. These progress reports shall be certified by the Operator, and shall constitute both the Operator's invoice of units of work performed on the project during the period covered by the report and his voucher for repayment by the Government, unless the Government requires the use of a standard voucher form with invoice attached. Progress reports shall include surface and/or underground engineering-geological maps or sketches showing the progress of the exploration, with assay-reports on samples taken concurrently with the advance in mineralized ground.

[1] If sufficient space is not provided in any blank, use an extra sheet of paper and refer to it in the blank.
[2] State name, address, and nature of organization if any.
[3] Give legal description or enough to identify the property, particularly excluding any land or interest therein to which the Government's lien is not to attach or the production from which is not to be subject to the Government's percentage royalty.
[4] Strike out the provision not applicable.
[5] Name of mineral or minerals.

(*b*) *Final report.*—Upon completion of the exploration work or termination of the contract the Operator shall provide the Government with an adequate geological and engineering report, in quintuplicate (five copies), including an estimate of ore reserves resulting from the exploration work.

(*c*) *Compliance with requirements.*—If, in the opinion of the Government, any of the Operator's reports are insufficient or incomplete, the Government may procure the making or completion of such reports and attachments as an expense of the exploration work; and the Government may withhold approval and payment of any vouchers depending upon insufficient or incomplete reports.

(*d*) *Accounts and audits.*—The Operator shall keep suitable records and accounts of the units of work performed, which the Government may inspect and audit at any time. The Government may at any time require a check of the work performed and an audit of the Operator's records and accounts, by a certified public accountant or otherwise, the cost thereof to be treated as a cost of the project. The Operator shall keep and preserve said records and accounts for at least 3 years after the completion of the project or the termination of this contract. Upon the completion of the project or termination of the contract the Operator shall render a final account and statement of work performed to accompany his final report.

ARTICLE 6. *Repayment by Operator.*—(*a*) If, at any time, the Government considers that a discovery or a development from which production may be made has resulted from the exploration work, the Government, at any time not later than 6 months after the Operator has rendered the required final report and final account, may so certify in writing to the Operator. The certification shall describe broadly or indicate the nature of the discovery or development. In the event of such certification, any minerals mined or produced from the land described in Article 2 within 10 years from the date of this contract, including any mined or produced before the certification, shall be subject to a percentage royalty which the Operator or his successor in interest shall pay to the Government, upon the net smelter returns, the net concentrator returns, or other net amounts realized from the sale or other disposition of any such production, in whatever form disposed of, including ore, concentrates, or metal, until the total amount contributed by the Government, without interest, is fully repaid, or said 10 years have elapsed, whichever occurs first, as follows:

(1) One and one-half (1½) percent of any such net amounts not in excess of eight dollars ($8.00) per ton.

(2) One and one-half (1½) percent of any such net amounts, plus one-half (½) percent of such net amounts for each additional full fifty cents ($0.50) by which such net amounts exceed eight dollars ($8.00) per ton, but not in excess of five (5) percent of such net amounts.

(For instance: The percentage royalty on a net amount of five dollars ($5.00) per ton, would be one and one-half (1½) percent; on a net amount of ten dollars ($10.00) per ton, three and one-half (3½) percent.)

(*b*) As here used, "net smelter returns," "net concentrator returns," and "other net amounts realized from the sale or other disposition," mean gross revenue from sales, or if not sold, the market value of the material after it is mined in the form in which and the place where it is held. In the case of integrated operations in which the material is not disposed of as such, these terms mean what is or would be the gross income from mining operations for percentage depletion purposes in income-tax determination.

(*c*) To secure the payment of its percentage royalty, the Government shall have and is hereby granted a lien upon the land described in Article 2 and upon any production of minerals therefrom, until the royalty claim is extinguished by lapse of time or is fully paid.

(*d*) This article is not to be construed as imposing any obligation on the Operator or the Operator's successor in interest to engage in any mining or production operations.

ARTICLE 7. *Assignment, transfer, or loss of Operator's interest.*—Without the written consent of the Government, the Operator shall not assign or otherwise transfer or hypothecate this contract or any rights thereunder. The Operator shall not make any voluntary nor permit any involuntary transfer or conveyance of the Operator's rights in the land described in Article 2, without making suitable provision for the preservation of the Government's right to a percentage royalty on production and lien for the payment thereof; *Provided*, that mere failure by the Operator to maintain the Operator's rights in the land, without any consideration running to the Operator other than relief from the cost of maintaining such rights (as by surrender of a leasehold, failure to perform assessment work, or failure to exercise an option), coupled with complete abandonment by the Operator of all interest in or operations on the land for a period of 10 years from the date of this contract, shall not constitute such a transfer or conveyance. Should the Operator make or permit any transfer or conveyance in violation of this provision, the Operator shall be and remain liable for payment to the Government of the same amounts, at the same times, as would have been paid under the terms of the percentage royalty on production. If for any reason the net smelter returns, net concentrator returns, or other net amounts realized from the sale or other disposition of such production are not available as a means of measuring the amount of the Operator's liability, the amount thereof shall be estimated as well as may be, and in the event of dispute as to such estimates, the determination thereof by the Administrator of Defense Minerals Exploration Administration or by his successor shall be final and binding upon the Operator.

ARTICLE 8. *Termination and completion.*—The Government may, at any time, by written notice to the Operator, terminate this contract: (*a*) If the Operator fails to provide his share of the money necessary to prosecute operations pursuant to the terms of the contract; (*b*) if the Operator, in the opinion of the Government, fails to prosecute operations pursuant to the terms of the contract; or (*c*) if, in the opinion of the Government, operations up to the time of the notice have not indicated the probability of making any worth while discovery and in the opinion of the Government further operations are not justified.

ARTICLE 9. *Changes and added provisions* A certified drill log must accompany each Monthly Progress Report. Reimbursement will be made only for diamond drill holes completed to the satisfaction of the DMEA Repre entative. Drill cores must be properly stored in acceptable core boxes. Cores must be split and one-half retained for the use of the DMEA.

Executed in sextuplicate the day and year first above written.

THE UNITED STATES OF AMERICA

By W. H. King
Executive Officer, DMEA
Field Team, Region IV

MATHIS AND MATHIS
(Operator)

By R W Mathis

By Lettie Mae Mathis

I, , certify that I am the secretary of the corporation named as Operator herein; that , who signed this contract on behalf of the Operator, was then of said corporation; that said contract was duly signed for and in behalf of said corporation by authority of its governing body, and is within the scope of its corporate powers.

[CORPORATE SEAL]

U. S. GOVERNMENT PRINTING OFFICE 16—66329-1

MF-202

DEFENSE MINERALS
ADMINISTRATION
WASHINGTON, D. C.

NOV 13 1 33 PM '51

LANDLORD'S SUBORDINATION AGREEMENT

KNOW ALL MEN BY THESE PRESENTS:

WHEREAS, the undersigned is the owner in fee simple of that certain parcel of ground in the county of Grant, State of New Mexico, described in a certain Exploration Project Contract dated _____, 195__, between Mathis and Mathis, the Lessee of said property, and the United States of America;

NOW, THEREFORE, the undersigned, as Lessor of said property under lease dated July 1, 1946, does by these presents subordinate all of his right, title, and interest under the provisions of said lease to the right, title, and interest of the United States of America under the provisions of said Exploration Project Contract, and agrees that the lien and claim of the United States of America under the provisions of said contract shall be prior to the undersigned's rights to rentals or royalties under the terms of said lease; and

The undersigned further agrees that if said leasehold interest should be surrendered or if said lease should terminate at any time prior to the expiration of the rights of the United States of America under said Exploration Project Contract, the undersigned shall assume and does hereby assume all of the obligations of the Lessee under said Exploration Project Contract to make repayment to the United States of America according to the terms of said contract; and

The undersigned agrees to commit no act, nor assert any claim under judicial process or otherwise that may contravene or conflict with the prior lien and claim of the United States of America under the provisions of said Exploration Project Contract.

This undertaking and covenant shall be binding upon the heirs, successors, and assigns of the undersigned.

Dated this 31st day of October, 1951

Louise B. Stewart
Mrs. Louise B. Stewart

U. S. GOVERNMENT PRINTING OFFICE 940768

John D. Finch
John D. Finch

Daniel P. Holting
Daniel P. Holting

EXHIBIT A

Description of the Work

The project consists of diamond core drilling approximately 15 holes, ranging in depth from 100 to approximately 350 feet for an estimated total of approximately 5,000 feet. The attached map shows the approximate locations of 15 proposed holes. The locations and directions of any of these holes may be changed if the proposed locations and directions are acceptable to the DMEA representative.

Estimated Costs of Project

5,000 feet of diamond drilling @ $5.68 per foot	$28,400.00
Cost of Project	$28,400.00
Government's participation @ 50%	$14,200.00

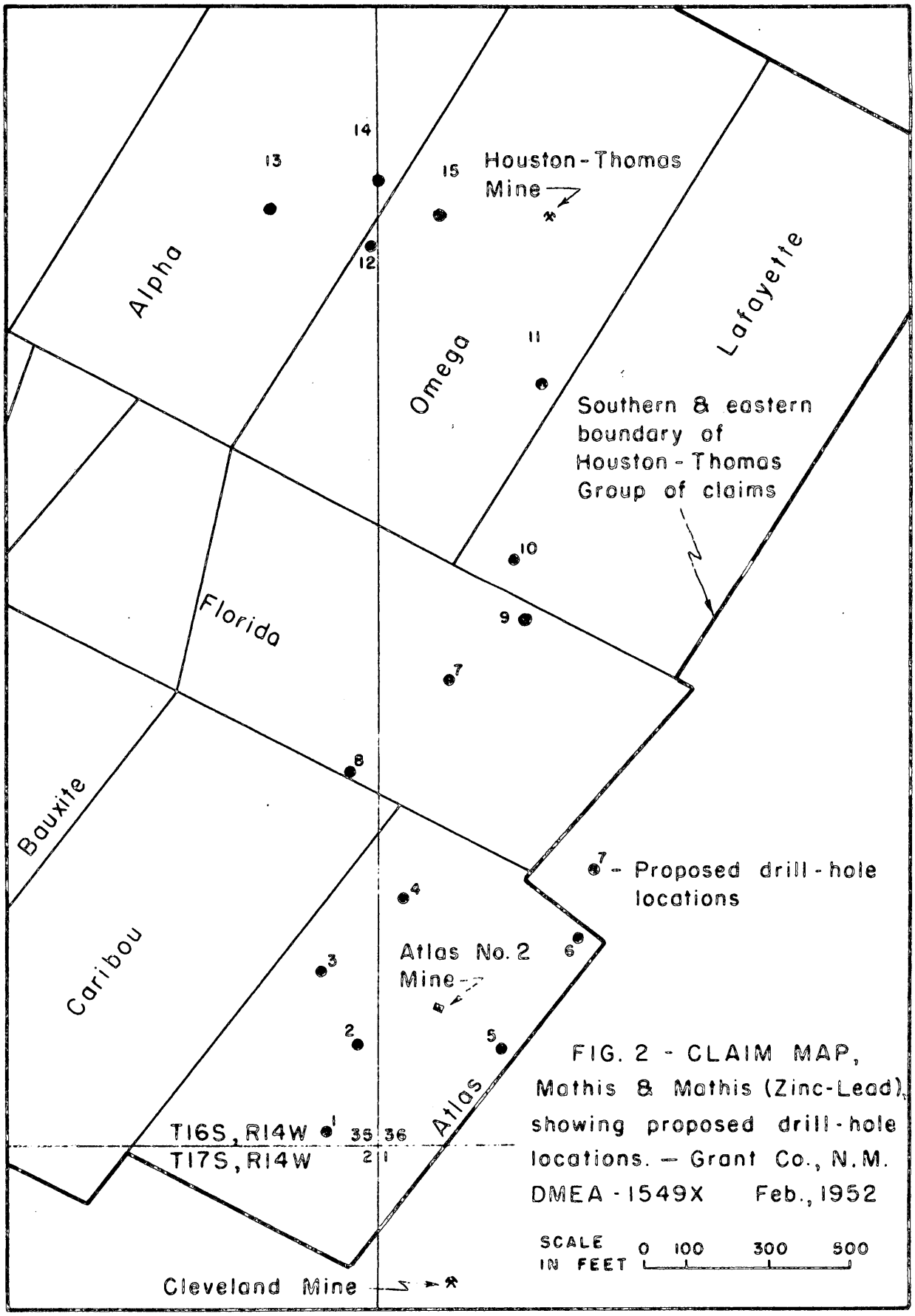

FIG. 2 - CLAIM MAP, Mathis & Mathis (Zinc-Lead), showing proposed drill-hole locations. — Grant Co., N.M.
DMEA-1549X Feb., 1952

DMA Form 1

DEFENSE MINERALS ADMINISTRATION
Control Slip

CONTROLLED DOCUMENT

DMA Docket No. 1549

DO NOT DETACH THIS SLIP

Action on this document is recorded and controlled in Reports and Records Branch. Any movement of this document between divisions or offices of DMA or movement outside DMA must be reported to the Reports and Records Branch. Actions taken that affect status of the case must also be reported.

This document has been recorded as

Exploration Loan

Any action taken to change the type of request for assistance must be promptly reported to the Reports and Records Branch. Use DMA Form 2 for submitting these reports.

Routing Slip

To: Mr. Mittendorf (Mr. Olund, Rm. 4070) Date 11/30/51

To: Gp Com Date 7-30-52

To: _____ Date _____

To: _____ Date _____

To: _____ Date _____

To: _____ Date _____

To: _____ Date _____

To: _____ Date _____

To: _____ Date _____

To: _____ Date _____

To: _____ Date _____

To: _____ Date _____

To: _____ Date _____

To: _____ Date _____

To: _____ Date _____

DO NOT DETACH

CONTROLLED DOCUMENT

FILE COPY
SURNAME:

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS ADMINISTRATION
WASHINGTON 25, D. C.

OCT 23 1953

Mr. Thomas H. Reading
DMEA Auditor
224 New Customhouse Building
Denver 2, Colorado

Dear Mr. Reading:

Receipt is acknowledged of your letter of October 19, 1951 in reference to certain completed contracts, and also your letter of the same date transmitting copies of your Audit Report and Certificate on Idm-E16, DMA-1094, Naildriver Mining Company.

With reference to Idm-F260, DMA-1931, White Canyon Mining Company and Idm-F498, DMEA-1548, Mathis & Mathis, it appears that the wrong form was used by the Executive Officer in closing these contracts. The Notice of Termination Prior Before Completion of Work infers that the work was started and it has been our procedure to withhold release of the obligated funds and the closing of the Operator's account until receipt of the final Audit Certificate or Report of Review.

In these two cases, however, it appears from your letter that no work was done and no costs were incurred on these projects, with the result that no Audit Certificates or Reports of Review are required. Accordingly, we will use your letter as the basis for releasing the obligated funds and closing the accounts the same as if the Rescission of Exploration Project Contract form had been used.

Your Audit Report and Certificate on Idm-E16, DMA-1094, Naildriver Mining Company is acceptable and may be distributed. Also, please advise Mr. Finch that his Report and Certificate on Idm-F100, DMA-1099, United Park City Mines also has been accepted and distribution may be effected.

Sincerely yours,

(Signed) E. D. Talbert

E. D. Talbert, Acting Chief
Contract Administration
and Audit Division

EDTalbert/wb
October 23, 1953

Copy to: Docket
Admr. Reading File
Mr. Chambers

R.C. 10-23-53

C
O
P
Y

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

October 13, 1953

Mr. Thomas H. Brading
DMEA Auditor
224 New Customhouse Building
Denver 2, Colorado

Dear Mr. Brading:

In reviewing the terminated and completed exploration projects in Region IV, it appears there are several "be-whiskered" ones for which neither Reports of Review nor Audit Reports have been issued. These are:

Idm-E71	DMEA-789	Erickson & Baer
" E260	" 1931	White Canyon Mining Co.
" E458	" 1549	Mathis & Mathis

The Erickson & Baer contract apparently was completed on August 18, 1953 except for the disposition of equipment; the White Canyon Mining Co. contract was terminated before completion of the work by notice dated March 2, 1953; and the Mathis & Mathis contract was terminated before completion of the work by notice dated March 6, 1953. Every effort should be made to close these accounts by final audit or review, so that the obligated funds may be released.

Please advise the present audit status of these contracts.

There is one other "old" termination in Region IV, that is the Kenneth L. Porter contract, Idm-E124, DMEA-1318, which was the subject of your letter of August 28, 1953. I am planning on sending an auditor from the Washington office to New York for this audit, but, in view of the small amount involved, a trip for this purpose alone is not justified. Therefore I am delaying the proposed audit until late November or December, when we expect to perform a few audits in New England. Please, however, keep me currently informed on the progress of the property disposition under this contract.

Sincerely yours,

(Signed) J. L. Chambers
Jay L. Chambers, Chief
Contract Administration
and Audit Division

EDTalbert/wb
October 13, 1953

Copy to: Docket
Admr. Reading File
Mr. Ellis
Mr. Griswold
Mr. Chambers

Mining Division
Region IV

DEPARTMENT OF THE INTERIOR
Defense Minerals Administration
RECEIVED
MAR 12 1953

March 26, 1952

Memorandum

To: Field Team, Region IV

From: Acting Chief, Mining Division, Region IV

Subject: Final Report, DMEA Docket 1989, Mathis & Mathis, Houston-Thomas Zinc-Lead Claims, West Pinos Altos District, Grant County, New Mexico

Enclosed are eight copies of the Engineering Report by T. M. Ramsle of the Bureau of Mines on subject application. Eight copies of the Geologic Report by C. S. Bromfield of the Geological Survey are also enclosed.

The project consists of drilling a minimum of 15 holes to test certain geologically favorable targets on structures similar to those that have localized ore bodies.

The estimated cost of the project is $28,362.40.

We concur with the conclusion of the examining engineers that the proposed drilling has a reasonable geologic chance of ore discovery and we recommend that the application be approved.

W. H. King
W. H. King

Reviewed by
DMEA OPERATING COMMITTEE
3-16-53
(date)

Min
Dai
MAR
Denver, Colo.

February 27, 1952

Memorandum

To : W. H. King, Denver, Colorado

From : Chief, Arizona-New Mexico Branch

Subject : Final Report, DMEA Docket 1549, Mathis & Mathis Houston-Thomas Zinc-Lead Claims, West Pinos Altos District, Grant County, N. Mex.

Enclosed are original and 7 copies of the section on Summary, Conclusions and Recommendations by C. E. Brenfield of the Geological Survey and T. M. Romalo of the Bureau of Mines, and the section on Engineering by Romalo for the above report. A separate report on Geology will be submitted by the Geological Survey.

This report has my approval.

~~Brochure is enclosed.~~

Walter R. Storms

CC W. H. King (7)
C. A. Anderson
DMEA-1549
DF

WRStorms:als

Reviewed by
DMEA [illegible]
(Date)

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS ADMINISTRATION
WASHINGTON 25, D. C.

700 New Customhouse
Denver 2, Colorado

March 24, 1952

Memorandum

To: DMEA Field Team, Region IV

From: A. H. Koschmann

Subject: DMEA Docket 18497, Houston-Thomas Claims (Mathis and Harris), Grant County, New Mexico (Lead-Zinc)

Enclosed are the original and 8 copies of the geologic report by C. H. Bromfield of the U. S. Geological Survey covering the above docket.

It has been recommended that the loan be approved.

The brochure is enclosed.

A. H. Koschmann
A. H. Koschmann
Supervising Geologist
Colorado-Wyoming

Enclosures (X)

Reviewed by
DMEA OPERATING COMMITTEE

(Date)

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
P.O. Box 4126, University Station
Tucson, Arizona

March 19, 1952

Memorandum

To: A. H. Koschmann, Denver, Colorado

From: A. F. Shride, Tucson, Arizona

Subject: Geologic Report, DMEA 1549X, Houston-Thomas Claims (Mathis and Mathis), Grant County, New Mexico (Lead-Zinc)

Enclosed are the original and 8 copies of the above report by C. S. Bromfield of the Geological Survey.

This report and the recommendations favorable to a diamond-drilling program have my approval. The recommendations are based largely on past successful interpretations of gossans and geologic structure in the area. The applicant has been one of those operators successful in such interpretation.

The brochure is enclosed.

A. F. Shride
Acting District Supervisor
Arizona-New Mexico

Enclosures 10

UNITED STATES
DEPARTMENT OF THE INTERIOR
OSCAR L. CHAPMAN, SECRETARY

DEFENSE MINERALS EXPLORATION ADMINISTRATION

REPORT OF EXAMINATION BY FIELD TEAM
REGION IV

DMEA-1547. Mathis & Mathis Hanaton-Thomas Zinc-Lead Claims

West Pinos Altos District, Grant County, N. Mex.

C. S. Bromfield, Geologist
U. S. Geological Survey

T. M. Rennie, Mining Engineer
U. S. Bureau of Mines

February 1952

Reviewed by
DMEA OPERATING COMMITTEE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

By C. S. Brenfield[1] and T. M. Romale[2]

The Houston-Thomas zinc-lead property, Grant County, N. Mex., was examined in connection with a request for Government exploration assistance by Mathis and Mathis, P. O. Box 452, Silver City, N. Mex. The examination was made by the Defense Minerals Exploration Administration under docket DMEA-1549M, as part of its program authorized by the Defense Production Act of 1950. It was made to determine if a proposed exploratory project warranted financial participation on the part of the Government.

Carbonate ores of zinc and lead formerly were produced from the property. At 2 places, zinc-lead sulfide ores were encountered below the carbonate ores and several thousand tons of sulfide ore was produced from these deposits prior to 1947. In 1947, a new discovery of sulphide ore was made by the Bureau of Mines (West Pines Altos Project 15-203). The deposit, the Atlas no. 2, was opened in 1947. It, and a nearby deposit discovered by the applicant, has yielded 31,460 tons of ore containing 8.43 percent zinc, 2.2 percent lead, 0.2 percent copper and 2.45 ounces of silver a ton. During 1951, the applicant discovered another mineralized zone by diamond drilling from the surface. An adit is presently being driven to this indicated ore zone.

In the Houston-Thomas area, Pennsylvanian Magdalena limestone, Cretaceous Beartooth quartzite, and Colorado shale are intruded by

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1/ Geologist, U. S. Geological Survey
2/ Mining Engineer, U. S. Bureau of Mines

dikes, sills, and irregular masses of diorite porphyry. Zinc-lead ore occurs in tabular replacement deposits usually oriented with the bedding in the Magdalena limestone. The ore bodies are localized by prominent northwesterly striking fractures and shear zones, and also are commonly near dikes and irregular crosscutting bodies of diorite porphyry. Several gossan areas, some quite extensive, are in the area. Some gossans evidently are not underlain by sulfide ore, and some are. With present knowledge, the presence or absence of a gossan is inconclusive evidence for the presence or absence of ore. The sulfide ore consists of sphalerite (marmatite), galena, chalcopyrite, and pyrite.

Present production of about 300 tons of ore monthly is confined to the Atlas no. 2 mine. The ore is shipped to a mill of the American Smelting and Refining Co. at Deming, N. Mex. The returns on average grade ore, before mining costs, are about $13.36 a ton. At present, the mining costs are about $8.00 a ton. The ore is of a slightly lower than average grade. In addition to the current mining operation that employs 3 men, 2 men are engaged in driving an adit to the new ore discovery and 2 men are operating a core-drill on both surface and underground explorations.

The proposed exploration consists of putting down one or more core holes in each of 15 areas where geologic structures and surface features are favorable to ore mineralization at depth. It is estimated that the depth of drill holes will range from 100 to 300 feet, and that

5,000 feet of drilling will be required. It is planned to use 2 diamond drill rigs and to complete the drilling in 10 months at an estimated cost of $28,362.40.

The writers have concluded that the project is technically feasible and that the applicant can be expected to carry out the work in a competent manner. They also have concluded that geologic conditions are favorable for discovery of small replacement ore bodies of the type now being economically exploited.

It is recommended that the proposed exploratory project be carried out and that 50 percent of its estimated cost of $28,362.40, (or $14,181.20) be financed by the Government.

MATHIS & MATHIS
HOUSTON-TEXAS CLAIMS
WEST PINOS ALTOS DISTRICT
GRANT COUNTY, NEW MEXICO
DNEA 154X

ZINC-LEAD

Geology

By Calvin S. Bromfield
Geologist, U. S. Geological Survey

MATHIS & MATHIS
HOUSTON - THOMAS CLAIMS
WEST PINOS ALTOS DISTRICT
GRANT COUNTY, NEW MEXICO
DMEA 15-6X

ZINC-LEAD

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2	Claim Map	" " "
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INTRODUCTION

The Houston-Thomas claims are in the West Pinos Altos district, Grant County, New Mexico. In the area of the claims zinc-lead limestone replacement bodies are localized along igneous contacts and high-angle northeast trending fractures.

ROCKS

The sedimentary rocks in the area of the Houston-Thomas claims consist of the Pennsylvanian Magdalena limestone, and Cretaceous Dakota quartzite and Colorado shale. The Magdalena limestone dips gently eastward under the area and is unconformably overlain by Dakota quartzite and Colorado shale.

The sedimentary rocks occur as isolated bodies surrounded and underlain by a diorite porphyry mass. Available geologic data indicate that the diorite porphyry mass is probably a thick laccolithic body or bulge on a sill which underlies an extensive area. Drilling to a depth of 1100 feet in the area of the Atlas No. 2 mine failed to find the bottom of the diorite porphyry body. Numerous dikes, sills, and irregular bodies of diorite porphyry and andesite porphyry cut the sediments.

STRUCTURE

The detailed structure of the district appears simple as shown on available small scale maps. Recent work by mining companies, however, reveals many complexities.[1]

1/ Harmon, R. E., et al., Geology and Ore Deposits of the Silver City Region, New Mexico, Guidebook Field Trip No. 3, West Texas Geol. Soc. and Southeastern New Mexico Section AIME, p. 39, 1949.

A reverse or thrust fault is indicated by Bureau of Mines drilling in the northern part of the area.[2] It strikes northwest and dips southwest. The fault is pre-intrusive and pre-ore; however, the geometry of the fault is poorly understood.

A major northeast trending, west dipping normal fault, known as the Houston-Thomas fault, crosses the area of the claims (Fig. 3). The fault has approximately 300 feet of vertical displacement. There are many minor faults and shear zones of parallel northeasterly trend and steep northwesterly dip; these faults were important in localizing the ore. Steeply dipping cross-fractures of northwesterly trend and small displacement can be observed in the stopes.

2/ Soule', J. H., West Pinos Altos Zinc-Lead Deposits, N. M. Bur. of Mines Rept. Inv. 4237, p. 6, 1948.

ORE DEPOSITS

The important ore bodies in this area are tabular zinc-lead replacement bodies oriented parallel to the bedding in the Magdalena limestone. The ore bodies are associated with fractures of northeasterly trend and are also commonly associated with dikes of diorite porphyry or andesite.

The largest production in the general area has come from the Cleveland Mine which adjoins the Houston-Thomas claims on the south. This mine, now dormant, has produced 134,000 tons of zinc-lead ore.

Ore bodies on the Houston-Thomas group include the Atlas No. 1, Atlas No. 2, and the Houston-Thomas ore bodies. The combined production from the Houston-Thomas and Atlas No. 1 ore bodies was only 11,031 tons. The Atlas No. 2 mine has produced 31,460 tons of ore up to February, 1952.

Previous exploration has had some success in the area. The Atlas No. 2 ore body was discovered through diamond drilling by the Bureau of Mines on a gravity anomaly determined from a geophysical survey by the applicant. The deposit is in limestone along and near the west side of a dike and over a diorite porphyry mass. Steep westerly dipping, northeasterly trending fractures can be observed in the back of the stope. The stope has a length of 230 feet paralleling the dike and the northeast fractures, a maximum width of 90 feet, and a maximum thickness of 30 feet. The applicant discovered additional ore by drifting 175 feet easterly through the dike. Two recent drill holes approximately 300 feet south of the Atlas No. 1 mine penetrated

8 and 11 feet of ore respectively at a depth of 66 feet. Where they penetrated ore they were 25 feet apart horizontally. At the time of the examination the applicant was driving an adit into this ore from the south (Fig. 3).

Several gossans, some quite extensive, outcrop in the area. The main ones include the Cleveland gossan area, Southern gossan area, Central gossan area, and Northern gossan area (Fig. 3). Some oxide ore has been produced from each of these gossan areas. In the Pinos Altos district some gossans reflect an underlying ore body, but some apparently represent completely oxidized deposits which are not underlain with sulphide ore. Some ore bodies may be hidden and not reflected by gossans at the surface. Small amounts of iron oxides along northeast fractures may indicate "leakages" of mineralization above concealed replacement ore bodies. Not enough geological detail is known in the area to interpret the meaning of a gossan in terms of possible ore at depth.

The primary ore consists chiefly of iron bearing sphalerite (marmatite), galena, pyrite, and chalcopyrite. Silver occurs in amounts ranging from one to 5 ounces a ton, and gold is present in insignificant amounts. The gangue is chiefly carbonates and silica.

The grade of ore mined in the Atlas No. 2 mine has averaged 8.43 percent zinc, 2.2 percent lead, 0.2 percent copper, and 2.45 ounces of silver per ton. Ore from the Houston-Thomas mine was of a similar grade.

The sedimentary rocks have not been markedly altered adjacent to intrusions. Epidotization and some garnetization have been observed.

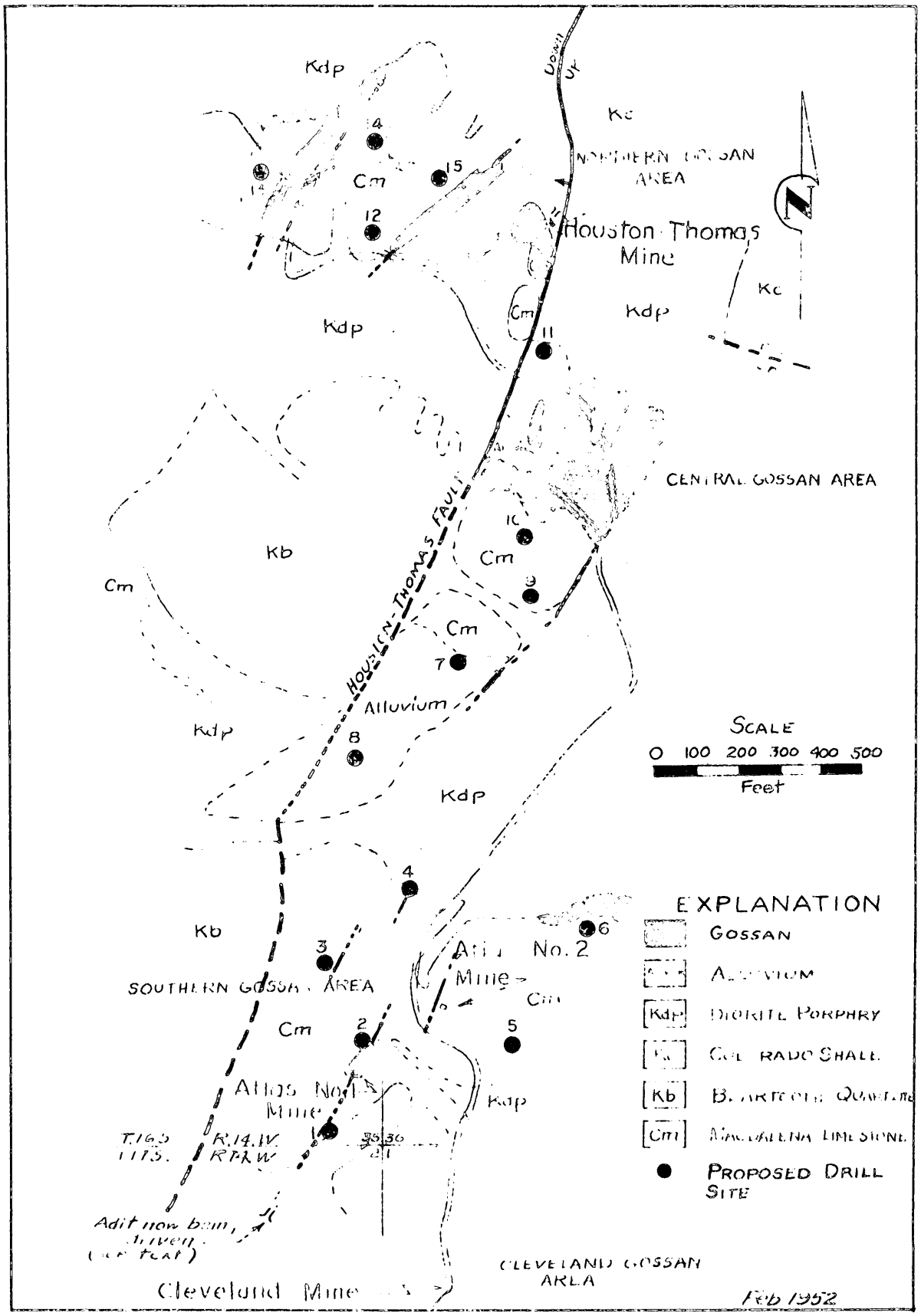

Figure 3. - Geologic Map Showing Location of Proposed Diamond Drilling
DMEA 1549 X

PROPOSED DRILLING PROGRAM

The applicant plans a minimum of 15 diamond drill holes on 15 targets, with additional holes to be drilled where indicated by results of early work. The general location of holes is shown on Figure 3. Individual holes would reach a maximum depth of 300 feet, and would probably average 150 to 200 feet. The program proposes a total of 5000 feet of drilling. The 15 sites are on geologically favorable targets which include northeast trending fractures and shear zones, limestone-diorite porphyry contacts, potential sulphide bodies indicated by gossans, and combinations of these.

As drilling progresses it probably would be desirable to drill more than one hole on certain of the 15 targets. These might include holes to obtain better intersections based on completed drilling results, to further test ground where some indications of mineralization are encountered, or, if mineralization of ore grade is penetrated, to better indicate the significance of the discovery.

Targets to be tested by each of the initial holes are outlined as follows:

DDH No.	Target
1	To test area on strike with recently discovered mineralization.
2	To test below gossan-carbonate ore of Atlas No. 1 mine at intersection of northwest fractures with underlying limestone-diorite porphyry contact.
3	To test northwest fracture and limestone intersection at depth.
4	New drilling; gossan on northwest structure near diorite porphyry contact; probably another hole in this area.

DDH No. (cont'd.)	Target
5	To test along extension of Atlas No. 2 structure to south.
6	To test gossan-lime-diorite contact at depth.
7	To test for limestone under diorite near outcrop of fissure containing galena.
8	Small outcrops of epidotized limestone; some galena in pity test structure at depth.
9	To test limestone-Houston-Thomas fault contact at depth. Iron oxide stains at surface.
10	To test limestone-gossan contact at depth. Lead carbonate ore in gossan-dike contact at surface.
11	To test a limestone-gossan contact at depth.
12	Lead carbonate in gossan at surface. Test at depth.
13	To test strong northeast structure at depth. Some gossan.
14	To test northeast fractures at depth. Iron oxide along fractures at surface.
15	To test under gossan along strong northeast fault.

GEOLOGIC CONCLUSIONS

Replacement lead-zinc bodies of tabular shape occur localized along steep northeast trending fractures in limestone. They are usually near igneous contacts. From existent knowledge of occurrence gossans may or may not reflect underlying ore bodies. Gossans have overlain the Cleveland, Atlas No. 1, and Houston-Thomas mine and lie within the gravity anomaly that reflected the underlying Atlas No. 2 mine. The applicant proposes to drill a minimum of 15 holes to test certain geologically favorable targets, including northeast trending fractures and shear zones, limestone-diorite porphyry contacts, ground underlying gossans, and combinations of these. These targets are on structures similar to those that have localized known ore bodies, and present a reasonable geologic chance of discovery.

The history of drilling in the area is encouraging. Recent drilling by the applicant has encountered ore grade material southwest of the Atlas No. 2, and past drilling by the Bureau of Mines was successful in discovering the Atlas No. 2 ore body. The applicant is a trained geologist and an experienced mine operator, and is, through his experience in the district, familiar with the geological controls for ore. The applicant has demonstrated his ability to find additional ore by this knowledge. The ground is amenable to drilling and core recovery in limestone and diorite porphyry is at least 75-80 percent, and in ore over 90 percent.

It is concluded that the proposed drilling has a reasonable chance of discovering small replacement ore bodies of zinc-lead of the magnitude of the Atlas No. 2 (30,000 tons), and it is recommended that the loan be approved.

MATTIE & MATHIS HORSECH-THOMAS ZINC-LEAD CLAIMS
WEST FORK LEWIS DISTRICT, GRANT COUNTY, N. MEX.
DMMA-1349

Engineering Report

By T. M. Rosalo
Mining Engineer
U. S. Bureau of Mines

February 1958

MATHIS & MATHIS HOUSTON-THOMAS ZINC-LEAD CLAIMS
WEST PINOS ALTOS DISTRICT, GRANT COUNTY, N. MEX.
DMRA-1549

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INTRODUCTION

The examination was made of the Houston-Thomas zinc-lead property in Grant County, N. Mex. in connection with an application for Governmental exploration assistance by R. W. Mathis, one of the partners of Mathis and Mathis, P. O. Box 452, Silver City, N. Mex. It was made by the Defense Minerals Exploration Administration, under docket DMEA-1545K, as part of its program authorized by the Defense Production Act of 1950. The object of the examination was to determine if the Government would be justified in participating with the applicant in an exploratory program designed to discover new deposits of zinc-lead ore. This report contains factual information obtained during the course of the examination and presents conclusions and recommendations as they pertain to the Defense Minerals Exploration Administration.

The applicant proposed to diamond-drill a minimum of 15 holes for a total of 5,000 feet. It was estimated the work could be completed in 25 weeks at a cost of $21,618.20. During the investigations these estimates were revised to completion of the project in 10 months at a cost of $28,362.40.

The property was examined February 13, 1952 by T. M. Romslo, Bureau of Mines, who on the following day completed the examination with C. S. Bromfield, Geological Survey. R. W. Mathis, the applicant, was present on both days of the examination.

[illegible]

An examination was made of the [illegible] home rehabilitation program in Nueces County, Texas. An examination was made of application for [illegible] general application materials [illegible], facilities, and the personnel of [illegible] and [illegible], Corpus Christi, Texas. It was made by the [illegible] Financial Administration [illegible] Section, Home Owners' Loan Corporation, as part of the program authorized by the National Housing Act of 1934. The purpose of the examination was to determine if the Corporation [illegible] the institution [illegible] the application of an applicant [illegible] home owner [illegible] to discover any defects in structure, etc. This report contains the final information obtained during the course of the examination and presents a discussion of the examination as they relate to the personnel either in inspection or administration.

The application procedure [illegible] a maximum of $1,500 for a period of 7,000 days. It was estimated the work could be completed in 30 weeks at a cost of $1,[illegible]. [illegible] investigations [illegible] estimates were revised to conformity of the project in 10 weeks at a cost of $[illegible].

The property was inspected February 6, 1934 by [illegible] Bonnie, Bureau of Plans, who on the following day completed the examination with [illegible] Financial [illegible] Section, [illegible], the applicant, the present [illegible] and [illegible].

ACKNOWLEDGMENTS

Much of the information contained in this report has been taken from the following 2 Bureau of Mines' publications: Report of Investigation 4237, West Pinos Altos Zinc-Lead Deposits, Grant County, N. Mex, by John H. Soule', and I. C. 7524, Mining Methods and Costs at the Atlas No. 2 Zinc-Lead Mine, West Pinos Altos Mining District, Grant County, N. Mex. by Walter R. Storms.

LOCATION AND ACCESSIBILITY

The property is about 6 air-miles north of Silver City, N. Mex., the county seat of Grant County (fig. 1). Silver City is on U. S. Highway 260 and is serviced by a branch line of the Atchinson, Topeka and Santa Fe Railroad. This line connects with the main line of the Southern Pacific Railroad at Deming, about 50 miles to the southeast, and connects with the ElPaso - Albuquerque branch of the Santa Fe at Rincon, about 40 miles northeast of Deming.

The property is reached from Silver City by traveling north on the Little Walnut road to a junction in the road that is reached just before entering the Little Walnut picnic grounds of the Gila National Forest. The road to the right at the junction is followed to its end at the Houston-Thomas mine, near the northern boundary of theproject area. The total distance from Silver City is about 10 miles; the first 2 miles are paved and the remainder is a well-maintained dirt road.

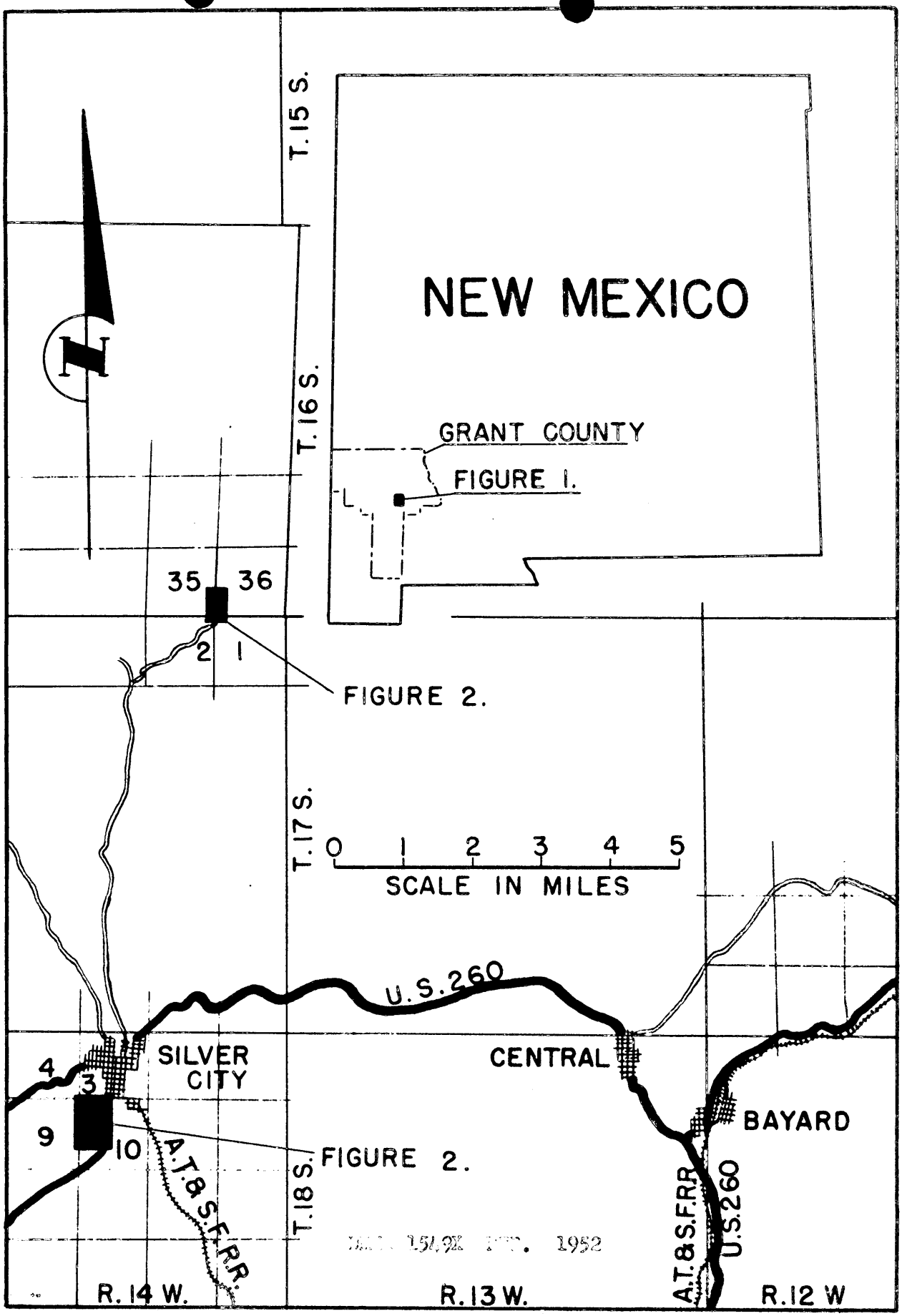

FIGURE 1 LOCATION MAP, [illegible]

PHYSICAL FEATURES AND CLIMATE

The property is on the western slope of the Pinos Altos Mountains. These form a range about 5 miles long in a north-south direction. They are approximately 3 miles wide. The mountains locally are rugged and attain a peak altitude of 8,036 feet above sea level. The property is at an average altitude of about 7,250 feet in an area of moderately rugged terrain with a range in relief of about 400 feet.

The climate is typical of the higher altitudes of southern New Mexico. The temperatures, moderate to cold, range from an estimated 0° F. to 90° F. The estimated annual precipitation of about 20 inches occurs as heavy rainfalls in the summer, and fairly heavy snowfalls during the winter.

There are no permanent streams in the area. The mines make little or no water and there are no nearby wells. All water for the proposed drilling project must be hauled from the domestic supply at Silver City.

Vegetation consists chiefly of ponderosa and pinon pine, juniper, scrub oak and range grasses. The ponderosa pine is not abundant but some of it is suitable for mine timber.

HISTORY AND PRODUCTION

Little is known about the early history of the Houston-Thomas property. It probably was worked for placer gold before 1905, and by that time a little oxidized lead ore had been shipped. About 1918, C. Amory Stevens opened the Stephens adit and shipped some carbonate and sulfide ore. G. F. Goodier produced over 7,000 tons of oxidized

lead ore from the same area during 1922 and 1923. The Empire Zinc Co. drilled several diamond drill holes on the property from 1928 to 1930. During the following few years, W. W. Slick is said to have operated the Slick gold mine.

E. O. Shepherd acquired the property in 1943 and started mining zinc-lead ores. Andrew E. Stewart purchased the property late in 1945 and worked a small gold-bearing vein for a few months.

Stewart leased the group of claims to Mathis and Mathis in 1946 and through the lessees, conducted a geophysical survey of the property. During 1946 and 1947, the Bureau of Mines put down 6 diamond-drill holes on the property for a total of 1,824 feet. Two of these holes encountered ore below an anomalous area of the geophysical survey. No ore mineralization was encountered by the other holes.

In 1947, the lessees sank a shaft, the Atlas No. 2, to the deposit found by the Bureau of Mines. Production from the deposit started in May 1947 and has continued to the present. Present pro duction is coming from a nearby deposit that was discovered by underground diamond drilling. During 1951, ore was encountered by 2 diamond-drill holes drilled from the surface at a point a few hundred feet southwest of the producing mine. At present an adit is being driven to intersect this deposit.

Total production from the Atlas No. 2 mine to January 1952 is 31,460 tons containing 8.43 percent zinc, 2.2 percent lead, 0.2 percent copper, and 2.45 ounces of silver a ton. A summary of production from

[illegible]

[illegible] drilling [illegible] drill holes on the property from 1944 to [illegible]. During the following few years, [illegible] which is said to have operated the [illegible] gold mine.

[illegible] acquired the property in 1951 and started mining [illegible]. Since it [illegible] operated for only four years in 1954 and worked a small gold-bearing vein [illegible] a few months.

Stanwell issued the group of claims to Lundin and Associates in 1969 and already [illegible] conducted a [illegible] field survey of the property. During 1970 and 1971, the Bureau of Mineral Resources drilled holes on the property for a total of [illegible]. In 1971, the [illegible] drilling [illegible] geophysical survey on the [illegible] and [illegible] discovered by the [illegible].

In 1971, the Bureau took a [illegible], the [illegible] to the [illegible] total of [illegible] of water. Production [illegible] amounts entered in the 1971 and [illegible] to the present. Interest in [illegible] is [illegible] a nearby deposit that was discovered by Barry Young [illegible] drilling. During 1971, ore was [illegible] by a [illegible] drill [illegible] a point a few hundred [illegible] the prospective [illegible] in which [illegible] to determine [illegible] such [illegible].

Total production [illegible] from [illegible] to January 1974 is [illegible] 10,000 tons of [illegible] with average grades [illegible], copper, and [illegible] ounces of silver a ratio of approximately [illegible]

the other areas on the property shows a total of 11,931 tons of which 1,018 tons was bismuth-bearing gold ore. Production records show that 2,687 tons of the remaining 10,913 tons of ore contained an average of about 8.0 percent zinc, 2.5 percent lead, 0.4 percent copper, and 4.4 ounces of silver and 0.02 ounce gold per ton.

PROPERTY AND OWNERSHIP

The property is a group of 13 patented lode mining claims in secs. 35 and 36, T. 16 S., R. 14 W., and secs. 1 and 2, T. 17 S., R. 14 W., of the West Pinos Altos mining district, Grant County, N. Mex. The location of a portion of the property that includes the project area is shown on figure 2. It is known as the Kruston-Thomas group of claims and is owned by Mrs. A. B. Stewart, of Grant County, N. Mex.

Mrs. J. B. Mathis, Sr., and her son R. W. Mathis, both of Silver City, N. Mex., held the above property under a lease agreement with the owner. The agreement, dated July 1, 1946, is for a 10-year period and calls for royalty payments of 10 percent of the net smelter returns on all ore produced from the property.

DESCRIPTION OF THE DEPOSITS

Limestone is the host rock for both carbonate and sulfide zinc-lead ores. The deposits of carbonate ores that were formerly worked, occur as gossans, some of which were quite extensive. The gossans probably represent the residium of exposed sulfide ore bodies. The ore minerals of the carbonate ores are smithsonite, cerussite and malachite.

[illegible]

[illegible]

[illegible]

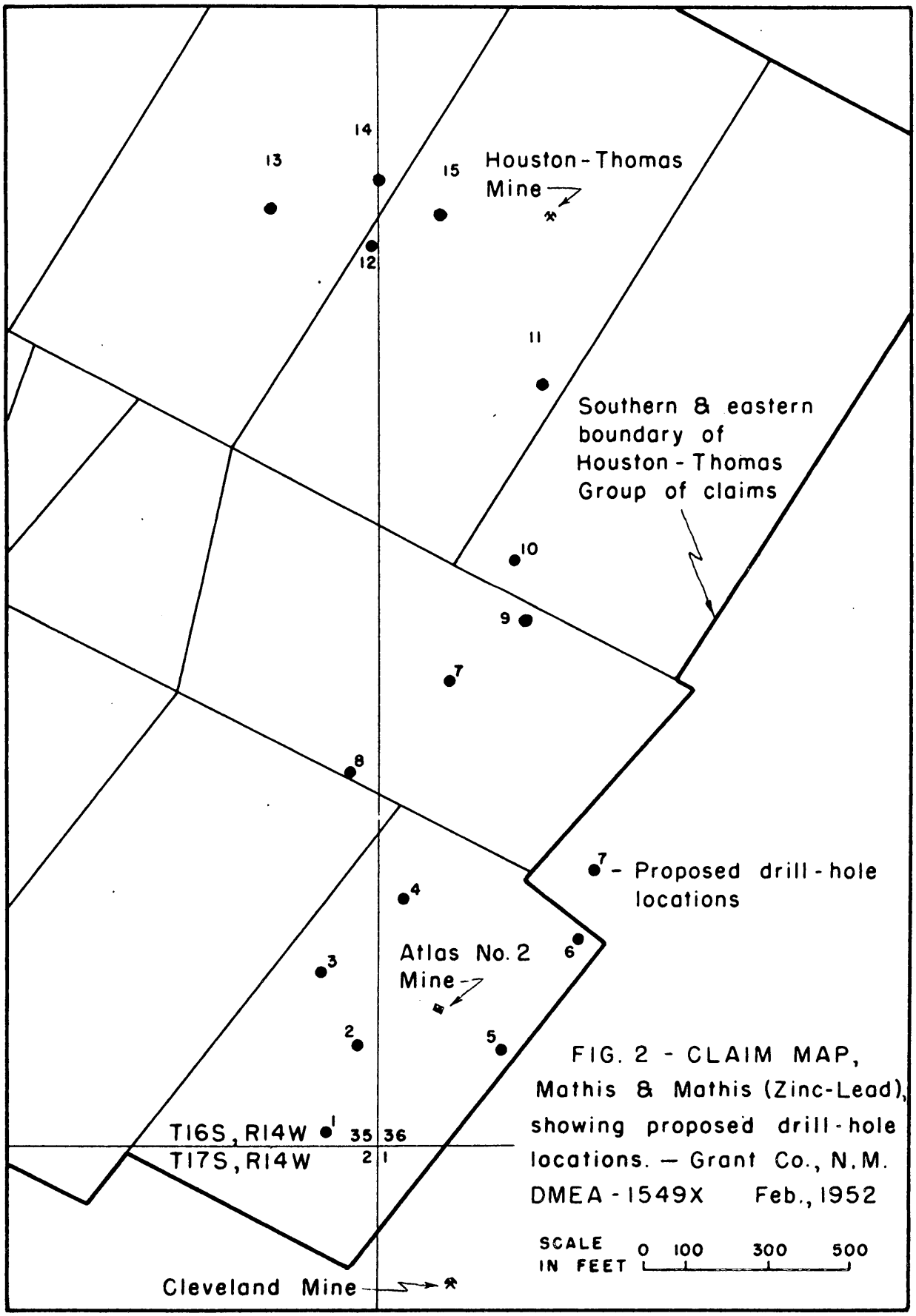

FIG. 2 - CLAIM MAP, Mathis & Mathis (Zinc-Lead), showing proposed drill-hole locations. — Grant Co., N.M.
DMEA-1549X Feb., 1952

The sulfide ore bodies occur usually as irregular, flat-lying, tabular deposits of the replacement type. They are localized along northeasterly-trending fissures, and contacts with igneous rocks. At the Cleveland mine, adjacent to the Houston-Thomas property, the largest stope measured almost 200 feet in length, 50 feet in width, and 15 feet high. The main ore body of the Atlas No. 2 mine, now being operated by the applicant, has maximum dimensions of 230 feet in length, 90 feet in width, and 30 feet in height.

The ore minerals of these sulfide deposits are marmatite, galena and a little chalcopyrite. Silver, probably associated with the galena, also is present.

PRESENT STATUS

Operations

About 300 tons of ore is presently being produced monthly from the small stope near the main deposit. The ore is mined by the open-stope method with small pillars left to support the roof. A complete report of the mining method is described by Walter R. Storms in Bureau of Mines I. C. 7524, Mining Methods and Costs at the Atlas No. 2 Zinc-Lead Mine, West Pinos Altos Mining District, Grant County, N. Mex. At present the ore is hauled by truck to Silver City and then transported by railroad to the mill of the American Smelting and Refining Co. at Deming, N. Mex.

The operations of Mathis and Mathis are supervised by R. W. Mathis. A total of 7 men are employed; a hoistman and 2 miners at the mine;

2 miners driving an adit to the recently discovered deposit; and 2 men on diamond drilling, both from the surface and underground workings.

The measured and indicated reserves of ore presently remaining in the Atlas No. 2 mine have been estimated by the applicant at about 1,500 tons.

Economics of Operation

The average ore produced from the Atlas No. 2 mine, i.e., 8.43 percent zinc, 2.2 percent lead, 0.2 percent copper, and 2.45 ounces of silver a ton, has a present smelter value, before deductions, of $21.02 a ton. After deductions per ton of $4.00 for treatment, $0.48 for freight, $1.16 for trucking, and $1.54 for royalty, the balance due the shipper is about $13.36. Thus, with mining costs at $8.00, ore of average grade would yield an operating profit of about $5.36 a ton. However, recent shipments have contained less than average grade ore and operating profits have dropped to about $3.00 a ton.

PROPOSED EXPLORATION

The proposed exploratory project consists of core-drilling a minimum of 15 holes, ranging in depths from 100 to 300 feet for an estimated total of 3,000 feet. Figure 3 shows the approximate locations of 15 proposed holes, each of which is in an area where structural features or surface indications are favorable for ore

mineralization at depth. These areas will not necessarily be drilled in the order that the holes are numbered. The drilling program in each area will be influenced by the results obtained as drilling progresses. The first hole to be drilled in each area will be put down at or near a location shown on figure 3. Additional drilling in each of the areas will be confined to favorable locations and to the partial delimitation of ore discoveries.

In event the Government participates financially in this project the examining engineers recommend that a statement to the following effect be made a part of the contract:

"Approval of a representative of the Defense Minerals Exploration Administration must be obtained for any drilling of targets other than those designated on figure 3."

ESTIMATED COST OF PROJECT

General

It is estimated that each of 2 diamond drill rigs will average about 10.5 feet of hole daily and that the 5,000 feet of hole can be completed in an estimated 240 working days, or 10 months. Each of the drill rigs will operate one shift daily, 6 days per week. Overtime for work in excess of 40 hours weekly will be at 1½ times the basic rate of pay.

R. W. Mathis proposes to supervise the project on a full-time basis and has agreed that all engineering and bookkeeping work shall be part of his duties. He has offered his services at the rate of $1.85 an hour.

[illegible]

[illegible]

[illegible]

Supervision

1 - Supervisor @ $1.85 an hour.
$96.20 per week or $384.80
per month.

10 months @ $384.80	$3,848.00	
Taxes, 10 percent	384.80	
Total supervision		$4,232.80

Labor

2 - Drillers, each @ $1.85 an hour.
Each at $96.20 per week or a
total of $769.60 per month.

10 months @ $769.60	$7,696.00
Taxes, 10 percent	769.60

2 - Drill helpers, each @ $1.50
an hour.
Each @ $78.00 per week or a
total of $624.00 per month.

10 months @ $624.00	$6,240.00
Taxes 10 percent	624.00
Total labor	$15,329.60

Equipment

All of the equipment for the project will be furnished by the applicant. It includes the following:

1 - Sullivan (JOY) No. 22 H.D. core-drill machine complete with water pump, AX drill rods, core barrels (1-rigid and 1-sectional B), tripod, sheave wheel, rod safety clamp, water swivel, water and sludge tank, hoses and tools $5,657.00

1 - Sullivan (Joy) No. 22 standard core-drill machine complete with water pump, AX drill rods, 5-foot rigid core barrel, tripod, sheave wheel, rod safety clamp, water swivel, water and sludge tanks, hoses and tools 3,983.00

1 - Dodge power-wagon truck with 1,000 gallon water tank	$1,000.00
Total value of equipment	$12,600.00

The allowance for depreciation of equipment with total depreciation at 5 years, would be $210.00 monthly or $2,100 for estimated life of project (10 months).

Supplies and Materials

Diamond bit cost for 5,000 feet of drilling @ $1.00 a foot	$5,000.00
Gasoline and lubricants	700.00
Repair parts for equipment	600.00
Total supplies and materials	$6,300.00

Other

Water for drilling, 250 loads of 1,000 gallons each @ $1.00	$ 250.00
Assaying	150.00
Total for other costs	$ 400.00

Recapitulation of Costs

Supervision	$ 4,232.80
Labor	15,329.60
Equipment	2,100.00
Supplies and materials	6,300.00
Other	400.00
Total estimated cost	$28,362.40

PROPOSED FINANCING

R. W. Mathis told the examining engineers that Mathis and Mathis are prepared to finance the project in accordance with regulations governing Governmental aid on exploratory projects. On this basis, the Government's share of the estimated cost of the project would be 50 percent of $28,362.40 or $14,181.20.

[illegible] water tank with [illegible] gallon water tank ..... [illegible]

[illegible] total value of equipment ..... [illegible]

[illegible] allowance for depreciation of equipment (the total [illegible] depreciation of [illegible] years, [illegible] is [illegible]) [illegible] for estimated life of project (10 years).

Supplies and Materials

[illegible] for the [illegible] 200 feet of drilling

[illegible] @ $[illegible] per foot ..... [illegible]

[illegible] for drilling ..... [illegible]

[illegible] for [illegible] equipment ..... [illegible]

Total supplies and materials ..... [illegible]

Other

Water [illegible] drill [illegible] 250 feet of 1.50 gallons

and [illegible] ..... [illegible]

[illegible] ..... [illegible]

Total for other costs ..... [illegible]

[illegible] of [illegible]

Engineering	[illegible]
Labor	[illegible]
Equipment	[illegible]
Supplies and materials	[illegible]
Other	[illegible]
Total estimated cost	[illegible]

[illegible]

[illegible] Indian tribe has expressed interest [illegible] and Metric are required to finance the project [illegible] [illegible] governing [illegible] laboratory [illegible]. [illegible] the estimated cost of the project would be in excess of [illegible] or [illegible].

CONCLUSIONS

1. Core-drilling is the most practicable method of exploring for ore deposits on this property. Good core recovery can be expected.

2. R. V. Mathis can be expected to carry out the proposed work in a competent manner. He understands the controls for ore deposition and has demonstrated his ability to discover sulfide ore bodies in the project area.

3. The chances of making additional ore discoveries in the project area are favorable. Furthermore it is reasonable to expect the ore will be of a grade similar to that now being produced.

4. In event a deposit of the magnitude of the Atlas No. 2 is discovered, it is reasonable to expect that it can be exploited by the applicant at a profit and will result in repayment of the Governmental loan.

RECOMMENDATIONS

It is recommended that the proposed exploratory project be carried out and that 50 percent of its estimated cost of $28,362.40, (or $14,181.20) be financed by the Government.

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

COPY

224 New Customhouse
Denver 2, Colorado

March 9, 1953

Memorandum

To: Secretary, Operating Committee
Defense Minerals Exploration Administration

From: Executive Officer, DMEA Field Team, Region IV

Subject: Final Report - Docket No. DMA 1549X, R. W. Mathis (Lead-Zinc), Grant County, New Mexico.

Enclosed are four copies of the final report on Docket No. DMA 1549X. The contract has been completed and is in force.

/s/ W. H. King

Enclosure

Reviewed by
DMEA OPERATING COMMITTEE
3-16-53
(Date)

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

224 New Customhouse
Denver 2, Colorado

March 9, 1953

DEPARTMENT OF THE INTERIOR
Defense Minerals Administration
RECEIVED
MAR 12 1953

Memorandum

To: Secretary to the Operating Committee
Defense Minerals Exploration Administration

From: Executive Officer, Field Team, Region IV

Subject: Termination of Contract Idm-E458, Docket No. DMA 1549X
Mathis and Mathis

Enclosed are three copies of Termination of Exploration Project Contract Before Completion of Work between the Government and Mathis and Mathis, Docket No. 1549X, Contract No. Idm-E458, dated October 23, 1952.

W. H. King

W. H. King

Enclosures

Cal
3-12

RECEIVED
MAR 18 1953
GENERAL COUNSEL
DEFENSE MINERALS
ADMINISTRATION

January 6, 1953

Memorandum

To: Miss Lanahan, Statistics and Control Div., DMEA

From: Hazel Berry, Operating Committee, DMEA (HB)

Subject: Region IV Contract

Attached is the docket copy of a contract executed in Region IV, under delegated authority, which has been reviewed and approved by the Commodity Division, Contract Administration and Audit Division, and the Legal Division:

Mathis and Mathis, DMEA-1549, Idm-E458.

cal 1/6/53

Attachment

Dockt Copy

DEPARTMENT OF THE INTERIOR
Defense Minerals Administration
RECEIVED
DEC 15 1952

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

224 New Customhouse
Denver 2, Colorado

December 10, 1952

REGISTERED # 59198

Memorandum

To: C. O. Mittendorf, Administrator, DMEA

From: Executive Officer, DMEA Field Team, Region IV

Subject: Contract Idm-E458, Docket DMEA 1549X, Mathis and Mathis

Enclosed are the original and two copies of Contract Idm-E458. Copies of this contract have been given to the operator, the Fiscal Officer, Region IV, and a copy has been retained for our files.

W. H. King

W. H. King

Enclosures

C a C
12.15

RECEIVED
JAN 2 1953
GENERAL COUNSEL
DEFENSE MINERALS
ADMINISTRATION

SURNAME COPY

Adams

Defense Minerals Exploration Administration
Robert E. Adams

2017

14X3923.970, Working Fund, Interior, DMEA
December 9, 1952
11:10 am

Bev.

W.H.King, Executive Officer, Region IV, 224 New Customhouse Bldg., Denver 2, Colorado

Assignment of Contract Number

REURTEL 12-8-52 MATHIS AND MATHIS, DMEA 1549X, CONTRACT NUMBER ASSIGNED

THIS CONTRACT IS IDM-E-458.

C. O. Mittendorf (fw)

ADMINISTRATOR

NS IN R&R

READams/meb
cc to: Adm.Reading File
Mails & Files Br.
Audits Division
Miss Curtin

SENT
DEC 9 1952

Clerical Service Section

Form 48

BUREAU OF MINES

SPECIAL

Mr. C. O. Mittendorf
December 8, 1952
3:15 P.M.

DEPARTMENT OF THE INTERIOR
Defense Minerals Administration
RECEIVED
DEC 9 1952

DN 235 BUREAU MINES 12-8-52 1-13 PM

C O MITTENDORF

ID NI-E 458

PLEASE ASSIGN A NUMBER TO CONTRACT COVERING DOCKET NUMBER DMEA 1549X A PARTNERSHIP CONSISTING OF R. W. MATHIS AND LETTIE MAE MATHIS, DOING BUSINESS AS MATHIS AND MATHIS, P. O. BOX 452, SILVER CITY, NEW MEXICO. COMMODITY ZINC, LEAD. CONTRACT DATED OCTOBER 23,1952. PROPERTY IN GRANT COUNTY, NEW MEXICO. AMOUNT OF GOVERNMENT PARTICIPATION $14,200.00. TOTAL AMOUNT OF CONTRACT $28,400.00.

50 4/0 W H KING

Denver, Colo.

DEC. 8 3 38 PM '52
BUREAU OF MINES
MAIL ROOM
WASHINGTON, D. C.

1-1027
(April 1946)

UNITED STATES
DEPARTMENT OF THE INTERIOR

AGENCY .....

TELETYPE

Originator:
Ext.: ..... Room: .....

Appro.:
Date: 12/8/52
Time:
No.:
To: C. O. Mittendorf DMEA Wash

DEPARTMENT OF THE INTERIOR
Defense Minerals Administration
RECEIVED
DEC 11 1952

Subject:

PLEASE ASSIGN A NUMBER TO CONTRACT COVERING DOCKET NO. DMEA 1549X, a PARTNERSHIP CONSISTING OF R. W. MATHIS AND LETTIE MAE MATHIS, DOING BUSINESS AS MATHIS AND MATHIS, P.O. BOX 452, SILVER CITY, NEW MEXICO. COMMODITY ZINC, LEAD. CONTRACT DATED OCTOBER 23, 1952. PROPERTY IN GRANT COUNTY, NEW MEXICO. AMOUNT OF GOVERNMENT PARTICIPATION $14,200.00. TOTAL AMOUNT OF CONTRACT $28,400.00.

W. H. King
W. H. KING

CONFIRMATION
Authorized: 9.7.5.

Sign original message and transmit to Room ..... in duplicate

U. S. GOVERNMENT PRINTING OFFICE 16—50915-1

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS ADMINISTRATION
WASHINGTON 25, D. C.

224 New Customhouse
Denver 2, Colorado

March 28, 1952

BS

Memorandum

To: Acting Administrator, Defense Minerals Exploration Administration - Attention: Code 210

From: Field Team, Region IV

Subject: Final Report, DMEA Docket 549, Mathis & Mathis, Houston-Thomas Zinc-Lead Claims, West Pinos Altos District, Grant County, New Mexico

Exploration assistance in the amount of $28,362.40 has been approved and the contract will be prepared by this office.

Four copies of the report will be forwarded you when contract is signed.

The original and one copy of Form 3b is attached.

J. H. East, Jr.

J. H. East, Jr.

A. H. Koschmann

A. H. Koschmann

Enclosures

Department of the Interior
Defense Minerals Administration
APR 7 1952

Copy of this memo. to Base Metals 4-7-52-DE

DMA Form 3b.

DEFENSE MINERALS ADMINISTRATION

CONTROLLED DOCUMENT
Revised Abstract

DMA Docket No. 1549

Change: From		To	
I 1	☐	I 1	☐
I 2	☐	I 2	☐
I 3	☒	I 3	☒
I 4	☐	I 4	☐
I 5	☐	I 5	☐
I 6	☐	I 6	☐
III 1	☐	III 1	☒ 3-27-52
III 2	☐	III 2	☐
III 3	☐	III 3	☐
III 4	☒	III 4	☐

Add:

II 7 $20,000

II 8 $ 28,362.40

II 8a %

DEPARTMENT OF THE INTERIOR
Defense Minerals Administration
RECEIVED
APR 7 1952

Initials of person preparing sheet H.M.C.

Date sheet prepared 3-27-52

DMA Form 3b.

DEFENSE MINERALS ADMINISTRATION

CONTROLLED DOCUMENT
Revised Abstract

DMA Docket No. 1549

Change: From		To	
I 1	☐	I 1	☐
I 2	☐	I 2	☐
I 3	☒	I 3	☒
I 4	☐	I 4	☐
I 5	☐	I 5	☐
I 6	☐	I 6	☐
III 1	☐	III 1	☒ 3-27-52
III 2	☐	III 2	☐
III 3	☐	III 3	☐
III 4	☒	III 4	☐

Add:

II 7 $20,000

II 8 $ 28,362.40

II 8a %

DEPARTMENT OF THE INTERIOR
Defense Minerals Administration
RECEIVED
APR 7 1952

Initials of person preparing sheet H.M.C.

Date sheet prepared 3-27-52

FILE COPY
SURNAME:

140

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

Rewritten by H. F. Keller

JUL 30 1952

Mr. W. H. King, Executive Officer
DMEA Field Team, Region IV
224 New Customhouse Building
Denver 2, Colorado

Subject: Docket No. DMA-1540X
Mathis and Mathis
Silver City, New Mexico

Dear Mr. King:

As requested in your letter of July 15, 1952, concerning the subject application, we are enclosing the following documents:

Original and five copies of the deed dated May 5, 1947, from B. O. Shepherd and Vera S. Shepherd to Andrew B. Stewart, covering certain patented lode mining claims in Pinos Altos Mining District, Grant County, New Mexico.

Original and six copies of the lease dated July 1, 1946, between Andrew B. Stewart and J. B. Mathis and R. W. Mathis, covering the aforesaid claims.

Six copies of "Landlord's Subordination Agreement," dated October 31, 1951, and signed by Louise B. Stewart, John D. Finch, and Daniel P. Nolting.

Although the Legal Department prefers the use of Form MF-203, "Owner's Consent to Lien," since the new contract is adapted to that form, they will approve the use of Form MF-202, "Landlord's Subordination Agreement," if the forms are already signed (as in this case) or if the owner refuses to sign Form MF-203.

In using Form MF-202, "Landlord's Subordination Agreement," delete "Owner's Consent to Lien" and substitute "Landlord's Subordination Agreement" in Article 2(b) in Exploration Project Contract Form MF-200.

We believe that with the enclosures you will be in a position to complete the proposed contract.

Sincerely yours, 7/30/52

(signed) FRANK E. JOHNSON

Chairman, Operating Committee (WB)

Enclosures

Approved:

J. H. Hedges

Member, Bureau of Mines (WB)

T. P. Thayer

Member, Geological Survey (WB)

HFKeller/AEKane/em
7/29/52
Copy to: Mails and Files
Adm. Reading File
Operating Comm.
H. F. Keller
Mr. McKnight
Mr. Bishop
J. L. Hofflund
A. E. Kane
chron.
pending

500

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

resubmitted 7/29/52 attorney

Mr. W. H. King, Executive Officer
DMEA Field Team, Region IV
224 New Customhouse Building
Denver 2, Colorado

Re: Docket No. DMA-1549X (Lead-Zinc)
Mathis and Mathis
Silver City, New Mexico

Dear Mr. King:

As requested in your letter of July 15, 1952, concerning the subject application, we are enclosing the following documents:

Original and five copies of "This Indenture", dated May 5, 1947, between B. O. Shepherd and Vera S. Shepherd and Andrew B. Stewart.

Original and six copies of "This Agreement", dated July 1, 1946, between Andrew B. Stewart and J. B. Mathis and R. W. Mathis.

Six copies of "Landlord's Subordination Agreement", dated October 31, 1951, and signed by Louise B. Stewart, John D. Finch, and Daniel P. Nolting.

Although the Legal Department prefers the use of Form MF-203, "Owner's Consent to Lien", since the new contract is adapted to that form, they will approve the use of Form MF-202, "Landlord's Subordination Agreement", if the forms are already signed (as in this case) or if the owner refuses to sign Form MF-203.

In using Form MF-202, "Landlord's Subordination Agreement", delete "Owner's Consent to Lien" and substitute "Landlord's Subordination Agreement" in Article 2(b) in Exploration Project Contract Form MF-200.

We believe that with the enclosures you will be in a position to complete the proposed contract.

Sincerely yours,

Chairman, Operating Committee

Enclosures
APPROVED:

Member, Bureau of Mines

Member, Geological Survey

FILE COPY
SURNAME:

500

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

HFKeller

resubmitted 7/29/52 ac Stone/em

Mr. W. H. King, Executive Officer
DMEA Field Team, Region IV
224 New Customhouse Building
Denver 2, Colorado

Re: Docket No. DMA-1549X (Lead-Zinc)
Mathis and Mathis
Silver City, New Mexico

Dear Mr. King:

As requested in your letter of July 15, 1952, concerning the subject application, we are enclosing the following documents:

Original and five copies of "This Indenture", dated May 5, 1947, between B. O. Shepherd and Vera S. Shepherd and Andrew B. Stewart.

Original and six copies of "This Agreement", dated July 1, 1946, between Andrew B. Stewart and J. B. Mathis and R. W. Mathis.

Six copies of "Landlord's Subordination Agreement", dated October 31, 1951, and signed by Louise B. Stewart, John D. Finch, and Daniel P. Holting.

Although the Legal Department prefers the use of Form MF-203, "Owner's Consent to Lien", since the new contract is adapted to that form, they will approve the use of Form MF-202, "Landlord's Subordination Agreement", if the forms are already signed (as in this case) or if the owner refuses to sign Form MF-203.

In using Form MF-202, "Landlord's Subordination Agreement", delete "Owner's Consent to Lien" and substitute "Landlord's Subordination Agreement" in Article 2(b) in Exploration Project Contract Form MF-200.

We believe that with the enclosures you will be in a position to complete the proposed contract.

Sincerely yours,

Chairman, Operating Committee

Copy to: Docket
Admr. R. File
Op. Com.
H. F. Keller
Mr. McKnight
Mr. Bishop
Chron.

Enclosures
APPROVED:

HFKeller/bjl(7/22/52)

Member, Bureau of Mines

Member, Geological Survey

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

224 New Customhouse
Denver 2, Colorado

July 15, 1952

Memorandum

To: C. O. Mittendorf, Acting Administrator
Defense Minerals Exploration Administration

From: Executive Officer, Field Team, Region IV

Subject: Docket DMA 1549X, Mathis & Mathis, Silver City, New Mexico (Lead and Zinc)

Enclosed is a copy of a letter from R. W. Mathis dated June 11, 1952. We wrote Mr. Mathis on May 14 enclosing six copies of Owner's Consent to Lien, Form MF-203, and requested a signed copy of his lease. We did not hear anything from him and wrote another letter on July 3 stating that we would cancel the application if we did not hear from him within 30 days.

According to the enclosed letter Mr. Mathis sent the only copy of his lease and six signed copies of Form MF-202 to Mr. T. B. Billings of the Lead-Zinc Branch in August, 1951. Please send the lease to this office.

If the Legal Department will approve use of the Landlord's Subordination Agreement in this instance in place of the Owner's Consent to Lien, kindly send the six copies of the Landlord's Subordination Agreements also. We will then be in a position to complete the exploration project contract between the Government and Mathis and Mathis.

W. H. King
W. H. King

Enclosure

JUL 21 1952

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS ADMINISTRATION
WASHINGTON 25, D. C.

224 New Customhouse
Denver 2, Colorado

July 15, 1952

Memorandum

To: C. O. Mittendorf, Acting Administrator
Defense Minerals Exploration Administration

From: Executive Officer, Field Team, Region IV

Subject: Docket DMA 1549A, Mathis & Mathis, Silver City, New Mexico (Lead and Zinc)

Enclosed is a copy of a letter from R. W. Mathis dated June 11, 1952. We wrote Mr. Mathis on May 14 enclosing six copies of Owner's Consent to Lien, Form MF-203, and requested a signed copy of his lease. We did not hear anything from him and wrote another letter on July 3 stating that we would cancel the application if we did not hear from him within 30 days.

According to the enclosed letter Mr. Mathis sent the only copy of his lease and six signed copies of Form MF-202 to Mr. T. B. Billings of the Lead-Zinc Branch in August, 1951. Please send the lease to this office.

If the Legal Department will approve use of the Landlord's Subordination Agreement in this instance in place of the Owner's Consent to Lien, kindly send the six copies of the Landlord's Subordination Agreements also. We will then be in a position to complete the exploration project contract between the Government and Mathis and Mathis.

W. H. King
W. H. King

Enclosure

JFS:ld

cc: Docket, chron.
Koschmann
Sterns
Shaw

COPY

MATHIS and MATHIS
Mining and Exploration
Box 452
Silver City, N. M.

July 11, 1952

W. H. King, Executive Officer
United States Department of the Interior
Defense Minerals Administration
224 New Customhouse
Denver 2, Colorado

Refer: Your Letter July 3, 1952

Dear Mr. King:

When we first made application for DMEA assistance in May of 1951, we included the one and only original copy of our lease.

In a letter of August 8, 1951, Mr. T. B. Billings of the lead-zinc branch, requested that we submit five copies of the lease and six copies of the "Landlord's Subordination Agreement", Form MF-202.

These requests were complied with. Apparently, you have the five copies of the lease. We can obtain a certified copy of the lease from the records in the court house if necessary, but we will surely appreciate it if you will make a supreme effort to find the original copy. It may be in Mr. Billings' office or some other which has handled it.

We do not understand why it should be necessary to obtain the owners' signatures on both the "Landlord's Subordination Agreement" and "Owners' Consent to Lien". It was only after extensive correspondence and explanation and some misgivings that the owners signed the "Landlord's Subordination Agreement". We couldn't put up a very convincing explanation why they should duplicate this lien if we do not know ourselves. However, if it is absolutely necessary to have the "Owner's Consent to Lien" in addition to the "Landlord's Subordination Agreement", let us know and we will make an effort to secure signatures on it.

Yours very truly,

/s/ R. W. Mathis

R. W. Mathis
MATHIS & MATHIS

RWM:1

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS ADMINISTRATION
WASHINGTON 25, D. C.

Mr. Ben Customhouse
Denver 2, Colorado

March 28, 1952

Memorandum

To: Acting Administrator, Defense Minerals Exploration Administration - Attention: Code 210

From: Field Team, Region IV

Subject: Final Report, DMEA Docket 3549, Mathis & Mathis, Houston-Thomas Zinc-Lead Claims, West Pinos Altos District, Grant County, New Mexico

Exploration assistance in the amount of $28,362.43 has been approved and the contract will be prepared by this office.

Four copies of the report will be forwarded you when contract is signed.

The original and one copy of Form 36 is attached.

J. H. Ent, Jr.

A. H. Koschmann

Enclosures

1952

Docket Copy

FILE COPY 500
SURNAME:

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS ADMINISTRATION
WASHINGTON 25, D. C.

Moulds
McKnight (Ryan)

JAN 9 1952

Mr. J. H. East, Jr.
Executive Officer, Region IV
DMEA Field Team
224 New Customhouse Building
Denver 2, Colorado

Re: Docket No. DMEA 1549X
Mathis and Mathis
Silver City, New Mexico

Dear Mr. East:

We are forwarding, herewith, the following material:

1 Copy - Form MF-100 with attached pamphlet "Gravity Prospecting for Lead and Zinc, New Mexico", "Geologic Map Houston-Thomas Prospect, Silver City, New Mexico", Plan of Atlas #2 Mine, and two typed pages relative to MF-100.

1 Copy - Form MF-103 with 4 typed pages relative to MF-103.

1 Copy - Letter from R. W. Mathis dated December 12, 1951 with attached revised page 3 of Form MF-103, "The Requirements and Costs".

1 Copy - Review of Application for Exploration Assistance.

The subordination agreements from the owners referred to in letter of December 12, 1951 have been supplied in satisfactory form to this office.

In that this application was filed in June and delayed by subordination requirements and information as to ownership, please review the project to the extent necessary according to attached memorandum as soon as conveniently possible and return the enclosed material with your recommendation.

Sincerely yours,

1-9-52

~~C. O. Mittendorf (for)~~
(signed) FRANK E. JOHNSON (for)
Chairman, Operating Committee
Defense Minerals Exploration
Administration

Enclosures
APPROVED:

DEMoulds/meh 1/5/52
cc to: Adm. R. Kile
Mails & Files
Mr. Mittendorf
Mr. East, Reg. IV
Mr. Moulds
Mr. Bishop
Mr. McKn Mote
Docket

Member, Bureau of Mines

Member, Geological Survey

JAN 9 1952

Mr. J. H. East, Jr.
Executive Officer, Region IV
DMEA Field Team
224 New Customhouse Building
Denver 2, Colorado

Re: Docket No. DMEA 1549A
Mathis and Mathis
Silver City, New Mexico

Dear Mr. East:

We are forwarding, herewith, the following material:

1 Copy - Form MF-100 with attached pamphlet "Gravity Prospecting for Lead and Zinc, New Mexico", "Geologic Map Rosston-Thomas Prospect, Silver City, New Mexico", Plan of Atlas #2 Mine, and two typed pages relative to MF-100.

1 Copy - Form MF-103 with 4 typed pages relative to MF-103.

1 Copy - Letter from R. W. Mathis dated December 12, 1951 with attached revised page 3 of Form MF-103, "The Requirements and Costs".

1 Copy - Review of Application for Exploration Assistance.

The subordination agreements from the owners referred to in letter of December 12, 1951 have been supplied in satisfactory form to this office.

In that this application was filed in June and delayed by subordination requirements and information as to ownership, please review the project to the extent necessary according to attached memorandum as soon as conveniently possible and return the enclosed material with your recommendation.

Sincerely yours,

~~C. O. Mittenbuhler~~

(signed) FRANK E. JOHNSON
Chairman, Operating Committee
Defense Minerals Exploration
Administration

Enclosures
APPROVED:

DEMgulds/mch 1/5/52
cc to: Adm. R. File
Mails & Files
Mr. Mittendorf
Mr. East, Reg. IV
Mr. Moulds
Mr. Bishop
Mr. Note
Docket

Member, Bureau of Mines

Member, Geological Survey

FILE COPY
SURNAME:

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS ADMINISTRATION
WASHINGTON 25, D. C.

110

JAN 9 1952

Moulds
McKnight (Ryan)

Mr. R. W. Mathis
Mathis and Mathis
P. O. Box 452
Silver City, New Mexico

Re: Docket No. DMA-1549X
Lead, Zinc

Dear Mr. Mathis:

Your application for assistance in exploring your property in Grant County, New Mexico, Docket No. DMA-1549X, has been reviewed by the Base Metals Division of the Defense Minerals Exploration Administration and has been referred to Mr. J. H. East, Jr., Executive Officer, DMEA Field Team, Region IV, 224 New Customhouse Building, Denver 2, Colorado, for a field examination.

The Regional office will contact you at the earliest opportunity in regard to your project.

Sincerely yours,

1-9-52

C. O. Mittendorf (fw)

Acting Administrator
Defense Minerals Exploration
Administration

COMittendorf/hb

Copy to: Adm. Reading File
Mr. Mittendorf
Mails & Files ✓
Mr. East, Region IV
Mr. Moulds
Mr. Bishop
Mr. Mote
Docket

JAN 9 1952

Mr. J. H. East, Jr.
Executive Officer, Region IV
DMEA Field Team
224 New Customhouse Building
Denver 2, Colorado

Re: Docket No. DMEA 1549X
Mathis and Mathis
Silver City, New Mexico

Dear Mr. East:

We are forwarding, herewith, the following material:

1 Copy - Form MF-100 with attached pamphlet "Gravity Prospecting for Lead and Zinc, New Mexico", "Geologic Map Houston-Thomas Prospect, Silver City, New Mexico", Plan of Atlas #2 Mine, and two typed pages relative to MF-100.

1 Copy - Form MF-103 with 4 typed pages relative to MF-103.

1 Copy - Letter from R. [illegible] dated December 14, 1951 with attached revised page 3 of Form MF-103, "The Requirements and Costs".

1 Copy - Review of Application for Exploration Assistance.

The subordination agreements from the owners referred to in letter of December 12, 1951 have been supplied in satisfactory form to this office.

In that this application was filed in June and delayed by subordination requirements and information as to ownership, please review the project to the extent necessary according to attached memorandum as soon as conveniently possible and return the enclosed material with your recommendation.

Sincerely yours,

~~C. O. Mittendorf~~
(signed) FRANK E. JOHNSON

Chairman, Operating Committee
Defense Minerals Exploration
Administration

Enclosures
APPROVED:

Member, Bureau of Mines

Member, Geological Survey

DEMoulds/mak 1/5/52
cc to: Adm. R. File
Mails & Files
Mr. Mittendorf
Mr. East, Reg. IV
Mr. Moulds
Mr. Bishop
Mr. Mote
Docket

Mr. R. W. Mathis
Mathis and Mathis
P. O. Box 468
Silver City, New Mexico

Re: Docket No. DMA-4[illegible]
Lead, Zinc

Dear Mr. Mathis:

Your application for assistance in exploring your property in Grant County, New Mexico, Docket No. DMA-4[illegible], has been reviewed by the Base Metals Division of the Defense Minerals Exploration Administration and has been referred to Mr. J. M. East, Jr., Executive Officer, DMEA Field Team, Region IV, 20th New Customhouse Building, Denver 2, Colorado, for a field examination.

The Regional office will contact you at the earliest opportunity in regard to your project.

Sincerely yours,

Acting Administrator
Defense Minerals Exploration
Administration

CCMittendorf/hh

Copy to: Adm. Reading File
Mr. Mittendorf
Mails & Files
Mr. East, Region IV
Mr. Moulds
Mr. Bishop
Mr. Mots
Docket ✓

Defense Minerals Exploration Administration

Review of Application for Exploration Assistance

Mr. J. H. East, Jr.
Executive Officer, Field Team
Region IV
224 New Customhouse
Denver 2, Colorado

Docket No. DMA-1549X

Commodity Zinc, lead

Total Amount $20,000

Govt. Participation 50% ($10,000)

1. Name and Address of Applicant Mathis and Mathis, Box 542, Silver City, New Mexico.

2. Location of Property Houston-Thomas claims, secs. 35 and 36, T. 16, S., R. 14 W., Grant County, New Mexico

3. Mineral or metal Zinc, lead, silver copper Is it listed in Section 9 of MO-5? Yes
If not, application will be rejected.

4. Geologic probability of discovery—based on data in application (question #16, 17, 18, 20 and 22)*

Mines or Survey reports, etc., do you rate chances:

a) Good

b) Poor

c) None

d) Don't know—needs field examination X

e) Is there an alternative and favorable project?
(If so, attach an explanation)

5. Is the applicant's right to the property clearly stated? Yes
(question 5, 6, 7)*

6. If applicant is a lessee, is a copy of the lease attached? Yes

Does the lease have sufficient time to run to cover a future productive period? Yes

*question numbers are those of MF-103

7. Are subordination agreements necessary? **Yes**

a) MF-201? _____

b) MF-202 **Yes, attached**

8. From the data presented, does the proposed project appear feasible from the point of view of:

a) Available manpower **Yes**

b) Equipment and supplies **Yes**
(question 14 plus general knowledge of availability)*

c) Accessibility (question 12)* **Yes**

d) Water (question 13)* **Yes**

e) Power (question 13)* **Yes**

Is a field check needed on any of these points? **No**

9. Does the experience of the applicant appear to be adequate to assure that he can properly conduct the proposed project? (question 4)* **Yes**

Is a field check needed on this point? **No**

10. Exhibit A. (questions 21 and 22)*

a) Is the project adequately described? **Yes**

If not, are there sufficient data given so that you can describe the project? _____ If so, attach a draft.

b) Is there an adequate map or sketch of the proposed work? **Yes, but a field check is needed**

c) Is the proposed work "exploration" under the definition of Section 8, MO-5? **Yes**

If not, what part of it is? _____

Is this part a worth-while exploration project?_____

d) Are the cost estimates detailed? Yes

Can they be summarized, as on page 2 of Procedural Instruction 5-A, from the available data? Yes If so, attach a draft.

e) Are the cost estimates reasonable? Yes

f) Should more information be requested from applicant? Yes

g) Is a field examination necessary to complete Exhibit A? Yes

11. Exhibit B (question 23-d)*

a) Is it applicable? No

b) If so, are sufficient data furnished?_____ If so, attach a draft.

c) Is a field check needed? No

12. Exhibit C (question 23-e, f and g)*

a) Is it applicable? Yes

b) Sufficient data? No If so, attach a draft.

c) Are rents and charges reasonable? Yes

d) Is a field check needed? Yes

13. Exhibit D (question 23-a, b)*

a) Are there sufficient data? Yes

b) Is the schedule adequate for the work proposed? Yes

c) Is the schedule excessive for the work proposed? No

d) Are the proposed wages and salaries reasonable? Yes

e) Is a field check needed? No

14. Exhibit E (question 23-c)*

a) Is it applicable? No

b) Sufficient data?

c) Reasonable?

d) Field check needed? No

15. In your judgment, can the proposed work be done in the proposed time? Yes

(All exploration must be completed within two years)

16. If field examination is not needed, attach your recommendation.

17. If field examination is needed, do you have any special instructions for the field team not indicated by your answers to the foregoing question? **An examination of the proposal in the field is needed in order to evaluate the selected drill sites in relation to geology and mineralized fissures. It is possible that some modification of the program is required. Inasmuch as the project lies within a district under current detailed study by the Geological Survey, information should be available for a quick appraisal of this project.**

Reviewed by: E. L. Newcomb GS 12-29-51
O. M. Bishop, BM

Date 1-2-52

MATHIS AND MATHIS
MINING AND EXPLORATION
P. O. BOX 452
SILVER CITY, NEW MEXICO

Defense Minerals Administration
RECEIVED
DEC 1 1951

December 12, 1951

Mr. C. O. Mittendorf
Acting Administrator
Defense Minerals Administration
Washington 25, D. C.

Re: Docket No. DMA 1549X

Dear Sir:

In reply to your letter of December 7, 1951, we wish to submit the following information:

Andrew B. Stewart, original lessor of the Houston-Thomas claims, is now deceased. Mrs. Louise B. Stewart, wife, and John D. Finch and Daniel P. Nolting are his sole heirs.

The purchase agreement dated November 23, 1945 between B. O. Shepherd and Andrew B. Stewart has been succeeded by a deed dated May 5, 1947, a copy of which is enclosed.

We enclose a list of the core-drilling equipment to be used and the value thereof.

In view of your ruling on the allowance of a monthly depreciation value only and in consideration of recent increases in wages in this district we wish to submit the enclosed page 3 of Form Mf-103 as a corrected substitute for the original.

Yours very truly,

R. W. Mathis

R. W. Mathis
MATHIS & MATHIS

RWM:1

FILE COPY
SURNAME:

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS ADMINISTRATION
WASHINGTON 25, D. C.

Moulds
Mittendorf

DEC 7 - 1951

Mr. R. W. Mathis
Mathis and Mathis
P. O. Box 452
Silver City, New Mexico

Re: Docket No. DMA 1549X

Dear Mr. Mathis:

With respect to your application for Government aid in connection with an exploration project, your attention is called to the following:

The Landlord's Subordination Agreement was signed by Mrs. Louise B. Stewart, apparently the wife of Andrew B. Stewart, the party who leased to you the mineral rights covered by agreement dated July 1, 1946, and by John D. Finch and Daniel P. Nolting. The signature of the above referred to, Andrew B. Stewart, does not appear on the subordination agreement. We surmise that Andrew B. Stewart is now deceased and that the parties who signed the subordination agreement represent his heirs. Is this the true situation? If so, do the three parties signing the agreement represent all of his heirs?

Your lease agreement refers to a purchase agreement dated November 23, 1945 between B. O. Shepherd and the above Andrew B. Stewart. A copy of said purchase agreement should be obtained and made available to us, in order that we may determine whether it is necessary to obtain Shepherd's consent, as owner, to the attachment of the Government's lien to any minerals discovered as a result of this project.

In regard to the rental value of two complete core drilling rigs, if this equipment is to be furnished by you the use allowance is determined on the basis of 60 month depreciation of value for each unit with the allowable monthly amount chargeable only for the months actually used for the benefit of the project. A statement of the value and operating time of this and any other equipment to be used on the project is thus required.

We will appreciate early receipt of the foregoing information and any other information you deem advisable to bring your project up to date for the proposed contract.

Sincerely yours,

C. O. Mittendorf (for) 12/7

Acting Administrator
Defense Minerals Exploration
Administration

DEMoulds/meh
12/5/51
cc to: Adm. Reading File
Reports and Records
Mr. Mittendorf
Mr. Moulds
Mr. Mate
Mr. McKnight
Docket
Region IV (2)

BASE METALS BR.

MATHIS AND MATHIS
MINING AND EXPLORATION
P. O. BOX 452
SILVER CITY, NEW MEXICO

November 7, 1951

Mr. T. P. Billings, Chief
Lead-Zinc Branch
Defense Minerals Administration
U. S. Department of the Interior
Washington 25, D. C.

Re: Docket DMA-1549X

Dear Sir:

In your letter of August 8, 1951 you ask for additional information before taking further action on our application for a DMA loan to explore the Houston-Thomas claims.

Enclosed are five copies of a geologic map of the principle mineralized portions of the claims showing the proposed location of the diamond drill holes; five copies of "Landlord's Subordination Agreement", Form MF-202; and five additional copies of the lease.

We encountered considerable hesitation and delay in securing the Landlord's Subordination Agreement.

Yours very truly,

R. W. Mathis

R. W. Mathis
Mathis and Mathis

DEFENSE MINERALS ADM. WASHINGTON, D.C.
NOV 13 1 33 PM '51

FILE COPY
SURNAME 750

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS ADMINISTRATION
WASHINGTON 25, D. C.

Lyons (ETM)
McKnight
O'Leary
(For Mote)
Billings

AUG 8 1951

R. W. Mathis, General Manager
Mathis and Mathis
Box 452
Silver City, New Mexico

Re: Docket DMA-1549K

Dear Mr. Mathis:

The Lead-Zinc Branch of the Defense Minerals Administrations has reviewed your application for a loan to explore the Houston-Thomas group of claims in Grant County, New Mexico.

Before further action can be taken on your application more information will be required.

Would you please submit a map showing the location of the holes you plan to drill in relation to the geology, present mine workings, etc.

Enclosed are seven copies of "Landlord's Subordination Agreement", Form MF-202. Please complete six of these and return to us. Also required will be five more copies of the lease.

Very truly yours,

SIGNED By 8/8

T. P. Billings, Chief
Lead-Zinc Branch

EJLyons:bc
G 8-6-51
Copies to: J. H. East, Jr. Region IV (2)
Chief, Lead-Zinc Br.
E. T. McKnight
R. H. Mote
Reports and Records Unit
Director's r. file 4214 GSA
Br. r. file 4214 GSA
Files

AUG 8 1951

Mr. [illegible] Mathis, General Manager
Mathis and Mathis
Box 458
Silver City, New Mexico

Re: Docket D.A.-15495A

Dear Mr. Mathis:

The Lead-Zinc Branch of the Defense Minerals Administration has reviewed your application for a lease to explore the Houston-Thomas group of claims in Grant County, New Mexico.

Before further action can be taken on your application more information will be required.

Would you please submit a map showing the location of the holes you plan to drill in relation to the geology, present mine workings, etc.

Enclosed are seven copies of "Landlord's Subordination Agreement", form DF-202. Please execute six of these and return to us. Also required will be five more copies of the lease.

Very truly yours,

[signature]
T. F. Billings, Chief
Lead-Zinc Branch

RJLyons:bo
8-3-51
Copies to: J. A. East, Jr. Region IV (2)
Chief, Lead-Zinc Br.
L. T. Jeanight
R. H. Cote
Reports and Records Unit
Director's r. file 4214, GSA
Br. r. file 4214, GSA
Files

FILE COPY
SURNAME:

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS ADMINISTRATION
WASHINGTON 25, D. C.

140 Holderer
Ballard
Gukson
Lemmon
Ron
Tom

July 24, 1951

JUL 27 1951

Mr. J. S. Kosman
Box 142
Frient, California

In reply please refer to:
DMA-1459-X — Tungsten

Dear Mr. Kosman:

Your application has been referred to Mr. H. C. Miller, Executive Officer, DMA Field Team Region III, 1012 Flood Bldg., 870 Market Street, San Francisco, California for a field examination.

Please contact Mr. Miller and advise him how his engineer can get in touch with you.

Very truly yours,

Tom Lyon
Director, Supply Division

TJBallard:awj

cc:File
Adm. Reading File
Reports & Records Unit
Field Team, Region III
Mr. Holderer

Bruce Lynn

856

FILE COPY
SURNAME:

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS ADMINISTRATION
WASHINGTON 25, D. C.

June 20, 1951

Mr. R. W. Mathis
Mathis and Mathis
P. O. Box 452
Silver City, New Mexico

Subject: DMA-1549X
Re: Exploration loan
Houston-Thomas group of
15 claims

My dear Mr. Mathis:

Receipt is acknowledged of your application and attachments of May 26, 1951 for an exploration loan under the Defense Production Act of 1950.

The application was assigned Docket Number DMA-1549X and was referred to Mr. Otto Herres, Chief, Lead-Zinc Branch on June 8, 1951.

In any future correspondence relating to your application, kindly refer to DMA-1549X.

Sincerely yours,

LANDON F. STROBEL

Landon F. Strobel
Executive Secretary

LFSTROBEL:Jeb
cc: Strobel-2
Files
Herres
Lyon

Form MF-103
(April 1951)

U. S. DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS ADMINISTRATION

Budget Bureau No. 42-R1035.
Approval expires 6-30-51.

APPLICATION FOR AID FOR AN EXPLORATION PROJECT PURSUANT TO MINERAL ORDER 5, UNDER DEFENSE PRODUCTION ACT OF 1950

DO NOT FILL IN THIS BLOCK

Docket No. dma 1549X

Date received 6-4-51

Participation

Mathis and Mathis
P. O. Box 452
Silver City, New Mexico

DEPARTMENT OF THE INTERIOR
Defense Minerals Administration
RECEIVED
JUN 4 - 1951
LANDON F. STROBEL
Executive Secretary

Name and address of applicant

FILL IN THIS BLOCK

Date of application May 26, 1951

Estimated cost $20,000.00

Mineral or metal Zinc and Lead

Percentage of Government participation 50%

Location of mine Pinos Altos Mining District

Nine Miles North of Silver City, N. Mex.

Date of filing MF-100 May 26, 1951

DMA Docket Number, if available

INSTRUCTIONS

Read Mineral Order 5, Regulations Governing Government Aid in Defense Projects, before completing this application. Submit four signed copies of the application to Defense Minerals Administration, Department of the Interior, Washington 25, D. C., or to the nearest field executive officer thereof, with your name and address on each sheet of the application and all accompanying papers. If any question is inapplicable, or if you cannot answer it, so state on the form. Where the space provided for answer is insufficient, answer on a separate sheet, annex it to the application form, and refer to it in space for answer. If the application is approved, you will be presented with an exploration project contract on Form MF-200, for your signature.

THE APPLICANT

*1. Is applicant an individual, partnership, or corporation?
*2. If a partnership, state names and addresses of partners.
*3. If a corporation, state names and addresses of officers, directors, and five largest stockholders.
*4. Describe the mining and general business experience of (*a*) the applicant, and (*b*) the person or persons who will manage the project.
*5. Are you the owner or the lessee of the property?
6. If owner, state what claims, liens, or encumbrances, if any, are against the property.
7. If lessee, attach a copy of the lease and state if it is in good standing.

NOTE.—It will be necessary to procure and attach to the exploration project contract agreements of claimants, lienors, encumbrances and lessors subordinating their interests in the property to the interest of the Government under the contract.

8. Furnish current financial statement, showing assets and liabilities, and a profit and loss statement.
9. How much money is applicant prepared to invest in proposed project? Is it sufficient to pay your part of the cost of the project as detailed in question 23 of this application form, in accordance with the regulations on Government participation (Section 9 of Mineral Order 5)?

*If you have already answered these questions on MF-100, you are not required to answer the questions for this application.

16—64067-1

THE PROPERTY

10. (*a*) Give a description of the real property that will be in any way involved in the exploration project, including any existing mine or operating property.
    (*b*) Give the legal description of the exact parcel, plot, or area upon which the exploration is to be conducted.

    NOTE.—If both areas are the same, so state. The only obligation to repay the Government is from the net earnings from any commercial discovery made in the area specified in (*b*) above in which the exploration is to be conducted, and the expenditure of funds which may be charged as costs of the project must be limited to that area or to work necessary to perform the exploration in that area.

*11. State the present and former names of the property, if any.
*12. State, in detail, the location of the property with reference to towns, railroads, roads, shipping points, including distances and directions and kinds and conditions of roads.
*13. State source and quantity of water available for operations and its sufficiency at all seasons.
State amount of power to be used, rate per hour or other cost, and source.
*14. Describe any existing useable facilities, equipment, buildings, or structure now on the property that will be devoted to the exploration work.
15. State in detail how the ore could be shipped and how and where milled.
*16. History:
    (*a*) Give a statement, as complete as possible, of previous exploration, development, operation, and production of property, with reasons for any past suspensions of operations.
    (*b*) State briefly the known history and production of adjoining and neighboring properties.
    (*c*) Furnish any available (private) reports that may apply to this application, including results of mine examinations, recommended exploration and development, and metallurgical investigations.
*17. Production:
    (*a*) If mine is in production, furnish the following information:

	Tons per day	*Grade or analysis*	*Cost per ton*	*Net value per ton*
(1) Mining				
(2) Milling				
(3) Shipped or sold				

*18. Ore or mineral reserves: (If property is or has been operating.)
    (*a*) Describe the ore or mineral deposits briefly.
    (*b*) Submit available maps and assay data.
    (*c*) Give estimated tonnage and grade of each class of ore reserves.
19. State any conditions or circumstances regarding the property not sufficiently brought out by the foregoing questions.

THE EXPLORATION

20. For what mineral or minerals and for what types of deposits and ores will the exploration be conducted?
21. Describe briefly, but concisely, the proposed work and the estimated time required to complete it.

    NOTE.—The Government will not participate in a project that will require more than 2 years to complete.

22. Furnish statement of the geological basis of the project with particular emphasis on factors leading the operator to expect the finding of commercial ore bodies. This statement should be accompanied by supporting maps such as geological maps, maps of the proposed openings and assay maps, sample lists, and other pertinent data.

THE REQUIREMENTS AND COSTS

23. Tabulate in the form of an itemized statement with a sum for each item the estimated requirements and costs of the project so that the total will give the estimated cost of the project in which the Government will participate, as follows:
    (*a*) Labor, by numbers and classes (miners, muckers, millmen, etc.), with wages of each.
    (*b*) Supervisors, by numbers and positions, with salaries of each.
    (*c*) Cost of necessary repairs to existing facilities, structures, and buildings.
    (*d*) Cost of necessary installation or construction of additional facilities, structures, and buildings.
    (*e*) Cost of items of equipment, not now owned by the applicant which must be purchased for operations at a cost of $50 or more each.
    (*f*) Cost of rental for equipment which the operator proposes to rent.
    (*g*) Rental value of items of equipment which the operator now owns and which will be devoted to the work.
    (*h*) Cost of materials and supplies, including items of equipment costing less than $50 each.
    (*i*) Cost of power, water, utilities, and any other items not provided for above.
24. Furnish a time schedule of the project, stated in terms of months after project is approved, showing progress expected to be accomplished and the money expected to be spent.

CERTIFICATION

The undersigned company, and the official executing this certification on its behalf, hereby certify that the information contained in this form and accompanying papers is correct and complete to the best of their knowledge and belief.

Mathis and Mathis
(Name of company)

By G. W. Mathis
(Signature of authorized official)

May 26, 1951
(Date)

Partner and General Manager
(Title)

Title 18, U. S. Code (Crimes), Section 1001, makes it a criminal offense to make a willfully false statement or representation to any department or agency of the United States as to any matter within its jurisdiction.

*Same as footnote on page 1.

16—64067-1 U. S. GOVERNMENT PRINTING OFFICE

Mathis and [illegible]his
P. O. Box 4[illegible]
Silver City, New Mexico

May 26, 1951

FORM MF-103

1. See MF-100

2. See MF-100

3. See MF-100

4. See MF-100

5. See MF-100

6. Not applicable

7. See attached lease. Lease is in good standing.

8. See attached financial statement.

9. Applicant is prepared to put $10,000.00 into this project, which is sufficient to match Government money.

10. The real property involved and the area upon which the exploration is to be conducted are one and the same, the Houston-Thomas group of 15 patented mining claims in the Pinos Altos Mining district of Grant County, New Mexico, more particularly described as follows:

Lafayette	M.S. #1211	Calcite	M.S. #1489
Manilla	M.S. #1211	Quartzite	M.S. #1489
Alpha	M.S. #1211	Rocker	M.S. #1489
Omega	M.S. #1211	Maverick	M.S. #1580
Florida	M.S. #1211	Opher	M.S. #1490
Caribou	M.S. #1211	Tunnelsite	M.S. #1490
Atlas	M.S. #1211	Klondyke	M.S. #1583
Bauxite	M.S. #1497		

11. See MF-100

12. See MF-100

13. See MF-100

14. See MF-100

15. Ore is hauled by truck from mine to AT&SF Railroad in Silver City and shipped to the Peru mill at Peru Hill Near Deming, New Mexico, for separation of sulfide components.

16. See MF-100

17. See MF-100

18. See MF-100

19. Foregoing questions and answers adequately cover conditions and circumstances covering operations.

MATHIS & MATHIS
Silver City, New Mexico

BALANCE SHEET
AS OF DECEMBER 31, 1950

ASSETS:					
Accounts Receivable - Sundry			197.51		
Notes Receivable			450.00		
Accounts Receivable - Ore			11,758.68		
				12,406.19	
Leaseholds				3,000.00	
Investments				3,648.89	
Insurance Deposits				439.37	
Office Furn & Fixt		255.10			
Less Depreciation		182.50	72.60		
Machinery		20,575.57			
Less Depreciation		11,247.14	9,328.43		
Buildings		90.00			
Less Depreciation		29.20	60.80		
Trucks & Autos		6,428.45			
Less Depreciation		2,092.47	4,335.98	13,797.81	
					33,292.26
LIABILITIES:					
American National Bank			2,216.70		
Accounts Payable			3,967.72		
Taxes Accrued			674.37	6,858.79	
Mrs. J. B. Mathis, Sr., Capital		16,458.91			
1950 Operating Profit		3,573.61			
		20,032.52			
Drawings 1950	1,180.00				
Capital Loss	3,798.23	4,978.23	15,054.29		
R. W. Mathis, Capital		13,603.53			
1950 Operating Profit		4,367.74			
		17,971.27			
Drawings 1950	2,022.10				
Capital Loss	4,642.29	6,664.29	11,306.88		
J. B. Mathis, Jr., Capital			72.30	26,433.47	
					33,292.26

FORM MF-103

THE EXPLORATION

20. The exploration will seek limestone replacement deposits of zinc and lead sulphide ores.

21. Applicant proposes to test the mineralized fissures which cut the limestone outcrops on the Houston-Thomas claims by core drilling. Approximately 15 holes, 300 feet deep are planned at present, and it is estimated that these can be completed within 8 months.

22. The exposed outcroppings of Magdalena limestone are cut discordantly by numerous mineralized fissures within the boundaries of the Houston-Thomas claims. The most extensive and persistent of these fissures are shown in red color on the geology map of the Houston-Thomas claims (Fig. 1) in the accompanying publications. These fissures apparently controlled the migration of mineralizing solutions at the time of deposition, and the zinc and lead sulphides replaced favorable beds of the Magdalena limestone along these fissures.

The ore bodies of the Atlas #2 mine, which applicant is presently working, occur along one of the stronger fissures; and although the discovery core-drill holes were directed by a gravity anomaly (see publication) is the main fissure could be traced on the surface.

The ore body of the Pershing mine were found along an extension of this same fissure, and the many ore bodies of the Cleveland mine were found along similar and usually parallel fissures.

Applicant believes that core drilling along the strong fissure on the Atlas claim will discover additional ore bodies. The possibilities of larger ore bodies are especially good at greater depths, for the gravity survey is not effective for finding ore bodies of the size usually found in this area at depths greater than 150 to 200 feet.

The other fissures shown on the geology map referred to above contain small veinlets of zinc and lead sulphides at various points along their strife, and it is believed that such occurrence warrants core drilling to test for replacement deposits at depth.

THE REQUIREMENTS AND COSTS

23. Itemized cost statement:

(a) Two core drill operators at $1.70 per hour each
(b) Two core drill helpers at $1.25 per hour each
(c) Total labor cost per week $306.80 plus 10% for insurance, unemployment tax, and social security equals $337.48 times 25 weeks, equals---------- $8,437.00

(b) One supervisor at $1.70 per hour. Total cost for 25 weeks, including insurance and taxes,------ 2,431.20

(c) None.

(d) None.

(e) Diamond bit cost, estimated at $1.00 per foot,---- 5,000.00

FORM MF-103

Continued-

THE REQUIREMENTS AND COSTS

		Balance Carried Forward ----------	$15,868.20
23.	(f)	None.	
	(g)	Rental value on two complete core drilling rigs at $35.00 per day, ----------	5,250.00
	(h)	Gasoline and lubricants	400.00
	(i)	Water for drilling at 2 cents per foot,----------	100.00
		TOTAL ----------	$21,618.20

The total of these estimated values is greater than the estimated value of the proposed project. However, applicant believes from experience that he can drill 5000 feet for $20,000.00 and hereby proposes to limit the project to $20,000.00 total cost.

24. The schedule of the proposed project calls for completion of 100 feet of hole each week by each machine. The project would be completed in 25 weeks at this rate.

GRAVITY PROSPECTING FOR LEAD AND ZINC, NEW MEXICO

By
V. E. BARNES, R. W. MATHIS, and F. ROMBERG
U.S.A.

Reprinted from International Geological Congress " Report of the Eighteenth Session Great Britain 1948," Part V.

GRAVITY PROSPECTING FOR LEAD AND ZINC, NEW MEXICO

By V. E. BARNES, R. W. MATHIS, and F. ROMBERG

U.S.A.

ABSTRACT

Observations of the force of gravity were made on the Houston-Thomas group of claims in the Pinos Altos Mountains north of Silver City, New Mexico. The observed values of gravity were corrected for terrain effects, and the resulting map revealed three positive anomalies. The second of the U.S. Bureau of Mines diamond-drill holes on one of the anomalies penetrated a lead-zinc ore body in which mining later was started. Two holes on another anomaly missed ore, and the third anomaly does not warrant drilling.

This is the first record of the use of a gravity meter in the discovery of a lead-zinc ore body. This investigation also proves that the use of a gravity meter in extremely rugged terrain for the discovery of such bodies is practicable.

An explanation is proposed for the systematic difference between the Bouguer correction as computed from observed surface densities and as computed from the graph of force versus elevation.

INTRODUCTION

THE Houston-Thomas group of 15 patented claims in the Pinos Altos mining district located about eight miles north of Silver City, New Mexico, was chosen for gravity exploration for the following reasons:—

(1) The district has a long history of productivity.

(2) The ore is appreciably heavier than the country rock.

(3) An area was available for lease.

Mathis proposed the project to be operated by him as a commercial prospect, the interpretation being done by Romberg for the privilege of publication of any significant results. The division of labour among the writers is as follows: Mathis obtained the gravity data, made the geological map, and described the ore body; Romberg made the gravity interpretation; and Barnes reviewed the geology. Romberg and Barnes spent two days in the field checking the results.

The gravity anomalies were drilled by the U.S. Bureau of Mines under Project 15–203, which was in progress at the time the gravity survey was made. Use of the results of the drilling by the U.S. Bureau of Mines is gratefully acknowledged. Geologists of the U.S. Smelting, Refining, and Mining Company aided in the underground mapping.

GEOLOGY

Stratigraphy.—The stratigraphic column in the vicinity of the Houston-Thomas prospect is that given by Paige (1916), modified by Spencer and Paige (1935), and quoted as follows:—

Cretaceous
- Colorado shale.
- Beartooth quartzite.

Pennsylvanian
- Magdalena group.

The sedimentary rocks have been extensively intruded by rocks of probable late Cretaceous age consisting predominantly of diorite-porphyry. The geologic map of the area (Fig. 1) shows the main areas of predominant rock types but shows neither the myriad of small intrusives in the sedimentary rocks nor the equally numerous small inclusions in the igneous rocks. Beyond the map area diorite-porphyry outcrops extensively, being terminated eastward by a large granodiorite mass.

GEOLOGIC MAP
HOUSTON-THOMAS PROSPECT
SILVER CITY, NEW MEXICO
0 100 200 300 400 500
SCALE OF FEET
TRUE NORTH
EXPLANATION
Gossan
Andesite
Diorite porphyry
(Many small intrusive bodies within sediments not shown)
Colorado shale
Beartooth quartzite
UNCONFORMITY
Magdalena limestone
CRETACEOUS
PENNSYLVANIAN
Drill hole
Mine dump
Open cut
Underground workings
Mine shaft
HOUSTON-THOMAS MINE
JAP WORKINGS
HOUSTON-THOMAS FAULT
PERSHING MINE
ATLAS 2 MINE
ATLAS 1 MINE
CLEVELAND MINE

FIG. 1.

In nearby mining districts the Magdalena group has been divided into two formations, and beneath them a Mississippian formation, the Lake Valley limestone, is prolifically ore bearing. In the Pinos Altos district the Lake Valley limestone has not been found, and the divisions of the Magdalena group have not been recognized.

Mineral deposits.—Graton (1910) described the mineral deposits of the Pinos Altos district and gave an account of the early history of the district. Paige (1916, p. 14, 1911) gives additional information about the mineral deposits, especially the replacement deposit in limestone with which this paper deals. The district was discovered about 1860, and since that time several million dollars worth of metals have been produced, with the precious metals predominating in the early part of its history and the base metals becoming more prominent later.

The lead-zinc deposits of the Houston-Thomas and adjoining claims are replacement deposits in the Magdalena limestone, the chief metallic minerals being ferriferous sphalerite (marmatite), galena, pyrite, and chalcopyrite. On the surface there are extensive gossans composed, according to Paige, of a mixture of limonite, smithsonite, azurite, and earthy materials with a dark-brown material containing manganese, copper, and iron. The geologic map (Fig. 1) shows the gossan areas and the principal mines. The estimated production in short tons of ore from the various mines is as follows: Cleveland, 130,000+; Houston-Thomas, 3,500 (sulphide ore); Atlas No. 1, 500 (carbonate and sulphide ore); and Pershing, 6,000 (sulphide ore).

On the Cleveland property, gossan occurs over both the Cleveland and the Pershing mines. A small area of gossan occurs above the carbonate and sulphide ores of the Atlas No. 1 mine, and another small area of gossan is exposed within the gravity anomaly over the known ore mass. However, large areas of gossan on the Houston-Thomas claims have been proven barren and, furthermore, no gravity anomalies have been found associated with them.

Density data.—The densities of the various rock types were determined before the gravity survey was made in order to judge whether or not a gravity survey would be feasible. The density data obtained are as follows:—

Rock type	*Average density*
Gossan	2·70
Colorado shale	2·74
Beartooth quartzite	2·66
Magdalena limestone	2·77
Diorite-porphyry	2·80
Andesite	2·67

Densities from cores are as follows:—

Rock type	*Average density*
Magdalena limestone	2·75
Diorite-porphyry	2·89

The average density of the ore mined up to February 22, 1948, is 3·84.

Structure.—According to Paige (1911, p. 123) the ore deposits appear to replace definite beds in the Magdalena limestone. The attitude of the limestone has been disturbed somewhat by the extensive intrusives, but in general it dips east-northeast. The unconformably overlying Beartooth quartzite in general dips south-southeast. Commonly the limestone and the quartzite in the area surveyed are separated by a thin diorite-porphyry sill.

Faulting is prevalent in the Pinos Altos district, and several faults are shown within the map area. Just east of the map area the contact between the Magdalena limestone and the Beartooth quartzite is at an elevation of 7,500 feet, whereas immediately west of the Houston-Thomas fault, it is at an elevation of 7,260 feet, indicating a drop on the western side of the fault of approximately 300 feet. Another north-south fault west of the map area, also downthrown to the west, places the Colorado shale in contact with the Magdalena limestone.

Near the northeastern margin of the map area, the Colorado shale is downthrown against the Magdalena limestone, and within the map area it is faulted against diorite-porphyry. This fault has several times the throw of the Houston-Thomas fault and is offset by it. A post-faulting andesite dyke is shown in the northwestern part of the map area.

TOPOGRAPHY

That portion of the Houston-Thomas group of claims covered by the gravity survey lies on the western slope of the Pinos Altos Mountains within a few hundred feet of the Continental Divide and

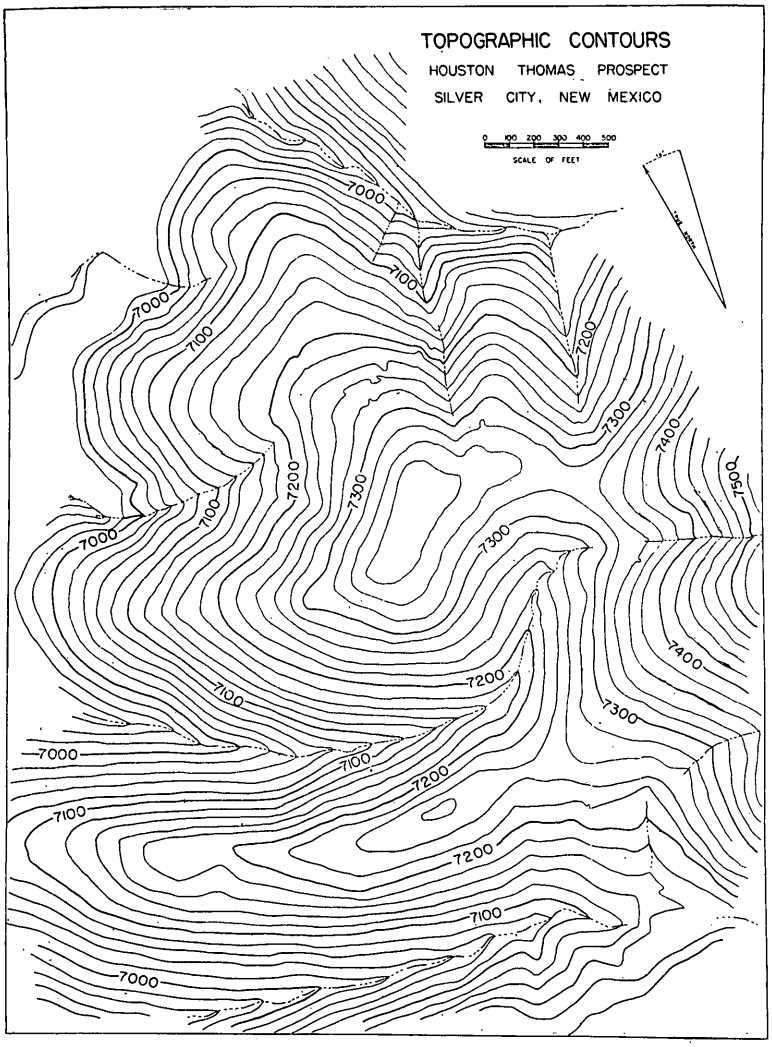

FIG. 2.

between elevations of 7,000 and 7,500 feet above sea level. The crest of the Pinos Altos Mountains is 8,036 feet in elevation and is about one-fourth of a mile from the surveyed area, which is about 3,000 by 3,400 feet in size. Figure 2 is a topographic map of the area showing the steepness of the slopes. The maximum slope is near 38°, and the average slope is estimated to be about 20°. The topography shown is typical of that within a two-mile radius.

The slopes are rubble and brush covered which, in combination with the extreme steepness, made surveying and observing with the gravity meter difficult tasks.

GRAVITY OBSERVATIONS

The stations for observing the gravitational force were laid out in an irregular network with a spacing of about 100 feet. This spacing was chosen because the shallow ore bodies which were being sought would presumably give rise to anomalies in the gravitational field with dimensions of the order of 200 feet. Such anomalies may be missed on the final map of the gravitational force if the spacing is too large. When the preliminary work was done, fill-in stations were set in areas where anomalies were indicated.

Observations of the force were made with a portable gravity meter which was read with a precision of plus or minus 0·01 milligal. The meter had to be transported on foot, as it was not possible to take an automobile anywhere on the prospect except on the one road that runs through it. The effect of tidal drift was kept small by reading the meter frequently on base stations; this was practical because the stations were close together. After the readings were corrected for drift, they appeared to be repeatable with a probable error of less than plus or minus 0·02 milligal. The corrected readings are probably in error with respect to each other by more than this amount if they are some distance apart on the prospect, but this is of no consequence in the search for small anomalies.

The observations were corrected for latitude and elevation in the usual manner, and a contour map (Fig. 4) drawn on the residual values. Terrain corrections were made for the stations in areas that seemed to be anomalous, and a second contour map was made using these corrected observations (Fig. 5). The values of the gravitational force shown are relative, since no purpose in prospecting could be served by trying to relate them to the absolute value of force.

When gravity surveys are made in areas of rough topography, there is always a question as to whether the effects of the terrain will mask the anomalies that are being sought, even after the terrain corrections have been made. On the Houston-Thomas prospect it was considered doubtful whether the anomalous gravitational effects of ore bodies could be perceived, since the surface was extremely rough and the surface material varied. With sufficient labour and very accurate topographic and geologic maps, a set of terrain corrections could no doubt be computed to any required correctness, but there was no assurance in the beginning that the extra labour of making accurate terrain corrections would be worth carrying out. As it was, the gravity map after correction showed no anomalies that were not hinted at by the uncorrected map, but the corrected map showed the closures more plainly. The authors do not know of another attempt to look for such small anomalies in such rough terrain.

DENSITY CORRECTIONS

It is customary to correct observations of the gravitational force for elevation differences with a factor which multiplies the relative elevation of each station. This factor is a combination of the free air elevation correction (which is nearly constant on the earth's surface) and the Bouguer factor, which is a function of the surface density. The surface density can be measured from samples. This measurement is usually supplemented with density profiles such as those described by Nettleton (1940), in which different values of the density are tried out for effect on the final values of the gravitational force. Profiles computed with a number of assumed densities are plotted for a line of observations, and these profiles are compared with a profile of the topography. If the assumed density is too small, its force profile follows the topography; if it is too large, its profile mirrors the topography. The correct density will, of course, be the one whose profile seems neither to follow nor to mirror the topography. This method works well if, on the profiles chosen, there is no relation between the residual force and the elevations, but if there is such a relation, it may lead to a choice of the wrong density.

Density profiles for the Houston-Thomas prospect were ambiguous; the profiles seemed to follow some topographic features and mirror others. However, the best choice of surface density indicated by the density profiles seemed to be about 2·2. This differs seriously from the measured density of 2·7.

Another method of finding a value for the combined elevation correction (and thence presumably for the surface density) is to plot all the observations on a graph of elevation versus force uncorrected for elevation. If there were no gravity anomalies present, the points on the graph would all lie in a

straight line, whose slope would be the elevation correction factor. The slope of the line can be found with sufficient accuracy if the elevation differences on the prospect are great enough. The elevation graph of the Houston-Thomas prospect (Fig. 3) showed the slope to have a value corresponding to a surface density of 2·0. This result is even more startling than the value of 2·2 which was deduced from the density profiles, as it deviates even further from the measured density. The elevation graph shows the slope the line would have, to correspond to a density of 2·7, and it is clearly out of the question to draw the line with such a slope. Thus if the elevation correction based on a density of 2·7 were used in correcting the observations of force, the uphill and downhill stations would appear to be anomalous merely on account of their elevations. The final elevation corrections were computed from the slope of the elevation graph rather than from the true density, since it was thought that fewer irrelevant anomalies would result.

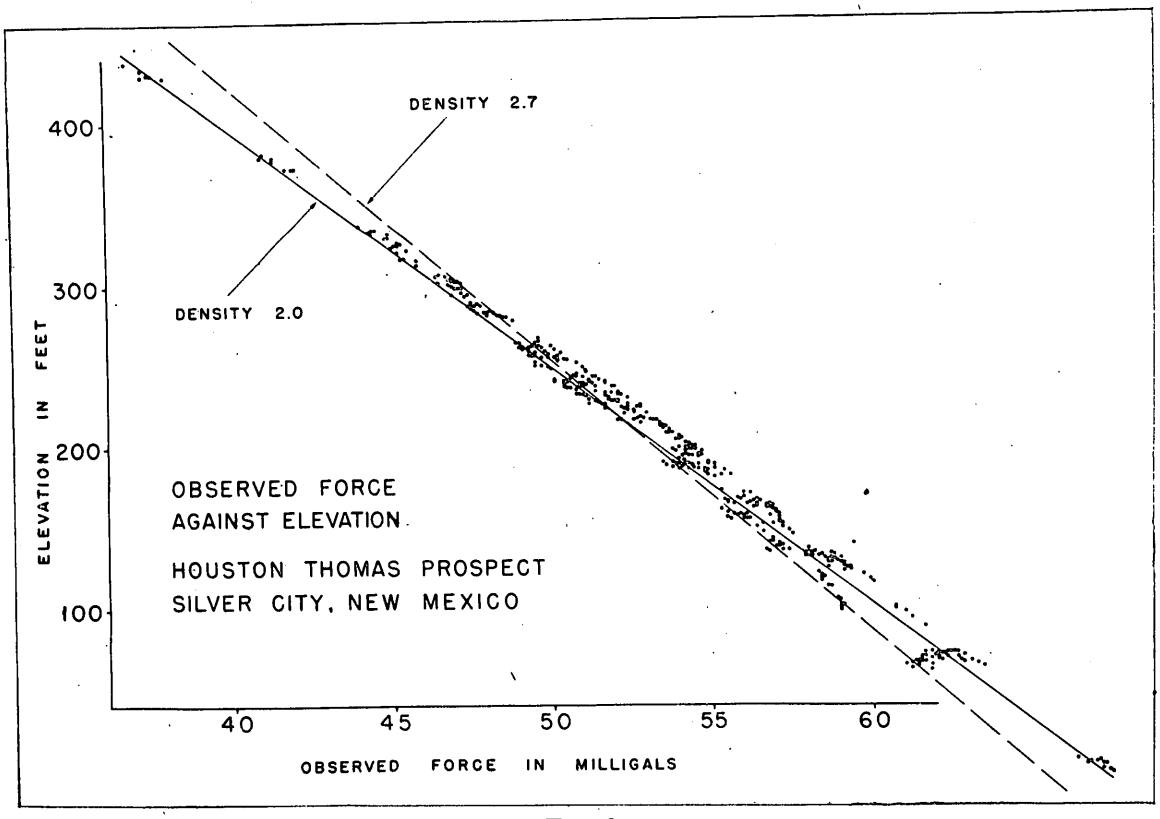

FIG. 3.

Three explanations suggest themselves for the discrepancy between the surface density as measured and as deduced from the density profiles and elevation graph. If the prospect slopes generally in one direction, the graphic correction factor will include the regional gradient in this direction, if there is one. This is not harmful unless the regional gradient itself is being sought. Again, if the higher stations and lower stations are generally on different outcrops, the graphic correction factor will include the anomaly caused by the density difference of the outcropping formations. Finally, if the higher elevations occur in regions of rougher topography, the total or large-scale terrain corrections (as opposed to the very local corrections made for the map) will increase with the elevations and cause the graphic correction factor to be greater than it ought to be, and the deduced surface density less. In an ideal case such as that of a cone-shaped mountain, it is clear that the total terrain correction will increase

systematically as the point of observation moves from the base of the mountain to its top. The present prospect is a fair approximation to such a case, and it seems probable that the abnormal slope of the elevation graph is caused by an increase with elevation of the terrain correction.

TERRAIN CORRECTIONS

Since topographic irregularities affect the observed gravitational force, a correction must be added to each station. The magnitude of each correction depends on the surface density and the topography in the neighbourhood of the station, and the corrections are usually computed graphically by means

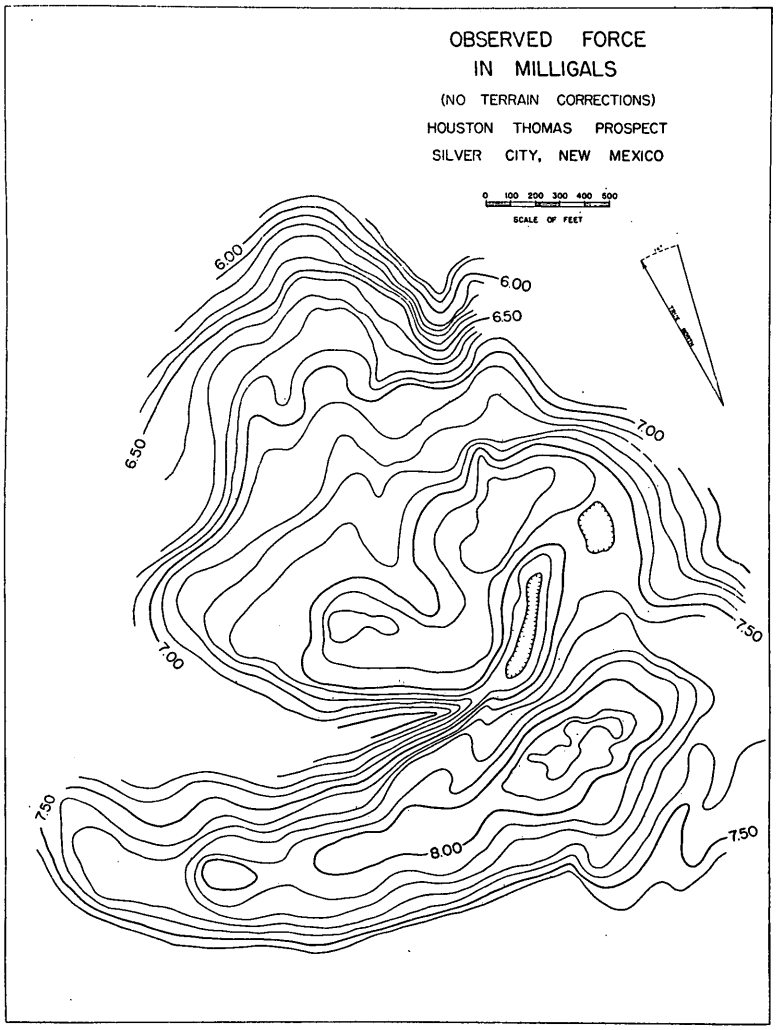

FIG. 4.

of reticules or zone charts superimposed on a contour map of the area surrounding the station. A practical method for making such computations has been described by Hammer (1939). In theory, the total terrain correction for a station is computed from all the topographic irregularities (mass above the station and voids below it) for an infinite distance out. In practice, of course, it is necessary to take into account only the irregularities close to the stations. The circle of ground for which corrections for a given station are made is usually chosen to have a radius several times the linear dimensions of the expected gravitational anomalies, so that the gradients from the uncorrected irregularities outside the circle will be small and not obscure the anomaly. In the present case, the terrain corrections were

based on a surface density of 2·7 and computed for a distance of about 1,500 feet around the stations, from a topographic map made from the surveyed elevations of the stations (Fig. 2).

DISCUSSION OF GRAVITY ANOMALIES

The contour map (observed force with terrain corrections, Fig. 5) shows three positive closures. The most interesting of these is the southeastern one, roughly 0·3 milligal in height and perhaps 300 by 600 feet in size. Considering the gradients in the vicinity, a closure of 0·3 milligal is not outstanding, but still the anomaly is better than a borderline case. Possible interpretations of this anomaly

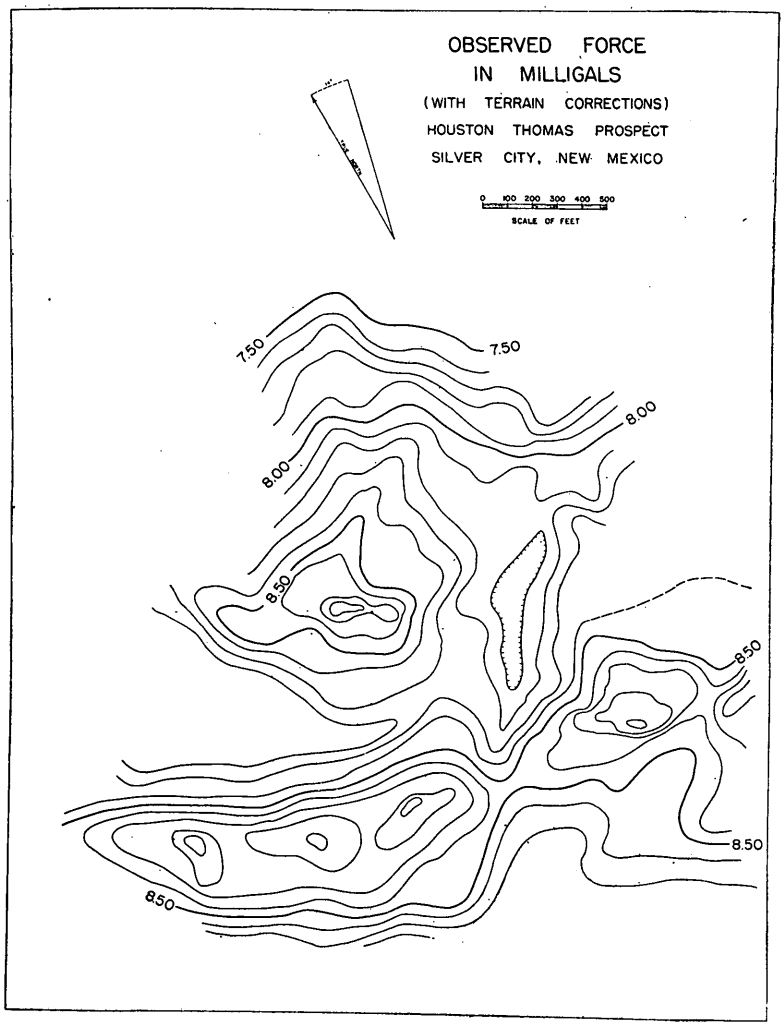

FIG. 5.

are: (1) A wrong elevation correction or an inadequate terrain correction under some conditions might cause a closure, but for this anomaly such a cause is ruled out because the anomaly is in an area which is neither high nor low topographically. (2) The anomaly is situated roughly over the eastern end of an outcrop of Magdalena limestone, but the limestone outcrop also extends westward beyond the closure indicating that any correspondence seen is fortuitous. (3) The remaining inference that the gravitational high must be caused by something heavy beneath the surface was confirmed when the core drill penetrated ore.

A gravity high of the dimensions shown could be caused by an infinite variety of anomalous mass distributions. However, if it is assumed that the anomalous mass is fairly simple in shape, it is safe to assign a maximum depth to it, corresponding to half its width or less. This would mean that the anomalous mass ought to be no deeper than 150 feet, though it might be shallower. In addition, the amount of the anomalous material is proportional to the " volume " of the gravitational anomaly. In the present case, the anomalous material can be estimated to be several hundred thousand tons. Estimates for other masses have previously been made by Romberg and Barnes (1943), and Hammer (1945).

The largest positive closure is in the southwestern part of the area and is about 500 by 1,500 feet in size. The closure corresponds in size and shape to a prominent topographic ridge of Beartooth quartzite underlain by the heavier diorite-porphyry and limestone. The coincidence between the ridge and the closure leads to the suspicion that the high is caused by surface irregularity rather than by heavy material. A density profile across the ridge indicated that the closure would have been much reduced if a different elevation correction had been chosen, and it would probably have been reduced still further by more extensive terrain corrections. Also, it is to be expected that the terrain corrections will be less effective as the topographic features get larger, and for this prospect the corrections were made out to a relatively small distance. No core drilling on this anomaly is recommended.

The third positive closure, west-central part of the map, is on the side of a steep hill, thus minimizing the possibility of its being due to topography. The surface geology is complex, with limestone, diorite-porphyry, and quartzite in an irregular pattern near the centre of the closure. The complex geology makes this high less attractive than the first one, but it is difficult to avoid suspecting that the high values are caused by heavy material beneath the surface. Two barren holes have been drilled, but additional drilling is probably advisable. From the size and shape of the anomaly, it is inferred that a small quantity of heavy material may be close to the surface, accounting for the localized high values in the middle of the anomaly, and in addition a large quantity of heavy material may be present at a depth of 200 or more feet. Whether or not this heavy material is ore remains to be seen.

Some other features of the gravity map which may be pointed out are:—

(1) The topographic low between the second and third anomalies shows a large gravity low associated with the Magdalena limestone. The low probably reflects topography.

(2) In contrast, the topographic high northeast of the third anomaly (centre of the topographic map) does not appear to be reflected on the gravity map.

(3) A small gravity terrace is associated with the limestone between the Houston-Thomas mine and the Jap workings.

(4) The closed low between the first and third anomalies is associated with quartzite but is also associated with a topographic low.

PROSPECTING AND DEVELOPMENT DATA

Core-drilling data.—The U.S. Bureau of Mines was conducting a drilling programme (Project 15–203) on the Houston-Thomas group of claims during the time the gravity survey was being made. The first hole (Fig. 1) was directed to prospect the Magdalena limestone beneath the Cretaceous in the northern part of the map area. The throw of the fault was greater than expected, and the limestone was not reached, the hole being bottomed in Colorado shale at 875 feet. The Bureau of Mines completed the first hole before the gravity data had been fully reduced.

The location for the second hole on the basis of the preliminary gravity reduction proved to be too far east, and only a few inches of ore was encountered. The hole passed through 40 feet of limestone followed mostly by diorite-porphyry to its total depth of 290 feet. By the time the second hole was completed, the gravity data had been sufficiently well reduced so that the location of hole No. 3 proved to be accurate. Hole No. 3, directed S. 29° E. at an angle of 70°, penetrated limestone containing a small amount of diorite-porphyry to 96 feet, ore from 96 to 105 feet, mineralized limestone from 105 to 120 feet, and bottomed in diorite-porphyry at 122 feet. Another hole, No. 4, from the same

station directed S. 29° E. but at an angle of 55°, penetrated 113 feet of limestone containing a small amount of diorite-porphyry, ore from 113 to 142 feet, and bottomed in diorite-porphyry at 143 feet. Since funds were not available to outline the ore body, the drill was moved to the northwestern anomaly where two holes were drilled.

Hole No. 5, drilled vertically, bottomed at 245 feet after passing through diorite-porphyry for 120 feet, followed by alternating unmineralized limestone and diorite-porphyry for the rest of the distance. Hole No. 6, directed N. 10° E. at an angle of 70°, penetrated 21 feet of diorite-porphyry, limestone from 21 to 64 feet, and bottomed in diorite-porphyry at 135 feet without encountering mineralization. The drilling on the second anomaly is not conclusive.

Mining data.—A shaft was sunk in the vicinity of the drill holes and was placed, as nearly as could be interpreted from the gravity data, to graze the southern margin of the ore body. However, the shaft

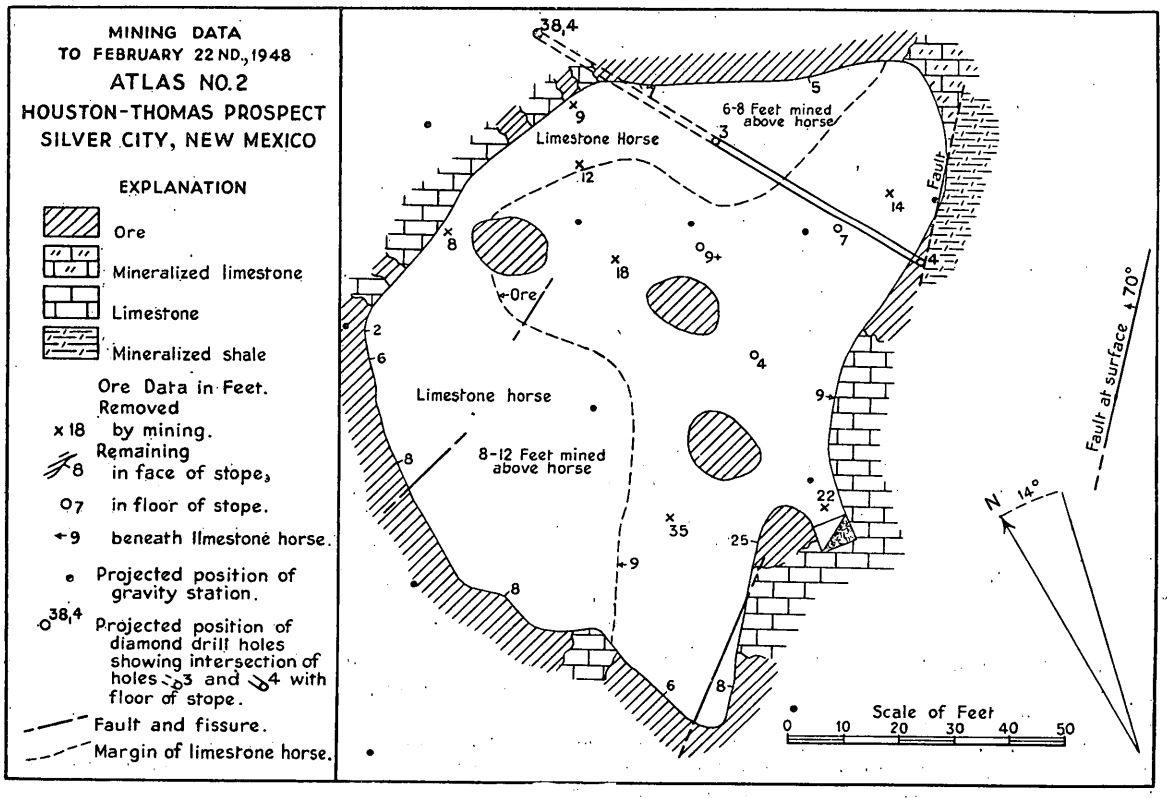

FIG. 6.

between 78 and 98 feet was approximately half in ore and half in limestone. Diorite is beneath the ore in the bottom of the shaft. A drift was driven toward the drill holes, and the ore about the holes has been removed.

The area stoped, up to February 22, 1948, is shown in Fig. 6, and the thicknesses of ore removed or still remaining are noted. An extensive limestone horse in the western and northern part of the stope, extending 5 to 6 feet above floor level in the northeastern part, is being left, and ore 6 to 12 feet thick has been mined from above it. Ore beneath the horse is indicated, but little is known about its thickness.

Shale is exposed on the southeastern side of a 4-foot brecciated fault zone containing broken ore, calcite, and gouge seams. The last movement along the fault was nearly horizontal and the vertical displacement appears to be less than 20 feet. The shale is cut by small veins containing pyrite, galena,

and marmatite which are terminated at the fault plane. This is the only place seen where there is definite evidence that the faulting is post-mineralization in age. A fissure seen at the surface and dipping 70° to the northwest is probably the surface expression of the fault.

A vein of galena, 1 to 4 inches thick, cuts vertically through the ore and adjacent limestone in the southwestern part of the stope. Other late veins filled with calcite and pyrite are common in the western part of the stope and for the most part are aligned approximately in an east-west direction.

The back of the stope is fairly plain, strikes about N. 20° W., and dips about 21° to the east. The ore appears to have selectively replaced beds of the Magdalena limestone as in the Cleveland mine.

The principal metallic minerals in the ore are pyrite, marmatite, galena, and chalcopyrite. The principal gangue mineral is calcite. The tenor of the ore up to February 22, 1948, was approximately as follows: zinc, 10·07 per cent; lead, 2·55 per cent; copper, 0·17 per cent; silver, 3·33 ounces; and gold, 0·012 ounces. The gold is of no value to the producer, and it is seldom that the copper content is sufficiently high to yield revenue. Penalty-bearing constituents such as arsenic and bismuth are absent. However, iron amounts to 29 per cent of the ore mined, and the marmatite, after milling, contains approximately 11 per cent iron, which is objectionable in smelting and reduces the value of the ore.

Until February 22, 1948, about 11,900 dry tons of ore having an average density of about 3·84 were mined. The tonnage of ore remaining is unknown, and until the body has either been mined or drilled, the correlation between the predicted amount and actual amount of ore will be unknown.

REFERENCES

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——————— 1916. Description of the Silver City quadrangle. *U.S. Geol. Surv. Geol. Atlas* (Folio No. 199).

ROMBERG, FREDERICK, and BARNES, V. E. 1943. Gravity and magnetic observations on Iron Mountain magnetite deposit, Llano County, Texas. *Geophysics*, vol. viii, p. 45.

SPENCER, A. C., and PAIGE, SIDNEY. 1935. Geology of the Santa Rita mining area, New Mexico. *U.S. Geol. Surv. Bull.*, no. 859.

DISCUSSION

K. C. DUNHAM congratulated the authors on this first discovery of a concealed lead-zinc orebody, and asked the nature of the oreshoot, whether it was a " manto " in the Magdalena Limestone. He also enquired about the average thickness of the deposit.

In reply V. E. BARNES regretted that these points, contained in the original paper, had been omitted from his presentation. The orebody appears to be a selective replacement of the Magdalena limestone as in the neighbouring Cleveland Mine and a rough estimate of its thickness is 14 feet.

CWS—25899 (R)

Form MF-100
(April 1951)

U. S. DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS ADMINISTRATION

Budget Bureau No. 42-R1035.
Approval expires 6-30-51.

APPLICATION FOR AID FOR AN EXPLORATION PROJECT PURSUANT TO MINERAL ORDER 5, UNDER DEFENSE PRODUCTION ACT OF 1950

DO NOT FILL IN THIS BLOCK

Docket No. dma 1549X

Date received 6-4-51

Participation

DEPARTMENT OF THE INTERIOR
Defense Minerals Administration
RECEIVED
JUN 4 - 1951
LANDON F. STROBEL
Executive Secretary

Date

Name and address of applicant

Mathis and Mathis
P. O. Box 452
Silver City, New Mexico

FILL IN THIS BLOCK

Date of application May 26, 1951

Estimated cost $20,000.00

Mineral or metal Zinc and Lead

Percentage of Government participation 50%

Location of mine Pinos Altos Mining District

Nine Miles North of Silver City, N. Mex.

Date of filing MF-100 May 26, 1951

DMA Docket Number, if available

INSTRUCTIONS

Read Mineral Order 5, Regulations Governing Government Aid in Defense Projects, before completing this application. Submit four signed copies of the application to Defense Minerals Administration, Department of the Interior, Washington 25, D. C., or to the nearest field executive officer thereof, with your name and address on each sheet of the application and all accompanying papers. If any question is inapplicable, or if you cannot answer it, so state on the form. Where the space provided for answer is insufficient, answer on a separate sheet, annex it to the application form, and refer to it in space for answer. If the application is approved, you will be presented with an exploration project contract on Form MF-200, for your signature.

THE APPLICANT

*1. Is applicant an individual, partnership, or corporation?
*2. If a partnership, state names and addresses of partners.
*3. If a corporation, state names and addresses of officers, directors, and five largest stockholders.
*4. Describe the mining and general business experience of (*a*) the applicant, and (*b*) the person or persons who will manage the project.
*5. Are you the owner or the lessee of the property?
6. If owner, state what claims, liens, or encumbrances, if any, are against the property.
7. If lessee, attach a copy of the lease and state if it is in good standing.

NOTE.—It will be necessary to procure and attach to the exploration project contract agreements of claimants, lienors, encumbrances and lessors subordinating their interests in the property to the interest of the Government under the contract.

8. Furnish current financial statement, showing assets and liabilities, and a profit and loss statement.
9. How much money is applicant prepared to invest in proposed project? Is it sufficient to pay your part of the cost of the project as detailed in question 23 of this application form, in accordance with the regulations on Government participation (Section 9 of Mineral Order 5)?

JUN 8 1951

*If you have already answered these questions on MF-100, you are not required to answer the questions for this application.

16—64067-1

8

THE PROPERTY

10. (*a*) Give a description of the real property that will be in any way involved in the exploration project, including any existing mine or operating property.
    (*b*) Give the legal description of the exact parcel, plot, or area upon which the exploration is to be conducted.

    NOTE.—If both areas are the same, so state. The only obligation to repay the Government is from the net earnings from any commercial discovery made in the area specified in (*b*) above in which the exploration is to be conducted, and the expenditure of funds which may be charged as costs of the project must be limited to that area or to work necessary to perform the exploration in that area.

*11. State the present and former names of the property, if any.
*12. State, in detail, the location of the property with reference to towns, railroads, roads, shipping points, including distances and directions and kinds and conditions of roads.
*13. State source and quantity of water available for operations and its sufficiency at all seasons.
State amount of power to be used, rate per hour or other cost, and source.
*14. Describe any existing useable facilities, equipment, buildings, or structure now on the property that will be devoted to the exploration work.
15. State in detail how the ore could be shipped and how and where milled.
*16. History:
    (*a*) Give a statement, as complete as possible, of previous exploration, development, operation, and production of property, with reasons for any past suspensions of operations.
    (*b*) State briefly the known history and production of adjoining and neighboring properties.
    (*c*) Furnish any available (private) reports that may apply to this application, including results of mine examinations, recommended exploration and development, and metallurgical investigations.
*17. Production:
    (*a*) If mine is in production, furnish the following information:

	Tons per day	*Grade or analysis*	*Cost per ton*	*Net value per ton*
(1) Mining				
(2) Milling				
(3) Shipped or sold				

*18. Ore or mineral reserves: (If property is or has been operating.)
    (*a*) Describe the ore or mineral deposits briefly.
    (*b*) Submit available maps and assay data.
    (*c*) Give estimated tonnage and grade of each class of ore reserves.
19. State any conditions or circumstances regarding the property not sufficiently brought out by the foregoing questions.

THE EXPLORATION

20. For what mineral or minerals and for what types of deposits and ores will the exploration be conducted?
21. Describe briefly, but concisely, the proposed work and the estimated time required to complete it.

    NOTE.—The Government will not participate in a project that will require more than 2 years to complete.
22. Furnish statement of the geological basis of the project with particular emphasis on factors leading the operator to expect the finding of commercial ore bodies. This statement should be accompanied by supporting maps such as geological maps, maps of the proposed openings and assay maps, sample lists, and other pertinent data.

THE REQUIREMENTS AND COSTS

23. Tabulate in the form of an itemized statement with a sum for each item the estimated requirements and costs of the project so that the total will give the estimated cost of the project in which the Government will participate, as follows:
    (*a*) Labor, by numbers and classes (miners, muckers, millmen, etc.), with wages of each.
    (*b*) Supervisors, by numbers and positions, with salaries of each.
    (*c*) Cost of necessary repairs to existing facilities, structures, and buildings.
    (*d*) Cost of necessary installation or construction of additional facilities, structures, and buildings.
    (*e*) Cost of items of equipment, not now owned by the applicant which must be purchased for operations at a cost of $50 or more each.
    (*f*) Cost of rental for equipment which the operator proposes to rent.
    (*g*) Rental value of items of equipment which the operator now owns and which will be devoted to the work.
    (*h*) Cost of materials and supplies, including items of equipment costing less than $50 each.
    (*i*) Cost of power, water, utilities, and any other items not provided for above.
24. Furnish a time schedule of the project, stated in terms of months after project is approved, showing progress expected to be accomplished and the money expected to be spent.

CERTIFICATION

The undersigned company, and the official executing this certification on its behalf, hereby certify that the information contained in this form and accompanying papers is correct and complete to the best of their knowledge and belief.

Mathis and Mathis (Name of company)

By R. W. Mathis (Signature of authorized official)

May 26, 1951 (Date)

Partner and General Manager (Title)

Title 18, U. S. Code (Crimes), Section 1001, makes it a criminal offense to make a willfully false statement or representation to any department or agency of the United States as to any matter within its jurisdiction.

*Same as footnote on page 1.

16—64067-1 U. S. GOVERNMENT PRINTING OFFICE

Mathis and Mathis
P. O. Box 452
Silver City, New Mexico

May 26, 1951

FORM MF-103

1. See MF-100

2. See MF-100

3. See MF-100

4. See MF-100

5. See MF-100

6. Not applicable

7. See attached lease. Lease is in good standing.

8. See attached financial statement.

9. Applicant is prepared to put $10,000.00 into this project, which is sufficient to match Government money.

10. The real property involved and the area upon which the exploration is to be conducted are one and the same, the Houston-Thomas group of 15 patented mining claims in the Pinos Altos Mining district of Grant County, New Mexico, more particularly described as follows:

Lafayette	M.S. #1211	Calcite	M.S. #1489
Manilla	M.S. #1211	Quartzite	M.S. #1489
Alpha	M.S. #1211	Rocker	M.S. #1489
Omega	M.S. #1211	Maverick	M.S. #1580
Florida	M.S. #1211	Opher	M.S. #1490
Caribou	M.S. #1211	Tunnelsite	M.S. #1490
Atlas	M.S. #1211	Klondyke	M.S. #1583
Bauxite	M.S. #1497		

11. See MF-100

12. See MF-100

13. See MF-100

14. See MF-100

15. Ore is hauled by truck from mine to AT&SF Railroad in Silver City and shipped to the Peru mill at Peru Hill Near Deming, New Mexico, for separation of sulfide components.

16. See MF-100

17. See MF-100

18. See MF-100

19. Foregoing questions and answers adequately cover conditions and circumstances covering operations.

MATHIS & MATHIS
Silver City, New Mexico

BALANCE SHEET
AS OF DECEMBER 31, 1950

ASSETS:					
Accounts Receivable - Sundry			197.51		
Notes Receivable			450.00		
Accounts Receivable - Ore			11,758.68		
				12,406.19	
Leaseholds				3,000.00	
Investments				3,648.89	
Insurance Deposits				439.37	
Office Furn & Fixt		255.10			
Less Depreciation		182.50	72.60		
Machinery		20,575.57			
Less Depreciation		11,247.14	9,328.43		
Buildings		90.00			
Less Depreciation		29.20	60.80		
Trucks & Autos		6,428.45			
Less Depreciation		2,092.47	4,335.98	13,797.81	
					33,292.26
LIABILITIES:					
American National Bank			2,216.70		
Accounts Payable			3,967.72		
Taxes Accrued			674.37	6,858.79	
Mrs. J. B. Mathis, Sr., Capital		16,458.91			
1950 Operating Profit		3,573.61			
		20,032.52			
Drawings 1950	1,180.00				
Capital Loss	3,798.23	4,978.23	15,054.29		
R. W. Mathis, Capital		13,603.53			
1950 Operating Profit		4,367.74			
		17,971.27			
Drawings 1950	2,022.10				
Capital Loss	4,642.29	6,664.29	11,306.88		
J. B. Mathis, Jr., Capital			72.30	26,433.47	
					33,292.26

FORM MF-103

THE EXPLORATION

20. The exploration will seek limestone replacement deposits of zinc and lead sulphide ores.

21. Applicant proposes to test the mineralized fissures which cut the limestone outcrops on the Houston-Thomas claims by core drilling. Approximately 15 holes, 300 feet deep are planned at present, and it is estimated that these can be completed within 8 months.

22. The exposed outcroppings of Magdalena limestone are cut discordantly by numerous mineralized fissures within the boundaries of the Houston-Thomas claims. The most extensive and persistent of these fissures are shown in red color on the geology map of the Houston-Thomas claims (Fig. 1) in the accompanying publications. These fissures apparently controlled the migration of mineralizing solutions at the time of deposition, and the zinc and lead sulphides replaced favorable beds of the Magdalena limestone along these fissures.

The ore bodies of the Atlas #2 mine, which applicant is presently working, occur along one of the stronger fissures; and although the discovery core-drill holes were directed by a gravity anomaly (see publication) is the main fissure could be traced on the surface.

The ore body of the Pershing mine were found along an extension of this same fissure, and the many ore bodies of the Cleveland mine were found along similar and usually parallel fissures.

Applicant believes that core drilling along the strong fissure on the Atlas claim will discover additional ore bodies. The possibilities of larger ore bodies are especially good at greater depths, for the gravity survey is not effective for finding ore bodies of the size usually found in this area at depths greater than 150 to 200 feet.

The other fissures shown on the geology map referred to above contain small veinlets of zinc and lead sulphides at various points along their strife, and it is believed that such occurrence warrants core drilling to test for replacement deposits at depth.

THE REQUIREMENTS AND COSTS

23. Itemized cost statement:

(a) Two core drill operators at $1.70 per hour each
(b) Two core drill helpers at $1.25 per hour each
(c) Total labor cost per week $306.80 plus 10% for insurance, unemployment tax, and social security equals $337.48 times 25 weeks, equals---------- $8,437.00

(b) One supervisor at $1.70 per hour. Total cost for 25 weeks, including insurance and taxes,------ 2,431.20

(c) None.

(d) None.

(e) Diamond bit cost, estimated at $1.00 per foot,---- 5,000.00

FORM MF-103

Continued-

THE REQUIREMENTS AND COSTS

		Balance Carried Forward ----------	$15,868.20
23.	(f)	None.	
	(g)	Rental value on two complete core drilling rigs at $35.00 per day, ----------	5,250.00
	(h)	Gasoline and lubricants	400.00
	(i)	Water for drilling at 2 cents per foot,----------	100.00
		TOTAL ----------	$21,618.20

The total of these estimated values is greater than the estimated value of the proposed project. However, applicant believes from experience that he can drill 5000 feet for $20,000.00 and hereby proposes to limit the project to $20,000.00 total cost.

24. The schedule of the proposed project calls for completion of 100 feet of hole each week by each machine. The project would be completed in 25 weeks at this rate.

GRAVITY PROSPECTING FOR LEAD AND ZINC, NEW MEXICO

By
V. E. BARNES, R. W. MATHIS, and F. ROMBERG
U.S.A.

Reprinted from International Geological Congress " Report of the Eighteenth Session Great Britain 1948," Part V.

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U.S.A.

ABSTRACT

Observations of the force of gravity were made on the Houston-Thomas group of claims in the Pinos Altos Mountains north of Silver City, New Mexico. The observed values of gravity were corrected for terrain effects, and the resulting map revealed three positive anomalies. The second of the U.S. Bureau of Mines diamond-drill holes on one of the anomalies penetrated a lead-zinc ore body in which mining later was started. Two holes on another anomaly missed ore, and the third anomaly does not warrant drilling.

This is the first record of the use of a gravity meter in the discovery of a lead-zinc ore body. This investigation also proves that the use of a gravity meter in extremely rugged terrain for the discovery of such bodies is practicable.

An explanation is proposed for the systematic difference between the Bouguer correction as computed from observed surface densities and as computed from the graph of force versus elevation.

INTRODUCTION

THE Houston-Thomas group of 15 patented claims in the Pinos Altos mining district located about eight miles north of Silver City, New Mexico, was chosen for gravity exploration for the following reasons:—

(1) The district has a long history of productivity.

(2) The ore is appreciably heavier than the country rock.

(3) An area was available for lease.

Mathis proposed the project to be operated by him as a commercial prospect, the interpretation being done by Romberg for the privilege of publication of any significant results. The division of labour among the writers is as follows: Mathis obtained the gravity data, made the geological map, and described the ore body; Romberg made the gravity interpretation; and Barnes reviewed the geology. Romberg and Barnes spent two days in the field checking the results.

The gravity anomalies were drilled by the U.S. Bureau of Mines under Project 15–203, which was in progress at the time the gravity survey was made. Use of the results of the drilling by the U.S. Bureau of Mines is gratefully acknowledged. Geologists of the U.S. Smelting, Refining, and Mining Company aided in the underground mapping.

GEOLOGY

Stratigraphy.—The stratigraphic column in the vicinity of the Houston-Thomas prospect is that given by Paige (1916), modified by Spencer and Paige (1935), and quoted as follows:—

Cretaceous
- Colorado shale.
- Beartooth quartzite.

Pennsylvanian
- Magdalena group.

The sedimentary rocks have been extensively intruded by rocks of probable late Cretaceous age consisting predominantly of diorite-porphyry. The geologic map of the area (Fig. 1) shows the main areas of predominant rock types but shows neither the myriad of small intrusives in the sedimentary rocks nor the equally numerous small inclusions in the igneous rocks. Beyond the map area diorite-porphyry outcrops extensively, being terminated eastward by a large granodiorite mass.

GEOLOGIC MAP
HOUSTON-THOMAS PROSPECT
SILVER CITY, NEW MEXICO
0 100 200 300 400 500
SCALE OF FEET
TRUE NORTH
EXPLANATION
Gossan
Andesite
Diorite porphyry
(Many small intrusive bodies within sediments not shown)
Colorado shale
Beartooth quartzite
UNCONFORMITY
Magdalena limestone
CRETACEOUS
PENNSYLVANIAN
Drill hole
Mine dump
Open cut
Underground workings
Mine shaft
HOUSTON-THOMAS MINE
JAP WORKINGS
HOUSTON-THOMAS FAULT
PERSHING MINE
ATLAS #2 MINE
ATLAS #1 MINE
CLEVELAND MINE

FIG. 1.

In nearby mining districts the Magdalena group has been divided into two formations, and beneath them a Mississippian formation, the Lake Valley limestone, is prolifically ore bearing. In the Pinos Altos district the Lake Valley limestone has not been found, and the divisions of the Magdalena group have not been recognized.

Mineral deposits.—Graton (1910) described the mineral deposits of the Pinos Altos district and gave an account of the early history of the district. Paige (1916, p. 14, 1911) gives additional information about the mineral deposits, especially the replacement deposit in limestone with which this paper deals. The district was discovered about 1860, and since that time several million dollars worth of metals have been produced, with the precious metals predominating in the early part of its history and the base metals becoming more prominent later.

The lead-zinc deposits of the Houston-Thomas and adjoining claims are replacement deposits in the Magdalena limestone, the chief metallic minerals being ferriferous sphalerite (marmatite), galena, pyrite, and chalcopyrite. On the surface there are extensive gossans composed, according to Paige, of a mixture of limonite, smithsonite, azurite, and earthy materials with a dark-brown material containing manganese, copper, and iron. The geologic map (Fig. 1) shows the gossan areas and the principal mines. The estimated production in short tons of ore from the various mines is as follows: Cleveland, 130,000+; Houston-Thomas, 3,500 (sulphide ore); Atlas No. 1, 500 (carbonate and sulphide ore); and Pershing, 6,000 (sulphide ore).

On the Cleveland property, gossan occurs over both the Cleveland and the Pershing mines. A small area of gossan occurs above the carbonate and sulphide ores of the Atlas No. 1 mine, and another small area of gossan is exposed within the gravity anomaly over the known ore mass. However, large areas of gossan on the Houston-Thomas claims have been proven barren and, furthermore, no gravity anomalies have been found associated with them.

Density data.—The densities of the various rock types were determined before the gravity survey was made in order to judge whether or not a gravity survey would be feasible. The density data obtained are as follows:—

Rock type	*Average density*
Gossan	2·70
Colorado shale	2·74
Beartooth quartzite	2·66
Magdalena limestone	2·77
Diorite-porphyry	2·80
Andesite	2·67

Densities from cores are as follows:—

Rock type	*Average density*
Magdalena limestone	2·75
Diorite-porphyry	2·89

The average density of the ore mined up to February 22, 1948, is 3·84.

Structure.—According to Paige (1911, p. 123) the ore deposits appear to replace definite beds in the Magdalena limestone. The attitude of the limestone has been disturbed somewhat by the extensive intrusives, but in general it dips east-northeast. The unconformably overlying Beartooth quartzite in general dips south-southeast. Commonly the limestone and the quartzite in the area surveyed are separated by a thin diorite-porphyry sill.

Faulting is prevalent in the Pinos Altos district, and several faults are shown within the map area. Just east of the map area the contact between the Magdalena limestone and the Beartooth quartzite is at an elevation of 7,500 feet, whereas immediately west of the Houston-Thomas fault, it is at an elevation of 7,260 feet, indicating a drop on the western side of the fault of approximately 300 feet. Another north-south fault west of the map area, also downthrown to the west, places the Colorado shale in contact with the Magdalena limestone.

Near the northeastern margin of the map area, the Colorado shale is downthrown against the Magdalena limestone, and within the map area it is faulted against diorite-porphyry. This fault has several times the throw of the Houston-Thomas fault and is offset by it. A post-faulting andesite dyke is shown in the northwestern part of the map area.

TOPOGRAPHY

That portion of the Houston-Thomas group of claims covered by the gravity survey lies on the western slope of the Pinos Altos Mountains within a few hundred feet of the Continental Divide and

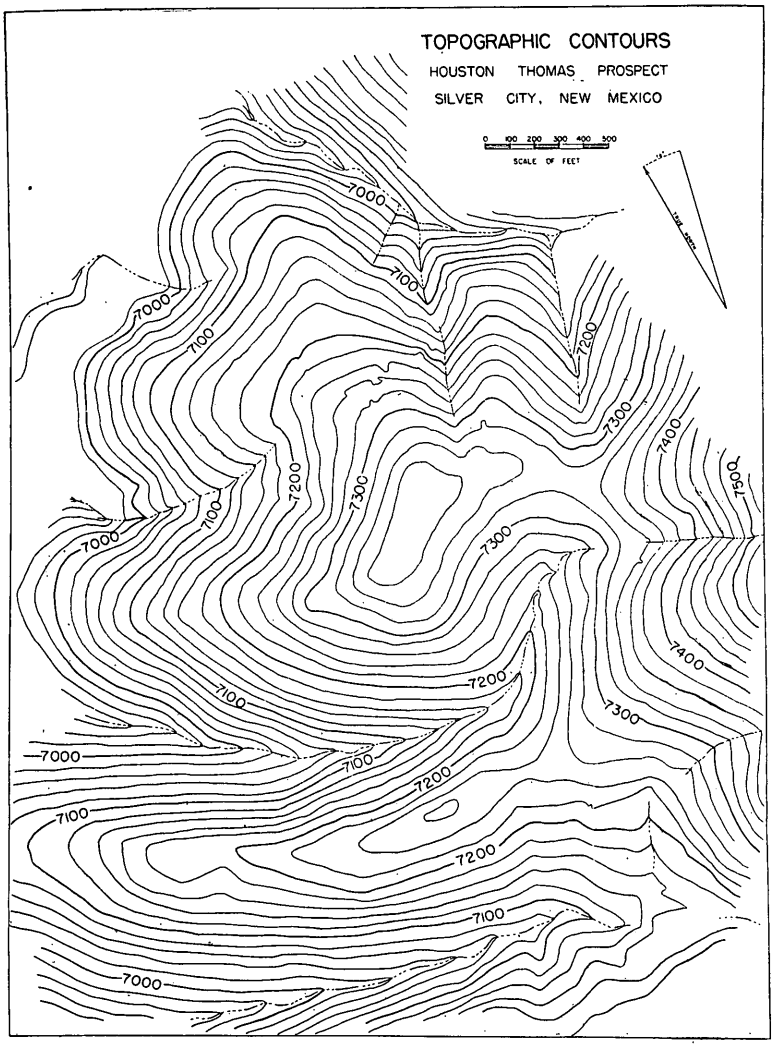

FIG. 2.

between elevations of 7,000 and 7,500 feet above sea level. The crest of the Pinos Altos Mountains is 8,036 feet in elevation and is about one-fourth of a mile from the surveyed area, which is about 3,000 by 3,400 feet in size. Figure 2 is a topographic map of the area showing the steepness of the slopes. The maximum slope is near 38°, and the average slope is estimated to be about 20°. The topography shown is typical of that within a two-mile radius.

The slopes are rubble and brush covered which, in combination with the extreme steepness, made surveying and observing with the gravity meter difficult tasks.

GRAVITY OBSERVATIONS

The stations for observing the gravitational force were laid out in an irregular network with a spacing of about 100 feet. This spacing was chosen because the shallow ore bodies which were being sought would presumably give rise to anomalies in the gravitational field with dimensions of the order of 200 feet. Such anomalies may be missed on the final map of the gravitational force if the spacing is too large. When the preliminary work was done, fill-in stations were set in areas where anomalies were indicated.

Observations of the force were made with a portable gravity meter which was read with a precision of plus or minus 0·01 milligal. The meter had to be transported on foot, as it was not possible to take an automobile anywhere on the prospect except on the one road that runs through it. The effect of tidal drift was kept small by reading the meter frequently on base stations; this was practical because the stations were close together. After the readings were corrected for drift, they appeared to be repeatable with a probable error of less than plus or minus 0·02 milligal. The corrected readings are probably in error with respect to each other by more than this amount if they are some distance apart on the prospect, but this is of no consequence in the search for small anomalies.

The observations were corrected for latitude and elevation in the usual manner, and a contour map (Fig. 4) drawn on the residual values. Terrain corrections were made for the stations in areas that seemed to be anomalous, and a second contour map was made using these corrected observations (Fig. 5). The values of the gravitational force shown are relative, since no purpose in prospecting could be served by trying to relate them to the absolute value of force.

When gravity surveys are made in areas of rough topography, there is always a question as to whether the effects of the terrain will mask the anomalies that are being sought, even after the terrain corrections have been made. On the Houston-Thomas prospect it was considered doubtful whether the anomalous gravitational effects of ore bodies could be perceived, since the surface was extremely rough and the surface material varied. With sufficient labour and very accurate topographic and geologic maps, a set of terrain corrections could no doubt be computed to any required correctness, but there was no assurance in the beginning that the extra labour of making accurate terrain corrections would be worth carrying out. As it was, the gravity map after correction showed no anomalies that were not hinted at by the uncorrected map, but the corrected map showed the closures more plainly. The authors do not know of another attempt to look for such small anomalies in such rough terrain.

DENSITY CORRECTIONS

It is customary to correct observations of the gravitational force for elevation differences with a factor which multiplies the relative elevation of each station. This factor is a combination of the free air elevation correction (which is nearly constant on the earth's surface) and the Bouguer factor, which is a function of the surface density. The surface density can be measured from samples. This measurement is usually supplemented with density profiles such as those described by Nettleton (1940), in which different values of the density are tried out for effect on the final values of the gravitational force. Profiles computed with a number of assumed densities are plotted for a line of observations, and these profiles are compared with a profile of the topography. If the assumed density is too small, its force profile follows the topography; if it is too large, its profile mirrors the topography. The correct density will, of course, be the one whose profile seems neither to follow nor to mirror the topography. This method works well if, on the profiles chosen, there is no relation between the residual force and the elevations, but if there is such a relation, it may lead to a choice of the wrong density.

Density profiles for the Houston-Thomas prospect were ambiguous; the profiles seemed to follow some topographic features and mirror others. However, the best choice of surface density indicated by the density profiles seemed to be about 2·2. This differs seriously from the measured density of 2·7.

Another method of finding a value for the combined elevation correction (and thence presumably for the surface density) is to plot all the observations on a graph of elevation versus force uncorrected for elevation. If there were no gravity anomalies present, the points on the graph would all lie in a

straight line, whose slope would be the elevation correction factor. The slope of the line can be found with sufficient accuracy if the elevation differences on the prospect are great enough. The elevation graph of the Houston-Thomas prospect (Fig. 3) showed the slope to have a value corresponding to a surface density of 2·0. This result is even more startling than the value of 2·2 which was deduced from the density profiles, as it deviates even further from the measured density. The elevation graph shows the slope the line would have, to correspond to a density of 2·7, and it is clearly out of the question to draw the line with such a slope. Thus if the elevation correction based on a density of 2·7 were used in correcting the observations of force, the uphill and downhill stations would appear to be anomalous merely on account of their elevations. The final elevation corrections were computed from the slope of the elevation graph rather than from the true density, since it was thought that fewer irrelevant anomalies would result.

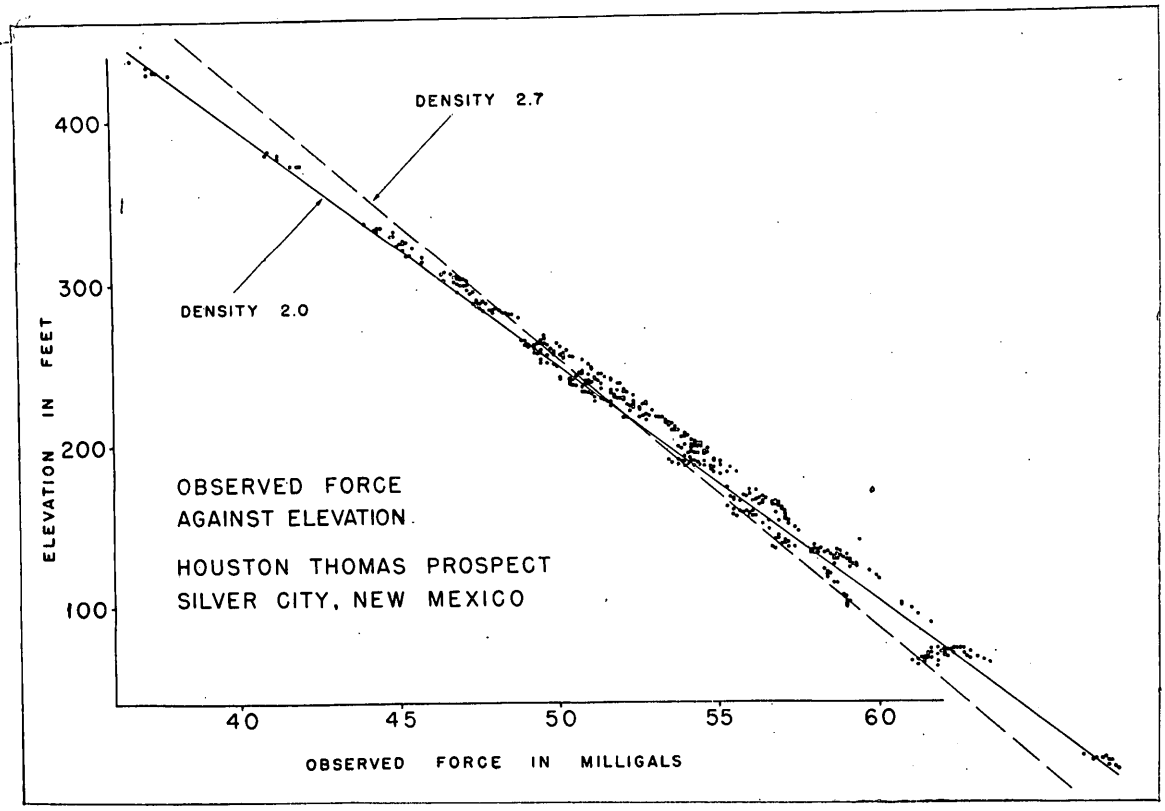

FIG. 3.

Three explanations suggest themselves for the discrepancy between the surface density as measured and as deduced from the density profiles and elevation graph. If the prospect slopes generally in one direction, the graphic correction factor will include the regional gradient in this direction, if there is one. This is not harmful unless the regional gradient itself is being sought. Again, if the higher stations and lower stations are generally on different outcrops, the graphic correction factor will include the anomaly caused by the density difference of the outcropping formations. Finally, if the higher elevations occur in regions of rougher topography, the total or large-scale terrain corrections (as opposed to the very local corrections made for the map) will increase with the elevations and cause the graphic correction factor to be greater than it ought to be, and the deduced surface density less. In an ideal case such as that of a cone-shaped mountain, it is clear that the total terrain correction will increase

systematically as the point of observation moves from the base of the mountain to its top. The present prospect is a fair approximation to such a case, and it seems probable that the abnormal slope of the elevation graph is caused by an increase with elevation of the terrain correction.

TERRAIN CORRECTIONS

Since topographic irregularities affect the observed gravitational force, a correction must be added to each station. The magnitude of each correction depends on the surface density and the topography in the neighbourhood of the station, and the corrections are usually computed graphically by means

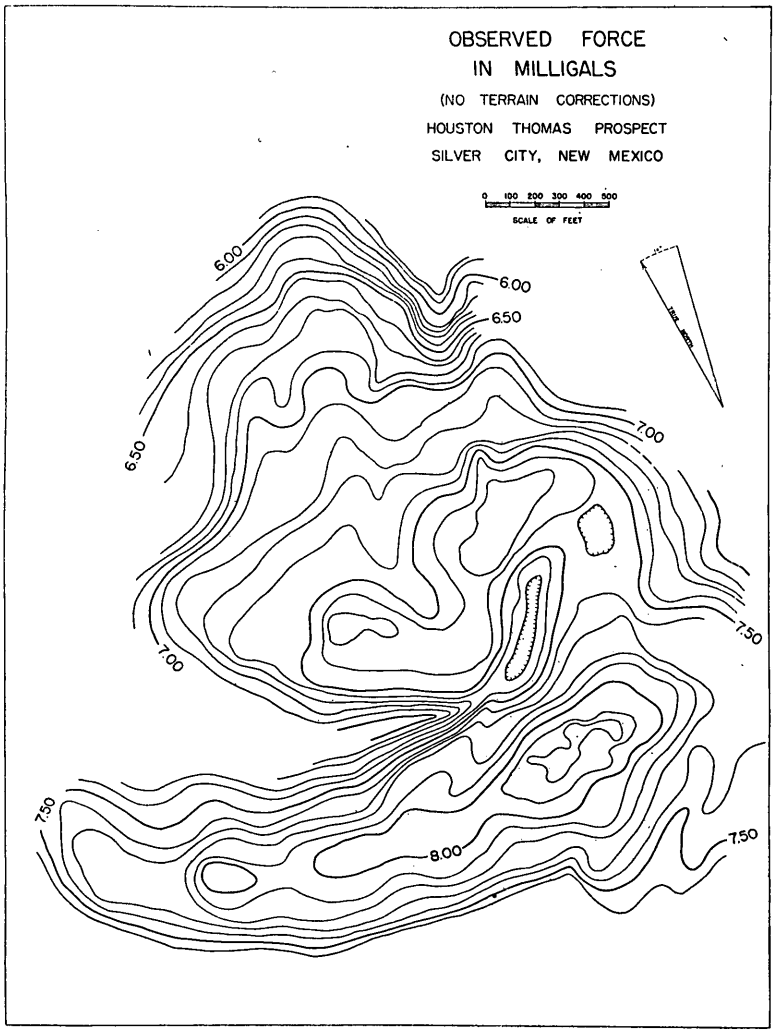

FIG. 4.

of reticules or zone charts superimposed on a contour map of the area surrounding the station. A practical method for making such computations has been described by Hammer (1939). In theory, the total terrain correction for a station is computed from all the topographic irregularities (mass above the station and voids below it) for an infinite distance out. In practice, of course, it is necessary to take into account only the irregularities close to the stations. The circle of ground for which corrections for a given station are made is usually chosen to have a radius several times the linear dimensions of the expected gravitational anomalies, so that the gradients from the uncorrected irregularities outside the circle will be small and not obscure the anomaly. In the present case, the terrain corrections were

based on a surface density of 2·7 and computed for a distance of about 1,500 feet around the stations, from a topographic map made from the surveyed elevations of the stations (Fig. 2).

DISCUSSION OF GRAVITY ANOMALIES

The contour map (observed force with terrain corrections, Fig. 5) shows three positive closures. The most interesting of these is the southeastern one, roughly 0·3 milligal in height and perhaps 300 by 600 feet in size. Considering the gradients in the vicinity, a closure of 0·3 milligal is not outstanding, but still the anomaly is better than a borderline case. Possible interpretations of this anomaly

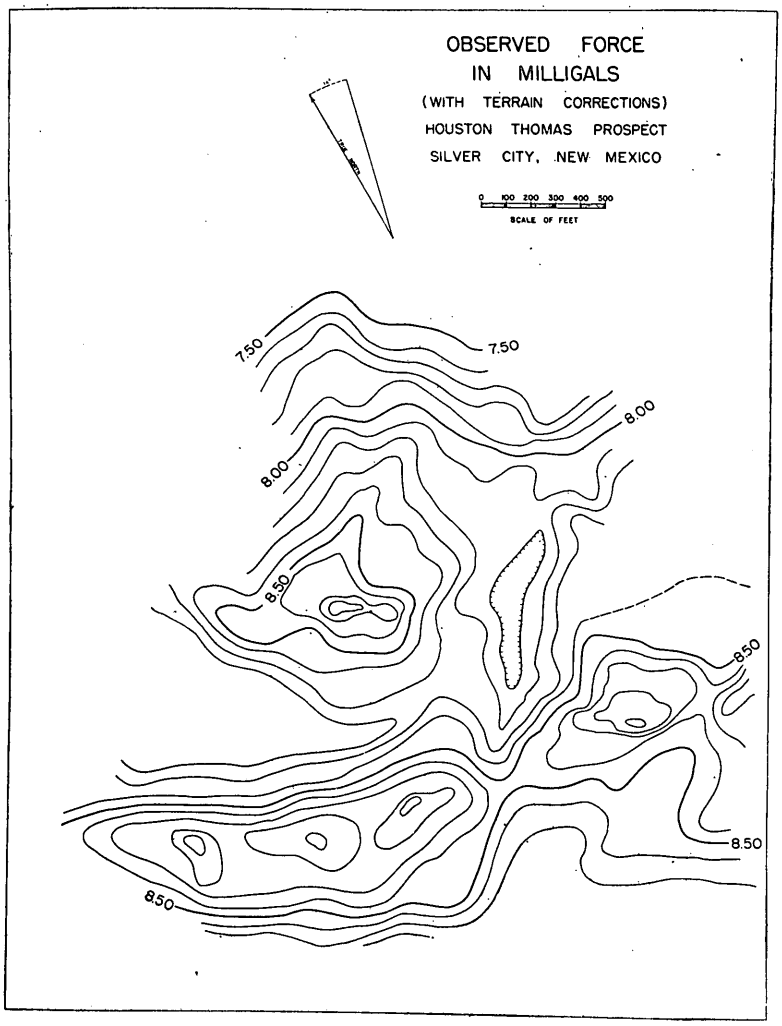

FIG. 5.

are: (1) A wrong elevation correction or an inadequate terrain correction under some conditions might cause a closure, but for this anomaly such a cause is ruled out because the anomaly is in an area which is neither high nor low topographically. (2) The anomaly is situated roughly over the eastern end of an outcrop of Magdalena limestone, but the limestone outcrop also extends westward beyond the closure indicating that any correspondence seen is fortuitous. (3) The remaining inference that the gravitational high must be caused by something heavy beneath the surface was confirmed when the core drill penetrated ore.

A gravity high of the dimensions shown could be caused by an infinite variety of anomalous mass distributions. However, if it is assumed that the anomalous mass is fairly simple in shape, it is safe to assign a maximum depth to it, corresponding to half its width or less. This would mean that the anomalous mass ought to be no deeper than 150 feet, though it might be shallower. In addition, the amount of the anomalous material is proportional to the " volume " of the gravitational anomaly. In the present case, the anomalous material can be estimated to be several hundred thousand tons. Estimates for other masses have previously been made by Romberg and Barnes (1943), and Hammer (1945).

The largest positive closure is in the southwestern part of the area and is about 500 by 1,500 feet in size. The closure corresponds in size and shape to a prominent topographic ridge of Beartooth quartzite underlain by the heavier diorite-porphyry and limestone. The coincidence between the ridge and the closure leads to the suspicion that the high is caused by surface irregularity rather than by heavy material. A density profile across the ridge indicated that the closure would have been much reduced if a different elevation correction had been chosen, and it would probably have been reduced still further by more extensive terrain corrections. Also, it is to be expected that the terrain corrections will be less effective as the topographic features get larger, and for this prospect the corrections were made out to a relatively small distance. No core drilling on this anomaly is recommended.

The third positive closure, west-central part of the map, is on the side of a steep hill, thus minimizing the possibility of its being due to topography. The surface geology is complex, with limestone, diorite-porphyry, and quartzite in an irregular pattern near the centre of the closure. The complex geology makes this high less attractive than the first one, but it is difficult to avoid suspecting that the high values are caused by heavy material beneath the surface. Two barren holes have been drilled, but additional drilling is probably advisable. From the size and shape of the anomaly, it is inferred that a small quantity of heavy material may be close to the surface, accounting for the localized high values in the middle of the anomaly, and in addition a large quantity of heavy material may be present at a depth of 200 or more feet. Whether or not this heavy material is ore remains to be seen.

Some other features of the gravity map which may be pointed out are:—

(1) The topographic low between the second and third anomalies shows a large gravity low associated with the Magdalena limestone. The low probably reflects topography.

(2) In contrast, the topographic high northeast of the third anomaly (centre of the topographic map) does not appear to be reflected on the gravity map.

(3) A small gravity terrace is associated with the limestone between the Houston-Thomas mine and the Jap workings.

(4) The closed low between the first and third anomalies is associated with quartzite but is also associated with a topographic low.

PROSPECTING AND DEVELOPMENT DATA

Core-drilling data.—The U.S. Bureau of Mines was conducting a drilling programme (Project 15–203) on the Houston-Thomas group of claims during the time the gravity survey was being made. The first hole (Fig. 1) was directed to prospect the Magdalena limestone beneath the Cretaceous in the northern part of the map area. The throw of the fault was greater than expected, and the limestone was not reached, the hole being bottomed in Colorado shale at 875 feet. The Bureau of Mines completed the first hole before the gravity data had been fully reduced.

The location for the second hole on the basis of the preliminary gravity reduction proved to be too far east, and only a few inches of ore was encountered. The hole passed through 40 feet of limestone followed mostly by diorite-porphyry to its total depth of 290 feet. By the time the second hole was completed, the gravity data had been sufficiently well reduced so that the location of hole No. 3 proved to be accurate. Hole No. 3, directed S. 29° E. at an angle of 70°, penetrated limestone containing a small amount of diorite-porphyry to 96 feet, ore from 96 to 105 feet, mineralized limestone from 105 to 120 feet, and bottomed in diorite-porphyry at 122 feet. Another hole, No. 4, from the same

station directed S. 29° E. but at an angle of 55°, penetrated 113 feet of limestone containing a small amount of diorite-porphyry, ore from 113 to 142 feet, and bottomed in diorite-porphyry at 143 feet. Since funds were not available to outline the ore body, the drill was moved to the northwestern anomaly where two holes were drilled.

Hole No. 5, drilled vertically, bottomed at 245 feet after passing through diorite-porphyry for 120 feet, followed by alternating unmineralized limestone and diorite-porphyry for the rest of the distance. Hole No. 6, directed N. 10° E. at an angle of 70°, penetrated 21 feet of diorite-porphyry, limestone from 21 to 64 feet, and bottomed in diorite-porphyry at 135 feet without encountering mineralization. The drilling on the second anomaly is not conclusive.

Mining data.—A shaft was sunk in the vicinity of the drill holes and was placed, as nearly as could be interpreted from the gravity data, to graze the southern margin of the ore body. However, the shaft

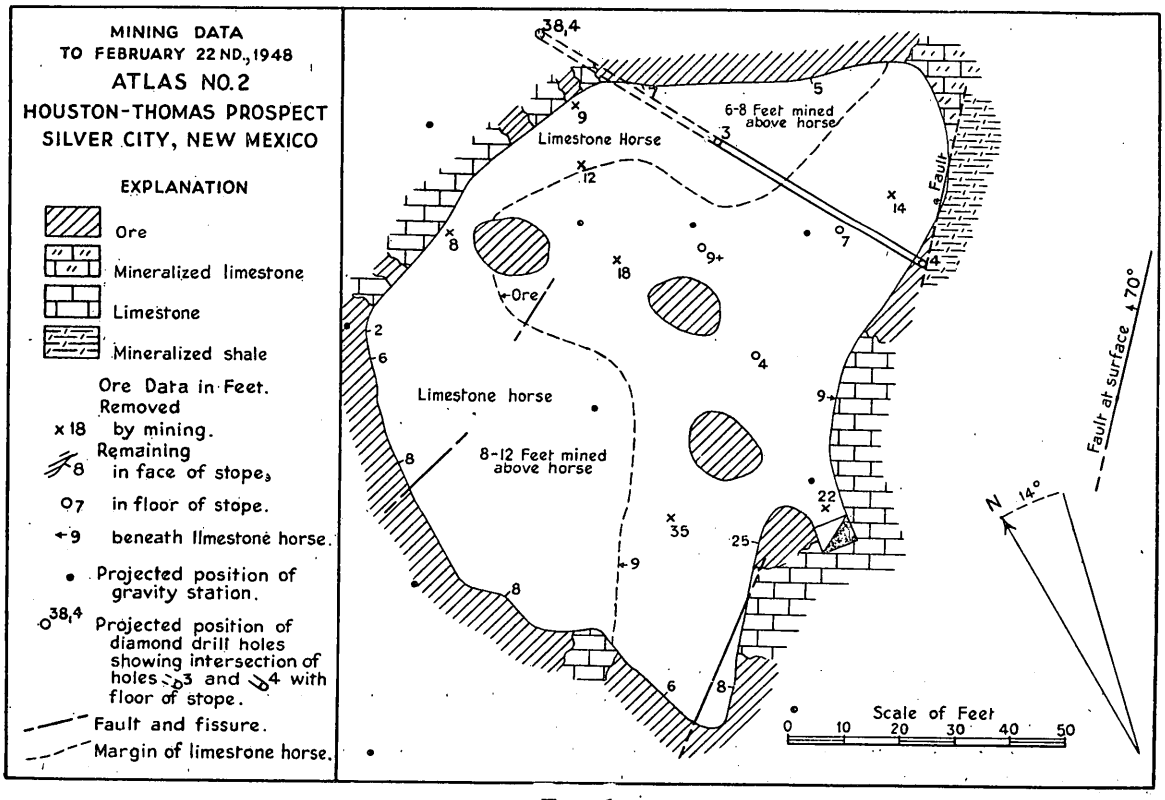

FIG. 6.

between 78 and 98 feet was approximately half in ore and half in limestone. Diorite is beneath the ore in the bottom of the shaft. A drift was driven toward the drill holes, and the ore about the holes has been removed.

The area stoped, up to February 22, 1948, is shown in Fig. 6, and the thicknesses of ore removed or still remaining are noted. An extensive limestone horse in the western and northern part of the stope, extending 5 to 6 feet above floor level in the northeastern part, is being left, and ore 6 to 12 feet thick has been mined from above it. Ore beneath the horse is indicated, but little is known about its thickness.

Shale is exposed on the southeastern side of a 4-foot brecciated fault zone containing broken ore, calcite, and gouge seams. The last movement along the fault was nearly horizontal and the vertical displacement appears to be less than 20 feet. The shale is cut by small veins containing pyrite, galena,

and marmatite which are terminated at the fault plane. This is the only place seen where there is definite evidence that the faulting is post-mineralization in age. A fissure seen at the surface and dipping 70° to the northwest is probably the surface expression of the fault.

A vein of galena, 1 to 4 inches thick, cuts vertically through the ore and adjacent limestone in the southwestern part of the stope. Other late veins filled with calcite and pyrite are common in the western part of the stope and for the most part are aligned approximately in an east-west direction.

The back of the stope is fairly plain, strikes about N. 20° W., and dips about 21° to the east. The ore appears to have selectively replaced beds of the Magdalena limestone as in the Cleveland mine.

The principal metallic minerals in the ore are pyrite, marmatite, galena, and chalcopyrite. The principal gangue mineral is calcite. The tenor of the ore up to February 22, 1948, was approximately as follows: zinc, 10·07 per cent; lead, 2·55 per cent; copper, 0·17 per cent; silver, 3·33 ounces; and gold, 0·012 ounces. The gold is of no value to the producer, and it is seldom that the copper content is sufficiently high to yield revenue. Penalty-bearing constituents such as arsenic and bismuth are absent. However, iron amounts to 29 per cent of the ore mined, and the marmatite, after milling, contains approximately 11 per cent iron, which is objectionable in smelting and reduces the value of the ore.

Until February 22, 1948, about 11,900 dry tons of ore having an average density of about 3·84 were mined. The tonnage of ore remaining is unknown, and until the body has either been mined or drilled, the correlation between the predicted amount and actual amount of ore will be unknown.

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DISCUSSION

K. C. DUNHAM congratulated the authors on this first discovery of a concealed lead-zinc orebody, and asked the nature of the oreshoot, whether it was a " manto " in the Magdalena Limestone. He also enquired about the average thickness of the deposit.

In reply V. E. BARNES regretted that these points, contained in the original paper, had been omitted from his presentation. The orebody appears to be a selective replacement of the Magdalena limestone as in the neighbouring Cleveland Mine and a rough estimate of its thickness is 14 feet.

CWS—25899 (R)

Form MF-103
(April 1951)

U. DEPARTMENT OF THE INTERI
DEFENSE MINERALS ADMINISTRATION

Budget Bureau No. 42-R1035.
Approval expires 6-30-51.

APPLICATION FOR AID FOR AN EXPLORATION PROJECT PURSUANT TO MINERAL ORDER 5, UNDER DEFENSE PRODUCTION ACT OF 1950

DO NOT FILL IN THIS BLOCK

Docket No. dma 1549X

Date received 6-4-51

Participation

Mathis and Mathis
P. O. Box 452
Silver City, New Mexico

DEPARTMENT OF THE INTERIOR
Defense Minerals Administration
RECEIVED
JUN 4 - 1951
LANDON F. STROBEL
Executive Secretary
Date

Name and address of applicant

FILL IN THIS BLOCK

Date of application May 26, 1951

Estimated cost $20,000.00

Mineral or metal Zinc and Lead

Percentage of Government participation 50%

Location of mine Pinos Altos Mining District

Nine Miles North of Silver City, N. Mex.

Date of filing MF-100 May 26, 1951

DMA Docket Number, if available

INSTRUCTIONS

Read Mineral Order 5, Regulations Governing Government Aid in Defense Projects, before completing this application. Submit four signed copies of the application to Defense Minerals Administration, Department of the Interior, Washington 25, D. C., or to the nearest field executive officer thereof, with your name and address on each sheet of the application and all accompanying papers. If any question is inapplicable, or if you cannot answer it, so state on the form. Where the space provided for answer is insufficient, answer on a separate sheet, annex it to the application form, and refer to it in space for answer. If the application is approved, you will be presented with an exploration project contract on Form MF-200, for your signature.

THE APPLICANT

*1. Is applicant an individual, partnership, or corporation?
*2. If a partnership, state names and addresses of partners.
*3. If a corporation, state names and addresses of officers, directors, and five largest stockholders.
*4. Describe the mining and general business experience of (*a*) the applicant, and (*b*) the person or persons who will manage the project.
*5. Are you the owner or the lessee of the property?
6. If owner, state what claims, liens, or encumbrances, if any, are against the property.
7. If lessee, attach a copy of the lease and state if it is in good standing.

NOTE.—It will be necessary to procure and attach to the exploration project contract agreements of claimants, lienors, encumbrances and lessors subordinating their interests in the property to the interest of the Government under the contract.

8. Furnish current financial statement, showing assets and liabilities, and a profit and loss statement.
9. How much money is applicant prepared to invest in proposed project? Is it sufficient to pay your part of the cost of the project as detailed in question 23 of this application form, in accordance with the regulations on Government participation (Section 9 of Mineral Order 5)?

*If you have already answered these questions on MF-100, you are not required to answer the questions for this application.

16—64067-1

THE PROPERTY

10. (*a*) Give a description of the real property that will be in any way involved in the exploration project, including any existing mine or operating property.

    (*b*) Give the legal description of the exact parcel, plot, or area upon which the exploration is to be conducted.

    NOTE.—If both areas are the same, so state. The only obligation to repay the Government is from the net earnings from any commercial discovery made in the area specified in (*b*) above in which the exploration is to be conducted, and the expenditure of funds which may be charged as costs of the project must be limited to that area or to work necessary to perform the exploration in that area.

*11. State the present and former names of the property, if any.

*12. State, in detail, the location of the property with reference to towns, railroads, roads, shipping points, including distances and directions and kinds and conditions of roads.

*13. State source and quantity of water available for operations and its sufficiency at all seasons. State amount of power to be used, rate per hour or other cost, and source.

*14. Describe any existing useable facilities, equipment, buildings, or structure now on the property that will be devoted to the exploration work.

15. State in detail how the ore could be shipped and how and where milled.

*16. History:

    (*a*) Give a statement, as complete as possible, of previous exploration, development, operation, and production of property, with reasons for any past suspensions of operations.

    (*b*) State briefly the known history and production of adjoining and neighboring properties.

    (*c*) Furnish any available (private) reports that may apply to this application, including results of mine examinations, recommended exploration and development, and metallurgical investigations.

*17. Production:

    (*a*) If mine is in production, furnish the following information:

	Tons per day	*Grade or analysis*	*Cost per ton*	*Net value per ton*
(1) Mining				
(2) Milling				
(3) Shipped or sold				

*18. Ore or mineral reserves: (If property is or has been operating.)

    (*a*) Describe the ore or mineral deposits briefly.

    (*b*) Submit available maps and assay data.

    (*c*) Give estimated tonnage and grade of each class of ore reserves.

19. State any conditions or circumstances regarding the property not sufficiently brought out by the foregoing questions.

THE EXPLORATION

20. For what mineral or minerals and for what types of deposits and ores will the exploration be conducted?

21. Describe briefly, but concisely, the proposed work and the estimated time required to complete it.

    NOTE.—The Government will not participate in a project that will require more than 2 years to complete.

22. Furnish statement of the geological basis of the project with particular emphasis on factors leading the operator to expect the finding of commercial ore bodies. This statement should be accompanied by supporting maps such as geological maps, maps of the proposed openings and assay maps, sample lists, and other pertinent data.

THE REQUIREMENTS AND COSTS

23. Tabulate in the form of an itemized statement with a sum for each item the estimated requirements and costs of the project so that the total will give the estimated cost of the project in which the Government will participate, as follows:

    (*a*) Labor, by numbers and classes (miners, muckers, millmen, etc.), with wages of each.

    (*b*) Supervisors, by numbers and positions, with salaries of each.

    (*c*) Cost of necessary repairs to existing facilities, structures, and buildings.

    (*d*) Cost of necessary installation or construction of additional facilities, structures, and buildings.

    (*e*) Cost of items of equipment, not now owned by the applicant which must be purchased for operations at a cost of $50 or more each.

    (*f*) Cost of rental for equipment which the operator proposes to rent.

    (*g*) Rental value of items of equipment which the operator now owns and which will be devoted to the work.

    (*h*) Cost of materials and supplies, including items of equipment costing less than $50 each.

    (*i*) Cost of power, water, utilities, and any other items not provided for above.

24. Furnish a time schedule of the project, stated in terms of months after project is approved, showing progress expected to be accomplished and the money expected to be spent.

CERTIFICATION

The undersigned company, and the official executing this certification on its behalf, hereby certify that the information contained in this form and accompanying papers is correct and complete to the ~~best of~~ their knowledge and belief.

Mathis and Mathis (Name of company)

By G. W. Mathis (Signature of authorized official)

May 26, 1951 (Date)

Partner and General Manager (Title)

Title 18, U. S. Code (Crimes), Section 1001, makes it a criminal offense to make a willfully false statement or representation to any department or agency of the United States as to any matter within its jurisdiction.

*Same as footnote on page 1.

16—64067-1 U. S. GOVERNMENT PRINTING OFFICE

Mathis and Mathis
P. O. Box 452
Silver City, New Mexico

May 26, 1951

FORM MF-103

1. See MF-100

2. See MF-100

3. See MF-100

4. See MF-100

5. See MF-100

6. Not applicable

7. See attached lease. Lease is in good standing.

8. See attached financial statement.

9. Applicant is prepared to put $10,000.00 into this project, which is sufficient to match Government money.

10. The real property involved and the area upon which the exploration is to be conducted are one and the same, the Houston-Thomas group of 15 patented mining claims in the Pinos Altos Mining district of Grant County, New Mexico, more particularly described as follows:

Lafayette	M.S. #1211	Calcite	M.S. #1489
Manilla	M.S. #1211	Quartzite	M.S. #1489
Alpha	M.S. #1211	Rocker	M.S. #1489
Omega	M.S. #1211	Maverick	M.S. #1580
Florida	M.S. #1211	Opher	M.S. #1490
Caribou	M.S. #1211	Tunnelsite	M.S. #1490
Atlas	M.S. #1211	Klondyke	M.S. #1583
Bauxite	M.S. #1497		

11. See MF-100

12. See MF-100

13. See MF-100

14. See MF-100

15. Ore is hauled by truck from mine to AT&SF Railroad in Silver City and shipped to the Peru mill at Peru Hill Near Deming, New Mexico, for separation of sulfide components.

16. See MF-100

17. See MF-100

18. See MF-100

19. Foregoing questions and answers adequately cover conditions and circumstances covering operations.

MATHIS & MATHIS
Silver City, New Mexico

BALANCE SHEET
AS OF DECEMBER 31, 1950

ASSETS:					
Accounts Receivable - Sundry			197.51		
Notes Receivable			450.00		
Accounts Receivable - Ore			11,758.68		
				12,406.19	
Leaseholds				3,000.00	
Investments				3,648.89	
Insurance Deposits				439.37	
Office Furn & Fixt		255.10			
Less Depreciation		182.50	72.60		
Machinery		20,575.57			
Less Depreciation		11,247.14	9,328.43		
Buildings		90.00			
Less Depreciation		29.20	60.80		
Trucks & Autos		6,428.45			
Less Depreciation		2,092.47	4,335.98	13,797.81	
					33,292.26
LIABILITIES:					
American National Bank			2,216.70		
Accounts Payable			3,967.72		
Taxes Accrued			674.37	6,858.79	
Mrs. J. B. Mathis, Sr., Capital		16,458.91			
1950 Operating Profit		3,573.61			
		20,032.52			
Drawings 1950	1,180.00				
Capital Loss	3,798.23	4,978.23	15,054.29		
R. W. Mathis, Capital		13,603.53			
1950 Operating Profit		4,367.74			
		17,971.27			
Drawings 1950	2,022.10				
Capital Loss	4,642.29	6,664.29	11,306.88		
J. B. Mathis, Jr., Capital			72.30	26,433.47	
					33,292.26

FORM MF-103

THE EXPLORATION

20. The exploration will seek limestone replacement deposits of zinc and lead sulphide ores.

21. Applicant proposes to test the mineralized fissures which cut the limestone outcrops on the Houston-Thomas claims by core drilling. Approximately 15 holes, 300 feet deep are planned at present, and it is estimated that these can be completed within 8 months.

22. The exposed outcroppings of Magdalena limestone are cut discordantly by numerous mineralized fissures within the boundaries of the Houston-Thomas claims. The most extensive and persistent of these fissures are shown in red color on the geology map of the Houston-Thomas claims (Fig. 1) in the accompanying publications. These fissures apparently controlled the migration of mineralizing solutions at the time of deposition, and the zinc and lead sulphides replaced favorable beds of the Magdalena limestone along these fissures.

The ore bodies of the Atlas #2 mine, which applicant is presently working, occur along one of the stronger fissures; and although the discovery core-drill holes were directed by a gravity anomaly (see publication) is the main fissure could be traced on the surface.

The ore body of the Pershing mine were found along an extension of this same fissure, and the many ore bodies of the Cleveland mine were found along similar and usually parallel fissures.

Applicant believes that core drilling along the strong fissure on the Atlas claim will discover additional ore bodies. The possibilities of larger ore bodies are especially good at greater depths, for the gravity survey is not effective for finding ore bodies of the size usually found in this area at depths greater than 150 to 200 feet.

The other fissures shown on the geology map referred to above contain small veinlets of zinc and lead sulphides at various points along their strife, and it is believed that such occurrence warrants core drilling to test for replacement deposits at depth.

THE REQUIREMENTS AND COSTS

23. Itemized cost statement:

(a)	Two core drill operators at $1.70 per hour each Two core drill helpers at $1.25 per hour each Total labor cost per week $306.80 plus 10% for insurance, unemployment tax, and social security equals $337.48 times 25 weeks, equals----------	$8,437.00
(b)	One supervisor at $1.70 per hour. Total cost for 25 weeks, including insurance and taxes,------	2,431.20
(c)	None.	
(d)	None.	
(e)	Diamond bit cost, estimated at $1.00 per foot,----	5,000.00

FORM MF-103

Continued-

THE REQUIREMENTS AND COSTS

		Balance Carried Forward ----------	$15,868.20
23.	(f)	None.	
	(g)	Rental value on two complete core drilling rigs at $35.00 per day, ----------	5,250.00
	(h)	Gasoline and lubricants	400.00
	(i)	Water for drilling at 2 cents per foot,----------	100.00
		TOTAL ----------	$21,618.20

The total of these estimated values is greater than the estimated value of the proposed project. However, applicant believes from experience that he can drill 5000 feet for $20,000.00 and hereby proposes to limit the project to $20,000.00 total cost.

24. The schedule of the proposed project calls for completion of 100 feet of hole each week by each machine. The project would be completed in 25 weeks at this rate.

GRAVITY PROSPECTING FOR LEAD AND ZINC, NEW MEXICO

By
V. E. BARNES, R. W. MATHIS, and F. ROMBERG
U.S.A.

Reprinted from International Geological Congress " Report of the Eighteenth Session Great Britain 1948," Part V.

GRAVITY PROSPECTING FOR LEAD AND ZINC, NEW MEXICO

By V. E. BARNES, R. W. MATHIS, and F. ROMBERG

U.S.A.

ABSTRACT

Observations of the force of gravity were made on the Houston-Thomas group of claims in the Pinos Altos Mountains north of Silver City, New Mexico. The observed values of gravity were corrected for terrain effects, and the resulting map revealed three positive anomalies. The second of the U.S. Bureau of Mines diamond-drill holes on one of the anomalies penetrated a lead-zinc ore body in which mining later was started. Two holes on another anomaly missed ore, and the third anomaly does not warrant drilling.

This is the first record of the use of a gravity meter in the discovery of a lead-zinc ore body. This investigation also proves that the use of a gravity meter in extremely rugged terrain for the discovery of such bodies is practicable.

An explanation is proposed for the systematic difference between the Bouguer correction as computed from observed surface densities and as computed from the graph of force versus elevation.

INTRODUCTION

THE Houston-Thomas group of 15 patented claims in the Pinos Altos mining district located about eight miles north of Silver City, New Mexico, was chosen for gravity exploration for the following reasons:—

(1) The district has a long history of productivity.

(2) The ore is appreciably heavier than the country rock.

(3) An area was available for lease.

Mathis proposed the project to be operated by him as a commercial prospect, the interpretation being done by Romberg for the privilege of publication of any significant results. The division of labour among the writers is as follows: Mathis obtained the gravity data, made the geological map, and described the ore body; Romberg made the gravity interpretation; and Barnes reviewed the geology. Romberg and Barnes spent two days in the field checking the results.

The gravity anomalies were drilled by the U.S. Bureau of Mines under Project 15–203, which was in progress at the time the gravity survey was made. Use of the results of the drilling by the U.S. Bureau of Mines is gratefully acknowledged. Geologists of the U.S. Smelting, Refining, and Mining Company aided in the underground mapping.

GEOLOGY

Stratigraphy.—The stratigraphic column in the vicinity of the Houston-Thomas prospect is that given by Paige (1916), modified by Spencer and Paige (1935), and quoted as follows:—

Cretaceous
- Colorado shale.
- Beartooth quartzite.

Pennsylvanian
- Magdalena group.

The sedimentary rocks have been extensively intruded by rocks of probable late Cretaceous age consisting predominantly of diorite-porphyry. The geologic map of the area (Fig. 1) shows the main areas of predominant rock types but shows neither the myriad of small intrusives in the sedimentary rocks nor the equally numerous small inclusions in the igneous rocks. Beyond the map area diorite-porphyry outcrops extensively, being terminated eastward by a large granodiorite mass.

GEOLOGIC MAP
HOUSTON-THOMAS PROSPECT
SILVER CITY, NEW MEXICO
0 100 200 300 400 500
SCALE OF FEET
TRUE NORTH
EXPLANATION
Gossan
Andesite
Diorite porphyry
(Many small intrusive bodies within sediments not shown)
Colorado shale
Beartooth quartzite
UNCONFORMITY
Magdalena limestone
CRETACEOUS
PENNSYLVANIAN
Drill hole
Mine dump
Open cut
Underground workings
Mine shaft
HOUSTON-THOMAS MINE
JAP WORKINGS
HOUSTON-THOMAS FAULT
PERSHING MINE
ATLAS MINE
ATLAS MINE
CLEVELAND MINE

FIG. 1.

In nearby mining districts the Magdalena group has been divided into two formations, and beneath them a Mississippian formation, the Lake Valley limestone, is prolifically ore bearing. In the Pinos Altos district the Lake Valley limestone has not been found, and the divisions of the Magdalena group have not been recognized.

Mineral deposits.—Graton (1910) described the mineral deposits of the Pinos Altos district and gave an account of the early history of the district. Paige (1916, p. 14, 1911) gives additional information about the mineral deposits, especially the replacement deposit in limestone with which this paper deals. The district was discovered about 1860, and since that time several million dollars worth of metals have been produced, with the precious metals predominating in the early part of its history and the base metals becoming more prominent later.

The lead-zinc deposits of the Houston-Thomas and adjoining claims are replacement deposits in the Magdalena limestone, the chief metallic minerals being ferriferous sphalerite (marmatite), galena, pyrite, and chalcopyrite. On the surface there are extensive gossans composed, according to Paige, of a mixture of limonite, smithsonite, azurite, and earthy materials with a dark-brown material containing manganese, copper, and iron. The geologic map (Fig. 1) shows the gossan areas and the principal mines. The estimated production in short tons of ore from the various mines is as follows: Cleveland, 130,000+; Houston-Thomas, 3,500 (sulphide ore); Atlas No. 1, 500 (carbonate and sulphide ore); and Pershing, 6,000 (sulphide ore).

On the Cleveland property, gossan occurs over both the Cleveland and the Pershing mines. A small area of gossan occurs above the carbonate and sulphide ores of the Atlas No. 1 mine, and another small area of gossan is exposed within the gravity anomaly over the known ore mass. However, large areas of gossan on the Houston-Thomas claims have been proven barren and, furthermore, no gravity anomalies have been found associated with them.

Density data.—The densities of the various rock types were determined before the gravity survey was made in order to judge whether or not a gravity survey would be feasible. The density data obtained are as follows:—

Rock type	*Average density*
Gossan	2·70
Colorado shale	2·74
Beartooth quartzite	2·66
Magdalena limestone	2·77
Diorite-porphyry	2·80
Andesite	2·67

Densities from cores are as follows:—

Rock type	*Average density*
Magdalena limestone	2·75
Diorite-porphyry	2·89

The average density of the ore mined up to February 22, 1948, is 3·84.

Structure.—According to Paige (1911, p. 123) the ore deposits appear to replace definite beds in the Magdalena limestone. The attitude of the limestone has been disturbed somewhat by the extensive intrusives, but in general it dips east-northeast. The unconformably overlying Beartooth quartzite in general dips south-southeast. Commonly the limestone and the quartzite in the area surveyed are separated by a thin diorite-porphyry sill.

Faulting is prevalent in the Pinos Altos district, and several faults are shown within the map area. Just east of the map area the contact between the Magdalena limestone and the Beartooth quartzite is at an elevation of 7,500 feet, whereas immediately west of the Houston-Thomas fault, it is at an elevation of 7,260 feet, indicating a drop on the western side of the fault of approximately 300 feet. Another north-south fault west of the map area, also downthrown to the west, places the Colorado shale in contact with the Magdalena limestone.

Near the northeastern margin of the map area, the Colorado shale is downthrown against the Magdalena limestone, and within the map area it is faulted against diorite-porphyry. This fault has several times the throw of the Houston-Thomas fault and is offset by it. A post-faulting andesite dyke is shown in the northwestern part of the map area.

TOPOGRAPHY

That portion of the Houston-Thomas group of claims covered by the gravity survey lies on the western slope of the Pinos Altos Mountains within a few hundred feet of the Continental Divide and

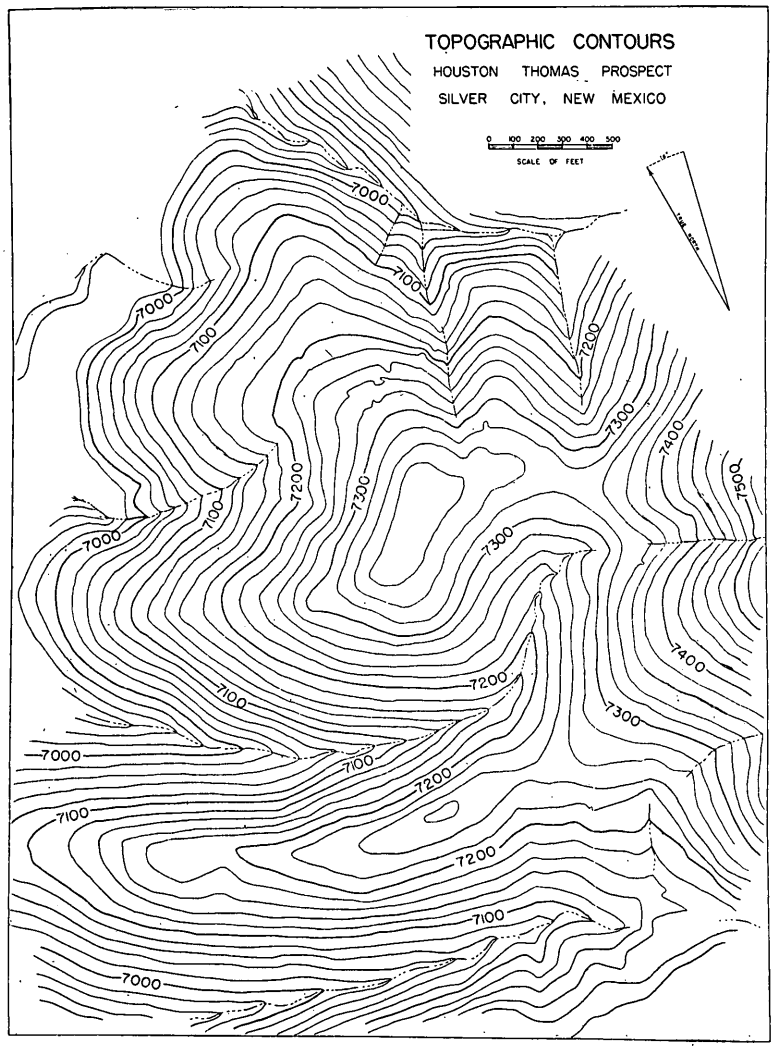

FIG. 2.

between elevations of 7,000 and 7,500 feet above sea level. The crest of the Pinos Altos Mountains is 8,036 feet in elevation and is about one-fourth of a mile from the surveyed area, which is about 3,000 by 3,400 feet in size. Figure 2 is a topographic map of the area showing the steepness of the slopes. The maximum slope is near 38°, and the average slope is estimated to be about 20°. The topography shown is typical of that within a two-mile radius.

The slopes are rubble and brush covered which, in combination with the extreme steepness, made surveying and observing with the gravity meter difficult tasks.

GRAVITY OBSERVATIONS

The stations for observing the gravitational force were laid out in an irregular network with a spacing of about 100 feet. This spacing was chosen because the shallow ore bodies which were being sought would presumably give rise to anomalies in the gravitational field with dimensions of the order of 200 feet. Such anomalies may be missed on the final map of the gravitational force if the spacing is too large. When the preliminary work was done, fill-in stations were set in areas where anomalies were indicated.

Observations of the force were made with a portable gravity meter which was read with a precision of plus or minus 0·01 milligal. The meter had to be transported on foot, as it was not possible to take an automobile anywhere on the prospect except on the one road that runs through it. The effect of tidal drift was kept small by reading the meter frequently on base stations; this was practical because the stations were close together. After the readings were corrected for drift, they appeared to be repeatable with a probable error of less than plus or minus 0·02 milligal. The corrected readings are probably in error with respect to each other by more than this amount if they are some distance apart on the prospect, but this is of no consequence in the search for small anomalies.

The observations were corrected for latitude and elevation in the usual manner, and a contour map (Fig. 4) drawn on the residual values. Terrain corrections were made for the stations in areas that seemed to be anomalous, and a second contour map was made using these corrected observations (Fig. 5). The values of the gravitational force shown are relative, since no purpose in prospecting could be served by trying to relate them to the absolute value of force.

When gravity surveys are made in areas of rough topography, there is always a question as to whether the effects of the terrain will mask the anomalies that are being sought, even after the terrain corrections have been made. On the Houston-Thomas prospect it was considered doubtful whether the anomalous gravitational effects of ore bodies could be perceived, since the surface was extremely rough and the surface material varied. With sufficient labour and very accurate topographic and geologic maps, a set of terrain corrections could no doubt be computed to any required correctness, but there was no assurance in the beginning that the extra labour of making accurate terrain corrections would be worth carrying out. As it was, the gravity map after correction showed no anomalies that were not hinted at by the uncorrected map, but the corrected map showed the closures more plainly. The authors do not know of another attempt to look for such small anomalies in such rough terrain.

DENSITY CORRECTIONS

It is customary to correct observations of the gravitational force for elevation differences with a factor which multiplies the relative elevation of each station. This factor is a combination of the free air elevation correction (which is nearly constant on the earth's surface) and the Bouguer factor, which is a function of the surface density. The surface density can be measured from samples. This measurement is usually supplemented with density profiles such as those described by Nettleton (1940), in which different values of the density are tried out for effect on the final values of the gravitational force. Profiles computed with a number of assumed densities are plotted for a line of observations, and these profiles are compared with a profile of the topography. If the assumed density is too small, its force profile follows the topography; if it is too large, its profile mirrors the topography. The correct density will, of course, be the one whose profile seems neither to follow nor to mirror the topography. This method works well if, on the profiles chosen, there is no relation between the residual force and the elevations, but if there is such a relation, it may lead to a choice of the wrong density.

Density profiles for the Houston-Thomas prospect were ambiguous; the profiles seemed to follow some topographic features and mirror others. However, the best choice of surface density indicated by the density profiles seemed to be about 2·2. This differs seriously from the measured density of 2·7.

Another method of finding a value for the combined elevation correction (and thence presumably for the surface density) is to plot all the observations on a graph of elevation versus force uncorrected for elevation. If there were no gravity anomalies present, the points on the graph would all lie in a

straight line, whose slope would be the elevation correction factor. The slope of the line can be found with sufficient accuracy if the elevation differences on the prospect are great enough. The elevation graph of the Houston-Thomas prospect (Fig. 3) showed the slope to have a value corresponding to a surface density of 2·0. This result is even more startling than the value of 2·2 which was deduced from the density profiles, as it deviates even further from the measured density. The elevation graph shows the slope the line would have, to correspond to a density of 2·7, and it is clearly out of the question to draw the line with such a slope. Thus if the elevation correction based on a density of 2·7 were used in correcting the observations of force, the uphill and downhill stations would appear to be anomalous merely on account of their elevations. The final elevation corrections were computed from the slope of the elevation graph rather than from the true density, since it was thought that fewer irrelevant anomalies would result.

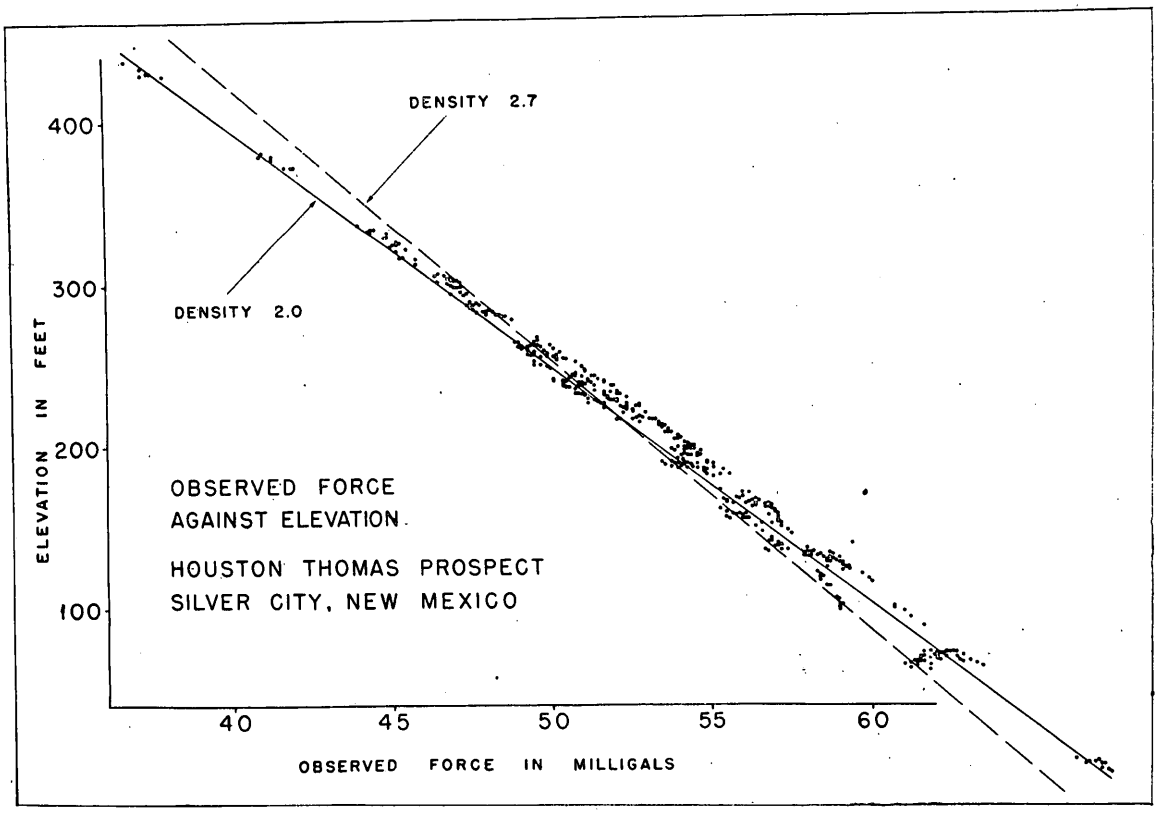

FIG. 3.

Three explanations suggest themselves for the discrepancy between the surface density as measured and as deduced from the density profiles and elevation graph. If the prospect slopes generally in one direction, the graphic correction factor will include the regional gradient in this direction, if there is one. This is not harmful unless the regional gradient itself is being sought. Again, if the higher stations and lower stations are generally on different outcrops, the graphic correction factor will include the anomaly caused by the density difference of the outcropping formations. Finally, if the higher elevations occur in regions of rougher topography, the total or large-scale terrain corrections (as opposed to the very local corrections made for the map) will increase with the elevations and cause the graphic correction factor to be greater than it ought to be, and the deduced surface density less. In an ideal case such as that of a cone-shaped mountain, it is clear that the total terrain correction will increase

systematically as the point of observation moves from the base of the mountain to its top. The present prospect is a fair approximation to such a case, and it seems probable that the abnormal slope of the elevation graph is caused by an increase with elevation of the terrain correction.

TERRAIN CORRECTIONS

Since topographic irregularities affect the observed gravitational force, a correction must be added to each station. The magnitude of each correction depends on the surface density and the topography in the neighbourhood of the station, and the corrections are usually computed graphically by means

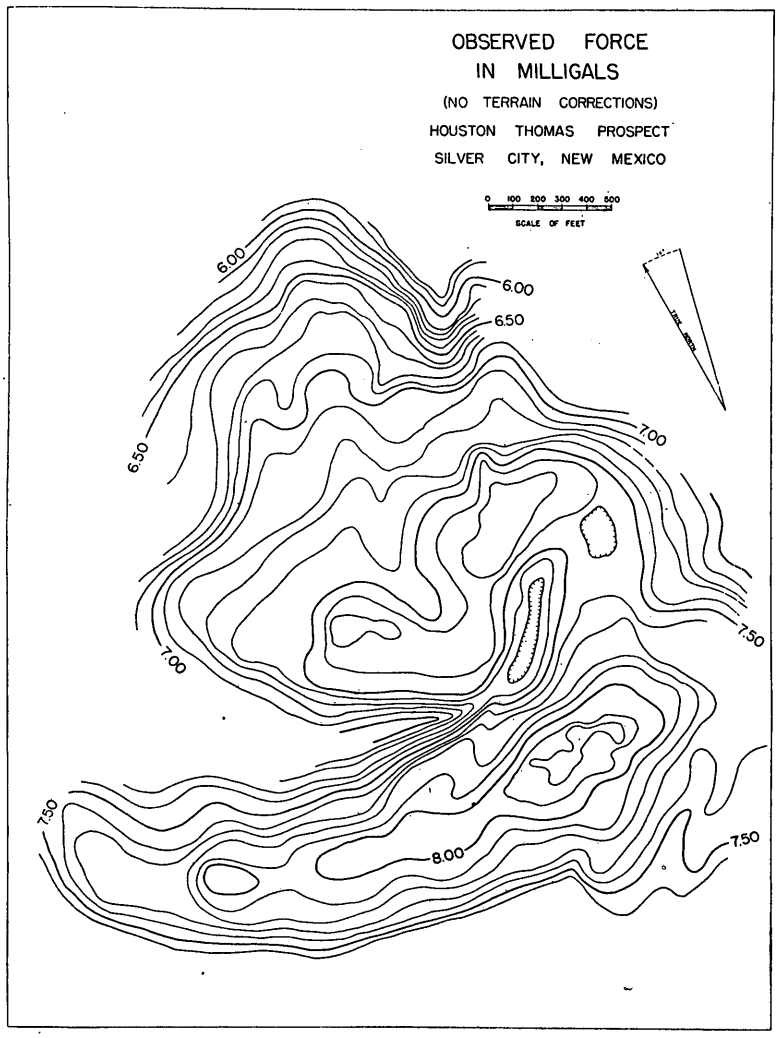

FIG. 4.

of reticules or zone charts superimposed on a contour map of the area surrounding the station. A practical method for making such computations has been described by Hammer (1939). In theory, the total terrain correction for a station is computed from all the topographic irregularities (mass above the station and voids below it) for an infinite distance out. In practice, of course, it is necessary to take into account only the irregularities close to the stations. The circle of ground for which corrections for a given station are made is usually chosen to have a radius several times the linear dimensions of the expected gravitational anomalies, so that the gradients from the uncorrected irregularities outside the circle will be small and not obscure the anomaly. In the present case, the terrain corrections were

based on a surface density of 2·7 and computed for a distance of about 1,500 feet around the stations, from a topographic map made from the surveyed elevations of the stations (Fig. 2).

DISCUSSION OF GRAVITY ANOMALIES

The contour map (observed force with terrain corrections, Fig. 5) shows three positive closures. The most interesting of these is the southeastern one, roughly 0·3 milligal in height and perhaps 300 by 600 feet in size. Considering the gradients in the vicinity, a closure of 0·3 milligal is not outstanding, but still the anomaly is better than a borderline case. Possible interpretations of this anomaly

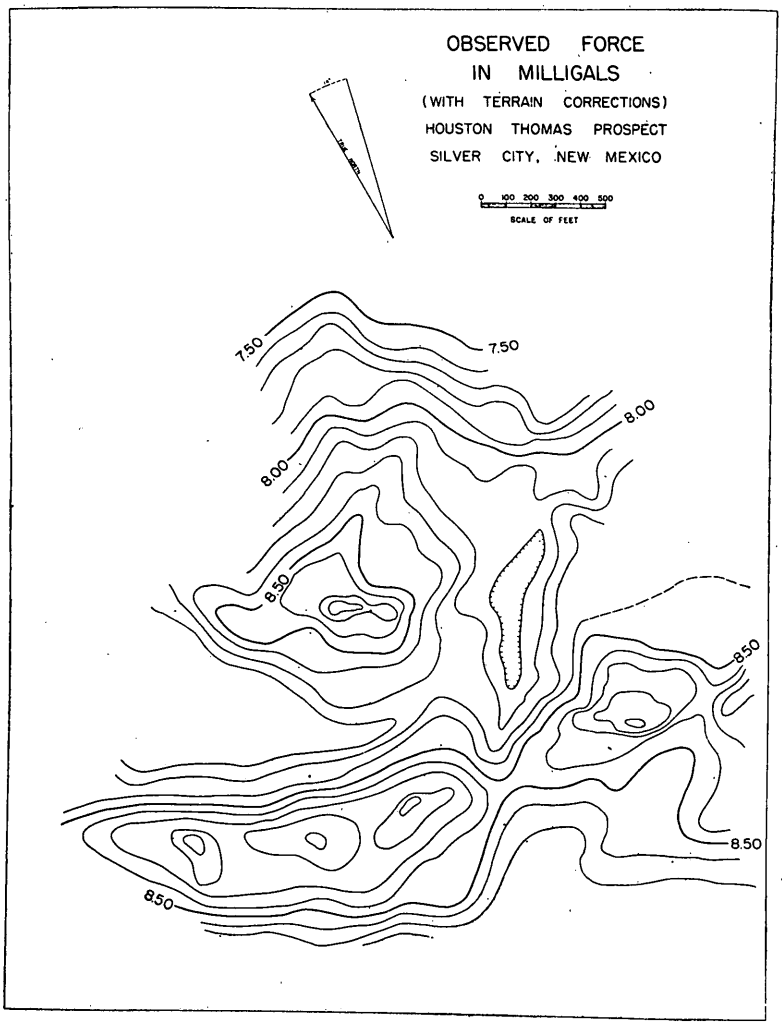

FIG. 5.

are: (1) A wrong elevation correction or an inadequate terrain correction under some conditions might cause a closure, but for this anomaly such a cause is ruled out because the anomaly is in an area which is neither high nor low topographically. (2) The anomaly is situated roughly over the eastern end of an outcrop of Magdalena limestone, but the limestone outcrop also extends westward beyond the closure indicating that any correspondence seen is fortuitous. (3) The remaining inference that the gravitational high must be caused by something heavy beneath the surface was confirmed when the core drill penetrated ore.

A gravity high of the dimensions shown could be caused by an infinite variety of anomalous mass distributions. However, if it is assumed that the anomalous mass is fairly simple in shape, it is safe to assign a maximum depth to it, corresponding to half its width or less. This would mean that the anomalous mass ought to be no deeper than 150 feet, though it might be shallower. In addition, the amount of the anomalous material is proportional to the " volume " of the gravitational anomaly. In the present case, the anomalous material can be estimated to be several hundred thousand tons. Estimates for other masses have previously been made by Romberg and Barnes (1943), and Hammer (1945).

The largest positive closure is in the southwestern part of the area and is about 500 by 1,500 feet in size. The closure corresponds in size and shape to a prominent topographic ridge of Beartooth quartzite underlain by the heavier diorite-porphyry and limestone. The coincidence between the ridge and the closure leads to the suspicion that the high is caused by surface irregularity rather than by heavy material. A density profile across the ridge indicated that the closure would have been much reduced if a different elevation correction had been chosen, and it would probably have been reduced still further by more extensive terrain corrections. Also, it is to be expected that the terrain corrections will be less effective as the topographic features get larger, and for this prospect the corrections were made out to a relatively small distance. No core drilling on this anomaly is recommended.

The third positive closure, west-central part of the map, is on the side of a steep hill, thus minimizing the possibility of its being due to topography. The surface geology is complex, with limestone, diorite-porphyry, and quartzite in an irregular pattern near the centre of the closure. The complex geology makes this high less attractive than the first one, but it is difficult to avoid suspecting that the high values are caused by heavy material beneath the surface. Two barren holes have been drilled, but additional drilling is probably advisable. From the size and shape of the anomaly, it is inferred that a small quantity of heavy material may be close to the surface, accounting for the localized high values in the middle of the anomaly, and in addition a large quantity of heavy material may be present at a depth of 200 or more feet. Whether or not this heavy material is ore remains to be seen.

Some other features of the gravity map which may be pointed out are:—

(1) The topographic low between the second and third anomalies shows a large gravity low associated with the Magdalena limestone. The low probably reflects topography.

(2) In contrast, the topographic high northeast of the third anomaly (centre of the topographic map) does not appear to be reflected on the gravity map.

(3) A small gravity terrace is associated with the limestone between the Houston-Thomas mine and the Jap workings.

(4) The closed low between the first and third anomalies is associated with quartzite but is also associated with a topographic low.

PROSPECTING AND DEVELOPMENT DATA

Core-drilling data.—The U.S. Bureau of Mines was conducting a drilling programme (Project 15–203) on the Houston-Thomas group of claims during the time the gravity survey was being made. The first hole (Fig. 1) was directed to prospect the Magdalena limestone beneath the Cretaceous in the northern part of the map area. The throw of the fault was greater than expected, and the limestone was not reached, the hole being bottomed in Colorado shale at 875 feet. The Bureau of Mines completed the first hole before the gravity data had been fully reduced.

The location for the second hole on the basis of the preliminary gravity reduction proved to be too far east, and only a few inches of ore was encountered. The hole passed through 40 feet of limestone followed mostly by diorite-porphyry to its total depth of 290 feet. By the time the second hole was completed, the gravity data had been sufficiently well reduced so that the location of hole No. 3 proved to be accurate. Hole No. 3, directed S. 29° E. at an angle of 70°, penetrated limestone containing a small amount of diorite-porphyry to 96 feet, ore from 96 to 105 feet, mineralized limestone from 105 to 120 feet, and bottomed in diorite-porphyry at 122 feet. Another hole, No. 4, from the same

station directed S. 29° E. but at an angle of 55°, penetrated 113 feet of limestone containing a small amount of diorite-porphyry, ore from 113 to 142 feet, and bottomed in diorite-porphyry at 143 feet. Since funds were not available to outline the ore body, the drill was moved to the northwestern anomaly where two holes were drilled.

Hole No. 5, drilled vertically, bottomed at 245 feet after passing through diorite-porphyry for 120 feet, followed by alternating unmineralized limestone and diorite-porphyry for the rest of the distance. Hole No. 6, directed N. 10° E. at an angle of 70°, penetrated 21 feet of diorite-porphyry, limestone from 21 to 64 feet, and bottomed in diorite-porphyry at 135 feet without encountering mineralization. The drilling on the second anomaly is not conclusive.

Mining data.—A shaft was sunk in the vicinity of the drill holes and was placed, as nearly as could be interpreted from the gravity data, to graze the southern margin of the ore body. However, the shaft

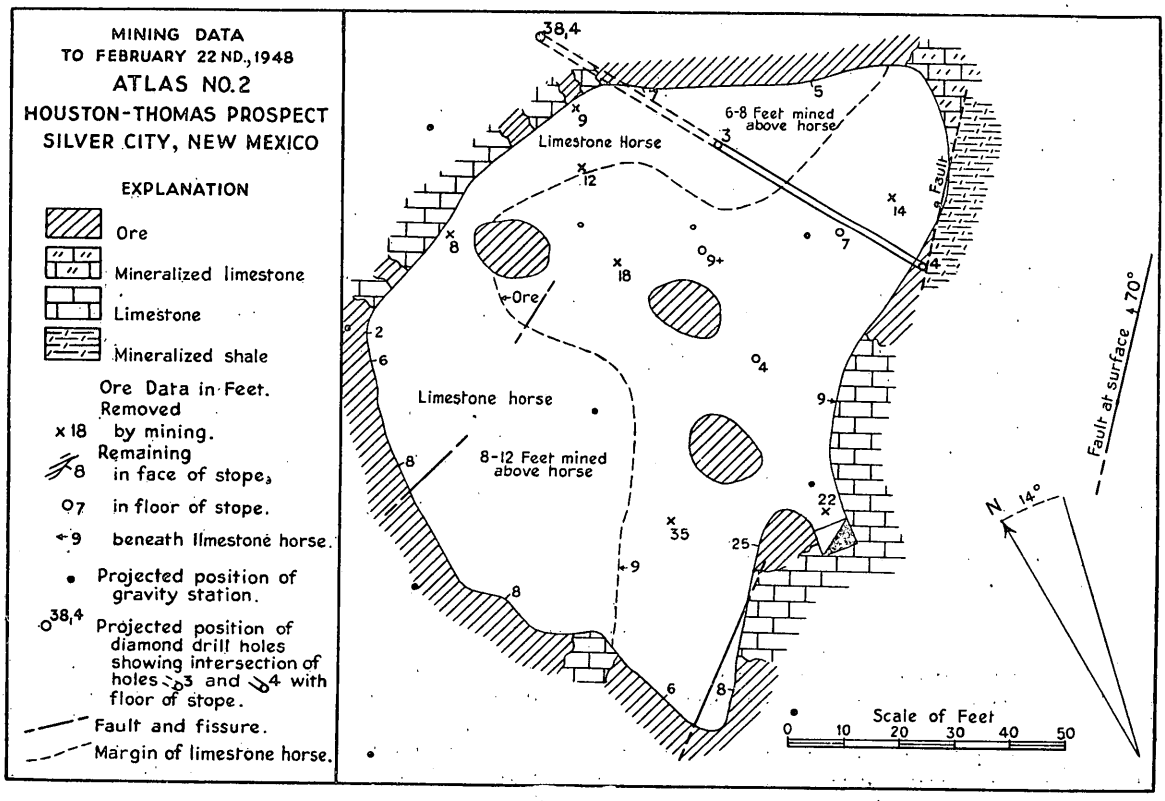

FIG. 6.

between 78 and 98 feet was approximately half in ore and half in limestone. Diorite is beneath the ore in the bottom of the shaft. A drift was driven toward the drill holes, and the ore about the holes has been removed.

The area stoped, up to February 22, 1948, is shown in Fig. 6, and the thicknesses of ore removed or still remaining are noted. An extensive limestone horse in the western and northern part of the stope, extending 5 to 6 feet above floor level in the northeastern part, is being left, and ore 6 to 12 feet thick has been mined from above it. Ore beneath the horse is indicated, but little is known about its thickness.

Shale is exposed on the southeastern side of a 4-foot brecciated fault zone containing broken ore, calcite, and gouge seams. The last movement along the fault was nearly horizontal and the vertical displacement appears to be less than 20 feet. The shale is cut by small veins containing pyrite, galena,

and marmatite which are terminated at the fault plane. This is the only place seen where there is definite evidence that the faulting is post-mineralization in age. A fissure seen at the surface and dipping 70° to the northwest is probably the surface expression of the fault.

A vein of galena, 1 to 4 inches thick, cuts vertically through the ore and adjacent limestone in the southwestern part of the stope. Other late veins filled with calcite and pyrite are common in the western part of the stope and for the most part are aligned approximately in an east-west direction.

The back of the stope is fairly plain, strikes about N. 20° W., and dips about 21° to the east. The ore appears to have selectively replaced beds of the Magdalena limestone as in the Cleveland mine.

The principal metallic minerals in the ore are pyrite, marmatite, galena, and chalcopyrite. The principal gangue mineral is calcite. The tenor of the ore up to February 22, 1948, was approximately as follows: zinc, 10·07 per cent; lead, 2·55 per cent; copper, 0·17 per cent; silver, 3·33 ounces; and gold, 0·012 ounces. The gold is of no value to the producer, and it is seldom that the copper content is sufficiently high to yield revenue. Penalty-bearing constituents such as arsenic and bismuth are absent. However, iron amounts to 29 per cent of the ore mined, and the marmatite, after milling, contains approximately 11 per cent iron, which is objectionable in smelting and reduces the value of the ore.

Until February 22, 1948, about 11,900 dry tons of ore having an average density of about 3·84 were mined. The tonnage of ore remaining is unknown, and until the body has either been mined or drilled, the correlation between the predicted amount and actual amount of ore will be unknown.

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DISCUSSION

K. C. DUNHAM congratulated the authors on this first discovery of a concealed lead-zinc orebody, and asked the nature of the oreshoot, whether it was a " manto " in the Magdalena Limestone. He also enquired about the average thickness of the deposit.

In reply V. E. BARNES regretted that these points, contained in the original paper, had been omitted from his presentation. The orebody appears to be a selective replacement of the Magdalena limestone as in the neighbouring Cleveland Mine and a rough estimate of its thickness is 14 feet.

CWS—25890 (R)

Form MF-100
(March 1951)

U. [stamp] DEPARTMENT OF THE INTERI[stamp]
DEFENSE MINERALS ADMINISTRATION

Ideres

Form approved.
Budget Bureau No. 42-R1026.

GENERAL TECHNICAL DATA
FOR USE UNDER THE
DEFENSE PRODUCTION ACT OF 1950

NOT TO BE FILLED IN BY APPLICANT

Docket No. DMA 1549 X

Date received MS- 0575

60370

Mathis and Mathis
Box 452
Silver City, N. M.

Name and address of applicant

Date May 26, 1951

INSTRUCTIONS

This form is to be filed with Defense Minerals Administration, Department of the Interior, Washington 25, D. C. It should be accompanied by appropriate application form when a specific type of Government assistance is requested, in the form of (1) loan, (2) purchase contract, (3) Government guarantee of a private loan, (4) ~~Necessity Cer- tificate [illegible] Sec. 124-A (Amorti- gation Deduction) of Internal Revenue Code, 1950, (5)~~ priorities or allocation of mining equipment, and maintenance, repair and operating supplies, and ~~(6)~~ 5 other forms of Government assistance that might arise under the Act. Submit four (4) signed copies of the form and accompanying papers. Name and address should be stamped or typed on each sheet of this form and all accompanying papers. *When a question is inapplicable it should be so stated on the form.* Additional sheets may be attached in answering any questions or in supplying additional information. (IF YOU CANNOT ANSWER A QUESTION, SO STATE.) If a question is answered elsewhere indicate where answered. It is not necessary to answer it again.

GENERAL TECHNICAL DATA

Supply the following information on separate sheets, arranged, numbered, and lettered as indicated:

1. Materials produced:
   - (*a*) What are the chief mine, mill, or smelter products?
   - (*b*) What are the byproducts, if any?
2. Name(s) and type(s) of mine(s), mill(s), smelter(s), refinery(ies), pit(s), quarry (ies), drilling operation(s). Include old names of property, if any. Show extent of workings, including the following:
   - (*a*) Linear feet of shafts.
   - (*b*) Linear feet of drifts and crosscuts.
   - (*c*) Linear feet of tunnels or adits.
   - (*d*) Linear feet of other mine openings (explain briefly).

   Indicate whether mine is flooded or not. Describe any pumping problems. Give size or productive capacity.
3. For each operation listed above supply the following:
   - (*a*) Distance and direction from nearest town and shipping point.
   - (*b*) Mining district.
   - (*c*) Township, Section, Range.
   - (*d*) County, State.
4. (*a*) State whether or not property is now in operation, and if in operation, by whom operated.

   (*b*) Are you operating this property as:
   - ☐ Owner.
   - ☐ Lessee.
   - ☐ Contractor.
5. Number of years in production ________

   If not in production or operation, estimated date when production will begin ________
6. Experience of operators:

   Describe the mining and general business experience of (*a*) the applicant, and (*b*) the person or persons who manage the project.
7. History:
   - (*a*) Give a statement, as complete as possible, of previous exploration, development, operation, and production of property, with reasons for suspension of operation.
   - (*b*) State briefly the known history and production of adjoining and neighboring properties.
   - (*c*) Furnish any available (private) reports that may apply to this application, including results of mine examinations, recommended exploration and development, and metallurgical investigations.

16

8. Names and addresses of Officers, Directors, or Partners, and in addition thereto, the five largest stockholders if a corporation.

Name and Address (a)	Official Title (If officer is also director indicate by "D") (b)	Total of Annual Salary, Commissions, Bonuses, Etc., Received From Applicant and Affiliates During Last Fiscal Year (c)	Estimated Net Worth Outside of Interest in Applicant (d)	Number of Shares Held in Applicant Corporation: Common (e)	Number of Shares Held in Applicant Corporation: Preferred (f)	Life Insurance Carried for Benefit of Applicant: Amount (g)	Life Insurance Carried for Benefit of Applicant: Net Cash Surrender Value After Loans (h)
R. W. Mathis	geologist &		none				
P. O. Box 452 Silver City, New Mexico	general mgr.						
Mrs. J. B. Mathis, Sr.	partner		none				
address the same							
	Total		x x x x x			x x x x x	x x x x x

If more lines are needed continue on separate sheet.

9. Capital Stock Issues: **Not applicable**

For Corporate Applicants

Item	Authorized (a)	Outstanding (b)	Par Value (c)	Number of Shares Outstanding (d)	Dividend Rate Last Paid* (e)
Common stock	$	$	$		
Preferred stock	$	$	$		

*Indicate period covered.

10. Production:

Item	Kind of Product (a)	1948 Total (b)	1949 Total (c)	1950 Total (d)	Present Average Monthly (e)
1. Quantity of product mined or quarried (Short, long, metric tons; barrels; pounds; etc.)	Zinc, lead ore	12,798 short tons	2,844 short tons	1831 short tons	350 tons
2. Quantity of product processed (specify unit of measure and type of process)	No processing				
3. Quantity and grade of product sold or shipped (specify units of measure)		Same tonnage 9% zinc 2% lead	8% zinc 2% lead	7% zinc 2% lead	7% zinc 2% lead

11. Do you contemplate a change in the present average monthly rate of production? If so, state estimated maximum monthly production and basis of change.

12. Ore or Mineral Reserves:

(a) Describe the ore or mineral deposit briefly. Accompany the application by any available report on the geology and ore reserves.

Mathis and Mathis
P. O. Box 452
Silver City, New Mexico

May 26, 1951

FORM MF-100

1. Materials produced:
   (a) Zinc and lead
   (b) Silver and copper

2. The Atlas #2 mine, subject of this report, is within the Atlas claim, which is one of 15 claims known as the Houston-Thomas group. Previous work on any of these claims has been referred as the Houston-Thomas mines.
   The Atlas #2 mine has
   (a) 100 feet of vertical shaft
   (b) 250 feet of drifts and cross-cuts connecting five stopes from which 28,000 tons of zinc and lead ore have been mined since May 1947
   (c) No tunnel or adit openings
   (d) A second exit through the old Atlas #1 shaft with which it is connected by 50 feet of drift
   The Atlas #2 mine is not flooded and has no pumping problems

3. The Atlas #2 and the Houston-Thomas group of claims are
   (a) Nine miles North of Silver City and the AT&SF railroad
   (b) In the Pinos Altos Mining district
   (c) In sections 35 and 36 of T16S, R14W
   (d) In Grant County, New Mexico

4. (a) The Atlas #2 mine is in operation at present, being operated by R. W. Mathis and Mrs. J. B. Mathis, Sr. doing business as Mathis & Mathis
   (b) Mathis & Mathis are operating as lessees of the Houston-Thomas group of claims

5. The Atlas #2 mine has been in operation since May 17, 1947, except for the period June 1949 - June 1950, or for 3 years

6. R. W. Mathis has been geologist and general manager for Mathis and Mathis since January 1946. He graduated from the University of Texas in 1942 with a Master of Arts degree in Geology

7. History
   (a) Other claims of the Houston-Thomas group have been worked intermittently since the latter part of the 19th century for lead carbonates and silver. Production records are not available
   The Atlas claim was first worked in 1943. About 1500 tons of lead carbonates and zinc sulphides were mined from the Atlas #1 shaft. In 1945 Mathis and Mathis obtained a lease on the Houston-Thomas group of claims and conducted a gravity survey covering the mineralized portions thereof. Three gravity anomalies were developed (See attached publication). The U. S. Bureau of Mines was core drilling on the claims at the time. Their rig was moved to test one of the anomalies, and discovered the main ore body of the Atlas #2 mine. The U. S. Bureau of Mines drilled two holes in a second gravity anomaly but found no denser mass to account for the anomaly. They then abandoned the project because of the transfer of remaining funds. Mathis & Mathis sunk a shaft into the ore body discovered by the

FORM MF-100

Continued-

7.
(a)
U. S. Bureau of Mines and began pproduction in May 1947. Approximately 25,000 dry tons were mined before the mine was closed in June 1949 because of low metal prices.
The Atlas #2 mine was re-opened in June 1950 and has subsequently produced approximately 3000 tons. Prices of zinc and lead ore are 10% and 20% lower respectively than their peak prices of 1948 and early 1949 and the costs of production are 20% higher than at that time. Thus, the margin of profit from production has not permitted the renewal of the core-drilling program sustained prior to June 1949.

(b) The Cleveland mine, lying within claims adjoining the Atlas claim on the east, produced approximately 170,000 tons of zinc-lead ore during the period 1914-1918.
The Pershing mine, produced about 5,000 tons of zinc-lead ore during 1943 and 1944 from the claim adjoining the Atlas claim on the North East.

(c) See attached publication

8. See FORM MF-100

9. SEE FORM MF-100

10. See FORM MF-100

11. Unless further ore reserves are discovered, production will be curtailed. If sufficient reserves are found, production will be increased proportionately.

12.
(a) The zinc-lead sulphide ore bodies sought for on the Houston-Thomas group of claims are limestone replacement deposits occurring in the Magdalena limestone of Pennsylvanian age. Ore deposition is apparently controlled by fault and fissure systems and by beds of Magdalena limestone favoring replacement.

(b)
(1) See Exhibit II
(2) Accurate estimates of ore reserves, class of ore, etc., are not obtainable. Judging by evidences from short test holes, it is believed that approximately 700 short tons of ore is blocked out. Another 700 short tons may be inferred to be present.

(c) Not applicable

13. The Atlas #2 mine and the Houston-Thomas claims are 9 miles North of Silver City and can be reached by travel on all weather graded gravel road.

14. All water must be hauled from the domestic supply at Silver City, N. Mex.

15. All power is furnished directly by gasoline or deisel Motors.

16. Labor. A recent payroll included:
1 hoistman
1 mucking machine operator
1 drilling machince operator

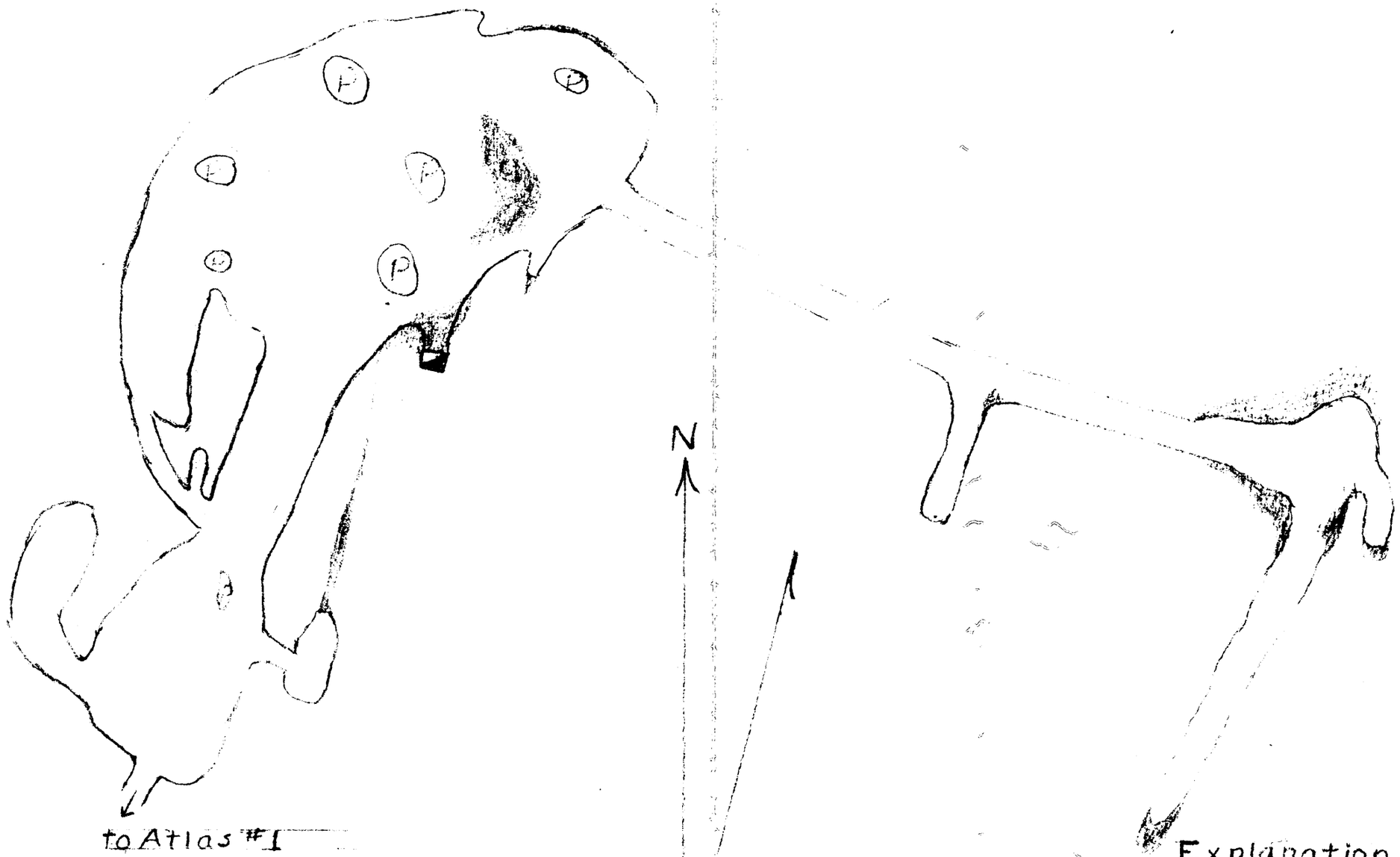
FORM MF-100

Continued-

16.
1 Drilling machine helper
1 Underground core drill operator

17. Present equipment on property includes headframe, ore bin, hoist house, change room, and store room. All are in good shape. Mining equipment is listed as follows:
Sullivan 22 HD Core drill
Sullivan 22 Standard Core drill
900 feet AX drilling rod
Two core drill water pumps
Chicago Pneumatic #5 Subsurface core drill
150 feet EX drilling rod
Two boiler head pumps
Continental Mine hoist
Gardener Denver 420 CFM Compressor
3/4 ton Mine skip
Gardner Denver Mucking Machine
Gardner Denver HB Double Drum hoist
Gardner Denver R91 stoper
Gardner Denver R94 stoper
Gardner Denver S73 Jackhammer
Gardner Denver D79 Drifter
400 feet of 16 lb rail
300 feet of 2" air line
300 feet of 1-1/2" air line
250 feet of 3/4" water line

18. Foregoing questions and answers adequately cover conditions and circumstances affecting operations.



Explanation

Known Ore Reserves
Shown in Red

"P" indicates Pillar

0 10 20 30 40 50
Scale of Feet

5/25/51 R.W.M.

PLAN OF ATLAS #2 MINE

GRAVITY PROSPECTING FOR LEAD AND ZINC, NEW MEXICO

By
V. E. BARNES, R. W. MATHIS, and F. ROMBERG
U.S.A.

Reprinted from International Geological Congress " Report of the Eighteenth Session Great Britain 1948," Part V.

GRAVITY PROSPECTING FOR LEAD AND ZINC, NEW MEXICO

By V. E. BARNES, R. W. MATHIS, and F. ROMBERG

U.S.A.

ABSTRACT

Observations of the force of gravity were made on the Houston-Thomas group of claims in the Pinos Altos Mountains north of Silver City, New Mexico. The observed values of gravity were corrected for terrain effects, and the resulting map revealed three positive anomalies. The second of the U.S. Bureau of Mines diamond-drill holes on one of the anomalies penetrated a lead-zinc ore body in which mining later was started. Two holes on another anomaly missed ore, and the third anomaly does not warrant drilling.

This is the first record of the use of a gravity meter in the discovery of a lead-zinc ore body. This investigation also proves that the use of a gravity meter in extremely rugged terrain for the discovery of such bodies is practicable.

An explanation is proposed for the systematic difference between the Bouguer correction as computed from observed surface densities and as computed from the graph of force versus elevation.

INTRODUCTION

THE Houston-Thomas group of 15 patented claims in the Pinos Altos mining district located about eight miles north of Silver City, New Mexico, was chosen for gravity exploration for the following reasons:—

(1) The district has a long history of productivity.

(2) The ore is appreciably heavier than the country rock.

(3) An area was available for lease.

Mathis proposed the project to be operated by him as a commercial prospect, the interpretation being done by Romberg for the privilege of publication of any significant results. The division of labour among the writers is as follows: Mathis obtained the gravity data, made the geological map, and described the ore body; Romberg made the gravity interpretation; and Barnes reviewed the geology. Romberg and Barnes spent two days in the field checking the results.

The gravity anomalies were drilled by the U.S. Bureau of Mines under Project 15–203, which was in progress at the time the gravity survey was made. Use of the results of the drilling by the U.S. Bureau of Mines is gratefully acknowledged. Geologists of the U.S. Smelting, Refining, and Mining Company aided in the underground mapping.

GEOLOGY

Stratigraphy.—The stratigraphic column in the vicinity of the Houston-Thomas prospect is that given by Paige (1916), modified by Spencer and Paige (1935), and quoted as follows:—

Cretaceous
- Colorado shale.
- Beartooth quartzite.

Pennsylvanian
- Magdalena group.

The sedimentary rocks have been extensively intruded by rocks of probable late Cretaceous age consisting predominantly of diorite-porphyry. The geologic map of the area (Fig. 1) shows the main areas of predominant rock types but shows neither the myriad of small intrusives in the sedimentary rocks nor the equally numerous small inclusions in the igneous rocks. Beyond the map area diorite-porphyry outcrops extensively, being terminated eastward by a large granodiorite mass.

GEOLOGIC MAP
HOUSTON-THOMAS PROSPECT
SILVER CITY, NEW MEXICO
0 100 200 300 400 500
SCALE OF FEET
TRUE NORTH
EXPLANATION
Gossan
Andesite
Diorite porphyry
(Many small intrusive bodies within sediments not shown)
Colorado shale
Beartooth quartzite
UNCONFORMITY
Magdalena limestone
CRETACEOUS
PENNSYLVANIAN
Drill hole
Mine dump
Open cut
Underground workings
Mine shaft
HOUSTON-THOMAS MINE
HOUSTON-THOMAS FAULT
PERSHING MINE
ATLAS MINE
ATLAS MINE
CLEVELAND MINE

FIG. 1.

In nearby mining districts the Magdalena group has been divided into two formations, and beneath them a Mississippian formation, the Lake Valley limestone, is prolifically ore bearing. In the Pinos Altos district the Lake Valley limestone has not been found, and the divisions of the Magdalena group have not been recognized.

Mineral deposits.—Graton (1910) described the mineral deposits of the Pinos Altos district and gave an account of the early history of the district. Paige (1916, p. 14, 1911) gives additional information about the mineral deposits, especially the replacement deposit in limestone with which this paper deals. The district was discovered about 1860, and since that time several million dollars worth of metals have been produced, with the precious metals predominating in the early part of its history and the base metals becoming more prominent later.

The lead-zinc deposits of the Houston-Thomas and adjoining claims are replacement deposits in the Magdalena limestone, the chief metallic minerals being ferriferous sphalerite (marmatite), galena, pyrite, and chalcopyrite. On the surface there are extensive gossans composed, according to Paige, of a mixture of limonite, smithsonite, azurite, and earthy materials with a dark-brown material containing manganese, copper, and iron. The geologic map (Fig. 1) shows the gossan areas and the principal mines. The estimated production in short tons of ore from the various mines is as follows: Cleveland, 130,000+; Houston-Thomas, 3,500 (sulphide ore); Atlas No. 1, 500 (carbonate and sulphide ore); and Pershing, 6,000 (sulphide ore).

On the Cleveland property, gossan occurs over both the Cleveland and the Pershing mines. A small area of gossan occurs above the carbonate and sulphide ores of the Atlas No. 1 mine, and another small area of gossan is exposed within the gravity anomaly over the known ore mass. However, large areas of gossan on the Houston-Thomas claims have been proven barren and, furthermore, no gravity anomalies have been found associated with them.

Density data.—The densities of the various rock types were determined before the gravity survey was made in order to judge whether or not a gravity survey would be feasible. The density data obtained are as follows:—

Rock type	*Average density*
Gossan	2·70
Colorado shale	2·74
Beartooth quartzite	2·66
Magdalena limestone	2·77
Diorite-porphyry	2·80
Andesite	2·67

Densities from cores are as follows:—

Rock type	*Average density*
Magdalena limestone	2·75
Diorite-porphyry	2·89

The average density of the ore mined up to February 22, 1948, is 3·84.

Structure.—According to Paige (1911, p. 123) the ore deposits appear to replace definite beds in the Magdalena limestone. The attitude of the limestone has been disturbed somewhat by the extensive intrusives, but in general it dips east-northeast. The unconformably overlying Beartooth quartzite in general dips south-southeast. Commonly the limestone and the quartzite in the area surveyed are separated by a thin diorite-porphyry sill.

Faulting is prevalent in the Pinos Altos district, and several faults are shown within the map area. Just east of the map area the contact between the Magdalena limestone and the Beartooth quartzite is at an elevation of 7,500 feet, whereas immediately west of the Houston-Thomas fault, it is at an elevation of 7,260 feet, indicating a drop on the western side of the fault of approximately 300 feet. Another north-south fault west of the map area, also downthrown to the west, places the Colorado shale in contact with the Magdalena limestone.

Near the northeastern margin of the map area, the Colorado shale is downthrown against the Magdalena limestone, and within the map area it is faulted against diorite-porphyry. This fault has several times the throw of the Houston-Thomas fault and is offset by it. A post-faulting andesite dyke is shown in the northwestern part of the map area.

TOPOGRAPHY

That portion of the Houston-Thomas group of claims covered by the gravity survey lies on the western slope of the Pinos Altos Mountains within a few hundred feet of the Continental Divide and

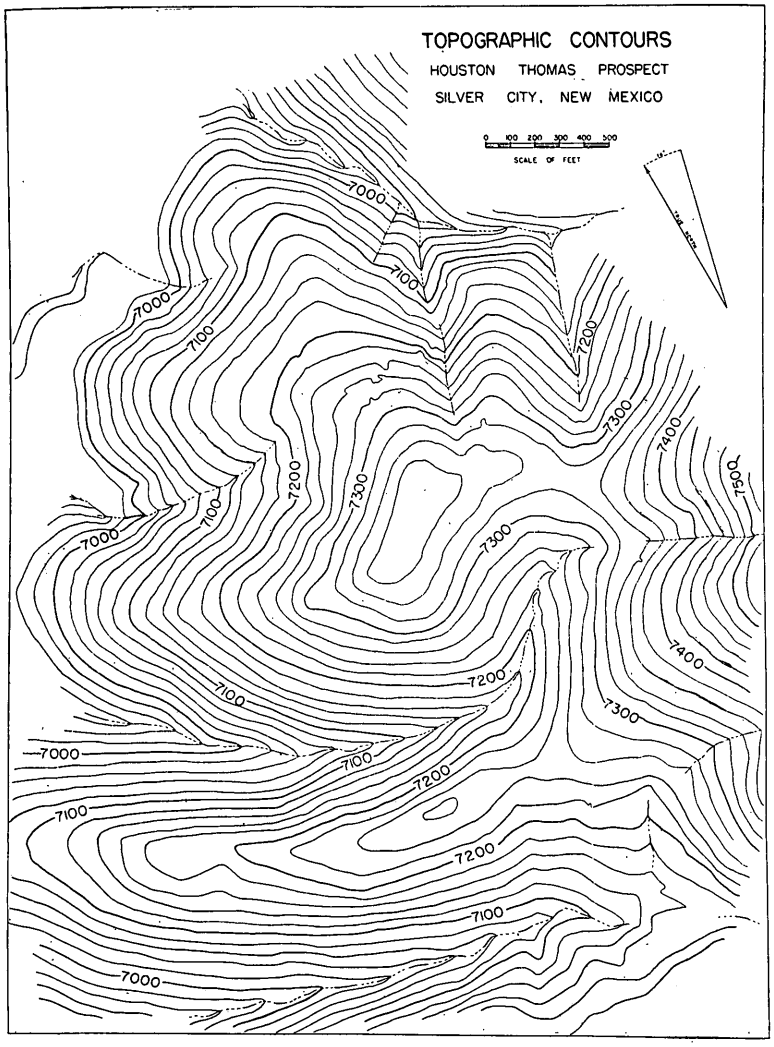


FIG. 2.

between elevations of 7,000 and 7,500 feet above sea level. The crest of the Pinos Altos Mountains is 8,036 feet in elevation and is about one-fourth of a mile from the surveyed area, which is about 3,000 by 3,400 feet in size. Figure 2 is a topographic map of the area showing the steepness of the slopes. The maximum slope is near 38°, and the average slope is estimated to be about 20°. The topography shown is typical of that within a two-mile radius.

The slopes are rubble and brush covered which, in combination with the extreme steepness, made surveying and observing with the gravity meter difficult tasks.

GRAVITY OBSERVATIONS

The stations for observing the gravitational force were laid out in an irregular network with a spacing of about 100 feet. This spacing was chosen because the shallow ore bodies which were being sought would presumably give rise to anomalies in the gravitational field with dimensions of the order of 200 feet. Such anomalies may be missed on the final map of the gravitational force if the spacing is too large. When the preliminary work was done, fill-in stations were set in areas where anomalies were indicated.

Observations of the force were made with a portable gravity meter which was read with a precision of plus or minus 0·01 milligal. The meter had to be transported on foot, as it was not possible to take an automobile anywhere on the prospect except on the one road that runs through it. The effect of tidal drift was kept small by reading the meter frequently on base stations; this was practical because the stations were close together. After the readings were corrected for drift, they appeared to be repeatable with a probable error of less than plus or minus 0·02 milligal. The corrected readings are probably in error with respect to each other by more than this amount if they are some distance apart on the prospect, but this is of no consequence in the search for small anomalies.

The observations were corrected for latitude and elevation in the usual manner, and a contour map (Fig. 4) drawn on the residual values. Terrain corrections were made for the stations in areas that seemed to be anomalous, and a second contour map was made using these corrected observations (Fig. 5). The values of the gravitational force shown are relative, since no purpose in prospecting could be served by trying to relate them to the absolute value of force.

When gravity surveys are made in areas of rough topography, there is always a question as to whether the effects of the terrain will mask the anomalies that are being sought, even after the terrain corrections have been made. On the Houston-Thomas prospect it was considered doubtful whether the anomalous gravitational effects of ore bodies could be perceived, since the surface was extremely rough and the surface material varied. With sufficient labour and very accurate topographic and geologic maps, a set of terrain corrections could no doubt be computed to any required correctness, but there was no assurance in the beginning that the extra labour of making accurate terrain corrections would be worth carrying out. As it was, the gravity map after correction showed no anomalies that were not hinted at by the uncorrected map, but the corrected map showed the closures more plainly. The authors do not know of another attempt to look for such small anomalies in such rough terrain.

DENSITY CORRECTIONS

It is customary to correct observations of the gravitational force for elevation differences with a factor which multiplies the relative elevation of each station. This factor is a combination of the free air elevation correction (which is nearly constant on the earth's surface) and the Bouguer factor, which is a function of the surface density. The surface density can be measured from samples. This measurement is usually supplemented with density profiles such as those described by Nettleton (1940), in which different values of the density are tried out for effect on the final values of the gravitational force. Profiles computed with a number of assumed densities are plotted for a line of observations, and these profiles are compared with a profile of the topography. If the assumed density is too small, its force profile follows the topography; if it is too large, its profile mirrors the topography. The correct density will, of course, be the one whose profile seems neither to follow nor to mirror the topography. This method works well if, on the profiles chosen, there is no relation between the residual force and the elevations, but if there is such a relation, it may lead to a choice of the wrong density.

Density profiles for the Houston-Thomas prospect were ambiguous; the profiles seemed to follow some topographic features and mirror others. However, the best choice of surface density indicated by the density profiles seemed to be about 2·2. This differs seriously from the measured density of 2·7.

Another method of finding a value for the combined elevation correction (and thence presumably for the surface density) is to plot all the observations on a graph of elevation versus force uncorrected for elevation. If there were no gravity anomalies present, the points on the graph would all lie in a

straight line, whose slope would be the elevation correction factor. The slope of the line can be found with sufficient accuracy if the elevation differences on the prospect are great enough. The elevation graph of the Houston-Thomas prospect (Fig. 3) showed the slope to have a value corresponding to a surface density of 2·0. This result is even more startling than the value of 2·2 which was deduced from the density profiles, as it deviates even further from the measured density. The elevation graph shows the slope the line would have, to correspond to a density of 2·7, and it is clearly out of the question to draw the line with such a slope. Thus if the elevation correction based on a density of 2·7 were used in correcting the observations of force, the uphill and downhill stations would appear to be anomalous merely on account of their elevations. The final elevation corrections were computed from the slope of the elevation graph rather than from the true density, since it was thought that fewer irrelevant anomalies would result.

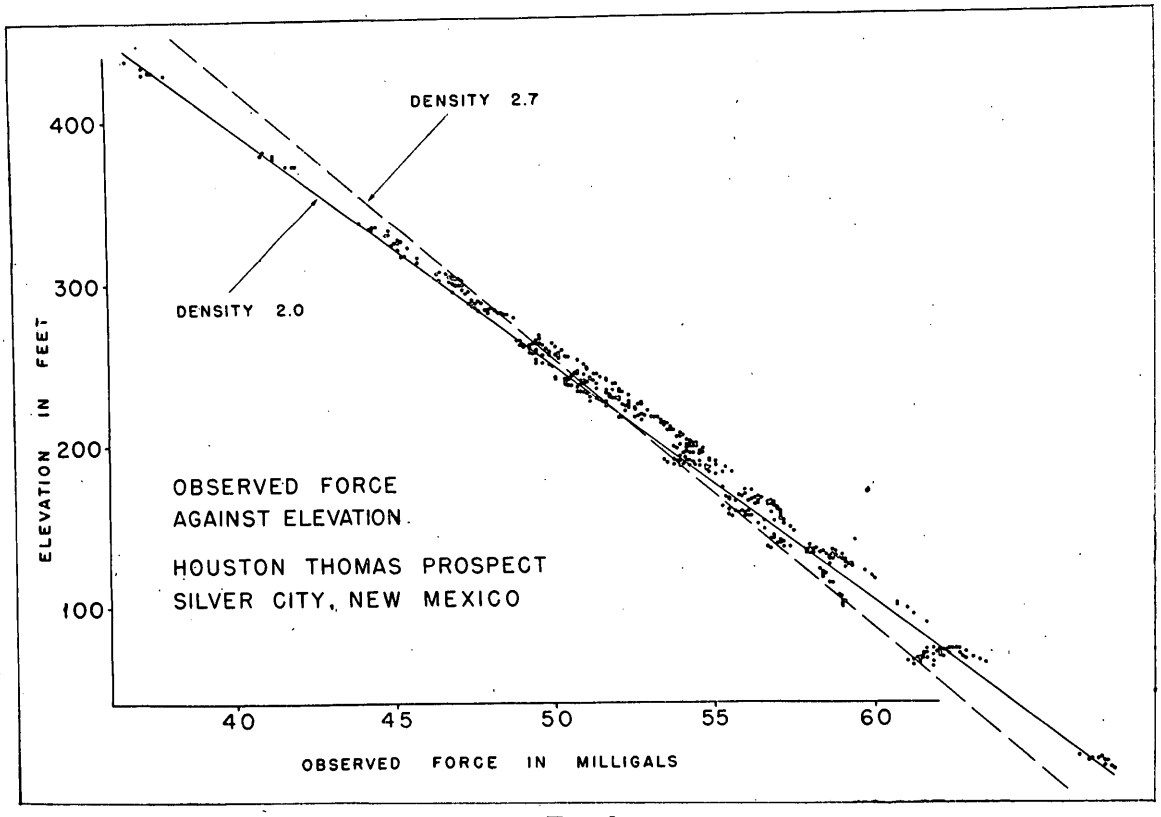


FIG. 3.

Three explanations suggest themselves for the discrepancy between the surface density as measured and as deduced from the density profiles and elevation graph. If the prospect slopes generally in one direction, the graphic correction factor will include the regional gradient in this direction, if there is one. This is not harmful unless the regional gradient itself is being sought. Again, if the higher stations and lower stations are generally on different outcrops, the graphic correction factor will include the anomaly caused by the density difference of the outcropping formations. Finally, if the higher elevations occur in regions of rougher topography, the total or large-scale terrain corrections (as opposed to the very local corrections made for the map) will increase with the elevations and cause the graphic correction factor to be greater than it ought to be, and the deduced surface density less. In an ideal case such as that of a cone-shaped mountain, it is clear that the total terrain correction will increase

systematically as the point of observation moves from the base of the mountain to its top. The present prospect is a fair approximation to such a case, and it seems probable that the abnormal slope of the elevation graph is caused by an increase with elevation of the terrain correction.

TERRAIN CORRECTIONS

Since topographic irregularities affect the observed gravitational force, a correction must be added to each station. The magnitude of each correction depends on the surface density and the topography in the neighbourhood of the station, and the corrections are usually computed graphically by means

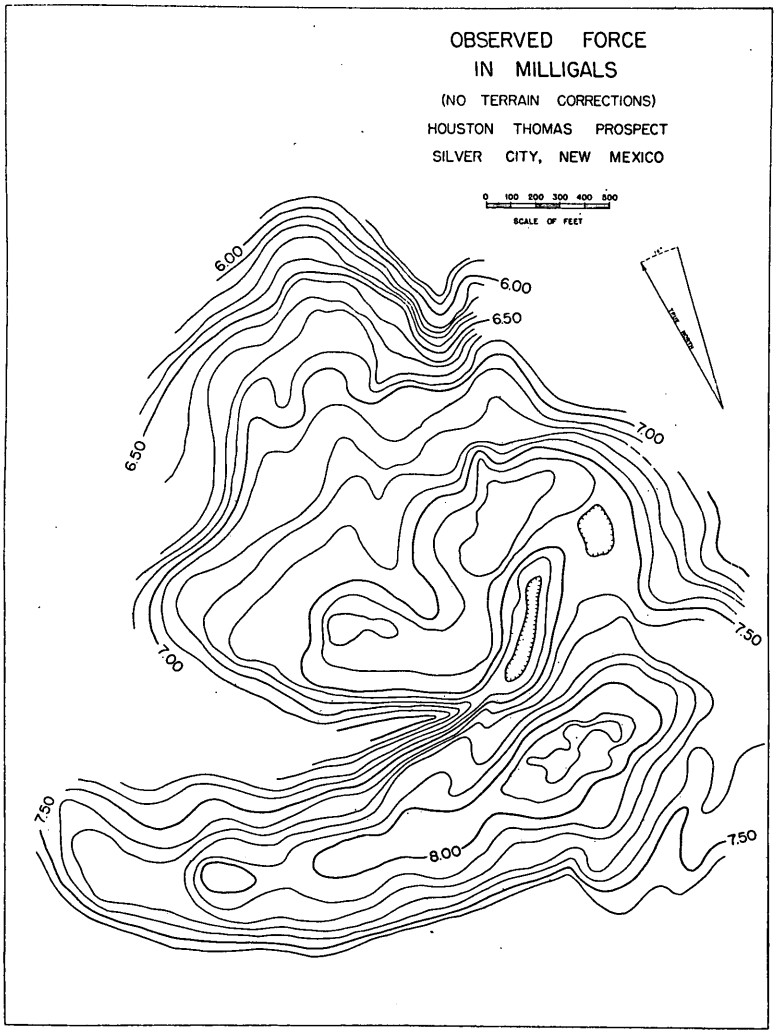


FIG. 4.

of reticules or zone charts superimposed on a contour map of the area surrounding the station. A practical method for making such computations has been described by Hammer (1939). In theory, the total terrain correction for a station is computed from all the topographic irregularities (mass above the station and voids below it) for an infinite distance out. In practice, of course, it is necessary to take into account only the irregularities close to the stations. The circle of ground for which corrections for a given station are made is usually chosen to have a radius several times the linear dimensions of the expected gravitational anomalies, so that the gradients from the uncorrected irregularities outside the circle will be small and not obscure the anomaly. In the present case, the terrain corrections were

based on a surface density of 2·7 and computed for a distance of about 1,500 feet around the stations, from a topographic map made from the surveyed elevations of the stations (Fig. 2).

DISCUSSION OF GRAVITY ANOMALIES

The contour map (observed force with terrain corrections, Fig. 5) shows three positive closures. The most interesting of these is the southeastern one, roughly 0·3 milligal in height and perhaps 300 by 600 feet in size. Considering the gradients in the vicinity, a closure of 0·3 milligal is not outstanding, but still the anomaly is better than a borderline case. Possible interpretations of this anomaly

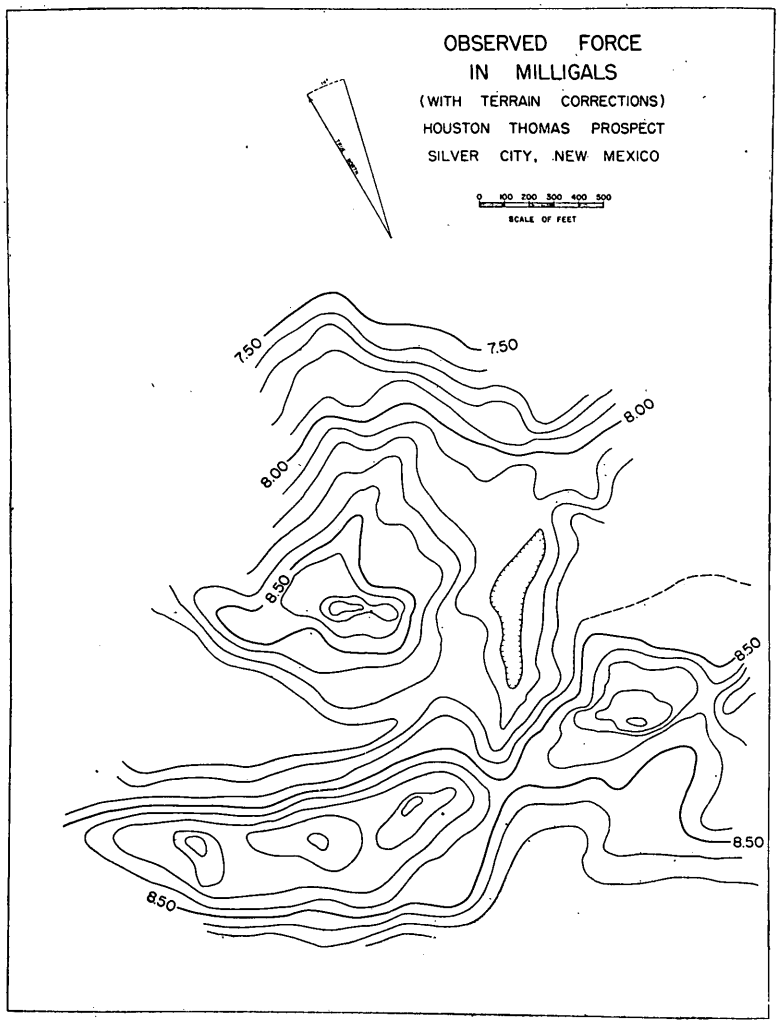


FIG. 5.

are: (1) A wrong elevation correction or an inadequate terrain correction under some conditions might cause a closure, but for this anomaly such a cause is ruled out because the anomaly is in an area which is neither high nor low topographically. (2) The anomaly is situated roughly over the eastern end of an outcrop of Magdalena limestone, but the limestone outcrop also extends westward beyond the closure indicating that any correspondence seen is fortuitous. (3) The remaining inference that the gravitational high must be caused by something heavy beneath the surface was confirmed when the core drill penetrated ore.

A gravity high of the dimensions shown could be caused by an infinite variety of anomalous mass distributions. However, if it is assumed that the anomalous mass is fairly simple in shape, it is safe to assign a maximum depth to it, corresponding to half its width or less. This would mean that the anomalous mass ought to be no deeper than 150 feet, though it might be shallower. In addition, the amount of the anomalous material is proportional to the " volume " of the gravitational anomaly. In the present case, the anomalous material can be estimated to be several hundred thousand tons. Estimates for other masses have previously been made by Romberg and Barnes (1943), and Hammer (1945).

The largest positive closure is in the southwestern part of the area and is about 500 by 1,500 feet in size. The closure corresponds in size and shape to a prominent topographic ridge of Beartooth quartzite underlain by the heavier diorite-porphyry and limestone. The coincidence between the ridge and the closure leads to the suspicion that the high is caused by surface irregularity rather than by heavy material. A density profile across the ridge indicated that the closure would have been much reduced if a different elevation correction had been chosen, and it would probably have been reduced still further by more extensive terrain corrections. Also, it is to be expected that the terrain corrections will be less effective as the topographic features get larger, and for this prospect the corrections were made out to a relatively small distance. No core drilling on this anomaly is recommended.

The third positive closure, west-central part of the map, is on the side of a steep hill, thus minimizing the possibility of its being due to topography. The surface geology is complex, with limestone, diorite-porphyry, and quartzite in an irregular pattern near the centre of the closure. The complex geology makes this high less attractive than the first one, but it is difficult to avoid suspecting that the high values are caused by heavy material beneath the surface. Two barren holes have been drilled, but additional drilling is probably advisable. From the size and shape of the anomaly, it is inferred that a small quantity of heavy material may be close to the surface, accounting for the localized high values in the middle of the anomaly, and in addition a large quantity of heavy material may be present at a depth of 200 or more feet. Whether or not this heavy material is ore remains to be seen.

Some other features of the gravity map which may be pointed out are:—

(1) The topographic low between the second and third anomalies shows a large gravity low associated with the Magdalena limestone. The low probably reflects topography.

(2) In contrast, the topographic high northeast of the third anomaly (centre of the topographic map) does not appear to be reflected on the gravity map.

(3) A small gravity terrace is associated with the limestone between the Houston-Thomas mine and the Jap workings.

(4) The closed low between the first and third anomalies is associated with quartzite but is also associated with a topographic low.

PROSPECTING AND DEVELOPMENT DATA

Core-drilling data.—The U.S. Bureau of Mines was conducting a drilling programme (Project 15–203) on the Houston-Thomas group of claims during the time the gravity survey was being made. The first hole (Fig. 1) was directed to prospect the Magdalena limestone beneath the Cretaceous in the northern part of the map area. The throw of the fault was greater than expected, and the limestone was not reached, the hole being bottomed in Colorado shale at 875 feet. The Bureau of Mines completed the first hole before the gravity data had been fully reduced.

The location for the second hole on the basis of the preliminary gravity reduction proved to be too far east, and only a few inches of ore was encountered. The hole passed through 40 feet of limestone followed mostly by diorite-porphyry to its total depth of 290 feet. By the time the second hole was completed, the gravity data had been sufficiently well reduced so that the location of hole No. 3 proved to be accurate. Hole No. 3, directed S. 29° E. at an angle of 70°, penetrated limestone containing a small amount of diorite-porphyry to 96 feet, ore from 96 to 105 feet, mineralized limestone from 105 to 120 feet, and bottomed in diorite-porphyry at 122 feet. Another hole, No. 4, from the same

station directed S. 29° E. but at an angle of 55°, penetrated 113 feet of limestone containing a small amount of diorite-porphyry, ore from 113 to 142 feet, and bottomed in diorite-porphyry at 143 feet. Since funds were not available to outline the ore body, the drill was moved to the northwestern anomaly where two holes were drilled.

Hole No. 5, drilled vertically, bottomed at 245 feet after passing through diorite-porphyry for 120 feet, followed by alternating unmineralized limestone and diorite-porphyry for the rest of the distance. Hole No. 6, directed N. 10° E. at an angle of 70°, penetrated 21 feet of diorite-porphyry, limestone from 21 to 64 feet, and bottomed in diorite-porphyry at 135 feet without encountering mineralization. The drilling on the second anomaly is not conclusive.

Mining data.—A shaft was sunk in the vicinity of the drill holes and was placed, as nearly as could be interpreted from the gravity data, to graze the southern margin of the ore body. However, the shaft

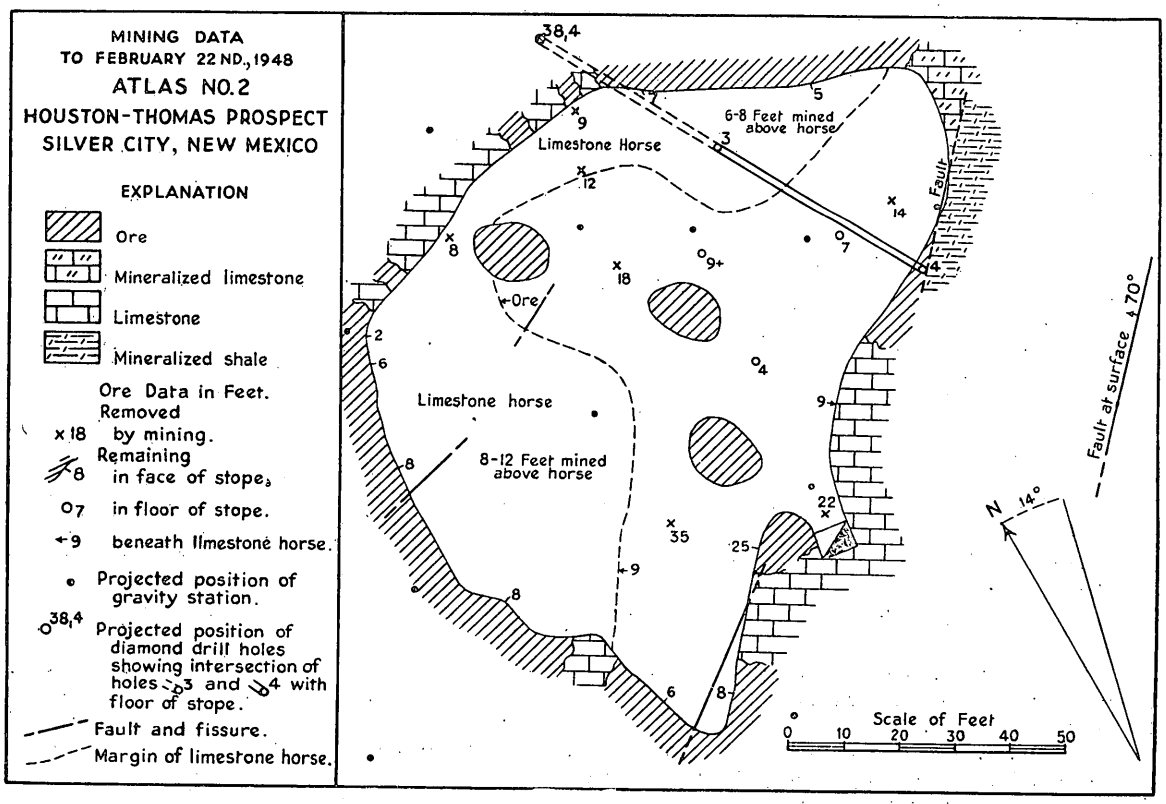


FIG. 6.

between 78 and 98 feet was approximately half in ore and half in limestone. Diorite is beneath the ore in the bottom of the shaft. A drift was driven toward the drill holes, and the ore about the holes has been removed.

The area stoped, up to February 22, 1948, is shown in Fig. 6, and the thicknesses of ore removed or still remaining are noted. An extensive limestone horse in the western and northern part of the stope, extending 5 to 6 feet above floor level in the northeastern part, is being left, and ore 6 to 12 feet thick has been mined from above it. Ore beneath the horse is indicated, but little is known about its thickness.

Shale is exposed on the southeastern side of a 4-foot brecciated fault zone containing broken ore, calcite, and gouge seams. The last movement along the fault was nearly horizontal and the vertical displacement appears to be less than 20 feet. The shale is cut by small veins containing pyrite, galena,

and marmatite which are terminated at the fault plane. This is the only place seen where there is definite evidence that the faulting is post-mineralization in age. A fissure seen at the surface and dipping 70° to the northwest is probably the surface expression of the fault.

A vein of galena, 1 to 4 inches thick, cuts vertically through the ore and adjacent limestone in the southwestern part of the stope. Other late veins filled with calcite and pyrite are common in the western part of the stope and for the most part are aligned approximately in an east-west direction.

The back of the stope is fairly plain, strikes about N. 20° W., and dips about 21° to the east. The ore appears to have selectively replaced beds of the Magdalena limestone as in the Cleveland mine.

The principal metallic minerals in the ore are pyrite, marmatite, galena, and chalcopyrite. The principal gangue mineral is calcite. The tenor of the ore up to February 22, 1948, was approximately as follows: zinc, 10·07 per cent; lead, 2·55 per cent; copper, 0·17 per cent; silver, 3·33 ounces; and gold, 0·012 ounces. The gold is of no value to the producer, and it is seldom that the copper content is sufficiently high to yield revenue. Penalty-bearing constituents such as arsenic and bismuth are absent. However, iron amounts to 29 per cent of the ore mined, and the marmatite, after milling, contains approximately 11 per cent iron, which is objectionable in smelting and reduces the value of the ore.

Until February 22, 1948, about 11,900 dry tons of ore having an average density of about 3·84 were mined. The tonnage of ore remaining is unknown, and until the body has either been mined or drilled, the correlation between the predicted amount and actual amount of ore will be unknown.

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DISCUSSION

K. C. DUNHAM congratulated the authors on this first discovery of a concealed lead-zinc orebody, and asked the nature of the oreshoot, whether it was a " manto " in the Magdalena Limestone. He also enquired about the average thickness of the deposit.

In reply V. E. BARNES regretted that these points, contained in the original paper, had been omitted from his presentation. The orebody appears to be a selective replacement of the Magdalena limestone as in the neighbouring Cleveland Mine and a rough estimate of its thickness is 14 feet.

CWS—25890 (R)

(*b*) If deposit is other than pla

(1) Submit assay plans and/or sections showing location and size of proved (measured) and probable (indicated) ore or mineral reserve.

(2) State the tonnage (indicate type of ton) and grade of each class of ore reserve, as above, and show how computed. Tabulated total ore reserve as follows:

TOTAL ORE OR MINERAL RESERVES

Ore or Mineral Reserve	Estimated Tons (a)	Metal or Mineral Content Per Ton (Grade) (b)	Gross Value Per Ton (c)	Recoverable Unit Value Per Ton (d)	Estimated Cost of Production Per Ton (e)
Measured (proved)	700	7% Zinc 2% Lead	$12.50 at mine	92% of Zn 85% of Pb	$6.50
Indicated (probable)	700	same	same	same	same

(*c*) If placer:

(1) Give estimated total yardage and average marketable mineral content of each deposit.

(2) Submit map showing location of placer deposit and surrounding area, with all test holes or pits. Submit logs of each hole and test pit with depth and average value of each.

(3) Describe gravel, stating whether fine, medium or coarse; loose, tight, cemented, or frozen, and whether it contains stumps or boulders more than 1 foot in diameter; if so, how large, and in what proportion.

(4) Describe bedrock, giving type (granite, sandstone, shale, etc.) and state whether it is hard or soft, smooth, uneven or rough.

(5) Describe overburden, stating whether loose, tight, or cemented; fine or coarse textured; furnish estimate of average thickness and total amount.

(6) Tabulate the reserves using the form outlined above for ore or mineral reserves.

13. Access Roads:

Give road distances to shipping, supply and residence points, stating kind and condition of roads.

14. Water Supply:

State source and quantity of water available for operations and whether sufficient for all seasons of year.

15. Power:

State amount of power used, rate per hour, and source thereof.

16. Labor:

State number and classes (miners, muckers, millmen, etc.) of men employed during a recent representative payroll period.

17. Equipment and Facilities:

Describe present equipment on the property, including buildings. (State condition.) List major pieces of equipment now owned or controlled and in serviceable condition available for this operation.

18. Are there any particular conditions or circumstances affecting your operations that are not described above? If so, explain.

CERTIFICATION

The undersigned company, and the official executing this certification on its behalf, hereby certify that the information contained in this form and accompanying papers is correct and complete to the best of their knowledge and belief.

Mathis and Mathis
(Name of company)

By R. W. Mathis
(Signature of authorized official)

May 26, 1951
(Date)

partner and general manager
(Title)

Title 18, U. S. Code (Crimes), Section 1001, makes it a criminal offense to make a willfully false statement or representation to any department or agency of the United States as to any matter within its jurisdiction.

U. S. GOVERNMENT PRINTING OFFICE 16—63792-1

DEPARTMENT OF THE INTERIOR
Defense Minerals Administration
RECEIVED
JUN 4 - 1951
LANDON F. STROBEL
Executive Secretary

MATHIS AND MATHIS
MINING AND EXPLORATION
P. O. BOX 452
SILVER CITY, NEW MEXICO

May 21, 1951

FORM MF-103

THE REQUIREMENTS AND COSTS

23. Itemized cost statement.

(a)	Two core drill operators at $1.85 per hour each Two core drill helpers at $1.50 per hour each Total labor cost per week, $348.80, plus 10% for insurance, unemployment tax, and Social Security, equals $383.68 X 25 weeks, equals	$9,592.00	
(b)	One supervisor at $1.85 per hour. Total cost for 25 weeks, including insurance and taxes	2,651.00	
(c)	None		
(d)	None		
(e)	Diamond bit cost, estimated at $1.00 per foot	5,000.00	
(f)	None		
(g)	Twelve months depreciation on two complete core drilling rigs, plus repair fund	3,071.80	
(h)	Gasoline and lubricants	400.00	
(i)	Water for drilling at 2¢per foot	100.00	
	Total		$20,814.80

24. The schedule of the proposed project calls for completion of 100 ft. of hole each week by each machine. The project would be completed in 25 weeks at this rate. However, applicant proposes that the project be limited only to 12 months because of the possibility of unforeseen shut-down due to equipment failure, labor trouble, etc., and that a depreciation allowance be set up for that period.

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FORM MF-103

TIME REQUIREMENTS AND COSTS

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(c) None

(d) None

(e) Diamond bit cost, estimated at $1.00 per foot ----- 5,000.00

(f) None

(g) Twelve months depreciation on two complete core drilling rigs, plus repair fund ---------- 3,071.80

(h) Gasoline and lubricants ---------- 400.00

(i) Water for drilling at 2¢per foot ---------- 100.00

Total ---------- $20,814.80

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Mathis & Mathis
May 21, 1951

Form MF 103 Item 23 (g) Applicant's equipment to be used on project:

Sullivan 22 Hd core-drill machine	$3680.00
Deming pump with Hercules engine	450.00
600 ft AX drill rod	792.00
Tripod	90.00
Hoses	40.00
Water tank	60.00
Sludge tanks	20.00
10 ft. rigid core barrel	72.00
10 ft. series D core barrel	89.00
Sheave wheel	74.00
Rod safety clamp	72.00
Water Swivel	33.00
Tools	185.00
	$5,657.00

Sullivan 22 Std Core-Drill machine	2700.00
Gould pump with Wisconsin engine	380.00
300 ft AX drill rod	396.00
Tripod	90.00
Hoses	40.00
Water tank	60.00
Sludge tanks	20.00
5 ft rigid core barrel	67.00
Sheave wheel	44.00
Water swivel	33.00
Rod safety clamp	72.00
	$3,902.00

Repair fund for above equipment	$1,200.00

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Deming pump with Hercules engine	450.00
600 ft AX drill rod	792.00
Tripod	90.00
Hoses	40.00
Water tank	60.00
Sludge tanks	20.00
10 ft. rigid core barrel	72.00
10 ft. series D core barrel	89.00
Sheave wheel	74.00
Rod safety clamp	72.00
Water Swivel	33.00
Tools	185.00
	$5,657.00

Sullivan 22 Std Core-Drill machine	2700.00
Gould pump with Wisconsin engine	380.00
300 ft AX drill rod	396.00
Tripod	90.00
Hoses	40.00
Water tank	60.00
Sludge tanks	20.00
5 ft rigid core barrel	67.00
Sheave wheel	44.00
Water swivel	33.00
Rod safety clamp	72.00
	$3,902.00

Repair fund for above equipment	$1,200.00

Mathis & Mathis
May 21, 1951

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GRAVITY PROSPECTING FOR LEAD AND ZINC, NEW MEXICO

By
V. E. BARNES, R. W. MATHIS, and F. ROMBERG
U.S.A.

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By V. E. BARNES, R. W. MATHIS, and F. ROMBERG

U.S.A.

ABSTRACT

Observations of the force of gravity were made on the Houston-Thomas group of claims in the Pinos Altos Mountains north of Silver City, New Mexico. The observed values of gravity were corrected for terrain effects, and the resulting map revealed three positive anomalies. The second of the U.S. Bureau of Mines diamond-drill holes on one of the anomalies penetrated a lead-zinc ore body in which mining later was started. Two holes on another anomaly missed ore, and the third anomaly does not warrant drilling.

This is the first record of the use of a gravity meter in the discovery of a lead-zinc ore body. This investigation also proves that the use of a gravity meter in extremely rugged terrain for the discovery of such bodies is practicable.

An explanation is proposed for the systematic difference between the Bouguer correction as computed from observed surface densities and as computed from the graph of force versus elevation.

INTRODUCTION

THE Houston-Thomas group of 15 patented claims in the Pinos Altos mining district located about eight miles north of Silver City, New Mexico, was chosen for gravity exploration for the following reasons:—

(1) The district has a long history of productivity.
(2) The ore is appreciably heavier than the country rock.
(3) An area was available for lease.

Mathis proposed the project to be operated by him as a commercial prospect, the interpretation being done by Romberg for the privilege of publication of any significant results. The division of labour among the writers is as follows: Mathis obtained the gravity data, made the geological map, and described the ore body; Romberg made the gravity interpretation; and Barnes reviewed the geology. Romberg and Barnes spent two days in the field checking the results.

The gravity anomalies were drilled by the U.S. Bureau of Mines under Project 15–203, which was in progress at the time the gravity survey was made. Use of the results of the drilling by the U.S. Bureau of Mines is gratefully acknowledged. Geologists of the U.S. Smelting, Refining, and Mining Company aided in the underground mapping.

GEOLOGY

Stratigraphy.—The stratigraphic column in the vicinity of the Houston-Thomas prospect is that given by Paige (1916), modified by Spencer and Paige (1935), and quoted as follows:—

Cretaceous
- Colorado shale.
- Beartooth quartzite.

Pennsylvanian
- Magdalena group.

The sedimentary rocks have been extensively intruded by rocks of probable late Cretaceous age consisting predominantly of diorite-porphyry. The geologic map of the area (Fig. 1) shows the main areas of predominant rock types but shows neither the myriad of small intrusives in the sedimentary rocks nor the equally numerous small inclusions in the igneous rocks. Beyond the map area diorite-porphyry outcrops extensively, being terminated eastward by a large granodiorite mass.

GEOLOGIC MAP
HOUSTON-THOMAS PROSPECT
SILVER CITY, NEW MEXICO
0 100 200 300 400 500
SCALE OF FEET
TRUE NORTH
EXPLANATION
Gossan
Andesite
Diorite porphyry
(Many small intrusive bodies within sediments not shown)
Colorado shale
Beartooth quartzite
UNCONFORMITY
Magdalena limestone
CRETACEOUS
PENNSYLVANIAN
Drill hole
Mine dump
Open cut
Underground workings
Mine shaft
HOUSTON-THOMAS MINE
JAP WORKINGS
HOUSTON-THOMAS FAULT
PERSHING MINE
ATLAS 2 MINE
ATLAS 1 MINE
CLEVELAND MINE

FIG. 1.

In nearby mining districts the Magdalena group has been divided into two formations, and beneath them a Mississippian formation, the Lake Valley limestone, is prolifically ore bearing. In the Pinos Altos district the Lake Valley limestone has not been found, and the divisions of the Magdalena group have not been recognized.

Mineral deposits.—Graton (1910) described the mineral deposits of the Pinos Altos district and gave an account of the early history of the district. Paige (1916, p. 14, 1911) gives additional information about the mineral deposits, especially the replacement deposit in limestone with which this paper deals. The district was discovered about 1860, and since that time several million dollars worth of metals have been produced, with the precious metals predominating in the early part of its history and the base metals becoming more prominent later.

The lead-zinc deposits of the Houston-Thomas and adjoining claims are replacement deposits in the Magdalena limestone, the chief metallic minerals being ferriferous sphalerite (marmatite), galena, pyrite, and chalcopyrite. On the surface there are extensive gossans composed, according to Paige, of a mixture of limonite, smithsonite, azurite, and earthy materials with a dark-brown material containing manganese, copper, and iron. The geologic map (Fig. 1) shows the gossan areas and the principal mines. The estimated production in short tons of ore from the various mines is as follows: Cleveland, 130,000+; Houston-Thomas, 3,500 (sulphide ore); Atlas No. 1, 500 (carbonate and sulphide ore); and Pershing, 6,000 (sulphide ore).

On the Cleveland property, gossan occurs over both the Cleveland and the Pershing mines. A small area of gossan occurs above the carbonate and sulphide ores of the Atlas No. 1 mine, and another small area of gossan is exposed within the gravity anomaly over the known ore mass. However, large areas of gossan on the Houston-Thomas claims have been proven barren and, furthermore, no gravity anomalies have been found associated with them.

Density data.—The densities of the various rock types were determined before the gravity survey was made in order to judge whether or not a gravity survey would be feasible. The density data obtained are as follows:—

Rock type	*Average density*
Gossan	2·70
Colorado shale	2·74
Beartooth quartzite	2·66
Magdalena limestone	2·77
Diorite-porphyry	2·80
Andesite	2·67

Densities from cores are as follows:—

Rock type	*Average density*
Magdalena limestone	2·75
Diorite-porphyry	2·89

The average density of the ore mined up to February 22, 1948, is 3·84.

Structure.—According to Paige (1911, p. 123) the ore deposits appear to replace definite beds in the Magdalena limestone. The attitude of the limestone has been disturbed somewhat by the extensive intrusives, but in general it dips east-northeast. The unconformably overlying Beartooth quartzite in general dips south-southeast. Commonly the limestone and the quartzite in the area surveyed are separated by a thin diorite-porphyry sill.

Faulting is prevalent in the Pinos Altos district, and several faults are shown within the map area. Just east of the map area the contact between the Magdalena limestone and the Beartooth quartzite is at an elevation of 7,500 feet, whereas immediately west of the Houston-Thomas fault, it is at an elevation of 7,260 feet, indicating a drop on the western side of the fault of approximately 300 feet. Another north-south fault west of the map area, also downthrown to the west, places the Colorado shale in contact with the Magdalena limestone.

Near the northeastern margin of the map area, the Colorado shale is downthrown against the Magdalena limestone, and within the map area it is faulted against diorite-porphyry. This fault has several times the throw of the Houston-Thomas fault and is offset by it. A post-faulting andesite dyke is shown in the northwestern part of the map area.

TOPOGRAPHY

That portion of the Houston-Thomas group of claims covered by the gravity survey lies on the western slope of the Pinos Altos Mountains within a few hundred feet of the Continental Divide and

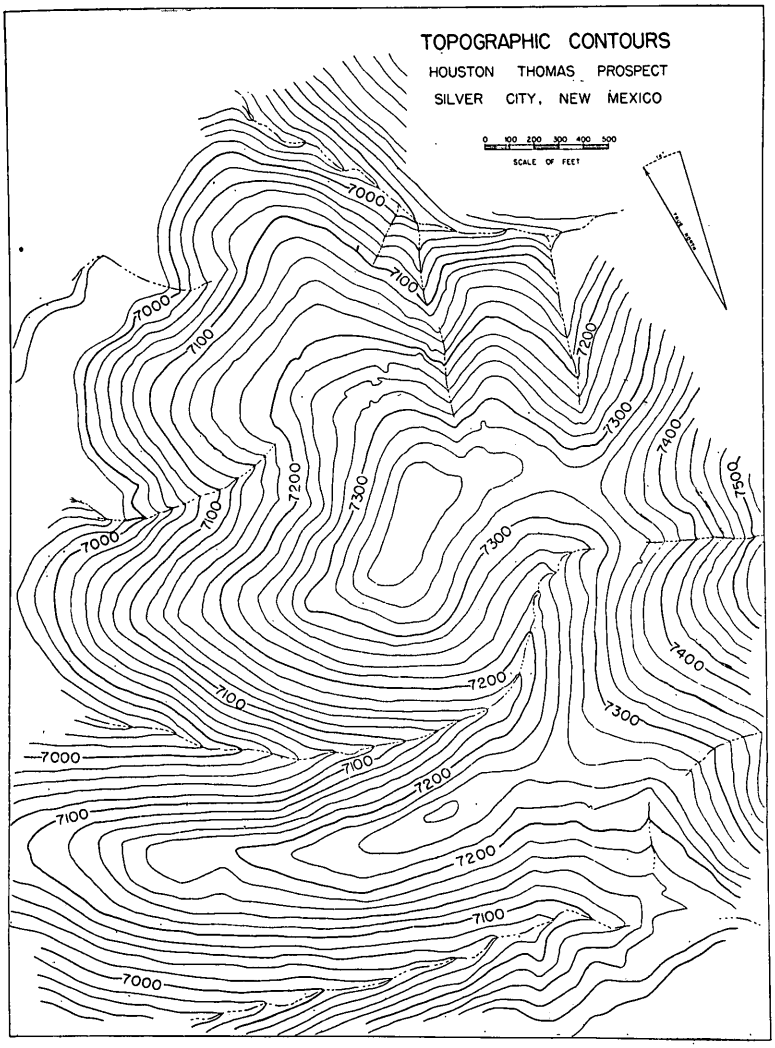

FIG. 2.

between elevations of 7,000 and 7,500 feet above sea level. The crest of the Pinos Altos Mountains is 8,036 feet in elevation and is about one-fourth of a mile from the surveyed area, which is about 3,000 by 3,400 feet in size. Figure 2 is a topographic map of the area showing the steepness of the slopes. The maximum slope is near 38°, and the average slope is estimated to be about 20°. The topography shown is typical of that within a two-mile radius.

The slopes are rubble and brush covered which, in combination with the extreme steepness, made surveying and observing with the gravity meter difficult tasks.

GRAVITY OBSERVATIONS

The stations for observing the gravitational force were laid out in an irregular network with a spacing of about 100 feet. This spacing was chosen because the shallow ore bodies which were being sought would presumably give rise to anomalies in the gravitational field with dimensions of the order of 200 feet. Such anomalies may be missed on the final map of the gravitational force if the spacing is too large. When the preliminary work was done, fill-in stations were set in areas where anomalies were indicated.

Observations of the force were made with a portable gravity meter which was read with a precision of plus or minus 0·01 milligal. The meter had to be transported on foot, as it was not possible to take an automobile anywhere on the prospect except on the one road that runs through it. The effect of tidal drift was kept small by reading the meter frequently on base stations; this was practical because the stations were close together. After the readings were corrected for drift, they appeared to be repeatable with a probable error of less than plus or minus 0·02 milligal. The corrected readings are probably in error with respect to each other by more than this amount if they are some distance apart on the prospect, but this is of no consequence in the search for small anomalies.

The observations were corrected for latitude and elevation in the usual manner, and a contour map (Fig. 4) drawn on the residual values. Terrain corrections were made for the stations in areas that seemed to be anomalous, and a second contour map was made using these corrected observations (Fig. 5). The values of the gravitational force shown are relative, since no purpose in prospecting could be served by trying to relate them to the absolute value of force.

When gravity surveys are made in areas of rough topography, there is always a question as to whether the effects of the terrain will mask the anomalies that are being sought, even after the terrain corrections have been made. On the Houston-Thomas prospect it was considered doubtful whether the anomalous gravitational effects of ore bodies could be perceived, since the surface was extremely rough and the surface material varied. With sufficient labour and very accurate topographic and geologic maps, a set of terrain corrections could no doubt be computed to any required correctness, but there was no assurance in the beginning that the extra labour of making accurate terrain corrections would be worth carrying out. As it was, the gravity map after correction showed no anomalies that were not hinted at by the uncorrected map, but the corrected map showed the closures more plainly. The authors do not know of another attempt to look for such small anomalies in such rough terrain.

DENSITY CORRECTIONS

It is customary to correct observations of the gravitational force for elevation differences with a factor which multiplies the relative elevation of each station. This factor is a combination of the free air elevation correction (which is nearly constant on the earth's surface) and the Bouguer factor, which is a function of the surface density. The surface density can be measured from samples. This measurement is usually supplemented with density profiles such as those described by Nettleton (1940), in which different values of the density are tried out for effect on the final values of the gravitational force. Profiles computed with a number of assumed densities are plotted for a line of observations, and these profiles are compared with a profile of the topography. If the assumed density is too small, its force profile follows the topography; if it is too large, its profile mirrors the topography. The correct density will, of course, be the one whose profile seems neither to follow nor to mirror the topography. This method works well if, on the profiles chosen, there is no relation between the residual force and the elevations, but if there is such a relation, it may lead to a choice of the wrong density.

Density profiles for the Houston-Thomas prospect were ambiguous; the profiles seemed to follow some topographic features and mirror others. However, the best choice of surface density indicated by the density profiles seemed to be about 2·2. This differs seriously from the measured density of 2·7.

Another method of finding a value for the combined elevation correction (and thence presumably for the surface density) is to plot all the observations on a graph of elevation versus force uncorrected for elevation. If there were no gravity anomalies present, the points on the graph would all lie in a

straight line, whose slope would be the elevation correction factor. The slope of the line can be found with sufficient accuracy if the elevation differences on the prospect are great enough. The elevation graph of the Houston-Thomas prospect (Fig. 3) showed the slope to have a value corresponding to a surface density of 2·0. This result is even more startling than the value of 2·2 which was deduced from the density profiles, as it deviates even further from the measured density. The elevation graph shows the slope the line would have, to correspond to a density of 2·7, and it is clearly out of the question to draw the line with such a slope. Thus if the elevation correction based on a density of 2·7 were used in correcting the observations of force, the uphill and downhill stations would appear to be anomalous merely on account of their elevations. The final elevation corrections were computed from the slope of the elevation graph rather than from the true density, since it was thought that fewer irrelevant anomalies would result.

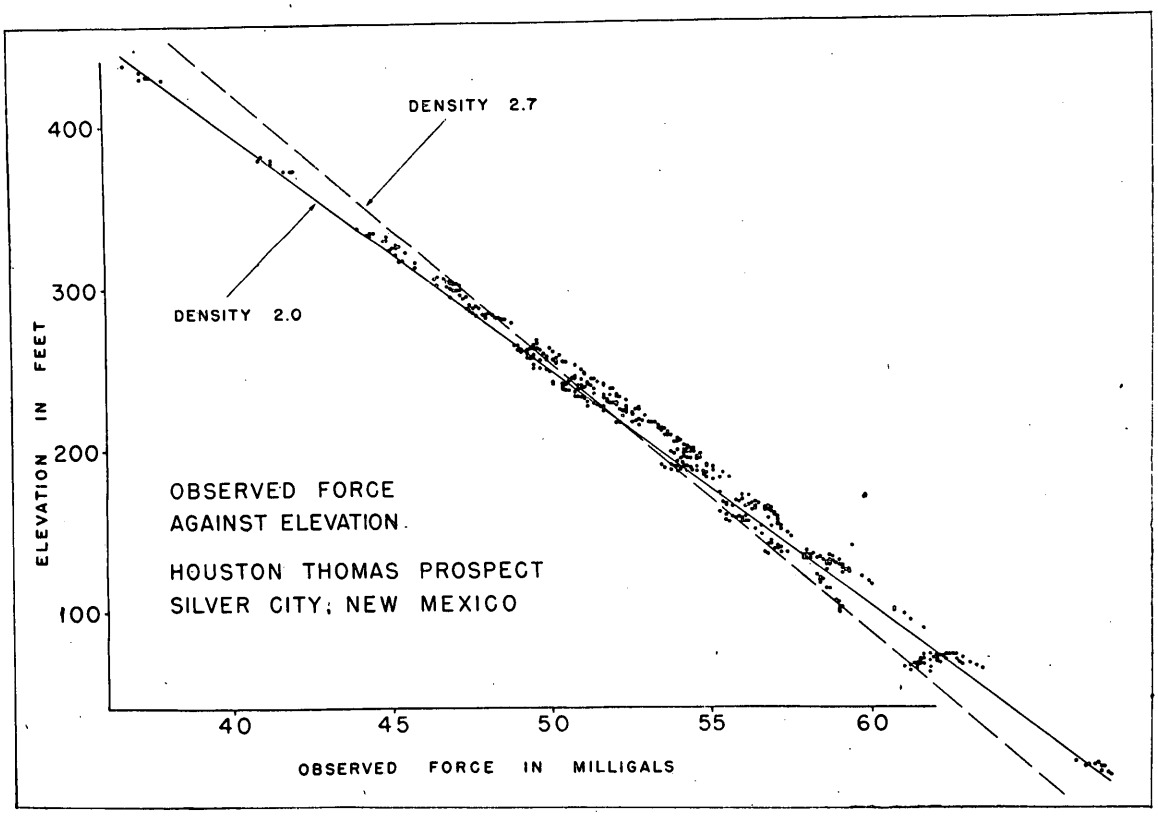

FIG. 3.

Three explanations suggest themselves for the discrepancy between the surface density as measured and as deduced from the density profiles and elevation graph. If the prospect slopes generally in one direction, the graphic correction factor will include the regional gradient in this direction, if there is one. This is not harmful unless the regional gradient itself is being sought. Again, if the higher stations and lower stations are generally on different outcrops, the graphic correction factor will include the anomaly caused by the density difference of the outcropping formations. Finally, if the higher elevations occur in regions of rougher topography, the total or large-scale terrain corrections (as opposed to the very local corrections made for the map) will increase with the elevations and cause the graphic correction factor to be greater than it ought to be, and the deduced surface density less. In an ideal case such as that of a cone-shaped mountain, it is clear that the total terrain correction will increase

systematically as the point of observation moves from the base of the mountain to its top. The present prospect is a fair approximation to such a case, and it seems probable that the abnormal slope of the elevation graph is caused by an increase with elevation of the terrain correction.

TERRAIN CORRECTIONS

Since topographic irregularities affect the observed gravitational force, a correction must be added to each station. The magnitude of each correction depends on the surface density and the topography in the neighbourhood of the station, and the corrections are usually computed graphically by means

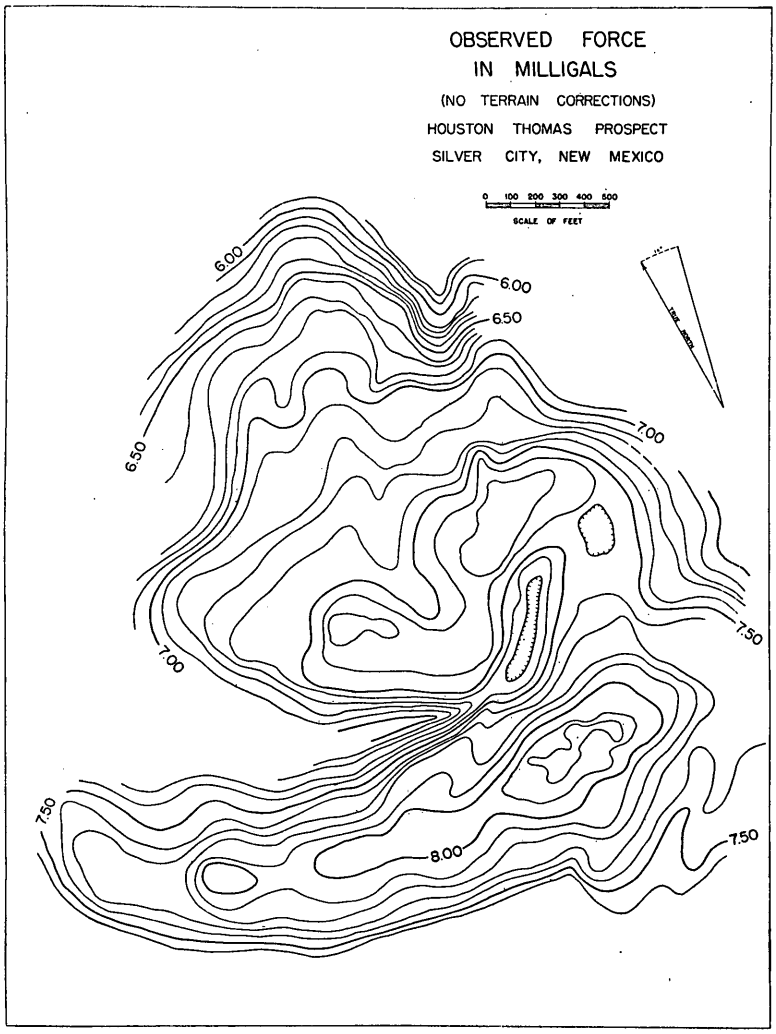

FIG. 4.

of reticules or zone charts superimposed on a contour map of the area surrounding the station. A practical method for making such computations has been described by Hammer (1939). In theory, the total terrain correction for a station is computed from all the topographic irregularities (mass above the station and voids below it) for an infinite distance out. In practice, of course, it is necessary to take into account only the irregularities close to the stations. The circle of ground for which corrections for a given station are made is usually chosen to have a radius several times the linear dimensions of the expected gravitational anomalies, so that the gradients from the uncorrected irregularities outside the circle will be small and not obscure the anomaly. In the present case, the terrain corrections were

based on a surface density of 2·7 and computed for a distance of about 1,500 feet around the stations, from a topographic map made from the surveyed elevations of the stations (Fig. 2).

DISCUSSION OF GRAVITY ANOMALIES

The contour map (observed force with terrain corrections, Fig. 5) shows three positive closures. The most interesting of these is the southeastern one, roughly 0·3 milligal in height and perhaps 300 by 600 feet in size. Considering the gradients in the vicinity, a closure of 0·3 milligal is not outstanding, but still the anomaly is better than a borderline case. Possible interpretations of this anomaly

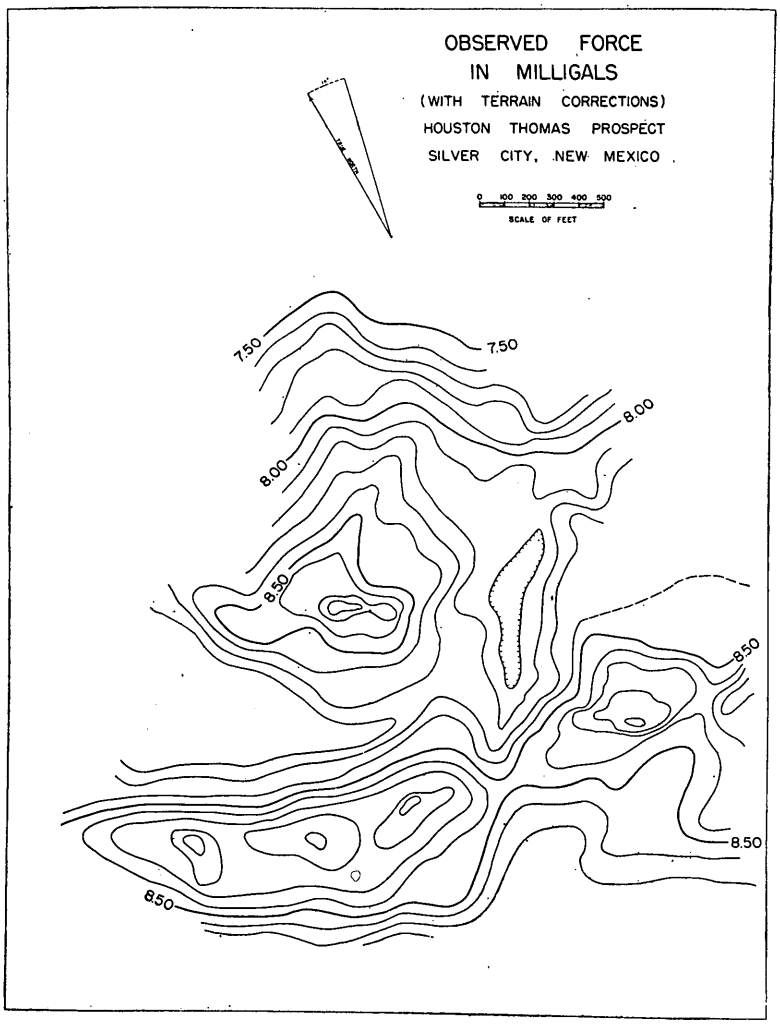

FIG. 5.

are: (1) A wrong elevation correction or an inadequate terrain correction under some conditions might cause a closure, but for this anomaly such a cause is ruled out because the anomaly is in an area which is neither high nor low topographically. (2) The anomaly is situated roughly over the eastern end of an outcrop of Magdalena limestone, but the limestone outcrop also extends westward beyond the closure indicating that any correspondence seen is fortuitous. (3) The remaining inference that the gravitational high must be caused by something heavy beneath the surface was confirmed when the core drill penetrated ore.

A gravity high of the dimensions shown could be caused by an infinite variety of anomalous mass distributions. However, if it is assumed that the anomalous mass is fairly simple in shape, it is safe to assign a maximum depth to it, corresponding to half its width or less. This would mean that the anomalous mass ought to be no deeper than 150 feet, though it might be shallower. In addition, the amount of the anomalous material is proportional to the " volume " of the gravitational anomaly. In the present case, the anomalous material can be estimated to be several hundred thousand tons. Estimates for other masses have previously been made by Romberg and Barnes (1943), and Hammer (1945).

The largest positive closure is in the southwestern part of the area and is about 500 by 1,500 feet in size. The closure corresponds in size and shape to a prominent topographic ridge of Beartooth quartzite underlain by the heavier diorite-porphyry and limestone. The coincidence between the ridge and the closure leads to the suspicion that the high is caused by surface irregularity rather than by heavy material. A density profile across the ridge indicated that the closure would have been much reduced if a different elevation correction had been chosen, and it would probably have been reduced still further by more extensive terrain corrections. Also, it is to be expected that the terrain corrections will be less effective as the topographic features get larger, and for this prospect the corrections were made out to a relatively small distance. No core drilling on this anomaly is recommended.

The third positive closure, west-central part of the map, is on the side of a steep hill, thus minimizing the possibility of its being due to topography. The surface geology is complex, with limestone, diorite-porphyry, and quartzite in an irregular pattern near the centre of the closure. The complex geology makes this high less attractive than the first one, but it is difficult to avoid suspecting that the high values are caused by heavy material beneath the surface. Two barren holes have been drilled, but additional drilling is probably advisable. From the size and shape of the anomaly, it is inferred that a small quantity of heavy material may be close to the surface, accounting for the localized high values in the middle of the anomaly, and in addition a large quantity of heavy material may be present at a depth of 200 or more feet. Whether or not this heavy material is ore remains to be seen.

Some other features of the gravity map which may be pointed out are:—

(1) The topographic low between the second and third anomalies shows a large gravity low associated with the Magdalena limestone. The low probably reflects topography.

(2) In contrast, the topographic high northeast of the third anomaly (centre of the topographic map) does not appear to be reflected on the gravity map.

(3) A small gravity terrace is associated with the limestone between the Houston-Thomas mine and the Jap workings.

(4) The closed low between the first and third anomalies is associated with quartzite but is also associated with a topographic low.

PROSPECTING AND DEVELOPMENT DATA

Core-drilling data.—The U.S. Bureau of Mines was conducting a drilling programme (Project 15–203) on the Houston-Thomas group of claims during the time the gravity survey was being made. The first hole (Fig. 1) was directed to prospect the Magdalena limestone beneath the Cretaceous in the northern part of the map area. The throw of the fault was greater than expected, and the limestone was not reached, the hole being bottomed in Colorado shale at 875 feet. The Bureau of Mines completed the first hole before the gravity data had been fully reduced.

The location for the second hole on the basis of the preliminary gravity reduction proved to be too far east, and only a few inches of ore was encountered. The hole passed through 40 feet of limestone followed mostly by diorite-porphyry to its total depth of 290 feet. By the time the second hole was completed, the gravity data had been sufficiently well reduced so that the location of hole No. 3 proved to be accurate. Hole No. 3, directed S. 29° E. at an angle of 70°, penetrated limestone containing a small amount of diorite-porphyry to 96 feet, ore from 96 to 105 feet, mineralized limestone from 105 to 120 feet, and bottomed in diorite-porphyry at 122 feet. Another hole, No. 4, from the same

station directed S. 29° E. but at an angle of 55°, penetrated 113 feet of limestone containing a small amount of diorite-porphyry, ore from 113 to 142 feet, and bottomed in diorite-porphyry at 143 feet. Since funds were not available to outline the ore body, the drill was moved to the northwestern anomaly where two holes were drilled.

Hole No. 5, drilled vertically, bottomed at 245 feet after passing through diorite-porphyry for 120 feet, followed by alternating unmineralized limestone and diorite-porphyry for the rest of the distance. Hole No. 6, directed N. 10° E. at an angle of 70°, penetrated 21 feet of diorite-porphyry, limestone from 21 to 64 feet, and bottomed in diorite-porphyry at 135 feet without encountering mineralization. The drilling on the second anomaly is not conclusive.

Mining data.—A shaft was sunk in the vicinity of the drill holes and was placed, as nearly as could be interpreted from the gravity data, to graze the southern margin of the ore body. However, the shaft

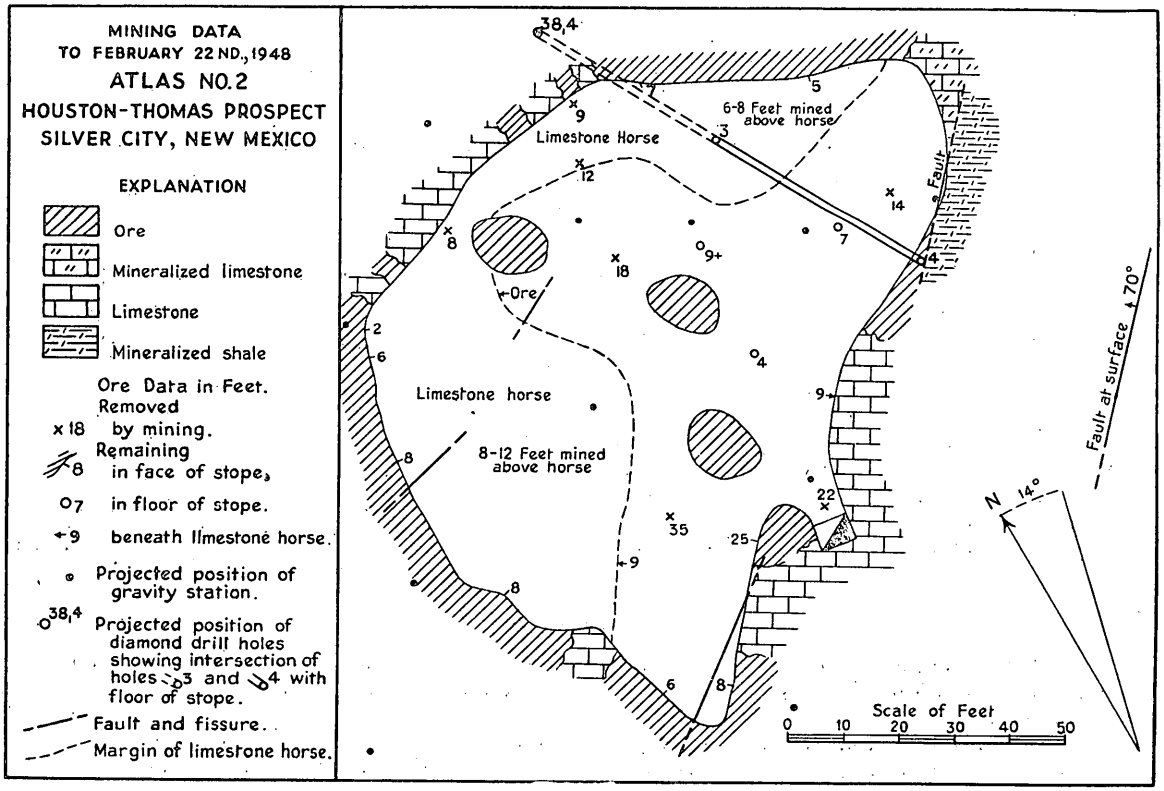

FIG. 6.

between 78 and 98 feet was approximately half in ore and half in limestone. Diorite is beneath the ore in the bottom of the shaft. A drift was driven toward the drill holes, and the ore about the holes has been removed.

The area stoped, up to February 22, 1948, is shown in Fig. 6, and the thicknesses of ore removed or still remaining are noted. An extensive limestone horse in the western and northern part of the stope, extending 5 to 6 feet above floor level in the northeastern part, is being left, and ore 6 to 12 feet thick has been mined from above it. Ore beneath the horse is indicated, but little is known about its thickness.

Shale is exposed on the southeastern side of a 4-foot brecciated fault zone containing broken ore, calcite, and gouge seams. The last movement along the fault was nearly horizontal and the vertical displacement appears to be less than 20 feet. The shale is cut by small veins containing pyrite, galena,

and marmatite which are terminated at the fault plane. This is the only place seen where there is definite evidence that the faulting is post-mineralization in age. A fissure seen at the surface and dipping 70° to the northwest is probably the surface expression of the fault.

A vein of galena, 1 to 4 inches thick, cuts vertically through the ore and adjacent limestone in the southwestern part of the stope. Other late veins filled with calcite and pyrite are common in the western part of the stope and for the most part are aligned approximately in an east-west direction.

The back of the stope is fairly plain, strikes about N. 20° W., and dips about 21° to the east. The ore appears to have selectively replaced beds of the Magdalena limestone as in the Cleveland mine.

The principal metallic minerals in the ore are pyrite, marmatite, galena, and chalcopyrite. The principal gangue mineral is calcite. The tenor of the ore up to February 22, 1948, was approximately as follows: zinc, 10·07 per cent; lead, 2·55 per cent; copper, 0·17 per cent; silver, 3·33 ounces; and gold, 0·012 ounces. The gold is of no value to the producer, and it is seldom that the copper content is sufficiently high to yield revenue. Penalty-bearing constituents such as arsenic and bismuth are absent. However, iron amounts to 29 per cent of the ore mined, and the marmatite, after milling, contains approximately 11 per cent iron, which is objectionable in smelting and reduces the value of the ore.

Until February 22, 1948, about 11,900 dry tons of ore having an average density of about 3·84 were mined. The tonnage of ore remaining is unknown, and until the body has either been mined or drilled, the correlation between the predicted amount and actual amount of ore will be unknown.

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DISCUSSION

K. C. DUNHAM congratulated the authors on this first discovery of a concealed lead-zinc orebody, and asked the nature of the oreshoot, whether it was a " manto " in the Magdalena Limestone. He also enquired about the average thickness of the deposit.

In reply V. E. BARNES regretted that these points, contained in the original paper, had been omitted from his presentation. The orebody appears to be a selective replacement of the Magdalena limestone as in the neighbouring Cleveland Mine and a rough estimate of its thickness is 14 feet.

CWS—25890 (R)

Map Showing Proposed Diamond Drill Hole Locations for DMA Docket # 1549X (Article 21)

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