Mining Division
Region IV

August 13, 1952

Memorandum

To: Field Team, Region IV

From: Acting Chief, Mining Division, Region IV

Subject: Final Report, DMEA Docket 2550 (Asbestos)
Bear Canyon Mining Company
Gila County, Arizona

Enclosed are nine copies of the engineering report by L. A. Stewart of the Bureau of Mines on subject docket.

The examining engineer recommends approval of the exploration loan in the amount of $26,220, Government participation $23,598.

We concur in the recommendation if it is possible to obtain a waiver so that a contract may be prepared.

W. H. King

W. H. King

Enclosures

Mining Division
Date Rec'd.

AUG 6 1952

BUREAU OF MINES DIVISION
Denver, Colorado REGION IV

August 6, 1952

Memorandum

To : W. H. King, Acting Chief, Mining Div., Region IV

From : Chief, Arizona-New Mexico Br., Mining Div., Region IV

Subject : Final Report, DMEA Docket 2550, Bear Canyon Mining Co. (Asbestos), Gila County, Ariz.

Enclosed are original and eight copies of the section on Summary, Conclusions and Recommendations by L. A. Stewart of the Bureau of Mines and A. F. Shride of the Geological Survey, and the section on Engineering by Stewart for the above report. A separate section on Geology will be submitted by the Geological Survey.

Regarding your recent correspondence concerning approval of leases on Indian lands, I believe the Bear Canyon Mining Co. has only a five year lease which has only one more year to go. The company has been assured that its lease will be renewed, but evidently this will not be as per the DMEA Chief Counsel's memorandum of July 10 to Mr. Mittendorf regarding the Sorsen-Williams application DMA-1776X.

If all leases must be for a period of 10 years and if an Owner's Consent to Lien must be obtained for applications for asbestos loans on Indian lands, then it would seem useless for us to make any more examinations on either Apache reservation here. I believe both Agencies grant only 5-year leases, and as Mr. Hoffland states, "The granting of liens on tribal lands is prohibited by statute - - -".

The enclosed report has my approval.

Brochure is enclosed.

Walter R. Storms

Walter R. Storms, Chief
Arizona-New Mexico Branch
Mining Division, Region IV

CC W. H. King (8)
DMEA-2550
DF

WRStorms:frj

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS ADMINISTRATION
WASHINGTON 25, D. C.
200 New Customhouse
Denver 2, Colorado

August 12, 1952

Memorandum

To; DMEA Field Team, Region IV

From: A. H. Koschmann

Subject: DMEA Docket 2550, Bear Canyon Mine, Bear Canyon Mining Company, Gila County, Arizona

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

It is recommended that an exploration loan be granted provided the San Carlos Indian tribal constitution, which prohibits the grantal of leases for periods longer than 5 years, can be met.

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

Enclosures (9)

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

Memorandum

To: A. H. Koschmann, Denver, Colorado

From: A. F. Shride, Tucson, Arizona

Subject: Geologic Report, DMEA 2550, Bear Canyon Mine, Bear Canyon Mining Company, Gila County, Arizona

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

The deposit is one of the most promising in the Arizona asbestos district, and the proposed exploration plan is feasible and in order, therefore it is recommended that an exploration loan be granted.

This project is on the San Carlos Indian Reservation. As the San Carlos tribal constitution prohibits the grantal of leases for periods longer than 5 years, and the grantal of liens on tribal lands also is prohibited, it seems hopeless to favorably recommend this project because DMEA procedure may not allow granting of an exploration contract. It should be noted that, although not specifically so stated in most leases, the usual practice of the tribal council is to give the lessee preference on a new lease for an additional 5 years.

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

Enclosures 9

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

DEFENSE MINERALS EXPLORATION ADMINISTRATION

REPORT OF EXAMINATION BY FIELD TEAM
REGION IV

DMEA-2550, Bear Canyon Mining Company

Gila County, Arizona

Asbestos

Lincoln A. Stewart, Mining Engineer
U. S. Bureau of Mines

Andrew F. Shride, Geologist
U. S. Geological Survey

July 1952

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

By Lincoln A. Stewart[1] and Andrew F. Shride[2]

An application was submitted to the Defense Minerals Exploration Administration by the Bear Canyon Mining Co. for a loan to explore for extensions of its currently operating asbestos deposit. The company has a lease on 19 contiguous unpatented mining claims in the San Carlos Indian Reservation. The property is 43 road miles northeast of Globe, Gila County, Ariz.

The request was for 1,177 feet of diamond drilling and 330 feet of drifting for a total cost of $25,000. One major and 2 minor areas were to be tested. After the examination of the property and discussion of the merits of the proposal, the applicant was advised of the unit bid method. This method appealed to the applicant who suggested that it be allowed to submit a modified proposal. The new proposal consisted of a total of 920 feet of drifting to determine extension of the ore body along the main structure.

A major asbestos company worked this deposit during the period of 1928-30 producing on the order of 900 tons fiber, most of which was crude Nos. 1 and 2. The applicant company reopened the mine in 194 9 and has since worked it on a small scale. The total production of the mine has been more than 1,200 tons of fiber, which makes it about the fifth largest producer in the Gila County asbestos district.

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

The applicant is mining around the edges of the old stope and has extended one area down dip from the lower haulage drift. The proposal is to explore for extensions of the deposit down dip from the lower haulage level for 470 feet. From the bottom of this inclined drift the lateral extent of the deposit is to be determined by 450 feet of cross drifting. The company has offered a unit bid of $28.50 per foot of drifting for a maximum total of $26,220. This contract price includes all costs pertaining to the advancement of the drifts.

Stocks of asbestos fiber in general, and strategic grades in particular are critically short. It is thought that the possibilities of finding extensions of the Bear Canyon deposit down dip are exceptionally good. The structure which localized the deposit has remained virtually constant for approximately 400 feet. If the exploration is only moderately successful, new faces will have been opened that will allow for increased production. The mining costs will be lowered because stoping can be done up dip. Back fill will be more compact and fewer pillars will be needed.

Unless cut off by an unpredictable structural change, the deposit might extend to the proposed depth of exploration. If extensions of the deposit contain asbestos in quantity and quality comparable to that of the past productive area, reserves developed as a result of the proposed exploration will be sufficient to amortize the loan.

It is recommended that the Bear Canyon Mining Co. be granted $26,220 to explore the deposit by drifting a maximum of 920 feet on its unit bid of $28.50 per foot, the work to be completed in 18 months.

A. F. Shride

Walter R. Storms.

Lemon A. Stewart

BEAR CANYON MINE
BEAR CANYON MINING COMPANY
GILA COUNTY, ARIZONA
DMEA 2550

ASBESTOS

Geology

By
Andrew F. Shride
and
Calvin S. Bromfield
Geologists, U. S. Geological Survey

BEAR CANYON MINE
BEAR CANYON MINING COMPANY
GILA COUNTY, ARIZONA
DMEA 2550

ASBESTOS

CONTENTS

	Page
Introduction	1
Geologic Setting of the Deposit	2
Asbestos Distribution	3
Potential of the Deposit	5
Review of Exploration Plan	8
Original Proposal	8
Revised Program	9
Conclusions and Recommendations	11

ILLUSTRATIONS

		Following Page
Figure 4	Geologic Map, Bear Canyon Asbestos Deposit	1
Figure 5	Geologic Sections, Bear Canyon Asbestos Deposit	8
	A-A' Section along proposed incline	
	B-B' Typical section along strike of deposit	
	C-C' Section through trough, northwest stope area	

INTRODUCTION

The Bear Canyon asbestos deposit is approximately 15 miles northeast of San Carlos and is in a canyon which has been cut through Tertiary basalts and gravels to expose the underlying diabase and pre-Cambrian Mescal limestone, with which Arizona asbestos deposits are associated. The mine is accessible from San Carlos by 19½ miles of dirt road passable except during, and sometimes for a few days after, summer thundershowers.

From Bureau of Indian Affairs records and hearsay data from past operators the writer estimates that approximately 1200 tons of all grades of chrysotile asbestos have been produced from the Bear Canyon deposit. Thus this mine has been one of the major producers of the Arizona asbestos district; upwards of 10 percent of the total production of the district has been derived from this deposit. Probably the first 800-900 tons of fiber produced was mostly long fiber crudes; the short fiber from the early operations was probably discarded. The main period of production was between 1927 and 1930 by the Keasbey and Mattison Company for their own fabrication plant. A large part of the production was harsh fiber; therefore between the early 1930's, when Keasbey and Mattison abandoned the property, and 1949, when the demand for semi-harsh fiber increased, there was little production from the Bear Canyon deposit.

The Bear Canyon deposit was mapped in detail by Shride in 1946. Figure 4 has been modified from that work only by sketching in recent development work. Very likely some of the pillars shown on figure 4 have been mined out during the past three years.

GEOLOGIC SETTING OF THE DEPOSIT

The asbestos occurs in serpentine zones which parallel the bedding of a thin "sliver" of Mescal limestone that everywhere is isolated by diabase from the main limestone mass except at the southwest corner of the mineralized area (fig. 4). The limestone "sliver" is overlain and underlain by diabase sills which are in general concordant. The limestone "sliver" is bounded on the northwest and southeast by cross-cutting diabase (fig. 5, sections B-B' and C'-C') along contacts that strike N. 15° to 40° E. (fig. 4). The diabase-limestone contacts as projected on figure 4 are the most likely projections. Numerous small pre-mineral fractures in the limestone parallel the diabase-limestone contacts as known. Experience in the district has shown that such parallelism is a moderately good, but not infallible, basis for predicting continued parallelism of such diabase-limestone contacts. The cross-cutting portion of the diabase sill that bounds the fiber-bearing limestone on the northwest side of the deposit is not exposed at the surface, but pinches out underground about 70 feet northeast of the southwesternmost portal of the mine. At this place several vertical, 4 to 12 inch thick diabase dikes, which strike N. 20° W., join the cross-cutting sill. Southwest of these dikes to the outcrop (fig. 4) the limestone beds are relatively flat-lying; to the northwest of the dikes, and including the major part of the deposit, the beds strike N. 15° to 30° W. and dip to the northeast. Locally this northeasterly dip varies from 11 to 16 degrees, but over the southeastern portion of the limestone "sliver" an average dip of 12 degrees can be used for planning development and exploration. Diabase intrusion caused

folding of the limestone near the diabase contacts as shown on sections B-B' and C-C', figure 5. An arch in the limestone parallels the northwest diabase contact and in the northwest part of the stoped area a northeast-trending trough exists (see fig. 4).

Pre-mineral bedding-plane faults are readily discernible in some parts of the area, and it can be assumed that bedding-plane adjustment, on intrusion of the diabase, was prevalent through most of the limestone block that has been mined. In the vicinity of the folds near the northwest diabase-limestone contact minor thrust fractures are common. Bedding-plane faulting was very favorable to asbestos localization.

ASBESTOS DISTRIBUTION

The main asbestos bearing zone is 16 feet above the lower diabase sill or approximately 40 feet stratigraphically below the top of the lower member of the Mescal limestone. Other zones, which contain minable quantities of asbestos only sporadically, and in only the areas of most intense pre-mineral folding and bedding-plane adjustment, are $2\frac{1}{2}$, $4\frac{1}{2}$, and 7 feet below the main zone. These asbestos zones are in the stratigraphic unit most productive of asbestos throughout the district.

The greatest quantities of asbestos were probably mined in the folded limestones adjacent to the northwest diabase-limestone contact and along the N. 20° W. dike swarm in the southwestern part of the area, where the change in attitude of the beds occurs. The next most productive area more or less paralleled the southeastern diabase-limestone contact; much of the asbestos in this area was probably marginal in quantity.

From remnants of asbestos left in pillars and stope walls it is judged that most of the asbestos mined in the past has been semi-harsh; but of moderate flexibility and tensile strength. In the southeastern part of the stoped area, in particular, some of the asbestos has been very harsh and too brittle for spinning. An unknown but appreciable percentage of the asbestos produced in the past has been soft fiber of excellent quality. Considerable care in selective mining has been required to keep this asbestos from being mined with the harsh fiber. Approximately 20 tons of No. 1 and No. 2 crudes were sold to the Emergency Procurement Service in 1951 by the applicant's predecessor. If more discretion had been exercised in mining, and if the fiber had been better graded, probably much more of the production of the past 3 years would have been acceptable for stockpiling.

Exposed in the upper zone in the present mine workings are veins of asbestos totaling 1 to 5 inches in thickness. These veins are distributed through a serpentine zone 6 to 24 inches in thickness. The greatest quantities of asbestos (veins totaling 2 to 5 inches in general) are in the folded beds adjacent to the northwest diabase-limestone contact. That portion of the deposit in which pillars are most common, as shown on figure 4 (i.e., in the center of the stoped area) contains marginal or submarginal quantities of asbestos. Along the southeastern contact the asbestos veins of the upper zone total 2 to 4 inches in thickness in most places, but the fiber in most exposures is harsh. The above described distribution of asbestos probably can be expected down the dip of the limestone "sliver" into the area to be explored.

POTENTIAL OF THE DEPOSIT

Prediction of grade and quantity of asbestos more than 50 feet from known exposures is usually not justified for the Arizona asbestos deposits because the asbestos of most deposits is very sporadic in distribution and the diabase intrusions, which are always associated with the deposits, are unpredictable as to outline and distribution. Based on a 50 foot projection of the ore zone as seen in present mine faces the writer estimates that 150 to 200 tons of asbestos of all grades is indicated. At least 50 percent of this fiber is probably of harsh or semi-harsh quality.

Compared with most other asbestos deposits of the district the Bear Canyon deposit as judged from past development is unusually persistent. The proposed exploration as shown on figure 4 is based on the premise that the geologic structural conditions favorable to the formation of asbestos will persist approximately 500 feet down the dip of the deposit. There is no indication in the present exposures that such a premise is not warranted. However, an indication of a disrupting structure or intrusion can be seldom noted more than a few feet from that structure or intrusion. Based on the assumption that the asbestos content of the ore zone persists down dip in comparable amounts to the asbestos content exposed in pillars and walls of the presently mined area, a block of ore containing 1300 to 2700 tons of all grades of asbestos might be outlined by the proposed exploration. The value of this asbestos, based on 1952 production records for estimating the content of the various grades, and on 1952 sale prices might be on the order of $1,000,000 to $2,000,000. There is a wide range in the above estimates

because a 200 foot wide limestone block roughly midway between the two bounding diabase sills may contain asbestos in submarginal quantities and therefore not be minable. The above estimates allow 25 percent for mine pillars, mill losses, etc., and ignore asbestos potential in the sporadically minable lower zones. The estimates should not be considered as even in the inferred reserve category, but should be considered potential reserves based on the premise that geologic structure, yet to be proved, persists through the area to be explored.

For another approach to the potential of the area to be explored, it can be seen by inspection of figure 4 that the area to be penetrated by the proposed exploration is approximately the size of the area stoped in the past. Therefore the reserves that can be hoped for might be approximately the past production of 1200 tons. This checks only the low estimate given in the above paragraph; however, it must be noted that, to the best of our knowledge, during the mining of approximately the first 900 tons only the long fiber was recovered. Mining of a comparable asbestos-bearing area at present probably could result in the recovery of approximately 2000 tons rather than 900 tons of all grades of asbestos.

If the quality of asbestos that may be exposed in the proposed exploration approximates that of past production a large part of the asbestos will range from semi-harsh to harsh in quality. However, past exploitation has resulted in production of soft fiber of excellent quality. Such strategic asbestos can be expected to be sporadically distributed through the deposit in concentrations suitable for selective mining; therefore exploration of this deposit should be considered valid under DMEA Order 1.

Approximately 40 percent of the 88 tons of asbestos produced in the first 5 months of 1952 has been No. 1 and No. 2 fiber (according to the applicant's standards of grading); the remainder has been combined in a product that the applicant states has tested 3K to 3Z by the Quebec Standard Testing Machine. Very little fiber was being discarded with the waste sands during the examiner's visit. The writer doubts that the above data gives a true picture of the average length of the asbestos produced from the Bear Canyon deposits because it is obvious that a very poor standard of grading is maintained in the applicant's mill. The No. 1 fiber produced contains much short fiber, and the Group 3 fiber produced includes much fiber that should be recovered as No. 1 and No. 2 grades. However, this production record,which includes fiber from at least 3 parts of the deposit, does indicate that a large percentage of the asbestos produced is long fiber. From incomplete records kept by the applicant the mill rock processed during the first 5 months of 1952 is estimated by the writers to have had a recoverable fiber content of between 5 and 20 percent.

The exploration proposed will not explore the area penetrated to adequately infer the reserves of the entire area outlined by exploration drifts. The writers, from previous experience in the district, judge that exposure of the ore zone by the proposed work will be adequate to predict reserves for only about 50 percent of the area outlined. However, if the project is successful, the reserves that may be inferred as a result of the work should be sufficient to allow the applicant to plan and carry out further exploration and a larger scale worthwhile milling and milling operations.

REVIEW OF EXPLORATION PLAN

Original Proposal

As submitted to the Defense Minerals Exploration Administration the applicants' exploration plan called for diamond drilling in 3 areas. The greatest amount of drilling was to be from the part of the main haulage adit that is in the sill above the deposit (see section A-A', fig. 5). This part of the drilling program, if successful, was to be followed by drifting. This part of the exploration plan, though technically feasible, was not as good as it might have been because (1) the portion of the deposit to be explored geologically is likely to be a lean area between two better mineralized areas, and (2) the cost of the drilling proposed was of the same order of magnitude as the cost of drifting to expose the same area would have been. Drifting would undoubtedly result in obtaining better data than drilling as to the potential of the deposit. Therefore costs of drilling versus drifting were discussed with the applicant. As a result of this discussion the applicant requested a modification of his original program to include 470 feet of inclined drifting as shown on figure 4 and section A-A', figure 5. This incline will test an area roughly $1\frac{1}{2}$ times the length of the area originally proposed for drilling from the haulage adit. The drift will be on an incline of 9 to 11 degrees. This modified proposal has advantages and disadvantages, to be discussed later, but is an improvement over the original proposal. Because elimination of diamond drilling from the main haulage level would decrease the drill footage required to justify an economical bid from the drilling contractor, the applicant further modified his original proposal by deleting diamond drilling from the two drifts that expose

diabase on the northwest side of the deposit. As a substitute he now proposes that drifting totaling 450 feet be carried out along the strike of the deposit from the end of the proposed incline. This modification takes care of the objection that the examiners would have had, namely that diamond drilling below the northeast extension of the main haulage drift would have tested only the least likely part of the limestone block that is surrounded by diabase.

The drilling proposed to explore the limestone to the northwest beyond the crosscutting diabase was of dubious technical feasibility. However, it is unfortunate that some sort of exploration is not planned in that direction as the geologic possibilities of a "blind" ore body beyond the crosscutting portion of the diabase sill are good. However, if the applicant feels it necessary to limit his expenditures for exploration the program as revised is the most valid as being less of a gamble than exploration in a geologically poorly understood area.

Revised Program

The inclined drift proposed would test a more likely portion of the deposit and would be shorter and therefore less costly if started at the northwesternmost portion of the present stope (point A, on figure 4). From this point the incline also could be directed in a northeasterly direction directly down the dip of the deposit and thereby appreciably shortened. The applicant prefers not to place the incline in this way for two reasons: (1) haulage would be more expensive, and (2) this part of the stope is in an area of considerable fracturing and the back of the present stope might not be held. The first reason seems valid to these writers; the second is not valid

because backfill could be used in the present stope to adequately hold the back. Development of an incline also might be more difficult, than in the place proposed by the applicant, because the attitudes of the beds may vary greatly in this area and would cause difficulty in keeping a uniform haulage grade. Even though the incline as proposed by the applicant will be more costly and probably will not expose as much asbestos as an inclined drift elsewhere in the deposit, the advantages of more direct haulage from the horizontal exploratory drifts, and the fact that the proposed incline will become the most strategic position for a development haulage-way if appreciable quantities of asbestos are discovered suggest that the placing of the incline as proposed by the applicant should be approved by the DMEA. If adequate reserves are developed, the incline and the horizontal drifts will become the major haulage workings of the mine.

Drifting along the strike of the beds is warranted to test the possible extensions of what in the past have been the best portions of the Bear Canyon deposit. The distribution of the asbestos mined in past operations suggests that the greatest amount and best quality of asbestos may be found along the northwestern part of the proposed horizontal drift. The writer would suggest that if the contacts of the crosscutting diabase and the limestone strike as projected on figure 4, the proposed 450 feet of drifting will be excessive. If minable quantities of asbestos are encountered at the level of the proposed strike drift, it will be unnecessary to drift the entire distance to the crosscutting diabase to prove the ore. It is suggested, however, that the entire 450 feet of strike drifting be allowed to take

care of the possibilities that the diabase-limestone contacts deviate from the projection shown on the geologic map and/or the strike of the formation changes so as to require longer drifts if proper track grades are to be maintained. Because the exploration program proposed will not adequately block out the potential ore body (see page 7) it would not be amiss to allow excess footage to be used for a horizontal drift to be driven between the level proposed and the present stope. The applicant is not aware of the above recommendations, but the writer believes that the exploration contract should be flexible enough to allow such modification of the applicants' proposal. If the exploration proposed is unusually successful it will not be surprising if the applicant makes a request for an amendment to allow an intermediate drift to further explore the ore body.

CONCLUSIONS AND RECOMMENDATIONS

The Bear Canyon asbestos deposit as previously mined has been very persistent compared with most deposits of the Arizona district. The exceptionally favorable structural controls for asbestos deposition persist into the area proposed to be tested as a possible extension of the known deposit. If the favorable structures persist for several hundred feet, as is possible, 1200 to 2700 tons of asbestos, a part of which can be expected to be of strategic quality and length may be partly outlined by the applicants' revised exploration program. If successful, the proposed exploration may result in incompletely outlining reserves of value on the order of $1,000,000 to $2,000,000. However, optimism is not warranted because structure is not predictable for the distance proposed for exploration, and irregular, unpredictable

diabase intrusions can cut out the favorable limestone beds. Because pre-mineral structural preparation of favorable limestone beds has been extraordinarily persistent in the previously developed area, the proposed exploration based on the premise that favorable geologic structural conditions will persist through the area proposed for exploration seems very worthwhile. The type of exploration proposed could be laid out to test the most favorable areas more adequately than under the plan proposed. If the writers were less optimistic they would suggest that drifting be confined to the areas most favorable geologically. However, the writers believe, for reasons outlined in the body of the report, the geologic potential of the area to be explored is sufficient to warrant the extra expenditure of DMEA funds in the interest of more efficient mining practices that will result if the proposed exploration is successful. Therefore, the revised exploration program submitted by the applicant can be recommended.

DMEA-2550, BEAR CANYON MINING COMPANY
GILA COUNTY, ARIZONA
(ASBESTOS)

Engineering Report

By Lincoln A. Stewart
Mining Engineer
U. S. Bureau of Mines

July 1952

DMEA-2550, BEAR CANYON MINING COMPANY
GILA COUNTY, ARIZONA
(ASBESTOS)

CONTENTS

Engineering report	Page
Introduction	1
Location and accessibility	2
Ownership and extent	2
History and production	3
Description of the deposit	4
Proposed exploration and cost	6
Review of proposed exploration	7
Conclusions	10
Recommendations	12
Appendix	13

ILLUSTRATIONS

Figure		Following page
1	Location map	2
2	Claim map	2
3	Plan and cross section, showing proposed work	5

INTRODUCTION

An application for an exploratory mining loan for asbestos was received by the Washington office of the Defense Minerals Exploration Administration on May 26, 1952 from the Bear Canyon Mining Co. It was docketed as DMEA-2550 and sent to Denver. The Field Team, Region IV, forwarded copies of form 100 and 103 to the Tucson office on June 9. The detailed report of the project plan and costs, maps, and lease were retained in Denver.

In brief, the request was for 1,177 feet of diamond drilling, and 330 feet of drifting for a total of $25,000. The purpose of the project was to explore for extensions of the asbestos deposit laterally and at depth.

The property had been examined by the present examiners[1/] in 1942-43 while investigating the Gila County asbestos area for possible exploratory project sites. Both have visited the property at other times prior to this application. The current investigation was made on June 26. The owner's file copy of detailed plan and costs was made available to the examiners.

During this visit the advantages and disadvantages of drifting and drilling were discussed, and the applicant was informed of the unit bid procedure now in use. The following day the applicant advised that it wished to modify the proposal and resubmit it under the unit

1/ Stewart, Lincoln A., mining engineer, Bureau of Mines.
Shride, A. F., geologist, U. S. Geological Survey.

bid system. This new proposal reached the Tucson office on July 11, 1952. The amended proposal consisted of a maximum of 970 feet of exploratory drifting on the favorable beds: 470 feet to be down dip and 450 feet to test the beds laterally. The cost had been detailed at a total of $27,425.20, but the applicant stated it would contract the proposed work on a unit bid of $28.50 per foot for a total of $26,220.

LOCATION AND ACCESSIBILITY

The Bear Canyon property is 43 road miles northeast of Globe, Gila County, Ariz., in approximate sec. 1, T. 2 N., and sec. 36, T. 3 N., R. 18 E., unsurveyed (figure 1). It is reached by traveling 22 miles east from Globe to the Indian Agency at San Carlos, thence north on a semi-graveled road for 17 miles, thence east for 4 miles on a poor dirt road. The mine is situated near the bottom of Bear Creek Canyon at an altitude of approximately 4,350 feet.

The property is accessible throughout the year, although the road is heavy with mud during wet weather.

OWNERSHIP AND EXTENT

The property, consisting of 19 full-sized unpatented lode claims, is under lease from the San Carlos Indian Reservation by the Bear Canyon Mining Co., whose address is Box 1730, Globe, Ariz. (figure 2). The company is composed of 4 partners, Dennis E. Green, J. B. Green, Roy Yarbrough and H. A. King. Dennis Green is general manager, and lives at the property.

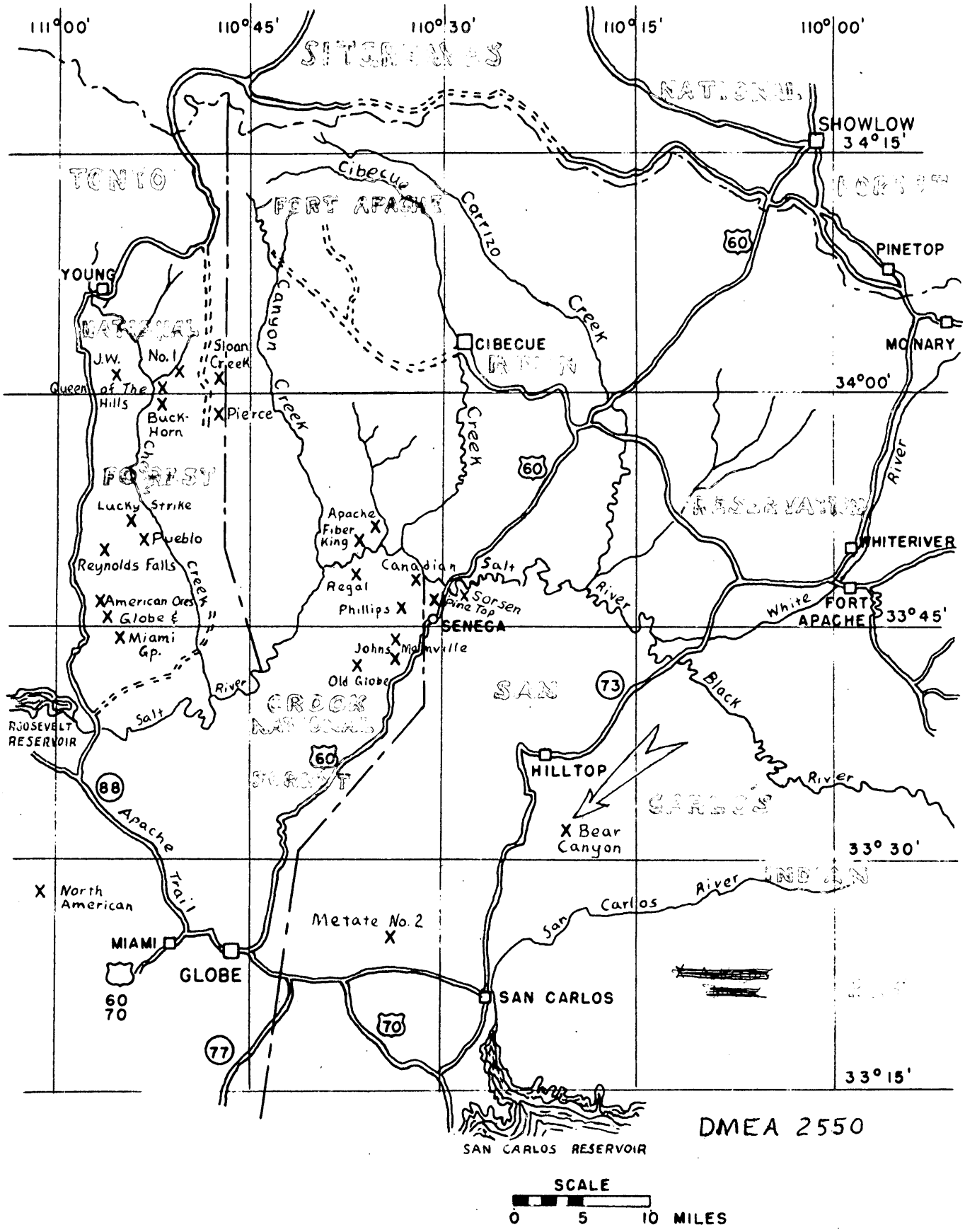
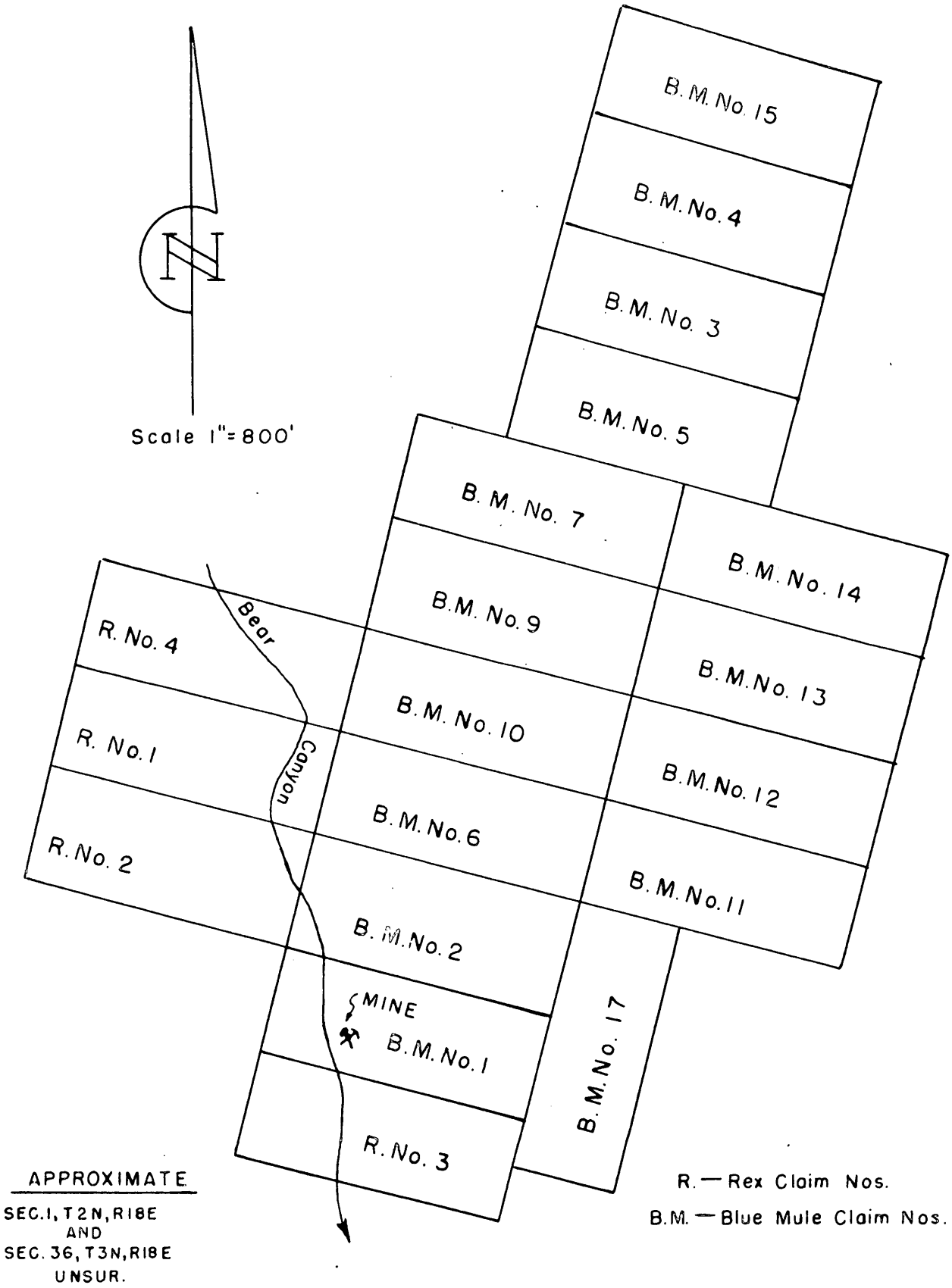


Fig. 1 → Location Map, Asbestos Deposits, Gila County, Arizona



DMEA 2550

Fig. 2 — Claim Map, Bear Canyon Mining Co., Gila County, Arizona

The time limit and provisions of the lease are not known to the writer, as it was retained in the Denver office.

The claims are recorded in the Gila County Court House at Globe, Ariz. as follows:

Blue Mule Nos. 1 through 7, 9 through 15, and 17 in

Book 35, pages 165 to 179, inclusive;

Rex Nos. 1 through 4 in Book 33, pages 244 to 246, inclusive.

HISTORY AND PRODUCTION

The Bear Canyon property originally was located in 1921, and relocated in 1927 by F. J. Lunn. The following year the property was absorbed by the Bear Canyon Asbestos Co., a subsidiary of Keasbey & Mattison Co., Ambler, Pa. Lunn stated[2] that the property produced 40 tons of fiber per month for 2 years. This was borne out by examination of the Indian Service records, which indicated that royalties were paid on 800 to 900 tons between 1927 and 1930. Work was suspended April 1930, all buildings, equipment, etc., were removed, and the property reverted to the Reservation.

The property laid idle until R. G. Robertson and associates took a lease on it in 1949, erected a camp, and constructed a mill. Robertson was in charge, with some changes of associates, until he sold out in January 1952, when Dennis Green, one of the associates took charge.

The following figures of total mine production have been gathered from various sources, but are thought to be reasonably accurate:

2/ Oral communication, 1942.

Operator	Year	Tonnage: All grades	Tonnage: (Breakdown of grades)
Keasbey & Mattison	1929-30	900	No information
Robertson	1949	38	Nos.1 & 2, 12 T; No. 3, 26 T.
Robertson	1950	68	No. 1, 10 T; No. 2, 10 T, Nos. 3 & 4, 48 T.
Robertson	1951	133	No information
Green (thru May)	1952	89	No. 1, 22 T; No. 2, 14 T; No. 3, 53 T.
Total thru May 1952		1,228	

During the period that Keasbey & Mattison Co. produced, hand cobbing was practiced, and probably only the Nos. 1 and 2 grades were shipped. Consequently the 900-ton production during 1929-30 is an understatement of the actual tonnage of fiber that was extracted from the area mined during that period. Unfortunately, the shorter grades that might have been stockpiled along the surface tracks have been washed away by the periodic floods that dissipate the dump areas.

The production figures of the applicant company indicate that the milled product yielded not less than 15 percent each of Nos. 1 and 2 grades. The following tabulation of prices received by the company shows the present upward trend.

Year	Selling price of grades ($): No. 1	No. 2	Mixed Nos. 3 & 4	Calculated minimum value per ton of fiber
1949-50	800- 900	700 - 750	250	$400
1952	1400-1500	900 -1000	375 - 440	700

DESCRIPTION OF THE DEPOSIT

The mine is situated on the east side of a canyon that has cut through the regional lava flows to expose the underlying pre-Cambrian Mescal limestone and diabase. The limestone occurs as a relatively thin sliver engulfed and split by diabase intrusions that have slightly arched the limestone formation and tilted it 10° to 12° downward into the hill.

The main fiber zone is about 15 feet above the lower diabase sill. In areas of greatest production, 3 other zones appear between $2\frac{1}{2}$ to 7 feet below the main zone.

The bed of limestone that contains the ore zones is about 400 feet wide, cut off on each side by crosscutting diabase sills. The fiber zone, dipping into the hill at 12°, was mined progressively from 3 levels, i. e., the outcrop, the upper, and the lower haulage levels. The latter are about 40 and 80 feet below the outcrop entries, respectively. The lower level was driven from a point about 10 feet above the creek bottom and interesected the fiber zone at 480 feet from the portal (see figure 3).

The early operators mined the area as one large stope. The back was supported by numerous pillars and there was virtually no back fill. At the time the mine was reopened in 1949, the maximum dimensions of the stope were 350 by 500 feet. The present company has enlarged the stoped area, notably on the east side, mining out the northeast corner above the lower cross-haulage drift to the diabase contact. It also has extended the northernmost part of the old stope, as well as whittling off some of the larger pillars and substituting back fill for support.

The fiber of the Bear Canyon deposit varies from fairly harsh to semi-harsh. It is said that some of the production in 1929-30 was fairly soft. The fiber left in the numerous pillars in the central part of the old stope shows this to be true, but the tensile strength does not equal that of most soft fiber. The fiber becomes more spicular toward the borders of the old stope. This may be the reason that the Keasbey & Mattison Co. ceased operations.

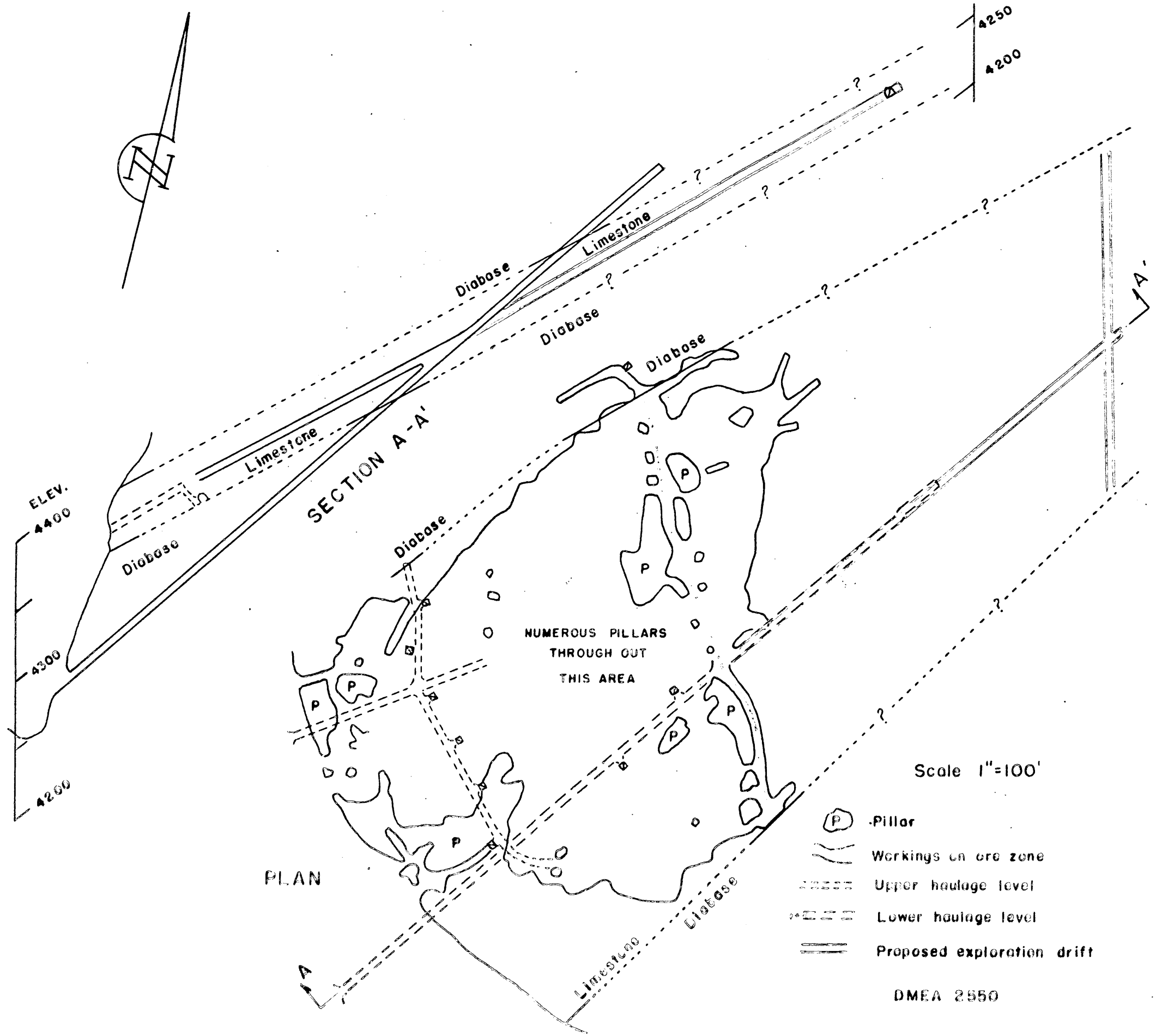


Figure 3 — Plan and Section of Bear Canyon Mine, Showing Proposed Work

Because of improvements in asbestos fiberization and spinning technique, and the urgent need for asbestos, semi-harsh fiber of only fair tensile strength has become desirable to the industry. It is blended with soft fiber of high tensile strength to make products that meet strategic requirements. The asbestos fabricators are likewise using Arizona harsh fiber in greater amounts than previously.

In 1950, this deposit produced 30 tons of crude grades 1 and 2 that was accepted by the stockpiling program.

PROPOSED EXPLORATION AND COSTS

The original exploration proposal was for 1,177 feet of diamond drilling, and 330 feet of drifting, of which the drifting and 855 feet of drilling in 13 holes was stipulated for the area down-dip on the main structure. The remaining 322 feet of drilling was to be divided in 6 holes to explore 2 areas on the west side of the mine. During the examination of the property on June 26, the investigating team discussed with the applicant the advantages and disadvantages of drilling versus drifting. When the applicant was informed of the unit bid procedure now in use, it requested an opportunity to modify the application.

L. J. Brewer, the engineer who formulated the exploration plans, revised the application and confined the proposal to exploratory drifting. In a letter of July 6 to the company, he states in part: "The diamond drilling that was previously proposed has been reconsidered and rejected. Drifting, although involving a larger capital expenditure, seems more logical in this particular case".

The revised program was brought to the Tucson office July 11 by Dennis Green, general manager of the applicant company. The covering letter states: "The development program consists of 470 feet of -12° incline to open the ore body to the northeast, and 450 feet of drifting along the projected strike of the beds. This 920 feet of proposed work is estimated to cost a total of $27,425.20 or $29.81 per foot.

"Time necessary to complete the project is estimated to be 12 months.

"The Bear Canyon Mining Co. is prepared to contract the proposed work for $28.50 per foot, for a total of $26,220.00".

The contract bid was discussed with Green to clarify the intent. He stated that the $28.50 includes all labor, supplies, equipment rental, pipe and track, and any other costs pertaining to the advancement of the drifts. The submission of detailed cost estimates, which are appended to this report, was solely for the purpose of substantiating the bid price.

REVIEW OF PROPOSED EXPLORATION

The proposal is to run an inclined drift down the favorable horizon to explore for extensions of the ore body. The logical location of such an exploration drift would be directly down-dip from the lowest point in the stope, the minimum distance to reach a given depth. However, as pointed out by the applicant, there are serious disadvantages in starting the exploration drift from these northeast workings. In this area the fiber zone was better than average and the operator mined

a relatively large block without leaving pillars. Roof failure has started and only at considerable and continued expense could a haulageway be kept open. From an incline at this point a car would have to be switched twice on the haulage level.

The applicant has suggested that the exploratory incline be started in line with the main haulage drift. The advantages of this location are that the back is strong and well supported, and no timbering will be required; no switching will be necessary; a car hauled up the incline can be released with sufficient momentum to coast out to the portal. The average dip of the formation is 12° but the angle of inclination of a drift from this point will be approximately 10°. When and if the lower block is mined, no maintenance should be required to keep the haulageway open, if sufficient pillars are left along the incline.

The applicant has made a bid of $28.50 per foot of drift, applicable equally to inclined or level drifting. The supporting detailed cost estimate assumes an average advance of 3 feet per day. More than half the footage is in the incline, where for obvious reasons, the average advance will be retarded. An analysis of the cost figures shows that some are on the high side but these are overbalanced by several items that seem exceptionally low. The use rental of the major items, 210-foot cfm compressor and hoist (slusher), is set at $115.00 per month; overall supervision and engineering is only 4.2 percent of the total project cost.

It is judged that it will cost more than $28.50 per foot for the inclined drifting and slightly less than this amount for level drifting. The tramming distance at the start will be 500 feet, but at completion it may be as much as 1,200 feet of which approximately 500 feet will be on the incline.

The applicant's averaged bid for the 2 types of drifting therefore is considered reasonable.

The question of ventilation was discussed with the applicant. There is a strong natural draft along the cross-haulage drift and smoke reaching this level is rapidly dissipated. The applicant states it has two, presently unused, smaller compressors that can be used for blowing at the headings if additional air is necessary. The use of a small Coppus blower near the end of the air lines in the strike drift headings may become necessary.

As in all asbestos exploratory projects, the drifting program should be left flexible, to take advantage of geologic changes as they develop.

If the unit bid offer is acceptable to the Defense Minerals Exploration Administration it is suggested that the total time allowed for the project be increased to 18 months. When the drift faces are in commercial ore, this extra time will allow the applicant to blast stoping rounds and thus save the fiber encountered.

CONCLUSIONS

Only 4 other asbestos mines in the Gila County area have made a greater production than the Bear Canyon mine. In general, the fiber is harsh but part of it is of a semi-harsh grade that has sufficient tensile strength to meet the requirements of strategic textile specifications.

The applicant is mining along the edges of the old stope and has extended the workings down dip in the northeast part. An area containing an exceptionally high percentage of fiber was encountered, and in the desire to recover all of it, sufficient pillar support was not provided. The roof is gradually subsiding and this area may soon become unsafe.

The proposed exploration work, if entirely or even partially successful, will allow the applicant to mine up the dip, thus lowering costs as well as increasing production. As the backfill can be placed more compactly, it is likely that fewer pillars will be required. If the exploration delineates the lower boundary of the deposit, a retreating method of mining can be employed, the need of pillars will be eliminated, and all ore possible can be recovered as the faces are advanced.

Because the favorable structure at 400 to 500 feet from the outcrop has remained virtually constant, it is thought that the possibility of continuation of ore down-dip is exceptionally good. Unless cut off by an unpredictable structural change, the deposit

might extend to the proposed depth of exploration. Allowing for some convergence of the diabase structures limiting the width of the deposit, and assuming a conservative average of 2 inches of fiber over the area, the calculated potential is on the order of 1,700 tons, all grades. If one third of the inferred area is barren or left as pillars, 1,130 tons would be the assumed productivity. At only $400 per ton of fiber, the return would be about $460,000, sufficient to amortize the loan.

It is thought that the proposed total of 920 feet of drifting is not excessive to explore this deposit, but it is suggested that the program be left flexible so that advantage may be taken of unpredictable geologic changes that might affect the location of an ore deposit.

The present company, with one change of management, has operated the mine since 1949. It has constructed a mill of sufficient capacity to beneficiate the current production on one shift daily. Increased production could be handled by running more than one shift. The mine foreman appears to understand the problems involved in asbestos mining.

A subordination agreement will have to be secured from the Indian Service, but by the time it is requested, a precedent (Sorsen Williams Asbestos Co., Docket 1776X) may have been established and action could be fairly rapid.

RECOMMENDATIONS

The Bear Canyon Mining Co. is currently producing asbestos, part of which is of strategic quality and grades. It is thought that an exploratory project is justified at this mine for the following reasons:

(1) The structure responsible for the localization of mineralization has been remarkably persistent;

(2) The geologic conditions that favored the formation of asbestos within this structure probably will continue unchanged for some distance down the dip;

(3) If the exploration proves extensions of the ore body, the applicant will be able to reduce mining costs by stoping up the dip. Additional working faces will be provided and increased production should result;

(4) There is a chance that the potential tonnage could be of a magnitude to virtually amortize the loan.

Therefore it is recommended that an exploratory loan be granted the Bear Canyon Mining Co., the work to consist of an allowable total of 920 feet of drifting to be completed within 18 months. It is to the advantage of the Government to contract this work to the company on its unit bid of $28.50 per foot. This price includes all labor, supplies, equipment rental, pipe, and track, and any other costs pertaining to the advancements of the drifts.

The applicant has stated that it is willing and able to pay 10 percent of the estimated cost of $26,220.

DMEA-2550, BEAR CANYON MINING COMPANY
GILA COUNTY, ARIZONA
(ASBESTOS)

APPENDIX

COPY OF AMENDED EXPLORATORY APPLICATION

OF BEAR CANYON MINING CO.

JULY 1952

The following is the transmittal letter from Dennis E. Green, general manager, Bear Canyon Mining Co., dated July 6, 1952:

> "Please find enclosed a revised cost estimate for development work at the Bear Canyon Mine, In this estimate only drifting is planned.
>
> "The development program consists of 470 feet of -12° incline to open the ore body to the northeast, and 450 feet of drifting along the projected strike of the beds. This 920 feet of proposed work is estimated to cost a total of $27,425.20, or $29.81 per foot.
>
> "Time necessary to complete the project is estimated to be 12 months.
>
> "The Bear Canyon Mining Company is prepared to contract the proposed work for $28.50 per foot, for a total of $26,220.00."

Development Program
Bear Canyon Mine

The most favorable location for the proposed incline is in line (N 35° E) with the main haulage drift at that point where the haulage drift turns to the west along the strike of the beds.

There are two advantages in locating the incline at this point. (A) The ore and waste need not be switched, but can be pulled directly up the incline by a hoist and the momentum of the pull when reaching the down grade haulage tunnel will make the operation practically self tramming. (B) Sufficient ground support in the form of pillars makes extra timbering unnecessary at this point.

By spotting the incline to the west of this point, a reduction in footage could be secured. However, maintenance costs will be excessive, as the hangingwall is now subsiding in the stope area.

The tongue of diabase in the northwest section of the present workings is believed to be a local condition, and as such should not extend eastward.

The incline should be driven the proposed footage, or to a point where a geological change indicates the termination of the orebody.

In this estimate the Defense Minerals Administration will not purchase any machinery, but will pay a rental price for equipment furnished by the Bear Canyon Mining Company.

Bear Canyon Cost Estimate

Basis:

5 x 7 Foot heading. To be run on approximately -12° incline. The upper ore horizon to be carried in the back of the heading.

From past experience at this property, pumping will not be necessary.

Rate of advance, 3 feet per day.

Work days per month, 25.

A thifd man will be needed on the muck shift for 4 hours. His duties will be to operate the tugger, and tram the waste some 500 feet.

Time Estimate:

Length of incline		470 feet.
Length of drifts on ore horizons		450 feet.
	Total	920 feet.

Incline:

$$\frac{470 \text{ feet}}{3 \text{ ft./day} \times 25 \text{ days/mo.}} = \text{6 Months, minimum time.}$$

Estimate 8 months maximum

Drifts on Ore Horizons:

$$\frac{450 \text{ feet}}{3 \text{ ft./day} \times 2 \times 25 \text{ days/mo.}} = \text{3 Months minimum time.}$$

Extimate 4 months maximum.

These drifts are to be run simultaneously to the east and to the west, along the strike of the beds.

To Complete Project:

9 Months minimum time.

12 Months maximum time.

Calculation of Costs

Rental of Equipment: (Furnished by Bear Canyon Mining Co.)

	Present Value
210 cuft Leroi Compressor	$5,500.00
Gardner-Denver Slusher	1,400.00
IR, J-50 Jackhammer	400.00
IR, Jackleg	200.00
IR, Line Oiler	20.00
3/4 Inch air hose (50 feet)	25.00
1/2 Inch water hose (50 feet)	15.00
Water Gooseneck	8.00
Mine Car	150.00
Total	$7,718.00

Rental Basis per Month

$$\frac{\$7,718.00}{60} = \$128.63$$

Rental Basis per Foot Advance:

3 ft./day x 25 days/month = 75 feet

$$\frac{\$128.63}{75} = \$1.72 \text{ per foot.}$$

Labor:

1 Miner at $12.50 per shift	$12.50
3 Muckers at $11.50 per shift	34.50
1 Trammer (1/2 shift) at $11.50	5.75
Total	$52.75

Includes overtime, industrial insurance of 9.92%, and Social Security Tax of 4.5%.

On advance of 3 feet per day.

$$\frac{\$52.75}{3.0} = \$17.58 \text{ per foot.}$$

Supplies:

Explosives: (14 Holes per Round)

Dynamite, 28 pounds at $0.21/lb.	$5.88
Caps, 14 at $0.02 each	.28
Fuse, 112 feet at $0.012/ft.	1.34
Total	$7.50

$$\frac{\$7.50}{3.0} = \underline{\$2.50 \text{ per foot.}}$$

Fuel for Compressor:

Compressor to be in operation 16 hours per day. 8 hours drilling, and 8 hours furnishing air for tugger to pull cars up incline.

30 gal. gas at $0.305/gal., 2 qts. oil at $0.30 = $9.75

$$\frac{\$9.75}{3.0} = \underline{\$3.25 \text{ per foot.}}$$

Pipe and Track:

Pipe and track to be purchased by the Company and to remain in the Company's possession upon the termination of the project. The project to be charged 40% of the estimated purchase price for these items.

	Per Foot
Rails, spikes, ties, and fishplates	$1.25
2 inch air line, with valves and fittings	.50
1 inch water line, with valves and fittings	.25
Total	$2.00

$2.00 x 40% = $\underline{\$0.80 \text{ per foot}}$.

Drill Steel and Bits:

Steel breakage estimated to be 1 - 4 foot piece per 3 rounds, or 9 feet advance.
4 Timken detachable bits per round, this also includes sharpening.

Steel - $\frac{\$6.00}{9.0}$ = $0.67 per foot.

Bits - $\frac{4 \times \$0.56}{3.0}$ = . 74 per foot.

Total $\underline{\$1.41 \text{ per foot.}}$

Other Supplies:	Per Foot
Machine oil for drill and tugger	$0.15
Carbide	.10
Picks, shovels, flatsheet, wrenches, jimcrow, bars, moils, loading sticks, and other small tools	$0.30
(This covers replacement and breakage)	
Total per foot	$0.55

Repairs:

Normal repairs on machinery to be rented from Company, including breakage and obsolesence.
$0.75 per foot.

Supervision and Engineering:

Estimated at $1.25 per foot.

Summary		Cost per Foot
Rental of Equipment		$1.72
Labor		17.58
Supplies		
Explosives	$2.50	
Fuel	3.25	
Pipe and track	.80	
Steel and bits	1.41	
Other	.55	8.51
Repairs		.75
Supervision and Engineering		1.25
	Total cost	$29.81

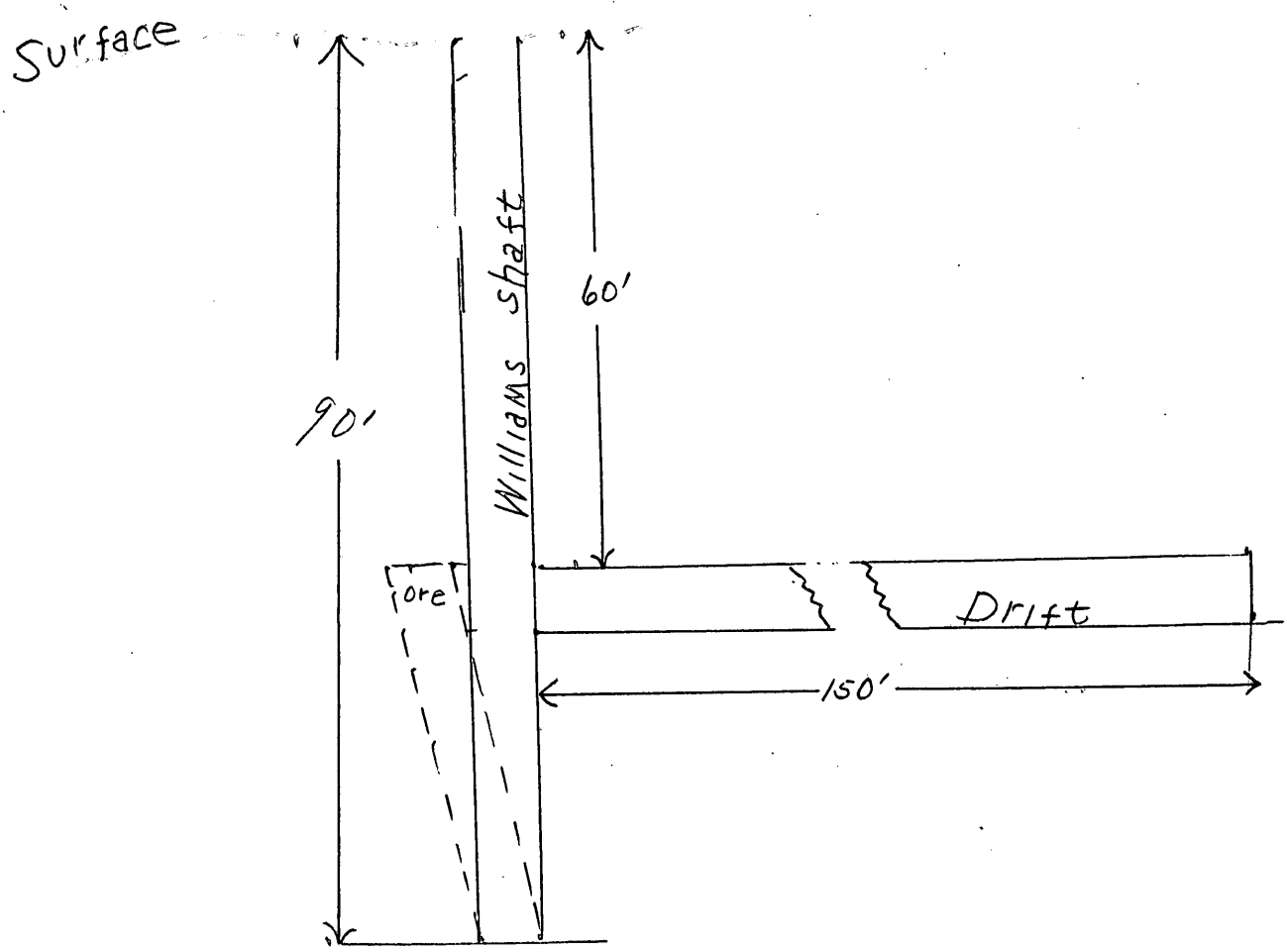
Estimated Cost of Project

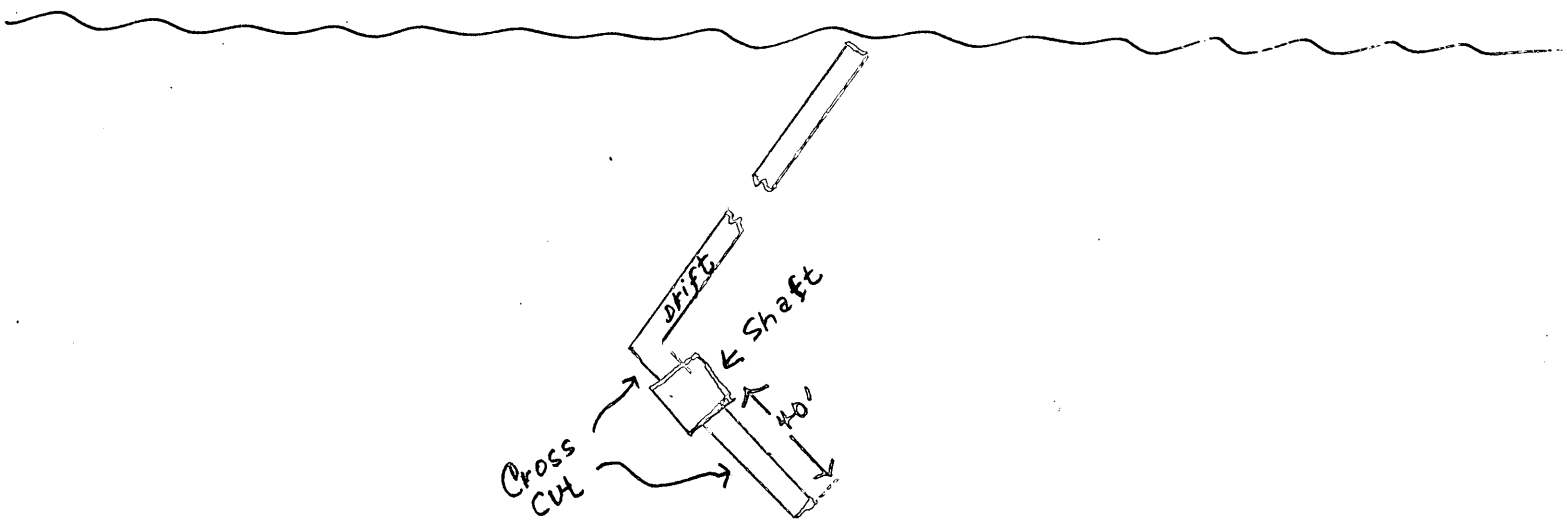
920 feet x $29.81 = $27,425.20

Bear Canyon Mining Co. (10%)	$2,742.52
Defense Minerals Administration(90%)	24,682.68
	$27,425.20

Gaylord Wallace, Wallace Baldwin
Route 3, Harrisburg, Ill.

4 (a)





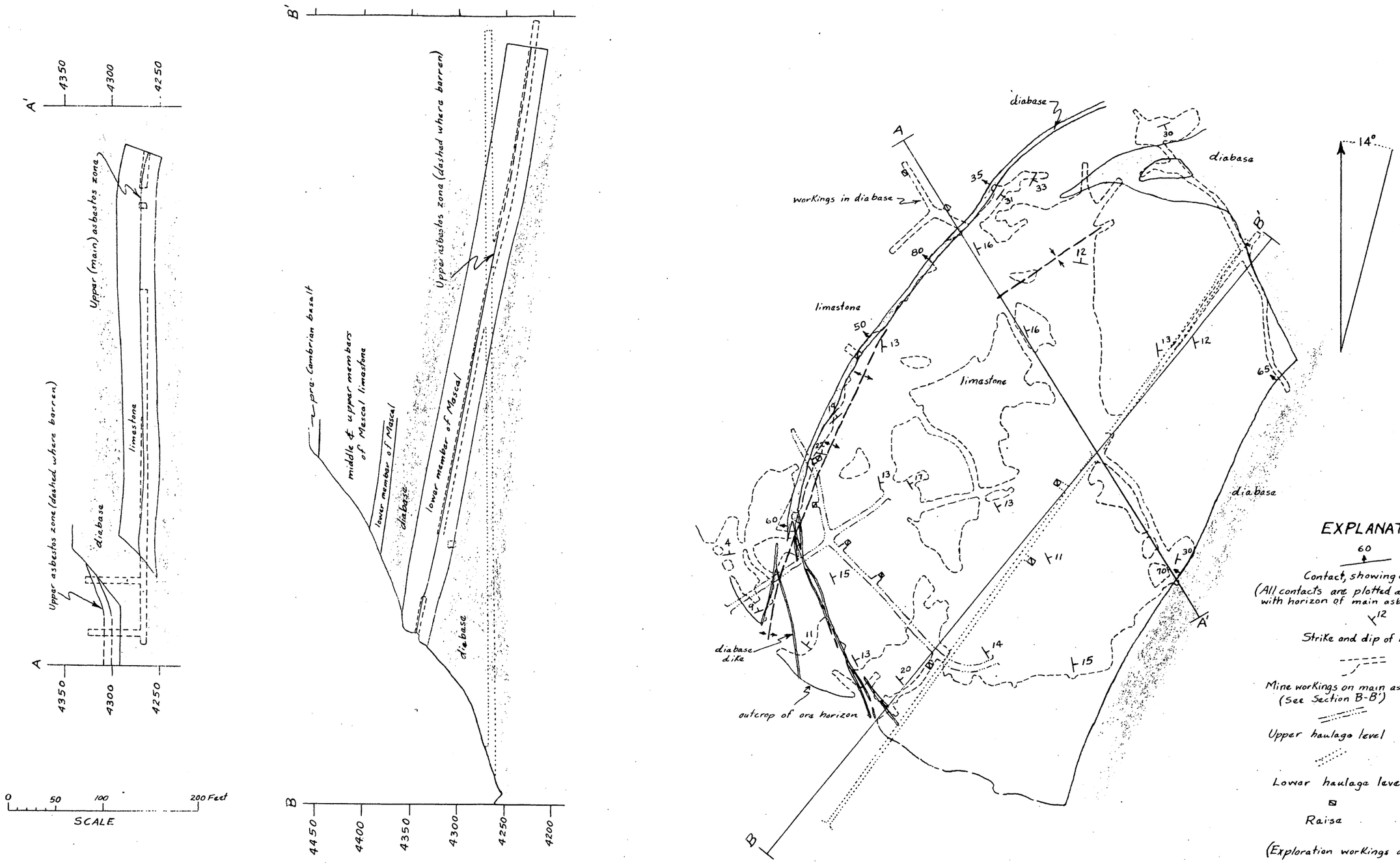


FIGURE 1.- GEOLOGIC MAP AND SECTIONS OF THE BEAR CANYON MINE

DMEA-2550
CONTRACT Idm-E446

IN REPLY REFER TO:
G-MD-CM

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WASHINGTON 25, D. C.

July 26, 1954

Memorandum

REVIEW OF FIELD TEAM REPORT ON APPLICATION DMEA 2550 (asbestos)

To: L. G. Houk, Defense Minerals Exploration Administration
From: D. M. Larrabee, U. S. Geological Survey
Applicant: Bear Canyon Mining Company
Name of property: Bear Canyon deposit
Location of property: Gila County, Arizona
Date of Field Team report: June 11, 1954
Authorship of Field Team report: A. F. Shride
Field Team's recommendation: 1 - No discovery made.
2 - Termination of work before completion, by mutual consent.
3 - No further work.
4 - No certification be made.
Comments: Only a small quantity of semi-harsh to harsh asbestos was found.
ACTION RECOMMENDATION: Follow Field Team's recommendation.

D. M. Larrabee

DMLarrabee:hlm
G-7/26/54
Copy to: Director's reading 4212
Branch reading 4212
DMEA (3)
Larrabee 5218 Interior

IN REPLY REFER TO:
G-ND-CEM

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WASHINGTON 25, D. C.

July 26, 1954

Memorandum

REVIEW OF FIELD TEAM REPORT ON APPLICATION DMEA 2550 (asbestos)

To: L. G. Houk, Defense Minerals Exploration Administration
From: D. M. Larrabee, U. S. Geological Survey
Applicant: Bear Canyon Mining Company
Name of property: Bear Canyon deposit
Location of property: Gila County, Arizona
Date of Field Team report: June 11, 1954
Authorship of Field Team report: A. F. Shride
Field Team's recommendation: 1 - No discovery made.
2 - Termination of work before completion, by mutual consent.
3 - No further work.
4 - No certification be made.
Comments: Only a small quantity of semi-harsh to harsh asbestos was found.
ACTION RECOMMENDATION: Follow Field Team's recommendation.

D. M. Larrabee

DMLarrabee:hlm
G-7/26/54
Copy to: Director's reading 4212
Branch reading 4212
DMEA (3)
Larrabee 5218 Interior

IN REPLY REFER TO:
G-MD-CNM

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WASHINGTON 25, D. C.

July 26, 1954

Memorandum

REVIEW OF FIELD TEAM REPORT ON APPLICATION DMEA 2550 (asbestos)

To: L. G. Houk, Defense Minerals Exploration Administration
From: D. M. Larrabee, U. S. Geological Survey
Applicant: Bear Canyon Mining Company
Name of property: Bear Canyon deposit
Location of property: Gila County, Arizona
Date of Field Team report: June 11, 1954
Authorship of Field Team report: A. F. Shride
Field Team's recommendation: 1 - No discovery made.
2 - Termination of work before completion, by mutual consent.
3 - No further work.
4 - No certification be made.
Comments: Only a small quantity of semi-harsh to harsh asbestos was found.
ACTION RECOMMENDATION: Follow Field Team's recommendation.

D. M. Larrabee

DMLarrabee:hlm
G-7/26/54
Copy to: Director's reading 4212
Branch reading 4212
DMEA (3)
Larrabee 5218 Interior

Work Begun Nov. 28 1952
Term. Approved Nov 8 1953

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

224 New Customhouse
Denver 2, Colorado

July 9, 1954.

Memorandum

To: Secretary to the Operating Committee, DMEA

From: DMEA Field Team, Region IV

Subject: Docket No. DMEA-2550 (Asbestos), Contract No. Idm-E446, Bear Canyon Mining Company, Gila County, Arizona.

Enclosed are the following final reports pertaining to work completed under the subject contract:

1. Original and one copy of the Operator's final report.

2. Original and three copies of the final geologic report by the U. S. Geological Survey.

3. Original and three copies of the final engineering report by the U. S. Bureau of Mines.

Final payment to the Operator was processed by this office April 19, 1954 in conformance with the Report of Review by the Contract Administration and Audit Division dated March 1, 1954, which was released to this office March 16, 1954.

The authorized exploration work was not completed in entirety as the results of the portion of work performed indicated that further work was not warranted and the contract was terminated by mutual agreement as of November 2, 1953. The exploration work completed consisted of 322.5 feet of drifting, 338 feet of crosscutting, and 98 feet of raising at a total accepted cost of $21,617.25, in which the Government participated to the extent of 90% or an amount of $19,455.53. The exploration work performed resulted in a discovery or development of a minor amount of subquality asbestos that was all mined out but which the Operator has been unable to market because of its poor grade. The examining team contend that no additional ore will be found or produced as a result of the exploration work. Therefore, the issuance of a certification of discovery or development is not recommended.

W H King
W. H. King

A. N. Koschmann
A. N. Koschmann

Enclosures

April 14, 1953

Memorandum

To : W. H. King, Chief, Mining Division, Region IV

From : Chief, Mining Methods Br., Mining Div., Region IV

Subject : Operator's Final Report, DMEA Contract Idm-E446, Docket DMEA-2550, Bear Canyon Mining Co. (asbestos) Gila County, Ariz.

Enclosed are original and 5 copies of the operator's final report for exploration work done under DMEA Exploration Project Contract No. Idm-E446. Although no maps are included with this report, I believe the report is adequate when taken with the engineering report by the Bureau of Mines and the geological report by the Geological Survey.

Walter R. Storms

Walter R. Storms

CC W. H. King (4)
J. N. Faick
DMEA-2550 with copy of oprs. rpt
DF

WRStorms:frj

Globe, Arizona
April 13, 1954
P. O. Box 1730

U. S. B...
APR 1 1954
TUCSON, ARIZ.

Mr. W. R. Storm
United States Bureau of Mines
P. O. Box 4097 University Station
Tucson, Arizona

Dear Mr. Storm: Re: Docket IMSA 2550, Contract No, IIM-K 446
Mineral- Asbestos.

Engineering and geological report covering the above mentioned project to point of termination, follows:

An incline drift down strike at approximately 12 degrees was advanced until diabase intrusion was encountered. This drift was in tight line all the way. Drifting in both directions was begun at this point parallelling the diabase intrusion and continued until diabase was encountered in the easterly end of this cross-cut. In the westerly end a diabase finger was encountered and drifted through, line was contacted on the other side of this finger and the cross-cut was continued into this line bed until it was determined that no ore of commercial value was to be found in this portion of the mine.

The work was then moved to a point in the west portion of the mine and a drift was begun into a diabase intrusion, with the hopes of putting in raises at intervals and contacting ore through this diabase intrusion. This drift work was completed and two raises up to the ore zone were made. In raise number one the ore zone was cut but no fiber discovered. In raise number 2, there was a little fiber encountered, this fiber was of a harsh quality and very little quantity. It was agreed by both the operator and the field team that no commercial ore had been discovered.

322½ feet of drifting
338 " " cross-cutting
98 " " raising, was completed up to the point of termination under the above mentioned contract. This work was done on a unit basis under contract by the Bear Canyon Mining Company with the United States Government at a unit cost of $28.50 per lineal foot, or a total of $21,617.25.

Yours very truly,

D. E. Brown

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

COPY

224 New Customhouse
Denver 2, Colorado

July 9, 1954.

Memorandum

To: Secretary to the Operating Committee, DMEA

From: DMEA Field Team, Region IV

Subject: Docket No. DMEA-2550 (Asbestos), Contract No. Idm-E446, Bear Canyon Mining Company, Gila County, Arizona.

1. Original and one copy of the Operator's final report.

2. Original and three copies of the final geologic report by the U. S. Geological Survey.

3. Original and three copies of the final engineering report by the U. S. Bureau of Mines.

Final payment to the Operator was processed by this office April 19, 1954 in conformance with the Report of Review by the Contract Administration and Audit Division dated March 1, 1954, which was released to this office March 16, 1954.

The authorized exploration work was not completed in entirety as the results of the portion of work performed indicated that further work was not warranted and the contract was terminated by mutual agreement as of November 2, 1953. The exploration work completed consisted of 322.5 feet of drifting, 338 feet of crosscutting, and 98 feet of raising at a total accepted cost of $21,617.25, in which the Government participated to the extent of 90% or an amount of $19,455.53. The exploration work performed resulted in a discovery or development of a minor amount of subquality asbestos that was all mined out but which the Operator has been unable to market because of its poor grade. The examining team contend that no additional ore will be found or produced as a result of the exploration work. Therefore, the issuance of a certification of discovery or development is not recommended.

/s/ W. H. King

/s/ A. H. Koschmann

Enclosures

Reviewed by
DMEA OPERATING COMMITTEE

7-19-54
(date)

IN REPLY REFER TO:

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
Defense Minerals Exploration Administration
Denver Federal Center
Denver 2, Colorado

July 7, 1954

Memorandum

To: DMEA Field Team, Region IV

From: A. H. Koschmann

Subject: DMEA Docket 2550, Contract Ida-6446, Bear Canyon Mining Company, Gila County, Arizona

Enclosed are 9 copies of the final geologic report by A. F. Shride of the U. S. Geological Survey covering the above docket.

Work under the contract resulted in the discovery of very minor amounts of asbestos ore, most of which has been mined but not sold. Mr. Shride concludes that no additional ore will be found as a result of the exploration and recommends that no Certificate of Discovery be issued.

E. M. Hauchman
for A. H. Koschmann
Supervising Geologist
Colorado-Wyoming

Enclosures (9)

Reviewed by
DMEA OPERATING COMMITTEE
7-19-54
(date)

IN REPLY REFER TO:

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Box 4125 University Station
Tucson, Arizona

June 11, 1954

To: . M. Koschmann

From: A. F. Shride

Subject: Completion Report, Contract Idm-8446 (DMEA-2590)
Bear Canyon Mining Company (Asbestos)
Gila County, Arizona

Enclosed are the original and 8 copies of the above report by A. F. Shride of the Geological Survey.

This exploration program was successful in exposing only a small quantity of semi-harsh to harsh asbestos, all of which has been mined. Because of the poor quality of this fiber the operator has not succeeded in marketing it. The exploration has definitely established the boundaries of the deposit, and no additional asbestos will be found in the vicinity of this deposit. This prediction can be made with a high degree of assurance. Therefore, unless a small amount of poor quality fiber is eventually sold, it can be said that no discovery was made. Under these circumstances no recommendation for certification is made, because in this case it would seem that policy of the DMEA would determine whether or not certification should be made.

A. F. Shride

A. F. Shride

AFS:ps

cc. Koschmann (8)
Storms

Reviewed by
DMEA OPERATING COMMITTEE
7-19-54
(date)

BEAR CANYON MINING COMPANY
GILA COUNTY, ARIZONA
(ASBESTOS)

Contract Idm-E446 (DMEA-2550)

Completion Report

Geology

By
A. F. Shride
Geologist, U. S. Geological Survey

Reviewed by
DMEA OPERATING COMMITTEE

7-19-54
(date)

BEAR CANYON MINING COMPANY
GILA COUNTY, ARIZONA
(ASBESTOS)

Contract I6m-E446 (DMEA-2550)

CONTENTS

	Page
Introduction	1
Geology	2
Exploration	
Winzing and drifting of original contract	3
Drifting and raising of amended contract	6
Conclusions	7

ILLUSTRATIONS

Figure 1 Geologic map and sections of the Bear Canyon mine — Following page 2

INTRODUCTION

Exploration under Contract Idm-2446 was to have consisted of 470 feet of incline and 450 feet of drifting from the end of the incline to test limestones possibly folded and faulted so as to have been favorable to asbestos deposition. If the limestone host to asbestos veins was not terminated against diabase intrusions this project was regarded as a good "geologic hot." Later the contract was amended to allow drifting and raising in a different part of the deposit.

All objectives of the program were satisfactorily explored. This should be emphasized because when the exploration had been finished footages remained for drifting and raising in excess of that needed. For this reason there apparently was some confusion as to whether or not the work had been completed; therefore considerable correspondence was required before the termination agreement was finalized, and the agreement erroneously is titled as an "agreement after commencement but before completion of the work."

The exploration resulted in the discovery of two small shoots of harsh asbestos. These have been mined; other than insignificant marginal reserves of at most a few tens of tons of harsh or semi-harsh asbestos in pillars no asbestos remains in the Bear Canyon deposit. This exploration and previous development conclusively define the boundaries of the Bear Canyon deposit. There are no targets for future exploration.

GEOLOGY

Most of the asbestos of the Bear Canyon deposit occurred in a 30 to 50-foot thick limestone block or sliver overlain and underlain by diabase sills and bounded laterally by discordant diabase intrusions. The main asbestos-serpentine zone that was exploited is 16 feet above the lower diabase sill or stratigraphically approximately 40 feet below the top of the middle member of the pre-Cambrian Meseal limestone and parallel to the bedding of the limestone. This zone, in general, ranged from 10 to 20 inches in thickness and included asbestos veins totaling 2 to 6 inches in thickness. Other serpentine zones, which included asbestos only in areas of greatest mineralization, are 2½, 4½, and 7 feet below the main zone.

The limestone block that includes asbestos is almost completely isolated by diabase from the main limestone unit of the Bear Creek area. The block is bounded on the southeast by a cross-cutting part of the enclosing diabase intrusion along a contact that strikes N. 15°-30° E. and dips 50°-70° N.W.; a diabase dike of parallel trend bounds the block on the northwest (figure 1). This dike, that limits the ore-bearing block, is not exposed at the outcrop but pinches out underground 70 feet northeast of the southwest portal of the mine. From the southwest end of this dike, several vertical 4 to 12-inch thick dikes trend S. 20° E. along the axis of a fold in the limestone. Southwest of this swarm of dikes, the limestones dip 4° to 10° to the north; northeast of the swarm the dip is 11° to 16° (average 12°) to the northeast. The above description defines the geometry of the host limestones of the deposit as known prior to BMMA-sponsored exploration. The exploration proved that the limestone block is also

terminated down-dip, to the northeast, by a cross-cutting part of the enclosing sills; this contact strikes N. 30° W., approximately parallel to the dike swarm.

Asbestos was concentrated along an arch, which parallels the dike that bounds the northwest side of the block, and adjacent to the fold along which the dike swarm was intruded. Pre-asbestos bedding-plane and thrust faults caused much shattering and preparation of the limestones for mineralization in the vicinity of both of these folds. A lesser concentration of asbestos was deposited in the vicinity of a small syncline in the northwestern part of the block (figure 1). Along the contact which bounds the block on the southeast the limestone was folded and fractured only locally to cause localization of small concentrations of asbestos. The central part of the stoped area included only marginal amounts of asbestos, as evidenced by the pillars left in the old mine workings.

EXPLORATION

Winzing and drifting of original contract

Exploration as set forth in the contract was to be drifts that would test areas in which the limestones might be folded adjacent to the diabase intrusions that bound the limestone block on the northwest and northeast. The end of a 470-foot access incline was to have been the starting point for these drifts. The incline was to be driven almost down the dip of the limestones that are hosts for asbestos. However, because of lack of favorable structure, little asbestos was anticipated in the incline which was positioned for ease of haulage.

Unfortunately, a discordant diabase intrusion was penetrated at 237 feet in the incline. The incline was driven an additional 23 feet into the diabase, and a 12-foot hole was drilled ahead of the face to verify that this diabase is a large mass rather than a narrow dike. The contact between this diabase and the limestone strikes N. 30° W. in general (see figure 1). The limestones were little folded and fractured adjacent to this discordant contact and only traces to 1-inch of harsh asbestos were exposed in the incline. This asbestos is confined to the limestone within 40 feet of the diabase-limestone contact. Although the degree of mineralization in the limestones near the foot of the incline was disappointing and the drifts could not be positioned as originally intended, the drifts were warranted to test for geologic structure near the northeast-trending contacts between limestone and diabase. The drift to the southeast encountered little structure in the limestone and only traces of asbestos.

The drift to the northwest penetrated diabase at 50 feet from the incline, then limestone at 100 feet, diabase again at 125 feet, and finally limestone again at 145 feet as shown on figure 1. The geometry of the diabase-limestone contact in this drift is not as simple as generalized on figure 1. Thin sills and narrow apophyses of diabase, which cannot be plotted on a plan view, inflate the limestone and wedge small slivers of limestone from the main block. Because of this intricate pattern of intrusion the operators understandably had difficulty in planning exploration and knowing whether or not

the main ore zone was exposed by the drift. The small block of limestone exposed in the drift, between 100 and 125 feet of the starting point, included as much as 3 inches of harsh asbestos in one of the zones below the main zone; all of the asbestos in this zone of this small isolated limestone block has been mined. Unfortunately holes were not drilled upward to determine the amount of asbestos in the main zone. However, the block of limestone is so small that if asbestos exists at the main horizon the reserves would be insignificant.

The last 40 feet of the northwest drift penetrated limestone that dips 28°-32° S.E. The main serpentine zone in this folded limestone included veins of harsh asbestos reputed to total as much as 4 inches in thickness. The stope at the end of the drift was developed to exploit this asbestos, and stoping was carried to the margins of the small oreshoot. The present stope walls expose only traces to 1 inch of asbestos.

The folds in limestone at the northwest end of the northwest-trending drift would appear to be excellent loci for concentrations of asbestos, and this theory is borne out by the concentration represented by the two small stopes from this drift. However, the northwesternmost concentration is not as extensive as might be expected. In this area the stresses caused by intrusion of the diabase were apparently relieved mainly by movement along one bedding-plane. A thin diabase sill was intruded along this plane, which is 1½ feet above the main ore zone. Because faulting was not distributed among

the limestone beds and effectively the one plane of adjustment was "lubricated" by a thin sill of diabase magma, the limestones were not fractured over a large area for the ingress of mineralizing solutions. The potential areas for asbestos in the northwestern part of the limestone block have been adequately explored. No recoverable reserves remain in this area.

Drifting and raising of amended contract

A possible, but only moderately promising, area for exploration bordered the northwest side of the dike that bounds the host limestone block on the northwest. The stoped area on the west side of the southeast termination of this dike is an example of an asbestos-bearing area on the west side of the dike. However, this stoped area is at the intersection of N. 20 E. and N. 20 W. trends of fracturing; and other like intersections were not expected on the northwest side of the dike. Therefore concentrations of asbestos as large as that of the stoped area were not anticipated. A narrow oreshoot on the northwest side of the dike parallel to and adjacent to the dike was a geologic possibility for exploration because the limestones adjacent to the dike might be folded and fractured where the limestone was displaced upward by intrusion of the diabase (section A-A', figure 1). On this premise an amendment to allow drifting and raising to explore the limestones on the west side of the dike was recommended and approved. A 63-foot drift was driven northwest in the diabase sill that underlies the asbestos-bearing limestones. One raise was driven from this drift and a raise already

existent near the dike was extended (figure 1). The raise nearest the dike exposed 1 to 2 inches of harsh asbestos at the horizon of the main zone; in the raise farthest from the dike serpentine, but no fiber, occurs at the main horizon. This work proved that the dike was narrower than had been expected. A third raise, halfway between these raises and the stope at the southwest end of the dike, was later driven by the operator at his expense to expose the zone on the west side of the dike. In this third raise traces to 2 inches of asbestos are exposed, but the fiber veins pinch out 15 feet northwest of the dike. Exposures in these three raises indicate that the limestone on the west side of the dike was little folded and fractured in preparation for mineralization. A few small pods of ore might be found if the limestone bordering the west side of the dike were exposed continuously. It would be uneconomic to probe for the very small potential (a few tons) of fiber that might be found in such pods.

CONCLUSIONS

The boundaries of the main limestone block in which the asbestos of the Bear Canyon deposit occurs have been thoroughly defined by exploration. Except for a few tens of tons of harsh to semi-harsh fiber in pillars no mineable quantities of asbestos remain in this block. The fiber discovered in the northwest corner of the block by DMEA-sponsored exploration has been mined beyond the practical limits of the two shoots. The last report from the operator indicated that none of the fiber mined as a result of the exploration had been sold. Undoubtedly the operator will have considerable difficulty in marketing the poor quality asbestos.

The "fringe" area west of the dike that bounds the northwest side of the asbestos-bearing block has been sufficiently explored to prove that the geologic potential for ore on the northwest side of the dike is insignificant.

Because the boundaries of the ore-bearing block of limestone against diabase are now well defined, it can be stated positively that no additional ore will be found as a result of the exploration. Therefore except for the little sub-quality asbestos found, there is no reason for certification of a discovery as a result of this work.

Defense Minerals
RECEIVED
JUL 15 1954

[illegible] 10, 195[illegible]

[illegible]

To : [illegible]

From : [illegible]

Subject : [illegible] report, [illegible] (asbestos), [illegible]

Enclosed are original and [illegible] copies of a final engineering report [illegible] of [illegible] exploration work done at the [illegible] asbestos mine under [illegible] exploration project [illegible]. [illegible] contract has not been formally terminated, all exploration work has been stopped upon [illegible] of the [illegible] representatives from the Bureau of Mines and the Geological Survey.

[illegible] has resigned, effective at the close of business on March 12, we are submitting this report before formal termination of the contract. This report has my approval.

Walter R. Storms

[illegible]

[illegible]

[illegible]

Reviewed by
DMEA OPERATING COMMITTEE
7-19-54
(date)

UNITED STATES
DEPARTMENT OF THE INTERIOR
DOUGLAS McKAY, SECRETARY

DEFENSE MINERALS EXPLORATION ADMINISTRATION

REPORT OF EXAMINATION BY FIELD TEAM
REGION IV

FINAL ENGINEERING REPORT

DMEA-2550, Contract Idm-2446

Bear Canyon Mining Company

Gila County, Arizona

(Asbestos)

Robert W. Agston, Mining Engineer
U. S. Bureau of Mines

March 1954

Reviewed by
DMEA OPERATING COMMITTEE

7-19-54
(Date)

EMSA-2550, CONTRACT Idm-2446
BEAR CANYON MINING COMPANY
GILA COUNTY, ARIZONA
(Asbestos)

CONTENTS

Final engineering report — Page

Summary, conclusions, and recommendations ——— 1
Introduction ——— 2
Description of work completed ——— 3
Description of geology ——— 4
Expenditures ——— 6
Efficiency of operations ——— 6
Equipment and supplies ——— 6

ILLUSTRATIONS

Figure — Following page

1 Location map ——— 2
2 Generalized geologic sketch ——— 3

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The Bear Canyon Mining Co., a limited co-partnership, applied for Government assistance under the Defense Production Act of 1950, as amended, to explore for asbestos on claims located within the San Carlos Indian Reservation, about 43 road miles northeast of Globe, Ariz. The United States of America, acting through the Department of the Interior, Defense Minerals Exploration Administration, entered into Exploration Project Contract No. IDn-4446, Docket DMA-2550, dated November 13, 1952, with the Bear Canyon Mining Co.

Contract exploration provided for the driving of an inclined drift, and lateral drifting in order to determine the down-dip extension of the asbestos deposit of the Blue Mule No. 1 and Blue Mule No. 2 claims. A total of 250 feet of incline, and 338 feet of lateral drifting was performed according to the terms of the contract. Since this work did not result in the discovery of a significant deposit of asbestos, Amendment No. 1 was executed to permit exploration for asbestos fiber in the mine near the western margin of the old stope. Under the terms of the amendment, 62.5 feet of drifting and 90 feet of raising exposed the ground in this area.

Sufficient exploration has been accomplished to warrant the conclusion that a significant discovery of asbestos fiber cannot be made around the immediate periphery of this deposit. However, additional exploration may be justified on adjacent claims.

Asbestos fiber may continue to be produced from mine pillars, but production will not result from the exploration program. Therefore, it is recommended that no Certification of Discovery be issued for this project.

INTRODUCTION

The Bear Canyon mine is 43 road miles northeast of Globe, Gila County, Ariz., tentatively located in unsurveyed sec. 1, T. 2 N., and sec. 36, T. 3 N., R. 18 E. (figure 1). The property consists of 19 full-sized unpatented lode claims, under lease from the San Carlos Indian Reservation. The altitude of the mine is approximately 4,180 feet above sea level.

The exploration application was docketed as DMEA 2550 (Asbestos) and the work was performed under contract Idm-2446. The operator of the property was the Bear Canyon Mining Company, Box 1739, Globe, Ariz. The project was recommended for exploration by Lincoln A. Stewart, mining engineer, U. S. Bureau of Mines, and Andrew F. Shride, geologist, U. S. Geological Survey.

DESCRIPTION OF WORK COMPLETED

The exploration project was contracted at a unit cost of $28.50 per foot for driving an inclined drift 470 feet, and for drifting 480 feet. Work under the contract started on November 28, 1952. The inclined drift (figure 2) was driven in a limestone formation until it cut a limestone-diabase contact at 237 feet from the starting point. The drift then was extended into the diabase 23 feet

for a total of 260 feet of inclined drifting. At the operator's expense, a 13-foot long hole was drilled in the face of the drift in order to test the ground ahead. Cuttings from the drill hole were diabase, therefore, the known width of the diabase beyond the limestone-diabase contact is at least 36 feet.

Lateral drifting northwesterly and southeasterly (roughly paralleling the limestone-diabase contact) was started during the month of February. The southeasterly crosscut was advanced 151 feet and the northwesterly crosscut was advanced 187 feet for a total of 338 feet of lateral drifting. No ore was found.

On March 25, 1953, the contract was amended by mutual agreement between the operator and the Government. The amendment provided that the unexpended portion of the footage and funds be made available to explore possible ore occurrences on the west edge of the old stope by raising and drifting at the same unit cost of $28.50 per foot (figure 2).

During the month of May 1953, work under Amendment No. 1 was started. Referring to figure 2, an old drift off the northwestern edge of the main stope was utilized to start an exploration drift bearing N. 30° W., that was advanced a total of 62.5 feet. At a point 80 feet from the limestone-diabase contact, the No. 1 raise was started from the west side of this exploration drift and was advanced a total height of 54 feet. On June 23, 1953, the No. 2 raise was started from an old 14-foot raise that was about 30 feet west of the limestone-diabase contact. The contract advance of the No. 2 raise was 44.0 feet.

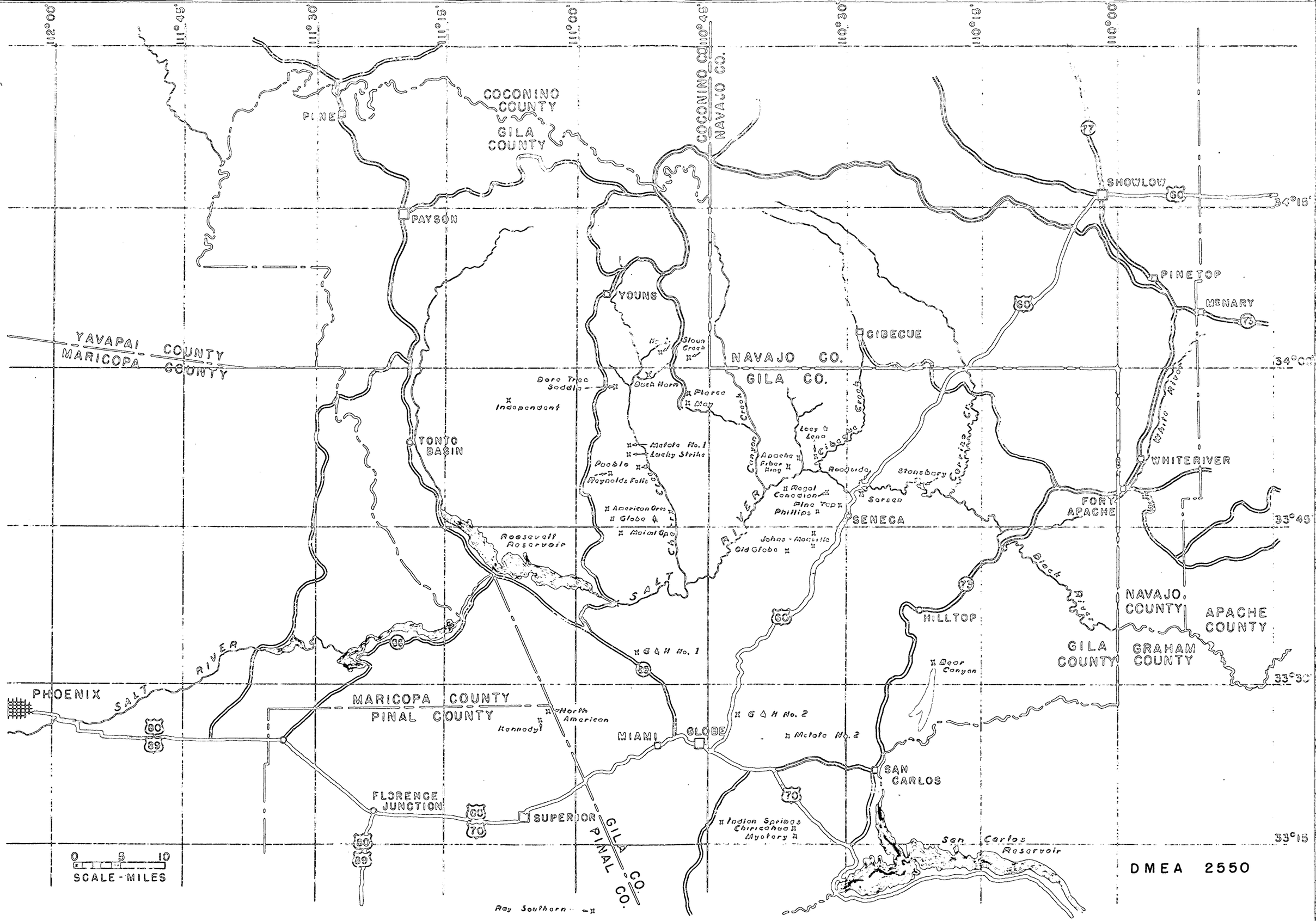


FIGURE 1. - LOCATION MAP - ASBESTOS DEPOSITS - CENTRAL ARIZONA

To recapitulate, 637.5 feet of drifting and crosscutting, and 28 feet of raising was performed according to the terms of the contract.

On October 14, 1953, the operator made a formal request for the termination before completion of Contract Idn-5446.

DESCRIPTION OF GEOLOGY

The asbestos deposit of the Bear Canyon mine occurs in pre-Cambrian Mescal limestone which is a part of a succession of strata known as the Apache group. The main fiber zone is stratigraphically about 40 feet below the Algal member of the Mescal limestone formation.

The limestone host is overlain and underlain by concordant diabase sills, and is bounded on the northwest and southeast by crosscutting diabase sills (figure 2). The fiber bearing bed thus is "isolated" and is a "sliver" of the Mescal limestone formation. Diabase intrusion has slightly arched the limestone formation and has tilted it 10° to 12° downward into the hill.

The main asbestos-bearing zone is 16 feet above the lower diabase sill, or approximately 40 feet stratigraphically below the top of the lower member of the Mescal limestone. In areas of greatest production in the Gila County asbestos district, 3 other zones appear between 2½ to 7 feet below the main zone.

Exploration under the contract included driving an incline northeasterly in the limestone from the east wall of the stope (Figure 2). As was expected, only traces of serpentine and fiber were exposed in this drift. After the inclined drift cut a diabase sill, BMEA representatives authorized drifting northerly and southerly along the limestone-diabase contact.

The southeasterly drift was driven along the contact, but only traces of fiber were exposed. The last 20 feet of this drift cut diabase that is presumably the main sill to the south. The northwesterly drift was started with diabase exposed along the right wall. Further drifting exposed small diabase sills that cut across the drift. At approximately 100 feet from the starting point, the top sill cut down and the ore-bearing beds appeared, but they were cut off again within 20 feet by a dike. The operator stoped from this small mineralized zone, extracting a minor quantity of non-strategic fiber that to date has not been sold.

Exploration of the deposit was continued under the terms of an amendment to the contract, which provided for drifting in diabase and raising through diabase to limestone at the west edge of the old stope. Referring to figure 3, an old drift off the northwestern edge of the main stope was utilized to start the exploration drift which was advanced 62.5 feet in diabase. The No. 1 raise was started in diabase about 10 feet from the end of this drift. Limestone was exposed in the No. 1 raise at 20 feet above the starting point, and serpentine zones were encountered at 5, 9, and 16.5 feet above the limestone-diabase contact. However, the serpentine zones did not contain fiber.

The No. 2 raise was started from an old 14-foot raise that was in diabase near the starting point of the drift. The limestone-diabase contact was exposed in the No. 2 raise at 42 feet above the

back of the drift. Four feet above the limestone-diabase contact, the No. 2 raise penetrated a 6-inch serpentine zone containing an average of 1 inch of total fiber. Approximately 7 feet above this lower zone was the 2nd fiber horizon in a 9- to 12-inch serpentine zone with 1½ to 2 inches of total fiber, zone fiber lengths ranging from 3/4 inch to 1 inch. The fiber was harsh and lacked tensile strength. In an attempt to locate a 3rd fiber horizon the operator drilled an 8-foot hole above the back of the raise, but the cuttings did not contain fiber or serpentine.

The potential of the area explored under the terms of the amendment to the contract is not significant because no fiber was found in the No. 1 raise, and the fiber exposed in the No. 2 raise was harsh to semi-harsh.

EXPENDITURES

Total approved	$26,220.00
Total cost of project *	21,617.25
Government's share of cost **	19,453.53
Government's share unexpended	4,142.47

* Contingent upon termination of the contract
** An amount of $600 has been withheld from payment to the operator contingent upon receipt of a final report.

EFFICIENCY OF OPERATIONS

The exploration was conducted in a workman-like manner and according to contract specifications.

EQUIPMENT AND SUPPLIES

This contract was on a unit cost basis, consequently there was no Government participation in the cost of equipment or supplies.

Mining Division
Region IV

August 13, 1952

Memorandum

To: Field Team, Region IV

From: Acting Chief, Mining Division, Region IV

Subject: Final Report, DMEA Docket 2550 (Asbestos)
Bear Canyon Mining Company
Gila County, Arizona

Enclosed are nine copies of the engineering report by L. A. Stewart of the Bureau of Mines on subject docket.

The examining engineer recommends approval of the exploration loan in the amount of $26,220, Government participation $23,598.

We concur in the recommendation if it is possible to obtain a waiver so that a contract may be prepared.

W. H. King

W. H. King

Enclosures

Mining Division
Date Rec'd.

AUG 8 - 1952

BUREAU OF MINES
Denver, Colorado

MINING DIVISION
REGION IV

August 6, 1952

Memorandum

To : W. H. King, Acting Chief, Mining Div., Region IV

From : Chief, Arizona-New Mexico Br., Mining Div., Region IV

Subject : Final Report, DMEA Docket 2550, Bear Canyon Mining Co. (Asbestos), Gila County, Ariz.

Enclosed are original and eight copies of the section on Summary, Conclusions and Recommendations by L. A. Stewart of the Bureau of Mines and A. F. Shride of the Geological Survey, and the section on Engineering by Stewart for the above report. A separate section on Geology will be submitted by the Geological Survey.

Regarding your recent correspondence concerning approval of leases on Indian lands, I believe the Bear Canyon Mining Co. has only a five year lease which has only one more year to go. The company has been assured that its lease will be renewed, but evidently this will not do as per the DMEA Chief Counsel's memorandum of July 18 to Mr. Mittendorf regarding the Sorsen-Williams application DMA-1776X.

If all leases must be for a period of 10 years and if an Owner's Consent to Lien must be obtained for applications for asbestos leases on Indian lands, then it would seem useless for us to make any more examinations on either Apache reservation here. I believe both Agencies grant only 5-year leases, and as Mr. Hefflund states, "The granting of liens on tribal lands is prohibited by statute - - -".

The enclosed report has my approval.

Brochure is enclosed.

Walter R. Storms

Walter R. Storms, Chief
Arizona-New Mexico Branch
Mining Division, Region IV

CC W. H. King (8)
DMEA-2550
BF

WRStorms:frj

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS ADMINISTRATION
WASHINGTON 25, D. C.
200 New Customhouse
Denver 2, Colorado

August 12, 1952

Memorandum

To: DMEA Field Team, Region IV

From: A. H. Koschmann

Subject: DMEA Docket 2550, Bear Canyon Mine, Bear Canyon Mining Company, Gila County, Arizona

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

It is recommended that an exploration loan be granted provided the San Carlos Indian tribal constitution, which prohibits the grantal of leases for periods longer than 5 years, can be met.

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

Enclosures (9)

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

Memorandum

To: A. H. Koschmann, Denver, Colorado

From: A. F. Shride, Tucson, Arizona

Subject: Geologic Report, DMEA 2550, Bear Canyon Mine, Bear Canyon Mining Company, Gila County, Arizona

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

The deposit is one of the most promising in the Arizona asbestos district, and the proposed exploration plan is feasible and in order, therefore it is recommended that an exploration loan be granted.

This project is on the San Carlos Indian Reservation. As the San Carlos tribal constitution prohibits the grantal of leases for periods longer than 5 years, and the grantal of liens on tribal lands also is prohibited, it seems hopeless to favorably recommend this project because DMEA procedure may not allow granting of an exploration contract. It should be noted that, although not specifically so stated in most leases, the usual practice of the tribal council is to give the lessee preference on a new lease for an additional 5 years.

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

Enclosures 9

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

DEFENSE MINERALS EXPLORATION ADMINISTRATION

REPORT OF EXAMINATION OF FIELD SITE
DMEA No. AV

DMEA-2550, Bear Canyon Mining Company

Gila County, Arizona

Asbestos

Lincoln A. Stewart, Mining Engineer
U. S. Bureau of Mines

Andrew P. Schride, Geologist
U. S. Geological Survey

July 1953

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

By Lincoln A. Stewart[1] and Andrew F. Shride[2]

An application was submitted to the Defense Minerals Exploration Administration by the Bear Canyon Mining Co. for a loan to explore for extensions of its currently operating asbestos deposit. The company has a lease on 19 contiguous unpatented mining claims in the San Carlos Indian Reservation. The property is 43 road miles northeast of Globe, Gila County, Ariz.

The request was for 1,177 feet of diamond drilling and 330 feet of drifting for a total cost of $25,000. One major and 2 minor areas were to be tested. After the examination of the property and discussion of the merits of the proposal, the applicant was advised of the unit bid method. This method appealed to the applicant who suggested that it be allowed to submit a modified proposal. The new proposal consisted of a total of 920 feet of drifting to determine extension of the ore body along the main structure.

A major asbestos company worked this deposit during the period of 1928-30 producing on the order of 900 tons fiber, most of which was crude Nos. 1 and 2. The applicant company reopened the mine in 194 9 and has since worked it on a small scale. The total production of the mine has been more than 1,200 tons of fiber, which makes it about the fifth largest producer in the Gila County asbestos district.

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

The applicant is mining around the edges of the old stope and has extended one area down dip from the lower haulage drift. The proposal is to explore for extensions of the deposit down dip from the lower haulage level for 470 feet. From the bottom of this inclined drift the lateral extent of the deposit is to be determined by 440 feet of cross drifting. The company has offered a unit bid of $28.50 per foot of drifting for a maximum total of $26,220. This contract price includes all costs pertaining to the advancement of the drifts.

Stocks of asbestos fiber in general, and strategic grades in particular are critically short. It is thought that the possibilities of finding extensions of the Bear Canyon deposit down dip are exceptionally good. The structure which localized the deposit has remained virtually constant for approximately 400 feet. If the exploration is only moderately successful, new faces will have been opened that will allow for increased production. The mining costs will be lowered because stoping can be done up dip. Back fill will be more compact and fewer pillars will be needed.

Unless cut off by an unpredictable structural change, the deposit might extend to the proposed depth of exploration. If extensions of the deposit contain asbestos in quantity and quality comparable to that of the past productive area, reserves developed as a result of the proposed exploration will be sufficient to amortize the loan.

It is recommended that the Bear Canyon Mining Co. be granted $26,220 to explore the deposit by drifting a maximum of 920 feet on its unit bid of $28.50 per foot, the work to be completed in 18 months.

BEAR CANYON MINE
BEAR CANYON MINING COMPANY
GILA COUNTY, ARIZONA
DMEA 2590

ASBESTOS

Geology

By
Andrew F. Shride
and
Calvin S. Brumfield
Geologists, U. S. Geological Survey

BEAR CANYON MINE
BEAR CANYON MINING COMPANY
GILA COUNTY, ARIZONA
DMEA 2550

ASBESTOS

CONTENTS

	Page
Introduction	1
Geologic Setting of the Deposit	2
Asbestos Distribution	3
Potential of the Deposit	5
Review of Exploration Plan	8
Original Proposal	8
Revised Program	9
Conclusions and Recommendations	11

ILLUSTRATIONS

		Following Page
Figure 4	Geologic Map, Bear Canyon Asbestos Deposit	1
Figure 5	Geologic Sections, Bear Canyon Asbestos Deposit	8
	A-A' Section along proposed incline	
	B-B' Typical section along strike of deposit	
	C-C' Section through trough, northwest stope area	

INTRODUCTION

The Bear Canyon asbestos deposit is approximately 15 miles northeast of San Carlos and is in a canyon which has been cut through Tertiary basalts and gravels to expose the underlying diabase and pre-Cambrian Mescal limestone, with which Arizona asbestos deposits are associated. The mine is accessible from San Carlos by 19½ miles of dirt road passable except during, and sometimes for a few days after, summer thundershowers.

From Bureau of Indian Affairs records and hearsay data from past operators the writer estimates that approximately 1200 tons of all grades of chrysotile asbestos have been produced from the Bear Canyon deposit. Thus this mine has been one of the major producers of the Arizona asbestos district; upwards of 10 percent of the total production of the district has been derived from this deposit. Probably the first 800-900 tons of fiber produced was mostly long fiber grades; the short fiber from the early operations was probably discarded. The main period of production was between 1927 and 1930 by the Keasbey and Mattison Company for their own fabrication plant. A large part of the production was harsh fiber; therefore between the early 1930's, when Keasbey and Mattison abandoned the property, and 1949, when the demand for semi-harsh fiber increased, there was little production from the Bear Canyon deposit.

The Bear Canyon deposit was mapped in detail by Shride in 1946. Figure 4 has been modified from that work only by sketching in recent development work. Very likely some of the pillars shown on figure 4 have been mined out during the past three years.

GEOLOGIC SETTING OF THE DEPOSIT

The asbestos occurs in serpentine zones which parallel the bedding of a thin "sliver" of Mescal limestone that everywhere is isolated by diabase from the main limestone mass except at the southwest corner of the mineralized area (fig. 4). The limestone "sliver" is overlain and underlain by diabase sills which are in general concordant. The limestone "sliver" is bounded on the northwest and southeast by cross-cutting diabase (fig. 5, sections B-B' and C'-C') along contacts that strike N. 15° to 40° E. (fig. 4). The diabase-limestone contacts as projected on figure 4 are the most likely projections. Numerous small pre-mineral fractures in the limestone parallel the diabase-limestone contacts as known. Experience in the district has shown that such parallelism is a moderately good, but not infallible, basis for predicting continued parallelism of such diabase-limestone contacts. The cross-cutting portion of the diabase sill that bounds the fiber-bearing limestone on the northwest side of the deposit is not exposed at the surface, but pinches out underground about 70 feet northeast of the southeasternmost portal of the mine. At this place several vertical, 4 to 12 inch thick diabase dikes, which strike N. 20° W., join the cross-cutting sill. Southwest of these dikes to the outcrop (fig. 4) the limestone beds are relatively flat-lying; to the northwest of the dikes, and including the major part of the deposit, the beds strike N. 15° to 30° W. and dip to the northeast. Locally this northeasterly dip varies from 11 to 16 degrees, but over the southeastern portion of the limestone "sliver" an average dip of 12 degrees can be used for planning development and exploration. Diabase intrusion caused

folding of the limestone near the diabase contacts as shown on sections B-B' and C-C', figure 5. An arch in the limestone parallels the northwest diabase contact and in the northwest part of the stoped area a northeast-trending trough exists (see fig. 4).

Pre-mineral bedding-plane faults are readily discernible in some parts of the area, and it can be assumed that bedding-plane adjustment, on intrusion of the diabase, was prevalent through most of the limestone block that has been mined. In the vicinity of the folds near the northwest diabase-limestone contact minor thrust fractures are common. Bedding-plane faulting was very favorable to asbestos localization.

ASBESTOS DISTRIBUTION

The main asbestos bearing zone is 16 feet above the lower diabase sill or approximately 40 feet stratigraphically below the top of the lower member of the Nascal limestone. Other zones, which contain minable quantities of asbestos only sporadically, and in only the areas of most intense pre-mineral folding and bedding-plane adjustment, are 2½, 4½, and 7 feet below the main zone. These asbestos zones are in the stratigraphic unit most productive of asbestos throughout the district.

The greatest quantities of asbestos were probably mined in the folded limestones adjacent to the northwest diabase-limestone contact and along the N. 20° W. dike swarm in the southwestern part of the area, where the change in attitude of the beds occurs. The next most productive area more or less paralleled the southeastern diabase-limestone contact; much of the asbestos in this area was probably marginal in quantity.

From remnants of asbestos left in pillars and stope walls it is judged that most of the asbestos mined in the past has been semi-harsh, but of moderate flexibility and tensile strength. In the southeastern part of the stoped area, in particular, some of the asbestos has been very harsh and too brittle for spinning. An unknown but appreciable percentage of the asbestos produced in the past has been soft fiber of excellent quality. Considerable care in selective mining has been required to keep this asbestos from being mined with the harsh fiber. Approximately 20 tons of No. 1 and No. 2 crudes were sold to the Emergency Procurement Service in 1951 by the applicant's predecessor. If more discretion had been exercised in mining, and if the fiber had been better graded, probably much more of the production of the past 3 years would have been acceptable for stockpiling.

Exposed in the upper zone in the present mine workings are veins of asbestos totaling 1 to 5 inches in thickness. These veins are distributed through a serpentine zone 6 to 24 inches in thickness. The greatest quantities of asbestos (veins totaling 2 to 5 inches in general) are in the folded beds adjacent to the northwest diabase-limestone contact. That portion of the deposit in which pillars are most common, as shown on figure 4 (i.e., in the center of the stoped area) contains marginal or submarginal quantities of asbestos. Along the southeastern contact the asbestos veins of the upper zone total 2 to 4 inches in thickness in most places, but the fiber in most exposures is harsh. The above described distribution of asbestos probably can be expected down the dip of the limestone "sliver" into the area to be explored.

POTENTIAL OF THE DEPOSIT

Prediction of grade and quantity of asbestos more than 50 feet from known exposures is usually not justified for the Arizona asbestos deposits because the asbestos of most deposits is very sporadic in distribution and the diabase intrusions, which are always associated with the deposits, are unpredictable as to outline and distribution. Based on a 50 foot projection of the ore zone as seen in present mine faces the writer estimates that 150 to 200 tons of asbestos of all grades is indicated. At least 50 percent of this fiber is probably of harsh or semi-harsh quality.

Compared with most other asbestos deposits of the district the Bear Canyon deposit as judged from past development is unusually persistent. The proposed exploration as shown on figure 4 is based on the premise that the geologic structural conditions favorable to the formation of asbestos will persist approximately 500 feet down the dip of the deposit. There is no indication in the present exposures that such a premise is not warranted. However, an indication of a disrupting structure or intrusion can be seldom noted more than a few feet from that structure or intrusion. Based on the assumption that the asbestos content of the ore zone persists down dip in comparable amounts to the asbestos content exposed in pillars and walls of the presently mined area, a block of ore containing 1300 to 2700 tons of all grades of asbestos might be outlined by the proposed exploration. The value of this asbestos, based on 1952 production records for estimating the content of the various grades, and on 1952 sale prices might be on the order of $1,000,000 to $2,000,000. There is a wide range in the above estimates

because a 200 foot wide limestone block roughly midway between the two bounding diabase sills may contain asbestos in submarginal quantities and therefore not be minable. The above estimates allow 25 percent for mine pillars, mill losses, etc., and ignore asbestos potential in the sporadically minable lower seams. The estimates should not be considered as even in the inferred reserve category, but should be considered potential reserves based on the premise that geologic structure, yet to be proved, persists through the area to be explored.

For another approach to the potential of the area to be explored, it can be seen by inspection of figure 4 that the area to be penetrated by the proposed exploration is approximately the size of the area stoped in the past. Therefore the reserves that can be hoped for might be approximately the past production of 1200 tons. This checks only the low estimate given in the above paragraph; however, it must be noted that, to the best of our knowledge, during the mining of approximately the first 900 tons only the long fiber was recovered. Mining of a comparable asbestos-bearing area at present probably could result in the recovery of approximately 2000 tons rather than 900 tons of all grades of asbestos.

If the quality of asbestos that may be exposed in the proposed exploration approximates that of past production a large part of the asbestos will range from semi-harsh to harsh in quality. However, past exploitation has resulted in production of soft fiber of excellent quality. Such strategic asbestos can be expected to be sporadically distributed through the deposit in concentrations suitable for selective mining; therefore exploration of this deposit should be considered valid under DMEA Order 1.

Approximately 40 percent of the 88 tons of asbestos produced in the first 5 months of 1952 has been No. 1 and No. 2 fiber (according to the applicant's standards of grading); the remainder has been combined in a product that the applicant states has tested 3K to 3E by the Quebec Standard Testing Machine. Very little fiber was being discarded with the waste sands during the examiner's visit. The writer doubts that the above data gives a true picture of the average length of the asbestos produced from the Bear Canyon deposits because it is obvious that a very poor standard of grading is maintained in the applicant's mill. The No. 1 fiber produced contains much short fiber, and the Group 3 fiber produced includes much fiber that should be recovered as No. 1 and No. 2 grades. However, this production record, which includes fiber from at least 3 parts of the deposit, does indicate that a large percentage of the asbestos produced is long fiber. From incomplete records kept by the applicant the mill rock processed during the first 5 months of 1952 is estimated by the writers to have had a recoverable fiber content of between 5 and 20 percent.

The exploration proposed will not explore the area penetrated to adequately infer the reserves of the entire area outlined by exploration drifts. The writers, from previous experience in the district, judge that exposure of the ore zone by the proposed work will be adequate to predict reserves for only about 50 percent of the area outlined. However, if the project is successful, the reserves that may be inferred as a result of the work should be sufficient to allow the applicant to plan and carry out further exploration and a larger scale worthwhile milling and milling operations.

REVIEW OF EXPLORATION PLAN

Original Proposal

As submitted to the Defense Minerals Exploration Administration the applicants' exploration plan called for diamond drilling in 3 areas. The greatest amount of drilling was to be from the part of the main haulage adit that is in the sill above the deposit (see section A-A', fig. 5). This part of the drilling program, if successful, was to be followed by drifting. This part of the exploration plan, though technically feasible, was not as good as it might have been because (1) the portion of the deposit to be explored geologically is likely to be a lean area between two better mineralized areas, and (2) the cost of the drilling proposed was of the same order of magnitude as the cost of drifting to expose the same area would have been. Drifting would undoubtedly result in obtaining better data than drilling as to the potential of the deposit. Therefore costs of drilling versus drifting were discussed with the applicant. As a result of this discussion the applicant requested a modification of his original program to include 470 feet of inclined drifting as shown on figure 4 and section A-A', figure 5. This incline will test an area roughly 1½ times the length of the area originally proposed for drilling from the haulage adit. The drift will be on an incline of 9 to 11 degrees. This modified proposal has advantages and disadvantages, to be discussed later, but is an improvement over the original proposal. Because elimination of diamond drilling from the main haulage level would decrease the drill footage required to justify an economical bid from the drilling contractor, the applicant further modified his original proposal by deleting diamond drilling from the two drifts that expose

diabase on the northwest side of the deposit. As a substitute he now proposes that drifting totaling 450 feet be carried out along the strike of the deposit from the end of the proposed incline. This modification takes care of the objection that the examiners would have had, namely that diamond drilling below the northeast extension of the main haulage drift would have tested only the least likely part of the limestone block that is surrounded by diabase.

The drilling proposed to explore the limestone to the northwest beyond the crosscutting diabase was of dubious technical feasibility. However, it is unfortunate that some sort of exploration is not planned in that direction as the geologic possibilities of a "blind" ore body beyond the crosscutting portion of the diabase sill are good. However, if the applicant feels it necessary to limit his expenditures for exploration the program as revised is the most valid as being less of a gamble than exploration in a geologically poorly understood area.

Revised Program

The inclined drift proposed would test a more likely portion of the deposit and would be shorter and therefore less costly if started at the northwesternmost portion of the present stope (point A, on figure 4). From this point the incline also could be directed in a northeasterly direction directly down the dip of the deposit and thereby appreciably shortened. The applicant prefers not to place the incline in this way for two reasons: (1) haulage would be more expensive, and (2) this part of the stope is in an area of considerable fracturing and the back of the present stope might not be held. The first reason seems valid to these writers; the second is not valid

because backfill could be used in the present stope to adequately hold the back. Development of an incline also might be more difficult, than in the place proposed by the applicant, because the attitudes of the beds may vary greatly in this area and would cause difficulty in keeping a uniform haulage grade. Even though the incline as proposed by the applicant will be more costly and probably will not expose as much asbestos as an inclined drift elsewhere in the deposit, the advantages of more direct haulage from the horizontal exploratory drifts, and the fact that the proposed incline will become the most strategic position for a development haulage-way if appreciable quantities of asbestos are discovered suggest that the placing of the incline as proposed by the applicant should be approved by the DMEA. If adequate reserves are developed, the incline and the horizontal drifts will become the major haulage workings of the mine.

Drifting along the strike of the beds is warranted to test the possible extensions of what in the past have been the best portions of the Bear Canyon deposit. The distribution of the asbestos mined in past operations suggests that the greatest amount and best quality of asbestos may be found along the northwestern part of the proposed horizontal drift. The writer would suggest that if the contacts of the crosscutting diabase and the limestone strike as projected on figure 4, the proposed 450 feet of drifting will be excessive. If minable quantities of asbestos are encountered at the level of the proposed strike drift, it will be unnecessary to drift the entire distance to the crosscutting diabase to prove the ore. It is suggested, however, that the entire 450 feet of strike drifting be allowed to take

care of the possibilities that the diabase-limestone contacts deviate from the projection shown on the geologic map and/or the strike of the formation changes so as to require longer drifts if proper track grades are to be maintained. Because the exploration program proposed will not adequately block out the potential ore body (see page 7) it would not be amiss to allow excess footage to be used for a horizontal drift to be driven between the level proposed and the present stope. The applicant is not aware of the above recommendations, but the writer believes that the exploration contract should be flexible enough to allow such modification of the applicants' proposal. If the exploration proposed is unusually successful it will not be surprising if the applicant makes a request for an amendment to allow an intermediate drift to further explore the ore body.

CONCLUSIONS AND RECOMMENDATIONS

The Bear Canyon asbestos deposit as previously mined has been very persistent compared with most deposits of the Arizona district. The exceptionally favorable structural controls for asbestos deposition persist into the area proposed to be tested as a possible extension of the known deposit. If the favorable structures persist for several hundred feet, as is possible, 1200 to 2700 tons of asbestos, a part of which can be expected to be of strategic quality and length may be partly outlined by the applicants' revised exploration program. If successful, the proposed exploration may result in incompletely outlining reserves of value on the order of $1,000,000 to $2,000,000. However, optimism is not warranted because structure is not predictable for the distance proposed for exploration, and irregular, unpredictable

diabase intrusions can cut out the favorable limestone beds. Because pre-mineral structural preparation of favorable limestone beds has been extraordinarily persistent in the previously developed area, the proposed exploration based on the premise that favorable geologic structural conditions will persist through the area proposed for exploration seems very worthwhile. The type of exploration proposed could be laid out to test the most favorable areas more adequately than under the plan proposed. If the writers were less optimistic they would suggest that drifting be confined to the areas most favorable geologically. However, the writers believe, for reasons outlined in the body of the report, the geologic potential of the area to be explored is sufficient to warrant the extra expenditure of DMEA funds in the interest of more efficient mining practices that will result if the proposed exploration is successful. Therefore, the revised exploration program submitted by the applicant can be recommended.

DMA-2550, BEAR CANYON MINING COMPANY
GILA COUNTY, ARIZONA
(ASBESTOS)

Engineering Report

By Lincoln A. Stewart
Mining Engineer
U. S. Bureau of Mines

July 1952

DYBA-2550, BEAR CANYON MINING COMPANY
GILA COUNTY, ARIZONA
(ASBESTOS)

CONTENTS

Engineering report — Page

Introduction — 1
Location and accessibility — 2
Ownership and extent — 2
History and production — 3
Description of the deposit — 4
Proposed exploration and cost — 6
Review of proposed exploration — 7
Conclusions — 10
Recommendations — 12
Appendix — 13

ILLUSTRATIONS

Figure — Following page

1. Location map — 2
2. Claim map — 2
3. Plan and cross section, showing proposed work — 3

INTRODUCTION

An application for an exploratory mining loan for asbestos was received by the Washington office of the Defense Minerals Exploration Administration on May 26, 1952 from the Bear Canyon Mining Co. It was docketed as DMEA-2550 and sent to Denver. The Field Team, Region IV, forwarded copies of form 100 and 103 to the Tucson office on June 9. The detailed report of the project plan and costs, maps, and lease were retained in Denver.

In brief, the request was for 1,177 feet of diamond drilling, and 330 feet of drifting for a total of $22,690. The purpose of the project was to explore for extensions of the asbestos deposit laterally and at depth.

The property had been examined by the present examiners[1/] in 1942-43 while investigating the Gila County asbestos area for possible exploratory project sites. Both have visited the property at other times prior to this application. The current investigation was made on June 26. The owner's file copy of detailed plan and costs was made available to the examiners.

During this visit the advantages and disadvantages of drifting and drilling were discussed, and the applicant was informed of the unit bid procedure now in use. The following day the applicant advised that it wished to modify the proposal and resubmit it under the unit

1/ Stewart, Lincoln A., mining engineer, Bureau of Mines.
Shride, A. F., geologist, U. S. Geological Survey.

bid system. This new proposal reached the Tucson office on July 11, 1952. The amended proposal consisted of a maximum of 970 feet of exploratory drifting on the favorable beds: 470 feet to be down dip and 450 feet to test the beds laterally. The cost had been detailed at a total of $27,425.20, but the applicant stated it would contract the proposed work on a unit bid of $29.50 per foot for a total of $26,220.

LOCATION AND ACCESSIBILITY

The Bear Canyon property is 43 road miles northeast of Globe, Gila County, Ariz., in approximate sec. 1, T. 2 N., and sec. 36, T. 3 N., R. 18 E., unsurveyed (figure 1). It is reached by traveling 22 miles east from Globe to the Indian Agency at San Carlos, thence north on a semi-graveled road for 17 miles, thence east for 4 miles on a poor dirt road. The mine is situated near the bottom of Bear Creek Canyon at an altitude of approximately 4,350 feet.

The property is accessible throughout the year, although the road is heavy with mud during wet weather.

OWNERSHIP AND ENTRY

The property, consisting of 19 full-sized unpatented lode claims, is under lease from the San Carlos Indian Reservation by the Bear Canyon Mining Co., whose address is Box 1730, Globe, Ariz. (figure 2). The company is composed of 4 partners, Dennis E. Green, J. D. Green, Roy Yarbrough and H. A. King. Dennis Green is general manager, and lives at the property.

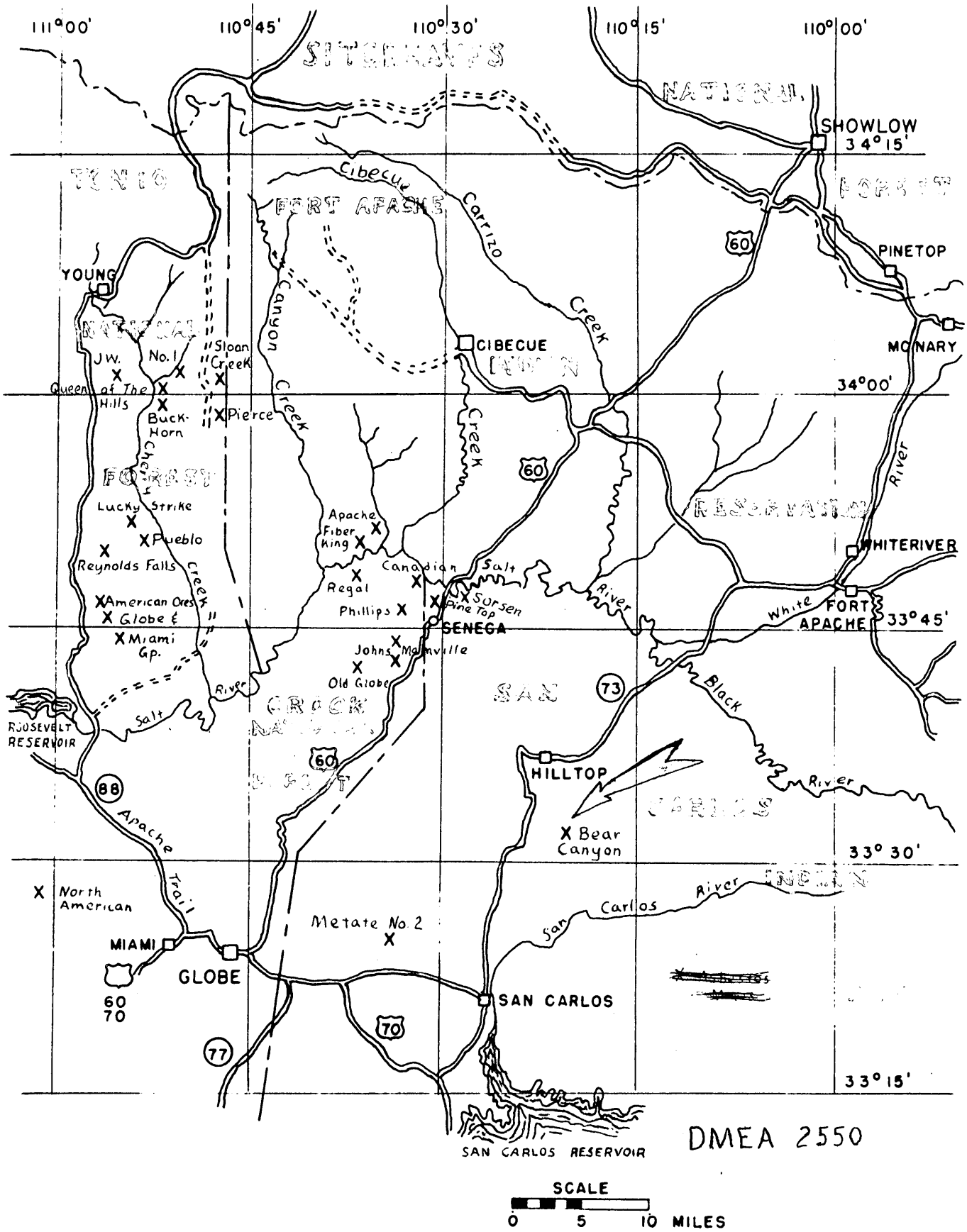
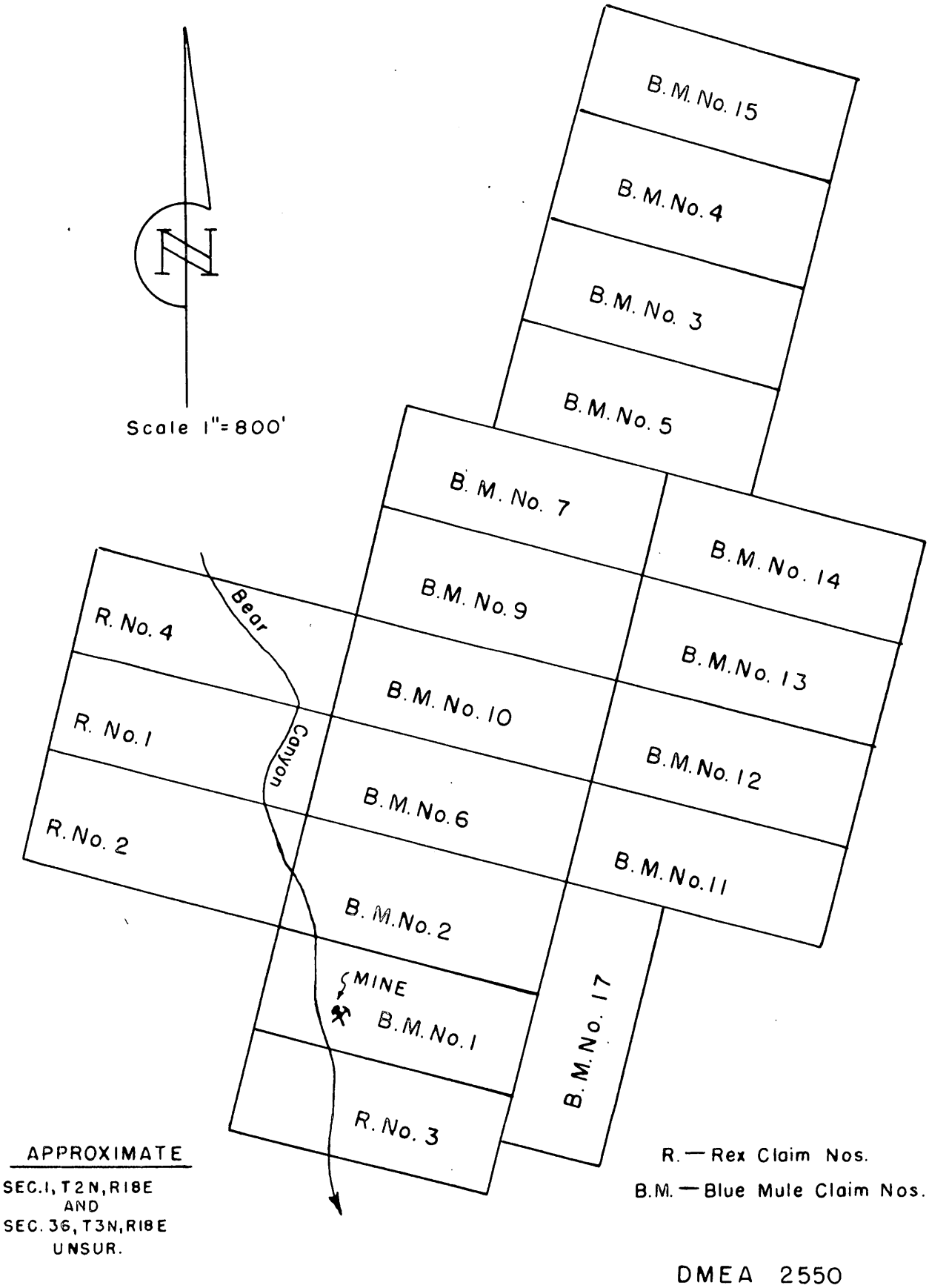


Fig. 1— Location Map, Asbestos Deposits, Gila County, Arizona



DMEA 2550

Fig. 2 — Claim Map, Bear Canyon Mining Co., Gila County, Arizona

The time limit and provisions of the lease are not known to the writer, as it was retained in the Denver office.

The claims are recorded in the Gila County Court House at Globe, Ariz. as follows:

Blue Mule Nos. 1 through 7, 9 through 15, and 17 in

Book 35, pages 165 to 179, inclusive;

Rex Nos. 1 through 4 in Book 33, pages 244 to 246, inclusive.

HISTORY AND PRODUCTION

The Bear Canyon property originally was located in 1921, and relocated in 1927 by F. J. Lunn. The following year the property was absorbed by the Bear Canyon Asbestos Co., a subsidiary of Reasbey & Mattison Co., Ambler, Pa. Lunn stated[2/] that the property produced 40 tons of fiber per month for 2 years. This was borne out by examination of the Indian Service records, which indicated that royalties were paid on 800 to 900 tons between 1927 and 1930. Work was suspended April 1930, all buildings, equipment, etc., were removed, and the property reverted to the Reservation.

The property laid idle until R. C. Robertson and associates took a lease on it in 1949, erected a camp, and constructed a mill. Robertson was in charge, with some changes of associates, until he sold out in January 1952, when Dennis Green, one of the associates took charge.

The following figures of total mine production have been gathered from various sources, but are thought to be reasonably accurate:

2/ Oral Communication, 1942.

Operator	Year	Tonnage All grades	Tonnage (Breakdown of grades)
Reasbey & Mattison	1929-30	900	No information
Robertson	1949	38	Nos.1 & 2, 12 T; No. 3, 26 T.
Robertson	1950	68	No. 1, 10 T; No. 2, 10 T, Nos. 3 & 4, 48 T.
Robertson	1951	133	No information
Green (thru May)	1952	89	No. 1, 22 T; No. 2, 14 T; No. 3, 53 T.
Total thru May 1952		1,228	

During the period that Reasbey & Mattison Co. produced, hand cobbing was practiced, and probably only the Nos. 1 and 2 grades were shipped. Consequently the 900-ton production during 1929-30 is an understatement of the actual tonnage of fiber that was extracted from the area mined during that period. Unfortunately, the shorter grades that might have been stockpiled along the surface tracks have been washed away by the periodic floods that dissipate the dump areas.

The production figures of the applicant company indicate that the milled product yielded not less than 15 percent each of Nos. 1 and 2 grades. The following tatulation of prices received by the company shows the present upward trend.

Year	Selling price of grades ($) No. 1	No. 2	Mixed Nos. 3 & 4	Calculated minimum value per ton of fiber
1949-50	800- 900	700 - 750	250	$400
1952	1400-1500	900 -1000	375 - 440	700

DESCRIPTION OF THE DEPOSIT

The mine is situated on the east side of a canyon that has cut through the regional lava flows to expose the underlying pre-Cambrian Mescal limestone and diabase. The limestone occurs as a relatively thin sliver engulfed and split by diabase intrusions that have slightly arched the limestone formation and tilted it 10° to 12° downward into the hill.

The main fiber zone is about 15 feet above the lower diabase sill. In areas of greatest production, 3 other zones appear between 2½ to 7 feet below the main zone.

The bed of limestone that contains the ore zones is about 400 feet wide, cut off on each side by crosscutting diabase sills. The fiber zone, dipping into the hill at 12°, was mined progressively from 3 levels, i. e., the outcrop, the upper, and the lower haulage levels. The latter are about 40 and 80 feet below the outcrop entries, respectively. The lower level was driven from a point about 10 feet above the creek bottom and interesected the fiber zone at 480 feet from the portal (see figure 3).

The early operators mined the area as one large stope. The back was supported by numerous pillars and there was virtually no back fill. At the time the mine was reopened in 1949, the maximum dimensions of the stope were 350 by 500 feet. The present company has enlarged the stoped area, notably on the east side, mining out the northeast corner above the lower cross-haulage drift to the diabase contact. It also has extended the northernmost part of the old stope, as well as whittling off some of the larger pillars and substituting back fill for support.

The fiber of the Bear Canyon deposit varies from fairly harsh to semi-harsh. It is said that some of the production in 1929-30 was fairly soft. The fiber left in the numerous pillars in the central part of the old stope shows this to be true, but the tensile strength does not equal that of most soft fiber. The fiber becomes more spicular toward the borders of the old stope. This may be the reason that the Keasbey & Mattison Co. ceased operations.

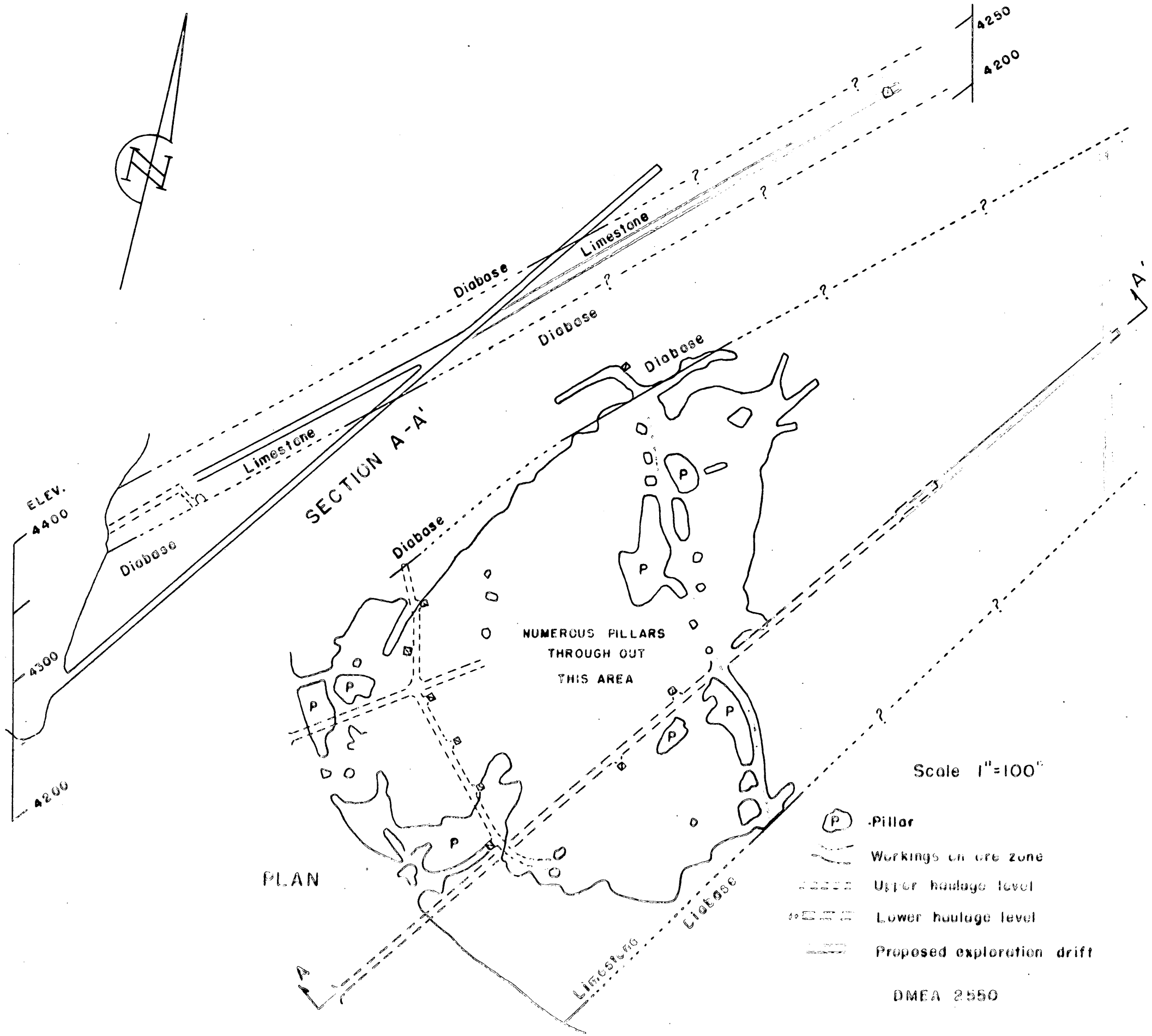


Figure 3 - Plan and Section of Bear Canyon Mine, Showing Proposed Work

Because of improvements in asbestos fiberization and spinning technique, and the urgent need for asbestos, semi-harsh fiber of only fair tensile strength has become desirable to the industry. It is blended with soft fiber of high tensile strength to make products that meet strategic requirements. The asbestos fabricators are likewise using Arizona harsh fiber in greater amounts than previously.

In 1950, this deposit produced 30 tons of crude grades 1 and 2 that was accepted by the stockpiling program.

PROPOSED EXPLORATION AND COSTS

The original exploration proposal was for 1,177 feet of diamond drilling, and 330 feet of drifting, of which the drifting and 855 feet of drilling in 13 holes was stipulated for the area down-dip on the main structure. The remaining 322 feet of drilling was to be divided in 6 holes to explore 2 areas on the west side of the mine. During the examination of the property on June 26, the investigating team discussed with the applicant the advantages and disadvantages of drilling versus drifting. When the applicant was informed of the unit bid procedure now in use, it requested an opportunity to modify the application.

L. J. Brewer, the engineer who formulated the exploration plans, revised the application and confined the proposal to exploratory drifting. In a letter of July 6 to the company, he states in part: "The diamond drilling that was previously proposed has been reconsidered and rejected. Drifting, although involving a larger capital expenditure, seems more logical in this particular case".

The revised program was brought to the Tucson office July 11 by Dennis Green, general manager of the applicant company. The covering letter states: "The development program consists of 470 feet of -12° incline to open the ore body to the northeast, and 450 feet of drifting along the projected strike of the beds. This 920 feet of proposed work is estimated to cost a total of $27,425.20 or $29.81 per foot.

"Time necessary to complete the project is estimated to be 12 months.

"The Bear Canyon Mining Co. is prepared to contract the proposed work for $28.50 per foot, for a total of $26,220.00".

The contract bid was discussed with Green to clarify the intent. He stated that the $28.50 includes all labor, supplies, equipment rental, pipe and track, and any other costs pertaining to the advancement of the drifts. The submission of detailed cost estimates, which are appended to this report, was solely for the purpose of substantiating the bid price.

REVIEW OF PROPOSED EXPLORATION

The proposal is to run an inclined drift down the favorable horizon to explore for extensions of the ore body. The logical location of such an exploration drift would be directly down-dip from the lowest point in the stope, the minimum distance to reach a given depth. However, as pointed out by the applicant, there are serious disadvantages in starting the exploration drift from these northeast workings. In this area the fiber zone was better than average and the operator mined

a relatively large block without leaving pillars. Roof failure has started and only at considerable and continued expense could a haulageway be kept open. From an incline at this point a car would have to be switched twice on the haulage level.

The applicant has suggested that the exploratory incline be started in line with the main haulage drift. The advantages of this location are that the back is strong and well supported, and no timbering will be required; no switching will be necessary; a car hauled up the incline can be released with sufficient momentum to coast out to the portal. The average dip of the formation is 12° but the angle of inclination of a drift from this point will be approximately 10°. When and if the lower block is mined, no maintenance should be required to keep the haulageway open, if sufficient pillars are left along the incline.

The applicant has made a bid of $29.50 per foot of drift, applicable equally to inclined or level drifting. The supporting detailed cost estimate assumes an average advance of 3 feet per day. More than half the footage is in the incline, where for obvious reasons, the average advance will be retarded. An analysis of the cost figures shows that some are on the high side but these are overbalanced by several items that seem exceptionally low. The use rental of the major items, 210-foot cfm compressor and hoist (slusher), is set at $115.00 per month; overall supervision and engineering is only 4.2 percent of the total project cost.

It is judged that it will cost more than $29.30 per foot for the inclined drifting and slightly less than this amount for level drifting. The tramming distance at the start will be 500 feet, but at completion it may be as much as 1,200 feet of which approximately 500 feet will be on the incline.

The applicant's averaged bid for the 2 types of drifting therefore is considered reasonable.

The question of ventilation was discussed with the applicant. There is a strong natural draft along the cross-haulage drift and smoke reaching this level is rapidly dissipated. The applicant states it has two, presently unused, smaller compressors that can be used for blowing at the headings if additional air is necessary. The use of a small Coppus blower near the end of the air lines in the strike drift headings may become necessary.

As in all asbestos exploratory projects, the drifting program should be left flexible, to take advantage of geologic changes as they develop.

If the unit bid offer is acceptable to the Defense Minerals Exploration Administration it is suggested that the total time allowed for the project be increased to 18 months. When the drift faces are in commercial ore, this extra time will allow the applicant to blast stoping rounds and thus save the fiber encountered.

CONCLUSIONS

Only 4 other asbestos mines in the Gila County area have made a greater production than the Bear Canyon mine. In general, the fiber is harsh but part of it is of a semi-harsh grade that has sufficient tensile strength to meet the requirements of strategic textile specifications.

The applicant is mining along the edges of the old stope and has extended the workings down dip in the northeast part. An area containing an exceptionally high percentage of fiber was encountered, and in the desire to recover all of it, sufficient pillar support was not provided. The roof is gradually subsiding and this area may soon become unsafe.

The proposed exploration work, if entirely or even partially successful, will allow the applicant to mine up the dip, thus lowering costs as well as increasing production. As the backfill can be placed more compactly, it is likely that fewer pillars will be required. If the exploration delineates the lower boundary of the deposit, a retreating method of mining can be employed, the need of pillars will be eliminated, and all ore possible can be recovered as the faces are advanced.

Because the favorable structure at 400 to 500 feet from the outcrop has remained virtually constant, it is thought that the possibility of continuation of ore down-dip is exceptionally good. Unless cut off by an unpredictable structural change, the deposit

might extend to the proposed depth of exploration. Allowing for some convergence of the diabase structures limiting the width of the deposit, and assuming a conservative average of 2 inches of fiber over the area, the calculated potential is on the order of 1,700 tons, all grades. If one third of the inferred area is barren or left as pillars, 1,130 tons would be the assumed productivity. At only $400 per ton of fiber, the return would be about $460,000, sufficient to amortize the loan.

It is thought that the proposed total of 920 feet of drifting is not excessive to explore this deposit, but it is suggested that the program be left flexible so that advantage may be taken of unpredictable geologic changes that might affect the location of an ore deposit.

The present company, with one change of management, has operated the mine since 1949. It has constructed a mill of sufficient capacity to beneficiate the current production on one shift daily. Increased production could be handled by running more than one shift. The mine foreman appears to understand the problems involved in asbestos mining.

A subordination agreement will have to be secured from the Indian Service, but by the time it is requested, a precedent (Sorsen Williams Asbestos Co., Docket 1770K) may have been established and action could be fairly rapid.

RECOMMENDATIONS

The Bear Canyon Mining Co. is currently producing asbestos, part of which is of strategic quality and grades. It is thought that an exploratory project is justified at this mine for the following reasons:

(1) The structure responsible for the localization of mineralization has been remarkably persistent;

(2) The geologic conditions that favored the formation of asbestos within this structure probably will continue unchanged for some distance down the dip;

(3) If the exploration proves extensions of the ore body, the applicant will be able to reduce mining costs by steping up the dip. Additional working faces will be provided and increased production should result;

(4) There is a chance that the potential tonnage could be of a magnitude to virtually amortize the loan.

Therefore it is recommended that an exploratory loan be granted the Bear Canyon Mining Co., the work to consist of an allowable total of 920 feet of drifting to be completed within 15 months. It is to the advantage of the Government to contract this work to the company on its unit bid of $25.50 per foot. This price includes all labor, supplies, equipment rental, pipe, and track, and any other costs pertaining to the advancements of the drifts.

The applicant has stated that it is willing and able to pay 15 percent of the estimated cost of $26,220.

DMA-2550, BEAR CANYON MINING COMPANY
GILA COUNTY, ARIZONA
(ASBESTOS)

APPENDIX

COPY OF AMENDED EXPLORATORY APPLICATION

OF BEAR CANYON MINING CO.

JULY 1952

The following is the transmittal letter from Dennis E. Green, general manager, Bear Canyon Mining Co., dated July 6, 1952:

> "Please find enclosed a revised cost estimate for development work at the Bear Canyon Mine. In this estimate only drifting is planned.
>
> "The development program consists of 470 feet of -12° incline to open the ore body to the northeast, and 450 feet of drifting along the projected strike of the beds. This 920 feet of proposed work is estimated to cost a total of $27,425.20, or $29.81 per foot.
>
> "Time necessary to complete the project is estimated to be 12 months.
>
> "The Bear Canyon Mining Company is prepared to contract the proposed work for $28.50 per foot, for a total of $26,220.00."

Development Program
Bear Canyon Mine

The most favorable location for the proposed incline is in line (N 35° E) with the main haulage drift at that point where the haulage drift turns to the west along the strike of the beds.

There are two advantages in locating the incline at this point. (A) The ore and waste need not be switched, but can be pulled directly up the incline by a hoist and the momentum of the pull when reaching the down grade haulage tunnel will make the operation practically self tramming. (B) Sufficient ground support in the form of pillars makes extra timbering unnecessary at this point.

By spotting the incline to the west of this point, a reduction in footage could be secured. However, maintenance costs will be excessive, as the hangingwall is now subsiding in the stope area.

The tongue of diabase in the northwest section of the present workings is believed to be a local condition, and as such should not extend eastward.

The incline should be driven the proposed footage, or to a point where a geological change indicates the termination of the orebody.

In this estimate the Defense Minerals Administration will not purchase any machinery, but will pay a rental price for equipment furnished by the Bear Canyon Mining Company.

Bear Canyon Cost Estimate

Basis:

5 x 7 Foot Heading. To be run on approximately -12° incline. The upper ore horizon to be carried in the back of the heading.

From past experience at this property, pumping will not be necessary.

Rate of advance, 3 feet per day.

Work days per month, 25.

A third man will be needed on the muck shift for 4 hours. His duties will be to operate the tugger, and tram the waste some 500 feet.

Time Estimate:

Length of incline	470 feet.
Length of drifts on ore horizons	450 feet.
Total	920 feet.

Incline:

$$\frac{470 \text{ feet}}{3 \text{ ft./day} \times 25 \text{ days/mo.}} = \text{6 Months, minimum time.}$$

Estimate 8 months maximum

Drifts on Ore Horizons:

$$\frac{450 \text{ feet}}{3 \text{ ft./day} \times 2 \times 25 \text{ days/mo.}} = \text{3 Months minimum time.}$$

Estimate 4 months maximum.

These drifts are to be run simultaneously to the east and to the west, along the strike of the beds.

To Complete Project:

9 Months minimum time.

12 Months maximum time.

Calculation of Costs

Rental of Equipment: (Furnished by Bear Canyon Mining Co.)

	Present Value
210 cuft Leroi Compressor	$5,500.00
Gardner-Denver Slusher	1,400.00
IR, J-50 Jackhammer	400.00
IR, Jackleg	200.00
IR, Line Oiler	20.00
3/4 Inch air hose (50 feet)	25.00
1/2 Inch water hose (50 feet)	15.00
Water Gooseneck	8.00
Mine Car	150.00
Total	$7,718.00

Rental Basis per Month

$$\frac{\$7,718.00}{60} = \$128.63$$

Rental Basis per Foot Advance:

3 ft./day x 25 days/month = 75 feet

$$\frac{\$128.63}{75} = \$1.72 \text{ per foot.}$$

Labor:

1 Miner at $12.50 per shift	$12.50
3 Muckers at $11.50 per shift	34.50
1 Trammer (1/2 shift) at $11.50	5.75
Total	$52.75

Includes overtime, industrial insurance of 9.92%, and Social Security Tax of 4.5%.

On advance of 3 feet per day.

$$\frac{\$52.75}{3.0} = \$17.58 \text{ per foot.}$$

Supplies:

Explosives: (14 Holes per Round)

Dynamite, 29 pounds at $0.21/lb.		$6.09
Caps, 14 at $0.02 each		.28
Fuse, 112 feet at $0.012/ft.		1.34
	Total	$7.50

$\frac{\$7.50}{3.0}$ = $2.50 per foot.

Fuel for Compressor:

Compressor to be in operation 16 hours per day. 8 hours drilling, and 8 hours furnishing air for tugger to pull cars up incline.

30 gal. gas at $0.305/gal., 2 qts. oil at $0.30 = $9.75

$\frac{\$9.75}{3.0}$ = $3.25 per foot.

Pipe and Track:

Pipe and track to be purchased by the Company and to remain in the Company's possession upon the termination of the project. The project to be charged 40% of the estimated purchase price for these items.

	Per Foot
Rails, spikes, ties, and fishplates	$1.25
2 inch air line, with valves and fittings	.50
1 inch water line, with valves and fittings	.25
Total	$2.00

$2.00 x 40% = $0.80 per foot.

Drill Steel and Bits:

Steel breakage estimated to be 1 - 4 foot piece per 3 rounds, or 9 feet advance.
4 Timken detachable bits per round, this also includes sharpening.

Steel - $\frac{\$6.00}{9.0}$ = $0.67 per foot.

Bits - $\frac{4 \times \$0.56}{3.0}$ = . 74 per foot.

Total $1.41 per foot.

Other Supplies:	Per Foot
Machine oil for drill and tugger	$0.15
Carbide	.10
Picks, shovels, flatsheet, wrenches, jimcrow, bars, moils, loading sticks, and other small tools	$0.30
(This covers replacement and breakage)	
Total per foot	$0.55

Repairs:

Normal repairs on machinery to be rented from Company, including breakage and obsolesence.
$0.75 per foot.

Supervision and Engineering:

Estimated at $1.25 per foot.

Summary		Cost per Foot
Rental of Equipment		$1.72
Labor		17.58
Supplies		
Explosives	$2.50	
Fuel	3.25	
Pipe and track	.80	
Steel and bits	1.41	
Other	.55	8.51
Repairs		.75
Supervision and Engineering		1.25
	Total cost	$29.81

Estimated Cost of Project

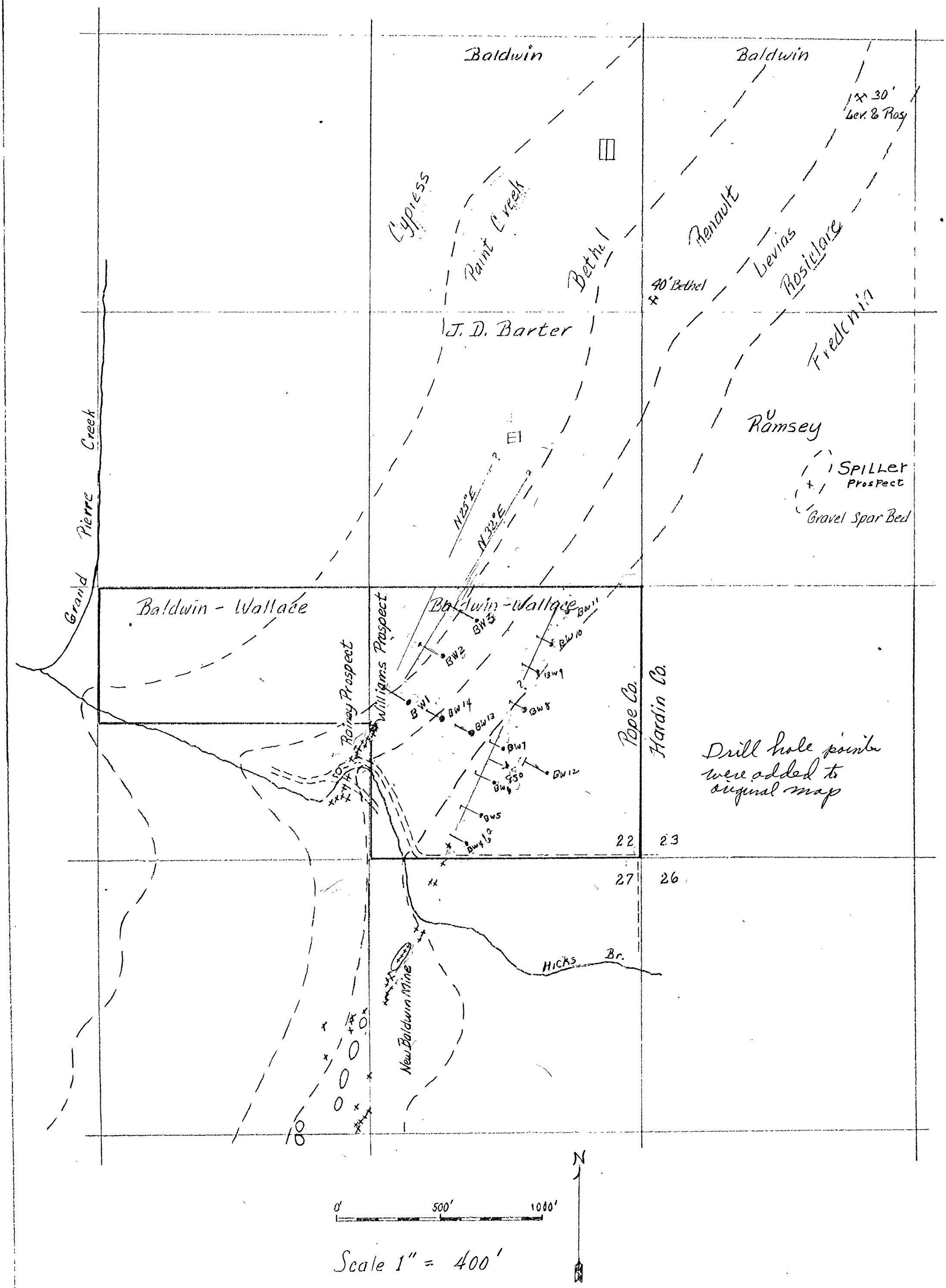
920 feet x $29.81 = $27,425.20

Bear Canyon Mining Co. (10%)	$2,742.52
Defense Minerals Administration(90%)	24,682.68
	$27,425.20

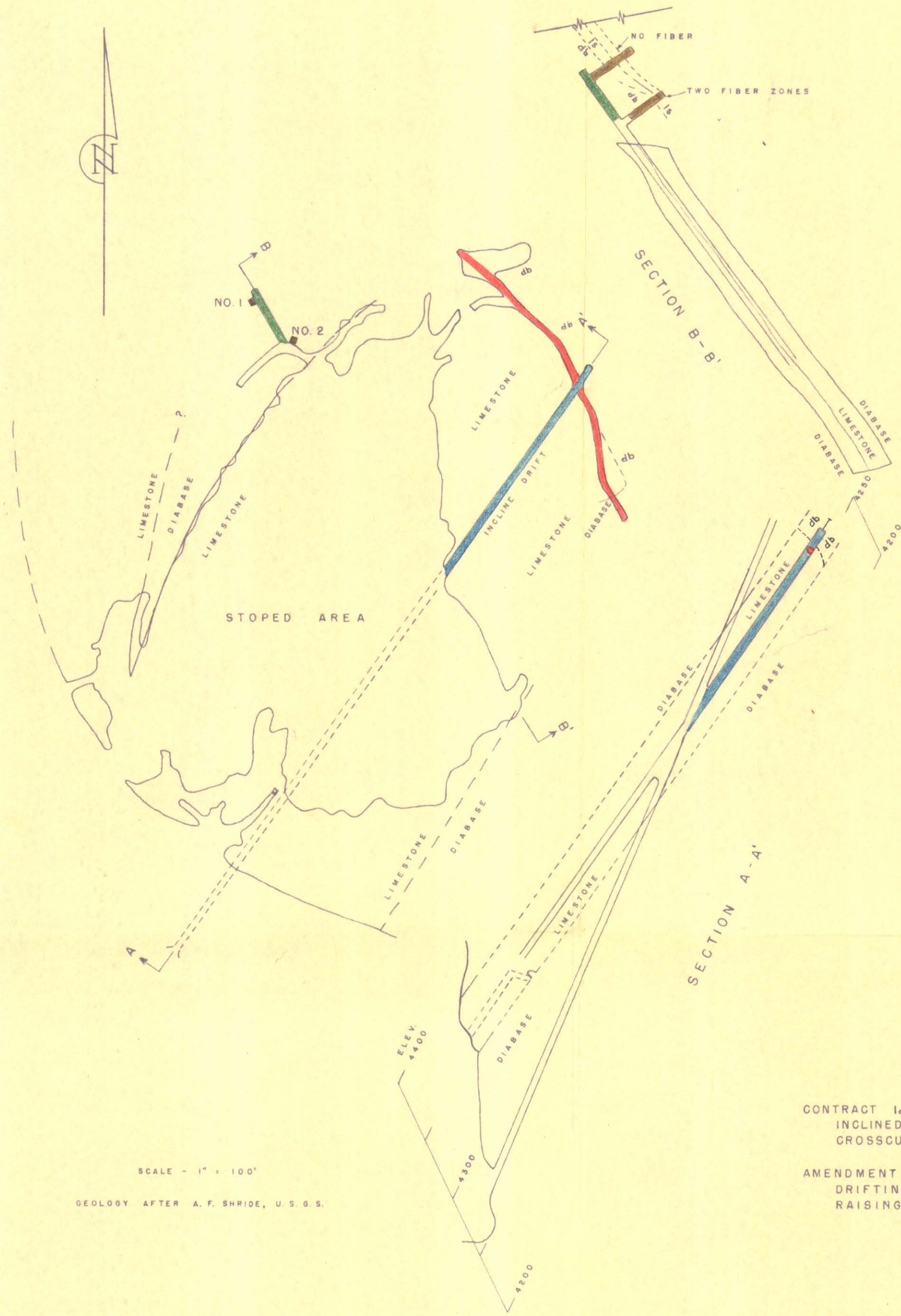
Wallace Baldwin, Gaylord Wallace
Route 3
Harrisburg, Ill.

Baldwin - Wallace Property

Sections 22-23-26-27 T.11S.- R.7E. Pope & Hardin Co's



Illinois State Geological Survey



EXPLORATION

		FEET
CONTRACT Idm-E 446		
INCLINED DRIFTING		260
CROSSCUTTING		338
AMENDMENT NO. 1		
DRIFTING		62.5
RAISING		98.0

SCALE - 1" = 100'

GEOLOGY AFTER A. F. SHRIDE, U. S. G. S.

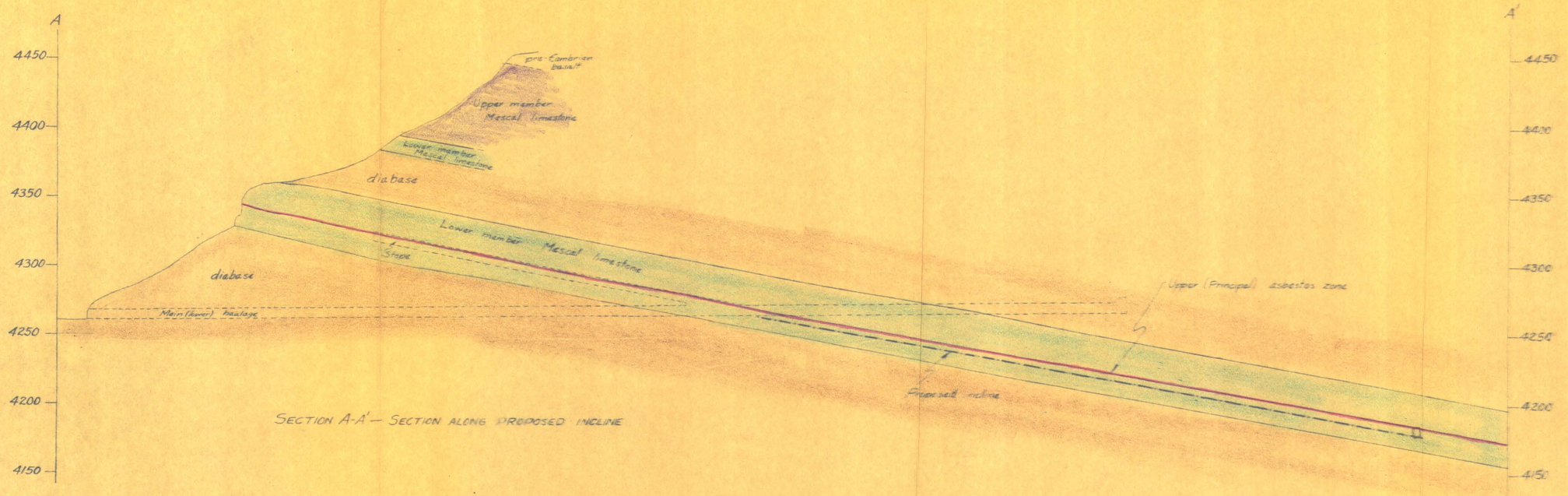
OCTOBER 1953

DMEA 2550

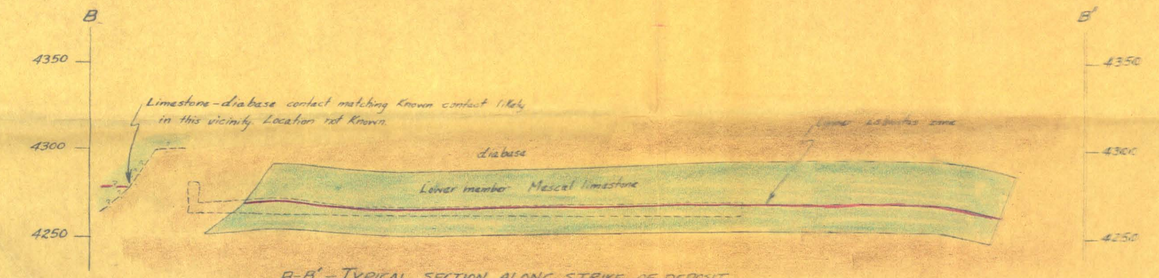
FIGURE 2. - GENERALIZED GEOLOGIC SKETCH SHOWING WORK PERFORMED UNDER CONTRACT Idm-E 446

BEAR CANYON ASBESTOS MINE

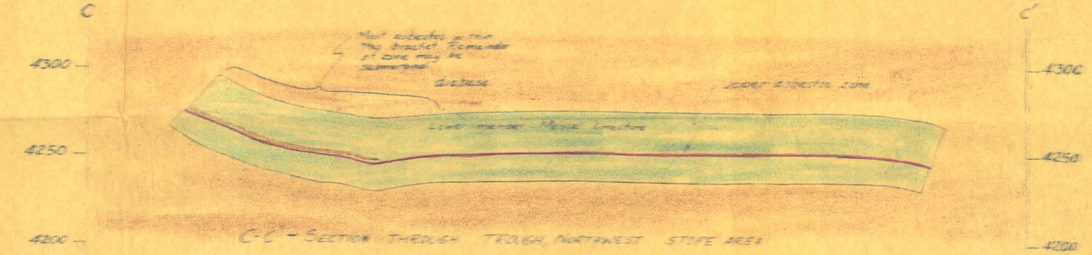
GILA COUNTY, ARIZONA



SECTION A-A' — SECTION ALONG PROPOSED INCLINE



B-B' — TYPICAL SECTION ALONG STRIKE OF DEPOSIT



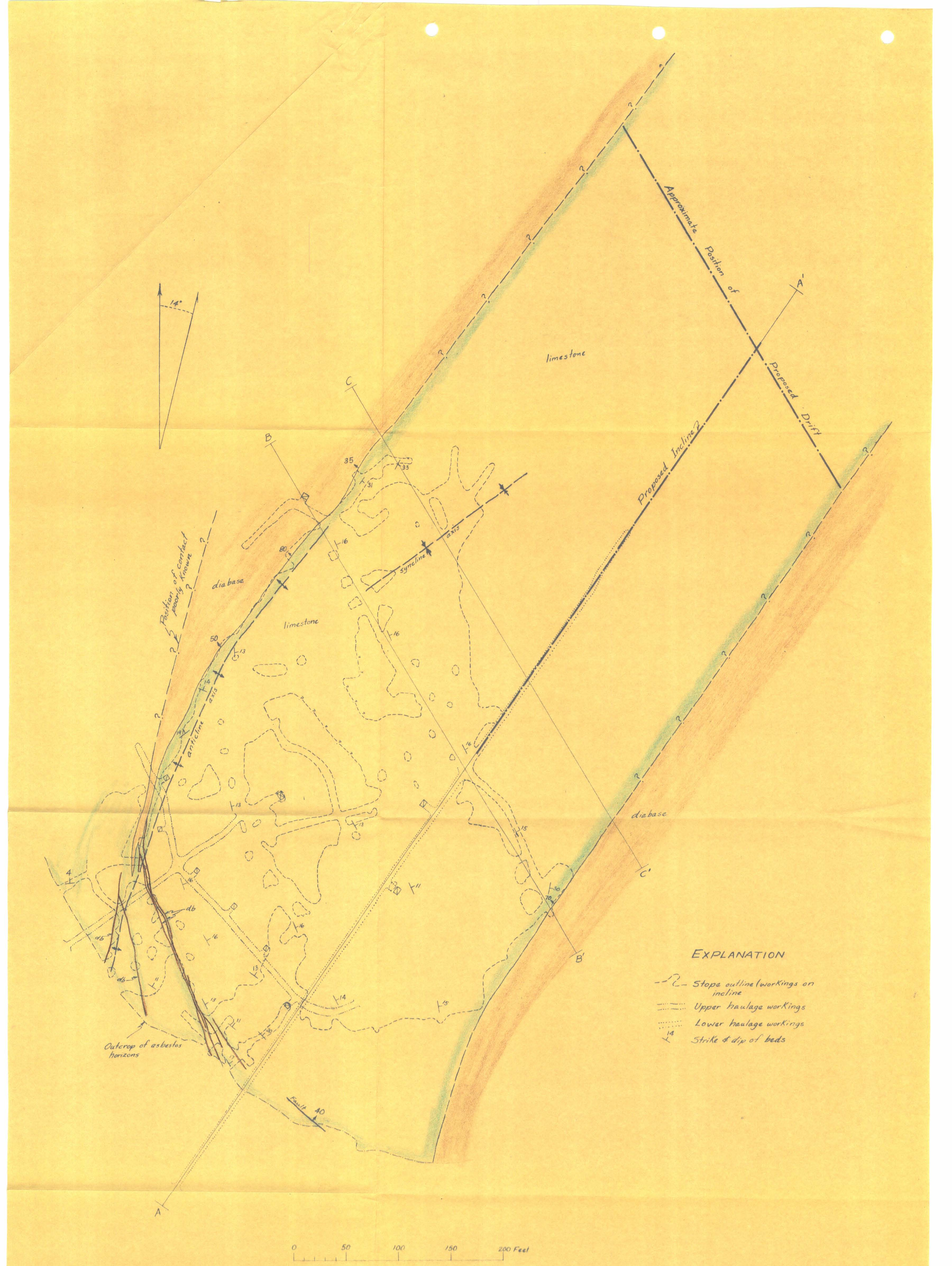
C-C' — SECTION THROUGH TROUGH, NORTHWEST STOPE AREA

NOTE: Sections B-B' and C-C' are typical of the structure that may be encountered in the proposed horizontal drifts.

FIGURE 5 — GEOLOGIC SECTIONS, BEAR CANYON ASBESTOS DEPOSIT, GILA COUNTY, ARIZONA

0 50 100 Feet

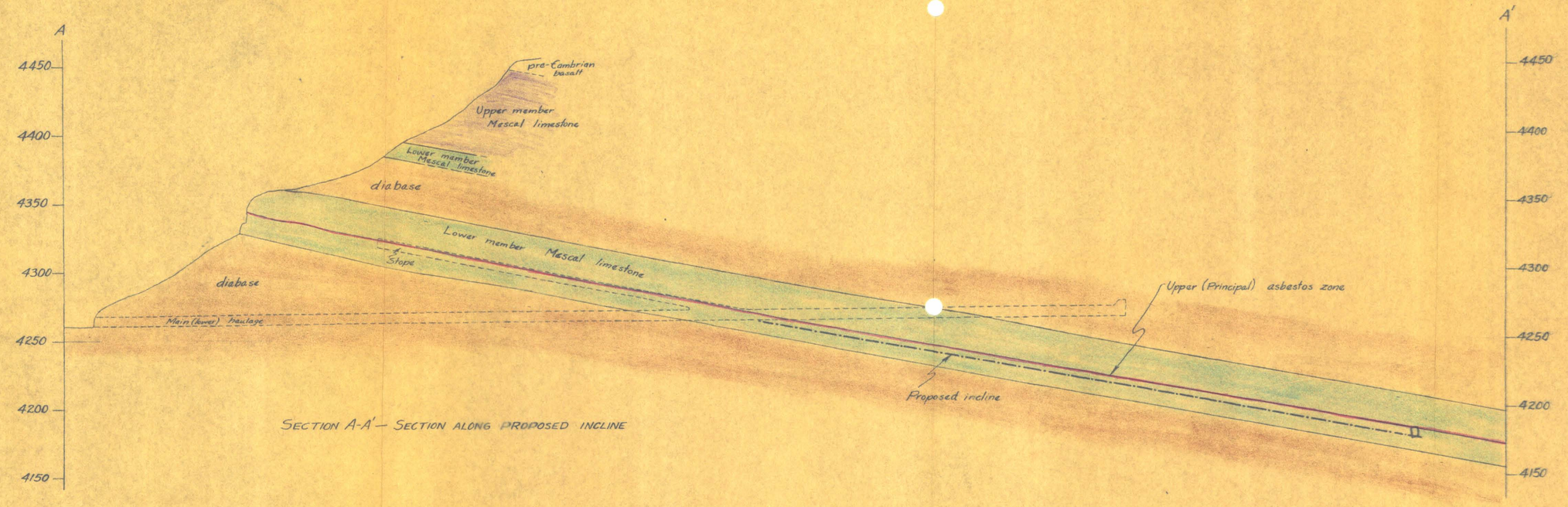
DMEA-2550



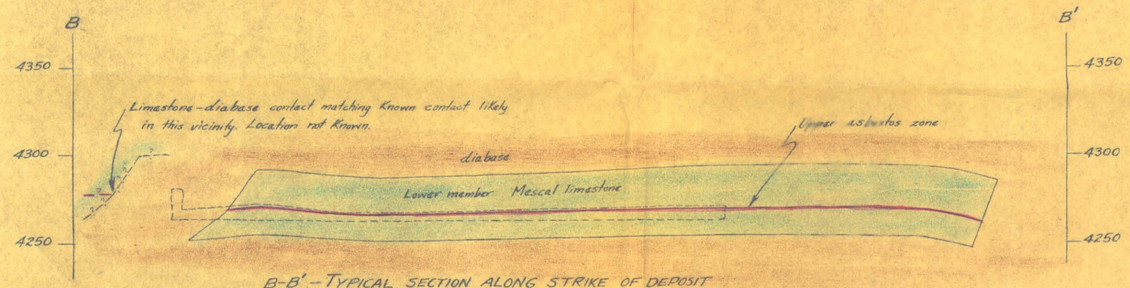
GEOLOGIC MAP, BEAR CANYON ASBESTOS DEPOSIT

FIGURE 4

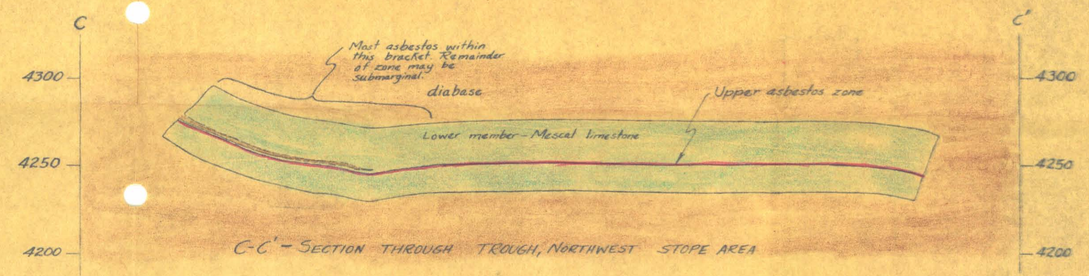
DMEA-2550



SECTION A-A' — SECTION ALONG PROPOSED INCLINE



B-B' — TYPICAL SECTION ALONG STRIKE OF DEPOSIT



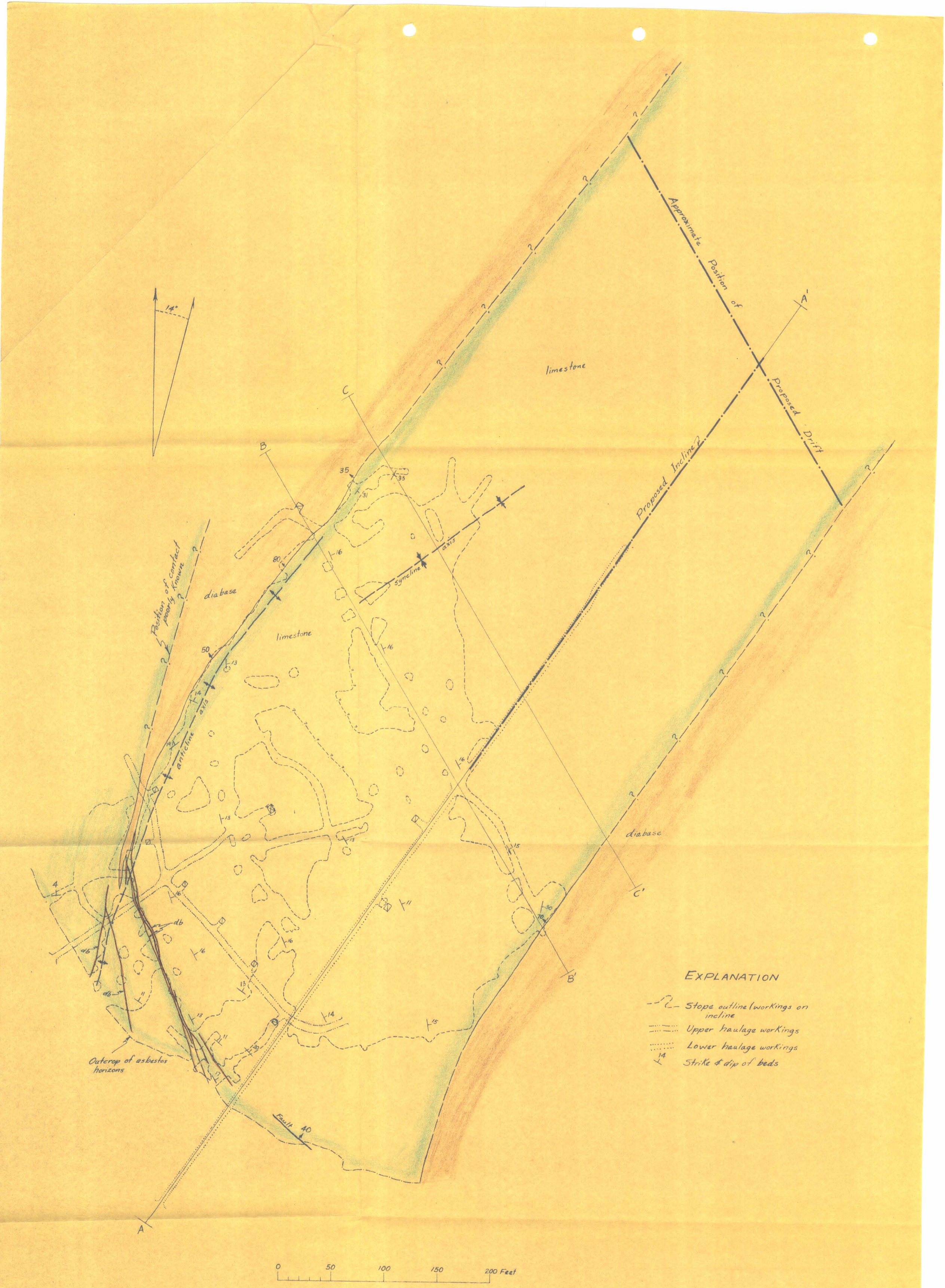
C-C' — SECTION THROUGH TROUGH, NORTHWEST STOPE AREA

NOTE: Sections B-B' and C-C' are typical of the structure that may be encountered in the proposed horizontal drifts.

FIGURE 5 — GEOLOGIC SECTIONS, BEAR CANYON ASBESTOS DEPOSIT, GILA COUNTY, ARIZONA

0 50 100 Feet

DMEA-2550



GEOLOGIC MAP, BEAR CANYON ASBESTOS DEPOSIT

FIGURE 4

DMEA-2550

Brunton Survey
PLAN AND SECTION
of the
Bear Canyon Mine
Scale 1" = 50'
July 6, 1952 J. J. Brewer

LEGEND
- Limestone
- Diabase
- Asbestos Vein
- Proposed Development Work

Accompanied June MF 102

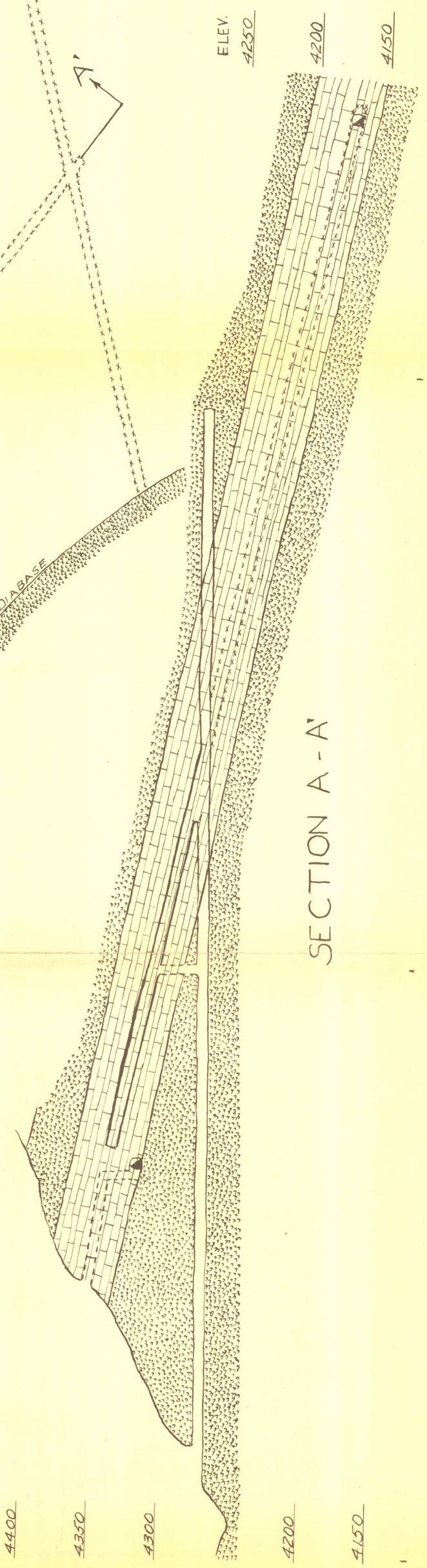
Brunton Survey
PLAN AND SECTION of the Bear Canyon Mine

Scale 1" = 50'

July 6, 1952 J. J. Brewer

LEGEND

- Limestone
- Diabase
- Asbestos Vein
- Proposed Development Work



Accompanied Rept. 701 F 10 L