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PRINTED: 06-11-2003

ARIZONA DEPARTMENT OF MINES AND MINERAL RESOURCES AZMILS DATA

PRIMARY NAME: MICA GIANT

ALTERNATE NAMES:
WAYNE MICA

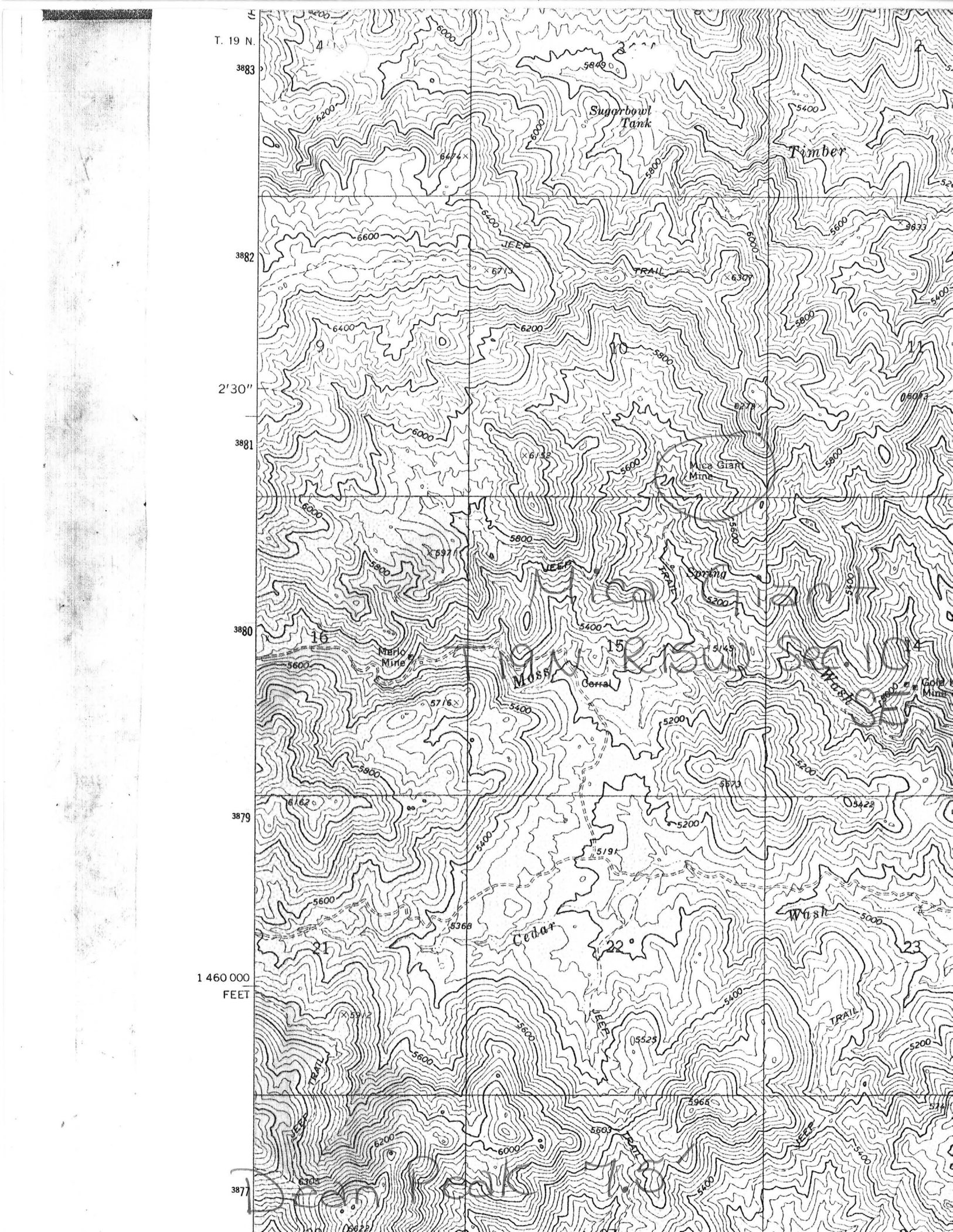
MOHAVE COUNTY MILS NUMBER: 524A

LOCATION: TOWNSHIP 19 N RANGE 15 W SECTION 10 QUARTER SE
LATITUDE: N 35DEG 02MIN 16SEC LONGITUDE: W 113DEG 51MIN 04SEC
TOPO MAP NAME: DEAN PEAK - 7.5 MIN

CURRENT STATUS: PAST PRODUCER

COMMODITY:
MICA
FELDSPAR

BIBLIOGRAPHY:
USGS DEAN PEAK QUAD
ADMMR FILES
ELEVATORSKI, E.A., ADMMR IND MIN. RPT. 2, P43
ADMMR MICA GIANT MINE FILE
BLM RES. ANALYSIS STEP 3 & 4, HUALAPAI UNIT
MEEVES, H., ET.AL., USBM IC 8298, P. 20
MOORE, R.T., AZBM BULL 180, P. 402
USGS RI 8457, P. 8


T. 19 N.
3883
3882
3881
3880
3879
3877
2'30"
1 460 000
FEET
Sugarbowl Tank
Timber
JEEP
TRAIL
Mica Giant Mine
Spring
Merlo Mine
Moss Corral
Wash
Cedar
Wash
Gold Mine
Mica Mountain
T 19 N R 5 W Sec. 10
Deem Peak 7.5'
4
5
9
10
11
15
16
21
22
23
14
6400
6600
6200
6000
5800
5600
5400
5200
6474
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5971
5716
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5573
5423
5191
5368
5525
5965
5603
6303

Arizona Department of Mines and Mineral Resources

INFORMATION FROM MINE CARDS IN MUSEUM

ARIZONA

Mohave Co.
28 mi from Kingman
Maynard Mining Dist.
Mica Giant Mine

MM-K111 Muscovite
K113 Muscovite
K114 Muscovite
K115 Muscovite

MILS # 524 A
1-AKA
MICA GIANT (file)

DEPARTMENT OF MINERAL RESOURCES
State of Arizona
Mineral Building, Fairgrounds
PHOENIX, ARIZONA

PHOENIX, ARIZ.
APR 14 7-PM
1958

RETURNED TO WRITER
REASON CHECKED
Unclaimed
Unknown
Insufficient address
Moved, Left no address
No such office in state
Refused
Do not remail in this envelope
POSTAGE DUE 2 CENTS

Mr. Robert Morgan
Kingman,
Arizona

APR 25 1958

DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
Mineral Building, Fairgrounds
PHOENIX, ARIZONA

PHOENIX, ARIZ.
APR 28 4-30PM
1958

RETURNED TO WRITER
REASON CHECKED
Unclaimed
Unknown
Insufficient address
Moved, Left no address
No such office in state
Refused
Do not remail in this envelope
POSTAGE DUE 2 CENTS

Mr. Roy V. Waughtel
Box 186
Kingman, Arizona

MICA GIANT MOHAVE COUNTY

KAP WR 7/26/85: The Mica Giant Deposit (file), Mohave County is located on Public Lands and held by a single lode claim, the Mica Giant (AMC #206234) is located in the SE$\frac{1}{4}$, Sec 10, T19N R15W on 9/01/83 by Jerry Merlo, 908 Via Mirada, Palos Verdes Estat s, California 90274. Mr. Merlo was contacted by letter in late July of 1985 for information for the files and for an appointment to meet with him in Southern California to discuss his plans for development at the property. As of September 12, 1985 there has been no response.

ARIZONA DEPARTMENT OF MINERAL RESOURCES
MINERAL BUILDING, FAIRGROUNDS
PHOENIX, ARIZONA

April 14, 1958

To the Owner or Operator of the Arizona Mining Property named below:

Mica Giant & Wyane Group (Mohave) Book Mica or white clear muscovite
(Property) (ore)

We have an old listing of the above property which we would like to have brought up to date.

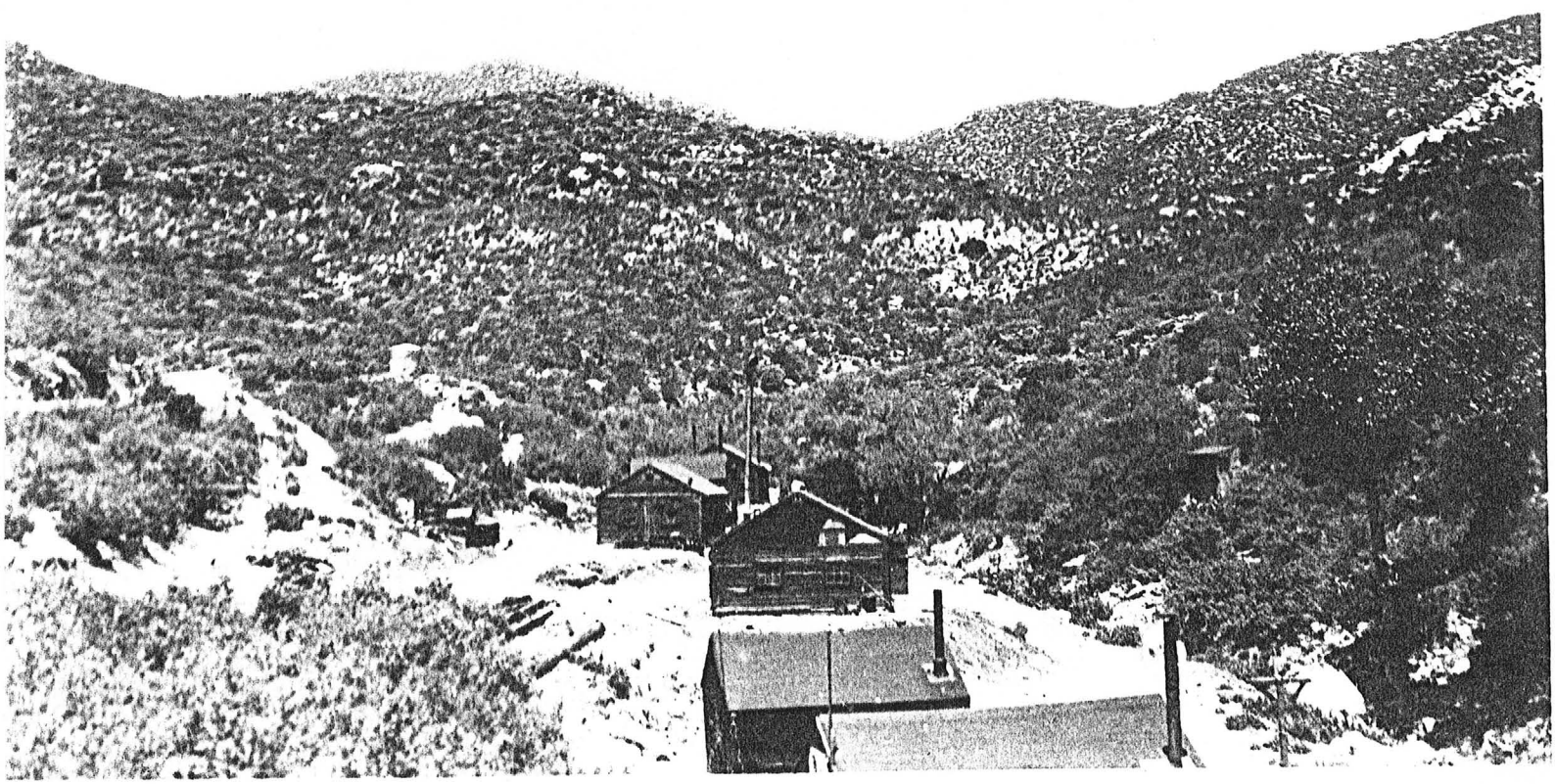
Please fill out the enclosed Mine Owner's Report form with as complete detail as possible and attach copies of reports, maps, assay returns, shipment returns or other data which you have not sent us before and which might interest a prospective buyer in looking at the property.

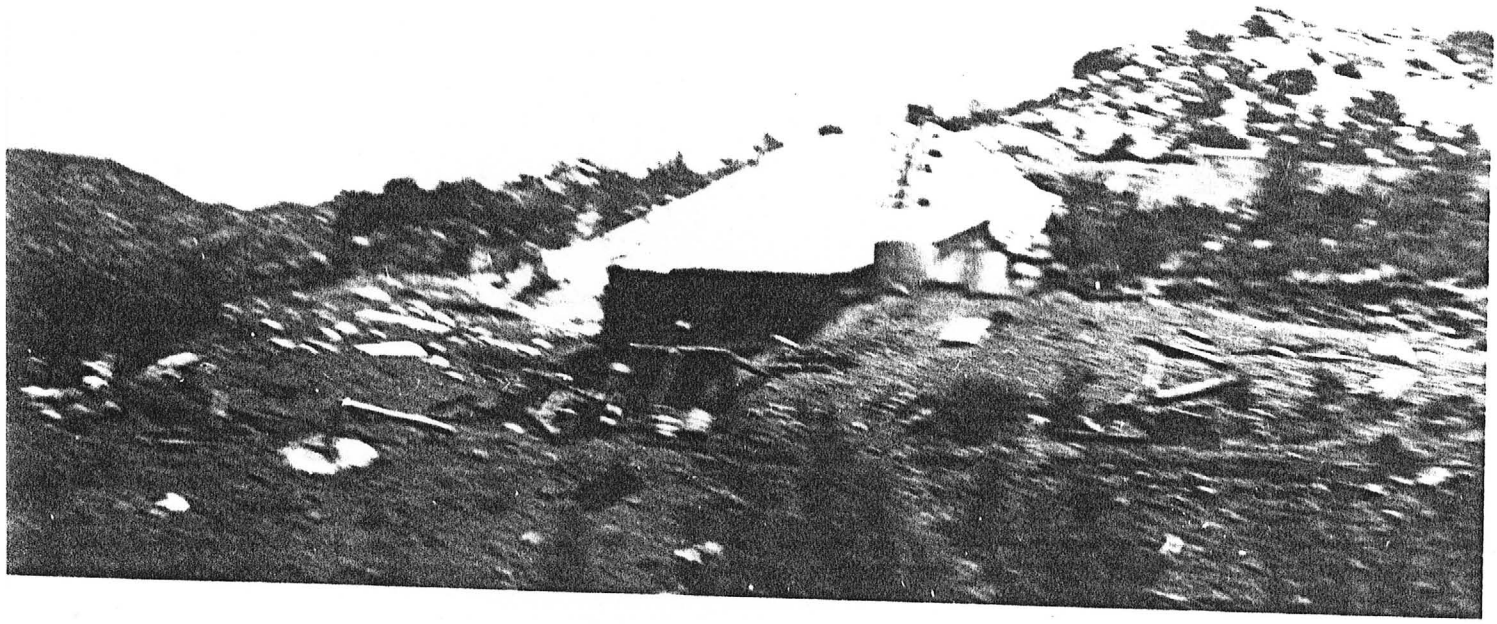
Frank P. Knight

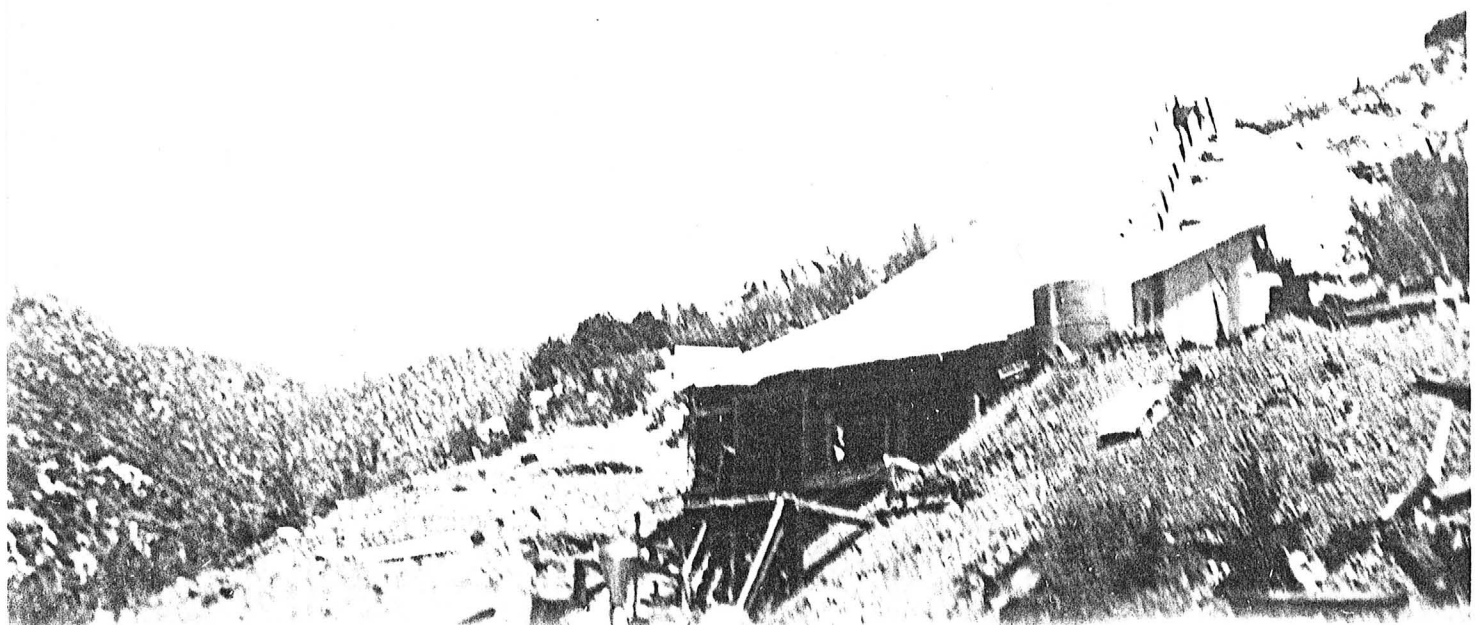
FRANK P. KNIGHT,
Director.

Enc: Mine Owner's Report

SEE RI 8457 p-8







December 28, 1945

Mr. John G. Becker
Box 186
Kingman, Arizona

Dear Mr. Becker:

Charlie Willis wants a little article for Pay Dirt on the outlook for our nonmetallic mining industry and I would like to include a paragraph on your operation.

Will you give me the latest on your situation, including an outline of your plant, grades (sizes) produced, and markets and prices?

Trusting you are progressing well.

Yours very truly,

Chas. H. Dunning
Director

CHD:LP

1 December 1941

Mr. T. Mac Smith,
2046 E. Helen,
Tucson, Arizona.

My dear Mr. Smith:

I am today mailing the copy of the Report of Philip S. Hoyt, Mining Geologist, on your MICA GIANT property to Mr. Fred P. Leaming, 1245 North Vine Street, Los Angeles, California.

Trusting that this contact may be helpful to you, and with best wishes, I am

Yours very truly,

J. S. Coupal

JSC-jrf

October 23, 1945

Mr. Henry L. Jackson
Box 343
Brawley, California

Dear Mr. Jackson:

Your letter of October 18 has been handed to me for reply.

As to the Mica Giant property the information that you included in your letter is practically correct. This property is considered one of our best mica properties in the State, however, I think they are a little optimistic in giving themselves too large a percentage of book mica. It is my opinion that 15 to 20 percent mica would cover the total mica contents in the dike. The pegmatite dike in which this occurs is from 30 to probably more than 70 feet but would average, I think, easily 50 feet in width.

With reference to your Plumosa property we will keep that in mind and will present it to any inquiring parties and should they be interested, we will gladly have them contact you so that you can make your own arrangements.

Yours very truly,

A. C. Nebeker
Field Engineer

ACN:LP

DEPARTMENT OF MINERAL RESOURCES

REPORT TO OPA ON ACTIVE MINING PROJECT

Date Apr 24 - 1945

Name of Mine Mica Giant + Waynma Group

Owner or Operator Great Western Mica Corp.

Address 42 West Palm Lane

Mine Location 32 mi from Kingman

Filing Information

File System.....

File No.....

This chart to be used for gallons of gasoline required per month.

PRESENT OPERATIONS: (check X)

Production ✓; Development ✓; Financing.....; Sale of mine.....;

Experimental (sampling).....; Owner's occasional trip.....;

Other (specify).....

PRODUCTION: Past and Future.

	Tons
Approx. tons last 3 months	
Approx. present rate per 3 months	
Anticipated rate next 3 months	
If in distant future check (X) here	

EQUIPMENT OPERATED:

Type	Quantity or Horse Power	Miles or Hours Per Month	Gallons Required Per Month
Personal Cars			
Light or Service Trucks			
Ore Hauling Trucks	95	4000	
Compressors			
Other Mine or Mill Eqpt.			

PRODUCT PRODUCED OR CONTEMPLATED: Name metals or minerals.

Mica Strategic

REMARKS:

This mica is beneficial for war effort. and company able to keep on!

Application Approved

ARIZONA DEPARTMENT OF MINERAL RESOURCES

By [illegible]

Field Engineer D. of M. R.

DEPARTMENT OF MINERAL RESOURCES

REPORT TO OPA ON ACTIVE MINING PROJECT

Filing Information

File System.....

File No.....

This chart to be used for gallons of gasoline required per month.

Date April 1st, 1945

Name of Mine McCleant + Wayne

Owner or Operator Boyd V. Waughtal

Address / Kingman

Mine Location 32 mi. out from Kingman

PRESENT OPERATIONS: (check X)

Production ✓; Development ✓; Financing.....; Sale of mine.....;

Experimental (sampling).....; Owner's occasional trip.....;

Other (specify) Used for mining mica

PRODUCTION: Past and Future.

	Tons
Approx. tons last 3 months	
Approx. present rate per 3 months	
Anticipated rate next 3 months	
If in distant future check (X) here	

EQUIPMENT OPERATED:

Type	Quantity or Horse Power	Miles or Hours Per Month	Gallons Required Per ~~Month~~ Quarter
Personal Cars	✓		300
Light or Service Trucks			~~2~~
Ore Hauling Trucks			
Compressors			
Other Mine or Mill Eqpt.			

PRODUCT PRODUCED OR CONTEMPLATED: Name metals or minerals.

mica

REMARKS:

This property has been producing mica which is a strategic material

ARIZONA DEPARTMENT OF MINERAL RESOURCES

By G. B. Tobin

Field Engineer

DEPARTMENT OF MINERAL RESOURCES

REPORT TO OPA ON ACTIVE MINING PROJECT

Date 5/19/45

Name of Mine Mica Queen

Owner or Operator J. G. Parker

Address 42 West Palm Lane Phoenix

Mine Location 32 Miles South of Kingman

Filing Information

File System

File No.

This chart to be used for gallons of gasoline required per month.

PRESENT OPERATIONS: (check X)

Production X; Development ; Financing ; Sale of mine ;

Experimental (sampling) ; Owner's occasional trip ;

Other (specify)

PRODUCTION: Past and Future.

	Tons
Approx. tons last 3 months	
Approx. present rate per 3 months	Considerable
Anticipated rate next 3 months	
If in distant future check (X) here	

EQUIPMENT OPERATED:

Type	Quantity or Horse Power	Miles or Hours Per Month	Gallons Required Per Month
Personal Cars	1	1800	120
Light or Service Trucks			
Ore Hauling Trucks			
Compressors			
Other Mine or Mill Eqpt.			

PRODUCT PRODUCED OR CONTEMPLATED: Name metals or minerals.

Mica - Sheet & ground.

REMARKS:

A producing and important operation
Mr. Parker is lessee - operator

ARIZONA DEPARTMENT OF MINERAL RESOURCES

By Chas. F. Blakeney

2046 East Helen,
Tucson, Arizona.
Nov. 28 th 1941.

Mr. Sam Coupel,
A.S.M.O. Pres.
Title Trust Bld.,
Phoenix, Arizona.

Dear Sam:-

Supplimenting our conversation of Wednesday night, I am sending you herewith, a copy of the report on my mica property, which is located in Mohave County, and which is made by Philip S. Hoyt, the most conservative non-metalic engineer that I know of. The report speaks for itself, and I trust that you will have the opportunity to give the data contained in the same to many mining people.

Thanking you for your co-operation, and with regards, I am,

Yours very truly,

T. Mac Smith

T. Mac Smith,
2046 East Helen,
Tucson, Arizoana.

Name of Mine or Prospect:	Township	Range	Section	Priority
Mica Giant Mine	19N	15W	16 a	C

Principal Minerals:	1:250,000 Quad	7.5' - 15' Quad
Muscovite Mica	Williams	Dean Peak
Associated Minerals:	District	Principal Product
	Maynard	Mica
Type of Operation:	County / State	Type of Deposit
	Mohave / Ar.	Vein

Ownership or Controlling Interest:
Consult current USBLM mining claim records

Access: From Wikieup, Ar. proceed north on U.S. 93 for 18 miles. Turn left on light duty road for 10.25 miles. Turn left on unimproved road and travel 2.5 miles. Turn right and proceed on jeep trail 1 mile. Mine is shown on topographical quadrangle.

Structural Control or Geological Association:

"Muscovite books in pegmatite."[1]

"Past production of sheet and scrap mica; muscovite books in pegmatite."[2]

"Dikes; in granite."[3]

Age of Mineralization:

Production History	Geochemical Analyses
Operated 1944-1977[1]	

References

1) ABM (1969) Bull. 180, p. 398-403.
2) Elevatorski (1979) p. 43.
3) Meeves & Others (1966) p. 20.

SPECIMEN Mi - 4 X 111

Cabinet

Section

Shelf

Presented by T. Mac Smith

Collected by T. Mac Smith

Date received October 9, 1945

Class (principal mineral) Electrical Mica

Other minerals Feldspar

Gangue Pegmatite

Depth at which specimen taken Surface to 100 ft.

Approximate mineral content (in terms of average per ton)

Quantity Strategic Mica, U. S. Gov. paid

Value $

$6 per lb. for 1"x1" full trimmed

$8 per pound for 1½" x 2" full trimmed

Name of mine or claim Mica Giant

Group Mica Giant

District Maynard Mining District

County Mohave

Location (distance and direction by highway from what town) 28 miles from Kingman, Sandy route

Mine active or inactive Active

If inactive, when operated

Owner T. Mac Smith

Operator Great Westerm Mica Co.

Notes: Only mine in sixx western states shipping strategic mica to U. S. government during World War II

3 16 26.0 X 20.0 X 2.0 cm

MINERAL SPECIMEN FOR DEPARTMENT OF LIBRARY AND ARCHIVES K113

Specimen No. ____, collected by _____ Date 10-9-45
(Wrap each specimen, or place in a substantial bag, separately, with a number identical with the number on this card)

E. L. Wayne

Name of ore SCRAP MICA

Minerals contained MICA & FELDSPAR

Gangue PEGMATITE

Depth at which taken SURFACE TO 100 FT DEPTH

Approximate mineral content (in terms of average per ton):

	Quantity or %	Value
Copper		$
Gold		
Silver		
SCRAP MICA		$30.00 PER TON CHICAGO. ILL.
GROUND MICA 50 MESH		$50.00 PER TON CHICAGO
DO DO 80 DO		$80.00 " " "

Name of mine or claim MICA GIANT & WAYNE

Group MICA GIANT & WAYNE GROUP

District MAYNARD MINING DISTRICT

County MOHAVE

Location (distance and direction by highway from what town) 26 MILES FROM KINGMAN SANDY ROUTE

Owner of property T. MAC SMITH & ROY V. WAUGHTEL

Operator GREAT WESTERN MICA CO.

Mine active or inactive ACTIVE

If inactive, when operated _____

Specimen presented by T. MAC SMITH

Notes: CHICAGO MICA CO'S HAVE OFFERED TO BUY TOTAL PRODUCTION OF SCRAP GROUND MICA @ ABOUT $1.00 PER MESH GROUND. FROM THESE PROPERTIES

P.6

MINERAL SPECIMEN FOR DEPARTMENT OF LIBRARY AND ARCHIVES

K 114

Specimen No. ____, collected by _____ Date 10-9-45
(Wrap each specimen, or place in a substantial bag, separately, with a number identical with the number on this card)

Name of ore ELECTRICAL MICA

Minerals contained MICA & FELDSPAR

Gangue PEGMATITE

Depth at which taken SURFACE TO 100 FT DEPTH

Approximate mineral content (in terms of average per ton):

	Quantity or %	Value
Copper		$
Gold		
Silver		
STRATEGIC MICA		
U.S. GOVERNMENT PAID	$6.00 PER POUND FOR	
	1" X 1" FULL TRIMMED	
Do. Do	DO $8.00 PER POUND FOR	

Name of mine or claim MICA GIANT

Group MICA GIANT

District MAYHARD MINING DISTRICT

County MOHAVE

Location (distance and direction by highway from what town) 28 MILES FROM KINGMAN/ SANDY ROUTE

Owner of property T. MAC SMITH

Operator GREAT WESTERN MICA CO.

Mine active or inactive ACTIVE

If inactive, when operated _____

Specimen presented by T. MAC SMITH

Notes: ONLY MINE IN SIX WESTERN STATES SHIPPING STRATEGIC MICA TO U.S. GOVERNMENT DURING WAR

Arizona Department of Mines and Mineral Resources

INFORMATION FROM MINE CARDS IN MUSEUM

ARIZONA

Mohave Co.
28 mi from Kingman
Maynard Mining Dist.
Mica Giant Mine

MM-K111 Muscovite
K113 Muscovite
K114 Muscovite
K115 Muscovite

MILS # 524 A
1-AKA
MICA GIANT (file)

MICA GIANT MOHAVE COUNTY

KAP WR 7/26/85: The Mica Giant Deposit (file), Mohave County is located on Public Lands and held by a single lode claim, the Mica Giant (AMC #206234) is located in the $SE\frac{1}{4}$, Sec 10, T19N R15W on 9/01/83 by Jerry Merlo, 908 Via Mirada, Palos Verdes Estat s, California 90274. Mr. Merlo was contacted by letter in late July of 1985 for information for the files and for an appointment to meet with him in Southern California to discuss his plans for development at the property. As of September 12, 1985 there has been no response.

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A.S.M.O. Pres.
Title Trust Bld.,
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Thanking you for your co-operation, and with regards, I am,

Yours very truly,

T. Mac Smith

T. Mac Smith,
2046 East Helen,
Tucson, Arizoana.

Bureau of Mines Report of Investigations/1980

See page 8

Pneumatic Concentration of Mica

By C. E. Jordan, G. V. Sullivan, and B. E. Davis

UNITED STATES DEPARTMENT OF THE INTERIOR

Report of Investigations 8457

Pneumatic Concentration of Mica

By C. E. Jordan, G. V. Sullivan, and B. E. Davis

UNITED STATES DEPARTMENT OF THE INTERIOR
Cecil D. Andrus, Secretary

BUREAU OF MINES

This publication has been cataloged as follows:

Jordan, C E
Pneumatic concentration of mica.

(Report of investigations • U.S.Bureau of Mines ; 8457)
Bibliography: p. 24.
Supt. of Docs. no.: I 28.23:8457.

1. Ore-dressing. 2. Mica. 3. Air classifiers. I. Sullivan, G. V., joint author. II. Davis, Broderick E., joint author. III. Title. IV. Series: United States. Bureau of Mines. Report of investigations ; 8457.

TN23.U43 [TN933] 622s [622'.36'74] 79-607934

CONTENTS

ILLUSTRATIONS

TABLES

PNEUMATIC CONCENTRATION OF MICA

by

C. E. Jordan,[1] G. V. Sullivan,[2] and B. E. Davis[3]

ABSTRACT

The Bureau of Mines is conducting research into the pneumatic recovery of coarse mica and has used this method to produce mica concentrates that contain more than 90 percent mica. This research is being carried out pursuant to the Bureau's objective to develop technology that will help maintain an adequate supply of minerals and metals to meet national economic and strategic needs.

Researchers used a Bureau-designed system of crushers, screens, and zigzag air classifiers to concentrate coarse liberated mica particles from mica-bearing materials. This pneumatic system was used to concentrate four mica ores from Arizona, North Carolina, and South Dakota and three waste tailings from Alabama, Georgia, and South Dakota. Using these samples, it was demonstrated that plus 65-mesh size mica can be effectively recovered by the pneumatic method. Not only were the concentrates high in mica content; it was also demonstrated that this method can be used to recover up to 78 percent of the mica that was originally contained in the samples.

Because it is a dry concentration method, the pneumatic beneficiation technique may be advantageous in areas where water resources are limited.

INTRODUCTION

As part of the Bureau of Mines program for advancing minerals technology, the Bureau studied pneumatic processing techniques as a method for concentrating coarse mica from mica ores and mica waste tailings. The pneumatic processing method was investigated as an alternative to methods currently used for the recovery of both sheet mica and coarse flake mica.

---

[1]Metallurgist.
[2]Supervisory metallurgist.
[3]Minerals engineer.

Although there are two major commercial mica minerals, muscovite and phlogopite, the research described in this report was conducted exclusively with muscovite. Therefore, unless otherwise stated, mica is used throughout this report to mean muscovite.

The two primary forms of commercial mica are (1) sheet mica and (2) scrap and flake mica. Sheet mica is relatively flat and free of structural defects and is used in the electronics and electrical industries. The American Society for Testing and Materials (ASTM) has designated 12 quality groups for sheet mica. These designations are based on the quantity of visible inclusions and structural imperfections; they range from black- and red-stained to perfectly clear. ASTM has also designated 12 grades based on the size of the maximum usable rectangle that can be cut from each piece of sheet mica in the product. Sizes range from grade 6, with one usable square inch, to grade OOEE special, with 100 usable square inches (2).[4]

Scrap and flake mica generally includes any mica of a quality or size that is not suitable for use as sheet mica (5). Most scrap and flake mica is recovered from schists and pegmatites; occasionally, it is also recovered as a secondary product from the beneficiation of feldspar and kaolin. Scrap and flake mica is generally processed into ground mica for various end uses. For example, coarse, dry-ground 5-mesh size mica is used in oil well drilling mud to overcome mud losses when wells are drilled through porous geological formations. Decorative finishes on concrete, stone, and brick are made with 16-mesh size mica. In the manufacture of roll roofing and shingles, 20- and 30-mesh size mica is used to prevent sticking and for weatherproofing. Wallboard joint cements contain 100- and 200-mesh size mica to eliminate cracking and reduce shrinking. Very fine mica is used in paints to improve exterior durability (6).

The domestic supply of scrap and flake mica is reported to be adequate, although there is a short supply of high-quality scrap and flake mica for mica paper production. For its supply of sheet mica, the United States is almost totally dependent on imports (5). The high cost of skilled labor needed to mine and beneficiate sheet mica is prohibitive for many U.S. mica deposits.

Current Beneficiation Methods

Sheet mica is selectively mined and beneficiated by hand. Scrap and flake mica can be recovered by several general methods. The simplest method is to separate the mica from its host rock by differential crushing and screening in washer plants. Crushing has little effect on mica because of its platy, flexible characteristics. This method can effectively recover plus 0.75-inch size mica . Another method utilizes screens, classifiers, and Humphreys spirals to concentrate the mica from the ground ore. This method permits recovery of a finer size mica than is produced by crushing and screening (6). Flotation methods can be used to recover minus 20-mesh size mica. Mica recovery by flotation methods ranges from 70 percent to 92 percent (4).

---

[4]Underlined numbers in parentheses refer to items in the list of references at the end of this report.

Pneumatic Concentration Methods

An alternative technique designed by the Bureau uses crushers, screens, and zigzag air classifiers to concentrate mica. In either sheet or flake form, mica has two dimensions many times larger than the third dimension. After screening the ore into close size fractions, the mica sheets or flakes are significantly lighter than the gangue particles of the same size fraction. Air classification separates the flat, light mica particles from the heavier gangue particles. Although air classifiers are fairly common in the minerals processing industry, the zigzag air classifier is new to this industry. Zigzag air classifiers have been successfully used in the seed- and grain-cleaning industry, and commercial equipment is now being marketed (3).

The pneumatic concentration method has several advantages over present commercial methods for mica concentration. These advantages are listed below:

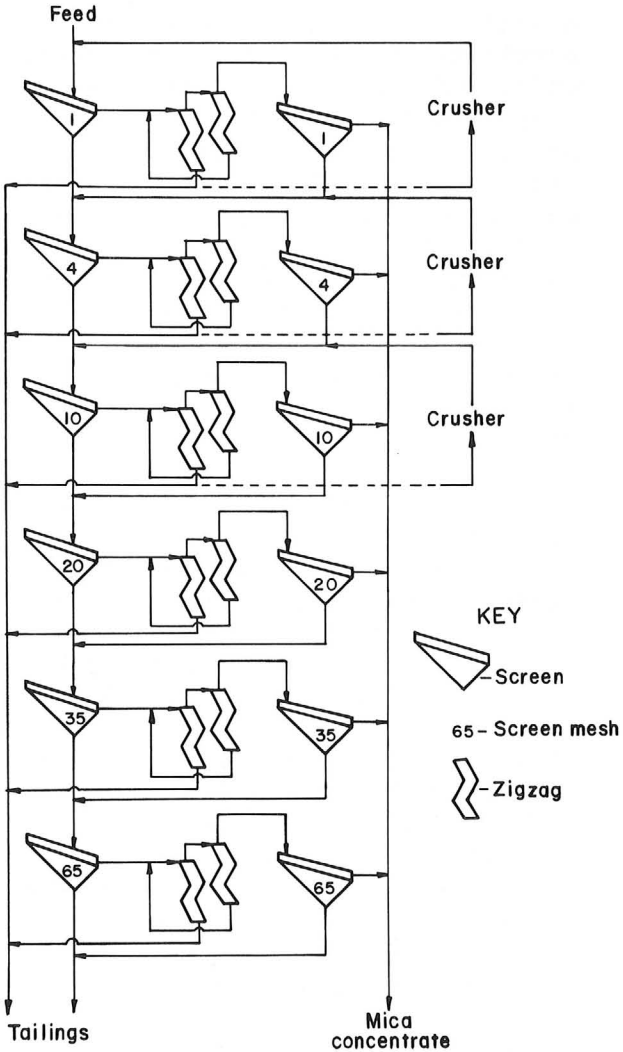


FIGURE 1. - Generalized flow diagram of the Bureau's pneumatic concentration method.

1. Crushing and grinding is limited to the amount necessary to liberate the mica from the host rock.

2. Process tailings are dry, coarse particles that can be easily handled.

3. The method can be used in areas with limited water resources.

4. Use of this method does not result in the water pollution problems associated with the flotation method.

5. Finally, liberated sheet mica particles can be recovered without being subjected to extensive crushing.

DESCRIPTION OF EQUIPMENT AND METHOD

A generalized flow diagram of the Bureau's pneumatic concentration method for mica recovery is shown in figure 1. For this study, three types of ore crushers were employed to liberate mica: a standard jaw crusher, a roll crusher, and a hammer mill. The hammer mill unit was modified by reducing the number of free-swinging hammers from 80 to 10; the 10 remaining hammers were spaced about 3 inches apart. In addition, the crushing screen or grate was removed so that particles received a minimum number of impacts before leaving the unit.

The impact-crushing action of the hammer mill broke and delaminated the mica particles. (Use of the hammer mill without modification resulted in over-crushing of both mica and gangue.) The hammer mill was also used to crush the zigzag tailings from the plus 4-mesh size fractions. Pieces to large to be fed to the hammer mill were broken with a sledge hammer. Only one two-stage zigzag unit was available for this study so that each size fraction was, of necessity, individually processed. The minus 65-mesh fraction could not be effectively treated by this method and was therefore regarded as tailings.

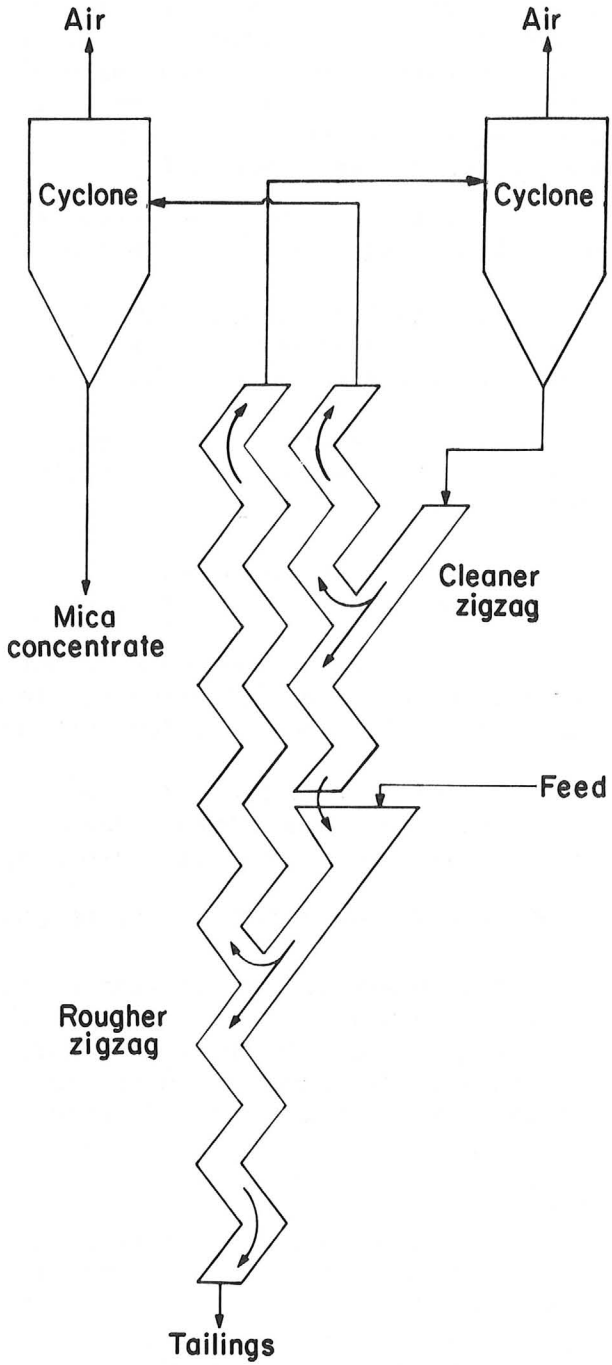
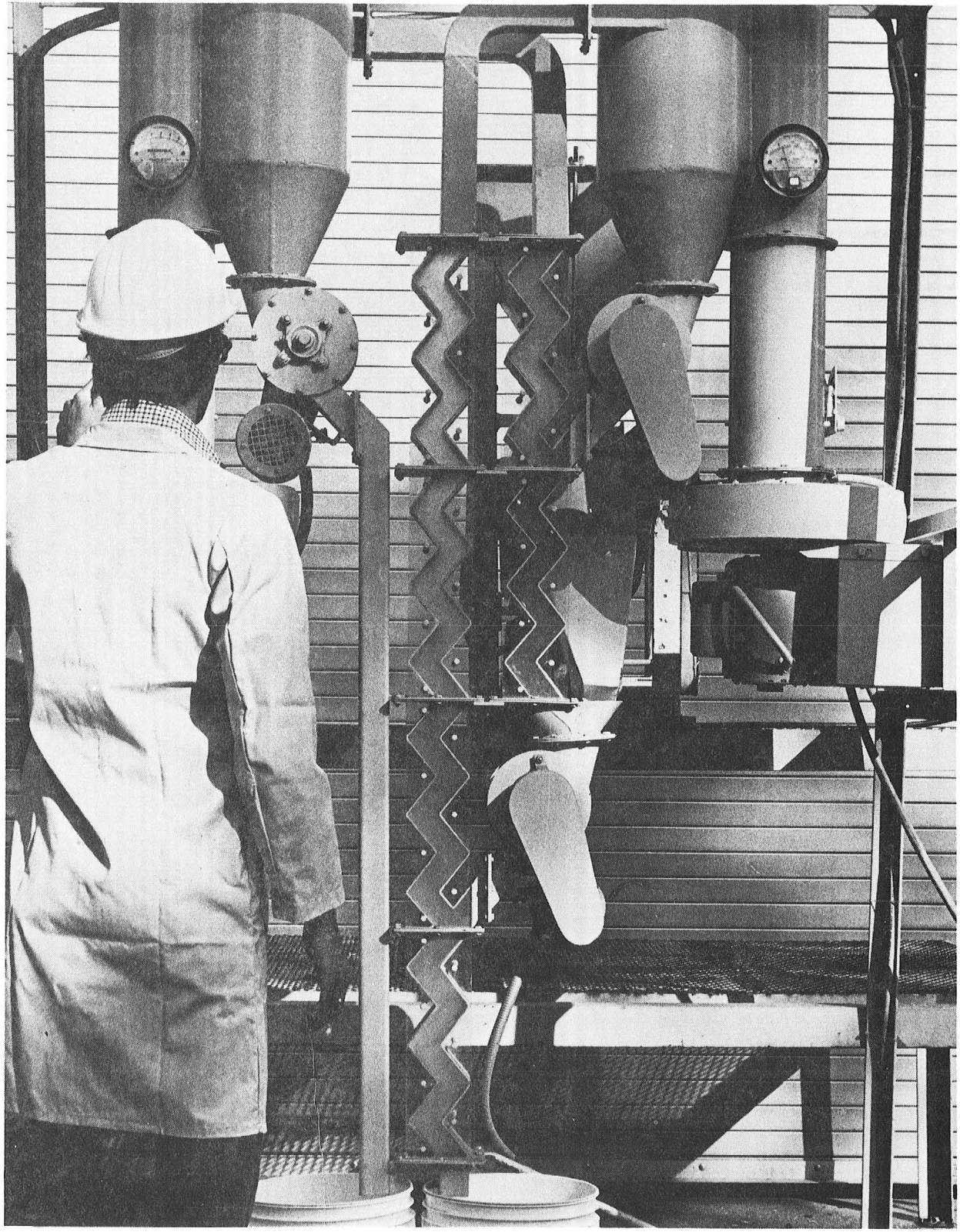
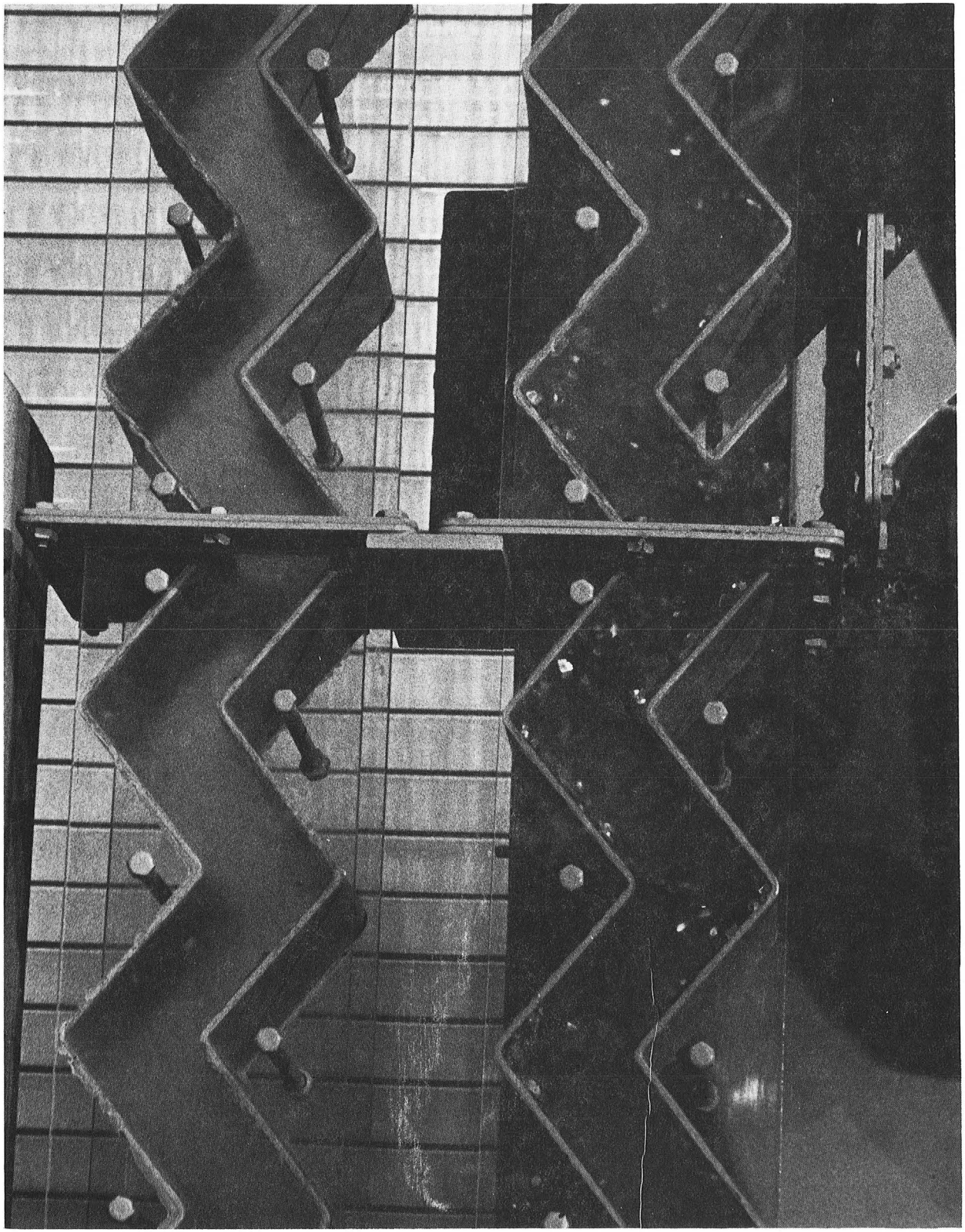


FIGURE 2. - Diagram of two-stage zigzag air classifier.

The Bureau's pneumatic concentration method for mica recovery is designed to process closely sized particles of mica ore. Two screening units and a two-stage zigzag air classifier are used to individually process each size fraction. The oversize particles of the first screen pass through the zigzag air classifier to separate the liberated mica from the host rock. A diagram of the two-stage zigzag air classifier is shown in figure 2. Figure 3 shows the classifier separating mica from gangue minerals, and figure 4 shows a closer view of the separating action.

The ore enters the rougher zigzag section through a rotating air lock. The zigzag sections have a rectangular cross section 1.75 inches wide by 3.75 inches deep. The channel changes direction every 2.5 vertical inches, and the channel sides have a 60° slope from horizontal. Airflow through the classifier can be varied according to the size of the particles being separated. The gangue material falls through the airstream of the rougher zigzag section and is then discarded as tailings. The mica flakes are carried by the airstream to the cyclone shown on the right side of figure 2, where they are collected. This rougher mica concentrate is fed to the cleaner zigzag section through another rotating air lock. The mica particles are again carried by the





airstream but they are now collected in the cyclone on the left side of figure 2. The cleaner concentrate leaves the left-side cyclone through a third rotating air lock and is rescreened to remove undersize material missed by the first screening. The airflow through the cleaner zigzag section is set slightly lower than the airflow through the rougher zigzag section. This allows most of the gangue particles that are unintentionally carried in the rougher section's airstream to fall through the cleaner section and rejoin the feed to the rougher section. The final product of this pneumatic process is generally a high-grade mica concentrate. Undersize screen products are combined and fed into the screen for the next smaller size fraction and then into the zigzag classifier.

In the Bureau's tests, the airflow required for pneumatic concentration in the zigzag air classifier was largely left to the discretion of the operator. For each size fraction, the operator first used an airflow setting that recovered most of the mica in the rougher section, regardless of the amount of gangue carried by the rougher airstream. The airflow in the rougher section was gradually reduced to minimize the gangue content of the rougher concentrate without increasing the mica content of the final tailings. Then, the cleaner section airflow was adjusted until a fairly clean mica concentrate was produced. After a few minutes of operation, the flow rate of the tailings from the cleaner section stabilized. If the quantity of the cleaner tailings did not stabilize, then the airflow to the rougher zigzag section was gradually decreased to lessen the recirculating load. When it was determined that airflow was properly adjusted, both the concentrate and the tailings product were collected, and airflows of both the rougher and cleaner sections were measured and recorded.

METHODS OF ANALYSIS

The minerals industry has not established a standard method of analysis to determine the mica content of a sample. For this study, three methods were used individually and in combination to separate the various products so that their mica contents could be determined. These methods were (1) hand sorting, especially of coarse materials; (2) the inclined-plane, or cardboard, method; and (3) separation in heavy liquids (1). Analyses were made by physically separating and weighing the products. Analytical products were examined with a binocular microscope to detect any misplaced particles. Analyses of the plus 10-mesh products were essentially 100 percent accurate. The precision of the analyses decreased as particle size decreased. A statistical analysis of the measured mica contents of the concentrates indicated a 95-percent confidence interval of plus or minus 5 percent. The same confidence interval of the measured mica content of the tailings was plus or minus 2 percent. It should be understood that all analyses reported in this study were within these boundaries of error.

EXPERIMENTAL RESULTS

The Bureau tested its pneumatic concentration method with four mica ores from Arizona, North Carolina, and South Dakota and three waste tailings from

Arizona Mica Deposit

Description

Two samples of the same mica ore, containing about 22 percent mica, were obtained from an Arizona mica-bearing pegmatite. Several mica sheets with surface areas up to approximately 1.5 square inches were found in the samples, but most of the mica grains had surface areas smaller than 1 square inch. The first sample (ore sample A) was run-of-mine rock that was up to 12 inches in diameter. About 60 percent by weight of this first sample was plus 8-inch size. The second sample (ore sample B) was a rod mill feed already crushed to minus 1-inch size. Table 1 shows the size analysis of this second sample.[5] The mica in this second sample was almost completely liberated in the minus 4-mesh material. Although some of the mica was liberated in the plus 4-mesh material, a significant amount of mica was still locked in particles of the host rock, which was mostly quartz and plagioclase with minor amounts of microcline.

TABLE 1. - Size analysis of Arizona mica ore B

Size, mesh	Wt-pct	Analysis, pct	Distribution, pct
Plus 4.....	35.6	23	36
Minus 4 plus 10..	39.1	23	39
Minus 10 plus 20.	5.1	31	7
Minus 20 plus 35.	10.6	26	12
Minus 35 plus 65.	4.2	18	3
Minus 65.....	5.4	11	3
Composite.....	100.0	23	100

Procedure

Ore Sample A

The run-of-mine rock sample was crushed with a hammer mill to about 1-inch size. Rocks too large for the hammer mill (plus 6-inch) were broken with a sledge hammer. The minus 1-inch material was fed to the pneumatic concentration system shown in figure 1. The plus 1-inch circuit was not used. A hammer mill was also used as the crusher in the minus 1-inch plus 4-mesh circuit. The minus 4- plus 10-mesh circuit did not need a crusher because the mica was already liberated in the minus 4-mesh material.

Ore Sample B

The rod mill feed sample was fed as-received into the pneumatic concentration system shown in figure 1. The plus 1-inch circuit was not used. A

[5]Size-analysis tables are not provided for the Arizona mica ore sample A, or for the South Dakota ore and tailings samples described later in this report. Because these samples contained significant amounts of large rocks, and because most of these samples were crushed in the mica recovery

jaw crusher was used with the minus 1-inch plus 4-mesh circuit. A roll crusher was used with the minus 4- plus 10-mesh circuit. Although the liberation size was about 4 mesh, this sample was crushed through 10 mesh to determine if mica recovery could be improved by crushing it to a size slightly smaller than the liberation size. A two-stage zigzag classifier was not available for this sample, but the two stages were simulated with a single-stage zigzag classifier to produce a cleaner concentrate, the rougher mica concentrate was treated a second time at a lower airflow than was used the first time. The tailings from the second zigzag operation were mostly gangue particles that were unintentionally carried into the rougher concentrate. The reduced airflow of the second pass through the zigzag classifier allowed these gangue particles to be removed, and also permitted a significant amount of mica to be dropped into the second zigzag tailings. This tailings product is called a middlings product and, in a continuous operation, the middlings product would be recirculated to the rougher zigzag feed.

Pneumatic Concentration Results

A material balance for the concentrates, middlings products, and tailings produced from both samples of the Arizona mica ore is shown in table 2. Table 3 shows the rate of airflow that was used in the zigzag section for each size fraction to obtain the results shown in table 2. For the rod mill feed (sample B), the "two-product" formula[6] gives an approximation--but only a rough approximation--of a continuous operation. In a continuous operation, the middlings product would be recirculated to the rougher feed. Eventually, this material would go either to the concentrate or to the tailings.

The actual mica recovered in the sample B concentrate was only 56 percent of the total mica in the ore; the middlings product contained 25 percent of the total mica. Sample B yielded a higher grade concentrate and lower grade tailings than did sample A, the run-of-mine rock, but a realistic comparison of results for these two samples was difficult. Nonetheless, the results showed that both ore samples produced high-grade concentrates and that from both samples a substantial portion of the mica was recovered. Only 2 percent to 5 percent of the total mica occurred in the untreated minus 65-mesh material. The mica lost in the plus 65-mesh tailings was mostly "book" mica with flakes that were too thick to be carried by the airstream. Like the gangue particles, these mica books were nearly equal in all three dimensions.

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[6]The "two-product" formula is a method for approximating the distribution of two final products as they would be made up without a middlings product. The formula takes into account that in a continuous operation, material from the middlings product would ultimately go to the concentrate or the tailings product. The formula is given below, with WP used to represent weight-percent of concentrate:

$$WP = \frac{100 \text{ percent} \cdot (\text{percent mica of feed} - \text{percent mica of tailings})}{(\text{percent mica of concentrate} - \text{percent mica of tailings})}$$

TABLE 2. - Pneumatic concentration results from two samples of an Arizona mica ore

Product, mesh	Wt-pct		Analysis, pct		Distribution, pct	
	Sample A	Sample B	Sample A	Sample B	Sample A	Sample B
Concentrate:						
Plus 4.....	3.8	3.6	100	100	18	16
Minus 4 plus 10.	5.3	6.3	97	99	24	28
Minus 10 plus 20	5.2	2.7	82	90	20	11
Minus 20 plus 35	1.1	.2	94	91	5	1
Minus 35 plus 65	1.0	.1	78	90	4	<1
Middlings:						
Minus 10 plus 20	NAp	4.3	NAp	38	NAp	7
Minus 20 plus 35	NAp	6.4	NAp	52	NAp	15
Minus 35 plus 65	NAp	2.4	NAp	25	NAp	3
Tailings:						
Minus 4 plus 10.	40.4	NAp	6.2	NAp	12	NAp
Minus 10 plus 20	20.1	36.4	3.5	7	3	11
Minus 20 plus 35	6.5	17.2	14.0	3	4	2
Minus 35 plus 65	12.3	10.1	13.0	2	8	1
Minus 65.....	4.3	10.3	11.0	11	2	5
Composite.....	100.0	100.0	22.0	22.0	100	100
Composite mica concentrate.....	16.4	[1]18.2	92	97	69	78
Composite tailings	83.6	81.8	7.9	6	31	22
Total.....	100.0	100.0	22	22	100	100

NAp Not applicable.
[1]Weight-percent calculated from the "two-product" formula given in text footnote 6.

TABLE 3. - Airflow through zigzag section for concentration of Arizona mica ore, cfm

Ore size, mesh	Rougher		Cleaner	
	Sample A	Sample B	Sample A	Sample B
Plus 4.....	160	120	120	NAp
Minus 4 plus 10...	130	115	110	NAp
Minus 10 plus 20..	120	110	100	92
Minus 20 plus 35..	90	105	70	46
Minus 35 plus 65..	70	80	30	33

NAp Not applicable.

To test the significance of the type of ore crusher used to liberate the mica, a small sample of the run-of-mine rock was treated with a jaw crusher taking the place of the hammer mill in the circuit. This modification produced a concentrate containing 82 percent mica, and 50 percent of the mica was recovered. The circuit with the hammer mill produced a concentrate containing 92 percent mica, and 69 percent of the mica was recovered.

Figure 5 shows typical mica concentrates and tailings from the jaw crusher circuit and from the hammer mill circuit. Of these two crushers,

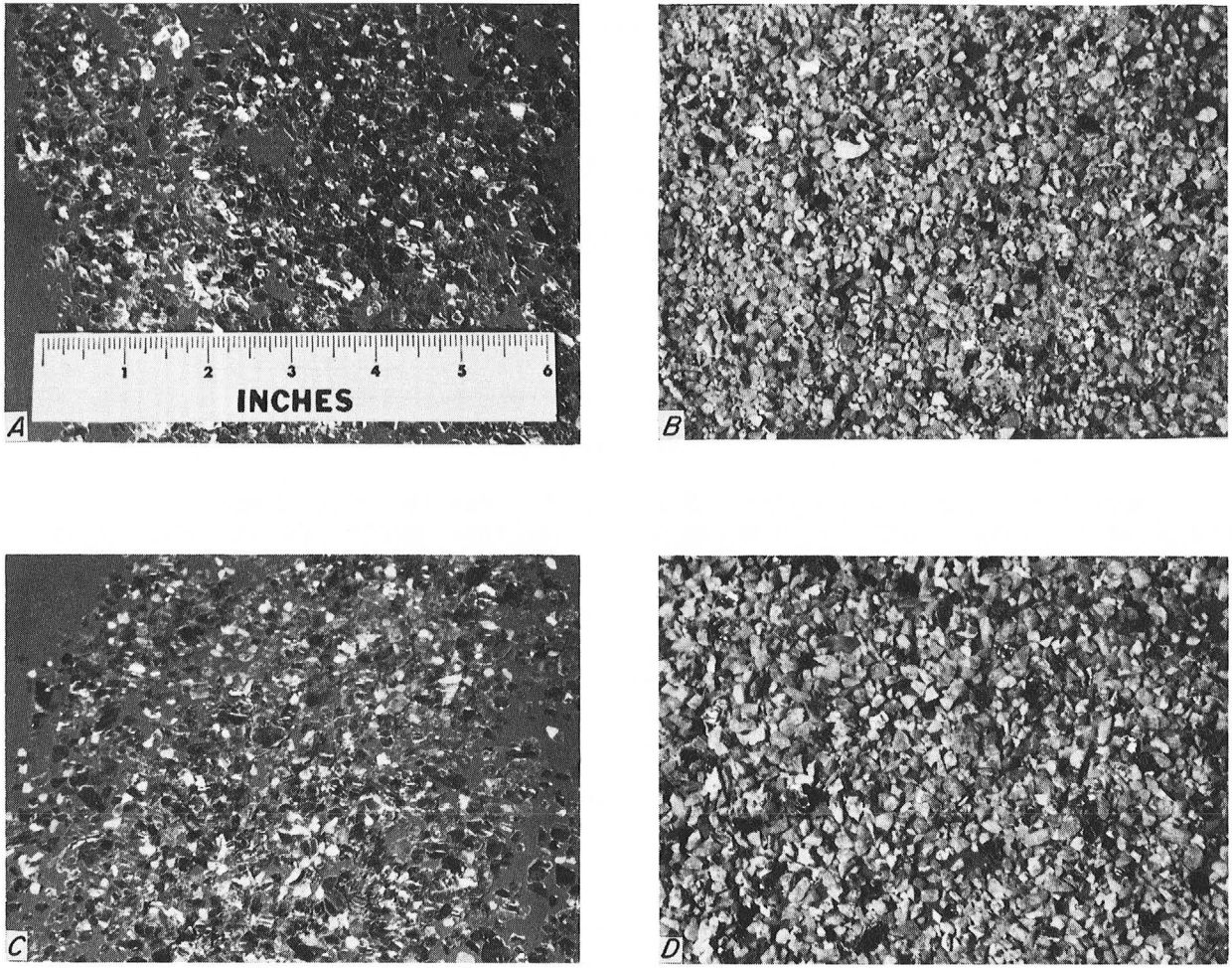

FIGURE 5. - Comparison of hammer mill products and jaw crusher products. *A*, The concentrate from the hammer mill circuit includes only a few pieces of gangue materials. *B*, The tailings from this same circuit include only a few pieces of Mica. *C*, The concentrate from the jaw crusher circuit has many pieces of gangue minerals; they are mostly flat particles. *D*, The tailings from the jaw crusher circuit contain many pieces of book mica.

the jaw crusher tended to produce a greater number of thick mica particles. Also, the concentrate produced from the jaw crusher circuit appeared to contain a greater number of flat gangue particles; this was due to the crushing action of the jaw crusher. These flat particles of gangue cannot be separated from the mica by the zigzag air classifier. In the jaw crusher tailings, there were many pieces of book mica that were not delaminated by the crusher action. Unless this mica is delaminated, it cannot be recovered with the zigzag classifier.

North Carolina Deposit A

Description

A sample of mica ore containing about 7 percent mica was obtained from a mica and feldspar deposit in North Carolina. The sample had already been

crushed at the mine and was nearly all minus 20 mesh. The size analysis of the ore sample is shown in table 4. The mica was completely liberated from the host rock and was fairly evenly distributed throughout the different size fractions. The gangue material was primarily quartz, plagioclase, and microcline.

TABLE 4. - Size analysis of North Carolina mica ore A

Ore size, mesh	Wt-pct	Analysis, pct	Distribution, pct
Plus 20.....	1.6	8	2
Minus 20 plus 35	23.6	8	26
Minus 35 plus 65	53.7	7	52
Minus 65.....	21.1	7	20
Composite.....	100.0	7	100

Procedure

Since the sample was all minus 10-mesh size, only the minus 10-mesh circuit of the pneumatic concentration system was needed for this sample. No crushing units were used. Each size fraction was individually separated with the two-stage zigzag classifier.

Pneumatic Concentration Results

A summary of the pneumatic concentration results for this ore sample is shown in table 5. Table 6 shows the airflows used in the zigzag section to produce these results. Only 26 percent of the mica from the sample was recovered in the mica concentrate, and the concentrate grade was only 80 percent mica. Examination of the performance of each size fraction revealed that only 12 percent of the mica in the minus 35- plus 65-mesh size fraction was recovered by the zigzag classifier. About 21 percent of the mica in the sample was too small to be recovered by this method.

TABLE 5. - Pneumatic concentration results from North Carolina mica ore A

Product, mesh	Wt-pct	Analysis, pct	Distribution, pct
Concentrate:			
Plus 20.....	0.1	85	1
Minus 20 plus 35.....	1.8	76	19
Minus 35 plus 65.....	.5	91	6
Tailings:			
Plus 20.....	1.5	3.2	1
Minus 20 plus 35.....	21.8	2.6	8
Minus 35 plus 65.....	53.2	5.9	44
Minus 65.....	21.1	7.2	21
Composite.....	100.0	7.2	100
Composite mica concentrate.....	2.4	80	26
Composite tailings.....	97.6	5.4	74
Total.....	100.0	7.2	100

TABLE 6. - Airflow through zigzag section for concentration of North Carolina mica ore A, cfm

Ore size, mesh	Rougher	Cleaner
Plus 20.....	110	110
Minus 20 plus 35.....	80	60
Minus 35 plus 65.....	60	30

North Carolina Deposit B

Description

A sample of mica ore was obtained from another mica and feldspar deposit in North Carolina. The sample was received wet and was air dried prior to any pneumatic processing. It contained 14 percent mica and was essentially minus 1-inch size. A size analysis is shown in table 7. Complete liberation of the mica was observed in particles smaller than 4 mesh. Very few plus 1-inch mica particles were present in this ore. The mica was fairly evenly distributed among the different size fractions. The gangue material was primarily quartz, plagioclase, and kaolinite.

TABLE 7. - Size analysis of North Carolina mica ore B

Ore size, mesh	Wt-pct	Analysis, pct	Distribution, pct
Plus 1.....	1.2	33	3
Minus 1 plus 4..	14.4	10	10
Minus 4 plus 10.	17.8	12	15
Minus 10 plus 20	18.3	15	20
Minus 20 plus 35	16.2	20	24
Minus 35 plus 65	13.1	15	14
Minus 65.....	19.0	10	14
Composite.....	100.0	14	100

Procedure

The minus 1-inch size circuit of the pneumatic concentration system was used for this sample. A jaw crusher was used in the plus 4-mesh circuit. No crushing units were used in the minus 4-mesh circuits.

Pneumatic Concentration Results

This ore sample did not respond well to pneumatic concentration techniques. A summary of the test results is shown in table 8. Table 9 shows the airflows used in the zigzag section to obtain these results. An 86-percent-mica concentrate was obtained, and only 53 percent of the mica originally contained in the sample was recovered. About 14 percent of the mica was lost to the minus 65-mesh material. The remaining mica was distributed fairly evenly throughout the tailings of the plus 65-mesh size fractions. Much of this mica was in book form.

The North Carolina ore sample B was tested before a hammer mill became available for the study. The results were similar to those obtained when the jaw crusher was used with the run-of-mine ore sample from Arizona. In that case, an 82-percent-mica concentrate was produced with only a 50-percent recovery of mica. However, when a hammer mill was used on that sample, the grade and recovery were improved. Therefore, because the feed and crusher products of the North Carolina ore sample B and the Arizona sample were similar, it would be expected that hammer milling the North Carolina sample B would likewise improve its grade and recovery.

TABLE 8. - Pneumatic concentration results from North Carolina mica ore B

Product, mesh	Wt-pct	Analysis, pct	Distribution, pct
Concentrate:			
Plus 4	0.3	100	2
Minus 4 plus 10	1.2	99	9
Minus 10 plus 20	1.8	94	12
Minus 20 plus 35	2.8	88	18
Minus 35 plus 65	2.5	71	12
Tailings:			
Minus 4 plus 10	22.8	5.9	10
Minus 10 plus 20	19.6	7.0	10
Minus 20 plus 35	14.3	7.2	7
Minus 35 plus 65	15.7	5.6	6
Minus 65	19.0	10.4	14
Composite	100.0	14.0	100
Composite mica concentrate	8.6	86	53
Composite tailings	91.4	7.2	47
Total	100.0	14.0	100

TABLE 9. - Airflow through zigzag section for concentration of North Carolina mica ore B, cfm

Ore size, mesh	Rougher	Cleaner
Plus 4	120	120
Minus 4 plus 10	120	90
Minus 10 plus 20	110	70
Minus 20 plus 35	100	60
Minus 35 plus 65	60	30

South Dakota Ore Deposit

Description

A sample of mica ore containing about 30 percent mica was obtained from a pegmatite mica deposit in South Dakota. Many of the sample pieces were as large as 12 inches in diameter, but most were between 6 and 8 inches in diameter. The sample contained large sheets of mica with surface areas as large as 6 to 8 square inches. The liberation size of the ore was near 4 mesh. However, a large portion of the mica was also liberated among the 2-inch diameter particles. About 1 percent biotite was also present in this ore; biotite flakes as large as 2 square inches in surface area were observed. The gangue material was mostly quartz and plagioclase and also included a minor amount of microcline and a trace of kaolinite.

Procedure

Due to the 1.75-inch channel width of the Bureau's two-stage zigzag classifier, only the minus 1.5-inch material was treated in the plus 1-inch circuit by the method outlined in figure 1. A hammer mill was used as the

for the hammer mill (plus 6-inch) were broken with a sledge hammer. No crusher was used in the plus 10-mesh circuit.

The plus 1.5-inch material was hand sorted rather than separated in the zigzag classifier, but only liberated mica flakes less than 0.25 inch thick were handpicked from the plus 1.5-inch rocks. (Since the plus 1.5-inch mica constituted only 5 percent of the mica concentrate, the overall effect of this hand sorting was minor.) The remaining plus 1.5-inch material was returned to the plus 1-inch circuit and crushed in the hammer mill. This procedure was repeated until all of the ore was minus 1.5-inch size. The minus 1.5-inch size material was treated by the method outlined in figure 1.

Pneumatic Concentration Results

A summary of the results of the pneumatic concentration of this ore sample is shown in table 10. Airflows used in the zigzag section for the South Dakota ore are shown in table 11. Concentration of this ore produced a 93-percent-mica concentrate, and 78 percent of the mica in the ore was recovered. Biotite flakes were included as mica in the analysis of these products. Figure 6 shows a typical mica concentrate from the South Dakota ore. As with the previous samples, most of the mica lost in the tailings was too thick to be concentrated by the airstream. Only 1 percent of the mica was lost in the minus 65-mesh material.

TABLE 10. - Pneumatic concentration results from a South Dakota mica ore

Product, mesh	Wt-pct	Analysis, pct	Distribution, pct
Concentrate:			
Plus 1	2.4	100	8
Minus 1 plus 4	10.1	100	34
Minus 4 plus 10	6.0	95	19
Minus 10 plus 20	5.7	75	14
Minus 20 plus 35	1.0	86	3
Minus 35 plus 65	.3	86	1
Tailings:			
Minus 4 plus 10	37.1	8.3	10
Minus 10 plus 20	18.4	8.1	5
Minus 20 plus 35	6.0	5.2	1
Minus 35 plus 65	10.6	11	4
Minus 65	2.4	≈20	1
Composite	100.0	30	100
Composite mica concentrate	25.5	93	78
Composite tailings	74.5	9	22
Total	100.0	30	100

TABLE 11. - Airflow through zigzag section for concentration of a South Dakota mica ore, cfm

Ore size, mesh	Rougher	Cleaner
Plus 1	160	160
Minus 1 plus 4	160	120
Minus 4 plus 10	140	110
Minus 10 plus 20	120	110
Minus 20 plus 35	80	50
Minus 35 plus 65	60	30

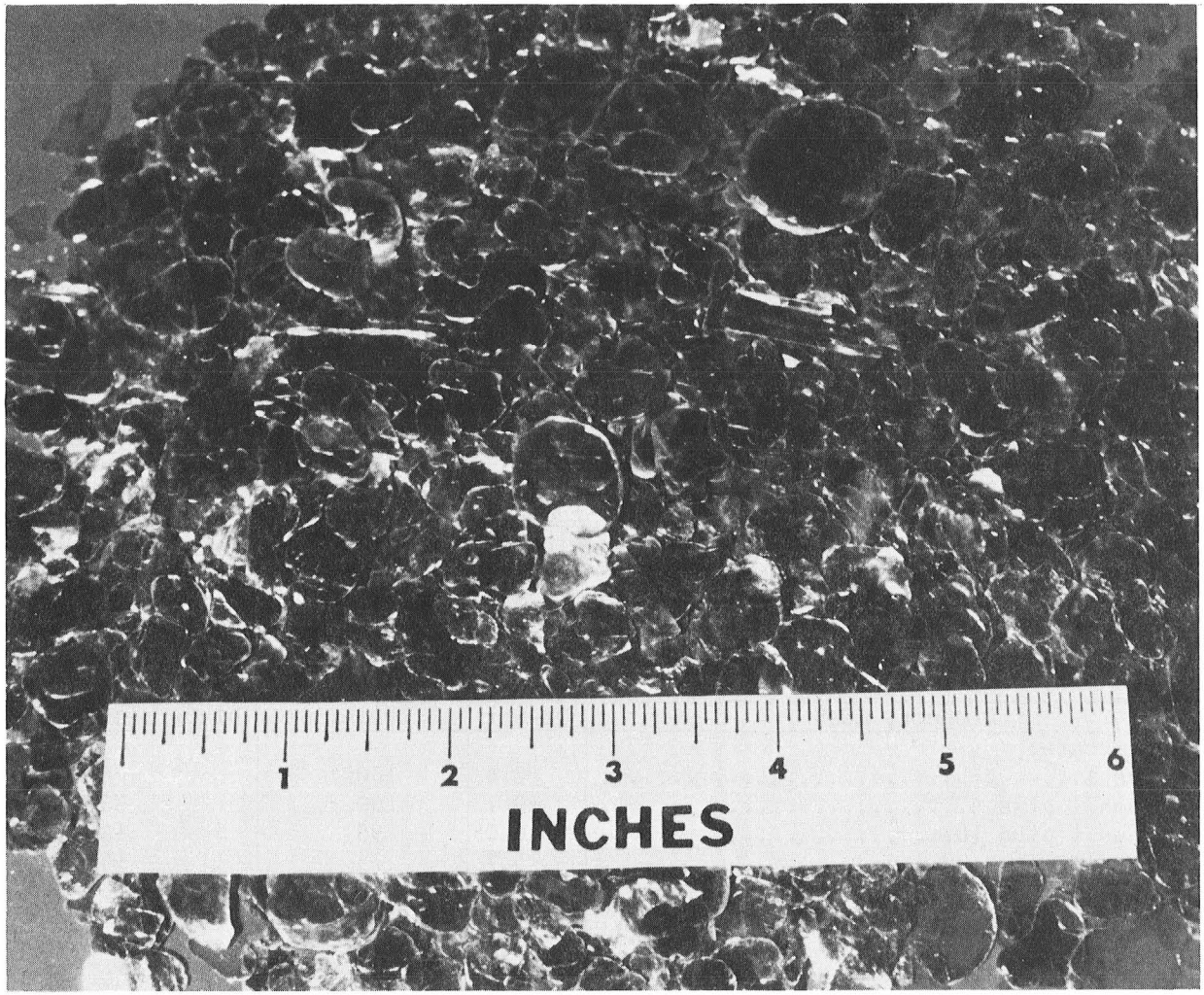

FIGURE 6. - Coarse mica particles recovered by the pneumatic concentration method.

Alabama and Georgia Waste Mica Tailings

Description

Alabama Tailings

A waste sample of mine tailings was obtained from an abandoned mica mine in Alabama. Although the sample contained 7.0 percent mica and was nearly all minus 10-mesh size, the plus 10-mesh size material had a substantially larger percentage of mica than was found in the other size ranges. A size analysis of this sample is given in table 12. Complete liberation of the mica particles was observed throughout the sample. The gangue material was mostly quartz and kaolinite and also included minor amounts of microcline and traces of plagioclase and gibbsite.

TABLE 12. - Size analysis of Alabama mica tailings

Tailings size, mesh	Wt-pct	Analysis, pct	Distribution, pct
Plus 10.....	2.9	27	12
Minus 10 plus 20.....	15.8	11	24
Minus 20 plus 35.....	46.7	4	28
Minus 35 plus 65.....	22.1	9	29
Minus 65.....	12.5	4	7
Composite.....	100.0	7	100

Georgia Tailings

A sample of white quartz sand was obtained from a Georgia mining operation. The material was nearly all minus 10-mesh size and it contained 7.5 percent mica. The mica particles were completely liberated from the host rock particles. The size analysis of this sample is shown in table 13. The mica was fairly evenly distributed throughout the plus 65-mesh material. The gangue material was practically all quartz, but also included minor amounts of microcline and kaolinite.

TABLE 13. - Size analysis of Georgia mica tailings

Tailings size, mesh	Wt-pct	Analysis, pct	Distribution, pct
Plus 10.....	0.6	11	1
Minus 10 plus 20.....	15.8	11	23
Minus 20 plus 35.....	38.1	7	35
Minus 35 plus 65.....	21.5	9	25
Minus 65.....	24.0	5	16
Composite.....	100.0	8	100

Procedure

Only the minus 4-mesh circuit of the pneumatic concentration system was used for the Alabama sample, and only the minus 10-mesh portion was used for the Georgia tailings. No crushers were used on either sample. Since both samples were tested before the two-stage zigzag classifier was available, a single-stage zigzag classifier was used. In both tests, the rougher mica concentrates were reclassified at reduced airflows to produce cleaner concentrates. The tailings from the second zigzag separations were middlings products. As with the ore samples, these products would have been recirculated to the rougher zigzag feed if the operation had been a continuous one.

Alabama Tailings Pneumatic Concentration Results

The results of pneumatic concentration of the Alabama tailings are shown in table 14. The airflow used in the zigzag section for each size fraction of these tailings is shown in table 15. A 97-percent-mica concentrate was produced, and mica recovery was about 30 percent. The middlings product contained 38 percent of the mica in the sample. Using the "two-product" formula, it was determined that the approximate mica recovery for a continuous system would be 58 percent. Most of the mica lost in the tailings was too thick to

be concentrated by the airstream. Only 7 percent of the mica was too small to separate by this method.

TABLE 14. - Pneumatic concentration results from Alabama mica tailings

Product, mesh	Wt-pct	Analysis, pct	Distribution, pct
Concentrate:			
Plus 10	0.5	96	7
Minus 10 plus 20	.8	97	11
Minus 20 plus 35	.6	98	8
Minus 35 plus 65	.3	94	4
Middlings:			
Plus 10	.7	36	4
Minus 10 plus 20	4.7	16	11
Minus 20 plus 35	14.9	6	13
Minus 35 plus 65	4.6	16	10
Tailings:			
Plus 10	1.7	3.3	1
Minus 10 plus 20	10.3	1.7	2
Minus 20 plus 35	31.2	1.6	7
Minus 35 plus 65	17.2	6.0	15
Minus 65	12.5	4.0	7
Composite	100.0	7.0	100
Composite mica concentrate	[1]14.2	97	58
Composite tailings	95.8	3.1	42
Total	100.0	7.0	100

[1]Weight-percent calculated from the "two-product" formula given in text footnote 6.

TABLE 15. - Airflow through zigzag section for concentration of Alabama mica tailings, cfm

Ore size, mesh	Rougher	Cleaner
Plus 10	140	120
Minus 10 plus 20	110	80
Minus 20 plus 35	100	70
Minus 35 plus 65	60	40

Georgia Tailings Pneumatic Concentration Results

The pneumatic concentration method produced from the Georgia tailings a mica concentrate that contained 93 percent mica. The results are shown in table 16; airflows used in the zigzag section are shown in table 17. Only 31 percent of the mica originally contained in the sample was recovered in this concentrate. The middlings product contained 40 percent of the mica in the sample. Using the "two-product" formula, the approximate mica recovery for this ore sample was 67 percent. About 17 percent of the mica in the sample was in the untreated minus 65-mesh portion.

TABLE 16. - Pneumatic concentration results from Georgia mica tailings

Product, mesh	Wt-pct	Analysis, pct	Distribution, pct
Concentrate:			
Plus 20	0.7	97.5	9
Minus 20 plus 35	1.0	95.5	13
Minus 35 plus 65	.8	87	9
Middlings:			
Plus 20	6.3	14	12
Minus 20 plus 35	10.8	13	19
Minus 35 plus 65	2.0	33	9
Tailings:			
Plus 20	9.4	2.0	3
Minus 20 plus 35	26.3	.8	3
Minus 35 plus 65	18.7	2.5	6
Minus 65	24.0	5.4	17
Composite	100.0	7.5	100
Composite mica concentrate	[1]5.4	93	67
Composite tailings	94.6	2.6	33
Total	100.0	7.5	100

[1]Weight-percent calculated from the "two-product" formula given in text footnote 6.

TABLE 17. - Airflow through zigzag section for concentration of Georgia mica tailings, cfm

Ore size, mesh	Rougher	Cleaner
Plus 20	130	90
Minus 20 plus 35	100	60
Minus 35 plus 65	60	40

South Dakota Tailings

Description

A waste sample of mine tailings was obtained from an abandoned mica mine in South Dakota. The sample contained 18 percent mica and was mostly minus 4-mesh size. Several large pieces of mica-bearing rock were included in this sample. These pieces, as large as 6 to 8 inches in diameter, amounted to about 25 percent of the sample's weight. Although these pieces could not have been previously treated in the mica beneficiation plant, they apparently were discarded in the tailings disposal area. Several pieces of plus 1-inch size mica were observed, but there were not enough of these pieces to be significant. Complete liberation of the mica particles was observed in the minus 4-mesh size fractions. Besides mica, this sample also contained about 3 percent biotite. The gangue material was mostly quartz and plagioclase and also included traces of kaolinite and gypsum.

Procedure

Only the minus 1-inch circuit of the pneumatic concentration system shown in figure 1 was used for this sample. Prior to zigzag separation, a hammer mill was used to crush the large rocks to minus 1-inch. Since the plus 1-inch size mica made up a very small portion of this sample, it was not treated separately; it too was crushed in the hammer mill. The zigzag tailings were also crushed by a hammer mill in the 4-mesh circuit.

Pneumatic Concentration Results

The results of pneumatic concentration of the South Dakota tailings are shown in table 18. Airflows used in the zigzag section for these tailings are shown in table 19. A 91-percent-mica concentrate was produced, and 69 percent of the mica contained in the sample was recovered. As with previous samples, most of the mica lost in the tailings was too thick to be carried by the air-stream. Only 7 percent of the mica from this sample was too small to be recovered by the pneumatic method.

TABLE 18. - Pneumatic concentration results from South Dakota mica tailings

Product, mesh	Wt-pct	Analysis, pct	Distribution, pct
Concentrate:			
Plus 4	4.6	100	25
Minus 4 plus 10	4.0	94	21
Minus 10 plus 20	3.5	78	15
Minus 20 plus 35	1.1	82	5
Minus 35 plus 65	.6	90	3
Tailings:			
Minus 4 plus 10	33.9	4.9	9
Minus 10 plus 20	21.8	5.4	7
Minus 20 plus 35	5.2	3.6	1
Minus 35 plus 65	18.1	6.8	7
Minus 65	7.2	18.0	7
Composite	100.0	18.0	100
Composite mica concentrate	13.8	91	69
Composite tailings	86.2	6.4	31
Total	100.0	18.0	100

TABLE 19. - Airflow through zigzag section for concentration of South Dakota mica tailings, cfm

Ore size, mesh	Rougher	Cleaner
Plus 4	140	120
Minus 4 plus 10	134	108
Minus 10 plus 20	117	90
Minus 20 plus 35	90	60
Minus 35 plus 65	61	33

GENERAL DISCUSSION

Although the mica analyses of the seven concentrates produced by pneumatic concentration varied between 80 and 97 percent mica, the chemical analyses of these concentrates compared favorably with commercial mica products obtained by flotation and with Indian ruby sheet mica, as shown in table 20. Several of the mica concentrates contained less Fe_2O_3 (ferric oxide) contamination than the typical contamination found in Indian ruby sheet mica, and all the concentrates contained less Fe_2O_3 than the commercial flotation mica product.

TABLE 20. - Chemical analyses of pneumatically processed mica and commercial mica

Mica sample	Chemical analyses					
	SiO_2	Al_2O_3	K_2O	Fe_2O_3	MgO	LOI[1]
Arizona mica ore.....	45.6	30.5	9.9	4.2	0.69	5.9
North Carolina ore A.....	52.6	24.9	8.0	1.7	.67	3.0
North Carolina ore B.....	45.2	31.1	7.6	3.7	1.00	7.1
South Dakota mica ore.....	48.7	28.7	8.8	2.6	.44	5.1
Alabama tailings.....	47.7	32.4	9.1	1.7	.38	5.9
Georgia tailings.....	62.0	22.2	6.0	1.2	.33	4.1
South Dakota tailings.....	54.1	25.3	6.6	2.7	.47	4.1
Commercial flotation mica.....	46.0	34.0	9.0	5.0	ND	5.5
Indian ruby sheet mica.....	45.8	35.5	10.3	2.0	.56	4.7

ND Not detected.
[1]LOI Loss on ignition at 1,000° C.

Airflows through the zigzag classifier were set by the operator and measured for each separation. The airflows ranged from about 160 cubic feet per minute for the minus 1-inch plus 4-mesh fractions to 30 cubic feet per minute for the cleaner zigzag with the minus 35- plus 65-mesh fractions. Figure 7 graphs the average rougher airflows versus the log of the smallest particle size of each size fraction. The average difference in airflow between each size fraction was about 25 cubic feet per minute. For the three plus 20-mesh separations, the cleaner airflows were generally 75 percent to 85 percent of the rougher airflows. For the two minus 20-mesh separations, the cleaner section airflows were 50 percent to 70 percent of the rougher section airflows.

Feed rates to the zigzag classifier were also set by the operator and ranged from about 20 pounds per hour for the 35- by 65-mesh size fraction to 150 pounds per hour for the 1-inch by 4-mesh size fraction.

In reviewing the results from the seven different samples, several general trends were noted. It was noted that the amount of minus 65-mesh material in the system had a negative influence on mica recovery and product grade. This influence can be seen in table 21, which shows that both mica recovery and the percent of mica analyzed in the product tended to decline as the amount of minus 65-mesh material increased. Several trends were noted

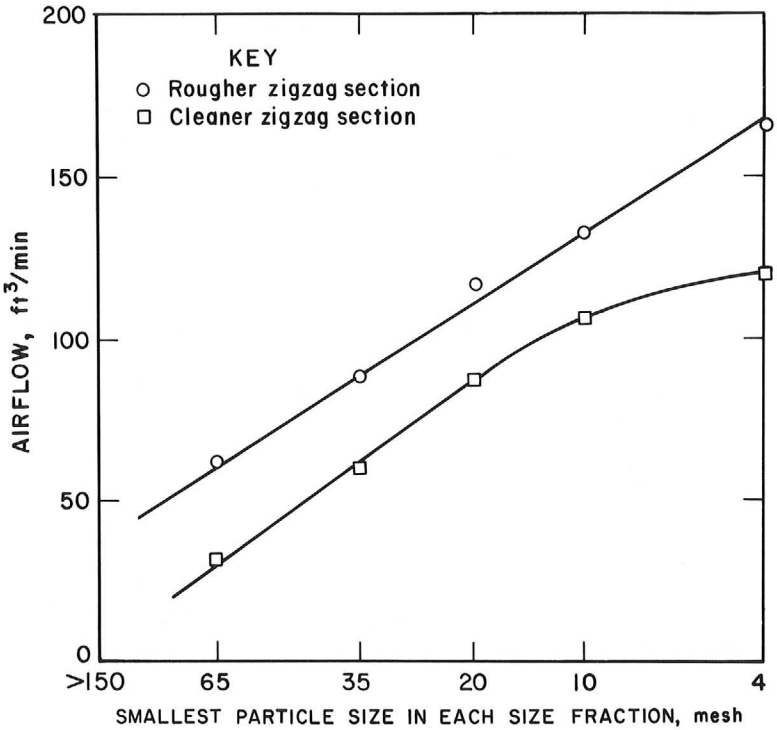

FIGURE 7. - Plot of airflow through the zigzag section versus the smallest particle size in each size fraction.

tions between 4 mesh and 65 mesh. Generally, the concentrate grade for each size fraction tended to decrease as particle sizes decreased. Although this was not the case with every sample, the trend was statistically present. The metallurgical efficiency[7] of the pneumatic concentration method tended to be between 80 percent and 85 percent for each of the three coarse size fractions between 4 mesh and 35 mesh. The minus 35- plus 65-mesh size fraction had a significantly lower metallurgical efficiency of approximately 65 percent.

By limiting ore crushing to the mica liberation size, the amount of minus 65-mesh material produced by the crushers can be minimized. Also, limiting the crushing of ore will minimize energy costs.

TABLE 21. - Comparison of minus 65-mesh materials by product grade, mica analysis, and mica recovery

Mica sample	Minus 65-mesh material, pct	Mica analysis, pct	Mica recovery, pct
Arizona ore.....	4.3	92	69
North Carolina ore A.....	21.1	80	27
North Carolina ore B.....	19.0	86	53
South Dakota ore.....	2.4	93	78
Alabama tailings.....	12.5	97	[1]58
Georgia tailings.....	24.0	93	[1]67
South Dakota tailings.....	7.2	91	69

[1]Approximated from the "two-product" formula shown below, in which R is used to represent recovery percent of concentrate:

$$R = \frac{100 \text{ percent} \cdot \left(\text{percent mica of concentrate}\right) \cdot \left(\text{percent mica of feed} - \text{percent mica of tailings}\right)}{\left(\text{percent mica of feed}\right) \cdot \left(\text{percent mica of concentrate} - \text{percent mica of tailings}\right)}$$

In these tests, the hammer mill tended to delaminate the thick mica particles, thereby increasing the likelihood that these particles would be recovered by the zigzag air classifier.

The pneumatic concentration method is a dry concentration technique that may be advantageous in areas where water resources are limited or where the cost of drying a mica concentrate precludes the use of a wet mica-concentrating process.

CONCLUSIONS

The Bureau's pneumatic concentration method for recovering mica has been demonstrated as an effective means for coarse mica recovery. Liberated mica as large as 1.5-inch size and as small as plus 65-mesh size was recovered by this method. However, the Bureau's pneumatic concentration system did not recover minus 65-mesh size mica. Therefore, the crushing circuit for this type of system must be designed to minimize the amount of minus 65-mesh size material if the best possible concentration results are to be achieved. When crusher types were compared, it was found that use of a hammer mill increased mica recovery by the zigzag classifier because the hammer mill needed to delaminate the thick mica particles. The pneumatic concentration method produced mica concentrates that contained 80 percent to 97 percent mica, and up to 78 percent of the mica originally contained in the samples was recovered.

REFERENCES

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2. American Society for Testing and Materials. Tentative Specification for Natural Muscovite Mica Based on Visual Quality. D351-60 T in 1961 Annual Book of ASTM Standards Including Tentatives: Part II, Rubber, Electrical Insulation. Philadelphia, Pa., 1961, pp. 1042-1050.

3. Boettcher, R. A. Air Classification of Solid Wastes. Solid Waste Management Series (SW-30c), U.S. Environmental Protection Agency, Washington, D.C., 1972, pp. 1-50.

4. Browning, J. S. Mica Beneficiation. BuMines Bull. 662, 1973, 21 pp.

5. Haines, S. K. Mica. Ch. in Mineral Facts and Problems. BuMines Bull. 667, 1975, pp. 683-698.

6. Petkof, B. Mica. Ch. in Industrial Minerals and Rocks. American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., New York, N.Y., 1975, pp. 837-850.

WR KP 8-19-77 - Nick Carter, P. O. Box 425, Maricopa, Arizona, 85239 can be contacted by telephone at Valley Auto Parts, Maricopa, 568-2341. He exhibited a quartz jar of very clean - 3/16 muscovite concentrate he has produced from pegmatitic ore taken from the Mica Giant mine in the Hualapai Mountains, Mohave County, He feels he has a market for the material at $60 per ton, but wants to make ground minus 100 mesh mica. He reported that Dave Rabb & Sam Rudy have observed or visited his little mill consisting primarily of a jaw crusher, rod mill, screen and Humphrey classifier. 9-23-77 bh

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WR KP 9-23-77 - Nick Carter, Maricopa, has staked two claims on the old Mica Giant property in the Haulapai Mountains south of Kingman, Maynard District, Mohave County. 9-30-77 bh

Memo from Glen Walker, dated January 13, 1978 (attached). 2/15/78 sef

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WR KP 8/4/78 - The U.S. Bureau of Mines Research Center on the University Campus at Tuscaloosa, Alabama, has been carrying on milling studies with his material from the Mica Giant Mine, they are trying to develop a low water consuming process for mica recovery. 1/4/79 a.p.

KP WR 6/7/79 - Discussed mica properties with ~~James~~ Nick Carter, Maricopa. He reported that the U.S. Bureau of Mines has been able to produce a 95% mica product from material he has sent from the Mica Giant Mine. 7/9/79 a.p.

KAP WR 8/19/77: He (Nick Carter) exhibited very clean 3/16 muscovite concentrate he has produced from pegmatitic ore taken from the Mica Giant mine in Hualipai Mts. Mohave County. He feels he has a market at $60 per ton, but wants to make ground minus 100 mesh mica.

KAP WR 9/23/77: Nich Carter has staked two claims on the old Mica Giant property in the Haulipai Mountains south of Kingman, Maynard Dist., Mohave Co. He later found out the previous owners had filed three old claims under the BLM mining claim recordation act and may therefore have an older valid title. He didn't feel it was worth a court fight over.

KAP WR 11/10/78: Discussed ore reserve estimating with Nick Carter, Maricopa Co. He is continuing to pursue development of mica properties and provide test lots of material to the US Bureau of Mines at Tuscaloosa, Ala.

May 27, 1957

MICA GIANT DEPOSIT

MOHAVE COUNTY
WALLAPAI DIST.

This property idle.

MARK GEMMILL

Jan. 30, 1959

Visited Merlo Mica properties (including the Mica Giant) in Maynard Mining District some 30 miles southeast of Kingman. The trip was made with Edwin White of Kingman in his pick-up. He is the non-resident caretaker of the property. The mines are idle.

T. P. LANE

ABM Bull. 180, p. 400, 402

IC 8298, p. 20

P.O. Box 425

Maricopa Mica Mines

Mica Products

Maricopa, Arizona 85239

Phone ~~(602) 568-2533~~ 568-2341

MICA GIANT (Fil.) MOHAVE WORK

4-27-87

Dear Ken,

As your know the Kingman mica (MEXICO MICA) came open; I applied for a Prospecting Permit. Paid my fee - and bond -

Last week I received a letter from the State Saying the Property will be ~~Ex~~changed for Federal Land. -

Could You Call me at work and lets talk about this?

Also is the RUSSEL Property STILL AVAILABLE?

Please call me, or better yet, Come By?

SINCERELY;

Nick Carter

"EXCERPTS FROM REPORT MADE BY U. S. DEPARTMENT OF THE INTERIOR, BUREAU OF MINES."

WAR MINERALS REPORT.

UNITED STATES DEPARTMENT ON INTERIOR, BUREAU OF MINES.

MICA GIANT MINE.

Mohave County, Arizona.

-MICA-

SUMMARY.

The Mica Giant Mine is on the east slope of the Hualipai Mountains, about thirty miles by road and trail from Kingman, Arizona.

The country is underlain by granites that are intruded by pegmatite dikes which in places, carry muscovite micas and feldspar. About 4% of the rock mined would produce scrap, punch and small sheet mica. Of this 4% or 80 pounds, 72 pounds would be scrap mica, 7 pounds punch mica and one pound small sheet mica. This would have a total value of about $4.93. On an estimated cost of $2.50 per ton for overhead, mining, sorting, rifting and transportation, this would leave a net profit of $2.43 per ton of ore mined. In the better area showing this ore about 100,000 tons of ore is indicated, and on this basis there would be a gross production of around $500,000,00.

To reach this property with trucks will require the building of about 2½ miles of road. This is estimated to cost $5,250.00.

As this mine is indicated to show a gross production of about $500,000.00 with a net of about $250,000.00, the building of this road is warrented and it is recommended.

INTRODUCTION.

The Mica Giant Mine was brought to the attention of the Bureau of Mines by the owner. It was examined by the Bureau of Mines engineer on January 17th 1943. An application for an access road was filed with the United States Grazing Service on March 2" 1943 by Harolds Club Mining Company, 236 Virginia Street, Reno, Nevada.

LOCATION AND ACCESSABILITY.

The Mica Giant Claims are in Section 10, T.19 N, R.15 W, 2½ miles by trail from the Gold King Mine, which is 27 miles southeast of Kingman, Arizona. Access from Kingman is by the Big Sandy graded road for 15 miles, thence west for 12 miles over fair and rough desert and mountain road to the Gold King Mine. From this point it will be necessary to build about 2½ miles of road, which is estimated to cost $2,500.00.

OWNERSHIP.

This property is owned by T. Mac Smith, 1927 E. Hawthorne Street, Tucson, Arizona. It is at present under lease to Mr. Roy V. Waughtel, Kingman, Arizona, who has in turn interested Harolds Club Mining Company, of Reno, Nevada.

Holdings consist of four lode mining claims held by annual assessment work, These claims are the Mica Giant, Mica Giant No.2, Mica Giant No.3 and Mica Giant No.4.

HISTORY.

These claims have been held by Mr. T. Mac Smith for ten or more years. Only a small amount of work has been done in the way of open cuts. Some work has been done on the extension of the road from the Gold King Mine.

PRODUCTION.

The mine has no production to date. Under the present need for punch and sheet mica, a production of 200 tons per day is warranted and could be carried on for several years on ore now indicated and probable. This would produce 14,100 pounds of scrap mica, 1400 pounds of punch mica, and 200 pounds of sheet mica per day, or 4,320,000 pounds of scrap mica, 420,000 pounds of punch mica, and 60,000 pounds of sheet mica per year.

PHYSICAL FEATURES.

The claims are at about 5000 feet altitude on the east slope of the Hualipai range of mountains, which is rugged and covered with dense vegitation, mostly scrub oak. Water is found in a canyon about a mile from the property. The climate is fair, not extrmely hot in the summer or extremely cold in the winter.

COST OF OPERATION.

It is estimated that about 4% of the ore mined could be sorted out as scrap, punch and sheet mica. Of this 80 lbs, about 72 lbs. would be scrap mica, 7 lbs. punch mica and 1 lb. sheet mica in the smaller sizes.

This would have the following values on board cars at Kingman, Arizona.

72 lbs. scrap mica at $12.00 per ton - - - - - - -	$0.43
7 lbs punch mica at 30 cents per pound - - - - - -	2.10
1 lb. 1½x2" sheet mica at $2.40 per pound - - - - -	2.40
Total value per ton of ore mined - - - -	$4.93

The cost of production would be as follows:

Mining, open cut per ton - - - - - -	$1.00
Sorting and rifting - - - - - - - -	1.00
Transportation - - - - - - - -	.50
Total cost per ton of ore mined	$2.50

This would show a net profit of $2.43 per ton of ore mined.

With a well established operation these costs would be improved from 15 to 20 per cent.

One the above basis the 100,000 tons of ore indicated would produce the following.

3600 tons of scrap at $12.00 per ton F.O.B. cars Kingman	$43,200.00
700,000 pounds of punch mica at 30 cents per pound. Kingman	210,000.00
100,000 pounds of sheet mica (1½x2") at $2.40 per pound	240,000.00
Total gross value - - - - - - - - -	$493,000.00

Of this total gross production $450,000.00 of it would be of strategic grades.

The total net value indicated is $243,000.00 before depletion, amortization etc.

CONCLUSIONS.

As this mine has an indicated 100,000 tons of ore which will produce 800,000 pounds of mica of strategic grades, with an estimated gross value of $450,000.00, the building of the road applied for at a cost of $5,250.00 is warranted and it is recommended.

Examined January 17th 1943.

John K. Bice Company
Mica Giant Mine

July 20, 1979

Mr. M. H. McKellar
John K. Bice Company Inc.
1319 Boyd Street
Los Angeles, California 90033

Dear Mr. McKellar:

Enclosed is a sample of mica produced by Mr. James Carter from what I believe was ore from the Mica Giant Mine in Mohave County. As yet I have not been able to get in touch with Mr. Carter.

Sincerely

Ken A. Phillips
Mineral Resources Engineer

KAP:mw

Enclosure

DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
FIELD ENGINEERS REPORT

Mine Mica Giant & Wyane Group. Date June 7th 1946

District McConnico, Arizona Engineer A. C. Nebeker

Subject:

The Mica Giant Mica group which is located 30 miles south of Kingman, has been under development for the past two years by Mr John Becker, who has put on the property a dry grinding mill with three steps of crushing and sizing with compressed air. The mill can handle 50 tons per day and is powered by gasoline motors.

There is also a camp of six buildings which furnishes a boarding house as well as cabins which can accommodate 25 men. Water is piped into the buildings from a well dug in the creek and fitted with a small pump.

The property consists of I2 lode locations. The Pegmatite dike a with of 50 feet to I00 feet can be followed for I½ miles through the property.
It is estimated that the Mica Giant has exposed I00,000 tons and that the Wyane has 300,000 tons. The mica content is claimed to be 20%.

Roy V. Waughtel, Box I86, Kingman Arizona, on June Is t I946 bought out Mr Becker and will continue with the operations at the property. Mr Waughtel informs me that the dump made from sorting out book mica has by mill tests produced 30% ground mica of I00 mesh, and a price of $20.00 per ton is offered at railhead.

Code

1927 E. Hawthorne,
Tucson, Aeizona.
April 19th 1943.

Mr. Charles F. Willis,
Title Trust Building,
Phoenix, Arizona.

MICA GIANT FILE

My dear sir:-

You may know that I succeeded in getting the U. S. Bureau of Mines to go up to Mohave County in January and make a survey and report on my mica property. I have not been able to get a copy of their report, but I have some excerpts from their report, copies of which I am sending you herewith.

You remember I have been in to see you about this mica a couple of times, but the more engineers that see it, the better it seems to look. According to this report there is on Mica Giant claim alone about $450,000.00 in strategic mica, which our Government is in dire need of. I have leased the property to a Mr. Roy V. Waughtel, and he has interested people with money to get out the mica. The Bureau of Mines, (U.S.) have recommended that the W.P.B. build 2½ miles of road to get the mica out, and the Grazing department of the Department of the Interior have also o.k'd the road I am told, now it is up to the W.P.B. to act.

It is my understanding that you have a Mr. Broadgate connected with you that can do wonders with matters like this. If so could you have him get behind this road matter and see what he can do if anything? Our Government need the mica, we are anxious to get it to them, everyone has passed on the mica and the road and have recommended that the road be built, so help us get this property to operating at the the first possible moment, if you please.

Im sure you will be interested in the excerpts of the report made by the bureau of mines, and I hope that you will think of ways to rush the road matter to a successful conclusion. Thanking you for your attention, and with kindest reagrds, I am,

Yours very truly,

T. Mac Smith

T. Mac Smith,

Mining World 9/1944

Shipping From Mica Giant

Mica is being produced from the properties of the Mica Giant mine in the Hualpai range south of Kingman, Ariz. Production was made possible by a recently completed access road into the district.

The Mica Giant is owned by T. MacSmith of Kingman and managed by Roy C. Waughtel.

NAME OF MINE: MICA GIANT

COUNTY: MOHAVE

OWNER: T.Mac Smith, Ariz.Tax Commission,Phx.

DISTRICT:

METALS: MICA

OPERATOR AND ADDRESS:		MINE STATUS	
DATE:		DATE:	
5/1/44	T. Mac Smith, Kingman	5/1/44	Shipping
	By V. Waughtel, Kingman Box 711	4/45	Developing
~~4/44~~/45	Great Western Mica Corp., J.G.Becker, 42 W.PalmLane, Phoenix (Box 186, Kingman)	3/46	Mining,milling,shipping
6/46	Roy Waughtel, Kingman	5/46	Idle
12/46	Robt. Morgan, Kingman	6/46	Developing

MICA GIANT

Mica

Mohave 8 - 9 T 19 N, R 15 W

T. Mac Smith, State Tax Commission, Phoenix ~~'45~~ '46

Tom & Al Tool

MM-41

DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA

OWNERS MINE REPORT

Date June 2, 1940

1. Mine Mica Giant Deposits

2. Mining District & County Wallapai Dist. Mohave County

3. Former name Mica Giant

4. Location 1½ miles west of Gold King Mine east side of Wallapai Mts., and about 30 miles south east of Kingman

5. Owner T. Mac Smith

6. Address (Owner) 715 West Lynwood St. Phoenix, Arizona

7. Operator

8. Address (Operator)

9. President

10. Gen. Mgr. #2046 E. Helen Tucson Ariz

11. Mine Supt.

12. Mill Supt.

13. Principal Metals Book Mica or white clear Muscovite.

14. Men Employed

15. Production Rate New virgin property.

16. Mill: Type & Cap.

17. Power: Amt. & Type

18. Operations: Present This deposit is a book mica blowout, in a pegmatite formation, and is in a real granite country. The main showing is on a sharp knoll, and extends from about 100 feet on the east side of the hill, on over the top and to the canyon on the west side, in all about 175 feet. The outcrop shows that the deposit is about 70 feet wide, the books laying criss-cross in the soft seams of ground, and the harder ground and boulders are impregnated all over with the book mica. The only work being the location and some of the assessment work, the other assessment work being done on the road near Gold King Mine.

19. Operations Planned

20. Number Claims, Title, etc. The mica giant claim covers the main mica deposit, and on this claim there are many places of contact on the book mica. The title is clear, and only one person to deal with--the owner.

21. Description: Topography & Geography The deposit is on the east side of the Wallapais, but up in the foothills, the elevation being around four thousand feet. The claims could be worked the year round, the climate being ideal. There is fine water in the canyons for camp purposes. The road at one time extended on past the Gold King Mine, the Company built two cement dams across the canyon for water storage, which cut off access up the canyon by auto. During the last two years we have been doing considerable work on a detour around these dams and have the road about 50% finished so that a small truck can get past the dams. Above that point the road work will be a small matter as the canyon is wide and not steep.

22. Mine Workings: Amt. & Condition

(over)

23. Geology & Mineralization

24. Ore: Positive & Probable, Ore Dumps, Tailings On the dump there are a good many tons of book mica, as none has been shipped from the property, except samples packed out, but these have been tested by different people and have stood every test given, I have been told.

24-A Vein Width, Length, Value, etc. Col. Rice from Missouri, who was in this country looking over lead-zinc properties looked over the property and he told the writer that one could mine one ton of book mica for every five tons of earth and rock moved, using the bench method of mining. With every ton of book mica mined there would be at least 100 lbs of mica good for cutting into plate mica, different sizes, and one hundred lbs of mica good for punch mica. The price of the plate and punch mica; together with the scrap, all of which is the best quality of white muscovite, would be about $85.00 per ton, of course after cutting and punching the clearest books. This party had operated mica properties in the Carolinas and seemed to know all about the business of mining and handling mica deposits.

25. Mine, Mill Equipment & Flow Sheet

26. Road Conditions, Route

27. Water Supply

28. Brief History

29. Special Problems, Reports Filed

30. Remarks

31. If property for sale: Price, terms and address to negotiate. This property is for sale at a moderate price, for cash, or will sell on Bond and lease, with certain work to be performed as will be agreed upon and inserted in the lease agreement.

32. Signed T. Mac Smith

33. Use additional sheets if necessary.

DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA

MINE OWNER'S REPORT

Date June 2" 1940.

1. Mine Mica Giant Deposit.

2. Location about 1½ miles west of Gold King Mine east side of Wallipai mountains, and about 30 miles south east of Kingman, Mohave, Co.

3. Mining District & County (Mohave County)

4. Former name Mica Giant.

5. Owner T. Mac Smith,

6. Address (Owner) 715 West Lynwood Street, Phoenix, Arizona.

7. Operator

8. Address (Operator)

9. President, Owning Co.

9A. President, Operating Co.

10. Gen. Mgr.

14. Principal Minerals Book Mica, or white clear Muscovite.

11. Mine Supt.

15. Production Rate New virgin property.

12. Mill Supt.

16. Mill: Type & Cap.

13. Men Employed

17. Power: Amt. & Type

18. Operations: Present

This deposit is a book mica blowout, in a pegmetite formation, and is in a real granite country. The main showing is on a sharp knoll, and extends from about 100 feet on the east side of the hill, on over the top and to the canyon on the west side, in all about 175 feet. The outcrop shows that the deposit is about 70 feet wide, the books laying criss-cross in the soft seams of ground, and the harder ground and boulders are impregnated all over with the book mica. The only work being the location work and some of the assessment work, the other assessment work being done on the road near Gold King mine.

19. Operations: Planned

20. Number Claims, Title, etc.

The mica giant claim covers the main mica deposit, and on this claim there are many places of contact on the book mica. The title is clear, and only one person to deal with---the onwer.

21. Description: Topography & Geography

The deposit is on the east side of the Wallipais, but up in the foothills, the elevation being around four thousand feet. The claims could be worked the year round, the climate being ideal, There is fine water in the canyons for camp purposes. The road at one time extended on past the Gold King up the canyon to within a short distance of the mica deposit, but at the Gold King Mine, the Company built two cement dams across the canyon for water storage, which cutoff access up the canyon by auto. During the last two years we have been doing considerable work on a detour around these dams and have the road about 50% finished so that a small truck can get past the dams. Above that point the road work will be a small matter, as the canyon is wide and not steep.

22. Mine Workings: Amt. & Condition

MM-41

DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
OWNERS MINE REPORT

Date June 2, 1940

Mine Mica Giant Deposit

Mining District & County - Wallapai Dist. Mohave County

Location - 1½ miles west of Gold King mine east side of Wallapai Mts. and about 30 miles southeast of Kingman.

Former Name - Mica Giant

Owner - T. Mac Smith

Address - 715 West Lynwood Street Phoenix, Arizona

Operator

Address

President

Gen. Mgr.

Mine Supt.

Mill Supt.

Principal Metals - Book Mica or white clear muscovite.

Men Employed

Production Rate - New virgin property

Mill: Type & Cap.

Power: Amt. & Type.

Operations: Present - This deposit is a book mica blowout, in a pegmatite formation and is in a real granite country. The main showing is on a sharp knoll and extends from about 100 ft. on the east side of the hill on over the top and to the canyon on the west side, in all about 175 ft. The outcrop shows that the deposit is about 70 ft. wide, the books laying crisscross in the soft seams of ground, and the harder ground and boulders are impregnated all over with the book mica. The only work being the location and some of the assessment work, the other assessment work being done on the road near Gold King Mine.

Operations: Planned

Number Claims, Title, etc. - The Mica Giant claim covers the main mica deposit, and on this claim there are many places of contact on the book mica. The title is clear, and only one person to deal with-- the owner.

Description: Topography & Geography - The deposit is on the east side of the Wallapais but up in the foothills, the elevation being around 4,000 ft. The claims could be worked the year round, the climate being ideal. There is fine water in the canyons for camp purposes. The road at one time extended on past the Gold King Mine, the Company built two cement dams across the canyon for water storage, which cut off access up the canyon by auto. During the last two years we have been doing considerable work on a detour around these dams and have the road about 50% finished so that a small truck can get past the dams. Above that point the road work will be a small matter as the canyon is wide and not steep.

Mine Workings: Amt. & Condition

Geology & Mineralization

Ore: Positive & Probable, Ore Dumps, Tailings - On the dump there are a good many tons of book mica, as none has been shipped from the property, except samples packed out, but these have been tested by different people and have stood every test given, I have been told.

Vein Width, Length, Value, etc. - Col. Rice from Missouri, who was in this country looking over lead-zinc properties looked over the property and he told the writer that one could mine one ton of book mica for every 5 tons of earth and rock moved, using the bench method of mining. With every ton of book mica mined there would be at least 100 lbs. of mica good for cutting into plate mica, different sizes, and 100 lbs. of mica good for punch mica. The price of the plate and punch mica; together with the scrap, all of which is the best quality of white muscovite, would be about $85 per ton, of course after cutting and punching the clearest books. This party had operated mica properties in the Carolinas and seemed to know all about the business of mining and handling mica Deposits.

Mine, Mill Equipment & Flow Sheet

Road Conditions, Route

Water Supply

Brief History

Special Problems, Reports Filed

Remarks

If property for sale: Price, terms and address to negotiate - This property is for sale at a moderate price, for cash, or will sell on Bond and Lease, with certain work to be performed as will be agreed upon and inserted in the lease agreement.

SIGNED - T. Mac Smith

A REPORT ON THE GEOLOGY AND ECONOMIC VALUE OF MICA DEPOSITS IN MOJAVE COUNTY ARIZONA

by

Philip S. Hoyt
Mining Geologist
Franklin, North Carolina

Mica Client file

1949

May & Sept 1941

Both

A REPORT ON THE GEOLOGY AND ECONOMIC VALUE OF MICA DEPOSITS IN MOJAVE COUNTY, ARIZONA

by
Philip S. Hoyt
Consulting Mining Geologist
102 Silver Street
Henderson, Nevada

May 1949

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HISTORY AND GENERAL DATA

During the latter part of September, 1941, an examination was made and a report prepared and submitted on certain mica deposits in Mojave County, Arizona, belonging to Mr. T. Mac Smith, of 715 West Lynwood Avenue, Phoenix, Arizona. Since that investigation, certain additional development work has been done and some additional ground included in the group of claims, and another visit to the property was made and this supplemental report completed, incorporating all of the pertinent data in the original report, the results of the work subsequently performed, and including the present favorable economic situation with reference to the production of mica from this location.

The property is held under unpatented lode mining locations, all annual assessment work has been performed and properly recorded to date, or the substitute "notices of intention to hold" filed as required under the waiver of annual assessment work.

To the original group of five claims, including the Cottonwood Springs Mill and Campsite claim, in the Smith group, there has been added the Waughtel group of six claims, including the Willow Springs Campsite and

Water-right claim, making a total of nine lode mining claims, and two Campsite and Millsite claims in this property.

The group of claims are contiguous, extending east-westerly, end to end, beginning with the Mica Giant on the east and terminating with the Wayne Mica claim on the west. The property is in Sections 9 and 10, Twp. 19 N., Range 15 West, and about two and a half miles west of the Gold King mine, in the Maynard Mining District, on the east side of the Walpai Range, Mojave County, about 30 miles from Kingman, Arizona, which would be the loading point on the AT&SF Railroad.

During the last war a good access road was built into the property from the Gold King mine. The Big Sandy road out of Kingman is followed for about 15 miles and at the forks of this road the right hand road is taken along the easterly side of the Walpai Range into the property. County maintainance will be done on the road when operations are conducted on a steady basis.

The names of the Smith-Waughtel group of claims covered by this report, as they are recorded, are as follows:

Name of Claim	Recorded in Book	Page
Mica Giant	3-S	517
Mica Giant Extension #2	3-S	532
Mica Giant Extension #3	3-S	533
Mica Giant Extension #4	3-S	531
Cottonwood Springs (Millsite)	#4-Millsites	94-95
Wayne Mica Claim	3-Y	160
Wayne Mica Extension #1	3-Y	160
Wayne Mica Extension #2	3-Y	162
Wayne Mica Extension #3	3-Y	163
Midget Extension #1	3-Y	225
Willow Springs-Campsite, Millsite	#4-Millsites	97

The above lode mining claims are all full size-600x1500-locations. The millsite and water right claims have been located to cover available springs for domestic water needs and some water for such mining and motive equipment as may be necessary and should be adequate for all needs.

GEOLOGY

The pegmatite area covered by these claims is in a region of granitic rocks and quartz-mica schists, the granites making up the interior of the Walpai Mountains. The pegmatites are injected into fault zones and fractures in the quartz-mica schist country rock, the particular zone of pegmatites covered by the report consisting of one major intrusion extending from the Mica Giant claim westerly, for a distance of about two miles, to the Wayne Mica claim, on the west end of the group.

Both ends of the pegmatite body, as exposed, are narrow, from 50 to 100 feet in width, the central portion of the zone widening across the exposed surface to approximately 1000 feet.

Many sills or sill-like pods are present adjacent to, and trending parallel with, the major fracture filling, but these smaller bodies of pegmatite are seldom of economic importance.

Both ends of the pegmatite zone contain mica of economic importance, while the central, wide area, as exposed on the surface, may develop high mica content adjacent to the large included quartz bodies. The width of this central zone may be due, in part, to the lower dip of the fracture zone into which the pegmatite has been intruded.

The pegmatites of economic importance are those that occupy the fracture or fault zones that cut across the trend of the country rock. Such pegmatites are genetically related to the large granite masses around which they form in a wide fringe in the enclosing schists. It is apparent that the pegmatites formed after the primary granite was consolidated and "juices" from this granite mass invaded the fracture and fault zones. They are, therefor, younger than the faulting, their orientation, size and shape being directly related to the fault structures.

A close genetic relationship of the quartz bodies with the pegmatites is suggested. Economic considerations justify close study of the contact zones between the larger quartz masses and the pegmatites where high mica concentrations are apparent.

It is believed that the major portion of any commercial sheet mica on these claims will come from mica crystals found in and around the larger quartz masses, while millable scrap mica ores will be taken from the zones of pegmatite along one or the other of the walls in contact with the country rock.

MINERALOGY

The pegmatite in the zone covered by these claims is simple in its composition, being made up of mica, feldspar and quartz, with a minimum of accessory, secondary minerals.

The mica is muscovite, with minor amounts of biotite seen in very sparse distribution and confined to definite zones, particularly where undigested portions of country rock are "floating" in the pegmatite.

The feldspar is of the potash variety, predominately microcline. Very little albite is present, and no replacement minerals were observed. Very minor tourmaline and spessertite garnet and a few beryl crystals were noted. The muscovite mica is normally present as primary crystals in the pegmatite. At some localities it is present as very fine grained muscovite in the border zones and in the country rock that has been invaded and altered by the pegmatitic solutions and as later veneers in the fractures. The mica of economic importance should be found in the narrower enriched zones at and near the country rock contacts and surrounding the larger included quartz bodies.

None of the rare earth minerals were seen except a few ceryl crystals, this no doubt being due to the absence of the soda feldspars, particularly albite.

One photo

only one

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for special

handling

Photographs

ECONOMICS

In considering the mining, milling and marketing of mica in the western states primary consideration must be given to the economics of marketing and to fit the type of mica produced to the market potential on a basis of highest priced product that can be milled from the scrap mica.

The processing and marketing of wet ground mica should be considered first, then the marketing possibilities for a dry ground, finer mesh product, for use in plastic, and then to develop the marketing of dry ground mica in the lower priced field.

The marketing and sales of sheet mica should be considered only as a by-product item and not calculated in the economics of a project, because of the erratic and uncertain nature of its distribution.

Due consideration and research should be made on the by-product material from the concentrating plant. This material consists of about 50% quartz, 48% white feldspar and 2% mica. This product will be crushed all thru 6 mesh, in the process of recovering the larger mica from the ore, and as the type of milling gives a minimum of fines, a rather coarse aggregate is produced, being all thru 6 mesh with about 20% thru 35 mesh. The minus 35 mesh can be removed, and the resulting coarser produce considered as a roofing granule, poultry grit material and other uses where a white and relatively coarse material can be applied. Some interest is developed in this material as a roofing granule, both in the natural white color and also as a stained granule, using the analine dye method. The writer is now doing some research on the marketing of this product as the sales of this item from a concentrating plant would greatly improve the economics of mica production here in the western States, and such a product might be sold in the building materials market which is now, and should continue to be, and active consuming market for such raw materials.

In calculating the costs and profit possibilities of a mica operation on this property, all estimates should be made based upon one operator doing the whole job and that no contracting be done on any of the functions including trucking. Financing should be arranged so that all needed equipment will be fully covered to eliminate the need for contracting any part of the activity in this way simplify and control the operation and figure the profit possibilities into one operating unit.

For this report all calculations and determinations of procedures and method of operation are based upon the requirements for this particular property, first, from the standpoint of ores available, their mica tenor, and costs of recovery of this mica by dry concentrating methods, using the Hoyt type of recovery which has been proven, and second, based upon the location of the property, distance to railroad and costs of hauling, etc., and third, based upon the location of a grinding plant on the railroad at or near Kingman, and the marketing territory that can be reached on a competitive basis from this point.

In considering the economics of marketing it must be emphasized that at this time no wet ground mica is being produced in the western area, all of this type of mica coming into the growing west coast market from presently established eastern mills. The tonnage capacity of the eastern mills has seldom been adequate to oversupply the wet ground mica requirements in the United States, and some foreign markets in Japan and Australia could be supplied from a western mill, altho the tonnage into this market is relatively small.

The schedule of prices outlined below are based on present prices being paid for the several grades of mica, both wet and dry ground, with freight costs shown from present supply points, particularly as to the wet ground mica from the eastern mills. I am setting down the present selling prices and freight

on wet ground from the eastern mills and using a somewhat reduced price as a basis for calculating the economics of the operation, in order to determine the factors as conservatively as possible and to calculate the profit possibilities on basis of some downward adjustment of all prices in the near future, including the cost of production.

PRESENT MARKET PRICES - in bags, F O B Kingman, Arizona.

	Per Ton	Freight from Chicago
Dry Ground - 20 Mesh roofing grade	$37.50	$16.50
40 Mesh roofing grade	42.50	16.50
10 Mesh Xmas snow	40.00	16.50
80 Mesh-plastic mica	75.00	16.50
Wet Ground - 150 Mesh-rubber grade	$115.00	Freight from Richmond
200 mesh-paper and paint grade	125.00	$20.00 (present selling price on west coast is 8and3/4¢ per lb. plus 1¢freight)

The Kingman mica is of a type that is suitable to make all products now being produced in the mica industry, both wet and dry, the mica is white, will delaminate and grind well in a wet milling unit, and it is the writer's judgement that no mica should be made from this scrap mica that will not bring the highest price.

The mica should not be ground dry as there are other types of mica and mica schists that might make a suitable dry ground product and compete with dry mica made from this excellent scrap, hence the economics of the project should be set up on basis of manufacturing only wet ground mica, with possibly a small tonnage of dry ground for the plastic trade. In this way the ground material can be moved into the west coast markets at considerable advantage over present sources of this product and can also be shipped into the central US area, Chicago and the Mississippi Valley and Texas, on a competitive basis with eastern grinders

The competitive situation for a western producer is that all of the wet grinding mills are located near the eastern seaboard, as far as the writer is informed none of the present grinders own or produce their own supply of scrap mica.

It is purchased from small miners in the eastern states who take a profit out of the scrap mica before it reaches the grinding mills. Some of this mica scrap is produced directly as scrap mica from mines operated as such, while some tonnage comes as a by-product from the feldspar quarries, especially in the North Carolina area.

The present selling price for scrap in the east is $25.00 per ton at the mine. No operator in the United States as far as the writer is informed produces his own scrap mica and mills the mica from his own mines. Several profits intervene by way of mining profits, trucking or rail hauls etc. to grinding mills and in some cases an erratic and uncertain supply of scrap mica is available.

During the last war the writer was a member of the Industrial Advisory Committee, of the WPB, for mica, and during the war period, when the sheet mica mining was very active and abnormal tonnage of scrap were being produced as a by-product, no grinder had over a sixty day supply of scrap mica, and several of the grinders were operating on a "hand-to-mouth" basis. There has never been any prolonged over supply of scrap mica, and during the depression of the 1930's scrap mica was always actively sought for by the grinders.

Any western mica operation should be set up on basis of supply of scrap being produced by the grinder for his own account and use.

To this end, all calculations and production data have been set up in this report on a basis of production of scrap and milling of this scrap into finished products by one operator where all of the profit can be figured into one project. The supply of scrap mica is figured at cost and the profit potential based on the scrap price and milling costs as against the selling price of the finished product, based on making the highest quality ground product now being marketed in this specialty field.

INVESTMENT REQUIREMENTS FOR
DEVELOPMENT OF THE SMITH-WAUGHTEL
MICA PROPERTIES.

In considering the development of the Smith-Waughtel property, its exploitation should be accomplished just as would be done with any metal property being developed by conservative and practical mining people.

In the two miles of exposed pegmatities, locations should be studied and mapped and selected for development of "blocks" of ore containing tonnages of mill grade pegmatite having a content of 15% recoverable mica in the ore, as a minimum. Such a development should be set up on the west end of the group on the Wayne Mica claim where exposures indicate mill tonnage of sufficient tenor and quantity to justify this development. A measured section from natural exposures indicates a width offorty feet a depth of seventy five feet and an estimated length of 350 feet. The length and depth can be readily developed with bulldozer and a short cross cut into the easterly end of the block. The ore should run about 50% of the content of the block, and the ore carry an estimated 20% recoverable mica. This estimated tonnage would aggregate 52,500 tons in place, an estimated one-half of which would be milling ore containing 20% mica or about 5000 tons of scrap mica.

The development of this block is recommended due to its natural exposure and location and the facility of development due to these factors.

Before a concentrating unit was installed two blocks of ore should be developed on the property to insure adequate tonnage for milling and large enough supply of scrap from these ores to liquidate the initial investment. One block as above mentioned and another block in the canyon above the old Ahberg holdings would be favorable for concentrating from the same mill location.

The concentrating unit installed should be of a capacity to handle 50 tons per day of eight hours. This unit would be semi-portable, inasmuch as its installation and operation should not be considered permanent in any one location, but subject to moving to points near the sources of ore supply. In the two mile length of these pegmatites, possibly four milling locations should be considered in the overall production from the property, beginning with a location at or near the above mentioned point on the west end of the claims. A good mill site is available here.

The estimated costs of initiating the project, including development work, which should be done before a mill is installed, road improvement, camp and mining facilities are as follows: (estimates are ample for all contingencies)

First phase: Development	Road work--to improve road from Gold King to the west end	$1500.00
	Camp and cook house etc.	3000.00
	Mining equipment-for development work	6000.00
	Bulldozer work--contracted	1000.00
	Estimated cost of labor and mining supplies to prove block of ore	7500.00
	Pickup truck for utility use	2500.00
	Total for development prior to mill	$21500.00

Second phase: Installation of concentrator	Ore bins and additional mining equipment	3500.00
	Ore crushing and screening plant, based on the Hoyt unit at Van Horn	
	Jaw crusher--with all accessories	3000.00
	Gyratory #4-for delamination	3500.00
	Three sets rolls-beginning with 16x36 inch size	7500.00
	Three Lahey Screens	3750.00
	Mica concentrate bins	1500.00
	Power unit for above (110 HP International with clutch pulley- all units pulled from main and line shafts.)	3000.00
	Cost of installation	5000.00
	Building-sheet iron and welded pipe frame- including necessary installations around units-	6000.00
	Shafting, pulleys, belting etc.	2500.00
		$35750.00

39,350.00

Third phase: Installation of wet grinding mill	Trucking equipment to handle scrap mica from mill to Kingman	$4000.00
	Wet mica grinding plant	
	Buildings-cement floor and four foot side walls (20 x 80 feet)	1000.00
	Quonset cover	4000.00
	Tubs-launders-dryer-screening equipment and sacking machine	16000.00
	Labor-installation of unit	5000.00
	Power installation including motors	2500.00
	Incidental items	1500.00
	Total capital requirements for wet milling unit	$34000.00
Working capital		25000.00
Payment on property-1st year		10000.00
Total capital requirements for project, including development costs, and first payment on property assuming property is purchased on basis of annual payments		$104,750.00
Working Capital		25,000.00
		$129,750.00

The total capital costs and investment, including the development costs and mill installation will approximate:

First phase-development work	$21500.00
Second phase-installation of mill (when ore proven)	39250.00
Third phase-installation of wet grinding mill	34000.00
	$94750.00

The above figures are adequate to cover management and supervision costs and all necessary insurance, social security and payroll cost items.

ESTIMATED OPERATING
AND PRODUCTION COSTS

Mining Costs- quarry or open cut benching methods, depending on width of the ore, or by drawing ore thru raise in crosscut. This item covers some selective mining and allows 25 cents per ton to amortize development work on the block of ore- including ore to mill bin----------$ 3.25 per ton

Milling costs- based on fifty tons thru crushing and screening plant per eight hours. The equipment is selected to sacrifice capacity for efficiency-each crushing unit to have rated capacity about double the actual tonnage handled- costs based on Hoyt plant---------- 1.25 per ton

Mining and Milling costs per ton of ore---------- 4.50

Mining and Milling costs on fifty tons per 8 hours----------$225.00

Cost per ton of mica recovered from fifty tons of ore on 8 hour basis, calculated on minimum 15% recoverable mica would be

$$\frac{50 \times 15}{225} \text{ or } \$30.00$$

Cost of delivery of one ton of mica scrap from concentrator to wet milling unit on railroad at Kingman
Truck haul, per ton----------$2.50
at 8 cents per ton mile using
own equipment.
Cost of scrap-per ton----------30.00
Cost of scrap mica at grinding plant at rail-
road----------32.00

ESTIMATED MILLING COSTS TO
PRODUCE WET GROUND MICA

Cost of raw material-scrap mica-fob mill bin	$32.50
Cost of delamination-----per ton	5.00
Cost of milling-labor and power-	
6 tub unit at 500# per tub per 6 hours	
$\frac{6 \times 500 \times 4}{2000}$ or 6 tons finished product per 24 hours.	
3 shifts labor and power costs-6 tons-per ton	10.00
Drying costs, fuel, labor and power----------perton----------	3.00
Bagging costs-bags in working capital item------per ton--------	3.00
Management and overhead----------per ton--------	5.00
Insurance, SS and auditing expense---------- per ton--------	2.00
Sales expense-10% of selling price---------- per ton--------	12.00
Total production costs, raw material milling and sales---------- per ton------	$73.00

On basis of $7\frac{1}{2}$ tons per day production of scrap mica-
$1\frac{1}{2}$ tons per day can be estimated for dry grinding into
minus 80 mesh product for plastic-This mica would be
ground during the month in the unit used for delamination
in the wet unit flow-sheet-and bagged and shipped as
dry ground mica. The estimated costs are:

forty tons monthly-dry grinding and screening cost----------per ton--	$15.00
bagging and loading costs----------per ton--	5.00
Total milling cost to storage----------per ton--	20.00
Cost of raw material----------per ton-	32.00
	$52.50

PRO FORMA P&L STATEMENT
BASED ON PRESENT COSTS AND
SELLING PRICES-MAY, 1949.

Selling price wet ground mica-8&3/4¢ per lb.-Los Angeles price April, 1949, but for this calculation-per ton-fob Kingman, Arizona----------$125.00

Cost of production---------- 73.00
Net profit-per ton-wet ground mica---------- $52.00

On production of 6 tons per day @ $52.00----------$312.00
On production of 1½ tons per day of dry ground-minus 80 mesh-on basis of selling price of $75.00 per ton on cars, Kingman, and at cost $52.50 per ton-1½tons-net profit-----$33.75

Total net profit-wet and dry ground-per day ----- $345.75

Annual net profit-before taxes--on basis of 300 days----------$103,725.00

The sale of the granules material from the crushing plant would add to this profit possibility. The writer is now doing some research on marketing of this item, which would add a thirty tons per day of aggregate. If it can be moved at all it should bring not less than $2.50 per ton profit to the operator. If the material is suitable for roofing granules and to be color treated its marketing distribution might be more widespread and profitable.

CONCLUSIONS

The pegmatite in the Smith-Waughtel property is favorable for application of mining and milling methods applied to other types of mining properties, and the tonnage of milling ores that may be developed would seem to be adequate to keep such a mill going for a long period of time.

By adopting a method of "blocking" out sections of the pegmatite and by careful sampling of exposed portions of the ore zones at intervals favorable for conservative determinations, the element of hazard can be greatly reduced in calculating the recovery of mica from such ore blocks by milling.

The many exposures of high-mica bearing pegmatite would indicate that many zones large enough to furnish ore having a tenor of 20% or better could be developed in large enough blocks of ore to favor low cost mining.

The location of this deposit with reference to the marketing of a finished product is favorable, Kingman being on a trans-continental railroad with direct lines into Chicago and Gulf Coast, and to the West Coast where a growing market, especially in the territory north of Los Angeles, is rapidly developing.

RECOMMENDATIONS

It is recommended that the project be handled as would be done on any metal mining property, develop the ore bodies first, and then mill the ore on a basis consistant with the supply. This will be a pioneer project from the standpoint of applying such methods to a non-metallic mineral. All of the elements for a successful operation are present if the first things will be done first and a plan of operation applied on conservative and sound basis.

Adequate financing is essential as this is not a project that will respond to limited effort, financially or otherwise.

No consideration has been made in the foregoing report to the sheet and punch mica that will be recovered and the possibliities for the granule production seem favorable;

Some sheet and punch mica was produced during the last war from the Mica Giant property and tonnages of scrap mica will be recovered from this property with a sheet mica by-product.

Detailed flow-sheet for both the wet grinding unit and the dry concentrating plant will be supplied when required.

Respectfully submitted,

Philip A. Hoyt.

A REPORT ON THE GEOLOGY AND ECONOMIC VALUE OF MICA DEPOSITS IN MOJAVE COUNTY, ARIZONA

BY
PHILIP S. HOYT

9-23-1941

A REPORT ON THE GEOLOGY AND ECONOMIC VALUE OF MICA DEPOSITS IN MOJAVE COUNTY, ARIZONA.

by
Philip S. Hoyt
Mining Geologist
Franklin, North Carolina.

September 23rd, 1941.

During the latter part of September an examination was made of certain mica deposits located in Mojave County, Arizona, belonging to T. Mac Smith, of 715 West Lynwood Ave., Phoenix, Arizona.

The property is held by unpatented lode mining locations, all assessment work has been done and properly recorded to date, the claims being held under the following names: Mica Giant, Mica Giant Extension #2, #3 and #4. Most of the assessment work done has been applied to the building of a road into the property, but some openings made on the several claims, more particularly on the Mica Giant at one point, which development will be more fully described hereafter.

GENERAL DESCRIPTION

The property lies in Section 10, Twp. 19N. Range 15 West, about 2½ miles west of the Gold King Mine, in the Maynard Mining District, on the east side of the Walapi Range, in Mojave County, about thirty miles from Kingman, Arizona. The road into the property is a good country road, with the exception of the last 2½ miles which would have to be built or repaired. The Big Sandy road out of Kingman is followed for about fifteen miles and at the forks on this road the left hand road goes on to Big Sandy, the right hand road following along the easterly side of the Walapi Range into the property. County maintainance is kept up to within 2½ miles of the claims.

The road construction necessary would not be difficult from the standpoint of steep grades or excessive rock work, but a road up the canyon would require cutting out the timer and removing rocks and filling in low points in gulches coming into the canyon, and several short bridges over the stream. E stimates for the cost of the road will be found in Exhibit "A".

GEOLOGY

The pegmatite area covered by these claims is in a region of granitic rocks which make up the interior of the Walapi Mountains. The area covered by these claims consists of a stock-works of pegmatite some of which is coarsely crystallized while other portions of the pegmatite are so-called graphic granites containing both white mica (muscovite) and in some places black mica (biotite) the black mica being segregated in well defined zones and not generally distributed. At some points some hydration of the black mica was observed but nothing approaching the "vermiculites" were seen.

No rare earth, accessory minerals were observed and no kaolinaz ation or hydration of the feldspar is evident.

The feldspar present in the pegmatite is all of the potash variety and in the form of microcline.

The area generally is deeply eroded by gulches that cut thru the pegmatites exposing them across the strike where study of the pegmatites can be readily made. At one point particularly on the Mica Giant claim a good exposure enables some accurate estimates to be made of the width of the intrusions along the strike, as well as depth of the intrusions below the higher exposed portions above the canyon floor. More detailed description of the appearnece of the pegmatite on this claim will be made later.

In considering the economic value of pegmatite dykes, it is well to observe particularly the character of the crystallization in that only the very coarsely crystallized zones are considered of economic value. The area immediately to the east of the gulch on the Mica Giant claim appears to have the best possibilities for production of mica and feldspar. There is at this point a "pipe" or "chimney" in the pegmatite where the "vein" has attained a width of approximately 100 feet and altho the surface exposures are not too plain, being shielded by some loose material on the slopes, it appears that at this point th length of the wide zone would approximate 100 feet, and from the top portion of the exposed pegmatite to the level of the gulch floor, there is a vertical distance of about 200 feet, all indicating a "block" of coarsely crystallized pegmatite at this point of approximately of the dimension 100x 100x 200 feet, or containing a tonnage of approximately 100,000 tons of "ore". This portion of the pegmatitie on the three claims, is, in the writers opinion the best part of the area for further development and operation.

A reconnaissance was made over the other three claims and particularly that area across the gulch from the Mica Giant, and inspection of the pegmatite at this point indicates more of a graphic granite type and relatively low in white mica and large crystals of feldspar that might offer commercial material. There may be, at some local point, some bodies of mica and spar that could be economically mined which additional prospecting might uncover.

There is no reason to think that at depth there will be any better material than surface crystallization would indicate, except possibly that on th Mica Giant larger "books" of mica and crystals of feldspar may be present around the large quartz masses present.

ECOMOMICS OF MICA AND FELDSPAR
IN THE MARKET AREA ADJACENT TO
THIS PROPERTY

In considering the value of a non-metallic mineral property it is well to study first the markets available within equitable freight haul of the producing district or property. The location of your property makes it necessary to consider the immediate area and the west coast markets for the feldspar and scrap or ground mica, while any sheet or punch mica might well be moved longer distances into the east if necessary.

Scrap or ground mica.

Your property is well located for marketing the scrap or ground mica in the west coast markets and it is th writers opinion that up to 2000 tons a yar of either scrap mica, if it is determined to ship it in this form, or of ground mica, can be sold in the west coast market.

The scrap mica should bring $20. or better per ton FOB cars at Kingman, Arizona, while ground mica, particularly for roofing grades should sell for an average of $35. per ton, in bags, on cars at Kingman.

There is very little mica production on the west coast, most of the scrap mica is now coming from Colorado and New Mexico, hence your location has a very advantageous position in this respect. At a price of $16. per ton for scrap in Colorado and New Mexico, plus freight of about $8. per ton, the above estimated sales value of $20 per ton for your scrap mica is not out of line.

On sale of ground mica, there would, of course, be some additional capital requirement for a grinding plant to handle the scrap mica production, but it would be the writers recommendation, that any operation of this property should consider seriously the installation of a grinding plant and grind all of the scrap into roofing, plastic and other mica grades and sell it ground, for the particular reason that in sales of scrap mica your market is restricted to just

concerns who have grinding and marketing facilities, while to grind your mica you widen your market possibilites as there are many users of ground mica among the larger manufacturing companies producing roofing, paper and paints. This in addition to the larger profit possibilites in selling ground mica as against sales of scrap makes the additional capital requirement well justified. On the sales of sheet and punch mica, the west coast has few outlets for this type of mica, but after proper preperation by knife trimming and grading, this type of mica will stand freight costs into the eastern consuming areas.
It is estimated from eveidence in th production of mica from the deposit on the Mica Giant, that out of a ton of mine run mica there shoudd be recovered $30 in small sheet, punch and washer stock or an estimated value of $50 per ton of mine run mica including sheet, punch, washers stock and scrap, the scrap mica being considered on a ground mica valuation basis.

Feldspar

Out of a ton of rock broken out of the pegmatite body on the Mica Giant claim it is estimated that there would be a 10% recovery of clean, number one, potash feldspar recoverable as shipping quality. The grinding plant at Kingman would, no doubt, handle this feldspar, and the writer is informed that there are other inquiries for crude lump form feldspar from markets on the west coast. This spar should bring $5. per ton on cars at Kingman or at the mill at Kingman.

ESTIMATED PRODUCTION VALUES.

It is estimated that for any economical operation of this property, after the further prospecting and development has been completed, that there should be produced an average of 100 tons a day of ore, out of which 10 tons of feldspar can be sorted at the mine, and that the recovery of mica out of ore from the Mica Giant location should approximate 4% of the broken ore as sorted and recoverable mica, or 4 tons of mine run mica.

Using the above estimated values as a basis, it would appear that out of 100 tons of broken ore, there should be a value of $250. recovered as mine run mica and feldspar, this value based on delivered at railroad price.

ESTIMATED PRODUCTION COSTS.

To break and sort the above 100 tons of ore daily it would cost an estimated 75 cents per ton for mining and sorting costs or $75 per day mining, sorting and loading expense. Cost of hauling to railroad, based on figures given the writer by local truckers is $2.50 per ton, or a total of $21. per day, making a total mining, sorting and loading cost of $96. per day. This figure includes cost of administration, insurance, taxes, depreciation, social security, workmens compensation, powder, fuse and caps and incidental mining expense. That portion of the ore broken that contains mica in sufficient quantity but too small to hand sort, can be stock-piled for future milling for the recovery of the mica content, this quantity, however, will be small as the pegmatite contains a small precentage of mica that cannot be recovered by hand sorting.

The above costs are estimates, but are based upon the writers experience in mining ores of a similar nature, where open cut, benching methods can be used, where dry type sinking can be done to best advantage.

The cost of sorting, sheeting and trimming punch and small sheet mica from the daily mica production would require the labor of four rifters at a daily wage of $5. per man or a total of $20 per day for cleaning up the mica.

The total estimated costs of mining and sorting, hauling and of sheeting the mica would be $116. per day, leaving a net estimated profit of $154. per day out of 100 tons of mine run ore produced.

On the basis of 4000 tons of recoverable mica, and in recovery of this mica to sort as a by-product 10,000 tons of feldspar, both of these products can be readily absorbed in the present markets without disturbing market supply or upsetting economic factors pertaining to this market.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions:

1. That there is on the group of claims commercial mica and feldspar in quantity large enough to justify its recovery.

2. That the physical features, road building, additional prospecting and cost of maintainance and supply are not out of line with the possibilities.

3. That the location of a mica deposit in that area is of especial value inasmuch as present sources of mica used on the west coast are largely coming from points much more remote than this deposit.

4. That special effort and consideration should be given to the finishing of the mica into a ground product rather than to sell it crude and to get for the operation all of the profit possible, by selling a finished product. This does not apply to the fledspar as the cost of installation of a feldspar plant is not justified in competition with present grinders, but that these grinders will no doubt be glad to get the supply of good grade potash spar.

5. That the quantity of mica and feldspar recoverable from the deposit can be readily sold in the nearby west coast market and that the scrap mica can be sold either as scrap to the wet or dry grinders or ground and sold to consumers of a ground mica product.

6. That anyone interested in mica should investigate this location for the small sheet and punch mica it may furnish, particularly with reference to the washer stock that may be available. From samples seen on the dump it appears that a large proportion of the mica could be used for making up washers of various sizes, this grade requiring a material that is flat but may be cracked or full of hair lines and other defects.

RECOMMENDATIONS

It is recommended that the following steps be taken in the further development and operation of this property:

1; That a road be built of a sufficient type to get in with compressor and mining equipment, that a camp be located on the ground and the property be opened and operated for the recovery of hand sorted blocks of mica and clean feldspar. That in such mining operations that any ore of a grade that cannot be hand sorted but which contains appreciable amounts of mica, be stockpiled for future milling and recovery of this mica.

2. That no consideration be given at this time to the erection of a mica seperation mill, that is , a plant that will take the ore and remove the small mica, but that enough tonnage of milling ore of this type be either mined and stockpiled as a by-product from hand sorted mica recovery, or ore of a high mica tenor be developed to justify the installation of such a mill.

3. That both the mica and feldspar be sold in the crude form to start with and that a grinding plant for grinding the scrap mica be installed at the railroad as soon as the property has been developed sufficiently to insure liquidation of the cost of such a mill and after sufficient ground mica market outlets have been arranged for on the west coast.

4. That it is the writers opinion that there is a deposit of commercially recoverable mica and feldspar on this property, particularly on the Mica Giant claim and that initial operation should be conducted on this claim in that portion on the east side of the gulch where the original location work has been done.

Respectfully submitted,

Philip Hoyt.

Mining Geologist.

EXHIBIT "A"

ESTIMATED ROAD, CAMP AND EQUIPMENT COSTS FOR OPERATIONS ON THE MICA GIANT CLAIM.

Cost of building road from the Gold King Mine to the property	$2000.00
Cost of compressor equipment, including jack hammers and steel and all accessory equipment, delivered and installed on property	$6000.00
Cost of camp buildings etc..	$1500.00
Cost of mica and feldspar bins	$1250.00
Working capital	$1750.00
Total capital required for operating property for recovery of hand sorted mica and feldspar and putting the property on an immediate producing basis.	$12500.00

WR KP 8-19-77 - Nick Carter, P. O. Box 425, Maricopa, Arizona, 85239 can be contacted by telephone at Valley Auto Parts, Maricopa, 568-2341. He exhibited a quartz jar of very clean - 3/16 muscovite concentrate he has produced from pegmatitic ore taken from the Mica Giant mine in the Hualapai Mountains, Mohave County, He feels he has a market for the material at $60 per ton, but wants to make ground minus 100 mesh mica. He reported that Dave Rabb & Sam Rudy have observed or visited his little mill consisting primarily of a jaw crusher, rod mill, screen and Humphrey classifier. 9-23-77 bh

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WR KP 9-23-77 - Nick Carter, Maricopa, has staked two claims on the old Mica Giant property in the Haulapai Mountains south of Kingman, Maynard District, Mohave County. 9-30-77 bh

Memo from Glen Walker, dated January 13, 1978 (attached). 2/15/78 sef

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WR KP 8/4/78 - The U.S. Bureau of Mines Research Center on the University Campus at Tuscaloosa, Alabama, has been carrying on milling studies with his material from the Mica Giant Mine, they are trying to develop a low water consuming process for mica recovery. 1/4/79 a.p.

KP WR 6/7/79 - Discussed mica properties with ~~James~~ Nick Carter, Maricopa. He reported that the U.S. Bureau of Mines has been able to produce a 95% mica product from material he has sent from the Mica Giant Mine. 7/9/79 a.p.

KAP WR 8/19/77: He (Nick Carter) exhibited very clean 3/16 muscovite concentrate he has produced from pegmatitic ore taken from the Mica Giant mine in Hualipai Mts. Mohave County. He feels he has a market at $60 per ton, but wants to make ground minus 100 mesh mica.

KAP WR 9/23/77: Nich Carter has staked two claims on the old Mica Giant property in the Haulipai Mountains south of Kingman, Maynard Dist., Mohave Co. He later found out the previous owners had filed three old claims under the BLM mining claim recordation act and may therefore have an older valid title. He didn't feel it was worth a court fight over.

KAP WR 11/10/78: Discussed ore reserve estimating with Nick Carter, Maricopa Co. He is continuing to pursue development of mica properties and provide test lots of material to the US Bureau of Mines at Tuscaloosa, Ala.

May 27, 1957

MICA GIANT DEPOSIT

MOHAVE COUNTY
WALLAPAI DIST.

This property idle.

MARK GEMMILL

Jan. 30, 1959

Visited Merlo Mica properties (including the Mica Giant) in Maynard Mining District some 30 miles southeast of Kingman. The trip was made with Edwin White of Kingman in his pick-up. He is the non-resident caretaker of the property. The mines are idle.

T. P. LANE

ABM Bull. 180, p. 400, 402

IC 8298, p. 20

P.O. Box 425

Maricopa Mica Mines

Mica Products

Maricopa, Arizona 85239

Phone ~~(602) 568-2533~~ 568-2341

MICA GIANT (fil.) MOHAVE WORK

4-2787

Dear Ken,

As you know the Kingman mica (Mexico Mica) came open; I applied for a Prospecting Permit. Paid my fee - and Bond -

Last week I received a letter from the State saying the Property will be ~~Ex~~changed for Federal Land. -

Could you call me at work and lets talk about this?

Also is the Russell Property STILL AVAILABLE?

Please call me, or better yet, Come By?

Sincerely;

Nick Castro

1927 E. Hawthorne,
Tucson, Aeizona.
April 19th 1943.

Mr. Charles F. Willis,
Title Trust Building,
Phoenix, Arizona.

MICA GIANT FILE

My dear sir:-

You may know that I succeeded in getting the U. S. Bureau of Mines to go up to Mohave County in January and make a survey and report on my mica property. I have not been able to get a copy of their report, but I have some excerpts from their report, copies of which I am sending you herewith.

You remember I have been in to see you about this mica a couple of times, but the more engineers that see it, the better it seems to look. According to this report there is on Mica Giant claim alone about $450,000.00 in strategic mica, which our Government is in dire need of. I have leased the property to a Mr. Roy V. Waughtel, and he has interested people with money to get out the mica. The Bureau of Mines, (U.S.) have recommended that the W.P.B. build 2½ miles of road to get the mica out, and the Grazing department of the Department of the Interior have also o.k'd the road I am told, now it is up to the W.P.B. to act.

It is my understanding that you have a Mr. Broadgate connected with you that can do wonders with matters like this. If so could you have him get behind this road matter and see what he can do if anything? Our Government need the mica, we are anxious to get it to them, everyone has passed on the mica and the road and have recommended that the road be built, so help us get this property to operating at the the first possible moment, if you please.

Im sure you will be interested in the excerpts of the report made by the bureau of mines, and I hope that you will think of ways to rush the road matter to a successful conclusion. Thanking you for your attention, and with kindest reagrds, I am,

Yours very truly,

T. Mac Smith

T. Mac Smith,