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Richard E. Mieritz
MINING CONSULTANT

June 7, 1957

Mr. H. A. Thurston
1648 E. Main Street
Mesa, Arizona

Dear Mr. Thurston:

Herewith is my completed "Geologic and Engineering Report" of the Rainbow Manganese Mines, Coconino County, Arizona.

I am also returning to you the twenty Notice of Location papers you loaned to me for review.

Five copies and the original of the report were made. One copy has been given to Mr. Dale Hutchison as you requested of me over the phone yesterday.

The tracings of the maps included in the report are being retained by my office for safe keeping. They are your property and can be recalled at any time. In the event more copies of the report are required, the only charge made will be for the extra typing, and costs of the prints.

You have a good property and I hope you will be able to do something with it. It has a good future, but some money will have to be spent to get it into production. It is a big mine and project.

I have appreciated preparing the report for you. Feel free to call on me to answer any questions you may have in or of the report.

Very truly yours,

R. E. Mieritz

cc

GEOLOGIC and ENGINEERING

REPORT

of

RAINBOW MANGANESE MINES

in

MOGOLLON RIM MINING DISTRICT

COCONINO COUNTY, ARIZONA

by

R. E. Mieritz
Mining Consultant
Phoenix, Arizona

June 7, 1957

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CONCLUSIONS

The writer, having examined the Rainbow Mines manganese property in Coconino County, Arizona, can conclude the following:

(1)- Manganese as psi lomelane nodules and replacement mineralization is in abundant evidence over much of the property,

(2)- that approximately 850,000 tons of a 20% manganese content reserve is in evidence for the small area outlined and developed by the limited surface pits and trenches,

(3)- that $35,000 will be required to "block" out and grade define by drilling, trenching and sampling the above calculated reserve block,

(4)- that several million tons of similar grade reserve could be proven in other areas within the property by additional geologic surface mapping and a well planned exploration and development program,

(5)- that the material can be mined by very low cost open pit methods employing shovels or front end loaders,

(6)- that the metallurgical test work completed by the Denver Equipment Company indicates that the manganiferous material is amendable to concentration and

(7)- that this same test work indicates further test work must be done to eliminate the presence of an insoluble barium sulphate which apparently does not dispose of itself during the mechanical sizing and gravity processes conducted by the Denver Equipment people.

PROPERTY

Two arreally unrelated groups of claims are currently known and designated by the co-owners as the Rainbow Mines. The two groups are referred to as the Rainbow and Royal Blue claims.

Since this condition exists, further reference to the property will include both groups unless specifically and individually identified.

Production from the property is sold under the name of Rainbow Mines.

LOCATION

Rainbow Mines are located in the Mogollon Rim Mining District, southeastern Coconino County, Arizona. The Royal Blue group of eight claims lie in Sections 11 and 12; Twp.11 N., Rge. 14 E., while those of the Rainbow group are situated in Sections 16 through 20 of Twp. 11 N., Rge. 15 E. of the Gila & Salt River Base & Meridian.

The nearest post office is Heber, a small ranching and lumber community on County Highway 160. The property is approximately 14 miles westerly of Heber via this road. This graveled highway is well maintained and is soon to be paved to better accommodate the heavy logging trucks now operating in the area. The road traverses the Rainbow claims in an east-west direction with approximately half the acreage on each side. (See Plate 3)

CLAIMS

The claims number 48, eight in the Royal Blue group and 40 in the Rainbow group. All claims are unpatented, being of standard dimensions and acreage.

Each group is identified by the following:

Royal Blue Group

Royal Blue No. 1	Mesa Verde No. 2
Royal Blue No. 2	Mesa Verde No. 3
Royal Blue No. 3	Mesa Verde No. 4
Mesa Verde No. 1	Mesa Verde No. 6

Rainbow Group

Rainbow No. 1	Royal Blue No. 4	Mesa Verde No. 7
Rainbow No. 2	Royal Blue No. 5	Mesa Verde No. 8
Rainbow No. 3	Royal Blue No. 6	Mesa Verde No. 9
Rainbow No. 4	Royal Blue No. 7	Glory Hole No. 1
Rainbow No. 5	Royal Blue No. 8	Glory Hole No. 2
Rainbow No. 6	Royal Blue No. 9	Glory Hole No. 3
Rainbow No. 7	Royal Blue No. 10	Glory Hole No. 4
Rainbow No. 8	Royal Blue No. 11	Glory Hole No. 5
Rainbow No. 9	Royal Blue No. 12	Glory Hole No. 6
Rainbow No. 10	Royal Blue No. 13	Glory Hole No. 7
Rainbow No. 11	Royal Blue No. 14	Glory Hole No. 8
Rainbow No. 12	Royal Blue No. 15	Glory Hole No. 9
Rainbow Ext. No. 5	Mesa Verde No. 5	Glory Hole No. 10
		Glory Hole No. 11

OWNERSHIP AND TITLES

Twenty-eight claims have been staked by John Pattrick, Box 72, Heber, Arizona, while twenty claims have been staked by J. A. Thurston, Paradise Palms Trailer Court, Mesa, Arizona. All claims have been joined into one "package" with equal ownership by the individuals.

Each claim notice is legally recorded in the proper County office at Flagstaff. Some claims have been staked and recorded as early as 1947. Each claim is properly discovered, cornered and end monumented in accordance with State and Federal regulations. Ample assessment work is in evidence. As a result, all claims are valid and in good order.

The writer's recent plane table-stadia survey of two small areas indicate that some overlapping of the claims exist. Proper amended locations should be made to correct this condition.

ADJOINING PROPERTIES

Approximately 1 mile separates the Royal Blue group from that of the Rainbow group. The intervening area, originally claimed by John Pattrick, was sold to Alvis Denison, who has since patented the 40 claims. A recent court decision awarded Mr. Denison undisputed right to patent 13 claims of this group which the Department of Agriculture protested. The mineral wealth (manganese) was proved to exceed the value of the timber stand on the property.

Although non-productive at this writing, the Denison management has proven ore and built a fair sized mill, the flow sheet of which will be discussed later. Time did not permit the writer to visit this property.

PRODUCTION

Mr. Patrick, co-owner, is solely responsible for the past production; shipping an average of five cars per year for the past several years. Tonnage-wise the production is small but it has provided an adequate financial aid to further develop the property on a limited basis. Mr. Patrick reports that shipments have ranged in grade from 40 to 45% Mn, 10 to 12% Silica and 3 to 6% alumina. Hand sorting and washing were required to maintain such grades.

The produced tonnage has been mined from various surface pits, shafts and adits, particularly on claims Royal Blue Nos. 2 and 3, Rainbow Nos. 1, 2, 6, 8 and 12.

FACILITIES

Accessibility

The property is readily accessible over well maintained graveled county roads either from Show Low or Snowflake, two towns on Federal and

State Highways respectively. The former town is 57 miles southeasterly of the property while the latter is 45 miles east and is served by a branch of the Santa Fe Railroad.

Heavy trucking is permitted on these county roads because of the very active lumber industry operating in the area.

Most claims are accessible through use of the lumber industry's access roads, and the Forest Service fire roads. These particular roads are serviceable when dry but difficult to traverse when wet except for low gear driven vehicles.

The gentle rolling topography and moderate soil and clay on the "Rim" permits inexpensive and rapid road construction; a feature worthy of much consideration.

Power

No electric power is available at the property. The nearest source is Heber. Pressure could, however, be brought to bear for erection of a power line to the properties if the demand of the existing mill was coupled with that of a new mill for this property.

Water

No visible water source is available for commercial or domestic use. I have been advised by Mr. Patrick that the Denison management has drilled a 510 foot well which will supply their mill and domestic requirements. Their first water was encountered at 200 feet.

The clay, sandy soil has very good impervious characteristics as evidenced by the fact that rain and snow precipitation collects and remains in natural and man made depressions for a long time. (See photo 2) Excellent reservoir construction conditions therefore exist. This added

feature would permit collection of rain and snow and a high reclamation of mill water storage to supplement a water source developed by drilling.

Timber

Good stands of Ponderosa Pine, 20 to 30 inches through at trunk, cover the claims moderately. Patenting of such claims on which mining operations could begin almost immediately would provide ample lumber for mill construction, housing, etc., as well as an added revenue from sale of the timber. A small saw mill on the property could mill the required board feet for a very nominal sum.

DEVELOPMENT

Only a small portion of the property is developed to any great extent and is limited to two areas from which ore has been mined. These areas are indicated by plates 4 and 5. Except for the usual discovery pits, the remainder of the property is virtually untouched, thereby leaving a large area open for exploration and development of substantial quantities of ore reserves to sustain a long mine life.

The previously referred to areas are developed by shallow pits, cuts, trenches and to a lesser degree by two shafts and an adit, the underground workings all being caved and inaccessible. Only a few trenches are of ample size and depth to properly expose the type mineralisation common to the property. The shallow pits do, in the opinion of the writer, reflect the strength of mineralisation which could be expected at a slightly deeper depth.

Development, as shown on plates 4 and 5, is sufficient to provide and justify the calculated ore reserved mentioned in succeeding paragraphs.

GEOLOGY

General

The Mogollon Rim and Plateau in the area of the mine is underlain by a series of flat or gently dipping beds of sandstone and limestone of Carboniferous age. In particular, the formations in descending order are; the Kiabab limestone, Coconino sandstone, Supai formation and the Redwall and related limestones.

Occasionally, small remnants of the Triassic Moenkopi formation are visible at elevations above the plateau. Surface wise there is no evidence of faulting which might cause disarrangement of the beds and complicate ore possibilities.

The only igneous rocks of any magnitude are the pre-Cambrian granite and diabase intrusives located approximately 12 to 16 miles southwest of the property and well below the Rim elevation.

Local

The Kiabab limestone is the topmost sedimentary formation in the immediate area of the property. It is within this formation that the manganese deposits occur.

In general, the manganese deposits occur near the surface as replacement bodies in decomposed sandy limestones, sandstones and as fracture fillings in a broken phase (breccia?) of the same formation. Within the limits of the property the manganese mineralization is primarily confined to one or more (?) sandstone members of the Kiabab formation which are separated by intermittent thin sandy limestone members. The one limestone member exposed appears void of mineralization.

As shown in several of the cuts and trenches the sandstone is decomposed several feet below the surface and usually stained yellow, brown, red and black as a result of the contained oxides of iron and manganese.

Nodules and masses of manganese as psilomelane are scattered over the surface and found in decomposed rock to several feet. The psilomelane has a peculiar structure being vesicular and ropy, but when broken are found to be composed of columnar rods one to two inches deposited as concentric crusts. Brown iron has been deposited in the interstices of this ore.

Information forwarded by Mr. Patrick to the writer with reference to the now inaccessible shafts indicates that oxides of manganese and iron have replaced the more fresh sandstone along its bedding planes at a 25 to 30 foot (thickness of limestone member) depth below the bunches, masses and disseminated nodules of manganese found in the decomposed clay and sandstone near the surface. (See Photos 1, 3 and 4) This possibility is somewhat substantiated by the remnant mode of mineralization exhibited in some of the pits and trenches in the decomposed surface sandstone.

Fracture filling of the broken phase (breccia)? of the fresh sandstone is quite evident in the discovery pit of Rainbow No. 10 Claim. Here the manganese and iron oxides have completely surrounded the angular sandstone fragments. In some instances there is evidence that the sandstone is actually being replaced. (See Photo 2) The lateral or vertical extent of this mineralization could not be determined because of the one and only exposure.

Photo 1-Shows nodules of psilomelane on sandstone boulder and psilomelane actually replacing the smaller sandstone fragment.

Photo 2-Looking north across water pond towards crusher, log-washer, washed ore and ore bin. Royal Blue No. 3 claim.

Photo 3-Looking north into face of open cut just south of owners cabin on Rainbow No. 12 claim. Shows heavy concentration of manganese mineralization in clay and sandy loam.

Photo 4-Shows lenses and heavy concentrations of manganese mineralization in pit on Royal Blue No. 2 claim. Looking south.

Source of Mineralization

Two hypothesis can be forewarded as to the source of the mineralization; (1) Manganese has been deposited in its present position as oxides from the solution of manganese minerals originally disseminated in overlying rocks which since have eroded and (2) the oxides are residual from weathered manganese minerals originally deposited in a fault or breccia? zone, solutions from which permeated the adjacent sediments and replaced them. (See Photos 3 and 4)

The evidence of origin of this deposit seems to favor the residual form (1) rather than the redistribution of weathered vein material since there is little evidence of true steep dipping vein manganese in the exposed sandstone or limestone.

ORE RESERVES

Ore reserves are limited to that small portion of the Rainbow claim area at the property that is developed by the various surface pits, cuts and trenches. (See Plate 4) Many surface workings are shallow and have not fully penetrated the existing mineralization.

No reserve consideration has been given the Royal Blue area for reason of limited and wide spaced development. It is, however, an area in which 700,000 tons of 20% manganese might easily be developed.

It is the opinion of the writer that the calculated ore reserve must be placed in the "probable" ore classification even though there is ample justification and geologic evidence to place a majority of the reserve in the "developed" category.

Probable Ore

The author has ascribed a reserve outline that has been based

and limited by visual examination, geologic conditions and the sampling done during the examination. (See Plate 4) The crescent shaped outline roughly approximates a block 2600 feet in length, averages 650 feet in width and would represent a volume of 845,000 tons using an 8 foot depth and a 16 cu.ft. volume factor (soil and sandy clay only) for the unconsolidated material.

The average grade of this block will approximate 20% Mn. Because of the limited available time, the writer did not embark upon a detailed sampling program for reason that the material mined by Mr. Patrick is indicative, yet in excess of the value assigned the block. The succeeding paragraphs describing the samples taken will further indicate a surface tenure of the ore expected below.

Sampling

Samples taken by the writer were selected from such workings (the most shallow pits, cuts, etc.) to purposely avoid taking high grade material which would tend to create an optimistic and misleading presentation of the mineral wealth which could be available from the property. Most of the samples taken were so selected to provide information for a guide to additional mineralized areas and as a limiting control for the ore outline. Clean psilomelane nodules were also purposely avoided, primarily because of the human tendency of "selection". Several unsampled pits exhibited 35% Mn in place.

Twelve samples were taken. One 350 pound composite metallurgical sample was selected from various workings. Seven individual samples were taken from various workings near the surface to provide the writer additional evidence on which to justify the reserve outline and also to provide information for a guide to locating new ore areas. One sample

was taken to provide information on a screen test made by the writer. One sample was taken of washed ore to be shipped by Mr. Pattrick. One sample was taken from material mined by Mr. Pattrick. One sample consisted of clean manganese nodules the writer picked up from the surface within and without the ore zone over much of the property.

The results of the above samples are shown below.

Sample No	Description	% Mn	% SiO_2	% Al_2O_3
1	Sandy loam at large trench on Rainbow Claim No. 8. Composite of 14 shovel grab samples covering 140 foot length.	4.4		
2	Screen analysis test of a portion of the above sample (1) + 8 mesh	13.4	42.8	
3	Screen analysis test of a portion of the above sample (1) - 8 mesh, + 20 mesh	3.2	55.8	
4	Screen analysis test of a portion of the above sample (1) - 20 mesh	1.6	69.8	
5	Sandy loam at large "T" trench on Rainbow Claim No. 12. Composite of 10 shovel grab samples covering 90 foot length	5.11		
6	Sandy loam from north leg of "L" trench on Rainbow No. 2 Claim. Composite of 6 shovel grab samples covering a 50 foot length.	4.4		
7	Sandy loam from west leg of above trench. Composite of 4 shovel grab samples covering a 30 foot length.	4.7		
8	Sandy loam from "T" trench on Rainbow No. 3 Claim. Composite of material from shallow pit filled with water.	3.1		
9	Sandy loam from small pit near center of Rainbow No. 2 Claim. Composite of material removed from shallow pit filled with water.	1.6		

Sample No.	Description	% Mn	% SiO_2	% Al_2O_3
10	Sandy loam from pit on Royal Blue Claim No. 2. Composite of 9 shovel grab samples covering an 80 foot length	4.9		
11	Composite of samples 1, 5, 6, 7, 8, 9 & 11	4.1	63.4	10.1
12	Clean manganese nodules picked at random from surface over much of the area	41.3		
13	Composite shovel grab sample of mined material to be processed by Mr. Pattrick	25.4	31.7	9.7
14	Composite grab of washed ore ready for shipment	41.2	8.7	3.8

Sample No. 14 is considered indicative of the ore grade that can be expected from the above described reserve block. This material had been mined by Mr. Pattrick from several pits on both claim groups and represents a composite of the ore available. Here again the writer purposely avoided the clean manganese nodules, taking only that material which appeared representative and thoroughly uniform. This same ore pile, including nodules, was sampled by a Geneva Steel representative, taking 1000 pounds and quartering same to 100 pounds. The results of these two samples are compared below.

	Mn	SiO_2	Al_2O_3	Cu	Fe	P	As	S
Geneva -	44.0	9.0	None	.06	2.4	.09	.14	.006
Writer -	25.4	31.2 (True)	9.7	.02				

Since the human element enters into Mr. Pattrick's operation also, the writer believes the 20% manganese grade is within the realm of the geologic and mineralogic limitations in evidence.

Possible Ore

Surface-wise, manganese mineralization is in abundant evidence

in many areas within the property. The writer therefore feels that closer field examination of the entire property will disclose virgin areas to be explored and developed. Wide spaced surface sampling may well be used as a tool and guide to such mineralized areas. Assay values whose magnitude approach or equal those of samples 5 through 10 can well be indicative of better mineralization at depth.

A possible potential of millions of tons of similar grade material could be developed from the sandstone member exposed on the surface within the property. Moreover, an undeterminable amount of reserve could possibly be developed in the second sandstone member indicated by the shaft work. This second member being overlain by the 22 to 25 foot thick barren limestone member. These potentials are geologic interpretations as evidenced on the property by the writer.

Exploration

Since mineralization is associated, for the most part, with the deteriorating characteristics of the sandstone, short exploratory drill holes will be required to check the reserve within the outline and any new areas of potential.

The writer believes that tractor mounted churn drills could be put to their best advantage of large diameter hole, ten or twelve inches, their ability to penetrate contrasting material types to be drilled and its portability. Few if any drill locations would be required. The holes should be drilled at 100 foot centers with every other hole reaching a depth of 50 feet and the intervening holes drilled to a depth slightly below the top of the underlying limestone.

Each hole should be sampled every 3 feet in the ore zone or the sandstone members. Samples should be wet split to a suitable size, dried and assayed.

A program such as this should not exceed 3 to 4 cents per ton of material developed including drilling, sampling, assaying and supervision. A total expenditure of some $35,000 would be required to complete the above program.

PRODUCTION METHODS

Mining

The mode of mineralization of the deposit makes it very amendable to a large daily production at a very inexpensive operating cost. Mining could be conducted on an open cut basis with shovels and trucks or by carry-alls. Little to no rock blasting will be required. Clearing the mineable area of its timber and stumps may constitute the only major problem and expense involved.

It is the opinion of the writer that a mining cost of less than $1.00 per ton could be achieved. This cost should include the necessary clearing of the land, the actual mining and the necessary short truck haul to a strategic mill location.

Milling

The writer made a simple dry screen test of material from sample No. 1 which assayed 4.42% Mn. Two screens (an 8 mesh and a 20 mesh) were used to obtain three products. Since the original sample was thoroughly mixed, we might assume the screen tested material contained an equivalent amount of manganese. The material screen tested weighed 3.91 pounds and contained various size particles of manganese nodules, sandstone fragments, and clay. Table 1 on page 17 shows the results of this test.

Several important physical and metallurgical characteristics can be concluded from the results of the test. These are (1) the bulk of the

TABLE I

Screen Test Analysis

Mesh	Weight in lbs.	% Weight	% Mn	Mn. Wt. in lbs.	Calc'd % Mn Recovered	% SiO_2	SiO_2 Weight in lbs.	Calc'd % SiO_2 Retained
+ 8	1.57	40.2	13.43	0.211	80.5	42.8	0.676	30.9
-8, +20	0.84	21.5	3.24	0.027	10.3	55.8	0.469	21.4
-20	1.50	38.3	1.62	0.024	9.2	69.8	1.047	47.7
Orig.	3.91	100.0	4.42	0.173	100.0			
Calc'd.	3.91	100.0	6.70	0.262	100.0	56.1	2.192	100.0

Photo 5-Shows front end of stationary ¼" screen and box. Owner hose-washes material at left in screen box, leaving coarse product in front end.

Photo 6-Shows coarse washed nodules of manganese which will be shipped. Writers sample contained 41% manganese. Not table top land level.

manganese is contained in the larger fragments (2) approximately 2/3 of the silica occurs as separable sandy or quartz grains; whereas the balance of the silica is apparently contained in the larger sandstone fragments, and (3) that extreme care must be taken in sampling any portion of the deposit because an over abundance or a reduced amount of the manganese nodules will easily influence any assay value. This fact is evidenced by comparison of the manganese content of the original sample with the calculated content. The writer felt sure the sample he prepared and mixed was of homogeneous mass.

The owners upgrading methods prove that better than average grade ore can easily be concentrated, however, there is no reliable information that material lower in average grade can be up-graded. Such information would be invaluable to planning future mining and milling operations.

To obtain some information thereof, a 350 pound composite sample of mineralized material from both areas; the Rainbow and Royal Blue groups, was therefore sent to Denver Equipment Company in Denver to determine the amendability to concentration. The sample was purposely prepared with a low manganese content so as to provide extreme hardships or problems for the test work. The reasoning behind this thought being that tonnage-wise, the present reserve and that of the future could be doubled or trebled with, of course, a corresponding decrease in average grade. If such test work was successful, the present suspected limited selective mining could be further reduced, although not completely eliminated.

The physical character of the sample can be described as containing clay, sandy loam, sandstone fragments not in excess of a one inch size, and psilomelane nodules from small grain size to not more than one

inch in size, the latter size nodules being kept to a bare minimum.

The metallurgical test indicates that except for one objection, the results are satisfactory. The insoluble barium sulfate apparently does not lose its affinity for the concentrate in the mechanical sizing and jigging processes since better than 18% of this material remains in the up-graded product.

The following is a copied report of the test conducted by the Denver Equipment Laboratories:

June 4, 1957

Reference: Ore Test JW-45271

Gentlemen:

We are hereby submitting the following report of the gravity concentration test which was conducted upon your sample of earthy manganese.

Sample Identification

We received on May 7, 1957 three sacks of manganese sample with a gross weight of 356-lbs. The sample was from R. E. Mieritz, Show Low, Arizona, and was shipped via prepaid truck freight.

Object of Tests

The purpose of the test work was to determine if the manganese sample could be upgraded to a minimum of 44 percent manganese and contain less than 15% combined silica plus alumina.

Estimated plant tonnage would be 250 to 500-tons per day. Water would have to be reclaimed.

Sample Preparation

The contents of the three sacks were thoroughly mixed and a 44-pound sample for testing cut out by coning and quartering procedures. All portions of the sample were reserved for testing and future reference.

Sample Description

The sample represents an earthy type of manganese which contains the major portion of the manganese as lumps or nodules in the fraction plus 20-mesh. The gangue was composed of gumbo clay, sandstone, and sand.

The nature of the sample, with the manganese in nodular form makes it virtually impossible to get a representative sample for a head sample assay. The calculated head assay based on the test results shown on page D-1 showed a manganese content of 4.71 percent. The plus 20-mesh fraction contained 82.7 percent of the total manganese and the weight percentage in this fraction was 15.3 percent.

Test Results

The following is a brief description of the test conducted on the manganese sample.

Test No. 1

Several charges of the sample as received without crushing was attritioned or scrubber at 50 percent solids in the laboratory rod mill followed by wet screening at 20-mesh to produce an oversize and undersize product. The total oversize was given a second attritioning to remove any residual clay and debris adhering to the manganese. The minus 20-mesh fraction was added to the original fines. The plus 20-mesh product which assayed 25.4% Manganese was sized at 3/8", 3-mesh, and 10-mesh for gravity concentration by jigging. The fraction plus 3/8 inch was hand jigged to produce a concentrate and a tailing. The two sizes -3/8" x 3-mesh and -3 x 10-mesh were treated by the Harz Jig to produce a concentrate and a tailing. All of the coarse jig tailings were combined for assay.

The minus 10-mesh x 20-mesh fraction was concentrated by the Denver Mineral Jig to produce a concentrate, jig bedding product and a tailing.

The test results given in detail on page D-1 revealed that the total gravity concentrates assayed 41.7 percent manganese, 11.40 combined silica and alumina, 3.12 percent iron and contained 70.8 percent of the total manganese. The chemical analysis showed a sulfate insoluble of 18.2 percent and the spectrographic analysis of the concentrates gave positive tests for barium. The difference between the sulphate insoluble and silica plus alumina is probably due to the barium in the concentrates.

A higher grade manganese concentrate could probably be produced, but the manganese recovery would be considerably lower.

The primary minus 20-mesh product thickens fairly well to approximately 30 percent solids, but at 30 percent solids the minus 20-mesh product settles into a jell-like mass and the settling rate is extremely slow. The water reclamation from the slimes would be very low.

Remarks and Conclusions

The sample tested was a low grade earthy type manganese which contained 4.70 percent manganese. The information required for ore tests indicated

that the sample should assay 15 to 25 percent manganese. The concentrates produced in the test did not meet the required grade of 44 percent manganese. The impurities in regards to silica, alumina and iron met specifications, but the barium content in the concentrates kept the concentrate grade below 44 percent manganese.

No flowsheet is being submitted in view of the fact that the manganese concentrates did not meet the required 44% minimum grade and the sample was much lower grade than anticipated.

Additional tests on a new higher grade sample may be warranted to determine if an acceptable grade of concentrate could be obtained.

The remaining unused portions of the sample will be discarded 6-months from the date of this report unless notified to the contrary.

Yours very truly,

DENVER EQUIPMENT COMPANY

/s/ Henry C. Hurd, Jr.
Henry C. Hurd, Jr.
Test Engineer

/s/ Clarence Thom
Clarence Thom, Director
Ore Testing Division

Table II is the assay and recovery summary of the test work by Denver Equipment.

TABLE II

SUMMARY OF RESULTS

DENVER EQUIPMENT COMPANY

Sample Identification 20,238-grams of sample as received

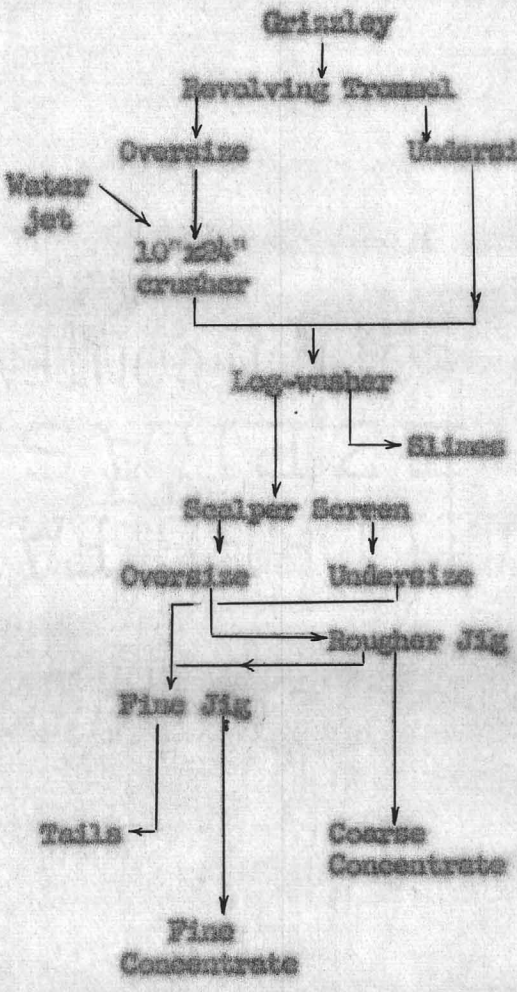
REPORT NO. JW-45271

	PRODUCT	Percent Weight	ASSAYS PERCENT Mn	SiO_2	Al_2O_3	Fe	Sulphate Insol.	% Recovery Mn
	Calculated Heads	100.0	4.71					100.0
1	Harz Conct. /3/8"	3.9	42.8	6.28	4.2	3.20	16.6	35.5
2	Harz Conct. /3-mesh	1.4	43.2	6.24	4.1	2.40	16.6	12.8
3	" " /10-mesh	2.4	39.0	8.76	6.3	3.20	21.7	19.9
4	Harz Tail	5.9	6.5					8.1
5	D.M. Jig Conct.	0.3	40.8	6.64	4.3	4.6	17.9	2.6
6	D.M. Jig Bed	0.4	25.6	25.48	8.5	7.1	37.0	2.2
7	D.M. Jig Tail	1.0	7.3					1.6
8	Heads -20x200-mesh	46.3	1.1					10.8
9	Heads -200-mesh	38.4	0.8					6.5
	(Combine 1,2,3,4,5,6,7) (Total / 20-fraction)	15.3	25.4					82.7
	Total Concts. 1,2,3,5	8.0	41.7					70.8

REMARKS: 6 charges of manganese sample as received were attritioned in the laboratory rod mill at 50% solids to disintegrate the lumps of clay. The resulting pulp was screened at 20-mesh to give an oversize and undersize product. The minus 20-mesh product was classified into a plus and minus 200-mesh product for assay purposes. The plus 20-mesh fractions were separated into 4 fractions for Harz Jig and mineral jig concentration. The test results are given above.

Although time did not permit the writer to visit the Denison property and mill, Mr. Pattrick had provided me with a simplified flow sheet as best as he could recall it on the one and only visit he made to the mill. The Denison mill flow sheet is as follows:

DENISON MILL FLOW SHEET



No information is available as to mill feed contents, the recoveries of manganese and the percentage of manganese content in the contentrates. As a result, the process cannot be evaluated. Mr. Denison might well be very cooperative in discussing his mill process.

RECOMMENDATIONS

The following recommendations are submitted to provide a guide for the owners or interested parties.

(1) the ore area as outlined on Plate 4 should be test drilled and sampled as outlined under the paragraph "Exploration",

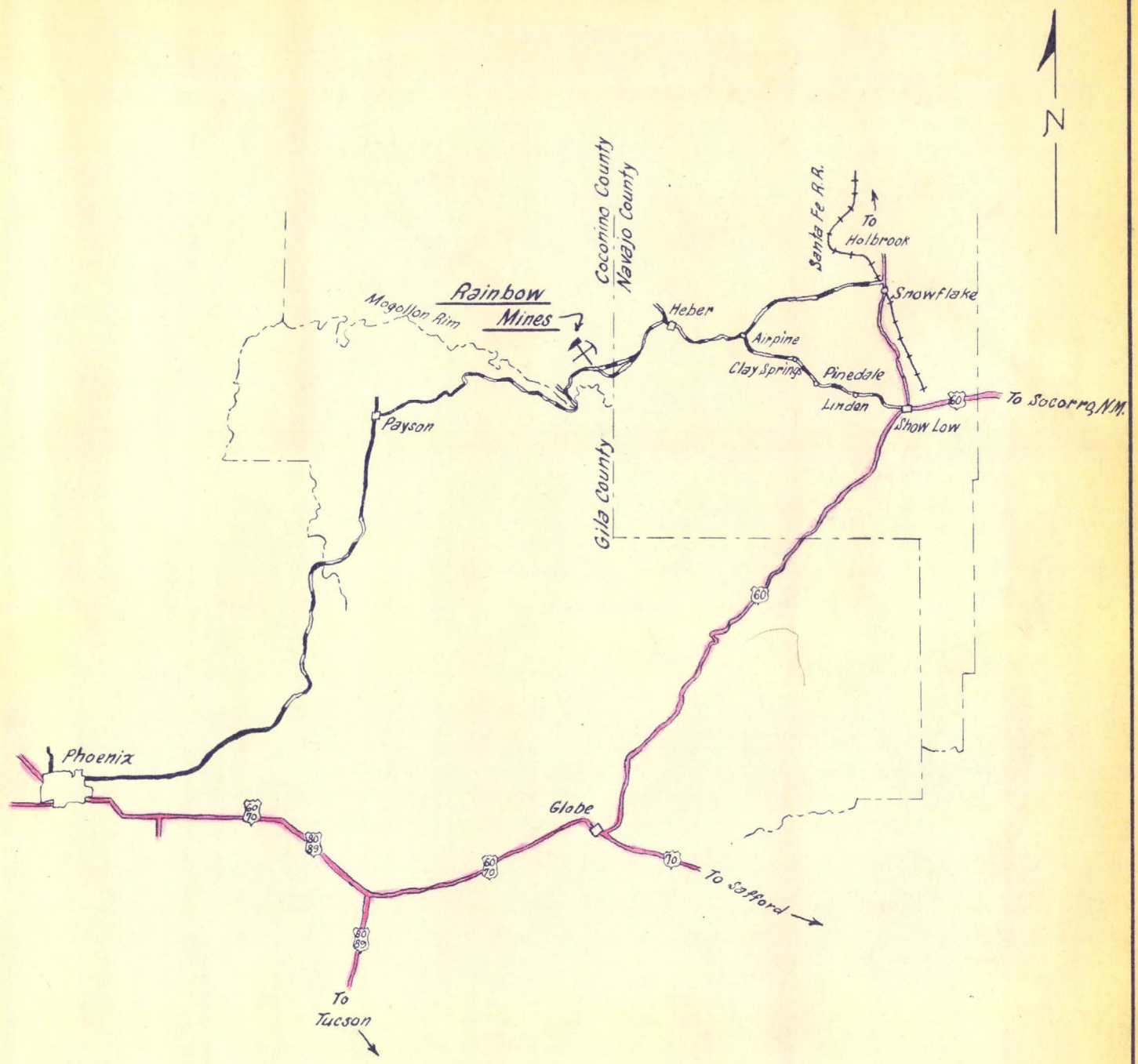
(2) additional surface geological work should be completed to indicate other areas of great potential,

(3) additional metallurgical test work should be done to rid the concentrate of the insoluble barium sulfate thereby increasing the manganese grade in the concentrate, and

(4) that these recommendations be completed as soon as possible and the mine put into production to take advantage of the high world market premium prices now offered for the metal.

Respectfully submitted,

R. E. Mieritz,
Mining Consultant
Phoenix, Arizona



NOTE

Federal Highways

Paved State roads

Graveled State or County roads

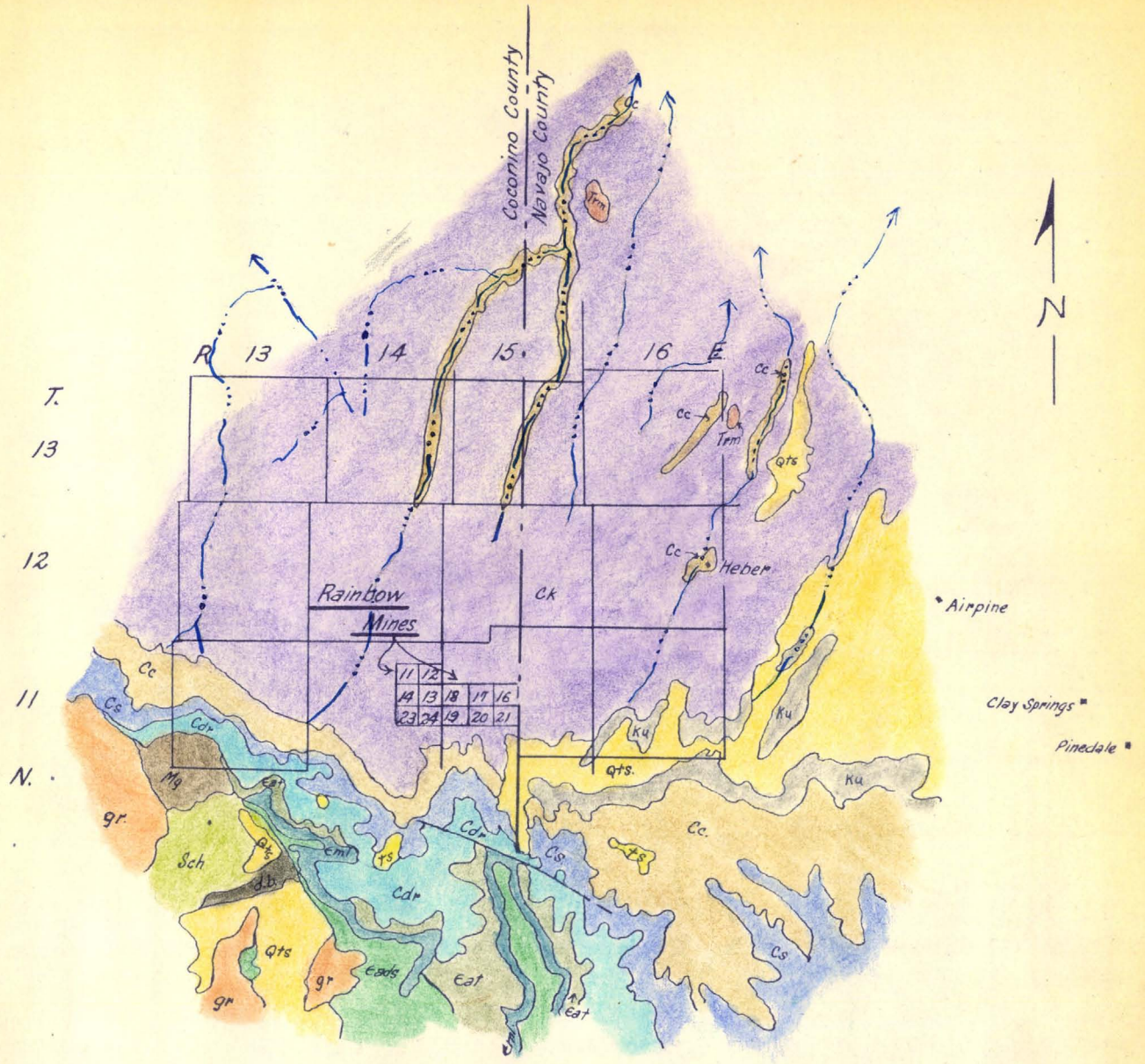
INDEX MAP
OF
EAST CENTRAL ARIZONA

SCALE: 1" = ± 21 MILES

0 10 20 30 40

MAY, 1957 R.E.M.

PLATE 1



LEGEND

867	Ts	Sand, gravel, limestone.	Quaternary & Tertiary
817	Qts	Sand, gravel, conglomerate.	
619	Ku	Upper, undivided.	Cretaceous
873	Trm	Moenkopi formation.	Triassic
895	Ck.	Kaibab limestone.	Carboniferous
953	Cc	Coconino sandstone.	
865	Cs	Supai formation.	
845	Cdr	Redwall & related limestones.	
853	Eat	Troy Quartzite.	Cambrian or Algonkian
898	Eml	Mescal Limestone	
868	EAds	Dripping Springs Quartzite	
893	Mg	Mazatzal Quartzite	Archean
846	Sch.	Schist	
862	Gr.	Granite	Pre-Cambrian

SURFACE MAP
OF
REGIONAL GEOLOGY
PARTS OF
COCONINO & NAVAJO COUNTIES,
ARIZONA

SCALE: 1" = 8 MILES

0 4 8 16 MILES

MAY, 1957 R.E.M.

PLATE 2

R. 14 15 E.

T. 11 N.

Royal Blue No.3
Mesa Verde No6
Mesa Verde No. 1
Mesa Verde No.2
Mesa Verde No.3
Royal Blue No.2
Royal Blue No.1
Mesa Verde No 4

L.D. No. 13
4352 - C & D. No. 14
4352 - C & D. No. 15
4352 - Ext. No. 5
4352 - Ext. No. 6
4352 - Ext. No. 7
4352 - Ext. No. 8
4352 - Ext. No. 9
4352 - C & D. No. 5
4352 - C & D. No. 6
4352 - C & D. No. 7
4352 - C & D. No. 8
4352 - C & D. No. 9
4352 - C & D. No. 4
4352 - C & D. No. 2
4352 - Campbell & Denison No. 1
4360 - Hillcrest No. 8
4360 - Hillcrest No. 7
4360 - Hillcrest No. 6
4360 - Hillcrest No. 5
4360 - Hillcrest No. 4
4360 - Hillcrest No. 3
4360 - Hillcrest No. 1
4360 - Hillcrest No. 2
4360 - Hillcrest No. 21
4415 - Hillcrest No. 24
4360 - Hillcrest No. 10
4360 - Hillcrest No. 12
4360 - Hillcrest No. 9
4360 - Hillcrest No. 11

4361 - Hillcrest No. 13
4361 - Hillcrest No. 14
4361 - Hillcrest No. 16
4361 - Hillcrest No. 15
4361 - Hillcrest No. 19
4361 - Hillcrest No. 20
4361 - Hillcrest No. 17
4361 - Hillcrest No. 18

Rainbow Ex. t. No. 5
Rainbow No. 5
Rainbow No. 7
Mesa Verde No. 8
Mesa Verde No. 5
Rainbow No. 4
Mesa Verde No. 7
Mesa Verde No. 9
Royal Blue No. 7
Royal Blue No. 6
Royal Blue No. 4
Royal Blue No. 5
Rainbow No. 3
Rainbow No. 6
Rainbow No. 12
Rainbow No. 8
Rainbow No. 1
Rainbow No. 2
Rainbow No. 11
Rainbow No. 9
Rainbow No. 10

Royal Blue No. 8 | Royal Blue No. 9 | Royal Blue No. 10 | Royal Blue No. 11
Royal Blue No. 15 | Royal Blue No. 14 | Royal Blue No. 13 | Royal Blue No. 12
Glory Hole No. 1 | Glory Hole No. 4 | Glory Hole No. 6 | Glory Hole No. 7
Glory Hole No. 3 | Glory Hole No. 10 | Glory Hole No. 9 | Glory Hole No. 8
Glory Hole No. 2 | Glory Hole No. 11 | Glory Hole No. 5

Heber

RAINBOW MINES
DENISON PROPERTY

CLAIM MAP
OF
RAINBOW MINES

MOGOLLON RIM MINING DISTRICT
COCONINO COUNTY, ARIZONA
SCALE: 1"=1200'

0 600 1200 2400 3600FT.

MAY, 1957 R.E.M.

PLATE 3

To Heber → 13 miles

Mesa Verde No. 5.

Rainbow No. 4

Rainbow No. 7

Rainbow No. 3

U.S.B.M. 7526 ft.

Barren shallow pit

Disc.

Moderate MnO nodules in sandy loam - shallow, 3ft. Pits - Water

Sparse Mn nodules in sandy loam. Some Ss fragments, disseminated ¢ seam MnO - 4ft water. Sample #8 MnO - 3.1%

Mn pebbles in sandy loam. 3ft deep.

Outline used for "Possible" ore calculations in report.

Sample #6 MnO - 4.4%
Sample #7 MnO - 1.7%

Strong Mn nodules and pebbles in clay ¢ sandy loam. 5ft deep. - Sparse Mn in SW trench - 3ft deep

Disc.

Sparse to moderate MnO nodules in sandy loam - 3ft deep.

Sample #9 MnO - 1.6%

Rainbow No. 2

"A"

Strong MnO nodules ¢ pebbles in clay ¢ sandy loam. Ss fragments heavily coated ¢ being replaced. 6ft. deep.

Disc.

MnO coated Ss fragments Small pebbles in loam. 2ft deep

2ft dozer trench, 5ft hand dug trench - MnO in clay, strong, little in soil or loam. Some arenaceous limestone boulders. Sandstone bedrock exposed at bottom - barren.

Rainbow No. 6

Outline used for "Possible" ore calculations in report.

Rainbow No. 12

Cabin

"C"

"B"

Area of much pebble MnO float.

Old Road to Heber 14 miles.

Area of boulder MnO float

Heavy MnO nodules ¢ replaced Ss fragments MnO as float.

Disc.

Sporadic MnO mineralization. Cut exposes surface water percolation

Shaft, now caved, had 11ft clay, 22ft barren limestone

Heavy MnO concentrated at north end as horizontal bed in clay, sandy loam. Clay ¢ loam 10ft at north end.

4" Iron ¢ 6" MnO - still in floor. 35%

Sample #5 MnO - 5.1%

Mod. to strong MnO nodules in thick Sandy loam - some clay. Heavy

2' deep trench Moderate MnO nodules in loam

Rainbow No. 8

Sample #1 MnO - 4.4%

Mod. MnO in sandy loam. 2' deep pit

MnO in small "E" 4 to 5' deep small pits

Shallow trench Sparse MnO - Ss fragments.

Sandstone ? Limestone ?

possible top of ? ft limestone member

base of sandstone member

Sparse MnO nodules Mostly soil.

Disc.

MnO nodules in sandy loam. Shallow pit.

Area of surface scratching. Moderate MnO nodules in sandy loam.

2ft deep pit. Sandstone fragments - barren

Rainbow No. 10

Very strong MnO replacing ss. fragments - in place? Much MnO nodules as float. 2 ft. deep.

Disc.

Disc.

Adit, caved - much iron, 4' wide, reported Heavy MnO. 2½ cars shipped, 40% MnO.

Rainbow No. 1

19 20 1/4 Cor.
19 20 T.11N.-R.15E.

N

LEGEND

- Pits - Trenches, etc
- Surveyed Claim Corners
- Surveyed Discovery monuments.
- Plane table survey stations.

SURFACE MAP
OF
GEOLOGY & DEVELOPMENT
RAINBOW MINES
COCONINO COUNTY, ARIZONA

SCALE: 1" = 200'

0 100 200 400 600 FT.

MAY, 1957 R.E.M.

PLATE 4

Washed Product - + ¼"
MnO - 41.2%
SiO_2 - 8.7%
Al_2O_3 - 3.8%

Ore bin

Log washer & crusher

Water Supply

Pre-Washed material from Royal Blue 2 & Rainbow 12
25.4% - MnO
31.8% - SiO_2 — 9.7% Al_2O_3

Mn pebbles in trench. (moderate)

4½ ft flat (vein?) bed 6 ft below surface in Shaft.
- 38% MnO

Royal Blue No. 3

Mesa Verde No. 6

Mesa Verde No. 1

N

"G"

"F"

"E"

¼ Cor.
11 | 12
11 | 12
T. 11 N. - R. 14 E.

Strong MnO nodules & pebbles in clay capped by 5' barren "trash" and 2 to 4 ft of sandstone
Sample #11 - MnO - 4.9%

"D"

Royal Blue No. 2

Disc

Mn nodules in bar pit of road

"B"

"C"

"A"

Mn nodules in Pit & pebbles on surface

Strong Mn with hematite & limonite reported. Pit sloughed. - 29% Mn reported.

Royal Blue No. 1

LEGEND

- Pits - Trenches, etc.
- Surveyed Claim Corners
- Surveyed Discovery monuments
- "A" Plane table survey Stations.

SURFACE MAP
OF
GEOLOGY & DEVELOPMENT
RAINBOW MINES
COCONINO COUNTY, ARIZONA

0 100 200 400 FT.

SCALE: 1" = 200'

MAY, 1957

R.E.M.

PLATE 5