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fault zone are psilomelane and pyrolusite. Fragments of brecciated country rock, calcite, barite and iron oxides are the chief gangue constituents.

The south end of the zone has been explored by several pits and cuts, some up to 12 feet deep. More extensive open cuts had been driven several hundred feet to the northwest. Largest was 100 feet long and up to 40 feet wide, and reached a maximum depth of 15 feet below the outcrop. p. 55-6

Farnham and Stewart in "Manganese Deposits of Western Arizona" USBM IC 7843 1958

YUCCA (SANTA FE)

The Yucca mine, known in the past as the Johnston and Jones property, is about 8 miles south of Powell, Ariz., in sec. 17, T. 15 N., R. 20 W., on land owned by the Santa Fe Pacific Railway Co., land management subsidiary of the Atchison, Topeka & Santa Fe Railway Co. The property can be reached over 7 miles of poor dirt road that branches south from United States Highway No. 66 about 6 miles east of Topock, Ariz. After leaving the highway the road follows the powerline for 3.3 miles, where a right branch leads to and terminates on the property.

In 1929 the property was optioned by the Chapin Exploration Co., which did some sampling and a small amount of exploration work, and in 1939 it was leased to Johnston and Jones, of Oatman, Ariz. In 1941 the lease was acquired by Frank Smith, of Bakersfield, Calif., who shipped a few hundred tons of sorted ore to the Fontana, Calif., plant of Kaiser Steel Corp. This ore was said to have contained 35 to 40 percent manganese. In 1948 the Yucca Manganese Mining Co. obtained a sublease from Frank Smith and mined several thousand tons of manganese-bearing material for use as a soil fertilizer. As far as known, little if any of this material was marketed and for the most part still remains in piles on the property. In 1953 Reed and Reed, of Kingman, Ariz., under a sublease from Frank Smith, shipped 107 long tons of sorted ore containing about 21 percent manganese to the Government purchasing depot in Wenden, Ariz. During the latter part of 1954 the Minerals Material Co. of Calif., under an agreement with Smith, explored the deposit by numerous drill holes. The results of this work are not available. When visited in December 1955, there was no activity in the area.

The property is about 3.5 miles east of the Colorado River near the southeast end of a chain of sharp, pointed volcanic peaks known as the Needles. The rocks in the region include granite, sandstone, tuff, and volcanic flows. The manganese deposits in the area occur as bedded deposits in sandstone and also in steeply dipping zones of shearing and faulting in volcanic rocks. The principal occurrences are in the south central part of sec. 17 about a quarter of a mile north of an old abandoned campsite.

In this area a bed of manganese-bearing sandstone crops out in places for about 550 feet along the upper part of a low ridge. The bed is composed of manganiferous lenses interlayered with lenses of barren sandstone. As exposed along the outcrop, the deposit is 4 to 7 feet thick, strikes northeast, and dips 5°–10° NW. Beyond its last surface exposure to the northeast the bed has been removed by erosion, and to the west it apparently terminates against a wide fault zone trending northwest and cutting volcanic rocks.

The outcrop of the bed had been explored in several places by shallow cuts and a small inclined adit that followed the mineralization for about 40 feet down the dip. Drill holes of unknown depth were found that indicated the deposit may have been explored in places for as much as 200 feet down the dip.

The chief manganese minerals in the bed are soft, amorphous, wadlike oxides intimately mixed with the sandy sediments.

In addition to the bedded deposit, manganese occurs in the fault zone, which limits the western extent of the manganiferous sandstone. The fault zone is 20 to 40 feet wide, dips almost vertically, and strikes N. 75° W. through volcanic rocks. The mineralized fractures range from a fraction of an inch to several inches in width. Occasional irregular masses of ore as much as 2 feet in their greater dimension occur in areas where the fractures are more numerous and closely spaced.

The principal manganese minerals in the

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FILE 19.0037

REPORT ON
TOPOCK MANGANESE DEPOSIT

BY
MINERAL MATERIALS CO.

M. W. REDHEAD
1955

OFFICE COPY

REPORT ON

TOPOCK MANGANESE DEPOSIT

BY

MINERAL MATERIALS CO.

M. W. REDHEAD

1955

C. W. DUNTON A. S. VINNELL

MINERAL MATERIALS CO.
Ore and Material Producers
1145 WESTMINSTER AVE. ALHAMBRA, CALIFORNIA
CUMBERLAND 3-1241

INTRODUCTION

The investigation and development drilling of the Topock manganese deposit by Mineral Materials Co. was executed during the month of September, 1954. The work, after surveying, consisted of test drilling 54 holes of varying depths to a maximum depth of 108 feet. The study was undertaken primarily for the purpose of investigating the extent of manganese deposition. Metallurgical tests on the ore were made and are herein reported. An important part of the investigation consisted of determining the relationship between the so-called andesite vein deposits and the wad deposition. Further investigation was made of the faulting system in order to determine the possibility of ore occurring in an area to the east.

SUMMARY

As a result of the examination and drilling, it is estimated that the deposit contains 137,200 tons of measured ore, averaging 15.7% manganese, and there is the possibility of developing an equal tonnage or more for reserve. The ore lies in nearly horizontal beds and consists primarily of wad type manganese ore, containing considerable bentonite. Metallurgical tests were executed by Southwestern Engineering Co., and the results indicate a metallurgically complex ore. The best results obtained from these preliminary tests were the production of a concentrate which amounted to 41.8% of the crude ore and assayed 30.4% manganese, 10.8% silica, and 2.2% alumina. This represented a recovery of 66.3% total manganese.

A nodulizing test on this concentrate raised the grade to 36%. The bentonite content of the ore appeared to not interfere excessively with the manganese recovery, but tended to dilute the concentrate. Southwestern Engineering advised that better elimination of the lime should contribute to a higher grade manganese concentrate.

It is to be emphasized that these metallurgical tests were of a preliminary nature and that further investigation is required.

LOCATION

The Topock manganese lies approximately eighteen miles south and east of the town of Topock, Arizona, in Section 17, Township 15 North, Range 20 West, Gila and Salt River Meridian, County of Mojave, State of Arizona. The property is owned in fee by the Santa Fe Pacific Railroad Co. It is leased to Frank P. Smith of Bakersfield, California, and sub-leased to Mineral Materials Co. At the time of this writing, both lease and sub-lease are in full compliance.

PHYSICAL FEATURES

The deposit is located at an altitude of approximately 1100 feet above sea level. The surrounding hills range from 100 to 200 feet above the deposit. The deposit itself is flat-lying and easily accessible by road. The area is approached by nine miles of dirt road south of Powell, a station on the Santa Fe Railroad. Powell is located approximately 10 miles east of Topock, Arizona. Topock is located on the Colorado River. It appears that Powell would be the shipping point for raw ore, and possibly the concentrate.

DEVELOPMENT

The development of the deposit consists primarily of test drilling 54 holes, varying in depth to the deepest of 108 feet. There are several test pits on the property and one small open pit from which a few cars of the ore have been shipped.

GEOLOGY

The area in the immediate vicinity of the Topock manganese consists of rock exposures ranging from pre-Cambrian up into Quaternary. These rocks consist primarily of flows, volcanic ash, and breccias of the Tertiary age. The pre-Cambrian rocks are exposed by erosion of the overlying effusives, etc. and consist of granite and gneiss. One of the conspicuous formations is an unconsolidated sandstone occurring in the area, which is exposed in the various arroyos. In general, the sandstone beds dip slightly to the southwest. They appear to be contemperaneous in age or younger than some of the Tertiary volcanics and evidently are a result of Colorado River system erosion and deposition. The manganese deposits are closely associated with these sandstones in that the deposition so far encountered as wad ore lies on top of the sandstone

or has replaced the sandstone beds. The sandstones appear to be very thick in places. Evidently, the wad manganese ore is a result of leaching the high manganese lavas and re-depositing same in lagoons or areas of quiescence shortly after the deposition of the sandstones. It is noticeable to the west of the deposit, the manganese lies in contact with some of the older andesite which has been down dropped by faulting. A very recent flow of dacite has covered the present manganese deposits, thereby protecting them considerably. (No petrographic study was executed on the rocks themselves, consequently, the classification of these rocks was made megascopically.) The later dacite flow appears to be older than the deposition of manganese and was associated with a late stage of the Tertiary volcanism.

Extensive recent faulting has occurred in the area. Faults are somewhat difficult to trace, due to the non-resistant type of formation through which they travel. They are more evident when encountering the lava flows. Most of the economically important faulting actually appears to have occurred after the deposition of the manganese. It will be noted from the map that the faulting occurs in a northwesterly, southeasterly direction, as well as echelon faulting taking place in a northerly direction.

A conspicuous valley occurs east of the deposit. It appears that some 300 feet east from the area drilled an important fault may be present, thereby dropping or lowering this valley area. It is in this down-dropped area that ore reserves exceeding those presently known may be developed.

ORE RESERVES

As a result of test drilling it is estimated that the measured ore is as follows:

Block "A" (N. Sect. Holes No. 45, 44, 33, 58, 32, 31, 30, 29, 39, 40, 41, 42, 43)

43,300 Tons Ave. Thickness 11.8 Ft. 16.4% Mn.

Block "B" (Mid-Sect. Holes No. 43, 42, 41, 40, 39, 29, 28, 27, 26, 34, 35)

64,900 Tons Ave. Thickness 20.2 Ft. 13.7% Mn.

Block "C" (S. Sect. Holes No. 35, 34, 26, 25, 24, 3, 2, 1)

29,000 Tons Ave. Thickness 15.3 Ft. 13.4% Mn.

Total Tonnage (Short Tons)	137,200 Tons
Thickness	12 to 21 Feet
Average Assay Value	15.7% Mn.

With reference to mining, the following was observed: The ore body lies almost horizontal and is conducive to open pit mining. Very little blasting would be required, except for the sandstone areas, because the wad ore can be practically dug by power shovel. Due to the fact that the ore is bentonitic, wet seasons would hamper mining operations to some extent.

Samples taken from surface cuts by Mineral Materials Co. and composited assayed as follows:

No. 1 17.96% Mn., 39.10% SiO_2, 1.08% Fe, 0.03% P

No. 2 17.40% Mn., 48.11% SiO_2, 1.55% Fe, 0.03% P

A spectrum analysis made on a sample running 39.26% Mn. was indicated as follows:

Manganese	Plus 10%
Iron	1 to 10%
Silica	1 to 10%
Barium	1 to 10%
Aluminum	0.5 to 1%
Calcium	0.5 to 1%

Magnesium	0.5 to 1%
Lead	0.5 to 1%
Molybdenum	0.05 to 0.5%
Vanadium	0.05 to 0.5%
Copper	0.01 to 0.05%
Titanium	0.01 to 0.05%
Strontium	0.01 to 0.05%
Antimony	0.005 to 0.01%
Nickel	Trace

Samples believed to have been taken by Mr. Berliner of U. S. Bureau of Mines and received from the files of the Santa Fe Railroad are presented for reference as follows:

Sample No. 9894, representing a 12-foot face of the vein deposit from a large open cut at west end of property.

18.45% Mn., 39.01% Insol., 0.28% Pb., 0.02% Cu., 0.01% Zn.

Sample No. 9895, representing a 6-foot face of wad ore in open cut at north end of property.

11.75% Mn., Insol., Pb., Cu., Zn.

Sample No. 9896, representing 6.5 foot face of wad ore in short tunnel at east side of property.

17.83% Mn., 37.1% Insol., 0.92% Pb., 0.01% Cu., 0.01% Zn.

Sample No. 9897. Grab sample of hand sorted ore from the vein deposit at south end of property.

29.29% Mn., 26.1% Insol., 2.38% Pb., 0.04% Cu., 0.02% Zn.

Samples assayed by the Colorado Fuel and Iron Corporation ran as follows: (This analysis was also received from the files of Santa Fe Railroad)

Manganese	26.4 to 42.0%
Iron	1.1 to 5.5%
Phosphorus	0.012 to 0.038%
Silica	1.7 to 33.6%
Calcium Oxide	0.4 to 4.0%
Magnesium Oxide	Trace
Alimina	0.1 to 3.8%
Barium Oxide	2.8 to 14.4%
Sulphur	Trace to 0.18%
Copper	Nil
Lead	Nil to 1.1%
Zinc	Nil

In May, 1953 a lessee shipped two carloads of ore to Wenden, Arizona for trial purchase. One car was the so-called andesite ore and one car the wad ore. Wenden Purchasing Depot advises that: the andesite ore ran 22.6% Mn., 24.2% to Insol., resulting in producing a concentrate assaying 40.2% Mn., 6.0% Fe., 5.4% Insol., and 1.93% Cu., Pb., and Zn. A recovery of 71.6% of the contained Mn. was made. The wad ore ran 21.6% Mn., 39.0% Insol., and resulted in the production of a concentrate of 29.2% Mn., 1.9% Fe., and 0.62% Cu., Pb., and Zn. A recovery of 70.8% of the contained Mn. was made. The andesite ore was acceptable and the wad ore rejected, due to the lower grade concentrate produced.

DRILL HOLE LOGS

Hole No.	Footage	Percent Manganese	Hole No.	Footage	Percent Manganese
1	0 ' to 6.5'	12.60	33	12 ' to 30 '	8.40
1	7 to 12	15.72	33	46 to 48	3.87
3	24 to 27	5.82	34	0 to 16	17.40
4	7.5 to 9.5	11.04	34	27 to 35	8.10
5	14 to 15.5	12.72	35	7 to 16	4.27
5	15.5 to 26	4.44	36	29 to 64	8.66
6	8 to 22	5.04	37	42 to 54	11.52
6	24 to 26.5	10.95	38	11 to 14	4.81
7	16 to 20	2.70	38	25 to 35	5.04
7	24 to 25	6.13	40	0 to 19	3.36
14	2 to 11	11.28	40	41 to 49	7.34
17	0 to 8	31.56	41	7 to 12	6.84
18	6 to 13	19.12	41	26 to 48	12.08
19	25 to 29	9.06	40	19 to 30	27.00
19	41 to 43	7.32	42	17 to 27	19.32
20	5 to 12.5	10.56	43	6 to 12	1.86
21	2 to 4.5	12.42	43	12 to 25	10.20
24	0 to 5	4.74	44	13 to 27	9.66
24	21 to 35	4.80	45	12 to 30	9.36
25	0 to 32	12.24	45	30 to 36	8.46
26	10 to 38	13.56	49	0 to 11	3.90
26	63 to 72	6.00	58	18 to 30	7.92
27	12 to 54	10.44	58	42 to 56	1.80
27	60 to 75	5.76			
31	10 to 14	3.72			
31	25 to 34	2.58			

METALLURGY

A sample, consisting of 200 pounds, was taken of the various outcrops for a metallurgical test. This material was sent to the Southwestern Engineering Co. and preliminary metallurgical tests were executed. The reports of their finding is herein appended to this report and is explained in detail.

RECOMMENDATION

It has been determined that the Topock manganese deposit is definitely of economical interest and constitutes a deposit of importance. Mineral Materials Co. has executed sufficient development work to afford these conclusions.

The difficulty now encountered is strictly metallurgy. Further investigation of the metallurgy is warranted previous to attempting additional development work on this deposit. Since Mineral Materials is primarily a mining company, and therefore not in position to pursue detailed metallurgical investigation, it is advisable that exploitation of this deposit be approached by assigning this later phase of development to a technical group qualified to bring the beneficiation research to a successful conclusion.

MINERAL MATERIALS CO.

By M. W. Redhead

July, 1955

SOUTHWESTERN ENGINEERING COMPANY
LOS ANGELES 58, CALIFORNIA
METALLURGICAL LABORATORY

SWECO

SEPTEMBER 15, 1954

REPORT OF PRELIMINARY FLOTATION TESTING

CONDUCTED ON SAMPLES OF MANGANESE WAD ORE RECEIVED

FROM

MINERAL MATERIALS COMPANY

1145 WESTMINSTER AVENUE

ALHAMBRA, CALIFORNIA

SOUTHWESTERN ENGINEERING COMPANY
4800 SANTA FE AVENUE
LOS ANGELES 58, CALIFORNIA

SWECO LOT NOS. 3526 & 3527

SOUTHWESTERN ENGINEERING COMPANY
LOS ANGELES 58, CALIFORNIA
METALLURGICAL LABORATORY

SEPTEMBER 15, 1954

REPORT OF PRELIMINARY FLOTATION TESTING CONDUCTED ON SAMPLES OF MANGANESE WAD ORE RECEIVED FROM MINERAL MATERIALS COMPANY, 1145 WESTERNICHER AVENUE, ALHAMBRA, CALIFORNIA.

SWECO LOT NOS. 3526 and 3527

SAMPLES

Two samples of manganese wad ore were delivered to the Southwestern Engineering Company laboratory on August 10, 1954 by Mr. W. W. Redhead of the subject Company. Both samples were understood to represent the same ore, the difference being that one lot had been calcined for the purpose dehydrating the bentonite content. The samples as received consisted of -1" ore, the calcined lot weighing 48 pounds and the uncalcined 36 pounds.

Each of the samples was well mixed by coning five times with a shovel, then a representative one quarter was cut out. This portion was crushed in a jaw crusher and rolls to -8 mesh, thoroughly mixed and a representative head sample cut out for assay.

The head samples assayed:

SWECO Lot. Nos.	Sample	% Mn	% SiO_2	% Al_2O_3	% CaO
3526	Calcined ore	22.32			
3527	Uncalcined ore	18.98	33.00	3.00	13.22

In addition to the bentonite content considerable mica was observed among the gangue minerals.

OBJECT OF TESTING

The object of the preliminary testing conducted was to indicate the amenability of the manganese content to beneficiation by flotation.

SEPTEMBER 15, 1954

FLOTATION TESTS ON UNCALCINED CRUDE ORE (LOT NO. 3527)

Five preliminary flotation tests were conducted on the uncalcined crude ore samples. Details of these tests are reported in the attached metallurgical data sheets.

TEST NO. 1

This was a preliminary test conducted for the purpose of observing the reaction of the ore to a general reagent combination and procedure previously found applicable to similar appearing manganese wad ores. A heavily mineralized manganese bearing froth resulted but too much weight (75.5%) of concentrate was obtained. Therefore, the products of this test were not assayed.

TEST NO. 2

In this test efforts were made to produce less weight of concentrate than obtained in test #1. The products of this test were assayed with the following results:

	% Wt.	% Mn	% SiO_2	% Al_2O_3	% CaO	% Distribution % Mn
Assayed Head		18.96	23.09	3.90	13.22	
Calculated Head	100.00	18.37				100.00
Concentrate	63.15	26.48	19.02	3.04		91.01
Middling #1	3.10)					
Middling #2	1.40)					
Middling #3	1.15)					
Middling #4	1.15)	5.67				2.72
Tailing	28.02	4.11				6.27

The concentrate amounted to 63.18% by weight as compared to 75.5% in test #1.

SOUTHWESTERN ENGINEERING COMPANY
LOS ANGELES 58, CALIFORNIA
METALLURGICAL LABORATORY

SWECO

SEPTEMBER 15, 1954

TEST NO. 3

In test #3, the rougher concentrate was cleaned twice then thickened and reground for 15 minutes in a pebble mill using a small charge of pebbles (1,500 grams). The reground concentrate was cleaned two more times. This procedure was followed in order to further reduce the weight and silica content of the final concentrate. Results are shown below:

	% Wt.	% Mn	% SiO_2	% Al_2O_3	% CaO	% Mn
Assayed Head		18.96	33.09	3.90	13.22	
Calculated Head	100.00	19.05				100.00
Concentrate	41.00	30.02	14.70	2.81		64.69
Middling #1	5.79*					
Middling #2	1.98*					
Middling #3	13.69)					
Middling #4	4.87)	24.06				23.44
Tailing	32.67	5.64				11.97

* Combined with tailing for assay.

TEST NO. 4

Owing to the large amounts of reagents required to float the manganese from a wad ore, most of the lime content usually reports in the concentrate. Therefore, it is usually necessary to float out as much of the lime as possible before floating the manganese concentrate. This procedure was carried out in test #4 but the lime content of the ore did not respond satisfactorily as only 27.9[illegible]% of it reported in the lime concentrate. The manganese concentrate was of about the same manganese grade as in test #3 but the silica content was higher. Results of this test are given below:

	% Wt.	% Mn	% SiO_2	% Al_2O_3	% CaO	% Distribution Mn	% Distribution CaO
Assayed Head		18.96	33.09	3.90	13.22		
Calculated Head	100.00	20.11				100.00	100.00
Lime Concentrate	13.05	15.74			28.35	10.21	27.9[illegible]
Mn Concentrate	43.98	29.64	[illegible]	3.48		65.26	
Mn Middling #1	5.07)						
Mn Middling #2	5.32)	10.30					
Mn Middling #3	11.15)						
Mn Middling #4	2.15)	20.22				13.37	
Mn Tailing	19.28	6.06				5.81	

SEPTEMBER 15, 1954

It was observed that the pulp effervesced rather slowly upon addition of one or two drops of dilute hydrochloric acid while usually effervescence is rapid from manganese pulps containing calcite. This seems to indicate that the lime content may be present in a form other than calcite, which might account for its poor response to flotation in this test.

TEST NO. 8

As the lime concentrate in test #4 accounted for only 27.95% of the total CaO content, indicating it floats less readily than the usual calcite found in many manganese ores, it seemed possible that it could be depressed. Therefore, efforts were made in test #8 to effect its depression. Results of this test are as follows:

	% Wt.	% Mn	% SiO_2	% Al_2O_3	% CaO	% Distribution Mn
Assayed Head		18.96	30.09	8.50	13.22	
Calculated Head	100.00	19.12				100.00
Concentrate	41.75	30.38	10.70	2.22		66.29
Middling #1	8.50)					
Middling #2	2.38)	9.60				5.46
Middling #3	9.87	22.02				11.83
Middling #4	3.00	20.48				3.21
Tailing	34.50	7.32				13.21

While the manganese content of the concentrate was not appreciably higher than in tests #2 and #4, silica and alumina were lower. The concentrate had a somewhat blacker appearance than in preceding tests.

A portion of the concentrate was nodulized at about 2000 gr. and the nodule assayed as follows:

% Mn	% SiO_2	% Al_2O_3
36.21	19.70	3.62

The manganese content was lower and the silica and alumina much higher than had been anticipated from the assays of the concentrate. Nodulizing was done in a clay roasting dish to which some of the nodule fused. While attempts were made to select only clean pieces for assay, it is possible that some clay attachments were included which could account for the high silica and alumina content.

FLOTATION TEST ON CALCINED ORE (LOT NO. 5626)

One preliminary flotation test was conducted on the sample of calcined ore at the same grind employed for uncalcined ore. The concentrate was assayed showing the following results:

	% Wt.	% Mn	% SiO_2	% Al_2O_3	% Recovery Mn
Assayed Head		22.32			100.00
Calculated Head	100.00				
Concentrate	76.63	24.72	39.04	4.11	84.87
Middling #1	5.75				
Middling #2	3.13				
Middling #3	3.50				
Middling #4	2.62				
Tailing	10.37				

The calcined ore gave an indication of requiring a little less reagent than uncalcined ore but in other respects the two samples appeared to respond similarly to flotation treatment. Therefore, only one preliminary test was conducted on the calcined sample.

GRINDABILITY

The ore was very soft, resulting in a fine grind in five minutes in a laboratory ball mill at 40% solids. A screen sizing analysis is given on metallurgical test sheet #1 for uncalcined crude ore.

While the bentonite content caused the pulp to swell, we experienced no difficulty in washing it out of the ball mill after grinding at 40% solids.

FLOTATION PULP SOLIDS

All flotation tests were conducted on an ore charge of 200 grams, making the rougher flotation pulp approximately 9% solids.

FLOTATION REAGENTS

It can not be stated that the most suitable combinations of reagents were determined in the short series of preliminary flotation tests conducted. Those employed were used on the basis of our general experience with somewhat similar ores.

CONCLUSIONS

The results of the preliminary testing conducted show that the manganese content of the crude (ane loined) ore was upgradedto about 30% Mn by flotation.

The best results were obtained in test #5 in which the concentrate, amounting to 41.75% by weight of the crude ore, assayed 30.38% Mn, 10.80% SiO_2 and 2.22% Al_2O_3 and represented a recovery of 66.2b% of the total manganese. A nodulising test on this concentrate raised the grade to 36% Mn.

The bentonite content of the ore appeared not to interfere excessively with manganese recovery but possibly tended to dilute the concentrate.

Better elimination of lime either by more complete flotation or depression should contribute to higher grade of manganese concentrate.

SOUTHWESTERN ENGINEERING COMPANY

Robert Lord

FORM 1507 4M 7-54 MP&S P6184

SOUTHWESTERN ENGINEERING COMPANY

4800 SANTA FE AVENUE, LOS ANGELES 58, CALIFORNIA

SWECO

LOT NO. 3826

METALLURGICAL TEST

TEST NO. 1

SAMPLE FROM:

Mineral Materials Company

GRINDING: 5 MINS. 40 % SOLIDS

LAB. MILL SIZE, INCHES 7 x 8

BALL CHARGE, GRAMS 4500

MESH	WEIGHT %

Note: Approximately the same grind as in Test #8527-1,2,3,4&5

Date Received: 8-10-54 Tested: 8-11-54

Character of ore: Manganese Oxide

Sample marked: Roasted Ore

Nature of test: Flotation

Rougher time-minutes: 4 Dilution: 9 % Solids

Dry weight of ore tested: 200 grams

Conditioning time-minutes: 2-8-1

Object of test: Preliminary Test.

ASSAYS

PRODUCTS	WEIGHT %	GOLD Mn OZ. %	SILVER SiO_2 OZ. %	COPPER Al_2O_3 %	LEAD %	ZINC %	IRON %	
Assayed Head		25.32						
Calculated Head	100.00							
Flot. Concentrate	76.83*	24.72	39.04	1.11				
Flot. Middling #1	3.75							
Flot. Middling #2	5.13							
Flot. Middling #3	3.60							
Flot. Middling #4	2.62							
Flot. Tailing	10.37							

* Concentrate only product assayed

% RECOVERY AND DISTRIBUTION (Based on Calculated Head)

PRODUCTS	WEIGHT %	GOLD Mn	SILVER	COPPER	LEAD	ZINC	IRON	
Calculated Head	100.00							
Flot. Concentrate	76.83	84.37*						
Flot. Middling #1	3.75							
Flot. Middling #2	5.13							
Flot. Middling #3	3.60							
Flot. Middling #4	2.62							
Flot. Tailing	10.37							

*Based on assayed Head

REAGENTS EMPLOYED: Pounds per ton added, point of addition and time of each operation

	Ball Mill 5-min	Conditioner 2-min	Conditioner 8-min	Conditioner 1-min	Rougher Float 4-min	Cleaner #1 3-min	Cleaner #2 3-min	Cleaner #3 2½-min
Reagent A		15.0						
Reagent B			37.2					
Reagent C			5.0					
Reagent D			32.4					
Sodium Fluosilicate				4.0				
Sodium Metaphosphate				2.0				1.0
Sodium Silicate						1.0	1.0	1.0
Cerehrobe						0.2	0.2	0.2
pH	8.3	7.1	7.5	8.1	8.9	7.5	7.8	7.8
							Cleaner 2½-min	#4
pH								7.8

Same reagents and amounts as cleaners #2 & #3.

REMARKS

Procedure: Reagents A, B, C, & D conditioned at 2400 R.P.M. Balance of test at 1200 R.P.M. Rougher froth, black color and fragile to a low grade fresh end point.

FORM 1507 4M 7-54 MP&S P6164

SOUTHWESTERN ENGINEERING COMPANY

4800 SANTA FE AVENUE, LOS ANGELES 58, CALIFORNIA

SWECO

LOT NO. 3527

METALLURGICAL TEST

TEST NO. 1

SAMPLE FROM:

Mineral Materials Company

Date Received: 2-10-54 Tested: -11-54

Character of ore: Manganese Oxide

Sample marked: Crude ore

Nature of test: Flotation

Rougher time-minutes: 5½ Dilution: 8 % Solids

Dry weight of ore tested: 200 grams

Conditioning time-minutes: 2-5-1

Object of test: Preliminary Test

GRINDING: 5 MINS. 40 % SOLIDS

LAB. MILL SIZE, INCHES 7" x 8"

BALL CHARGE, GRAMS 4500

MESH	WEIGHT %
+ 48	Trace
-48 + 65	0.12
-65 + 100	1.78
-100+ 150	4.50
-150+ 200	5.58
-200+ 325	11.67
-325	75.38
	100.00

ASSAYS

PRODUCTS	WEIGHT %	GOLD Au OZ. %	SILVER SiO_2 OZ. %	COPPER Al_2O_3 %	LEAD CaO %	ZINC %	IRON %
Assayed Head		10.56	13.03	3.20	13.22		
Calculated Head	100.00						
Flot. Concr.	75.5						
Flot. Midd #1	9.1		Not assayed				
Flot. Midd #2	2.0						
Flot. Midd #3	1.1		Concr. insoluble - 23.20%				
Flot. Midd #4	1.3						
Flot. Tailing	11.0						

% RECOVERY AND DISTRIBUTION (Based on Calculated Head)

PRODUCTS	WEIGHT %	GOLD	SILVER	COPPER	LEAD	ZINC	IRON

REAGENTS EMPLOYED: Pounds per ton added, point of addition and time of each operation

	Ball Mill 5-min	Conditioner 2-min	Conditioner 5-min	Conditioner 1-min	Rougher Float 5½-min	Cleaner #1 3½-min	Cleaner #2 3-min	Cleaner #3 2-min
Reagent A		16.9						
Reagent B			120.6					
Reagent C			[illegible]					
Reagent D			48.2					
Sodium Silicate				2.0				
Sodium Metaphosphate				1.0				
Sodium Silicate								1.0
pH	7.8	8.6	7.2	6.6	7.3	7.7	7.6	7.7
								Cleaner 2-min
Sodium Metaphosphate								1.0
								7.7

REMARKS

MEMO: Wagstaff flotation cell - Conditioning reagents A, [illegible] 5 min. Balance of test at 1,100 RPM. Froth heavily mineralized to [illegible] end. Cleaners and [illegible] white froth. Silica visible in concentrate in all cleaners.

FORM 1507 4M 7-54 MP&S P6184

SOUTHWESTERN ENGINEERING COMPANY

4800 SANTA FE AVENUE, LOS ANGELES 58, CALIFORNIA

SWECO

METALLURGICAL TEST

LOT NO. 3527 TEST NO. 2

SAMPLE FROM: Mineral Materials Company

GRINDING: 5 MINS. 40 % SOLIDS

LAB. MILL SIZE, INCHES 7" x 8"

BALL CHARGE, GRAMS 4500

MESH	WEIGHT %

Note: Same grind as in Test #1

Date Received: 8-10-54 Tested: 8-11-54

Character of ore: Manganese Oxide

Sample marked: Crude Ore

Nature of test: Flotation

Rougher time-minutes: 5 Dilution: 8 % Solids

Dry weight of ore tested: 200 grams

Conditioning time-minutes: 2-8-1

Object of test: Reducing reagent amount from Test #1.

ASSAYS

PRODUCTS	WEIGHT %	~~GOLD~~ Mn ~~OZ.~~ %	~~SILVER~~ SiO_2 ~~OZ.~~ %	~~COPPER~~ Al_2O_3 %	~~LEAD~~ CaO %	ZINC %	IRON %	
Assayed Head		18.96	33.09	3.90	13.22			
Calculated Head	100.00	18.37						
Concentrate	63.18	28.46	19.02	3.04				
Middling #1	5.10)							
Middling #2	1.40)							
Middling #3	1.15)							
Middling #4	1.15)	5.67						
Tailing	28.02	4.11						

% RECOVERY AND DISTRIBUTION (Based on Calculated Head)

PRODUCTS	WEIGHT %	~~GOLD~~ Mn	SILVER	COPPER	LEAD	ZINC	IRON	
Calculated Head	100.00	100.00						
Concentrate	63.18	91.01						
Middling #1	5.10)							
Middling #2	1.40)							
Middling #3	1.15)							
Middling #4	1.15)	2.72						
Tailing	28.02	6.27						

REAGENTS EMPLOYED: Pounds per ton added, point of addition and time of each operation

	Ball Mill 5-min	Conditioner 8-min	Conditioner 6-min	Conditioner 1-min	Rougher Float 5-min	Cleaner #1 3½-min	Cleaner #2 3-min	Cleaner #3 3-min
Reagent A		19.0						
Reagent B			162.0					
Reagent C			3.0					
Reagent D			36.0					
Sodium Fluosilicate				5.0				
Sodium Metaphosphate				2.5				
Sodium Silicate								3.0
pH	7.6	8.6	7.3	8.0	6.8	7.3	7.4	7.3
							Cleaner #4 2-2/4 min	
Sodium Silicate								3.0
Sodium Metaphosphate								1.0
pH								7.5

REMARKS: Reagents A, B, C, D conditioned at 2400 RPM. Balance of test at 1200 RPM. Rougher froth controlled to barren froth end point. Depressants in cleaners did not seem to have appreciable effect.

FORM 1507 4M 7-54 MP&S P6164

SOUTHWESTERN ENGINEERING COMPANY

4800 SANTA FE AVENUE, LOS ANGELES 58, CALIFORNIA

SWECO

LOT NO. 3527

METALLURGICAL TEST

TEST NO. 3

SAMPLE FROM: Mineral Materials Company

GRINDING: 8 MINS. 40 % SOLIDS

LAB. MILL SIZE, INCHES 7" x 8"

BALL CHARGE, GRAMS 4800

MESH	WEIGHT %

Note: Same grind as in Test #1

Date Received: 8-10-54 Tested: 8-12-54

Character of ore: Manganese Oxide

Sample marked: Crude Ore

Nature of test: Flotation

Rougher time-minutes: 4½ Dilution: 9 % Solids

Dry weight of ore tested: 200 grams

Conditioning time-minutes: 2-8-1

Object of test: To produce a higher grade Mn concentrate.

ASSAYS

PRODUCTS	WEIGHT %	GOLD OZ.	SILVER OZ.	COPPER %	LEAD %	ZINC %	IRON %	
		Mn %	SiO_2 %	Al_2O_3 %	CaO %			
Assayed Head		18.88	38.09	3.80	13.22			
Calculated Head	100.00	19.05						
Flot. Concentrate	41.00	30.02	14.70	2.81				
Flot. Middling #1	5.79*							
Flot. Middling #2	1.98*							
Flot. Middling #3	13.69)							
Flot. Middling #4	4.87)	24.06						
Flot. Tailing	32.67*	5.84						

* Combined with tailing for assay.

% RECOVERY AND DISTRIBUTION (Based on Calculated Head)

PRODUCTS	WEIGHT %	GOLD Mn	SILVER	COPPER	LEAD	ZINC	IRON	
Calculated Head	100.00	100.00						
Flot. Concentrate	41.00	64.59						
Flot. Middling #1	5.79*							
Flot. Middling #2	1.98*							
Flot. Middling #3	13.69)							
Flot. Middling #4	4.87)	23.44						
Flot. Tailing	32.67*	11.97						

REAGENTS EMPLOYED: Pounds per ton added, point of addition and time of each operation

	Ball Mill 5-min	Conditioner 2-min	Conditioner 8-min	Conditioner 1-min	Rougher Float 4-1/4-8.	Cleaner #1 8½-min	Cleaner #2 5½-min	Pebble Mill 15-min
Reagent A		10.0						
Reagent B			151.2					
Reagent C			3.0					
Reagent D			32.4					
Sodium Fluosilicate				5.0				
Sodium Metaphosphate				2.5				
pH	7.6	8.7	7.3	8.0	8.8	7.1	7.1	
							Cleaner #3 5-min	Cleaner #4 4-min
pH							7.8	7.6

REMARKS: Reagents A, B, C, & D conditioned at 2400 RPM. Balance of test at 1200 RPM. Cleaner #2 concentrate thickened and reground 15 minutes in pebble mill with 1600 grams pebbles. Rougher froth controlled to a brown frothand point. Slower floating after regrind.

FORM 1507 4M 7-54 MP&S P6184

SOUTHWESTERN ENGINEERING COMPANY

4800 SANTA FE AVENUE, LOS ANGELES 58, CALIFORNIA

SWECO

LOT NO. 3527

METALLURGICAL TEST

TEST NO. 4 (Sht. #1)

SAMPLE FROM:

Mineral Materials Company

GRINDING: 5 MINS. 40 % SOLIDS

LAB. MILL SIZE, INCHES 7" x 8"

BALL CHARGE, GRAMS 4500

MESH	WEIGHT %

Note: Same grind as in Test #1

Date Received: 8-10-54 Tested: 8-18-54

Character of ore: Manganese Oxide

Sample marked: Crude Ore

Nature of test: Flotation

Rougher time-minutes: Lime-8 Mn-7 Dilution: 9 % Solids

Dry weight of ore tested: 200 grams

Conditioning time-minutes: Lime-4 - Mn-2-8-1

Object of test: Preflotating a lime concentrate.

ASSAYS

PRODUCTS	WEIGHT %	GOLD Au OZ.	SILVER SiO_2 OZ.	COPPER Al_2O_3 %	LEAD MgO %	ZINC %	IRON %
Assayed Head		15.96	53.09	3.30	13.22		
Calculated Head	100.00	20.11					
Lime Concentrate	13.05	16.74			23.36		
Mn Concentrate	45.98	20.84	13.21	6.48	11.37		
Mn Middling #1	(5.07)						
Mn Middling #2	(8.32)	10.38					
Mn Middling #3	11.13)						
Mn Middling #4	2.16)	20.22					
Mn Tailing	19.28	6.06					

% RECOVERY AND DISTRIBUTION (Based on Calculated Head)

PRODUCTS	WEIGHT %	GOLD Au	SILVER	COPPER	LEAD MgO	ZINC	IRON
Calculated Head	100.00	100.00			100.00*		
Lime Concentrate	13.05	10.21			27.39		
Mn Concentrate	45.98	55.25					
Mn Middling #1	5.07)						
Mn Middling #2	8.32)	8.86					
Mn Middling #3	11.13)						
Mn Middling #4	2.16)	13.27					
Mn Tailing	19.28	8.41					

* Assayed Head

REAGENTS EMPLOYED: Pounds per ton added, point of addition and time of each operation

	Ball Mill 6-min	Lime Conditioner 2-min	Lime Rougher Float 4-min	Lime Conditioner 1-min	Lime Rougher Float 2-min	Lime Conditioner 1-min	Lime Rougher Float 2-min
Armour Fat B-142 P#		5.0		2.0		2.0	3.0

	Lime Cleaner Float 4-min	Condition 2-min	Float 1-min
Armour Fat B-142 P#		2.0	2.0

REMARKS: See Sheet #2

FORM 1507 4M 7-54 MP&S P6184

SOUTHWESTERN ENGINEERING COMPANY
4800 SANTA FE AVENUE, LOS ANGELES 58, CALIFORNIA

SWECO

METALLURGICAL TEST

LOT NO. 5527 TEST NO. 4 (Sht. #2)

SAMPLE FROM: Mineral Materials Company

GRINDING: MINS. % SOLIDS
LAB. MILL SIZE, INCHES
BALL CHARGE, GRAMS

MESH	WEIGHT %

Date Received: 8-10-54 Tested: 8-19-54
Character of ore: Manganese Oxide
Sample marked: Crude Ore
Nature of test: Flotation
Rougher time-minutes: Lime-8 Mn-7 Dilution: 9 % Solids
Dry weight of ore tested: 200 grams
Conditioning time-minutes: Lime-4 - Mn-2-3-1
Object of test: Preflooting a lime concentrate.

Note: Same grind as in Test #1

ASSAYS

PRODUCTS	WEIGHT %	GOLD OZ.	SILVER OZ.	COPPER %	LEAD %	ZINC %	IRON %	
Assayed Head								
Calculated Head								

% RECOVERY AND DISTRIBUTION (Based on Calculated Head)

PRODUCTS	WEIGHT %	GOLD	SILVER	COPPER	LEAD	ZINC	IRON	

REAGENTS EMPLOYED: Pounds per ton added, point of addition and time of each operation

	Mn Conditioner 2-min	Mn Conditioner 5-min	Mn Conditioner 1-min	Mn Rougher Float 7-min	Mn Cleaner #1 4-min	Mn Cleaner #2 Conditioner 1-min	Mn Cleaner #2 Float 3½-min	Regrind Pebble Mill 5-min
Reagent A	10.0							
Reagent B		129.6						
Reagent C		3.0						
Reagent D		25.8						
Sodium Fluosilicate			5.0					
Sodium Metaphosphate			2.3			1.0		
pH	7.1	8.0	6.2	7.3	7.8		7.8	
							Cleaner #3 4-min	Cleaner #4 4-min
pH							7.8	7.8

REMARKS
Lime flotation and cleaning at 1928 RPM. Mn reagents A, B, C, & D conditioned at 1928 RPM. Balance of test at 1078 RPM.

FORM 1507 4M 7-54 MP&S P6184

SOUTHWESTERN ENGINEERING COMPANY
4800 SANTA FE AVENUE, LOS ANGELES 58, CALIFORNIA

SWECO

LOT NO. 3527

METALLURGICAL TEST

TEST NO. 5

SAMPLE FROM: Mineral Materials Company

GRINDING: 5 MINS. 40 % SOLIDS
LAB. MILL SIZE, INCHES 7" x 9"
BALL CHARGE, GRAMS 4500

MESH	WEIGHT %
Note: Same grind as in test #1	

Date Received: 8-10-54 Tested: 8-30-54
Character of ore: Manganese Oxide
Sample marked: Crude Ore
Nature of test: Flotation
Rougher time-minutes: 6½ Dilution: 9 % Solids
Dry weight of ore tested: 200 grams
Conditioning time-minutes: 2-8-1
Object of test: To depress CaO

ASSAYS

PRODUCTS	WEIGHT %	GOLD Mn OZ. %	SILVER SiO_2 OZ. %	COPPER Al_2O_3 %	LEAD CaO %	ZINC %	IRON %	
Assayed Head		18.96	33.0[illegible]	3.90	13.22			
Calculated Head	100.00	10.12						
Flot. Concentrate	41.75	30.36	10.80	2.22				
Flot. Middling #1	3.50)							
Flot. Middling #2	2.88)	9.60						
Flot. Middling #3	9.87	22.92						
Flot. Middling #4	3.00	20.46						
Flot. Tailing	34.50	7.32						

% RECOVERY AND DISTRIBUTION (Based on Calculated Head)

PRODUCTS	WEIGHT %	GOLD Mn	SILVER	COPPER	LEAD	ZINC	IRON	
Calculated Head	100.00	100.00						
Flot. Concentrate	41.75	66.29						
Flot. Middling #1	3.50)							
Flot. Middling #2	2.88)	5.48						
Flot. Middling #3	9.87	11.53						
Flot. Middling #4	3.00	5.21						
Flot. Tailing	34.50	13.21						

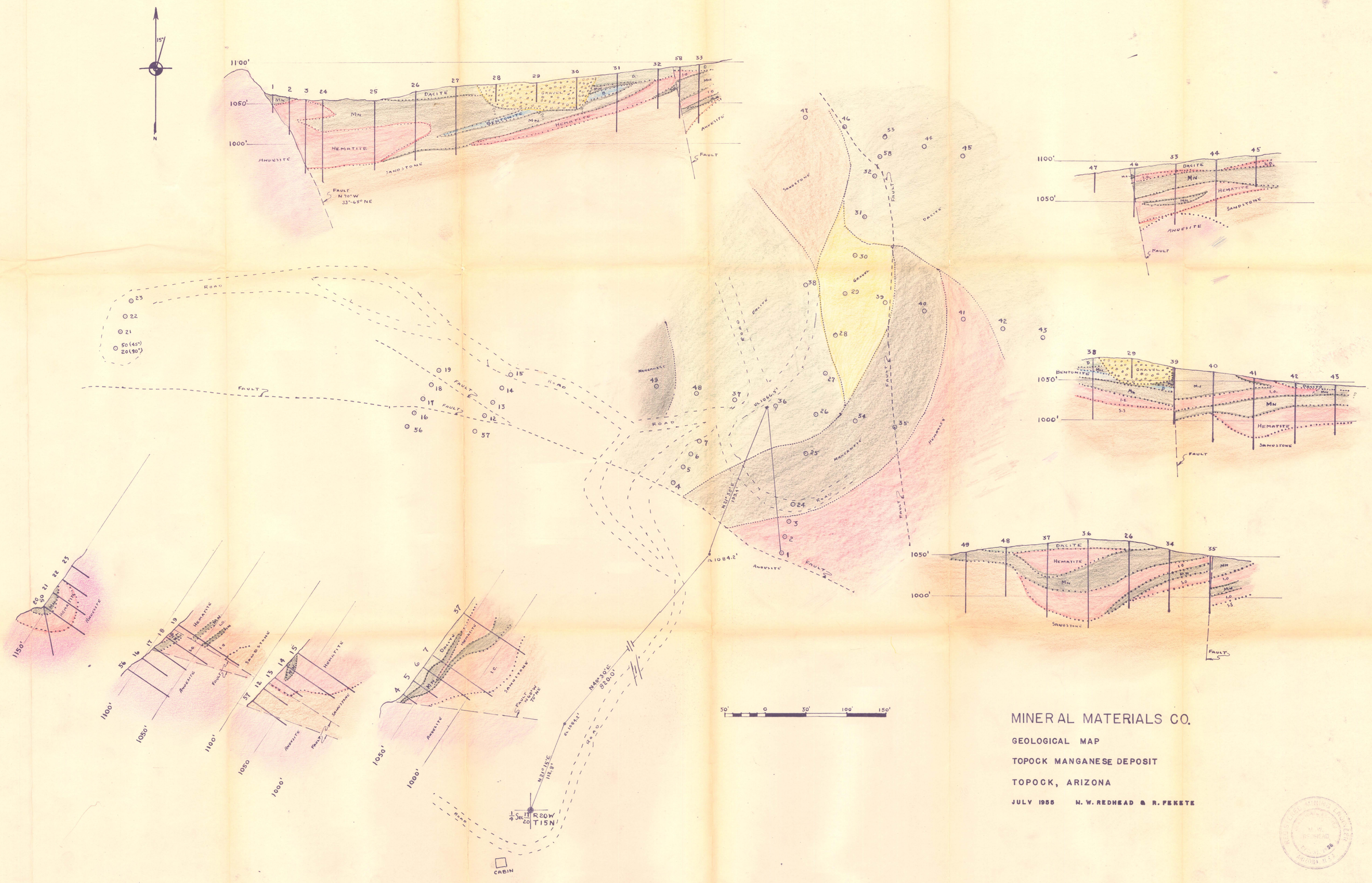
REAGENTS EMPLOYED: Pounds per ton added, point of addition and time of each operation

	Ball Mill 5-min	Conditioner 2-min	Conditioner 3-min	Conditioner 1-min	Rougher Float 6½-min	Cleaner #1 3-min	Cleaner #2 3-min	Regrind Pebble Mill 5-min
Reagent A		10.0						
Reagent B			172.[illegible]					
Reagent C			3.0					
Reagent D			36.[illegible]					
Sodium Fluosilicate				10.0				
Sodium Metaphosphate				5.0				
Sodium Silicate						1.5	1.5	
Quebracho						0.3	0.3	
pH	7.8	6.9	7.4	5.5	6.7	7.5	7.5	

	Cleaner #3 4-min	Cleaner #4 2-3/4 min
Sodium Silicate	1.0	
Quebracho	0.2	
pH	7.5	7.5

REMARKS

REMARKS: Reagents A, B, C, D conditioned at 2400 RPM. Balance of test at 1200 RPM. Bulk of rougher concentrate off in 3 min. then slower floating to an indefinite end point. Cleaner #2 concentrate thickened and reground 5 minutes in pebble mill.



MINERAL MATERIALS CO.

GEOLOGICAL MAP

TOPOCK MANGANESE DEPOSIT

TOPOCK, ARIZONA

JULY 1956 H. W. REDHEAD & R. FEKETE