

BENEFICIATION OF FRANK OLIVINE
FC Report #3, December 1968 Progress Report

Lab. Nos. 3218 & 3258 - Book 233, p. 6-182
by
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Object

This project is a continuation of the research program on olivine extraction and product improvement. The Frank ore (Lab. No. 3258) used for most of this project came from the same pit as did Lab. Nos. 3218, 3239, 3240. The ore was obtained by progressively sampling across two-hundred feet of pit until a composite of 1500 pounds was obtained.

Procedure

The ore was given a size reduction by jaw crushing followed by rolls crushing at 3/8" roll spacing. A representative sample, obtained by riffing, assayed 3.98 percent loss on ignition. Samples (minus 14 mesh) as received and deslimed were separated into sinks and floats by heavy liquid (sp gr 2.95). The data derived from these tests (see Table 1) were useful in arriving at an approximate product distribution. Several series of tests were performed to observe the effects of different variables on the beneficiation of the Frank ore. The tests include scrubbing of ore, scrubbing concentrate only, high solids grinding, acid scrubbing the concentrate, acid scrubbing flotation feed, no scrubbing before tabling, scrubbing before tabling, flotation of table concentrate, scavenger tabling, reagent comparison series, acid scrub tests with various strengths of acid. These tests are summarized for quick reference and are also attached for more detailed information. A beneficiation graph (Table A) shows the relative merits of the tests. A table separation in which the tails were given a second grind in a rod mill followed by desliming and tabling is shown in Table 19. An attempt was made to determine the best flotation reagent system to use with the Frank ore. Series of tests were performed using either anionic, cationic or fatty acid collectors. In order to compare the reagents, the following standard set of conditions was established:

Sample

Head feed Lab. No. 3258 (Frank Deposit)
jaw crushed and roll crushed through
1/4" opening. 500-gram feed samples.

Preparation

Stainless steel rod mill, 10 rods.
40 percent solids grind for 2 minutes.
Screen on 20 mesh.
Deslime twice at 200 mesh with full
bucket (stainless steel) for 1 minute settling.

Standard Float Cell

North float room, Denver cell.

Individual test sheets are included for those tests in which the yield exceeded 40 percent and the ignition loss was less than 1.0 percent. An acid scrub series (test 26) shows the effect of different acid strengths on the ignition loss of an olivine concentrate.

Results

The heavy liquid separation and ignition loss analysis data (see Table 1) shows 54.7 percent of the head feed assaying 1.14 percent loss on ignition, with an additional 15.5 percent assaying 2.71 percent loss on ignition.

Flotation without scrubbing (Tables 2, 3 and 4) results in a good recovery but poor grade. The grade can be improved by scrubbing the concentrate followed by flotation as shown in Table 4. The use of caustic in the grind was found to be beneficial as shown by the increased recovery in Table 5. The series of tests using a high solids (65 percent) grind showed a definite improvement in grade, while maintaining recovery (see Tables 5, 6 and 7). A further improvement in grade can be made by following the high solids grind and flotation procedure with high density scrubbing, or acid scrubbing of the concentrate and re-floating (Tables 9, 10, 11 and 12). Acid scrubbing before flotation is also a method for improving the grade (see Table 13).

The ore responded very well to table separation. The ore that had not been scrubbed before tabling gave a higher recovery and ignition loss than the ore that was scrubbed before tabling. This probably reflects more on the operation of the table than on the preparation of the feed. Flotation of the concentrate from these tests resulted in low ignition loss products (see Table 15-18). An additional gravity test (see Table 19) was performed in which a rougher concentrate was made on a shaking table, and the table tails were returned to the rod mill for additional grinding and desliming,

and were then treated again on the table in a scavenger separation. The concentrates were cleaned with two stages. The results show a good recovery and grade.

The reagent series (Tables 20-25) are the best tests (plus 40 percent yields and minus 1.0 percent ignition loss) of a series of nineteen tests. This series was run to study the effects of sulfonated oil, amine, and fatty acid collectors under a standard set of conditions. The fatty acid tests did not perform as well as the other two. The results are inconclusive at this time as to which of the two reagents, sulfonated oil or amine, is most effective. The anionic system has the advantage of floating the smaller amount of material as gangue. The amine system has an advantage of floating in a neutral pH. The acid scrub test (Table 26) shows the comparison by ignition loss in the concentrate when using various strengths of acid. The maximum strength of acid necessary to acid scrub is approximately ten percent.

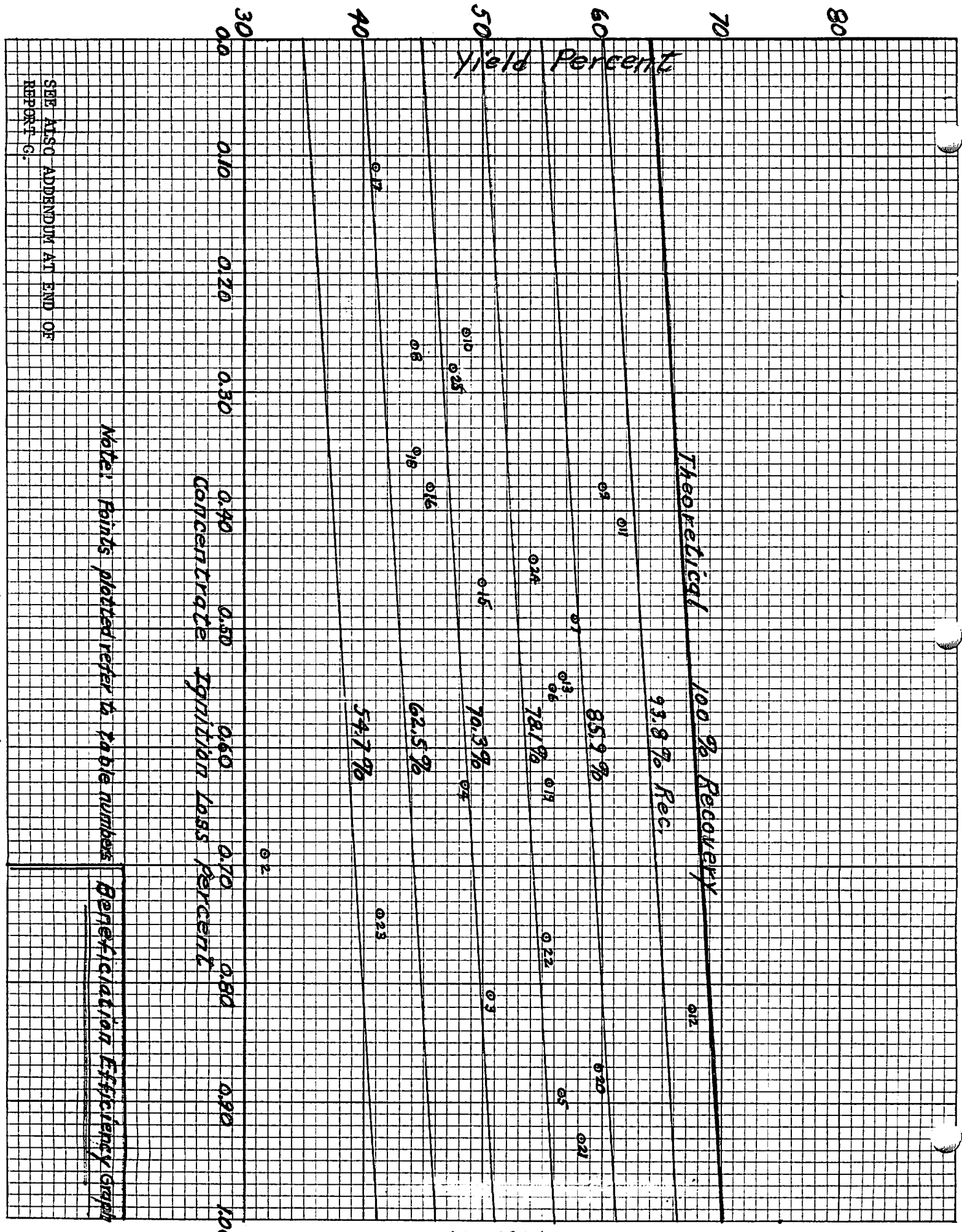


Table A

Note: Points plotted refer to table numbers

Refractometer Efficiency Graph

SEE ALSO APPENDUM AT END OF REPORT G.

Table B

S U M M A R Y

<u>Table No.</u>	<u>Main Variable</u>	<u>Stage</u>	<u>Ign. Loss</u>	<u>% Yield</u>	<u>% Rec.</u>	<u>Remarks</u>
2	No scrubbing	Ro.	1.47	66.6	100.0	Rod milled, deslimed, no scrub, amine float
		Cl.	0.69	31.6	49.3	
3	No scrubbing	Cl.	0.81	50.6	79.1	Rod milled, deslimed, no scrub, amine float
4	Scrub conc. only	Cl.	0.63	48.5	75.8	Rod milled, deslimed, no scrub, amine float, scrub conc., amine float
5	Scrub conc. only	Cl.	0.89	56.6	88.4	Rod milled, deslimed, no scrub, amine float, scrub conc., amine float
6	High solids grind	Cl.	0.55	55.9	87.3	Rod milled, deslimed, scrub, amine float
7	High solids grind	Cl.	0.49	57.8	90.3	Rod milled, deslimed, scrub, amine float, scrub conc., deslime
8	High solids grind	Cl.	0.26	44.2	69.1	Rod milled, deslimed, scrub, amine float, scrub conc., amine float
9	High solids grind	Cl.	0.38	60.0	93.8	Rod milled, deslimed, scrub, amine float, scrub conc, deslimed, amine float, scrub conc.
10	Acid scrub conc.	Cl.	0.25	48.5	75.8	High solids grind, deslime, scrub, amine float, acid scrub conc.
11	Acid scrub conc.	Cl.	0.41	61.6	96.3	High solids grind, deslime, scrub, amine float, acid scrub conc., amine float
12	Acid scrub conc.	Cl.	0.82	67.5	100.0	Low solids grind, deslime, scrub, amine float, acid scrub conc., deslime
13	Acid scrub float feed	Cl.	0.54	56.6	88.4	Low solids grind, deslime, acid scrub, neutralize pH with water, amine fl., sc. conc, deslime
15	No scrub before tabling	Ro.	0.46	50.0	78.1	Rod milled, deslimed, tabled
16	Scrubbed before tabling	Ro.	0.38	45.4	70.9	Rod milled, deslimed, scrubbed, deslimed, tabled
17	Flotation table conc. test 2	Ro.	0.17	46.4	72.5	Rod milled, deslimed, tabled, scrub, amine float
		Cl.	0.11	41.0	64.0	

Table B
(continued)

S U M M A R Y

Table No.	Main Variable	Stage	Ign. Loss	% Yield	% Rec.	Remarks
18	Flotation table conc. test 3	Ro.	0.35	44.5	69.5	Rod milled, deslimed, scrubbed, deslimed, tabled, amine float
19	Scavenger tabling	Ro. Cl.	0.63 0.41	55.6 38.0	86.9 59.4	Rod milled, deslimed, tabled, rod milled table tails, deslimed, scavenger table tails
25	Anionic	Cl.	0.28	47.6	74.4	Caustic used instead of H ₂ SO ₄
*3258-47 N-4	Anionic	Cl.	0.22	38.9	60.8	H ₂ SO ₄ , M-70, F.O., P.O.
24	Anionic	Cl.	0.44	54.1	84.5	H ₂ SO ₄ , reduced M-70, F.O., P.O.
*3258-47 N-9	Anionic	Cl.	0.20	12.5	19.5	H ₂ SO ₄ , reduced M-70, F.O., P.O.
*3258-47 N-16	Anionic	Cl.	0.24	16.8	26.3	H ₂ SO ₄ , increased M-70, F.O., P.O.
*3258-47 N-17	Anionic	Cl.	0.20	34.3	53.6	H ₂ SO ₄ , reduced M-70, F.O., P.O.
20	Amine	Cl.	0.87	59.9	93.6	Amine, MIBC
*3258-47 N-6	Amine	Cl.	0.49	35.5	55.5	Reduced amine, MIBC
*3258-47 N-10	Amine	Cl.	0.45	23.2	36.3	Increased amine, MIBC
23	Amine	Cl.	0.74	41.4	64.7	Amine, MIBC
22	Amine	Cl.	0.76	55.3	86.4	Increased amine, MIBC
*3258-47 N-18	Amine	Cl.	0.61	38.3	59.8	Amine, MIBC
21	Amine	Cl.	0.93	58.1	90.8	Increased amine, MIBC

* Refers to test numbers, not table numbers

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Table 1

ORE DRESSING TEST DATA

Sample No. 3258-L

Test No. 1

Engineer _____

Date 2/9/68

Object of Test Heavy Liquid (2.95 Gravity) Separation

Product		Wt. %	Ign. Loss	Residue	Residue Units				
(1)	-14 Mesh { Sinks	54.7	1.14	98.86	54.08				
	as rec'd. { Mids	15.5	2.71	97.29	15.08				
	{ Floats	29.8	11.80	88.20	26.28				
	{ Total	100.0	4.56	95.44	95.44				
(2)	Deslimed { Sinks	67.4	1.23	98.77	66.57				
	{ Mids	4.3	3.71	96.29	4.14				
	{ Floats	28.3	8.65	91.35	25.85				
	+200 m. Total	100.0	3.44	96.56	96.56				
(3)	As Rec'd. { +200	92.6	3.00	97.00	89.22				
	{ -200	7.4	10.30	89.70	6.64				
	{ Total	100.0	4.14	95.86	95.86				
(4)	Head Feed Analysis		3.98						

Process			Reagents						
Equipment	Time	% Solid	pH						

Remarks:

(1) As received sample was roll crushed to minus 14 mesh.

(2) Deslimed sample was deslimed two times on 200 mesh with one-minute settling in full bucket.

(3) Sample as received was deslimed on 200 mesh and both screen fractions assayed.

(4) Sample as received was assayed.

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Table 2

ORE DRESSING TEST DATA

Sample No. 3258-L

Test No. 20

Engineer _____

Date 2/16/68

Object of Test Flotation Without Scrubbing

Product	Wt. %	Cum. %		Ign. Loss					
Concentrate(FP)	31.6			0.69					
Cleaner Tails	35.0	66.6	1.47	2.17					
Rougher Tails	17.8								
Slimes & Losses	15.6								
Total	100.0								

Process				Reagents						
Equipment	Time (min)	% Solid	pH		Alamac 11-C	MIBC				
Rod Mill	2	40								
Screen 20 m.										
Deslime 3X, 200m	1									
Cond. in cell	0.25				1.25	2 drops				
Float olivine	2									
Clean olivine						2 drops				

Remarks:

Cleaner Float

Yield = 31.6%
Recovery = 49.3%

Ign. Loss = 0.69%

Rougher Float

Yield = 66.6%
Recovery = 100.0%

Ign. Loss = 1.47%

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Table 3

ORE DRESSING TEST DATA

Sample No. 3258-L

Test No. 21

Engineer _____

Date 2/16/68

Object of Test Flotation Without Scrubbing

Product	Wt. %	Cum. %		Ign. Loss					
Concentrate (FP)	40.4			0.54					
2nd Cl. Tails	10.2	50.6	0.81	1.87					
1st Cl. Tails	15.4								
Rougher Tails	17.8								
Slimes & Losses	16.2								
Total	100.0								

Process				Reagents					
Equipment	Time (min)	% Solid	pH	Alamac	11-C	MIBC			
Rod Mill	2	40							
Screen 20 m.									
Deslime 3X, 200m.	1								
Cond. in cell	0.25	18		1.25		2 drops			
Float olivine	2	18							
Clean olivine		18							
Re-clean olivine		18							

Remarks:

Yield = 50.6% Ign. Loss = 0.81

Recovery = 79.1%

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Table 4

ORE DRESSING TEST DATA

Sample No. 3258-L

Test No. 22

Engineer _____

Date 2/27/68

Object of Test Flotation Without Scrubbing, Scrub Concentrate and Re-float

Product	Wt. %	Cum. %		Ign. Loss					
+20 m.	5.2			4.58					
Conc. F.P.	49.4			0.84					
Cl. Tails	19.4			3.80					
(1) Rod Mill Tails	12.0			8.13					
Slimes	11.5			9.30					
Loss	2.5			-					
Total	100.0			3.52					
Conc. F.P.	96.5			0.63					
(2) Tails	1.6	98.1	0.66	2.71					
Slimes	1.9			7.50					
Total	100.0			0.79					

Process				Reagents			
Equipment	Time (min)	% Solid	pH	Alamac 11-C	MIBC		
Rod Mill	2	60					
Screen 20 m.							
(1) Deslime 4X, 200m.	1						
Cond. in cell	0.25	18		1.25	2 drops		
Float olivine	1.5	18	7.0				
Clean olivine	1.5	18					
Dry sample							
Scrub olivine	10	80					
(2) Deslime 2X, 200m.	1						
Cond. in cell	0.25	18		0.50	2 drops		
Float olivine							

Remarks:

Yield = 48.5%

Ign. Loss = 0.63

Recovery = 75.8%

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Table 5

ORE DRESSING TEST DATA

Sample No. 3258-L

Test No. 23

Engineer _____

Date 2/27/68

Object of Test Flotation Using Caustic in Grind, Scrub Concentrate

Product	Wt. %	Cum. %			Ign. Loss				
+20 m.	2.6				4.56				
Conc. FP	58.8				1.18				
(1) Cl. Tails	15.0	73.8		1.98	5.14				
Ro. Tails	11.3				8.24				
Slimes	9.8				9.65				
Loss	2.5				-				
Total	100.0				3.55				
Conc. FP	74.8	96.3		0.89	0.67				
(2) Tails	21.5				1.69				
Slimes	3.7				7.10				
Total	100.0				1.12				

Process				Reagents						
Equipment	Time (min)	% Solid	pH	NaOH	Alamac 11-C	MIBC				
Rod Mill	2	40		2.0						
Screen 20 m.										
Deslime 2X, 200m.	1		9.7							
(1) Cond. in cell	0.25	18			1.25	2 drops				
Float olivine	2		8.9							
Clean olivine										
Dry olivine										
(2) Scrub olivine	10	80								
Deslime 2X, 200m.										
Cond. in cell					0.2	2 drops				
Float olivine										

Remarks:

Yield = 56.6%

Ign. Loss = 0.89

Recovery = 88.4%

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Table 6

ORE DRESSING TEST DATA

Sample No. 3258-L

Test No. 29

Engineer _____

Date 3/8/68

Object of Test Flotation After High Solids Grind

Product	Wt. %			Ign. Loss						
+20 m.	0.6			4.69						
Conc. FP	55.9			0.55						
Cl. Tails	3.1			5.14						
Ro. Tails	19.3			6.12						
1st Slime	11.0			9.99						
2nd Slime	8.5			10.25						
Loss	1.6			-						
Total	100.0									

Process				Reagents							
Equipment	Time (min)	% Solid	pH	NaOH	Alamac 11-C	MIBC					
Rod Mill	2	65		2.0							
Screen 20 m.											
Deslime 2X, 200m											
Wemco scrub	15	75		2.0							
Deslime 2X, 200m											
Cond. in cell	0.25				1.25	2 drops					
Float olivine	1.5		8.7								
Clean olivine											

Remarks:

Yield = 55.9%

Ign. Loss = 0.55

Recovery = 87.3%

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Table 7

ORE DRESSING TEST DATA

Sample No. 3258-L

Test No. 33

Engineer _____

Date 4/3/68

Object of Test Flotation After High Solids Grind

Product	Wt. %	Ign. Loss							
+35 m.	2.2	4.15							
Conc. FP	58.2	0.61							
1st Cl. Tails	12.4	7.60							
2nd Cl. Tails	2.5	6.34							
Rougher Tails	3.9	10.80							
1st Slimes	13.2	10.21							
2nd Slimes	4.6	8.30							
Loss	3.0	-							
Total	100.0								
Conc.	99.3	0.49							
Slimes	0.7								
Total	100.0								

Process				Reagents						
Equipment	Time (min)	% Solid	pH	NaOH	Alamac 11-C	MIBC				
Rod Mill	2	65		2.0						
Screen 35 m.										
Deslime 2X, 200m	1									
Cond. in cell	0.25	18			1.10	2 drops				
Float olivine	2.5	18								
Clean olivine										
Scrub oliv. conc.	15	75								
Deslime 2X, 200m										

Remarks:

Yield = 57.8%

Ign. Loss = 0.49

Recovery = 90.3%

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Table 8

ORE DRESSING TEST DATA

Sample No. 3258-L

Test No. 34

Engineer _____

Date 4/4/68

Object of Test Flotation After High Solids Grind

Product	Wt. %	Ign. Loss							
+35 m.	2.2	4.20							
Conc. FP	44.2	0.26							
2nd Cl. Tails	7.5	1.24							
1st Cl. Tails	15.3	3.93							
Rougher Tails	7.3	11.96							
1st Slimes	12.5	10.27							
2nd Slimes	4.9	11.17							
Loss	6.1	-							
Total	100.0								

Process				Reagents						
Equipment	Time (min)	% Solid	pH	NaOH	Alamac 11-C	MIBC				
Rod Mill	2	65		2.0						
Screen 35 m.										
Deslime 2X, 200m	1									
Cond. in cell	0.25	18			1.0	2 drops				
Float olivine		18								
Scrub conc.	15	75		2.0						
Deslime 2X, 200m										
Cond. in cell	0.25	18			0.50	2 drops				
Float olivine										
Clean olivine						2 drops				

Remarks:

Used Wemco 500-gram scrubber.

Yield = 44.2% Ign. Loss = 0.26

Recovery = 69.1%

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Table 9

ORE DRESSING TEST DATA

Sample No. 3258-L

Test No. 40

Engineer _____

Date 4/11/68

Object of Test High Solids Grind, Flotation, Scrub Concentrate, Re-float

Product	Wt. %		Ign. Loss						
+35 m.	2.0		3.65						
Conc. FP	60.3		0.58						
1st Cl. Tails	1.5		9.77						
2nd Cl. Tails	2.8		6.39						
Rougher Tails	2.0		11.70						
1st Slimes	12.3		10.03						
2nd Slimes	7.2		10.85						
3rd Slimes	2.0		8.33						
Loss	9.9		-						
Total	100.0								
(Rescrubbed) Conc	99.3		0.38						
Slimes	0.7		8.58						
Total	100.0								

Process				Reagents						
Equipment	Time (min)	% Solid	pH	NaOH	Alamac 11-C	MIBC				
Rod Mill	2	70		4.0						
Screen 35 m										
Deslime 2X, 200m	1									
Wemco scrub	15	75		4.0						
Deslime 2X, 200m										
Cond. in cell	0.25	18			0.40	2 drops				
Float olivine	3									
Clean olivine										
Scrub conc.	15	75		4.0						
Deslime 2X, 200m										
Cond. in cell	0.25	18			0.30	2 drops				
Float olivine										

Scrub olivine 15 75
Deslime

Remarks:

Yield = 60.0%

Ign. Loss = 0.38%

Recovery = 93.8%

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Table 10

ORE DRESSING TEST DATA

Sample No. 3258-L

Test No. 42

Engineer _____

Date 4/11/68

Object of Test Flotation, Acid-Scrub Concentrate

Product	Wt. %	Ign. Loss								
+35 m.	2.3	4.15								
Conc. FP	56.2	0.61								
Cl. Tails	6.8	4.20								
Ro. Tails	13.4	7.16								
1st Slimes	11.8	10.24								
2nd Slimes	7.2	10.44								
Loss	2.3									
Total	100.0									
(Scrubbed) conc.	86.2	0.25								
Slimes	13.8	3.00								
Total	100.0									

Process				Reagents						
Equipment	Time (min)	% Solid	pH	NaOH	Alamac 11-C	MIBC	H ₂ SO ₄			
Rod Mill	2	70		4.0						
Screen 35 m										
Deslime 2X, 200m	1									
Scrub	20	75		4.0						
Deslime 2X, 200m	1									
Cond. in cell	0.25				0.35	2 drops				
Float olivine		18								
Clean olivine										
Scrub oliv. conc	30	75					5%			
Deslime 2X, 200m										

Remarks:

Yield = 48.5%

Ign. Loss = 0.25

Recovery = 75.8%

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Table 11

ORE DRESSING TEST DATA

Sample No. 3258-L

Test No. 43

Engineer _____

Date 4/12/68

Object of Test Flotation and Acid Scrub Concentrate and Re-float

Product	Wt. %	Ign. Loss							
+35 m.	3.0	3.79							
Conc. FP	67.3	0.93							
Cl. Tails	2.8	9.06							
Ro. Tails	4.4	10.41							
1st Slimes	11.0	10.61							
2nd Slimes	8.4	10.61							
Loss	3.1								
Total	100.0								
(Rescrubbed) (& floated) Conc. FP	91.7	0.41							
Tails	1.3	2.02							
Slimes	7.0	6.23							
Total	100.0								

Process				Reagents						
Equipment	Time (min)	% Solid	pH	NaOH	Alamac 11-C	MIBC	H ₂ SO ₄			
Rod Mill	2	70		4.0						
Screen 35 m.										
Deslime 2X, 200m	1									
Scrub	30	75		4.0						
Deslime 2X, 200m	1									
Cond. in cell	0.25	18			0.40	2 drops				
Float olivine	2									
Clean olivine										
Scrub conc.	30	75					5%			
Deslime 2X, 200m										
Cond. in cell	0.25				0.30	2 drops				
Float olivine										

Remarks:

Yield = 61.6% Ign. Loss = 0.41

Recovery = 96.3%

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Table 12

ORE DRESSING TEST DATA

Sample No. 3258-L

Test No. 44

Engineer _____

Date 4/12/68

Object of Test Flotation With Acid Scrub of Concentrate

Product	Wt. %	Ign. Loss							
+20 m.	1.7	4.73							
Conc. FP	69.0	1.11							
Cl. Tails	2.2	8.95							
Ro. Tails	5.2	9.50							
1st Slimes	9.0	10.21							
2nd Slimes	10.0	11.00							
Loss	2.9								
Total	100.0								
(Rescrubbed) conc	97.8	0.82							
Slimes	2.2	3.78							
Total	100.0								

Process				Reagents					
Equipment	Time (min)	% Solid	pH	NaOH	Alamac 11-C	MIBC	H ₂ SO ₄		
Rod Mill	2	40							
Screen 20 m.									
Deslime 2X, 200m	1								
Scrub	30	75		4.0					
Deslime 2X, 200m	1								
Cond. in cell	0.25	18			0.4	2 drops			
Float olivine									
Clean olivine									
Scrub conc.	30	75					5%		
Deslime 2X, 200m									

Remarks:

Yield = 67.5%

Ign. Loss = 0.82

Recovery = 100%

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Table 13

ORE DRESSING TEST DATA

Sample No. 3258-L

Test No. 45

Engineer _____

Date 4/12/68

Object of Test Acid Scrub Before Flotation

Product	Wt. %	Ign. Loss								
+20 m.	1.2	5.02								
Conc. FP	57.7	0.75								
Cl. Tails	10.4	3.63								
Ro. Tails	7.6	6.52								
1st Slimes	8.6	10.02								
2nd Slimes	10.8	11.65								
Loss	3.7									
Total	100.0									
(Rescrubbed) conc.	98.0	0.54								
Slimes	2.0	4.67								
Total	100.0									

Process				Reagents							
Equipment	Time (min)	% Solid	pH	H ₂ SO ₄	Alamac 11-C	MIBC					
Rod Mill	2	40									
Screen 20 m.											
Deslime 2X, 200m	1										
Wemco scrub	30	75		5%							
Deslime 2X, 200m	1										
Neutralize with H ₂ O											
Cond. in cell	0.25				0.4	2 drops					
Float olivine											
Clean olivine											
Scrub olivine	10	75			0.1						
Deslime 2X, 200m											

Remarks:

Yield = 56.6%

Ign. Loss = 0.54%

Recovery = 88.4%

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NORTH CAROLINA STATE MINERALS RESEARCH LABORATORY

Table 14

ORE DRESSING TEST DATA

Sample No. 3258-A-L

Test No. 1

Engineer _____

Date 4/8/68

Object of Test Grind and Deslime Thirty 500-Gram Samples

Product	Wt. %			Ign. Loss					
+20 m.	2.4			4.71					
-20+200	88.4			3.09					
-200 Slimes	9.2			9.78					
Total	100.0			3.74					
Feed				3.98					

Process				Reagents					
Equipment	Time (min)	% Solid	pH						
Grind	2	40							
Screen 20 m.									
Deslime 2X, 200m									

Remarks:

Each sample ground in stainless stell mill with 10 rods.

NORTH CAROLINA STATE MINERALS RESEARCH LABORATORY

Table 15

ORE DRESSING TEST DATA

Sample No. 3258-AL-1

Test No. 2

Engineer _____

Date 4/16/68

Object of Test Table Separation of Deslimed Rod Milled Ore (-20+200 Mesh)
No Scrub Before Tabling

Product	Wt. %		Ign. Loss						
Conc.	56.6		0.46						
Tails	35.5		5.57						
Slimes	7.9		8.22						
Total	100.0		2.89						
Feed			3.09						

Process				Reagents					
Equipment	Time (min)	% Solid	pH						
Rod Mill	2	40							
Screen 20 m.									
Deslime 2X, 200m	1								
Table									

Remarks:

Head feed ore was obtained from batch rod milling thirty 500-gram samples, screening on 20 mesh, and desliming two times on 200 mesh (see Table 14).

Yield = 50.0% Ign. Loss = 0.46%

Recovery = 78.1%

Percent weights in table are based on deslimed feed representing 88.4 percent of original head feed.

NORTH CAROLINA STATE MINERALS RESEARCH LABORATORY

Table 16

ORE DRESSING TEST DATA

Sample No. 3258-AL-1

Test No. 3

Engineer _____

Date 4/16/68

Object of Test Table Separation of Deslimed Rod Milled Ore (-20+200 Mesh)
Scrubbed Before Tabling

Product	Wt. %		Ign. Loss						
Conc.	57.2		0.38						
Tails	39.2		4.60						
Slimes	3.6		4.18						
Total	100.0		2.17						
Head Feed			2.27						

Process				Reagents					
Equipment	Time (min)	% Solid	pH		NaOH				
Rod Mill	2	40							
Screen 20 m.									
Deslime 2X, 200m									
Wemco scrub	10	75			4.0				
Deslime 2X, 200m									
Table									

Remarks:

Head feed ore was obtained from batch rod milling thirty 500-gram samples, screening on 20 mesh, and desliming two times on 200 mesh.

Yield = 45.5% Ign. Loss = 0.38%

Recovery = 70.9%

Percent weights in table are based on deslimed feed representing 79.3 percent of original head feed.

NORTH CAROLINA STATE MINERALS RESEARCH LABORATORY

Table 17

ORE DRESSING TEST DATA

Sample No. 3258-AL-2

Test No. 5

Engineer _____

Date 4/19/68

Object of Test Flotation (With Scrubbing) of Table Concentrate
From Test 2 (No Scrubbing) Before Tabling)

Product	Wt. %	Cum. %	Ign. Loss						
Conc.	82.0	92.8	0.17	0.11					
Cl. Tails	10.8			0.65					
Ro. Tails	4.4			0.66					
Slimes	2.0			8.27					
Loss	0.8								
Total	100.0			0.36					
Head Feed				0.46					

Process				Reagents						
Equipment	Time (min)	% Solid	pH	rpm	NaOH	Alamac 11-C	MIBC			
Wemco scrub	30	75		1750	4.0					
Deslime 2X, 200m										
Cond. in cell	0.25					0.20	2 drops			
Float olivine										
Clean olivine										

Remarks:

Rougher Float

Yield = 46.4%

Ign. Loss = 0.17%

Recovery = 72.5%

Cleaner Float

Yield = 41.0%

Ign. Loss = 0.11%

Recovery = 64.0%

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Table 18

ORE DRESSING TEST DATA

Sample No. 3258-AL-3

Test No. 6

Engineer

Date 4/19/68

Object of Test Flotation (No Scrubbing) of Table Concentrate From Test 3 (Scrubbed Before Tabling)

Product	Wt. %			Ign. Loss							
Conc. FP	98.1			0.35							
Tails	1.5			2.06							
Loss	0.4										
Total	100.0			0.37							
Head Feed				0.38							

Process				Reagents							
Equipment	Time (min)	% Solid	pH	rpm	Alamac 11-C	MIBC					
Cond. in cell	0.25	18		1200	0.4	2 drops					
Float olivine	2										
Clean olivine											

Remarks:

Yield = 44.5% Ign. Loss = 0.35%

Recovery = 69.5%

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Table 19

ORE DRESSING TEST DATA

Sample No. 3258-BL

Test No. 7

Engineer

Date

Object of Test Table Separation and Scavenger Separation of Tails

Product	Wt. %	Cum. %		Ign. Loss							
Cl. Conc.	38.0			0.41							
Cl. Scav. Conc.	17.6	55.6	0.63	1.09							
Cl. Scav. Tails	1.5			2.42							
1st Cl. Tails	2.0			2.31							
2nd Cl. Tails	0.9			2.21							
Ro. Scav. Tails	19.1			8.14							
1st Slimes	11.0			10.64							
2nd Slimes	4.0			9.78							
Loss	5.9			-							
Total	100.0			3.79							

Process				Reagents								
Equipment	Time	% Solid	pH									

Remarks:

1st Slime = -200 slime after rod milling ore
2nd Slime = -200 slime after rod milling table tails

Original table conc. cleaned 2 times.

Original table tails cleaned 2 times.

Yield = 55.6% Ign. Loss = 0.63%

Recovery = 86.9%

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Table 20

ORE DRESSING TEST DATA

Sample No. 3258-47N

Test No. 3

Engineer _____

Date _____

Object of Test Amine Series

Product	Wt. %	Ign. Loss								
Cl. FP Conc.	75.0	0.87								
1st Cl. Tails	3.0	6.10								
2nd Cl. Tails	1.3	4.87								
MD Tails	13.0	7.45								
Slimes	6.7	11.05								
Loss	1.0	-								
Total	100.0	2.60								
Head Feed		2.52								

Process					Reagents				
Equipment	Time (min)	% Solid	pH	rpm	NaOH	Alamac 11-C	MIBC		
Wemco scrub	10	75		1750	4.0				
Deslime 2X, 100m	1								
Cond. in cell	0.25	18				0.50	2 drops		
Float olivine	3								
Clean olivine	2								
Clean olivine									

Remarks:

Yield = 59.9% Ign. Loss = 0.87%

Recovery = 93.6%

Percent weights in table are based on deslimed feed representing 79.8 percent of original head feed.

NORTH CAROLINA STATE MINERALS RESEARCH LABORATORY

Table 21

ORE DRESSING TEST DATA

Sample No. 3258-47N

Test No. 19

Engineer _____

Date _____

Object of Test Amine Series

Product	Wt. %			Ign. Loss							
Cl. FP Conc.	72.8			0.93							
Cl. Tails	5.2			4.97							
MD Tails	15.4			6.70							
Slimes	6.4			11.77							
Loss	0.2			-							
Total	100.0										

Process					Reagents							
Equipment	Time (min)	% Solid	pH	rpm	NaOH	Alamac 11-C	MIBC					
Wemco scrub	10	75		1750	4.0							
Deslime 2X, 100m												
Cond. in cell	0.25	18				0.60	2 drops					
Float olivine	3											
Clean olivine	2.5											

Remarks:

Yield = 58.1%

Ign. Loss = 0.93%

Recovery = 90.8%

Percent weights in table are based on deslimed feed representing 79.8 percent of original head feed.

NORTH CAROLINA STATE MINERALS RESEARCH LABORATORY

Table 22

ORE DRESSING TEST DATA

Sample No. 3258-47N

Test No. 13

Engineer _____

Date _____

Object of Test Amine Series

Product	Wt. %	Ign. Loss							
Cl. FP Conc.	69.3	0.76							
1st Cl. Tails	4.2	4.97							
2nd Cl. Tails	6.7	3.35							
Ro. Tails	13.6	7.75							
Slime	5.9	11.55							
Loss	0.3	-							
Total	100.0								

Process					Reagents				
Equipment	Time (min)	% Solid	pH	rpm	NaOH	Alamac 11-C	MIBC		
Wemco scrub	10	75		1750	4.0				
Deslime 2X, 100m	1								
Cond. in cell	0.25	18				0.50	2 drops		
Float olivine	2.5								
Clean olivine	2								
Clean olivine	2								

Remarks:

Yield = 55.3%

Ign. Loss = 0.76%

Recovery = 86.4%

Percent weights in table are based on deslimed feed representing 79.8 percent of original head feed.

NORTH CAROLINA STATE MINERALS RESEARCH LABORATORY

Table 23

ORE DRESSING TEST DATA

Sample No. 3258-47N

Test No. 12

Engineer _____

Date _____

Object of Test Amine Series

Product	Wt. %	Cum. %		Ign. Loss					
FP Ro. Conc.	51.5			0.74					
Cl. Conc.	30.6	82.1	1.10	2.34					
1st Cl. Tails	4.1			8.43					
2nd Cl. Tails	4.0			7.33					
Ro. Tails	1.5			11.75					
1st Slimes	3.8			13.07					
2nd Slimes	1.9			8.38					
Loss	2.6			-					
Total	100.0								

Process					Reagents				
Equipment	Time (min)	% Solid	pH	rpm	NaOH	Alamac 11-C	MIBC		
Wemco scrub	10	75		1750	4.0				
Deslime 2X, 100m	1								
Cond. in cell	0.25	18				0.40	2 drops		
Float olivine									
Rod mill ro. tails	1	60			2.0				
Deslime 2X, 100m									
Cond. in cell									
Float olivine						0.40	4 drops		
Clean olivine									

Remarks:

1st Float

Yield = 41.1%

Ign. Loss = 0.74%

Recovery = 64.2%

Combined Float

Yield = 65.5%

Ign. Loss = 1.10%

Recovery = 100.0%

Percent weights in table are based on deslimed feed representing 79.8 percent of original head feed.

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Table 24

ORE DRESSING TEST DATA

Sample No. 3258-47-B-N

Test No. 7

Engineer _____

Date _____

Object of Test Anionic Series

Product	Wt. %	Cum. %	Ign. Loss							
MD - Olivine	67.8		0.44							
FP - Tails	24.2		6.05							
Slimes	6.7		10.94							
Loss	1.3		-							
Total	100.0									

Process					Reagents					
Equipment	Time (min)	% Solid	pH	rpm	NaOH	H ₂ SO ₄	M-70	F.O.	P.O.	
Wemco scrub	10	75		1750	4.0					
Deslime 2X, 100m	1									
Cond. in cond.	3	65	5.5			3.0	0.6	1.70	2 drops	
Cond. in cell	0.1									
Float gangue										

Remarks:

Yield = 54.1% Ign. Loss = 0.44%

Recovery = 84.5%

Percent weights in table are based on deslimed feed representing 79.8 percent of original head feed.

NORTH CAROLINA STATE MINERALS RESEARCH LABORATORY

Table 25

ORE DRESSING TEST DATA

Sample No. 3258-47N

Test No. 1

Engineer _____

Date _____

Object of Test Anionic Series

Product	Wt. %	Ign. Loss								
MD - Olivine	59.7	0.28								
FP - Tails	32.8	5.19								
Slimes	6.8	11.55								
Loss	0.7	-								
Total	100.0	2.66								
Head Feed		2.52								

Process					Reagents				
Equipment	Time (min)	% Solid	pH	rpm	NaOH	M-70	F.O.	P.O.	
Wemco scrub	10	75		1750	4.0				
Deslime 2X, 100m	1								
Cond. in cond.	3	70		700	15cc*	0.70	1.70	2 drops	
Cond. in cell	0.1			1200					
Float gangue	3								

Remarks:

*Unknown alkaline reagent

Yield = 47.6%
Recovery = 74.4%

Ign. Loss = 0.28%

Percent weights in table are based on deslimed feed representing 79.8 percent of original head feed.

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Table 26

ORE DRESSING TEST DATA

Sample No. 3218-2

Test No. _____

Engineer _____

Date _____

Object of Test Acid Scrub Tests (P.P. Olivine #70 Product)

Product	H ₂ SO ₄				Ign. Loss					
	Wt. %	%	lb/ton							
Conc.	95.8	40	266		0.27					
Slimes	4.2									
Total	100.0									
Conc.	95.5	20	133		0.26					
Slimes	4.5									
Total	100.0									
Conc.	96.3	10	66.5		0.28					
Slimes	3.7									
Total	100.0									
Conc.	96.8	5	33.2		0.33					
Slimes	3.2									
Total	100.0									
Conc.	98.0	0	0		0.54					
Slimes	2.0									
Total	100.0									
Head Feed					0.62					

Remarks:

400 gram samples

Acid scrubbed (Wemco scrubber) 75% solids, 10 min., 1600 rpm

Deslime 2X at 200 mesh, 1 minute settling

The feed material for this test was obtained from a concentrate produced in a spiral pilot plant. The pilot plant recovered 70.8% of the head feed as a product which assayed 0.91% loss on ignition. The #70 product represented 68.8% of the spiral concentrate.

5/5/71

CONFIDENTIAL REPORT FILES (68-26 & 68-27)

NOTE with reference to Reports 68-26 and 68-27, dealing with research by RML and JPN on Frank olivine (Sample No. 3258):

During March 1970, R. M. Lewis was informed verbally by Carroll P. Rogers, Jr., Vice President of Feldspar Corporation, that sponsored research reports on olivine performed by RML for FC could be made public, since that company was no longer interested in beneficiating or selling olivine.

Since FC paid only for work performed by RML, it may be assumed that research by JPN on this same sample, which was not paid for or sponsored, may also be set out as public information.

In May 1971, copies of the above reports were given to Dr. Paul Bennett of C. E. Minerals Inc., who was currently interested in olivine and who submitted a sample of his own (No. 3865) for evaluation.

Note - Transfer these two reports to Public Report files. Change from (11 P) to (11 B) - 10/1/71

9/2/71 - These 2 reports (68-26-P and 6827-P) ARE in the Public Report files. In addition to above distribution, a copy of each of these have been sent (9/2/71) to Jerry Bundy.