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ALLUVIAL CHROMITE DEPOSITS
RED MOUNTAIN DISTRICT, KENAI PENINSULA, ALASKA

SUMMARY REPORT
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By: D. C. Dahlin
J. J. Kinney
L. L. Brown

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By David C. Dahlin, Metallurgist, Jeanne J. Kinney, Geologist, and
Lawrence L. Brown, Group Supervisor-Geologist

SUMMARY

Three samples of unconcentrated minus 1/2-inch river gravel were evaluated to determine the chromite resource potential of three sites on the Windy River in the Red Mountain District on Kenai Peninsula, Alaska. The samples were received from the Alaska Field Operations Center, Fairbanks. Mineralogical examination and beneficiation tests were performed to determine the grade and recovery of chromite concentrates that could be produced from the samples. The results of this investigation indicate that the deposits are low grade; that, although acceptable high-iron chromite concentrates can be produced, several beneficiation steps are necessary that result in low concentrate recoveries; and that the three sites do not represent a significant chromite resource.

The three samples consisted primarily of pebbles of dunite, serpentine, and other basic rock fragments. Small amounts of chromite were present as free particles and as particles locked with olivine in the dunite pebbles. The head analyses ranged from 2.1 to 4.5 pct Cr_2O_3. High-purity chromite concentrates that were prepared from samples submitted for mineralogical studies had grades of 52.6 to 53.5 pct Cr_2O_3 with chromium-to-iron (Cr:Fe) ratios of 1.7:1 to 1.8:1.

Beneficiation studies were done to try to concentrate the chromite from these placer gravels without grinding. Sizing, gravity concentration, electrodynamic separation, magnetic separation, and acid scrubbing were used to produce chromite concentrates that had grades of 38.4 to 51.5 pct Cr_2O_3 with Cr:Fe ratios of 1.3:1 to 1.7:1. Chromite recoveries in the concentrates ranged from 18 to 52 pct.

The head samples and products from a sizing and gravity concentration test were submitted for precious metals analyses. No Pt, Pd, or Ag was detected in the head samples; however, Au was detected in one concentrate at a grade of 0.003 oz/ton.

SAMPLE DESCRIPTION AND PREPARATION

Three samples of alluvial deposits were received from Steve Will, Alaska Field Operations Center (AFOC), Fairbanks, Alaska, for evaluation as potential chromite resources. The samples were from three locations along the Windy River near Red Mountain on the Kenai Peninsula, Alaska. A description of the sample locations and the methods used to collect the samples, provided by Steve Will, follows:

AFOC Sample No. CM 17676 [Albany Research Center (ALRC) Sample No. ME 1407]

> Screened (minus 1/2 inch), unconcentrated river gravel collected after the removal of plus 8-inch cobbles and boulders. Sample size before screening was 25 gallons of loose material. Perhaps a 25 to 30 pct swell factor should be used in final calculations. Sample site is about 100 yards above bridge near location of several massive boulders. Alluvial valley bottom here is approximately 650 feet across with talus slopes to either side....

AFOC Sample No. CM 17677 [ALRC Sample No. ME 1408]

> Screened (minus 1/2 inch), unconcentrated river gravel collected approximately 1,400 feet downstream of CM 17676 and at Anaconda grid locations 12 + 50 N., 5 + 25 E. Original, minus 8-inch sample volume was 20 gallons. The river at this location is changing from a braided to a meandering mode though flow is still quite turbulent. Occasional 10 foot dunite boulders in valley. The alluvial flats at the location are more than a quarter mile across with remnant benches beyond that....

AFOC Sample No. CM 17678 [ALRC Sample No. ME 1409]

> Screened (minus 1/2 inch), unconcentrated river gravel located approximately 1,600 feet downstream of No. CM 17677 and at Anaconda grid station 28 + 50 N. Valley bottom here is approximately 400 feet wide with extensive benches to either side. Bench enscarpments are about 15 feet high. Original sample was 20 gallons of loose, moist, silty sand with minor gravel....

Each sample of as-received material was screened on 8 mesh. As requested in the handling instructions, the samples were not crushed. A head sample and a petrographic sample were split from the plus 8-mesh fraction. A second head sample was split from the minus 8-mesh fraction, and the remainder was split into test batches for petrographic examination and beneficiation tests.

The head analysis of each sample is shown in table 1. The composite analysis was obtained by mathematically combining the analyses for the plus 8-mesh and minus 8-mesh fractions. The composite samples ranged in grade from 2.1 to 4.5 pct Cr_2O_3. No Pt, Pd, Au, or Ag was detected above the minimum limits shown in the footnote in the table.

PETROGRAPHY

Screen products and gravity concentration products from each sample were examined to determine their mineralogy and to estimate the amount of free and locked chromite in each size fraction. High-purity chromite concentrates were prepared for chemical analysis.

The samples consisted primarily of pebbles of dunite, serpentine, and other basic rock fragments. Small amounts of free chromite and chromite locked with olivine in the dunite pebbles were present. Other minerals that were present included ferromagnesian silicates, magnetite, biotite, and sulfides. Table 2 shows the estimated mineral composition, based on weight, of each sample and the percentage of locked chromite in each fraction. The magnetics, minerals removable from each sample, with a permanent, low-intensity, hand magnet, contained chromite intimately associated with magnetite. The samples were poorly liberated, even in the minus 28-mesh fractions, and ME 1407 and especially ME 1408 had iron oxide surface coatings on the minerals. No precious-metal minerals were observed, but the gravity concentrate from ME 1409 contained a trace of sulfides.

High-purity chromite concentrates were prepared by carefully controlled magnetic separation of gravity concentrates that had been submitted for detailed mineralogical examination. Each sample was fractionated at several electromagnetic field settings on a laboratory-model Frantz[1] isodynamic separator. Incomplete liberation caused some problems with separation, and the concentrates submitted for analysis contained about 5 pct locked olivine. The grade of these concentrates ranged from 52.6 to 53.5 pct Cr_2O_3, and the Cr:Fe ratios ranged from 1.7:1 to 1.8:1. These materials would be classified as high-iron chromites.

[1]Reference to specific equipment does not imply endorsement by the Bureau of Mines.

BENEFICIATION

Beneficiation techniques including sizing, gravity concentration, electrodynamic separation, magnetic separation, and acid scrubbing were used to produce chromite concentrates. No crushing or grinding was done, as per the instructions that accompanied the samples.

Table 3 shows the results of sizing each sample on 8, 10, 14, 20, and 28 mesh and tabling the minus 28-mesh fractions on a Deister sand deck in the first series of tests. The table concentrates ranged in grade from 43.4 to 47.5 pct Cr_2O_3, and the Cr:Fe ratios ranged from 1.3:1 to 1.4:1. Chromite recoveries were only 18 to 24 pct, but the table middlings contained an additional 25 to 55 pct of the chromite.

The table concentrate from ME 1407 contained 0.003 oz/ton Au, but none of the other products contained Pt, Pd, Au, or Ag in quantities above the detection limits shown in the table. The sensitivity of the precious-metals analyses depends on the chromium content of the sample to be analyzed. The detection limits for samples with more than about 20 pct Cr_2O_3 are 0.01 oz/ton

for Pt and Pd, 0.002 oz/ton for Au, and 0.1 oz/ton for Ag. For samples with less than about 20 pct Cr_2O_3, the detection limits are improved to 0.004 oz/ton for Pt and Pd, 0.0008 oz/ton for Au, and 0.04 oz/ton for Ag.

The second series of tests was performed on the samples to improve the chromite recovery and the Cr:Fe ratio of the concentrates. A split of the minus 8-mesh fraction of each sample was sized on 28 mesh, and the minus 28-mesh fraction was tabled on a sand deck. The table middlings were dried and treated electrodynamically on a Carpco high-tension separator. Three rougher steps were done in which the middlings from one step became the feed for the next step. The three rougher concentrates were combined for a cleaner step. The table concentrate and the electrodynamic cleaner concentrate and cleaner middlings were combined for magnetic separation with a permanent, low-intensity, hand magnet. The final chromite concentrate was the nonmagnetic table concentrate, electrodynamic cleaner concentrate, and electrodynamic cleaner middlings.

The results of the above procedure are shown in table 4. The chromite concentrate grades ranged from 41.8 to 48.1 pct Cr_2O_3, and the Cr:Fe ratios ranged from 1.3:1 to 1.5:1. Chromite recoveries in the concentrates were improved to 26 to 52 pct.

In the third series of tests, the same unit processes were used, but the procedure was simplified. A split of the minus 8-mesh fraction of each sample was again sized on 28 mesh, and the minus 28-mesh fraction was tabled. The table concentrate and middlings were collected as one product and dried for electrodynamic separation. A single electrodynamic rougher step was done, and the concentrate and middlings were combined for a cleaner step. The cleaner concentrate and cleaner middlings were then magnetically separated with the hand magnet described earlier. The calculated combined concentrates

(nonmagnetic electrodynamic cleaner concentrate and middlings) ranged in grade from 44.8 to 51.5 pct Cr_2O_3 with Cr:Fe ratios of 1.6:1 to 1.7:1 and Cr_2O_3 recoveries of 26 to 48 pct. Results are shown in table 5.

The petrographic examination revealed that many of the minerals had iron oxide surface coatings. In the fourth series of tests, acid scrubbing was added to the procedure described for the third series to try to further improve mineral separation and the Cr:Fe ratios. The table concentrate and middlings, collected as one product, were scrubbed in a 10-pct HCl solution for 15 minutes at 33 pct solids. The residues were washed and decanted over a 400-mesh screen. The decant weight loss was 4 to 6 pct of the weight of the feed to the acid-scrubbing step. The scrubbed residue was dried and treated electrodynamically and magnetically in the same manner as that described for the third series of tests. Results are shown in table 6. The calculated combined concentrates ranged in grade from 38.4 to 49.2 pct Cr_2O_3 with Cr:Fe ratios of 1.6:1 to 1.7:1 and Cr_2O_3 recoveries of 34 to 52 pct. In this series of tests the acid scrubbing did not improve the grades or Cr:Fe ratios as anticipated, but marginally improved the recoveries.

The results of this investigation indicate that the deposits are low grade and that, although acceptable high-iron chromite concentrates can be produced, several beneficiation steps are necessary that result in low concentrate recoveries. Recoveries were also limited because 19 to 51 pct of the chromite was lost to the untreated, plus 28-mesh fractions, in which the chromite was unliberated.

TABLE 1. - Head analysis of the three alluvial chromite samples[1]

Sample No.	Field No.	Size fraction	Wt-pct	Analysis, pct				
				Cr_2O_3	Fe	MgO	Al_2O_3	SiO_2
ME 1407	CM 17676	Plus 8 mesh	52.9	1.2	6.6	44.0	0.8	41.4
		Minus 8 mesh	47.1	4.4	7.9	41.0	1.9	38.3
		Composite	100.0	2.7	7.2	42.6	1.3	39.9
ME 1408	CM 17677	Plus 8 mesh	58.4	3.2	6.7	34.7	3.2	43.0
		Minus 8 mesh	41.6	6.3	8.8	34.4	3.0	37.5
		Composite	100.0	4.5	7.6	34.6	3.1	40.7
ME 1409	CM 17678	Plus 8 mesh	38.1	.7	5.9	25.4	4.4	50.8
		Minus 8 mesh	61.9	3.0	7.5	32.8	3.4	41.8
		Composite	100.0	2.1	6.9	30.0	3.8	45.2

[1] The precious metals analyses of each size fraction were less than the minimum levels of detection: 0.004 oz/ton for Pt and Pd, 0.0008 oz/ton for Au, and 0.04 oz/ton for Ag.

TABLE 2. - Estimated mineral composition of the three alluvial chromite samples based on products from sizing and table concentration tests

	Wt-pct	Minerals, wt-pct[1]					Pct of locked chromite
		Chromite	Serpentine	Olivine	Ferromagnesian silicates	Magnetics[2]	
ME 1407							
Plus 8 mesh	52.9	5	4	75	15	TR	100
8 by 10 mesh	4.7	5	ND	85	10	ND	100
10 by 14 mesh	4.6	1	ND	84	15	ND	100
14 by 20 mesh	4.8	TR	ND	85	15	ND	100
20 by 28 mesh	4.5	TR	ND	85	15	1	100
Minus 28 mesh							
Table concentrate	1.4	74	2	5	1	19	20
Table middlings	7.5	25	4	63	5	3	10
Table tailings	19.6	TR	ND	85	15	1	50
Composite	100.0	6	2	77	14	1	
ME 1408							
Plus 8 mesh	58.4	TR	35	40	25	TR	100
8 by 10 mesh	6.3	TR	50	30	20	1	98
10 by 14 mesh	4.5	TR	50	30	20	1	90
14 by 20 mesh	4.2	TR	40	35	25	1	75
20 by 28 mesh[3]	3.5	1	25	50	20	1	50
Minus 28 mesh							
Table concentrate	1.8	72	2	9	TR	18	40
Table middlings	8.3	19	22	47	4	7	30
Table tailings[4]	13.0	TR	25	50	15	1	50
Composite	100.0	3	34	40	21	1	
ME 1409							
Plus 8 mesh	38.1	TR	38	20	40	2	100
8 by 10 mesh	4.1	TR	48	30	20	2	100
10 by 14 mesh	4.0	TR	53	30	15	2	100
14 by 20 mesh	4.3	TR	58	25	15	2	100
20 by 28 mesh	4.3	TR	60	30	10	2	100
Minus 28 mesh							
Table concentrate[5]	.9	64	2	10	TR	23	10
Table middlings	17.9	10	43	35	10	2	10
Table tailings	26.4	TR	60	30	10	2	50
Composite	100.0	2	47	27	22	2	

TR Trace.
ND Not detected.
1 Totals may not add up to 100 pct due to independent rounding.
2 Material removable with a permanent hand magnet.
3 Contains 5 pct biotite.
4 Contains 10 pct biotite.
5 Contains 1 pct sulfides.

TABLE 3. - Results of sizing and gravity concentration; first series

Product	Wt-pct	Analysis, pct					Analysis, oz/ton				Cr distr
		Cr_2O_3	Fe	MgO	Al_2O_3	SiO_2	Pt[1]	Pd[2]	Au[1]	Ag[2]	pc
E 1407											
lus 8 mesh[3]	52.9	1.2	6.6	44.0	0.8	41.4	<0.004	<0.004	<0.0008	<0.04	23.
nus 8 mesh[3]	47.1	4.4	7.9	41.0	1.9	38.3	< .004	< .004	< .0008	< .04	76.
8 by 10 mesh	4.7	1.3									2.
10 by 14 mesh	4.6	1.3									2.
14 by 20 mesh	4.8	1.4									3.
20 by 28 mesh	4.5	1.6									2.
Minus 28 mesh	28.5										67.
Table concentrate[4]	1.4	47.5	22.7	10.9	11.1	2.2	< .01	< .01	.003	< .1	23.
Table middlings	7.5	14.5					< .004	< .004	< .002	< .04	39.
Table tailings	19.6	.6					< .004	< .004	< .0008	< .04	4.
Composite or total	100.0	2.8									100.
E 1408											
lus 8 mesh[3]	58.4	3.2	6.7	34.7	3.2	43.0	< .004	< .004	< .0008	< .04	41.
nus 8 mesh[3]	41.6	6.3	8.8	34.4	3.0	37.5	< .004	< .004	< .0008	< .04	58.
8 by 10 mesh	6.3	3.1									4.
10 by 14 mesh	4.5	2.8									2.
14 by 20 mesh	4.2	2.8									2.
20 by 28 mesh	3.5	4.2									3.
Minus 28 mesh	23.1										46.
Table concentrate[4]	1.8	45.6	22.7	11.5	10.5	3.0	< .01	< .01	< .002	< .1	18.
Table middlings	8.3	13.7					< .004	< .004	< .0008	< .04	25.
Table tailings	13.0	.8					< .004	< .004	< .0008	< .04	2.
Composite or total	100.0	4.5									100.
E 1409											
us 8 mesh[3]	38.1	.7	5.9	25.4	4.4	50.8	< .004	< .004	< .0008	< .04	17.
nus 8 mesh[3]	61.9	3.0	7.5	32.8	3.4	41.8	< .004	< .004	< .0008	< .04	83.
8 by 10 mesh	4.1	.9									1.
10 by 14 mesh	4.0	.9									1.
14 by 20 mesh	4.3	1.1									2.
20 by 28 mesh	4.3	1.7									3.
Minus 28 mesh	45.2										78.
Table concentrate[5]	.9	43.4	23.1	12.0	10.6	3.7	< .01	< .01	< .002	< .1	18.
Table middlings	17.9	6.7					< .004	< .004	< .0008	< .04	55.
Table tailings	26.4	.5					< .004	< .004	< .0008	< .04	5.
Composite or total	100.0	2.2									100.

Average of four determinations.
Average of two determinations.
From head analysis.
Cr:Fe = 1.4:1.
Cr:Fe = 1.3:1.

TABLE 4. - Results of sizing, gravity concentration, electrodynamic separation and magnetic separation; second series

Product	Wt-pct	Analysis, pct					Cr_2O_3 distribution, pct
		Cr_2O_3	Fe	MgO	Al_2O_3	SiO_2	
ME 1407							
Plus 8 mesh[1]	52.9	1.2	6.6	44.0	0.8	41.4	24.1
8 by 28 mesh	20.1	1.5					11.1
Minus 28 mesh	27.0						64.8
Concentrate [2,3]	3.0	46.6	20.9	12.4	10.9	2.8	51.8
Magnetic reject	.2	30.5	29.6				2.3
Electrodynamic:							
Cleaner tailings	.3	18.4					2.0
3rd rougher middlings	.4	18.0					2.7
Rougher tailings	7.2	.8					2.0
Table tailings	15.9	.7					4.0
Composite or total	100.0	2.7					100.0
ME 1408							
Plus 8 mesh[1]	58.4	3.2	6.7	34.7	3.2	43.0	40.4
8 by 28 mesh	16.8	3.3					12.2
Minus 28 mesh	24.8						47.4
Concentrate [2,3]	2.5	48.1	21.8	11.4	10.2	2.3	26.3
Magnetic reject	1.0	33.8	30.0				7.4
Electrodynamic:							
Cleaner tailings	.3	19.7					1.3
3rd rougher middlings	1.0	40.8					8.9
Rougher tailings	5.8	1.0					1.2
Table tailings	14.2	.7					2.3
Composite or total	100.0	4.6					100.0
ME 1409							
Plus 8 mesh[1]	38.1	.7	5.9	25.4	4.4	50.8	13.9
8 by 28 mesh	17.1	1.0					9.0
Minus 28 mesh	44.8						77.1
Concentrate [2,4]	1.8	41.8	21.8	11.8	10.6	6.3	39.0
Magnetic reject	.6	29.5	28.0				9.2
Electrodynamic:							
Cleaner tailings	.3	4.8					.7
3rd rougher middlings	1.1	25.1					14.3
Rougher tailings	12.2	1.3					8.1
Table tailings	28.8	.4					5.8
Composite or total	100.0	1.9					100.0

[1] From head analysis.

[2] Nonmagnetic table concentrate, electrodynamic cleaner concentrate, and electrodynamic cleaner middlings.

[3] Cr:Fe = 1.5:1.

[4] Cr:Fe = 1.3:1.

TABLE 5. - Results of sizing, gravity concentration, electrodynamic separation, and magnetic separation; third series

Product	Wt-pct	Analysis, pct					Cr_2O_3 distribution, pct
		Cr_2O_3	Fe	MgO	Al_2O_3	SiO_2	
ME 1407							
Plus 8 mesh[1]	52.9	1.2	6.6	44.0	0.8	41.4	23.4
8 by 28 mesh	18.7	1.3					8.8
Minus 28 mesh	28.4						67.8
Nonmagnetic electrodynamic cleaner concentrate[2,3]	.7	48.5	22.3	9.2	10.6	1.0	12.2
Nonmagnetic electrodynamic cleaner middlings[3,4]	2.1	47.6	19.9	12.3	9.3	3.7	36.0
Magnetic reject	.4	34.6	29.5				5.0
Electrodynamic cleaner tailings	.2	15.2					1.1
Electrodynamic rougher tailings	4.4	5.8					9.2
Table tailings	20.6	.6					4.3
Composite or total	100.0	2.8					100.0
ME 1408							
Plus 8 mesh[1]	58.4	3.2	6.7	34.7	3.2	43.0	40.9
8 by 28 mesh	17.7	2.9					11.4
Minus 28 mesh	23.9						47.7
Nonmagnetic electrodynamic cleaner concentrate[5,6]	.8	52.3	20.3	10.6	10.3	.9	9.3
Nonmagnetic electrodynamic cleaner middlings[6,7]	1.5	51.0	20.3	10.8	9.7	1.6	16.9
Magnetic reject	.9	36.2	27.8				7.2
Electrodynamic cleaner tailings	.5	33.0					3.7
Electrodynamic rougher tailings	3.6	9.9					7.9
Table tailings	16.6	.7					2.7
Composite or total	100.0	4.5					100.0
ME 1409							
Plus 8 mesh[1]	38.1	.7	5.9	25.4	4.4	50.8	12.3
8 by 28 mesh	16.4	1.1					8.5
Minus 28 mesh	45.5						79.2
Nonmagnetic electrodynamic cleaner concentrate[4,8]	.3	50.1	21.0	10.8	10.4	1.6	6.9
Nonmagnetic electrodynamic cleaner middlings[4,8]	1.4	43.7	18.5	14.4	10.3	7.4	28.2
Magnetic reject	1.0	31.3	27.3				14.4
Electrodynamic cleaner tailings	.4	9.7					1.8
Electrodynamic rougher tailings	8.8	5.2					20.9
Table tailings	33.6	.4					7.0
Composite or total	100.0	2.2					100.0

[1] From head analysis.
[2] Cr:Fe = 1.5:1.
[3] Calculated combined concentrate: 47.8 pct Cr_2O_3, 20.5 pct Fe, 11.5 pct MgO, 9.6 pct Al_2O_3, 3.0 pct SiO_2; 48.2 pct Cr_2O_3 recovery; Cr:Fe = 1.6:1.
[4] Cr:Fe = 1.6:1.
[5] Cr:Fe = 1.8:1.
[6] Calculated combined concentrate: 51.5 pct Cr_2O_3, 20.3 pct Fe, 10.7 pct MgO, 9.9 pct Al_2O_3, 1.4 pct SiO_2; 26.2 pct Cr_2O_3 recovery; Cr:Fe = 1.7:1.
[7] Cr: = 1.7:1.
[8] Calculated combined concentrate: 44.8 pct Cr_2O_3, 18.9 pct Fe, 13.8 pct MgO, 10.3 pct Al_2O_3, 6.4 pct SiO_2, 35.1 pct Cr_2O_3 recovery; Cr:Fe = 1.6:1.

TABLE 6. - Results of sizing, gravity concentration, acid scrubbing, electrodynamic separation, and magnetic separation; fourth series

Product	Wt-pct	Analysis, pct					Cr_2O_3 distribution, pct
		Cr_2O_3	Fe	MgO	Al_2O_3	SiO_2	
ME 1407							
Plus 8 mesh[1]	52.9	1.2	6.6	44.0	0.8	41.4	23.1
8 by 28 mesh	18.7	1.3					8.6
Minus 28 mesh	28.4						68.3
Nonmagnetic electrodynamic cleaner concentrate[2,3]	1.1	49.8	21.3	10.3	10.5	1.1	19.5
Nonmagnetic electrodynamic cleaner middlings[2,3]	2.0	45.5	18.9	14.3	8.9	5.7	32.3
Magnetic reject	.4	34.8	30.3				5.0
Electrodynamic cleaner tailings	1.0	9.8					3.5
Electrodynamic rougher tailings	3.3	3.2					3.8
Table tailings	20.6	.6					4.2
Composite or total	100.0	2.8					100.0
ME 1408							
Plus 8 mesh[1]	58.4	3.2	6.7	34.7	3.2	43.0	40.2
8 by 28 mesh	17.7	2.9					11.2
Minus 28 mesh	23.9						48.6
Nonmagnetic electrodynamic cleaner concentrate[4,5]	1.4	51.2	21.1	9.1	8.9	.9	15.6
Nonmagnetic electrodynamic cleaner middlings[5,6]	1.8	47.6	18.3	13.7	8.9	4.9	18.6
Magnetic reject	.9	37.3	29.0				7.3
Electrodynamic cleaner tailings	.6	11.2					1.5
Electrodynamic rougher tailings	2.6	5.3					3.0
Table tailings	16.6	.7					2.6
Composite or total	100.0	4.6					100.0
ME 1409							
Plus 8 mesh[1]	38.1	.7	5.9	25.4	4.4	50.8	11.1
8 by 28 mesh	16.4	1.1					7.7
Minus 28 mesh	45.5						81.2
Nonmagnetic electrodynamic cleaner concentrate[2,7]	.3	49.0	21.1	10.8	10.7	1.9	6.1
Nonmagnetic electrodynamic cleaner middlings[2,7]	2.2	37.0	16.2	18.8	8.5	13.6	33.9
Magnetic reject	1.4	33.5	27.5				19.6
Electrodynamic cleaner tailings	1.3	2.2					1.2
Electrodynamic rougher tailings	6.7	5.0					14.1
Table tailings	33.6	.4					6.3
Composite or total	100.0	2.4					100.0

[1] From head analysis.

[2] Cr:Fe = 1.6:1.

[3] Calculated combined concentrate: 47.0 pct Cr_2O_3, 19.8 pct Fe, 12.9 pct MgO, 9.5 pct Al_2O_3, 4.1 pct SiO_2; 51.8 pct Cr_2O_3 recovery; Cr:Fe = 1.6:1.

[4] Cr:Fe = 1.7:1.

[5] Calculated combined concentrate: 49.2 pct Cr_2O_3, 19.5 pct Fe, 11.7 pct MgO, 8.9 pct Al_2O_3, 3.2 pct SiO_2; 34.2 pct Cr_2O_3 recovery; Cr:Fe = 1.7:1.

[6] Cr:Fe = 1.8:1.

[7] Calculated combined concentrate: 38.4 pct Cr_2O_3, 16.8 pct Fe, 17.8 pct MgO, 8.8 pct Al_2O_3, 12.2 pct SiO_2; 40.0 pct Cr_2O_3 recovery; Cr:Fe = 1.6:1.