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O T T A W A July 15th, 1940.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 865.

Concentration of Chromite from the
Sterrett Property, Richmond, Quebec.

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BUREAU OF MINES
DIVISION OF METALLIC MINERALS

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CANADA
DEPARTMENT
OF
MINES AND RESOURCES
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Shipment:

A 300-pound shipment of chrome ore was received on June 14th, 1940, from the Northern Exploration Syndicate Limited, Montreal, Quebec. This sample was made up of material lying on the dumps of the Sterrett Company, Richmond, Quebec. It was stated that this shipment does not

necessarily represent the grade of material that would be concentrated when the property is in production.

This shipment was made to determine the grade of concentrate that could be obtained and to determine by chemical analysis the suitability of the concentrate for various industrial applications.

Characteristics of the Ore:

Six polished sections and two thin sections were prepared and examined microscopically for the purpose of determining the character of the ore.

Gangue -

The examination of thin sections showed that the gangue consists of two constituents, serpentine and carbonate. The former predominates in quantity and is largely the irregular granular type regarded as having resulted from the alteration of olivine. Occasional narrow veinlets of the fibrous serpentine chrysotile traverse the granular type. The carbonate is probably dolomite, because when tested with HCl it effervesced only when it was finely powdered. The carbonate occurs as masses of crystals and corroded remnants of crystals in serpentine. Both minerals vein the chromite. Unquestionably the dolomite was deposited subsequent to the chromite and serpentinization occurred after dolomitization.

Metallic Minerals -

Chromite: Chromite is the only abundant metallic mineral. It occurs as small to large disseminated grains and as coarsely granular masses of considerable

size. The disseminated grains vary in size from a fraction of a millimetre to several millimetres. They almost always contain inclusions of gangue; in some cases these inclusions are concentrated around their outer borders only (see Figure 1) while in others they occur well within the grains. The massive chromite shows considerable fracturing and contains veinlets of dolomite and serpentine. In some cases replacement of the chromite by gangue is prominent, and locally this has proceeded to such an extent that all that remains of the chromite is numerous small remnants in the gangue (see Figures 2 and 3).

Magnetite: The quantity of magnetite is very small. Rare grains of sizes similar to that of the chromite occur with the latter mineral, and numerous tiny grains of magnetite occur throughout the serpentine masses; the distribution of these tiny grains is such that it constitutes evidence that the serpentine was derived from olivine. Rare small grains of magnetite occur along narrow veinlets in chromite, and this magnetite is obviously of the same age as the tiny grains in serpentine and like it has resulted from the alteration of the olivine. Olivine commonly alters to serpentine, while its iron forms magnetite.

Pyrite: Rare small grains of pyrite occur in the gangue.

Paragenesis -

The order of deposition of the various minerals

is well displayed in the sections. The paragenesis is as follows:

1. Chromite and possibly a little magnetite (and olivine?).
2. Pyrite(?).
3. Carbonate.
4. Serpentine of the massive variety.
5. Serpentine of the fibrous variety (chrysotile) was probably deposited during the later stages of serpentinization.

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(NOTE: Figures 1, 2 and 3 are placed at the end of this report.)

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Sampling and Analysis:

The shipment was crushed to ¼ inch and then sampled by standard procedure.

Analysis of the sample so obtained gave the following results:

		Per cent	
Chromium (Cr)	-	21.36	= 31.22 per cent Cr_2O_3.
Iron (Fe)	-	9.07	= 11.67 per cent FeO.

Concentration by jigs and tables recovered 63 per cent of the chromium as a concentrate containing 45.58 per cent Cr_2O_3 and 10.9 per cent iron, with a ratio of concentration of 2.4:1.

Twenty-seven per cent of the chromium was

contained in a middling product. The greater part of this would subsequently be recovered.

A composite sample of the concentrates made from aliquot portions of the various sizes had the following analysis:

		Per cent			Per cent
Cr_2O_3	-	45.58	Sulphur	-	0.01
SiO_2	-	5.21	MnO	-	0.22
			Copper	-	0.03
Fe as FeO	-	14.06	TiO_2	-	0.28
			NiO	-	0.19
Al_2O_3	-	12.98	V_2O_5	-	None detected.
MgO	-	16.80	Lead	-	" "
CaO	-	0.46	Na_2O and K_2O	-	0.21
P_2O_5	-	0.02			

Investigative Procedure:

The concentration of the sample was carried out by gravity methods. Coarser portions were jigged and the finer sizes were table-concentrated.

100 pounds of the ore, crushed to pass ¼ inch, was screened on 8, 14, 35 and 65 mesh screens. The division of the sample was as follows:

Mesh size	Weight, pounds	Weight, per cent
- ¼ in. + 8 mesh	32.5	32.0
- 8 + 14 mesh	15.0	14.8
-14 + 35 "	23.0	22.7
-35 + 65 "	12.0	11.8
- 65 mesh	19.0	18.7
	101.5	100.0

(Investigative Procedure, cont'd) -

Jigging.

Feed size = -$\frac{1}{4}$ in. + 8 mesh
Feed weight = 32$\frac{1}{2}$ pounds.

Results:

Product	Weight, per cent	Assays, per cent Cr	Assays, per cent Fe	Distribution, per cent Cr	Distribution, per cent Fe
Feed (calculated)	100.0	19.15	8.83	100.0	100.0
Concentrate	32.0	25.60	10.31	42.8	37.3
Tailing	68.0	16.12	8.14	57.2	62.7

The tailing from this operation was ground minus 8 mesh and screened on 14, 35 and 65 mesh. The -8+14 mesh portion was jigged and the other fractions were added to the fractions obtained by the initial sizing operation.

Results:

Jigging -8+14 mesh portion of reground jig tailing.

Product	Weight, Pounds	Weight, Per cent	Assays, per cent Cr	Assays, per cent Fe	Distribution, per cent Cr	Distribution, per cent Fe
Feed	10.5	100.0	-	-	-	-
Concentrate	3.75	35.7	28.41	10.31	-	-
Tailing	6.75	64.3	No samples taken.			

Jigging main -8+14 mesh fraction of feed.

Feed	15.0	100.0	21.02	8.38	100.0	100.0
Concentrate	4.0	26.7	30.85	11.03	39.2	35.1
Tailing	11.0	73.3	17.44	7.42	60.8	64.9

The -8+14 jig tailings were ground and screened on 35 and 65 mesh, and these fractions were then added to the screened fractions of the original feed.

These finer products were concentrated on a small Wilfley table.

(Investigative Procedure, cont'd) -

Table Concentration.

The results obtained by table concentration are shown in the following compilation of the total concentration of the sample:

Product	Weight: Pounds	Weight: Per cent	Assays, per cent: Cr	Assays, per cent: Fe	Distribution, per cent: Cr	Distribution, per cent: Fe
Feed (cal.)	97.00	100.0	20.42	8.30	100.0	100.0
-¼ in. +8 mesh jig conc.	9.75	10.1	25.60	10.31	12.7	12.5
-8+14 jig concentrate	3.75	3.9	28.41	10.31	5.4	4.8
-8+14 " "	4.00	4.1	30.85	11.03	6.2	5.4
-14+35 table concentrate	7.60	7.8	32.99	11.96	12.6	11.2
" " middling	15.20	15.7	22.95	8.96	17.6	17.0
" " tailing	15.20	15.7	7.31	4.73	5.6	8.9
-35+65 table concentrate	6.47	6.7	34.46	12.57	11.3	10.2
" " middling	6.04	6.2	20.16	7.52	6.1	5.7
" " tailing	4.74	4.9	2.09	2.88	0.5	1.7
-65 mesh table concentrate	8.49	8.7	35.02	12.78	14.9	13.4
" " " middling	3.64	3.7	18.32	7.62	3.3	3.5
" " " tailing	12.12	12.5	6.03	3.81	3.7	5.7

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Examination of Middlings.

In order to determine the nature of the middling product produced by table concentration, samples of the three table middlings were tested by a heavy solution. A 'float' product containing the light gangue and a 'sink' product containing the heavier particles were obtained. These products were analysed.

Results:

-14+35 table middling.

Float - 0.99 per cent Cr - small grains of chromite on gangue.

Sink - 10.49 per cent Cr - attached gangue

(Investigative Procedure, cont'd) -

Examination of Middlings, cont'd -

(Results) -

-35+65 table middling.

Float - 0.35 per cent Cr - clean serpentine.

Sink - 31.10 per cent Cr - clean chromite with some calcite.

-65 mesh table middling.

Float - 0.86 per cent Cr.

Sink - 11.65 per cent Cr.

This size contained too many fines for a satisfactory separation.

Summary:

63.1 per cent of the chromium in the feed was recovered in the combined jig and table concentrates representing 41.3 per cent of the weight of the feed. This concentrate contained 45.58 per cent Cr_2O_3, and 10.9 per cent iron.

Twenty-seven per cent of the chromium in the feed is contained in the table middlings, the major amount being in the -14+35 mesh size. 'Sink and float' tests show that this coarsest middling is a true middling, while the minus 35 mesh middling contains practically all its value as free chromite.

The coarsest jig concentrate, $-\frac{1}{4}$ in. +8 mesh, is low grade, as is the -8+14 mesh concentrate. This is due to attached gangue on the chromite grains.

Conclusions:

The predominantly coarse size of the chromite and its relative freedom (compared with many chromites) from inclusions of gangue minerals present a particularly attractive picture from an economic viewpoint. Furthermore, iron minerals (pyrite and much of the magnetite) are finely divided and tend to occur in larger areas of gangue which presumably may be easily removed in treatment. It is true that some of the chromite contains finely divided gangue which cannot be freed economically, but even including this it should be possible to produce a good grade of concentrate of about 35 per cent chromium, as shown by the results of tabling the finer sizes.

A recovery of about 80 per cent of the chromium should be obtained. The main losses will be in fine mineral escaping in the tailing. Therefore, the initial crushing should be done in a manner which will keep the production of fines to a minimum and a classified feed should be provided for the tables.

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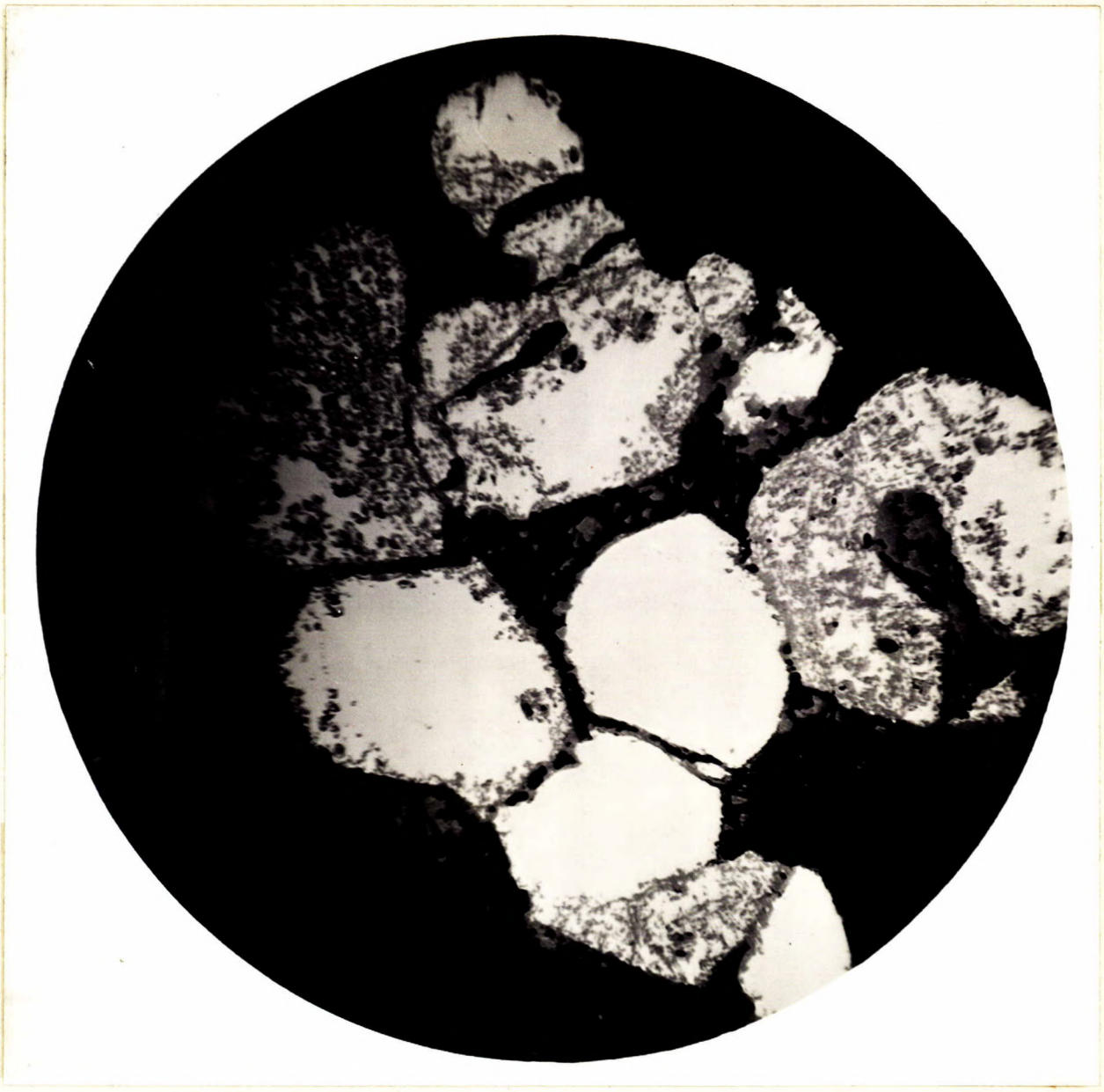
Figure 1.



Richmond Chromite.

Photomicrograph of polished section of disseminated chromite, showing grains which are comparatively free from gangue inclusions and grains which contain numerous such inclusions. While they are designated as "inclusions" they are probably chiefly due to replacement of the chromite by the gangue.

Chromite - white; carbonate - grey;
serpentine - black.

Magnification - X 60.

Figure 2.

Richmond Chromite.

Massive chromite fractured and cut by veinlets of gangue. Some of the veinlets show no replacement of the chromite, while others show some.

Chromite - white; carbonate - grey; serpentine and pits - black.

Magnification - X 60.

Figure 3.

Richmond Chromite.

Massive chromite cut by veinlets of gangue, showing advanced replacement of the chromite by gangue.

Chromite - white; carbonate - grey; serpentine and pits - black.

Magnification - X 60.

(NOTE: In all of the photomicrographs, the size of a 200-mesh opening would be about 4.5 millimetres, or nearly 2/10ths of an inch.)