INDUSTRIAL CONFIDENTIAL

Declassified
Déclassifié

CANADA

DEPARTMENT OF MINES AND TECHNICAL SURVEYS

OTTAWA

MINES BRANCH INVESTIGATION REPORT IR 58-158 c.1

CONCENTRATION TESTS ON A SAMPLE OF MAGNETITE ORE FROM NEWBORO, ONTARIO, SUBMITTED BY NEW MYLAMAQUE EXPLORATIONS LTD.

by

J. D. JOHNSTON

MINERAL DRESSING AND PROCESS METALLURGY DIVISION

NOTE: THIS REPORT RELATES ESSENTIALLY TO THE SAMPLES AS RECEIVED. IT SHALL NOT, NOR ANY CORRESPONDENCE CONNECTED THEREWITH, BE USED IN PART OR IN FULL AS PUBLICITY OR ADVERTISING MATTER.

COPY NO. 6

SEPTEMBER 16, 1958

Mines Branch Investigation Report IR 58-158

CONCENTRATION TESTS ON A SAMPLE OF MAGNETITE ORE FROM NEWBORO, ONTARIO, SUBMITTED BY NEW MYLAMAQUE EXPLORATIONS LTD.

by

J. D. Johnston*

- - - - -

SUMMARY OF RESULTS

The ore contains 11.5% titanium dioxide in the form of ilmenite and attempts to produce a magnetic concentrate containing less than 3.0% titanium dioxide were unsuccessful owing to the extremely fine grained state of the ilmenite inclusions in magnetite.

---

* Senior Scientific Officer, Mineral Dressing and Process Metallurgy Division, Mines Branch, Department of Mines and Technical Surveys, Ottawa.

INTRODUCTION

A shipment of ore weighing 390 lb was received at the Mines Branch on March 22, 1958. The shipment was submitted by Gordon W. Moore, Consulting Engineer for New Mylamaque Explorations Ltd., Room 409, 44 Wellington Street East, Toronto 1, Ontario.

Location of Property

The property from which this sample was taken is located approximately one mile southwest of the village of Newboro, in Leeds county, eastern Ontario.

Sampling and Analysis

A representative sample, cut by standard methods from the shipment, was assayed and reported as follows:

Iron*	-	48.40 %
Titanium dioxide	-	11.50 %
Silica	-	6.60 %
Sulphur	-	3.09 %
Phosphorus	-	1.55 %
Magnesia	-	3.82 %
Alumina	-	6.10 %

* This iron determination was done by bi-sulphate fusion.

MINERALOGICAL EXAMINATION*

Introduction

Four polished sections were prepared from a sample and were studied microscopically in order to determine the characteristics of the ore. Mineral identifications are based on physical and optical properties and on X-ray diffraction patterns made from powder samples taken during the microscopic examination.

Gangue Minerals

Gangue minerals occupy only a small portion of the four polished surfaces and consist chiefly of coarse to fine particles of pyroxene, plagioclase feldspar, and chlorite scattered unevenly through ore minerals. In addition to these inclusions, numerous tiny parallel needles of gangue, which suggest exsolved lenses of spinel, are visible in magnetite in many places and an X-ray powder pattern verifies the presence of this mineral. However, it appears to be common magnesium-aluminum spinel and not the titaniferous variety (ulvospinel). Figures 1 and 2.

Ore Minerals

Each section is strongly attracted to the poles of a horseshoe magnet, and, as nearly as can be determined with unaided eyes, each of the mounted fragments of ore appears to be composed of massive magnetite containing numerous small inclusions of gangue and iron sulphide. Under a microscope ilmenite is seen to be present also.

As noted above, massive magnetite predominates in the four polished sections and is host to other metallic minerals and inclusions of gangue. A considerable amount of ilmenite occurs with

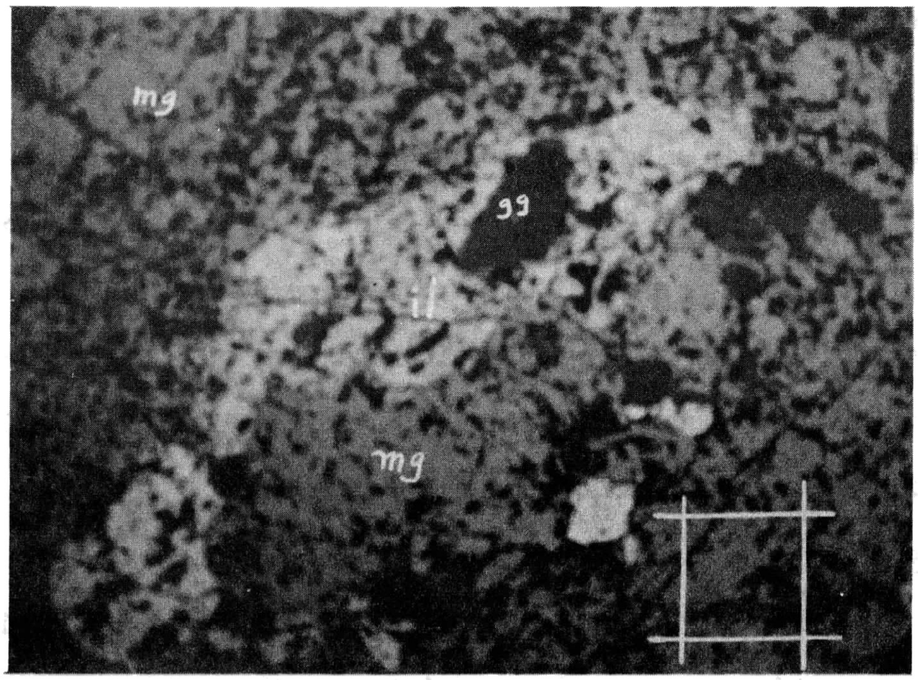
---

*From Mineragraphic Report M-1585-E, April 25, 1958, by W. E. White.

magnetite, largely as coarse admixed grains but a minor portion of the titanium mineral is present in fine grain sizes. In addition to tiny random inclusions of ilmenite in magnetite, narrow exsolution lamellae of ilmenite in magnetite are seen to be fairly common under a high-power oil immersion objective with nicols crossed (Figure 3). Anhedral grains of pyrite, ranging from 2 mm down to 0.019 mm (800-mesh) or less in size, are rather prevalent in magnetite, less often in gangue (Figure 1). Many particles of pyrite appear to be altering to a brownish mineral which resembles pyrrhotite but it is not anisotropic and an X-ray diffraction pattern of a powder sample is that of pyrite. Occasional tiny oriented lamellae of hematite in ilmenite are also visible under oil immersion.

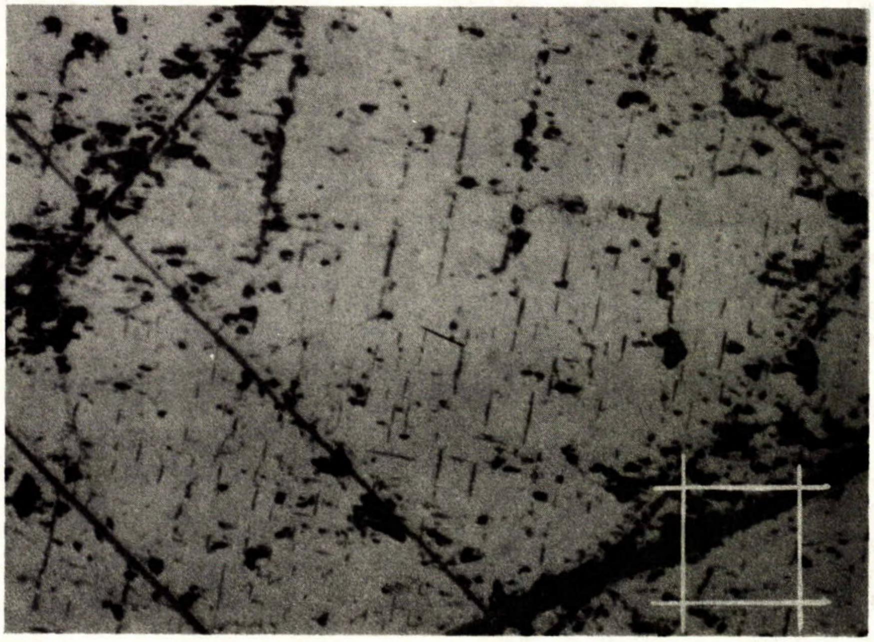
Discussion

Although the bulk of the ilmenite in four polished sections occurs in coarse-grained admixture with magnetite, an appreciable proportion of this mineral (i.e. ilmenite) is present in fine grain sizes and as narrow exsolution lamellae in magnetite. In the writer's opinion, there is sufficient fine ilmenite, sulphide, and gangue in magnetite to make it very doubtful that satisfactory iron concentrates can be economically made from this ore by standard methods of treatment, even if ulvöspinel is completely absent. This opinion, of course, is based on the assumption that the four polished sections are truly representative of the sample as a whole.



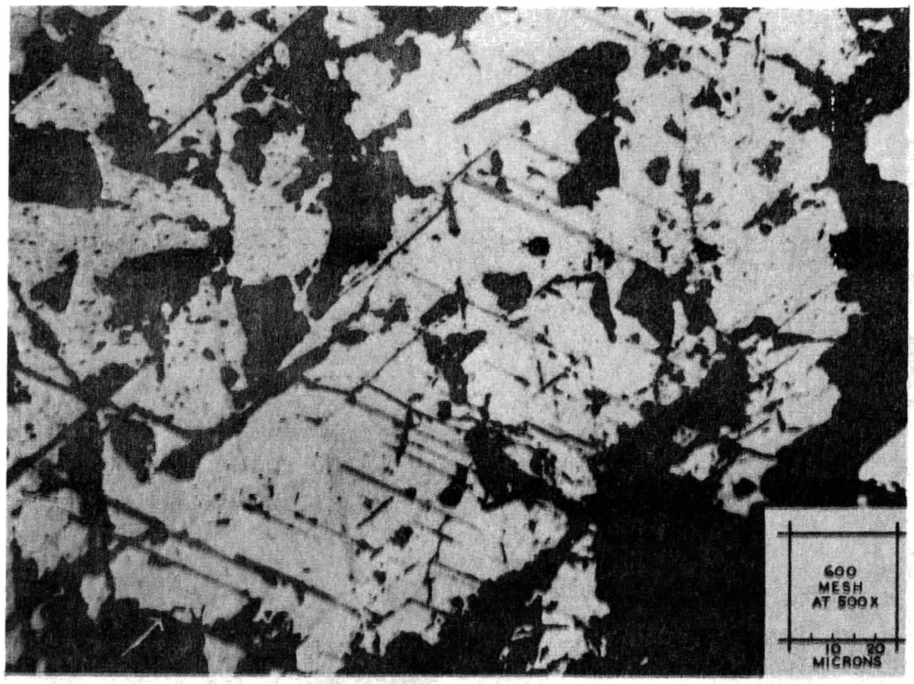
50 X

Figure 1. - Typical field in polished sections showing magnetite (mg), dark grey rough surface, ilmenite (il), light grey almost white, pyrite, small white grains near top left corner of white square (48-Tyler mesh), and gangue (gg), dark grey smooth surface; note the smaller particles of ilmenite at bottom left; polishing pits are black; crossed polars.



200 X

Figure 2. - Photomicrograph of field in polished sections to illustrate tiny spindles and straight narrow lamellae of gangue (dark grey) in parallel arrangement in magnetite (light grey); pits are black and white square is a 200-Tyler mesh screen opening.



500 X

Figure 3. - Exsolution lamellae of ilmenite (grey) in magnetite (white); the main row, indicated by white arrow, is in parallel arrangement with long axis in a N.W. - S.E. direction but two or three more are visible in an almost N.S. direction; the parallel black lamellae oriented N.E.-S.W. are gangue; polishing pits and fractures are also black; oil immersion.

DETAILS OF INVESTIGATION

Test No. 1

A sample of the ore, dry crushed to pass through a 20 mesh screen, was treated in a Crockett magnetic machine to produce a magnetic concentrate, a non-magnetic product and a small amount of overflow from the concentrate collecting vessel. The magnetic and non-magnetic products were fractionated on 35, 48, 65, 100 and 150 mesh screens and the screen fractions assayed for iron, titanium dioxide and silica as follows:

(Test No. 1, cont'd)

Product	Weight, %	Assay, %			Distribution, %		
		Fe	TiO_2	SiO_2	Fe	TiO_2	SiO_2
Conc. - 20+35 mesh	32.04	54.0	8.50	3.64	35.51	24.16	20.07
" - 35+48 "	11.77	54.4	8.21	2.60	13.14	8.57	5.27
" - 48+65 "	8.42	56.4	8.02	2.64	9.75	5.99	3.82
" - 65+100 "	7.04	56.8	8.02	2.68	8.21	5.01	3.25
" -100+150 "	5.37	58.2	8.02	2.28	6.41	3.82	2.11
" -150 "	13.10	59.0	7.82	2.48	15.86	9.08	5.59
Average conc. (calc.)	77.74	55.71	8.21	3.00	88.88	56.63	40.11

(Test No. 1, cont'd)

Product	Weight, %	Assay, %			Distribution, %		
		Fe	TiO_2	SiO_2	Fe	TiO_2	SiO_2
Non-mag. - 20+35 mesh	3.34	22.1	22.8	17.7	1.51	6.75	10.17
" - 35+48 "	2.31	23.7	25.0	16.4	1.12	5.12	6.52
" - 48+65 "	2.41	24.5	24.7	16.1	1.21	5.28	6.68
" - 65+100 "	2.48	24.5	24.3	15.7	1.25	5.35	6.70
" -100+150 "	2.08	24.1	24.3	12.2	1.03	4.48	4.37
" -150 "	7.60	22.5	21.0	15.0	3.51	14.16	19.62
Average non-magnetics (calc.)	20.22	23.22	22.94	15.53	9.63	41.14	54.06
Conc. overflow	2.04	35.6	12.3	16.6	1.49	2.23	5.83

(Test No. 1, concluded)

Results of Test No. 1

Product	Weight, %	Assay, %			Distribution, %		
		Fe	TiO_2	SiO_2	Fe	TiO_2	SiO_2
Concentrate	77.74	55.71	8.21	3.00	88.88	56.63	40.11
Non-magnetics	20.22	23.22	22.94	15.53	9.63	41.14	54.06
Conc. overflow	2.04	35.6	12.3	16.6	1.49	2.23	5.83
Feed (calc.)	100.00	48.73	11.27	5.81	100.00	100.00	100.00

In the foregoing test, iron recovery is very good but the iron concentrate carries too much titanium. A further test with finer grinding and a weaker magnetic field was tried. A sample of the concentrate was given a mineralogical examination, the findings of which are given in report No. M-1598-E. (See p 13).

Test No. 2

In this test the ore was ground finer than 65 mesh and treated on a three drum magnetic machine in which the magnetic intensity can be controlled by rheostats. The concentrate passed along progressively from drum to drum where the amperage dropped successively from 2.2 to 1.2 to 0.7, the final concentrate coming off at the last drum. The concentrate was fractionated on 100, 150 and 200 mesh screens and assayed as before.

Analysis of Concentrate Fractions

Product	Weight, %	Assay, %		
		Fe	TiO_2	SiO_2
Conc. - 65+100 mesh	32.64	59.8	7.34	1.48
" -100+150 "	22.08	60.2	7.63	1.24
" -150+200 "	16.16	61.0	7.44	1.52
" -200 "	29.12	61.8	6.96	1.12
Average concentrate (calc.)	100.00	60.66	7.31	1.33

(Test No. 2, concluded)

Results of Test No. 2

Product	Weight, %	Assay, %			Distribution, %		
		Fe	TiO_2	SiO_2	Fe	TiO_2	SiO_2
Concentrate	65.77	60.8	7.29	1.33	79.93	42.05	13.18
Middling	3.76	42.6	12.0	9.08	3.20	3.96	5.14
Tailing	30.47	27.7	20.2	17.8	16.87	53.99	81.68
Feed (calc.)	100.00	50.03	11.40	6.64	100.00	100.00	100.00

The TiO_2 content of the concentrate is down a little from Test No. 1 but is still much too high. A further test with finer grinding and a still weaker magnetic field was tried. A sample of the concentrate was given a mineralogical examination, the findings of which are given in report No. M-1598-E. (See below).

MICROSCOPIC EXAMINATION* OF TWO MAGNETIC CONCENTRATES

Introduction

Two magnetic concentrates were received for microscopic examination. They were designated as "magnetic concentrate, -150 mesh, Test No. 1" and "magnetic concentrate, -200 mesh, Test No. 2", and were produced from a 390 lb shipment received March 22, 1958.

The purpose of this examination is to determine the reason for the high titanium content of the concentrates (7.82% and 6.96% TiO_2, respectively).

Results of Examination

Polished sections were prepared from both samples, and these were examined under an ore microscope using high-power oil immersion objectives. This examination revealed that the principal component in both samples is magnetite, but that considerable ilmenite is also present. It occurs primarily as long narrow lamellae, a few microns in width, in the magnetite grains. Some free ilmenite grains were also observed, especially in the concentrate from Test No. 1.

The occurrence of the ilmenite lamellae in the magnetite is in contrast to the relatively pure magnetite noted in the two drill core fragments from the same property, described in Internal Report MDT-58-9. It is therefore evident that the ore from this deposit is not uniform in its mineralogical constitution.

---

* From Mineralogical Report M-1598-E, by E. H. Nickel.

Test No. 3

A sample of the ore was ground to 94.6% finer than 325 mesh and treated in the same machine as was used in Test No. 2. The amperage on the final concentrate drum was reduced from 0.7 to 0.4. The concentrate was infrasized and the products assayed for TiO_2 as follows:

Analysis of Infrasized Concentrate

Nominal Size of Fraction	Weight, %	TiO_2, %
+56 microns	12.47	6.40
-56+40 "	22.40	6.13
-40+28 "	18.18	6.00
-28+20 "	13.29	6.10
-20+14 "	9.57	6.20
-14+10 "	7.03	6.20
-10 "	17.06	5.55
Average concentrate	100.00	6.05

(Test No. 3, concluded)

Results of Test No. 3

Product	Weight, %	Assay, %			Distribution, %		
		Fe	TiO_2	Insol	Fe	TiO_2	Insol
Final concentrate	33.92	63.8	6.27	4.72	44.50	19.51	7.48
Middling	29.68	62.0	7.00	6.78	37.84	19.06	9.40
Tailing	36.40	23.6	18.40	48.86	17.66	61.43	83.12
Feed (calc.)	100.00	48.63	10.90	21.40	100.00	100.00	100.00

The final concentrate, although containing only 44.5% of the iron in the feed is still too high in titanium to be marketable. Since there is little difference in the titanium content in the whole size range there seems to be little hope of reducing it further.

CONCLUSION

The ilmenite mineral in this ore sample is much too fine grained to be liberated by grinding and it, therefore, cannot be eliminated. The high titanium content makes the product undesirable for use in the steel industry.

- - - -

JDJ/DV