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File Ref. EL 17/68	
- 3 OCT 1988	
Doc. Ref.	
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TASMANIA MINES LIMITED

EXPLORATION LICENCE 17/68

ANNUAL REPORT

NOVEMBER 4TH 1987 to NOVEMBER 3RD 1988

MICROFILMED

Cliff H. Whitehead,
for and on behalf of
TASMANIA MINES LIMITED.

1. INTRODUCTION - NATURE OF WORK.

Activities within E.L. 17/68 during the current year were not as extensive as originally proposed.

Due to budgetary constraints, surface exploration work and proposed drilling over and on ground with significant magnetite and tungsten potential was not initiated as planned.

Investigations of wollastonite deposits located within the E.L. 17/68 area were however completed during the current term, these studies being in the form of metallurgical/bench test work on representative surface samples from the Limestone Creek occurrences. Refer to Figure No. 1. Proposed exploration work to evaluate the potential of wollastonite ground in the eastern section of the E.L. was not undertaken.

2. WOLLASTONITE INVESTIGATIONS.

ALL SAMPLES OBTAINED FROM ONE
LOCATION. GRID REF CQ 996292
(HELLYER)

Two independent metallurgical investigations have been completed on representative wollastonite samples, these being at the Department of Mines Laboratories, Launceston, and at the Mineral Sands Consulting Group, Brisbane.

Final reports on both of the above test work are attached as Appendices A and B. Below are documented details of the nature and results of the investigations.

(A) Mines Department, Launceston, test work (Appendix A)

A 20kg wollastonite sample from surface exposures at the Limestone Creek area has been subjected to bench scale metallurgical tests and mineralogical/chemical analyses. The prime objective of the work was to assess various possible techniques of upgrading the material to a wollastonite concentrate suitable for commercial evaluation.

The test work consisted of the following programme:-

- crush to minus 4mm
- grind (ball mill) to minus 600 microns
- Jones wet magnetic separation
- non magnetic product subjected to calcite froth flotation (Denver Laboratory flotation cell).
- flotation tailing product (wollastonite concentrate) subjected to silica froth flotation.
- products submitted for chemical analyses (primarily L.O.I., CaO, SiO₂, MgO, Fe₂O₃, Al₂O₃).
- products submitted for mineralogical examination.

Test work resulted in producing a rougher flotation tail product constituting 51.8% of the sample and having a calculated 70.5% wollastonite content. However, the conventional silica flotation tests of this sample did not achieve any additional wollastonite content concentration or SiO₂ removal.

.... continued

Chemical analyses show the following:-

	<u>CaO</u>	<u>SiO₂</u>	<u>MgO</u>	<u>Fe₂O₃</u>	<u>Al₂O₃</u>	<u>L.O.I.</u>
Head Sample	39.5	41.4	3.5	1.3	2.3	9.0
Rougher Wollastonite Concentrate	41.4	52.1	2.7	0.8	2.4	0.62

Firing tests (electric furnace for six hours at 1000°c) on the produced wollastonite concentrate (to assess its ceramic potential) produced a slight pinkish coloured product (oxidation of contained iron).

Wollastonite samples produced from this test work are being provided to potential buyers.

(B) Mineral Sands Consultancy test work (Appendix B)

Metallurgical tests co-ordinated by the above group have been underway since mid May 1988.

The techniques applied were as follows:-

- rolls crush to minus 300 micron (Fox-Anamet, Sydney)
- process through Wet High Intensity Magnetic Separator (Readings)
- Whims non-magnetic fraction subjected to flotation tests (Amdel) after regrinding to minus 150 micron. An anionic float was used to reject calcite, followed by cationic float to reject silica/quartz.
- The products were examined mineralogically and chemically.

Flotation tests showed that a wollastonite product was produced, which by Amdels chemical assessment contained 57.56% wollastonite, and 70% by W. Fänder mineralogical examination.

The main remaining contaminant in the product was believed to be diopside.

3. EXPLORATION EXPENDITURES.

Total expenditures incurred within Exploration Licence 17/68 during the period 22nd October 1987 to 21st September 1988 amount to \$24,183.

A breakdown of these expenditures are itemised overleaf (Table No. 1).

Cliff H. Whitehead
Geologist
29.09.1988

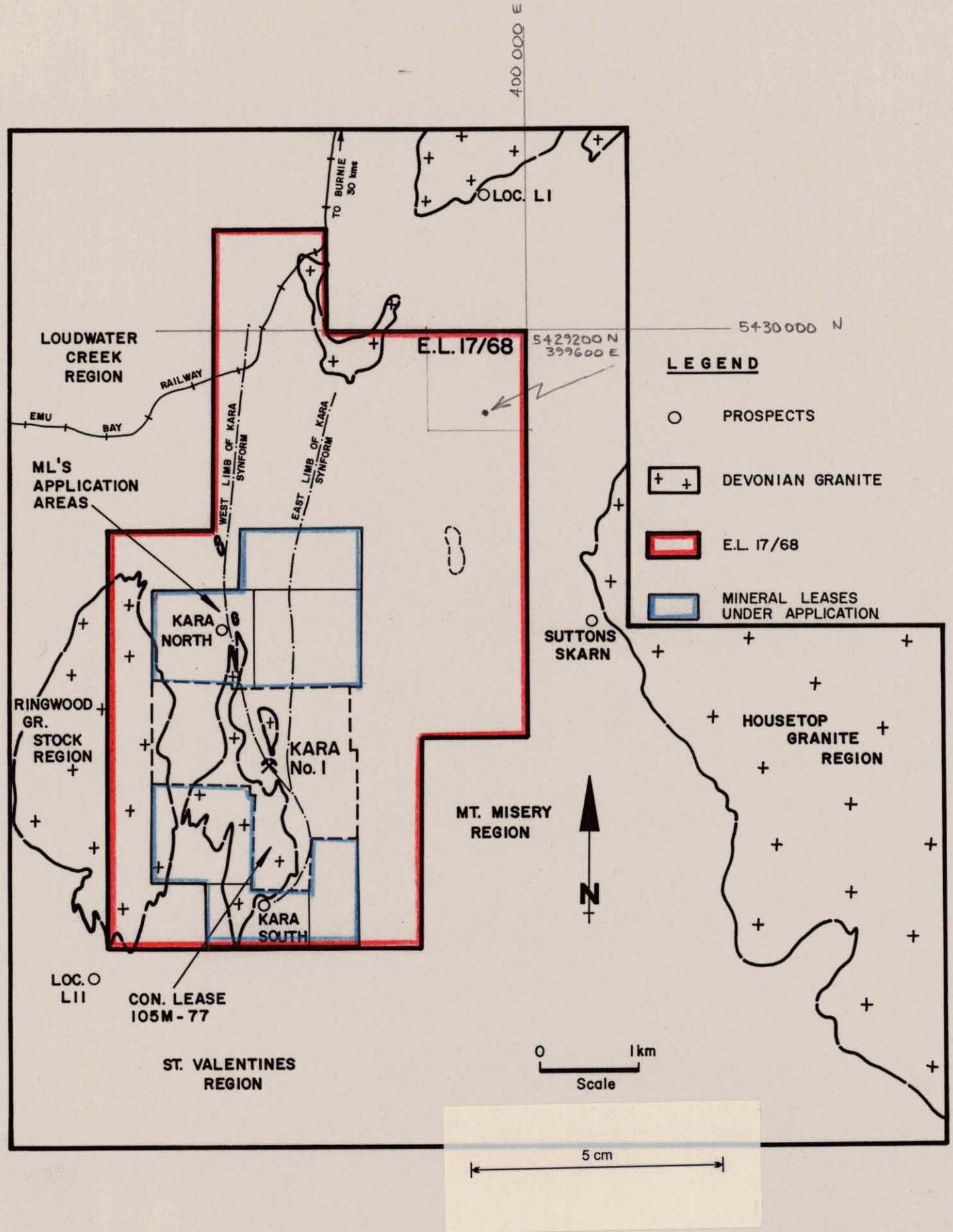
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EXPLORATION LICENCE 17/68TASMANIA MINES LIMITEDTABLE NO. 1EXPLORATION EXPENDITURES

<u>PERIOD</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>	<u>11</u>	<u>12</u>	<u>13</u>	<u>1</u>	<u>2</u>	<u>3</u>	
<u>DATE</u>	22.10.87	19.11.87	17.12.87	14.1.88	11.2.88	10.3.88	7.4.88	6.5.88	2.6.88	30.6.88	28.7.88	25.8.88	
	18.11.87	16.12.87	13. 1.88	10.2.88	9.3.88	6.4.88	5.5.88	1.6.88	29.6.88	27.7.88	24.8.88	21.9.88	<u>TOTALS</u>
	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$	
<u>GEOLOGY</u>	2000	2500	2000	3500	1000	-	1000	450	225	450	-	-	13,125
<u>DRAFTING</u>	992	1273	711	881	138	300	-	-	-	-	-	-	4,295
<u>WOLLASTONITE</u>													
	1365	-	720	-	-	-	969	62	691	1302	-	-	5,109
<u>TENURE</u>	715	-	563	230	(1000)	-	-	-	389	-	-	-	897
<u>OTHER EXPENSES</u>													
	-	-	437	320	-	-	-	-	-	-	-	-	757
<u>TOTALS</u>	5072	3773	4431	4931	138	300	1969	512	1305	1752	NIL	NIL	24,183

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E.L. 17/68 - LOCATION PLAN



E.L. 17/68
ANNUAL REPORT
APPENDIX A

DEPARTMENT OF MINES

732007



TASMANIA

Launceston Office:
Chemical and Metallurgical
Laboratory,
287 Wellington Street,
LAUNCESTON 7249

6th July 1988

Enquiries:
Phone:
Your ref.: Tasmania Mines Ltd ,
Our file: P.O. Box 815
Burnie 7320
TASMANIA

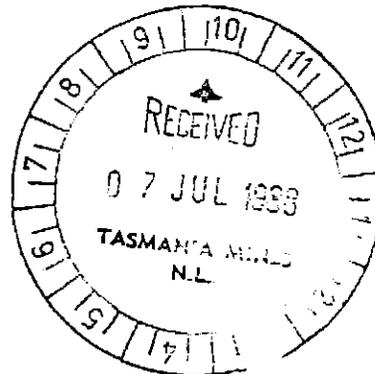
Attention Mr. J. Scales

R886

Dear Sir,

Please find enclosed R886 Wollastonite Concentration
by Metallurgist Ken Austin, and Appendix by R. Bottrill.

(P.L. JAMES)
Chief Chemist & Metallurgist.



4TH July 1988

R886TASMANIA MINES - WOLLASTONITE CONCENTRATIONIntroduction:

Tasmania Mines requested that experimental work be undertaken on a low grade sample of Wollastonite (from their Kara deposit) to produce a Wollastonite concentrate for commercial evaluation.

Object:

To produce a quantity of high grade Wollastonite.

Sample:

The sample submitted Reg. No 880509 consisted of approximately 25 kilograms of pieces of Wollastonite ore ranging from about 5mm to 25mm in size.

Method:

1. The as received ore was jaw crushed to -4mm, mixed, then riffled to produce:
 - (a) A head sample for chemical analysis.
 - (b) 10X1 kilogram samples for test work.
2. Each of the 1 kilogram test samples were separately ground in a laboratory ball mill at forty percent solids for 25 minutes. Any + 600µm material remaining was reduced to -600µm by mortar and pestle.
3. One kilogram of ground ore was wet then dry screened to provide a description of grind.
4. Two of the one kilogram ball mill ground samples were combined (test N1) and fed to a Jones Wet Magnetic Separator using the following conditions:
 - (a) Maximum magnetic strength (i.e. 40 amp current)
 - (b) Feed rate 250g/minute
 - (c) Wash water 3 litres/minute
5. The Jones magnetic product was fed to a Davis Tube for ball mill iron removal.
6. The Jones Non magnetic product was subjected to calcite froth flotation in a Denver laboratory flotation cell using the following reagents and conditions.

(a) Sodium carbonate (Regulator)	0.6 kg/tonne
(b) Oleic acid (Collection)	3.3 kg/tonne
(c) Aero frother 77 (Frother)	
(d) Flotation time	5 minutes
(e) Cleaner Flotation time	5 minutes

7. The flotation tailing product (Wollastonite concentrate) was subjected to silica froth flotation in a Denver laboratory flotation cell using the following conditions and reagents.

(a) Aeromine 3037 (Collector)	4 kg/tonne
(b) Fuel Oil (Collector)	1.5 kg/tonne
(c) Aerofrother 77 (Frother)	
(d) Flotation Time	5 minutes
(e) Cleaner Flotation Time	5 minutes

8. Except for the Davis Tube magnetics or ball mill iron product, all N1 products were assayed for Loss on Ignition, CaO, MgO, Fe₂O₃, Al₂O₃, and SiO₂.

9. A further Jones Magnetic separation test was performed on 6 kilograms of sample with the non magnetic product being subjected to rougher calcite froth flotation only. All conditions used were those as previously described. This test was termed N2 and only the rougher flotation tail or Wollastonite concentrate was analysed.

10. Portion of the products of Test N1 and the ball mill (description of grind) particle size analysis were submitted along with chemical analysis to Mineralogist R.S. Bottrill for examination.

Appendix 1 is a copy of his evaluation of those products.

Results Obtained

1. Head Sample analysis

Percent L.O.I.	9.0
Percent CaO	39.5
Percent SiO ₂	41.4
Percent MgO	3.5
Percent Fe ₂ O ₃	1.3
Percent Al ₂ O ₃	(2.3)
Calc. % Wollastonite	42.0

2. Sizing Analyses - 25 Minute Ball Mill Grind.

<u>Particle</u> <u>Size</u> <u>µm</u>	<u>Percent</u> <u>Mass</u>	<u>Cumulative</u> <u>Percent</u> <u>Mass</u>
-4000 + 2360	0.4	0.4
-2360 + 1180	0.1	0.5
-1180 + 600	0.1	0.6
- 600 + 300	0.1	0.7
- 300 + 150	2.7	3.4
- 150 + 75	3.7	7.1
- 75 + 38	0.3	7.4
(- 38)	(92.6)	(100.0)
C/S 1	19.8	27.2
C/S 2	21.6	48.8
C/S 3	12.8	61.6
C/S 4	13.2	74.8
C/S 5	6.0	80.8
O/F	(19.2)	100.0
Head	100.0	-

C/S. at 24°C.

732011

3. Overall Results Test N1

Product	% Mass	% LOI	% CaO	% SiO ₂	% MgO	% Fe ₂ O ₃	% Al ₂ O ₃	% CaCO from L.O.I.
+ 600 µm	0.6	-	-	-	-	-	-	-
Davis tube M/A (Tramp iron)	0.3	-	-	-	-	-	-	-
Davis tube Non Mag	4.6	3.5	29.7	44.5	7.3	10.1	3.5	8.0
=Jones Magnetics Diopside, Augite etc	4.9	3.5	29.7	-	-	-	-	-
Jones M/S Washings =Middlings	11.1	5.4	37.9	45.1	5.5	1.5	2.7	12.3
Cleaner FC (Calcite Conc)	23.7	25.5	44.2	21.0	3.5	0.9	1.5	58.0
Cleaner FT (Middling)	7.9	1.2	36.7	49.5	5.6	1.5	2.7	2.7
Rougher FC (mainly cal) =Sum of CFC & CFT above	31.6	(19.4)	(42.3)	(28.1)	(4.0)	(1.1)	(1.8)	(44.1)
Rougher FT (Wollastonite Conc)	51.8	0.62	41.1	52.1	2.7	0.8	2.4	1.4
Jones Non Mags =Sum of FC & FT above	83.4	(7.7)	(41.6)	(43.0)	(3.2)	(0.9)	(2.2)	(17.5)
Calc: H/D	100.0	(7.2)	(40.2)	(42.9)	(3.6)	(1.4)	(2.3)	(16.4)
Head assays	-	9.0	39.5	41.4	3.5	1.3	-	(20.5)

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732012

The calculated Wollastonite content of the Rougher FT (Wollastonite concentrate was found to be approximately 70.5 percent in a mass of 51.8 percent overall.

4. Silica Flotation of Rougher FT (Wollastonite Conc.)

Product	% Mass	% L.O.I.	% CaO	% SiO ₂	% MgO	% Fe ₂ O ₃	% Al ₂ O ₃
CFC	34.3	0.77	41.7	51.8	2.2	0.90	2.2
CFT	2.4	0.75	39.8	51.5	3.5	0.87	3.1
F1C	36.7	(0.77)	(41.6)	(51.8)	(2.3)	(0.90)	(2.3)
F1T	15.1	0.70	39.9	51.3	3.5	0.70	2.3
FT	51.8	(0.75)	(41.1)	(51.6)	(2.6)	(0.84)	(2.3)

Whilst it is readily apparent that the Wollastonite concentrate contains an excess of SiO₂, conventional silica flotation did not achieve any SiO₂ removal or concentration.

C. 11

5. Overall Results Test N2.

Product	% Mass	% L.O.I.	% CaO	% SiO ₂	% MgO	% Fe ₂ O ₃	% Al ₂ O ₃
FlT (Wollastonite Conc)	55.0	0.9	40.8	51.9	2.8	0.9	2.3
FlC (Calcite Conc)	29.1	-	-	-	-	-	-
Jones M/S N	84.1	-	-	-	-	-	-
Jones M/S W (washings)	11.8	-	-	-	-	-	-
Jones M/S M/A	4.1	-	-	-	-	-	-
Head	100.0	-	-	-	-	-	-

The yield and chemical composition of the Wollastonite product from test N2 was very similar to that of test N1. Test N2 was only performed such that a quantity of Wollastonite concentrate would be available for commercial evaluation.

6. Fusion Point Determination of Concentrate.

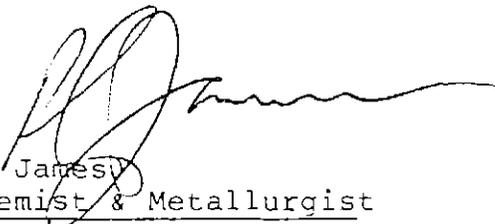
The fusion point of the test N2 Wollastonite concentrate was found to be 1400°C. The softening point was found to be 1280°C.

7. Firing Tests of N2 Concentration

Small test pieces were made (using the Wollastonite Concentrate) and fired in an electric furnace for six hours at 1000°C. The surfaces of the fired test pieces showed a slight pink tinge probably due to the oxidation of the contained iron (0.9% Fe₂O₃). Superficial fritting occurred and the test pieces were quite fragile.

Conclusion

This investigation has shown that it is possible to upgrade this ore containing 42% Wollastonite to a concentrate containing 70% Wollastonite by means of wet magnetic separation and flotation. The Company has been supplied with a sample of concentrate for market evaluation. When the results of this evaluation are known some discussion should ensue on whether further test work should be undertaken.



(P.L. James)
Chief Chemist & Metallurgist

Metallurgist
K. Austin

K. Austin

DEPARTMENT OF MINES



Head Office

Gordons Hill Road,
P.O. Box 56,
ROSNY PARK 7018Enquiries R.S. Bottrill
Phone 30 8359
Your ref:
Our file RSB(2):JHAPPENDIX 1

Mr P. James,
Chief Chemist & Metallurgist,
Department of Mines,
LAUNCESTON

R886 - WOLLASTONITE PRODUCTS, KARA

Sixteen products from metallurgical tests on wollastonite ores from the Kara area were submitted for determination of their mineralogical constitution. Sample details are summarised in Table 1.

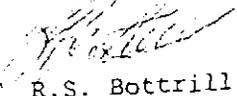
The samples were all run on the X-ray diffractometer, calibrated externally with pure and weighed mixes of minerals similar to the constituent phases (calcite, wollastonite, diopside and feldspar). Calibration was difficult due to the mixture of several minerals with complex X-ray patterns and indefinite compositions. The results are shown in Table 1.

The measured whole-rock analyses (Table 2, by XRF) were used to estimate compositions for constituent phases (Table 3) and thus calculate the expected whole-rock composition (Table 4). The measured and calculated compositions are not in particularly good agreement: CaO, SiO₂ and CO₂ are generally comparable (A2 would be better if an iron-bearing phase could have been measured) but the minor components Al₂O₃, MgO and Fe₂O₃ correlate poorly. This suggests that the calibrating samples may have been inappropriate in composition for these products, and/or the minerals have greater compositional variability than expected. The results in Table 1 are thus more precise than accurate and may only be taken to indicate relative compositional trends.

The XRF analyses (Table 2) were converted into mineralogical constitutions (Table 5) using the estimated mineral compositions in Table 3. These figures may be more accurate than those in Table 1 but should still be used with caution as accurate mineral compositions are not available. Quartz and haematite were not detected but are represented in Table 5 to indicate excess silica and Fe₂O₃ from the calculations, which could be corrected to zero by manipulation of mineral compositions. Na and K in the XRF analyses could indicate some albite and alkali feldspars.

2.

The calculated mineralogy of the feed (A1 in Table 5) is about 42% wollastonite, 23% diopside, 20% calcite and 9% feldspar. This indicates a little more diopside than expected from preliminary studies (see my previous memoranda of November 1985 and February 1988). The ore samples examined to date indicate ranges in mineralogy of about: 30-70% wollastonite, 5-60% calcite, 1-20% diopside, 2-40% feldspar and 1-2% sulphides. The ore is obviously very variable and more selective mining may be necessary to maximise the wollastonite in the feed.


R.S. Bottrill
MINERALOGIST/PETROLOGIST

Encl.

Table 1. Mineral Constitution by XRD (Wt. %, semi-quantitative), and sample descriptions.

No.	Description	Woll. *	Di	Calcite	Fsp
A1	Head	-	-	-	-
A2	Jones M/S. M/A	65	30	4	1
A3	1st M/S test, +600	81	17	1	1
A5	Jones washings	69	18	12	1
A6	CFC (Calcite Con)	19	11	68	2
A7	CFT (Middling)	76	18	4	2
A8	FT (Woll. Con)	92	7	0	1
A9	C/S 1	74	13	11	2
A10	C/S 2	79	7	13	1
A11	C/S 3	77	10	12	1
A12	C/S 4	79	10	10	1
A13	C/S 5	77	9	13	1
A14	-4000+150µm	83	11	5	1
A15	-150+38µm	83	10	6	1
A17	F1T	91	8	0	1
A18	F2T	92	5	1	2
A19	F2C	94	4	0	2

*Abbreviations in table 6.

Table 2: Whole rock analyses -XRF (Wt. %).

No.	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	MgO	CaO	CO ₂	SO ₃	total
A1	41.44	2.30	1.32	3.47	39.51	8.97	0.10	97.11
A2	44.51	3.47	10.06	7.27	29.67	3.52	1.12	99.62
A5	45.05	2.71	1.49	5.47	37.90	5.35	0.08	98.05
A6	20.96	1.46	0.90	3.53	44.24	25.51	0.02	96.62
A7	49.47	2.69	1.52	5.61	36.72	1.23	0.04	97.28
AC	52.08	2.37	0.78	2.67	41.14	0.62	0.03	99.69

Table 3. Estimated Mineral Compositions (Wt. %)

No.	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	MgO	CaO	CO ₂	SO ₃	total
Woll.	51.7	0	0	0	48.3	0	0	100
Di	53	2.5	3.6	15	25.9	0	0	100
Calcite	0	0	0	0	56	44	0	100
Fsp (An)	64.8	18.3	0	0	17	0	0	100.1
Qtz	100	0	0	0	0	0	0	100
Po	0	0	90.7	0	0	0	91.2	181.9

Table 4: Whole rock analyses calculated from Table 1.

No	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	MgO	CaO	CO ₂	Total
A2	50.15	0.93	1.08	4.50	41.58	1.76	100
A3	51.54	0.61	0.61	2.55	44.26	0.44	100
A5	45.86	0.63	0.65	2.70	44.88	5.28	100
A6	16.95	0.64	0.40	1.65	50.45	29.92	100
A7	50.13	0.82	0.65	2.70	43.95	1.76	100
A8	51.92	0.36	0.25	1.05	46.42	0.00	100

Table 5: Calculated mineral constitution (from Table 2).

No	Woll	Di	Calcite	Fsp(An)	Qtz	Po	Hem	Total
A1	42.46	23.1	20.4	9.4	1.13	0.11	0.39	97.02
A2	21.61	48.5	8.0	12.3	-0.35	1.23	7.20	98.51
A5	41.34	36.5	12.2	9.8	-2.02	0.09	0.10	97.97
A6	10.01	23.5	58.0	4.8	0.22	0.02	0.03	96.57
A7	49.40	37.4	2.8	9.6	-2.11	0.04	0.13	97.26
A8	70.45	17.8	1.4	10.5	-0.59	0.03	0.11	99.73

Table 6: Abbreviations

Woll.	Wollastonite (CaSiO ₃)
Di	Diopside (CaMgSi ₂ O ₆)
Fsp (An)	Feldspar (anorthite) (CaAl ₂ Si ₂ O ₈)
Qtz	Quartz (SiO ₂)
Po	Pyrrhotite (FeS)



TASMANIA

DEPARTMENT OF MINES

732019

Launceston Office:

Chemical and Metallurgical
Laboratory,
287 Wellington Street,
LAUNCESTON 7249

Enquiries:

Phone:

Your ref.:

Our file:

Tasmania Mines Ltd,
P.O. BOX 815
Burnie 7320 Tasmania

29th ~~July~~ 1988

~~June~~

Attention Mr. J. Scales

R886

Wollastonite Concentration

Dear Sir,

Further to our previous report on the project, a further quantity of Wollanstonite concentrate has been prepared by the same methods as previously by Metallurgist K. Austin, i.e. fine grinding, magnetic separation and flotation.

Results agree extremely well. The concentrate is essentially of the same composition as the one previously prepared. Yield of Wollanstonite product is slightly higher.

The comparative analyses and yields are as follows:

Item	<u>1st Batch</u>	<u>2nd Batch</u>
	%	%
SiO ₂	51.8	51.9
Al ₂ O ₃	2.4	2.3
Fe ₂ O ₃	0.8	0.9
MgO	2.7	2.8
CaO	41.1	40.8
L.O.I.	0.6	0.9
Total	99.4	99.6
<u>Product Yield</u>		
	51.8	55.0

Feed Grinding Sizing:

92.6% Minus 38 µm.

The slightly higher yield in the second batch is due to a shorter flotation time for calcite removal. This also probably accounts for the slightly higher ignition loss due to a little more calcite remaining in the product.

A fusion point determination was made on the product using the heating microscope, with the following results.

Fusion Point	1400° C
Softening Point	1280° C

Small test pieces were made and fired in the electric muffle furnace at 1000° for 6 hours.

Surfaces of the fired test pieces showed a slight pink tinge almost certainly due to oxidation of the contained iron.

Superficial fritting occurred - the test pieces were quite fragile.

A sample of the Wollastonite concentrate estimated to contain about 75% Wollanstonite. (See previous letter re mineral analyses), and a fired test piece is enclosed for your examination.

A more comprehensive metallurgical report on operations and results to date is being prepared by Mr. Austin. This will be forwarded shortly.

Note: Please refer to our letter of 13th April 1988, paragraph 4, line 1.

Correct "Yield" from 75.4% to 51.8%.

The figure 75.4% should refer to calculated Wollanstonite recovery from total estimated feed content of the mineral.

Yield refers to recovered mass of concentrates.

Yours faithfully,


(P.L. James)
Chief Chemist & Metallurgist

E.L. 17/68
ANNUAL REPORT
APPENDIX B

SUMMARY REPORT
ON
PRELIMINARY TESTS
RE. UPGRADING OF WOLLASTONITE ORE

FOR
TASMANIA MINES LIMITED

BY
THE MINERAL SANDS CONSULTANCY



N. DAWSON.

SEPTEMBER 1988

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APPENDICES

- I Previous Data
- II Mineralogical Assays
- III WHIMS Tests Data
- IV Float Test Data

1. INTRODUCTION

As a follow on to discussions with Mr. C. Whitehead of Tasmanian Mines Limited a 5 Kg sample of Wollastonite Ore was submitted for Upgrading Tests.

The objective was to produce a high grade, +90%, Wollastonite Concentrate. A number of techniques were discussed ie fine grinding, magnetic separation, flotation etc. as being applicable to achieving the production of a concentrate.

The following describes the tests conducted and the resultant data is discussed.

2. TEST PROGRAMME

Previous Mineralogical Studies by the Department of Mines in Tasmania (refer Appendix I) showed that on two out of three of the ore samples examined, the Wollastonite and in particular the Calcite contaminant had average grain sizes 800 and 350 micron respectively. On the third ore sample all minerals were stated to have an average grain size of 50 micron.

Hence, these preliminary tests were aimed at assessing the possibility of producing a Wollastonite Concentrate by utilizing a grind coarser than the 20 microns expressed in the initial Mineralogical work.

The Test Programme, as conducted, is described in the enclosed diagram - refer Fig. 1 , Page 2 .

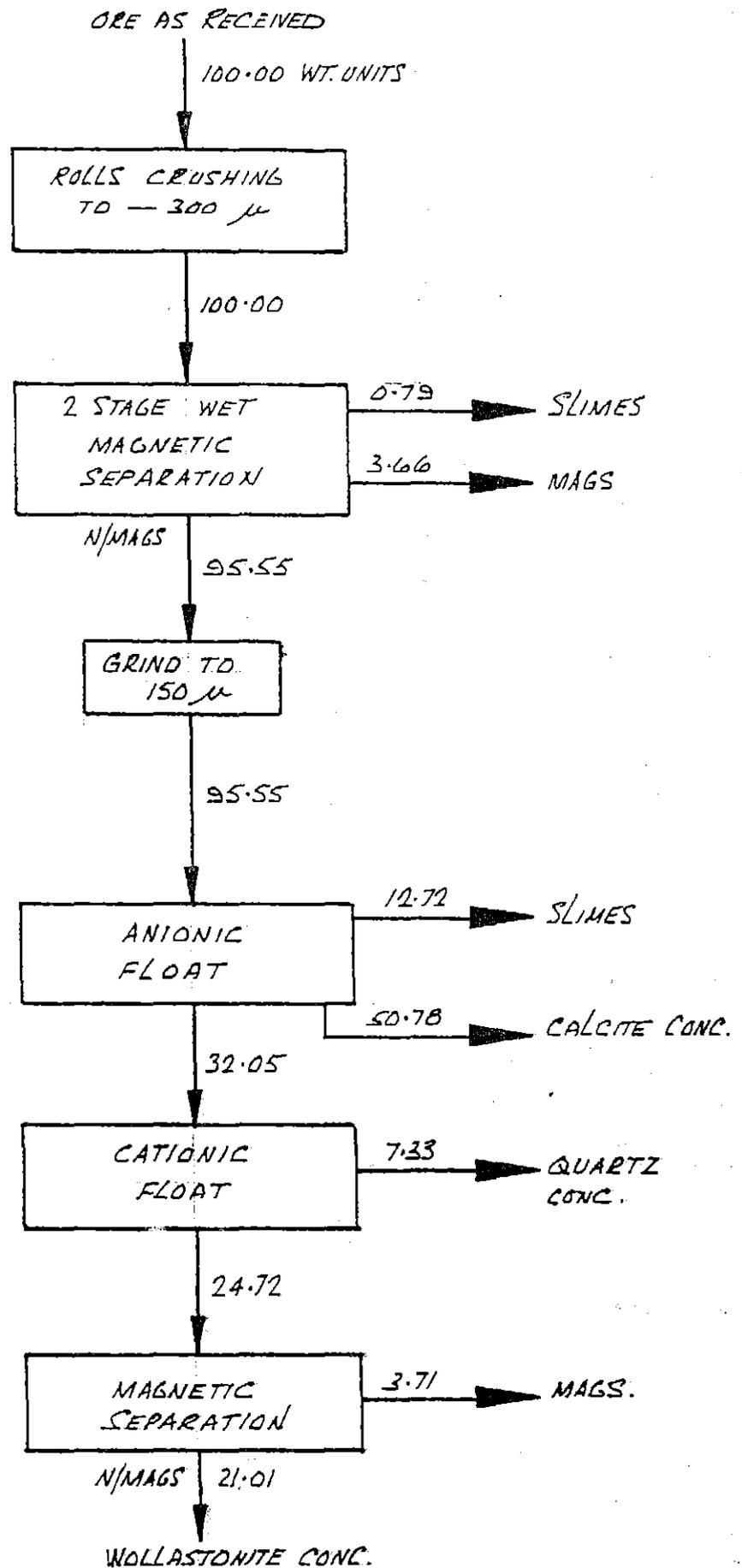
2.1 Crushings

An initial crush to 100% - 300 micron was done by Fox-Anamet Laboratories in Sydney.

2.2 Wet Magnetic Separations

The - 300 micron material was passed through a Wet High Intensity Magnetic Separator (W.H.I.M.S.)

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LABORATORY TREATMENT FLOWSHEET - FIG. 1

The non-mags from the 1st Stage was repassed through a 2nd Stage. The 2nd Stage WHIMS non-mags represented 95.55% by WT of the original feed. Refer to Appendix III for WHIMS Test data.

This 2 pass WHIMS step reduced the Total Fe as Fe_2O_3 from 0.79 in the feed to 0.186% in the 2nd pass WHIMS non-mags. This Fe level is within the Product specification as given - refer to Appendix I.

2.3 Flotation Tests

The 2nd Stage WHIMS non-mags was forwarded to Amdel for flotation tests.

This step was adopted as a follow on to Mineralogical assessment of the WHIMS non-mags by W. Fander - refer to Appendix II . This assessment advised that the Calcite content of WHIMS non-mags was 70% with Wollastonite content being 30% (maximum).

Amdel utilized a two stage Flotation Approach. The WHIMS non-mags was ground to 100% minus 150 micron. An Anionic Float was used to reject the Calcite followed by a Cationic Float to reject the Silica/Quartz..

The aim was for the Cationic Float Sinks to be enriched in Wollastonite.

These Flotation tests produced a Wollastonite concentrate which by Amdel's assessment contained 57.56% Wollastonite and 70% Wollastonite by W. Fander's examination.

The main contaminant in the Flotation concentrate was diopside.

Amdel's Test Report is enclosed in Appendix IV.

2.4 Additional Magnetic Separation Tests

In an attempt to reduce the diopside content of the Float Conc. further Magnetic separation tests were done. The small size of samples available, at this stage of the test programme restricted these separations to dry magnetic.

Although a 15% Weight take to magnetics was made the resultant "non-mags" from the Float Conc. still contained 20-25% diopside - refer to Mineralogical Report in Appendix II.

3. DISCUSSION OF RESULTS

The results obtained from this work showed some potential for the upgrading of Wollastonite contents in the ore sample submitted. In particular

3.1 Positive Results Obtained.

- a. Significant reduction in Fe levels by Wet Magnetic Separations.
- b. Promising rejections of Calcite and Quartz by Flotation technique even at a relatively coarse (150 micron) grind.

3.2 Negative Results Obtained.

At the 150 micron grind composites of diopside mineral are still present in the Wollastonite concentrate. These could not be significantly reduced by Magnetic separations.

Grinding finer, for diopside liberation, in particular, is clearly necessary.

Based on the above observations a conceptual treatment flowsheet is described in Fig. 2, Page 6 . This flowsheet requires further development.

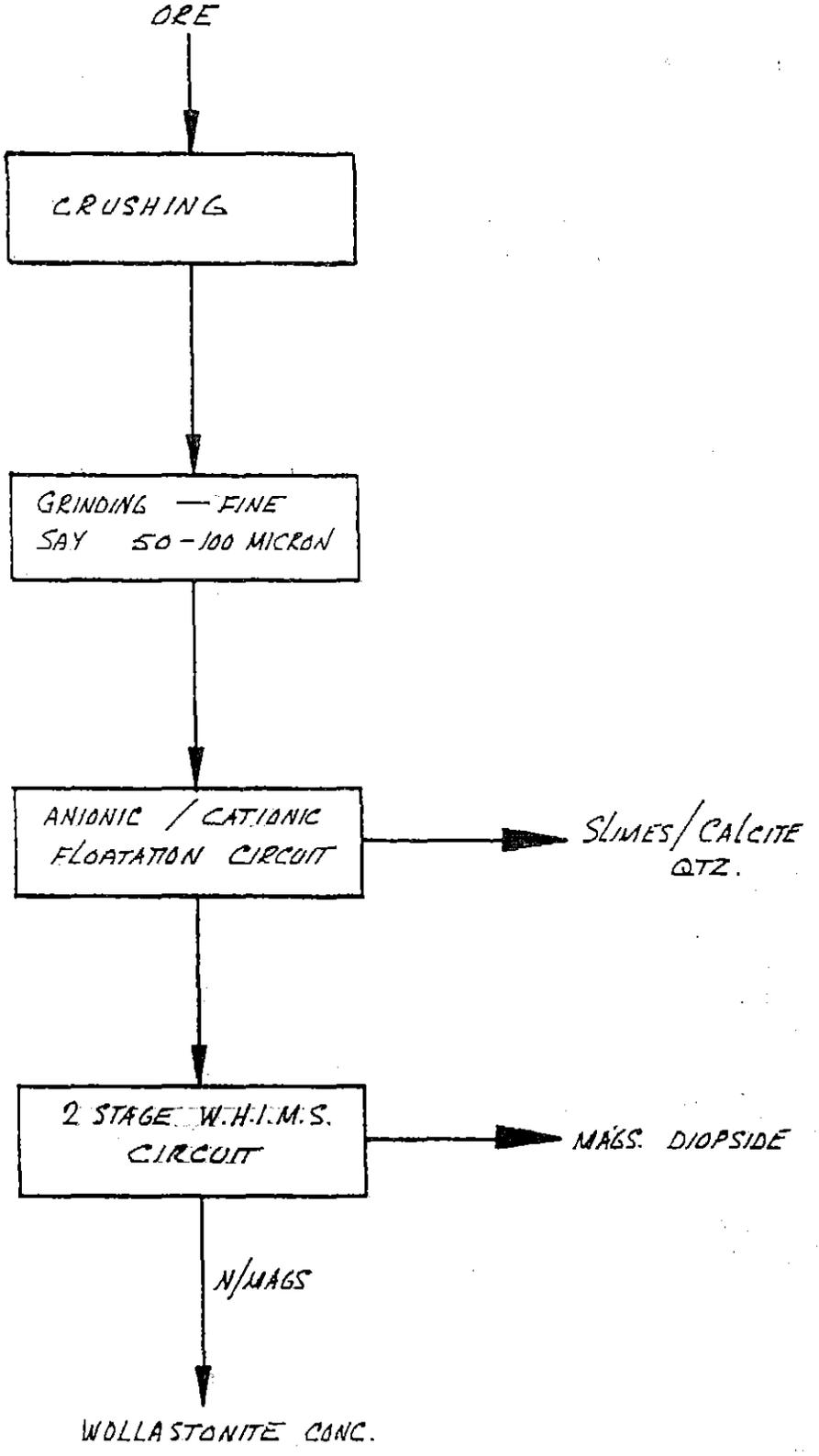
4. RECOMMENDATIONS

Although the work conducted did not produce a +90% Wollastonite Conc. some of the results obtained were promising.

Provided Market conditions warrant, and assuming significant tonnages of ore exist, then further Metallurgical work should be directed towards

- a. Conducting a number of grinds to various micron sizes and conducting WHIMS separations to assess the coarsest grind which will allow the majority of the diopside to be rejected by WHIMS.
- b. Once a. is established, then to conduct Flotation at this grind, and proceed to use WHIMS on Float Conc.

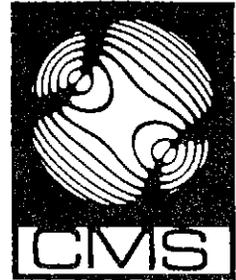
This work should be conducted at Amdel in Adelaide with the final WHIMS tests done by Readings in Lismore.



CONCEPTUAL TREATMENT FLOWSHEET — FIG. 2.

APPENDIX II

Mineralogical Assays



Central Mineralogical Services

39 Beulah Road, Norwood, South Australia 5067
 Telephone (08) 42 5659 Fax (08) 363 1820
 International: Telephone + 618 42 5659 Fax + 618 363 1820

Mr. N. Dawson
 Metallurgical Consultant
 The Mineral Sands Consultancy
 Suite 3
 Sunnybank Woods Shopping Centre
 218, Padstow Road
EIGHT MILE PLAINS / QLD. 4123

9th September, 1988

REPORT CMS 88/9/10

YOUR REFERENCE:	Purchase Order No. 262
DATE RECEIVED:	5th September, 1988
SAMPLE NOS.:	"Wollastonite"
SUBMITTED BY:	N. Dawson
WORK REQUESTED:	Mineralogy

H.W. Fander.

H.W. Fander, M. Sc.

MINERALOGICAL ANALYSIS
OF N/MAGS EX. FLOAT CONC.

SAMPLE REPORT (Mineralogy, Petrology, Ore Microscopy)

Job No. CMS 88/9/10 Date Received: 5.9.1988Reference Purchase Order No. 262Sample No. "Wollastonite"Nature of Sample: Float Con. Non-Mags.

IDENTIFICATION

DESCRIPTION

SECTION No.

a. Hand Specimen:

b. Microscopic:

A portion of the sample was mounted in an R.I. oil of 1.63 and microscopically examined.

The sample consists of approximately 65 % wollastonite, 25 % diopside, 7-10 % carbonate and 2-3 % quartz.

Almost all the carbonate occurs as 5-30 um inclusions in wollastonite and diopside; some of the quartz is free, as single grains and fine-grained aggregates, and some forms small inclusions in wollastonite.

Diopside is present as very irregular grains, and about half is composite with wollastonite in varying proportions; half occurs as free grains in the 10 um to 120 um range, mostly around 50 um.

About 50 % of the wollastonite is free or substantially free (i.e. with only a few small inclusions of quartz and/or carbonate); the remainder contains substantial numbers of inclusions or forms composites, generally texturally complex, with diopside.

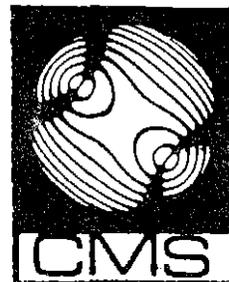
The diopside is a colourless, very low-Fe variety, and is very probably non-magnetic.

A small trace of pyrite occurs as fine inclusions in the silicates.

H.W. Fander, M. Sc.

Central Mineralogical Services

39 Beulah Road, Norwood, South Australia 5067
Telephone (08) 42 5659 Fax (08) 363 1820
International: Telephone + 618 42 5659 Fax + 618 363 1820



Mr. N. Dawson
H. & N. Investments Pty. Ltd.
The Mineral Sands Consultancy
Suite R
Sunnybank Woods Shopping Centre
218, Padstow Road
EIGHT MILE PLAINS / QLD. 4123

15th July, 1988

REPORT CMS 88/7/14

YOUR REFERENCE:	Order No. 129 Facsimile Message 12.7.1988
DATE RECEIVED:	13th July, 1988 (sample)
SAMPLE NOS.:	"Wollastonite"
SUBMITTED BY:	N. Dawson
WORK REQUESTED:	Mineralogy

H. W. Fander
H.W. Fander, M. Sc.

MINERALOGICAL ANALYSIS OF
FLOAT CON C.

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SAMPLE REPORT (Mineralogy, Petrology, Ore Microscopy)

Job No. CMS 88/7/14 Date Received: 13.7.1988

Reference P.O. No. 129

Sample No. "Wollastonite"

Nature of Sample: Flotation Concentrate

IDENTIFICATION

DESCRIPTION SECTION No.

a. Hand Specimen:

b. Microscopic:

The product was examined as received, using specific immersion oils.

Mineral percentages are difficult to determine with accuracy because of the very different shapes of the mineral constituents, but approximate percentages are as follows:

Free wollastonite	-	70 %; clean, thin crystals and needles.
Free diopside	-	20 %; granular, often with minute opaque inclusions.
Free quartz	-	1-2 %; clear grains and cloudy masses full of inclusions.
Composites	-	8-10 %; mainly diopside, with carbonate, quartz, wollastonite.
Sulphides	-	Trace

The presence of diopside in this sample, and its absence in the previous sample (CMS 88/5/30), suggest that it is weakly magnetic, presumably due to the inclusions; the cloudy masses of quartz may well be magnetic also.

H.W. Fander, M. Sc.

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CENTRAL MINERALOGICAL SERVICES

Date 31st May, 1988

SAMPLE REPORT (Mineralogy, Petrology, Ore Microscopy)

IDENTIFICATION

Job No. CMS 88/5/30 Date Received: 30.5.1988

Reference Order No. 662710

Sample No. "Wollastonite"

Nature of Sample:

DESCRIPTION SECTION No.

a. Hand Specimen:

b. Microscope:

Representative portions of material were mounted on slides, using different refractive index oils; the material is unsized, and grainsizes ranged from 1 um up to 300 um - thus quantitative estimates were not possible, and figures given are only approximate.

The sample consists of at least 70 % calcite, and no more than 30 % wollastonite, with a trace to 1 % of sulphides; the minerals are dominantly free, but there are calcite-wollastonite composites.

In order to make a more accurate estimate of the minerals present, a portion of the sample was treated with HCl to remove calcite; however, wollastonite is also somewhat soluble and thus calcite could not be dissolved without the danger of losing some wollastonite. The SGs of the two minerals are fairly close also, and clean separations on that basis would be questionable. Quantitative XRD or DTA/TGA may be more successful in providing more accurate data, and FeO assays could be used to calculate the amount of calcite present, with wollastonite obtained by difference (this only applies to this particular sample, which consists essentially only of two minerals).

The sulphides are fine-grained (1-100 um, mostly < 50 um) and are free and also occur as inclusions in calcite; they consist of pyrite, sphalerite, possible chalcopyrite and ?galena.

H.W. Fander, M. Sc.

APPENDIX III

WHIMS Tests Data

READINGS OF LISMORE PTY LTD
8 COOK STREET
SOUTH LISMORE
N.S.W. 2480

FACSIMILE SHEET

TELEPHONE: (066) 21 7451
TELEX: 166158 READG
FAX: (066) 21 9384

CLIENT FILE: H & N INVESTMENTS

TO: NOLA HINES NUMBER: 07-8411665

FROM: EUGENE DARDENGO DATE: 31/5/88

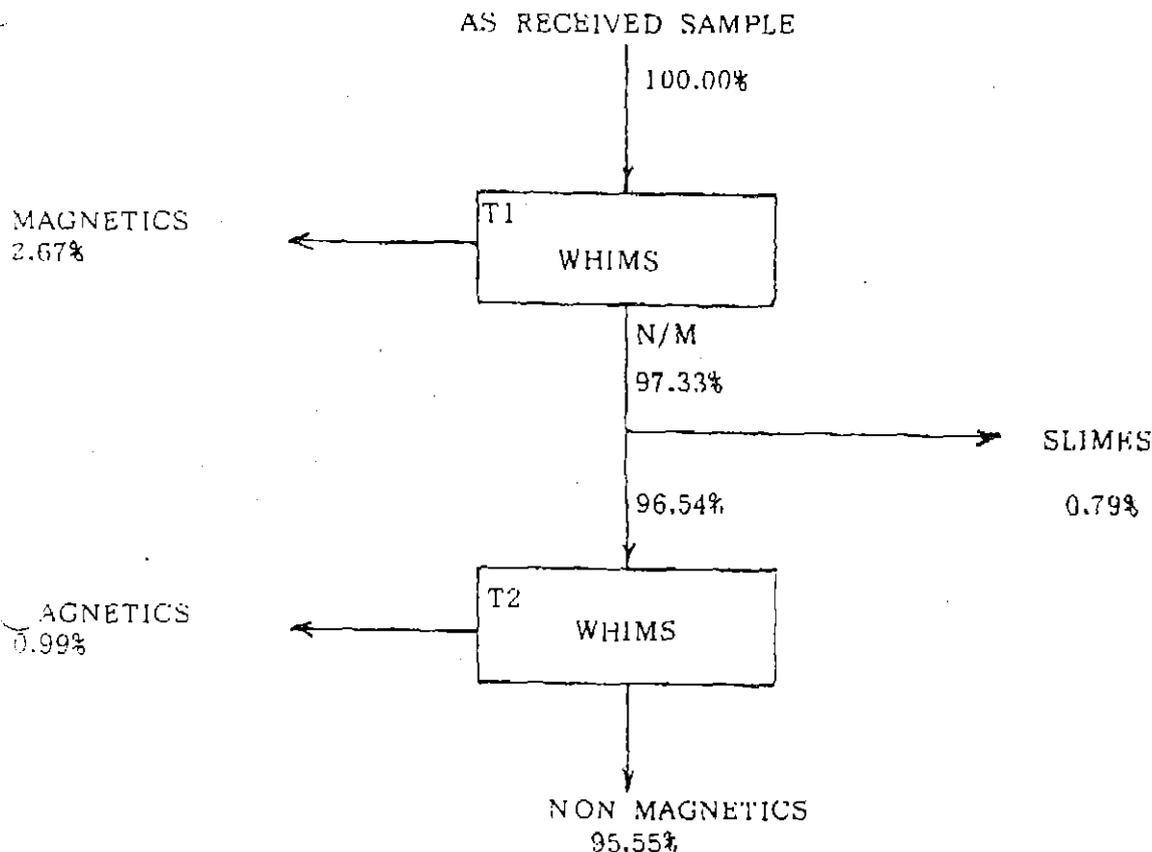
REF NO: RL 2650 TOTAL OF PAGES INCLUDING THIS ONE.

PLEASE CALL IF ANY PAGES NOT RECEIVED.

MESSAGE:

RE: WOLLASTONITE SAMPLE

The sample received by Readings, after consultation with Neil Dawson was processed thru a Readings WHIMS with the objective of attaining maximum extraction of magnetics. This was done by retreating the non magnetics. The testwork procedure can be seen below, along with percent weights obtained around this circuit.



Samples of head feed and final non magnetics have been sent for chemical assays - Total Fe. Also have sent the non magnetics for mineralogy. To date, no assays are available.

Regards,

Eugene

E. DARDENGO
PROJECT METALLURGIST

APPENDIX IV

Float Test Data

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technology and enterprise

Amdel
International Operations Group
(Incorporated in S.A.)
Osman Place,
Thebarton, S.A. 5031

Telephone: (08) 43 5733
International: +618 43 5733

732040

Address all correspondence to:
P.O. Box 114,
Eastwood, S.A. 5063,
Australia

Telex: AA82725
Facsimile: (08) 352 8243

26 July 1988

OD 3/0/0-06749

Mr. N. Dawson
Consultant
The Mineral Sands Consultancy
Suite 3, Sunnybank Woods Shopping Centre
218 Padstow Road
Eight Mile Plains
BRISBANE Qld 4123

REPORT NO. 06749/88

YOUR REFERENCE: Purchase Order No. 242

MATERIAL: Wollastonite Ore

IDENTIFICATION: 2907 Test 2 N/Mags

LOCATION: Tasmania

WORK REQUIRED: Flotation testing.

Investigation and Report by: *I.W. McPheat*
General Manager, International Operations Group: Peter M. Cameron

Sydney, Melbourne, Perth, Canberra, Darwin, Townsville. Represented world-wide.

SUMMARY

A single flotation test was carried out on a sample of wollastonite ore which had been treated by magnetic separation to remove iron-bearing minerals.

The test procedure employed anionic flotation to remove calcite, followed by cationic flotation to remove quartz and some silicate minerals.

The wollastonite contents of the flotation products were calculated from CO₂ and acid soluble calcium assays. Although the precision of this technique needs to be verified for the ore sample tested, the results indicate that the sample was upgraded from a feed grade of 22% wollastonite to a concentrate grade of 57% wollastonite, for a wollastonite recovery of 66%.

FLOTATION OF WOLLASTONITE ORE1. INTRODUCTION

A sample of wollastonite ore was received for testing. This sample had previously been treated by magnetic separation to remove iron bearing minerals.

At the time of testing, little was known about the mineralogical composition of the sample, but it was assumed that the major gangue minerals present were calcite and quartz. The validity of this assumption was not confirmed because of the client's doubts concerning the representivity of the ore sample.

The client requested that a single preliminary test be undertaken to examine the flotation response of the sample using a feed grind of 100% passing 150 μm .

2. FLOTATION TESTING

On the basis of the above assumed mineralogical composition a flotation test was undertaken using a 1000 g feed charge stage ground to the requested size. The ground material was deslimed, using a 50 mm dia cyclone.

Grinding and flotation were carried out using distilled water. Adelaide mains water was used for the desliming, and the deslimed material was washed three times on a vacuum filter with distilled water.

2.1 Anionic Flotation

Anionic flotation was carried out without pH adjustment. The pulp was conditioned with sodium silicate to depress wollastonite and then with calcium chloride to activate quartz.

Five stages of rougher flotation were carried out using an anionic collector* based on Acintol FA-1 (tall oil fatty acids).

2.2 Cationic Flotation

Cationic flotation was undertaken on the anionic flotation tailing to remove quartz and some silicate minerals as the froth product.

The pH of the anionic tailing was adjusted to 4 using sulphuric acid and three stages of rougher flotation carried out using the collector Flotigam CA (coconut fatty amine acetate).

The flotation conditions are given in Table 1.

* The composition of the collector is given in Appendix A.

The test products were assayed for acid soluble Ca and for CO₂. The results are shown in Appendix B.

The wollastonite and calcite concentrations were calculated assuming that calcite was the only carbonate mineral present, that wollastonite is acid soluble and that wollastonite and calcite were the only acid soluble calcium minerals present.

The flotation test results are shown in Table 2. Based on the assumptions stipulated above, the flotation feed (before desliming) contained 22.5% wollastonite and 42.9% calcite. The wollastonite concentrate (cationic tailing) contained 57.6% wollastonite and the corresponding wollastonite recovery was 66.3%.

Calcite removal by anionic flotation was good.

It should be noted that the wollastonite content of the Anionic Rougher Concentrate 1 and 2, calculated from the CO₂ and acid soluble Ca assays, was -12.3%. It is evident from this result that the analytical procedures used and the assumptions made concerning the mineralogical composition of the ore need to be verified.

Until a confirmed analytical technique for wollastonite determination is available the accuracy of the results presented in this report cannot be stipulated and the results should be used with caution.

APPENDIX ACOMPOSITION OF ANIONIC COLLECTOR

The anionic collector had the following composition:

	Weight %
Acintol FA-1 (tall oil fatty acid)	58.2
Distillate (extender)	38.8
Terric X-10* (emulsifier)	3.0

The above mixture was diluted with distilled water to produce an emulsion containing 5% w/v of the above constituents.

* Octyl phenol ethoxylate.

APPENDIX B

ASSAY OF FLOTATION PRODUCTS

Product	Assay, %	
	Ca (acid sol)	CO ₂
Cationic Ro Tail	20.3	0.48
Cationic Ro Conc 2 + 3	11.1	0.09
Cationic Ro Conc 1	10.8	0.21
Anionic Ro Conc 4 + 5	11.6	5.8
Anionic Ro Conc 3	28.0	27.3
Anionic Ro Conc 1 + 2	30.0	37.6
Slimes	25.1	20.3

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TABLE 1: CONDITIONS FOR WOLLASTONITE FLOTATION TEST 1

	Time, min		pH	REAGENT ADDITION, kg/t				
	Condit.	Flotation		MIBC	SODIUM SILICATE	CALCIUM CHLORIDE	ANIONIC COLLECTOR	FLOTIGAM CA
Anionic Flotation	2		9.6		1			
Rougher 1	3	3	9.3			0.5		
Rougher 2	3	2	9.0				0.5	
Rougher 3	3	1-1/2	8.7				0.25	
Rougher 4	3	1	8.5				0.25	
Rougher 5	3	1	8.3				0.25	
Cationic Flotation								
Rougher 1	3	3	5.0	0.075				
Rougher 2	3	3	5.0				0.025	2.3
Rougher 3	3	3	5.0				0.025	0.7
							0.025	nr *

* Not recorded

TABLE 2: RESULTS OF WOLLASTONITE FLOTATION TEST 1

Product	Weight %		Assay				Distribution, %			
			WOLL %		CALC %		WOLL		CALC	
			Product	Cum.	Product	Cum.	Product	Cum.	Product	Cum.
Cat. Re. Tail	25.88	25.88	57.56	57.56	1.09	1.09	66.29	66.29	0.66	0.66
Cat. Re. Conc. 2+3	5.41	31.29	31.93	53.13	0.20	0.94	7.68	73.97	0.03	0.68
Cat. Re. Conc. 1	2.26	33.55	30.74	51.62	0.48	0.91	3.09	77.07	0.03	0.71
An. Re. Conc. 4+5	8.80	42.35	18.31	44.70	13.19	3.46	7.17	84.23	2.71	3.42
An. Re. Conc. 3	10.91	53.25	9.10	37.41	62.09	15.46	4.42	88.65	15.80	19.21
An. Re. Conc. 1+2	33.44	86.69	0.00*	22.98	85.20	42.36	0.00	88.65	88.46	85.67
Sizes	15.31	100.00	19.17	22.47	46.17	42.87	11.35	100.00	14.33	100.00

* Calculated wollastonite assay was -12.3%

File name: WNT01.REP