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EL 43/70 ARTHUR RIVER AREA, TASMANIA

REPORT ON EXPLORATION FOR 12 MONTHS TO 15TH OCTOBER, 1985

OPEN FILE

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DATE: October, 1985

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CRAE Report No. 12999

CONTENTS

1. SUMMARY

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One diamond drill hole, DD 85 CC 2, was collared at AMG co-ordinates 369640E 5446950mN, to test the section below a series of small magnesite outcrops on Cann Creek. The hole passed through a sequence of dolomite, dolomitic shale and schist. It passed into amphibolitic rocks at 186.3 metres and was completed at 212.5 metres in amphibolite. Only two thin sections of magnesite, 4.4 metres (131.8 to 136.2 metres) and 6.5 metres thick (158.5 to 165.0 metres) were intersected.

The tonnage potential for magnesite at Cann Creek is therefore very restricted and no further evaluation of this deposit is recommended at this stage.

Metallurgical testing of the bulk samples obtained in 1983 from the Pinner outcrop at Lyons River continued throughout the year. Initial flotation tests indicate a high grade magnesite concentrate can be obtained though recoveries are relatively poor and variable.

2. INTRODUCTION

Following a joint venture agreement between CRA Exploration Pty. Limited and Mineral Holdings of Australia Pty. Limited, dated 8th April, 1982, detailed exploration has outlined two major magnesite bodies at Lyons River and Arthur River in north-west Tasmania. Bulk sampling was also carried out at the most important of these deposits (Lyons River) to provide material for beneficiation and metallurgical testing.

Several small outcrops of magnesite were also known to occur at Cann Creek some 6km north-west of the Arthur River deposit. Mapping indicated the magnesite and associated dolomite was quite extensive, but one hole, DD 84 CC 1, drilled 400 metres south of the magnesite outcrop, intersected a section composed entirely of dolomite. The magnesite passed under Permian cover 150 metres north of Cann Creek.

Despite the restricted nature of the outcrops at Cann Creek, some of the magnesite, particularly on the western margin, had extremely low iron contents (0.02 to 0.05% Fe_2O_3) and, even if only moderate tonnages were available, it could provide a valuable source of high quality magnesite. Consequently a second hole, DD 85 CC 2, was developed to test the section below the creek outcrops.

3. CONCLUSIONS

DD 85 CC 2 intersected only two thin sections (total 10 metres) of magnesite at a depth of 100 metres below the creek level. The magnesite outcrops seen at creek level are therefore limited as both lateral and vertical extent and total tonnage potential is very limited.

4. RECOMMENDATIONS

No further exploration work is warranted at the Cann Creek Deposit while beneficiation tests of the Lyons River magnesites are underway.

5. DRILLING

DD 85 CC 2 was collared at 369640mE and 5446950mN (AMG co-ordinates), and depressed -46° to 285° magnetic. It was designed to traverse the full carbonate section exposed along Cann Creek.

The hole passed through alluvial material to 23.5 metres and traversed a section composed dominantly of siliceous dolomite with occasional schist and amphibolite bands. The hole passed into amphibolite at 186.3 metres and was terminated in amphibolite at 212.5 metres. Only two bands of magnesite rich material were intersected, the first 4.4m in thickness between 131.8 to 136.2 metres. The second band 6.5m in thickness, occurred between 158.5 to 165.0 metres.

Both magnesite sections consist largely of angular magnesite breccia. There is considerable CaO (8.4 to 12.9% CaO) and high SiO_2 contents (6.03 - 10.87% SiO_2). MgO content is therefore somewhat reduced and ranges from 38.5 to 35.1%. Fe_2O_3 contents of the magnesite averages 0.2%.

Full details of the log and assay results are given in Appendices 1 and 2.

6. METALLURGICAL TESTWORK

A bulk sample of magnesite was taken from the Pinner outcrop at Lyons River and was shifted to KHD Humboldt Wedog AG for beneficiation and metallurgical evaluation. Initial tests indicate a good quality product can be obtained by two-stage flotation, but at this stage the recoveries are somewhat variable.

Reports on the beneficiation tests are included as Appendix 3.

T. W. DICKSON

REFERENCES

Mackenzie P.C.	1984	EL 43/70 Arthur River, Tasmania Report on Exploration for 12 Months to 15th October, 1984. CRAE Report No. 12828.
Williams, V.A.	1983	EL 43/70 Arthur River, Tasmania Report on Exploration for the Year Ending 15th October, 1983. CRAE Report No. 12283.

KEYWORDS

Magnesite, Carbonate, Drill-Diamond, Mineral Processing.

LOCALITY

Burnie 1:250,000 Sheet SK 55 - 3

LIST OF APPENDICES

APPENDIX I	:	DD 85 CC 2 Log
APPENDIX II	:	Assay Results DD 85 CC 2
APPENDIX III	:	Beneficiation Tests KHD Humboldt Wedog AG

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LIST OF PLANS

Plan No.	Title	Scale
TASh 1510	Location Plan	1:500,000
TASh 2664	DD 85 CC 2 Sections	1:1,000
TASh 1992	Cann Creek Magnesite Prospect, Geology	1:2,000

APPENDIX I

DD 85 CC 2 Log

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DRILL CORE LOG

SHEET No. 1

TENEMENT NAME ARTHUR RIVER No 43/70

PLAN – MAP REFERENCE

CO-ORDINATES ..... AZIMUTH 285°(m) DRILLERS K. PARRY COMMENCED 21-5-85 DEPTH 212.5m HOLE No DD85CA2

RL COLLAR ..... INCLINATION -46° DRILL TYPE BOYLES COMPLETED 1-6-85 CASING LEFT 5.0m DPO No(s) .....

DEPTH From	DEPTH To(M)	Core Rec. (M)	Core Size	Graphic Log	CORE DESCRIPTION	SPECIAL FEATURES Weath, Alteration, Fracturing, Veining, Mineralization	Sample No.	From (M)	To (M)	Rec (M)	ASSAY VALUES (Analysed by .....
					Drillhole Surveys						
					Depth Azimuth Dip						
					90m 273° -48°						
					150m 230° -52°						
					180m 268° -53°						
					212.5m 265° -55°						

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DRILL CORE LOG

SHEET No. 1/4

TENEMENT NAME ARTHUR RIVER No. 43/7

PLAN – MAP REFERENCE

CO-ORDINATES ... AZIMUTH 285° (m) ... DRILLERS K. PARRY ... COMMENCED 21-5-85 ... DEPTH 212.5m ... HOLE No DDH85CC

RL COLLAR ... INCLINATION -46° ... DRILL TYPE BOYLES ... COMPLETED 1-6-85 ... CASING LEFT 5.0m ... DPO No(s) ...

DEPTH From (M)	DEPTH To (M)	Core Rec. (M)	Core Size	Core to Bedding Depth / Angle	CORE DESCRIPTION	SPECIAL FEATURES Weath, Alteration, Fracturing, Veining, Mineralization	Sample No.	From (M)	To (M)	Rec (M)	ASSAY VALUES (Analysed by ...)
					0.0 – 23.5m Tricone precollar – no core						
23.5	30.5	6.3	NQ		23.5 – 43.5m						
30.5	33.5	3.0			Variable dolomite sequence; light-dark grey,						
33.5	41.5	7.2			bedded to massive dolomite with minor						
41.5	42.3	2.9			magnesite; magnesite associated with minor						
					quartz veining.						
					23.5 – 27.3m Massive, medium grey dolomite with minor magnesite		1154851	23.8	24.0	[redacted]	
				29.6 / 20°	27.3 – 41.5m Dark grey laminantly bedded		852	31.0	31.2	0.2	
				31.0 / 31°	dolomite.						
				32.5 / 59°	41.5 – 43.5m Medium grey, dominantly massive		853	39.6	39.8	0.2	
				36.5 / 21°	dolomite with minor magnesite.						
				42.7 / 45°			854	42.3	42.5	0.2	
42.3	45.5	3.0		43.5 / 34°	43.5 – 45.5m						
				43.7 / 35°	Khaki green amphibolite with minor carbonate		855	45.15	45.3	0.15	
					strongly foliated; minor quartz veining and						
					associated rare magnesite and pyrite.		856	52.5	52.7	0.2	
45.5	54.3	6.2		46.5 / 42°	45.5 – 130.5m		857	61.9	62.1	0.2	
54.3	57.6	3.1			Variable dolomite sequence; light-dark grey,						
57.6	59.0	1.6			bedded to massive dolomite with minor		858	69.8	70.0	0.2	
59.0	60.5	1.6			magnesite; siliceous zones.						
60.5	63.5	3.1		54.7 / 35°	45.5 – 86.6m Medium grey, dominantly massive		859	75.4	75.6	0.2	
63.5	65.0	1.5		71.9 / 26°	dolomite; minor magnesite usually						
65.0	66.5	1.5		83.9 / 23°	associated with quartz veining		860	84.3	84.6	0.2	
66.5	68.0	1.6		87.1 / 23°	56.6 – 56.7m, 69.4m, 75.4m Trace pyrite assoc with qz veining						
				91.0 / 12°	86.6 – 91.7m Dark grey, bedded dolomite.		861	89.4	89.55	0.15	

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DRILL CORE LOG

SHEET No. 2/4

TENEMENT NAME..... No. .....

PLAN – MAP REFERENCE.....

CO-ORDINATES..... AZIMUTH..... DRILLERS..... COMMENCED..... DEPTH..... HOLE No DD85CC1

RL COLLAR..... INCLINATION..... DRILL TYPE..... COMPLETED..... CASING LEFT..... DPO No(s).....

DEPTH from (M)	DEPTH To (M)	Core Rec. (M)	Core Size	Core to Bedding	CORE DESCRIPTION	SPECIAL FEATURES Weath, Alteration, Fracturing, Veining, Mineralization	Sample No.	From (M)	To (M)	Rec (M)	ASSAY VALUES (Analysed by.....
68.0	69.5	1.4	NQ		91.7 – 93.3m Dominantly massive, medium grey dolomite		862	91.8	92.0	0.2	
69.5	77.0	8.1									
77.0	80.0	2.6		97.8/65°	93.3 – 104.0m Dark grey bedded dolomite; sericitic; slump structures.		863	93.7	93.9	0.2	
80.0	83.0	3.0									
83.0	86.0	3.1		113.2/35°	104.0 – 114.5m Dominantly massive, light grey dolomite; minor magnesite		864	103.6	103.8	0.2	
86.0	89.0	3.2									
89.0	92.0	3.2					865	106.0	106.2	0.2	
92.0	98.0	6.5				associated with quartz and carbonate veining					
98.0	101.0	2.9			114.5 – 118.2m Medium grey, bedded dolomite.		866	112.1	112.3	0.2	
101.0	104.0	3.4		119.9/65°	118.2 – 123.0m Dominantly massive, light grey dolomite; breccia texture towards						
104.0	107.0	3.1					867	116.8	117.0	0.2	
107.0	110.0	3.0			bottom of subunit.						
110.0	113.0	3.0		123.5/69°	123.0 – 125.3m Medium grey, bedded dolomite		868	122.2	122.4	0.2	
113.0	120.0	4.3			125.3 – 129.5m Variable zones of massive and bedded dolomite; massive						
120.0	123.0	5.2					869	124.7	124.9	0.2	
123.0	126.0	3.0			dolomite has locally coarse						
126.0	129.0	3.0			breccia zones with clasts up to 3cm		870	125.3	129.5	4.2	
					129.5 – 130.5m Sheared variable massive and bedded dolomite sequence.		871	129.5	130.5	1.0	
129.0	132.0	3.0		131.9/45°	130.5 – 131.8m		872	130.5	131.8	1.3	
					Pale khaki amphibolite schist with minor carbonate; highly foliated and cleaved.						
132.0	135.0	3.1			131.8 – 136.2 m		873	131.8	136.2	4.4	
					Coarse magnesite breccia containing magnesite fragments up to 3cm within a dark grey magnesite rich matrix						

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DRILL CORE LOG

SHEET No. 3/

TENEMENT NAME..... No. ....

PLAN – MAP REFERENCE.....

CO-ORDINATES..... AZIMUTH..... DRILLERS..... COMMENCED..... DEPTH..... HOLE No. DD85CC

RL COLLAR..... INCLINATION..... DRILL TYPE..... COMPLETED..... CASING LEFT..... DPO No(s).....

DEPTH From (M)	DEPTH To(M)	Core Rec. (M)	Core Size	Core to Bedding	CORE DESCRIPTION	SPECIAL FEATURES Weath, Alteration, Fracturing, Veining, Mineralization	Sample No.	From (M)	To (M)	Rec (M)	ASSAY VALUES (Analysed by.....
			NQ		136·2 – 136·7m		154874	136·2	136·7	0·5	
					Pale – dark green sericite schist with minor carbonate						
135·0	138·0	3·0		137·0/47°	136·7 – 145·4m		875	136·7	140·7	4·0	
138·0	141·0	3·1		142·8/24°	Light – dark grey, variable sequence of a dark fine grained sediment (shale?) and light dolosilte. Sequence becomes more dolomite rich with depth. Common white carbonate clasts; strongly foliated; minor schist zones		876	141·0	144·4	3·4	
141·0	144·0	3·3			140·7 – 141·0m } Dark green amphibolite schist; 144·4 – 144·5m } strongly foliated with minor carbonate 144·8m Trace pyrite associated with quartz veining						
144·0	147·0	3·0			145·4 – 186·3m		877	149·6	149·8	0·2	
147·0	150·0	2·9			Light – dark grey, variable bedded and massive dolomite rich sequence; minor quartz veining and magnetite.		878	153·0	153·2	0·2	
150·0	153·0	3·2									
153·0	156·0	3·0									
156·0	159·0	3·0			145·4 – 152·7m Variable bedded and massive dolomite with common coarse – medium sized carbonate fragments. Common quartz and carbonate veining with minor magnetite.		879	157·1	157·3	0·2	
159·0	162·0	3·0									
162·0	165·0	3·0									
165·0	168·0	3·0									
168·0	171·0	3·0									
171·0	174·0	3·0			152·7 – 154·7m Medium grey dolomite with a sandy texture; bedded; minor carbonate clasts to 1cm						
174·0	177·0	3·0									
177·0	180·0	3·0									
180·0	183·0	3·0		157·2/32°	154·7 – 158·5m Bedded and sheared, dark grey dolomite rich rock; possible shale and dolomite stringers.						
183·0	189·0	6·0									

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DRILL CORE LOG

SHEET No. 4/4

TENEMENT NAME..... No. .....

PLAN – MAP REFERENCE.....

CO-ORDINATES..... AZIMUTH..... DRILLERS..... COMMENCED..... DEPTH..... HOLE No DDBS.CC

RL COLLAR..... INCLINATION..... DRILL TYPE..... COMPLETED..... CASING LEFT..... DPO No(s).....

DEPTH From (M)	DEPTH To (M)	Core Rec. (M)	Core Size	Core to Bedding	CORE DESCRIPTION	SPECIAL FEATURES Weath, Alteration, Fracturing, Veining, Mineralization	Sample No.	From (M)	To (M)	Rec (M)	ASSAY VALUES (Analysed by.....
			NQ	158.5 / 35°	158.5 – 170.4m	Medium-coarse dolomite rich sequence; varies from a sandy	154880	160.1	160.3	0.2	
				168.3 / 40°		texture to a coarse agglomeratic	881	162.7	162.9	0.2	
						texture; coarse subrounded 'clasts'	882	168.6	168.8	0.2	
						(≤1.5cm) occur within the sandy zone; trace pyrite (164.6m)					
				173.0 / Subvl	170.4 – 174.1m	As for zone 154.7 – 158.5m; minor	887	173.2	173.4	0.2	
						carbonate clasts + quartz veining.					
					174.1 – 177.1m	Sandy textured dolomite rich	883	175.6	175.8	0.2	
						rock containing coarse (≤10cm)	884	179.1	179.3	0.2	
						subrounded carbonate 'clasts'					
					177.1 – 186.3m	Variable bedded and massive	885	183.6	183.8	0.2	
						dolomite; medium grey; common					
						quartz veining; locally well	886	197.6	197.8	0.2	
						cleaved.					
189.0	192.0	2.5		187.3 / 35°	186.3 – 212.5m						
192.0	195.0	2.9		192.2 / 45°	Khaki green and dark green amphibolite						
195.0	201.0	6.9		201.1 / 49°	schist; common quartz + lesser carbonate						
201.0	204.0	3.1		207.7 / 46°	veining; well cleaved and bedded; minor						
204.0	207.0	3.0		212.0 / 51°	dolomite						
207.0	210.0	2.9			199.4 – 200.1m	Medium-grey, massive dolomite					
210.0	212.5	2.7									
					End of hole 212.5m						

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APPENDIX II

Assay Results - DD 85 CC 2

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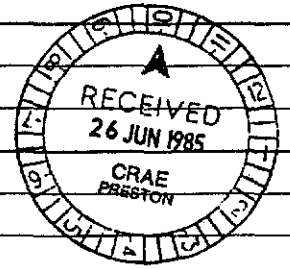
25/06/85 D.E.O. 30396 HOBART TAS. A/C 2073

SAMPLE NO.	1154851	1154852	1154853	1154854	1154855	1154856	1154857	1154858	1154859	1154860	SAMPLE NO.
MGO	16.12	19.65	21.20	13.62	8.54	21.51	21.18	21.32	18.62	21.45	MGO
CAO	21.17	26.53	28.20	17.30	3.76	29.42	28.04	23.94	22.75	28.19	CAO
SIO2	23.36	10.08	4.89	29.46	47.96	2.21	4.22	11.07	16.30	3.53	SIO2
AL203	3.03	2.03	0.582	6.65	12.47	0.298	1.200	2.70	2.69	0.920	AL203
FE203	1.046	0.804	0.434	2.25	11.40	0.345	0.548	1.006	0.696	0.388	FE203
MNO	<0.030	<0.030	<0.030	<0.030	0.071	<0.030	<0.030	<0.030	<0.030	<0.030	MNO
SO3	1.018	0.588	<0.010	2.24	1.470	0.017	<0.010	0.746	0.350	0.061	SO3
NA20	0.310	<0.100	0.110	0.359	2.07	<0.100	<0.100	<0.100	0.223	<0.100	NA20
K20	0.891	0.620	0.024	2.14	0.800	0.057	0.238	0.401	0.925	0.253	K20
TIO2	0.163	0.095	0.034	0.308	2.57	0.014	0.061	0.150	0.157	0.043	TIO2
P205	0.027	0.060	<0.010	0.128	0.283	0.011	0.012	0.036	0.022	0.021	P205
PBO	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	PBO
ZNO	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	ZNO
CUO	<0.010	<0.010	<0.010	<0.010	0.018	<0.010	<0.010	<0.010	<0.010	<0.010	CUO
WO3	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	WO3
BAO	0.037	0.018	<0.010	0.042	0.035	<0.010	0.011	0.016	0.034	0.010	BAO

ELEMENT CONCENTRATIONS EXPRESSED AS MOST COMMON OXIDES

SAMPLES DRIED AT 105 C PRIOR TO ANALYSIS

ALL ELEMENTS DETERMINED BY XRF



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25/06/85 D.E.O. 30396 HOBART TAS. A/C 2023

SAMPLE NO.	1154861	1154862	1154863	1154864	1154865	1154866	1154867	1154868	1154869	1154870	SAMPLE NO.
MGO	14.10	21.09	10.99	18.35	21.30	19.14	11.25	14.50	15.12	18.24	MGO
CAO	14.98	28.03	7.13	23.61	29.09	26.24	12.04	18.10	19.28	24.53	CAO
SIO2	33.60	4.53	50.87	16.45	2.69	10.35	43.01	26.74	25.21	13.04	SIO2
AL203	6.60	0.771	10.42	1.797	0.359	1.321	7.33	5.77	4.91	2.45	AL203
FE203	2.45	0.714	2.62	1.145	0.325	0.620	2.40	2.12	1.825	1.192	FE203
MNO	0.039	<0.030	<0.030	0.049	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	MNO
SO3	2.01	<0.010	1.429	0.129	<0.010	<0.010	1.729	1.514	1.041	0.517	SO3
NA20	0.211	<0.100	<0.100	<0.100	<0.100	0.626	0.151	0.881	0.343	0.762	NA20
K20	1.828	0.105	2.90	0.380	0.116	0.095	2.27	1.503	1.508	0.415	K20
TIO2	0.289	0.036	0.483	0.081	0.014	0.044	0.419	0.281	0.270	0.109	TIO2
P205	0.044	0.019	0.080	0.017	0.011	0.015	0.068	0.073	0.079	0.028	P205
PBO	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	PBO
ZNO	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	ZNO
CUO	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	CUO
WO3	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	WO3
BAO	0.036	<0.010	0.063	<0.010	<0.010	<0.010	0.050	0.028	0.030	0.010	BAO

ELEMENT CONCENTRATIONS EXPRESSED AS MOST COMMON OXIDES

SAMPLES DRIED AT 105 C PRIOR TO ANALYSIS

ALL ELEMENTS DETERMINED BY XRF

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25/06/85 P.O. 30396 HOBART TAS. A/C 2073

SAMPLE NO.	1154871	1154872	1154873	1154874	1154875	1154876	1154877	1154878	1154879	1154880	SAMPLE NO.
MGO	25.39	21.50	35.18	22.57	24.12	23.43	23.46	31.26	25.27	35.13	MGO
CAO	15.35	6.02	12.94	5.12	14.35	16.44	17.82	12.38	11.10	11.10	CAO
SIO2	30.83	39.15	6.07	41.98	32.18	27.87	25.59	16.97	32.03	10.87	SIO2
AL203	0.622	7.00	0.219	6.81	1.994	2.23	0.178	0.638	1.940	0.357	AL203
FE203	0.812	9.72	0.203	8.27	1.027	0.972	0.088	0.302	0.786	0.185	FE203
MNO	0.064	0.127	<0.030	0.131	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	MNO
SO3	0.044	0.458	<0.010	0.115	0.504	0.660	<0.010	0.025	0.351	<0.010	SO3
NA20	<0.100	0.108	<0.100	0.342	0.589	0.754	0.151	0.291	0.605	0.206	NA20
K20	0.072	0.391	<0.010	0.429	0.105	0.101	0.016	0.059	0.384	0.029	K20
TIO2	0.027	1.271	0.010	1.109	0.111	0.099	<0.010	0.027	0.087	0.015	TIO2
P205	<0.010	0.131	<0.010	0.122	0.016	0.014	<0.010	<0.010	0.014	<0.010	P205
PBO	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	PBO
ZNO	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	ZNO
CUO	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	CUO
WO3	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	WO3
BAO	0.031	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.017	<0.010	BAO

ELEMENT CONCENTRATIONS EXPRESSED AS MOST COMMON OXIDES

SAMPLES DRIED AT 105 C PRIOR TO ANALYSIS

ALL ELEMENTS DETERMINED BY XRF

077019

25/06/85 D.E.O. 30396 HOBART TAS. A/C 2023

SAMPLE NO.	1154881	1154882	1154883	1154884	1154885	1154886	1154887	SAMPLE NO.
MGO	38.49	25.45	30.41	24.21	23.80	19.64	25.42	MGO
CAO	8.40	20.37	14.15	20.94	18.36	26.60	10.59	CAO
SIO2	6.03	18.36	17.63	12.84	24.64	8.50	37.54	SIO2
AL203	0.304	0.217	0.642	0.285	0.240	1.175	2.33	AL203
FE203	0.209	0.125	0.183	0.131	0.169	1.192	0.773	FE203
MNO	<0.030	<0.030	<0.030	<0.030	<0.030	0.051	<0.030	MNO
SO3	<0.010	<0.010	<0.010	<0.010	0.032	0.028	0.718	SO3
NA20	0.174	<0.100	0.234	<0.100	0.132	0.345	0.577	NA20
K20	<0.010	<0.010	0.084	0.070	0.025	0.196	0.421	K20
TIO2	0.014	<0.010	0.031	0.013	<0.010	0.046	0.093	TIO2
P205	<0.010	<0.010	<0.010	<0.010	<0.010	0.019	0.017	P205
PBO	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	PBO
ZNO	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	ZNO
CUO	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	CUO
WO3	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	WO3
BAO	<0.010	<0.010	<0.010	<0.010	<0.010	0.020	0.013	BAO

ELEMENT CONCENTRATIONS EXPRESSED AS MOST COMMON OXIDES

SAMPLES DRIED AT 105 C PRIOR TO ANALYSIS

ALL ELEMENTS DETERMINED BY XRF

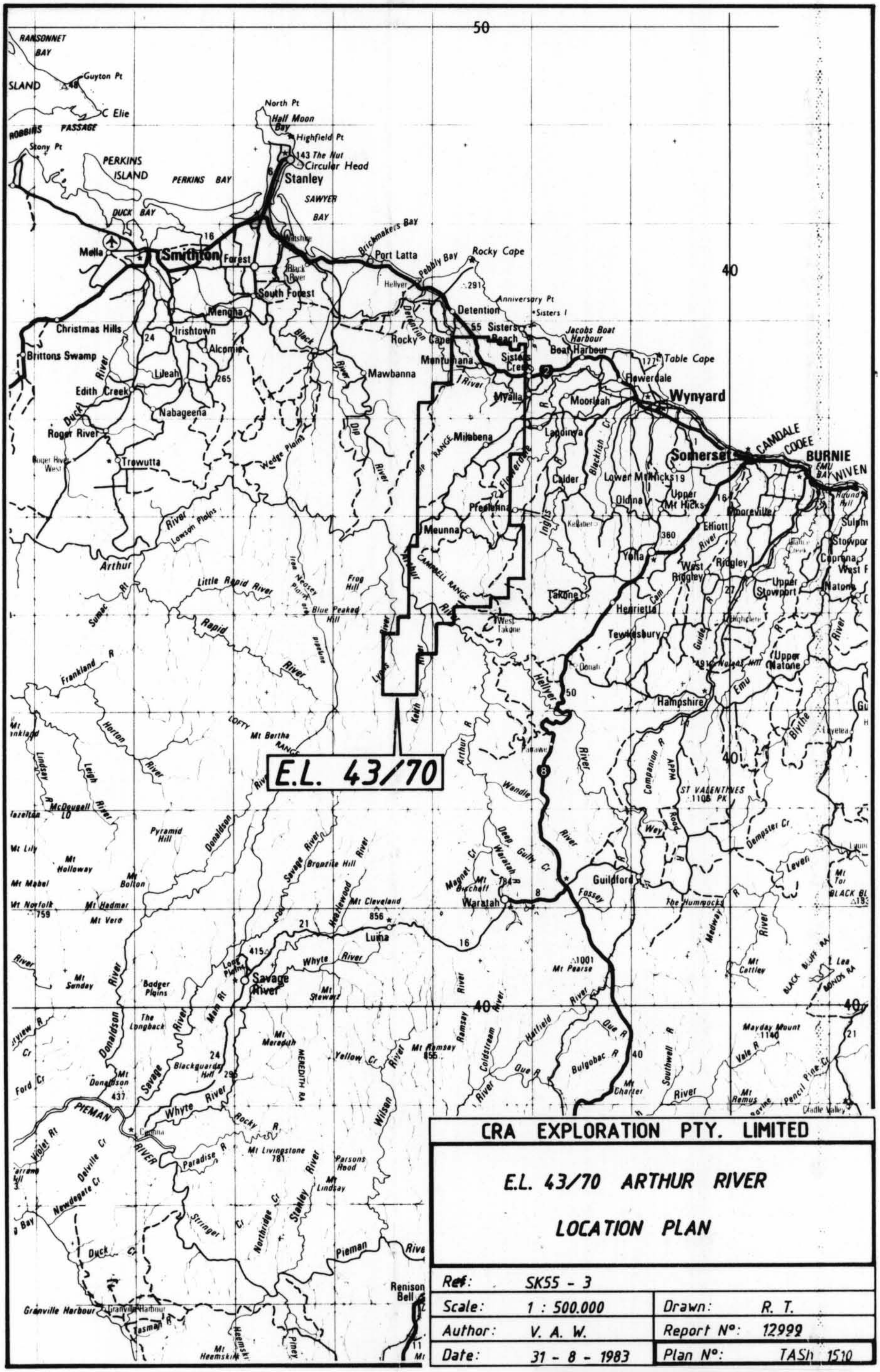
Perth (09) 350 5944 Adel. (08) 297 4788

077020

D.E.O. 30396 HOBART TAS.

SAMPLE NO.	L.O.I.
1154851	32.93
1154852	39.77
1154853	44.40
1154854	25.54
1154855	8.41
1154856	46.14
1154857	44.25
1154858	38.49
1154859	37.29
1154860	44.77
1154861	23.81
1154862	44.54
1154863	12.74
1154864	37.65
1154865	45.90
1154866	41.30
1154867	19.10
1154868	28.12
1154869	30.25
1154870	38.47
1154871	26.61
1154872	13.95
1154873	45.46
1154874	12.77
1154875	24.92
1154876	27.25
1154877	32.51
1154878	37.71
1154879	27.20
1154880	42.04
1154881	44.34
1154882	35.40
1154883	36.69
1154884	41.30
1154885	32.53
1154886	42.10
1154887	21.51

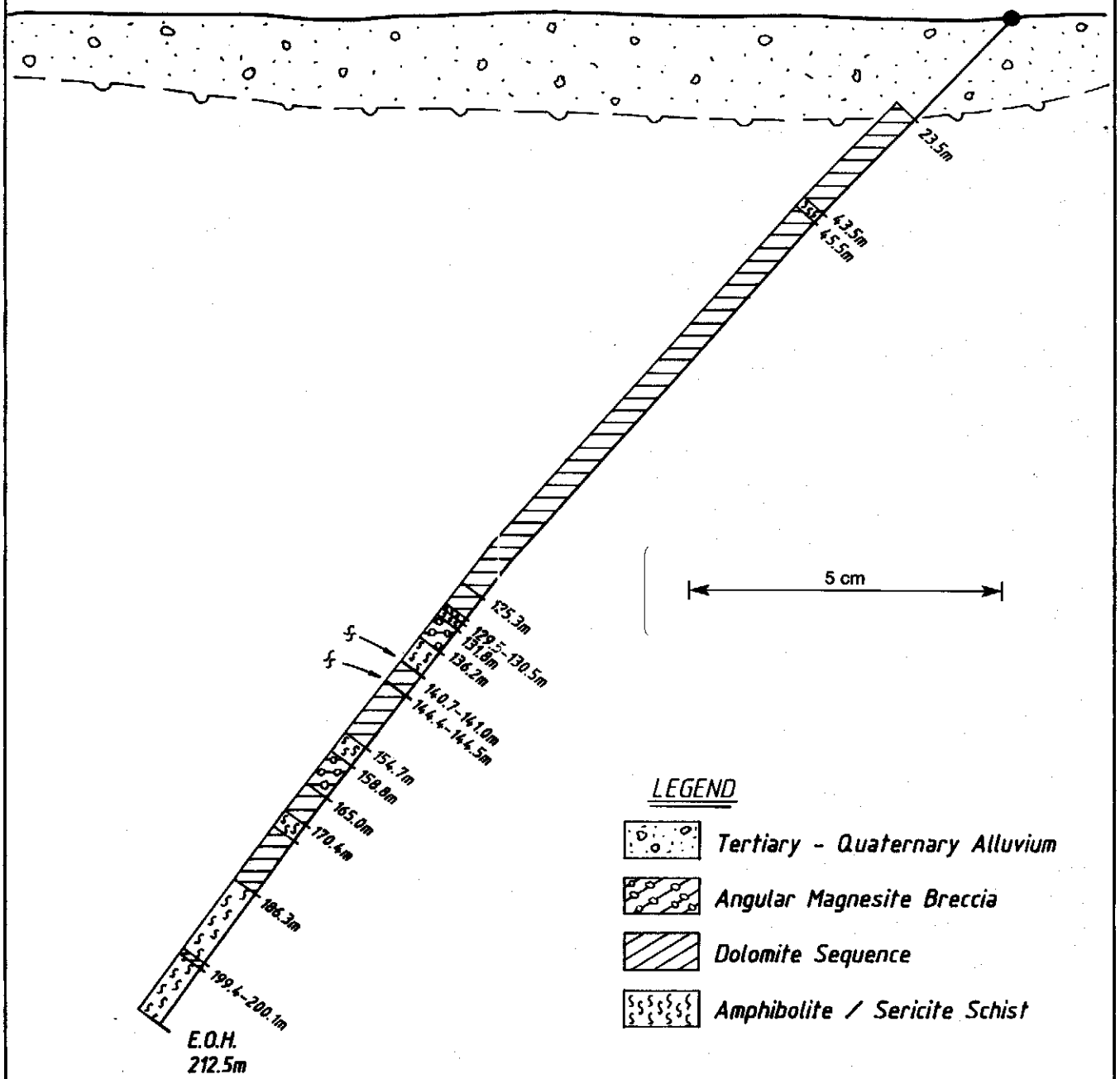
077021



CRA EXPLORATION PTY. LIMITED			
E.L. 43/70 ARTHUR RIVER			
LOCATION PLAN			
Ref:	SK55 - 3		
Scale:	1 : 500.000	Drawn:	R. T.
Author:	V. A. W.	Report N°:	12999
Date:	31 - 8 - 1983	Plan N°:	TASh 1510

077022

DD85 CC 2
Inclination : -46°
Azimuth : 285° (mag)



LEGEND

- Tertiary - Quaternary Alluvium
- Angular Magnesite Breccia
- Dolomite Sequence
- Amphibolite / Sericite Schist

CRA EXPLORATION PTY. LIMITED

ARTHUR RIVER E.L. 43/70
DD85 CC 2
SECTION

REF.	SK55 - 3		
SCALE	1 : 1000	DRAWN	R.T.
AUTHOR	S.J.C.	REPORT No.	12999
DATE	25 - 6 - 1985	PLAN No. TASn	2664

369 000m E(AMG)

5 447 000m N(AMG)

5 446 000m N(AMG)

5 445 000mN (AMG)

Dolerite
PEs
4310
4314
4334
4330
1056801, 1056806
1056803
1056811
4300
4294
4316
PEm
Talc Schist
4375
4290
1056802
1056807
1056808
1056809
DD 85
CC 2
4322
4340
CANN CREEK
Best (visual) magnesite
(surface projection)
SURFACE PROJECTION OF
CARBONATE-SCHIST CONTACT.
Silicified Quartz gravel
4346
4350
4360
4280
4269
4270
4268
4369
4366
4231
BORROW PIT
4243
4240
4244
DD84 CC 1
Outcrops of Silica after carbonate
Massive Silica after carbonate
Float of Silica after carbonate
4245
4246
4247
4248
4249
4463
4468
4250
4397
4390
4380
4251
4252
4253
Abundant Schist floats
Tb
4262
4263
4264
4265
4266
Weakly Talcose Schist
4469
4470
4471
4254
4255
4256
4257
4258
4259
4260
4261
T16
4485
4484
4483
4482
4481
Tg
4480
4446
4445
4444
4443
4440
4455
4456
4457
4458
4459
4460
T15 Azimuth Peg
4403
4450
4454
4486
4488
4430
4420
4410
4472
T15
4474
4475
S
PEs

077023

5 cm

00 40 80m
40 20

CRA EXPLORATION PTY. LIMITED	
E.L. 43/70 ARTHUR RIVER CANN CREEK MAGNESITE PROSPECT GEOLOGY	
REF. SK55-3	
SCALE 1 : 2000	DRAWN I.F.W.
AUTHOR V.A.W.	REPORT No. 12999
DATE 17 / 9 / 1984	PLAN No. TASh 1992

APPENDIX III

Beneficiation Tests

KHD Humboldt Wedog A.G.

077025 ITEM 1 - REPORT

KHD HUMBOLDT WEDAG AG

Cologne, July 25, 1985

IH-YM2 Wi/He -
phone extension 658

KOVS ro

Report

on

process engineering tests
carried out with magnesite
for Conzinc Riotinto Australia Ltd. (CRA),
Melbourne/Australia
P.-No. 9-2121-5-0089
A.-No. 9-8125-9-5011

1. Summary

Following a very heedful reduction of the raw magnesite to a fineness of 100 % less than 0.12 mm, a magnesite concentrate of a MgO-content of 96 - 97 % and a SiO_2-content of approx. 0.5 % (related to burnt magnesite) was produced by way of two-stage flotation at a concentrate recovery of more than 63.5 % .

This report describes implementation as well as the results of investigation and tests carried out in our test centres and laboratories. We hold the copyright of this report and pertinent illustrations and other representations, if any; duplicates of the report etc. or its transfer to or making it available or disclosing the contents, also in an abridged form, to third parties, is not permitted. Moreover, without our previous express approval, the report etc. must not be used for a different purpose than entrusted with the party receiving. - All rights with regard to granting of a patent, design registration or other protective rights, are reserved. -

TN 0103 0889
(HW 1630 E)
1.000 2.84

077026

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2. Material to be tested

On March 15, 1985 the research- and development center of KHD Humboldt Wedag AG received a magnesite sample of 300 kg from Messrs. Conzinc Riotinto Australia Ltd., Melbourne 3000, Australia.

The consignment included lump rock samples of a max. grain size of 400 mm.

3. Test objective

The test objective was to produce a magnesite concentrate of the following contents:

MgO-content	approx. 97 %
SiO_2-content	less than 1 %
Fe_2O_3-content	less than 1 %.

All values are related to burnt magnesite.
The ratio CaO - SiO_2 content was to be > 2.

The values below were reached by the customer during preliminary tests:

MgO-content	97 %
SiO_2-content	0.5%
CaO-content	1.4%
Fe_2O_3-content	0.85 %

According to information by the customer, the MgO-recovery equalled 61 %.

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4. Test procedure and -results

After completion of a particle size analysis the overall sample was subjected to a reduction to a fineness of 100 % less than 31.5 mm. Subsequently, representative samples were extracted for the different tests.

4.1 Raw material testing

4.1.1 Chemical analysis

The wet-chemical analysis of a representative sample of the delivered magnesite yielded the following constituents:

MgO-content	43.81	%
SiO_2-content	5.60	%
CaO-content	1.14	%
Fe_2O_3-content	0.51	%
Al_2O_3-content	0.05	%
loss on ignition	48.54	%

The following semi-quantitive analysis was made by means of X-ray emission analyzing:

element or oxide	contents* portions % by weight (fraction)
Na_2O	not evidenced
MgO	70 - 90
Al_2O_3	0.03 - 0.1
SiO_2	3 - 7
P_2O_5	not evidenced
SO_3	0.03 - 0.07

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element or oxide	contents* portions % by weight (fraction)
Cl	traces
K_2O	0.01 - 0.03
CaO	2 - 5
TiO_2	0.005 - 0.02
Cr	0.01 - 0.03
Mn	0.05 - 0.2
Fe	0.8 - 1.5
Cu	0.05 - 0.2
Sr	traces
Ba	0.005 - 0.02
Zn	traces

*contents related to burnt magnesite

4.1.2 Moisture

By drying in a drying oven at 106 °C ± 2 °C, the moisture of the sample was determined at less than 0.1 %.

4.1.3 Bulk density

The bulk density of a representative sample reduced by 100 % to a size less than 5.6 mm, equalled 1.85 t/m^3.

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4.1.4 Grain size distribution

The total delivered sample was subjected to dry sieving with three mesh widths and the coarse pieces were measured. The following grain size distribution resulted:

beyond		125	mm	72	%
125	-	63	mm	23.5	%
63	-	31.5	mm	3.2	%
less than		31.5	mm	1.3	%

The largest pieces had the following dimensions: 400 x 200 x 110 mm, 350 x 300 x 290 mm and 350 x 330 x 160 mm.

4.1.5 Mineralogic testing

4.1.5.1 X-ray powder diffraction method

The X-ray powder diffraction analysis of a representative sample of the raw material yielded the following minerals constituents:

1.	magnesite	main portion
2.	dolomite	secondary component
3.	quartz	low content
4.	talcum	very low content

4.1.5.2 Microscopic investigation of thin- and polished sections of the raw material

The following minerals of the stated fraction ranges were ascertained with the aid of microscopic investigations of thin- and polished sections:

mineral	fraction range total mm	main portion mm
magnesite	approx. 0.005 - approx. 5	0.1 - 0.6
dolomite	0.01 - 0.65	> 0.05
quartz	0.005 - 0.5	< 0.2
goethite	0.01 - 0.3	> 0.1
talcum	< 0.05	finely grained
calcite	0.02 - 0.25	
mica	approx. 0.005 - 0.25	

The delivered raw material is a magnesite, being partly finely- and partly coarsely crystalline (enclosure 1), the main impurities of which are dolomite (enclosure 2) and quartz (enclosure 3). The dolomite occurs partly as veins (enclosure 4) and partly as fine (enclosure 5) and coarse inclusions in the magnesite structure. On the one hand it can be observed along the grain boundaries of the magnesite crystallites and on the other hand as inclusions in the crystallites. The actual dolomite for the predominant portion contains fine magnesite inclusions of a size from 0.005 mm to 0.1 mm.

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The quartz is present as binder between the magnesite crystallites (enclosure 6), but also as coarse inclusion in the magnesite (enclosure 7). It is partly idiomorphous and frequently includes - as infiltrated - fine and superfine inclusions of magnesite of a fraction range from 0.001 mm to 0.05 mm. To a minor degree, magnesite and quartz form an intimately intergrown, granular structure (enclosure 8), the maximum grain size of both minerals equalling 0.13 mm. This suggests two generations of mineralization, which likewise explains the idiomorphous formations of quartz and magnesite.
Moreover, quartz occurs as inclusions in the dolomite. Intergrowth, i.e. magnesite existing as binder between the particles in coarse quartz lots (enclosure 9), is observed to a minor degree only.
Goethite as pseudomorphosis of pyrite, is intergrown with magnesite and/or quartz. Talcum, for the major portion, occurs at the grain boundaries of the magnesite crystallites and as inclusions in the magnesite, although rarely only.
Calcite is present in the magnesite as inclusions and is frequently associated with dolomite. Also the coarser calcite inclusions mostly contain fine inclusions of magnesite (enclosure 12) (up to 0.030 mm, max.).
Mica could be observed exclusively as fine inclusions in the quartz.

The microscopic investigations suggest that grinding of 100 % less than approx. 0.12 mm would be suitable for processing the delivered raw magnesite. Due to the partly superfine intergrowth between quartz and magnesite and the fact that dolomite is the main gangue, it has to be presumed that a high magnesite recovery at a high MgO-concentration will hardly be realizable.

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4.1.6 Specific gravity distribution of grain fractions

A representative sample of the raw material reduced to a fineness of 100 % less than 5.6 mm was subjected to wet classification at 0.5 mm. The wet residues retained were admitted to a tank filled with distilled water and transferred to a 0.1 mm sieve after 1 hour. Following a dripping-off period of 15 minutes, the material was immersed into an organic liquid of a tested specific gravity of 2.46 g/cm^3, split into floats and sinks. The sinks were separated by sink-float tests directly afterwards at the next higher specific gravity. The specific gravity distribution of grain fractions obtained with chemical analyses of the specific gravity fractions can be taken from enclosure 13, showing that lowering of the SiO_2-content is not possible for the grain size distribution selected by spec. gravity sizing.

4.2 Flotation

The mineralogic test carried out with the raw magnesite as well as flotation tests revealed that comminution of 100 % less than approx. 0.125 mm is required for processing the magnesite.

4.2.1 Grinding

Applied was a laboratory rod mill of a volumetric capacity of 5 litres. Eight rods made of V2A-steel of a diameter of 20 mm served as grinding media. The solids/water mass ratio equalled 1 : 1.

...

One kilogram, each, of the raw ore crushed by 100 % to a size less than 2 mm, was subjected to dry sieving at 0.12 mm and the residues retained on the sieve were ground for five minutes. Subsequently, the material ground was sieved wet at 0.12 mm, the residues retained were ground for five minutes. Following this, they were again subjected to wet classification and the remaining coarse fraction was again ground for three minutes. The grain size distribution of the total quantity of material ground is shown in the RRSB-grading graph in enclosure 14.

4.2.2 Flotation tests

The flotation tests were carried out in a 3 l laboratory flotation cell, type WEDAG.
The solids content equalled 330 g/l, the tap water used had a hardness degree of 10° German hardness and the temperature of the pulp was $15^{\circ}C$.
SiO_2-flotation as well as MgO-flotation were carried out fractionally, i.e. several products were separated by sink-float tests during each stage of flotation.
The advantage of this mode of flotation is that it enables a better evaluation of the different products and adding up of the different MgO-concentrates, depending on the SiO_2- and CaO-content.

4.2.2.1 Reagents

The following reagents were applied for flotation of the SiO_2-impurities:

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EKOFACT DD 95 200 g/t of ore as well as
RESANOL 450 120-150 g/t of ore as
collecting reagent/effervescing reagent combination.

The conditioning time for EKOFACT DD 95 equals 1 - 2 minutes and for RESANOL 450 approx. 5 minutes.

Prior to the subsequent MgO-flotation, 200 g/ton of EKOFACT DD 95 ^{R} and 400 - 500 g/ton of soda water-glass were added for deadening of calcite, dolomite and quartz.

Following a conditioning period of approx. 1 minute for these two reagents, the magnesite was separated in a sink- and float process with RESONAL A ^{R} (as 10 % emulsion).

RESONAL A is a collecting-, effervescing reagent combination, specially developed for flotation of magnesite, which recovers magnesite highly selectively.

Since this reagent is emulsified very rapidly in the flotation pulp, special conditioning periods are not required.

MgO-product 1 and 2 = 300 g/ton of RESONAL A ^{R}
MgO-product 3 = 200 g/ton of RESONAL A ^{R}

and, if required, for MgO-product 4 100 g/ton of RESONAL A ^{R}.

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4.2.2.2 Flotation period

As regards flotation of SiO_2, flotation periods between 8 and 10 minutes are required.
MgO-flotation requires approx. 5 minutes.

Including the reacting periods for SiO_2-flotation reagents and a sheer flotation period of approx. 8 minutes, 15 - 16 minutes shall be planned for the total silicic acid flotation.

Including the reacting period required for the reagents for MgO-flotation and a flotation time of 5 minutes, a total of 7 minutes is necessary for MgO-flotation.

4.2.2.3 Results

Apart from a number of flotation tests, which were evaluated only for the mass distributions and the SiO_2-contents, also the contents of MgO, CaO, Fe_2O_3 as well as the losses on ignition of the different products were determined during tests 6139 and 6141.

The results are included in the enclosures, related on the one hand to non-ignited magnesite and on the other hand to burnt magnesite. They show that - at a recovery of 63 - 65 % - a concentrate was produced, being characterized as follows:

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test		6139	6141
concentrate recovery	%	63.83	65.30
contents (non-ignited)			
MgO	%	46.74	46.58
SiO_2	%	0.27	0.23
CaO	%	0.59	0.62
Fe_2O_3	%	0.46	0.47
contents (ignited)			
MgO	%	96.65	95.76
SiO_2	%	0.56	0.47
CaO	%	1.22	1.27
Fe_2O_3	%	0.96	0.97

The MgO-recovery in the concentrate during the tests approx. amounted to 70 % (68.42 % non-ignited during test 6139, 71.30 % related to burnt magnesite). However, this value cannot unrestrictedly serve as a basis for characterizing the success of classifying, since magnesium oxide is not only included in valuable mineral magnesite, but also in the tailings dolomite.

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4.3 Sedimentation

4.3.1 SiO_2-product

After a sedimentation period of 15 minutes, thickening of 400 g/l (575 g/l) in the feed to only 500 g/l (600 g/l) could be achieved without addition of flocculants during the sedimentation tests with the froth product from SiO_2-flotation at a slightly turbid excess.
The sedimentation behaviour substantially improved only after addition of 15 g/m^3 of flocculant Praestol 2900/75 (enclosure 19, refer).
At an initial concentration of 400 g of solids in 1 l pulp, a clear water phase of 184 mm was obtained after 15 minutes. After this sedimentation period, the thickening degree equalled 878 g/l.

4.3.2 MgO-concentrate

No auxiliary sedimentation agents are required for thickening the magnesite concentrate, i.e. the froth from MgO-flotation. At an initial concentration of 530 g/l and 740 g/l, respectively, a solids content in the sedimented material of 1100 g/l and 1060 g/l, resp., were reached after a sedimentation period of 15 minutes (see enclosure 20).
At the low specific gravity of the feed pulp, a clear water phase of 180 mm was formed, of which 10 - 20 mm existed as froth, after the period mentioned above.
During all sedimentation tests carried out with the magnesite concentrate, a stable froth layer of a thickness of 10 - 50 mm, in exceptional cases up to 100 mm, was formed at the upper part of the clear water phase.

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4.3.3 Tailings

As regards the residues from MgO-flotation, a small addition of auxiliary sedimentation agents is required, since no phase separation could be determined for the sedimentation tests in the vertical cylinder without addition of flocculants. After addition of 2.5 g/m^3 of Praestol 2900/74, a slightly turbid water phase of 327 mm (see enclosure 21) was formed within five minutes. At a solids content of the feed of 72.5 g/l, the final thickening degree equalled approx. 1100 g/l. A higher addition of flocculants did not improve the results.

4.4 Filtering tests

The magnesite concentrate from the flotation tests was examined for its filtering capacity with the aid of a vertical suction filter. The filtering surface of this suction filter (0.01 m^2) was covered with tissue M/PP 2425. Pulp of a solids content of 550 g/l and 1400 g/l, respectively, served as feed material. The results can be taken from the table included in enclosure 22.
At the low specific gravity of the feed pulp, a residual moisture of 7.3 % was reached at a theoretic throughput of 730 kg/(hm^2). With the thickened slime (1400 g/l), the calculated feed rate could be raised to 2 t/(hm^2) at a residual moisture equalling 10 %.

The tests were carried out by us to the best of our knowledge and ability. A liability, in particular for the process engineering results of machines, plant sections or plants delivered by us can be undertaken by us only, if this has been agreed upon in writing.

KHD Humboldt Wedag AG

i.V. Dr. Kellerwessel i.V. Dr. Imhof

Encl.

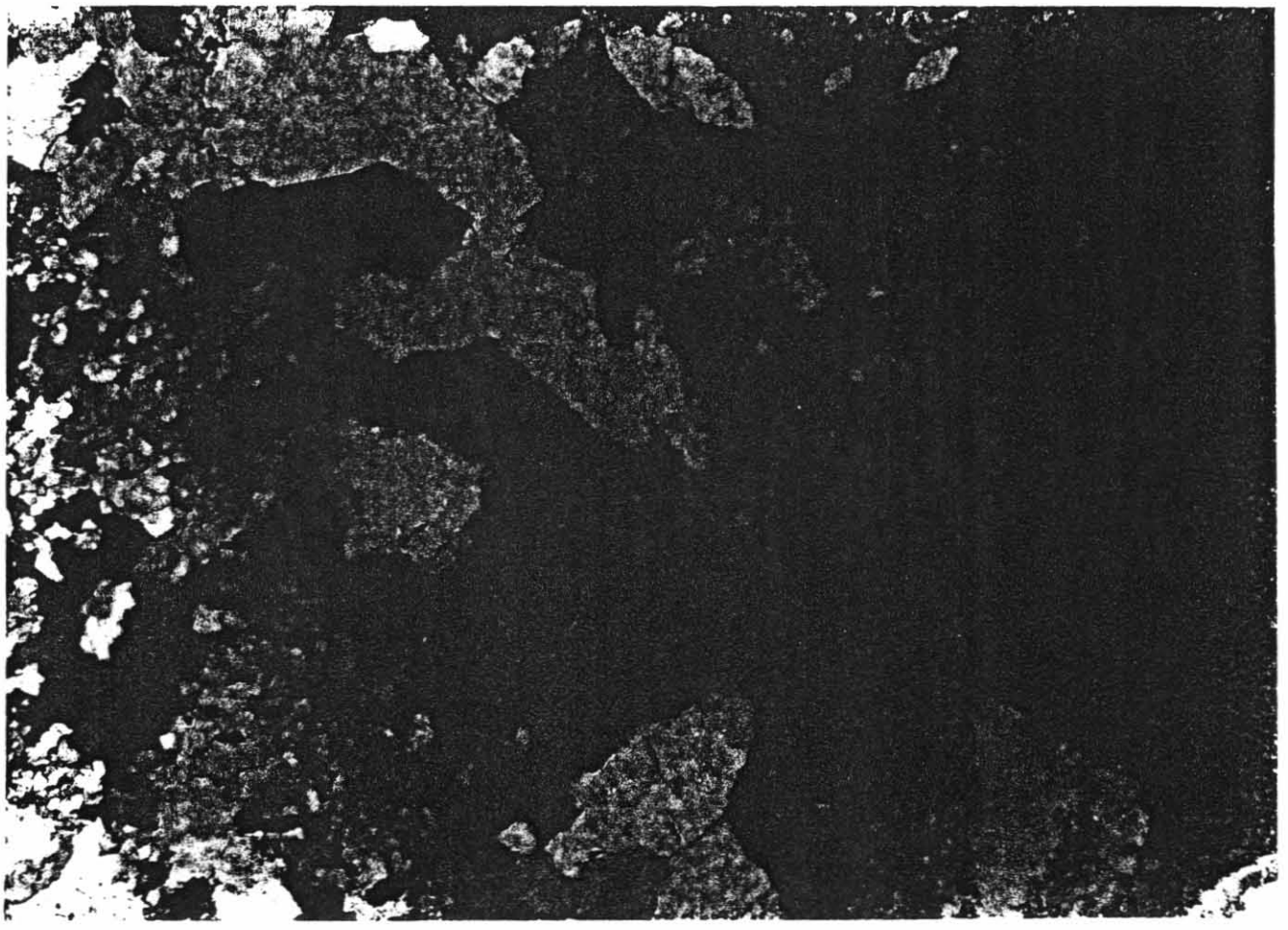
KHD HUMBOLDT WEDAG AG

Enclosure

1	Microphotograph no. 1
2	" " 2
3	" " 3
4	" " 4
5	" " 5
6	" " 6
7	" " 7
8	" " 8
9	" " 9
10	" " 10
11	" " 11
12	" " 12
13	Sink-Float-Analysis
14	Grading graph - feed -
15	Balanceflotation test 6139
16	" " " " (dead burned basis)
17	" " " 6141
18	" " " " (dead burned basis)
19	Settling curve SiO_2-product
20	" " MgO-concentrate
21	" " tailings
22	List of filtration tests MgO-concentrate

077040

Enclosure 1



200 µm

Microphotograph no. 1 thin section, N+

magnification - microscope 67 x)
enlargment - photograph 1.6x) 107 x

Sample: Magnesite from Messrs. C.R.A., Australia

Magnesite (coloured), partly coarse-, partly fine-crystalline exist next to each other. The fine-crystalline magnesite (right-hand side of microphotograph) includes minute quartz veins (light grey, dark grey to black).

5 cm

077041

Enclosure 2

0,1 mm

Microphotograph no. 2 polished section, etched with $Al(NO_3)_3$

magnification - microscope 100 x)
enlargement - photograph 1.6 x) 160 x

Sample: Magnesite from Messrs. C.R.A., Australia

Coarser inclusions of dolomite (grey, etched; grinding scratches visible) in magnesite (grey, smooth).

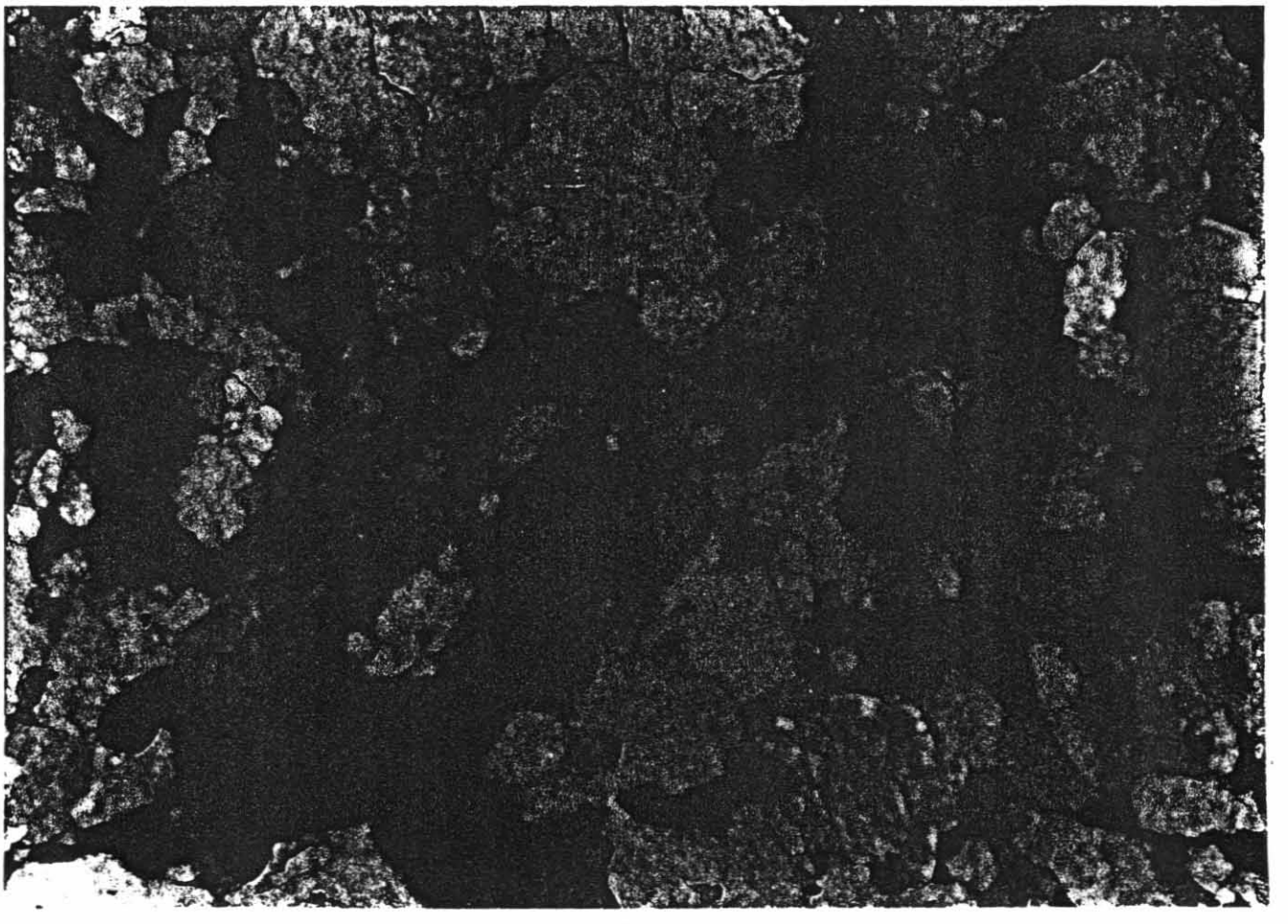
The dolomite shows fine inclusions of magnesite.

Pores and cavities are black.

5 cm

077042

Enclosure 3



0,2 mm

Microphotograph no. 3 thin section, N+

magnification - microscope 67 x)
enlargment - photograph 1.6x) 107 x

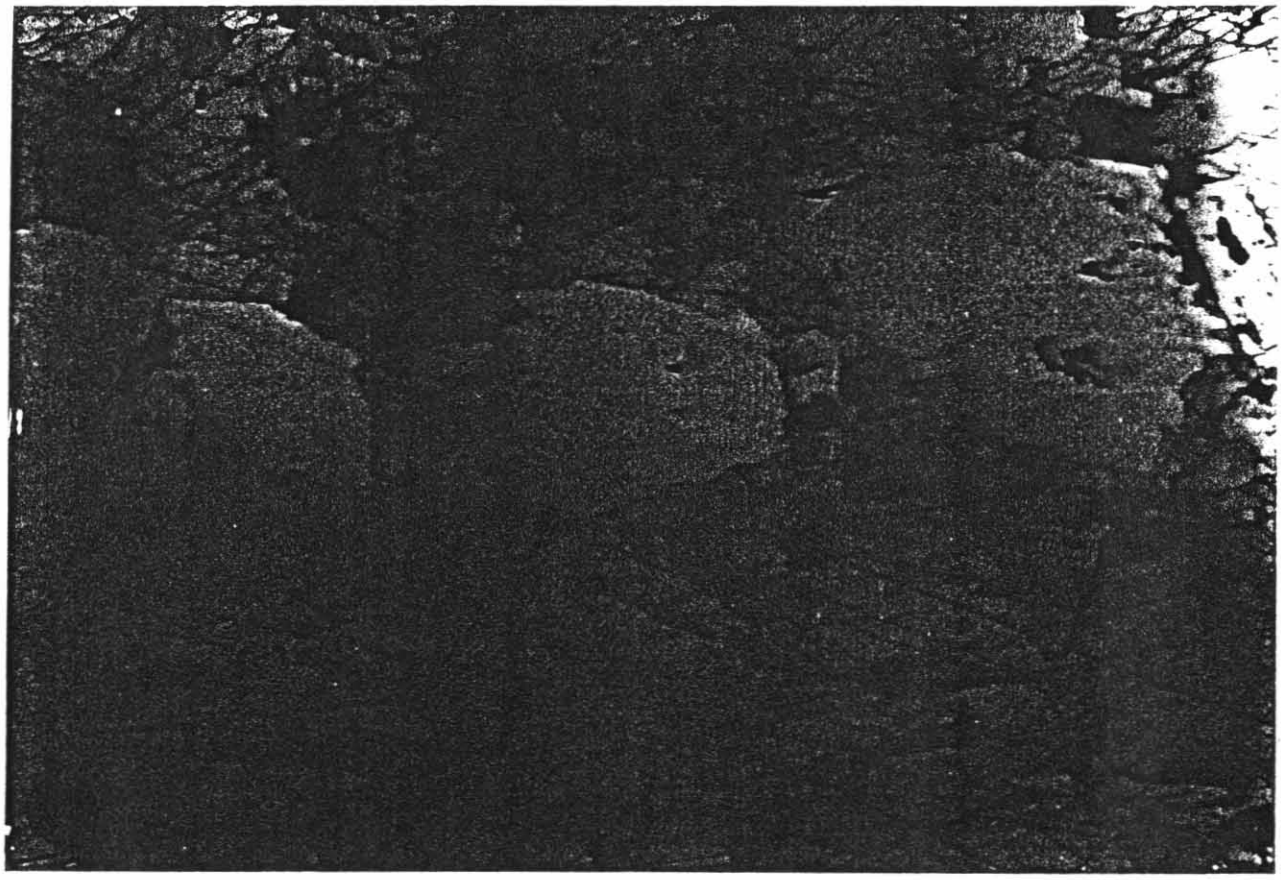
Sample: Magnesite from Messrs. C.R.A., Australia

Outline microphotograph, magnesite structure (coloured, coarser crystalline) with inclusions of quartz (blue, red purple, yellow-brown) and goethite (black).

5 cm

077043

Enclosure 4



0,1 mm

Microphotograph no. 4

polished section, etched with Al $(NO_3)_3$

magnification - microscope 100 x) 160 x
enlargement - photograph 1.6 x

Sample: Magnesite from Messrs. C.R.A., Australia

Dolomite vein (dark grey, etched; grinding scratches visible) with coarser inclusions of magnesite (medium grey, smooth).

Pores and cavities are black.

5 cm

Enclosure 5

0,1 mm

Microphotograph no. 5

polished section, etched with $Al(NO_3)_3$

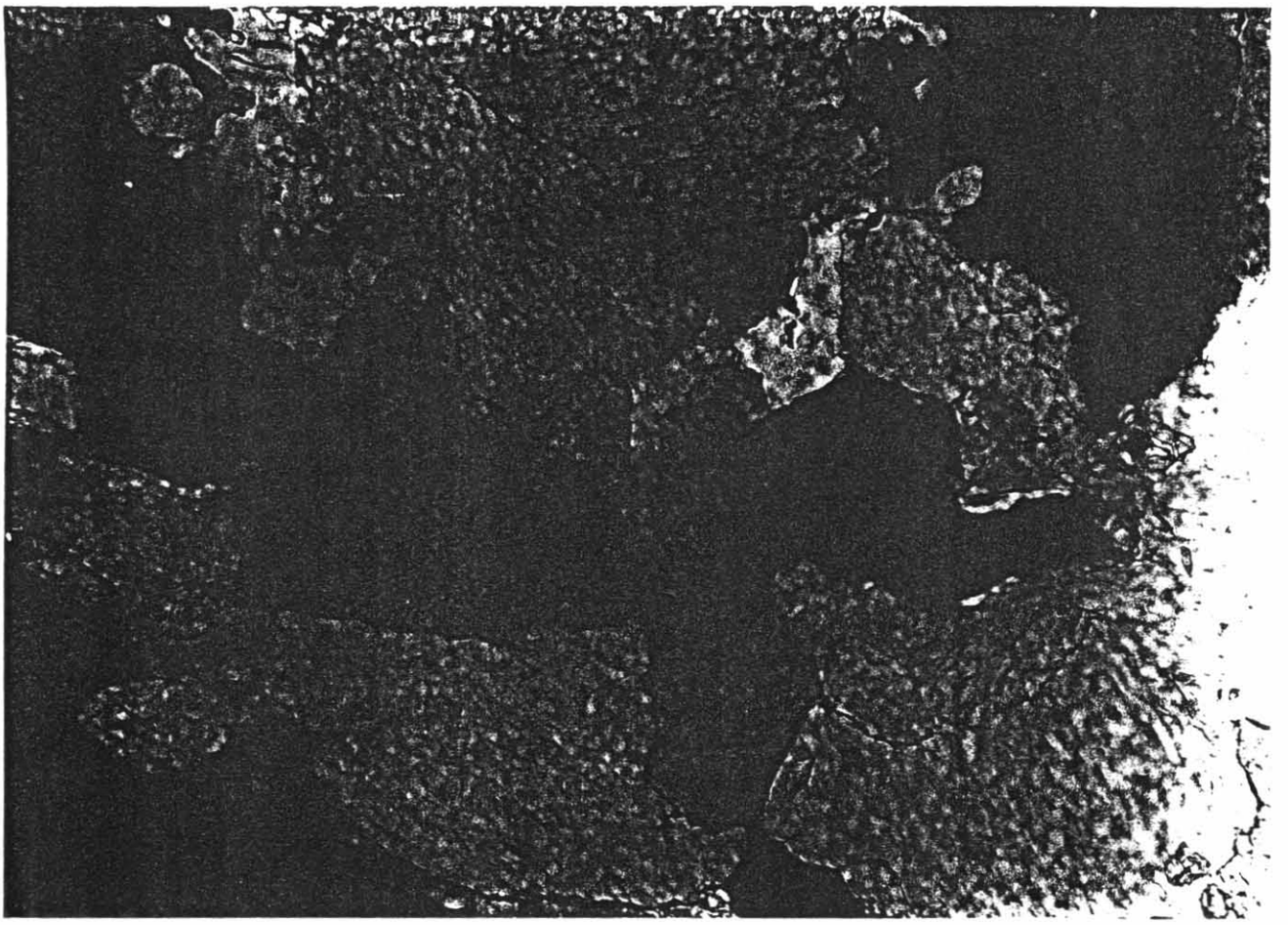
magnification - microscope 200 x)
enlargement - photograph 1.6 x) 320 x

Sample: magnesite from Messrs. C.R.A., Australia

Fine inclusions of dolomite (grey, D) in magnesite (grey, smooth).
Pores and cavities are black.

5 cm

Enclosure 6



0,1 mm

Microphotograph no. 6 thin section, N+

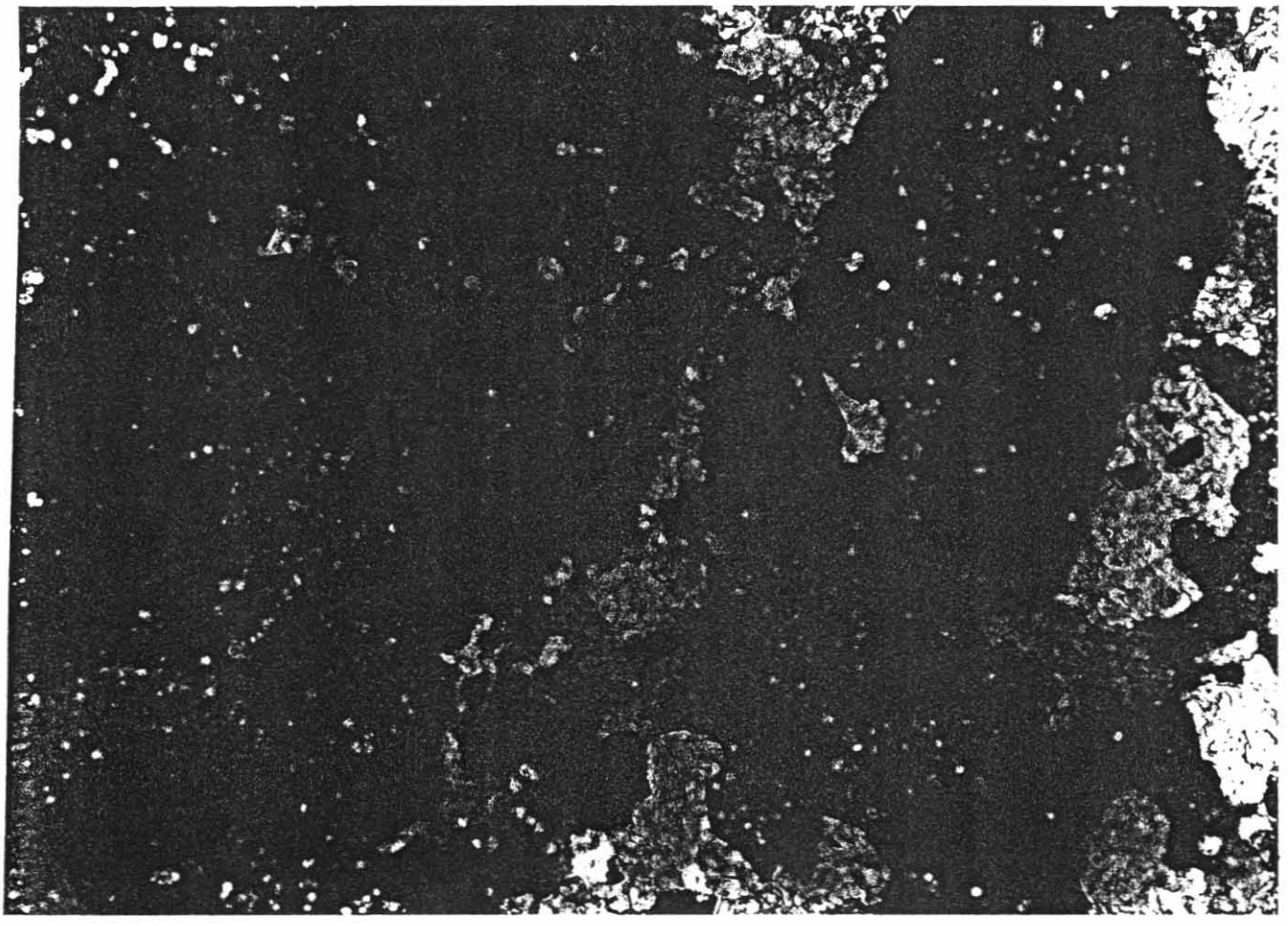
magnification - microscope 160 x)
enlargement - photograph 1.6 x) 256 x

Sample: magnesite from Messrs. C.R.A., Australia

Quartz (blue, light blue, yellow, red purple) partly displaying minute inclusions of magnesite (yellow to yellowish-green) as binder between the various magnesite crystallites (blue-purple, grey-green and grey-pink).

5 cm

Enclosure 7



0,1mm

Microphotograph no. 7 thin section, N +

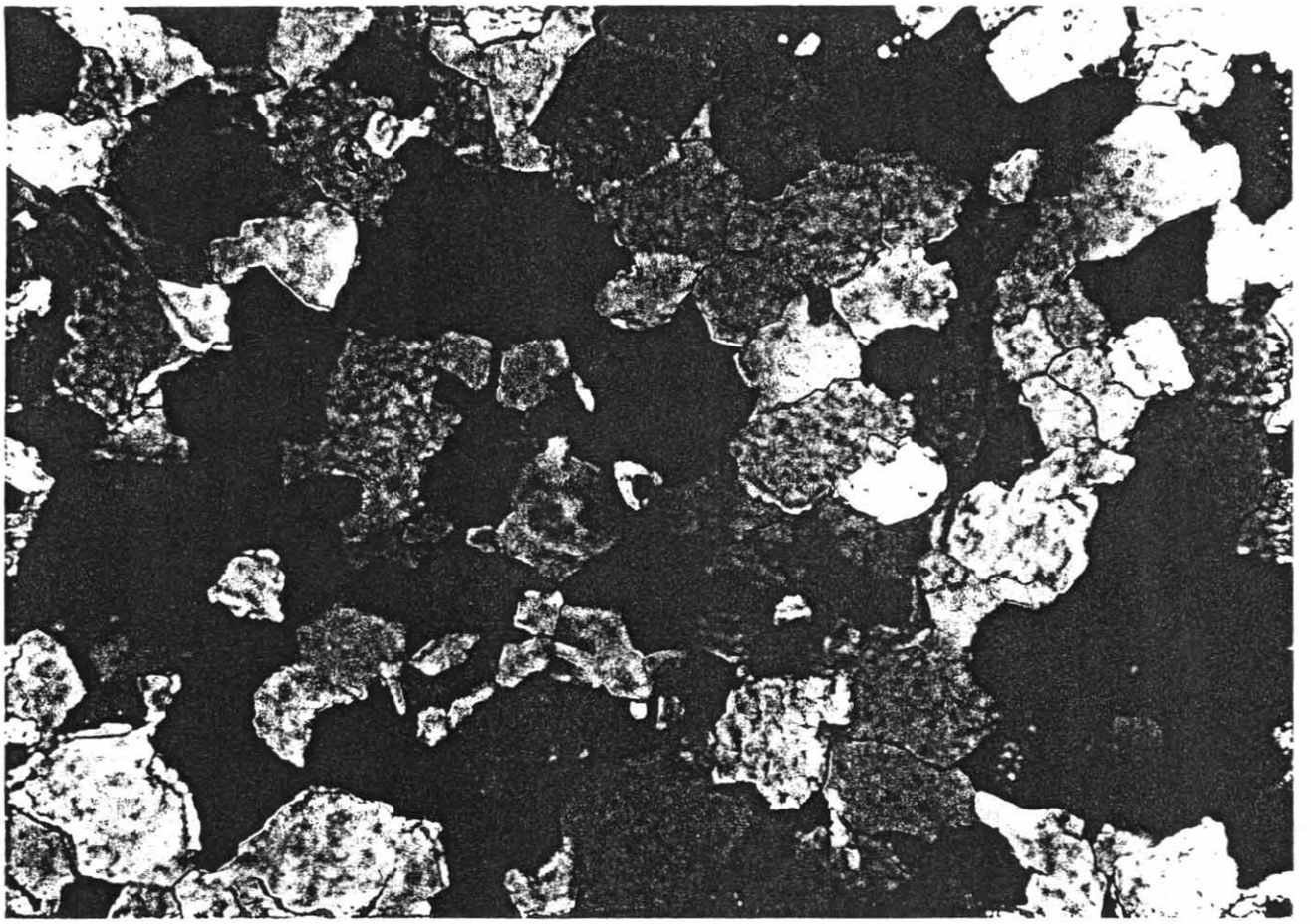
Magnification - microscope 160 x) 256 x
enlargement - photograph 1.6 x)

Sample: magnesite from Messrs. C.R.A., Australia

Quartz (orange-red, blue, red-purple, blue-purple), partly idiomorphic texture with fine and superfine inclusions of magnesite.

5 cm

Enclosure 8



0,1 mm

Microphotograph no. 8 thin section, N+

magnification - microscope 160 x)
enlargement - photograph 1.6 x) 256 x

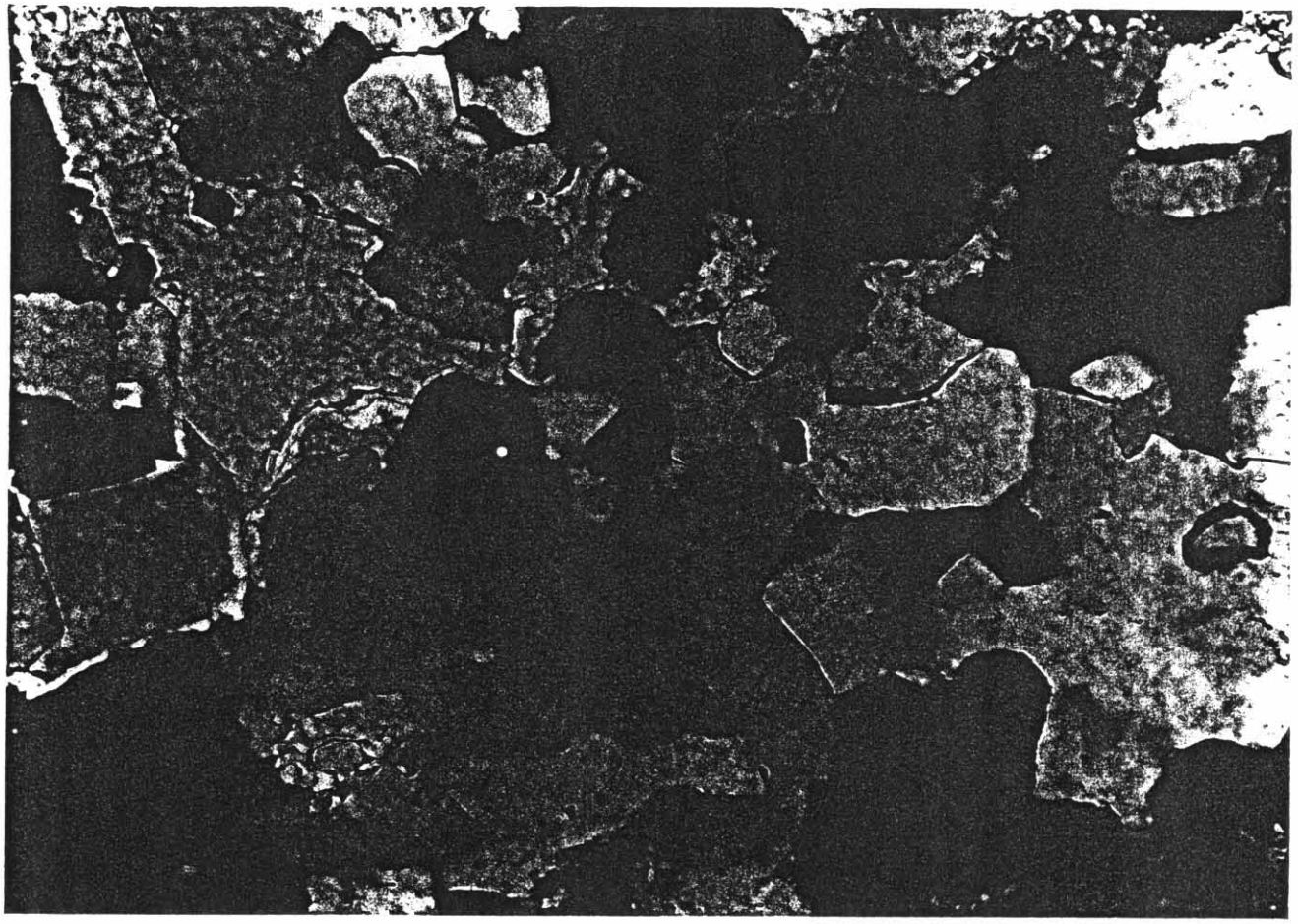
Sample: magnesite from Messrs. C.R.A., Australia

Intimate intergrowth between magnesite (coloured) and quartz (blue grey to black). The grainy structure of this batch is clearly displayed.

5 cm

077048

Enclosure 9



0,1mm

Microphotograph no. 9 thin section, N+

Magnification - microscope 160 x)
enlargement - photograph 1.6 x) 256 x

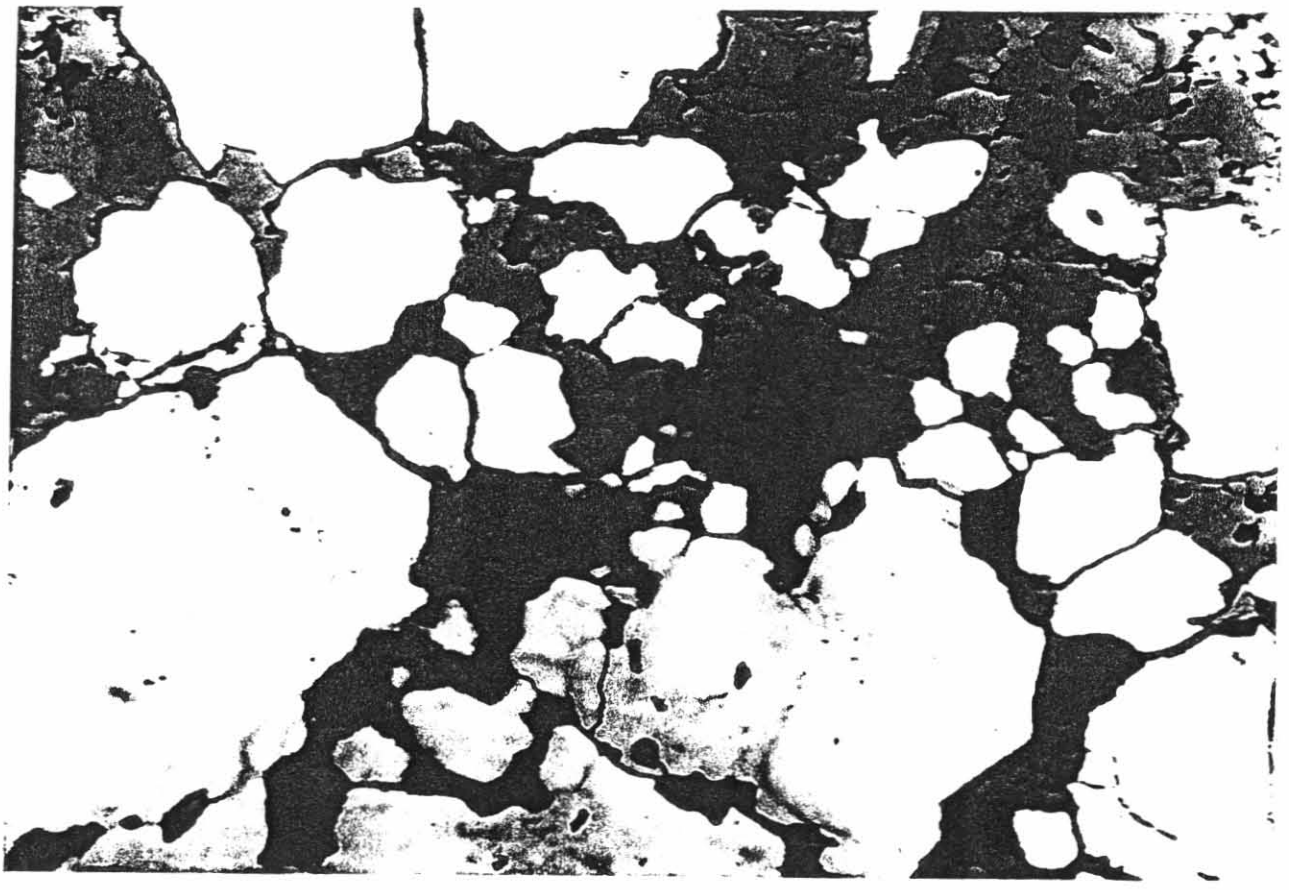
Sample: magnesite from Messrs. C.R.A., Australia

Magnesite (coloured) occurs as binder in quartz (light to dark grey and black). The sample displays occasional fine inclusions of quartz (black).

5 cm

077049

Enclosure 10



0,1 mm

Microphotograph no. 10

polished section, etched with $Al(NO_3)_3$

Magnification - microscope 100 x)
enlargement - photograph 1.6 x) 160 x

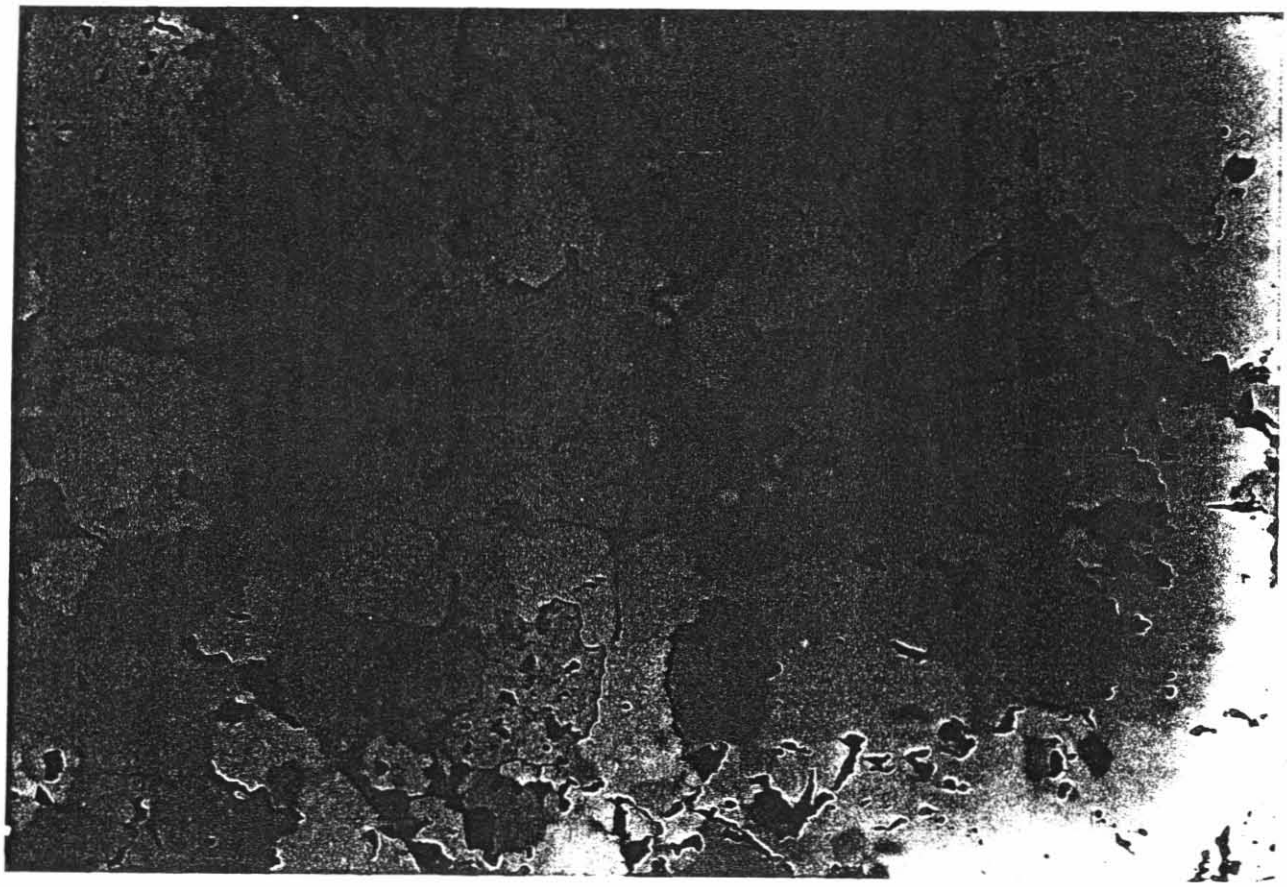
Sample: Magnesite from Messrs. C.R.A., Australia

Clusters of goethite (light grey) in magnesite (grey).

Pores and cavities are black.

5 cm

Enclosure 11



0,1 mm

Microphotograph no. 11

polished section, etched with $Al(NO_3)_3$

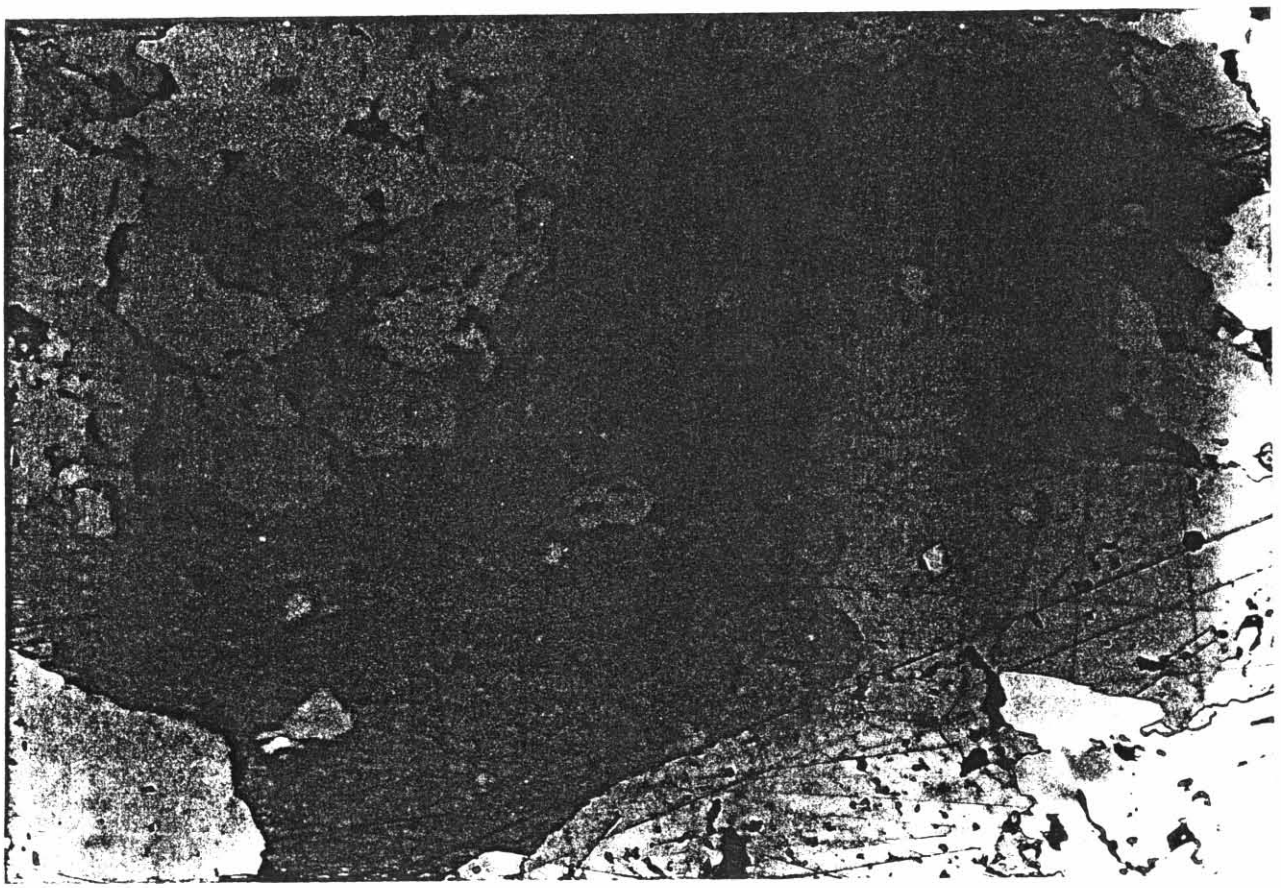
Magnification - microscope 100 x)
enlargement - photograph 1.6 x) 160 x

Sample: magnesite from Messrs. C.R.A., Australia

Dolomite (grey, etched, displaying grinding scratches) and calcite (dark grey, etched, rough) occurring as fine inclusions in magnesite (light- to medium grey, smooth).
Pores and cavities are black.

5 cm

Enclosure 12



0,1 mm

Microphotograph no. 12

polished section, etched with $Al(NO_3)_3$

Magnification - microscope 100 x)
enlargement - photograph 1.6 x) 160 x

Sample: magnesite from Messrs. C.R.A., Australia

Fairly coarse calcite (dark grey, rough) occurring in addition to dolomite (grey, showing grinding scratches) as inclusion in the magnesite (light to medium grey, smooth). The calcite contains minute magnesite inclusions.

Pores and cavities are black.

5 cm

S I N K - F L O A T - A N A L Y S I S

enclosure: 13
date: 06.05.1985
A.-Nr.: 9-8125-9-5011

client: CRA Ltd. / Australia
material: Magnesite
grain size: 5.6 - 0.5 mm

density	weight	recovery	MgO				CaO				SiO2			
			grade	recovery		content	grade	recovery		content	grade	recovery		content
Kg/L	%	add.%	%	%	add.%	%	%	%	add.%	%	%	%	add.%	%
-2.46	13.34	13.34	43.32	13.16	13.16	5.7789	1.15	15.06	15.06	.15341	6.87	15.70	15.70	.916458
2.46-2.54	2.88	16.22	43.18	2.83	16.00	1.2436	1.07	3.03	18.09	.030816	7.70	3.80	19.50	.22176
2.54-2.63	2.29	18.51	42.91	2.24	18.24	.9826	1.17	2.63	20.72	.026793	8.11	3.18	22.68	.185719
2.63-2.73	6.46	24.97	42.02	6.18	24.42	2.7145	1.30	8.25	28.97	.08398	9.77	10.81	33.49	.631142
2.73-2.77	10.43	35.40	42.88	10.19	34.61	4.4724	1.46	14.95	43.92	.152278	8.11	14.49	47.98	.845873
2.77-2.83	23.50	58.90	43.69	23.39	58.00	10.2672	.93	21.46	65.38	.21855	5.95	23.95	71.94	1.39825
2.83-2.88	5.67	64.57	44.69	5.77	63.77	2.5339	.79	4.40	69.78	.044793	4.57	4.44	76.38	.259119
+2.88	13.69	78.26	45.80	14.28	78.05	6.2700	.39	5.24	75.02	.053391	3.07	7.20	83.58	.420283
- 0.5 mm	21.74	100.00	44.31	21.95	100.00	9.6330	1.17	24.98	100.00	.254358	4.41	16.42	100.00	.958734
Summe:	100.00	---	43.81	100.00	---	43.8961	1.14	100.00	---	1.01837	5.60	100.00	---	5.83734

0770052

077053

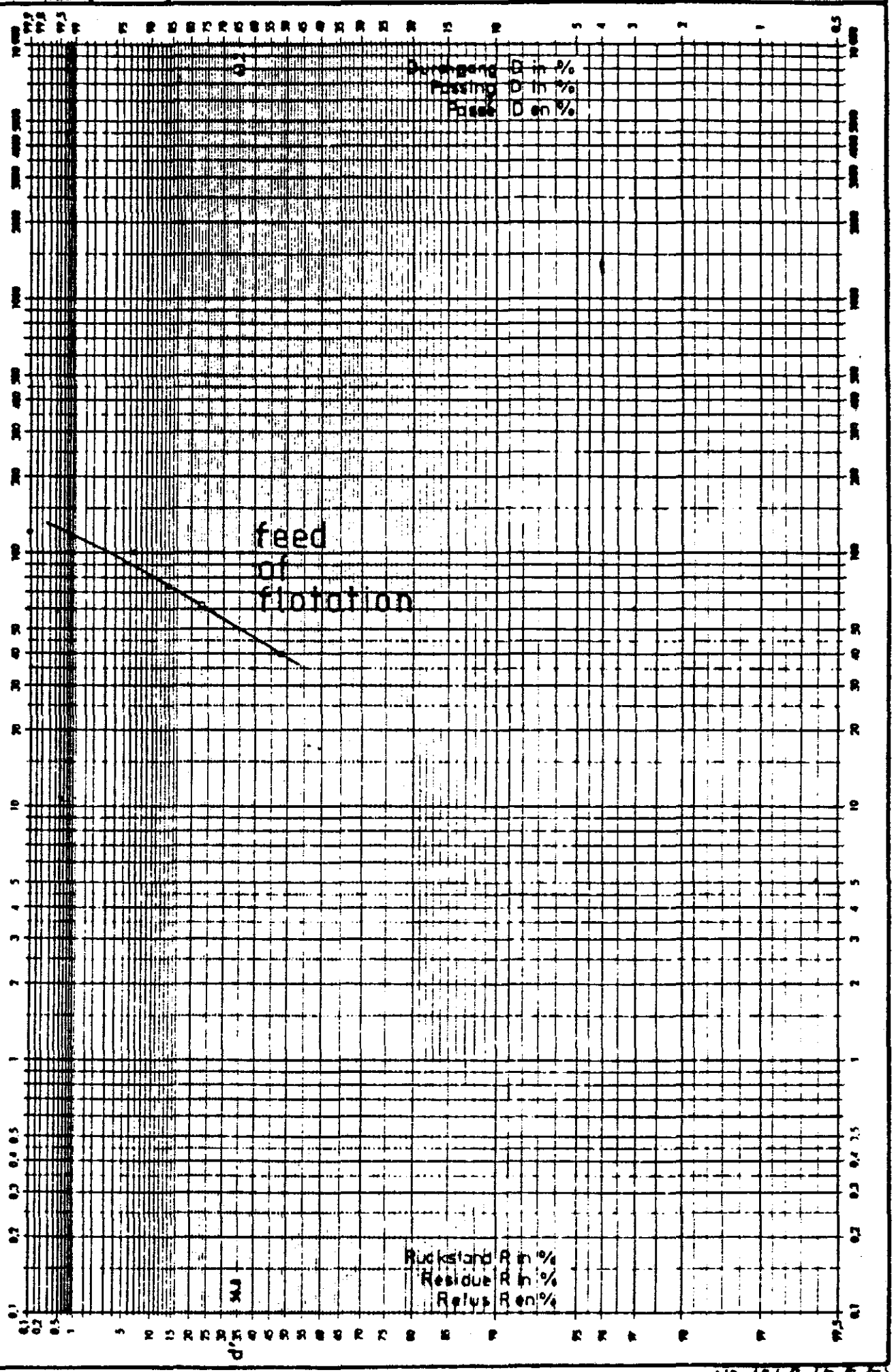
Körnungsnetz / Grading graph
Diagramme granulométrique

Enclosure: 14
Datum:
Date: 25.7.85

Maschine:
Machine:
Appareil: Rod mill

Firma:
Customer:
Client: CRA

Stoff:
Material:
Produit: Magnesite



HB 454/1 (D/E/F)

B A L A N C E

enclosure : 15
date: 25.05.1985
A. - Nr.: 9-8125-9-5011

client: CRA Ltd. / Australia
material: magnesite discharge of the rod mill
84 % - 0.075 mm, 52 % - 0.040 mm
procedure: flotation test 6139
Humboldt Wedag 3 l - flotation cell

product	weight	recovery	MgO				CaO				SiO2			
			grade	recovery		content	grade	recovery		content	grade	recovery		content
	%	add.%	%	%	add.%	%	%	%	add.%	%	%	%	add.%	%
SiO2-product 1	7.95	7.95	28.69	5.23	5.23	2.2809	.61	4.35	4.35	.0485	38.70	53.23	53.23	3.0767
SiO2-product 2	17.13	25.08	39.71	15.60	20.83	6.8023	.71	10.91	15.26	.1216	14.43	42.76	95.99	2.4719
MgO-product 1	9.19	34.27	46.25	9.75	30.58	4.2504	.74	6.10	21.36	.0680	1.06	1.69	97.68	.0974
MgO-product 2	49.64	83.91	47.00	53.50	84.08	23.3308	.39	17.37	38.73	.1936	.13	1.12	98.79	.0645
MgO-product 3	10.73	94.64	45.10	11.10	95.18	4.8392	2.31	22.23	60.96	.2479	.22	.41	99.20	.0236
tailings	5.36	100.00	39.21	4.82	100.00	2.1017	8.12	39.04	100.00	.4352	.86	.80	100.00	.0461
feed	100.00	---	43.81	100.00	---	43.6052	1.14	100.00	---	1.1148	5.60	100.00	---	5.7802

product	weight	recovery	MgO				CaO				SiO2			
			grade	recovery		content	grade	recovery		content	grade	recovery		content
	%	add.%	%	%	add.%	%	%	%	add.%	%	%	%	add.%	%
SiO2 - product	25.08	25.08	36.22	20.83	20.83	9.0840	.68	15.30	15.30	.1705	22.12	96.00	96.00	5.5477
MgO-concentrate	63.83	88.91	46.74	68.42	89.25	29.8341	.59	33.78	49.07	.3766	.27	2.98	98.98	.1723
tailings	11.09	100.00	42.25	10.75	100.00	4.6855	5.12	50.93	100.00	.5678	.53	1.02	100.00	.0588
feed	100.00	---	43.81	100.00	---	43.6036	1.14	100.00	---	1.1149	5.60	100.00	---	5.7788

027054

B A L A N C E

enclosure : 16
date: 25.05.1985
A. - Nr.: 9-8125-9-5011

client: CRA Ltd. / Australia
material: magnesite discharge of the rod mill
84 % - 0.075 mm, 52 % - 0.040 mm
procedure: flotation test 6139
Humboldt Wedag 3 l - flotation cell

dead burned basis

product	weight		recovery	MgO				CaO				SiO2			
				grade	recovery		content	grade	recovery		content	grade	recovery		content
	%	add.%		%	%	add.%	%	%	%	add.%	%	%	%	add.%	%
SiO2-product 1	7.95	7.95		41.27	3.79	3.79	3.2810	.88	3.20	3.20	.0700	55.67	47.56	47.56	4.4258
SiO2-product 2	17.13	25.08		70.82	14.02	17.81	12.1315	1.27	9.96	13.17	.2176	25.74	47.39	94.95	4.4093
MgO-product 1	9.19	34.27		94.33	10.02	27.83	8.6689	1.51	6.36	19.52	.1388	2.16	2.13	97.08	.1985
MgO-product 2	49.64	83.91		97.53	55.95	83.79	48.4139	.81	18.42	37.94	.4021	.27	1.44	98.52	.1340
MgO-product 3	10.73	94.64		92.21	11.44	95.22	9.8941	4.72	23.20	61.14	.5065	.45	.52	99.04	.0483
tailings	5.36	100.00		77.13	4.78	100.00	4.1342	15.83	38.86	100.00	.8485	1.66	.96	100.00	.0890
feed	100.00	---		85.13	100.00	---	86.5236	2.22	100.00	---	2.1833	10.88	100.00	---	9.3048

product	weight		recovery	MgO				CaO				SiO2			
				grade	recovery		content	grade	recovery		content	grade	recovery		content
	%	add.%		%	%	add.%	%	%	%	add.%	%	%	%	add.%	%
SiO2 - product	25.08	25.08		61.45	17.81	17.81	15.4117	1.15	13.19	13.19	.2884	35.23	94.93	94.93	8.8357
MgO-concentrate	63.83	88.91		96.65	71.30	89.12	61.6917	1.22	35.62	48.81	.7787	.56	3.84	98.77	.3574
tailings	11.09	100.00		84.92	10.88	100.00	9.4176	10.09	51.19	100.00	1.1190	1.03	1.23	100.00	.1142
feed	100.00	---		85.13	100.00	---	86.5210	2.22	100.00	---	2.1861	10.88	100.00	---	9.3074

0770352

B A L A N C E

enclosure : 17
date: 25.05.1985
A. - Nr.: 9-8125-9-5011

client: CRA Ltd. / Australia
material: magnesite discharge of the rod mill
84 % - 0.075 mm, 52 % - 0.040 mm
procedure: flotation test 6141
Humboldt Wedag 3 l - flotation cell

product	weight	recovery	MgO				CaO				SiO2			
			grade	recovery		content	grade	recovery		content	grade	recovery		content
	%	add.%	%	%	add.%	%	%	%	add.%	%	%	%	add.%	%
SiO2-product 1	8.32	8.32	25.80	4.92	4.92	2.1466	.55	4.40	4.40	.0458	45.06	65.25	65.25	3.7490
SiO2-product 2	11.51	19.83	39.51	10.43	15.35	4.5476	.72	7.97	12.37	.0829	14.82	29.69	94.95	1.7058
MgO-product 1	9.45	29.28	46.17	10.01	25.36	4.3631	.71	6.45	18.82	.0671	1.59	2.62	97.56	.1503
MgO-product 2	59.30	88.58	46.71	63.53	88.89	27.6990	.50	28.51	47.33	.2965	.16	1.65	99.21	.0949
MgO-product 3	6.78	95.36	44.47	6.92	95.81	3.0151	2.90	18.90	66.23	.1966	.25	.30	99.51	.0170
tailings	4.64	100.00	39.41	4.19	100.00	1.8286	7.57	33.77	100.00	.3512	.61	.49	100.00	.0283
feed	100.00	---	43.81	100.00	---	43.5999	1.14	100.00	---	1.0401	5.60	100.00	---	5.7452

product	weight	recovery	MgO				CaO				SiO2			
			grade	recovery		content	grade	recovery		content	grade	recovery		content
	%	add.%	%	%	add.%	%	%	%	add.%	%	%	%	add.%	%
SiO2 - product	26.28	26.28	36.80	22.18	22.18	9.6710	.66	16.70	16.70	.1734	21.15	96.73	96.73	5.5582
MgO-concentrate	65.30	91.58	46.58	69.77	91.95	30.4167	.62	38.97	55.67	.4049	.23	2.61	99.34	.1502
tailings	8.42	100.00	41.68	8.05	100.00	3.5095	5.47	44.33	100.00	.4606	.45	.66	100.00	.0379
feed	100.00	---	43.81	100.00	---	43.5972	1.14	100.00	---	1.0389	5.60	100.00	---	5.7463

070056

B A L A N C E

enclosure : 18
date: 25.05.1985
A. - Nr.: 9-8125-9-5011

client: CRA Ltd. / Australia
material: magnesite discharge of the rod mill
84 % - 0.075 mm, 52 % - 0.040 mm
procedure: flotation test 6141
Humboldt Wedag 3 l - flotation cell

dead burned basis

product	weight		MgO				CaO				SiO2			
		recovery	grade	recovery		content	grade	recovery		content	grade	recovery		content
	%	add.%	%	%	add.%	%	%	%	add.%	%	%	%	add.%	%
SiO2-product 1	8.32	8.32	35.51	3.41	3.41	2.9544	.76	3.09	3.09	.0632	62.02	58.79	58.79	5.1601
SiO2-product 2	11.51	19.83	70.15	9.33	12.74	8.0743	1.28	7.21	10.30	.1473	26.31	34.50	93.29	3.0283
MgO-product 1	9.45	29.28	93.29	10.18	22.92	8.8159	1.43	6.61	16.92	.1351	3.21	3.46	96.75	.3033
MgO-product 2	59.30	88.58	96.15	65.86	88.78	57.0170	1.03	29.89	46.80	.6108	.33	2.23	98.98	.1957
MgO-product 3	6.78	95.36	90.46	7.08	95.87	6.1332	5.90	19.57	66.38	.4000	.51	.39	99.37	.0346
tailings	4.64	100.00	77.11	4.13	100.00	3.5779	14.81	33.62	100.00	.6872	1.19	.63	100.00	.0552
feed	100.00	---	85.13	100.00	---	86.5726	2.22	100.00	---	2.0437	10.88	100.00	---	8.7772

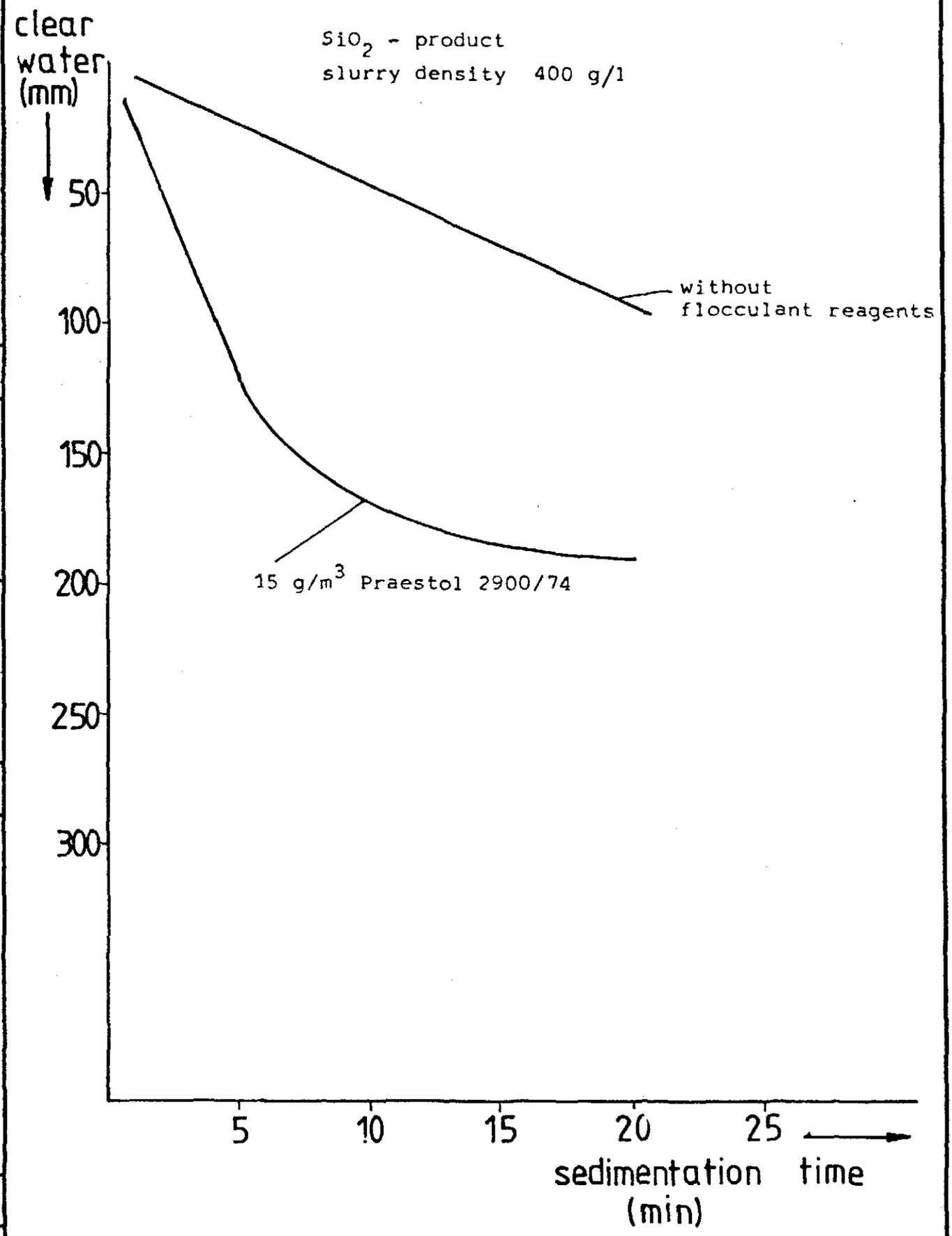
product	weight		MgO				CaO				SiO2			
		recovery	grade	recovery		content	grade	recovery		content	grade	recovery		content
	%	add.%	%	%	add.%	%	%	%	add.%	%	%	%	add.%	%
SiO2 - product	26.28	26.28	64.86	19.69	19.69	17.0452	1.15	14.80	14.80	.3022	31.95	95.66	95.66	8.3965
MgO-concentrate	65.30	91.58	95.76	72.23	91.92	62.5313	1.27	40.62	55.42	.8293	.47	3.50	99.16	.3069
tailings	8.42	100.00	83.10	8.08	100.00	6.9970	10.81	44.58	100.00	.9102	.88	.84	100.00	.0741
feed	100.00	---	85.13	100.00	---	86.5735	2.22	100.00	---	2.0417	10.88	100.00	---	8.7775

027057

HUMBOLDT WEDAG

Settling curve SiO_2 - product

enclosure 19



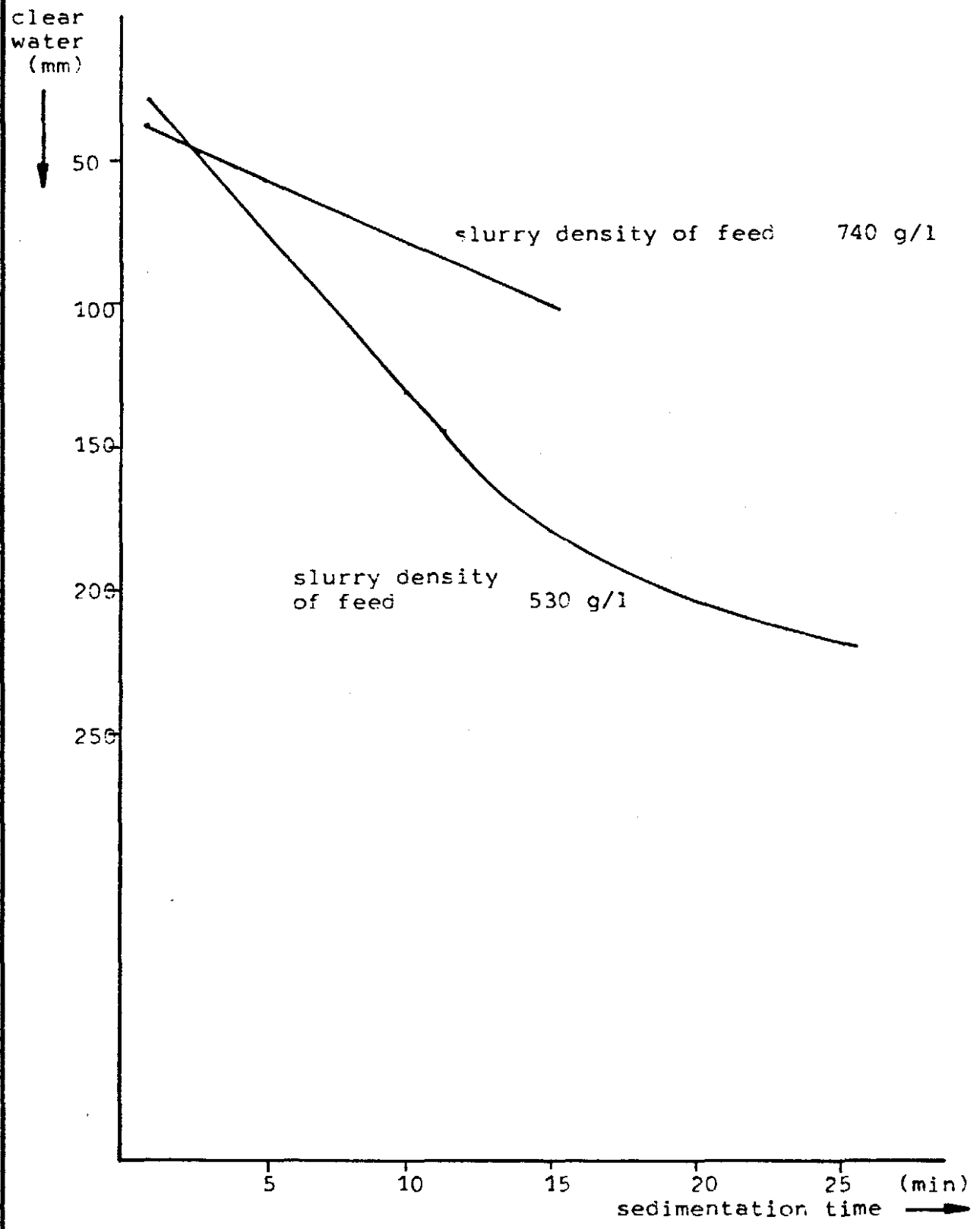
Hb 370/1

HUMBOLDT WEDAG

S E T T L I N G C U R V E

MgO - concentrate

enclosure 20



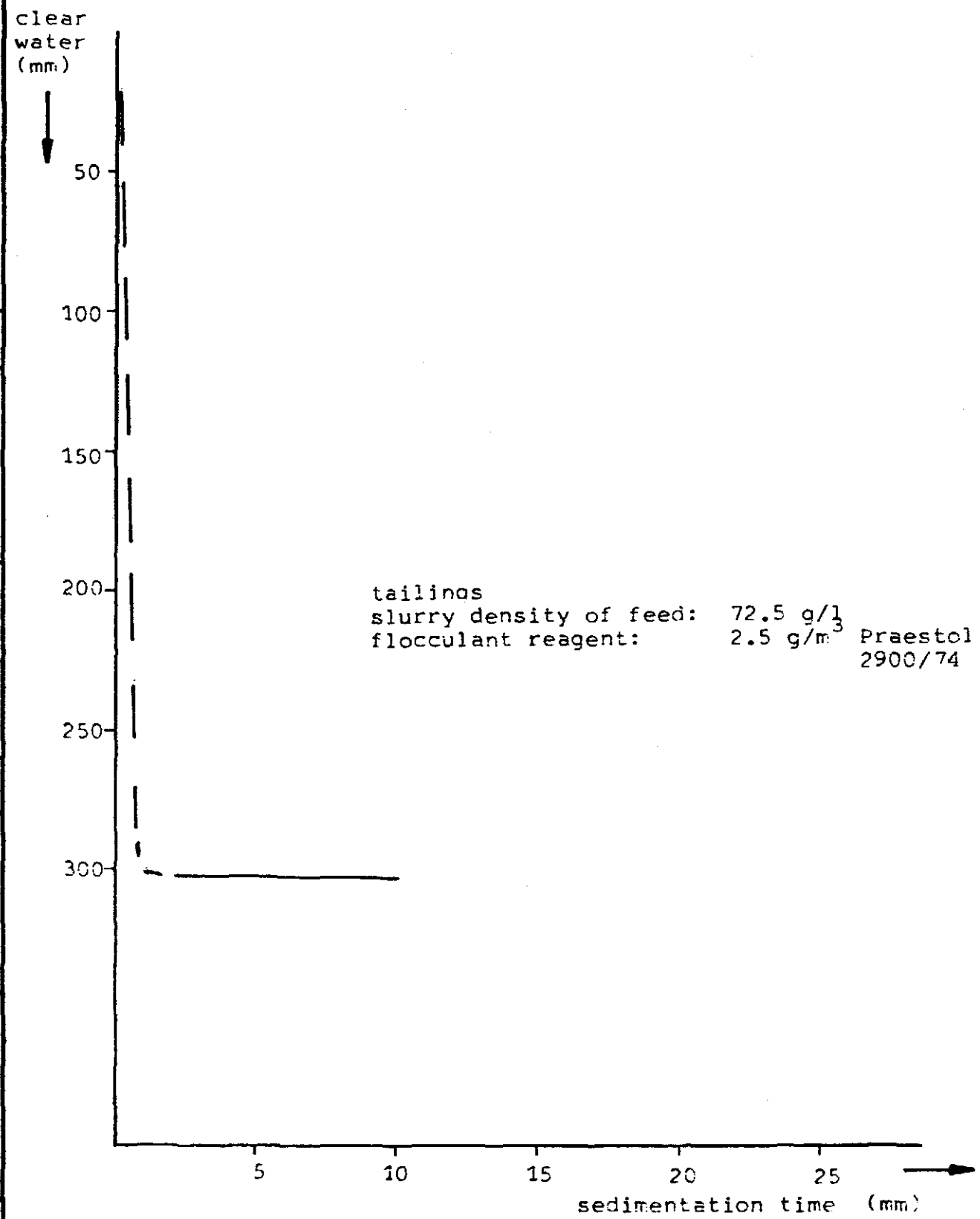
Hb 370/1

HUMBOLDT WEDAG

SETTLING CURVE

tailings

enclosure 21



tailings
slurry density of feed: 72.5 g/l
flocculant reagent: 2.5 g/m³ Praestol 2900/74

Hb 370/1

enclosure 22

List of filtration tests

MgO-concentrate

test no.	slurry density	suction time	drying time	height	filtration cake weight		moisture	calc. capacity (dry)
					wet	dry		
	g/l	sec	sec	mm	g	g	%	kg/(h · m²)
4	553	40	40	16	316	284	10,1	1022
5	553	40	80	20	328	304	7,3	730
6	553	40	60	20	320	294	8,1	852
11	1400	20	60	36	667	598	10,3	2153
12	1400	20	40	35	680	606	10,9	2909
13	1400	20	80	34,5	664	602	9,2	1746

0774061

077062 ITEM 2 — SUPPLEMENT

KHD HUMBOLDT WEDAG AG

Köln-Porz, August 06, 1985
IH-YS 2 Wi/He - phone ext. 658
KOVS ro

Supplement to

R E P O R T

on

process-engineering tests
carried out with magnesite
for Conzinc Riotinto Australia Ltd. (CRA),
Melbourne/Australia
P.-No. 9-2121-5-6089
A.-No. 9-8125-9-5011

1. Summary

The tests carried out for producing a larger quantity of magnesite concentrate have shown that the particle size distribution of the flotation feed is of considerable importance. Regarding the MgO-recovery, the results achieved by the laboratory flotation tests, during which the size of the samples was reduced by means of rod grinding, could not be achieved with the ground product of the ball mill. This is probably attributable to the higher fines portion in the product discharged from the ball mill as against the product discharged from the rod mill.

During a multiple-batch test, a magnesite product of an MgO-content of approx. 97 % and an SiO_2-content of 0.58 % (related to burnt magnesite) was produced by way of three-stage flotation at a concentrate recovery of 57.6 %.

TN 0103 0431/04
(HW 3002/4)
50000 1.85 O

KHD HUMBOLDT WEDAG AG

2

2. Size reduction

2.1 Preliminary size reduction

For production of the required quantity of concentrate and implementation of the multiple-batch test, approx. 150 kg of raw magnesite were crushed to a fineness of 100 % less than 5.6 mm by way of a jaw crusher with intermediately arranged sieve. The product had the following particle size distribution:

product jaw crusher / feed - ball mill

grain size mm			portions in % by weight	cumulative portions in % by weight
	+	4	21.3	21.3
4	-	2.8	21.9	43.2
2.8	-	2	12.4	55.6
2	-	1	15.8	71.4
1	-	0.5	8.4	79.8
0.5	-	0.315	3.0	82.8
0.315	-	0.18	2.8	85.6
0.18	-	0.125	1.7	87.3
	-	0.125	12.7	100.0

2.2 Grinding

A discontinuously operating ball mill of 600 mm diameter with obliquely arranged grinding vessel with a contents of 50 l was applied for fine grinding.

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The grinding vessel made of wear-resistant cast steel is arranged as rotation ellipsoid at an inclination of 30°. The operating speed equals $n = 50\ min^{-1}$. The drive has a capacity of 1.1 kW. The ball charge was selected as follows:

ball diameter mm	mass kg
40	40
30	36
25	13
≤ 20	11

During all grinding tests the solids/water-mass ratio equalled 1 and the feed quantity / batch approx. amounted to 20 kg of magnesite. Grinding was done batchwise in closed-circuit operation - mill - sieve - mill. After each grinding operation the total ground material was subjected to wet classification by means of a vibratory screen (make Sweco), which was covered by a 0.142 mm-screen deck. The residues retained, mixed with raw magnesite (together approx. 20 kg) served as feed material for next batch grinding. A circulating load of approx. 30 % resulted for each batch at a grinding period of 10 minutes. The particle size distribution of the combined ground product after six batches including chemical analyses of the fractions can be taken from enclosure 1. During a second closed-circuit grinding the grinding period was shortened to 6 minutes/batch, which resulted in an increase of the circulating load to more than 100 %.

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However, the sizing characteristic obtained essentially corresponds to that for the first grinding operation.
In case of the two grinding operations carried out in the ball mill, the particle size distribution of the feed material for the laboratory flotation tests could not be exactly reached. Rod grinding combined with intermediate sieving in the laboratory mill was more heedful (see enclosure 2), i.e. it produced less quantities of superfine material.

3. Flotation

The results of the laboratory flotation tests could be applied to the tests for production of the concentrate quantity only to a limited degree. On the one hand the quantity of reagents had to be adjusted due to the higher hardness of the water (approx. 15° German hardness instead of 10° German hardness). Proportioning of the calcite- and dolomite depressing agent EKOFACT DD 95 had to be reduced considerably and addition of the magnesite collector RESANOL A had to be increased, at least during the tests without medium-size material.

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On the other hand, the flotation periods and the mode of operation had to be modified due to the varying mode of grinding (grinding in a ball mill instead of grinding in a rod mill). On the whole, SiO_2-flotation of the product discharged from the ball mill was less selective than that of the product discharged from the rod mill, which probably is attributable to the higher fines portion of less than approx. 0.01 mm in the ground product. The SiO_2-froth always contained a not insignificant portion of magnesite. Since the required purity in the MgO-concentrate for this material in a two-stage flotation process without secondary cleaning can be achieved only if the quartz during SiO_2-flotation is recovered at approx. 95 % in the froth product, a higher loss of magnesite will occur in this processing stage at lower selectivity.
For partly making good for this loss of recovery, it was required to accept a lower SiO_2-recovery during SiO_2-flotation and to subject the froth of magnesite flotation to secondary cleaning (see enclosure 3).

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3.1 Multiple-batch test

A multiple-batch test was carried out after a series of preliminary tests for matching the proportioning rate of reagents to the changed conditions. To that end, a Humboldt-cell of a capacity of 18 l with double wobble agitator was applied. 6 kg of ground raw magnesite of a fineness of 86 % less than 0.090 mm were fed per batch.

The reagents below were applied for SiO_2-flotation:

EKOFACT DD 95	75 g/t of ore
RESANOL 450	150 g/t of ore in three batches (80 g/t at the beginning, 2 x 35 g/t during flotation)

The conditioning period for EKOFACT DD 95 equalled two minutes and five minutes for RESANOL 450 (1st addition). The overall duration of flotation equalled 8 - 10 minutes.

Prior to subsequent MgO-flotation, soda waterglass at a proportioning rate of 400 g/t of ore was admitted for deadening the quartz. The collecting-/effervescing reagent combination RESANOL A was admitted after a conditioning period of approx. 1 minute. MgO-flotation was started after a short period of conditioning. RESANOL A was added twice.
During the preliminary tests carried out with the water of greater hardness and during the first runs of the multiple-batch test, the required proportioning rate for RESANOL A amounted to 800 - 1000 g/t of ore.

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As from batch 10 of the multiple-batch test up to the end of flotation, the consumption could be reduced to 500 g/t of ore due to recycling of the medium-size.
Compared to the laboratory tests, addition of EKOFACT DD 95 had to be strongly reduced, since the magnesite recovery was substantially lowered upon higher proportioning rates.

Contrary to the laboratory tests, provision was made for a secondary cleaning stage for flotation of magnesite. The magnesite froth was collected, mixed with soda waterglass (300 g/t of raw ore, resp. approx. 450 g/t of magnesite froth) and subjected to secondary flotation after a short conditioning period. The cleaned froth was the final magnesite concentrate and the residues retained in the cell (approx. 10 % by weight related to raw ore and 15 - 20 % by weight related to the magnesite concentrate, respectively) were added to the next batch after completion of SiO_2-flotation (see enclosure 3).
The products obtained from flotation of the last batch were dried, weighed and chemical analyses were made. The product distribution is listed on next page.

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Product	% by weight	loss on ignition %	MgO-content %	SiO_2-content %	CaO-content %	Fe_2O_3-content %
SiO_2-product	32.04	42.00	39.00	16.41	0.86	0.72
MgO-concentrate	57.64	51.41	47.17	0.28	0.3	0.51
tailings	10.32	48.12	40.52	3.71	10.31	1.38
feed (calc.)	100	-	43.87	5.80	1.00	0.67
(found)		48.54	43.81	5.60	1.14	0.51
medium-size (circulating load)	10.60	50.64	45.36	0.93	1.83	0.82
sum	110.60					

By variation of the admitting rate of depressing agent, the ratio of the CaO/SiO_2-contents can probably be raised to more than 2.

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3.2 Secondary cleaning of the SiO_2-product

An SiO_2-product of one cycle of the multiple-batch test was subjected to secondary cleaning. After a flotation period of 3 minutes for the froth product without addition of reagents, RESANOL 450 (60 g/t) was added and SiO_2-flotation was discontinued after additional 3 minutes. Following this, attempts were made to win a froth product of low SiO_2-content by means of soda waterglass as depressing reagent and RESANOL A as collecting/effervescing reagent. The product distribution shown below reveals that this objective could not be reached.

Product	% by weight	SiO_2-content %
froth 1	45	25.7
froth 2	46) 55	2.3) 7.75
residues	9)	35.6)
SiO_2-product	100	15.8

3.3 Production of concentrate

A total of 57 kg of final concentrate was produced from the magnesite products of the multiple-batch test as well as from the previous tests carried out with the 18 l-Humboldt-flotation cell. The chemical composition of this concentrate calculated on the basis of the analyses for the different products is as follows:

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	non-ignited	ignited
MgO-content (%):	46.31	96.54
CaO-content (%):	0.40	0.81
SiO_2-content(%):	0.27	0.55
Fe_2O_3-content (%):	0.5	1.03

The tests were carried out by us to the best of our knowledge and ability. A liability, in particular for the process engineering results of machines, plant sections or plants delivered by us, can be undertaken by us only if this has been agreed upon in writing.

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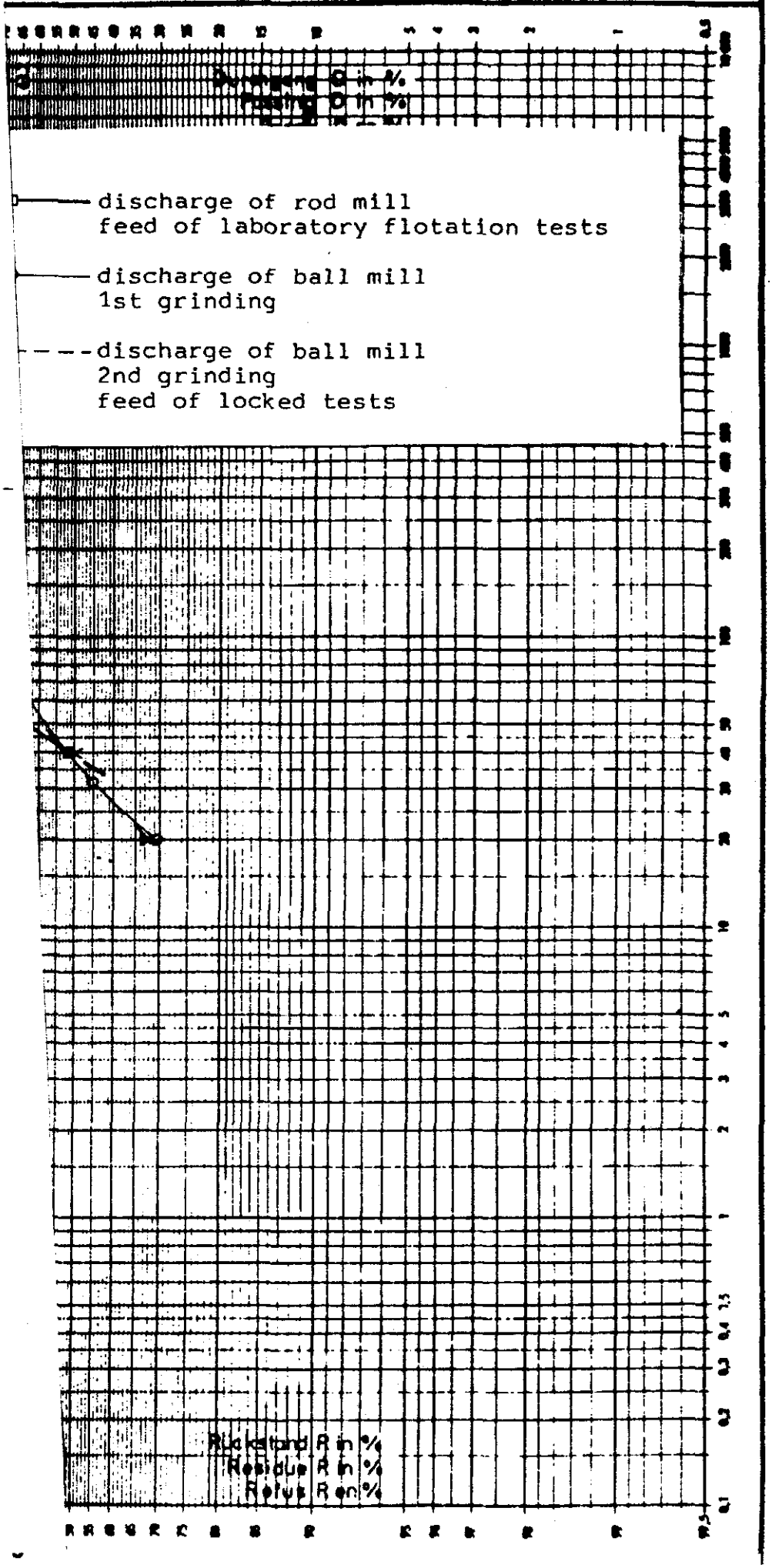
Dr. Imhof Dr. Bleckmann

Körnungsnetz / Grading graph
Diagramme granulométrique

enclosure: 2
Datum: Date: 15.07.85



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MAGNESITE

Flow - sheet locked test

enclosure 3

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