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PROPOSAL FOR A FEASIBILITY STUDY

INTO

THE PRODUCTION OF MAGNESIUM METAL

AND ORES IN NORTHERN TASMANIA

MICROFILMED
FICHE No. 013074-

21 January 1992

TO BE ACCESSIONED
CLOSED FILE
RK 8717 & RK 8718

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PROPOSAL FOR A FEASIBILITY STUDY INTO THE PRODUCTION OF MAGNESIUM
METAL AND ORES IN NORTHERN TASMANIA

A. MAGNESIUM METAL

1. INTRODUCTION

The western world production of magnesium is about 250,000 tonnes per annum and there is maybe another 70,000 tonnes production in the former Communist countries. Australia does not produce any magnesium in spite of the presence of several world class ore deposits. It has a consumption of about 5000 tonnes per annum.

For decades, there have been predictions that magnesium "is about to take off". The 20 kg of magnesium used by the Volkswagon "Beetle" for die cast crankcase and transmission housings was often quoted as "proof" that the metal had penetrated the automotive industry but in fact it had not. There was, however, an increase of 35% in the use of magnesium in the U.S. auto industry over the past three years (1).

What has held back the growth of magnesium consumption ?
It has not been

- . the scarcity of magnesium ores
- . excessive energy consumption
- . difficult casting and fabrication technologies
- . flammability problems
- . environmental restrictions

The answer to the question is firstly price relative to aluminium and secondly (to some extent) the structure of the industry.

The principal object of this Proposal is to suggest that improved technology to which Mineral Holdings Australia (MHA) has access, together with the availability of excellent ores of magnesium and silicon in coastal deposits of Northern Tasmania, may offer a cost competitive entry into magnesium production.

2. THE PRICE REDUCTION REQUIRED

The principal competitor of magnesium is aluminium and the early growth of magnesium will depend largely on its ability to displace some of the aluminium and also zinc die castings currently used in the automotive industry. Magnesium has this potential because it is only 67% of the weight of aluminium for the same volume and 24% of the weight of zinc. Replacement of ferrous materials is even more favourable but the cost differential is of course greater.

A prediction by M. Holland of Ford Motor Co. in 1980 (2) was that magnesium could begin to displace aluminium in minor automotive applications when the Mg/Al price ratio was 1.7, a figure related to the difference in density. The aluminium price is depressed at present (US\$1.10 - 1.20/kg) but with a more realistic figure of say \$1.50, a price of \$2.55/kg (\$1.16/lb.) would be required for magnesium to satisfy the ratio of 1.7.

The current price of magnesium is about \$3.15/kg (\$1.43/lb.) which is 60 cents/kg or 23.5% above \$2.55. Dr. A.M. Cameron, the inventor of the new technology to be described, is confident that his improvements to the conventional Magnetherm process of Societe Francaise d'Electrometallurgie (SOFREM), a subsidiary of Pechiney, will yield savings of much more than 20% in the cost of magnesium production (see later).

3. ENVIRONMENTAL PRESSURE FOR INCREASED MAGNESIUM PRODUCTION

After many years of speculation about the future of magnesium, there are now positive indications that governments are moving faster to reduce the weight of automobiles for environmental reasons. The Japan Government now requires the average weight per car to be reduced to 1,200 kg by 1995 and 850 kg by 2000. The Japanese Automotive Association consequently expects the weight reduction to require the amount of magnesium used per average car to increase by 3900% between 1989 and 2000.

While it has become fashionable to predict the western world consumption of magnesium to be "1 million tonnes by the year 2000", these forecasts now raise the prediction to "1.6 million t.p.a. over the next 10 years" (3). Be that as it may, there is little doubt that the consumption of magnesium will grow and that Australia is well placed to play a significant part in this growth.

4. TECHNOLOGY FOR MAGNESIUM REDUCTION

The western world magnesium industry has a relatively small output of primary metal which is currently valued at about US\$0.8 billion p.a. It consists of some large producers using the chloride electrolysis route technology and a larger number of smaller producers using the thermal route. Most of the magnesium producers are also producers of aluminium and over half of the magnesium produced is later alloyed with aluminium. In most cases, the amount of magnesium in the alloy is small, being only one or two percent.

The chloride route technology is tightly held by those companies using it. This technology involves two distinct parts - the preparation of magnesium chloride from sea water, brine, dolomite or magnesite followed by its electrolysis and the recycling of chlorine. The producers will licence out part of their technology but not all of it. For example, Queensland Metals Corporation is reported to have an option on the Alcan electrolysis cell but will have to develop its own chloride preparation technology which it is doing with the assistance of C.S.I.R.O.

The thermal route technology can readily be purchased and is operated in 9 countries. The largest installation of 36,000 t.p.a. is at Northwest Alloys, Washington, U.S.A., a subsidiary of ALCOA and consists of nine 4 MW Magnetherm units.

The improved technology that is the subject of this Proposal is a thermal process owned by the University of Manchester Institute of Science & Technology (UMIST). (There is a royalty arrangement with Royal Dutch Shell.) Option agreements are held by MHA (for Australia & New Zealand) and by Northwest Alloys (for U.S.A.).

5. SELECTION OF REDUCTION TECHNOLOGY

The following is an extract from a report commissioned by the U.S. Dept. of Energy (DOE) dated February, 1981 entitled "An Assessment of Magnesium Primary Production Technology" by M.C. Flemings et al. of MIT (4).

"In the opinion of the writers, the current and potential costs of producing magnesium by the electrolysis versus the metallothermic route are sufficiently close that the optimum magnesium primary production process depends, not on the intrinsic technological advantage, but rather site selection with respect to the availability of raw materials, energy, labor and markets for both magnesium and process by-products. Given the variation in resources in industrial regions in the United States, electrolytic and metallothermic magnesium production technologies can both be expected to remain competitive for at least the medium term (20 years)."

The small number of producers and the low total production of magnesium have had the effect of limiting the amount of available information about the industry. The DOE report is probably still the best collective source even though it is over 10 years old, possibly because the industry has not changed much and the output has remained fairly constant.

Some figures quoted in the report are given in Table 1.

TABLE 1: MAGNESIUM INDUSTRY STATISTICS IN 1980

	<u>Metallothermic</u>	<u>Electrolytic</u>
1980 world capacity (tons)	83,000 (27.5%)	218,500 (72.5%)
Max. plant size (tons)	26,000	125,000
Average plant size (tons)	10,375	54,625
Total energy requirements (equiv. kwh thermal/lb Mg)	41.1	42.8
Estimated capital cost (US\$/annual ton for a 20,000 tpa plant in 1980)	3,500	4,500

The proportions of capacity coming from the two routes have not changed much over the decade indicating that the metallothermic or thermal route is still viable in spite of its smaller unit capacity (Table 2.).

TABLE 2: MAGNESIUM PRODUCTION: INSTALLED CAPACITY IN 1991 (5)

<u>Metallothermic</u>		<u>Electrolytic</u>	
Country	m.t.p.a.	Country	m.t.p.a.
Brazil : Brasmag	6,000	Canada : Norsk Hydro	40,000
Canada : Timminco	12,000	India : Tamil Nadu	600
China (est.)	9,000		
France : Pechiney	18,000	Norway : Norsk Hydro	55,000
India : Southern M & C	1,200	U.S.A. : Dow Chem.	90,000
Italy : SIM	12,000	U.S.A. : Mag. Company	36,000
Japan : Japan Met. & Chem.	5,000	U.S.S.R. (est.) 2 plants	90,000
Japan : Ube Industries	9,000		
USA : N.W. Alloys	36,000		
Yugoslavia: Magnohrom	5,000		
Total	113,200		311,600
Average plant size	11,320	excluding India	62,320

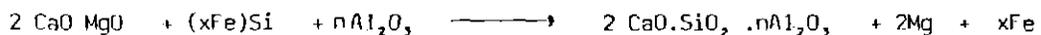
There are many factors to be considered in the choice of the route to magnesium if a 60,000 tonne per annum plant were to be contemplated but for a plant with a final capacity of 5,000 to 10,000 t.p.a. the choice would certainly be thermal. That such plants outnumber electrolytic plants at low tonnages is "attributable to the simplicity of thermic reduction equipment design and ease of operation. Thermic facilities also have the advantages of less restrictive site selection criteria, low capacity economies of scale and consequently lower initial investment requirements" (6).

Although the exports of some of Australia's mineral and agricultural commodities are high in relation to local consumption, it is preferable, when commencing a new venture with a view to early entry into established world markets, to begin on a small scale and increase gradually. With a market for about 5,000 t.p.a. of magnesium in Australia, an acceptable procedure would be to start with a production of 5,000 t.p.a. from a single unit and increase it in similar increments when local and overseas markets become available. This would apply particularly to a commodity like magnesium which has for decades defied predictions of rapid world growth.

Such a policy would point to the thermal over the electrolytic process providing other essential requirements can be satisfied.

6. THE MAGNETHERM PROCESS

Magnetherm is the most modern process for thermal production of magnesium. It is based on the reduction of magnesium oxide by silicon contained in ferrosilicon:



The slag composition is held close to 55% CaO by weight, 25% SiO₂, 14% Al₂O₃, and 6% MgO which at the operating temperature of 1550°C is not fully molten. The temperature cannot be allowed to go much higher because the graphite furnace lining will react to form CO which will oxidise the magnesium vapour produced. Nor can the silicon level in the residual ferrosilicon be allowed to go below about 20%.

The Magnetherm process is conducted in an AC arc furnace comprising an upper water-cooled electrode with current flow through the bath to the carbon hearth. The slag is electrically conducting and the passage of current heats the bath. The reaction by which the magnesium is formed and released as a gas occurs at the surface and is strongly endothermic, requiring heat to be transferred there from the body of the melt.

Many improvements have been made to the Magnetherm process over the years but it still has the disability of operating under vacuum in order for the production of magnesium to proceed at an acceptable rate, a reasonable temperature, and with satisfactory silicon consumption. The sub-atmospheric operating pressure allows some leakage of air into the condenser and causes a loss of metal production. Also, it requires the vacuum to be broken twice per day to tap slag and to change the condenser.

According to Fleming et al: "conversion (of Magnetherm) to continuous operation at a positive pressure would significantly reduce energy consumption and labor requirements, substantially increase the production capacity of the reduction unit and reduce both capital and operating cost requirements" (7).

7. THE CAMERON PROCESS

7.1 Introduction

Several improvements of the Magnetherm process have been developed by Dr. Andrew M. Cameron of UMIST. They are covered by International Patent W089/00613 with a priority date of 10th July, 1987. An Australian patent has been accepted by the Patent Office and is open for public inspection (Serial 618272).

In discussing the history of the development, Cameron said that he graduated from the Universities of Strathclyde and London (Royal School of Mines, Imperial College) in the mid-seventies, he joined the Thornton Research Centre, Chester of Shell Research Ltd. After several years he was transferred to Shell's Billiton laboratories in the Netherlands as officer-in-charge of pilot plant operations. He worked on the carbothermic reduction of magnesium using a D.C. plasma arc furnace but he had little confidence in this route. He took a position with UMIST where he had the opportunity to develop his improvement to the Magnetherm technology on the basis of detailed chemical thermodynamic studies.

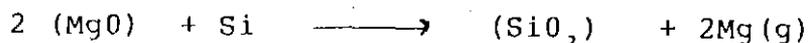
The technology was subsequently piloted continuously at Billiton in a D.C. plasma arc furnace which had an input of 0.6 MW. Enough information was obtained to prove the thermodynamics and kinetics of the technology although further work is required to confirm the engineering, equipment and operational aspects.

The DC plasma transferred arc generator is constructed of graphite and is not water-cooled. Such equipment has so far only been used for melting and other 'unsophisticated' applications such as vaporising zinc from steel plant dusts. Intensities of 40 MW are possible with this type of equipment. The Cameron process would be the first to make full use of its unique characteristics for a metallurgical reduction process (8).

Incidentally, the Council for Mineral Technology (Mintek), South Africa has patented the use of a DC plasma arc using the Magnetherm slag conditions but Cameron believes this is not practicable and that low silicon use and poor condensation efficiencies would result.

7.2 Basis of the Cameron Technology

Ideal conditions for the silicothermal reduction of magnesium according to the reaction:



include the following:

- . a slag saturated with MgO
- . a slag with a low activity of SiO₂
- . molten reactants in the reaction zone
- . the reaction zone located at the surface of the slag for ready Mg gas evolution
- . a high temperature in the reaction zone.

Careful examination of the phase diagrams of the MgO, CaO, Al₂O₃, SiO₂ system indicates that the required conditions can be found in the periclase (MgO) region.

The conditions provide a strong thermodynamic driving force at temperatures of the order of 1600-1650°C which permits the reaction to proceed at a satisfactory rate at atmospheric pressure. Furthermore, it enables the silicon reductant to be used efficiently allowing the silicon in the residual ferrosilicon to be reduced to a very low level (provided a graphite furnace lining is not used as in Magnetherm).

The DC transferred arc operation does not require the bath composition to be governed by its ohmic resistance in order to generate heat. Most of the heat transfer from arc to bath is by convection and radiation. A magnesite refractory brick bonded with dicalcium silicate could be used as the furnace lining and it could be similar in composition to the bath and have a frozen wall. Only the area under the arc needs to be fully molten.

Reference to the phase diagram in the Cameron patent indicates that the level of MgO in the slag at operating temperature could be held at 13% or above compared with 6 to 8% in Magnetherm. The volume of slag produced per unit weight of magnesium produced will be 15% lower than with magnetherm. It is envisaged that the process would operate with an invariant slag composition which would minimise refractory wear and eventually lead towards continuous operation.

7.3 Improved Efficiencies and Cost of Production

UMIST claims that the successful 0.6 MW pilot plant trial in the Netherlands confirmed several predicted improvements to the Magnetherm process. Although magnesium was not actually condensed during the trial, analysis of the off-gas indicated that the efficiency of condensation of magnesium vapour to metal would improve because of the substantial reduction in the production of magnesium oxide and nitride. Ingress of air to the condenser was much reduced as the operation was under slightly positive rather than substantially negative pressure. The saving was believed to be equivalent to a 25% increase in magnesium production at no extra cost compared with Magnetherm.

The second source of saving resulting from atmospheric pressure operation was due to not having to break the vacuum to tap slag from the furnace and to replace the condenser. This will reduce daily downtime from 15% to 10%.

Of course there would be capital and operating cost savings by avoiding the need for vacuum pumps and related equipment. There is a possibility of the Cameron process being made continuous thereby providing a further cost reduction.

Cameron estimates that the cost of magnesium metal would be reduced from \$2.50 to less than \$2.00 per kg. Continuous operation would further reduce this to \$1.75.

7.4 Return on Investment

At this stage MHA has little to go on in assessing capital and operating costs and the possible return on the investment for a Cameron magnesium reduction plant. More information will become available from UMIST and elsewhere during the Feasibility Study.

8. LOCATION OF THE MAGNESIUM PRODUCTION FACILITY

This proposal is related to a Joint Venture Proposal (Section C) and the eventual operation of a magnesium production facility that draws its ore requirements from deposits controlled by or associated with Mineral Holdings Aust. Pty. Ltd. The deposits are located close to the northwest Tasmanian coast so that logical locations for a facility are near the coastal towns and ports of Smithton, Stanley, Port Latta, Burnie and Bell Bay in Tasmania or across Bass Strait at Portland and Point Henry in Victoria. Bell Bay, Portland and Point Henry are locations of aluminium smelters while Port Latta is the site of an iron ore pelletising and calcination plant (part of which is available for "Toll Calcining") and a bulk minerals export terminal.

Of course, the magnesium plant with its relatively small requirements of ore, at least in the early stages, could well be sited in Tasmania at Burnie, Smithton or Bell Bay or at a Victorian smelter location, while high tonnage bulk exports of magnesium ores or calcines could still go through Port Latta. There is a rail line from Smithton/Stanley to Bell Bay as well as a good sealed highway system along the entire length of the north coast of Tasmania.

9. RAW MATERIALS FOR CAMERON PROCESS MAGNESIUM PRODUCTION

The raw materials required for a 4 MW single furnace operation of the Cameron process producing 5,000 t.p.a. magnesium metal would depend on whether aluminium scrap was available at a suitable price to replace portion of the silicon reductant and to provide alumina to achieve the appropriate slag characteristics. Otherwise some calcined bauxite would be required. Two possible situations would be as follows:

<u>For 5,000 t.p.a. Magnesium production</u>		
<u>Option A: Aluminium Scrap</u>		<u>Option B: Bauxite</u>
Calcined dolomite	20,400 tonnes	29,400 tonnes
Calcined magnesite	3,000	620
Aluminium	1,140	-
Alumina in bauxite	-	3,120
75% Si ferrosilicon	3,020	4,360

The nature of the raw materials can be changed depending on local economics provided the specified MgO, CaO, Al₂O and SiO₂ contents of the slag were maintained. For example, dolomite could be replaced by a mixture of magnesia, lime or magnesia-enriched lime.

B. MAGNESIUM AND CALCIUM ORE RESOURCES

1. INTRODUCTION

Consideration of the establishment of a magnesium metal industry in Tasmania provides an added incentive to evaluate deposits of high grade carbonate and silicate minerals which are likely to be of international significance for a number of markets. The potential of the magnesite, dolomite, limestone and silica has been recognized by MHA and others for some time but the available markets to date have not provided the necessary opportunity for their closer examination or development.

MHA has mineral leases in the following areas:

EL25/89 : dolomite south of Smithton adjoining an existing small quarry.

EL31/90, : limestone, magnesium-rich limestone,
32/90, dolomite west of Smithton near Redpa,
33/90 Togari and Montagu.

EL25/88 : high grade quartzite, silica sand and silica flour at Thomas Mountain in the Dip Ranges south of Rocky Cape.

In addition, CRA Ltd. (75%) and MHA (25%) hold very extensive magnesite leases near Arthur River and Lyons River west of Hellyer Gorge (RL.8717 & RL.8718).

It has not yet been possible to make detailed estimates of the tonnages available but the surface expressions and drilling already conducted leave no doubt that the exploration licences cover a huge carbonate resource which could support major export operations both in respect to quality and quantity. Some details are given in Appendix 1.

2. LOCATION/INFRASTRUCTURE

The location is excellent being on flat undulating cleared land with much of the deposit being mainly on private land with some Crown land. The limestone deposit is 41 km from the Port of Stanley, 50 km from Port Latta and 82 km from Burnie, Tasmania. These ports have established bulk loading facilities for

30,000 tonnes at Stanley and Burnie and a 100,000 tonne facility at Port Latta. All ports have much free time. MHA has an option for rights to a non-metallic bulk storage area at Burnie Port. A full infrastructure exists nearby, including water, airport, labour, roads, railway, hydro-power and ready accommodation, as many employees would be resident at Smithton. These existing infrastructures should greatly enhance the viability of a mine with minimum capital costs.

3. ENERGY

The existing energy sources are generated by the State's low cost hydro-electricity plants.

A possible alternative for energy could be Amoco's recent Yolla discovery of natural gas, about 100 km offshore in shallow water in the Bass Basin, or B.H.P. gas from the Gippsland Basin field. MHA is hopeful that natural gas will become available on site at Port Latta - being the nearest on-shore site to Yolla - for calcining. These energy factors will enhance the viability of a substantial industrial development in this area. MHA has an assurance of an allocation of hydro-power from the Tasmanian Government and also of a site and some assurance of assistance with other development costs.

4. TRANSPORT - TASMANIA AND MAINLAND AUSTRALIA

The existing local rail and road infrastructure will be utilised for Tasmanian industries. The Federal Government Freight Interstate Equalisation Scheme is proving of benefit to Tasmanian industry by subsidising exports to all States on the mainland. This scheme covers any containerised materials and some bulk shipments with substantial subsidies ensuring that a Tasmanian industry is not at a disadvantage to a mainland industry, ie. basically it allows Tasmanian industry to transport its product at much the same 'road freight' cost that exists between States, ie. Victoria to New South Wales, Queensland or Western Australia.

Hopefully 'reform' on the waterfront will greatly reduce bulk transport costs to the mainland and overseas.

5. ACTIVITY TO DATE

MIA's mineral exploration in N.W. Tasmania has been conducted for over 18 years. Exploration, testing, consulting and drilling costs have been substantial on a number of minerals. It is believed that these Tertiary and Precambrian prospects have indications on the surface of very large mineral ore bodies which will be economically mined as open cut mines with little overburden.

C. THE PROPOSAL

1. INTRODUCTION

MHA wishes to find a joint venture partner to help further evaluate in a step-wise manner the economic potential of the Cameron process and the dolomite and limestone deposits in its exploration leases.

MHA would plan to pass over the management of the joint venture to the partner following a positive conclusion of the Feasibility Study while still retaining a 50% interest in the magnesium metal project and the mineral deposits.

2. PROPOSAL

The following steps are proposed:

2.1 Stage 1: Feasibility Study

MHA will organize and manage a Feasibility Study with the assistance of geological, mining, engineering and metallurgical consultants in association with the joint venture partner, UMIST and, if possible, with the other option holder(s) of the UMIST technology.

The Study will include further explorational drilling and will recommend the preferred mining and smelting sites, taking account of the available existing infrastructures. Some experimental work on calcination and other aspects is envisaged.

2.2 Stage 2: Semi-commercial Smelter & Mine Development

If the project proceeds, the joint venture partner will have earned a 25% equity in the project and have the option of taking over the management of the project at this stage. A site will be selected and contracts let for the design, supply and erection of materials handling, pilot calcination and smelting plants, and the opening up of selected mining areas.

The Cameron smelting unit will preferably be of 4 MW capacity which represents a reasonable scale-up from the former 0.6 MW Billiton pilot plant. The same furnace could later be upgraded for commercial production. Ancilliary equipment will initially be minimal but where possible it will be designed for later upgrading for full scale production.

Mining and shipment of raw ores will be expected to proceed throughout Stage 2.

The joint venture partner will earn a 50% equity in the project during Stage 2.

2.3 Stage 3: Semi-commercial Operation of Smelter

It is expected that 9 month's operation of the calcination and smelting plants will be required, but also during the second half, design will proceed towards upgrading to full commercial operation.

2.4 Stage 4: Commercial Operation and Expansion of Smelter

If the growth in world magnesium consumption allows, the operation would expand at the rate of one new 5000 t.p.a. furnace per year up to a total of say 20,000 t.p.a. magnesium.

3. INDICATIVE TIME SCHEDULE AND COSTS TO JOINT VENTURE PARTNER

Stage 1:

Costs of geological, mining, metallurgical and engineering consultants, mapping, drilling, analysis, testing, MHA administration, part licence payments to UMIST, part reimbursement of past exploration costs, etc. to cover the period from commencement (say 1st February 1992) to 31st May 1993

Cost: \$ 1 million

Stage 2:

Site selection, contracts for detailed design, supply erection and installation of materials handling, pilot calcination, semi-commercial smelting (4 MW) and calcination plants, the opening up of selected mining areas, roads, storage and loading facilities, environmental studies, final licence payment to UMIST, etc.

From June 1993 to March 1994 Cost: \$25 million

Stage 3:

Operation of semi-commercial smelter, design of full commercial facilities. (Mining costs to be included in operating costs but calcination facilities if any to be considered separately.)

From April 1994 to December 1994 Cost: \$ 5 million

Stage 4:

Upgrading of semi-commercial to full-scale commercial smelter from March 1995 to September 1995

Commence commercial operation Cost: \$10 million
June 1995.

Total Cost: \$41 million

In addition to the above, the joint venture partners would be required to pay production royalties to UMIST and to MHA. The royalty to UMIST has not been finalised at this stage but would not exceed 2.5% of metal sales. The royalty to MHA would be 3.5% on the indexed sale price of any ore and 1% royalty on the sale price of any processed product arising from the current leases.

The ownership of the mineral leases will become 50/50 MHA and the joint venture partner during Stage 2, but the above royalties will be expected to continue as long as MHA retains part ownership in recognition of past initiatives and unrecouped expenditure.

N. M. THOMAS
21st January, 1992

J. C. NIXON

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CARBONATE AND SILICA RESOURCES OF
MINERAL HOLDINGS AUSTRALIA PTY. LTD.

1. CARBONATE HILLS (EL31/90, 32/90, 33/90)

The most likely long-term source of dolomite for a Cameron magnesium operation in north-west Tasmania is dolomite near Redpa, Togari and Montagu, about 50-60 km west of Smithton (the "Carbonate Hills").

The carbonates consist of high-grade limestone, magnesium-rich limestone and dolomite. The following analyses of dolomite are available:

	<u>%Mgo</u>	<u>%CaO</u>	<u>%SiO₂</u>	<u>%Al₂O₃</u>	<u>%Fe₂O₃</u>
<u>1.1 Togari</u>					
Percuss. Drill (6/90) (Av. S. 902950-1-3.)	21.41	30.28	0.15	0.03	0.13
Surface (9/90) (Av. 11-18) (S. 903983-8,) (904036,5)	20.30	32.41	0.13	0.05	0.23
<u>1.2 Redpa</u>					
Percuss. Drill (1/91)					
Hole 1 (910411-2) Av.	19.12	30.44	5.60	0.065	0.065
Hole 26 (910415-8) Av.	18.98	32.07	0.21	0.10	0.08
Holes 1 and 26 indicated over 21m. of dolomite and stopped in dolomite.					
<u>1.3 Montagu</u>					
Surface (11/90)					
Mont 1-2 Av.	21.35	30.55	0.35	0.22	0.22
Mont 3	19.7	26.4	0.35	0.75	0.65

2. SMITHTON (EL25 /89)

The Smithton dolomites have been described by Nye, Finucane and Blake (1), Carey and Scott (2) and Hughes (3). Carey & Scott assigned the dolomite beds to the Carbine Group at the base of the Cambrian and the top of the Precambrian. The thickness of the beds was estimated at 900m (revised from an earlier 2700m).

The dolomite is mostly covered with alluvium except in the Irishtown area south-south-east of Smithton and is divided by the Cambrian Dundas Group of Shales immediately south of Smithton.

The best dolomite in the immediate vicinity of Smithton occurs to the west of Smithton and of the Dundas Shale adjoining Duck River and in particular at Watson's Bend and north of Blackwood Bridge where the course of the river changes from west to east. The area was diamond drilled by BHP in 1944-45 and the drill logs are in MHA's possession. Fifteen holes were drilled to a depth of 60 feet. The range of analyses of the weighted averages was:

17.90 - 21.48% MgO 0.16-21.74% SiO₂ 0.30-1.37% Fe₂O₃,

Only two holes had a silica content over 8%.

One 150 ft. hole was also drilled at North Irishtown, which is east of the Dundas Shales and a little further south. The weighted average for this hole was:

20.83% MgO, 1.90% SiO₂, 0.36% Fe₂O₃, 0.64% Al₂O₃, 30.64% CaO,
45.50% ignition loss.

Surface samples in the Smithton area all fell within the drilling results.

These dolomites would contain acceptable grade for the Cameron magnesium process but their proximity to the town of Smithton would preclude their mining in the longer term. They would be quite suitable initially while the Carbonate Hills deposits were being developed.

3. PHYSICAL CHARACTERISTICS - DOLOMITE

The dolomites are generally fine grained although there are some weathered samples that are coarse grained and may have been recrystallised. Laboratory tests have indicated that (at least) the fine grained samples can be calcined without decrepitation. This also applies to magnesia-rich limestone of which there are large reserves in the Carbonate Hills.

4. MAGNESITE

Large deposits of magnesite occur at Arthur River and Lyons River, about 50 km south-east of Smithton. They are held by CRA (75%) and MHA (25%) and are the subject of CRA Information Memorandum (4).

While it is intended that dolomite would be the principal feed material for magnesium production, a small amount of calcined magnesite would also be required. Furthermore, magnesite and lime or high magnesia lime could be used in place of dolomite. Apart from the large southern deposits, there are some smaller deposits of magnesite closer to the coast that should be suitable for the Cameron process in the early stages, subject to further examination.

5. SILICA

Ferrosilicon is required as a reductant for magnesium oxide in the Cameron process. It is currently manufactured by the BHP subsidiary TEMCO at Bell Bay on the north-east coast of Tasmania which is connected to the Smithton area by road and rail.

Substantial deposits of high grade quartzite rock are held by MHA at Thomas Mountain in the Dip Ranges, south of Rocky Cape about 80 km east of Smithton. This material would be suitable for the manufacture of ferrosilicon.

REFERENCES TO APPENDIX 1.

1. P.B. Nye, K.J. Finucane and F. Blake - "The Smithton District", Tasmanian Geolgocial Survey Bulletin No. 41, 1934.
2. S.W. Carey and B. Scott - "Revised Interpretation of the Geology of the Smithton District of Tasmania", Papers & Proceedings of The Royal Society of Tasmania, Vol. 86, p.63, 1952.
3. T.D. Hughes - "Limestone in Tasmania", Tas. Geol. Survey Mineral Resources No. 10, 1957, pp32, 281 which quotes description and results from Bulletin 41, 1957.
4. "Arthur River Joint Venture - Magnesite Deposit, Tasmania" CRA Information Memorandum 1990(?)

Carbonate Hills & Togari Dolomite

Smithton Dolomite

Thomas Mountain Quartzite Mine

