

MINERAL HOLDINGS AUSTRALIA PTY LTD

EXPLORATION LICENCES

EL 16/2001 CHRISTMAS HILLS; EL 21/2001 MARRAWAH

EL 22/2001 MONTAGU; EL 23/2001 SMITHTON

NW TASMANIA

ANNUAL REPORT ON EXPLORATION

TO SEPTEMBER 2003

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7th October 2003**

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ELS 16, 21, 22 & 23/2001- MHA EXPLORATION LICENCES, NW TAS**ABSTRACT**

Large resources of high quality carbonates- dolomites, dolomitic limestones and limestones- have been outlined to various degrees of certainty in the Mineral Holdings Australia Pty Ltd mineral tenements in the Smithton Basin of NW Tasmania.

Resources in the two Retention Licences at Redpa and Brittons Swamp are as follows-

- **Precambrian dolomite** **Inferred: 102 million tonnes**
Indicated: 1.9 million tonnes
- **Precambrian dolomitic limestone** **Inferred: 14 million tonnes**
Indicated: 670,000 tonnes
- **Tertiary limestone** **Inferred: 10 million tonnes**
Indicated: 1.7 million tonnes

Four Exploration Licences 16, 21, 22 and 23/2001 were selected in the northern part of the Smithton Basin to extend the present resources, to explore for new prospects and to provide Joint Venture partners with enough ground to develop a regional approach to exploration and evaluation.

An analysis of the available data, including previous exploration, suggests that the Smithton Dolomite is the best potential target and that the upper part is more prospective for the highest-grade dolomite than the lower part.

Recommendations for future drilling of prospects are given on areas within the licences including the need for stratigraphic drilling of the Smithton Dolomite to aid regional exploration and to open up this major, but poorly exposed, carbonate province. The Seventeen Mile Plain is the stand out area that should be tested for flat-lying dolomite capable of supporting a large export quarry.

The challenge is to find a large enough tonnage of carbonate of suitable high grade for extraction and processing in a mineable and environmentally acceptable location.

The infrastructure is capable of supporting a large carbonate export industry with the deepwater loader at Port Latta with the expanded industrial site for calcining and further downstream processing and a projected power surplus based on electricity and natural gas. However, a competitive power price will be essential to attract a major mineral-processing project.

In the interests of the search for a joint venture partner with the resources to carry out the drilling, testing and marketing of the deposits, MHA has asked for a moratorium on exploration expenditure for Year Two.

ELS 16, 21, 22 & 23/2001- MHA EXPLORATION LICENCES, NW TAS**1.0 INTRODUCTION**

Mineral Holdings Australia Pty Ltd (MHA) was awarded title to four mineral tenements in the Smithton Region of NW Tasmania on 27th September 2002. They are exploration licences EL 16/2001- Christmas Hills (193 sq km), EL 21/2001- Marrawah (248 sq km), EL 22/2001- Montagu (248 sq km) and EL 23/2001- Smithton (155 sq km). The areas were applied for under the ETA System and the boundaries of each licence do not necessarily fit the geology in the most optimal fashion (Plan 1). Because the regional exploration is at an early stage, MHA applied for permission to produce a combined annual report on the licences for the Year One.

The four licences for category 5 (a) industrial minerals only were taken out to secure a major resource position for the company covering the extensive dolomite sequences of the northern part of the Smithton Basin. The timing of the ground selection was to gain maximum benefit from the new geophysical studies conducted under the Western Tasmanian Regional Minerals Program (WTRMP). The incentive to explore and develop the carbonates was also provided by the promise of increased energy resources in the form of natural gas and electricity being available from the Australian mainland, the upgrading of infrastructure at the Port Latta Industrial Site and the presence of the deepwater loader just east of Stanley.

For more than two decades, Mineral Holdings has been engaged on exploration for carbonates in the region and as a result currently holds two Retention Licences for carbonate resources (Plan 1) at Redpa (RL 9/1997, 3 sq km) and Brittons Swamp (RL 10/1997, 5 sq km). The regional exploration licences above were taken out to provide a suitable large resource company the option of conducting its own investigation as a joint venture to secure additional carbonate resource suitable for a large dolomite quarry exporting to the developed countries of the Pacific Rim. Negotiations have been conducted with a number of major resource companies including Western Mining, Rio Tinto, Australian Bulk Minerals, Coburn Cement and Westmag, both of Perth, and Unimin Ltd, Sydney.

2.0 REGIONAL GEOLOGICAL SETTING OF THE LICENCES

2.1 EL 16/2001 Christmas Hills

EL 16/2001 of 193 sq km covers the core of the main regional syncline between Smithton and Montagu with the youngest rocks- the Cambrian Scopus Group sediments- forming the low, NS trending, Christmas Hills range up to 100m high. These sediments overlie the Smithton Dolomite which occupies the margins of the tenement and the flat lying re-entrant of Brittons Swamp under the cover of the Quaternary alluvium. Attached to the SW corner of the licence, are the dolomite resources of RL 10/1999 underlying the upper Montagu River Plains (Plan 1).

The land tenure is mainly State Forest and Private Land with two small encroachments of Forest Reserves- Plains Creek to the east and Montagu Swamp to the southwest of the RL (Plan 2).

2.2 EL 21/2001 Marrawah

EL 21/2001 of 248 sq km covers the central part of the Welcome Syncline, the corresponding anticline to the east in the sediments and volcanics of the Kanunnah Subgroup and, in the northeast corner, the east-dipping Smithton Dolomite in the Montagu River and the Seventeen Mile Plain Embayment. In the southwest, the licence encroaches on the metasediments of the Proterozoic Rocky Cape Group (Plan 1).

Characteristically, the Smithton Dolomite is concealed by alluvium, by the extensive Tertiary basalts of the Marrawah volcanic field and in the north by wind blown sands. Dolomites and limestones of the Smithton Dolomite outcrop sporadically in the Redpa area and are secured by RL 9/1997 where resources have been established by drilling. Also investigated were the overlying Tertiary limestones which form outliers on a series of low hills before they disappear to the north under the Tertiary basalts.

Shallow- to moderately-dipping dolomite occurs along the Montagu River in the northeast but most is hidden by the alluvial plain at just over 20m in height. The alluvial cover also extends into a triangular-shaped area defined by the river and the flanking sediment and volcanic ridges up to 70m high to the west and referred to in this report as the Seventeen Mile Plain Embayment. The cover of this area also includes wind blown sand with trails of linear sand dunes, lunettes and swamp deposits.

The wind blown sand deposits towards the coast at Ann Bay also conceal older beach strand lines which have been previously investigated for heavy mineral deposits.

Land tenure in the licence is a mixture of Private Property, State Forest and three Forest Reserves- Bond Tier, Dismal Swamp and Welcome Swamp- and some pockets of Crown Land. Most of the Seventeen Mile Plain Proposed Reserve Area is contained in the northeast corner and this is to protect a stand of Eucalyptus Brookeriana as well as being a phytoperha management zone. The Aboriginal Administered Mount Cameron West area in the northwest corner is excluded from the licence (Plan 2).

2.3 EL 22/2001 Montagu

EL 22/2001 of 248 sq km covers the northern part of the Welcome River Syncline under the Woolnorth Plains, the Jims Plain Dome to the east and, further east again, the east dipping limb of the Christmas Hills Syncline in the Montagu River (Plan 1).

Concealed by alluvium and windblown sand except for some exposures in the Welcome River, both the Smithton and the Black River Dolomites are represented in the bedrock under the Woolnorth Plains of 10-20m elevation but little is known of their extent or quality. On the cross-sections on the Woolnorth Atlas Sheet, the former is represented as 1300m in stratigraphic thickness with the latter being much thinner.

The Black River Dolomite is present in outcrop at about 30m elevation in the Jims Plains Dome and is expected to be somewhat flat lying although reportedly silicified.

Smithton Dolomite is again exposed along the Montagu River but is mostly concealed by windblown sand at elevations of 10-20m. Some dolomite outcrops occur in a faunal reserve which has caves with vertebrate fossils.

Land tenure is overwhelmingly Private Property with, in the southeast corner, some State Forest and a small part of the Seventeen Mile Plain Proposed Reserve Area (including a Private APPM Faunal Reserve) where special permission to enter is required (Plan 2).

2.4 EL 23/2001 Smithton

EL 23/2001 of 155 sq km covers the eastern half of the Christmas Hills Syncline from Montagu through Smithton to Forest as it runs north onto the coastal plain at an elevation of about 5-20m. The rocks get younger towards the west with oldest- the Rocky Cape Group- being found in a series of hills up to 60m near South Forest, Lake Mikany and Briant Hill. The Black River Dolomite is only found in outcrop in the last mentioned locality; otherwise it is found south or east of the licence boundary at the type locality (Plan 1).

A NS- trending range of hills up to 100m composed of Crimson Creek correlates of basalts and sediments runs from Smithton to Edith Creek. Then, to the west, is found the westerly-dipping Smithton Dolomite covered by the alluvial plains of the Duck River except in outcrops in the riverbed, in the Circular Head Dolomite Quarry on the outskirts of Smithton, and in a few rocky outcrops at Edith Creek.

Finally, in the extreme west, the Cambrian Scopus Group sediments are found in the Christmas Hills Range. The coastal plain is covered by windblown sand except where the Tertiary basaltic volcanics form hills of up to 80m high at Montagu, Forest and Stanley.

The land tenure is mainly Private Property with some State Forest in the southwest, small pockets of Crown Land near Smithton, and the Briant Hill Nature Conservation Area and the Nut State Reserve at Stanley (Plan 2).

3.0 EARLY HISTORY OF CARBONATE EXPLORATION

In the Smithton region of NW Tasmania, dolomitic sedimentary sequences were surveyed and studied in 1929-30 as part of the first regional mapping campaign by State Government geologists as recorded in Bulletin 41 (Nye et al, 1934). This investigation followed earlier recommendations from the Development and Migration Commission to advance Tasmania's economic position by providing geological maps as a guide to mineral resources as proposed by Dr W.G. Woolnough, Geological Advisor to the Commonwealth Government.

The fieldwork employed the full staff of the Geological Survey and was concentrated in the area around Smithton, Edith Creek and Irishtown (i.e. in the Smithton NE and SE quarter map sheets). Topographic maps had to be surveyed as a base for the geology.

From the geological mapping, extensive areas of dolomite bedrock were found throughout the Circular Head Municipality from Montagu in the west, through Smithton township, and as far as Black River in the east, a distance of 30km. Also extending inland, the dolomite reached the Arthur River some 35km to the south. These dolomites were declared to be the first of commercial importance within the State.

The dolomites were considered part of the Cambro-Ordovician sediments which were assigned to the Dundas Series and were described, in this region, in five stages including two dolomite horizons- Stage (iiia) mainly in the Irishtown area and Stage (v) in the Duck River area, south of Smithton.

The Duck River dolomite was estimated as 9000 feet thick, dipping 40 degrees west, while the Irishtown dolomite was much thinner in the range 500 to 1000 feet and 5000 feet stratigraphically below the former.

Two main types of dolomite were noted- a fine-grained dolomite, light grey to yellowish grey or dirty white in colour and thinly bedded and- a coarse-grained white type sometimes with a greyish tinge which was massive or thickly-bedded and possibly derived by recrystallisation from the former. The field relations between the two types were not clear but the coarse or crystalline type appeared to occupy the western or upper part of the Duck River dolomite.

The carbonates being soluble formed a flat topography and were covered with alluvial deposits and consequently good natural exposures were uncommon and outcrops were restricted to creek and river channels, drainage ditches, road and railway cuttings and quarries. At the time of survey, a few small quarries had been opened up for road metal on the Duck River dolomite where erosion of the sand had exposed the bedrock and on a rare hill at Edith Creek. At Irishtown, the dolomite is rather better exposed in a series of low hills on the plateau.

Chemical analyses (Table 1) were presented to show the high quality of the dolomites with the MgO and CaO content mainly within the range 19-22.5% and 28-32% respectively with SiO₂, Al₂O₃ and Fe₂O₃ generally up to 7, 4 and 1% respectively. The crystalline type (Nos 1-5 and 15) was found to be purer than the finer grained

type (Nos 6-14) and located further west and so stratigraphically above. Insolubles determined by comparison between the raw dolomites and their calcines were calculated as 82.6% SiO₂, 11.92% Al₂O₃ and 4.59% K₂O. This was confirmed by limited petrographic work on thin sections in which interstitial quartz was found in some dolomite samples.

The dolomites were considered to be replacements of limestones some of which are still found preserved in the stratigraphy. For example, oolitic members were found in a quarry near Scotchtown and in the nearby Duck River.

In the Irishtown area, the dolomites had numerous quartz veins and in places were partly or wholly silicified to cherts interbedded with the dolomites.

A small deposit of Quaternary limestone was mapped at Pulbeena, 4km south of Smithton township and was described as “tuffaceous and marly” and interbedded with peat. Some had been removed from shallow excavations for agricultural use.

It was realised that broad open folding on a NS axis was responsible for the NS trend of the Duck River carbonates which dipped about 40 degrees westerly and connected with those in the Montague River which dipped moderately easterly across a broad regional syncline. In the Irishtown area, it was recognized that the rock distribution was controlled by open anticlines, synclines and domes. Some minor folding was apparent causing local strike and dip variations in outcrop.

The results of the work as detailed in Bulletin 41 still remain the most comprehensive descriptions of the field occurrence of the dolomites in the Smithton area.

Areas recommended for resource investigation of the dolomites were in priority-Duck River/Watsons Bend, Irishtown, Edith Creek and Scotchtown.

In 1944, Government geologist D E Thomas and others carried out some additional sampling and made geological observations on all known localities from Montagu to Black River with generally similar conclusions and results to the earlier work. It was also determined that the whiter, more weathered dolomite was no different in purity to the darker, fresher material.

Shortly thereafter, the BHP Company in the 1944-45 period, carried out the first drilling of the dolomites with a program of 14 cored drill holes, on a 100m by 140m grid, in the Watson's Bend area, just west of Smithton and one hole of 47m at Irishtown in the search for deposits of refractory grade dolomite. No company reports have been found but the logs and assays and a chart of the drilling are presented in Threader (1987) who has also calculated some resource figures. The deposit is currently being mined as an open cut by the Circular Head Dolomite and Trading Company Pty Ltd.

The holes were vertical and mostly drilled to 60 feet (18.29m) in high-grade dolomite with an overburden of sand ranging from 1m up to 9.6m thick.

The dolomite is light to dark grey to blue grey in colour and is mostly, fine-grained, crystalline material or dolostone. The dolomite is slightly shaley in places with thin veinlets of white carbonate, chert and quartz and some brecciation.

The most easterly holes, B 5 and B 6, intersected up to 7m of basalt interpreted by BHP as Cambrian dykes intruding the dolomites. Basic rocks have since been encountered in the dolomite quarry where up to three sub vertical, parallel dykes up to 3m thick are apparent on the benches (Duncan, 2002). The age of these basaltic dykes is unknown but may be much younger than Cambrian. These are believed to be responsible for the pronounced WNW magnetic linears in the region.

Analyses from the drilling are presented in the Table 2.

Measured resources of dolomite were given as follows-

- **9.24M tonnes of 93% dolomite with 2.25% SiO₂, 0.67% Fe₂O₃ and 1.00% Al₂O₃,**
containing a possible high-grade resource of –
- **4.0M tonnes of 96% dolomite with 0.25% SiO₂, 0.42% Fe₂O₃ and 0.33% Al₂O₃.**

The beds dip moderately 40-45 degrees west and strike north south which suggests that the prospective high-grade zone may continue to the south.

It is not clear why BHP did not develop the resource but suggestions are that dolomite of similar grade was available in South Australia, closer to markets.

Subsequently, following field studies, Carey and Scott (1952) reinterpreted Nye's two dolomite horizons- sub stage (iii) at Irishtown and stage (v) at Duck River as a single formation or succession called the Smithton Dolomite with an approximate thickness of 3000 feet, underlying the slates and basic lavas (stage iv) but repeated by strike faulting.

Later workers accepted this concept of a single dolomite succession in the Smithton Basin (for details see Brown, 1989).

In 1957, Spry (in Hughes, 1957) formally defined the formation- The Smithton Dolomite- of 3,000 feet thickness adopting the type area as immediately west of the Duck River just north of the Smithton-Marrawah Road (i.e. near the Blackwood bridge). Spry also defined – the Black River Dolomite- in the area where the Bass Highway crosses the Black River- as a thin (50 feet), grey to buff dolomite probably lower than the Smithton Dolomite both being (wrongly) in the Rocky Cape Group but later changed his mind (Spry, 1964) to have the dolomite included in a succession unconformably overlying the Rocky Cape Group.

The single dolomite concept- the Smithton Dolomite- for the various dolomite occurrences in the Smithton area endured through to publication in the Smithton 1:50,000 scale geological map (Lennox et al, 1982). However, by the time the explanatory notes for the Smithton Sheet were published (Brown, 1989), mineral

exploration conducted by Geopeko Ltd (Large, 1982 and Pemberton, 1983) in areas west of the Montague River had resulted in the reinterpretation of the stratigraphic column, based on aeromagnetic surveys and shallow drilling, to feature two distinct dolomite stratigraphic horizons one above and one below the Cambrian volcanics and sediments.

The Forest No.1 diamond drill hole (352,738mE: 5,480,111mN) was collared by the Geological Survey in the Cambrian volcanics in the Smithton Quadrangle and, as it then intersected the Black River Dolomite, confirmed that the dolomite lay stratigraphically below the volcanics. The drill hole intersected about 300m of dolomites with minor limestones and black mudstones or shales which is correlated with the upper third of the Black River Dolomite (Calver, 1998). This is the only dolomite succession of either formation which is represented in drill core. As only minor chert (150mm) was encountered in about 300m of the carbonate succession, the silicification so characteristic of the exposed Black River dolomites is probably only a near surface effect caused by groundwater (Brown, 1989 in Geology and Mineral Resources of Tasmania).

This relationship was confirmed in the Government geological mapping in the 1:50,000 scale Woolnorth Quadrangle (Seymour & Baillie, 1992) where the two dolomite successions have been identified and their wide distribution documented. Recent geophysical work under the WTRMP project has provided high quality aeromagnetic and radiometric data to confirm the present understanding of the regional stratigraphy and structure and to allow valuable insight into the bedrock distribution under the extensive alluvial cover of much of the region (Plan 2A).

The bedrock sequence in the Smithton Basin is now recognized as the following (stratigraphic top to bottom and omitting the local occurrence of the Salmon River Siltstone at the top of the Smithton Dolomite and the Forest Conglomerate at the base of the Black River Dolomite; the age ranges are after Calver, 1998) -

Scopus Formation	conglomerates, lithicwackes, siltstones, mudstones, rare marine fossils	Mid to Late Cambrian
	Hiatus	
Smithton Dolomite 1500m	shallow marine dolomite and minor limestone	Mid to Late Neoproterozoic 545- 580Ma
Kanunnah Subgroup	clastics and rift basaltic volcanics	Early Neoproterozoic To Late Cryogenian 580-650Ma
Black River Dolomite 600-800m	shallow marine dolomite, chert, shale and diamictite	Mid Cryogenian 650-750Ma
	Unconformable	
Rocky Cape Group	orthoquartzite, siltstone and minor carbonate	Proterozoic - 1200Ma

The previous geological mapping reinforced by the recent WTRMP geophysics particularly the detailed aeromagnetics has led to the modern understanding of the main controls on the disposition of the rock formations of the Smithton Basin.

Four deformation phases (D1-4) have affected the Smithton Basin and their basement rocks. The main regional NS lithological trends have been produced by D4 giving a major regional syncline in the Smithton Dolomite and the overlying Scopus Formation centred on the Christmas Hills area (Everard et al, 2003). The solution affects of chemical weathering have caused two dolomite arms to occupy the low-lying drainage basins of the Duck River in the east and the Montagu River in the west.

The Roger River Fault dominates the structure east of the syncline where only lower stratigraphies are present with the resistant basic volcanics of the Kanunnah formation forming the hills and the Black River Dolomite being the only carbonates represented to the east. The Roger River structure running from Edith Creek south to near Balfour was probably an early growth fault reactivated during D 3. From Edith Creek to Smithton, the contact is a normal stratigraphic one.

To the west, a north-trending anticline brings up a basement core of Rocky Cape Group in the Jims Plain Dome flanked by Black River Dolomite and the thinner basic volcanics and sediments of the Kanunnah group. Further west again, another regional syncline preserves in its core both carbonate horizons and underlies the topographically low catchment of the Welcome River. To the south, the syncline narrows and changes to a NW trend as it comes under the influence of the earlier and over-thrusting D 3 phase.

4.0 MODERN EVALUATION OF CARBONATES

This section presents an account of the exploration and evaluation of the carbonate resources in more recent times with the ground held under modern title as Exploration and Retention Licence mainly by Mineral Holdings Australia Pty Ltd with the work carried out by that company or its joint venture partners (Plan 3).

4.1 EL 46/1970 Smithton

In 1970, Marble Quarries Pty Ltd took out EL 46/70 near Smithton and contracted Mining Systems Pty Ltd to develop proposals for finding suitable sites for dolomite extraction.

Following field visits, Mining Systems presented a few analyses of surface samples and proposed a program for the location of all dolomite occurrences, careful field mapping and the drilling of prospect areas with the potential to host larger deposits. They drew attention to areas where there was sufficient relief to allow a low- cost, quarrying operation such as the undulating, hilly country around Irishtown (Morris & Smith, 1971).

Three diamond drill holes were completed in dolomite in 1971- one at Edith Creek to 43m (MCQECDDH1: 339500mE; 5463600mN) and two about 1km NE of Irishtown of 21m and 53m (MCQIDDH1 & 2: 344000mE; 5469600mN) both on the same site.

Reference has been made to numerous analyses of dolomite in these holes (Bacon, in Brown, 1989), but neither these nor any logs have ever been found.

4.2 EL 10/1979 Irishtown

Longworth and McKenzie Ltd (L&M) were contracted by MHA to carry out a limited exploration program on a dolomite prospect near Irishtown in EL 10/79, granted on 28th September 1979. The dolomites here were topographically higher than elsewhere because overlying Tertiary basalt had protected them from solution and weathering so allowing better access for any possible mining development.

The dolomite had been drilled by drill hole No. 1 to 150 feet (47m) by BHP in 1945.

Two (PH 1 and PH 4) of five percussion holes by L & M intersected dolomite, the remaining holes being ineffective due to blow outs on the bedrock-overburden interface (Plan 4).

PH 1 intersected light grey, fine-grained dolomite, under 13m of basalt and sediment to 34.5m, some of it described as siliceous.

Analyses were carried out only on hole PH 1 over four different intervals from 13m to 34.5m (EOH) (Table 3) as previous drilling (BHP No1) had provided analyses at the PH 4 site.

The results show a progressive decrease in silica content with depth from 21.5% to 2.3% and an increase in MgO from 16.2% to 20.9% and in CaO from 22.0% to 30.1%. Other impurities such as Fe₂O₃ and Al₂O₃ decrease with depth also. The results from PH 1 are plotted up in graphical form and compared with the results from BHP No 1 (Plan 5).

The silica content reflects the incidence of vein quartz and pervasive silicification tending to replace the carbonate to produce a chert. The deeper BHP drill hole shows that quartz veining persists with depth and it is suggested that the pervasive silicification is only a surface effect.

Some surface samples were analysed and are presented in Table 4 showing a complete range of silica contents from 1.7- 72.6%. No resource figures were calculated. More drilling was recommended to study the extent of silica contamination and to provide data on the ground water conditions.

CRA continued the exploration in EL 10/79 under a joint venture with MHA which ran from April 1982 to August to 1983. The target was to test for dolomite to be extracted in an open cut for agricultural and refractory use.

CRA drilled four holes in the Duck River area (two hit dolomite) and five holes in the Irishtown area (three hit dolomite) a combined depth of 190m using a Warman 500 (Plan 6). The holes were percussion drilled to solid bedrock then cored at NQ size. Overburden depth was 5-30m (av. 17.5m) at Duck River and 13-21m (av. 16.6m) at Irishtown.

The five holes intersected dolomite within the 30m-depth requirement of CRA. Average grades were about 30% CaO, 20% MgO with silica as the major contaminant varying from 0.8% to 19.2% (Plan 6A).

Inferred resources were calculated to be-

27M tonnes/vertical m at Duck River of 28.5% CaO, 19.72% MgO, 5.37% SiO₂ and 1.16% Fe₂O₃, and

7M tonnes/vertical m at Irishtown of 29.5% CaO, 19.9% MgO, 6.36% SiO₂ and 0.20% Fe₂O₃

The variability of silica assays particularly at Irishtown implied patchy silicification and very detailed drilling would be required to assess the degree of contamination and hence grade.

It was recognized that the Duck River dolomite was better quality than the Irishtown dolomite but that the overburden depth of up to 30m would be a problem as would a high water table and potential flooding by the Duck River.

The conclusion (Weir, 1981) was that although large resources of dolomite were demonstrated in EL 10/79, the prospects were abandoned because of a combination of factors such as - an extensive soil cover, in well-developed farm land, with anticipated

drainage problems, and with abundant resources of dolomite occurring elsewhere in Tasmania.

The licence lapsed on 28th September 1984 and was reissued as EL 43/84.

4.3 EL 29/1980 Smithton

The licence was applied for by MHA on June 1980 for an area between Smithton and Detention for a variety of deposits including silica (both quartzites and sand), dolomite, limestone, ochre, clay and lignite.

The Pulbeena limestone consisting of a Pleistocene fresh water marl was noted as having been mined previously and two dolomites- one near the Black River Bridge and another near South Forest- were also recorded for further investigation.

Two grab samples of dolomite and one chip sample were taken at the Black River locality and analysed with the MgO and CaO contents being about 20wt % and nearly 30wt % respectively. However, silica was rather high at an average of 5wt %. It was concluded that the dolomite being only several feet above sea level and adjacent to the river would make it impossible as an extractable resource (Nye, 1981, 1982).

The South Forest prospect was mentioned as a dolomite occurrence with a mapped extent of about a mile but no further investigation was carried out.

The tide of exploration then passed onto silica with the test drilling (eight percussion holes) of Precambrian quartzite at Beacon Hills (Ware, 1983.) Then, additional drilling was carried on the adjacent Ballast Reserve as well as nine more holes within the licence (Thomas, 1985). Resources were given as 40,000 tonnes of quartzite suitable for smelting (with less than 0.1% Al₂O₃) along with 60,000 tonnes of white sand and fine aggregate.

About 1985, this EL of 121 sq km was amalgamated with EL 43/84 (39 sq km), described below, to give an area of 170 sq km when the adjustments were made towards the Km grid. Following relinquishment in September 1988, EL 29/80 had two parts- a western area of 10 sq km in dolomite south of Smithton and an eastern area of 9 sq km near South Forest for quartzite.

A well was drilled in Smithton Dolomite just 30m off the Trowutta Road (340,900mE; 5,473,600mN) for water level monitoring over a twelve month period. This was to estimate likely drainage problems in the event of quarrying in this area, as foreshadowed by CRA, as well as the costs of pumping and the possible effects on the underground water supply by a dewatering operation. There appear to be no major problems keeping the open cut dewatered in the Circular Head quarry.

Monitoring in the well from mid January to mid March recorded a drop in static level by about 0.5m. Available data from the Mines Department on surrounding bores in the area, although meagre, suggest that water yields in dolomite are highly variable with some being dry while broken rock or solution cavities ensure a good flow. Satellite bores were to be drilled near the well to enable pump tests but this did not take place.

Chemical analyses on the bore were conducted over 3m intervals and showed a high level of silica with a range 13-45% SiO₂ (av 27%) to a depth of 18m and 2-9% SiO₂ (av 6%) over the bottom 12m. Fe₂O₃ averaged 2.5% (range 1.4-4.0) while Al₂O₃ averaged 2.3% (range 0.8- 4.7). Because of these contaminants, this stone is clearly inferior to that drilled by BHP in 1945 and by CRA in 1983 in the Smithton region.

In the eastern area, a small program of eleven percussion holes was carried out on Forest Quartzite occurrences (Threader, 1989) one kilometer east of Lake Mikany (JB 1-4) and the same distance south west of South Forest (BB 1-7).

The quartzite outcrops appeared to be of high quality but surface sampling in 1988 was below 98% SiO₂. From the limited drilling, the results were highly variable but conformed to a pattern of surface enrichment of about 99% SiO₂ in the top 4-6m and then with a marked increase in impurities below that depth.

It was planned to extend the drilling program into the area to the north of the BB series of holes where an area of 25ha could be prospective for larger tonnages of quartzite but this was not pressed forward. The EL was eventually relinquished.

4.4 EL 43/1984 Smithton

During the tenure of this licence, a joint venture was formed between MHA and Pan Australia Mining Ltd as operators and the focus became the gold potential of the dolomites, the potential for other metallic mineralisation throughout the licence and the investigation of the EW trending aeromagnetic anomaly near Smithton township.

Gold values of 3g/t and 4g/t over 5m and 15m respectively were reported by the Mines Department Laboratory for surface chip samples of dolomite collected by CRA from near the Duck River, south of Smithton.

Re-sampling by Pan Australia Mining could not repeat these values and gave results below the 0.008ppm lower limit of detection (other than one value of 0.017 ppm). It was concluded that the early results were due to contamination (Douglas McKenna & Partners, 1985).

A stream sediment survey with both cyanide-leach and pan concentrate samples failed to find any anomalism of gold or other metals. A ground magnetic survey was not successful in locating an aeromagnetic anomaly which had been defined by EZ in areas to the west of this licence and attributed to Tertiary basalts or Cambrian spilites (Whitehead, 1987).

4.5 EL 25/1989 Smithton

This tenement was selected to cover the southern strike extension of the dolomite being mined in the Circular Head quarry at Smithton.

The licence of 6 sq km completely surrounded the current mine lease 101M/87 of 35ha as well as a second mine lease 102M/71 of 96ha to the south also held by the Circular Head Dolomite Company.

The testing by Mineral Holdings was restricted to a small corner of the licence area covering freehold land north of the Bass Highway with its eastern boundary as the Duck River at the Blackwood Bridge and completely surrounded to the west by the 96 ha mining lease. To the south of the highway, the licence covered closely settled agricultural land.

The Smithton Dolomite bedrock is entirely covered by surficial sand to a depth of 3-4m. Dolomite outcrop can be seen under Blackwood Bridge and to the north at Watson's Bend near the quarry. The carbonate rocks strike NS and dip between 30-50 degrees west.

In June 1990, ten percussion holes (1-10) totalling 92m were drilled by MHA along the Bass Highway and in the freehold land to the north (Plan 7). All holes encountered dolomite with an aggregate 64m being bored in solid rock but the overlying sand column contaminated the carbonate samples and the high water table restricted the open-hole drilling. Due to the contamination, the analyses were not presented in the report.

Further exploration was completed by September 1990 with surface sampling and drilling proceeding an additional 500m to the north of the previous work (Plan 7) and in and around the old quarry workings of the Ballast Reserve (UPI 5315). Eight outcrop samples were taken and eight drill holes (D 1 and 2, DK 1, 2, 4, 5, 7 and 8) were completed with an aggregate of 60.5m. Composite borehole samples of dolomite were made up from 1m sample intervals and are presented in Table 6 along with the surface values.

The carbonate values tested at Blackwood Bridge prospect are > 20% MgO and > 29% CaO. The impurities are minor at SiO₂ <0.31%, FeO <0.24% and Al₂O₃ <0.03%. CaO is marginally more liable to be enriched on the surface compared with the depth but MgO may be either enriched or depleted with no obvious trend.

Values above compare favourably with the Smithton quarry as revealed by the BHP drilling- average MHA 30.28% CaO, 21.78% MgO; average BHP 30.4% CaO, 20.3% MgO; best average BHP 31.3% CaO; 20.9% MgO. Impurities are generally less at Blackwood in SiO₂, Fe₂O₃ and Al₂O₃.

No resource figures were calculated in the report for the area tested. However, taking the area of the licence shown in Plan 7 including the ballast reserve as 120ha and using the average thickness of the dolomite as 6m from the drilling, then the inferred resource is-

$$120,000 \text{ sq m} \times 6\text{m} \times 2.85 = 2,052,000 \text{ tonnes} = 2\text{Mt}$$

It was proposed to bulk sample the dolomite in the NW of the licence or in the Ballast reserve but this was not implemented. No reason is advanced in the report for abandoning the prospect but it appears there was some doubt expressed by Mineral Resources Tasmania that a mining lease application would be successful so close to housing situated on the southern side of the Bass Highway.

For the above reason, MHA shifted its focus from Smithton to concentrate on exploration further out at Redpa, Brittons Swamp and Montagu Plains.

The ELs 31, 32 and 33/1990 were taken out by Mineral Holdings to investigate the resources of Smithton Dolomite possibly triggered by the availability of new Government mapping in the Woolnorth Atlas quadrangle to the west of the Smithton map sheet. The emphasis was on finding dolomite of metallurgical and chemical grade more remote from Smithton township where the encroachment of building and subdivision threatened to make any resource extraction resulting from the work by MHA on EL 25/1989 a difficult proposition. The challenge in view of the wide variation in grade of the samples tested to date was to find a sufficient reserve of an acceptable grade in an environmentally acceptable and mineable location.

4.6 EL 31/1990 Redpa

4.6.1 Exploration

This exploration licence in the headwaters of the Welcome River at Redpa, near Marrawah was issued on 3rd April 1991 as 6 sq km and was reduced to 3 sq km on the 1996 renewal date (Plan 3). It subsequently became RL 9/1997.

A detailed account of the investigation by Mineral Holdings of the carbonate resources in this area, previously reported on by Twelvetrees (1908), Nye (1932), Hughes (1957) and Longman and Matthews (1961), is given in a series of reports by VM Threader covering 1992 to 1997 (TCR 92-3349, 93-3448, 95- 3735, 96-3861, 96-3875 and 97-4052).

At Redpa Prospect, called Carbonate Hills by MHA, flat lying, pale pink Tertiary limestone beds occupy a series of low hills and unconformably overlie a bedrock of Precambrian Smithton Dolomite, here composed of a folded sequence of magnesian limestones and dolomites mostly concealed under a veneer of Quaternary sediments (Plan 8). The targets were given as chemical and metallurgical grade limestone and dolomite and dimension stone.

The licence was located on freehold pastoral land in the headwaters of the Welcome River. The Tertiary marine limestone is some 10m thick on the hills of the area and, in the west of the licence, disappears under Tertiary basalt, part of the extensive Marrawah basalt field reaching to the coast. Basaltic detritus covers the limestone on Coffeys Hill and may extend to Michaels.

Evaluation began with rock chip sampling, percussion drilling (June 1991) and diamond drilling (November 1991) aimed mainly at the Tertiary limestone. The M-, E- and C-series sample results and descriptions are given in Tables 7 and 8 and locations on Plan 8. The M-series, 8 samples of Tertiary limestone taken over 6 sites, relate to Michaels Hill; the E-series, 8 samples over 8 sites, mostly Tertiary limestone but 3 are dolomite, relate to Edwards property and C-series, 7 samples over 6 sites, all in Tertiary limestone are from Coffeys Hill.

The surface samples averaged 53% CaO (95% CaCO₃) from the analyses run by MHA (Table 6) which compares favourably with those collected during a separate study by David Mitchell Ltd (Cochrane and Runge, 1991) at 53.5% CaO (95.5% CaCO₃).

The surface sampling was followed by 257m of percussion drilling and 70m of diamond drilling mainly in the limestone which caps Coffeys and Michaels Hills (Plan 9). The drilling was mostly collared in outcrops of carbonates rather than overburden as the latter proved to have a high failure rate by not reaching carbonate within 10m due to irregular karst features in the bedrock or the drill being blocked by clay or rubble.

Sixteen of the twenty-six percussion holes were drilled in Tertiary limestone, three in dolomite, three in dolomitic limestone and four remained in overburden. The drilling was 80% effective in the sense that, although few holes reached the 20m-target depth, a hole was judged effective if enough target rock was returned to be worth analyzing. Most of the failures were holes drilled for Tertiary limestone where no bedrock was returned. Most of the holes drilled in Tertiary limestone ended in cavities except 16 and 22. Table 9 give a summary of all of the drill holes at Redpa.

Full analyses over selected intervals, mostly 3m, are given in the Tables 10 and 11 for the Tertiary limestone, the dolomite and the magnesium limestone. The Tertiary limestone ranges from 50-55% CaO, the dolomite above 18% MgO and above 28% CaO and the magnesium limestone from 5-17% MgO and 35-50% CaO.

Six holes (D 1-6) were drilled on Michaels Hill and only two of them (D 5 & D 6) cored Tertiary limestone and one (D 7) cored dolomite to the southwest in the Precambrian bedrock (Plan 9). The diamond drilling was conducted with Melocco Pty Ltd, NSW which had tested the pink limestone in outcrop and determined its suitability as a dimension stone with an attractive high polish.

Overall, the diamond drill program was only 43% effective with water return being lost in the cavities. Not enough drilling has been carried out to prove a sufficient dimension stone resource for mining. Only, D7 was analysed with the dolomite being above 20% MgO and above 30% CaO (Table 11).

In 1992-93, chemical and physical tests were carried out on the carbonates by David Mitchell Ltd, Herbert Lange, APPM and Comalco. A proposal for the production of magnesium metal using the Cameron plasma process was commissioned by MHA (Nixon, 1993). A moratorium or relaxation of the exploration commitment on the three carbonate licences was granted by the Director of Mines in recognition of MHA securing the exclusive rights in Australia to the Cameron Process.

In 1994-95, two 500kg bulk samples of dolomite were blasted from outcrop on Kings (K) and Edwards (E) properties. Half of each sample was airfreighted overseas for furnace trials in Canada. These results were never reported to MHA on the grounds of confidentiality. Analyses of these bulk samples based on 2kg splits are given in Table 12 with the MgO and CaO being greater than 19% and 31% respectively.

In 1995-96, the focus of exploration changed from the Tertiary limestone to the dolomites and dolomitic limestone of the Precambrian Smithton Dolomite Formation, some of which had been intersected in the previous drilling.

The objective was to define a mineable resource of dolomite and it was necessary to include drill collars in overburden to increase the area of potential resource. Ten percussion holes (R1-10) were drilled in this phase mostly on the southwest of Kings property with R 6, 7 and 8 collared in outcrop and R 1-5 and 9 in overburden (Table 9, Plan 9).

The six overburden holes were particularly unsuccessful as, after 7-13m of brown clay, the holes “belled out” on the bedrock contact preventing sample return except for R2 which got 13m of dolomitic limestone which was too contaminated to analyse.

The three outcrop holes, R 6, 7 and 8, recorded 4m, 14m and 10m respectively of dolomite with cavities. No analyses were presented for these holes. It was considered doubtful that a dolomite resource of such restricted area would be viable for extraction under more than 10m of overburden.

R10 was drilled successfully on the angle to its design depth of 20m on the eastern side of Michaels Hill where magnesian limestone crops out sporadically. Analyses of 5m intervals are presented in Table 14 ranging from 5.5-11.7% MgO and 42.3- 49.7% CaO.

By 1996-97, from the mapping and drilling evidence, it was appreciated that the magnesian limestone occupied the Precambrian bedrock over most of the north and east of the licence, was at least 100m thick stratigraphically and occurred in the trough of a SE-plunging syncline towards the top of the Smithton Dolomite. Exploration was then directed at proving resources of dolomitic limestone in the NE of the licence.

A composite 40kg rock chip sample was collected from four locations and sent overseas for furnace trials as a slagging medium in steel making with no results being reported.

The magnesian limestone was thinly bedded, current bedded and discontinuously banded by partial replacement of limestone by dolomite.

All nine known outcrop locations (R O/C 1-9) on Kings property over an area of 3ha, east of Michael’s Hill, were sampled to guide drill target selection (Plan 10). Analytical results are shown in Table 13 and the results from the follow up percussion drill program (R11-16) in Table 14. Six of the nine sample locations were drilled on or close to outcrop but loss of air pressure at the water table around 5-10m prevented the 20m-target depth being reached except in R 14. However, all holes but one returned limestone samples. This makes this part of the R-series drill program some 85% effective while the early part (R1-10) was only 45%. Solution cavities are also a feature of the dolomitic limestone.

The surface samples were in the range 3.68- 12.85% MgO and 38.3- 47.6% CaO with SiO₂ <0.2- 2.6% and drilling analyses conformed to these ranges also except for R14B which changed to dolomite in the 5-20m depth interval in the hole with MgO

analyses in the range 19-21%. This is taken to indicate that R14B may be on the eastern limit of the dolomitic limestone bed.

4.6.2 Resources

Drilling Summary

Date	Drill Holes	Metres	Target
1991/92	1-26 Percussion	257	T limestone, pC dolomite
1991/92	D 1-7 Diamond	70	T limestone
1995/96	R 1-10 Percussion	142.5	pC limestone, dolomite
1996/97	R 11-16	62	pC limestone
Total	49 holes	531.5m	

4.6.3 Tertiary Limestone

The Tertiary limestone is the best-drilled carbonate with the first percussion program being 80% effective although the smaller diamond program was about half that value.

The features to consider in the resource calculations are as follows.

- The limestone on Coffeys and Michaels Hills and on the rest of the RL covers an area of about 50ha but crops out over only 16ha. This area is further reduced by 5ha of Tertiary basalt talus on Coffeys Hill leaving an area of 11ha
- The average thickness of limestone in 17 boreholes is 7.6m.
- From the two effective diamond drill holes, D 5 and D 6, an average value of 0.75-recovery factor was calculated to allow for cavities.

The flat-lying limestone occupying the hills runs towards the northwest corner of the licence. With an estimated area of 50ha and an assumed thickness of 7.6m, the **inferred resource** of limestone is (Plan 9) -

$$500,000 \text{ sq m} \times 7.6 \times 2.7 = 10,260,000 \text{ tonnes} = 10\text{Mt}$$

Within that resource, **an indicated in situ limestone resource** on Michaels Hill is-

$$110,000 \text{ sq m} \times 7.6 \times 0.75 \times 2.7 \text{ (RD)} = 1,692,900 \text{ tonnes} = 1.7\text{Mt}$$

The quality of the Tertiary limestone based on 18 rock chip analyses, 20 percussion drill holes and 2 diamond drill holes is-

$$\text{CaO} = 52.8\text{-}55.2\%, \text{ MgO} = 0.5\text{-}1.75\%$$

$$\text{Fe}_2\text{O}_3 = 0.04\text{-}0.41\%, \text{SiO}_2 + \text{Al}_2\text{O}_3 = 0.5\text{-}2.9$$

The diamond drilling was not effective enough to establish a sufficient resource of limestone for dimension stone although some of the limestone has an attractive pink colour and takes a high polish. However, rock quality tended to deteriorate at about 5m depth due to solution effects and iron staining probably as a result of water table movements.

4.6.4 Precambrian dolomite and limestone

Drilling in the dolomite bedrock is exploratory only as an indicated resource under the AIMM code would require a greater number of holes with less spacing, greater depth and more recovery data.

There have been 17 holes in the Smithton Dolomite formation, 7 in dolomite with an average thickness of 12.8m and 10 in dolomitic limestone with an average of 10.5m.

Based on the mapping of outcrop and drilling, magnesium limestone occupies the bedrock over most of the northern part of the RL except the southwest corner on Edwards property where dolomite is found.

Underlying an area of 50ha on Edwards property, a resource of **dolomite** is inferred as-

$$500,000\text{sq m} \times 12.8 \times 2.85 = 18,240,000\text{t} = 18\text{Mt}$$

That the above tonnage figure is conservative is proved by the evidence from Government water bores on the western boundary of the licence where one records a thickness of 39m of dolomite under 9.8m of overburden. All resources are expressed according to the JORC Code (1999).

Restrictions on this resource would be the clay-rich overburden of 10m average depth which could make evaluation and mining of this resource problematical.

As for the **magnesium limestone**, the area of Kings and Edwards properties underlain with this bedrock approaches 50ha as shown from mapping and drilling and so an inferred resource is-

$$500,000 \text{ sq m} \times 10.5 \times 2.7 = 14,175,000\text{t} = 14\text{Mt}$$

The overburden in the southern part of the area varies up to 7m while to the north the area of best outcrop occurs off the nose of Michaels Hill on Edwards property. An area of about 3ha has 1% sporadic outcrop and has been drilled by 6 percussion holes (R10 and R13-16, Plan 10).

Hence, within the above 14Mt of dolomitic limestone, an indicated resource can be calculated as-

$$30,000 \text{ sq m} \times 11 \times 0.75(\text{recovery factor}) \times 2.7 = 668,250\text{t} = 670,000\text{t}$$

Cavities and the water table are clearly features which have restricted the drilling and a recovery factor of 0.75 has been assumed to be the same as the Tertiary limestone. As the drilling has been restricted to outcropping areas, the overburden thickness variability has not been tested here.

As no clear market exists for these resources either as dimension stone, metallurgical flux, or environmental or agricultural lime, a retention licence was applied for in September 1997 and granted as RL 9/1997 of 2 sq km (Threader, 1997) and much of the resource figures above are based on that application.

4.7 EL 32/1990- Montagu Plains

This exploration licence of 62 sq km was issued on 3rd May 1991. A series of reports by V M Threader spanning the duration 1991-96 gives an account of the exploration (TCR 92- 3348, 93- 3448, 95- 3735 and 96- 3903).

The licence area covers the lower plains of the Montagu River and is separated from EL 33/90 covering the upper catchment by the farming settlement of Togari. Both licences target the east-dipping, western limb of the regional syncline in the Smithton Dolomite formation which is concealed beneath alluvium and, in the case of the northern part of EL 32/90, windblown sand of the coastal, aeolian plain (Plan 3).

The bulk of the area has an elevation between 10 and 20m apart from the southern part which is just above 20m. The land tenure is mainly freehold private property given over to farming and private forestry with some State Forest on the margins.

Initial exploration in 1991-92 was confined to searching for dolomite outcrop for surface sampling aided by Mines Department mapping of Woolnorth Atlas Sheet (Seymour and Baillie, 1992). The only known outcrops of dolomite bedrock occur on or close to the bed of the Montagu River in the River Reserve and in the 150ha APPM Caves Reserve at 323,100mE; 5,474,500mN. Otherwise, dolomite is known from a few water bores in the area (Plan 14).

The dolomite in the River Reserve was not sampled but under an agreement with APPM four samples (M 1-4) were taken from surface outcrop (Plan 11) all within 100m of each other and analyses (Table 15) showed it to be of high quality with CaO in the range 31.03- 31.28%, MgO 20.05- 21.34%, SiO₂ 0.14- 0.41%, Al₂O₃ 0.01- 0.16% and Fe₂O₃ 0.33- 0.49%.

The limited sampling program was to guide a possible hammer-drilling program outside the reserve which was recognised as having no official status but which was made to protect a deposit of vertebrate fossil remains (Murray and Geode, 1976). However, it was accepted that a mining proposal for the area would have little chance of getting the required approvals.

It was proposed that a limited hammer-drilling program would be carried out in 1992-93 to test covered areas outside the reserve area to determine dolomite extent and quality and overburden thickness. However, this did not eventuate. By 1993-94, the area was involved in the moratorium.

In 1994, the area was reduced to 15 sq km and 22 test pits were dug with a backhoe in the north (six pits, Plan 12) and south (sixteen pits, Plan 11) of the licence to provide dolomite samples. The program was only 45% effective in returning dolomite samples from 10 pits with the rest having too deep overburden (+3m) yellow clay, or grey to brown to black sandy clay or black peaty clay.

In summary, 15 pits were dug on the east side of the river and only 4 successfully returned a dolomite sample (BP 10,11 and 22) in the north and BP 1 in the south. The results were better on the west side with 7 pits dug (BP 12-18) and only BP12 failing to return a dolomite sample.

Dolomite samples were mainly grey or occasionally blue-grey in colour and mostly hard with a grain size ranging from meso- through finely- to micro- crystalline.

The chemistry is as follows omitting BP 13 (Table 15) -

	West Side of River	East Side of River
CaO	30.54- 32.51%	29.44- 30.47%
MgO	19.46- 21.20	20.00- 21.04%
SiO ₂	0.07- 1.14%	0.44- 4.10%
Al ₂ O ₃	0.08- 0.54%	0.47- 0.83%
Fe ₂ O ₃	0.10- 0.24%	1.04- 1.85%

So the west side dolomite has higher grade CaO and lower impurities than that of the east side of the river and is similar to the surface samples from the Cave Reserve also on the west side. A 5km strike extent of dolomite in the middle of the licence remained to be sampled.

In 1996, the Montagu Plains EL 32/90 was dropped by Mineral Holdings in favour of concentrating on the other carbonate resources in the licences at Redpa and Togari. It was accepted that a large resource of dolomite could be confidently predicted on the licence but that it would be difficult and costly to prove up because of the extensive cover and difficult to mine because of the swampy ground.

4.8 EL 33/1990- Brittons Swamp

4.8.1 Exploration

This exploration licence of 32 sq km was issued on 7th June 1991. A detailed account of the exploration by Mineral Holdings on the licence is given in a series of annual reports by VM Threader covering the duration 1992-97 (TCR 92- 3348, 93- 3448, 95- 3735, 96- 3875 and 97- 4052).

The bedrock geology consists of the Smithton Dolomite formation concealed by a thin veneer of alluvial deposits in the upper catchment of the Montagu River at an elevation of about 20m and with absolutely no topographic relief (Plan 3). Outcrop of dolomite is restricted to the drainage channels including the Montagu River and some outcrops of silicified dolomite in the south of the licence which have been exploited in the past for road gravel in a series of small quarries or scrapes.

Exploration became focused on the south of the EL and on the basis of results an RL 10/1997 of 7 sq km was granted covering partly identified dolomite resources. The RL covers a combination of partially cleared freehold land (Leis property) and adjoining State Forest including the Montagu Swamp Forest Reserve. The prospect is referred to as Togari by Mineral Holdings and the RL as Brittons Swamp by Mineral Resources Tasmania despite neither locality being enclosed by the licence boundary.

Initial assessment of the resources went ahead in 1991 with ten surface chip samples (T1-10) from dolomite exposures along the Montagu River and tributary drainage channels (Plan 13) returning good carbonate grades (Table 16).

The licence was part of the moratorium in 1992-93 and then in 1994-95 a bulk sample of 500kg was extracted from along a 400m exposure in a drainage channel (previously sampled by T7-9) at the same time as the two from Redpa and half was sent overseas for furnace testing with a split from the remaining half being chemically analysed (Table 12).

In 1995, a backhoe program was employed in this area to extend the sub crop sampling (T12-25) along tracks as part of a similar program to the north in the Montagu Plains EL 32/90. The rock chip program (Plan 13) then continued (T26-41) along the channels in the south east of the licence (Table 17).

The good quality of the dolomite is shown by the analyses in Tables 16 and 17 and in summary is CaO in the range 30.69- 34.32%, MgO 18.04- 22.09%, SiO₂ <0.01- 4.52% (mostly well under 1%), Al₂O₃ <0.01- 0.17% and Fe₂O₃ 0.05 – 0.75%.

In 1995-96, percussion drilling took place at both Redpa and Togari prospects using an airtrack drill with down hole hammer and PVC casing to avoid sample contamination. TP 1-5 were drilled on a vehicle track adjacent to the channel in the middle of the licence which was bulk sampled (Plan 13). Overburden was found to be 2m thick here whereas it was only 1m thick around 200m to the south in the backhoe pits.

The deepest hole (TP 1) went to 18m, the total metreage drilled was 62.5 and 52.5m total of dolomite was cut being light grey to light brown to white in colour. All holes stopped in dolomite. TP 3 was drilled through an ironstone cap 2m thick and was abandoned in the underlying dolomite due to sample contamination.

Analyses showed good grades of dolomite as follows (Table 18) with CaO in the range 29.4- 33.3% (mostly above 32%), MgO 18.4- 20.4%, SiO₂ 0.11- 6.3% (mostly less than 1%), Al₂O₃ 0.04- 2.23% (mostly less than 0.3%) and Fe₂O₃ 0.06- 0.91% (mostly less than 0.2%).

The percussion program was continued in 1996-97 with five more holes (TP 6-10) being drilled in the south west of the licence (Plan 13) following up the high quality surface samples. Two (TP 9 and 10) were on the edge of the freehold land along the State Forest boundary and three (TP 6, 7 and 8) in the State Forest alongside the Montagu River. Four of the holes reached the target depth of 20m while TP8 hit a mud filled cavity at 12m and was abandoned. An aggregate metreage of 83m of hard, grey dolomite was cut and the analyses are given in Table 13 (along with the assay intervals and logs) as CaO in the range 20.8- 32.93% (mostly above 31%), MgO 18.87- 20.52%, SiO₂ <0.53- 5.0% (mostly less than 2.5%), Al₂O₃ <0.1- 0.5% and Fe₂O₃ 0.1- 1.9% (mostly less than 0.4%). TP 9 and 10 are of marginally higher purity than TP 6, 7 and 8.

4.8.2 Resources

Drilling Summary

Date	Drill Hole	Metres	Target
1995-96	TP 1-5 Percussion	62.5	pC dolomite
1996-97	TP 6-10 Percussion	92	pC dolomite
Total	10 holes	154.5m	

Regional mapping has shown that the licence area is on the east-dipping, western limb of a regional syncline in the 1000m thick Smithton Dolomite Formation. Ten percussion drill holes and 41 surface samples testify that unspecified large resources of Precambrian dolomite is widespread throughout the licence with no silicification despite the outcrop just outside the licence area to the southwest being silicified. The bedrock is under 1-2m of clayey or sandy overburden.

The area of dolomite bedrock can be confidently predicted as 2 sq km from the above data and so an inferred resource of dolomite is –

$$2,000,000 \text{ sq m} \times 14.8\text{m} \times 2.85 = 84,360,000 \text{ tonnes} = 84\text{Mt}$$

The area in the southwest, where five close-spaced drill holes (TP 6-10) were completed, covers some 4ha and the resource here is indicated as-

$$40,000 \text{ sq m} \times 16.6\text{m} \times 2.85 = 1,892,400 \text{ tonnes} = 1.9\text{Mt}$$

This could be reduced by a recovery factor still to be assessed. No cavities were found in four of the holes but TP 8 was abandoned at 12m due to a cavity.

Compared with the Redpa dolomite, there are slightly higher levels of impurities here in SiO₂ and Fe₂O₃ although TP 9 and 10 are similar to the former. This may be explained by the higher water table here at Togari where it comes to within 1m of the surface.

Cored drilling would be required to confirm the resource category as indicated or to raise it to measured. However, it was decided to discontinue exploration until a firm market could be established and a Retention Licence (RL 10/1997) of 5 sq km was sought and awarded in 1997.

5.0 INDUSTRIAL TESTING

Limited physical testing only has been carried out on the NW carbonates.

In 1986, some chemical analyses and furnace tests were carried on the dolomites. Societa Italiana, Bolzano reported on three dolomite samples from the Smithton Quarry and Blackwood Bridge. The dolomites were reported to have a good composition and during calcination at 1100 degrees C their behaviour in the furnace was considered to be good.

Other tests in the same year by Steeley, Hartlepool, UK on dolomite samples from the two above localities revealed that both samples calcined satisfactorily at 1200 degs C to dolime but tended to decrepitate when dead burned to 1800 degs C giving a product density of 3.1 G/ML. When caustic calcined and briquetted, the quarry sample dead burned at 1800 deg C to 3.3 G/ML density whereas Blackwood Bridge achieved only 3.0 G/ML presumably because of higher impurity levels.

As part of an evaluation of the Redpa deposits, David Mitchell Ltd (Cochrane and Runge, 1991) completed furnace tests on five samples of Tertiary limestone and two samples of Precambrian rocks-one of magnesium limestone and one of dolomite. The samples were heated in a muffle furnace to 1300 degs C and four out of five Tertiary limestone samples held together as did both Precambrian samples. The conclusion was that both the limestone and the dolomite would be likely to maintain integrity in passage through a shaft kiln.

In the 1991-92 period, several companies conducted brightness tests on the carbonates to determine their suitability as a paper coating and filler. White dolomite from Carbonate Hills (Redpa) was tested by Herbert Lange, Wittenborn, Germany; APPM, Burnie and Comalco Ltd, Australia. All test showed the Redpa dolomite sample to be lower in brightness and colour than the commercially available carbonate or kaolin used by these companies in their operations. In 1996, Amdel also did a brightness and colour test on a dolomite sample said to be from the King property at Redpa.

Mineralogical studies by Mineral Resources Tasmania carried out in 1991 on the Redpa dolomite from the percussion drilling (1/2) showed by X-ray diffraction a composition of 85% dolomite, 5% calcite, 10% quartz and 2% feldspar. In thin sections, the homogeneous grain size is in the range 150-200um which makes it sparry, mesocrystalline or macrocrystalline depending on the classification scheme used. No cryptocrystalline material is present.

In 1994-95, a bulk sample of 250 kg of dolomite from both Redpa and Togari prospects were sent overseas to a Canadian company for furnace trials. No results were returned apparently on the grounds of confidentiality. A composite rock chip sample of 40 kg of dolomitic limestone from Kings, Redpa was also sent overseas in 1996-97 for furnace trials but once again no results eventuated.

6.0 HEAVY MINERAL SANDS

Beach strand lines are prospective for heavy mineral sand deposits on the coastline between Marrawah and Cape Grim. Work on the deposits including drilling has been carried out by Pickands Mather in 1967, by EZ in 1970 as EL 6/68, by Aberfoyle in 1979 and by National Mineral Sands in 1988-91 under EL 51/86.

Although there are indications of heavy minerals (HM) as far north as Studland Bay with grades ranging up to 1.23% (av. 0.5%) HM, the best area is in the south at Ann Bay just north of Marrawah township currently in EL 21/2001.

Results of the most recent evaluation by National Mineral Sands (series of reports by A. Dove, 1988-90) show that the HM concentrations occur in the frontal dunes and extend for more than 3km along the beach. The HM grades of more than 1.5% occur to depths of over 10m in the frontal dunes but in the hinterland the mineralisation reduces to the top 2m.

Significant mineralisation was encountered in 3 lines drilled at the south end of Ann Bay with grades in the range 4-9% HM and extending over widths of up to 200m. Mineralogical examination revealed a minimum of 20% of economic heavy minerals in the HM suite of the samples tested. Tentative figures for the HM assemblage are 3-4% rutile, 7-11% leucoxene, 4-6% zircon and monazite < 1%.

Neither cassiterite nor gold were determined by National Mineral Sands but previous work by Pickands Mather and Aberfoyle have estimated the raw sand grade as 10-20ppm Sn and a grade of 0.098% of cassiterite in the heavy mineral concentrates giving 103 tons of cassiterite in 108,000 tons of heavy mineral concentrate. From the recent drilling, an Indicated and Inferred HM resource in the order of 200,000 tonnes has been calculated by National Mineral Sands. EL 51/86 was finally dropped in 1991 (Toomath, 1991).

A Western Australian company – Matilda Minerals- is interested in the heavy mineral deposits and is currently negotiating with MHA for the rights to explore the beach strand lines with new geophysical technology.

7.0 REGIONAL CARBONATE PROSPECTIVITY

From some 70 years of geological mapping, the regional structure of the Smithton Basin is now well understood and this has been greatly helped by the geophysical coverage in recent years (2000-02) particularly the high quality aeromagnetic and radiometric surveys of the Western Tasmanian Regional Minerals Program (Plan 2A).

However, estimates of the prospectivity of the licences for carbonates are hindered by poor outcrop and an almost complete lack of drilling to support the geoscience mapping. The stratigraphy of the both the Smithton and the Black River Dolomite Formation is consequently poorly known, particularly the former being a thicker and more dolomite-rich formation and thus suffering more solution weathering and concealment. These formations have a substantial bedrock surface area to prospect in the whole Basin with that of the Smithton Dolomite being 563 sq km and of the Black River Dolomite being 224 sq km as calculated approximately in this report.

Under these circumstances, the water bore data base of Mineral Resources Tasmania (BORIS) gives valuable information on the presence of dolomite bedrock under the more recent veneer of unconsolidated sediments- alluvium, swamp deposits and wind blown sands (Plan 14). These are only drillers' log identifications so must be used with caution.

In addition, the construction materials database (CONMAT) provides quarry site locations with estimates of resources and uses to guide field examination and the collection of representative rock samples for analyses. In Plan 15, the dolomite quarries, mostly disused, are shown in yellow and all others in red. Not all quarries, particularly the smaller ones, are expected to be in the database.

7.1 The Smithton Dolomite

The Smithton Dolomite is some 1500m thick and is best exposed in the northern Montagu River section, and also in the Duck River near Smithton, where there is a lower, 500m thick member of pale-grey, fine grained dolomite, thinly bedded with well preserved primary textures and an upper, 1000m thick member of grey to white, medium grained, massive, crystalline dolomite with obscured 'ghost' primary textures (Calver, 1998).

Oolitic limestone occurs just above the base of the formation at Scotchtown and in three dark grey horizons in the upper member at Montagu River. Scarce shales are also known in the upper member at the latter locality.

At Redpa, a thickness of 130m of limestones and dolomitic limestones have been correlated as the upper member by Calver (1998) at the same stratigraphic level as the Montagu limestones.

Overall, the lithologies in the Smithton Dolomite formation have been put at 85% dolomite, 10% limestone and 5% shales but this is tentative only in the absence of well-exposed, measured sections (Calver, pers. com. 2003).

The highest quality dolomite is found frequently, and possibly may even be widespread, in the Smithton Dolomite Formation. There are indications that the upper 1,000m thick member may have purer dolomite than the lower 500m thick member.

In the Smithton area, the operating Circular Head dolomite quarry is in high quality dolomite and this runs south to Blackwood Bridge (eg. Table 1, Samples 1-5 and 15, SiO₂ < 0.52%) and has been tested in the MHA drilling in former EL 25/1989. These dolomite lithologies are presumed to be in the upper member.

The lower member, presumed to be close to the underlying sediments and volcanics on the Scotchtown- Nabageena ridge, has dolomite with greater silica contents at Edith Creek and in the Duck River near Scotchtown (eg. Table 1, Samples 6-14, SiO₂ 2-7%).

At Montagu Plains (former EL 32/1990), the prominent linear course of the river along 325,000mE has outcrops of dolomite which must be in or close to the lower member. Here, the silica content is variable but up to 4% based on only three samples (BP 10,11 and 22). To the south in the Seventeen Mile Plain, five samples (BP 14-18) of dolomite thought to be in the upper member gave low silica values up to 1%. However, at the APPM Cave Reserve, four surface samples (M1-4), which from their position must be in the lower member, had silica < 0.4% so the lower member can be pure also.

At Redpa (RL 9/1997), the limestones and dolomites have been placed in the upper member (Calver, 1998) and, from its position, Brittons Swamp (RL 10/1997) is expected to be in the upper member also. Both of these areas have good quality dolomite. Most of the analyses from surface sampling and drilling have silica at 1% or less with occasional spikes to 4- 10% particularly on the surface or at the shallowest drill intersections. There are certainly areas where silicified dolomite has been recorded in outcrop in the Smithton Dolomite formation as at the SW corner of the Brittons Swamp RL.

There is therefore some sparse evidence that the upper, thicker member has a better quality of dolomite and is more prospective than the lower member as judged by the silica content but because of the poor outcrop this cannot be certain.

There is a pressing imperative for the lithology of the Smithton dolomite to be revealed by a stratigraphic diamond drill hole cutting the entire section or a series of holes sited to get a representative section across the formation. This would aid exploration greatly if certain pure lithologies could be targeted even under alluvial cover.

7.2 The Black River Dolomite

The Black River Dolomite as a formation consists of 600-800m of interbedded dolomite, black shale and chert. The formation is well exposed in the Arthur River section well to the south of the licences, also in the Irishtown and South Forest areas east and south of Smithton and the upper third of the formation has been drilled in the only Government diamond drill hole in the region, Forest No 1 just south of Stanley.

The upper 200m section – the Julius River Member- is characterized by coarse dolomitic conglomerates or sedimentary breccias (diamictites) of unknown origin. The chert units often show well-preserved oolitic, pisolitic and stromatolitic fabrics suggesting early diagenetic replacement of carbonate (Calver, 1998) and this is true of the Arthur River section and the areas around Irishtown, Forest and Nabageena.

However, in the Forest drill hole only 150mm of chert was encountered in over 250m of the Black River Dolomite succession suggesting that silicification is a near surface, ground water effect (Brown, 1985).

With a higher percentage of non-carbonate lithologies than the Smithton Dolomite, the Black River Dolomite is more resistant to solution weathering and so has better natural exposures for the geological record. Its rapidly varying lithologies are not liable to give the continuity of quality grades of dolomite required for large volumes of extractable resources capable of meeting dolomite specifications.

Where the formation has been drilled at Irishtown by BHP, Longworth and McKenzie and CRA for MHA, the dolomite tends to have a high-silica content both from quartz veining and a pervasive silicification (SiO₂ up to 21.5%). This is regarded as a contaminant along with others such as Fe₂O₃ and Al₂O₃ and degrades the quality of the dolomite. In addition, the variability of the silica assays make it a difficult and expensive drilling exercise to define a sufficient volume of high-grade dolomite for extraction. However, there is evidence from the assays that the pervasive silicification decreases with depth and that it is a surface effect while the incidence of quartz veining appears to continue with depth from BHP No 1.

There is therefore some chance that the Black River Dolomite may eventually be a target if future industrial uses allowed some silica content to be tolerated or even to be desirable. There are areas in the Jims Plains Dome, for example, where silicified carbonates are mapped in outcrop and which are expected to be flat lying and so accessible to open cut mining if good quality dolomite is present under the silicified cap.

8.0 PROSPECTIVITY OF MHA EXPLORATION LICENCES

The current MHA exploration licences were taken out to seek for extensions of the carbonate resources already defined in the Retention Licences at Redpa and Brittons Swamp and to allow for other prospects to be revealed by the new geophysics and mapping of the WTRMP. The licences form a consolidated block taking up a major position in the north Smithton Basin to attract major companies with the financial resources and business commitment to market and develop this significant carbonate province (Plan 1). The prospectivity of each licence is reviewed in turn in the light of this study.

8.1 EL 16/2001 Christmas Hills

Much of this licence is occupied by the unprospective Cambrian Scopus Group sediments- reddish brown, interbedded siltstones, sandstones and conglomerates, as described in the Mineral Resources Tasmania mapping- forming the core of the regional syncline.

The top of the Smithton Dolomite is expected to occur in the covered bedrock around the edge of the Scopus Group assuming near conformability between the two formations and also in the south-facing embayment of Brittons Swamp which is probably caused by a local anticlinal warp.

There are no mapped outcrops of dolomite in the embayment although two Government drill holes record it in the bedrock under about 20m of sediments. Being in the core of a regional syncline, the beds should be flat lying. A stratigraphic hole could be considered here or in the overlying Salmon River Siltstone to the south. The Geological Survey had planned a hole in the latter locality about ten years ago but this did not take place because of the disbanding of the Drilling Section.

The embayment is probably too closely settled, small in area and landlocked, the bedrock too deep and the drainage too poor to support a major open cut.

The licence borders RL 10/19997 in the southwest where MHA drilling has established dolomite resources under about 2m of cover and the northern extension of these could be pursued in farmland with advantage to increase the resource base.

8.2 EL 21/2001- Marrawah

This licence contains the Welcome Syncline with the Redpa RL covering the Precambrian Smithton Dolomite and the Tertiary carbonate resources already outlined by MHA. There is scope for exploring the Precambrian carbonates-dolomite and limestones- to the southeast but not to the immediate northwest where all sedimentary bedrock is covered by the Tertiary basalt. With the thickness of alluvial cover being some 7-10m at Redpa and the land becoming low-lying and swampy to the southeast it is not an ideal situation, but not considered impossible, for an open cut mine.

In the northwest of the licence towards the coast, there is little doubt that the dolomite-bearing stratigraphy forms the bedrock under alluvium and aeolian sands but

there are no leads to follow up and a program of shallow bedrock drilling would be necessary to establish the potential.

In the northeast, the licence encloses the east-dipping Smithton Dolomite in the Montagu River and the Seventeen Mile Plain Embayment. The dolomite beds strike SSW parallel to the river course as mapped in low outcrop in the riverbed and does not swing into the embayment as defined by the underlying sediments and volcanics. This is considered to be a structural anomaly (Duncan, 2003) and if the dolomite is not tectonically- or stratigraphically-thickened to fill the space, the embayment centred on 321,000mE; 5,472,000mN must be occupied by flat lying dolomite beds. The area is underlain by magnetic signatures correlated with the underlying basic volcanics suggesting a shallow dipping contact.

From the Government mapping, the area is covered by alluvium of unknown depth including aeolian sand dunes, lunettes and swamp deposits. Exploration on former EL 32/1990 reached the northern edge of the area and recorded high quality dolomite bedrock within 3m depths (Plan 11, Table15) in backhoe pits.

On this interpretation, the embayment may contain potentially enormous quantities of flat-lying, high-grade dolomite. The area is about 10 sq km and if it is underlain by say 100m thickness of quality dolomite, the resource would be in the order of 3,000 million tonnes.

This could only be revealed by drilling, perhaps a combination of diamond to establish the stratigraphy, lithology and rock quality and recovery factors and percussion to outline and measure the resources. This could be costly and so is best left to a big joint venture company.

There are environmental constraints on this area. The land tenure is Private Forest Lands and the description of the area in the licence is the Seventeen Mile Plain Proposed Reserve Area over 2029ha. No exploration activities are allowed on this area without the prior written approval of the Director of Mines.

It is understood the proposed reservation is to protect stands of Eucalyptus Brookeriana from forest industry logging. It is important that it remains available to the mining industry for the purpose of exploration and resource extraction if justified under suitable environmental constraints and conditions.

MHA, on expressing concern about the Reserve, received the information from the Minister of Mines that the area had been purchased by the Regional Forests Agreement Private Reserves Program. The Minister gave a written assurance that he would not allow any such area to be removed from the provisions of the Mineral Resources Development Act 1995 and that the area would remain available for exploration and mining.

8.3 EL 22/2001- Montagu

The licence occupies the northern part of the Welcome Syncline with the cover of the alluvium and aeolian sands overlying the bedrock of the Woolnorth Plains. From the

sparse outcrop along the Welcome River, it has been established that all formations in the Smithton Basin are represented here but their extent under the cover is uncertain.

The western limb is nearly vertical or even overturned and the Black River Dolomite is relatively thin compared with the extensive Smithton Dolomite as represented on the cross-section on the Woolnorth 1:50,000 scale map sheet. This means that substantial areas under the cover are expected to contain high quality dolomite. The possible Scopus Formation outcrop in the Welcome River and magnetic horizons defined by the new geophysics suggest that all bedrock lithologies will not be dolomite and may be of formations in the core of the syncline not seen on the surface elsewhere and so not represented in the geological record.

There are a number of water bores in dolomite in the core of the syncline particularly north of the Montagu- Woolnorth road (Plan 14). These are drillers' logs and the drill hole positions are not accurately known but they indicate some potential for testing carbonate resources by shallow percussion drilling through the cover of the Woolnorth Plains. The centre of the syncline is also an ideal site for a diamond drill hole to identify the stratigraphic column and to establish the potential for high quality dolomite in the bedrock under the cover.

The licence also covers the Smithton Dolomite on the western limb of the Christmas Hills Syncline on the Montagu River Plains. This is the best area of exposure of the dolomite succession in the riverbed and near old terraces just west of the Montagu township. The bulk of the dolomite bedrock is concealed by the aeolian and alluvial cover of the Montagu Plains. The sparse Government drilling indicates that the cover is some 18-22m thick.

Most of the test pits dug by MHA under EL 32/1990 on the plains did not reach bedrock within the reach of the backhoe (3m). The only successful pits were immediately adjacent to the River Reserve and recorded good quality dolomite (BD 10, 11 and 22, Table 15).

Drilling would be necessary to measure the dolomite resources in this area of the licence. Eventual mining would require the overcoming of the deep overburden and the acquisition of several farming properties to position an open cut.

The southern part of the licence encroaches on the Seventeen Mile Plain embayment. There is little scope for exploration for environmental reasons as, despite the good quality of the dolomite, the APPM cave/faunal reserve (1sq km: 323,000mE; 5,474,500mN) is excluded from the licence.

The structurally emergent, Jim's Plains Dome presents a chance to explore the Black River Dolomite although much of it is covered by the alluvium of the Harcus River headwaters. An area of some 6 sq km contains a group of mapped outcrops depicted on the Woolnorth Atlas series map as massive to banded cherts after shallow water carbonates and occur along Redbank Road centred on 321,000mE; 5,477,000mN.

This area would require percussion drilling to establish the potential for good quality dolomite under the silicified cap if the resources were advantageous for special carbonate applications involving silica as an essential blend.

8.4 EL 23/2001- Smithton

This licence covers the east limb of the Christmas Hills Syncline in and around the Smithton Township including the entire thickness of the Smithton Dolomite. It surrounds the Circular Head Quarry leases of 131ha with their high grade dolomite resources currently producing 50-60,000 tonnes of dolomite per annum for local State use in agriculture and construction including ready mix concrete. No estimate has been made in this report of the resources of dolomite on the leases but the undeveloped 100ha south of the river could theoretically produce 2.85 Mt per vertical metre of dolomite. In practice, the extractable resource yield would be less than this due to discounts due to the mining methods, dilution and zoning requirements. However, the main constraint on the quarry is the lease condition to operate at no more than 100,000 tonnes per annum.

The quality of the carbonate is high as measured by the 1945 BHP drilling and by the drill testing at Blackwood Bridge prospect by MHA under EL 25/1989. There is little doubt that the high quality dolomite will be present to the west of the quarry leases before being covered by the overlying Scopus Formation.

However, the area would require substantial drilling to prove up and the cover is up to 15m thick from the geology maps. There appears to be little chance of the small area being able to physically encompass a major export quarry or to get an operating licence to produce say 500,000 tonnes per annum in close proximity to Smithton Township.

9.0 USES OF CARBONATES

9.1 Carbonate Technology

As part of its downstream processing interests, MHA is investigating a new technology for the production of magnesium metal being developed by an overseas company Magnesium Technologies Ltd (MTL). This is a direct reduction method rather, than the more common electrolytic method, called the carbothermic route and involves the mixture of magnesium material feedstock and a carbon source (coal, coke, woodchips) through a furnace. The magnesium is reduced to metal and the resulting hot gas phase containing CO, Mg gas and less than 1% impurities is condensed initially precipitating silicon carbide and then magnesium metal.

The method is simpler with less processing steps than the electrolytic route and is cheaper with lower running costs as it uses less energy per tonne metal produced. MHA is currently studying the use of its magnesites and dolomites as possible feedstocks in this process and holds the Australian franchise for the MTL technology.

9.2 Quality of Carbonates

As far as quality is concerned, the average analyses of dolomite from Togari (Brittons Swamp) and Redpa are given in Table 19 and compare more than favourably with the average grades of existing suppliers- BHP, Ardrossan and ACI, Mt Gambier (Dickson, 2003).

The Tertiary limestone from Carbonate Hills (Redpa) also compares well with other limestone sources in Tasmania such as Railton, Mole Creek and Flowery Gully as well as in Adelaide (Table 20).

9.3 Potential Uses of Carbonates

A marketing report commissioned by MHA (Hatch, 1999) has confirmed the high quality of the NW carbonates –the dolomites, the limestones and the dolomitic limestones- with their low impurities, their excellent furnace-ability and their all round versatility resulting in a potentially wide range of uses and applications. It is widely acknowledged that no other industrial mineral has as many uses for mankind as carbonates (Carr & Rooney, 1983).

The options are for MHA to market the carbonate ore directly with some beneficiation with a low selling price or after calcining at Port Latta as lime/dolime at a high selling price. The products identified for the carbonates are- calcium oxide, calcium hydroxide, calcium carbide, magnesium carbonate, magnesia, magnesium metal and other indirect chemicals.

The main applications are given as follows- as flux in steel making, in non-ferrous metallurgy (eg. the alumina, copper and gold-silver industries), in environmental use, in sanitation (neutralisation), in cement, refractory, construction, and agriculture (fertilizer) industries. Some companies are currently considering the substitution of

dolomite or magnesian limestone for ordinary limestone as there are advantages for the refractory linings in blast furnaces.

The main markets would be both Australian and overseas such as Japan, Southeast Asia and other Pacific Rim countries.

10.0 INFRASTRUCTURE

By most standards, Tasmania has a well-developed, industrial infrastructure and a competitive edge over most Mainland States with its mineral resources being close to export and processing points. The State has efficient power, transport, engineering and communications facilities and services and a world –class heavy industry zone at Bell Bay (Mining Journal, 1994). These factors coupled with established communities, a skilled, educated and stable work force and a warm temperate climate make the State an attractive place to invest.

The World Class dolomite resources of the Smithton Basin in NW Tasmania are bisected by the all-weather, sealed Bass Highway, are close to the railhead some 16km east of Smithton and are within a 50km radius of Port Latta and an under utilised deep water loader where a new industrial zone is now being developed.

The Western Tasmanian Regional Development Program produced a new Development Plan (Woodward-Clyde, 1999) to support the Mineral Industry in the State through planned and coordinated infrastructure development. It was recognised that Port Latta was an ideal industrial site for expanded mineral processing due to its existing infrastructure and deep water loader, capable of servicing ships of 110,000 tonne capacity, currently being used to process and export 2.5M tonnes of pelletised iron ore.

Recommended studies have since taken place concerning council rezoning, baseline environmental information, identification of access corridors and of capacity for increased energy, water and transport to reduce development time for potential industries.

With increased energy planned to be available to the site in the short term through the Duke Energy natural gas pipeline and the Basslink undersea electrical cable from the mainland, the scene is set for major expansion of the Port Latta Industrial Site. The point was made in the report that there is no projected capacity for producing additional low cost energy although industry has indicated that a competitive power price would be necessary to attract major mineral processing projects.

It is considered possible or even likely that Tasmania will be at an energy price disadvantage compared to the mainland. This makes it imperative for the State to use indigenous ores with lower transport costs to overcome any energy price differentials.

The dolomite resources of the Smithton Basin are well placed to expand the processing facilities at Port Latta with calciners and other downstream plants. However, it is a major omission in the report that the dolomite resources were unaccountably not included in the resource inventory available to Port Latta and that the Circular Head Dolomite Quarry producing 50-60,000 tonnes per annum was left off the map and the resource tables.

A previous report by Mineral Resources Tasmania (Turner, 1993) had considered bulk materials close to Port Latta and identified dolomite as a potential resource but had discounted the bulk of the dolomite base in the Smithton Basin due to an arbitrary 20km maximum radius and other assumed difficulties involving open cut mining.

11.0 CONCLUSIONS

1) Large resources of high quality carbonates- dolomite, dolomitic limestone and limestone- have been outlined to various degrees of certainty in the MHA licences in NW Tasmania.

2) Carbonate resources in RL 9/1997 at Redpa are-

- **Tertiary limestone - inferred resource- 10 Mt**
- **indicated resource- 1.7 Mt**

- **Precambrian dolomite - inferred resource- 18 Mt**

- **Precambrian dolomitic limestone - inferred resource- 14 Mt**
- **indicated resource- 670,000 t**

3) Carbonate resources in RL 10/1997 at Brittons Swamp are-

- **Precambrian dolomite - inferred resource- 84 Mt**
- **indicated resource- 1.9 Mt**

3) Four regional exploration licences have been selected in the northern part of the Smithton Basin to extend the present resources and to explore for new resource positions and to provide JV partners with enough ground to develop a regional approach.

4) An analysis of the available data suggests that the Smithton Dolomite is the best potential target for high-quality dolomite and that the upper part is more prospective than the lower.

5) There is at least one major area which should be tested for resources of flat-lying dolomite capable of supporting a large export quarry and that is the Seventeen Mile Plain. Recommendations for future drilling are given to investigate potential resources including the need for stratigraphic drilling to reveal the poorly known Smithton Dolomite stratigraphy and lithologies to aid regional exploration and to open up this major carbonate province.

6) The infrastructure is capable of supporting a large carbonate export industry with the deepwater loader at the Port Latta and the expanded industrial site for calcining and value-adding and a possible projected power surplus based on electricity and liquid petroleum gas.

7) With an increasing steel supply predicted for the next ten years – the scene is set for the carbonate demand for flux to increase, with substitution of dolomite for limestone in the steel industry and as existing quarry supplies becoming exhausted.

8) In the interests of the search for a joint venture partner for the drilling and testing and marketing of the deposits, MHA has asked for a moratorium for Year Two.

9) The ultimate challenge is to find a sufficiently large tonnage of carbonate, of suitably high grade for extraction and processing in an environmentally acceptable location.

12.0 ENVIRONMENT

No ground-based activities were carried on any of these licences during the first year, consequently there are no rehabilitation issues.

13.0 EXPENDITURE

The amounts spent on exploration in Year One, including an estimate for the September 2003 quarter, in the various licences are as follows-

EL 16/2001 Christmas Hills	\$18,093
EL 21/2001 Marrawah	\$19,991
EL 22/2001 Montagu	\$19,991
EL 23/2001 Smithton	\$16,781
Total	\$74,856

ACKNOWLEDGEMENTS

The writer wishes to thank Mineral Resources Tasmania for the provision of technical information from its open file databases for this report and for help and advice from its officers particularly Dennis Burgess, Clive Calver, Mike Davie, Kylie Lau, Miladin Latinovic, John Pemberton and David Seymour.

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KEYWORDS

Smithton, Marrawah, Montagu, Christmas Hills, Redpa, Brittons Swamp, Carbonate Resources, Dolomite, Limestone, Heavy Minerals, Industrial Uses, Export

PLANS

APPENDIX- TABLES

