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SML 372, SML 452 AND SML 453

WESTERN AND SOUTHERN LAKE EYRE PLAINS

PROGRESS REPORTS TO LICENCE EXPIRY FOR THE PERIOD 15/1/70 TO 29/1/71

Submitted by
Umbum Creek Pty Ltd
1970

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PRIMARY INDUSTRIES AND RESOURCES SA

CONTENTS ENVELOPE 1231

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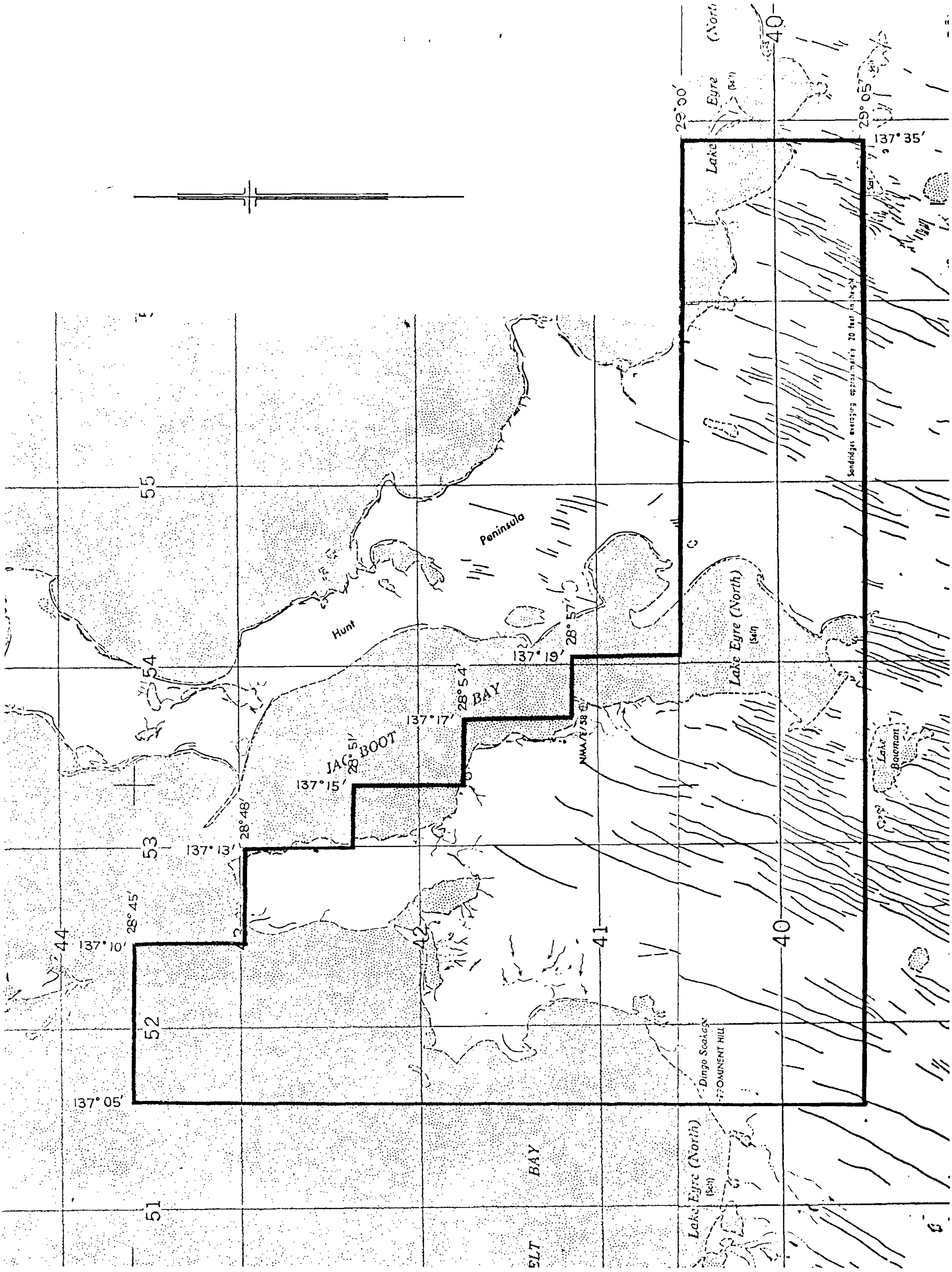
TENEMENT HOLDER: Umbum Creek Pty. Ltd.



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UMBUM CREEK PTY. LTD.

DOCKET DM 153/70 AREA 350 SQ MILES

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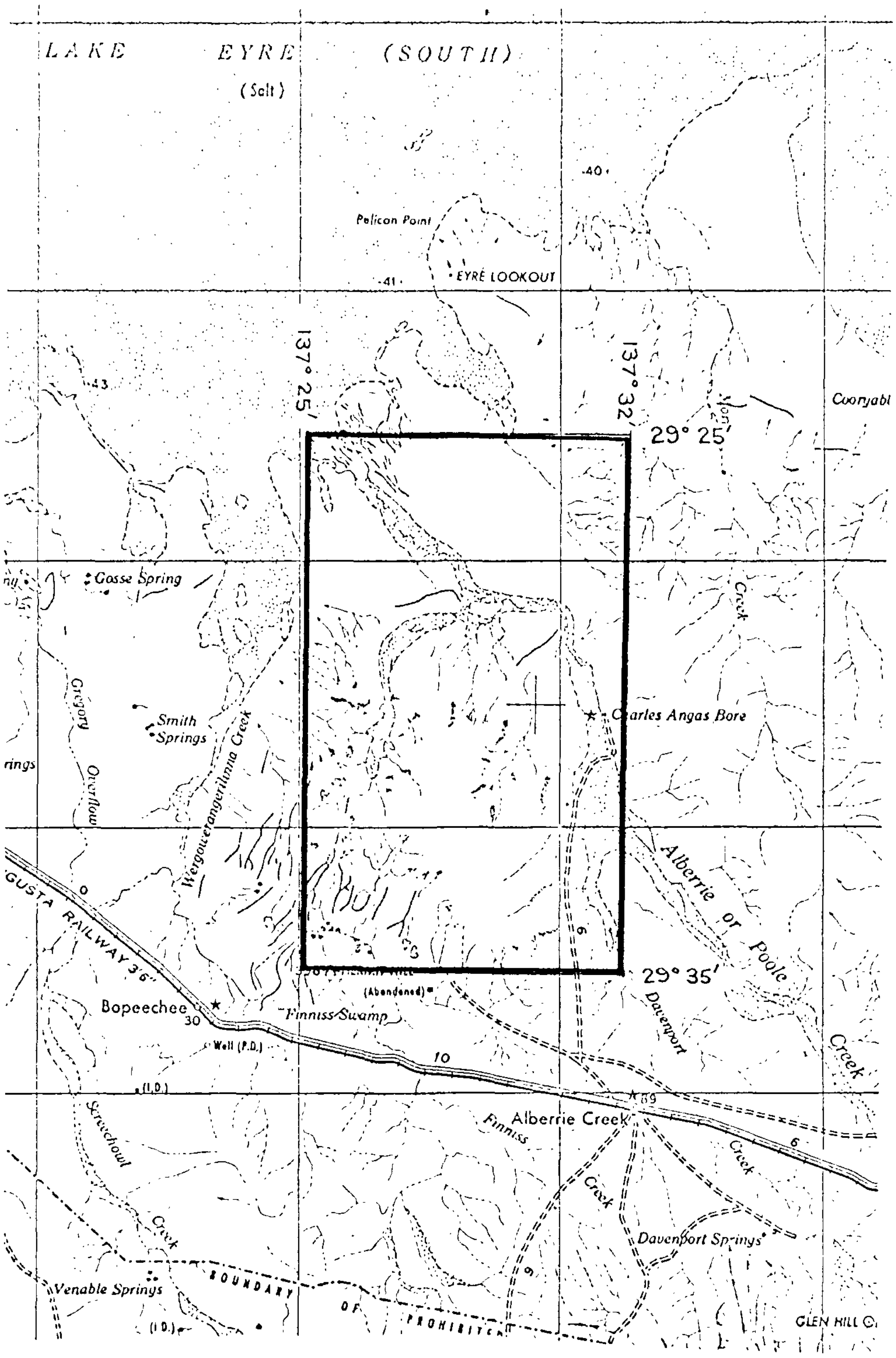

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UMBUM CREEK PTY. LTD.

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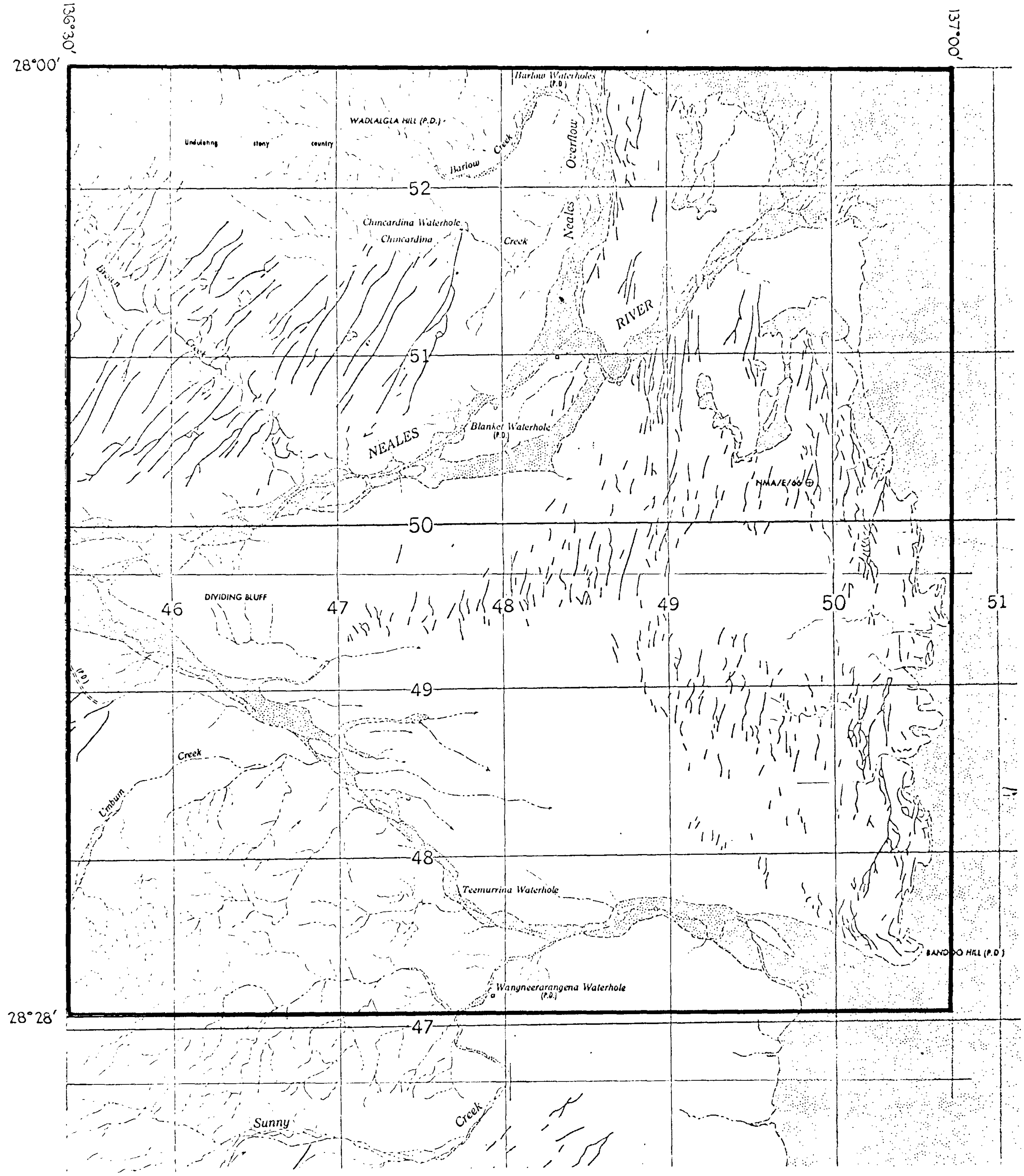

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~~A.J. MOLLOY, SCARBOROUG MINING N.L.~~
~~& SIBAF MINING N.L.~~

DOCKET D.M. 1322/69 AREA 985 SQ MILES

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LOCALITY

S.M.L. No. 372 EXPIRY DATE 14·1·71

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9th January, 1970.

UMBUM CREEK SYNDICATE

REPORT ON DOLOMITE DEPOSITS, NEALES RIVER, NORTH WEST LAKE EYRE, SOUTH AUSTRALIA

SUMMARY

Geological investigations have delineated a dolomite deposit extending at least eight miles along the Neales River. Approximately 20 million tons is estimated to be present. It is considered that the deposit will prove to be of considerable extent, at least to the south. Eight drill holes each being approximately half a mile from the mapped cliff faces are initially recommended. A total of 58 strip samples were collected from the 31 locations. Their positions are shown in figs. 5 - 10.

LOCATION

The area lies in the lower reaches of the Neales River on the north west margin of Lake Eyre, in South Australia. (see figs. 1 and 2). A 60 mile track provides access from Anna Creek on the Marree - Oodnadatta Road. The distance from Port Augusta is approximately 450 miles.

GEOLOGY

A dolomite deposit was observed in six cliff faces along eight miles of the Neales River (figs. 3 and 4). The maximum total thickness was observed in "Face 2", being at least 22 feet at location 2G.

On the western extremity of "Face 1" some local structural disturbance was observed, possibly resulting from leaching of underlying evaporites and the subsequent subsidence of the ground. It is considered that in the vicinity of the stockyard shown on fig. 3 are sediments which underlie the dolomite. These are generally a hard fine grained sandstone, often iron-rich. A lenticular band of ironstone up to 18 inches thick and 100 feet wide occurs in the river bed to the west of the most westerly observed outcrop of dolomite. It contains common irregular "box structures".

When fresh the dolomite is usually off-white in colour and has a moderate moisture content. On exposure it becomes hard and brittle with an uneven blocky fracture. Some darker more impure bands varying up to six inches in thickness were also observed. This possibly represents sapropelic phases of deposition. Capping the thicker exposed faces of dolomite is a layer of darker impure dolomite up to three feet thick, containing some secondary gypsum.

Overlying the dolomite, apparently conformably, is an arenaceous unit consisting of alternating coarse pebbly bands or lenses and sandstones. Both contain a high clay content and have coarse irregular cross-bedding. The pebble bands and lenses predominate towards the base and sandstones towards the top.of the sequence.

Some "washout" structures on the dolomite arenaceous rock boundary were observed.

The pebble bands in particular are sometimes interbedded and frequently encrusted with secondary gypsum and/or dolomite crystals in irregular masses and clusters. Origin of these is attributed to ground water circulation from underlying evaporite beds. In places, generally towards the margins of the dolomite outcrops veins of secondary gypsum occur. At the north easterly end of "Face 4" the beds overlying the dolomite have been eroded to form a bench up to 25 yards wide on which are flat residual chert boulders up to 2 inches thick and 2 feet wide.

Occasional lenses of dolomitic? clay up to 2 feet thick were observed a few feet above the main dolomite in the cliff of "Face 2".

The pattern of deposition occurring in those cliff faces where the dolomite exposures are thickest is different to the marginal exposures. It is suggested that the dolomite actually thickens at these locations. The high cliff exposures are not purely a result of present topographical development, but seem actually to reflect localised thickening of dolomite.

Possibly the individual outcrops represent separate lenticular beds, postulated as having formed as evaporite deposits of the "lunette" type. The dolomite outcrops are invariably obscured by scree or aeolian sand deposits. A programme of drilling as shown in fig. 3 will help in the delineation of the dolomite deposit.

Outcrops away from the exposed cliff faces of the Neales River are sparse and confined to a couple of hundred yards of tributary gullies. Aeolian sand dunes and clay pans cover most of the surface and the topography is flat to slightly undulating. From limited evidence however, it is considered that the dolomite dips slightly to the south and east, at least in faces "2", "3" and "4".

SAMPLING

A total of 58 strip samples were collected at the 31 locations shown in figs. 5 - 10. Geological logs, which also indicate sample widths, were made at each locations and these accompany this report.

Assay results are not yet available. All samples are being assayed for MgO and CaO with selected samples for FeO, boron and the halogen minerals chlorine and bromine.

RESERVES

Direct geological observation has so far been confined to the banks of the Neales River. Lensing of the dolomite is suspected. On this basis estimated probable reserves cannot at present be put at greater than 20 million tons.

All thicknesses are taken only to the top of the scree. This is shown in the cliff diagrams. It is a reasonable assumption that at practically every site the thickness of dolomite could be increased. This would take the reserves to 30 - 35 million tons.

Drilling at the sites suggested in fig. 3 should clarify the dimensional interpretation of the dolomite body and reserves would be adjusted accordingly.

ECONOMIC CONSIDERATIONS

The value (f.o.b.) of an average grade dolomite at present varies from three dollars to five dollars per ton. Upgrading by calcining produces magnesite (MgO) valued at $15 - $20 per ton. ?

Due to the isolated location of the dolomite body it would be necessary that all treatment be carried out on site in order to minimise transport costs.

A large nearby supply of brine would be expected to be available from Lake Eyre. Unfortunately lake brine samples were not possible due to inaccessibility. Some samples were collected from a large pool in the Neales River but it is not expected that these would be representative of the lake.

THE MACUMBER RIVER AREA

Outcrops of dolomitic-looking rock were observed from the air in the lower reaches of the Macumber River, 16 to 20 miles north of the Neales River. It is not suggested that the dolomite body is continuous between these points, but a second area, possibly of similar dimensions, may exist.

CONCLUSIONS

1. A body of dolomite which is considered to be of economic proportions occurs on the Neales River. A small scale drilling programme may be necessary to fully justify this statement.

2. The isolated location of the body at once necessitates that any treatment of material be carried out "in situ".

3. A similar body appears to be present on the Macumber River to the north.

RECOMMENDATION

1. Dependent on assay results, a drilling programme of approximately eight holes averaging 35 - 40 feet depth, be carried out in order to more accurately delineate reserves and structure.

HALL, RELPH & ASSOCIATES PTY. LTD.

PAR/lz

Per [signature]

APPENDIX

ASSAY RESULTS

Individual assay results are shown with each strip sample record. Values for MgO% are also represented on the diagramatic sections shown in figures 12-17 (inclusive).

In general the results obtained are not really promising. The best value is given as 22.7% in a 6 foot section in face 6, and only three samples give values of 15% MgO or better.

Values seem to improve towards the center of each strip sample and also laterally eastwards towards faces 4 and 5.

It is now suggested that drilling be initially concentrated in the vicinity of faces 4 and 5 and proposed sites C, D and H.

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3/494/1

Progress Report No. 1
March - May 1970

UMBUM CREEK SYNDICATE

[illegible]TION OF MAGNESIA FROM DOL[illegible] (S[illegible])

THE AUSTRALIAN MINERAL DEVELOPMENT LABORATORIES

Adelaide South Australia

CONYNGHAM ST. FREWVILLE SOUTH AUSTRALIA 5063 TELEPHONE 79 1662 TELEGRAMS 'TELEX' AA82520

09

THE AUSTRALIAN MINERAL DEVELOPMENT LABORATORIES

PLEASE ADDRESS ALL CORRESPONDENCE TO THE DIRECTOR.

OUR REFERENCE: CME 3/494/1
YOUR REFERENCE:
25 May 1970

Mr. J. de Vere,
de Vere and Haymes,
22 Alfred Street,
MILSONS POINT, N.S.W. 2061.

UMBUM CREEK SYNDICATE

PRODUCTION OF MAGNESIA FROM DOLOMITE (STAGE 1)

Progress Report No. 1

19-3-70 to 15-5-70

Investigation and Report by: H.L. D'Rozario and K.B. Quast

Officer in Charge,
Chemical and Metallurgical Engineering Section: P.K. Hosking,

for M. Draper,
Director.

DATE PROPOSED:	19-3-70
DATE AUTHORISED:	-4-70
AMOUNT AUTHORISED:	$1680
AMOUNT EXPENDED:	$1436 to 15-5-70

1. INTRODUCTION

Mr. J. de Vere visited Amdel on 12th March 1970, on behalf of Umbum Creek syndicate and held discussions concerning the exploitation of the dolomite deposits along the Neales River N.W. Lake Eyre S,A, A proposal was submitted containing a programme of preliminary test work designed to evaluate the quality of the deposits from the samples supplied, their amenability to beneficiation by possibly applicable techniques and the suitability of the product to magnesia production.

2. REVIEW OF PROGRESS

A total of 57 samples of approximately ½ lb each were received. The samples represented 6 cliff faces along the Neales River bed which were shown in detail on a map supplied. The samples were logged in groups (face wise) with their MgO assays and these were then combined to give 5 composites with rejection of material of less than 10% MgO: bearing in mind the practical aspects of mining.

Lump specimens (15 in number) approximately 1" in size were selected and these were examined individually for their reflectance properties, apparent Specific Gravity and MgO analysis. The results have indicated a correlationship between reflectance and MgO content though these are rather scattered. A more definite relationship is shown between apparent SG and MgO content which suggests the feasibility of applying gravity-separation techniques to the material for up grading purposes.

Head samples of the 5 composites gave analysis as under:-

	Assay %			
	MgO	CaO	CO_2	
Composite 1	12.3	19.1	26.0	≈ 58.4
2	15.3	22.5	32.7	70.5
3	17.7	20.3	24.4	≈ 62.4
4	16.0	23.1	35.3	≈ 74.4
5	15.1	25.7	36.9	≈ 77.7

Heavy liquid separation tests on the composite samples as -¼ inch at 2.6 S.G. were not satisfactory.

3. WORK IN HAND

Two of the most promising composites will now be examined by thermogravimetric analysis to determine optimum calcination temperatures. These will be calcined, slaked and investigated for their purification by elutriation for the obtaining of suitably pure lime magnesia slurry for addition to brine. Products will be analysed.

4. MATERIAL EXAMINED

Fifty-seven half pound samples were received. These consisted of various footages from a series of channels in 6 different cliff faces along the bed of the Neales River, identified on a map and designated 1, 2, 2½, 3 4 and 5. A list of these samples with brief descriptions and MgO assays as logged by the syndicate's geologist is given as Appendix A.

5. EQUIPMENT

Items of special equipment used were:-

1. Bausch and Lomb colorimeter for reflectance determinations.
2. Laboratory apparatus for heavy liquid separation tests.
3. Laboratory apparatus for apparent specific gravity determinations.

6. EXPERIMENTAL PROCEDURE AND RESULTS

6.1 Sample Preparation

The 57 samples were each divided in halves and one half portion was returned to the original bags for storage. The remaining portions of these samples of low MgO content which were rejected as unsuitable for inclusion in the investigations were bagged and stored and the rest were combined to form the 5 composites for the test work. Details of composites are shown in Appendix A.

6.2 Reflectance Tests

Reflectance determinations were made on 15 sample specimens of approximately 1 inch size which were selected to include the full colour range of whites and greys shown in the samples. These determinations were made using a Bausch and Lomb Spectronic 20 colorimeter with a reflectance attachment and were carried out at three different wave lengths. The specimens were later (after apparent Specific Gravity determinations) crushed and assayed for MgO content. Results are shown in Table 1 and have been plotted in Figure 1.

6.3 Apparent Specific Gravities

The apparent specific gravities of the 15 specimens selected for the reflectance tests were determined in order to try and correlate this property with the MgO content. Results are shown in Table 1 and have been plotted in Figure 2.

6.4 Head Analyses and Heavy Liquid Separation Tests

The five composite samples were crushed to minus ¼ inch and samples were cut out for head analysis and heavy liquid separation tests. The composite gave the following analyses:-

	Assay %		
	MgO	CaO	CO_2
Composite 1	12.3	19.1	26.0
2	15.3	22.5	32.7
3	17.7	20.3	24.4
4	16.0	23.1	35.3
5	15.1	25.7	36.9

Samples of the minus ¼ inch composites were separated in a heavy liquid at a density of 2.6. The sink and float products were sized at 5, 12 and 25 mesh and the size fractions were assayed for MgO. The results are shown in Tables 2 to 6.

7. DISCUSSION

Figure 1 would indicate some discernable relationship between the reflectance properties of the dolomite material and its MgO concentration but it is doubtful as to whether this would be a reliable enough basis for beneficiation at a coarse size by colour sorting equipment. The apparent specific gravity of the lump material and its MgO content as shown in Figure 2 would appear to be more closely related and the results would indicate a cut point of 2.5 S.G. as being somewhat optimum for heavy medium beneficiation.

Results of the heavy liquid separation tests were unsatisfactory due probably to too high a liquid density.

Composite samples 3 and 4 would seem to be the most suitable for further testing.

TABLE 1:

RESULTS OF REFLECTANCE TESTS

Sample Identification	Percent light reflected			Apparent Specific Gravity	% MgO of specimen
	400 mμ	610 mμ	750 mμ		
1A T-3	33	48	47	2.19	1.04
1B T-3	37	50	48	2.29	0.41
1E T-6	55	59	66	2.52	13.9
1E 6-12	42	58	59	2.58	14.6
1F T-3	46	58	55	2.51	0.61
2A T-3	66	74	70	2.56	16.0
2C 5-10	44	67	57	2.49	12.4
2E 10-15	51	66	64	2.47	12.1
2H 7-13	45	52	57	2.24	8.6
3B T-5	54	72	66	2.62	16.4
4B T-4	63	66	61	2.63	19.2
4B 4-10	51	67	62	2.75	19.3
5B T-3	67	78	78	2.62	15.1
5C 4-6	59	67	67	2.53	15.3
5D T-4	48	61	61	2.52	15.3

TABLE 2:

RESULTS OF HEAVY LIQUID SEPARATION COMPOSITE NO. 1

Size Fraction	Sink		Float	
	Wt.%	MgO %	Wt.%	MgO %
+ 5 mesh	9.3	15.9	31.3	8.9
+ 12 mesh	37.4	16.1	27.4	10.1
+ 25 mesh	20.0	15.4	18.5	10.1
- 25 mesh	33.3	13.9	22.8	10.8
Heads (Calc.)	100.0	15.21	100.0	9.88

	Wt.%	MgO % (Calc.)
Sink	28.6	15.21
Float	71.4	9.88
Feed (Calc.)	100.0	11.30
(Assayed)		12.3

TABLE 3:

RESULTS OF HEAVY LIQUID SEPARATION COMPOSITE NO. 2

Size Fraction	Sink		Float	
	Wt.%	MgO %	Wt.%	MgO %
+ 5 mesh	1.7	15.7	23.5	14.1
+12 mesh	19.9	15.7	44.1	13.7
+25 mesh	24.3	15.7	16.0	13.6
-25 mesh	54.1	14.8	16.4	13.7
Heads (Calc.)	100.0	15.21	100.0	13.78

	Wt.%	MgO % (Calc.)
Sink	22.6	15.21
Float	77.4	13.78
Feed (Calc.)	100.0	14.10
(Assayed)		15.3

TABLE 4:

RESULTS OF HEAVY LIQUID SEPARATION COMPOSITE NO. 3

Size Fraction	Sink		Float	
	Wt.%	MgO %	Wt.%	MgO %
+ 5 mesh	11.2	17.1	19.1	12.5
+12 mesh	26.8	16.6	44.1	11.7
+25 mesh	12.2	16.6	15.9	11.4
-25 mesh	49.8	13.6	20.9	10.5
Heads (Calc.)	100.0	15.21	100.0	11.56

	Wt.%	MgO % (Calc.)
Sink	10.9	15.21
Float	89.1	11.56
Feed (Calc.)	100.0	11.98
(Assayed)		17.7

TABLE 5:

RESULTS OF HEAVY LIQUID SEPARATION COMPOSITE NO. 4

Size Fraction	Sink		Float	
	Wt.%	MgO %	Wt.%	Mgo %
+ 5 mesh	25.9	18.7	6.6	15.7
+12 mesh	36.6	18.7	38.3	16.4
+25 mesh	12.8	18.1	21.4	16.1
-25 mesh	24.7	16.4	33.7	15.1
Heads (Calc.)	100.0	18.06	100.0	15.85

	Wt.%	MgO % (Calc.)
Sink	25.0	18.06
Float	75.0	15.85
Feed (Calc.)	100.0	16.40
(Assayed)		16.0

TABLE 6:

RESULTS OF HEAVY LIQUID SEPARATION COMPOSITE NO. 5

Size Fraction	Sink		Float	
	Wt.%	MgO %	Wt.%	MgO %
+ 5 mesh	10.3	15.9	27.9	15.5
+12 mesh	32.2	16.6	45.6	15.3
+25 mesh	18.7	16.0	14.2	14.8
-25 mesh	38.8	15.1	12.3	13.8
Heads (Calc.)	100.0	15.83	100.0	15.10

	Wt.%	MgO %(Calc.)
Sink	31.7	15.83
Float	68.3	15.10
Feed (Calc.)	100.0	15.33
(Assayed)		15.1

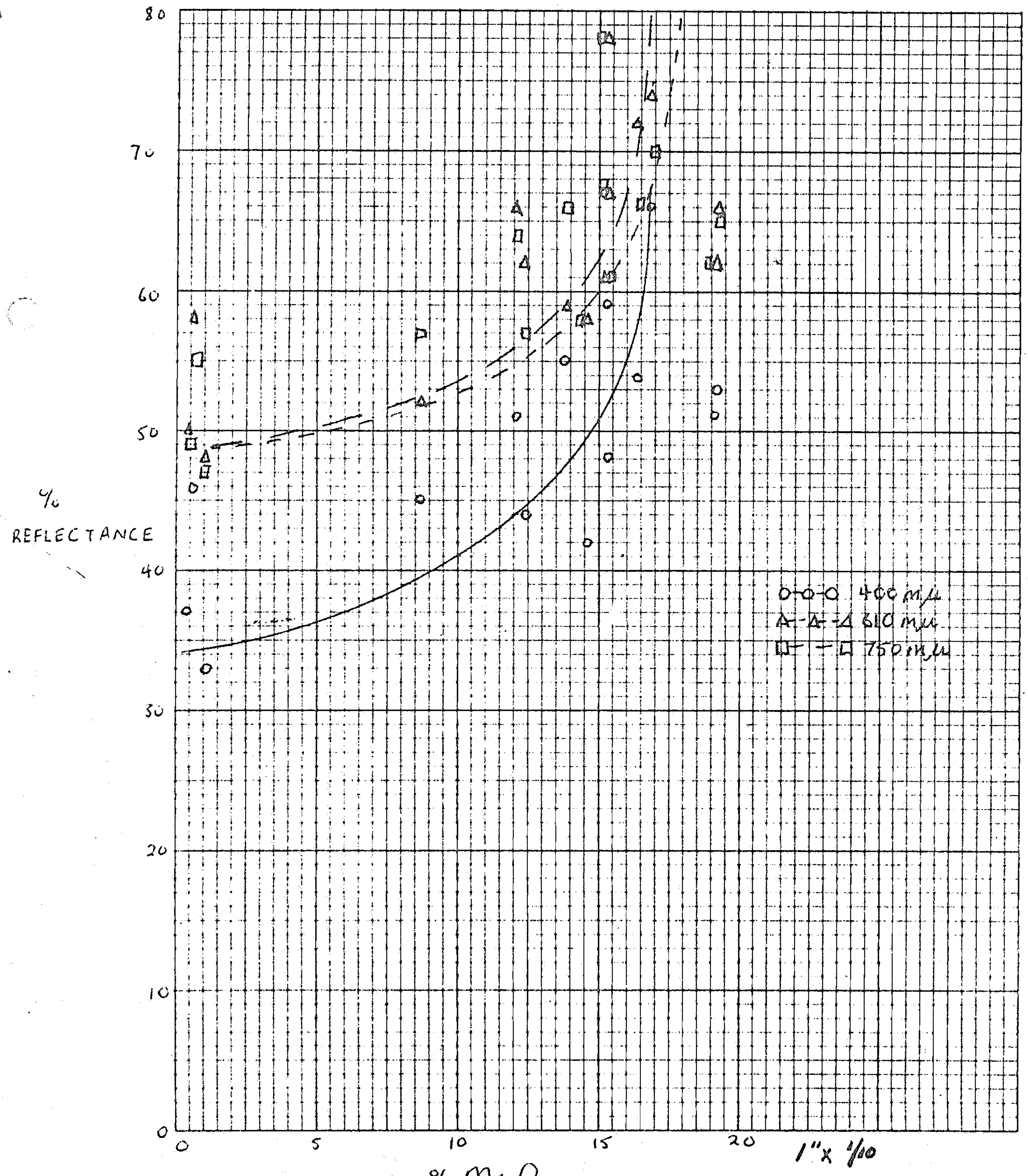

FIGURE 1. RESULTS OF REFLECTANCE TESTS ON LUMP SPECIMENS.

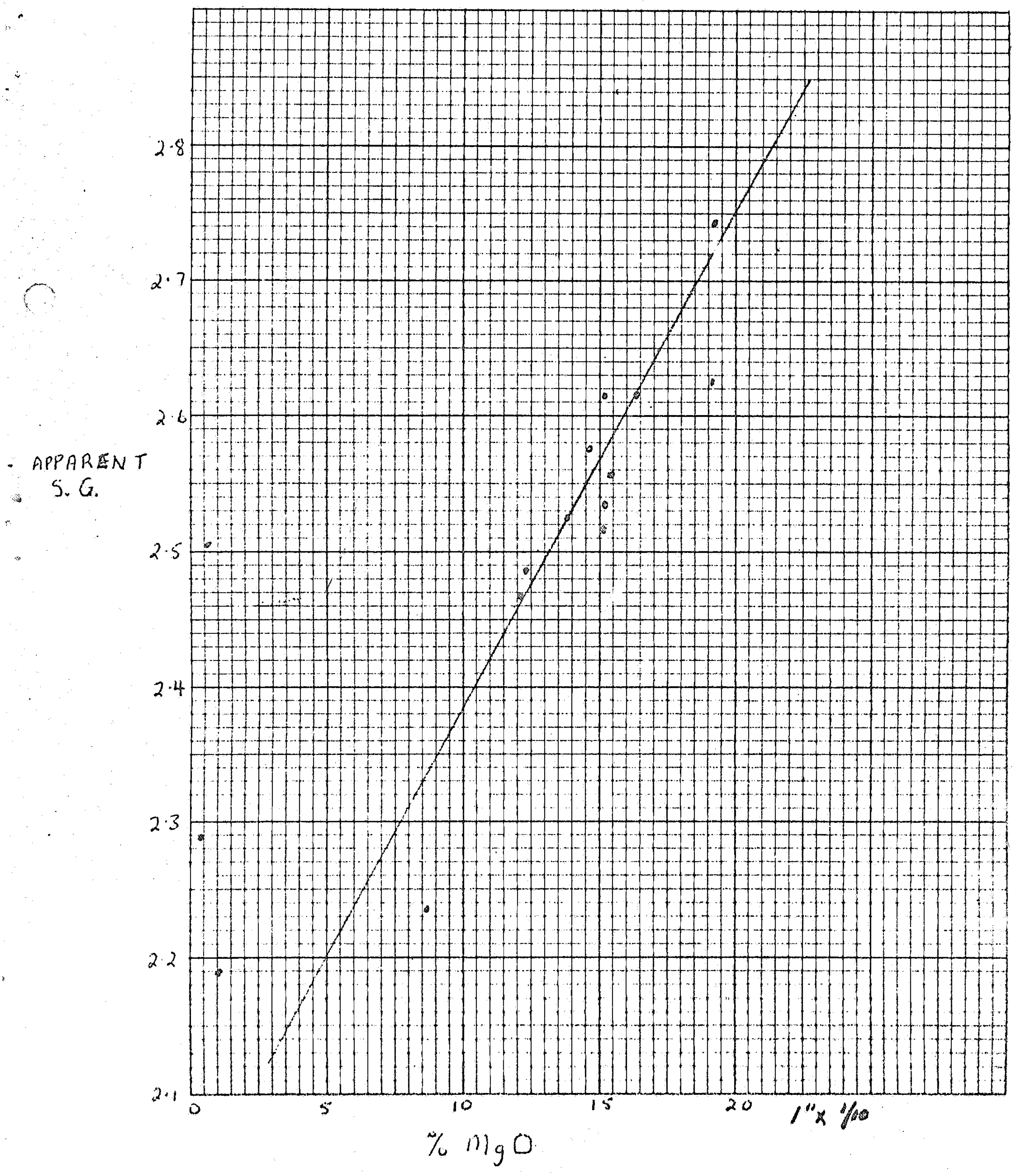

FIGURE 2. RESULTS OF SPECIFIC GRAVITY DETERMINATIONS ON LUMP SPECIMENS.

APPENDIX 'A'

List of Umbum Creek Dolomite Samples Received

Sample Identification	Description	Colour	MgO %	Remarks
1A T-3'	Dolomite and clay stone	grey	1.5)	
1B T-3'	Dolomite and gypsum	light grey	2.2)	
1C T-4'	Dolomite and gypsum	light grey	1.1)	Samples from cliff face 1.
1D T-4'	Dolomite and fine gypsum	light grey	1.1)	
1D 4-8'	"	"	1.5)	All samples rejected for test work
1E T-6'	" + some crumbly gypsum	off white	5.6)	
1E 6-12'	Dolomite crumbly	"	4.7)	
1E 12-18'	" hard	white	0.8)	
1F T-3'	Dolomite	off white	1.9)	
1G T-4'	Dolomite + some silt	"	9.4)	
2A T-3'	Dolomite	off white	10.3)	
2B T-3'	"	"	3.9)	
2C T-5'	"	light grey	2.9)	
2C 5-10'	"	"	7.1)	
2C 10-15'	"	"	4.0)	
2D T-4'	Dol. + greenish mud	"	3.5)	
2D 4-8'	Dolomite	"	6.0)	Sample from cliff face 2.
2D 8-12'	"	"	6.3)	
2E T-5'	Dol, clayey and crumbly	off white	9.6)	Only these samples rejected for the test work.
2E 5-10'	Dol - hard	white	12.6)	
2E 10-15'	Dol - clayey	light grey	8.6)	
2E 15-19'	Dol - hard add clayey	white and grey	3.6)	
2F T-4'	Dol - crumbly and gypsum	grey	6.2)	
2F 4-10'	Dol - hard	white	10.9)	
2G T-4'	Dol - gypsum bands	grey	3.2)	
2G 4-9'	Dol - compact	white	8.9)	
2G 9-14'	Dol - some gypsum	off white	10.2)	
2G 14-18'	Dol - mainly compact	off white	3.7)	
2G 18-22'	Dol - mainly compact	off white	3.1)	
2H T-2'	Dol - crumbly	grey	12.5)	These samples included in composite 1 test sample.
2H 2-7	Dol - compact	white	15.0)	
2H 7-13'	Dol and clay	grey and white	12.0)	These samples included in composite 1 test sample
2H 13-17'	"	"	11.8)	
2H 17-23'	"	"	12.4)	

Cont. 2/

Appendix 'A' (Cont.)

Sample Identification	Description	Colour	MgO %	Remarks
2J T-4'	Dol and clay	grey and white	5.8)	Sample rejected
2K T-2'	" "	" "	6.3)	
2K 2-6'	Dolomite	white	11.2)	Samples included in composite 2
2L T-4'	Dol and clay	white + grey	13.5)	
2M T-2'	Dolomite	off white	10.0)	
2½A T-2'	Dol + sandstone	grey	1.5)	Sample rejected
2½A 2-4'	Dolomite	white and grey	11.9)	Sample included in composite 2
2½A 4-6'	Dolomite	off white	15.2)	
3A T-4'	Dol. + some gypsum	light grey	4.7)	Sample rejected
3A 4-4'6"		-	-)	
3B T-5'	Dol. - crumbly	off white	8.4)	
3C T-4'	Dol. - crumbly	white + grey	9.7)	Samples included in composite 3
3C 4-8'	Dolomite	white	10.1)	
3C 8-12'	Dolomite	white	10.1)	
3D T-4'	Dolomite - drity	grey	12.8)	
4A T-4'	Dolomite	white	17.4)	Samples included in composite 4.
4B T-4'	Dolomite - dirty	off white	12.2)	
4B 4-10'	Dol. and clay	white + brown	14.5)	
4C T-5'	" "	off white	13.5)	
5A T-4'	Dol - lumpy	white	13.0)	Samples included in composite 5.
5B T-3'	Dolomite	white	14.3)	
5C T-4'	Dol. - lumpy, clay	white-grey	14.9)	
5C 4-6'	Dolomite	white	22.7)	
5D T-4'	Dol. - clay, gypsum	grey	9.4)	

DRILL HOLE NO. 1

Sample marked DH.1

11th May, 1970.

1231

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DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
0				
1'	RED	DRY	SOFT	DIRT
3'	RED	DRY	SOFT	GYPSUM & DIRT
9'	GREY	DRY	SOFT	DOLOMITE
10'	DARK GREY	DRY	MEDIUM SOFT	DOLOMITE
15'	GREY ~~SLIGHT~~	DRY	SOFT	DOLOMITE
21'	GREY	DAMP	SOFT	DOLOMITE ?
27'	GREY	SLIGHT DAMP	MEDIUM SOFT	DOLOMITE ?
33'	LIGHT GREY	DRY	MEDIUM HARD	DOLOMITE ?
36'	RED BROWN	DRY	MEDIUM HARD	DOLOMITE ?
39'	LIGHT GREEN	DRY	MEDIUM HARD	DOLOMITE ?
45'	DARK GREEN	DAMP	MEDIUM SOFT	DOLOMITE ?
47'	GREEN KHAKI	VERY SLIGHT DAMP	SOFT	DOLOMITE ?
48'	GREEN	?	HARD	DOLOMITE ? K?
51'	GREEN KHAKI	VERY SLIGHT DAMP	MEDIUM SOFT	DOLOMITE ?

DRILL HOLE NO. 2 12th May, 1970.

Sample marked DH.2

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
0				
2'	RED DIRT	NIL	SOFT	DIRT
3'	CREAM	NIL	HARD - VERY BRITTLE	DOLOMITE ?
6'	WHITE CREAM	VERY SLIGHT	HARD MEDIUM	DOLOMITE
9'	WHITE	SLIGHT	MEDIUM HARD	DOLOMITE
15'	LIGHT GREY Alternating Harder Bands.	SLIGHT	MEDIUM SOFT	DOLOMITE ?
21'	GREY - RED BROWN	DAMP	SOFT	DOLOMITE ?
27'	RED BROWN	DAMP	MEDIUM SOFT	DOLOMITE ?
33'	LIGHT BROWN GREY	DAMP	MEDIUM SOFT	DOLOMITE ?
39'	LIGHT GREY	SLIGHTLY DAMP	MEDIUM HARD	DOLOMITE ?
42'	GREY	SLIGHTLY DAMP	MEDIUM HARD	DOLOMITE ?
45'	GREY	SLIGHTLY DAMP	HARD	DOLOMITE ?
51'	GREY	SLIGHTLY DAMP	HARD	DOLOMITE ?
57'	GREY LIGHT	WET	SOFT	DOLOMITE ?

DRILL HOLE No. 3

12th May, 1970

Sample marked DH.3

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
0				
2'	RED	DRY	SOFT	DIRT
3'	CREAM	DRY	VERY HARD BRITTLE	DOLOMITE
5'	CREAM	DRY	VERY HARD	DOLOMITE
9'	WHITE	DRY	MODERATELY	DOLOMITE
15'	GREY	SLIGHTLY DAMP	SOFTER	DOLOMITE ?
21'	GREY	DAMP	SOFT	DOLOMITE ?
27'	GREY	VERY DAMP	SOFT	DOLOMITE ?
33'	GREY	GETTING DRY	GETTING HARD	DOLOMITE ?
39'	LIGHT GREY	DAMP	GETTING SOFT	DOLOMITE ?
45'	LIGHT GREY	WET	SOFT	DOLOMITE ?
48'	LIGHT GREY	WET	SOFT	DOLOMITE ?
51'	LIGHT GREY	WET	VERY HARD	DOLOMITE ?
57'	LIGHT GREY	VERY WET	VERY SOFT	DOLOMITE. ?

DRILL HOLE No 4. 13th May, 1970

Sample marked DH.4

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
0'				
3'	RED	DRY	SOFT	DIRT & DOLOMITE
	Alternating thin bands Hard Material.			
6'	WHITE	DRY	MEDIUM	DOLOMITE
9'	WHITE	DRY	HARD BRITTLE	DOLOMITE
15'	LIGHT GREY	SLIGHTLY DAMP	HARD	DOLOMITE
	Alternating very Hard Brittle Bands			
21'	LIGHT GREY	SLIGHTLY DAMP	HARD MEDIUM	DOLOMITE
	Alternating very Hard Brittle Bands			
27'	GREY	DAMP	SOFT	DOLOMITE ?
33'	GREY	DAMP	SOFTER	DOLOMITE ?
39'	GREY	DAMP	SOFTER	DOLOMITE ?
45'	GREY	WET	SOFT	DOLOMITE ?
51'	GREY-GREEN	DAMP	MEDIUM SOFT	DOLOMITE ?

DRILL HOLE No. 5. 14th May, 1970.

Sample marked DH.5

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
0				
6"	RED DIRT	DRY	SOFT	DIRT 6"
3'	CREAM	DRY	HARD BRITTLE	DOLOMITE 2'6"
9'	OFF WHITE	DRY	MEDIUM HARD	DOLOMITE
15'	LIGHT GREY	SLIGHT DAMP	SOFTER	DOLOMITE
21'	LIGHT GREY	SLIGHT DAMP	MEDIUM SOFT	DOLOMITE ?
27'	GREY	SLIGHT DAMP	SOFT	DOLOMITE ?
33'	GREY	SLIGHT DAMP	SOFT	DOLOMITE ?
36'	RED	SLIGHT DAMP	MEDIUM HARD	DOLOMITE ?
39'	GREY	SLIGHT DAMP	MEDIUM HARD	DOLOMITE ?
45'	GREY	SLIGHT DAMP	MEDIUM HARD	DOLOMITE ?
51'	GREY	DAMP	SOFTER	DOLOMITE ?

DRILL HOLE NO. 6
Sample marked DH.6

17th May, 1970.

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
0				
3'	RED	DRY	SOFT	DIRT
6'	CREAM	DRY	BRITTLE	DOLOMITE
9'	WHITE	DRY	HARD	DOLOMITE
12'	OFF WHITE	DRY	CHALKY	DOLOMITE
15'	LIGHT GREY	VERY SLIGHTLY DAMP	MEDIUM SOFT	DOLOMITE
18'	LIGHT GREY	DRY	MEDIUM SOFT	DOLOMITE
21'	BROWN	SLIGHTLY DAMP	SOFT	DOLOMITE ?
23'	BROWN	DAMP	MEDIUM SOFT CLAY	DOLOMITE ?
24'	BROWN	DRY	VERY HARD BRITTLE	DOLOMITE ?
27'	BROWN	DAMP	SOFT	DOLOMITE ?
33'	RED BROWN	DAMP	SOFT	DOLOMITE ?
39'	RED BROWN	MODERATELY DAMP	MODERATELY SOFT	DOLOMITE ?
45'	BROWN	MEDIUM DAMP	MEDIUM SOFT	DOLOMITE ?
51'	GREY BROWN	DAMP	SOFT	DOLOMITE ?

DRILL HOLE NO. 7 — 17th May, 1970.

Sample marked DH.7

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
0				
3'	RED	DRY	SOFT	DIRT
5'	CREAM	DRY	BRITTLE	DOLOMITE
9'	OFF WHITE	DRY	HARD	DOLOMITE
12'	LIGHT GREY	DRY	MEDIUM HARD	DOLOMITE
15'	OFF WHITE	SLIGHTLY DAMP	SOFTER	DOLOMITE
18'	LIGHT GREY	SLIGHTLY DAMP	MEDIUM SOFT	DOLOMITE ?
21'	GREY	SLIGHTLY DAMP	MEDIUM SOFT	DOLOMITE ?
27'	GREY	DAMP	SOFT	DOLOMITE ?
33'	GREY BROWN	DAMP	SOFT	DOLOMITE ?
39'	DARK GREY	SLIGHT DAMP	HARDER	DOLOMITE ?
48'	LIGHT BROWN	DAMP	SOFT	DOLOMITE ?
51'	BROWN GREY	DAMP	SOFT	DOLOMITE ?

DRILL HOLE NO. 8

Sample Marked DH.8

18th May, 1970.

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
0 2'	RED	DRY	SOFT	DIRT
3'	YELLOW	DRY	SOFT	DIRT
6'	CREAM	DRY	BRITTLE BANDS VERY HARD	DOLOMITE
8'	LIGHT GREY-OFF WHITE	DRY	FINE GRAIN POWDERY HARD.	DOLOMITE
15'	OFF WHITE	DRY to very slight damp.	MEDIUM HARD	DOLOMITE
21'	GREY	DAMP	SOFT	DOLOMITE ?
27'	GREY-RED BROWN	DAMP	SOFT	DOLOMITE ?
33'	RED BROWN-CHARCOAL	DAMP	MEDIUM SOFT	DOLOMITE ?
39'	LIGHT BROWN	MEDIUM DAMP	MEDIUM SOFT	DOLOMITE ?
45'	LIGHT GREY-BROWN	MEDIUM DAMP	MEDIUM HARD	DOLOMITE ?
51'	LIGHT BROWN	MEDIUM DAMP	MEDIUM SOFT	DOLOMITE ?

DRILL HOLE NO. 9

Sample marked DH.9

18th May, 1970.

	DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
	0				
	2'	RED	DRY	SOFT	DIRT
Traces of Gypsum (	3'	CREAM	DRY	BRITTLE	DOLOMITE
(	6'	WHITE	DRY	SOFT	DOLOMITE
(	9'	GREY	DAMP	SOFT	DOLOMITE ?
	15'	LIGHT GREY	SLIGHT DAMP	SOFT	DOLOMITE ?
	21'	LIGHT GREY	SLIGHTLY DAMP TO DAMP	MEDIUM SOFT	DOLOMITE ?
	27'	GREY-RED BROWN BANDS	DAMP	MEDIUM SOFT	DOLOMITE ?
	33'	GREY	VERY DAMP TO DAMP	SOFT	DOLOMITE ?
	39'	GREY BROWN	DAMP	SOFT	DOLOMITE ?
	45'	GREY	DAMP	SOFT	DOLOMITE ?
	51'	GREY WITH CHARCOAL BANDS	DAMP-WET	VERY SOFT	DOLOMITE ?

DRILL HOLE NO. 10 14th May, 1970

Sample marked DH.10

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
0 1'	RED	DRY	SOFT	DIRT
3'	WHITE	DRY	MEDIUM HARD	DOLOMITE
9'	WHITE	DRY	HARD - BRITTLE	DOLOMITE
15'	OFF WHITE	DRY	HARD	DOLOMITE
21'	LIGHT GREY	DRY	HARD	DOLOMITE
27'	LIGHT GREY	SLIGHT DAMP	SOFTER	DOLOMITE ?
33'	LIGHT GREY	SLIGHT DAMP	SOFT	DOLOMITE ?
39'	GREY LIGHT	DAMP	SOFT	DOLOMITE ?
45'	GREY	DAMP	HARDER	DOLOMITE ?
51'	GREY	DAMP	MEDIUM HARD	DOLOMITE ?

DRILL HOLE NO. 11 18th May, 1970.

Sample marked DH.11

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
0 6"	RED	DRY	SOFT	DIRT
4'	CREAM	DRY	BRITTLE	DOLOMITE
9'	WHITE	DRY	POWDERY HARD	DOLOMITE
15'	OFF WHITE	DRY	MEDIUM HARD	DOLOMITE
21'	LIGHT GREY	SLIGHTLY DAMP	SOFT MEDIUM	DOLOMITE ?
23'	GREY	DAMP	SOFT	DOLOMITE ?
24'	BROWN Occasional Hard Brittle Bands.	DAMP	SOFT	DOLOMITE ?
27'	GREY	DAMP	SOFT	DOLOMITE ?
33'	GREY	DAMP-WET	SOFT	DOLOMITE ?
39'	RED BROWN	DAMP	SOFT	DOLOMITE ?
48'	GREY-CHARCOAL BANDS.	DAMP	SOFT	DOLOMITE ?
51'	GREY	DAMP	SOFT	DOLOMITE ?

DRILL HOLE NO. 12 19th May, 1970.

Sample marked DH.12

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
0				
2'	RED	DRY	SOFT	DIRT
5'	CREAM-GREY	DRY	BRITTLE	DOLOMITE
9'	WHITE	DRY	HARD (with occasional ¼ brittle bands)	DOLOMITE
13'	WHITE-OFF WHITE	VERY SLIGHT DAMP	MEDIUM HARD	DOLOMITE
19'	LIGHT GREY	VERY SLIGHT DAMP	MEDIUM HARD	DOLOMITE
24'	LIGHT GREY	SLIGHT DAMP	MEDIUM SOFT	DOLOMITE ?
27'	LIGHT GREY-RED BROWN	DAMP	SOFT	DOLOMITE ?
33'	LIGHT RED BROWN (FAWN)	DAMP	SOFT	DOLOMITE ?
36'	LIGHT GREY-BROWN BANDS	DAMP	SOFT	DOLOMITE ?
39'	GREY (with Red Bands)	DAMP	MEDIUM SOFT	DOLOMITE ?
45'	GREY (with Dark Grey Bands)	MEDIUM DAMP	MEDIUM SOFT	DOLOMITE ?
48'	GREY (with Dark Green Band)	DAMP	SOFT	DOLOMITE ?
51'	RED BROWN	DAMP	SOFT	DOLOMITE ?

DRILL HOLE NO. 13 19th May, 1970.
Sample marked DH.13

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
0 6"	RED	DRY	SOFT	DIRT
4'	CREAM PINK	DRY	BRITTLE	DOLOMITE
9'	FINE GRAINED WHITE	DRY	HARD	DOLOMITE
12'	WHITE	DRY	HARD	DOLOMITE
15'	LIGHT GREY	VERY SLIGHT DAMP	HARD-MED/SOFT	DOLOMITE
19'	LIGHT GREY	SLIGHT DAMP	MEDIUM SOFT	DOLOMITE ?
21'	LIGHT GREY	DAMP	SOFT	DOLOMITE ?
27'	LIGHT GREY	DAMP	SOFT	DOLOMITE ?
33'	LIGHT BROWN WITH RED BANDS.	DAMP	SOFT	DOLOMITE ?
39'	GREY OCCASIONAL RED BANDS.	DAMP	SOFT	DOLOMITE ?
45'	GREY-CHARCOAL GREY BANDS.	DAMP	SOFT	DOLOMITE ?
51'	GREY	DAMP	SOFT	DOLOMITE ?

* THIS HOLE RE-DRILLED AND BAGGED SEPARATELY 31ST MAY, 1970

DRILL HOLE NO. 14 19th May, 1970.
Sample marked DH.14

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
0				
18"	RED	DRY	SOFT	DIRT
4'	CREAM	DRY	BRITTLE	DOLOMITE
6'	WHITE	DRY	VERY HARD OCCASIONALLY BRITTLE	DOLOMITE
9'	OFF WHITE	DRY occasional thin brittle band ½".	(MEDIUM HARD (	DOLOMITE
15'	OFF WHITE	DRY	(MEDIUM HARD (	DOLOMITE
21'	LIGHT GREY	DRY ?	MEDIUM SOFT-HARD	DOLOMITE ?
27'	LIGHT GREY	SLIGHT DAMP progress to DAMP	MEDIUM SOFT	DOLOMITE ?
33'	GREY	DAMP	SOFT	DOLOMITE ?
39'	GREY (Dark Grey) (band at) (37'.)	DAMP	SOFT	DOLOMITE ?
45'	GREY CHARCOAL BANDS.	DAMP	MEDIUM SOFT	DOLOMITE ?
51'	GREY GREEN	DAMP	MEDIUM SOFT	DOLOMITE ?

DRILL HOLE NO. 15
Sample marked DH.15

20th May, 1970.

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
0				
3'	RED (occasional Dolomite Brittle Bands after 1')	DRY	SOFT	DIRT
6'	GREY	DRY	BRITTLE BANDED	DOLOMITE
9'	GREY	DRY	HARD (NOT BRITTLE)	DOLOMITE
13'	OFF WHITE	DRY	HARD (OCCASIONAL BRITTLE BAND UP TO 6" THICK)	DOLOMITE
15'	LIGHT GREY	DRY	MED/HARD—HARD	DOLOMITE
19'	OFF WHITE	DRY	MEDIUM SOFT	DOLOMITE
21'	OFF WHITE	VERY SLIGHT DAMP	MEDIUM SOFT	DOLOMITE
27'	LIGHT GREY	SLIGHT DAMP progress to DAMP	SOFT	DOLOMITE ?
33'	GREY	DAMP	SOFT	DOLOMITE ?
39'	GREY) (some Grey Dark) bands $\frac{1}{4}$" thick))	DAMP	MEDIUM SOFT	DOLOMITE ?
45'	GREY))	DAMP	MEDIUM SOFT	DOLOMITE ?
51'	DARK GREY – CHARCOAL BANDS $\frac{1}{4}$" thick. Getting harder with depth.	DAMP	MEDIUM SOFT – MEDIUM HARD	DOLOMITE ?

* WATER SAMPLE OBTAINED FROM THIS HOLE ON 24th May, 1970
STATIC WATER LEVEL 18' FROM SURFACE.

DRILL HOLE NO. 16

Sample marked DH.16

20th May, 1970.

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
0				
3'	RED (with traces of Gypsum)	DRY	SOFT	DIRT
6'	WHITE	DRY	MEDIUM HARD	DOLOMITE
9'	OFF WHITE	DRY	MEDIUM SOFT	DOLOMITE
11'	GREY	DAMP	SOFT	DOLOMITE
12'	CREAM (Light Grey) Banded and in Nodule form.	DRY	BRITTLE	DOLOMITE
15'	WHITE & (Light Grey)Bands.	DRY	HARD occasionally slight brittle.	DOLOMITE
21'	OFF WHITE (Light Grey)	DRY	HARD occasionally brittle.	DOLOMITE
27'	OFF WHITE	DRY	HARD	DOLOMITE
29'	LIGHT GREY	MEDIUM DAMP	MEDIUM SOFT	DOLOMITE ?
33'	LIGHT GREY	DAMP	SOFT	DOLOMITE ?
51'	OFF WHITE	EXTREMLY WET	EXTREMLY SOFT	DOLOMITE ?

* CUTTINGS CAME UP HOLE LIKE CREAM.

THIS HOLE WAS RE-DRILLED TO GET WATER SAMPLE ON 27th May, 1970
STATIC WATER LEVEL IN HOLE WAS 20' FROM SURFACE.

DRILL HOLE NO. 17 21th May, 1970.

Sample marked DH. 17

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
0 3'	RED	DRY	SOFT occasional brittle lump after 2'.	DIRT
5'	CREAM	DRY	BRITTLE & LUMPY	DOLOMITE
7'	OFF WHITE	DRY	VERY HARD	DOLOMITE
9'	OFF WHITE	DRY	HARD	DOLOMITE
15'	LIGHT GREY-OFF WHITE	DRY	HARD	DOLOMITE
21'	LIGHT GREY	DRY	HARD	DOLOMITE
24'	LIGHT GREY	DRY	MEDIUM SOFT	DOLOMITE ?
27'	LIGHT GREY	SLIGHT DAMP	SOFT	DOLOMITE ?
30'	LIGHT GREY	DAMP	VERY SOFT	DOLOMITE ?
33'	LIGHT BROWN	DAMP	SOFT	DOLOMITE ?
39'	MEDIUM DARK GREY. (with Red Brown Bands at 38-39')	DAMP	SOFT	DOLOMITE ?
45'	GREY WITH MORE RED BROWN BANDS.	DAMP	SOFT	DOLOMITE ?
51'	LIGHT GREY WITH DARK GREY MED. HARD BANDS.	DAMP	SOFT	DOLOMITE ?

DRILL HOLE NO. 18 21st May, 1970.

Sample marked DH.18

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
0				
1'	RED	DRY	SOFT	DIRT
3'	CREAM-GREY	DRY	BRITTLE	DOLOMITE
5'	WHITE (with brittle bands.)	DRY	VERY HARD	DOLOMITE
9'	OFF WHITE (with Gypsum Crystals and brittle bands)	DRY	HARD	DOLOMITE
15'	OFF WHITE (Diminishing brittle bands)	DRY	MEDIUM HARD	DOLOMITE
21'	OFF WHITE	DRY	MEDIUM SOFT	DOLOMITE
27'	OFF WHITE	VERY SLIGHTLY DAMP	MEDIUM SOFT	DOLOMITE
30'	LIGHT GREY	SLIGHT DAMP	SOFT	DOLOMITE ?
33'	LIGHT GREY (with darker grey bands.)	DAMP	SOFT	DOLOMITE ?
39'	GREY	DAMP	SOFT	DOLOMITE ?
45'	GREY (with dark grey bands.)	DAMP	SOFT	DOLOMITE ?
51'	GREY (more dark bands.)	NOT SO DAMP	SOFT	DOLOMITE ?

DRILL HOLE NO. 19

21st May, 1970.

Sample marked DH.19

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
0 3'	RED	DAMP	SOFT	DIRT
6'	WHITE	SLIGHT DAMP	SOFT	DOLOMITE
9'	WHITE	DRY	HARD	DOLOMITE
11'	CREAM	DRY	BRITTLE	DOLOMITE
15'	OFF WHITE	DRY	VERY HARD (occasionally brittle.)	DOLOMITE
21'	OFF WHITE	DRY	HARD	DOLOMITE
24'	LIGHT GREY	DAMP	SOFT	DOLOMITE ?
27'	GREY	DAMP	SOFT	DOLOMITE ?
33'	GREY	DAMP	SOFT	DOLOMITE ?
39'	DARK GREY BANDS.	DAMP	SOFT	DOLOMITE ?
45'	GREY	DAMP	SOFT	DOLOMITE ?
51'	GREY	DAMP	SOFT	DOLOMITE ?

DRILL HOLE NO. 20 24th May, 1970.

Sample marked DH.20

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
0 6"	RED	DRY	SOFT	DIRT
4'	GREEN	MEDIUM DAMP	SOFT	SOAPY DOLOMITIC CLAY ?
9'	CREAM	DRY	HARD & BRITTLE	DOLOMITE
13'	OFF WHITE	DRY	HARD	DOLOMITE
18'	WHITE	DRY	MEDIUM SOFT	DOLOMITE
21'	OFF WHITE	DRY	MEDIUM SOFT	DOLOMITE
24'	LIGHT GREY	VERY SLIGHT DAMP	SOFT	DOLOMITE ?
27'	LIGHT GREY	SLIGHT DAMP	SOFT	DOLOMITE ?
33'	GREY (with dark grey bands.)	DAMP	SOFT	DOLOMITE ?
39'	GREY-RED BROWN	DAMP	SOFT	DOLOMITE ?
45'	GREY-DARK GREY	DAMP	SOFT	DOLOMITE ?
51'	DARK GREY	DAMP	SOFT	DOLOMITE ?

DRILL HOLE NO. 21 26th May, 1970. 44

Sample marked DH. 21

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
0 4'	RED-GREY	DRY	SOFT	DIRT
7'	GYPSUM CRYSTALS (Quarts Gravel and Green Med. Hard Clay bands)	DRY	MEDIUM SOFT	DOLOMITE ?
16'	WHITE-CREAM	DRY	HARD (often brittle)	DOLOMITE
21'	OFF WHITE	DRY	MEDIUM SOFT	DOLOMITE
27'	OFF WHITE	DRY	SOFT	DOLOMITE
33'	LIGHT GREY	MEDIUM DAMP	SOFT	DOLOMITE ?
39'	LIGHT BROWN	DAMP	SOFT	DOLOMITE ?
45'	LIGHT BROWN (Charcoal band)	DAMP	SOFT	DOLOMITE ?
51'	LIGHT BROWN	DAMP	SOFT	DOLOMITE ?

DRILL HOLE NO. 22 26th May, 1970

Sample marked DH. 22

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
0 2'	RED	DRY	SOFT	DIRT
4'	CREAM-GREY	DRY	BRITTLE & HARD	DOLOMITE
5'	CREAM-WHITE	DRY	EXTREMELY HARD	DOLOMITE
7'	CREAM-WHITE	DRY	VERY HARD	DOLOMITE
15'	WHITE	DRY	MEDIUM HARD	DOLOMITE
21'	OFF WHITE	DRY	MEDIUM SOFT	DOLOMITE
27'	LIGHT GREY	SLIGHT DAMP	SOFT	DOLOMITE ?
33'	LIGHT GREY	DAMP	SOFT	DOLOMITE ?
39'	LIGHT GREY	DAMP	SOFT	DOLOMITE ?
45'	LIGHT GREY- LIGHT BROWN	DAMP	SOFT	DOLOMITE ?
51'	LIGHT BROWN-GREY with Charcoal bands	DAMP	SOFT	DOLOMITE ?

DRILL HOLE NO. 23 25th May, 1970.
Sample marked DH.23

Two Samples taken A & B.

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
0				
2'	RED	DRY	SOFT	DIRT
4'	CREAM	DRY	SOFT with brittle lumps.	DOLOMITE
9'	CREAM progress to Light Grey.	DRY	EXCEPTIONALLY HARD - Alternating Brittle Bands.	DOLOMITE
13'	WHITE	DRY	VERY HARD	DOLOMITE
15'	WHITE	DRY	MEDIUM HARD	DOLOMITE
17'	WHITE	DRY	HARD	DOLOMITE
21'	OFF WHITE	DRY	MEDIUM SOFT	DOLOMITE
24' SAMPLE A.				
27'	LIGHT GREY	SLIGHT DAMP	SOFT	DOLOMITE ?
33'	GREY	DAMP	SOFT	DOLOMITE ?
39'	GREY-BROWN	DAMP	SOFT	DOLOMITE ?
45'	GREY with Charcoal Bands.	DAMP	SOFT	DOLOMITE ?
51'	GREY	DAMP	SOFT	DOLOMITE ?
SAMPLE B				

THIS HOLE WAS BAGGED IN TWO SECTIONS

VIZ: 0 - 24' = Sample DH.23A.
24'- 51' = Sample DH.23B.

DRILL HOLE NO. 24 27th May, 1970.

Sample marked DH.24

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
0				
1'	RED	DRY	SOFT	DIRT
4'	CRYSTALINE (stones like hard sugar lumps) Banded with some dirt.	DRY	SOFT	GYPSUM
5'	CREM-GREY (Hard lump with Crystaline bands)	DRY	DRITTLE	DOLOMITE
9'	OFF WHITE-LIGHT GREY.	DRY with thin damp band.	HARD	DOLOMITE
15'	OFF WHITE	DRY	MEDIUM HARD	DOLOMITE
18'	CREAM	DRY	BRITTLE-HARD	DOLOMITE
21'	LIGHT GREY	DRY	MEDIUM SOFT	DOLOMITE ?
27'	LIGHT GREY	SLIGHT DAMP to DAMP	SOFT	DOLOMITE ?
33'	LIGHT GREY	DAMP-VERY DAMP	VERY SOFT	DOLOMITE ?
39'	LIGHT GREY	DAMP progress to WET	VERY SOFT	DOLOMITE ?
45'	GREY (with Charcoal bands)	DAMP	VERY SOFT	DOLOMITE ?
51'	GREY (with Charcoal Bands)	DAMP	SOFT	DOLOMITE ?

DRILL HOLE NO. 25 25th May, 1970.

Sample marked DH. 25

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
0 6"	RED	DRY	SOFT	DIRT
3'	GREY-CREAM LUMPS	DRY	BRITTLE	DOLOMITE
6'	GREY-OFF WHITE	DRY	HARD Occasionally Brittle.	DOLOMITE
9'	OFF WHITE	DRY	HARD	DOLOMITE
13'	OFF WHITE	DRY	HARD	DOLOMITE
19'	OFF WHITE	DRY	MEDIUM HARD	DOLOMITE
21'	LIGHT GREY	DRY	MEDIUM SOFT	DOLOMITE ?
27'	LIGHT GREY	VERY SLIGHT DAMP	SOFT	DOLOMITE ?
34'	LIGHT GREY	SLIGHT DAMP progress to DAMP	SOFT	DOLOMITE ?
36'	RED BROWN	MEDIUM DAMP	MEDIUM SOFT	DOLOMITE ?
41'	LIGHT BROWN-GREY	DAMP	SOFT	DOLOMITE ?
42'	CHARCOAL BAND (Green Grey)	MEDIUM DAMP	MEDIUM SOFT	DOLOMITE ?
45'	LIGHT BROWN	DAMP	SOFT	DOLOMITE ?
46'	CHARCOAL BAND	DAMP	SOFT	DOLOMITE ?
51'	LIGHT BROWN	DAMP	SOFT	DOLOMITE ?

DRILL HOLE NO. 26 24th May, 1970.

Sample marked DH.26

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
0				
3'	RED	SLIGHT DAMP	SOFT	SAND
6'	RED (occasional Dolomitic Stones)	SLIGHT DAMP	SOFT	SAND
12'	GREY CLAY	SLIGHT DAMP	SOFT	DOLOMITE ?
18'	DARK GREY TO PINK	VERY SLIGHT DAMP	SOFT	DOLOMITE ?
24'	DARK GREEN	VERY SLIGHT DAMP	MEDIUM SOFT	DOLOMITE ?
30'	DARK GREEN	VERY SLIGHT	MEDIUM HARD	DOLOMITE ?
36'	LIGHT GREEN	DAMP	SOFT	DOLOMITE ?
42'	LIGHT GREEN	VERY WET	VERY SOFT	DOLOMITE ?
48'	LIGHT GREEN	VERY WET	VERY SOFT	DOLOMITE ?

* WATER SAMPLE OBTAINED FROM THIS HOLE IMMEDIATELY AFTER DRILLING 24TH MAY, 1970 STATIC WATER LEVEL 18 FROM SURFACE.

DRILL HOLE NO. 27 27th May, 1970.

Sample Marked DH.27

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
0				
3'	RED GREY	DRY	SOFT	SOIL
4'	GREEN GREY (with some Gypsum)	SLIGHT DAMP	SOFT	CLAY
6'	GREEN YELLOW (some pellets of clay)	SLIGHT DAMP	SOFT	SAND
9'	YELLOW-LIGHT GREY (White)	DAMP	SOFT	SAND
12'	LIGHT BROWN (progress to brown)	DAMP	SOFT	SAND
16'	GREY progress to BROWN (with some Gypsum)	DAMP	SOFT	CLAY
18'	YELLOW-GREEN	DAMP	SOFT	SAND
21'	LIGHT GREY-GREEN	DAMP	SOFT	SAND
25'	LIGHT GREY	WET	SOFT	SANDY CLAY
27'	BROWN	WET	SOFT	SANDY CLAY
51'	GREY MUD	WET	SOFT	MUD

* THIS HOLE WAS ORIGINALLY DRILLED FOR WATER BUT IMPOSSIBLE TO GET WATER SAMPLE FROM THIS HOLE AS WET SAND KEPT FILLING HOLE WITHIN 6' OF SURFACE.

DRILL HOLE NO. 13 31st May, 1970.

Sample marked DH. 13

DEPTH	COLOUR	DAMPNESS	HARDNESS	SAMPLE NO.	TYPE
0-6"	RED	DRY	SOFT DIRT	UC. 1	DIRT
6"-2'	GREY-CREAM	DRY	HARD & BRITTLE - BROKEN	UC. 2	DOLOMITE
2'-4'	LIGHT GREY-CREAM	DRY	HARD & BRITTLE - UNFRACTURED	UC. 3	DOLOMITE
4'-6'	OFF WHITE CREAM-PINK	DRY	HARD - LESS BRITTLE	UC. 4	DOLOMITE
6'-8'	OFF WHITE LIGHT GREY STONES	DRY	HARD	UC. 5	DOLOMITE
8'-10'	OFF WHITE	DRY	MEDIUM HARD	UC. 6	DOLOMITE
10'-12'	OFF WHITE	DRY	MEDIUM SOFT	UC. 7	DOLOMITE ?
12'-14'	LIGHT GREY	DRY	MEDIUM SOFT	UC. 8	DOLOMITE ?
14'-16'	LIGHT GREY	VERY SLIGHT DAMP	SOFT	UC. 9	DOLOMITE ?
16'-18'	LIGHT GREY	SLIGHT DAMP	SOFT	UC. 10	DOLOMITE ?
18'-21'	LIGHT GREY with small green bands.	DAMP	SOFT	UC. 11	DOLOMITE ?
21'-24'	LIGHT GREY small red bands.	DAMP	SOFT	UC. 12	DOLOMITE ?
24'-30'	LIGHT GREY-LIGHT BROWN.	DAMP	SOFT	UC. 13	DOLOMITE ?
30'-36'	LIGHT BROWN-LIGHT GREY.) GREEN & RED BANDS.	VERY DAMP	SOFT	UC. 14	DOLOMITE ?
36'-42'	LIGHT GREY with GREEN & RED BANDS.	DAMP	SOFT	UC. 15	DOLOMITE ?

DRILL HOLE NO. 13 (CONTINUED) 31st May, 1970.

Sample marked DH. 13

DEPTH	COLOUR	DAMPNESS	HARDNESS	SAMPLE NO.	TYPE
39'	RED AND GREEN BANDS FOR ABOUT 6" EXTRA SAMPLE			UC. 16	DOLOMITE
42'-51'	GREY with charcoal bands.	DAMP	SOFT	UC. 17	DOLOMITE

above .

DRILL HOLE NO. 28 (1 mile East Access Point) 3rd June, 1970.

Sample marked DH.28

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE SAMPLE NO.
0				
2'	RED	DRY	SOFT Occasional hard lump	UC.21
4'	CREAM	DRY	MEDIUM HARD Occasionally brittle	UC.22
6'	CREAM	DRY	MEDIUM HARD Occasionally brittle	UC.23
8'	OFF WHITE	DRY	HARD Less brittle	UC.24
10'	WHITE	DRY	HARD Very Hard	UC.25
12'	WHITE	DRY	VERY HARD	UC.26
14'	WHITE CREAM CRYSTALINE	DRY	VERY HARD With some rounded stones Crystaline with Red Bands.	UC.27
16'	WHITE CRYSTALINE	DRY	VERY HARD With stones as above plus brown chips.	UC.28
18'	WHITE CRYSTALINE LUMPS.	DRY	HARD Brown chips remain	UC.29
20'	WHITE CRYSTAL	DRY	HARD Occasional Lumps.	UC.30
22'	WHITE	DRY	HARD Occasional Lumps.	UC.31
24'	WHITE	DRY	HARD Occasional Lumps	UC.32
26'	WHITE	DRY	HARD -LUMPY	UC.33
28'	WHITE-YELLOW	DRY	MEDIUM HARD	UC.34

DRILL HOLE NO. 28 (CONTINUED)　　　　3rd June, 1970.

Sample marked DH.28

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE SAMPLE NO.
30'	LIGHT YELLOW	DRY	MEDIUM SOFT	UC.35
32'	WHITE YELLOW	DRY	MEDIUM SOFT LUMBY	UC.36
34'	LIGHT YELLOW	DRY	SOFT	UC.37
36'	LIGHT YELLOW	SLIGHT DAMP	SOFT	UC.38
38')				(UC.39
40')	YELLOW	DAMP MUD	SOFT	(UC.40
42')				(UC.41
44')				(UC.42

DRILL HOLE NO. 29 *where* 4th June, 1970.

Sample marked DH. 29

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE SAMPLE NO.
0				
3'	MISC. GRAVEL & SAND	DRY	SOFT	
9'	CHARCOAL COLOURED CLAY	VERY SLIGHT DAMP	SOFT	UC. 51
15'	CHARCOAL COLOURED CLAY	SLIGHT DAMP	SOFT	UC. 52
21'	CHARCOAL COLOURED CLAY	DAMP	SOFT	UC. 53
27'	CHARCOAL COLOURED CLAY	WET	SOFT	UC. 54

* THIS HOLE DRILLED TO OBTAIN WATER SAMPLE.

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June 1970

de Vere & Haymes — Consulting Engineers

Amdel Report

No.709

LAKE EYRE DOLOMITE

by

Sylvia Whitehead

Investigated by: Mineralogy & Petrology Section
Officer in Charge: Dr K.J. Henly

N. Draper. Director

THE AUSTRALIAN MINERAL DEVELOPMENT LABORATORIES
Adelaide South Australia

CONTENTS

SUMMARY

Background

In March 1970 Dr J. de Vere of de Vere and Haymes — Consulting Engineers, discussed the possibility of Amdel investigating deposits of dolomite known to occur in the Lake Eyre region of South Australia. An investigation was accordingly undertaken, the ultimate aim of which was to determine the feasibility of treating this dolomite with brine from Lake Eyre, to produce magnesium oxide of a suitable grade for refractory purposes.

Objective

The aim of this first stage of the investigation was to:

a. determine the amount and grade of the dolomite available in the Lake Eyre region, and

b. select an area for drilling.

Summary of Work Done

The area under investigation was visited at the end of April. Samples of dolomite were collected from cliff faces on the eastern side of the Babbage Peninsula and a bulk sample was also collected from the eastern side of Hunt Peninsula near the boundary of the National Park.

An area on the eastern side of the Babbage Peninsula, shown in Figure 1, was selected for scout drilling and a sketch map showing this, together with a brief report, was left at Maloorina Station for Mr A.J. Molloy, driller for de Vere and Haymes.

Samples of subsurface brine were collected from Jackboot Bay and a sample of surface brine from Lake Eyre South. A sample of salt crust was collected from Belt Bay.

Detailed work undertaken at Amdel included chemical analysis of some of the samples of dolomite collected and petrographic examination of thin sections of the dolomite. Maps were prepared using field data and aerial photographs.

Samples of dolomite, brine and salt are being held by Amdel for testing possible methods of beneficiation.

Conclusions

The investigation has shown that:

1. An estimated 250 million tons of dolomite with little or no overburden is avilable on the Babbage Peninsula at the southern

end of the Lake Eyre North (Fig.1) and additional dolomite is present in this area beneath a cover of wind-blown sand.

2. The dolomite is essentially flat lying and analysis of samples from a cliff section on the eastern side of the peninsula suggests a thickness of 10 feet of dolomite averaging almost 19% MgO. Analyses of drill-hole samples will be necessary to confirm these reserves and grade.

3. The dolomite is slightly porous with a grain size of 2-3 microns, and the most abundant impurity is clay. Most of the clay occurs disseminated throughout the dolomite in low concentration and as extremely small particles, but a little may occur in rounded pellets 0.1 to 0.2 mm in size which contain dolomite and dark organic material. Iron oxide impurity is also disseminated in low concentration and stains the surface of a few small cavities and joints or fractures. It is more abundant in layers containing a higher percentage of clay.

4. Gypsum fills a few small solution channels or cavities and in places penetrates joints and bedding planes.

5. Other impurities including quartz, mica flakes and other mineral grains are present in trace amounts only.

6. Similar dolomite forms a plateau approximately 10 square miles in area between Lake Eyre South and the Maree-Alice Springs railway line (Fig.2). This area has the advantage of being close to transport and is more accessible but the grade of dolomite will not be known until drill-hole samples have been analysed.

7. Overall, an adequate supply of dolomite is present in the areas indicated and overburden is absent or is limited to a thin covering of wind blown sand. It has yet to be determined whether this dolomite can be used to produce magnesium oxide of a sufficiently high grade.

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4. Gypsum fills a few small solution channels or cavities and in places penetrates joints and bedding planes.

5. Other impurities including quartz, mica flakes and other mineral grains are present in trace amounts only.

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7. Overall, an adequate supply of dolomite is present in the areas indicated and overburden is absent or is limited to a thin covering of wind blown sand. It has yet to be determined whether this dolomite can be used to produce magnesium oxide of a sufficiently high grade.

Recommendations

The economic feasibility of the whole project must be very critically examined and some points to be considered, in this context, are listed below:

1. An adequate and continuous supply of brine has yet to be proved.
2. Fresh or soft water is not available except after very infrequent rain which is not to be relied upon.
3. This is a very remote, arid and inhospitable area and any industrial undertaking would require considerable expenditure on road making, water supply, and the provision of good housing and associated amenities necessary to attract and hold staff.
4. Freight and shipping costs for the finished product would be high.

1. INTRODUCTION

In March 1970 Dr J. de Vere of de Vere and Haymes — Consulting Engineers, discussed the possibility of Amdel investigating deposits of dolomite known to occur in the Lake Eyre region of South Australia. An investigation was accordingly undertaken, the ultimate aim of which was to determine the feasibility of treating this dolomite with brine from Lake Eyre, to produce magnesium oxide of a suitable grade for refractory purposes.

This report concerns the first stage of the project, which is the estimation of the amount and grade of dolomite available and selection of an area for drilling.

The present investigation has been largely restricted to the Babbage Peninsula on the southern part of Lake Eyre North, for the following reasons:

1. Larger areas of outcropping dolomite were known to be present at the southern end of Lake Eyre.
2. Drainage in Lake Eyre is from north to south suggesting a better supply of brine at the southern end of the Lake.
3. Access is relatively easy; a track goes from Muloorina Homestead to the Artesian bore (see locality Map), and a fence can then be followed north to the southern end of Jackboot Bay.
4. The Hunt Peninsula, also containing outcropping dolomite, has been proclaimed a National Park and removal of material is prohibited.

1.1 Location

Lake Eyre is in a very low lying area about 400 miles north of Adelaide, and has an average rainfall of 5 to 6 inches per year. The lake floor covers an area of 3,600 square miles, is normally dry and has a salt crust up to 17 inches thick in places. Drainage is from north to south (Johns, 1963), and most of the salt crust is deposited towards the southern end of the lake, particularly in Madigan Gulf and Belt Bay (see locality Map). The lake has been filled during years of exceptionally high rainfall and "the evaporation rate was then found to be of the order of 80-90 inches per annum" (Bonython, 1958).

Much of the surrounding area is sand covered and desolate, and its use for sheep and cattle production has been made possible only by the use of artesian water. This water is mineralised.

1.2 Previous Work

The dolomite under investigation is part of the Etadunna Formation, believed by Ludbrook (1963) to be of Miocene age. It occurs as a series of beds associated with dolomitic clays and silts and some pyritic clays. Some beds contain fossil fish bones and the sediments were probably deposited under lagoonal conditions. Dolomites of the Etadunna Formation outcrop mainly along the southern shore of Lake Eyre North, particularly on the Hunt Peninsula and the Babbage Peninsula, and they are intersected in bore holes put down in the lake floor in Madigan Gulf (Johns, 1963).

An area along the Neales River near the north-western corner of Lake Eyre (locality Map) was investigated by P.A. Raymens and A.J. Molloy during the summer of 1969-1970 and samples of dolomite which they collected from cliff sections in that area were submitted to Amdel for analysis, and for testing possible methods of beneficiation, in an earlier investigation. These samples proved to be of very variable grade, with most of the better material containing from 9% to 17% MgO, and were chip samples from 2-ft, 4-ft and 6-ft sections of cliff face. Only one sample gave 22% MgO.

This dolomite outcropping in cliff sections along the Neales River is covered by 3 to 6 ft of overburden, mainly sandstone and clay.

Access to the Neales River area is from William Creek and is reported to be extremely difficult by land.

2. BABBAGE PENINSULA DOLOMITE

2.1 Field Occurrence

Dolomite occurs over much of the surface of the Babbage Peninsula and forms a fairly level plateau elevated above the general level of the lake floor. The surface of the southern part of the peninsula is covered by wind-blown sand and parallel sand ridges trending north north-east extend out over parts of the dolomite in the central part of the peninsula (Fig.1). North and east of the sand cover, much of the surface is covered by an accumulation of hard lumps of white dolomite several inches across, mixed with varying amounts of sand.

Dolomite is exposed in cliff sections along the eastern side of the peninsula (Plates 1 & 2), these cliffs are up to 30 ft high and in places are up to half a mile distant from the present edge of the lake. They were formed during some earlier period of erosion and a typical section is described below. This refers to samples collected during the present investigation:

Depth, ft	Sample	Description
0- 3	-	Contaminated surface dolomite with varying amounts of sand and gypsum penetrating along joints and bedding planes.
3- 5	A	Moderately hard, white dolomite
5- 7	B	Slightly softer dolomite
7- 8	C	Softer impure dolomite — slightly darker colour
8- 9	D	Moderately soft dolomite
9-12	E	Hard, white dolomite
12-13	F	Softer dolomite, silty in places
13-25 or 30	-	Scree covered slope

The low-lying area between the base of the cliffs and the edge of the lake is partly covered by sand and silt. A few small hills of clay have a thin dolomite capping indicating that clay or mudstone underlies the dolomite in this area. The total thickness of hard dolomite overlying the clay cannot be determined because of the scree cover. However, a minimum thickness of 10 ft is exposed along sections examined.

The dolomite appears essentially flat lying (Plate 2) but minor undulations or a very low angle of dip cannot be determined from the exposures.

The narrow, northern extension of Babbage Peninsula is also bounded by cliffs of dolomite.

An area 4 miles square on the eastern side of the Babbage Peninsula (Fig.1) was selected for scout drilling. The dolomite cliffs are higher in this part of the area (Plate 1) and the dolomite exposed in the cliffs appeared, on visual examination in the field, to be of better grade.

2.2 Composition

Chip samples were collected from different layers in one of the cliff sections. The contaminated 2-3 ft of surface material was disregarded and the other samples, A-F described above, were analysed with the following results:

Sample Designation	Depth ft	Element				
		MgO	Al_2O_3	SiO_2	Fe	SO_4
A	3- 5	19.5	2.42	2.16	0.20	0.76
B	5- 7	19.5	1.89	1.73	0.19	1.55
C	7- 8	14.4	7.94	7.60	0.50	4.30
D	8- 9	17.9	2.0	1.46	0.18	1.85
E	9-12	20.3	1.78	1.41	0.23	0.62
F	12-13	17.2	3.97	3.92	0.43	2.69
Average over 10 ft	-	18.93	2.78	2.6	0.26	1.53
Average over 9 ft (disregarding impure layer C)	-	19.43	1.82	1.37	0.23	1.2

If the lower impure Sample F were discarded the impurities would be further reduced.

These analyses are from one locality only and it is also possible that material collected from an exposed cliff surface may not be truly representative of dolomite occurring at depth inland from the cliffs. The results given above should therefore be regarded only as an indication of the grade of dolomite to be expected. Complete evaluation of the dolomite cannot be made until the results of drilling are known.

A grab sample taken from the bulk sample collected from over 10 ft (vertical) of cliff face at the southern end of the area suggested for drilling (Plate 1) gave the following results:

MgO	CaO	Al_2O_3	SiO_2	Fe	SO_4
19.10	30.10	0.41	2.35	0.24	0.46

2.3 Petrography

Thin sections were cut from specimens from each of the six layers (Samples A to F) described and analysed. They were examined under the microscope and portions of two sections were analysed by the electron probe to determine the distribution of impurities.

The samples are all composed predominantly of extremely fine grained dolomite with an average grain size of 2-3 microns (Plates 3 - 6) and a maximum grain size of 5 microns.

There are no sharply defined bedding planes but in places, a few small elongate cavities or solution channels are approximately parallel to the layering. Other irregular small cavities show no definite orientation. Most of the cavities in the dolomite are from 20 to 300 microns wide and up to several millimetres long, many contain gypsum (Plates 4, 5, & 6).

Clay. Chemical analysis indicates that this is the most abundant and widespread impurity.

In thin sections, most of the clay particles are obscured by the general cloudiness of the dolomite, but electron probe microanalysis shows aluminium and silicon dispersed in low concentrations through parts of the dolomite. Residues remaining after digestion of some of the samples in hydrochloric acid consist mainly of small particles of clay 20 to 100 microns in size.

Some thin sections show dark, well-rounded pellets 0.1 to 0.2 mm in size (Plates 3 & 6) in the dolomite. Some of these are probably small pellets of dolomite clay slightly stained by iron oxide; electron-probe micro-analyses of others suggest they contain organic material.

Quartz. A few rounded to subrounded quartz grains 20 to 50 microns in size are scattered through parts of the dolomite (Plate 3) but these compose less than a fraction of a percent in the areas covered by the thin sections. Layers of silt were not detected but these sections cover only a very small proportion of the whole sample.

Gypsum. Small gypsum crystals line many of the small cavities in parts of the dolomite (Plates 4, 5, & 6), and a few cavities have been completely filled by gypsum. The distribution is irregular and in these samples more gypsum is present in the impure layer containing abundant clay. As noted above, these samples were collected from a cliff face which has been exposed for some considerable time and the presence of gypsum may be a surface phenomenon.

Iron Oxide. Small, opaque grains of iron oxide (Plate 5) are sparsely scattered through parts of the dolomite but these are not common in any of the samples examined. Brown iron oxide stains the surface of dolomite lining some small cavities (Plate 4) and also the surfaces of irregular joints. Eloctron-probe microanalysis shows iron to be dispersed in very low concentration through much of the dolomite. It may be present simply as staining, as very few of the concentrations are sufficiently large to indicate definite mineral grains visible under the microscope.

Other Mineral Grains. A few very small flakes of mica and extremely rare heavy mineral grains (zircon elidote etc.) were noted but these are present in trace amounts only.

Halite (Salt). The samples all have a strong taste of salt (NaCl) which probably occurs as films along grain boundaries. It was not detected microscopically even in crushed fragments mounted in oil but some was detected by X-ray diffraction examination.

The impure Sample C shows particles of mottled, dark staining of undetermined composition. Some of these are associated with algal structures in the dolomite and may be of organic origin.

2.3.1 Conclusions

The results of chemical analyses, microscopic examination and electron probe microanalyses described above all show that clay is the most abundant impurity in this dolomite and most of it is dispersed in low concentration as very small particles less than 0.1 mm in size. Iron oxide is also dispersed as extremely small particles and occurs as staining in parts of the dolomite.

Physical separation of these impurities would appear to be extremely difficult, if not impossible, but it may be possible to upgrade the dolomite to a sufficiently high level of purity by discarding the layers containing higher concentrations of clay and iron oxide.

2.4 Reserves

Until additional samples from drill holes have been analysed, estimation of reserves must be based on the analyses of the cliff samples described above. These suggest a layer of dolomite at least 10 ft thick averaging approximately 19% MgO.

Assuming a bulk density of 30 cu ft to the ton, and a layer 10 ft thick one million tons will be obtained from every 3 million square feet of area, or approximately 9.3 million tons from every square mile. The area recommended for scout drilling contains 16 square miles of outcropping dolomite with thin sand cover in places and there is an additional 10 to 12 square miles of outcropping dolomite on the northern extension of the peninsula. This gives, at a conservative estimate, 250 million tons of dolomite with very little sand cover. Additional areas of dolomite on the peninsula are buried beneath several feet of wind blown sand.

3. DOLOMITE SOUTH OF LAKE EYRE

Horizontally bedded dolomite forms the surface of a plateau approximately 10 square miles in area, situated between Lake Eyre South and the Maree-Alice Springs railway line (locality Map and Fig.2). Cliffs cut in dolomite mark the edge of this plateau.

The southern tip of this dolomite plateau is 4 miles north west of Alberrie Creek railway station and an earth road from Alberrie Creek to Charles Angas bore passes close to the eastern boundary. This area is therefore more accessible than the Babbage Peninsula but it has the possible disadvantage in that it is not on the shores of Lake Eyre — the northern tip of the plateau is 5 miles south of the southern shore of Lake Eyre South. However, embayments and wide creek beds or alluvial flats in the area between this plateau and Lake Eyre South appear to have very little gradient and sub-surface brine may be available.

The quality of the dolomite forming this plateau will not be known until drill-hole samples have been analysed.

4. BRINE

Lake Eyre is dry except after very infrequent, heavy rains and much of the surface of Belt Bay, Jackboot Bay and Madigan Gulf is covered by salt crust. In most places, this crust does not extend to the edge of the lake but is separated from it by up to 1 mile of mud flats.

The thickness of the salt crust varies. (Madigan (1930)* reported a maximum of 17 inches and Johns (1963) reported a maximum of 9 inches. During this investigation salt was collected from Belt Bay where the crust is 2-inches thick, at a distance of one half mile from the southern edge of the lake. The salt has a porous, honey-like texture.

Johns (1963) shows an area of approximately 100 square miles of salt crust in Belt Bay, and, assuming an average thickness of 4 inches and a bulk density of 35 cu ft per ton, this will contain approximately 25 million tons of salt of which less than 0.5% is magnesium (Bonython, 1956 reports 0.05 to 0.34% $MgSO_4$ in salt from the surface).

Jackboot Bay probably contains less salt than Belt Bay and Madigan Gulf contains more, but this salt is not available as brine except during rare intervals when the lake contains water.

* In Johns (1963).

The amount and availability of subsurface brine has not been determined. Holes dug in the floor of the lake in Belt Bay and Jackboot Bay filled with brine to within 2-3 feet of the surface, but this was after heavy rain at a time when surface water was present in the lake. It would be necessary to ensure that an adequate supply of brine is available, and will continue to be available before consideration is given to other aspects of this project.

5. CONCLUSIONS

The investigation has shown that:

1. An estimated 250 million tons of dolomite with little or no overburden is available on the Babbage Peninsula at the southern end of Lake Eyre North (Fig.1) and additional dolomite is present in this area beneath a cover of wind blown sand.

2. The dolomite is essentially flat lying and analysis of samples from a cliff section on the eastern side of the peninsula suggest a thickness of 10 feet of dolomite averaging almost 19% MgO. Analyses of drill-hole samples will be necessary to confirm these reserves and grade.

3. The dolomite is slightly porous with a grain size of 2-3 microns, and the most abundant impurity is clay. Most of the clay occurs disseminated throughout the dolomite in low concentration and as extremely small particles, but a little may occur in rounded pellets 0.1 to 0.2 mm in size which contain dolomite and dark organic material. Iron oxide impurity is also disseminated in low concentration and stains the surface of a few small cavities and joints or fractures. It is more abundant in layers containing a higher percentage of clay.

4. Gypsum fills a few small solution channels or cavities and in places penetrates joints and bedding planes.

5. Other impurities including quartz, mica flakes and other mineral grains are present in trace amounts only.

6. Similar dolomite forms a plateau approximately 10 square miles in area between Lake Eyre South and the Maree-Alice Springs railway line (Fig.2). This area has the advantage of being

close to transport and is more accessible but the grade of dolomite will not be known until drill-hole samples have been analysed.

7. Overall, an adequate supply of dolomite is present in the areas indicated and overburden is absent or is limited to a thin covering of wind blown sand. It has yet to be determined whether this dolomite can be used to produce magnesium oxide of a sufficiently high grade.

6. RECOMMENDATIONS

The economic feasibility of the whole project must be very critically examined and some points to be considered, in this context, are listed below:

1. An adequate and continuous supply of brine has yet to be proved.
2. Fresh or soft water is not available except after very infrequent rain which is not to be relied upon.
3. This is a very remote, arid and inhospitable area and any industrial undertaking would require considerable expenditure on road making, water supply, and the provision of good housing and associated amenities necessary to attract and hold staff.
4. Freight and shipping costs for the finished product would be high.

7. ACKNOWLEDGEMENT

The electron-probe microanalysis and the chemical analysis in this investigation were done by P.K. Schultz and S.C. Smith.

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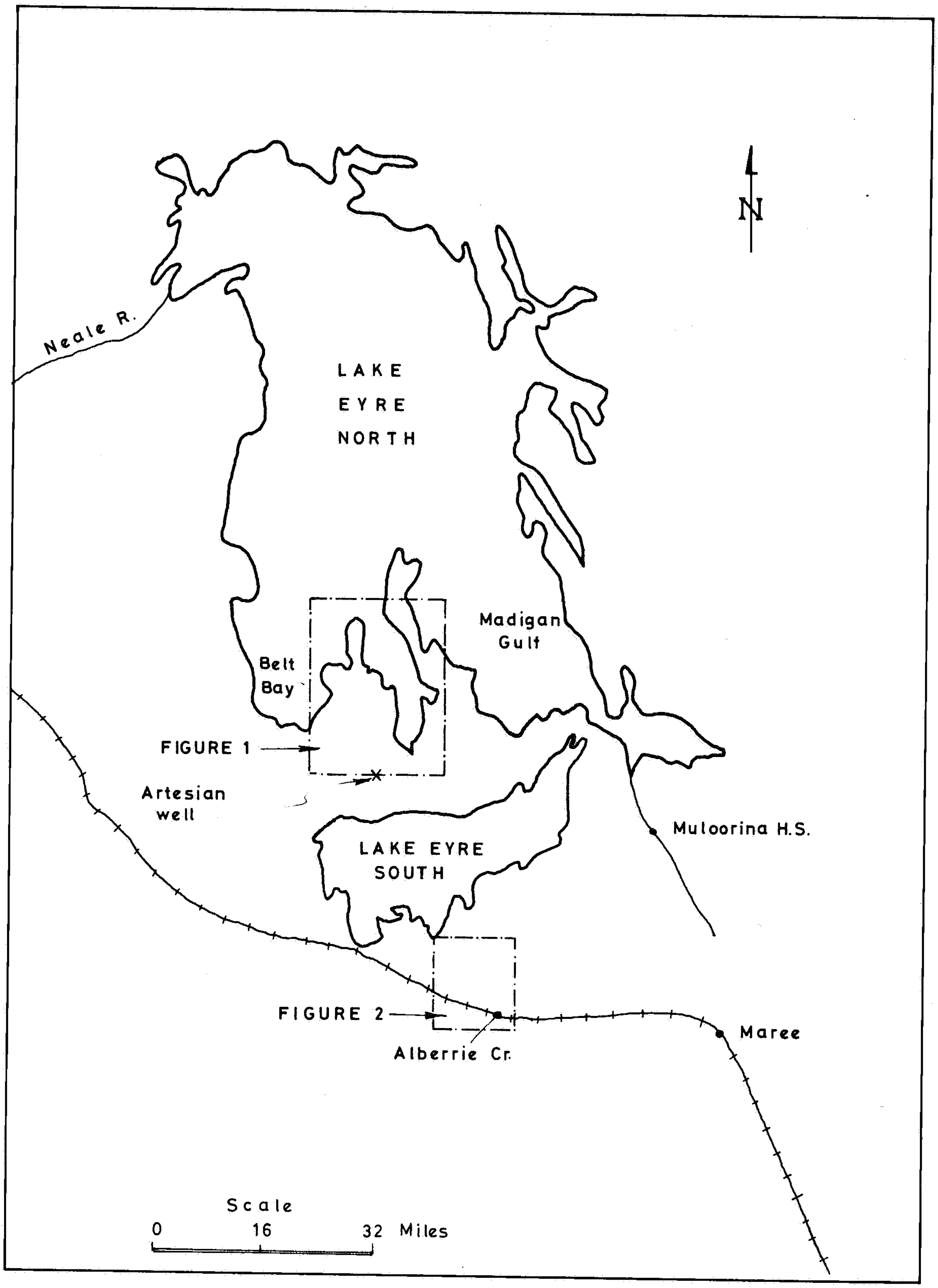
LUDBROOK, N.H. (1963). Investigation of Lake Eyre, Part II. Department of Mines, South Australia. Report of Investigation No.24.

FIGURES 1 and 2

PLATES 1 to 6

LOCALITY MAP



LOCALITY MAP LAKE EYRE REGION
SOUTH AUSTRALIA

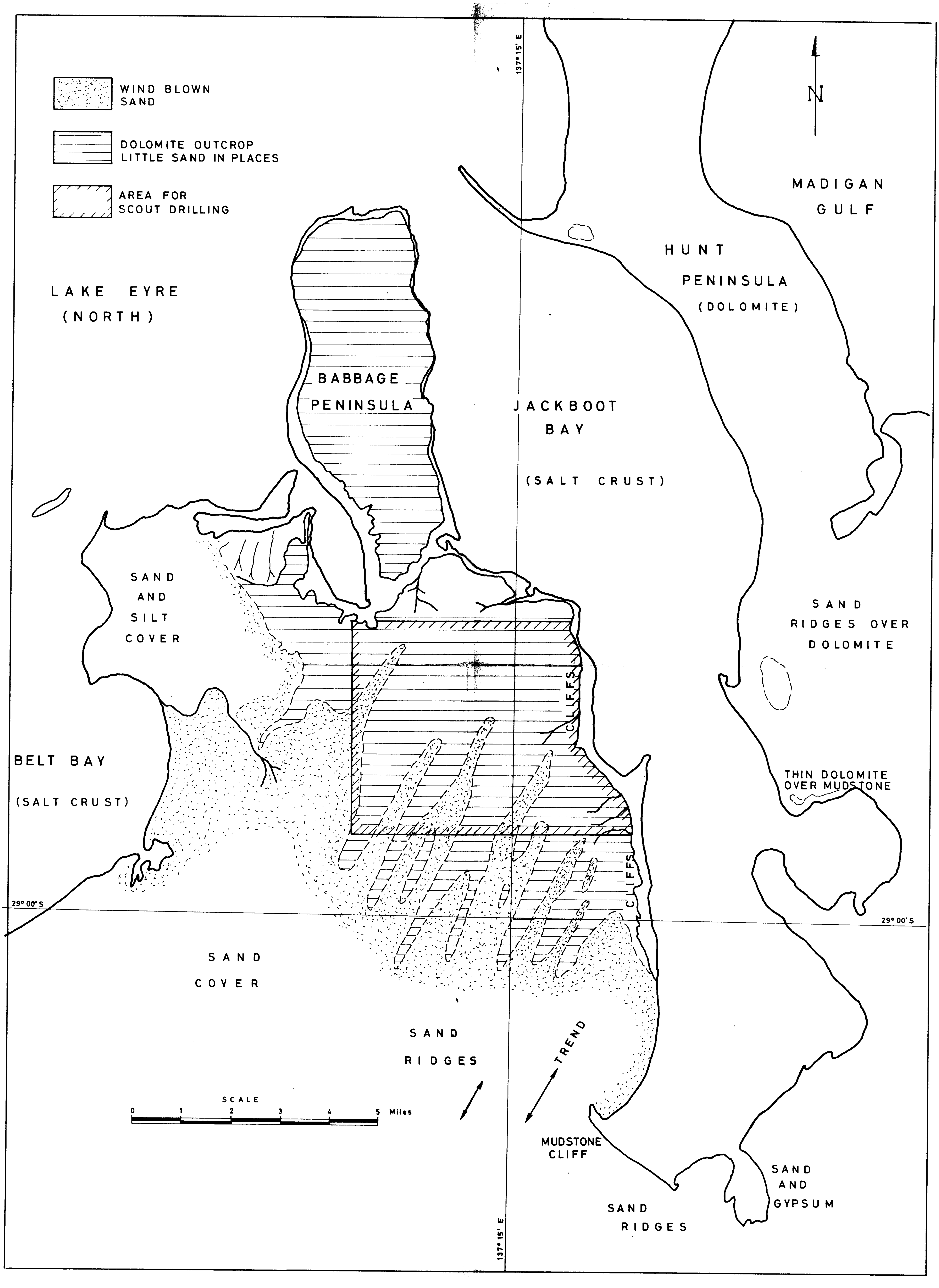


FIGURE 1: SKETCH MAP SHOWING AREAS OF DOLOMITE ON BABBAGE PENINSULA

ENV 1231-1

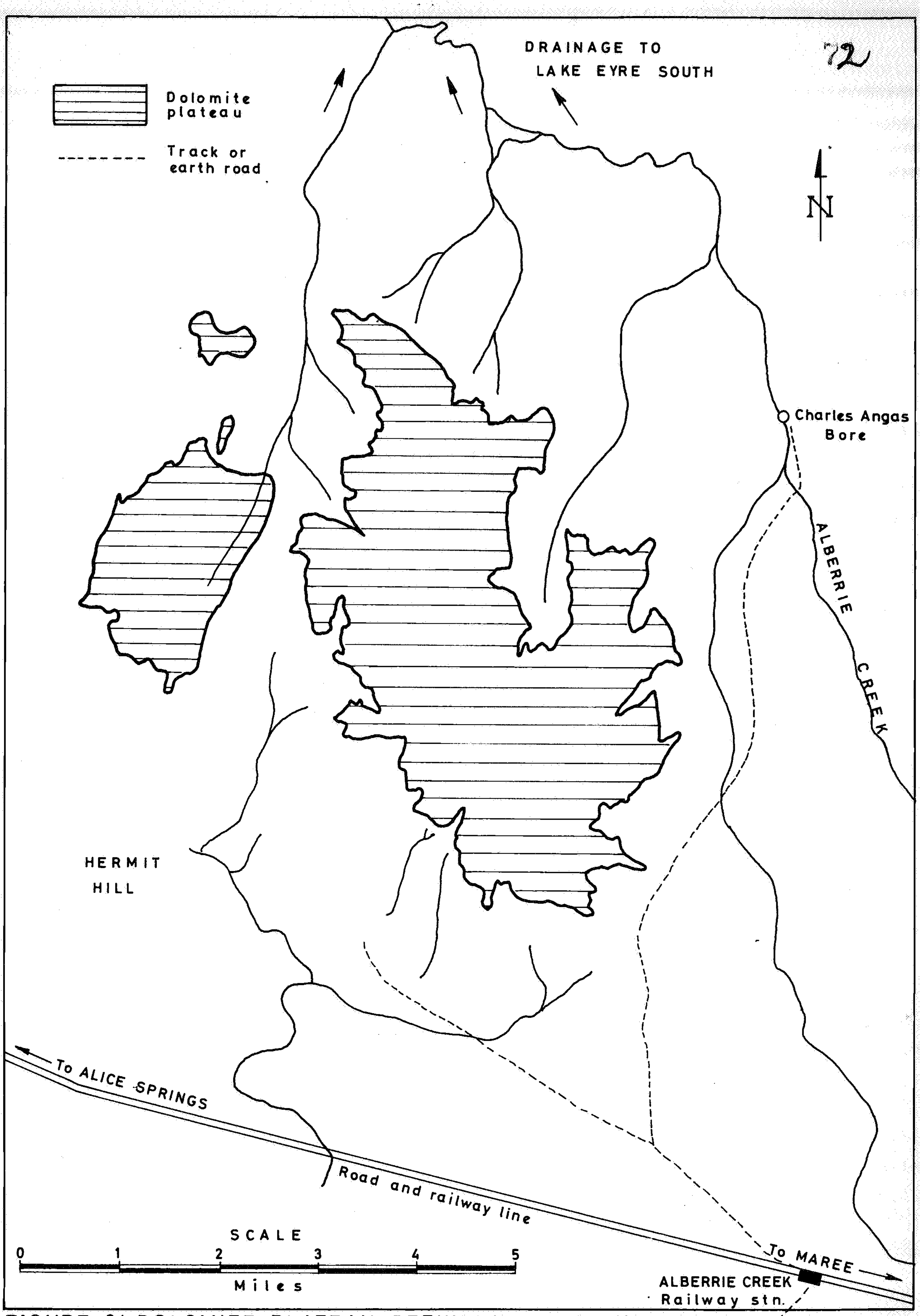


FIGURE 2: DOLOMITE PLATEAU BETWEEN LAKE EYRE SOUTH AND RAILWAY LINE

PLATE 1: Cliff cut in dolomite along the eastern side of Babbage Peninsula.

View from the south eastern corner of the area suggested for scout drilling facing north. The flat plateau is part of the area to be drilled.

PLATE 2: Dolomite layers in cliff section south of area drilled.

PLATE 1

PLATE 2

PHOTOMICROGRAPHS SHOWING IMPURITIES IN DOLOMITE

PLATE 3: Thin section of dolomite from Sample A. x350 (crossed nicols)

Very fine-grained dolomite with a quartz grain (lower left) and two dark-stained pellets (upper right) which probably contain clay and organic material.

PLATE 4: Thin section of dolomite from Sample B. x180 (crossed nicols)

A small cavity (centre) contains a little gypsum (white and grey). The surface of dolomite lining the cavity is stained with brown iron oxide (dark grey) and this staining extends along a small fracture below the cavity.

PLATE 5: Thin section of dolomite from Sample B. x180

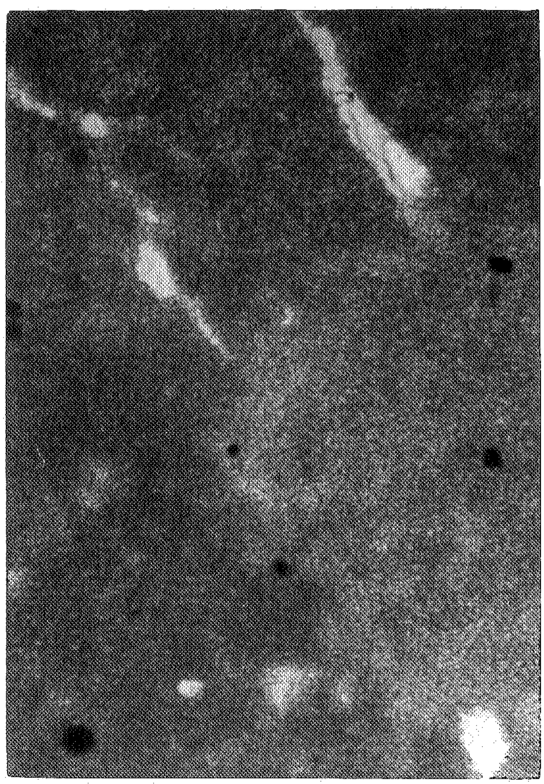
Elongate cavities in fine grained dolomite contain gypsum (white and pale grey). Dark spots are grains of iron oxide.

PLATE 6: Thin section of dolomite from Sample B. x180

This shows one of the larger, dark-stained pellets which probably contains clay.
Cracks developed around the pellet have been partly filled with gypsum.
Iron oxide (dark) stains some of the dolomite.

PLATE 3
0·1 mm

PLATE 4
0·1 mm



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de VERE & HAYMES CONSULTING ENGINEERS

56 ALFRED STREET, MILSONS POINT, 2061   929 6619   929 6620

JOHN de VERE B.E., Ph.D., M.I.E.(AUST.)
JOHN W. HAYMES B.E., M.I.E.(AUST.)
Associate: RONALD J. WALKER
B.Sc.(TECH.), M.I.E.(AUST.), A.M.Aus.I.M.M.

JDV/CDW   30th October, 1970.

The Chairman,
Umbum Creek Pty. Ltd.,
99 Elizabeth Street,
SYDNEY. 2000.

70A.

Dear Sirs,

We have much pleasure in submitting our report covering studies carried out by this firm into the feasibility of production of Refractory Grade Magnesia utilising dolomites at Lake Eyre, South Australia.

A preliminary report covering that study has been submitted to you on 19th October, 1970. Concurrently Australian Mineral Development Laboratories has carried out similar study, which is being presently up-dated by them following our comments and submission of further information. It is expected that the A.M.D.E.L. final report will be available this week.

From the studies carried out by us we have no doubt as to the viability of the project and strongly recommend that a marketing study will be carried out as soon as possible.

We further recommend that should a market be established immediate steps are taken to develop this study to working designs and bring the project to production reality.

Yours faithfully,

de VERE & HAYMES.

C O N T E N T S

C O N T E N T S (Cont.)

INTRODUCTION

This study has been prepared in order to consider the feasibility of production of 100,000 tons per annum of refractory grade Magnesia. A number of processes and variations of raw materials have been considered and finally it has been decided on a process described herein using Lake Eyre Dolomite and Spencer Gulf sea water. Although the Lake Eyre brines are extremely rich in Magnesia, and although it was hoped that these brines could be successfully used in production of Magnesia reducing the liquid throughputs and thus reducing the size of plant and capital costs, due to the large number of impurities contained in the Lake Eyre brines and varying content of Magnesia from bore to bore, it is felt that for the purpose of this study, sea water should be considered. Nevertheless, it is recommended that when a full scale feasibility of the project is undertaken, further consideration to the brines must be given.

After appraisal of a number of the Dolomite deposits situated at or near Lake Eyre, it has been decided to initially exploit the Alberrie Creek Dolomite reserves being estimated at 500,000,000 tons.

In appraisal of the whole project, a number of variants offered themselves for consideration as far as the location of various sections of the plant was concerned. After careful consideration of all locations, the following has been decided upon for the purpose of this study : -

1. The Alberrie Creek Dolomite deposit to be exploited initially;

2. Due to change of rail gauge at Maree, it has been decided to locate the Upgrading and Dolomite Calcination Departments at Maree, the ore being trucked from Alberrie Creek. However, in more detailed feasibility study we should consider the economics of :

   (a) building a spur line of constant gauge to Alberrie Creek;

   (b) location of the Upgrading and Dolomite Calcination Departments at Alberrie Creek;

   (c) Retention of the plant at Maree, but usage of mechanical conveying to Maree which possibly would increase the capital costs considerably but decrease the operating costs to a very large degree.

3. The Magnesia plant to be located at Port Pirie. The location of the Magnesia plant has been carefully considered and our earlier report dated 19th October, 1970 has shown comparative figures for Magnesia plant located at either Lake Eyre or Port Pirie and, even though capital cost savings can be effected by locating the Magnesia plant at Lake Eyre, the corresponding raise in operating costs is such that there is no overall saving. It is therefore felt that, if for no other than purely for accessibility reasons, the Magnesia plant should be located at Port Pirie.

4. After establishing the various locations and in order to determine the required personnel, the following shifts have been decided upon :-

   (a) the quarry to work 1 shift per day 6 days per week;

   (b) the trucking to be carried out on a 2 shifts per day basis 6 days per week;

   (c) the Dolomite calcination Magnesia plant to work on a 3 shifts per day 7 days per week basis.

In order to enable us to estimate possible profits, a sales price of $70 per ton in Japan has been used. A range of prices varying between $60 and $100 per ton has been indicated to us and it is therefore felt that the figure of $70 per ton may be a fair and conservative estimate and can be used for the purpose of this study. As we are looking towards export market - possibly in Japan, the amount of $1,000,000 per annum in operating costs has been included to cover freight to Japan at the rate of $10 per ton.

The discussion of the possible profits in this study is purely speculative as none of the selling prices indicated to us are firm and therefore the market potential should be fully investigated. However, in order to help those who will carry out that investigation, this report shows that a high grade refractory Magnesia can be produced at Port Pirie for $36 per ton.

PART 1. DOLOMITE WINNING, BENEFICIATION AND CALCINATION PLANT

PROCESS DESCRIPTION

PREAMBLE :

Dolomite occurrence in the Lake Eyre District is characteristically of relatively high purity, consisting generally of 94% Dolomite and approximately 6% finely divided clays.

Mineralisation to an average depth of 10'0" can be regarded as typical of the deposits which are generally devoid of overburden, except for isolated areas of drift sand.

Based on economic and climatic considerations, it is proposed to mine the Dolomite at a rate of 1000 tons per day.

1.1. WINNING OPERATION : LOCALITY REFERENCE PLATE NO. 3.

Open cut quarrying techniques, being simple, economical and effective, will be employed, using a bulldozer for operation on the Dolomite face and a front end loader for truck loading. Trucks will be used to transport the quarried Dolomite to the crushing/calcination plant, located at the railhead some 35 miles distant.

The possible economic practicability of having the Dolomite quarried and transported to the crushing plant on a contract basis, so avoiding capital expenditure on quarrying and trucking plant has been considered, as has the feasibility of installing a light gauge rail link.

However, for the purpose of this evaluation, it will be assumed that winning and transport operations will be carried out as initially described above.

1.2. CRUSHING & SCREENING : LOCALITY REFERENCE PLATE NO. 3.

The trucks will offload the Dolomite into a feed hopper which discharges to a conveyor feeding a primary crushing mill. This mill causes a size reduction in the lumps of Dolomite and discharges by means of a conveyor belt to a wet screen. The oversize from this screen then passes through a set of crushing rolls for further size reduction, the product from these crushing rolls being recycled across the screen.

Undersize from the screen feeds directly into a Rake or Screw Type Classifier which removes all -100 number material from the flow and delivers product, now sized nominally -¼" - 100, by conveyor to a drainage stockpile.

From the drainage yard the Dolomite is elevated to a kiln feed bin from which Dolomite is fed to the calciner by means of a screw feeder.

1.3. CALCINATION :

The crushed sized Dolomite will be fed at a constant rate to the calciner. The calciner will be either a rotary kiln or fluidisied bed calciner incorporating a product cooler and air preheater for wash heat utilisation. Required operating temperature is estimated to be of the order of 1100°C in the case of a rotary kiln and possibly lower in a fluid bed calciner.

The offgas from either type of calciner can then be passed through a electrostatic precipatator, or a similar device to reduce the dust loading in the stack gases, should this be deemed necessary. Fluidised bed kilns such as the Dorr-Oliver FluoSolids system have been used extensively for this type of application, and there is indication that these units are more attractive on both economical and operational grounds than the Rotary kilns.

The now calcinised Dolomite is transported by a conveyor system to bulk storage silos. These silos are so designed as to allow direct loading into rail cars for shipment south, and are of such a size as to make only daylight loading of rail cars necessary.

1.4. PERSONNEL AND MAINTENANCE FACILITIES :

All maintenance facilities, accommodation, messing and general utilities will be located at the crushing/calcination plant site, whilst mobile messing facilities shall be provided at the quarrying site, for the use of mining personnel, who shall travel to the workings from the general accommodation area daily.

PART II : MAGNESIA PLANT LOCALITY REFERENCE PLATE NO. 1.

2.1. GENERAL :

The proposed Magnesia Plant will be located at Port Pirie in South Australia, a city situated on Spencer Gulf some 150 road miles from Adelaide. This city has an established heavy industry and an adequate supply of engineering services and skilled labour. These, together with fine harbour facilities make the choice of the site entirely logical.

The two major raw materials to be used in the plant are
(1) Sea Water. At the head of Spencer Gulf, evaporation has raised overall salinity with the result that the concentration of magnesium iron is some 30% above that at a typical ocean front location.
(2) Calcined Dolomite. Delivered by rail to the plant from the calcining plant at the railhead.

2.2. PROCESS DESCRIPTION :

The following is based largely upon a successful plant operated by Kaiser Refractories Ltd., in California and described in "Chemical Engineering" August 2nd, 1965.

2.2.1 GRINDING SECTION :

Calcined Dolomite from the Calcination Plant will be delivered by rail, dumped into bulk storage, then conveyed to two secondary storage vessels. From these it is fed to a hammer mill or similar at a controlled rate in preparation for reaction with sea water.

2.2.2 BRINE TREATMENT :

At Port Pirie the concentration of magnesium ion in sea water is 8.49 grains per imp. gallon on the average. Bicarbonate hardness is removed to prevent carbonates being precipitated in the reactors. A unit such as Dorr-Oliver's "Hydrotreater", which combines the functions of reaction, flocculation and sludge removal is recommended. An accurately metered predetermined quantity of calcined Dolomite is slurried with the sea water prior to entering the hydrotreater.

2.2.3 REACTION SECTION :

The calcined Dolomite will be reacted with the treated sea water in a three stage process. The major proportion of the reaction occurs in the first stage, two thickeners in parallel. During reaction, the calcined Dolomite particles disappear and are replaced by a fine suspension of magnesium hydroxide. The larger calcined dolomite particles which are not fully reacted report to the thickener underflow, to be allowed to react further in the second stage, one more thickener. Still some unreacted dolomite and other solids will report to the underflow of this unit, from whence they pass to the third stage, a rake classifier. In this unit, the last of the calcined dolomite disappears and any solids left will be clay particles, base metal oxides and other similar impurities which are removed from the system by the rakes. The magnesium hydroxide formed in all three stages is a very fine suspension (milk of magnesia) and in the first two stages, reports to the thickener overflows. That formed in the third stage (the Classifier) remains in suspension long enough to be pumped out. This and the overflow from the second stage is recycled back into the two thickeners which are the first stage, eventually reporting to the overflow of these.

The milk of magnesia from the reactors is concentrated in two large thickeners in parallel. From the underflow of these, it is washed in a countercurrent operation. Please refer to flowsheet.

2.2.4 WASHING SECTION :

This section consists of two thickeners in series. The thickened milk of magnesia is mixed in the first thickener with the overflow from the second thickener. From the first thickener's underflow, it passes to the second thickener wherein it is mixed with fresh, softened water (note - South Australian mains water is hard and bicarbonate hardness must be removed. This can be accomplished in a small Hydrotreater as outlined under Brine Treatment,part2.2.2.

The twice washed milk of magnesia in the underflow from the second thickener is pumped to a Rotary Vacuum Drum Filter where it is dewatered from 74% to 45% moisture. If desired, a third washing stage may be incorporated by applying fresh water to the Filter. This is recommended for higher purity milk of magnesia. The magnesium hydroxide cake is discharged from the Filter by taut wire against the drum.

2.2.5. MAGNESIA KILN :

The desired product from the unit is dead burnt magnesia which requires a firing temperature of some 1700°C. The filter cake containing 55% solids is fed by screw conveyor to the kiln. This may be one of several types, but preferred designs at this stage are a Fluidised Bed or Rotary Type. For the size being considered it appears as though the Fluid Bed type is the more attractive, giving superior fuel economy, closer control, and reduced operating costs. But for the very high operating temperature required, initial costs would probably be higher than for the rotary type. A whole range of grades of magnesia is possible, type being determined by the maximum temperature it reaches. Conversion to the oxide is essentially complete at 600°C. The very high temperature product is used as a refractory.

Countercurrent flow of air and magnesia conserves heat assisting fuel economy, and also cools the product to near ambient temperature prior to discharge from the kiln. From the kiln the product is stored for export.

2.2.6. WASH WATER RECLAIMATION :

Subject to the price and availability of fresh water, some of that used in the washing step may be recycled. At present this does not seem necessary, but if recycling is to be carried out, then all that is required is to return some of the overflow from the fresh water thickener. A constant acceptable purity of recycle water is maintained by bleeding a portion off to waste, and making up losses with fresh water.

Price and availability of fresh water at Port Pirie necessitates the above process being augmented by a filtration/clarification station to reduce turpidity of the recovered process water, followed by an "Osmotic Membrane" Plant to reduce the level of soluble salts. Should the need arise, the Reverse osmosis system could be made to sufficient capacity to function as a direct Desalination Plant for freshwater recovery from seawater.

PART III. PROCESS CALCULATIONS

3.1 The formula of Dolomite is generally taken as $CaCO_3 \cdot MgCO_3$, of which the Molecular mass of $MgCO_3$ is 45.65%.

Tests of Lake Eyre Dolomite confirm that Dolomite composition at thi location is close to the above level, therefore, all calculations are based on this figure.

Dolomite under calcination gives the following reaction : -

$$\underset{\text{Dolomite}}{CaCO_3 \cdot MgCO_3} + \text{Heat} \rightarrow \underset{\text{Dolomite Lime}}{CaO \cdot MgO} + CO_2$$

3.2 DOLOMITE FEED RATE :

410 tons/day is required feed rate to magnesia plant. Therefore, Dolomite feed to Kiln :

$$410 \times 1.91 \times \frac{1}{0.925} \text{ (allowing 7½% stack loss)}$$

= 850 tons/day of Dolomite.

Assume production rate from quarrying and crushing at 1000 tons/day. This rate allows adequate plant downtime for maintenance.

3.3 FUEL CONSUMPTION - DOLOMITE KILN :

From published information, fuel consumption of rotary kilns on Dolomite at maximum efficiency is 6.25 million B.T.U./ton of Dolomite.

Therefore, fuel oil consumption in tons/day : -

$$\frac{6.25 \times 106 \times 410}{1.895 \times 104 \times 2240}$$

= 60.4 tons/day

Therefore - Tons of fuel oil/annum

$$= 60.64 \times \frac{100,000}{300}$$

= 20,100 tons/annum.

3.4 WASH WATER CONSUMPTION :

Based on requirements of physically similar material, it will be assumed that wash water requirements will be 1 gallon of wash per pound of $Mg(OH)_2$.

Therefore Fresh Water Requirements

= 470 x 1 x 2240

= 1,050,000 Imperial Gallons/day.

3.5 MAGNESIA KILN FUEL CONSUMPTION :

Calcination fuel requirements are believed to be 13.56 million B.T.U./ton of finished product then at a calorific value of 18,950 B.T.U./Lb.

Requirements are for : -

$$\frac{13.56 \times 106 \times 300}{1.895 \times 104 \times 2240} \text{ tons/day}$$

= 96.0 tons/day of Fuel Oil.

Therefore Annual Consumption of Fuel Oil

$$= 96.0 \times \frac{100,000}{300}$$

= 32,000 tons/annum.

3.6 FEED AND PRODUCT CALCULATIONS :

Magnesia Production (MgO) = 300 tons/day.
Then $Mg(OH)_2$ feed to Magnesia Kiln

$$= 300 \times 1.447 \times \frac{1}{0.925}$$

= 470 tons/day (with 7½% stack losses)

As equal amounts of magnesium come from sea water and from Dolomite $Mg(OH)_2$ from each is 238 tons/day.

Then Dolomite Lime feed to Reactors: -

$$235 \times 1.65 = 390 \text{ tons/day} \qquad \frac{CaO \cdot MgO}{Mg(OH)_2} = 1.65$$

Assuming that 5% of Dolomite Lime feed to plant is used for softening sea water, then total Dolomite Lime to Plant : -

$$390 \times \frac{1}{0.950} = 910 \text{ tons/day}$$

Feed to Dolomite Kiln

$$= 410 \times 1.91 \times \frac{1}{0.925} = 850 \text{ tons/day} \qquad \frac{CaCO_3 \cdot MgCO_3}{CaO \cdot MgO} = 1.91$$

(7½% stack losses)

3.8 SEA WATER FEED :

$Mg(OH)_2$ from sea water = 235 tons/day $\qquad \frac{Mg(OH)_2}{Mg} = 2.40$

Then: Mg from sea water $= 235 \times \frac{1}{2.40}$

= 98 tons/day of Mg.

Mean Magnesium concentration in Sea Water = 8.49 gm/gal.

Then $\frac{8.49 \times 1000}{2240 \times 454}$ = 0.00835 tons/gal.of Mg.

Sea water requirements = $\frac{98 \times 1000}{0.00835}$

= 11,710,000 gal/day

Assuming 5% of Mg is lost in water treatment

Then 11,170,000 x $\frac{1}{0.950}$ = 12,350,000 gals/day actually required.

PART IV. BASIS FOR COST ESTIMATES.

The following methods and reasons have been applied in obtaining capital and operating costs.

4.1 INSTALLED PLANT COST :

Theoretical determinations of the process and preparation of flow sheet throughputs were determined thus allowing the various units of equipment to be sized. Subsequently, budget prices from manufacturers and suppliers were obtained. No correction was made on prices including installation on site. However, in cases of prices for equipment only, an installation factor of 3 was used throughout.

4.2 LOCATION FACTORS :

In cases of prices for basic equipment only, when calculating the installed cost, the following location factors were used : -

Capital City	1.00
Port Pirie	1.02
Lake Eyre	1.12

4.3 HOUSING :

As Port Pirie is a well developed city having all facilities available, no allowance is made in this study for accommodation of personnel employed in the magnesia plant. However, accommodatio must be provided for staff employed in quarrying, dressing and dolomite calcining areas. Accommodation for this personnel will be provided at Maree where limited facilities are available. It is estimated that the cost of housing at Maree will be $15,000 per person.

4.4 DEPRECIATION :

Due to less rapid changes in the technology of this process the amortisation will be lower than for the average chemical plant. The depreciation will be therefore taken at 7%.

4.5 MAINTENANCE :

The labour content of maintenance has been allowed for in personnel estimates. Due to the large size and lack of complexity of much of the equipment a further 2% only of the installed plant cost has been used to cover all other maintenance costs.

4.6 INSURANCE :

The insurance on fixed capital has been taken at 1% after enquiries and quotes from Insurance Brokers.

4.7 DOLOMITE CONSUMPTION :

The following ratios have been taken in determination of throughputs

Tons of mined rock per ton of Dolomite feed to kiln	1.20
Tons of Dolomite feed to kiln per ton of Magnesia product	2.70
Tons of calcined Dolomite per ton of Magnesia product	1.25

4.8 FUEL OIL CONSUMPTION :

Dolomite kiln	0.20tons/ton of Magnesia
Magnesia kiln	0.32tons/ton of Magnesia

Therefore, annual consumption at Lake Eyre has been calculated to be 20,100 tons and at Port Pirie, 32,000 tons.

Bases for this consumption are included in process calculations. The cost of fuel oil has been taken at $15 per ton, a figure quoted by Shell Oil Co. f.o.b. Port Pirie, freight to site being added as an extra.

4.9 FREIGHT :

The following freight rates were obtained from the Chief Traffic Manager, Commonwealth Railways, Port Augusta : -

Maree to Port Pirie	$4.52 per ton
Port Pirie to Maree (fuel backload)	$4.52 per ton

4.10 LABOUR :

It is estimated that the following labour shall be required : -

4.10.1 Mine, Upgrading Plant and Dolomite Calcination:

Manager	1
Works Chemist	1
Works Engineer	1
Maintenance	5
Quarry	4
Ore dressing	3
Process Supervisors	4
Process Operators	8
Loading	2
Drivers	14
Clerks	2
	45

Hours per ton of product 0.93

90

4.10.2 Magnesia Plant :

General Manager	1
Works Chemist	1
Works Engineer	1
Laboratory	2
Accountant	1
Office	4
Storemen	2
Maintenance	6
Drivers	2
Loading	2
Process Supervisors	4
Process Operators	16
	42

Hours per ton of Magnesia product 0.87

4.10.3 The labour rates have been calculated as follows: -

Mine Site	\$3.20 per hour
Port Pirie	\$2.10 per hour

4.11 WORKING CAPITAL :

The working capital will be taken as the value of four month's operating costs.

4.12 SELLING PRICE :

On the information available, the selling price shall be assumed to be \$70.00 per ton.

4.13 LOCATION OF PLANT :

Because of uncertainty as to the suitability of Lake Eyre brines and Lake Eyre salt cake and for the purpose of this feasibility the Magnesia plant shall be located at Port Pirie on Spencer Gulf. For this reason, the following plant locations will be considered :

Mine	Alberrie Creek
Upgrading Plant and Dolomite Calcination	Maree
Magnesia Plant	Port Pirie

PART V. CAPITAL COST

5.1 MINE, UPGRADING AND DOLOMITE CALCINATION :

5.1.1 Mine :

1.	Bulldozer	$ 60,000	
2.	Front End Loader 2 of - 5 cu.yd. Caterpillar model	$ 120,000	
3.	Trucks - 7 off - 30 tons capacity (unit equipment cost - $40,000)	$ 280,000	
4.	Site building	$ 10,000	
5.	Auxiliary mining equipment, compressors, drills etc.	$ 50,000	$ 520,00

5.1.2 Upgrading Plant:

Budget price obtained from Dorr-Oliver includes loading ramps, bins, feeders, conveyors, screens, classifier, water circulating system, impact and roll crushers	$ 350,000	$ 350,00

5.1.3 Dolomite Calcination :

1.	Kiln, cooler and precipitation.	$1,850,000	
2.	Storage bins and loading conveyor	$ 150.000	$2,000,00

5.1.4 Miscellaneous:

1.	Housing	$ 675,000	
2.	Workshop and office	$ 100,000	
3.	Road improvements	$ 50,000	
4.	Electrical	$ 100,000	
5.	Fuel oil installation	$ 70,000	$ 995,00

5.2. MAGNESIA PLANT :

5.2.1 Sea Water Treatment :

1.	Piping Station	$ 60,000	
2.	Treatment Plant	$ 750,000	$ 810,00

5.2.2. Fresh Water Treatment :

1.	Treatment plant including Reverse Osmosis System	$ 500,000	$ 500,00

5.2.3 Grinding :

1.	1 Hammermill	$ 50,000	
2.	Grinding Mills	$ 50,000	
3.	Feed bins, conveyors and feeders	$ 150,000	$ 200,00

5.2.4 Reaction Section :

1.	Reactors	$ 90,000	
2.	Rake Classifier	$ 60,000	
3.	Conveyors and feeders	$ 80,000	$ 230,00

5.2.5 Washing Section :

1.	Thickener	$ 260,000	
2.	2. Wash thickeners	$ 350,000	
3.	Vacuum filters	$ 320,000	$ 930,00

5.2.6 Magnesia Kiln :

1.	Kiln, cooler, electrostatic precipitators, feeders and ancillary equipment	$2,000,000	
2.	Fuel oil storage	$ 100,000	$2,100,00

5.2.7 Magnesia Storage :

1.	Bins, conveyors and feeders	$ 175,000	
2.	Weighbridge, containers and ancillaries	$ 200,000	$ 375,00
			$9,060,00
	Contingency 10%		$ 940,00
			$10,000,00

Fixed Capital :	$10,000,000	
Working Capital :	1,516,000	
Total Capital:		$11,516,00(

PART VI OPERATING COSTS

6.1	**Direct Operating Costs :**		
	Labour & Supervision	480,000	
	Fuel Oil 52,000 tons	780,000	
	Water	50,000	
	Electricity	100,000	
	Maintenance 2% Spares	200,000	1,610,000
6.2	**Indirect Operating Costs :**		
	Payroll Overheads	72,000	
	Freight Calcined Dolomite Maree-Port Pirie	565,000	
	Freight Magnesia to Japan	1,000,000	
	Fuel Port Pirie to Maree	88,000	1,725,000
6.3	**Fixed Operating Costs :**		
	Depreciation 7%	700,000	
	Insurances 1%	100,000	800,000
			4,135,000
	Contingency 10%		413,000
	Total Operating Costs :		4,548,000
6.4	**Sales :**		
	100,000 tons @ $70/ton		7,000,000
	Estimated Annual Profit :		2,452,000

3/494/2

June 1970

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de Vere & Haymes — Consulting Engineers

Amdel Report

No.709

LAKE EYRE DOLOMITE

by

Sylvia Whitehead

Investigated by: Mineralogy & Petrology Section

Officer in Charge: Dr K.J. Henly

N. Draper. Director

THE AUSTRALIAN MINERAL DEVELOPMENT LABORATORIES

Adelaide South Australia

CONTENTS

SUMMARY

Background

In March 1970 Dr J. de Vere of de Vere and Haymes – Consulting Engineers, discussed the possibility of Amdel investigating deposits of dolomite known to occur in the Lake Eyre region of South Australia. An investigation was accordingly undertaken, the ultimate aim of which was to determine the feasibility of treating this dolomite with brine from Lake Eyre, to produce magnesium oxide of a suitable grade for refractory purposes.

Objective

The aim of this first stage of the investigation was to:

a. determine the amount and grade of the dolomite available in the Lake Eyre region, and
b. select an area for drilling.

Summary of Work Done

The area under investigation was visited at the end of April. Samples of dolomite were collected from cliff faces on the eastern side of the Babbage Peninsula and a bulk sample was also collected from the eastern side of Hunt Peninsula near the boundary of the National Park.

An area on the eastern side of the Babbage Peninsula, shown in Figure 1, was selected for scout drilling and a sketch map showing this, together with a brief report, was left at Maloorina Station for Mr A.J. Molloy, driller for de Vere and Haymes.

Samples of subsurface brine were collected from Jackboot Bay and a sample of surface brine from Lake Eyre South. A sample of salt crust was collected from Belt Bay.

Detailed work undertaken at Amdel included chemical analysis of some of the samples of dolomite collected and petrographic examination of thin sections of the dolomite. Maps were prepared using field data and aerial photographs.

Samples of dolomite, brine and salt are being held by Amdel for testing possible methods of beneficiation.

Conclusions

The investigation has shown that:

1. An estimated 250 million tons of dolomite with little or no overburden is avilable on the Babbage Peninsula at the southern

end of the Lake Eyre North (Fig.1) and additional dolomite is present in this area beneath a cover of wind-blown sand.

2. The dolomite is essentially flat lying and analysis of samples from a cliff section on the eastern side of the peninsula suggests a thickness of 10 feet of dolomite averaging almost 19% MgO. Analyses of drill-hole samples will be necessary to confirm these reserves and grade.

3. The dolomite is slightly porous with a grain size of 2-3 microns, and the most abundant impurity is clay. Most of the clay occurs disseminated throughout the dolomite in low concentration and as extremely small particles, but a little may occur in rounded pellets 0.1 to 0.2 mm in size which contain dolomite and dark organic material. Iron oxide impurity is also disseminated in low concentration and stains the surface of a few small cavities and joints or fractures. It is more abundant in layers containing a higher percentage of clay.

4. Gypsum fills a few small solution channels or cavities and in places penetrates joints and bedding planes.

5. Other impurities including quartz, mica flakes and other mineral grains are present in trace amounts only.

6. Similar dolomite forms a plateau approximately 10 square miles in area between Lake Eyre South and the Maree-Alice Springs railway line (Fig.2). This area has the advantage of being close to transport and is more accessible but the grade of dolomite will not be known until drill-hole samples have been analysed.

7. Overall, an adequate supply of dolomite is present in the areas indicated and overburden is absent or is limited to a thin covering of wind blown sand. It has yet to be determined whether this dolomite can be used to produce magnesium oxide of a sufficiently high grade.

Recommendations

The economic feasibility of the whole project must be very critically examined and some points to be considered, in this context, are listed below:

1. An adequate and continuous supply of brine has yet to be proved.
2. Fresh or soft water is not available except after very infrequent rain which is not to be relied upon.
3. This is a very remote, arid and inhospitable area and any industrial undertaking would require considerable expenditure on road making, water supply, and the provision of good housing and associated amenities necessary to attract and hold staff.
4. Freight and shipping costs for the finished product would be high.

1. INTRODUCTION

In March 1970 Dr J. de Vere of de Vere and Haymes — Consulting Engineers, discussed the possibility of Amdel investigating deposits of dolomite known to occur in the Lake Eyre region of South Australia. An investigation was accordingly undertaken, the ultimate aim of which was to determine the feasibility of treating this dolomite with brine from Lake Eyre, to produce magnesium oxide of a suitable grade for refractory purposes.

This report concerns the first stage of the project, which is the estimation of the amount and grade of dolomite available and selection of an area for drilling.

The present investigation has been largely restricted to the Babbage Peninsula on the southern part of Lake Eyre North, for the following reasons:

1. Larger areas of outcropping dolomite were known to be present at the southern end of Lake Eyre.
2. Drainage in Lake Eyre is from north to south suggesting a better supply of brine at the southern end of the Lake.
3. Access is relatively easy; a track goes from Muloorina Homestead to the Artesian bore (see locality Map), and a fence can then be followed north to the southern end of Jackboot Bay.
4. The Hunt Peninsula, also containing outcropping dolomite, has been proclaimed a National Park and removal of material is prohibited.

1.1 Location

Lake Eyre is in a very low lying area about 400 miles north of Adelaide, and has an average rainfall of 5 to 6 inches per year. The lake floor covers an area of 3,600 square miles, is normally dry and has a salt crust up to 17 inches thick in places. Drainage is from north to south (Johns, 1963), and most of the salt crust is deposited towards the southern end of the lake, particularly in Madigan Gulf and Belt Bay (see locality Map). The lake has been filled during years of exceptionally high rainfall and "the evaporation rate was then found to be of the order of 80-90 inches per annum" (Bonython, 1958).

Much of the surrounding area is sand covered and desolate, and its use for sheep and cattle production has been made possible only by the use of artesian water. This water is mineralised.

1.2 Previous Work

The dolomite under investigation is part of the Etadunna Formation, believed by Ludbrook (1963) to be of Miocene age. It occurs as a series of beds associated with dolomitic clays and silts and some pyritic clays. Some beds contain fossil fish bones and the sediments were probably deposited under lagoonal conditions. Dolomites of the Etadunna Formation outcrop mainly along the southern shore of Lake Eyre North, particularly on the Hunt Peninsula and the Babbage Peninsula, and they are intersected in bore holes put down in the lake floor in Madigan Gulf (Johns, 1963).

An area along the Neales River near the north-western corner of Lake Eyre (locality Map) was investigated by P.A. Raymens and A.J. Molloy during the summer of 1969-1970 and samples of dolomite which they collected from cliff sections in that area were submitted to Amdel for analysis, and for testing possible methods of beneficiation, in an earlier investigation. These samples proved to be of very variable grade, with most of the better material containing from 9% to 17% MgO, and were chip samples from 2-ft, 4-ft and 6-ft sections of cliff face. Only one sample gave 22% MgO.

This dolomite outcropping in cliff sections along the Neales River is covered by 3 to 6 ft of overburden, mainly sandstone and clay.

Access to the Neales River area is from William Creek and is reported to be extremely difficult by land.

2. BABBAGE PENINSULA DOLOMITE

2.1 Field Occurrence

Dolomite occurs over much of the surface of the Babbage Peninsula and forms a fairly level plateau elevated above the general level of the lake floor. The surface of the southern part of the peninsula is covered by wind-blown sand and parallel sand ridges trending north north-east extend out over parts of the dolomite in the central part of the peninsula (Fig.1). North and east of the sand cover, much of the surface is covered by an accumulation of hard lumps of white dolomite several inches across, mixed with varying amounts of sand.

Dolomite is exposed in cliff sections along the eastern side of the peninsula (Plates 1 & 2), these cliffs are up to 30 ft high and in places are up to half a mile distant from the present edge of the lake. They were formed during some earlier period of erosion and a typical section is described below. This refers to samples collected during the present investigation:

Depth, ft	Sample	Description
0- 3	-	Contaminated surface dolomite with varying amounts of sand and gypsum penetrating along joints and bedding planes.
3- 5	A	Moderately hard, white dolomite
5- 7	B	Slightly softer dolomite
7- 8	C	Softer impure dolomite — slightly darker colour
8- 9	D	Moderately soft dolomite
9-12	E	Hard, white dolomite
12-13	F	Softer dolomite, silty in places
13-25 or 30	-	Scree covered slope

The low-lying area between the base of the cliffs and the edge of the lake is partly covered by sand and silt. A few small hills of clay have a thin dolomite capping indicating that clay or mudstone underlies the dolomite in this area. The total thickness of hard dolomite overlying the clay cannot be determined because of the scree cover. However, a minimum thickness of 10 ft is exposed along sections examined.

The dolomite appears essentially flat lying (Plate 2) but minor undulations or a very low angle of dip cannot be determined from the exposures.

The narrow, northern extension of Babbage Peninsula is also bounded by cliffs of dolomite.

An area 4 miles square on the eastern side of the Babbage Peninsula (Fig.1) was selected for scout drilling. The dolomite cliffs are higher in this part of the area (Plate 1) and the dolomite exposed in the cliffs appeared, on visual examination in the field, to be of better grade.

2.2 Composition

Chip samples were collected from different layers in one of the cliff sections. The contaminated 2-3 ft of surface material was disregarded and the other samples, A-F described above, were analysed with the following results:

Sample Designation	Depth ft	Element MgO	Al_2O_3	SiO_2	Fe	SO_4
A	3- 5	19.5	2.42	2.16	0.20	0.76
B	5- 7	19.5	1.89	1.73	0.19	1.55
C	7- 8	14.4	7.94	7.60	0.50	4.30
D	8- 9	17.9	2.0	1.46	0.18	1.85
E	9-12	20.3	1.78	1.41	0.23	0.62
F	12-13	17.2	3.97	3.92	0.43	2.69
Average over 10 ft	-	18.93	2.78	2.6	0.26	1.53
Average over 9 ft (disregarding impure layer C)	-	19.43	1.82	1.37	0.23	1.2

If the lower impure Sample F were discarded the impurities would be further reduced.

These analyses are from one locality only and it is also possible that material collected from an exposed cliff surface may not be truly representative of dolomite occurring at depth inland from the cliffs. The results given above should therefore be regarded only as an indication of the grade of dolomite to be expected. Complete evaluation of the dolomite cannot be made until the results of drilling are known.

A grab sample taken from the bulk sample collected from over 10 ft (vertical) of cliff face at the southern end of the area suggested for drilling (Plate 1) gave the following results:

MgO	CaO	Al_2O_3	SiO_2	Fe	SO_4
19.10	30.10	0.41	2.35	0.24	0.46

2.3 Petrography

Thin sections were cut from specimens from each of the six layers (Samples A to F) described and analysed. They were examined under the microscope and portions of two sections were analysed by the electron probe to determine the distribution of impurities.

The samples are all composed predominantly of extremely fine grained dolomite with an average grain size of 2-3 microns (Plates 3 - 6) and a maximum grain size of 5 microns.

There are no sharply defined bedding planes but in places, a few small elongate cavities or solution channels are approximately parallel to the layering. Other irregular small cavities show no definite orientation. Most of the cavities in the dolomite are from 20 to 300 microns wide and up to several millimetres long, many contain gypsum (Plates 4, 5, & 6).

Clay. Chemical analysis indicates that this is the most abundant and widespread impurity.

In thin sections, most of the clay particles are obscured by the general cloudiness of the dolomite, but electron probe microanalysis shows aluminium and silicon dispersed in low concentrations through parts of the dolomite. Residues remaining after digestion of some of the samples in hydrochloric acid consist mainly of small particles of clay 20 to 100 microns in size.

Some thin sections show dark, well-rounded pellets 0.1 to 0.2 mm in size (Plates 3 & 6) in the dolomite. Some of these are probably small pellets of dolomite clay slightly stained by iron oxide; electron-probe microanalyses of others suggest they contain organic material.

Quartz. A few rounded to subrounded quartz grains 20 to 50 microns in size are scattered through parts of the dolomite (Plate 3) but these compose less than a fraction of a percent in the areas covered by the thin sections. Layers of silt were not detected but these sections cover only a very small proportion of the whole sample.

Gypsum. Small gypsum crystals line many of the small cavities in parts of the dolomite (Plates 4, 5, & 6), and a few cavities have been completely filled by gypsum. The distribution is irregular and in these samples more gypsum is present in the impure layer containing abundant clay. As noted above, these samples were collected from a cliff face which has been exposed for some considerable time and the presence of gypsum may be a surface phenomenon.

Iron Oxide. Small, opaque grains of iron oxide (Plate 5) are sparsely scattered through parts of the dolomite but these are not common in any of the samples examined. Brown iron oxide stains the surface of dolomite lining some small cavities (Plate 4) and also the surfaces of irregular joints. Eloctron-probe microanalysis shows iron to be dispersed in very low concentration through much of the dolomite. It may be present simply as staining, as very few of the concentrations are sufficiently large to indicate definite mineral grains visible under the microscope.

Other Mineral Grains. A few very small flakes of mica and extremely rare heavy mineral grains (zircon elidote etc.) were noted but these are present in trace amounts only.

Halite (Salt). The samples all have a strong taste of salt (NaCl) which probably occurs as films along grain boundaries. It was not detected microscopically even in crushed fragments mounted in oil but some was detected by X-ray diffraction examination.

The impure Sample C shows particles of mottled, dark staining of undetermined composition. Some of these are associated with algal structures in the dolomite and may be of organic origin.

2.3.1 Conclusions

The results of chemical analyses, microscopic examination and electron probe microanalyses described above all show that clay is the most abundant impurity in this dolomite and most of it is dispersed in low concentration as very small particles less than 0.1 mm in size. Iron oxide is also dispersed as extremely small particles and occurs as staining in parts of the dolomite.

Physical separation of these impurities would appear to be extremely difficult, if not impossible, but it may be possible to upgrade the dolomite to a sufficiently high level of purity by discarding the layers containing higher concentrations of clay and iron oxide.

2.4 Reserves

Until additional samples from drill holes have been analysed, estimation of reserves must be based on the analyses of the cliff samples described above. These suggest a layer of dolomite at least 10 ft thick averaging approximately 19% MgO.

Assuming a bulk density of 30 cu ft to the ton, and a layer 10 ft thick one million tons will be obtained from every 3 million square feet of area, or approximately 9.3 million tons from every square mile. The area recommended for scout drilling contains 16 square miles of outcropping dolomite with thin sand cover in places and there is an additional 10 to 12 square miles of outcropping dolomite on the northern extension of the peninsula. This gives, at a conservative estimate, 250 million tons of dolomite with very little sand cover. Additional areas of dolomite on the peninsula are buried beneath several feet of wind blown sand.

3. DOLOMITE SOUTH OF LAKE EYRE

Horizontally bedded dolomite forms the surface of a plateau approximately 10 square miles in area, situated between Lake Eyre South and the Maree-Alice Springs railway line (locality Map and Fig.2). Cliffs cut in dolomite mark the edge of this plateau.

The southern tip of this dolomite plateau is 4 miles north west of Alberrie Creek railway station and an earth road from Alberrie Creek to Charles Angas bore passes close to the eastern boundary. This area is therefore more accessible than the Babbage Peninsula but it has the possible disadvantage in that it is not on the shores of Lake Eyre — the northern tip of the plateau is 5 miles south of the southern shore of Lake Eyre South. However, embayments and wide creek beds or alluvial flats in the area between this plateau and Lake Eyre South appear to have very little gradient and sub-surface brine may be available.

The quality of the dolomite forming this plateau will not be known until drill-hole samples have been analysed.

4. BRINE

Lake Eyre is dry except after very infrequent, heavy rains and much of the surface of Belt Bay, Jackboot Bay and Madigan Gulf is covered by salt crust. In most places, this crust does not extend to the edge of the lake but is separated from it by up to 1 mile of mud flats.

The thickness of the salt crust varies. (Madigan (1930)* reported a maximum of 17 inches and Johns (1963) reported a maximum of 9 inches. During this investigation salt was collected from Belt Bay where the crust is 2-inches thick, at a distance of one half mile from the southern edge of the lake. The salt has a porous, honey-like texture.

Johns (1963) shows an area of approximately 100 square miles of salt crust in Belt Bay, and, assuming an average thickness of 4 inches and a bulk density of 35 cu ft per ton, this will contain approximately 25 million tons of salt of which less than 0.5% is magnesium (Bonython, 1956 reports 0.05 to 0.34% $MgSO_4$ in salt from the surface).

Jackboot Bay probably contains less salt than Belt Bay and Madigan Gulf contains more, but this salt is not available as brine except during rare intervals when the lake contains water.

* In Johns (1963).

The amount and availability of subsurface brine has not been determined. Holes dug in the floor of the lake in Belt Bay and Jackboot Bay filled with brine to within 2-3 feet of the surface, but this was after heavy rain at a time when surface water was present in the lake. It would be necessary to ensure that an adequate supply of brine is available, and will continue to be available before consideration is given to other aspects of this project.

5. CONCLUSIONS

The investigation has shown that:

1. An estimated 250 million tons of dolomite with little or no overburden is available on the Babbage Peninsula at the southern end of Lake Eyre North (Fig.1) and additional dolomite is present in this area beneath a cover of wind blown sand.

2. The dolomite is essentially flat lying and analysis of samples from a cliff section on the eastern side of the peninsula suggest a thickness of 10 feet of dolomite averaging almost 19% MgO. Analyses of drill-hole samples will be necessary to confirm these reserves and grade.

3. The dolomite is slightly porous with a grain size of 2-3 microns, and the most abundant impurity is clay. Most of the clay occurs disseminated throughout the dolomite in low concentration and as extremely small particles, but a little may occur in rounded pellets 0.1 to 0.2 mm in size which contain dolomite and dark organic material. Iron oxide impurity is also disseminated in low concentration and stains the surface of a few small cavities and joints or fractures. It is more abundant in layers containing a higher percentage of clay.

4. Gypsum fills a few small solution channels or cavities and in places penetrates joints and bedding planes.

5. Other impurities including quartz, mica flakes and other mineral grains are present in trace amounts only.

6. Similar dolomite forms a plateau approximately 10 square miles in area between Lake Eyre South and the Maree-Alice Springs railway line (Fig.2). This area has the advantage of being

close to transport and is more accessible but the grade of dolomite will not be known until drill-hole samples have been analysed.

7. Overall, an adequate supply of dolomite is present in the areas indicated and overburden is absent or is limited to a thin covering of wind blown sand. It has yet to be determined whether this dolomite can be used to produce magnesium oxide of a sufficiently high grade.

6. RECOMMENDATIONS

The economic feasibility of the whole project must be very critically examined and some points to be considered, in this context, are listed below:

1. An adequate and continuous supply of brine has yet to be proved.
2. Fresh or soft water is not available except after very infrequent rain which is not to be relied upon.
3. This is a very remote, arid and inhospitable area and any industrial undertaking would require considerable expenditure on road making, water supply, and the provision of good housing and associated amenities necessary to attract and hold staff.
4. Freight and shipping costs for the finished product would be high.

7. ACKNOWLEDGEMENT

The electron-probe microanalysis and the chemical analysis in this investigation were done by P.K. Schultz and S.C. Smith.

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BORE LOGS

OF

BABBAGE PENINSULA

DOLOMITE DEPOSITS

LAKE EYRE

DRILL HOLE NO. 1

Sample marked DH.1 11th May,1970.

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
0				
1'	RED	DRY	SOFT	DIRT
3'	RED	DRY	SOFT	GYPSUM & DIRT
9'	GREY	DRY	SOFT	DOLOMITE
10'	DARK GREY	DRY	MEDIUM SOFT	DOLOMITE
15'	GREY SLIGHT	DRY	SOFT	DOLOMITE
21'	GREY	DAMP	SOFT	DOLOMITE ?
27'	GREY	SLIGHT DAMP	MEDIUM SOFT	DOLOMITE ?
33'	LIGHT GREY	DRY	MEDIUM HARD	DOLOMITE ?
36'	RED BROWN	DRY	MEDIUM HARD	DOLOMITE ?
39'	LIGHT GREEN	DRY	MEDIUM HARD	DOLOMITE ?
45'	DARK GREEN	DAMP	MEDIUM SOFT	DOLOMITE ?
47'	GREEN KHAKI	VERY SLIGHT DAMP	SOFT	DOLOMITE ?
48'	GREEN	?	HARD	DOLOMITE ?
51'	GREEN KHAKI	VERY SLIGHT DAMP	MEDIUM SOFT	DOLOMITE ?

DRILL HOLE NO. 2

Sample marked DH.2 12th May,1970.

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
0				
2'	RED DIRT	NIL	SOFT	DIRT
3'	CREAM	NIL	HARD - VERY BRITTLE	DOLOMITE
6'	WHITE CREAM	VERY SLIGHT	HARD MEDIUM	DOLOMITE
9'	WHITE	SLIGHT	MEDIUM HARD	DOLOMITE
15'	LIGHT GREY Alternating Harder Bands.	SLIGHT	MEDIUM SOFT	DOLOMITE ?
21'	GREY - RED BROWN	DAMP	SOFT	DOLOMITE ?
27'	RED BROWN	DAMP	MEDIUM SOFT	DOLOMITE ?
33'	LIGHT BROWN GREY	DAMP	MEDIUM SOFT	DOLOMITE ?
39'	LIGHT GREY	SLIGHTLY DAMP	MEDIUM HARD	DOLOMITE ?
42'	GREY	SLIGHTLY DAMP	MEDIUM HARD	DOLOMITE ?
45'	GREY	SLIGHTLY DAMP	HARD	DOLOMITE ?
51'	GREY	SLIGHTLY DAMP	HARD	DOLOMITE ?
57'	GREY LIGHT	WET	SOFT	DOLOMITE ?

DRILL HOLE NO. 3

Sample marked DH.3 12th May, 1970.

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
0				
2'	RED	DRY	SOFT	DIRT
3'	CREAM	DRY	VERY HARD BRITTLE	DOLOMITE
5'	CREAM	DRY	VERY HARD	DOLOMITE
9'	WHITE	DRY	MODERATELY	DOLOMITE
15'	GREY	SLIGHTLY DAMP	SOFTER	DOLOMITE ?
21'	GREY	DAMP	SOFT	DOLOMITE ?
27'	GREY	VERY DAMP	SOFT	DOLOMITE ?
33'	GREY	GETTING DRY	GETTING HARD	DOLOMITE ?
39'	LIGHT GREY	DAMP	GETTING SOFT	DOLOMITE ?
45'	LIGHT GREY	WET	SOFT	DOLOMITE ?
48'	LIGHT GREY	WET	SOFT	DOLOMITE ?
51'	LIGHT GREY	WET	VERY HARD	DOLOMITE ?
57'	LIGHT GREY	VERY WET	VERY SOFT	DOLOMITE ?

DRILL HOLE NO. 4 13th May, 1970.

Sample marked DH.4

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
0				
3'	RED	DRY	SOFT	DIRT &
	Alternating thin bands hard material.			DOLOMITE
6'	WHITE	DRY	MEDIUM	DOLOMITE
9'	WHITE	DRY	HARD BRITTLE	DOLOMITE
15'	LIGHT GREY	SLIGHTLY DAMP	HARD	DOLOMITE
	Alternating very Hard Brittle Bands.			
21'	LIGHT GREY	SLIGHTLY DAMP	HARD MEDIUM	DOLOMITE
	Alternating very Hard Brittle Bands.			
27'	GREY	DAMP	SOFT	DOLOMITE ?
33'	GREY	DAMP	SOFTER	DOLOMITE ?
39'	GREY	DAMP	SOFTER	DOLOMITE ?
45'	GREY	WET	SOFT	DOLOMITE ?
51'	GREY-GREEN	DAMP	MEDIUM SOFT	DOLOMITE ?

DRILL HOLE NO. 5

Sample marked DH.5 14th May, 1970.

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
0				
6"	RED DIRT	DRY	SOFT	DIRT 6"
3'	CREAM	DRY	HARD BRITTLE	DOLOMITE 2'6"
9'	OFF WHITE	DRY	MEDIUM HARD	DOLOMITE
15'	LIGHT GREY	SLIGHT DAMP	SOFTER	DOLOMITE
21'	LIGHT GREY	SLIGHT DAMP	MEDIUM SOFT	DOLOMITE ?
27'	GREY	SLIGHT DAMP	SOFT	DOLOMITE ?
33'	GREY	SLIGHT DAMP	SOFT	DOLOMITE ?
36'	RED	SLIGHT DAMP	MEDIUM HARD	DOLOMITE ?
39'	GREY	SLIGHT DAMP	MEDIUM HARD	DOLOMITE ?
45'	GREY	SLIGHT DAMP	MEDIUM HARD	DOLOMITE ?
51'	GREY	DAMP	SOFTER	DOLOMITE ?

DRILL HOLE NO. 6.

Sample marked DH.6 17th May, 1970

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
0				
3'	RED	DRY	SOFT	DIRT
6'	CREAM	DRY	BRITTLE	DOLOMITE
9'	WHITE	DRY	HARD	DOLOMITE
12'	OFF WHITE	DRY	CHALKY	DOLOMITE
15'	LIGHT GREY	VERY SLIGHTLY DAMP	MEDIUM SOFT	DOLOMITE
18'	LIGHT GREY	DRY	MEDIUM SOFT	DOLOMITE
21'	BROWN	SLIGHTLY DAMP	SOFT	DOLOMITE ?
23'	BROWN	DAMP	MEDIUM SOFT CLAY	DOLOMITE ?
24'	BROWN	DRY	VERY HARD BRITTLE	DOLOMITE ?
27'	BROWN	DAMP	SOFT	DOLOMITE ?
33'	RED BROWN	DAMP	SOFT	DOLOMITE ?
39'	RED BROWN	MODERATELY DAMP	MODERATELY SOFT	DOLOMITE ?
45'	BROWN	MEDIUM DAMP	MEDIUM SOFT	DOLOMITE ?
51'	GREY BROWN	DAMP	SOFT	DOLOMITE ?

DRILL HOLE NO. 7 17th May, 1970

Sample marked DH.7

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
0				
3'	RED	DRY	SOFT	DIRT
5'	CREAM	DRY	BRITTLE	DOLOMITE
9'	OFF WHITE	DRY	HARD	DOLOMITE
12'	LIGHT GREY	DRY	MEDIUM HARD	DOLOMITE
15'	OFF WHITE	SLIGHTLY DAMP	SOFTER	DOLOMITE
18'	LIGHT GREY	SLIGHTLY DAMP	MEDIUM SOFT	DOLOMITE ?
21'	GREY	SLIGHTLY DAMP	MEDIUM SOFT	DOLOMITE ?
27'	GREY	DAMP	SOFT	DOLOMITE ?
33'	GREY BROWN	DAMP	SOFT	DOLOMITE ?
39'	DARK GREY	SLIGHT DAMP	HARDER	DOLOMITE ?
48'	LIGHT BROWN	DAMP	SOFT	DOLOMITE ?
51'	BROWN GREY	DAMP	SOFT	DOLOMITE ?

DRILL HOLE NO. 8. 18th May, 1970.

Sample marked DH.8

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
0				
2'	RED	DRY	SOFT	DIRT
3'	YELLOW	DRY	SOFT	DIRT
6'	CREAM	DRY	BRITTLE BANDS VERY HARD	DOLOMITE
8'	LIGHT GREY - OFF WHITE	DRY	FINE GRAIN POWDERY HARD	DOLOMITE
15'	OFF WHITE	DRY to very slight damp	MEDIUM HARD	DOLOMITE
21'	GREY	DAMP	SOFT	DOLOMITE ?
27'	GREY-RED BROWN	DAMP	SOFT	DOLOMITE ?
33'	RED BROWN-CHARCOAL	DAMP	MEDIUM SOFT	DOLOMITE ?
39'	LIGHT BROWN	MEDIUM DAMP	MEDIUM SOFT	DOLOMITE ?
45'	LIGHT GREY-BROWN	MEDIUM DAMP	MEDIUM HARD	DOLOMITE ?
51'	LIGHT BROWN	MEDIUM DAMP	MEDIUM SOFT	DOLOMITE ?

DRILL HOLE NO. 9. 18th May, 1970

Sample marked DH.9

	DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
	0				
	2'	RED	DRY	SOFT	DIRT
Traces (	3'	CREAM	DRY	BRITTLE	DOLOMITE
of (	6'	WHITE	DRY	SOFT	DOLOMITE
Gypsum (	9'	GREY	DAMP	SOFT	DOLOMITE ?
	15'	LIGHT GREY	SLIGHT DAMP	SOFT	DOLOMITE ?
	21'	LIGHT GREY	SLIGHTLY DAMP TO DAMP	MEDIUM SOFT	DOLOMITE ?
	27'	GREY-RED BROWN BANDS	DAMP	MEDIUM SOFT	DOLOMITE ?
	33'	GREY	VERY DAMP TO DAMP	SOFT	DOLOMITE ?
	39'	GREY BROWN	DAMP	SOFT	DOLOMITE ?
	45'	GREY	DAMP	SOFT	DOLOMITE ?
	51'	GREY WITH CHARCOAL BANDS	DAMP-WET	VERY SOFT	DOLOMITE ?

DRILL HOLE NO. 10 14th May, 1970.

Sample marked DH.10

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
0				
1'	RED	DRY	SOFT	DIRT
3'	WHITE	DRY	MEDIUM HARD	DOLOMITE
9'	WHITE	DRY	HARD - BRITTLE	DOLOMITE
15'	OFF WHITE	DRY	HARD	DOLOMITE
21'	LIGHT GREY	DRY	HARD	DOLOMITE
27'	LIGHT GREY	SLIGHT DAMP	SOFTER	DOLOMITE ?
33'	LIGHT GREY	SLIGHT DAMP	SOFT	DOLOMITE ?
39'	GREY LIGHT	DAMP	SOFT	DOLOMITE ?
45'	GREY	DAMP	HARDER	DOLOMITE ?
51'	GREY	DAMP	MEDIUM HARD	DOLOMITE ?

DRILL HOLE NO. 11. 18th May, 1970.

Sample marked DH.11

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
0				
6"	RED	DRY	SOFT	DIRT
4'	CREAM	DRY	BRITTLE	DOLOMITE
9'	WHITE	DRY	POWDERY HARD	DOLOMITE
15'	OFF WHITE	DRY	MEDIUM HARD	DOLOMITE
21'	LIGHT GREY	SLIGHTLY DAMP	SOFT MEDIUM	DOLOMITE ?
23'	GREY	DAMP	SOFT	DOLOMITE ?
24'	BROWN	DAMP	SOFT	DOLOMITE ?
	Occasional Hard Brittle Bands.			
27'	GREY	DAMP	SOFT	DOLOMITE ?
33'	GREY	DAMP-WET	SOFT	DOLOMITE ?
39'	RED BROWN	DAMP	SOFT	DOLOMITE ?
48'	GREY-CHARCOAL BANDS	DAMP	SOFT	DOLOMITE ?
51'	GREY	DAMP	SOFT	DOLOMITE ?

DRILL HOLE NO. 12 19th May, 1970.

Sample marked DH.12

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
0				
2'	RED	DRY	SOFT	DIRT
5'	CREAM-GREY	DRY	BRITTLE	DOLOMITE
9'	WHITE	DRY	HARD (with occasional ¼ brittle bands)	DOLOMITE
13'	WHITE - OFF WHITE	VERY SLIGHT DAMP	MEDIUM HARD	DOLOMITE
19'	LIGHT GREY	VERY SLIGHT DAMP	MEDIUM HARD	DOLOMITE
24'	LIGHT GREY	SLIGHT DAMP	MEDIUM SOFT	DOLOMITE ?
27'	LIGHT GREY-RED BROWN	DAMP	SOFT	DOLOMITE ?
33'	LIGHT RED BROWN (FAWN)	DAMP	SOFT	DOLOMITE ?
36'	LIGHT GREY-BROWN BANDS	DAMP	SOFT	DOLOMITE ?
39'	GREY (with Red Bands)	DAMP	MEDIUM SOFT	DOLOMITE ?
45'	GREY (with Dark Grey Bands)	MEDIUM DAMP	MEDIUM SOFT	DOLOMITE ?
48'	GREY (with Dark Green Bands)	DAMP	SOFT	DOLOMITE ?
51'	RED BROWN	DAMP	SOFT	DOLOMITE ?

DRILL HOLE NO. 13 — 19th May, 1970.

Sample marked DH.13

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
0				
6"	RED	DRY	SOFT	DIRT
4'	CREAM PINK	DRY	BRITTLE	DOLOMITE
9'	FINE GRAINED WHITE	DRY	HARD	DOLOMITE
12'	WHITE	DRY	HARD	DOLOMITE
15'	LIGHT GREY	VERY SLIGHT DAMP	HARD-MED/SOFT	DOLOMITE
19'	LIGHT GREY	SLIGHT DAMP	MEDIUM SOFT	DOLOMITE ?
21'	LIGHT GREY	DAMP	SOFT	DOLOMITE ?
27'	LIGHT GREY	DAMP	SOFT	DOLOMITE ?
33'	LIGHT BROWN WITH RED BANDS	DAMP	SOFT	DOLOMITE ?
39'	GREY OCCASIONAL RED BANDS	DAMP	SOFT	DOLOMITE ?
45'	GREY-CHARCOAL GREY BANDS	DAMP	SOFT	DOLOMITE ?
51'	GREY	DAMP	SOFT	DOLOMITE ?

* THIS HOLD RE-DRILLED AND BAGGED SEPARATELY 31ST MAY,1970.

DRILL HOLE NO. 14. — 19th May, 1970

Sample marked DH.14

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
0				
18"	RED	DRY	SOFT	DIRT
4'	CREAM	DRY	BRITTLE	DOLOMITE
6'	WHITE	DRY	VERY HARD OCCASIONALLY BRITTLE	DOLOMITE
9'	OFF WHITE	DRYoccasional thin brittle band ½".	(MEDIUM HARD ((	DOLOMITE
15'	OFF WHITE	DRY	(MEDIUM HARD	DOLOMITE
21'	LIGHT GREY	DRY ?	MEDIUM SOFT-HARD	DOLOMITE ?
27'	LIGHT GREY	SLIGHT DAMP progress to DAMP	MEDIUM SOFT	DOLOMITE ?
33'	GREY	DAMP	SOFT	DOLOMITE ?
39'	GREY (Dark Grey band at 37'.	DAMP	SOFT	DOLOMITE ?
45'	GREY CHARCOAL BANDS	DAMP	MEDIUM SOFT	DOLOMITE ?
51'	GREY GREEN	DAMP	MEDIUM SOFT	DOLOMITE ?

DRILL HOLE NO. 15 20th May, 1970.

Sample marked DH.15

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
0				
3'	RED (Occasional Dolomite Brittle Bands after 1').	DRY	SOFT	DIRT
6'	GREY	DRY	BRITTLE BANDED	DOLOMITE
9'	GREY	DRY	HARD (NOT BRITTLE)	DOLOMITE
13'	OFF WHITE	DRY	HARD (OCCASIONAL BRITTLE BAND UP TO 6" THICK)	DOLOMITE
15'	LIGHT GREY	DRY	MED/HARD-HARD	DOLOMITE
19'	OFF WHITE	DRY	MEDIUM SOFT	DOLOMITE
21'	OFF WHITE	VERY SLIGHT DAMP	MEDIUM SOFT	DOLOMITE
27'	LIGHT GREY	SLIGHT DAMP progress to DAMP	SOFT	DOLOMITE ?
33'	GREY	DAMP	SOFT	DOLOMITE?
39'	GREY (some Grey Dark bands ¼" thick)	DAMP	MEDIUM SOFT	DOLOMITE ?
45'	GREY	DAMP	MEDIUM SOFT	DOLOMITE ?
51'	DARK GREY - CHARCOAL BANDS ¼" thick. Getting harder with depth.	DAMP	MEDIUM SOFT - MEDIUM HARD	DOLOMITE ?

* WATER SAMPLE OBTAINED FROM THIS HOLE ON 24TH MAY, 1970
STATIC WATER LEVEL 18' FROM SURFACE.

DRILL HOLE NO. 16 20th May, 1970

Sample marked DH.16

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
0				
3'	RED (with traces of Gypsum)	DRY	SOFT	DIRT
6'	WHITE	DRY	MEDIUM HARD	DOLOMITE
9'	OFF WHITE	DRY	MEDIUM SOFT	DOLOMITE
11'	GREY	DAMP	SOFT	DOLOMITE
12'	CREAM (Light Grey) Banded and in Nodule form.	DRY	BRITTLE	DOLOMITE
15'	WHITE & (Light Grey) Bands	DRY	HARD occasionally slight brittle	DOLOMITE
21'	OFF WHITE (Light Grey)	DRY	HARD occasionally brittle.	DOLOMITE
27'	OFF WHITE	DRY	HARD	DOLOMITE
29'	LIGHT GREY	MEDIUM DAMP	MEDIUM SOFT	DOLOMITE ?
33'	LIGHT GREY	DAMP	SOFT	DOLOMITE ?
51'	OFF WHITE	EXTREMELY WET	EXTREMELY SOFT	DOLOMITE ?

* CUTTINGS CAME UP HOLE LIKE CREAM.

THIS HOLE WAS RE-DRILLED TO GET WATER SAMPLE ON 27TH MAY,1970
STATIC WATER LEVEL IN HOLE WAS 20' FROM SURFACE.

DRILL HOLE NO. 17 — 21st May, 1970.

Sample marked DH.17

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
0				
3'	RED	DRY	SOFT occasional brittle lump after 2'.	DIRT
5'	CREAM	DRY	BRITTLE & LUMPY	DOLOMITE
7'	OFF WHITE	DRY	VERY HARD	DOLOMITE
9'	OFF WHITE	DRY	HARD	DOLOMITE
15'	LIGHT GREY-OFF WHITE	DRY	HARD	DOLOMITE
21'	LIGHT GREY	DRY	HARD	DOLOMITE
24'	LIGHT GREY	DRY	MEDIUM SOFT	DOLOMITE ?
27'	LIGHT GREY	SLIGHT DAMP	SOFT	DOLOMITE ?
30'	LIGHT GREY	DAMP	VERY SOFT	DOLOMITE ?
33'	LIGHT BROWN	DAMP	SOFT	DOLOMITE ?
39'	MEDIUM DARK GREY (with Red Brown Bands at 38-39').	DAMP	SOFT	DOLOMITE ?
45'	GREY WITH MORE RED BROWN BANDS	DAMP	SOFT	DOLOMITE ?
51'	LIGHT GREY WITH DARK GREY MED. HARD BANDS	DAMP	SOFT	DOLOMITE ?

DRILL HOLE NO. 18 — 21st May, 1970.

Sample marked DH.18

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
0				
1'	RED	DRY	SOFT	DIRT
3'	CREAM-GREY	DRY	BRITTLE	DOLOMITE
5'	WHITE (with brittle bands)	DRY	VERY HARD	DOLOMITE
9'	OFF WHITE (with Gypsum Crystals and brittle bands)	DRY	HARD	DOLOMITE
15'	OFF WHITE (Diminishing brittle bands)	DRY	MEDIUM HARD	DOLOMITE
21'	OFF WHITE	DRY	MEDIUM SOFT	DOLOMITE
27'	OFF WHITE	VERY SLIGHTLY DAMP	MEDIUM SOFT	DOLOMITE
30'	LIGHT GREY	SLIGHT DAMP	SOFT	DOLOMITE ?
33'	LIGHT GREY (with darker grey bands)	DAMP	SOFT	DOLOMITE ?
39'	GREY	DAMP	SOFT	DOLOMITE ?
45'	GREY (with dark grey bands)	DAMP	SOFT	DOLOMITE ?
51'	GREY (more dark bands).	NOT SO DAMP	SOFT	DOLOMITE ?

DRILL HOLE NO. 19 — 21st May, 1970.

Sample marked DH.19

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
0				
3'	RED	DAMP	SOFT	DIRT
6'	WHITE	SLIGHT DAMP	SOFT	DOLOMITE
9'	WHITE	DRY	HARD	DOLOMITE
11'	CREAM	DRY	BRITTLE	DOLOMITE
15'	OFF WHITE	DRY	VERY HARD (occasionally brittle.)	DOLOMITE
21'	OFF WHITE	DRY	HARD	DOLOMITE
24'	LIGHT GREY	DAMP	SOFT	DOLOMITE ?
27'	GREY	DAMP	SOFT	DOLOMITE ?
33'	GREY	DAMP	SOFT	DOLOMITE ?
39'	DARK GREY BANDS	DAMP	SOFT	DOLOMITE ?
45'	GREY	DAMP	SOFT	DOLOMITE ?
51'	GREY	DAMP	SOFT	DOLOMITE ?

DRILL HOLE NO. 20 — 24th May, 1970.

Sample marked DH.20

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
0				
6"	RED	DRY	SOFT	DIRT
4'	GREEN	MEDIUM DAMP	SOFT	SOAPY DOLOMITIC CLAY ?
9'	CREAM	DRY	HARD & BRITTLE	DOLOMITE
13'	OFF WHITE	DRY	HARD	DOLOMITE
18'	WHITE	DRY	MEDIUM SOFT	DOLOMITE
21'	OFF WHITE	DRY	MEDIUM SOFT	DOLOMITE
24'	LIGHT GREY	VERY SLIGHT DAMP	SOFT	DOLOMITE ?
27'	LIGHT GREY	SLIGHT DAMP	SOFT	DOLOMITE ?
33'	GREY (with dark grey bands.)	DAMP	SOFT	DOLOMITE ?
39'	GREY-RED BROWN	DAMP	SOFT	DOLOMITE ?
45'	GREY-DARK GREY	DAMP	SOFT	DOLOMITE ?
51'	DARK GREY	DAMP	SOFT	DOLOMITE ?

DRILL HOLE NO. 21

26th May, 1970.

Sample DH.21

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
0				
4'	RED-GREY	DRY	SOFT	DIRT
7'	GYPSUM CRYSTALS (Quartz Gravel and Green med. Hard Clay bands.)	DRY	MEDIUM SOFT	DOLOMITE ?
16'	WHITE-CREAM	DRY	HARD (often brittle)	DOLOMITE
21'	OFF WHITE	DRY	MEDIUM SOFT	DOLOMITE
27'	OFF WHITE	DRY	SOFT	DOLOMITE
33'	LIGHT GREY	MEDIUM DAMP	SOFT	DOLOMITE ?
39'	LIGHT BROWN	DAMP	SOFT	DOLOMITE ?
45'	LIGHT BROWN (Charcoal Band)	DAMP	SOFT	DOLOMITE ?
51'	LIGHT BROWN	DAMP	SOFT	DOLOMITE ?

DRILL HOLE NO. 22

26th May, 1970.

Sample marked DH.22

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
0				
2'	RED	DRY	SOFT	DIRT
4'	CREAM-GREY	DRY	BRITTLE & HARD	DOLOMITE
5'	CREAM-WHITE	DRY	EXTREMELY HARD	DOLOMITE
7'	CREAM-WHITE	DRY	VERY HARD	DOLOMITE
15'	WHITE	DRY	MEDIUM HARD	DOLOMITE
21'	OFF WHITE	DRY	MEDIUM SOFT	DOLOMITE
27'	LIGHT GREY	SLIGHT DAMP	SOFT	DOLOMITE ?
33'	LIGHT GREY	DAMP	SOFT	DOLOMITE ?
39'	LIGHT GREY	DAMP	SOFT	DOLOMITE ?
45'	LIGHT GREY-LIGHT BROWN	DAMP	SOFT	DOLOMITE ?
51'	LIGHT BROWN-GREY with Charcoal Bands	DAMP	SOFT	DOLOMITE ?

DRILL HOLE NO. 23. 25th May, 1970.

Sample marked DH.23

Two Samples taken A & B.

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
0				
2'	RED	DRY	SOFT	DIRT
4'	CREAM	DRY	SOFT with brittle lumps.	DOLOMITE
9'	CREAM progress to Light Grey	DRY	EXCEPTIONALLY HARD - alternating Brittle Bands.	DOLOMITE
13'	WHITE	DRY	VERY HARD	DOLOMITE
15'	WHITE	DRY	MEDIUM HARD	DOLOMITE
17'	WHITE	DRY	HARD	DOLOMITE
21'	OFF WHITE	DRY	MEDIUM SOFT	DOLOMITE
24'	SAMPLE A.			
27'	LIGHT GREY	SLIGHT DAMP	SOFT	DOLOMITE ?
33'	GREY	DAMP	SOFT	DOLOMITE ?
39'	GREY-BROWN	DAMP	SOFT	DOLOMITE ?
45'	GREY with Charcoal Bands	DAMP	SOFT	DOLOMITE ?
51'	GREY	DAMP	SOFT	DOLOMITE ?
	SAMPLE B.			

THIS HOLE WAS BAGGED IN TWO SECTIONS

VIZ: 0 - 24' = Sample DH.23A
24' - 51' = Sample DH.23B

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DRILL HOLE NO. 24

27th May, 1970.

Sample marked DH.24

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
0				
1'	RED	DRY	SOFT	DIRT
4'	CRYSTALINE (stoned like hard sugar lumps) Banded with some dirt.	DRY	SOFT	GYPSUM
5'	CREAM-GREY (Hard lump with Crystaline bands)	DRY	BRITTLE	DOLOMITE
9'	OFF WHITE - LIGHT GREY	DRY with thin damp band.	HARD	DOLOMITE
15'	OFF WHITE	DRY	MEDIUM HARD	DOLOMITE
18'	CREAM	DRY	BRITTLE-HARD	DOLOMITE
21'	LIGHT GREY	DRY	MEDIUM SOFT	DOLOMITE ?
27'	LIGHT GREY	SLIGHT DAMP to DAMP	SOFT	DOLOMITE ?
33'	LIGHT GREY	DAMP-VERY DAMP	VERY SOFT	DOLOMITE ?
39'	LIGHT GREY	DAMP progress to WET	VERY SOFT	DOLOMITE ?
45'	GREY (with Charcoal bands)	DAMP	VERY SOFT	DOLOMITE ?
51'	GREY (with Charcoal Bands)	DAMP	SOFT	DOLOMITE ?

DRILL HOLE NO. 25

25th May, 1970.

Sample marked DH.25

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
0				
6"	RED	DRY	SOFT	DIRT
3'	GREY-CREAM LUMPS	DRY	BRITTLE	DOLOMITE
6'	GREY-OFF WHITE	DRY	HARD Occasionally Brittle.	DOLOMITE
9'	OFF WHITE	DRY	HARD	DOLOMITE
13'	OFF WHITE	DRY	HARD	DOLOMITE
19'	OFF WHITE	DRY	MEDIUM HARD	DOLOMITE
21'	LIGHT GREY	DRY	MEDIUM SOFT	DOLOMITE ?
27'	LIGHT GREY	VERY SLIGHT DAMP	SOFT	DOLOMITE ?
34'	LIGHT GREY	SLIGHT DAMP progress to DAMP	SOFT	DOLOMITE ?
36'	RED BROWN	MEDIUM DAMP	MEDIUM SOFT	DOLOMITE ?
41'	LIGHT BROWN-GREY	DAMP	SOFT	DOLOMITE ?
42'	CHARCOAL BAND (Green Grey)	MEDIUM DAMP	MEDIUM SOFT	DOLOMITE ?
45'	LIGHT BROWN	DAMP	SOFT	DOLOMITE ?
46'	CHARCOAL BAND	DAMP	SOFT	DOLOMITE ?
51'	LIGHT BROWN	DAMP	SOFT	DOLOMITE ?

DRILL HOLE NO. 26 — 24th May, 1970.

Sample marked DH.26

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
0				
3'	RED	SLIGHT DAMP	SOFT	SAND
6'	RED (occasional Dolomitic Stones)	SLIGHT DAMP	SOFT	SAND
12'	GREY CLAY	SLIGHT DAMP	SOFT	DOLOMITE ?
18'	DARK GREY TO PINK	VERY SLIGHT DAMP	SOFT	DOLOMITE ?
24'	DARK GREEN	VERY SLIGHT DAMP	MEDIUM SOFT	DOLOMITE ?
30'	DARK GREEN	VERY SLIGHT	MEDIUM HARD	DOLOMITE ?
36'	LIGHT GREEN	DAMP	SOFT	DOLOMITE ?
42'	LIGHT GREEN	VERY WET	VERY SOFT	DOLOMITE ?
48'	LIGHT GREEN	VERY WET	VERY SOFT	DOLOMITE ?

* WATER SAMPLE OBTAINED FROM THIS HOLE IMMEDIATELY AFTER DRILLING 24TH MAY, 1970 STATIC WATER LEVEL 18' FROM SURFACE.

DRILL HOLE NO. 27 — 27th May, 1970

Sample marked DH.27

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE
0				
3'	RED GREY	DRY	SOFT	SOIL
4'	GREEN GREY (with some Gypsum)	SLIGHT DAMP	SOFT	CLAY
6'	GREEN YELLOW (some pellets of clay)	SLIGHT DAMP	SOFT	SAND
9'	YELLOW-LIGHT GREY (White)	DAMP	SOFT	SAND
12'	LIGHT BROWN (Progress to brown)	DAMP	SOFT	SAND
16'	GREY progress to BROWN (with some Gypsum)	DAMP	SOFT	CLAY
18'	YELLOW-GREEN	DAMP	SOFT	SAND
21'	LIGHT GREY-GREEN	DAMP	SOFT	SAND
25'	LIGHT GREY	WET	SOFT	SANDY CLAY
27'	BROWN	WET	SOFT	SANDY CLAY
51'	GREY MUD	WET	SOFT	MUD

* THIS HOLE WAS ORIGINALLY DRILLED FOR WATER BUT IMPOSSIBLE TO GET WATER SAMPLE FROM THIS HOLE AS WET SAND KEPT FILLING HOLE WITHIN 6' OF SURFACE.

DRILL HOLE NO. 13

31st May, 1970.

Sample marked DH.13

DEPTH	COLOUR	DAMPNESS	HARDNESS	SAMPLE NO.	TYPE
0- 6"	RED	DRY	SOFT DIRT	UC.1	DIRT
6"- 2'	GREY-CREAM	DRY	HARD & BRITTLE- BROKEN	UC.2	DOLOMITE
2'- 4'	LIGHT GREY - CREAM	DRY	HARD & BRITTLE - UNFRACTURED	UC.3	DOLOMITE
4'- 6'	OFF WHITE CREAM-PINK	DRY	HARD - LESS BRITTLE	UC.4	DOLOMITE
6'- 8'	OFF WHITE LIGHT GREY STONES	DRY	HARD	UC.5	DOLOMITE
8'-10'	OFF WHITE	DRY	MEDIUM HARD	UC.6	DOLOMITE
10'-12'	OFF WHITE	DRY	MEDIUM SOFT	UC.7	DOLOMITE ?
12'-14'	LIGHT GREY	DRY	MEDIUM SOFT	UC.8	DOLOMITE ?
14'-16'	LIGHT GREY	VERY SLIGHT DAMP	SOFT	UC.9	DOLOMITE ?
16'-18'	LIGHT GREY	SLIGHT DAMP	SOFT	UC.10	DOLOMITE ?
18'-21'	LIGHT GREY with small green bands.	DAMP	SOFT	UC.11	DOLOMITE ?
21'-24'	LIGHT GREY small red bands.	DAMP	SOFT	UC.12	DOLOMITE ?
24'-30'	LIGHT GREY- LIGHT BROWN	DAMP	SOFT	UC.13	DOLOMITE ?
30'-36'	LIGHT BROWN - LIGHT GREY. GREEN & RED BANDS	VERY DAMP	SOFT	UC.14	DOLOMITE ?
36'-42'	LIGHT GREY with GREEN & RED BANDS	DAMP	SOFT	UC.15	DOLOMITE ?
39'	RED AND GREEN BANDS FOR ABOUT 6"			EXTRA SAMPLE	DOLOMITE ?
42'-51'	GREY with charcoal bands.	DAMP	SOFT	UC.17	DOLOMITE ?

DRILL HOLE NO. 28 (1 mile East Access Point) 3rd June, 1970.

Sample marked DH.28

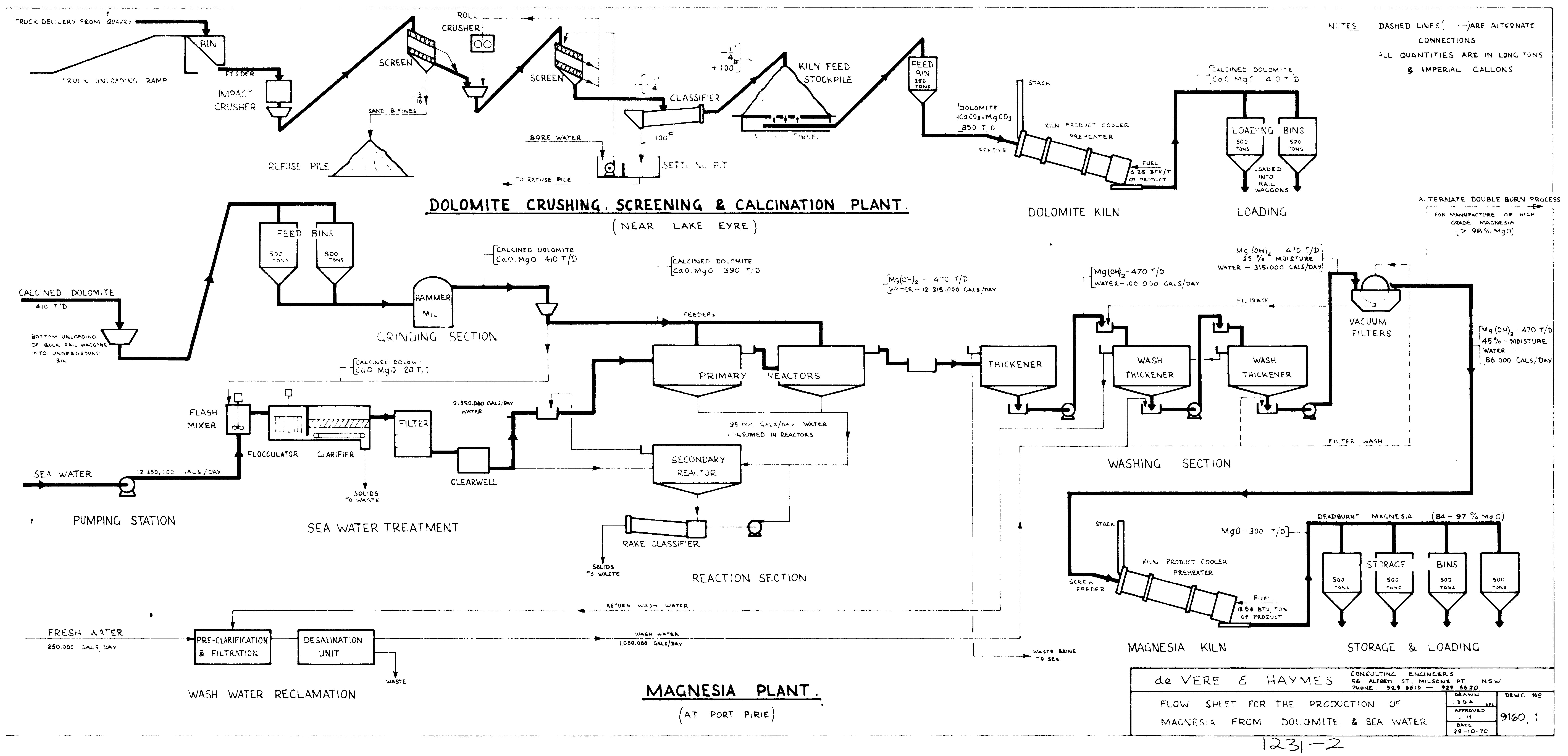
DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE SAMPLE NO.
0				
2'	RED	DRY	SOFT Occasional hard lump	UC.21
4'	CREAM	DRY	MEDIUM HARD Occasionally brittle	UC.22
6'	CREAM	DRY	MEDIUM HARD Occasionally brittle	UC.23
8'	OFF WHITE	DRY	HARD Less Brittle	UC.24
10'	WHITE	DRY	HARD Very hard	UC.25
12'	WHITE	DRY	VERY HARD	UC.26
14'	WHITE CREAM CRYSTALINE	DRY	VERY HARD With some rounded stones Crystaline with Red Bands.	UC.27
16'	WHITE CRYSTAL-INE	DRY	VERY HARD With stones as above plus brown chips.	UC.28
18'	WHITE CRYSTAL-INE LUMPS	DRY	HARD Brown Chips remain	UC.29
20'	WHITE CRYSTAL	DRY	HARD Occasional Lumps	UC.30
22'	WHITE	DRY	HARD Occasional Lumps	UC.31
24'	WHITE	DRY	HARD Occasional Lumps	UC.32
26'	WHITE	DRY	HARD - LUMPY	UC.33
28'	WHITE-YELLOW	DRY	MEDIUM HARD	UC.34
30'	LIGHT YELLOW	DRY	MEDIUM SOFT	UC.35
32'	WHITE YELLOW	DRY	MEDIUM SOFT - lumpy	UC.36
34'	LIGHT YELLOW	DRY	SOFT	UC.37
36'	LIGHT YELLOW	SLIGHT DAMP	SOFT	UC.38
38') 40') 42') 44')	YELLOW	DAMP MUD	SOFT	(UC.39 (UC.40 (UC.41 UC.42

DRILL HOLE NO.29

Sample marked DH. 29 4th June,1970

DEPTH	COLOUR	DAMPNESS	HARDNESS	TYPE SAMPLE NO.
0				
3'	MISC. GRAVEL & SAND	DRY	SOFT	
9'	CHARCOAL COLOURED CLAY	VERY SLIGHT DAMP	SOFT	UC.51
15'	CHARCOAL COLOURED CLAY	SLIGHT DAMP	SOFT	UC.53
21'	CHARCOAL COLOURED CLAY	DAMP	SOFT	UC.53
27'	CHARCOAL COLOURED CLAY	WET	SOFT	UC.54

* THIS HOLE DRILLED TO OBTAIN WATER SAMPLE.


NOTES DASHED LINES (- - -) ARE ALTERNATE CONNECTIONS
ALL QUANTITIES ARE IN LONG TONS & IMPERIAL GALLONS
TRUCK DELIVERY FROM QUARRY
BIN
FEEDER
TRUCK UNLOADING RAMP
IMPACT CRUSHER
SCREEN
ROLL CRUSHER
SCREEN
-3/16
SAND & FINES
REFUSE PILE
TO REFUSE PILE
BORE WATER
SETTLING PIT
CLASSIFIER
100#
-1/4" +100#
KILN FEED STOCKPILE
TUNNEL
FEED BIN 250 TONS
DOLOMITE CaCO3.MgCO3 850 T/D
FEEDER
STACK
KILN PRODUCT COOLER
PREHEATER
FUEL 6.25 BTU/T OF PRODUCT
CALCINED DOLOMITE CaO.MgO 410 T/D
LOADING BINS 500 TONS 500 TONS
LOADED INTO RAIL WAGGONS
DOLOMITE KILN
LOADING
DOLOMITE CRUSHING, SCREENING & CALCINATION PLANT.
(NEAR LAKE EYRE)
ALTERNATE DOUBLE BURN PROCESS FOR MANUFACTURE OF HIGH GRADE MAGNESIA (> 98% MgO)
CALCINED DOLOMITE 410 T/D
BOTTOM UNLOADING OF BULK RAIL WAGGONS INTO UNDERGROUND BIN
FEED BINS 500 TONS 500 TONS
HAMMER MILL
GRINDING SECTION
CALCINED DOLOMITE CaO.MgO 410 T/D
CALCINED DOLOMITE CaO.MgO 390 T/D
FEEDERS
CALCINED DOLOMITE CaO.MgO 20 T/D
PRIMARY REACTORS
Mg(OH)2 - 470 T/D WATER - 12 315.000 GALS/DAY
Mg(OH)2 - 470 T/D WATER - 100 000 GALS/DAY
Mg(OH)2 - 470 T/D 25% MOISTURE WATER - 315.000 GALS/DAY
FILTRATE
VACUUM FILTERS
Mg(OH)2 - 470 T/D 45% - MOISTURE WATER 86.000 GALS/DAY
THICKENER
WASH THICKENER
WASH THICKENER
FILTER WASH
WASHING SECTION
FLASH MIXER
FLOCCULATOR
CLARIFIER
FILTER
12.350.000 GALS/DAY WATER
35.000 GALS/DAY WATER CONSUMED IN REACTORS
SECONDARY REACTOR
SOLIDS TO WASTE
CLEARWELL
SEA WATER
12.350.000 GALS/DAY
PUMPING STATION
SEA WATER TREATMENT
RAKE CLASSIFIER
SOLIDS TO WASTE
REACTION SECTION
STACK
MgO - 300 T/D
DEADBURNT MAGNESIA (84 - 97% MgO)
KILN PRODUCT COOLER
PREHEATER
SCREW FEEDER
FUEL 13.56 BTU/TON OF PRODUCT
STORAGE BINS 500 TONS 500 TONS 500 TONS 500 TONS
MAGNESIA KILN
STORAGE & LOADING
RETURN WASH WATER
FRESH WATER 250.000 GALS/DAY
PRE-CLARIFICATION & FILTRATION
DESALINATION UNIT
WASH WATER 1.050.000 GALS/DAY
WASTE
WASTE BRINE TO SEA
WASH WATER RECLAMATION
MAGNESIA PLANT.
(AT PORT PIRIE)
de VERE & HAYMES CONSULTING ENGINEERS 56 ALFRED ST. MILSONS PT. NSW PHONE 929 6619 — 929 6620
FLOW SHEET FOR THE PRODUCTION OF MAGNESIA FROM DOLOMITE & SEA WATER
DRAWN
APPROVED
DATE 29-10-70
DRWG. No 9160, 1
1231-2

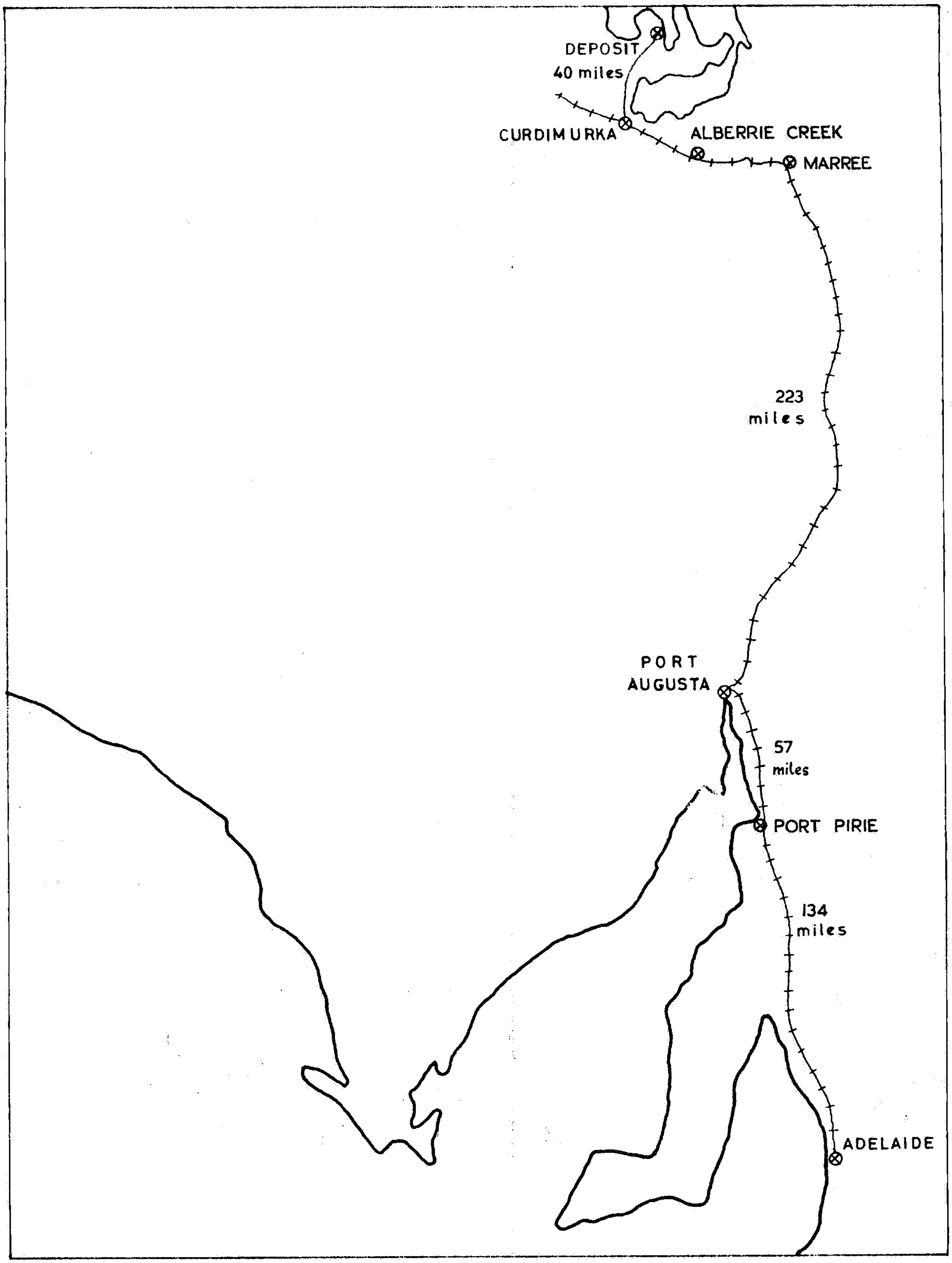


FIGURE I : LOCATION OF THE DEPOSIT

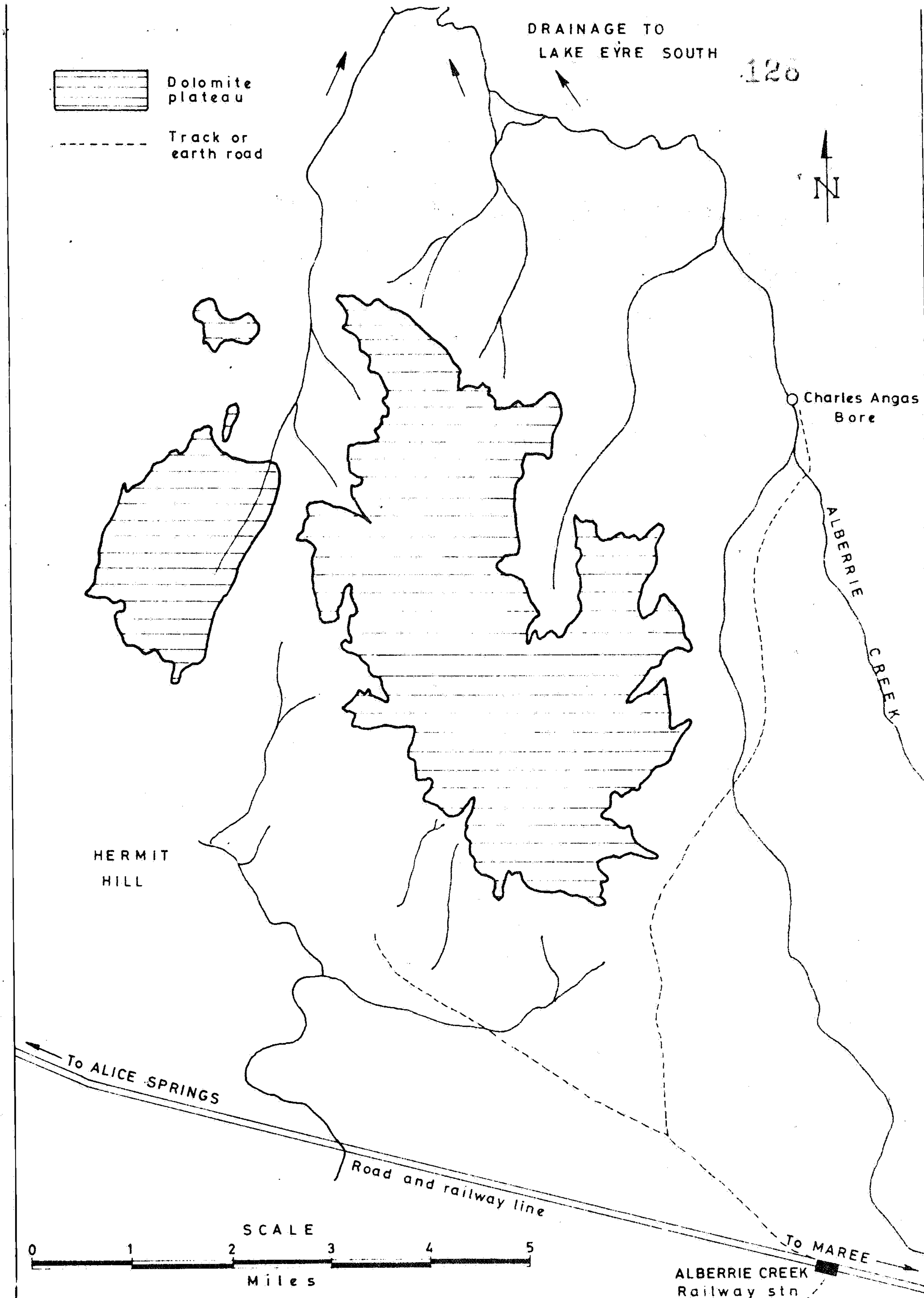
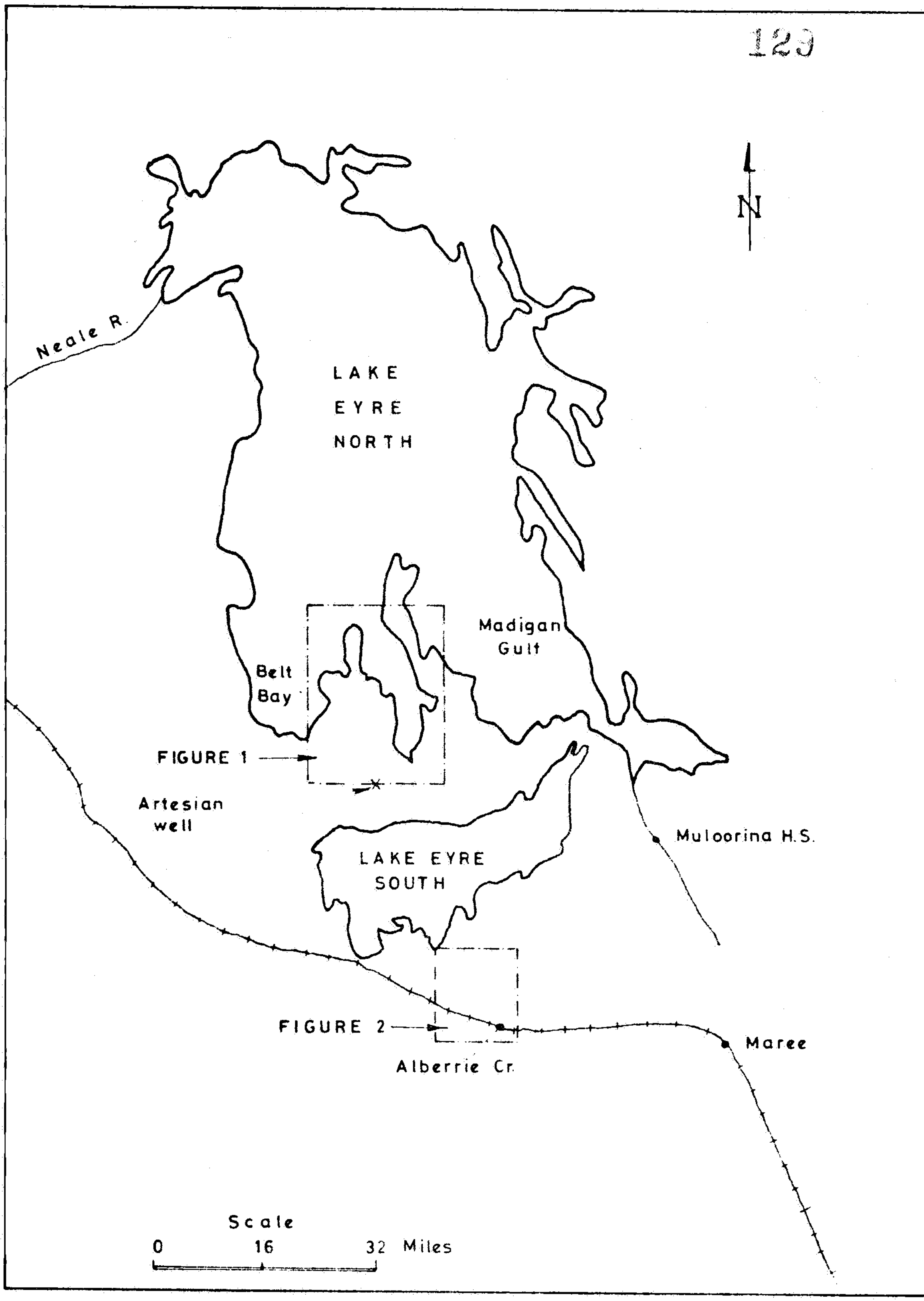


FIGURE 2: DOLOMITE PLATEAU BETWEEN LAKE EYRE SOUTH AND RAILWAY LINE



LOCALITY MAP LAKE EYRE REGION
SOUTH AUSTRALIA
FIGURE 3

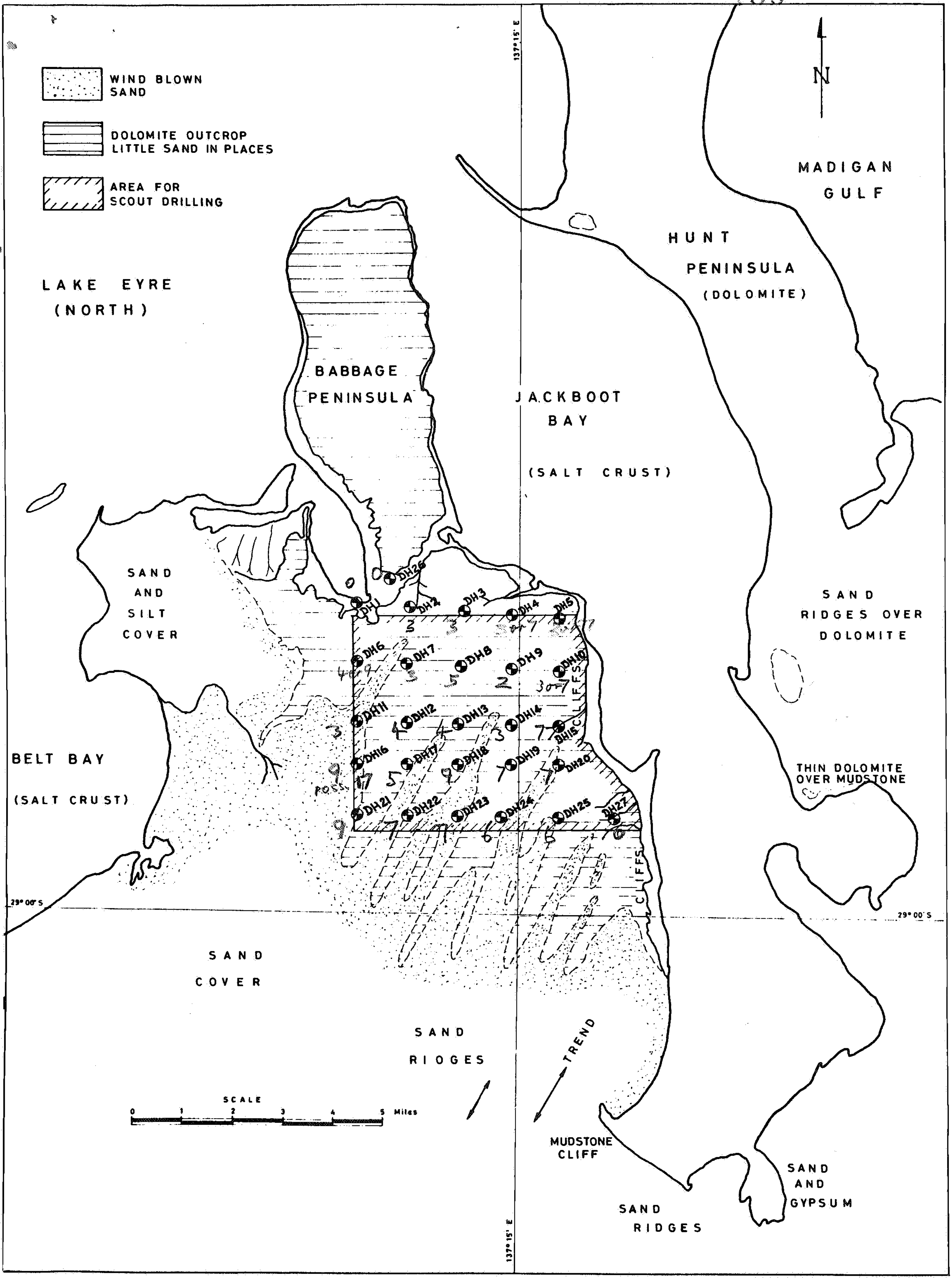


FIGURE 4: SKETCH MAP SHOWING AREAS OF DOLOMITE ON BABBAGE PENINSULA

de VERE & HAYMES CONSULTING ENGINEERS

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JDV/CDW 18th November, 1970.

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The Chairman,
Umbum Creek Pty. Ltd.,
99 Elizabeth Street,
SYDNEY. 2000.

Dear Sir,

We have much pleasure in submitting A.M.D.E.L.'s Progress Report No. III dealing with the feasibility of magnesia production at a rate of 100,000 tons per annum from Lake Eyre dolomites. As you are aware A.M.D.E.L. have submitted to us their initial report on 4th August, 1970, in which they considered the production to be only 75,000 tons per annum. On examination of that report we found quite a number of misconceptions and inaccuracies and subsequently an independent study was prepared by us and submitted to you on 30th October, 1970.

Concurrently A.M.D.E.L. has corrected their earlier report and that report is enclosed herewith.

The initial A.M.D.E.L. report has shown the cost of 1 ton of magnesia ready for shipment at Port Pirie to be $61.50 per ton. The corrected report has shown the cost to be $43.00, whilst our report estimated the cost on a comparative basis to be $35.50.

We still disagree with the corrected A.M.D.E.L. report and our basis for this disagreement is enclosed herewith.

Yours faithfully,

Encls. de VERE & HAYMES

BASIS FOR CORRECTION OF A.M.D.E.L.'S REPORT NO. 3

Dealing with A.M.D.E.L.'s report Section 2.1 "Basis for Cost Estimation" we disagree with the following :

Housing - Page 3 of A.M.D.E.L.'s Report

A.M.D.E.L. estimates that the cost of housing a married man at Maree would be $35,000 and for a single man - $10,000. A.M.D.E.L. further estimate that half of the staff to be housed at Maree would be married and that the total labour force at Marree would be 58 people.

We estimated that it will cost $10,000 to house a single man and $25,000 for a married man. We further feel that not more than one third of the personnel employed at Maree would be married. Furthermore our detailed analysis of labour requirements show the personnel required at Marree to be 45. On this basis the cost of housing in Marree would be :

Single	30 x 10,000	$300,000
Married	15 x 25,000	$375,000
		$675,000
A.M.D.E.L.'s estimate		$1, 310 ,000
Saving in capital cost		$635,000

Fuel Oil Consumption - Page 4 of A.M.D.E.L.'s Report

A.M.D.E.L. estimated the total fuel oil consumption at 59,000 tons per annum, whilst we estimated that only 52,000 tons per annum should be required. The basis for our estimate was submitted to you on Pages 7 and 8 of our report under Part 3 'Process Calculations.' We feel that our estimate is the more accurate one as the actual fuel consumption was calculated taking into account the complete process and was not taken out of an old text book as done by A.M.D.E.L. The difference between A.M.D.E.L.'s and our figure is 7,000 tons of fuel oil per annum, making an effective saving in operating costs of $105,000 per annum.

Utilities - Page 4 of A.M.D.E.L.'s Report

Although agreeing with their estimates of electricity costs we disagree with their estimate of water consumption.

Due to the general shortage of fresh water in the area we have included a reverse osmosis system in our estimate so that two thirds of the water can be recleaned and reused in the process.

We therefore feel that our water costs of $50,000 per annum are a more realistic figure than A.M.D.E.L.'s $126,000 per annum resulting in an effective saving in operating costs of $76,000 per annum.

Labour - Page 5 of A.M.D.E.L.'s Report

We completely disagree with A.M.D.E.L.'s labour estimate, which once again has been taken out of an old text book. According to our detailed estimates as shown on pages 11 and 12 of our report we would require a staff of 45 people for the mine up-grading and dolomite calcination plant and 42 people for the magnesia plant making a total of 87 people or 1.8 man hours per ton of magnesia produced. On the other hand A.M.D.E.L.'s estimates are completely inconsistent as their Report No. 2 dealing with the production of 75,000 tons of magnesia per annum shows a total labour requirement of 120 personnel or 3 man hours per ton of magnesia produced. In their Report No. 3 dealing with a magnesia plant capable of producing 100,000 tons per annum they estimate their total labour force at 180 or 3.3 man hours per ton of magnesia produced. This appears to be completely inconsistent as we feel that an increase of the rate of capacity of the plant by one third would not result in a one third increase in total employ and most certainly would not increase the man hours per ton required as stated in A.M.D.E.L.'s Report. We therefore feel that our estimate, which was prepared taking into consideration each item of equipment needing supervision is the more accurate one.

On the above basis A.M.D.E.L.'s total estimated labour costs were $835,000 per annum as against our cost of $480,000 per annum resulting in operating cost saving of $355,000 per annum.

Summary

	Operating Cost Saving
Capital Cost Saving $635,000	$63,000
Fuel Oil	$105,000
Water	$76,000
Labour	$355,000
Total Operating Cost Saving per annum	$599,000

Note :

This represents a saving of $6 per ton of magnesia produced, reducing A.M.D.E.L.'s cost of magnesia at Port Pirie to $37 per ton, which is comparable with our figure of $35.50 per ton.

CONYNGHAM ST. FREWVILLE SOUTH AUSTRALIA 5063 TELEPHONE 79 1662 TELEGRAMS 'TELEX' AA82520

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THE AUSTRALIAN MINERAL DEVELOPMENT LABORATORIES

PLEASE ADDRESS ALL CORRESPONDENCE TO THE DIRECTOR.

OUR REFERENCE: CME 3/494/1
YOUR REFERENCE:

6 November 1970

Dr J. de Vere
de Vere and Haymes
22 Alfred Street
MILSONS POINT N.S.W. 2061

UMBUM CREEK SYNDICATE

PRODUCTION OF MAGNESIA FROM DOLOMITE (PART 2)

PROGRESS REPORT NO. 3

Investigation and Report by: H.W. Byerlee

Officer in Charge,
Chemical and Metallurgical Engineering Section: P. K. Hosking

for P. Dixon
Acting Director

1. INTRODUCTION

In a letter of 22 June 1970, Mr J.W. Haymes of de Vere & Haymes, authorised Amdel to proceed with Part 2 of a feasibility study of the production of magnesia from dolomite deposits near Lake Eyre, S.A. The present report arises from suggestions made by Dr de Vere during his visit to Adelaide on 5 October 1970. It follows on from Part 2 and considers in more detail certain aspects of producing magnesia by the sea water process.

2. MAGNESIA FROM SEA WATER

(a) General

Extraction of magnesia from sea water is a well established process operating on a commercial basis. There are a number of plants operating, both in England and the U.S.A. Plant practice varies only slightly between the two countries and there will be no significant differences in the economics.

(b) Outline of Process

The Moss Landing plant of the Kaiser Chemical Division is typical of American practice and will be taken as a model for estimating the ecnomic feasibility of the process for the present case. A modified flowsheet of the Kaiser plant is shown in Figures 1 and 2.

Scrubbed rocks are conveyed to a heavy media separation unit that contains a mixture of ferrosilicon and magnetite ore with a specific gravity of about 2.74. Dolomite, with a specific gravity of 2.85, sinks to the bottom and lighter reject rock floats to the surface. Cleaned sized dolomite is conveyed to a stockpile at the plant level. At this point, 68 to 70% of the original crush has been separated from the dolomite ore. The dolomite is then crushed and screened into +¼ inch and -¼" fractions, so that it can be calcined more economically in the kilns. These operate at a maximum temperature of 1100°C and require 6.75 million BTU for each short ton of calcined dolomite produced. After cooling and screening, most of the calcined dolomite is shipped to the magnesia plant which is fifteen miles away at Moss Landing.

At the magnesia plant the calcined dolomite is added to three 125 feet diameter hydrotreaters to soften the incoming sea water by precipitating carbonates. The softened sea water flows to two primary reactors, 75 feet in diameter, into which is fed the main addition of calcined dolomite to precipitate the $Mg(OH)_2$, which in fine suspension overflows into three parallel-flow 250 ft diameter thickeners, the overflow being returned to the sea. The thickened $Mg(OH)_2$ slurry is washed countercurrently with calcined-dolomite-softened fresh water in two 250 ft thickeners to decrease the NaCl content from 30,000 parts per million to 5000 parts per million. The underflow containing 2.2 lbs of $Mg(OH)_2$ per gallon is conducted to five 14 by 18 ft rotary vacuum filters which deliver a cake containing 50% $Mg(OH)_2$. This is conveyed to rotary kilns where calcining at 1800°C produces dead burnt magnesia.

The reactions involved in the process are principally the following:

Calcination:

$$CaMg(CO_3)_2\ (c) \rightarrow CaO(c) + MgO\ (c) + 2CO_2\ (g)$$

Slaking:

$CaO\ (c) + MgO\ (c) + 2\ H_2)\ (1) \rightarrow Ca(OH)_2(c) + Mg(OH)_2(c)$

Precipitation:

$Ca(OH)_2(c) + Mg(OH)_2(c) + MgCl_2\ (ag) \rightarrow 2Mg(OH)_2(c) + CaCl_2\ (ag)$

Calcination:

$2Mg(OH)_2(c) \rightarrow 2MgO\ (c) + 2H_2O\ (g)$

(c) Size of Plant

It will be assumed that the plant has a capacity of 100,000 long tons per annum.

(d) Grade of Product

It will be assumed that a single burnt magnesia containing about 95% MgO is produced. This relatively high grade may be difficult to produce with a single burning step.

2.1 Basis for Cost Estimation

Before giving the plant and operating costs it is necessary to first state the basis for the calculation of certain of the costs.

Installed Plant Cost

In the chemical industry the installed plant cost is usually about three times the value of the process equipment. This ratio will be used throughout the cost estimation except for the heavy medium plant and the rotary kiln for calcining dolomite. The cost of the heavy medium plant is based on the estimated total cost for complete plants. In the case of the magnesia kiln it appears that in Australia the installed cost is about 3.5 times the cost of the kiln. The installed cost of the thickeners will be taken as 1.5 times the equipment cost, and with the filters the ratio will be taken as 2.7.

Location Factors

The basic cost of the plant will be taken as the cost in a capital city. In other areas the cost will be higher because of the cost of transporting equipment, materials and labour to the site. In remote areas it is also necessary to supply accommodation for erection personnel as well as paying higher wages. For these reasons the following location factors will be used:-

Location	Location Factor
Adelaide	1.00
Port Pirie	1.02
Lake Eyre	1.12

Annual Increase in Cost of Construction

It will be considered that the cost of construction increases at the rate of 2.5 per cent per annum.

Rate of Exchange

The rate of exchange will be taken as $1.00 Australian equals $1.12 U.S.

Housing

Budget quotations from Wowic Industries Limited indicate that the cost of supplying housing only, without further amenities, will be $26,000 per married man and $6,500 per single man. Costs to develop a complete township will include such items as power, water, sewerage, roads and community services, and these have been considered to increase the total cost of housing for a married man to $35,000 and for a single man to $10,000.

Since 58 employees will be located at the mine site, and considering 29 to be married, the population to be housed amounts to 160 persons. This approaches the present population of Marree, so it is doubtful if any significant saving could be effected by locating the town at Marree. It should be pointed out that Marree is only just self-sufficient in power, water and other community services.

Depreciation

Because of the less rapid change in the technology of this process the amortisation will be lower than for the average chemical plant. For this reason the amortisation rate will be taken as 7% rather than the more usual 10%.

Maintenance

Because of the relatively large size and lack of complexity of much of the equipment, the maintenance charge will be taken as 4% rather than the more usual 5%. Half of the maintenance charge will be attributed to materials and the other half to labour.

Interest

The interest rate on the borrowed capital is assumed to be 8 per cent per annum.

Insurance

The insurance on the fixed capital is assumed to be 1 per cent per annum.

Dolomite Consumption

The following ratios will be assumed in the estimation of throughputs in various parts of the plant.

Tons of mined rock per ton of dolomite feed to kiln	=	1.40
Tons of dolomite feed to kiln per ton of magnesia product	=	2.70
Tons of calcined dolomite per son of magnesia product	=	1.25

Fuel Oil Consumption

From published figures the heat requirements of the dolomite kiln can be taken as 8 million B.T.U. per long ton of product. The heat requirements of the magnesia kiln would be about 15 million B.T.U. per ton of product. This latter figure is based on the following assumptions:-

(1) The feed to the kiln contains 50% by weight of water.
(2) The outlet temperature of the exhaust gases of 500°C.
(3) A maximum temperature of 1800°C.
(4) A kiln efficiency of 70%.

Assuming the use of heavy fuel oil with a quoted calorific value of 18,950 B.T.U. per pound, the fuel consumption per ton of magnesia will be:

Dolomite kiln $$\frac{8 \times 10^6 \times 1.25}{1.895 \times 10^4 \times 2240} = 0.236 \text{ tons/ton of magnesia}$$

Magnesia Kiln $$\frac{15 \times 10^6}{1.895 \times 10^4 \times 2240} = 0.354 \text{ tons/ton of magnesia}$$

Total = 0.590 tons/ton of magnesia

The cost of fuel oil will be taken as the cost in Port Pirie, freight being added as an extra.

Sea Water

The ratio of the concentration of the sodium radicle to the magnesium radicle in sea water, Lake Eyre brines, and Lake Eyre salt cake is as follows:-

	Ratio of Na to Mg
Sea water	8
Lake Eyre Brines	25
Lake Eyre salt cake	520

From this it is apparent that neither Lake Eyre brines or Lake Eyre salt cake are suitable alternatives to sea water.

Utilities

Only the two main utilities, electricity and water, will be considered. The cost of these being taken as the cost at Port Pirie. These assumptions cannot be completely justified since the water at the mine site must be supplied by a bore, however most of the total water consumption will occur at Port Pirie.

The required electricity is 50 Kw hr per ton of magnesia (Aries and Newton 1955) and the required water consumption is 3600 gallons per ton of magnesia. Most of this water consumption is required in the two stage countercurrent washing thickeners in order to reduce the NaCl concentration from 30,000 ppm to 5000 ppm.

Freight

The following freight rates, per long ton, were obtained from the Commonwealth Railways and Mayne Nickless Limited.

Mine site - Marree (40 miles road transport)	$2.55
Marree - Port Pirie	$4.52
Port Pirie - Marree (fuel)	$4.52

The different localities are shown in Figure 3.

Road freight between the minesite and Marree must be used because the railway past Marree will probably be closed in 1977. Considering the tonnages involved, it is not likely that the Commonwealth Railways could be induced to keep the line open. At present rail freight from Alberrie Creek is about 90 cents per ton less than combined road and rail freight. A major expense in railing from Alberrie Creek is the transhipment to standard gauge at Marree. Unfortunately a considerable capital outlay would be required to make this step less expensive.

Labour

Comstock (1963) has given a table showing the labour requirements to produce magnesia, a copy of which is given below.

TABLE 2

ESTIMATED LABOUR REQUIREMENTS TO PRODUCE MAGNESIUM OXIDE IN THE UNITED STATES, 1960 (COMSTOCK 1963)

TYPE OF LABOUR	AVERAGE MAN-HOURS PER SHORT TON
Professional	
Engineers	0.45
Others	0.32
Total	0.77
Clerical	0.34
Labour	
Skilled	0.97
Semiskilled	1.31
Unskilled	0.68
Total	2.96
Grand Total	4.07

It will be assumed that, because of more efficient instrumentation and machinery, the present labour requirements are 75% of those given by Cornstock. In addition it will also be assumed that two thirds of thelabour is required at the magnesia plant.

Section	Number of Employees	Manhours per long ton of magnesia
Mine, upgrading plant, and Dolomite Calcining plant	58	1.1
Magnesia Plant	122	2.3

Because of the locality the average hourly wage rate at the mine site will be considerably higher than at Port Pirie.

Location	Average hourly rate
Mine Site	$3.20
Port Pirie	$2.10

Working Capital

The working capital will be taken as the total cost associated with three total operating costs.

Location of the Plant

It will be assumed that the Mine, Upgrading Plant and Dolomite Calcining Plant are located at Alberrie Creek and the Magnesia Plant is located at Port Pirie. From the map of Port Pirie given in Figure 4, it can be seen that there may be certain difficulties associated with either the plant foundations or the intake and discharge of sea water.

Shipment of Magnesia

At present bulk material at Port Pirie is shipped from the wheat silos and the Broken Hill Associated Smelters wharf. The bulk loading facilities at the wheat silos could not be used because, in this area, there is no spare land where bulk storage facilities could be located. The other location would present two difficulties, the first being the problem of obtaining permission to use Broken Hill Associated Smelters' loading facilities, and the other being the fact that the adjacent mineral concentrate heaps and the general condition of the area introduces considerable contamination problems.

Alternative loading methods would be either a completely separate bulk loading facility, or to load into bags or other containers. Considering the costs involved, neither of these alternatives would be suitable.

For the above reasons the production cost of magnesia will be taken as the cost in a bulk store located at the plant. The problem of shipping the product from Port Pirie is a very serious one and warrants considerable attention.

2.2 Capital Cost

The installed equipment costs have been rounded off to the nearest $10,000.

Mine, Upgrading Plant, Dolomite Calcining Plant and Road

(1) Tractor. Catepillar Model D9, with blade and ripping attachments — Cost: $130,000

(2) Auxiliary Mining Equipment. This includes drills, compressors and other items. — Cost: $ 50,000

(3) Front End Loader. One five cubic yard Catepillar Model 980, front end loader. — Cost: $ 60,000

(4) Trucks. Two, twenty ton ore trucks. Unit equipment cost = $40,000 — Cost: $ 80,000

(5) Jaw crusher. One jaw crusher to crush the product to minus 4 inch size.

Equipment cost = $10,000
Installed cost = 3.0 x 1.12 x 10,000 = $ 30,000

(6) Drum Scrubber. This is to scrub the crushed dolomite.

Equipment cost = $37,000
Installed cost = 3.0 x 1.12 x 37,000 = $120,000

(7) Screens. Three vibrating screens for the crushed dolomite.

Unit equipment cost = $4,000
installed cost = 3 x 3.0 x 1.12 x 4,000 = $ 40,000

(8) Heavy Medium Plant. One plant with a capacity of 35 tons/hr

Installed cost = 1.12 x 370,000 = $410,000

(9) Workshop. For the maintenance of the mining and upgrading equipment.

Installed cost = $ 90,000

(10) Dewatering Classifier. One dewatering classifier unit.

Unit equipment cost = $20,000
installed cost = 3.0 x 1.12 x 20,000 = $ 60,000

(11) Dolomite Kilns. Two 9 ft diameter by 210 ft long rotary kilns. The auxiliary equipment includes expensive items such as electrostatic precipitators and coolers

Unit equipment cost = $250,000
installed cost = 2.0 x 1.12 x 3.5 x 250,000 = $1,960,000

(12) Bulk Fuel Oil Storage. This system is to have a capacity of 1000 tons.

Installed cost = $ 70,000

(13) Road. An earth formed road suitable for heavy traffic.

Cost per mile = \$5,000
Installed cost = 6.0 x 5,000 = \$ 30,000

(14) Housing. It will be assumed that 50% of the work force is single.

Unit cost = \$10,000 per single man
= \$35,000 per married man

Installed cost = 58 x (0.5 x 10,000 + 0.5 x 35,000) = \$1,310,000

Total cost of Mine, Upgrading Plant, Dolomite Calcining Plant and Road = \$4,440,000

Calcined Dolomite Storage at Marree

Installed cost = \$40,000

Magnesia Plant

(1) Magnesia Thickeners. Two 290 ft. diameter thickeners.

Mechanism = \$410,000 (Dorr-Oliver estimate)
Concrete Tank = \$ 80,000
Rumps = \$ 17,000

Equipment cost = \$507,000

Installed cost = 2 x 1.5 x 507,000 = \$1,520,000

(2) Washing Thickeners. Two 240 ft. diameter thickeners. The cost will be based on the cost of the 290 ft thickeners and an exponent of 0.65 for area will be used.

Installed cost = $2 \times \left(\frac{240}{290}\right)^{1.3} \times 760{,}000$ = \$1,190,000

(3) Hydrotreater. One 205 ft. diameter hydrotreater. The cost will be taken, as advised by Dorr-Oliver as 10% higher than for a thickener.

Installed cost = $1.1 \times \left(\frac{205}{290}\right)^{1.3} \times 760{,}000$ = \$530,000

(4) Primary Reactors. Two 70 ft. diameter primary reactors. The cost will be arbitrarily taken as 20% higher than for thickeners.

Installed cost = $2 \times 1.2 \times \left(\frac{70}{290}\right)^{1.3} \times 760{,}000$ = \$290,000

(5) Secondary Reactor. One 55 ft. diameter secondary reactor. The cost will be taken as 20% higher than that for a thickener.

Installed cost = $1.2 \times \left(\frac{55}{290}\right)^{1.3} \times 760{,}000$ = \$110,000

(6) Vacuum Filters. Four 900 sq.ft. epoxy coated disc filters plus auxiliary equipment.

Disc filters	=4 x 45,000 = 180,000	Dorr-Oliver estimate	
Auxiliary equipment	= 160,000	" " "	
Total equipment cost	$340,000		
Installed cost = 2.7 x 340,000			$920,000

(7) Magnesia Kilns. Two 10 ft diameter by 265 ft long rotary kilns.

Unit equipment cost = $320,000
Installed cost = 2 x 3.5 x 320,000 — $2,240,000

(8) Pumping Station. Three 7500 g.p.m. pump with motors. One pump is on standby.

Pump cost = $3,500
Motor cost = $2,000

Unit cost = $5,500

Installed cost = 3 x 3.0 x 5,500 — $ 50,000

(9) Pipeline. One 27 inch diameter pipeline to and from the plant, length say 1½ miles.

Cost per mile = $90,000

Total cost = 1.5 x 90,000 — $140,000

(10) Dolomite Unloading and Storage Facilities.

Installed cost — $ 50,000

(11) Dolomite Feeding System. This is to include an elevator, an elevated bin, and conveyors to feed the hydrotreaters and reactors

Installed cost — $ 70,000

(12) Fuel Oil Storage

Installed cost — $ 40,000

(13) Magnesia Storage. This shed is to have a capacity of 15,000 tons

Installed cost — $ 80,000

(14) Workshop

Installed cost — $ 70,000

(15) Warehouse

Installed cost — $ 30,000

(16) Office

Installed cost — $ 70,000

(17) Laboratory

Installed cost $ 50,000

(18) Change Rooms

Installed cost $ 10,000

Total cost of Magnesia Plant $7,460,000

<u>Fixed Capital</u> $11,900,000

<u>Working Capital</u> (3 months total operating costs) $1,070,000

<u>Total Capital</u> $12,970,000

2.3 Operating Costs

<u>Labour and Supervision</u>

Cost = {1.1 x 3.20 + 2.3 x 2.10} 100,000 $835,000

<u>Utilities</u>

<u>Fuel Oil</u>. The total fuel oil consumption of the dolomite kiln plus the magnesia kiln is 0.59 tons per ton of magnesia. The price in Port Pirie is $15.000 per long ton.

Cost = 0.59 x 100,000 x 15.00 $885,000

<u>Water</u>. The fresh water consumption will be 3600 gallons per ton of magnesia. The price of water in Port Pirie is $0.35 per 1000 gallons.

Cost = 3.6 x 100,000 x 3.5 $126,000

<u>Electricity</u>. The electricity consumption should be about 55 KW hr per ton of magnesia, and the cost at Port Pirie is $0.17 per KW hr

Cost = 50 x 100,000 x 0.017 $ 85,000

<u>Maintenance</u>

Cost = 0.02 x 11,900,000 $238,000

Indirect Operating Cost

<u>Payroll Overhead</u>

This will be taken as 15 per cent of labour and supervision cost.

Cost = 0.15 x 835,000 $125,000

<u>Freight</u>

Transport of calcined dolomite from Mine to Marree.

Transport of calcined dolomite from Marree to Port Pirie

1.25 x 100,000 x 4.52 $565,000

Transport of fuel from Port Pirie to Mine

(2.55 + 4.52) x .236 x 100,000 $167,000

Total freight cost $1,051,000

Fixed Operating Cost

Depreciation

Cost = 0.07 x 11,900,000 $833,000

Insurance

Cost = 0.01 x 11,900,000 $119,000

The cost associated with the total operation is summarised in Table 2.

TABLE 2: SUMMARY OF COST DATA FOR PRODUCTION OF MAGNESIA FROM ALBERRIE CREEK DOLOMITE AND SPENCER GULF SEAWATER

ITEM	COST $
Fixed Capital	11,900,000
Working Capital	1,070,000
Total Capital	12,970,000
Operating Costs (per annum)	
Labour and Supervision	835,000
Fuel Oil	885,000
Other Utilities	211,000
Maintenance	238,000
Direct Operating Costs	2,169,000
Payroll Overhead	125,000
Freight	1,051,000
Indirect Operating Costs	1,176,000
Depreciation	833,000
Insurance	119,000
Fixed Operating Costs	952,000
Total Operating Costs	4,297,000
Interest on Capital @ 8%	1,032,000
Cost per ton of Magnesia in Plant Store	42.97
Interest Charge per ton of Magnesia	10.32

3. DISCUSSION

The above study gives an approximate production cost for magnesia from Alberrie Creek dolomite. If this cost is sufficiently low to warrant a more extensive investigation, a suitable method of upgrading the dolomite should first be established. In addition it will be necessary to select a location for the plant that will avoid the problems of expensive foundations and the dilution of the seawater feed by the discharge from the plant. Another factor warranting early attention is the selection of a suitable method for loading ships at the wharf.

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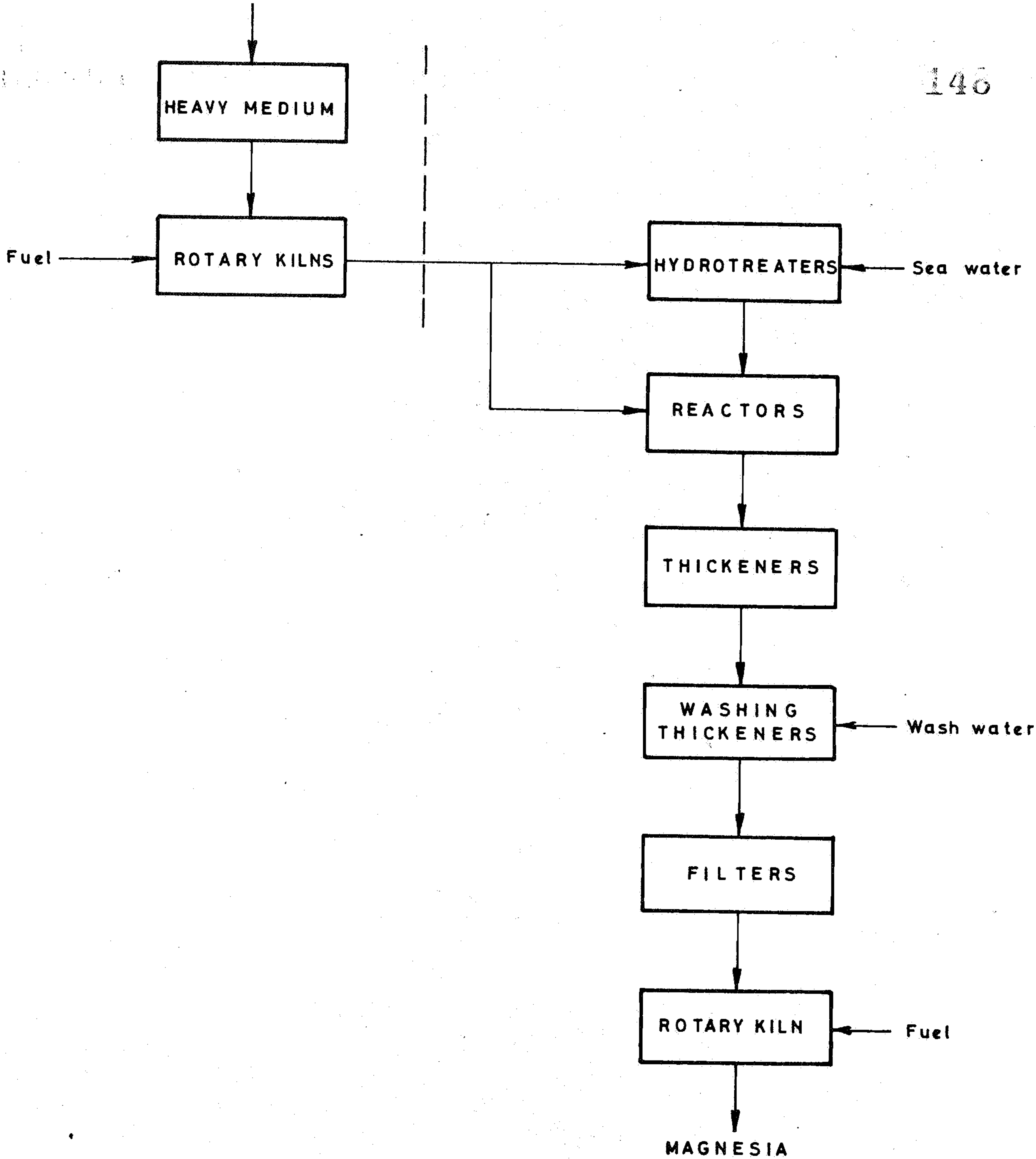

FIGURE 1: SIMPLIFIED FLOWSHEET FOR PRODUCTION OF MAGNESIA FROM SEA WATER

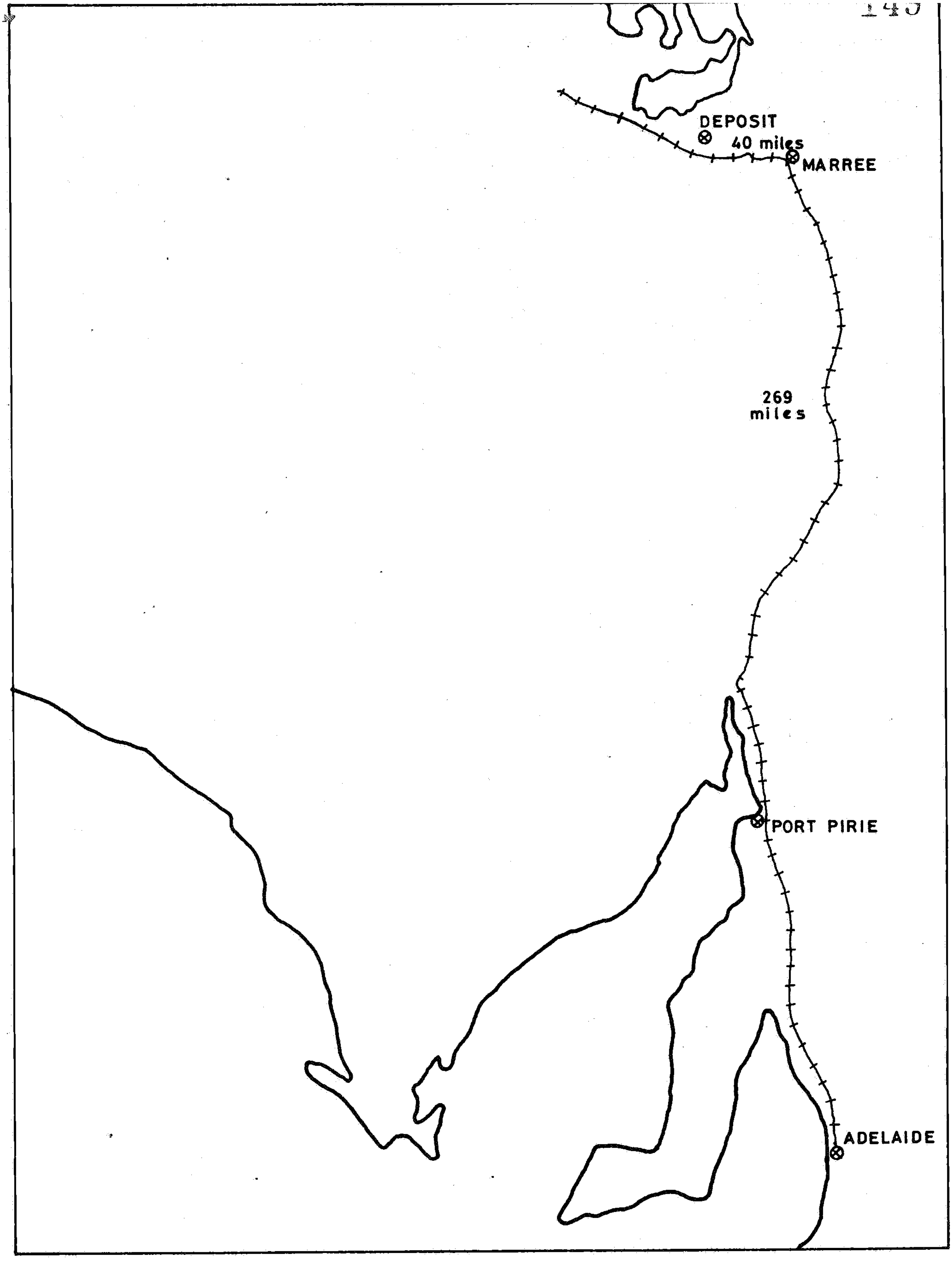

FIGURE 3: LOCATION OF THE DEPOSIT

ENV 1231.

150

STRIP SAMPLE
~~XXXXXXXXXXXXXXXXXXXX~~ RECORD

-ordinates of Collar
.... E ....
rted ....
ished ....

Location The Neales River, S.A.
Direction .... Inclination ....
Depth .... Vert. Depth ....

Logged by: P.A. Rayment
Elevation Collar ....
Casing ....

Site ~~Xxxx~~ No. 1A
Size ....

EC. %	SECTION From	SECTION To	DESCRIPTION	SAMPLE No.	SAMPLE From	SAMPLE To	ASSAY MgO%			
	0'0"	6'0"	SANDSTONE, brown, with ironstone lenses, some gypseous patches							
	6'0"	7'0"	DOLOMITE, dirty, some gypseous clay iron-stained in part		Top of Dolomite (3ft sample)					
	7'0"	7'2"	CLAYSTONE, dolomitic							
	7'2"	9'0"	DOLOMITE, grey, clayey	1A			1.5			
			RIVER BED LEVEL							

STRIP SAMPLE

~~XXXXXXXXXXXXXXXXXX~~ RECORD

151

rdinates of Collar ... E ...
ed ...
hed ...

Location The Neales River, SA.

Direction ... Inclination ...

Depth ... Vert. Depth ...

Logged by: P.A. Rayment

Elevation Collar ...

Casing ...

Site ~~XXX~~ No. 1B

Size ...

SECTION From	SECTION To	DESCRIPTION	SAMPLE No.	SAMPLE From	SAMPLE To	ASSAY MgO%			
0'0"	2'0"	SANDSTONE, fine with moderate clay content; also some pebbles							
2'0"	6'0"	DOLOMITE, light grey with a fine GYPSUM band at base.	1B	Top of Dolomite (4ft sample)		2.2			
		RIVER BED LEVEL							

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STRIP SAMPLE
~~[illegible]~~ RECORD

Co-ordinates of Collar
N .... E ....
Started ....
Finished ....

Location The Neales River, S.A.
Direction .... Inclination ....
Depth .... Vert. Depth ....

Logged by: P. A. Rayment
Elevation Collar ....
Casing ....

Site ~~Hole~~ No. 1C
Size ....

REC. %	SECTION From	SECTION To	DESCRIPTION	SAMPLE No.	SAMPLE From	SAMPLE To	ASSAY MgO%			
	Ft. in.	Ft. in.								
	0	5 0	CLAY, sandy							
	5 0	9 0	DOLOMITE, light grey, soft, crumbly, decomposed; contains an irregular network of GYPSUM bands and veins up to ½" thick,	1C	Top of Dolomite (4ft sample)		1.1			
			RIVER BED LEVEL							

STRIP SAMPLE
~~DIAMOND DRILL HOLE~~ RECORD

-ordinates of Collar
E

rted
ished

Location The Neales River, S.A.
Direction
Depth
Inclination
Vert. Depth

Logged by: P.A. Rayment
Elevation Collar
Casing

Hole No. 1D
Size

EC. %	SECTION From	SECTION To	DESCRIPTION	SAMPLE No.	SAMPLE From	SAMPLE To	ASSAY MgO%			
	Ft.in	Ft.in								
	0	6 0	SANDSTONE, fine with moderate clay content; also some pebbles and fine gypseous layers.							
	6 0	14 0	DOLOMITE, contains occasional fine gypsum bands, as at 5 feet from the top.	1D	Top (4ft. sample)	4ft	1.1			
					4ft (4ft sample)	8 ft	1.5			
			CREEK BED LEVEL.							

STRIP SAMPLE ~~XXXXXXXXXXXXXXXXXXXXX~~ RECORD

Co-ordinates of Collar .... E ....

Started ....

Finished ....

Location The Neales River, S.A.

Direction .... Inclination ....

Depth .... Vert. Depth ....

Logged by: P.A. RAYMENT

Elevation Collar ....

Casing ....

Hole No. 1E

Size ....

REC. %	SECTION From	SECTION To	DESCRIPTION	SAMPLE No.	SAMPLE From	SAMPLE To	ASSAY MgO%		
	Ft.in	Ft.in							
	0' 0"	3"	CLAY, silty.						
	3"	3' 3"	DOLOMITE, with clayey gypseous bands, crumbly partly decomposed.	1E	Top (6ft sample)	6ft	5.6		
	3' 3"	12' 3"	DOLOMITE, off-white, crumbly partly decomposed ('Bench'-line, equivalent to top of dolomite at site 1D).		6'0" (6ft sample)	12'0"	4.7		
	12'3"	18'3"	DOLOMITE, white, hard.		12'0" (6ft sample)	18'0"	0.8		
			RIVER BED LEVEL						

STRIP SAMPLE ~~XXXXXXXXXXXXXXXXXX~~ RECORD

o-ordinates of Collar .... E ....

arted .... nished ....

Location The Neales River S.A.
Direction .... Inclination ....
Depth .... Vert. Depth ....

Logged by: P.A. Rayment
Elevation Collar ....
Casing ....

Site ~~Hole~~ No. 1F
Size ....

REC. %	SECTION From	SECTION To	DESCRIPTION	SAMPLE No.	SAMPLE From	SAMPLE To	ASSAY MgO%			
	0'0"	10'0"	SANDSTONE, fine grained with some clayey dolomitic lenses.							
	10'0"	11'0"	DOLOMITE, white to grey	1F	Top (Total sample 3ft thick)		1.9			
	11'0"	12'0"	SANDSTONE, as above							
	12'0"	14'0"	DOLOMITE							
			RIVER BED LEVEL.							

STRIP SAMPLE ~~XXXXXXXXXXXXXXXXXX~~ RECORD

-ordinates of Collar .... E .... Location The Neales River Logged by: P.A. RAYMENT Site ~~XXX~~ No. 1G

rted .... Direction .... Inclination .... Elevation Collar .... Size ....

ished .... Depth .... Vert. Depth .... Casing ....

EC. %	SECTION From	SECTION To	DESCRIPTION	SAMPLE No.	SAMPLE From	SAMPLE To	ASSAY MgO%			
	0'0"	7'0"	SANDSTONE, fine silty							
	7'0"	11'0"	DOLOMITE, off white, contains some brown silty bands	1G	Top of Dolomite (4ft sample)		9.4			
			RIVER BED LEVEL							
			(North-east of this location the dolomite appears to thin out, at some 20-30 yds. Difficulty in estimating due to rapid decrease in creek bank accompanied by aeolian sand dune and scree).							

STRIP SAMPLE
~~XXXXXXXXXXXXXXXXX~~ RECORD

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...-ordinates of Collar ... E ...	Location The Neales River, S.A.	Logged by: P.A. Rayment
...arted	Direction / Inclination	Elevation Collar
...nished	Depth / Vert. Depth	Casing

Site ~~Hole~~ No. 2A
Size

REC. %	SECTION From	SECTION To	DESCRIPTION	SAMPLE No.	SAMPLE From	SAMPLE To	ASSAY MgO%			
	0'0"	3'0"	SANDSTONE, brown, fine clayey							
	3'0"	3'8"	CRYSTALLINE BAND, hard, consists of irregular aggregates of intergrown scaly crystals of dolomite? up to 2" in diameter, which contain included sand grains.							
	3'8"	6'8"	DOLOMITE, off-white, fairly pure.	2A	Top of dolomite (3ft sample)		10.3			
			SCREE approximately 4 ft to RIVER BED LEVEL							

STRIP SAMPLE
~~XXXXXXXXXXXXXXXXXXXX~~ RECORD

-ordinates of Collar
.... E ....
Location The Neales River, S.A.
Logged by: P.A. Rayment
Site ~~Hole~~ No. 2B
-rted ....
Direction ....
Inclination ....
Elevation Collar ....
-ished ....
Depth ....
Vert. Depth ....
Casing ....
Size ....

REC. %	SECTION From	SECTION To	DESCRIPTION	SAMPLE No.	SAMPLE From	SAMPLE To	ASSAY MgO%			
	0'0"	2'6"	SANDSTONE, brown, coarse grained, crumbly, some fine crystalline layers.							
	2'6"	2'8"	DOLOMITE, hard							
	2'8"	3'8"	SANDSTONE, fine grained, moderate clay content, banded.							
	3'8"	5'8"	SANDSTONE, coarse grained, common cross-bedding.							
	5'8"	7'8"	PEBBLE BAND, some fine sandy layers, cross-bedded.							
	7'8"	10'8"	DOLOMITE, off-white							
			SCREE - approximately 5 ft to RIVER BED LEVEL	2B	Top of Dolomite (3ft sample)		3.9			

STRIP SAMPLE
XXXXXXXXXXXXXXXXXX RECORD

ordinates of Collar .... E .... Location: The Neales River, S.A. Logged by: P.A. Rayment Site ~~Hole~~ No. 2C

ted .... Direction .... Inclination .... Elevation Collar ....

shed .... Depth .... Vert. Depth .... Casing .... Size ....

C. SECTION From	To	DESCRIPTION	SAMPLE No.	From	To	ASSAY MgO%			
0'0"	1'0"	SANDSTONE, coarse grained to pebbly.							
1'0"	3'0"	SANDSTONE, finer, encrusted with irregular aggregates of small intergrown scaly crystals of dolomite?, common intergranular sand.							
3'0"	3'3"	CRYSTALLINE BAND, coarse hard,							
3'3"	7'3"	SANDSTONE, coarse to pebbly with some clay bands and some crystalline layers; also some cross-bedding.							
7'3"	22'3"	DOLOMITE, light grey	2C	Top of Dolomite (5ft sample)		2.9			
				5ft (5ft sample)		7.1			
				10ft (5ft sample)		4.0			
		SCREE - approximately 2ft to RIVER BED LEVEL		15ft					

STRIP SAMPLE ~~XXXXXXXXXXXXXXXXXXXXX~~ RECORD

-ordinates of Collar .... E ....

Location The Neales River, S.A.

Direction .... Inclination ....

Depth .... Vert. Depth ....

urted ....

nished ....

Logged by: P.A. RAYMENT

Elevation Collar ....

Casing ....

Site ~~XXXe~~ No. 2D

Size ....

REC. %	SECTION From	To	DESCRIPTION	No.	SAMPLE From	To	ASSAY MgO%			
	0'0"	4'6"	SANDSTONE, high clay content, crumbly some crystalline bands.							
	4'6"	6'0"	CLAYSTONE, greenish.							
	6'0"	7'6"	SANDSTONE, brown, fine grained, even.							
	7'6"	13'6"	PEBBLE BAND, medium to coarse, some SANDSTONE bands to 6"							
	13'6"	25'6"	DOLOMITE, light grey, contains a greenish mud band 3" - 4" thick at 1ft from the top; also a 4" greenish muddy band at 4ft from the top.	2D	Top of Dolomite (4ft sample)		3.5			
					4ft (4ft sample)		6.0			
					8ft (4ft sample)		6.3			
					12ft					
			SCREE - approximately 5ft to RIVER BED LEVEL.							

STRIP SAMPLE
~~XXXXXXXXXXXXXXXXXXX~~ RECORD

Co-ordinates of Collar .... E ....

Started ....

Finished ....

Location The Neales River, S.A.

Direction .... Inclination ....

Depth .... Vert. Depth ....

Logged by: P.A. Rayment

Elevation Collar ....

Casing ....

Site ~~XXX~~ No. 2F

Size ....

REC. %	SECTION From	SECTION To	DESCRIPTION	SAMPLE No.	SAMPLE From	SAMPLE To	ASSAY MgO%			
			(This sample was taken 125 yards away from the river opposite site 2E. The top 4ft of dolomite outcrops a further 75 yards away from the river).							
	0'0"	3'0"	SANDSTONE, brown, clayey, contains some crystalline bands							
	3'0"	5'6"	CLAYSTONE, greenish, crumbly							
	5'6"	7'0"	SANDSTONE, some clay, banded							
	7'0"	8'6"	PEBBLE BAND, medium							
	8'6"	10'6"	SANDSTONE, pebbly in part, some crystalline bands.							
	10'6"	14'6"	DOLOMITE, grey, crumbly, some gypsum	2F	Top of Dolomite (4ft sample) 4ft		6.2			
	14'6"	20'6"	DOLOMITE, white, harder than above		(6ft sample) 10ft		10.9			
			TRIBUTARY CREEK BED							

STRIP SAMPLE RECORD

-ordinates of Collar
.... E ....

Location: The Neales River.
Direction:
Depth:
Inclination:
Vert. Depth:

-rted:
-ished:

Logged by: P.A. Rayment
Elevation Collar:
Casing:

Site No. 2E
Size:

REC. %	SECTION From	SECTION To	DESCRIPTION	SAMPLE No.	SAMPLE From	SAMPLE To	ASSAY MgO%			
	0'0"	1'0"	CLAYSTONE, greenish, sandy							
	1'0"	5'6"	SANDSTONE, moderate clay content with some fine pebbly bands, also some thin crystalline bands.							
	5'6"	7'0"	PEBBLE BAND							
	7'0"	8'0"	DOLOMITE, off-white, clayey	2E	Top of Dolomite					
	8'0"	9'6"	DOLOMITE, white, crumbly		(5ft sample)		9.6			
	9'6"	10'0"	DOLOMITE, off-white, clayey		5ft (5ft sample)		12.6			
	10'0"	21'0"	DOLOMITE, white, hard, crumbly		10ft (5ft sample)		8.6			
	21'0"	21'3"	DOLOMITE, grey, clayey		15ft (4ft sample)		3.6			
	21'3"	26'0"	DOLOMITE, banded, variable		19ft					
			RIVER BED LEVEL							

STRIP SAMPLE RECORD

-ordinates of Collar .... E ....
rted ....
ished ....

Location: The Neales River, S.A.
Direction .... Inclination ....
Depth .... Vert. Depth ....

Logged by: P. A. Rayment
Elevation Collar ....
Casing ....

Site No. 2G
Size ....

REC. %	SECTION From	SECTION To	DESCRIPTION	SAMPLE No.	SAMPLE From	SAMPLE To	ASSAY MgO%			
	0'0"	1'0"	SANDSTONE, brown, some clay, pebbly in part							
	1'0"	2'0"	CLAYSTONE, greenish-grey							
	2'0"	4'0"	SANDSTONE, brown, pebbly in part, some crystalline bands, some gypsum.							
	4'0"	8'0"	DOLOMITE, grey, common gypsum in thin bands and vertical sheets	2G	Top of Dolomite					
					(4ft sample)		3.2			
	8'0"	13'0"	DOLOMITE, white, compact		4ft					
					(5ft sample)		8.9			
	13'0"	16'0"	DOLOMITE, off-white, some gypsum bands		9ft					
	16'0"	26'0"	DOLOMITE, white to off-white, mainly compact		(5ft sample)		10.2			
					14ft					
			RIVER BED LEVEL		(4ft sample)		3.7			
					18ft					
					(4ft sample)		3.1			
					22ft					

STRIP SAMPLE ~~XXXXXXXXXXXXXXXXXX~~ RECORD

-ordinates of Collar
.... E ....

-ted ....
ished ....

Location The Neales River, S.A.
Direction .... Inclination ....
Depth .... Vert. Depth ....

Logged by: P. A. Rayment
Elevation Collar ....
Casing ....

Site ~~Hole~~ No. 2H
Size ....

SECTION From	SECTION To	DESCRIPTION	SAMPLE No.	SAMPLE From / To	ASSAY MgO%	CaO%	Cl	Br	B_2O_3
0'0"	1'0"	SANDSTONE, brown, some crystal aggregates							
1'0"	3'0"	SANDSTONE, coarse to pebbly, common intergranular clay, encrusted with irregular intergrown crystals of dolomite?							
3'0"	5'0"	DOLOMITE, grey, crumbly, some gypseous inclusions		Top of Dolomite (2ft sample)	12.5	25.3	Tr	Nil	Nil
5'0"	10'0"	DOLOMITE, white, compact		2ft					
10'0"	10'3"	CLAY, dolomitic		(5ft sample)	15.0	25.3	0.34	Tr	Nil
10'3"	13'0"	DOLOMITE, white, compact		7ft					
13'0"	13'6"	CLAY, dolomitic		(6ft sample)	12.0	18.3	0.88	.003	Nil
13'6"	15'6"	DOLOMITE, white, compact			The order of these two samples is not known.				
15'6"	16'0"	CLAY, dolomitic, grey, crumbly							
16'0"	17'6"	DOLOMITE, white		13ft					
17'6"	18'0"	CLAY dolomitic		(4ft sample)	11.8	18.0	1.3	.003	Nil
18'0"	20'0"	DOLOMITE, white		17ft					
20'0"	20'6"	CLAY, dolomitic, dark grey, mainly puggy crumbly in part.							

PAGE: 2

Sample 2H

REC. %	SECTION From	To		No.	SAMPLE From	To	ASSAY MgO%	CaO%	Cl	Br	B_2O_3
	20'6"	24'3"	DOLOMITE, white		17ft						
	24'3"	24'6"	CLAY, dolomitic, grey, puggy		(6ft sample)		12.4	18.5	0.79	.003	Nil
	24'6"	26'0"	DOLOMITE, white		23 ft						
			RIVER BED LEVEL								

STRIP SAMPLE RECORD

Co-ordinates of Collar
N .... E ....
Started ....
Finished ....

Location: The Neales River, S.A.
Direction .... Inclination ....
Depth .... Vert. Depth ....

Logged by: P.A. Rayment
Elevation Collar ....
Casing ....

Site No. 2J
Size ....

REC. %	SECTION From	SECTION To	DESCRIPTION	SAMPLE No.	SAMPLE From	SAMPLE To	ASSAY MgO%			
			(This sample was taken 175 yards upstream of 2H, then 70 yards away from the river).							
	0'0"	3'0"	SANDSTONE, brown, clayey in part, encrusted in part with intergrown gypsum crystals							
	3'0"	5'0"	PEBBLE BAND, sandy, some coarse irregular gygsum crystal aggregates with included sand particles.							
	5'0"	7'6"	DOLOMITE, white	2J	Top of Dolomite					
	7'6"	8'0"	CLAY BAND, dolomitic, greenish-grey		(4ft sample)		5.8			
	8'0"	9'0"	DOLOMITE, white		4ft.					
			TRIBUTARY CREEK BED							

STRIP SAMPLE
XXXXXXXXXXXXXXXXX RECORD

Co-ordinates of Collar .... E ....

Started ....

Finished ....

Location The Neales River, SA.

Direction .... Inclination ....

Depth .... Vert. Depth ....

Logged by: P.A. Rayment

Elevation Collar ....

Casing ....

Site XXXX No. 2K

Size ....

REC. %	SECTION From	SECTION To	DESCRIPTION	SAMPLE No.	SAMPLE From	SAMPLE To	ASSAY MgO%			
	0'0"	1'0"	SANDSTONE, brown. clayey in part with some pebbly inclusions.							
	1'0"	5'0"	SANDSTONE, brown, crumbly, pebbly in part with heavy crystalline coating; also some crystalline bands.							
	5'0"	8'0"	SANDSTONE, clayey in part with common pebbly bands and lenses.							
			(The SANDSTONE - DOLOMITE contact is very irregular at this location with noticeable 'washout' structures).							
	8'0"	9'0"	DOLOMITE white	2K	Top of Dolomite					
	9'0"	10'0"	CLAY BAND, dolomitic, grey		2ft	(2ft sample)	6.3			
	10'0"	14'0"	DOLOMITE, white		6ft	(4ft sample)	11.2			
			SCREE - approximately 3ft to RIVER BED LEVEL.							

STRIP SAMPLE
~~XXXXXXXXXXXXXXXXXX~~ RECORD

o-ordinates of Collar
N .... E ....
arted ....
nished ....

Location The Neales River, S.A.
Direction .... Inclination ....
Depth .... Vert. Depth ....

Logged by: P.A. Rayment
Elevation Collar ....
Casing ....

Site ~~XXXX~~ No. 2L
Size ....

REC. %	SECTION From	SECTION To	DESCRIPTION	SAMPLE No.	SAMPLE From	SAMPLE To	ASSAY MgO%			
	0'0"	6'0"	SANDSTONE, brown, common pebbly bands, some cross-bedding							
	6'0"	9'0"	PEBBLE BAND, contains common fine sandy bands.							
	9'0"	11'0"	DOLOMITE, white	2L	Top of Dolomite					
	11'0"	11'3"	CLAY BAND, dolomitic, greenish-grey		(4ft sample)		13.5			
	11'3"	13'0"	DOLOMITE white.							
					4ft					
			RIVER BED LEVEL							

STRIP SAMPLE
~~DIAMOND DRILL HOLE~~ RECORD

Co-ordinates of Collar ... E ...	Location The Neales River, S.A.	Logged by: P. A. Rayment	Site ~~Hole~~ No. 2M
Started ...	Direction ... Inclination ...	Elevation Collar ...	Size ...
Finished ...	Depth ... Vert. Depth ...	Casing ...	

REC. %	SECTION From	SECTION To	DESCRIPTION	SAMPLE No.	SAMPLE From	SAMPLE To	ASSAY MgO%		
			(This sample was taken 300 yards slightly west of south from location 2L).						
	0'0"	4'0"	SANDSTONE, brown, medium, partly obscured by dunes.	2M	Top of Dolomite				
	4'0"	6'0"	DOLOMITE, off-white		(2ft sample)		10.1%		
			TRIBUTARY CREEK FLOOR		2ft				

STRIP SAMPLE
XXXXXXXXXXXXXXXXXX RECORD

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Co-ordinates of Collar
N .... E ....
Started ....
Finished ....

Location The Neales River, S.A.
Direction .... Inclination ....
Depth .... Vert. Depth ....

Logged by: T. Malloy
Elevation Collar ....
Casing ....

Site
XXXX No. 2(X)A
Size ....

REC. %	SECTION From	SECTION To	DESCRIPTION	SAMPLE No.	SAMPLE From	SAMPLE To	ASSAY MgO%	ASSAY CaO%	ASSAY Cl	ASSAY Br	ASSAY B_2O_3
	0'0"	1'0"	CLAY, red								
	1'0"	3'0"	GRAVEL								
	3'0"	3'6"	DOLOMITE, grey								
	3'6"	7'0"	SANDSTONE with pebble bands, current-bedded	2(X) A	Top of Dolomite						
	7'0"	9'0"	DOLOMITE, grey, with dirt horizons.								
					(2ft sample)		1.5	2.0	0.12	Nil	.02
	9'0"	10'0"	DOLOMITE, white, hard, broken								
					2ft						
	10'9"	11'3"	DOLOMITE, grey.								
					(2ft sample)		11.9	18.0	0.09	Nil	Nil
	11'3"	13'0"	DOLOMITE, white with a hard ½" crystalline coating; off-white, soft and wet below.		4ft						
					(2ft sample)		15.2	23.2	0.90	.005	Nil
			RIVER BED LEVEL.		6ft						

DIAMOND DRILL HOLE RECORD

Co-ordinates of Collar
N .... E ....
Started ....
Finished ....

Location The Neales River, S.A.
Direction .... Inclination ....
Depth .... Vert. Depth ....

Logged by: P.A. Rayment
Elevation Collar ....
Casing ....

Site ~~xxxx~~ No. 3A
Size ....

REC. %	SECTION From	SECTION To	DESCRIPTION	SAMPLE No.	SAMPLE From	SAMPLE To	ASSAY MgO%			
			(This sample was taken in a tributary gully 150 yards south-east of a point on the river bank 500 yards north-east of site No. 3B).							
	0'0"	1'0"	SANDSTONE, brown, pebbly							
	1'0"	3'0"	PEBBLE BAND, sandy, contains gypsum crystals which also encrust exposed surface on crop-face.							
	3'0"	7'0"	DOLOMITE, pale grey, crumbly, weathered with common gypsum crystals in top 1 ft; also some crystalline encrustation on crop-face	3A	Top of Dolomite (4ft sample)		4.7			
	7'0"	7'6"	CLAY, dolomitic, black, soft soapy		4ft (6" sample) 4ft 6in.		14.5			
			TRIBUTARY CREEK FLOOR							

STRIP SAMPLE
~~DIAMOND DRILL HOLE~~ RECORD

172

Co-ordinates of Collar
.... E ....
Started ....
Finished ....

Location The Neales River, S.A.
Direction .... Inclination ....
Depth .... Vert. Depth ....

Logged by: P.A. Rayment
Elevation Collar ....
Casing ....

Site No. 3B
Size ....

REC. %	SECTION From	SECTION To	DESCRIPTION	SAMPLE No.	SAMPLE From	SAMPLE To	ASSAY MgO%			
	0'0"	6'0"	SANDSTONE, brown, some gypsum							
	6'0"	9'0"	PEBBLE BAND, sandy, strongly cross-bedded							
	9'0"	10'6"	DOLOMITE, off-white, crumbly	3B	Top of Dolomite					
	10'6"	13'0"	DOLOMITE, white							
	13'0"	14'0"	DOLOMITE, off-white		(5ft sample)		8.4			
			SCREE, approximately 4ft to RIVER BED LEVEL...		5ft					

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STRIP SAMPLE RECORD

~~DIAMOND DRILL HOLE RECORD~~

Co-ordinates of Collar ______ E ______	Location The Neales River, S.Aust.
Started ______	Direction ______ Inclination ______
Finished ______	Depth ______ Vert. Depth ______

Logged by: P.A. Rayment
Elevation Collar ______
Casing ______
Site ~~Hole~~ No. 3C
Size ______

REC. %	SECTION From	SECTION To	DESCRIPTION	SAMPLE No.	SAMPLE From	SAMPLE To	ASSAY MgO%		
	Ft.in.	Ft.in.							
	0	5'0"	SANDSTONE, brown, crumbly, common gypsum						
	5'0"	7'0"	PEBBLE BAND, sandy, common gypsum bands	3C	Top of Dolomite				
	7'0"	9'0"	DOLOMITE, grey, crumbly		(4 ft. sample)		9.7		
	9'0"	19'0"	DOLOMITE, white		4 ft.				
			SCREE, approximately 2 ft. to		(4 ft. sample)		10.1		
			RIVER BED LEVEL.		8 ft.				
					(4 ft. sample)		10.1		
					12 ft.				

STRIP SAMPLE RECORD

~~DIAMOND DRILL HOLE RECORD~~

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Co-ordinates of Collar ______ E ______

Started ______

Finished ______

Location: The Neales River, S.Aust.

Direction ______ Inclination ______

Depth ______ Vert. Depth ______

Logged by: P.A. Rayment

Elevation Collar ______

Casing ______

Site ~~Hole~~ No. 3D

Size ______

Rec. %	SECTION From	SECTION To	DESCRIPTION	SAMPLE No.	SAMPLE From	SAMPLE To	ASSAY MgO%		
	Ft.in.	Ft.in.							
	0	2'0"	SANDSTONE, brown, common gypsum bands, pebbly in top 1 ft.						
	2'0"	4'0"	DOLOMITE, grey, dirty, very hard with common gypseous growth on exposed crop face	3D	Top of Dolomite (4 ft. sample) 4 ft.		12.8		
	4'0"	6'0"	DOLOMITE, grey, dirty						
			SCREE, approximately 5 ft. to RIVER BED LEVEL.						

STRIP SAMPLE RECORD

XXXXXXXXXXXXXXXXXXXXXXXXXXXXX

-ordinates of Collar
E
rted
nished

Location The Neales River, S.Aust.
Direction
Depth
Inclination
Vert. Depth
Logged by: P.A. Rayment
Elevation Collar
Casing
Site No. 4A
XXXXXX.
Size

EC. %	SECTION From Ft.in.	To Ft.in.	DESCRIPTION	SAMPLE No.	From	To	ASSAY MgO%			
			No overburden Some flint boulders up to 2" thick and 2 ft. across							
	0	4'0"	DOLOMITE, white	4A	Top of Dolomite (4 ft. sample) 4 ft.		17.4			
			SCREE, approximately 2 ft. to river bed level							

STRIP SAMPLE RECORD

o-ordinates of Collar
E
arted
inished

Location The Neales River, S.Aust.
Direction
Depth
Inclination
Vert. Depth

Logged by: P.A. Rayment
Elevation Collar
Casing

Site ~~Xxxx~~ No. 4B
Size

REC. %	SECTION From (Ft.in.)	SECTION To (Ft. in.)	DESCRIPTION	SAMPLE No.	SAMPLE From	SAMPLE To	ASSAY MgO%			
	0	2'0"	SANDSTONE, some pebble bands, moderate intergranular clay							
	2'0"	3'0"	PEBBLE BAND, common interstitial sand; also common irregular chert nodules							
	3'0"	7'0"	DOLOMITE, dirty in part	4B	Top of Dolomite (4 ft. sample)		12.2			
	7'0"	12'6"	DOLOMITE, white		4 ft.					
	12'6"	13'0"	CLAY, dolomitic, dark brown to black		(6 ft. sample)					
					10 ft.		14.5			
			RIVER BED LEVEL							

STRIP SAMPLE RECORD

~~[illegible]~~

Co-ordinates of Collar
N ______ E ______
Started ______
Finished ______

Location: The Neales River, S.Aust.
Direction ______ Inclination ______
Depth ______ Vert. Depth ______

Logged by: P.A. Rayment
Elevation Collar ______
Casing ______

Site ~~Hole~~ No. 4C
Size ______

REC. %	SECTION From Ft.in.	SECTION To Ft.in.	DESCRIPTION	SAMPLE No.	SAMPLE From	SAMPLE To	ASSAY MgO%
	0	3'0"	CLAY, sandy, common gypsum crystals				
	3'0"	8'0"	DOLOMITE, mainly off-white, contains a 3" dark clayey band near the base	4C	Top of Dolomite (5 ft. sample) 5 ft.		13.5
			SCREE, approximately 8 ft. to RIVER BED LEVEL				

STRIP SAMPLE RECORD

176

-ordinates of Collar .... E ....

Location The Neales River, S.Aust.

Logged by: T. Malloy

Site No. 5A

rted .... Direction .... Inclination .... Elevation Collar .... Size ....

nished .... Depth .... Vert. Depth .... Casing ....

EC. %	SECTION From	To	DESCRIPTION	SAMPLE No.	From	To	ASSAY MgO%			
	Ftin.	Ft.in.								
	0	2'0"	SAND, fine							
			SANDSTONE							
			PEBBLE BAND, with gypsum							
			SANDSTONE							
	2'0"	6'0"	PEBBLE BAND							
	6'0"	6'6"	DOLOMITE, white, lumpy	5A	Top of Dolomite					
	6'6"	10'0"	DOLOMITE, white		(4 ft. sample)					
			SCREE, approximately 1 ft. to		4 ft.		13.0			
			RIVER BED LEVEL							

STRIP SAMPLE
~~XXXXXXXXXXXXXXXXXXX~~ RECORD

ordinates of Collar	Location The Neales River, S.A.	Logged by: T. Malloy	Site ~~XXXX~~ No. 5B
E	Direction / Inclination	Elevation Collar	Size
ted	Depth / Vert. Depth	Casing	
shed			

C. SECTION From	To	DESCRIPTION	SAMPLE No.	From	To	ASSAY MgO%			
0'0"	6'0"	SAND AND PEBBLE BANDS, interbedded, common gypsum encrustations							
6'0"	9'0"	DOLOMITE, white.							
		SCREE, approximately 3ft to RIVER BED LEVEL	5B	Top of Dolomite (3ft sample) 3ft.		14.3			
		NOTE: Common gypsum crystals and flint pieces occur on the cliff-top between sites 5A and 5B)							

STRIP SAMPLE RECORD

~~XXXXXXXXXXXXXXXXXXXXXXXXX~~

Co-ordinates of Collar
N .... E ....

Started ....
Finished ....

Location: The Neales River, S.Aust.
Direction .... Inclination ....
Depth .... Vert. Depth ....

Logged by: T. Malloy
Elevation Collar ....
Casing ....

Site ~~XXXX~~ No. 5C
Size ....

REC. %	SECTION From Ft.in.	SECTION To Ft.in.	DESCRIPTION	SAMPLE No.	SAMPLE From	SAMPLE To	ASSAY MgO%		
	0	6'0"	SANDSTONE & GRAVEL, flat-bedded						
	6'0"	6'6"	DOLOMITE, lumpy	5C	Top of Dolomite				
	6'6"	9'9"	DOLOMITE, white		(4 ft. sample)		14.9		
					4 ft.				
	9'9"	10'0"	CLAY BAND, grey, puggy		(6 ft. sample)		22.7		
	10'0"	12'0"	DOLOMITE, white						
			SCREE, approximately 2 ft. to water on RIVER BED LEVEL						

STRIP SAMPLE RECORD

~~DIAMOND DRILL HOLE RECORD~~

o-ordinates of Collar .... E ....

Location The Neales River, S.Aust.

Logged by: T. Malloy

Site ~~XXX~~ No. 5D

arted .... Direction .... Inclination .... Elevation Collar .... Size ....

inished .... Depth .... Vert. Depth .... Casing ....

REC. %	SECTION From	SECTION To	DESCRIPTION	SAMPLE No.	SAMPLE From	SAMPLE To	ASSAY MgO%		
	Ft.in.	Ft.in.							
	0	6'0"	SANDSTONE & GRAVEL, interbanded with gypsum crystals						
	6'0"	10'0"	DOLOMITE, a gypsum and/or salt coating encrusts exposed crop-face; behind this the dolomite is wet, grey and clayey; easily sampled		Top of Dolomite (4 ft. sample) 4 ft.		9.4		
			SCREE, approximately 2 ft. to RIVER BED LEVEL.						

ENV 1231.

LOCATION MAP.

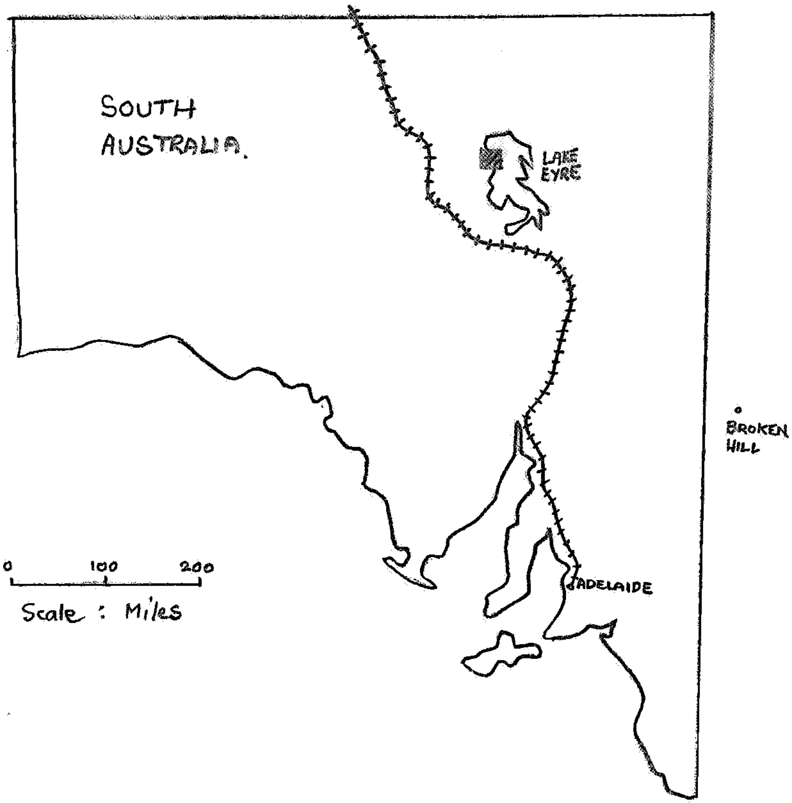


Fig. 1.

GEOLOGY AND LOCATION OF MOUTH OF NEALES RIVER

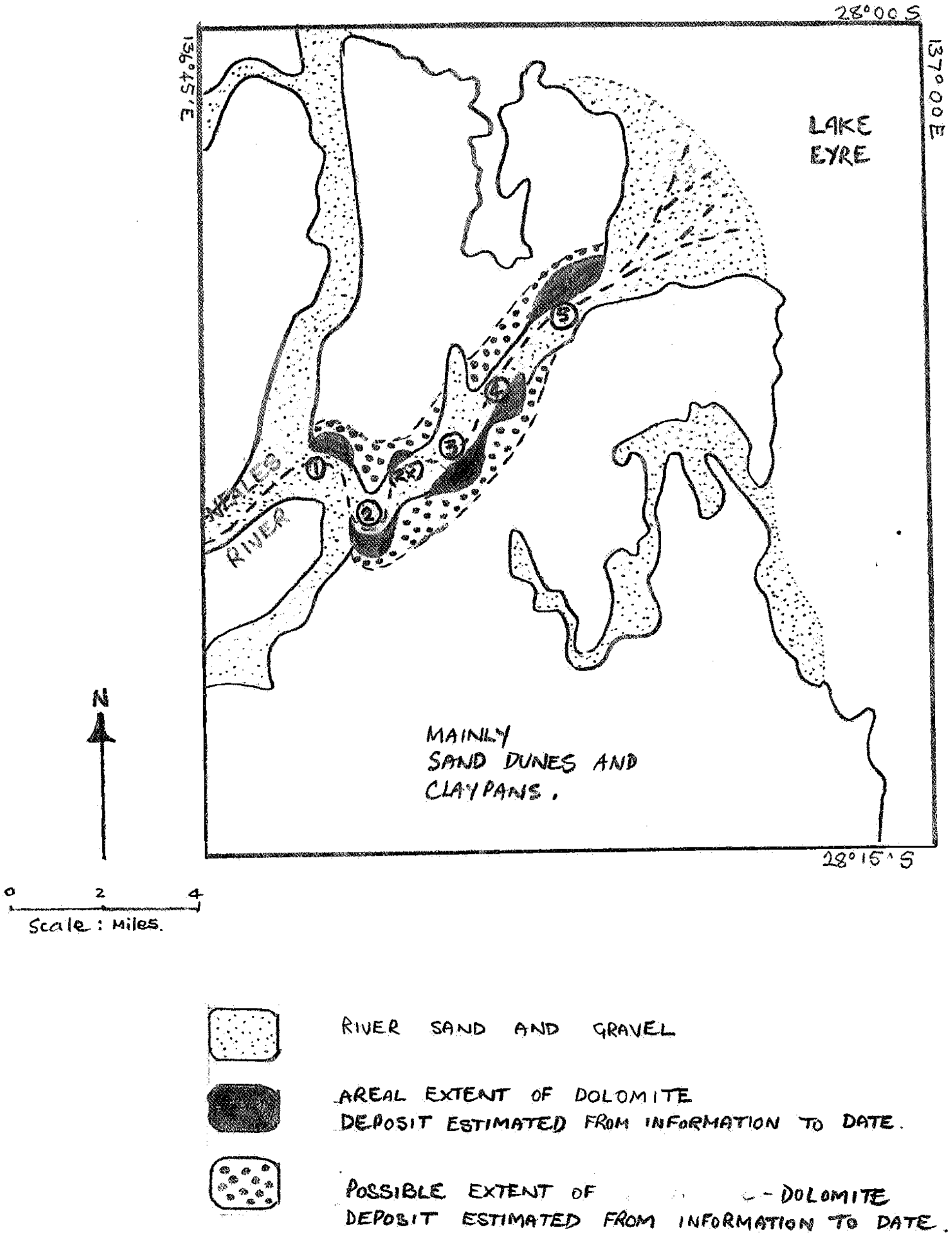


Fig. 2.

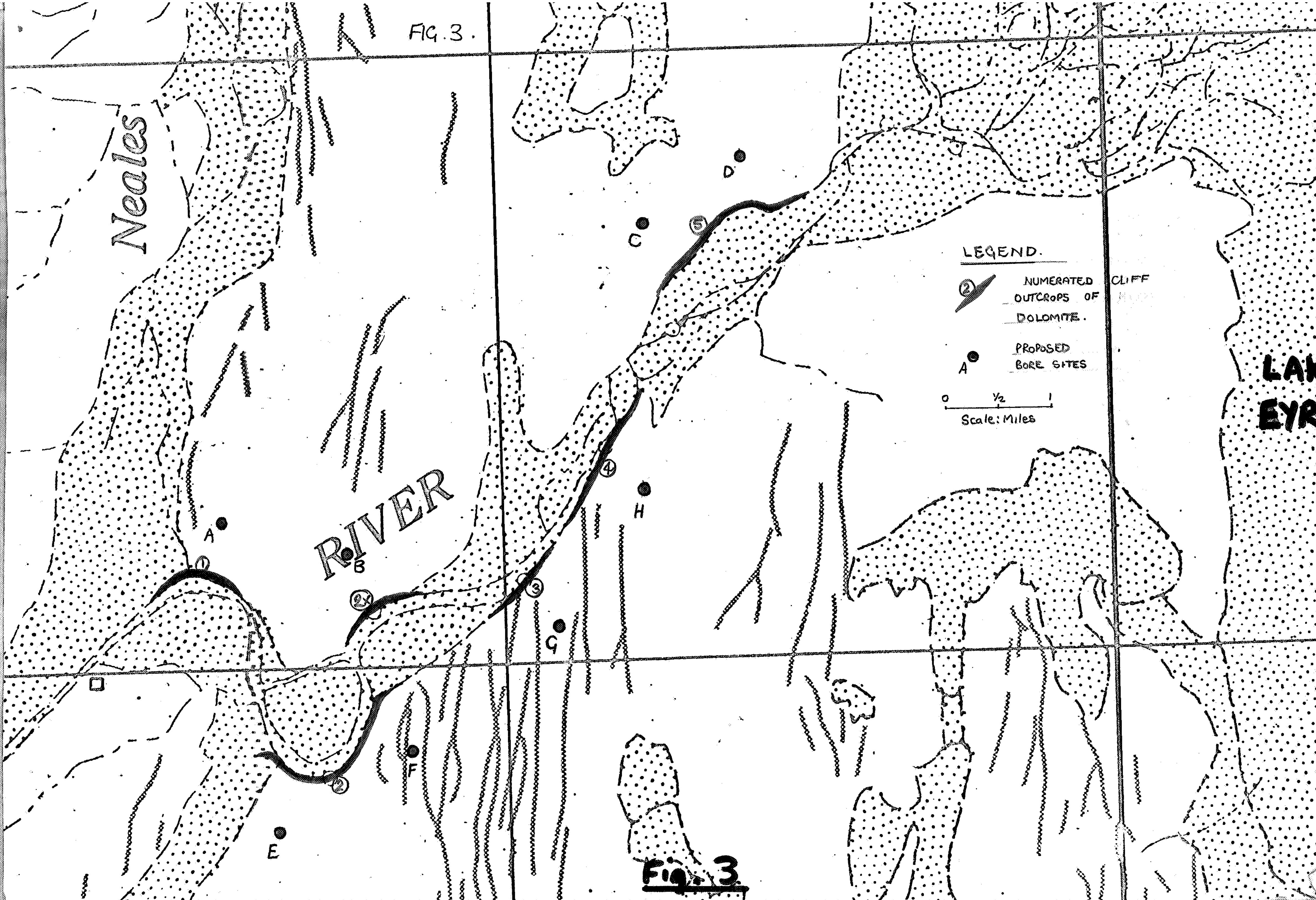
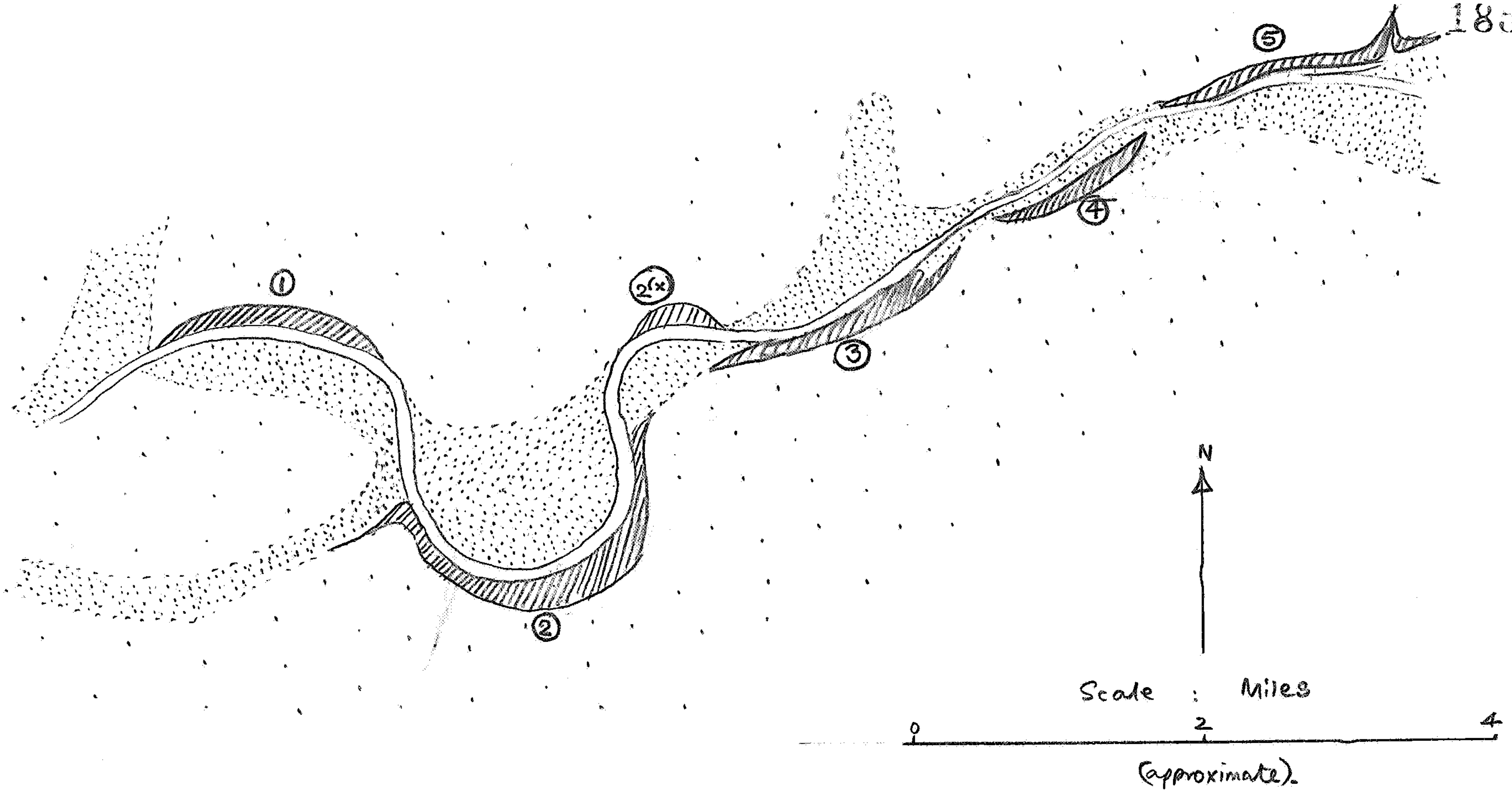
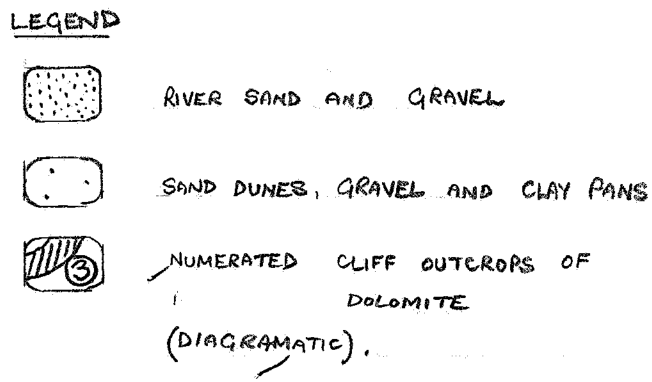


FIG. 3.
Neales
RIVER
LAKE EYRE.
LEGEND.
NUMERATED CLIFF OUTCROPS OF DOLOMITE.
PROPOSED BORE SITES
0 ½ 1
Scale: Miles
A
B
C
D
E
F
G
H
1
2
3
4
5

Fig. 3



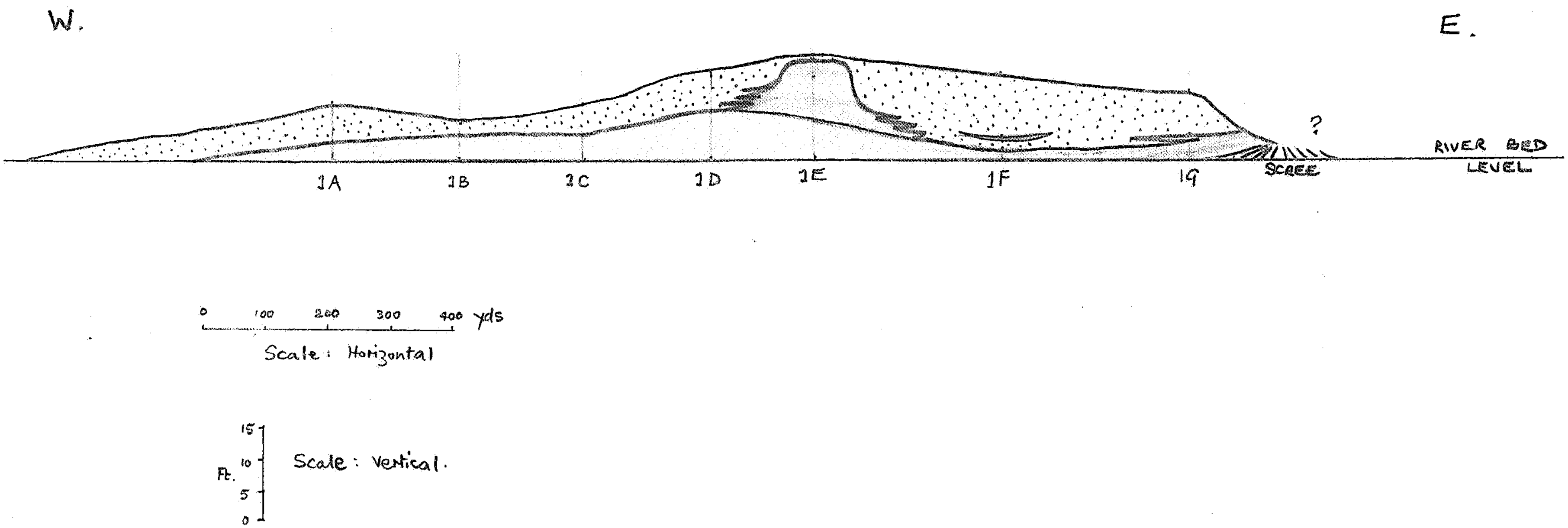


DIAGRAMATIC SKETCH ILLUSTRATING RELATIVE LOCATIONS OF THE NUMERATED OUTCROPS OF DOLOMITE

NEALES RIVER, LAKE EYRE.

Fig 4.

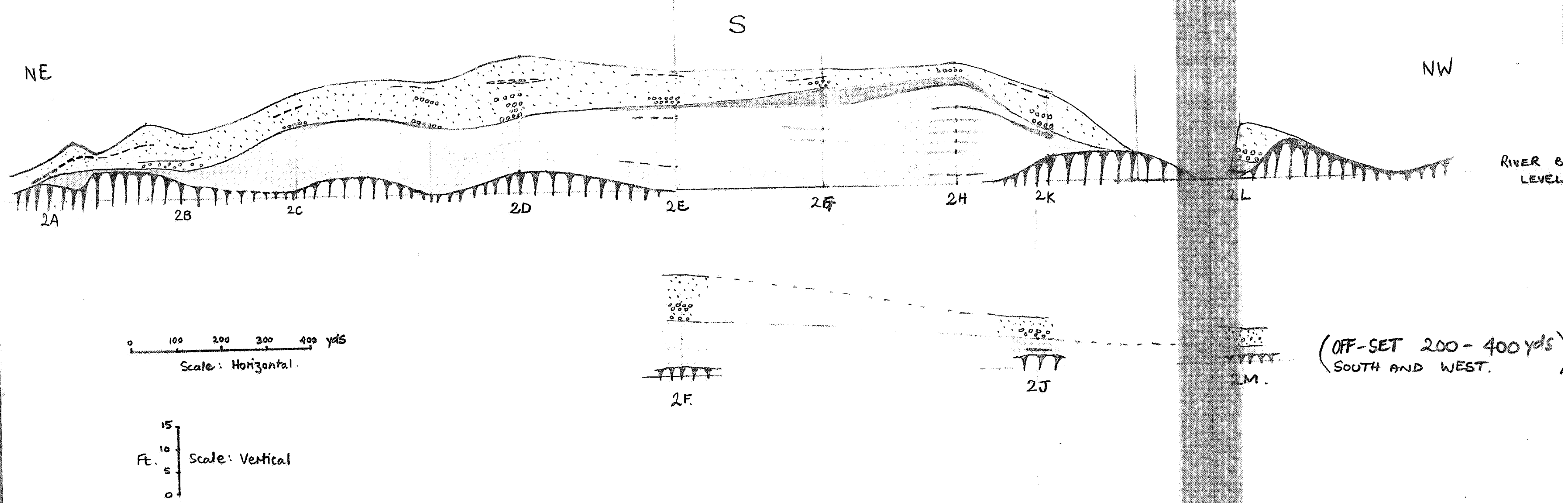
FACE ①.

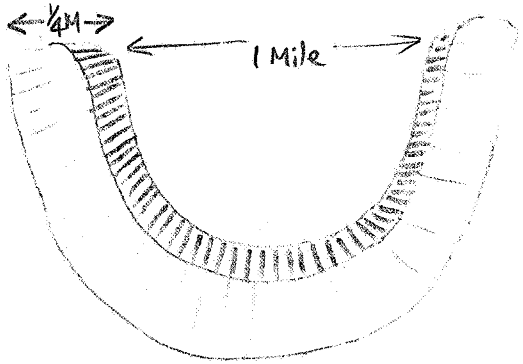


Taking 7 ft. average thickness of Dolomite and assuming a semi-lenticular body, total tonnage is estimated at 1¼ M. tons.

Fig 5

FACE ②

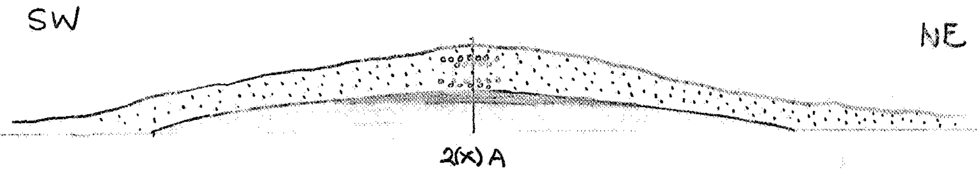


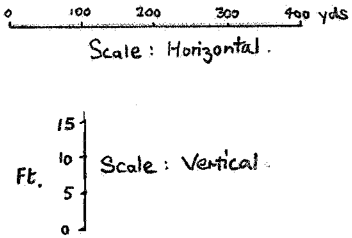


Taking 12 ft average thickness of Dolomite and assuming an areal extent as shown as a minimum, total tonnage is estimated at 9½ M. tons

Fig 6

FACE 2(x)





ASSAY RESULT

MgO%

Taking 4 ft. average thickness of Dolomite.
and assuming a semi-lenticular body, total tonnage
is estimated at 1/4M. tons.

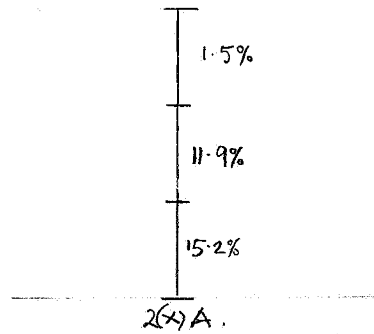
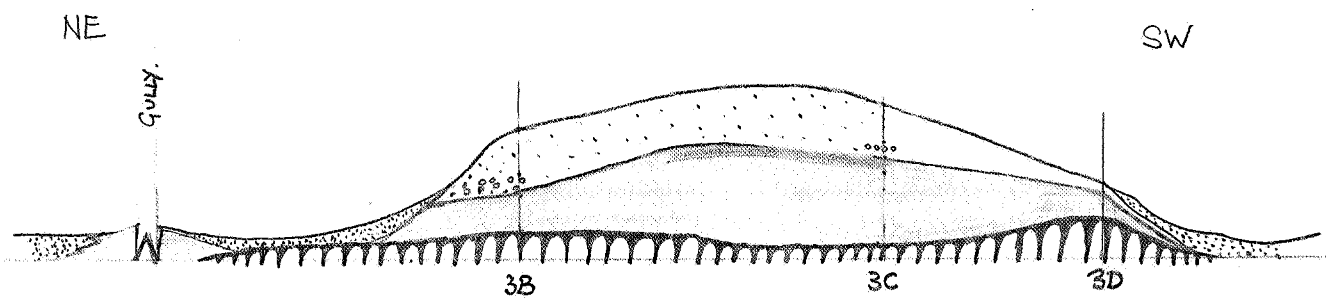


Fig 7

FACE ③



3A. (OFF-SET 150 yds TO SOUTH IN GULLY).

0 100 200 300 400 yds

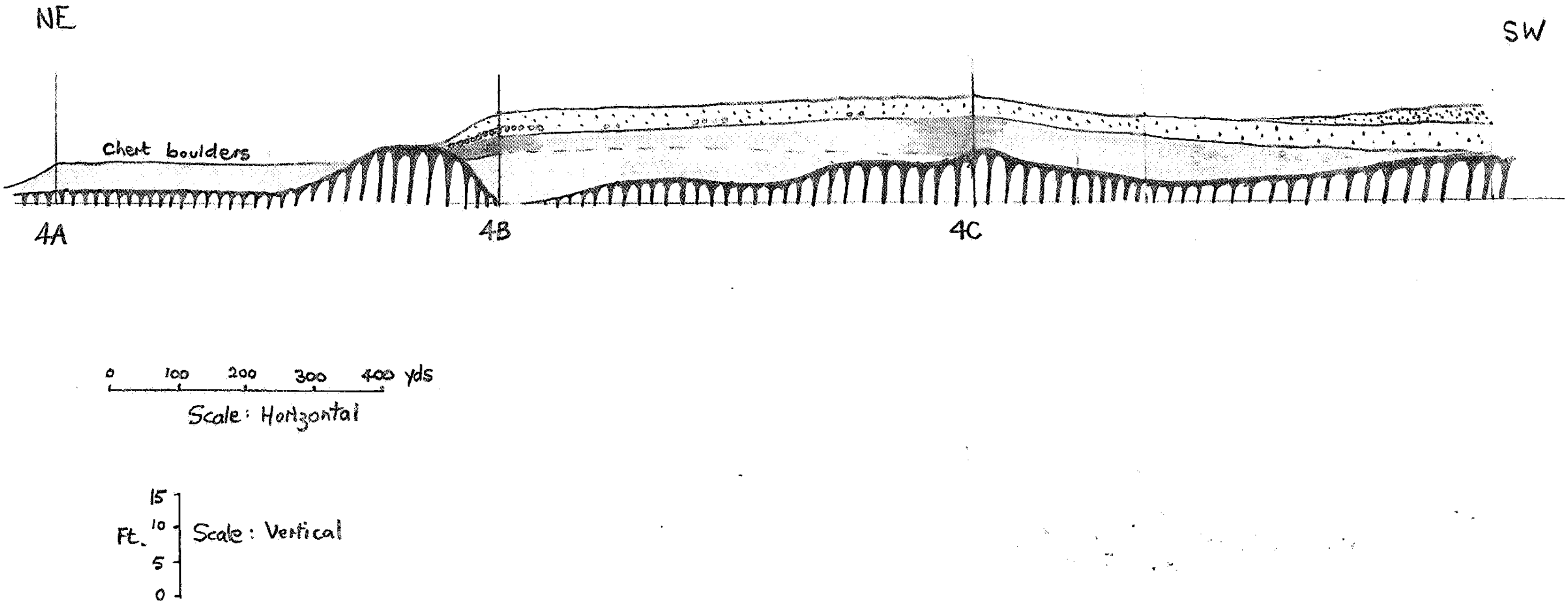
Scale: Horizontal

Ft. 0 5 10 15 Scale: Vertical

Taking 9 ft. average thickness of Dolomite and assuming a semi-lenticular body, total tonnage is estimated at 2 M. tons

Fig 8

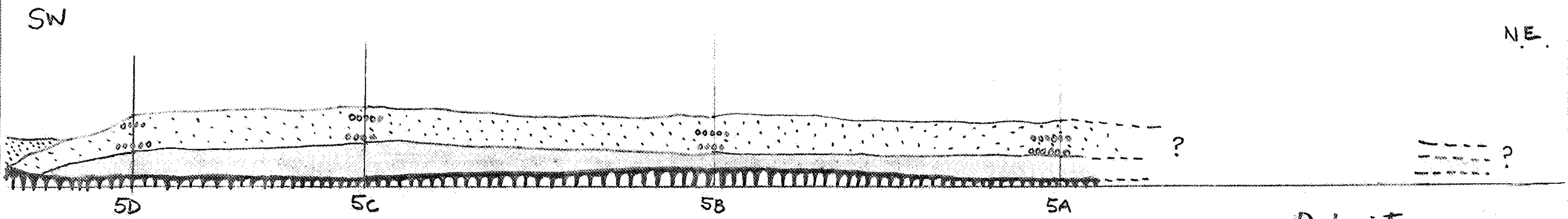
FACE ④



Taking 7 ft. average thickness of Dolomite and assuming a semi-lenticular body, total tonnage is estimated at 3½ M. tons.

Fig 9.

FACE (5)



Dolomite visible for an estimated 800 yds to N.E. of sample 5A.

0 100 200 300 400 yds.
Scale : Horizontal

Ft. 15 10 5 0 Scale: vertical

Taking 4 ft. average thickness of Dolomite and assuming a semi-lenticular body, total tonnage is estimated at <u>2½ M. tons</u>.

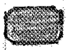
Fig 10.

LEGEND TO CLIFF-FACE SECTIONS ILLUSTRATED IN FIGURES 5-10 (INCL).

 AEOLEAN DUNE SAND.

 CONSOLIDATED SANDSTONE; OCCASIONAL CROSS - BEDDING; SOME GYPSUM ENCRUSTATIONS.

 SANDSTONE AND PEBBLE BANDS; COMMON CROSS - BEDDING; COMMON GYPSUM ENCRUSTATIONS, SOME CLAY HORIZONS.

 DOLOMITE; DARK GREY, IMPURE.

 DOLOMITE

 SCREE

Fig. 11.

FACE ① ASSAY RESULTS

Mg O%

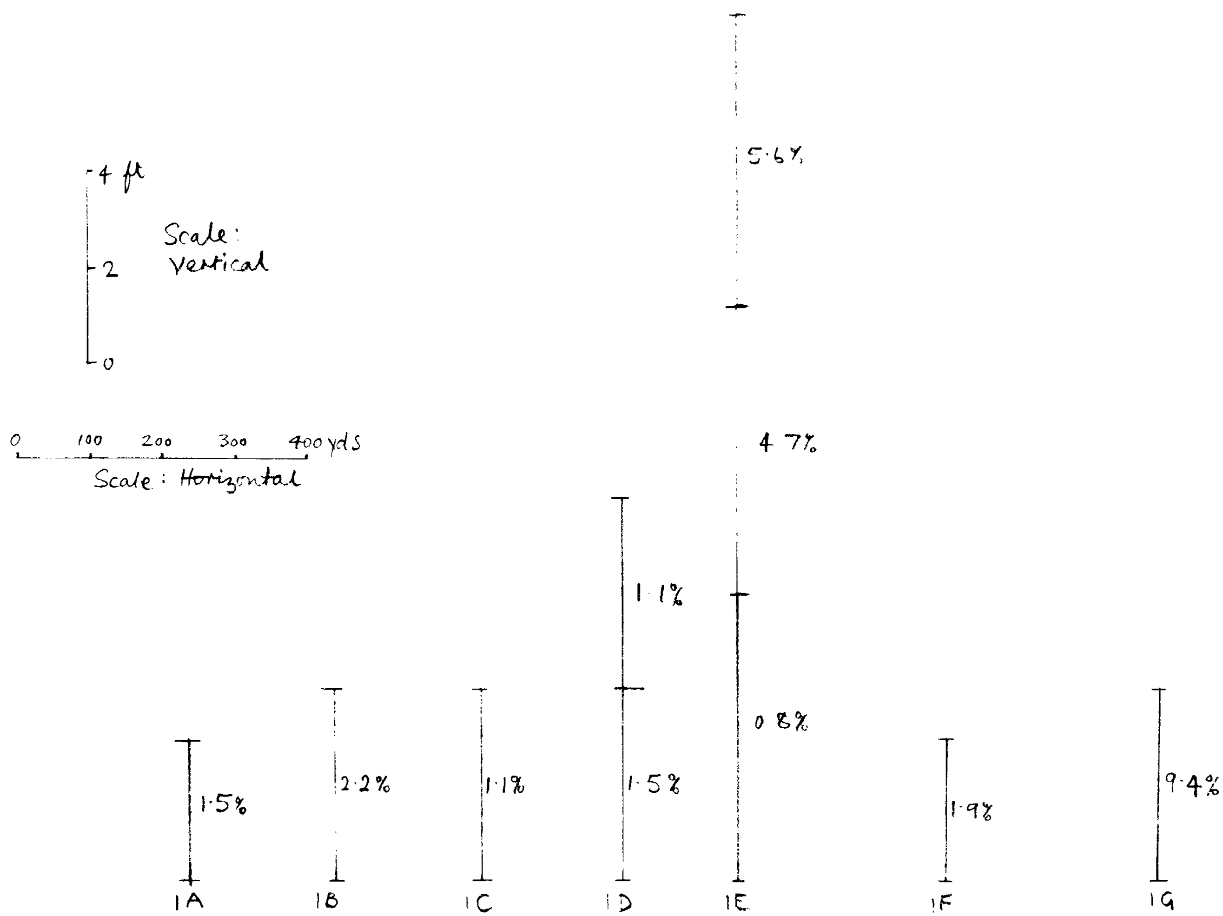


Fig 12

FACE ② ASSAY RESULTS

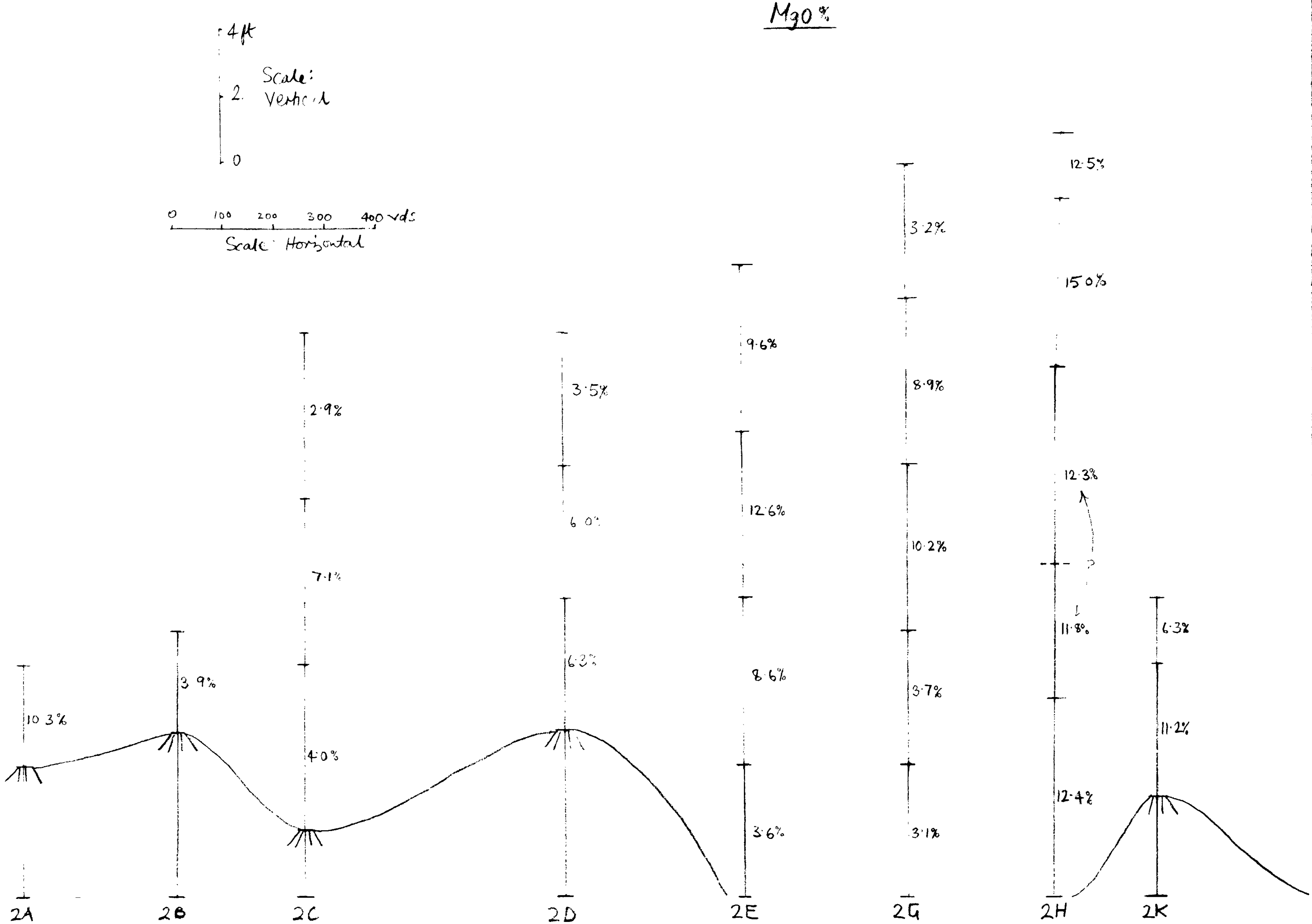


Fig 13

ASSAY RESULTS OF SAMPLES TAKEN

SOUTH AND WEST OF FACE (2).

MgO %

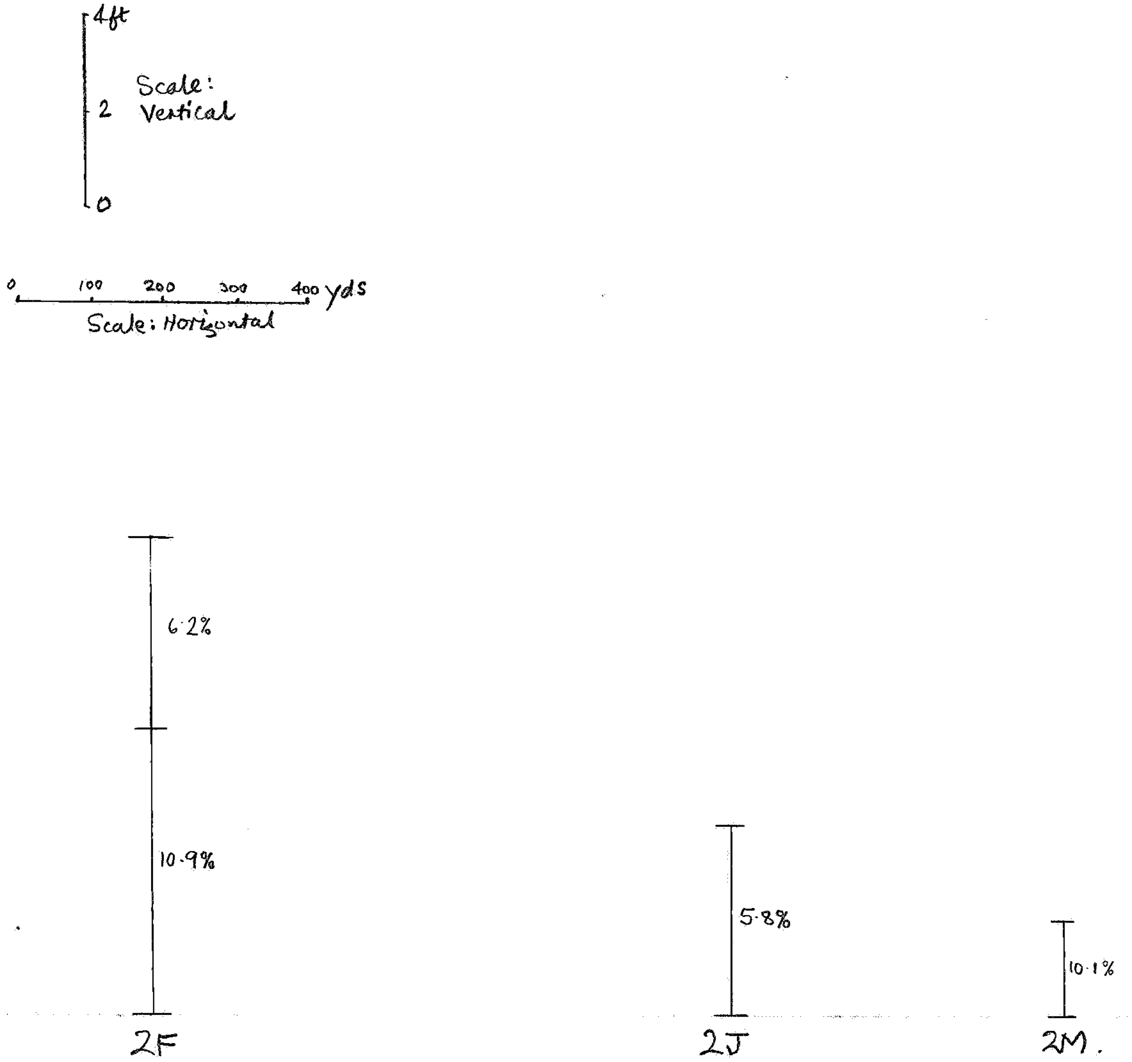


Fig 14

ASSAY RESULTS, FACE ③

MgO %

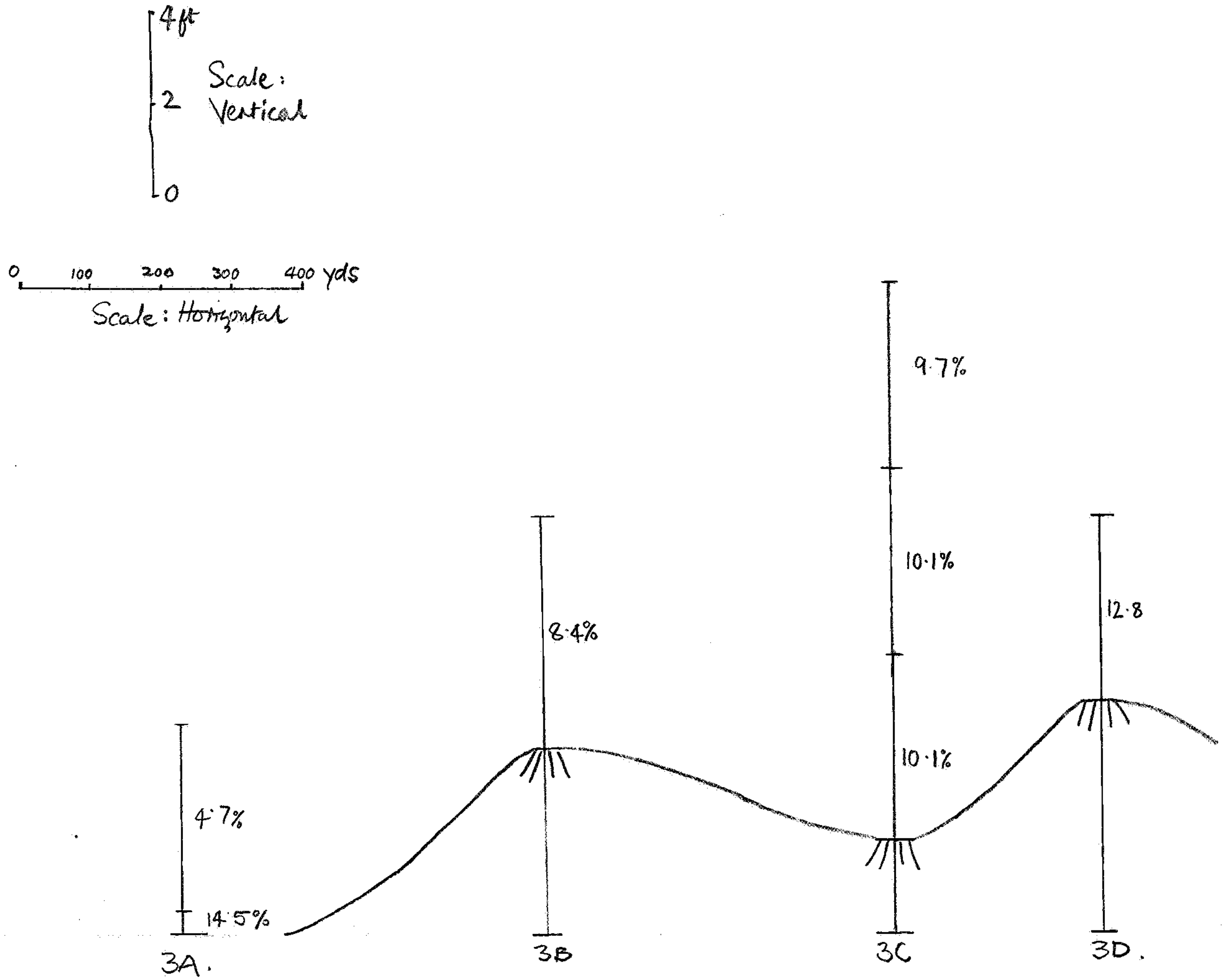


Fig 15

ASSAY RESULTS FACE (4)
MgO %.

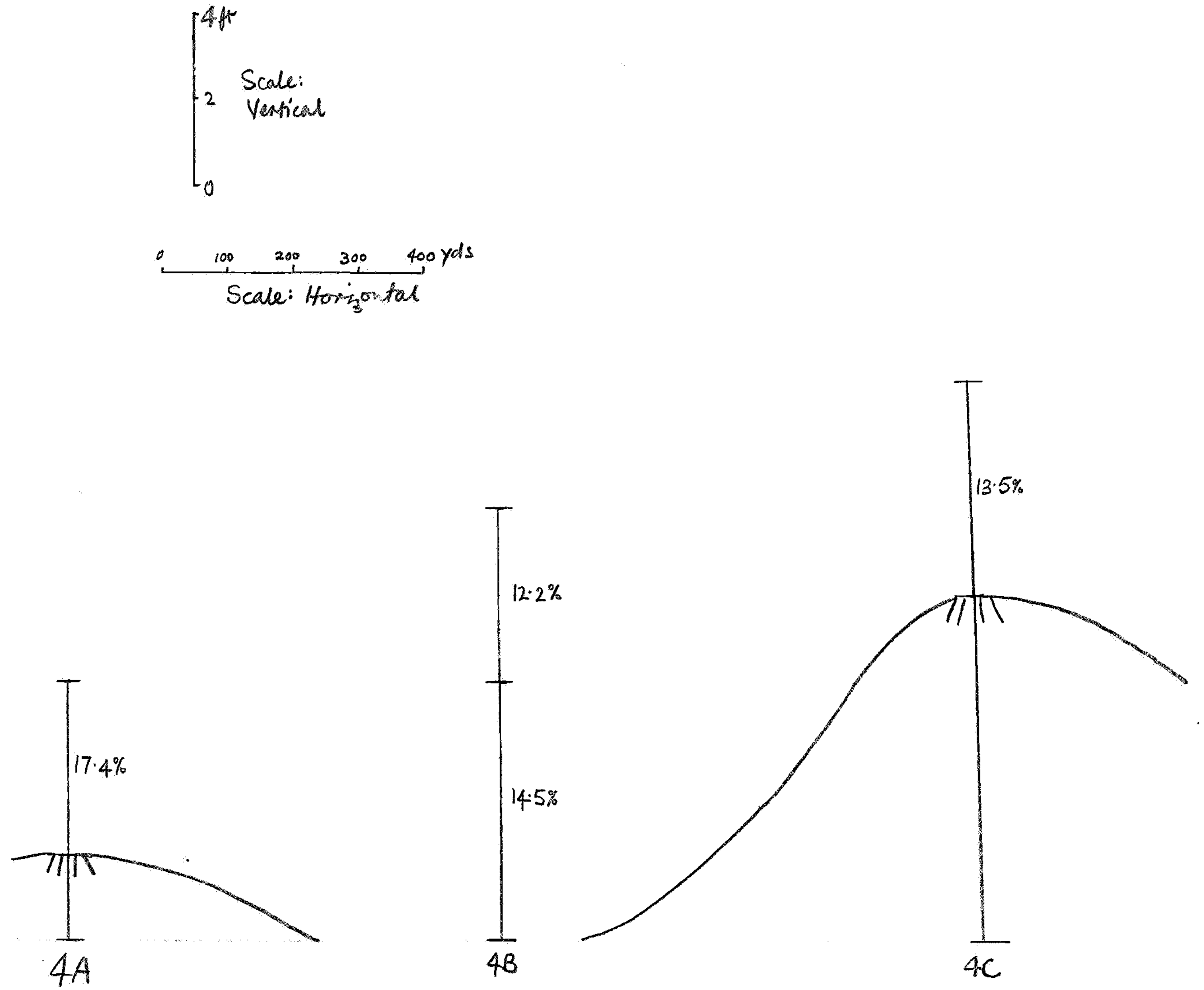


Fig 16

ASSAY RESULTS FACE (5)

MgO%

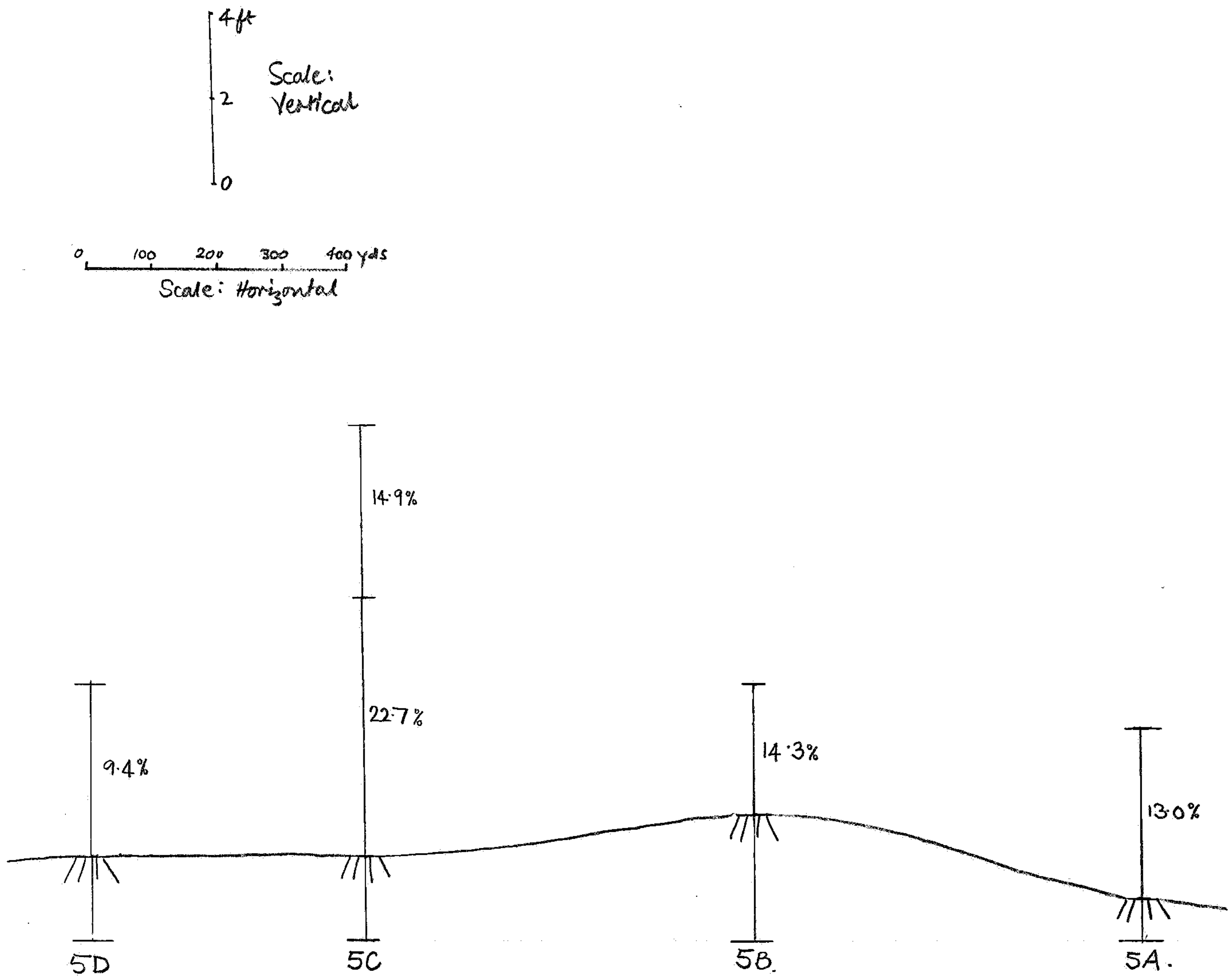


Fig. 17

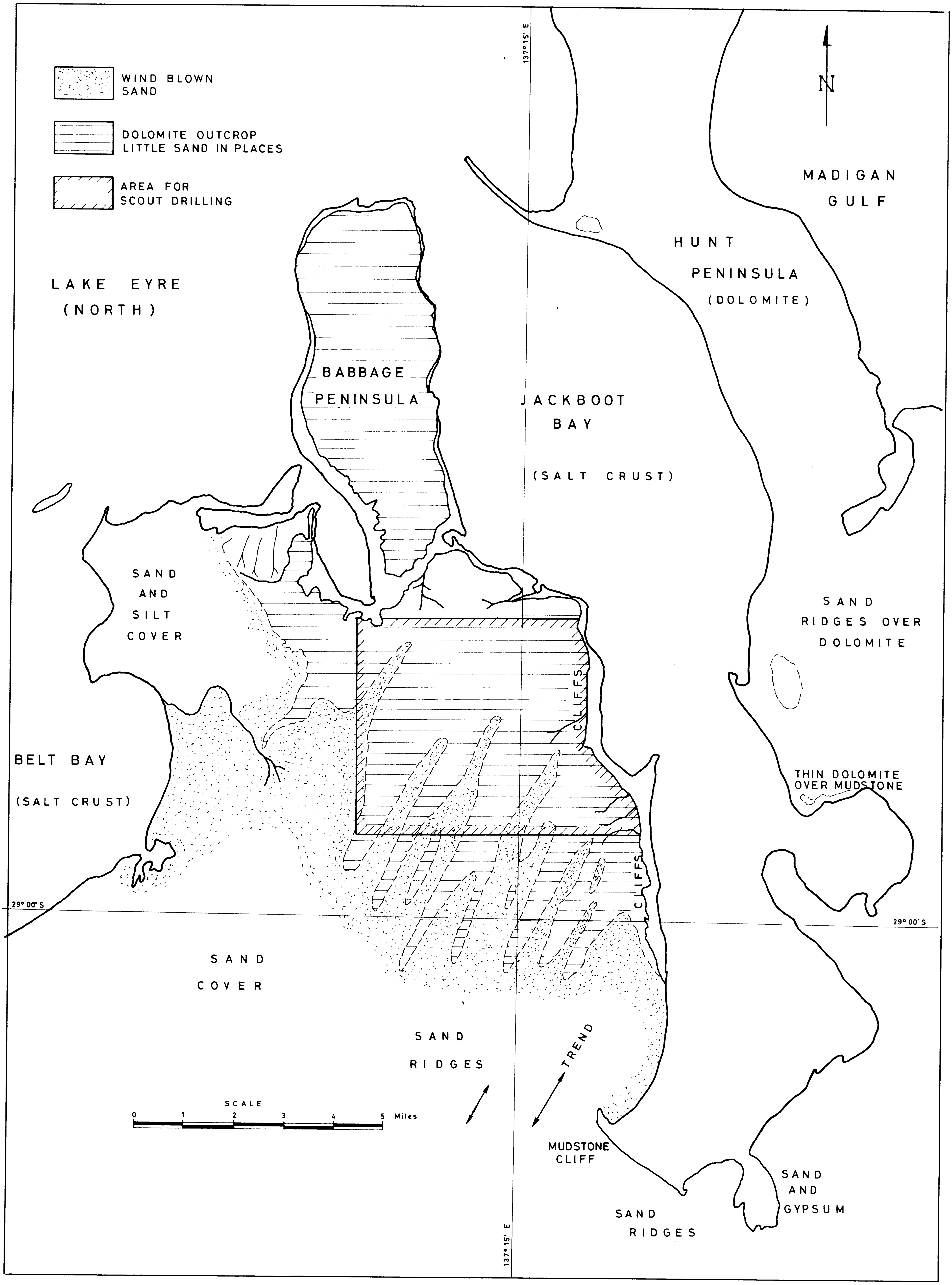


FIGURE 1: SKETCH MAP SHOWING AREAS OF DOLOMITE ON BABBAGE PENINSULA

ENV 1231-1