COMMONWEALTH ALUMINIUM CORPORATION LIMITED

E.L. 7/74 TASMANIA

REPORT ON INVESTIGATIONS

ZEOLITES, GAD'S HILL AREA.

P.W. ASKINS.
May, 1980.

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1. INTRODUCTION

Investigations in the Gad's Hill area commenced in 1979 when it was thought that natural zeolites held promise as a industrial mineral. Fig. 1 shows the area covered by this report.

Gad's Hill has long been known as a source of specimen quality chabazite crystals. Various publications by Sutherland refer to the zeolite assemblages here and the nature of the host Tertiary basaltic rocks.

This area (above 400m ASL only) is excluded from the area of E.L. 7/74 subject to joint venture with the Shell Company of Australia Ltd. Fig. 2 shows the excluded area. The area is defined as:

"all ground containing zeolites above R.L. 400m ASL of the area bounded by 5401 000mN, 435 000mE
5393 000mN, 435 000mE
5393 000mN, 429 000mE
5401 000mN, 429 000mE

2. GEOLOGY

The regional geology is shown on the Middlesex one inch to one mile sheet.

Gad's Hill is part of a large area of thick Tertiary Basalt. The overall features of the Tertiary geological history appear to be, in chronological order:

1. a massive basalt flow which dammed streams in the rugged topography and formed local lakes.

2. deposition of locally thick siltstones, shales, conglomerates in the lakes. The sediments are probably partly reworked basaltic tuffs, which are now(?) montmorillonitic.

3. deposition of thick hyaloclastite breccias, pillow breccias, with some tuffaceous siltstone interbeds. The hyaloclastite breccias possibly formed when basalt lava was extruded beneath the lake and cooled very rapidly, whereas the pillow breccias possibly formed when basalt lava entered water from air.

4. a second massive basalt flow, typically columnar marks the point of complete filling of the lake, and all subsequent basalt is similarly massive.

Once capped by massive basalt, long acting convection cells were set up in the porous permeable hyaloclastite breccias adjacent to the still hot volcanic vents. This enabled the replacement of the glassy matrix of the breccias by zeolites, montmorillonite, and other minerals such as tacharanite. These minerals also filled voids and vesicles, and now constitute up to 25% of the volume of the breccias over large areas.

A geological reconnaissance by P. Askins and R. Poltock established that the area around Ration Tree Creek on the old

V.D.L. road is the most intensely zeolitized, and consequently diamond drilling to evaluate the nature and extent of zeolites was concentrated in this area.

Notes on R. Poltock's traverses are in Appendix 1. Rock samples collected by R. Poltock, R. Duraj and P. Askins are filed in the Devonport office.

Miscellaneous data published and unpublished is in Appendix 8.

3. DIAMOND DRILLING

Two holes were drilled to test the zeolite rich breccia sequences near Ration Tree Creek, on or near the old V.D.L. road.

Detailed drill logs are in Appendix 2. Core was inspected by Lin Sutherland and Julian Hollis of the Australian Museum, and pertinent features were pointed out by them. Visual estimates of zeolite content are also tabulated in Appendix 2.

Some of the Tertiary sediments in the core has been sampled by a Mr. Ian McKenrick for University of Tasmania paleo botanical studies, but no results have been received.

The first diamond drill hole GHD1 was vertical, at grid co-ords. 431 800mE, 5397 700mN.

A summary log is:

0 - 24m	Pillow lavas containing much chabazite in matrix (overall 25% zeolites).
24 - 30m	Pillow lavas, minor zeolites, montmorillonitic clay matrix.
30 - 101m	Hyaloclastites, fine grained, some visible zeolite in matrix, especially below 90m.
101 - 134m	Siltstone, semi-consolidated, khaki, probably montmorillonitic, replacing tuffaceous components.
134m	END OF HOLE

The second drill site was located stratigraphically above and near the richest chabazite outcrops which occur on the old V.D.L. road. The hole was above the cliff lines at grid co-ords. 431 800mE, 5398 300mN. It was originally planned that the hole test the entire Tertiary basalt and underlying Tertiary sediments which could carry zeolites and bentonites, and then penetrate basement of what was thought to be Ordovician Gordon Limestone close to the buried Bismuth Creek Fault. However the hole was terminated at 263m due to drilling difficulties after passing through soft sediments and then into a basal basalt.

A summary log is:

0 - 22m	Massive basalt (columnar in outcrop).
22 - 41m	Hyaloclastite, fine or coarse grained, about 10-15% visible zeolites.
41 - 58m	Pillow lavas, 15-25% visible zeolites.
58 - 71m	Tuffaceous, montmorillinitic? siltstone.
71 - 136m	Hyaloclastites, fine to medium, variable zeolite content, about 10-15% most places, but 25% 124-136m.
137 - 172m	Vitric tuffs and tuffaceous siltstones complexly interbedded. Visible zeolites overall less than 10%.
172 - 176m	Hyaloclastite, fine.
176 - 261m	Siltstones, shales, local conglomerate, semi consolidated, greenish greys.
261 - 263m	Massive basalt.
263m	*END OF HOLE*

4. PETROLOGICAL STUDIES

A. CHABAZITE RICH ROCKS

Appendix 3 has descriptions by W. Fander of 2 specimens of hyaloclastites from surface outcrops.

Appendix 6 contains petrographic descriptions of basaltic breccia submitted to the Mines Department for beneficiation studies. The rock comes from a scree slope on Oliver's Road near the V.D.L. road crossing.

A suite of samples from core of GHD 1 (as detailed in Appendix 4) was sent to J. Hollis of the Australian Museum for petrological study and evaluation of the nature of zeolites present. The results of this study have not been received.

B. MONTMORILLONITE RICH ROCKS

The waterfall on upper Ration Tree Creek, AMG co-ords. 432 000mE, 5397 900mN, is over a spectacular exposure of pillow breccias, which have a matrix of a khaki coloured montmonillonite material. A sample (GH 20) of this material was examined for its bentonitic properties by Amdel, but it was found to be of poor quality. The report is in Appendix 5.

C. STREAM SEDIMENTS, RATION TREE CREEK

Stream sediment sampling and panning near Emu Plains in basaltic terrain, had previously found grains of a mineral which fluoresces white under short wave UV light. This was thought to be scheelite, derived from deep leads, and so samples were also collected around Ration Tree Creek to try to track down the extent of the deep lead and the source.

The same fluorescent mineral was found in the pan concentrates from Ration Tree Creek, Shaws Creek and Lynds Creek. Grains of this material were hand picked and sent to Lin Sutherland of the Australian Museum, who had them identified as herschelite, the complexly twinned soda-rich variety of chabazite (see Appendix 6).

The only analyses of minus 80 mesh stream sediments from this location are for total fluorine (by fusion), being 200, 160, 150 ppm for each of the respective creeks.

5. BENEFICIATION STUDIES

A continuing study to evaluate whether the chabazite of the breccias is recoverable with simple beneficiation is being conducted by the Mines Department. Appendix 6 includes all the data to date.

The rock studied consists of about 75kg of boulders of hyaloclastite containing much chabazite and some easily visible tacharanite from a landslip scree slope on Oliver's Road near the V.D.L. road crossing.

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REFERENCES

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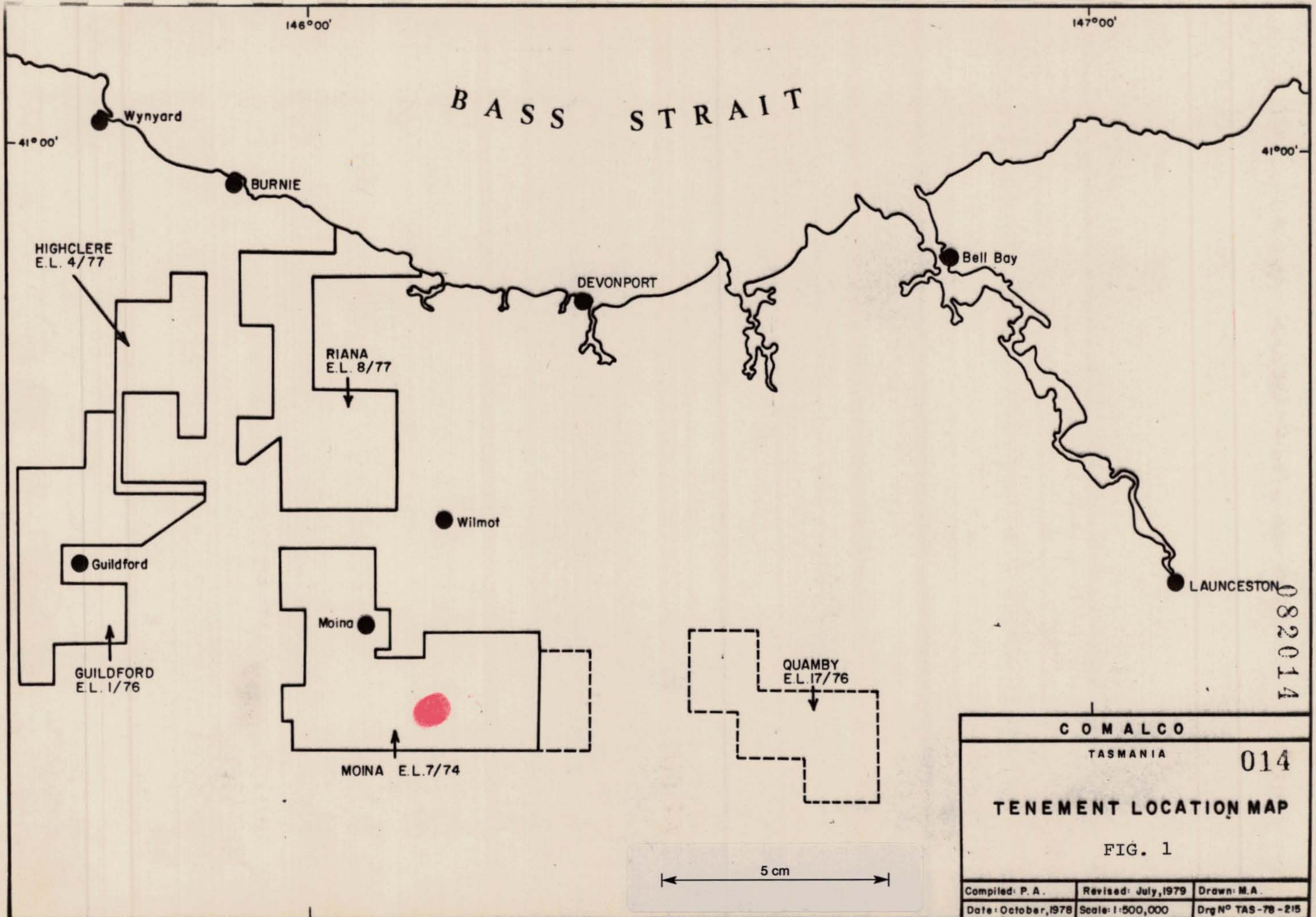

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TENEMENT LOCATION MAP

FIG. 1

Compiled: P. A.	Revised: July, 1979	Drawn: M.A.
Date: October, 1978	Scale: 1:500,000	Drg N° TAS-78-215

FIG 2.

1:100 000

APPENDIX 1

TRAVERSE DESCRIPTIONS

GAD'S HILL

by R. Poltock.

TRAVERSE 1

Ration Tree Creek, Liena from 430m A.S.L. massive basalts lacking columnar jointing. This flow deeply dissected by creek to 320m, where Gordon Limestone is exposed. In the lower part of flow columnar jointing occurs, no zeolite was seen.

TRAVERSE 2a, b.

Between sealed road and plateau top in the vicinity of Shaw's Creek:

Top - massive columnar basalt
- vesicular basalt with zeolite
- breccias consisting namely of blocks with minor zeolitic matrix
- slope covered with soil and scree
- fine breccias with scattered limestone rock fragments, zeolite minor

Main Road

TRAVERSE 3

Eastern scarp of plateau overlooking the Mersey River valley.

Top	- Massive basalt
600 (m, ASL)	- Basalt breccias, consisting mainly of blocks with minor zeolitic matrix
560	- Scree and land slips
520	- Massive outcrops could be fine breccia
480	- Medium grained, fresh, very hard basic rock, some of these could be dolerite
?	- Pre basalt or dolerite rocks not reached

TRAVERSE 4

Lynds Creek down stream from Lemonthyme Road to below scenic lookout. Section very similar to that seen in Lemonthyme Road, outcrop nearly continuous in a series of small waterfalls. Breccias are zeolitic.

TRAVERSE 5a, b.

On steep grass covered slopes on northern side of Liena Valley. Massive columnar basalts occur on plateau rim, (base 580 ASL) scree from these obscures downslope outcrop except for a small exposure of zeolitic breccia in a land slip area. 560m ASL.

TRAVERSE 6 & 7

Tertiary stratigraphy in the Lorinna area is similar to Liena see Fig., exposures are poor being covered in scree and land-slip material derived from two main massive basalt horizons.

The first of these forms the plateau top and edge between 600-700m ASL, the second forms an upper level area of farmland in Lorinna about 400-440m ASL. Above and below this second flow, lake sediments and deep lead gravels occur, evidence for this is presence of abundant rounded cobbles and pebbles at 440m ASL and fossilferous mudstones in a branch of Olivers Creek in the vicinity of Briners.

Beneath the lake sediments Gordon Limestone outcrops through the valley below 340m ASL, at Liena in Ration Tree Creek limestone occurs at 320m.

No zeolite or breccias were seen in the Lorinna area, these softer rocks covered by scree, probably occuring between 600-500m ASL below the massive plateau top basalts.

GAD'S HILL - ZEOLITE

RP/T/GAD

NO.	CO-ORD.	DESCRIPTION
1	5398N/433100E	Vesicular basalt (zeolite filling) underlain by breccias with zeolite. In these breccias blocks predominate.
2	5398150N/432700E	Breccia fine with scattered limestone fragments.
3	5397450N/434000E	Breccia blocks predominate, matrix minor but contains zeolite.
4	5399750N/432650E	Breccia with zeolite in Lynds Creek similar to Scenic Lookout section.
5	5400450N/434150E	Breccia with zeolite, small outcrop. Hillside covered with massive basalt scree.

LORINNA - LIENA SECTION

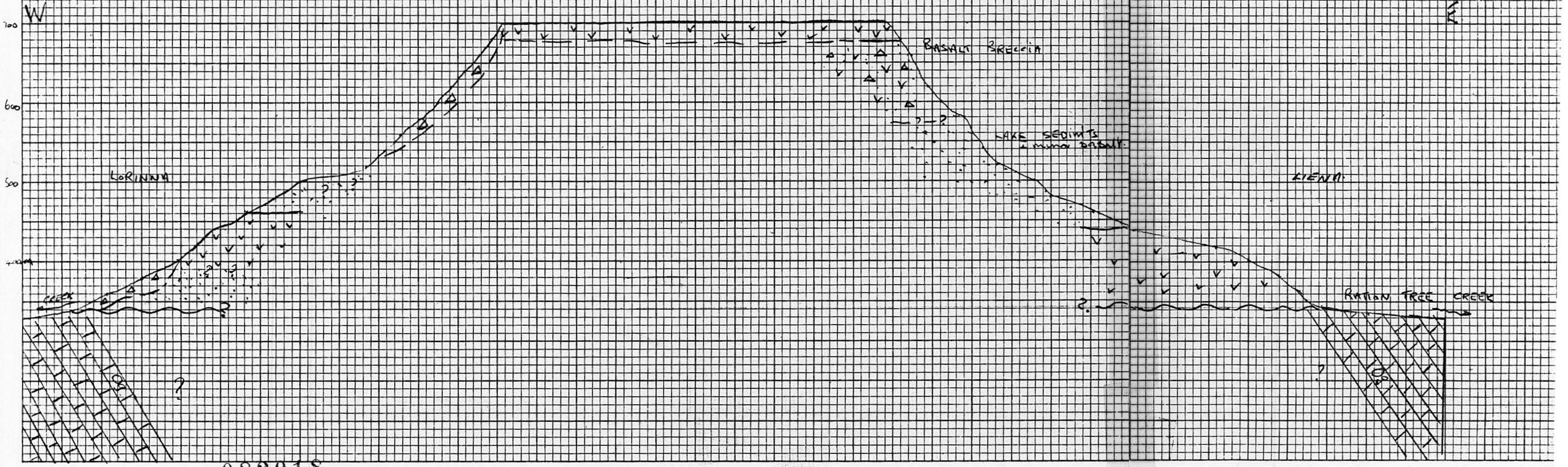
SCALE HORIZ 1 cm 200 m
VERTICAL 1 cm 50 m

5 cm

LAND SLIP - massive basalt blocks.

BASALT BRECCIA

Basalt massive

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LORINNA
STAVERTON
STAVERTON
Gads Hill
Olivers Road
Oliver Creek
Lorinna
LIENA
LAND DISTRICT BOUNDARY
PARISH BOUNDARY
MUNICIPALITY AND WARD BOUNDARY
TOWN BOUNDARY
FORTH RIVER
Tree Creek
Shaws Creek
Lynds Creek
Heaton Creek
massive
columnar
zeolite
GN
MN
W
E
1
2a
2b
3
4
5a
5b
6
7
5 cm
Stockroute 27
COMALCO
082019
LIENE - GADS HILL - LORINNA
ZEOLITE TRAVERSES
R. Poltock. 27,28-11-78
Scale 1cm = 200m
019

APPENDIX 2

DIAMOND DRILL LOGS

ESTIMATION OF ZEOLITE CONTENTS

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HOLE NO.: GHD 1

LOCATION: AMG Co-ords. 431 800mE/5397 700mN

ORIENTATION: Vertical CORE SIZE: 0 - 5.50 H
5.50 - 134.25 NQ

DATE DRILLED: November, 1979. PHOTOGRAPHED: Yes

0	30.00	Pillow lavas. Massive basalt cores up to 0.5m across with a matrix of tachylitic breccia, variably zeolitised to 23.75. Some very coarse chabazite patches. Below 23.75 lesser zeolites and more khaki silty looking montmorillinitic matrix between the pillows. Some oxidized, but fresh below 23.75.
30.00	101.50	Hyaloclastites. Variable fragment sizes from around 1mm to over 2cm. Patchy limestone fragments, angular, up to 19cm across at 51.25. Layering well developed in places, 70° at 38.50, 70° at 43.25, 80° at 52.25, 55° at 56.25, 70° at 71.00, 80° at 86.00, 50° at 95.25 (measured from core axis). Variably zeolitised.
101.50	132.50	Sericitic (or montmorillonitic) silty clays and thin sandy silts/sandstones. Scattered fragments of lignite. Khaki coloured. Bedding 60° at 106.50, 60° at 113.00, 55° at 115.25, 45° at 120.25.
132.25	134.25	Siltstones with rounded pebbles, and with fragments of lignite.

- END OF HOLE -

GHD 1

VISUAL ESTIMATION OF ZEOLITE CONTENT

NOTE: Percentages of zeolites were computed at each distance peg by overlaying a 14 mesh nylon screen and counting the number of holes occupied by zeolites in a total grid of 1000 holes.

At	%	At	%
1.00	37	50.25	26
1.50	1	53.30	26
2.60	20	56.25	27
3.35	Nil	59.25	27
4.20	22	62.25	26
5.50	1	65.25	14
6.00	0.5	68.25	14
6.90	30	71.25	14
8.25	18	73.30	14
9.75	20	74.25	15
10.30	20	77.25	13
11.90	28	80.25	28
13.25	49	83.25	29
14.75	19	86.25	26
16.75	24	89.15	25
18.00	15	92.15	26
18.30	20	95.25	29
19.25	19	98.25	21
20.75	13	101.35	15
23.25	42		
26.25	10		
29.30	26		
32.25	16		
35.25	16		
38.25	18		
39.50	16		
41.25	18		
44.25	14		
47.25	16		

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PROJECT: GAD'S HILL   HOLE NO: D 1   RECOVERY LOG

FROM	TO	ADVANCED INTERVAL	RECOVERY	RECOVERED %
0	1.00	1.00	.20	20.0
1.00	1.50	.50	.20	40.0
1.50	2.60	1.10	1.10	100.0
2.60	3.35	.75	.75	100.0
3.35	4.20	.85	.85	100.0
4.20	5.50	1.30	.80	61.5
5.50	6.00	.50	.40	80.0
6.00	6.90	.90	.80	88.9
6.90	8.25	1.35	1.20	88.9
8.25	9.75	1.50	1.50	100.0
9.75	10.30	.55	.55	100.0
10.30	11.90	1.60	1.60	100.0
11.90	13.25	1.35	1.35	100.0
13.25	14.75	1.50	1.50	100.0
14.75	16.75	2.00	1.30	65.0
16.75	18.00	1.25	1.10	88.0
18.00	18.30	.30	.15	50.0
18.30	19.25	.95	.95	100.0
19.25	20.75	1.50	1.50	100.0
20.75	23.25	2.50	2.50	100.0
23.25	26.25	3.00	3.00	100.0
26.25	29.25	3.00	3.00	100.0
29.25	32.25	3.00	3.00	100.0
32.25	35.25	3.00	3.00	100.0
35.25	38.25	3.00	3.00	100.0
38.25	39.50	1.25	1.25	100.0
39.50	41.25	1.75	1.75	100.0
41.25	44.25	3.00	3.00	100.0
44.25	47.25	3.00	3.00	100.0
47.25	50.25	3.00	3.00	100.0
50.25	53.25	3.00	3.00	100.0
53.25	56.25	3.00	3.00	100.0
56.25	59.25	3.00	3.00	100.0
59.25	62.25	3.00	3.00	100.0
62.25	65.25	3.00	3.00	100.0
65.25	68.25	3.00	3.00	100.0
68.25	71.25	3.00	3.00	100.0
71.25	73.30	2.05	2.05	100.0
73.30	74.25	.95	.95	100.0
74.25	77.25	3.00	3.00	100.0
77.25	80.25	3.00	3.00	100.0
80.25	83.25	3.00	3.00	100.0
83.25	86.25	3.00	3.00	100.0
86.25	89.15	2.90	2.90	100.0
89.15	92.15	3.00	3.10	103.0
92.15	95.25	3.10	3.30	106.0
95.25	98.25	3.00	3.00	100.0
98.25	101.25	3.00	3.00	100.0
101.25	104.25	3.00	3.00	100.0
104.25	107.25	3.00	3.00	100.0

PROJECT: GAD'S HILL HOLE NO: D 1 RECOVERY LOG

FROM	TO	ADVANCED INTERVAL	RECOVERY	RECOVERED %
107.25	110.25	3.00	2.55	85.0
110.25	113.25	3.00	2.80	93.3
113.25	116.25	3.00	3.20	106.7
116.25	119.25	3.00	3.00	100.0
119.25	122.25	3.00	3.20	106.7
122.25	125.25	3.00	2.80	93.3
125.25	128.25	3.00	3.00	100.0
128.25	131.25	3.00	1.20	40.0
131.25	134.25	3.00	2.90	96.7

HOLE NO.: GHD 2

LOCATION: AMG Co-ords. 431 800mE/5398 300mN

ORIENTATION: Vertical CORE SIZE: 13 - 159.50 NQ
159.50 - 262.75 BQ

DATE DRILLED: December, 1979 PHOTOGRAPHED: Yes

0	22.50	Basalt, massive, Frst; columnar basalt in outcrop.
22.50	40.60	Tuff sequence. Alternating fine and coarser agglomeratic tachylitic tuffs (hyaloclastites) grading into lacustrine sands with plant fragments. Layering at 60° at 25.00, 80° at 29.00, 70° at 39.00 Several oxidized horizons. Components of sediments largely of volcanic origin, but reworked sedimentary material prominent especially 28.80 - 29.20. Zeolitization at many levels but especially in lowest 2m. Fine sand or ash for 10cm at base.
40.60	58.30	Zeolitised pillow lavas (flow foot breccias). Coarse zeolite infill between basalt blocks and pillows up to 25cm across. Chabazite has reasonably complex twinning suggesting higher temperature forms Oxidized in places.
58.30	71.00	Lacustrine sands and silts, finely current bedded, possibly largely reworked tuffs. Possibly very zeolitic and montmorillonitic but needs thin section study. Oxidized to 65.00, below this grey green coloured, fresh.
71.00	94.50	Hyaloclastite; basaltic fragments up to 2cm, scattered angular limestone fragments; much of the glassy matrix zeolitised. Tacharanite occurs at 71.25 (intense white, fine grained). Layering prominent in places, at 70°.
94.50	95.75	Sericitic silty sands with slumped patches of hyacloclastite.
95.75	135.85	Hyacloclastites. Coarser to about 118 and finer below. Coarser material similar to 71.00 - 94.50; finer material generally has fragments less than 0.5mm. Limestone fragments common in the coarser material. Variably zeolitised, frequently concentrated along layering. Tendency towards graded layering e.g. around 98.00 (coarse layering might be formed at time of eruption and finer layering later due to slower settling). Slump folding at 102.00. Layering 80°-90°, 95.75-103.75, then suddenly 45° to 120.00 (normal angle of rest is 35° for foresets, so these have presumably been further tilted by slumping), layering becomes steeper (i.e. steeper relative to core axis, or flatter measured from the horizontal), but less well defined, below.

135.85	140.00	Silty sandstones with horizons of reworked hyaloclastite. Patchy plant fragments. Bedding 70°.
140.00	151.50	Vitric and reworked tuffs. Interlayered vitric tuff and silty reworked ash and hyacloclastite. Layering 70°. At 144.00 rounded pebbles several cm across of similar composition to host which is a reworked ash. Very fine tacharanite around 145.50
151.50	152.95	Hyaloclastite similar to 71.00-94.50. Tacharanite around 152.00.
152.95	172.00	Fawn to khaki sandstones and siltstones, probably largely volcaniclastic. At the top 5m there is clayey siltstone and horizons of vitric tuff and hyaloclastites 5-10cm thick. Lowest 5m grades into vitric and reworked tuffs. A complex sequence requiring detailed inspection.
172.00	175.50	Hyaloclastite. Mostly relatively fine breccia with fragments less than 0.5cm.
175.50	177.40	Silty micaceous sandstones grading to siltstones. Coarser ashy horizons in last metre. Silicified at top for 0.5m, probably caused by upper hyaloclastite
177.40	183.50	Conglomerates. Well rounded pebbles of sandstone (of sedimentary origin) set in micaceous silty to clayey sandstone.
183.50	185.25	Sericitic sandstones and siltstones with seams of lignitised plant fragments. Cross stratified at 80° overall.
185.25	188.15	Conglomerates similar to 177.40-183.50.
188.15	192.20	Sandstones as for 183.50-185.25.
192.50	203.20	Sandstones and conglomerates similar to above; all bedding 90° from here to 262.
203.20	204.80	Conglomerates and grits. Lignitic and argillaceous horizons. Well rounded and well sorted grit and pebble horizons.
204.80	217.20	Siltstones and silty mudstones with some slickensiding. Finely disseminated lignitic seams.
217.20	218.25	Sericitic, quartzose sandstones with lignitic seams and partings.
218.25	228.30	Grey to fawn siltstones. Variable sericite and indistinct lignitic content, forming seams & partings
228.30	229.80	Sericitic, silty sandstones with lignitic fragments resting on grits and conglomerates.

HOLE NO.: GHD 2 cont.

229.80	232.70	Conglomerates. Dark matrix of material to be determined - could prove to be vitric tuff but more likel a sandstone.
232.70	235.10	Conglomerate. Poorly sorted components in sericitic and silty sand matrix.
235.10	240.20	Alternating grits and sandstones. Sericitic. Distinct lignitic seams.
240.20	244.60	Finely bedded brown siltstones with sandstone horizo Variable lignite seams.
244.60	245	Sandstone. Silty and sericitic with lignite at base.
245	246.70	Conglomerate. Well rounded coarse pebbles in seams alternating with finer pebbles to grit.
246.70	262.00	Brown mudstone and siltstones with fine sericite flakes. Scattered plant fragments.
262.00	262.75	Massive fine grained basalt. Possibly the chilled top of the basal flow. In outcrop this basalt has a white spotty appearance; this texture is not present here.

END OF HOLE - HOLE TERMINATED DUE TO DRILLING DIFFICULTIES BEFORE PENETRATING PRE-TERTIARY BASEMENT ROCK, (PRESUMABLY GORDON LIMESTONE).

GHD 2

VISUAL ESTIMATION OF ZEOLITE CONTENT

NOTE: Percentages of zeolites were computed at each distance peg by overlaying a 14 mesh nylon screen and counting the number of holes occupied by zeolites in a total grid of 1000 holes.

Zeolite percentages in brackets are guesstimates, where counting could not be done because of either coarse or very fine grain size.

At	%	At	%	At	%
24.65	25%	95.25	(40%)	173.25	59%
26.25	27%	98.25	37%	175.50	?
29.30	26%	101.25	(15%)	176.25	?
32.25	27%	104.25	11%	179.25	?
35.25	30%	107.25	34%	182.25	?
36.75	40%	110.00	(25%)	183.50	?
38.75	21%	113.25	(25%)	185.25	?
39.45	21%	116.25	13%	188.25	?
41.25	15%	119.25	26%	192.50	?
44.25	32%	122.25	(20%)	194.25	?
45.75	21%	125.25	(25%)	197.25	?
47.25	32%	128.25	52%	200.25	?
50.25	22%	131.00	58%	203.25	?
53.25	31%	134.10	65%	206.25	?
56.25	50%	137.25	?	209.25	?
59.25	40%	140.25	?	211.60	?
61.00	20%	143.25	?	212.25	?
61.65	30%	146.25	?	215.25	?
62.25	30%	149.25	49%	218.25	?
65.25	?	152.25	13%	221.25	?
68.25	?	155.25	?	224.25	?
71.25	60%	158.25	(40%)	227.00	?
74.25	15%	159.50	?	230.25	7%
77.25	15%	160.50	?	233.20	40%
80.25	15%	161.25	?	235.10	?
83.25	10%	164.25	?	236.25	?
86.00	25%	167.25	?	239.25	?
89.00	25%	170.25	?	242.25	?
92.25	25%	171.25	?	245.25	?

PROJECT: GAD'S HILL HOLE NO: D 2 RECOVERY LOG

FROM	TO	ADVANCED INTERVAL	RECOVERY	RECOVERED %
0	3.50	3.50	1.60	45.7
3.50	4.75	1.25	1.00	80.0
4.75	6.00	1.25	1.55	124.0
6.00	6.90	.90	.90	100.0
6.90	7.75	.85	1.00	117.6
7.75	10.75	3.00	3.15	105.0
10.75	11.40	.65	.65	100.0
11.40	14.25	2.85	2.85	100.0
14.25	17.25	3.00	3.05	101.7
17.25	20.25	3.00	3.00	100.0
20.25	23.25	3.00	3.00	100.0
23.25	24.65	1.40	1.40	100.0
24.65	26.25	1.60	1.75	109.4
26.25	29.25	3.00	3.00	100.0
29.25	32.25	3.00	3.00	100.0
32.25	35.25	3.00	3.05	101.7
35.25	36.75	1.50	1.50	100.0
36.75	38.25	1.50	1.15	76.7
38.25	39.50	1.25	1.25	100.0
39.50	41.25	1.75	1.75	100.0
41.25	44.25	3.00	3.00	100.0
44.25	45.75	1.50	1.30	86.7
45.75	47.25	1.50	1.60	106.7
47.25	50.25	3.00	2.80	93.3
50.25	53.25	3.00	3.10	103.3
53.25	56.25	3.00	3.20	106.7
56.25	59.25	3.00	2.95	98.3
59.25	61.00	1.75	1.30	74.3
61.00	61.65	.65	.90	138.5
61.65	62.25	.60	.55	91.7
62.25	65.25	3.00	3.00	100.0
65.25	68.25	3.00	2.70	90.0
68.25	71.25	3.00	3.20	106.7
71.25	74.25	3.00	3.00	100.0
74.25	77.25	3.00	3.00	100.0
77.25	80.25	3.00	3.05	101.7
80.25	84.25	4.00	2.35	58.7
84.25	86.00	1.75	2.00	114.3
86.00	89.00	3.00	3.00	100.0
89.00	92.25	3.25	3.25	100.0
92.25	95.25	3.00	3.00	100.0
95.25	98.25	3.00	3.00	100.0
98.25	101.25	3.00	3.00	100.0
101.25	104.25	3.00	3.00	100.0
104.25	107.25	3.00	3.00	100.0
107.25	110.00	2.75	2.75	100.0
110.00	113.25	3.25	3.10	95.4
113.25	116.25	3.00	3.00	100.0
116.25	119.25	3.00	3.00	100.0
119.25	122.25	3.00	3.00	100.0

030

082030

PROJECT: GAD'S HILL HOLE NO: D 2 RECOVERY LOG

FROM	TO	ADVANCED INTERVAL	RECOVERY	RECOVERED %
112.25	125.25	3.00	3.00	100.0
125.25	128.25	3.00	3.00	100.0
128.25	131.00	2.75	2.75	100.0
131.00	134.10	3.10	3.10	100.0
134.10	137.25	3.15	3.05	96.8
137.25	140.25	3.00	3.00	100.0
140.25	143.25	3.00	3.00	100.0
143.25	146.25	3.00	3.00	100.0
146.25	149.25	3.00	3.00	100.0
149.25	152.25	3.00	3.00	100.0
152.25	155.25	3.00	3.00	100.0
155.25	158.25	3.00	3.00	100.0
158.25	159.50	1.25	1.25	100.0
159.50	160.50	1.00	1.00	100.0
160.50	161.25	.75	.45	60.0
161.25	164.25	3.00	3.00	100.0
164.25	167.25	3.00	2.90	96.7
167.25	170.25	3.00	2.75	91.7
170.25	171.75	1.50	1.50	100.0
171.75	173.25	1.50	1.50	100.0
173.25	175.50	2.25	2.05	91.1
175.50	176.25	.75	.90	120.0
176.25	179.25	3.00	3.00	100.0
179.25	182.25	3.00	2.20	73.3
182.25	183.50	1.25	1.55	124.0
183.50	185.25	1.75	1.75	100.0
185.25	188.25	3.00	3.00	100.0
188.25	191.25	3.00	3.00	100.0
191.25	192.50	1.25	1.00	80.0
192.50	194.25	1.75	1.80	102.8
194.25	197.25	3.00	3.00	100.0
197.25	200.25	3.00	1.40	46.7
200.25	203.25	3.00	2.50	83.3
203.25	206.25	3.00	2.80	93.3
206.25	209.25	3.00	2.90	96.7
209.25	211.60	2.35	2.35	100.0
211.60	212.25	.65	.60	92.3
212.25	215.25	3.00	1.80	60.0
215.25	218.25	3.00	.60	20.0
218.25	221.25	3.00	2.80	93.3
221.25	224.25	3.00	2.60	86.7
224.25	227.00	2.75	3.00	109.1
227.00	230.25	3.25	3.00	92.3
230.25	233.25	3.00	2.90	96.7
233.25	235.10	1.85	1.50	81.1
235.10	236.25	1.15	.50	43.5
236.25	239.25	3.00	1.70	56.7
239.25	242.25	3.00	2.60	86.7

031

082031

PROJECT: GAD'S HILL   HOLE NO: D 2   RECOVERY LOG

FROM	TO	ADVANCED INTERVAL	RECOVERY	RECOVERED %
242.25	245.25	3.00	3.00	100.0
245.25	247.00	1.75	1.50	85.7
247.00	248.25	1.25	.80	64.0
248.25	251.25	3.00	3.00	100.0
251.25	252.75	1.50	1.30	86.7
252.75	254.25	1.50	1.50	100.0
254.25	257.25	3.00	3.30	110.0
257.25	259.50	2.25	2.25	100.0
259.50	262.10	2.60	2.60	100.0

Central Mineralogical Services

CMS

231 Magill Road
Maylands, S.A. 5069
Telephone 425659

Mr. P. Askins
Geologist
Comalco Limited
Exploration Department
P.O. Box 691
DEVONPORT / TAS. 7310

9th August, 1979

REPORT CMS 79/7/43

YOUR REFERENCE:	PA/T/GH Lab. Work Requisition Note
DATE RECEIVED:	25th July, 1979
SAMPLE NOS.:	PA/T/GH 1, 6, 15 PA/T/LC 1, 2
SUBMITTED BY:	P. Askins
WORK REQUESTED:	Petrology

H.W. Fander, M. Sc.

P.S. Will call in on 29th - about 11 a.m.

Wally.

REPORT CMS 79/7/43

Rock Samples Reference PA/T/GH

The five rocks were thin-sectioned and petrographically examined; they are described below.

PA/T/GH 1 (T.S. 28462)
This rock is a zeolitised basalt-breccia; the basalt is a porphyritic glassy amygdaloidal type in which the glass is decomposed.

There are large and small, irregular, ångular fragments of basalt consisting of fresh labradorite phenocrysts, occasional fresh augite phenocrysts, and small labradorite laths, set in a uniform brown, isotropic mass of soft, decomposed glass; a few small ovoid amygdales occur. Basalt fragments comprise about 75-80 % of the rock.

The fragments are veined and cemented by zeolite; generally, each fragment is fringed with small crystals of heulandite, and the veins are filled with relatively coarse crystals of chabazite. Amygdales are filled with these two zeolites, and rimmed with a brown fibrous mineral (?iddingsite). Zeolites do not occur within the basalt fragments themselves except in amygdales. The breccia fabric may be a scoriaceous lava-breccia rather than a tectonic feature.

PA/T/GH 6 (T.S. 28463)
This is a zeolitised basalt-breccia, quite similar to GH 1; however, zeolites are not as common.

The basalt fragments themselves seem to be entirely fresh (except along the edges), consisting of clean, well-defined labradorite and augite phenocrysts randomly set in a groundmass of fresh brown glass carrying small labradorite laths and showing minor fluxion-banding. A few vesicles occur, and some are thinly lined with heulandite or filled with chabazite.

The basalt fragments are "cemented" with brown isotropic material, which is thought to be ultrafine vitric tuff of basaltic composition. There are a few irregular spaces filled with white minerals; the linings are small heulandite crystals, and the fillings are medium-to coarsely-crystalline analcite (not a true zeolite); these comprise less than 5 % of the rock and do not occur within the basalt fragments themselves.

PA/T/GH 15 (T.S. 28464)
This is a fine vitric tuff, finely-banded and presumed to be of basaltic composition, though chemical analysis would be needed to establish this.

The rock consists dominantly of small splintery fragments of devitrified brown glass, and the banding is due partly to grainsize variations (i.e. sorting/sizing), though the coarser bands also contain small angular grains of plagioclase, quartz and rare augite.

The coarser layers are more porous and may contain minor interstitial zeolites, but these would comprise less than 5 % of the total rock; no zeolites were in fact identified, but would be difficult to detect under the circumstances.

PA/T/LC 1 (T.S. 28465)
The hand specimen appearance suggests that the rock is a scoriaceous basalt, or perhaps a basaltic flow-breccia. It closely resembles GH 1.

The basalt fragments, of irregular shape and variable size, show some continuity; the amygdales give the impression of merging into larger branching cavities (now filled with zeolites), and are of much more irregular shape than in GH 1 and GH 6,suggesting the crust of a flow.

The basalt itself consists of labradorite and augite phenocrysts, and labradorite laths, set in a homogeneous brown glass which is fresh in the coarser fragments, but altered in the smaller ones; each fragment has a regular, thin selvedge of a fibrous brown mineral (?iddingsite).

The amygdales and larger branching bodies are lined with euhedral heulandite crystals and filled with massive chabazite; the heulandite is a doubtful identification and the mineral may be gmelinite.

In the offcut and thin-section, zeolites comprise 30-35 % of the rock, but this may not be representative.

The largest, most solid parts of the specimen consist of a darker basalt with far more groundmass feldspar laths and a black, semi-opaque glassy groundmass.

PA/T/LC 2 (T.S. 28466)

This is a zeolitised basalt breccia, quite possibly a flow-breccia, and there is evidence of two similar, butdistinct basaltic phases, forming an agglomerate in places.

There are fragments of pale-brown, fresh glassy basalt (virtually identical with that described above); these fragments are rimmed with softer brown isotropic material, evidently an alteration-product (i.e. not a coating of introduced material), containing labradorite laths and phenocrysts which can be seen to span the contact between fresh basalt and the brown material. At this stage, the brown substance (which is quite conspicuous in hand specimen) is thought to be hydrated and perhaps oxidised glass, though evidently still isotropic and amorphous.

In places, a darker basalt with a semi-opaque glassy groundmass envelops the lighter basalt fragments, and represents a younger (but obviously related) phase.

Zeolites occupy amygdales, canals, and interstices between basalt fragments and comprise 10-15 % of the total rock; individual patches seldom exceed 1 mm in size, and consist of chabazite and small radiating aggregates of fibrous natrolite (tentative identification based on habit and some optical porperties).

Heulandite and clinoptilolite are evidently closely related, with clinoptilolite regarded as a high-Si variety of heulandite by some authors.

Zeolite References:

1. Industrial Minerals Oct. 1973 (p. 30): "World Deposits/Utilisation" (Mumpton)
2. Industrial Minerals Jan. 1978 (p. 10): "More Zeolites for Detergents"

H.W. Fander, M. Sc.

036

APPENDIX 4 082036

COMMONWEALTH ALUMINIUM CORPORATION LIMITED

DESPATCH and LABORATORY WORK REQUISITION NOTE

REFERENCE No. GHD 1

TO: JULIAN HOLLIS
AT: c/- AUSTRALIAN MUSEUM
6-8 COLLEGE ST
SYDNEY
DATE: 10.4.80
Per: ANSETT
No. of Items: ONE CARTON

FROM: P. ASKINS
AT: PO BOX 691
DEVONPORT
7310
Consignment No.: S 57826

Category: EXPLORATION, R. & D., PRODUCTION, EXTERNAL

Claimable Under I. R. & D. Grant: YES/NO.

Sample Numbers	Sample Type	Work Required
GHD1 7.25	CHABAZITE RICH	Thin sections ~ $8
14.25	BASALT BRECCIAS	Petrographic descriptions ~ $17
21.75	FROM DRILL CORE	as per your quote of 18 Feb 80
29.45 – (montmorillonite rich)		
35.25		After initial work please advise
41.25		what further microprobe work
47.25		at what cost, is necessary to
53.35		define the zeolite compositions
59.30		and the nature of montmorillonite
65.25		if it is volumetrically significant
71.25		Please phone (004) 272296
77.25		+ reverse charges to discuss this
83.25		if necessary.
89.10		
92.15 98.75		
104.15 110.30	} siltstone	
127.45	}	TOTAL NUMBER OF SAMPLES: 19

SEND RESULTS TO: (1) P. ASKINS as above (2) (3)

CHARGE TO: 25.07.015 SIGNATURE: Paul Askins

THIS COPY TO ~~THE LABORATORY WITH SAMPLES.~~ FILE

037

082037

the australian museum
sydney

Department of Mineralogy and Petrology

18th February 1980.

Mr. P. W. Askins,
Comalco Ltd,
Exploration Dept.
P.O. Box 691
Devonport, Tas 7310.

Dear Paul,

Sorry to be so long sending you the information you asked for, concerning the cost of thin sections and petrographic analyses. Ms Joan Hingley would be prepared to cut thin sections at $8 each and I can then describe the material for you. Based on an examination time of about 15 minutes per slide, I would suggest an additional $9 for examination and compiling petrographic reports. Total cost per section would then be $17.

I have ready access to electron microprobe facilities, should you want such work done on zeolites or other minerals, but I would have to find out what Macquarie Univ. charges for probe time on a consulting basis.

It was good to be with you the other day. Thanks for the hospitality.

Yours Sincerely
Julian D. Hollis.

6-8 College Street
Telephone: 339-8111 Cable: MUSEUM
P.O. Box A285 Sydney South, N.S.W. 2000

038

APPENDIX 5

082038

The Australian Mineral Development Laboratories

Fl[illegible]ington Street, Frewville,
South Australia 5063
Phone Adelaide 79 1662
Telex AA 82520

Please address all correspondence to
P.O. Box 114 Eastwood
SA 5063
In reply quote:

amdel

14 December, 1979

GS 3/1/4/0

Commonwealth Aluminium Corporation Ltd,
P.O. Box 691,
DEVONPORT, TAS. 7310.

Attention: Mr P. Askins

REPORT GS 2496/80

YOUR REFERENCE: Despatch & Laboratory Work Requisition Note dated 21/11/79

MATERIAL: Clay

IDENTIFICATION: PA/T/GH20

DATE RECEIVED: 23/11/79

WORK REQUIRED: Examination for 'bentonite' and bentonitic properties.

Investigation and Report by: Dr Roger Brown & Lyn J. Day

Manager, Geological Services Division: Dr Keith J. Henley

Keith Henley

for Norton Jackson,
Managing Director.

jdy/2

c.c. Comalco,
95 Collins Street,
MELBOURNE, Vic.

Attention: Mr A.H. Bartlett

Pilot Plant: Osman Place
Thebarton S.A.
Telephone 43 8053
Branch Laboratory: Perth

MINERALOGY AND PROPERTIES OF CLAY

1. INTRODUCTION

A sample of brown clay was received from Commonwealth Aluminium Corporation Ltd (Mr P. Askins) for mineralogical examination. In the event of the presence of bentonite-like clay a brief description of the properties was requested.

2. PROCEDURE

2.1 XRD Examination

The bulk material was examined by X-ray powder diffractometry. A weighed subsample was dispersed in water and allowed to sediment to give a -2 μm e.s.d.fraction by the pipette method. An oriented clay preparation was produced from this, saturated with Mg^{++} ions and treated with glycerol. When air-dry, this was examined in the X-ray diffractometer.

2.2 Physical Properties

The rheological properties of the material were determined in accordance with American Petroleum Institute procedures. These involve the dispersion of 22.5 grams of the material in 350 millilitres of distilled water using a high-shear mixer. After standing for 16 hours the suspension was sheared again. The rheological properties were then measured using a Fann direct-reading viscometer.

Soda modification was made by adding 3% dry sodium carbonate to a similar suspension which was also allowed to stand overnight prior to measurement.

The sample was wet-screened at 150 and 53 micrometres.

3. RESULTS

3.1 Mineralogy

Bulk sample

The bulk material is dominantly montmorillonite, with accessory (∿10%) analcite, minor (∿5%) feldspar and a trace of mica.

Clay fraction

It was found that 26% of the sample separated into the -2 μm fraction, and this fraction was found to consist overwhelmingly of montmorillonite (∿ 90%) with minor analcite and mica/illite.

3.2 Rheological Properties

		Sample	Sample + 3% Na_2CO_3
Gel Strength (lbs/100 sq.ft)	intermediate	1	2
	10-minute	1	1
Viscosity (centipoise)	Plastic	2.5	3.5
	apparent	3	3.5
Yield Point (lbs/100 sq ft)		1	0
Temperature °C		22.5	22.5
Suspension strength		22.5 g/350 ml	22.5 g/350 ml
Moisture content of original clay		13.5%	13.5%

3.3 Sizing Results

+100 mesh (150 μm)	38%
-100+300 mesh	10%
-300 mesh (53 μm)	52%

4. DISCUSSION

Although mineralogically promising, the material is a sub-bentonite in that it does not meet the general requirements for bentonites. The rheological properties of this sample both before and after soda modification are poor in comparison with bentonites used for oil-well drilling fluids. Such bentonites produce a fluid of an apparent viscosity of 15 cp at 22.5 gm/350 ml.

The sample appears to be fairly coarse since only approximately half the material is less than 53 micrometres (300 mesh).

041

APPENDIX 6.

082041

the australian museum sydney

Department of Mineralogy & Petrology

6-8 College Street
Telephone: 339-8111 Cable: MUSEUM
PO Box A285 Sydney South, NSW 2000

2nd July, 1979

Paul Askins
Camalco Ltd (Exploration)
P.O. Box 691,
Devonport. Tasmania 7310

Dear Paul,

The small alluvial grains of fluorescent mineral from Ration Tree Creek closely match the X-ray pattern for herschelite, the complexly twinned soda-rich variety of chabazite. The X-ray was done at CSIRO by our colleague Bill Ryall.

If the complexity of twinning is related to temperature then herschelite should indicate fairly close promixity to a heat source, i.e. perhaps the Gads Hill volcanic centre?

I will contact you about the other zeolites from Guildford when we identify them.

Yours sincerely,

F. L. Sutherland

F.L. Sutherland
Curator of Rocks and Minerals

APPENDIX 7

BENEFICIATION STUDIES

Exploration Department,
P.O. Box 691,
DEVONPORT. TAS. 7310.

28th September, 1979.

Mr. H. Wellington,
Chief Chemist & Metallurgist,
Department of Mines,
Wellington Street,
LAUNCESTON. TAS. 7250.

Dear Mr. Wellington,

This letter confirms our verbal request for an initial investigation into producing a chabazite product from the chabazite rich rock samples which I delivered on 25th September. We wish to know whether a chabazite rich product can be produced by a simple beneficiation process. If a product can be obtained we will then arrange for its testing and further evaluation.

The lumps of chabazite rich basalt breccia came from the road cut along Olivers Road at Gad's Hill in our E.L. 7/74.

Attached is a copy of information on zeolite beneficiation which you requested.

Yours sincerely,

P.W. Askins.
Senior Geologist.

Encl.

044

M 1588

DEPARTMENT OF MINES—TASMANIA

082044

TELEPHONES:
Metallurgical Research .. ..
Laboratory .. .. ..
Mines Inspection .. .. ..
Explosives & Inflammable Liquids
44 2431-2 (2 lines)

LAUNCESTON OFFICES
287 WELLINGTON STREET
SOUTH LAUNCESTON 7250

18th October, 1979

Commonwealth Aluminium Corp. Ltd.,
Exploration Department,
P.O. Box 691,
DEVONPORT Tas. 7310

Attn: Mr Paul Askins

R783

Dear Mr Askins,

Please find enclosed a copy of David Green's report on hand specimens from the Zeolitic basalt submitted by you for this project.

With a view to establishing some method of control for the oredressing work some heavy liquid separations have been made and we have had the float (F/T) fractions examined for mineral purity. It would appear that a heavy liquid separation at 2.20 would afford such control.

Unfortunately to date oredressing results from visual appraisal have not been very effective. There are operating problems, for example in tabling we are seeking the light mineral not the heavy hence some modification of proceedure is having to be developed.

However this initial heavy liquid appraisal suggests a good grade chabazite should be obtainable with the right technique.

Yours sincerely,

(H. K. Wellington)
Chief Chemist & Metallurgist

Encl.

00738 NOTE:- ALL CORRESPONDENCE TO BE ADDRESSED TO THE DIRECTOR OF MINES

082045

TASMANIA

DEPARTMENT OF MINES

TELEPHONE: 30 8033

G.P.O. BOX 124 B
HOBART
TASMANIA 7001

17th, October, 1979

Chief Chemist & Metallurgist,
Department of Mines,
LAUNCESTON

R 783

The hand specimens of basalt from Gads Hill (E.L. 7/74) submitted on 27th September, 1979 have been examined optically and by x-ray diffraction. The cavity fillings are essentially chabazite (density 2.18-2.16) with minor calcite (density 2.71) and acicular apophyllite (density 2.38). A trace of tobermorite (a breakdown product of tacharanite (density 2.36) is seen in the XRD traces.

The heavy liquid concentrates submitted on 4th October are described as follows:-

(a) R 783 N1 2.088 F/T - about 90% chabazite with 10% composite grains consisting of chabazite and rock fragments.

(b) R 783 N1 2.196 F/T - about 75% chabazite with 25% composite grains consisting of chabazite and apophyllite and rock fragments (chiefly chlorite).

(J.G. Symons)
DIRECTOR OF MINES

046

082046

Central Mineralogical Services

CMS

231 Magill Road
Maylands, S.A. 5069
Telephone 42 5659

Mr. P. Askins
Geologist
Comalco Ltd.
Exploration Department
P.O. Box 691
Devonport / Tas. 7310

19th October, 1979

REPORT CMS 79/10/2

SAME ROCK AS R783 SUBMITTED TO MINES DEPT.

YOUR REFERENCE:	PA/T/GH 18
DATE RECEIVED:	1st October, 1979
SAMPLE NOS.:	PA/T/GH 18
SUBMITTED BY:	P. Askins
WORK REQUESTED:	Petrology

H.W. Fander

H.W. Fander, M. Sc.

Copy to:
Mr. A.H. Bartlett
Exploration Manager
Comalco Ltd.
G.P.O. Box 2773Y
MELBOURNE / VIC. 3001

047

082047

CENTRAL MINERALOGICAL SERVICES PTY. LTD.

Date 19th October, 1979

SAMPLE REPORT (Mineralogy, Petrology, Ore Microscopy)

IDENTIFICATION
PA/T/GH 18
Zeolites in Basalt Breccia

Job No. CMS 79/10/2 Date Received: 1.10.1979

Reference PA/T/GH 18

Sample No. PA/T/GH 18

Nature of Sample: Hand Specimen

DESCRIPTION **SECTION No.** 29473

a. Hand Specimen:

Dark breccia with zeolite cement, cavity-fillings.

Microscopic:

A thin-section was prepared, and an X-ray powder photo was prepared of the white material lining cavities.

The thin-section shows that the rock is an amygdaloidal basalt breccia, very probably a lava-flow-breccia, since individual fragments have chilled glassy margins and partly crystalline cores. The rock consists of small enstatite/hypersthene phenocrysts and occasional olivine, with laths of plagioclase (andesine where recognisable), set in a brown, altered, isotropic glass. Small amygdales are common, and are mostly lined with fine, fibrous ?nontronite; this mineral also forms irregular edges on the basalt fragments and appears resinous brown in hand specimen.

The cementing and cavity-filling minerals are dominantly chabazite, with minor tacharanite and traces of apophyllite.Chabazite occurs as well-developed clear crystals up to 1 mm in size, forming mosaics. Apophyllite is very rare as isolated small (< 0.5 mm) crystals in chabazite mosaics. The tacharanite (confirmed by XRD) tends to line and fill cavities; it occurs as white, opaque, cryptocrystalline masses.

It would seem that, in order to produce a zeolite concentrate, the rock would need to be carefully and gently crushed to avoid unnecessary overgrinding of the soft, brittle zeolites; this could be followed by either gravity or magnetic methods (or a combination of both) to remove heavies/more magnetic basalt fragments. It may be possible to use a heavy-media method similar to that used in coal-washing plants, perhaps with a ferrosilicon fluid adjusted to an SG of, say, 2.2.

H.W. Fander, M. Sc.

048 M 1588

082048

DEPARTMENT OF MINES—TASMANIA

TELEPHONES:
Metallurgical Research .. ..
Laboratory .. .. ..
Mines Inspection .. .. ..
Explosives & Inflammable Liquids
} 44 2431-2 (2 lines)

LAUNCESTON OFFICES
287 WELLINGTON STREET
SOUTH LAUNCESTON 7250

8th November 1979

Commonwealth Aluminium Corp Ltd,
Exploration Dept,
P.O. Box 691,
Devonport,
TASMANIA 7310

Attn Mr. Paul Askins.

R783: Chabazite Concentration

Dear Sir,

Under separate cover I am sending small samples of fairly coarse chabazite concentrates for your inspection.

A sample of material has been sized and each size fraction is being examined. When we have completed these investigations we should be in a position to process the main bulk of the sample to produce a chabazite concentrate. While we expect a chabazite concentrate to be colourless to white the products we are getting contain some dark minerals. These could well be oxidized material in the surface boulders that would not be present at depth. We are sending samples to David Green for his comments.

The samples being sent you were obtained in the following way:-

1. The sample was roll crushed to pass a 1mm screen then screened. The -1mm + 0.85mm fraction contained 6.1% of the total mass.

2. This fraction was tabled to produce:-

Product	Mass (%)	Lm (%)	Lm Distrib (%)
T1C	12.0	(91.9)	17.1
T1M	45.5	(70.7)	50.0
T1T	42.5	(49.8)	32.9
H	100	(64.4)	100

Notes 1. Lm = Light mineral = heavy liquid float fraction at density 2.20 t/m^3

2. () = Calculated figures.

3. Each table product was magnetically separated to produce:-

Product	Mass (%)	Lm (%)	Lm Distrib (%)
T1C N*	3.8	98.2	5.8
T1C M/A	8.2	89.0	11.3
T1C	12.0	(91.9)	17.1
T1M N*	15.3	95.2	22.6
T1M M/A	30.2	58.3	27.4
T1M	45.5	(70.7)	50.0
T1T N*	9.2	(92.5)	13.2
T1T M/A	33.3	38.0	19.7
T1T	42.5	(49.8)	32.9

N = Non magnetic fraction
M/A = Magnetic fraction.

4. Although the magnetic separations were done on tabled products the results can be expressed to show what magnetic separation would produce from the original feed, namely:-

Product	Mass (%)	Lm (%)	Lm Distrib (%)
N	28.3	(94.7)	41.6
M/A	71.7	(52.4)	58.4

5. The actual products being sent you are heavy liquid float (H/L. F/T) products from the non magnetic (N) fractions of each table product. (Asterisk * in Item 3 above). The small amount of sink (S/K) in each case has been sent to David Green. The products being sent you are :-

A 529 T1C N F/T 2.20
A 530 T1M N F/T 2.20
A 532 T1T N F/T 2.20

Results are also available for size fraction -500 + 425 um which contained 8.1% of the total mass. These are:-

1. Tabling.
2. Magnetic separation followed by tabling the N fraction.

Product	Mass (%)	Lm (%)	Lm Distrib (%)
T2C	3.2	96.1	5.1
T2M	24.1	93.1	37.1
T2T	72.7	48.1	57.8
H	100	(60.5)	100
T3C	11.2	99.6	18.4
T3M	8.5	91.5	12.9
T3T	2.7	88.4	3.9
M/S 2 N	22.4	(95.2)	35.2
M/S 2 M/A	77.6	50.5	64.8
H	100	(60.5)	100

Conclusion

Test work indicates achieving a high recovery will be a problem rather than achieving grade if the "Lm" figures represent chabazite.

Magnetic separation appears to be the better initial step than gravity concentration. Jigs, flotation and hydraulic cycloning have been used in some tests to date.

In part sending you samples of products is to get an idea of at what grade of product we should aim.

Thank you for the Fander report with its suggestions for concentrating the zeolites.

Yours faithfully,

(H. K. Wellington)
Chief Chemist & Metallurgist.

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COMALCO

COMALCO LIMITED

Incorporated in Victoria

95 Collins Street
Melbourne Australia

AHB/bb

11th January, 1980.

Mr. H.K. Wellington,
Chief Chemist & Metallurgist,
Department of Mines - Tasmania,
287 Wellington Street,
SOUTH LAUNCESTON. Tas. 7250.

Dear Mr.Wellington,

Re: R783 : Chabazite Concentration

Thank you for your letter dated 8th November, 1979, which Paul Askins has passed on to me for reply. I am most grateful for the beneficiation studies that you have carried out on the chabazite bearing tuff from Gad's Hill in Tasmania - I have given a copy of your report to Comalco's Manager Technical Services - Bill Andrews and he has been able to make some useful comments.

I am still keen to pursue the marketing of zeolites and obviously the purer the mineral concentrate the better it is for some of the special applications. Although there are many uses for zeolites that are not sensitive to the presence of iron in particular.

Bill Andrews has suggested that heavy media separation should be tried again using :

- as coarse a grind as feasible, and
- as fine a grind as feasible, that is not less than 25 mesh.

Obviously recovery needs to be improved, but preferably we will need greater than 90% chabazite in the concentrate and I guess to be economic we need to recover 50% of the contained chabazite.

Paul and I are actively pursuing the uses and marketing of zeolites and in particular we will endeavour to find out what grades can be used for each particular application. Chabazite appears to be the only zeolite we can produce in Tasmania and some of the uses we know of at present for this zeolite are:

...2/

GPO box 2773Y Melbourne Vic. 3001
Telegraphic 'Forcomal' Telex 30108
Telephone 63 0491

Radioactive waste disposal - collection
Oxygen production - absorbes nitrogen
Coal gasification
Natural gas purification
Solar energy - heat storage
Petroleum refining
Metallurgy - leaching - collection
Paper filler
Cements
etc. etc.

I would greatly appreciate your further help with this beneficiation project, Paul and I will keep you advised on the acceptable grades that can be used in the various applications.

Yours sincerely,

A.H. Bartlett

MANAGER EXPLORATION

053

082053

Mr. H.K. Wellington,
Chief Chemist & Metallurgist,
Department of Mines - Tasmania,
287 Wellington Street,
SOUTH LAUNCESTON, TAS. 7250

14th January 1980

Dear Hugh,

re: R783: Chabazite Concentration.

Tony Bartlett sent me a copy of his letter to you dated the 11th January regarding Chabazite Concentration.

There is confusion regarding my suggestions which he has listed in his 3rd paragraph. In view of the obvious difficulty of achieving good recovery athhigh grades, I suggested that it may be desirable to make a heavy media separation at a relatively coarse crush, particularly to determine if this would yield a reasonable method of pre-concentration. The use of a heavy media cyclone could be attractive in the size range from say 6mm down to .6mm.

The other possibility is to grind the material finely and try flotation. I have no information on the application of flotation to Chabazite, but a preliminary look at the products you supplied suggest that a reasonably fine grind will be necessary to achieve complete liberation, and thus flotation may be required to achieve good grade and recovery.

If I have the opportunity to visit Launceston at any time, I would like to call in and renew old acquaintances.

Yours sincerely,

W.H. Andrews
Manager
Technical Services - Mining.

c.c. A.H.Bartlett,Manager - Exploration Dept.

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DEPARTMENT OF MINES—TASMANIA

TELEPHONES:
Metallurgical Research .. .. } 44 2431-2
Laboratory .. .. .. } (2 lines)
Mines Inspection .. .. ..
Explosives & Inflammable Liquids

LAUNCESTON OFFICES
287 WELLINGTON STREET
SOUTH LAUNCESTON 7250

14th April 1980

Commonwealth Aluminium Corp. Ltd.,
Exploration Dept.,
P.O. Box 691, Devonport
TASMANIA

Attn. Mr. Paul Askins.

R783: Chabazite Concentration

Dear Sirs,

Further results are available from work on this project and I must apologise for not answering your letters written in January.

Heavy liquid test work has not been possible for some months here due to urgent work on coal and the limited capacity we have at present. I believe Bill Andrews' suggestion of a heavy media cyclone is attractive and worth following. In our initial approach it was intended to do heavy liquid separations in the range 2.1 to 2.6 t/m^3 but due to the oxidized nature of the basalt sample there were difficulties and heavy liquid separations around 2.1 & 2.2 were pursued only as a means of evaluating the other concentration methods employed. However as sink products from such evaluations seem devoid of zeolites it does appear that unoxidized basalt could be successfully rejected as an initial concentration step although I would not say the present sample would show this up to the best advantage.

The sample as received was all reduced to pass 5mm and from this a sample was cut and roll crushed to pass 1mm then sized to yield:-

Fraction (um)	Mass (%)	Cum Mass (%)	Assay (% Lm)*	Remarks.
+ 850	6.1	6.1	64.4	See letter 8.11.79
710	11.0	17.1		
600	6.8	23.9		
500	12.5	36.4		See below
425	8.1	44.5	60.5	See letter 8.11.79
300	10.6	55.1		
150	14.9	70.0		See below
38	15.8	85.8		
- 38	14.2	100		

* Lm = light mineral.

In addition to the results reported on 8th Nov'79 test work has been done on two more fractions with the following results from tests which:-

1. produced table concentrates which were then
2. magnetically separated.

-600 + 500 um material

Product	Mass (%)	Assay (%Lm)*		% of Lm Chabazite	S/K
M/S 3 N	8.8	(A540)	80.5	30	A541
M/S 3 M/A	5.8				
T 4 C	14.6				
M/S 4 N	16.9	(A542)	79.8	60	A543
M/S 4 M/A	13.3				
T 4 M	30.2				
M/S 5 N	24.3				
M/S 5 M/A	30.9				
T 4 T	55.2				
T H	100				

-300 + 150um material

Product	Mass (%)				
M/S 6 N	6.1	(A544)	95.5	90	A545
M/S 6 M/A	14.3				
T 5 C	20.4				
M/S 7 N	15.7	(A546)	94.6	70	A547
M/S 7 M/A	35.7				
T 5 M	51.4				
M/S 8 N	11.7				
M/S 8 M/A	16.5				
T 5 T	28.2				
T H	100				

* Lm = Light mineral floating at 2.10 t/m^3 Figure in ( ) e.g. (A540) refers to number in description of contents.

S/K column gives numbers for description of minerals present in sink fraction when H/L separation made.

The following are the mineralogist's descriptions of the products made in the above tests the first group being for tests detailed in my letter of 8th Nov'79 and for samples sent to you, the second group are the sink products corresponding to the first group and the third for the tests described above.

<u>Group 1</u>	A529	T1C N F/T 2.2 - approximately 50% chabazite with 50% chabazite + rock fragment composites.
	A530	T1M N F/T 2.2 - approximately 65% chabazite with 35% chabazite + rock fragment composites.
	A532	T1T N F/T 2.2 - approximately 75% chabazite with 25% chabazite + rock fragment composites.
<u>Group 2</u>	A528	T1C N S/K 2.2 - largely basalt rock fragments with tacharanite and some tobermorite.
	A531	T1C N S/K 2.2 - largely rock fragments with minor calcite, tacharanite.
	A533	T1C N S/k 2.2 - laregly rock fragments with minor calcite, tacharanite.
<u>Group 3</u>	A540	M/S 3 N F/T 2.1 - Approximately 30% chabazite with clay, goethite and opaline quartz fragments, trace calcite. (Opaline quartz (density 2.0 to 2.16) is the main problem at this density).
	A541	M/S 3 N S/K 2.1 - Only ~10% chabazite with goethite, opaline quartz rock fragments and composites. Abundant tacharanite - tobermorite, trace calcite.
	A542	M/S 4 N F/T 2.1 - Approximately 60% clean chabazite, 10% iron stained chabazite with 30% opaline quartz and rock fragment-chabazite composites.
	A543	M/S 4 N S/K 2.1 - Only 5% chabazite remainder rock fragments etc.
	A544	M/S 6 N F/T 2.1 - $90\%^{+}$ clean chabazite with $<7\%$ opaline quartz and $<3\%$ composites - mostly iron stained chabazite. A good concentrate.
	A545	M/S 6 N S/K 2.1 - 30% clean chabazite, 40% iron stained chabazite + composites, 20% opaline quartz + rock fragments, 5% calcite, ~ 5% tacharanite - tobermorite.
	A546	M/S 7 N F/t 2.1 - 70% clean chabazite, ~20% opaline quartz, ~10% composite chabazite + rock fragments, trace calcite composites.
	A547	M/S 7 N S/K 2.1 - ~50% clean chabazite + 30% opaline quartz + rock fragments, ~10% tobermorite + tacharanite, ~10% calcite.

A flotation test to concentrate the zeolite has been tried without success. We may try to float the basalt and hopefully leave the zeolites next time flotation is practised.

Yours faithfully,

(H. K. Wellington)
<u>Chief Chemist & Metallurgist.</u>

APPENDIX 8

MISCELLANEOUS DATA

058

082058

Department of Mineralogy & Petrology

the australian museum
sydney

6-8 College Street
Telephone: 339-8111 Cable: MUSEUM
PO Box A285 Sydney South, NSW 2000

26th June, 1979

Paul Askins
Comalco Ltd
P.O. Box 691
Devonport; Tas. 7310

Dear Paul,

Please find enclosed copies of analyses of chabazite I have from Gads Hill and Sheffield areas; also information on Gads Hill chabazite (phacolite) that was analyzed by Elio Passaglia and is given in his paper in American Mineralogist. In addition I enclose a few miscellaneous reprints on Tasmanian zeolites and associated minerals.

Enclosed are the only maps I have of the distribution of volcanic rocks in the Gads Hill area, not very detailed I am afraid, and some script re the zeolites which is presently in press with Pap. Proc. Roy. Soc. Tasm. due out in mid 1980.

Alan Spry's work on the petrology of the basalts around Gads Hill is Spry, A.H. 1958. Precambrian Rocks of Tasmania, part III Mersey-Forth Area Pap. Proc. Roy. Soc. Tasm, 92, pp 117-137.

If you look up Petterds Minerals of Tasmania and the later Mines Department Minerals of Tasmania under the various zeolites, this will give you a good idea of the best zeolite localites in the State. The only Na-chabazite I know is near Redpa, and a provisional analysis is published in Sutherland and Corbett, Pap. Roc. Soc. Tasm, 101, pp.71-90, 1967.

As mentioned, I have collected from Gads Hill several times, the last being with a joint Australian Museum - National Science Museum of Japan project in which we are making detailed studies of this and other zeolite associations in Tasmania.

I am hoping to come down to Tasmania for the Geological Convention in early 1980 and this might be a good chance to get together and have a look at some of the interesting basalts you mentioned.

Hope this helps,

Yours sincerely,

Lin Sutherland

F.L. Sutherland
Curator of Rocks & Minerals

059

DEPARTMENT OF MINES, TASMANIA

LABORATORY,
LAUNCESTON, 082059

4th March, 1966.

CERTIFICATE OF ANALYSIS

To Queen Victoria Museum,

Wellington Street, Launceston, Tas.

The samples .... *received*

from the above (per Mr. F. Sutherland) *on the* 11th May, 1965,

and stated to be from see below ~~has~~ *have been*

examined, with the following results:—

Registered Number	Constituents		Per Cent	Per Ton Ozs.	Per Ton Dwts.	Per Ton Grs.
1896	3. Tacharanite. Locality Gads Hill					
		SiO_2	46.5			
69 70 Ot [illegible]		Al_2O_3	5.9			
		Fe_2O_3	0.36			
		CaO	27.0			
		MgO	0.76			
		K_2O	0.45			
	$SiO_2 \cdot CaO$ 1·72	Na_2O	0.50			
		H_2O+	18.6			
			100·07			
1897	4. Phacolite. Locality Gads Hill.					
	Chabazite	SiO_2	46.9			
		Al_2O_3 : 2·41	19.4			
		CaO	8.8			
		K_2O	0.95			
		Na_2O	1.0			
	$SiO_2 \cdot CaO$ 5·3	H_2O+	22.6			
			99·65			

060

DEPARTMENT OF MINES TASMANIA

LABORATORY,
LAUNCESTON, 082060

4th March, 1966.

CERTIFICATE OF ANALYSIS

To Queen Victoria Museum,
Wellington Street, Launceston, Tas.

The samples ... *received from* the above (per Mr. F. Sutherland) *on the* 11th May, 1965, *and stated to be from* see below *have been examined, with the following results:—*

Registered Number	Constituents		Per Cent	Per Ton Ozs.	Per Ton Dwts.	Per Ton Grs.
1894	1 Chabazite. Locality Sheffield.					
		SiO_2	44.0			
		Al_2O_3 : 2.51	17.5			
		CaO	8.0			
		K_2O	1.3			
	CaO:SiO₂ 5.5	Na_2O	0.52			
		H_2O+	28.1			
			99.42			
1895	2. Chabazite. Locality Sheffield.					
		SiO_2	47.6			
		Al_2O_3 : 2.57	18.5			
		CaO	9.2			
		K_2O	1.2			
	CaO:SiO₂ 5.2	Na_2O	0.52			
		H_2O+	22.5			
			99.52			

061

DEPARTMENT OF MINES TASMANIA

LABORATORY,
LAUNCESTON,

082061

4th March, 1966.

CERTIFICATE OF ANALYSIS

To Queen Victoria Museum,

Wellington Street, Launceston, Tas.

The samples received from the above (per Mr. E. Sutherland) on the 11th May, 1965. and stated to be from see below have been examined, with the following results:—

Registered Number	Constituents	Per Cent	Per Ton Ozs.	Per Ton Dwts.	Per Ton Grs.
1904	11. Gonnardite. (Scolecite) Locality Hillwood.				
	SiO_2	45.4			
	Al_2O_3	26.7			
	CaO	13.5			
	K_2O	0.1			
	Na_2O	0.50			
	H_2O+	14.2			
		100.40			
1905	12. Natrolite. Locality Lietinna.				
	CaO	trace			
	K_2O	0.16			
1906	13. Chabazite. Locality Gads Hill.				
	SiO_2	46.6			
	Al_2O_3 2.26.	20.6			
	CaO	9.5			
	K_2O	1.0			
	Na_2O	0.45			
	H_2O+	22.2			
		100.35			

Aquagenic volcanics have been recognized in the ancestral Mersey-Forth (Sutherland, 1976b) and Derwent River systems (Banks, 1955; Anandalwar, 1960; Sutherland & Hale, 1970; Sutherland, 1973b, 1976a, 1977a) and pillowy contacts were described from lava infilling wet sediments in the ancestral Tamar River (Sutherland, 1971).

MERSEY-FORTH LEADS (Figure 4)

Basalt breccias, agglomerates and tuffs up to 150m thick in Oligocene-Miocene leads under Borrodaile Plains and Gads Hill (Spry, 1958), near Moina (Paterson, 1967) and at Paloona (Burns, 1964) were thought to indicate nearby centres, but are aquagene volcanics not necessarily formed close to a vent.

Basalt remnants and silicified sub-basaltic sediments suggest at least 300m of incised relief in upper leads (Jennings, 1963; Rawlings, 1967) and more subdued relief around 200m in lower leads (Burns, 1964). The eruptive history, location of centres, drainage dislocations and burial depths are revised from examination of sections in several leads. Initial lead positions (Figure 4) are approximate and would change during volcanism.

Lorinna-Liena Leads (Mersey 1:100,000 Sheet 8144)

Massive flows fill the gutters of these leads, poorly exposed near Lorinnia between 430-540m elevations, but well exposed in a thick flow in Ration Tree Creek between 390-490m (east Liena Lead). At least three flows occur on Lemonthyme Road between 440-550m (south Lorinna Lead). The highest overlies fine grained inter-basaltic sediments (520-540m) along an irregular intrusive pillowy contact dipping north west and underlies soft unsorted sediments which contain blocks of basalt and dip up to 25° north, but become rarer in basalt fragments and subhorizontal towards the top. The beds contain altered horizons and may represent old partly weathered fluvial or landslip deposits.

Gads Hill volcano. The lower flows and sediments are followed by fine grained vitric tuffs, exposed in a 3m cliff above 540m elevation, 2km south east of Lorinna (Grid ref. 8114-DP295992) and in the Ration Tree Creek section, where 0.1m of tuff at 495m elevation underlies tachylytic agglomerate in Shaws Creek. The agglomerate dips over 35° south west and contains fragments of basalt, Ordovician limestone, rare dolerite, chert and vein calcite up to 15cm across in zeolitized tachylytic matrix. It grades up into massive fine basaltic agglomerates and coarse tachylytic tuffs to over 550m elevation. These horizons resemble phreatic deposits and probably erupted from a partly submerged vent east of Gads Hill, as they do not appear in Lemonthyme Road south of Gads Hill.

Flow foot breccias form prominent cliffs (Plate 3a) south of Ration Tree Creek, where they dip 20-25° westerly, but are disfigured by landslips on the north side. They are capped by massive scoriaceous to columnar flows from 620m to over 800m elevation on Emu Plains. Massive basalt with a vertical to bulbous lateral contact cuts the breccias on Olivers Road (Grid ref. 8114-DP324988) and may form a feeder dyke for a capping flow.

The Ration Tree Creek section is strongly zeolitized (Sutherland, 1965, 1976b) and secondary minerals will be detailed elsewhere. The species and habits would require burial depths around 700-1500m to form, but as zeolitization is irregular in the Upper Mersey-Forth Sequences and overtopping into the Mole Creek Valley is not substantial (Jennings, 1963), it more likely reflects elevated temperatures during late stage extrusion from Gads Hill volcano.

A four stage growth is suggested for this volcano (Figure 5).

a) subaerial lavas blocked the Lorinna-Liena Leads north of Gads Hill, damming the Liena Lead.

b) phreatic eruption of tuffs and breccias further ponded the drainage into a substantial lake.

064

c) eruption of subaerial lavas into the lake built a delta of flow foot breccias westwards.

d) overtopping of the lake by subaerial lavas fed from dykes and late stage zeolitization around the centre.

082064

The distribution of the volcanics suggests fissure-like growth (Figure 5), possibly with some east south easterly migration of activity, and location on a north westerly trending basement fault extending from Moina (Jennings, 1963).

Emu-Borrodaile Plains volcanoes

Flow foot breccias in Lemonthyme Road near Addison Creek are stratigraphically higher (580-675m elevation) and unrelated in dip to Ration Tree Creek breccias. The lowest breccias (580-600m elevation) overlie and partly intrude fine grained mudstone and minor hyaloclastite tuff. Pillowy intrusive tongues (Plate 3b) dip north west northerly up to 25°, a similar attitude to underlying boulder beds and flow. This suggests a source under Emu Plains which changed to aquagene volcanism, probably from damming of the southern Lorinna Lead by growth of Gads Hill volcano.

The highest Lemonthyme Road breccias (600-675m elevation) dip up to 40° north north easterly to north easterly. This suggests eruption into the ponded Lorinna Lead from a further upstream source, probably near Borrodaile Creek, where 120m of zeolitized tachylytic tuffs and overlying flow foot breccias are exposed in landslips. Growth of this Borrodaile volcano would dam higher drainage and build the aquagene volcanics to elevations of 720m.

Unzeolitized flow foot breccias, 15m thick, dip south westerly below Borrodaile Plains around 620m elevation in the Mersey-Arm junction road (Grid ref. 8114 DP-331853), above 10m of massive basalt and sub-basaltic sediments. The lowest basalts in the section; they appear unconnected to the Borrodaile centre, but may relate to flows between 600-760m elevation east at Dublin

Plains (Ford, 1960). Eruption from Dublin Plains into the Lorinna-Maggs Lead junction could explain the limited damming and breccia flow direction.

Unzeolitized flow foot breccias at 660m elevation, dipping north from the Lorinna junction, 1km south of Machinery Creek on Olivers Road, may represent flows that descended from upstream leads and backed into earlier dammed sections of Liena Lead.

<u>Maggs Lead</u> (Mersey 1:100,000 Sheet 8114)

Flows capping Maggs Mt above 760-840m elevation may be upstream continuations from Borrodaile Plains (Spry, 1958). Zeolitization in the basal Maggs succession, away from known centres, belongs to the top of the chabazite zone, usually developed under 200-700m in burial. This suggests less than 80-580m stripped from Borrodaile-Maggs successions and original thicknesses between 520-980m.

The Forth River lies at 340-360m elevation relative to the present basalt top at 880m and estimated Miocene top between 960-1420m. This gives average lowering of 21-27m/m.y.(min.) to 43-54m/m.y.(max.) over the last 20-25 m.y. This exceeds average lowering for Tasmania (10-15m/m.y.) since burial of Jurassic dolerites (Sutherland, 1977b), but is expected after late Mesozoic/early Tertiary epeirogeny.

<u>Middlesex-Moina Leads</u> (Forth & Mersey 1:100,000 Sheets 8115 & 8114)

These leads joined Lorinna Lead (Jennings, 1963). The Moina Lead contains basalt breccias associated with Lower Miocene sediments above 490m elevation (Patterson, 1967). The breccias reach 660m elevation on Cradle Mountain Road and are unzeolitised with south westerly to south easterly dips. Massive basalts occur down from Moina to 540m elevation ½km along Lake Geirdner Dam Road where they are updragged (?) against easterly dipping sands overlying Ordovician sandstones.

The breccias suggest a dammed Moina lead, either blocked locally or by flows in the Middlesex or Lorinna Leads, before overtopping with lavas to over 760m elevation. Absence of phreatic tuffs and zeolitization favours distant sources for the breccias.

Flow foot breccias, over 40m thick, underlie massive lavas at 720m in the Middlesex Lead at Bull Creek. Mildly zeolitized, they dip easterly from an upstream source.and are the highest breccias found in the Mersey-Forth Leads. They may owe their elevation to damming of the Lorinna Lead by the Borrodaile flows.

<u>Paloona-Kindred Leads</u> (Forth 1:100,000 Sheet 8115)

The ancestral Forth probably flowed into Bass Basin via Paloona and Kindred Leads (Burns, 1964). The oldest flows under Miocene (?) sediments petrographically match late Eocene-early Oligocene alkali basalts and olivine nephelinite in the adjacent Devonport Lead (Sutherland, 1973a).

<u>Forth volcano.</u> 'Pyroclastics' are common in the Don-Forth interfluve (Burns, 1964). Tachylytic lapilli tuffs are interbedded with flows south of Lillicos Beach (Grid ref. 8115-DQ400423) ~~breccias~~ and flow foot breccias extend from 50-75m elevation below Forthside Hill in Fulton Creek down to 15m elevation 0.5km east of Forth Post Office. The tuffs rest on alkali basalt but petrographically resemble the flow foot breccias and olivine tholeiite flows that extend north east to 40m high cliffs at Don Heads.

The Fulton Creek breccias, zeolitized with tacharanite, suggests a nearby centre between Lillico and Forth, which dammed upstream drainage. The capping flows diverted the Paloona Lead westwards and developed the post-Oligocene Leith Lead across the old Kindred Lead. The new Kindred Lead shifted eastwards and post-Oligocene flow fillings can be traced from Forthside Hill to Don Heads.

<u>Paloona-Sheffield volcanoes.</u> Gorge-blocking agglomerate in Hoggs Creek (Burns, 1964) is flow foot breccia formed after initial damming by flows downstream of Paloona. Vitric tuffs above Tertiary sands in the Eugenana Lead (Burns, 1964) may represent phreatic emergence of the Paloona volcano.

The breccias at 80-200m elevation east of Hogg Creek dip north north easterly to west south westerly and converge on a focus about 1.5km south of Paloona. They are moderately zeolitized, but further upstream west of Hogg Creek, between 180-200m elevation in Paloona Power Station road cuts, breccias under capping flows (Plate 3c) are unzeolitized.

The Paloona centre erupted olivine tholeiites, but other flows in the Lead include alkali basalts. The higher flows extensively dammed the Lead to form Lake Sheffield and its sediments reach 300m elevation south of Sheffield.

Flow foot breccias overlie Lake Sheffield sediments in poor exposures on Claude Road and in abandoned railway cuts 2-3 km south west of Sheffield. They are olivine tholeiites and fresh specimens from railway excavations donated to the Queen Victoria Museum, Launceston, in 1914 are strongly zeolitized with development of tacharanite. This suggests eruption into southern Lake Sheffield from a nearby centre.

Mersey-Forth Aquagene Volcanism

Aquagene volcanics in Mersey-Forth Leads relate to six and possibly eight or more centres (Figure 5). Flow foot breccias suggest waters up to 120m deep, backing upstream up to 15km from blockages. Breccias lie successively higher upstream (Figure 5), corresponding roughly to order of eruption, with pre-Miocene breccias in the lower Kindred and Paloona Leads and Miocene breccias in the higher Lorinna, Liena, Moina and Middlesex Leads.

Most aquagene centres erupted olivine tholeiites. In the Upper Mersey-Forth lower flows include alkali and transitional basalts, but with vigorous growth of Gads Hill and Borrodaile volcanoes initiating aquagene activity, tholeiitic basalts appear and dominate the capping lavas (petrologic examinations; Spry, 1958 and this study).

Zeolitization in the Mersey-Forth basalts is patchy, becoming more intense with higher temperature associations around large centres with several eruptive phases (Gads Hill volcano). Away from eruptive centres, low grade zeolitization may develop by burial in thicker sequences (Maggs Mt).

Other Aquagene Volcanism

Other leads in North West Tasmania contain aquagene volcanics, but many sequences are deeply weathered and poorly exposed. Flow foot breccias were observed in the Expressway near Penguin and east of Upper Castra. Extensive pyroclastics, up to 200m thick, near West Ridgley, Cam River (Gee, 1977) are partly tachylytic and may represent phreatic eruptions from the centre in a river section dammed by a basal flow.

DERWENT LEADS (Figures 6 & 7)

Basalts, with aquagene horizons, overlie Palaeocene-Oligocene sediments of the ancestral Derwent (Harris, 1968) and are isotopically dated late Oligocene-early Miocene (21-30 m.y.; Sutherland, et al, 1973; Sutherland, 1976a). This survey describes aquagene volcanics at eighteen localities and the episodic damming is discussed in descending order downstream.

Nive Lead (Nive & Shannon 1:100,000 Sheets 8113 & 8213)

Lavas erupted into the lead 14km north west of Bronte Park from 900-600m elevation. Four flows of alkali, tholeiitic and transitional olivine basalts broaden west of Bronte, with a base at 560m elevation. They include 3-6m of pillowy lava and breccia under an olivine tholeiite at 650m on the Lyell Highway, east Nive crossing. Some diversion or damming of the Nive is indicated, possibly by downstream eruption from suspected dykes (Prider, 1948) as basalts near Tarraleah contain glomeroporphyritic alkali basalt and orthopyroxene-olivine tholeiite, types not recognized at Bronte.

FIGURE CAPTIONS

Fig 1. Distribution of aquagene volcanics (black dots), Tasmania, with known limits of Miocene marine Transgression (dashes)

Fig 2. Distribution of aquagene volcanics, volcanic centres and marine beds, North West Tasmania (a) Woolnorth and off-shore islands, (b) Robbins Island, (c) Wynyard district.

Fig 3. Detailed distribution of volcanic units, Flat Topped Bluff N.W. Tasmania.

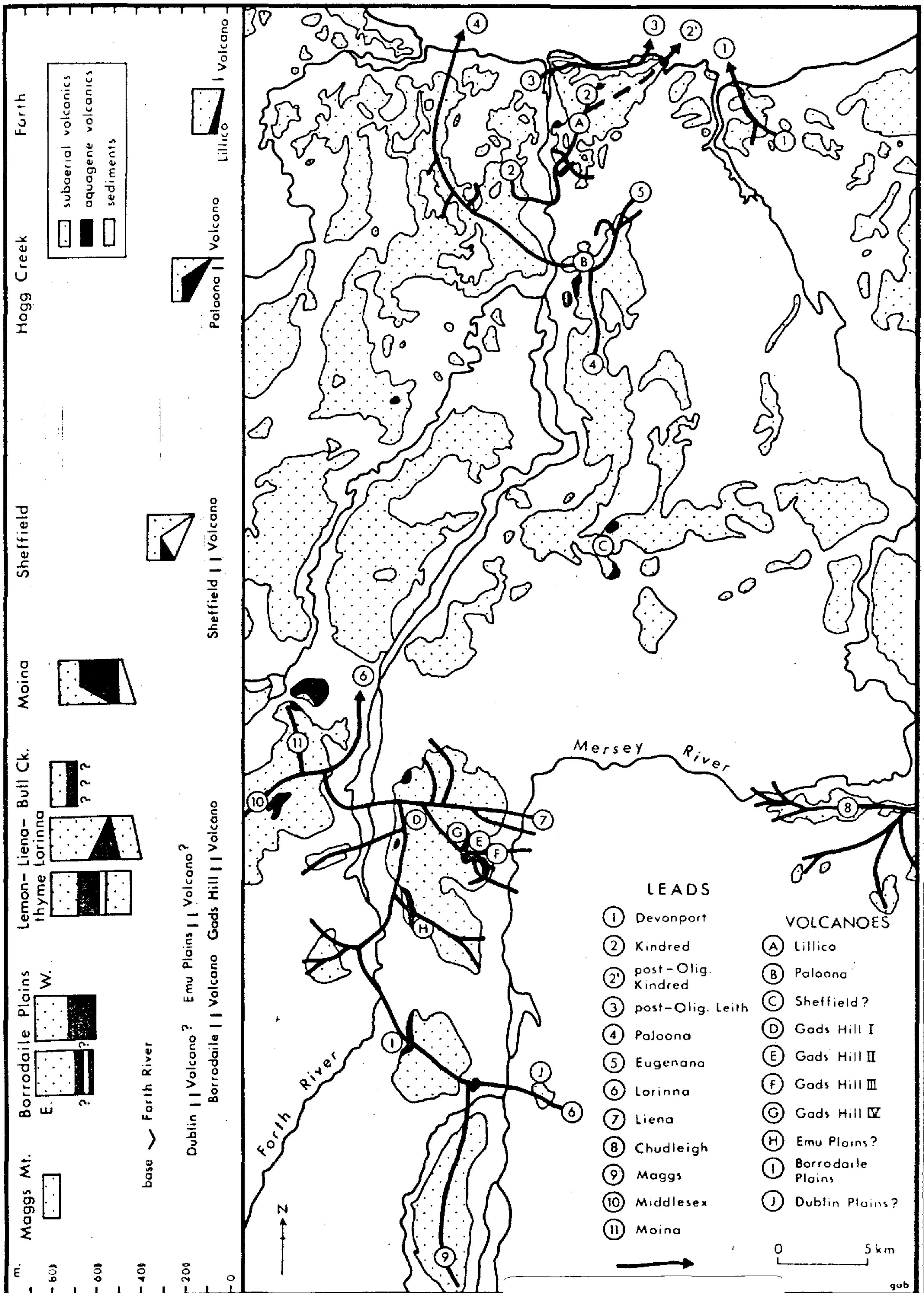
X Fig 4. Distribution of aquagene volcanics (black areas) and volcanic centres (lettered circles) in relation to deep leads (numbered circles) of the ancestral Mersey-Forth drainage (after Jennings, 1963 and Burns, 1964). Volcanic Sections with aquagene volcanics, showing relative elevations and thicknesses, are shown opposite their projected geographic position on the map.

X Fig 5. Tentative reconstruction of volcanic history, Upper Mersey-Forth Leads (strong lines) from initial eruption of flows into the Liena-Lorinna Leads up to filling of the Maggs Lead and damming of the Middlesex Lead (1-6), with volcanic vents (hachured circles), valley filling flows (symbolic arrowed directions, not showing flow into all tributaries), approximate limits of upstream damming (dashed areas), phreatic cones (shaded deposits), flow foot breccias (open dotted areas) and major fault (strong dashed line).

Fig 6. Distribution of aquagene volcanics in relation to basaltic fills and drainage, Upper Derwent and tributaries.

Fig 7. Distribution of aquagene volcanics in relation to basaltic fills and drainage, Middle-Lower Derwent and tributaries. Volcanic Sections with aquagene volcanics, showing relative elevations and thicknesses, are shown below their projected geographic positions on the maps.

Fig. 4.



5 cm

FIG 4

Fig 5

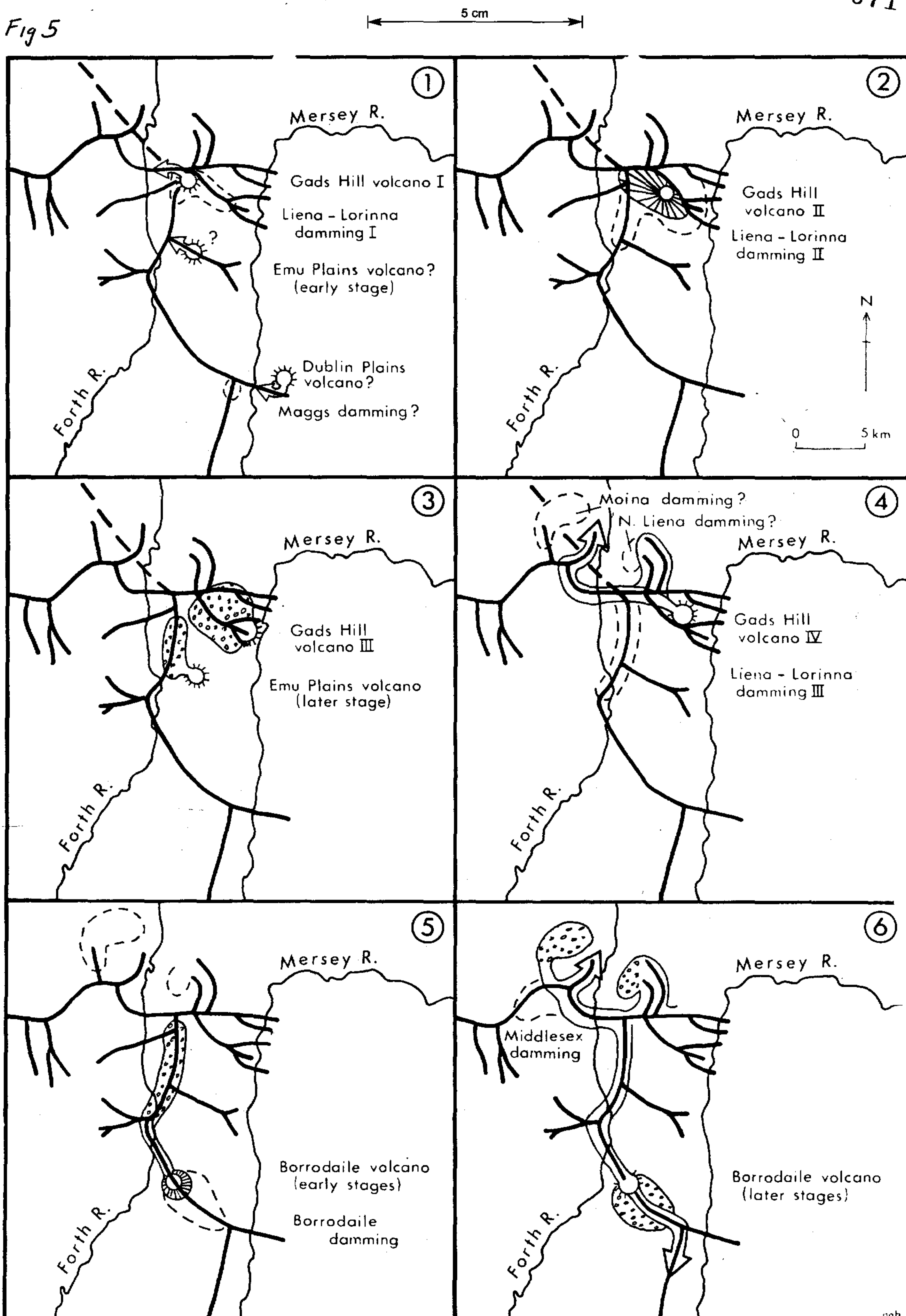

5 cm
1
Mersey R.
Gads Hill volcano I
Liena - Lorinna damming I
Emu Plains volcano? (early stage)
Dublin Plains volcano?
Maggs damming?
Forth R.
2
Mersey R.
Gads Hill volcano II
Liena - Lorinna damming II
N
0
5 km
Forth R.
3
Mersey R.
Gads Hill volcano III
Emu Plains volcano (later stage)
Forth R.
4
Moina damming?
N. Liena damming?
Mersey R.
Gads Hill volcano IV
Liena - Lorinna damming III
Forth R.
5
Mersey R.
Borrodaile volcano (early stages)
Borrodaile damming
Forth R.
6
Mersey R.
Middlesex damming
Borrodaile volcano (later stages)
Forth R.
gab

FIG 5