

UR1987-61

1987/61. Completion report: Sub-basalt Drilling Project Hole 4

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Abstract

SBDP Hole-4 penetrated approximately 375 m of latest Eocene and Oligocene basalt and interbedded sediments unconformably overlying sedimentary rocks correlated with the Florence Quartzite (Lower Devonian - Upper Silurian) of the Zeehan area.

INTRODUCTION

This report is the third in the series which will be written for each of the holes completed in the Department of Mines Sub-basalt Drilling Project (SBDP). The hole is located near Snipeford Marsh, a little over one kilometre south-west of Talbots Lagoon (fig. 1) at:-

Easting	391 893.7 m
Northing	5 410 206.5 m

Chemical analyses were performed by the Department of Mines Laboratories, Launceston; XRD analyses were by R. N. Woolley under the supervision of R. S. Bottrill; palynology by Dr R. P. Morgan, Maitland, South Australia; and down-hole logging by J. V. Wright.

STRATIGRAPHY

The first 104 m of the hole was precollared; a lithological log of the fully-cored section (104.5-412.4 m) is presented as Appendix 1.

Basalt, often vesicular or brecciated, was encountered between 104 m and 366.7 m. Fresh basalt suitable for dating was not seen, and some degree of deuteric alteration is ubiquitous. The tops of some flows are altered to a reddish or reddish/brown colour, perhaps indicative of subaerial weathering. Brecciated zones are present at the base(?) of a few flows; minor sedimentary inclusions may be present within such zones.

An intrabasalt sedimentary horizon is present at 150.6-152.6 m; further minor horizons (or sedimentary inclusions) occur at approximately 170 m and 211 m. Sub-basalt sediments occur from 366.7-375.1 m, where siliceous sandy gravels overlie white, often carbonaceous, fine-grained sand.

Basement rocks were first encountered at 375.1 m and consist of a succession of buff or brown/grey coloured, dominantly massive, fine-grained to very fine-grained calcareous sandstone, sometimes containing solitary corals and shelly debris (dominantly crinoids, but some brachiopods), and minor limestone.

In thin-section, the limestones (e.g. 101648, 101649) consist of shelly debris (dominantly crinoids) or very fine-grained carbonate grains, together with a subordinate, but significant siliciclastic component, usually silt or very fine-sand grade.

On lithostratigraphic and biostratigraphic grounds the succession is clearly a correlate of the Eldon Group of the Zeehan area, and the hole occurs some 5 km to the south-west of outcrop correlated with the

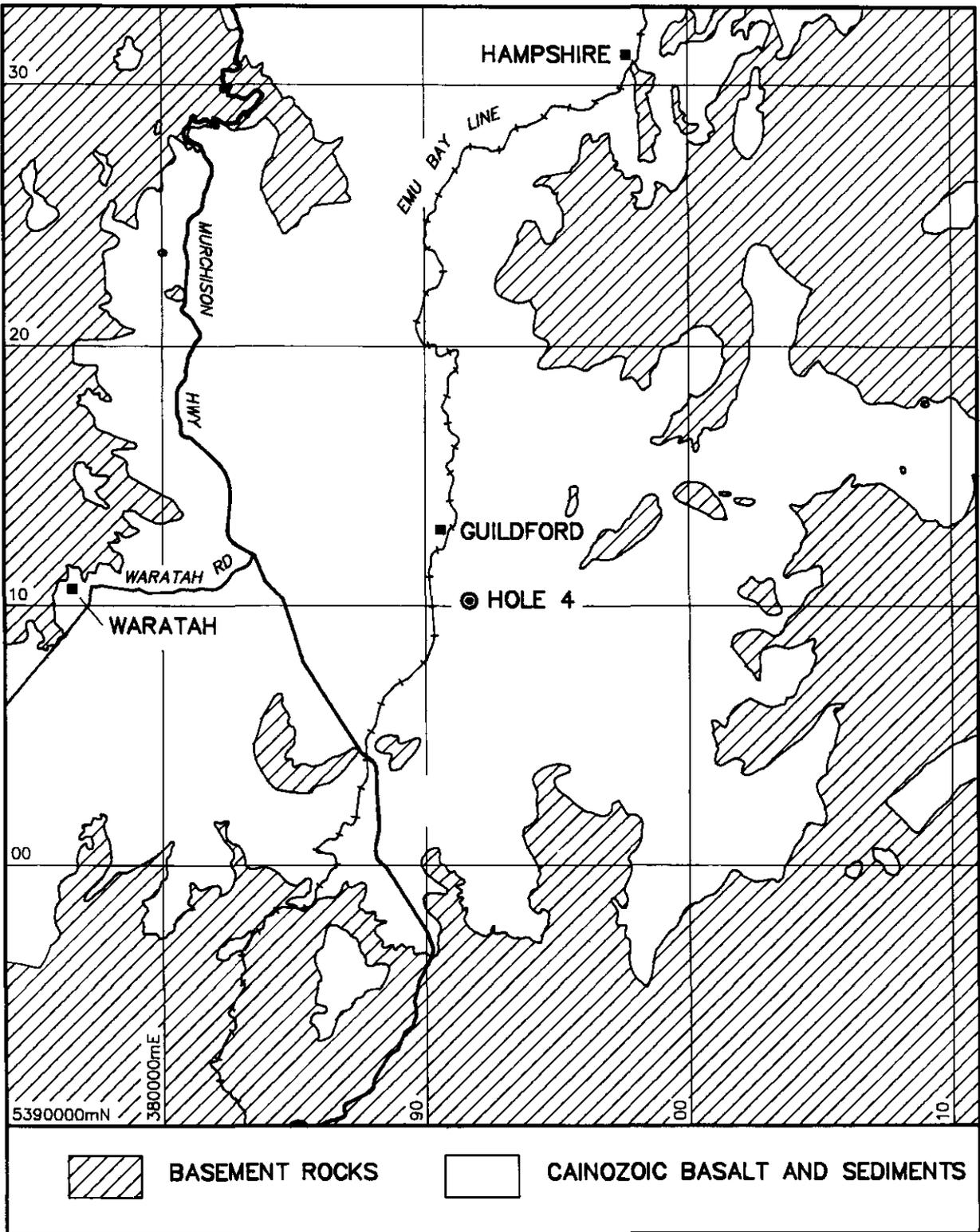


Figure 1. Location of Hole SBDP-4

Florence Quartzite (Baillie et al., 1986). The succession encountered in the drill hole contains none of the lithologies typical of the Bell Shale of western Tasmania (Baillie and Williams, 1975), nor is it similar to the Bell Shale correlate which crops out 11 km to the north-east in the Peak Plain Road area (Baillie et al., 1986). It seems most likely, therefore, that the succession encountered is a correlate of the Florence Quartzite, and hence of latest Silurian or early Devonian age.

GEOPHYSICAL LOGGING

Gamma ray (GR) and caliper tools were run in the upper 340 m of the hole (below which caving had occurred). No sedimentary horizons were detected by GR, possibly indicating a lack of illite or montmorillonite in the horizons present (Appendix 1); alternatively the sediments noted could be inclusions and so would have no significant effect on the GR.

PALYNOLOGY

Five core samples were submitted for palynological analysis; although all yielded palynomorphs, all were fairly lean with two (168.2 and 275.0) extremely lean. A checklist of determined palynomorphs is presented as Appendix 2.

Samples from 171.1 m and 211.4 m were dominated by *Nothofagidites*, especially *N. emarcidus*, in moderately diverse but lean assemblages. The co-occurrence of *Periporopollenites vesicus* and *Cyatheacidites annulatus* indicates assignment to the *Proteacidites tuberculatus* Zone (Stover and Evans, 1973; Stover and Partridge, 1973; Partridge, 1976) of early Oligocene age. Non-marine environments are indicated by the absence of dinoflagellates and the presence of the freshwater alga *Botryococcus*. Minor, reworked Cretaceous palynomorphs were present in the 211.4 m sample.

A sample from 275.0 m contained *Nothofagidites* spp. but could not be assigned to any zone.

The assemblage from 371.0 m is also dominated by *Nothofagidites*, although *Phyllocladidites mawsonii* is also common. The presence of *Grandodiporites nebulosus* indicates an upper *Nothofagidites asperus* Zone assignment i.e. latest Eocene to earliest Oligocene.

GEOCHEMISTRY

Analyses of nine relatively fresh basalt samples (872226-34) are shown in Table 1. Figure 2 is an alkali-silica diagram (constructed after Brown, 1986).

The analyses indicate the presence of a previously unrecorded suite of undersaturated rocks (872230-32) in the region. Table 2 shows calculated CIPW and Rittman Norms for all the analysed basalts, and clearly differentiates the undersaturated suite. In thin section (101643-5), the undersaturated rocks are seen to consist of (altered) phenocrysts of augite and olivine in a groundmass of nepheline, augite laths and opaques; using the terminology of Joplin (1964) the rocks are *olivine nephelinites*. Other analysed specimens are basalts with alkaline and tholeiitic affinities, similar to other basalts from the region.

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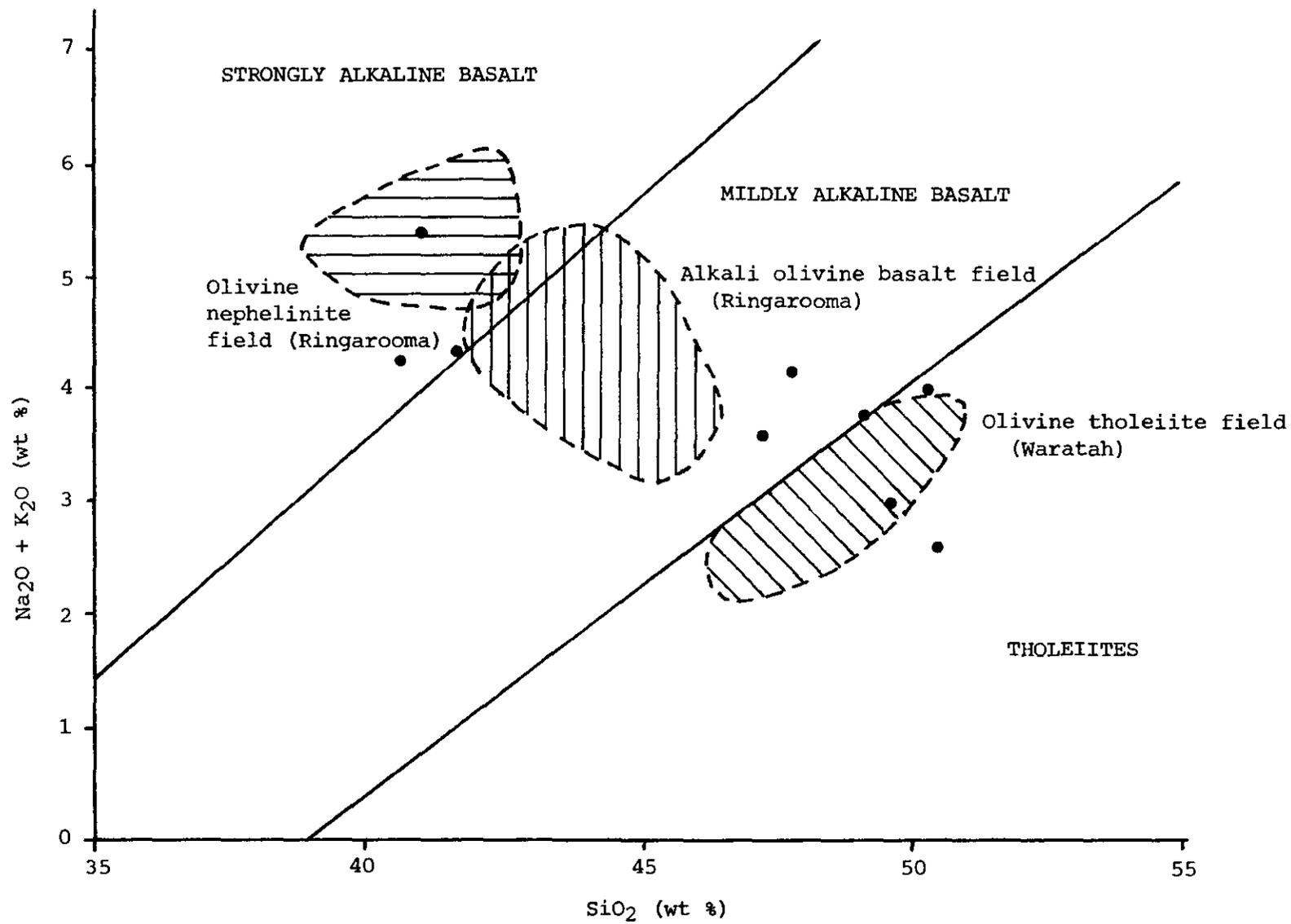


Figure 2. Alkali-silica diagram (after Brown, 1986), Tertiary basalt

5 cm

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Table 1. ANALYSES OF NINE BASALT SAMPLES

Analysis	872226	872227	872228	872229	872230	872231	872232	872233	872234
Field No.	101639	101640	101641	101642	101643	101644	101645	101646	101647
Depth (m)	107.9	129.1	160.9	206.0	251.1	255.8	269.1	341.0	366.0

Oxides (%)

SiO ₂	49.55	50.38	50.25	48.99	41.69	40.57	40.89	47.78	47.17
TiO ₂	1.68	1.56	1.60	1.72	2.62	2.51	2.52	1.90	1.97
Al ₂ O ₃	13.78	13.95	13.78	13.55	11.25	10.74	10.56	13.37	13.93
Fe ₂ O ₃	3.55	4.27	3.03	3.27	5.69	6.43	4.13	2.61	3.08
FeO	7.17	6.91	8.52	7.27	7.54	6.94	8.97	8.17	7.62
MnO	0.15	0.17	0.15	0.16	0.22	0.20	0.20	0.15	0.18
MgO	8.16	7.89	8.21	8.76	10.90	11.20	11.96	9.74	8.21
CaO	9.77	9.48	8.68	8.06	10.69	11.41	11.09	8.84	9.67
Na ₂ O	2.70	2.39	3.43	2.79	3.65	3.24	4.57	2.92	2.51
K ₂ O	0.29	0.17	0.56	0.96	0.67	0.82	0.80	1.21	1.05
P ₂ O ₅	0.21	0.20	0.21	0.31	0.85	0.96	0.93	0.46	0.49
H ₂ O+	1.95	2.07	1.12	3.29	3.79	3.99	2.98	2.41	2.74
CO ₂	0.46	2.09	0.18	0.26	0.14	0.28	0.29	0.11	0.67
Total S	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

Trace elements (g/t)

Ag	<5	<5	5	<5	12	12	8	<5	<5
As	14	<10	15	<10	17	22	16	15	23
Ba	<9	<9	26	99	340	330	320	155	210
Bi	7	<5	<5	<5	9	9	6	<5	6
Ce	43	45	53	62	125	140	130	69	70
Co	48	48	49	45	57	63	60	50	48
Cr	280	270	280	250	320	390	400	320	300
Cu	46	60	66	48	65	76	78	57	54
Ga	17	18	18	18	20	21	20	19	20
La	7	<6	<6	23	50	68	50	11	11
Mo	2	2	2	3	4	5	6	3	3
Nb	13	9	13	26	84	85	85	32	31
Nd	12	12	12	20	31	34	34	20	17
Ni	175	165	170	130	250	320	310	215	195
Pb	<4	6	5	6	<4	<4	<4	<4	6
Rb	6	8	12	22	15	24	24	19	14
Sc	22	19	20	19	17	17	19	22	18
Sn	<4	<4	4	<4	<4	<4	<4	<4	<4
Sr	300	270	300	350	930	1160	920	610	620
Ta	<9	<9	<9	<9	<9	<9	<9	<9	<9
Th	<4	5	4	6	5	4	5	<4	6
U	<5	<5	<5	<5	<5	<5	<5	<5	<5
V	165	145	150	165	210	195	195	180	170
W	48	53	42	35	34	30	36	33	36
Y	20	19	19	19	24	24	23	19	19
Zn	115	115	125	105	140	140	140	110	115
Zr	105	100	99	125	250	240	240	135	140

Table 2. CALCULATED CIPW AND RITTMAN NORMS

Analysis	872226	872227	872228	872229	872230	872231	872232	872233	872234
Field No.	101639	101640	101641	101642	101643	101644	101645	101646	101647
Depth (m)	107.9	129.1	160.9	206.0	251.1	255.8	269.1	341.0	366.0

CIPW Norm

Q	1.56	5.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Or	1.71	1.00	3.31	5.67	3.96	4.85	4.73	7.15	6.21
Ab	22.84	20.22	29.02	23.61	13.13	9.44	3.15	24.71	21.24
An	24.60	26.84	20.56	21.62	12.34	12.34	5.94	19.81	23.65
Ne	0.00	0.00	0.00	0.00	9.61	9.73	19.24	0.00	0.00
Di	18.06	15.15	17.14	13.13	27.87	29.97	34.41	16.95	17.02
Hy	19.38	19.28	14.04	21.72	0.00	0.00	0.00	4.52	12.33
Ol	0.00	0.00	6.43	1.36	13.66	12.37	16.22	15.56	6.09
Mt	5.15	6.19	4.39	4.74	8.25	9.32	5.99	3.78	4.47
Il	3.19	2.96	3.04	3.27	4.98	4.77	4.79	3.61	3.74
Hap	0.50	0.47	0.50	0.73	2.01	2.26	2.19	1.09	1.16

Rittman Norm

Quartz	0.7	5.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sanidine	0.0	0.0	0.0	3.2	2.7	4.8	6.0	6.8	4.4
Plagio- clase	55.1	53.0	58.5	54.9	27.5	21.9	8.6	50.9	53.3
Nepheline	0.0	0.0	0.0	0.0	11.4	11.5	19.3	0.0	0.0
Pigeonite	39.6	32.3	0.0	34.1	0.0	0.0	0.0	0.0	0.0
Subcalcic augite	0.0	0.0	31.7	0.0	0.0	0.0	0.0	0.0	30.4
Titan- augite	0.0	0.0	0.0	0.0	34.3	36.6	42.6	0.0	0.0
Augite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.5	0.0
Olivine	0.0	0.0	5.7	3.2	18.4	19.0	18.2	13.3	5.5
Magnetite	1.4	1.3	1.7	1.5	2.1	2.0	2.4	1.6	1.4
Calcite	1.2	5.3	0.5	0.7	0.4	0.8	0.8	0.3	1.8
Apatite	0.5	0.4	0.5	0.7	2.0	2.3	2.2	1.0	1.1
Ilmenite	1.6	1.7	1.5	1.7	1.1	1.0	0.0	1.7	2.0

XRD DETERMINATIONS

Representative samples of vesicle infillings were collected, and mineral determinations made by XRD. Depths of samples and mineral species present are:-

- 138.8 m Chabazite
Heulandite
Calcite
Montmorillonite
- 200.2 m Chabazite
Montmorillonite
- 208.0 m Chabazite
- 322.2 m Gonnardite (Natrolite sub-group)
Chabazite
Montmorillonite
Calcite
- 332.0 m Chabazite
Analcite
Thomsonite (Natrolite sub-group)
Calcite

SUMMARY

The hole has confirmed the presence of a south-westerly extension of the Eldon Group correlate rocks mapped in the Talbots Lagoon/Old Park Road area of the St Valentines Quadrangle (Baillie et al., 1986). It is probable that the succession is faulted against the ridge of Denison Group correlates occurring from Westwing Plain to Grasstree Ridge and confirmed by SBDP Hole 2 (Baillie, 1987).

The further presence of intra-basalt and sub-basalt sedimentary horizons confined to the *Proteacidites turberculatus* and upper *Nothofagidites asperus* biostratigraphic zones provides further evidence that the basalt pile in the region was formed during a relatively short period of time.

A summary geological log is:-

- 0 -367 m Oligocene and late Eocene(?) basalt with minor sediments
- 367-375 m Late Eocene(?) sediments
- 375-412 m Eldon Group correlative sandstone and minor limestone; probable correlate of the Florence Quartzite.

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[20 November 1987]

APPENDIX 1

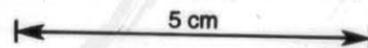
Geological log of Hole SBDP-4

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DIAMOND DRILL CORE GEOLOGICAL RECORD

INTERVAL		REC. (%)	Core lift	Core loss	Depth (m)	Graphic Log	Min	DESCRIPTION	SPECIMEN			
From (m)	To (m)								Number	Depth	Prep'n	
					100			104.54-366.7 m. Dark coloured, massive or vesicular basalt, some brecciated zones at ?base of flows. Tops of some flows altered to reddish or reddish/brown. Minor sedimentary inclusions within brecciated zones.				
					110						107.9	Anal, TS
					120							
					130						129.1	Anal, TS
					140						138.8	XRD
					150			150.6-151.0 m Two beds of very coarse epiclastic basaltic sandstone with interbedded basalt boulder (80 mm) or thin flow. Chilled base of flow at 151.8 overlying 80 mm of coal in turn overlying pink (?altered) 1 m zone (?weathered flow top) above basalt				
					160						160.9	Anal, TS
					170			Minor ?inclusions of ?baked dark grey sediments 168.8-171.4			168.2	Paly
					180			Weathered zones 181.0-183.5			171.1	Paly
					190							
					200						200.2	XRD
					210						206.0	Anal, TS
											208.0	XRD

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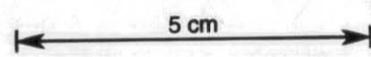
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GEOLOGICAL SURVEY BRANCH

DIAMOND DRILL CORE GEOLOGICAL RECORD

HOLE No. SBDP-4
REF. No. SHEET No. 2 of 3

INTERVAL		REC. (%)	Core lift	Core loss	Depth (m)	Graphic Log	Min	DESCRIPTION	SPECIMEN		
From (m)	To (m)								Number	Depth	Prep'n
					210	●●●●●●				211.4	Paly
						▲▲▲▲▲▲					
						●●●●●●					
					220	●●●●●●					
						●●●●●●					
						●●●●●●					
					230	●●●●●●					
						●●●●●●					
						●●●●●●					
					240	●●●●●●					
						●●●●●●					
					250	▲▲▲▲▲▲				251.1	Anal, TS
						●●●●●●				255.8	Anal, TS
					260	●●●●●●					
						●●●●●●					
					270	●●●●●●				269.1	Anal, TS
						●●●●●●					
		90				●●●●●●				275.0	Paly
					280	●●●●●●					
						●●●●●●					
					290	●●●●●●					
						●●●●●●					
					300	●●●●●●					
						▲▲▲▲▲▲					
					310	●●●●●●					
						●●●●●●					
					320	●●●●●●					

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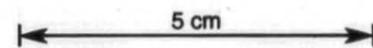
TASMANIA DEPARTMENT OF MINES
GEOLOGICAL SURVEY BRANCH

DIAMOND DRILL CORE GEOLOGICAL RECORD

HOLE No. SBDP-4
REF. No. _____ SHEET No. 3 of 3

INTERVAL		REC. (%)	Core lift	Core loss	Depth (m)	Graphic Log	Min	DESCRIPTION	SPECIMEN		
From (m)	To (m)								Number	Depth	Prep'n
					320					322.2	XRD
					330					332.0	XRD
					340					341.0	Anal, TS
					350						
					360						
		90									
		60									
		70			370			366.7-370.0 Siliceous sandy gravel		366.0	Anal, TS
		35						370-375.1 White, often carbonaceous, fine sand		371.0	Paly
		40									
		90			380			375.1-412.4 m. Buff or brown-grey coloured, dominantly massive, fine to very fine-grained calcareous sandstone, sometimes containing solitary corals and shelly debris (crinoids dominantly, but some brachiopods) and subordinate fine-grained (often shelly) limestone			
					390						
		70									
		70									
		90								399.0	TS
		50			400						
		90								406.5	TS
		90									
		40			410						
					420						

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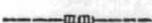


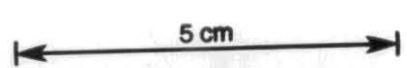
APPENDIX 2

Checklist of determined palynomorphs

CHECKLIST OF GRAPHIC ABUNDANCE BY LOWEST APPEARANCE

-  = Abundant
-  = Common
-  = Few
-  = Rare
-  = Very Rare
-  = Questionably Present
-  = Not Present

168.2	171.1	211.4	275.0	371.0		
COF	COF	COF	COF	COF		
					1	CYATHIDITES SPP.
					2	DILWYNITES GRANULATUS
					3	ERICIPITES SCABRATUS
					4	GRANODIPORITES NEBULOSUS
					5	ISCHYOSPORITES GREMIUS
					6	LYGISTEPOLLENITES FLORINII
					7	NOTHOFAGUS ASPERUS
					8	NOTHOFAGUS BRACHYSPINULOSUS
					9	NOTHOFAGUS EHARCIDUS/HETERUS
					10	NOTHOFAGUS FALCATUS
					11	NOTHOFAGUS FLEMINGII
					12	PHYLLOCLADIDITES MAWSONII
					13	PHYLLOCLADIDITES VERRUCOSUS
					14	PODOSPORITES MICROSACCATUS
					15	PROTEACIDITES SPP.
					16	STEREISPORITES ANTIQUISPORITES
					17	DILWYNITES TUBERCULATUS
					18	RETITRILETES AUSTRICLAVATIDITES
					19	*BOTRYOCOCCUS*
					20	CINGUTRILETES CLAVUS
					21	CYATHEACIDITES ANNULATUS
					22	FALCISPORITES SIMILIS
					23	ILEXPOLLENITES SP.
					24	LAEVIGATOSPORITES
					25	MATONISPORITES ORNAMENTALIS
					26	MICROCACHRYIDITES ANTARCTICUS
					27	NOTHOFAGUS DEMINUTUS
					28	VERRUCATOSPORITES ATTENATUS
					29	VERRUCOSISPORITES CF. CRISTATUS
					30	VERRUCOSISPORITES KOPUKUENSIS
					31	DACRYCARPITES AUSTRALIENSIS
					32	MICROFOVEOSPORITES
					33	NOTHOFAGUS VANSTEENISII
					34	PERIPOROPOLLENITES VESICIUS
					35	PEROMONOLITES VELLOUSUS
					36	VERRUCOSISPORITES SPP.
					37	HALORAGACIDITES HARRISII
					38	MALVACIPOLLIS SUBTILIS
					39	TRICOLPITES SPP.



SPECIES LOCATION INDEX

Index numbers are the columns in which species appear.

INDEX NUMBER	SPECIES
19	*BOTRYOCOCCUS*
20	CINGUTRILETES CLAVUS
21	CYATHEACIDITES ANNULATUS
1	CYATHIDITES SPP.
31	DACRYCARPITES AUSTRALIENSIS
2	DILWYNITES GRANULATUS
17	DILWYNITES TUBERCULATUS
3	ERICIPITES SCABRATUS
22	FALCISPORITES SIMILIS
4	GRANODIFORITES NEBULOSUS
37	HALORAGACIDITES HARRISII
23	ILEXPOLLENITES SP.
5	ISCHYOSPORITES GREMIUS
24	LAEVIGATOSPORITES
6	LYGISTEPOLLENITES FLORINII
38	MALVACIPOLLIS SUBTILIS
25	MATONISPORITES ORNAMENTALIS
26	MICROCACHRYIDITES ANTARCTICUS
32	MICROFOVEOSPORITES
7	NOTHOFAGUS ASPERUS
8	NOTHOFAGUS BRACHYSPINULOSUS
27	NOTHOFAGUS DEMINUTUS
9	NOTHOFAGUS EMARCIDUS/HETERUS
10	NOTHOFAGUS FALCATUS
11	NOTHOFAGUS FLEMINGII
33	NOTHOFAGUS VANSTEENISII
34	PERIPOROPOLLENITES VESICUS
35	PEROMONOLITES VELLOUSUS
12	PHYLLOCLADIDITES MAWSONII
13	PHYLLOCLADIDITES VERRUCOSUS
14	PODOSPORITES MICROSACCATUS
15	PROTEACIDITES SPP.
18	RETITRILETES AUSTRICLAVATIDITES
16	STEREISPORITES ANTIQUISPORITES
39	TRICOLPITES SPP.
28	VERRUCATOSPORITES ATTENATUS
29	VERRUCOSISPORITES CF. CRISTATUS
30	VERRUCOSISPORITES KOPUKUENSIS
36	VERRUCOSISPORITES SPP.