PALYNOLOGICAL ANALYSIS OF SIDEWALL CORES FROM BLACKBACK-2, GIPPSLAND BASIN

by

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INTERPRETED DATA

INTRODUCTION

This is an initial palynological report on Blackback-2 as it only summarises the palynological analyses on 23 sidewall cores and a single sample from conventional core-2 which had been collected at the rig site and dispatched for urgent age dating. At the time of preparation of this report the remaining conventional cores recovered over the interval 2797-2869m were not available for inspection and selection of palynological samples as they were still packed in wax for analysis involved with formation evaluation. Because of the uncertainty of when it will be possible to perform palynological analyses on additional samples from the conventional cores a formal report is prepared on the currently available results. Note also that the depth of the single core sample analysed has not been tied to the logs and may be out of order with respect to the sidewall cores. For this reason the spore-pollen and microplankton assemblages from this sample are not included on the range charts.

All the sidewall cores were inspected, and 20 of the 21 recovered sidewall cores (out of 42 shot) from the Latrobe Group were selected for palynology processing. The only exception was SWC 7 at 3091m which was considered too coarse grained to contain palynomorphs. From the Seaspray Group the deepest 3 of 11 recovered sidewall cores were selected.

The palynological slides were prepared by Laola Pty Ltd in Perth and returned to the author for examination and recording of their contained spores, pollen and microplankton to derive the data and interpretations in this report.

Between 8 to 20 grams (average 13.8g) of each sidewall core was processed for palynological analysis. In anticipation of similar yields to those obtained from the adjacent Hapuku-1 and Blackback-1 wells as much of the sidewall cores were sampled as possible, without jeopardising the potential for other analyses on the samples. As expected 16 or 70% of the sidewall cores gave low to very low residue yields. Fortunately the palynomorph concentration on the slides from many of these samples was high enough to result in confident age datings. Preservation of palynomorphs overall was fair to good and at times exceptional. Average spore-pollen diversity was a moderate 17+ species and average microplankton diversity in productive samples a low 8+ species. Both averages are low reflecting the initial low yields.

Lithological units and palynological zones from the base of the Seaspray Group to Total Depth are given in the following summary. The interpretative data with zone identification and Old and New Confidence Ratings are recorded in Table-1 and basic data on residue yields, preservation and diversity are recorded on Tables-2 and 3. All species, recorded from the sidewall cores, which have been identified with binomial

names are tabulated on separate range charts for spore-pollen and microplankton. Relinquishment lists for palynological slides and residues from samples analysed in Blackback-2 will be prepared after analysis of additional conventional core samples.

PALYNOLOGICAL SUMMARY OF BLACKBACK-2

AGE	UNIT/FACIES		SPORE-POLLEN ZONES (DINOFLAGELLATE ZONES)	DEPTHS (mKB)
MIOCENE - OLIGOCENE	SEASPRAY GROUP		*P. tuberculatus*	2725.0-2778.5
EARLY EOCENE	LATROBE GROUP	Flounder Formation Equivalent	Upper *M. diversus* *(D. waipawaense)*	2780.5-2796.5 (2780.5-2796.5)
PALEOCENE	LATROBE GROUP	"Hapuku Marine Sands"	Lower *M. diversus*	2807.6-2812.5
			Upper *L. balmei* *(A. homomorphum)*	2835.5-2839.5 (2835.5-2839.5)
			Lower *L. balmei* *(E. crassitabulata)*	2872.0 (2872.0)
MAASTRICHTIAN	LATROBE GROUP	Undifferentiated sand, shales and minor coals.	Upper *T. longus* *(M. druggii)*	2899.5 (2899.5-2924.0)
			Lower *T. longus*	3139.0-3141.0

GEOLOGICAL COMMENTS

1. Because of the very low yields and hence low recorded diversity the three samples from the Seaspray Group can only be assigned a broad Oligocene to Early Miocene age.

2. The interval with an overall higher gamma ray reading between 2779.5-2798.5m is assigned to the Flounder Formation based on its predominant black-grey siltstone lithology and spore-pollen and dinoflagellate content.

3. The interval between 2798.5m to probably 2897m which on sidewall core lithologies is predominantly a glauconitic sandstone is equated to the Paleocene to Early Eocene condensed section in Hapuku-1. This section is here informally referred to as the "Hapuku Marine Sands". It contains similar well preserved microplankton assemblages as found in Hapuku-1 (Partridge, 1975a) and probably has similar low depositional rates. The four conventional cores cut between 2797-2869m in Blackback-2 will need to be sampled and analysed to obtain a detailed correlation to Hapuku-1. This whole section was missing due to erosion by the "*N. asperus* Channel" in Blackback-1 (Partridge & Hannah, 1990).

4. The characteristic K/T (Cretaceous/Tertiary) boundary section in the Gippsland Basin, where the *T. evittii* dinoflagellate Zone overlies the *M. druggii* dinoflagellate Zone in a shaly interval, is not present in Blackback-2 (for comparison see Roundhead-1, Partridge 1989). In this Blackback-2 is similar to Hapuku-1 where the 63 Ma Sequence Boundary of Haq *et al.* (1987, 1988) within the Paleocene is considered to cut down into the underlying Maastrichtian *T. longus* Zone. In Hapuku-1 this sequence boundary is picked at 2890m. In Blackback-2 it lies between the *E. crassitabulata* Zone at 2872m and first reliable Upper *T. longus/M. druggii* Zone pick at 2899.5m. The best log pick for the 63 Ma Sequence Boundary in Blackback-2 would appear to be 2897m.

5. The interval of high gamma ray values between 2897-2939m which is predominantly sandstone based on the sidewall core lithologies (Table-2) is considered to be a marine unit within the Upper *T. longus* Zone. All analysed samples contain dinoflagellates diagnostic of the *M. druggii* dinoflagellate Zone.

6. Between the base of the above unit at 2939m (or base of *M. druggii* Zone at 2924m) and the two samples assigned to the Lower *T. longus* Zone near the bottom of Blackback-2 (at 3139m & 3141m) there are no reliable sidewall core samples.

   Thus the boundary between the Upper and Lower *T. longus* Zone and transition from marine to predominantly non-marine coastal plains facies are not adequately picked. However, over this 200+ metres of section there are a number of shales which may be datable on cuttings. Based on high gamma ray readings and the widest separation on the bulk density/neutron porosity logs the cutting intervals that could be analysed lie at 2990-93m; 3035-39m; 3042-48m; 3060-63m; the thick shale between 3069-3083m; the probable coal at 3083.5-85m and underlying shale at 3085-90m.

BIOSTRATIGRAPHY

Zone and age determinations are based on the spore-pollen zonation scheme proposed by Stover & Partridge (1973), partially modified by Stover & Partridge (1982) and Helby, Morgan & Partridge (1987), and a dinoflagellate zonation scheme which has only been published in outline by Partridge (1975b, 1976). Other modifications and embellishments to both zonation schemes can be found in the many palynological reports on the Gippsland Basin wells drilled by Esso Australia Ltd. Unfortunately this work is not collated or summarised in a single report. Note also that the name of the Upper *T. longus* Zone has not been changed to conform with recent nomenclature change to the name of the eponymous species *Forcipites* (al. *Tricolpites*) *longus* (Stover & Evans) Dettmann & Jarzen 1988.

Author citations for most spore-pollen species can be sourced from Stover & Partridge (1973, 1982), Helby, Morgan & Partridge (1987) or other references cited herein. Author citations for dinoflagellates can be found in the indexes of Lentin & Williams (1985, 1989) or in the papers of Wilson (1988) and Marshall & Partridge (1988) or other references cited herein. Species names followed by "ms" are unpublished manuscript names.

Proteacidites tuberculatus Zone: 2725.0-2778.5 metres Oligocene-Miocene.

The three sidewall cores analysed from the Seaspray Group all gave meagre yields with limited but overall similar assemblages. The two deepest samples can be assigned to the *P. tuberculatus* Zone on the occurrence of the key spore *Cyatheacidites annulatus*, whilst the shallowest sample contains the eponymous species *Proteacidites tuberculatus*. The remaining spore-pollen species recorded are not particularly diagnostic but are consistent with this zone assignment.

The microplankton assemblages can be assigned to the informal *Operculodinium* spp. Association of Partridge (1976) based on the frequent to common occurrence of the long ranging *Operculodinium centrocarpum* associated with the Oligocene or younger index species *Protoellipsodinium simplex* ms.

Upper *Malvacipollis diversus* Zone: 2780.5-2796.5 metres and *Dracodinium waipawaense* Dinoflagellate Zone: 2780.5-2796.5 metres Early Eocene.

Of the four samples over this interval only the shallowest at 2780.5m can be confidently assigned to the Upper *M. diversus* Zone on the presence of *Myrtaceidites tenuis* and *Proteacidites pachypolus*. The three underlying samples, although they contain moderate to high diversity spore-pollen

assemblages lack these key indicator species and are assigned to the zone based on assemblage composition and the presence of key dinoflagellates which elsewhere in the Gippsland Basin are not known to range below the Upper *M. diversus* Zone. A low confidence rating by definition has to be assigned to the base of the zone.

The spore-pollen assemblages are all dominated by *Dilwynites* spp. (22%-54%) with *Haloragacidites harrisii* (Casuarina), *Proteacidites* app. and *Nothofagidites* spp. the next most abundant.

Microplankton dominate the total count in all samples with average abundance 60% (range 36%-95%). The zone index *Dracodinium waipawaense* occurs in the shallowest 2780.5m and deepest 2796.5m samples. Other species which support this zone assignment are *Homotryblium tasmanense* which represents 40% of the microplankton assemblage at 2780.5m and is also recorded at 2795m, and the characteristic species of the Flounder Formation *Deflandrea flounderensis* which occurs in all four samples. Of particular interest is the records of the acritarch *Tritonites bilobus* Marshall & Partridge 1988 at 2780.5m and 2787.5m. This species was first recorded in the Gippsland Basin as a reworked form in the "*N. asperus* channel-fill" unit in Blackback-1 (Partridge & Hannah, 1990, p.7).

Lower *Malvacipollis diversus* Zone: 2807.6-2812.5 metres Early Eocene.

Of the two samples assigned to the Lower *M. diversus* Zone the shallowest is the core sample at 2807.6m which is assigned on the presence of the species *Myrtaceoipollenites australis* Harris 1965, *Proteacidites grandis, P. incurvatus, Malvacipollis subtilis* and frequent *Haloragacidites harrisii* and no younger indicator species. The deeper sample at 2812.5m was even less diagnostic containing only a fragment of *P. grandis* in a limited assemblage recorded from only the kerogen slide. It is assigned to the zone principally on the absence of older indicator species. The zone assignment for both samples is of very low confidence.

Significant microplankton only occur in the core sample at 2807.6m where they comprise 22% of total count. The presence of *Deflandrea dartmooria, Diphyes colligerum, Achomosphaera septata* and the long spined variety of *Apectodinium homomorphum* support the spore-pollen zone assignment.

Upper *Lygistepollenites balmei* Zone: 2835.5-2839.5 metres and *Apectodinium homomorphum* Dinoflagellate Zone: 2835.5-2839.5 metres Late Paleocene.

The top of the Paleocene *L. balmei* Zone is recorded in Blackback-2 at 2829m based on the youngest occurrence of *Lygistepollenites balmei* but the spore-

pollen assemblage is too limited for confident assignment to the Upper subdivision. This sample could just as likely be assigned to Lower *M. diversus* Zone. The next two underlying samples however can be confidently assigned to the Upper *L. balmei* Zone. At 2835.5m *L. balmei* (1.4%) is associated with the LADs (Last Appearance Datums) of *Australopollis obscurus* and *Gambierina rudata*, whilst the deeper sample at 2839.5m, which contains common *L. balmei* (8%), is considered no older than the Upper *L. balmei* Zone based on the FAD (First Appearance Datum) of *Proteacidites annularis*. Both spore-pollen assemblage are dominated by gymnosperm pollen (55%-59%) with *Dilwynites* spp. (24%) dominant in the shallower and *Podocarpidites* spp. (25%) dominant in the deeper sample.

The microplankton average 21% of the total count whilst microplankton diversity is a moderate 12 species. The occurrence of the short spined variety of *Apectodinium homomorphum* associated with *Deflandrea dartmooria* in both samples confirms the presence of the *A. homomorphum* dinoflagellate Zone.

Lower *Lygistepollenites balmei* Zone: 2872.0 metres and
***Eisenackia crassitabulata* Dinoflagellate Zone: 2872.0 metres**

Early Paleocene.

The single samples at 2872m is assigned to the Lower *L. balmei* Zone on the presence of *Proteacidites angulatus*. Other significant species are *Lygistepollenites balmei* (1.5%), *Australopollis obscurus* (<1%), *Gambierina* spp. (3.8%) and *Peninsulapollis gillii* (11%). Overall the spore-pollen assemblages are dominated by gymnosperm pollen (57%) with *Phyllocladidites mawsonii* (20%), *Podocarpidites* spp. (18%) and *Dilwynites* spp. (7%) being most abundant.

Upper *Tricolpites longus* Zone: 2899.5 metres and
***Manumiella druggii* Dinoflagellate Zone: 2899.5-2924.0 metres**

Maastrichtian.

Of the three sidewall cores analysed over this interval only the shallowest at 2899.5m could be confidently assigned to there Upper *T. longus* Zone based on the presence of *Stereisporites (Tripunctisporis)* spp. and the common occurrence of *Gambierina rudata* (8%). In addition this sample contained a number of species whose last appearances indicate an age no younger than this zone. These include *Proteacidites clinei* ms, *P. reticuloconcavus* ms, *P. wahooensis* ms, *Tricolpites confessus*, *Triporopollenites sectilis*, and the eponymous species *Forcipites (al. Tricolpites) longus*. The two deeper samples on the basis of their contained spore-pollen can only be assigned to the broader *T. longus* Zone.

All three samples contain members of the *Manumiella* species complex enabling confident assignment to the *M. druggii* dinoflagellate Zone. The shallowest sample at 2899.5m contains the key species *M. druggii* and *M. seelandica*. The two deep samples in contrast are essentially monospecific with only *M. conorata* confidently identified, although lots of broken specimens which could only be referred to *Manumiella* spp. were present. This latter category is the dominant palynomorph in the deepest sample at 3924m but this is partly an artefact of the very low yield.

Indeterminate Interval

Although four samples were analysed over the 215 metre interval between the base of the Upper and top of the Lower *T. longus* Zones only one sample could be broadly assigned to the Late Cretaceous. The other samples contained negligible *insitu* palynomorphs. The shallowest at 2996.5m was apparently contaminated with the algal(?) cyst *Nummus*. Assignment of the specimens to any fossil species of *Nummus* is questionable as the specimens were very pale and showed no sign of maturation.

Lower *Tricolpites longus* Zone: 3139.0-3141.0 metres Maastrichtian.

The shallower sample is assigned to the Lower *T. longus* Zone on the presence of the eponymous species *Forcipites longus* and *Grapnelispora evansii* Stover & Partridge 1984. Other spore-pollen species in both samples whilst consistent with this zone assignment can range into the immediately older *T. lilliei* Zone. The deeper sample is retained within the Lower *T. longus* Zone because it is only 2 metres deeper.

Both samples can be characterised by their high *Nothofagidites* spp. content (47% at 3139m; 10% at 3141m). The other dominant categories in the counts are *Podocarpidites* spp. and *Proteacidites* spp., whilst *Tricolpites waiparaensis* at 12% is also characteristic in the shallower sample.

A good specimen of the monoporate pollen *Aglaoreidia qualumis* was recorded at 3139m. This is a significant anomalous occurrence as this species does not normally range below the Late Eocene Middle *N. asperus* Zone. A similar anomalous occurrence of this species was recorded from an open marine environment in the Upper *M. diversus* Zone, in Whaleshark-1 (Partridge 1993, p.10).

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TABLE-1: INTERPRETATIVE PALYNOLOGICAL DATA FOR BLACKBACK-2, GIPPSLAND BASIN.

SHEET 1 OF 2

SAMPLE TYPE	DEPTH (M)	SPORE-POLLEN ZONES	*CR OLD	*CR NEW	MICROPLANKTON ZONES OR ASSOCIATIONS	*CR OLD	*CR NEW	COMMENTS
SWC 47	2725.0	*P. tuberculatus*	1	B2	(*Operculodinium* spp.)	1	B3	*Proteacidites tuberculatus* present.
SWC 45	2774.0	*P. tuberculatus*	0	B2	(*Operculodinium* spp.)	0	B3	*Cyatheacidites annulatus* present.
SWC 43	2778.5	*P. tuberculatus*	0	B2	(*Operculodinium* spp.)	0	B3	FAD *Cyatheacidites annulatus.*
SWC 42	2780.5	Upper *M. diversus*	0	B1	*D. waipawaense*	0	B2	Microplankton 36%. *T. bilobus* present. *Homotryblium tasmaniense* 14%.
SWC 40	2787.5	*M. diversus*	2	B4	(*Tritonites bilobus*)	0	B2	Microplankton 52%.
SWC 38	2795.0	*M. diversus*	2	B4				Microplankton 56%. *Glaphyrocysta retiintexta* 21%.
SWC 37	2796.5	Upper *M. diversus*	2	B4	*D. waipawaense*	1	B2	Microplankton 95%.
CORE-2	2807.6	Lower *M. diversus*	2	B4				Depth needs to be adjusted to logs!
SWC 32	2812.5	Lower *M. diversus*	2	B5				Very low yield, kerogen only.
SWC 29	2829.0	*L. balmei*	2	B5				Microplankton 54%.
SWC 27	2835.5	Upper *L. balmei*	0	B1	*A. homomorphum*	0	B2	Microplankton 20%. *L. balmei* common.
SWC 26	2839.5	Upper *L. balmei*	0	B2	*A. homomorphum*	1	B3	FAD *Proteacidites annularis.*
SWC 25	2859.5	Indeterminate						Low yield, insuffient species present.
SWC 21	2872.0	Lower *L. balmei*	0	B1	*E. crassitabulata*	0	B2	*Proteacidites angulatus* present.
SWC 20	2878.5	Indeterminate						Virtually barren.
SWC 18	2899.5	Upper *T. longus*	0	B1	*M. druggii*	0	B3	Microplankton 6%. *S. (Tripunctispories)* spp. present.
SWC 17	2912.5	*T. longus*	0	B2	*M. druggii*	1	B3	Microplankton <5%.
SWC 16	2924.0	*T. longus*	2	B5	*M. druggii*	1	B3	Microplankton 74%. Mostly *Manumiella conorata.*

TABLE-1: INTERPRETATIVE PALYNOLOGICAL DATA FOR BLACKBACK-2, GIPPSLAND BASIN.

SAMPLE TYPE	DEPTH (M)	SPORE-POLLEN ZONES	*CR OLD	*CR NEW	MICROPLANKTON ZONES OR ASSOCIATIONS	*CR OLD	*CR NEW	COMMENTS
SWC 12	2996.5	Indeterminate						Probably contaminated.
SWC 6	3094.5	Indeterminate						Virtually barren.
SWC 5	3117.0	*T. longus*						Zone species extremely rare.
SWC 3	3132.5	Indeterminate						Very low yield.
SWC 2	3139.0	Lower *T. longus*	1	B1				*Nothofagidites* spp. 46%. *Grapnelispora evansii* present.
SWC 1	3141.0	Lower *T. longus*	1	B4				*Nothofagidites* spp. 10%.

*CR = Confidence Ratings OLD & NEW
FAD = First Appearance Datum
LAD = Last Appearance Datum

CONFIDENCE RATINGS

The concept of Confidence Ratings applied to palaeontological zone picks was originally proposed by Dr. L.E. Stover in 1971 to aid the compilation of micropalaeontological and palynological data and to expedite the revision of the then rapidly evolving zonation concepts in the Gippsland Basin. The original or OLD scheme which mixes confidence in fossil species assemblage with confidence due to sample type has gradually proved to be rather limiting as additional refinements to existing zonations have been made. With the development of the STRATDAT computer database as a replacement for the increasingly unwieldy paper based Palaeontological Data Sheet files a NEW set of Confidence Ratings have been proposed. Both OLD and NEW Confidence Ratings for zone picks are given on Table 1, and their meanings are summarised below:

OLD CONFIDENCE RATINGS

0 SWC or CORE, Excellent Confidence, assemblage with zone species of spore, pollen and microplankton.

1 SWC or CORE, Good Confidence, assemblage with zone species of spores and pollen or microplankton.

2 SWC or CORE, Poor Confidence, assemblage with non-diagnostic spores, pollen and/or microplankton.

3 CUTTINGS, Fair Confidence, assemblage with zone species of either spore and pollen or microplankton, or both.

4 CUTTINGS, No Confidence, assemblage with non-diagnostic spores, pollen and/or microplankton.

NEW CONFIDENCE RATINGS

Alpha codes: Linked to sample type

A Core

B Sidewall core

C Coal cuttings

D Ditch cuttings

E Junk basket

F Miscellaneous/unknown

G Outcrop

Numeric codes: Linked to fossil assemblage

1 **Excellent confidence:** High diversity assemblage recorded with key zone species.

2 **Good confidence:** Moderately diverse assemblage recorded with key zone species.

3 **Fair confidence:** Low diversity assemblage recorded with key zone species.

4 **Poor confidence:** Moderate to high diversity assemblage recorded without key zone species.

5 **Very low confidence:** Low diversity assemblage recorded without key zone species.

BASIC DATA

TABLE 2: BASIC SAMPLE DATA

TABLE 3: BASIC PALYNOMORPH DATA

RELINQUISHMENT LISTS

SPORE-POLLEN RANGE CHART
(ATTACHMENT)

MICROPLANKTON RANGE CHART
(ATTACHMENT)

TABLE-2: BASIC SAMPLE DATA FOR BLACKBACK-2, GIPPSLAND BASIN.

SAMPLE TYPE	DEPTH (M)	LITHOLOGY	SAMPLE WT (g.)	RESIDUE YIELD
SWC 47	2725.0	Med grey calcisiltite/lutite	11.0	Very low
SWC 45	2774.0	Med grey calisiltite tr. glauc.	15.4	Very low
SWC 43	2778.5	Med grey clac. clay/calcisiltite	14.7	Very low
SWC 42	2780.5	Dk. gry-blk siltstone	12.4	Moderate
SWC 40	2787.5	Med gry-brn siltstone w/glauconite (20%)	10.5	Low
SWC 38	2795.0	Dk gry-blk siltstone (no obvious glauc.)	18.3	Moderate
SWC 37	2796.5	Blk-grn glauconitic siltstone	9.8	Low
CORE-2	2807.6		15.0	Moderate
SWC 32	2812.5	Coarse qtz & glauconitic sst.	13.3	Very low
SWC 29	2829.0	Med gry-grn glauconitic sandstone	16.7	Low
SWC 27	2835.5	Lt gry-grn pyritic glauc. f.g. sandstone	20.6	Low
SWC 26	2839.5	Grey grn glauconitic sandstone	16.1	Low
SWC 25	2859.5	Lt gry glauconitic sandstone	11.2	Very low
SWC 21	2872.0	Grn-gry glauconitic sandstone	13.3	Very low
SWC 20	2878.5	Lt gry-grn pebbly glauc. sandstone	19.6	Very low
SWC 18	2899.5	Lt gry mottled qtz sandstone	11.7	High
SWC 17	2912.5	Gry carbonaceous sst with laminae	17.5	High
SWC 16	2924.0	Med gry glauconitic sandstone	17.4	Low
SWC 12	2996.5	Lt gry argillaceous sandstone tr. glauc.	15.0	Very low
SWC 6	3094.5	Lt gry silty sandstone	10.8	Very low
SWC 5	3117.0	Med gry silty-v.f.g. sandstone	9.8	High
SWC 3	3132.5	Med gry argillaceous sandstone	11.2	Low
SWC 2	3139.0	Lt gry med sst with clay clasts	13.4	High
SWC 1	3141.0	Dk gry brn claystone	8.4	High

TABLE-3: BASIC SAMPLE DATA FOR BLACKBACK-2, GIPPSLAND BASIN.

SAMPLE TYPE	DEPTH (M)	PALYNOMORPH CONCENTRATION	PRESERVATION	*No S/P SPECIES	MICROPLANKTON ABUNDANCE	*No. MP SPECIES
SWC 47	2725.0	Moderate	Fair-good	11	Very abundant	7
SWC 45	2774.0	High	Fair	18	Very abundant	9
SWC 43	2778.5	Moderate	Poor	13	Very abundant	7
SWC 42	2780.5	High	Fair-good	33	Abundant	17
SWC 40	2787.5	High	Poor-good	27	Very abundant	17
SWC 38	2795.0	Moderate	Poor-good	33	Very abundant	17
SWC 37	2796.5	High	Good	13	Very abundant	19
CORE-2	2807.6	Moderate	Good	30	Common	10
SWC 32	2812.5	Low	Fair	13	Frequent	4
SWC 29	2829.0	Low	Fair	15	Very abundant	12
SWC 27	2835.5	High	Fair-good	39	Common	14
SWC 26	2839.5	Moderate	Good	23	Common	10
SWC 25	2859.5	Low	Fair	5	Rare	1
SWC 21	2872.0	High	Good	29	Abundant	10
SWC 20	2878.5	Very low	Poor	1	Rare	1
SWC 18	2899.5	Moderate	Good	28	Frequent	6
SWC 17	2912.5	Low	Fair-good	19	Rare	2
SWC 16	2924.0	Very low	Fair-good	4	Common	2
SWC 12	2996.5	Very low	Poor	1	(Frequent)	(1)
SWC 6	3094.5	Very low	Fair	2		
SWC 5	3117.0	Very low	Fair-good	16	Rare	1
SWC 3	3132.5	Very low	Poor	2		
SWC 2	3139.0	High	Fair	32		
SWC 1	3141.0	Low	Fair	20	Very rare	1

Microplankton species shown in (brackets) = contamination

*DIVERSITY: Very low = 1- 5 species
Low = 6-10 species
Moderate = 11-25 species
High = 26-74 species
Very high = 75+ species