# GSA Data Repository Item 2009029

**Material and Methods**

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## MATERIAL

The Waipara River, north Canterbury (**Fig. DR1**), trends northwest-southeast through a Mesozoic-Cenozoic sedimentary succession. Eocene Ashley Mudstone outcrops in the mid-Waipara River section (Morgans et al., 2005), which is the middle portion of the river downstream from Doctor's Gorge (grid reference M34/7530 9470 on the 1:50,000 New Zealand topographic map series 260). Ashley Mudstone is a blue-grey to medium green-grey, moderately indurated, calcareous, glauconitic and smectitic mudstone (Browne and Field, 1985). It overlies Waipara Greensand either conformably or disconformably at a burrowed contact, and is conformably overlain by Amuri Limestone. All samples (M34/f822 to f869; **Table DR1**) were collected from well-exposed 60-m thick stratigraphic section of Ashley Mudstone on the southwest bank of the river bed (M34/78329478 to 78459466) (**Fig DR2**). Although continuous exposure extended no higher than sample M34/f868, one spot sample (M34/f869) was collected 10 m above to determine the age range of the missing interval. All bulk samples, sediment residues, microfossil slides and palynology slides are stored at GNS Science, Lower Hutt, New Zealand.

## METHODS

### Calcareous nannofossils

Twenty samples were examined for nannofossils (**Table DR2**). Smear slides were examined by light microscope at x1500 magnification. Biostratigraphic assignment is based on the NP zonation of Martini (1971), with modifications from Okada and Bukry (1980) and Perch-Nielsen (1985). Taxonomic concepts follow Perch-Nielson (1985) and Bown (2005). Additional relative abundance data of dominant taxa are based on counts of ~200 nannofossils. Preservation was assessed visually based on the degree of etching and carbonate overgrowth with five categories ranging from moderately etched/overgrown to excellent.

**Foraminifera**

Forty-seven samples were processed for foraminifera (**Table DR3**). Bulk rock was dried at 40°C, and 500 g was washed over a 75 µm screen, dried at 40°C, and the residue weighed. Residues were split repeatedly with a Carpco microsplitter to get census counts on sediment (50-100+ grains) > 150 µm. Foraminiferal abundance was determined and splits reconstituted to get a foraminiferal count of 100+ specimens in the >150 µm fraction. This procedure gives a planktonic/benthic ratio and foraminiferal productivity. For each sample, half the remaining residue was exhaustively picked onto a faunal slide. Examination of the faunal slides supplied biostratigraphic and paleodepth data, and selected taxa from this material was also utilised for geochemical studies.

**Radiolaria and sand content**

Twenty samples were prepared for radiolarian analysis (**Table DR4**) by crushing, digestion in 10% HCl, and boiling in 10% $H_2O_2$ and calgon. Residues were sieved into three fractions; >300µm (coarse), 212-300µm (medium) and 63-212µm (fine). The coarse fraction of all samples were picked under a stereo-microscope and specimens mounted on gummed slides. From the medium fraction, samples with abundant material were made into strewn slides

while samples with less abundant material were picked. All fine fraction samples were made into strewn slides. These strewn slides were then examined by light microscope at x160 magnification. Radiolaria were counted in groups with close morphological/taxonomic affinities. Taxonomy follows Hollis (1997) and Kozlova (1999). Groups with extreme morphological similarity, such as non-spinose actinommids or spongodiscids, were combined in counts as identification to genus-level was not always possible. Preservation was based on visual examination and specimens ranked as poor, fair and good, depending on the degree of breakage. Poor preservation precluded species-level identification in many instances where fragile diagnostic features were not preserved. Biostratigraphy is based on the South Pacific radiolarian zonation of Hollis (1997, emend. 2002). While marker species are sparse, six biostratigraphic events were recognised. The radiolarian processing method also provided sand content, i.e. amount of >63 μm acid-leached residue per gram of processed sediment.

**Palynology**

For palynological analysis, 20 samples were processed (**Table DR5**). Between 10.1 and 13.8 g of sediment was crushed, dried, weighed, and the carbonate and siliceous components removed by treating with hot 10% HCl and 50% HF, respectively. Samples were oxidised with 30% $HNO_3$ for 15 minutes, washed with 5% KOH, and sieved over a 10μm mesh to remove small organic and mineral particles. To break up clumps of residue the sample was placed in an ultrasonic bath for up to 3 minutes during the sieving process. Well-mixed representative fractions of the >10μm residue were then mounted on glass slides using a glycerine jelly medium. Palynomorph assemblages are well-preserved and abundant. Quantitative analysis involved three steps, firstly a minimum of 150 palynomorphs (e.g., pollen, dinocysts, foraminiferal linings) were counted, followed by a count of a minimum of 200 dinocysts and 200 miospores. Slides were also scanned for additional taxa. Dinocyst

taxonomy follows Fensome and Williams (2004). Quantitative results are expressed as a percentage of the total palynomorph, dinocyst or miospore count.

**Biostratigraphy**

Calcareous nannofossils and foraminifera provide the primary age control, supplemented with dinocyst and radiolarian bioevents (**Fig. DR2**). Stages of the New Zealand Paleogene timescale (Cooper, 2004) are calibrated to the Cenozoic timescale of Berggren et al. (1995) and, hence, this timescale is used here. The base of calcareous nannofossil zone NP13 (50.6 Ma) is identified by the last occurrence (LO) of *Tribrachiatus orthostylus* (Martini, 1971; Perch-Nielsen, 1985), which is recorded near the base of the section in sample M34/f823 (64.81 m). The LO of *Discoaster kuepperi*, which is dated at 48.6 Ma (Wei, 2004) is well constrained in this section, occurring in sample M34/f843 (87.17 m). However, nannofossil preservation and diversity decrease up-section, making it difficult to recognise further datums or zonal boundaries. An isolated occurrence of *Discoaster sublodoensis* in M34/f849 (93.87 m) is not considered a reliable marker in this section for the base of zone NP14, dated at 49.7 Ma. No key species were recognised to identify the NP14/15 boundary. The first occurrence of benthic foraminifera *Elphidium hampdenense* at 81.58 m (M34/f838) marks the base of the Heretaungan Stage, which is dated at 49.5 Ma (Cooper, 2004). Foraminifera indicate that the interval up to M34/f868 (113.07 m) is Heretaungan, i.e. older than 46.2 Ma. Dinocyst assemblages also indicate that the upper part of the section lies within the Heretaungan: zonal marker *Membranophoridium perforatum* is common and key taxa from overlying stages are absent. The LO of radiolarian *Podocyrtis aphorma* in M34/f852 (97.22 m) indicates the base of zone RP10 (Hollis, 1997, 2002), which is loosely correlated with lower Heretaungan, c. 48.5 Ma. A spot sample (M34/f869) collected at 123.1 m is assigned to New Zealand Bortonian Stage (43-37 Ma) (Morgans et al., 2004), based on the FO of the planktic

foraminifer *Globigerapsis index*. The presence of *Reticulofenetra umbilica* and *R. reticulate*, nannofossil markers for zone NP16 (43.4 to 40.4 Ma), support this correlation. As in many other New Zealand sections (King et al. 1999), there appears to be a significant hiatus in this section, which corresponds to the entire Porangan stage (46.2-43 Ma). Using four relatively well-constrained bioevents in the 49 m-thick section between samples M34/f822 (63.69 m) and f868 (113.06 m), we infer an age range of 4.5 million years, from 50.7 to 46.2 Ma, with average sedimentation rate of ~12 cm/kyr (**Table DR1**).

**Organic geochemistry**

Organic biomarker analyses were carried out on twenty samples (**Table DR1**). Samples were gently washed with methanol, freeze-dried and powdered with a Retsch PM100 Ball Mill. The powdered samples were extracted via Soxhlet extraction over 24 hours using dichloromethane/methanol (2:1 v/v) as the organic solvent. The total lipid extracts were separated into two fractions on an aminopropyl solid phase extraction column by elution with dichloromethane/*iso*-propanol (3:1 v/v; neutral fraction) and 2% (by volume) acetic acid in diethyl ether (acid fraction). The neutral fraction was further split using a column packed with (activated) alumina by elution with hexane (saturated hydrocarbon fraction), hexane/DCM (9:1 v/v; aromatic fraction) and dichloromethane/methanol (1:2 v/v; polar fraction) and all fractions were evaporated to dryness under a steady flow of nitrogen. The polar fraction was re-dissolved in 200 µl of hexane/isopropanol (99:1 v/v) and subsequently filtered through a 0.45 µm, 4mm diameter PTFE filter attached to a 1 ml Luer syringe.

GDGT analysis was performed using an HP (Palo-Alto, CA, USA) 1100 series HPLC/MS instrument equipped with an auto-injector and Chemstation chromatography manager software. Separation was achieved with a Prevail Cyano column (2.1 x 150 mm, 3 µm;

Alltech, Deerfield, IL, USA), maintained at 30°C. Injection volume varied from 1 to 20 µl. GDGT lipids were eluted isocratically with 99% A and 1% B for 5 min, followed by a linear gradient to 1.8% B over 45 min, where A = hexane and B = propanol. Flow rate was 0.2 ml/min. After each analysis the column was cleaned by back- flushing hexane/propanol (90:10, v/v) at 0.2 ml/min for 10 min. Detection was achieved using atmospheric pressure positive ion chemical ionization mass spectrometry (APCI-MS) analysis of the eluent. Conditions were: nebulizer pressure 60 psi, vaporizer temperature 400 °C, drying gas ($N_2$), flow 6 l/min, temperature 200 °C, capillary voltage -3 kV, corona 5 µA (~ 3.2 kV). GDGTs were detected via single ion monitoring (SIM) of their $[M+H]^+$ ions (dwell time = 234 ms) and quantified by integration of the peak areas.

We derived SST estimates from the TetraEther index of 86 carbon atoms, $TEX_{86}$, which is based on the relative distribution of archaeal glycerol dialkyl glycerol tetraether (GDGT) marine lipids (Schouten et al., 2002, 2007). This distribution is thought to be independent of surface water parameters such as salinity or nutrient availability (Wuchter et al., 2004). Conversion of $TEX_{86}$ values into SST were completed using methods outlined by Schouten et al. (2002, 2003, 2007) as revised by Kim et al. (2008). In addition, the concentration of branched and isoprenoid tetraether (BIT) lipids were measured. The BIT index is the ratio of non-isoprenoidal ether lipids, derived from soil, to archaeal ether lipids that are derived from pelagic crenarchaeota, and hence, is used as a proxy for the input of terrestrial organic matter into marine realms (Hopmans et al., 2004).

**Stable isotopes and carbonate content**

Individual shells of the foraminiferal species *Morozovella crater* and *Cibicides* cf. *novozelandicus* obtained from 13 samples (**Table DR1**) were analysed for oxygen isotope

and carbon isotopes at the University of California, Santa Cruz, using an Autocarb coupled to a PRISM mass spectrometer. Precision based on replicate analyses of in-house standard CM is better than +/- 0.05 and +/- 0.10 for $\delta^{13}C$ and $\delta^{18}O$, respectively. All values are reported relative to VPDB. Carbonate content was determined by digestion of powdered rock samples in %10 HCl.

**Elemental analyses**

Trace element ratios (Mg, Mn, Zn, Sr, Ba/Ca) were determined for individual foraminiferal shells (*Morozovella crater*, *Subbotina* spp. and benthic *Cibicides* cf. *novozelandicus*) at five stratigraphic levels (**Table DR1**) by laser ablation inductively-coupled plasma mass spectrometry (ICP-MS) at Victoria University of Wellington. Samples were subjected to multiple cleaning procedures by ultrasonicating in ultra-clean water and methanol prior to analysis. Foraminifera from the two upper samples (M34/f855, f867) are not well preserved and the geochemical and paleotemperature data obtained needs to be viewed in that context. Individual foraminifera were mounted on double-sided tape onto National Institute of Standards and Technology glass standard NIST610. Foraminifera were ablated with a New Wave laser ablation system operating at a wavelength of 193 nm and with a spot size of 25 μm, laser repetition rate of 2 or 3 Hz and laser power of ~50%. Under these conditions, a laser ablation pit is gradually ablated at a rate of ~0.2 to 0.3 μm/s. Ablation was completed in a helium atmosphere and ablated material carried to the ICP-MS in a helium-argon gas mixture. An Agilent 7500CS ICP-MS was used to measure trace element abundances relative to Ca during ablation. The following masses were sequentially and repeatedly monitored during ablation ($^{24}Mg$, $^{25}Mg$, $^{43}Ca$, $^{55}Mn$, $^{66}Zn$, $^{88}Sr$ and $^{138}Ba$) with dwell times of 10 to 30 ms. Instrumental backgrounds (60 s) were determined prior to each analysis, which typically comprised a 60-120 s analysis. Analyses of the NIST610 glass interspersed between

foraminifera analyses were made to correct analyses for trace element fractionation induced by the analytical procedures. The validity of using a silicate glass standard to correct for trace element fractionation in carbonate samples was tested by analysing samples of *Globigerinoides ruber* from a modern core top in the Coral Sea. Six individuals of *G. ruber* yielded Mg/Ca ratios that correspond to a mean SST of 26.1ºC using the Mg/Ca – temperature calibration for this species of Anand et al. (2003), which is in excellent agreement with the measured mean SST (26.4ºC) at this locality.

Data were processed offline using the follow protocol: (1) each scan corrected for instrumental background using the mean counts per second intensity obtained during the preceding background measurement, and (2) trace element data for each scan were divided by the $^{43}$Ca signal intensity and these data corrected for trace element fractionation induced during the analysis by reference to the mean trace element fractionation observed in bracketing analyses of the NIST 610 glass standard. Reference values used for the NIST610 glass were the GEOREM preferred values (http://georem.mpch-mainz.gwdg.de/). Fractionation factors in a typical analytical session varied by < ±5%.

Elemental/Ca ratios were plotted versus ablation time, producing a depth profile of foraminifera chemistry from its exterior through to the interior. Elemental/Ca profiles were screened for the effects of diagenesis. In general, most profiles showed a zone of high Mg/Ca at the start of each analysis followed by an interval of relatively constant and lower Mg/Ca. Ablating further into the interior resulted in a return to high Mg/Ca values. Zones of high Mg/Ca are also typically marked by high Mn/Ca and Sr/Ca that deviate markedly from values expected of foraminiferal carbonate in equilibrium with Eocene seawater (ca. Sr/Ca = 1.1

mmol/mol). Typically, 3-4 individual spots were analysed in two foraminifera of each species from each stratigraphic level.

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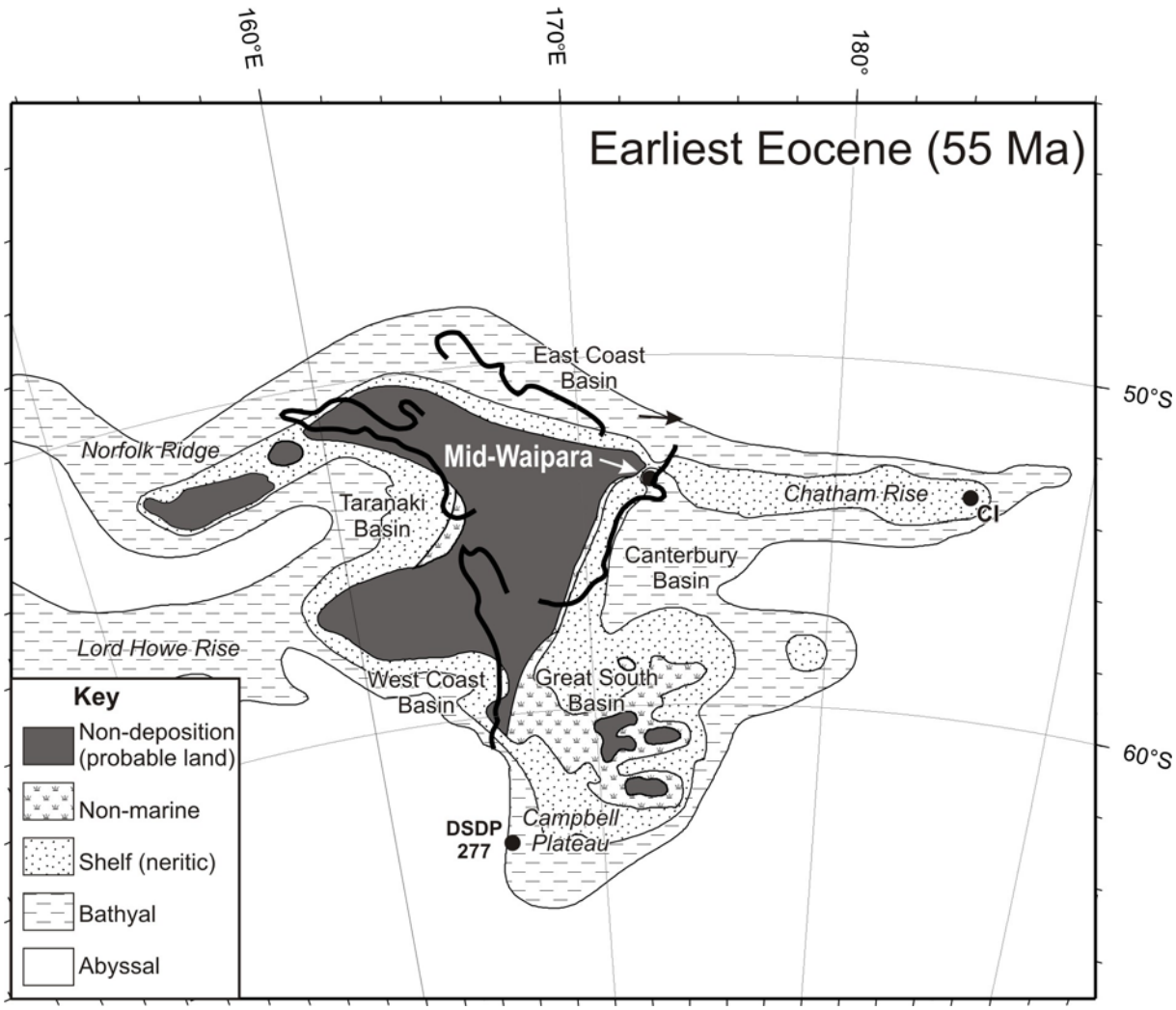


**Figure DR1**. Location of Mid-Waipara River section on early Eocene palinspastic reconstruction for New Zealand (after King et al. 1999).

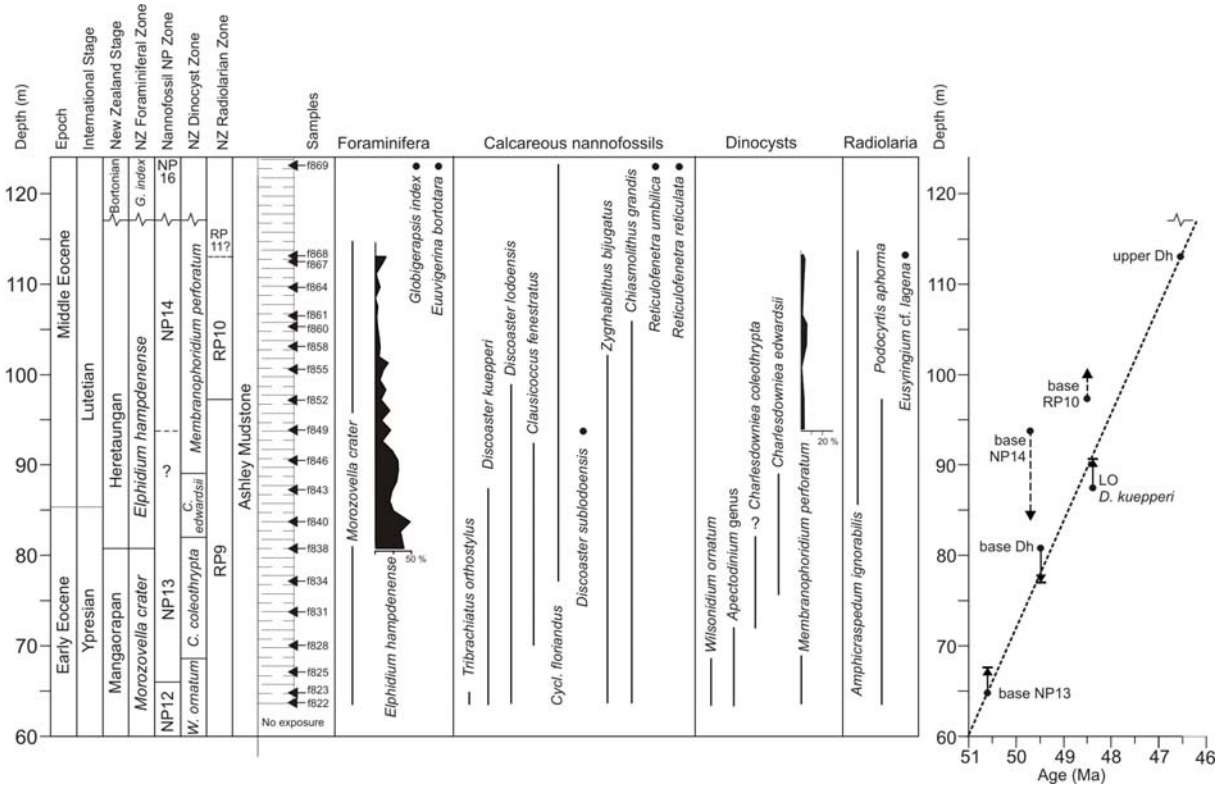


**Figure DR2**. Sample locations, biostratigraphy and age model of the Ashley Mudstone sequence from the mid-Waipara River section. Correlation with International and New Zealand stages and microfossil zones are based on the stratigraphic ranges of key taxa of foraminifera, calcareous nannofossil, dinocysts and radiolaria. Key biostratigraphic datums are shown in relation to depth (m) and age (Ma) to estimate the duration of the interval studied and average sedimentation rates.

**Table DR1.** Samples and geochemistry data table

| Fossil Record File Number | Field number | Strati-graphic height (m) | Linear sediment-ation rate | Age (Ma) | $TEX_{86}$ | BIT | $TEX_{86}$ SST (°C) | Mg/Ca (Morozo-vella) mmol/mol | Mg/Ca temp-erature (°C) | No. of specimens /ablation holes | Mg/Ca (Sub-botina) mmol/mol | Mg/Ca temp-erature (°C) | No. of specimens /ablation holes | Mg/Ca (Cibi-cides) mmol/mol | Mg/Ca temp-erature (°C) | No.of specimens /ablation holes | d13C (Morozo-vella) | d18O (Morozo-vella) | Temp-erature (°C) | d13C (Cibi-cides) | d18O (Cibi-cides) | Temp-erature (°C) | CaCO3 (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M34/f869 | MW144 | 123.11 | | 42.50 | 0.57 | 0.12 | **21.0** | | | | | | | | | | | | | 0.76 | -3.28 | **27.5** | 11.6 |
| M34/f868 | MW143 | 113.06 | 11.8 | 46.50 | 0.73 | 0.13 | **30.3** | | | | | | | | | | | | | | | | 11.3 |
| M34/f867 | MW142 | 112.46 | 11.8 | 46.55 | 0.72 | 0.15 | **29.8** | 4.040 | **30.1** | 1 / 2 | | poor preservation | | | **16.2** | | | | | | | | 9.0 |
| M34/f864 | MW139 | 109.71 | 11.8 | 46.78 | 0.69 | 0.13 | **28.2** | | | | | | | | | | | | | | | | 10.2 |
| M34/f861 | MW136 | 106.4 | 11.8 | 47.06 | 0.65 | 0.17 | **26.0** | | | | | | | | | | | | | | | | 12.0 |
| M34/f860 | MW135 | 105.31 | 11.8 | 47.16 | 0.70 | 0.19 | **28.7** | | | | | | | | | | | | | | | | 9.2 |
| M34/f859 | MW134 | 104.23 | 11.8 | 47.25 | | | | | | | | | | | | | 2.84 | -1.92 | **21.2** | -0.60 | -0.45 | **14.5** | 9.4 |
| M34/f858 | MW133 | 103.06 | 11.8 | 47.35 | 0.68 | 0.15 | **27.6** | | | | | | | | | | | | | | | | 10.4 |
| M34/f855 | MW130 | 100.57 | 11.8 | 47.56 | 0.70 | 0.13 | **28.8** | 2.473 | **25.4** | 1 / 3 | 2.397 | **24.5** | 2 / 7 | | **10.2** | | | | | 0.72 | -1.15 | **17.7** | 11.4 |
| M34/f852 | MW127 | 97.22 | 11.8 | 47.84 | 0.70 | 0.13 | **28.3** | | | | | | | | | | 2.46 | -1.72 | **20.3** | 0.80 | -0.97 | **16.8** | 14.3 |
| M34/f849 | MW124 | 93.87 | 11.8 | 48.13 | 0.70 | 0.09 | **28.4** | | | | | | | | | | 2.03 | -1.86 | **20.9** | 0.93 | -1.15 | **17.7** | 16.4 |
| M34/f846 | MW121 | 90.52 | 11.8 | 48.41 | 0.76 | 0.10 | **32.0** | | | | | | | | | | 4.12 | -3.30 | **27.6** | 0.54 | -1.40 | **18.8** | 18.0 |
| M34/f843 | MW118 | 87.16 | 11.8 | 48.69 | 0.77 | 0.13 | **32.5** | 4.284 | **30.8** | 1 / 4 | 3.431 | **28.4** | 2 / 8 | | **16** | | 2.77 | -3.74 | **29.6** | 0.68 | -2.84 | **25.4** | 19.7 |
| M34/f840 | MW115 | 83.81 | 11.8 | 48.98 | 0.74 | 0.11 | **30.6** | | | | | | | | | | 4.35 | -2.92 | **25.8** | 0.73 | -1.78 | **20.5** | 15.8 |
| M34/f837 | MW112 | 80.46 | 11.8 | 49.26 | 0.75 | 0.09 | **31.6** | | | | | | | | | | 4.39 | -4.14 | **31.5** | 0.78 | -1.92 | **21.2** | 23.9 |
| M34/f834 | MW109 | 77.1 | 11.8 | 49.55 | 0.78 | 0.09 | **33.0** | | | | | | | | | | 1.44 | -4.11 | **31.4** | -0.31 | -2.71 | **24.8** | 19.7 |
| M34/f831 | MW106 | 73.75 | 11.8 | 49.83 | 0.78 | 0.12 | **33.2** | 4.031 | **30.2** | 2 / 9 | 2.297 | **24** | 2 / 7 | | **18.5** | | 2.82 | -5.02 | **35.7** | 0.92 | -2.41 | **23.4** | 21.3 |
| M34/f828 | MW103 | 70.4 | 11.8 | 50.12 | 0.75 | 0.08 | **31.3** | | | | | | | | | | 2.67 | -2.81 | **25.3** | 0.96 | -1.59 | **19.7** | 18.2 |
| M34/f825 | MW100 | 67.04 | 11.8 | 50.40 | 0.80 | 0.05 | **34.4** | | | | | | | | | | 2.81 | -2.98 | **26.1** | 0.12 | -2.07 | **21.9** | 17.4 |
| M34/f823 | MW98 | 64.81 | 11.8 | 50.59 | 0.81 | 0.08 | **34.5** | | | | 3.013 | **26.9** | 2 / 9 | | **19.2** | | 0.42 | -3.79 | **29.8** | -0.56 | -2.52 | **23.9** | 22.1 |
| M34/f822 | MW97 | 63.69 | 11.8 | 50.68 | 0.80 | 0.07 | **34.2** | | | | | | | | | | 1.41 | -5.51 | **38.0** | -0.38 | -4.03 | **31.0** | 21.1 |

**Table DR2**. Calcareous nannofossil distribution chart.

| Fossil Record File Number | preservation | Stratigraphic height (m) | Zone | ?Biscutum | Blacklites | Cd? Bicircus/ T.? gammation | Cd.? pacificus | Campylosphaera dela | Chiasmolithus grandis | C. solitus | Clausicoccus fenestratus | C. subdistichtus | Coccolithus pelagicus | C. crucis | Coronocyclus bramlettei | Cruciplacolithus latipons | C. frequens | Cyclicarg. floriandus | Discoaster binodosus | D. distichtus | D. kuepperi | D. lodoensis* | D. minimus | D. mohleri | D. multiradiatus | D. salisburgensis? | D. sublodoensis | rosette discoasters | D. sp. | Ericsonia robusta/form. | Helicosphaera lophota | H. bramlettei | H. seminulum | holococcoliths | Markalius inversus | Neococcolithes protenus | N. dubius | Pontosphaera sp. | P. exilis | P. discopora | Reticulofenestra sp. | Sphenolithus moriformis | S. radians | S. editus? | S. sm w spine | Thoracosphaera | Toweius callosus | T. eminens/occul. | T. (call/)rotunda | T. sp. | Tribrachiatus orthostylus | Zygrhablithus bijugatus | Discoaster/Chiasmolithus ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M34/f869 | x-(e/o1) | 123.12 | NP16 | | + | | | | | | | | + | | | | | + | | | | | | | | | | | | | | | | | | | | | + | | + | + | + | | | | + | | | | | | + | |
| M34/f868 | e1 | 113.07 | NP14 | | | | | | | + | | | + | | | | | | | + | | 1 | | | | | | | 1 | + | | | | | | | | | | | + | 1 | | | 1 | 1 | | | | | | | |
| M34/f867 | e1 | 112.47 | NP14 | | | | | | | + | | + | + | | | | | | | | | | | | | | | 1 | + | + | | | | | | | | | | | + | 1 | | | 1 | 1 | | | + | | | | |
| M34/f864 | e1 | 109.72 | NP14 | | | | | | | + | | 1 | + | | | | | | 1 | | | | | | | | | 1 | + | | | | | | | | + | | 2 | | + | + | | | | 1 | | | + | | | | |
| M34/f861 | | 106.41 | NP14 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| M34/f860 | e1-(x) | 105.32 | NP14 | | | | | | + | + | | 2 | + | | | | | | | + | | | | | | | | + | + | + | | | | | | | + | | | | + | 2 | | | | 2 | | | + | | | | 0.086 |
| M34/f858 | e1-(x) | 103.07 | NP14 | | | | | | + | + | | + | + | | | | | + | 2 | | | | | | | | | 1 | 2 | | | | | | | | + | frg | | | + | + | | 1 | | 3 | | | + | | | | 0.207 |
| M34/f855 | e1-(x) | 100.58 | NP14 | | | | | | 2 | + | | 2 | + | | | 1 | | + | + | 2 | | | | | | | | + | + | | | | 1 | | 1 | | + | frg | | | + | 1 | | | 1 | | ? | | + | + | | 1 | 0.346 |
| M34/f852 | e/o1-(x) | 97.23 | NP14 | | | | | | + | + | | + | + | | | | | | | + | | + | | | | | | | | + | | | | | | | + | | + | | + | | | | + | | | | | + | | | 0.188 |
| M34/f849 | x-e1 | 93.88 | NP13-14 | | + | | | | + | + | | | + | | | | | | + | + | | + | | | | | 2 | + | + | + | | | | | + | | + | | + | | + | + | | | | + | | | + | + | | | 0.357 |
| M34/f846 | x-(e1) | 90.53 | NP13-14 | | + | + | | | + | + | + | | + | | | | | + | + | + | | + | | | | | | + | | | + | | + | | + | + | + | + | + | | + | + | | | | + | | | | + | | + | 2.400 |
| M34/f843 | x-(e/o1) | 87.17 | NP13-14 | | + | + | | | | + | + | | + | | | | | | | + | + | + | | | | | | | | + | | | + | | + | | + | | + | | + | + | + | | | + | | | + | | | + | 0.714 |
| M34/f840 | x-(e/o1) | 83.82 | NP13-14 | | + | | | 1 | + | + | | + | + | | | | 1 | | + | + | + | + | | 1 | | | | | + | + | | + | + | | | | + | + | + | | + | + | + | | | + | ? | | | | | 1 | 0.714 |
| M34/f837 | x-(e/o1) | 80.47 | NP13-14 | | + | + | | | + | + | + | + | + | | + | | | + | + | + | + | + | | | | | | + | | + | | | | + | | | | + | | + | + | + | | | | + | | + | | | | + | 2.750 |
| M34/f834 | x-(e/o1) | 77.11 | NP13-14 | | + | | + | | | + | | + | + | | | | | + | + | + | + | + | | | | + | | + | | | | | | | | | + | | + | | + | + | | + | | + | + | + | | | | + | 1.667 |
| M34/f831 | x | 73.76 | NP13-14 | | + | | | | | + | | + | + | | | | | | + | + | + | + | | | | | | + | | + | | | + | | | | + | | + | | + | + | + | | | + | + | + | | | | + | 2.429 |
| M34/f828 | x | 70.41 | NP13-14 | | | + | | + | + | + | + | + | + | + | | | | | + | + | + | + | | | + | | | + | | + | | | + | | | + | + | + | + | + | + | + | + | | | + | + | + | | | | + | 2.545 |
| M34/f825 | (x)-e/o1 | 67.05 | NP13-14 | | + | + | | | | + | | | + | | | | | | + | | + | + | | | | | | | | + | | | + | | + | | + | | + | | + | + | + | + | | + | | + | | | | + | 3.222 |
| M34/f823 | x-(e/o1) | 64.82 | NP12 | | | + | | | + | + | | | + | | | | | | + | | + | + | + | | | | | | | + | | + | + | | | | + | | + | + | + | + | + | | | + | + | + | | + | + | + | 2.250 |
| M34/f822 | x | 63.7 | NP12 | + | + | + | | | + | + | | | + | | | | | | + | | + | + | + | | | | | | | | | | + | | | | + | | + | | + | + | + | | | + | + | + | | + | + | + | 2.100 |

**Table DR3**. Foraminiferal distribution chart.

| Fossil record number | Field Number | Strati-graphic height (m) | Census | Agglutinated benthics | Calcareous benthics | Trifarina sp. | Bulimina spp. | Elphidium hampdenensis | Total benthics | Morozovella crater | Subbotina spp. | Globanomalina spp. | Acarinina collactea | Acarinina primitiva | "Muricoglobigerina" | Globigerina | Candeina | Planorotalites | misc planktonics | Total planktics |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M34/f868 | MW143 | 113.07 | | 6 | 51 | 1 | | 10 | 68 | 2 | 9 | | | 2 | | | | | | 13 |
| M34/f867 | MW142 | 112.47 | | 17 | 58 | | 2 | 9 | 86 | | 7 | | | 5 | | | | | | 12 |
| M34/f866 | MW141 | 111.25 | | 54 | 30 | | 1 | 1 | 86 | | 4 | | | | | | | | | 4 |
| M34/f865 | MW140 | 110.69 | | 113 | 75 | | | 5 | 193 | 1 | 6 | | | 3 | | | | | | 10 |
| M34/f864 | MW139 | 109.72 | | 9 | 60 | | 1 | 5 | 75 | 1 | 9 | | | 6 | | | | | | 16 |
| M34/f863 | MW138 | 108.55 | | 30 | 10 | | | | 40 | | | | | | | | | | | |
| M34/f862 | MW137 | 107.5 | | 42 | 14 | | 1 | 2 | 59 | | 6 | | | 4 | | | | | | 10 |
| M34/f861 | MW136 | 106.41 | | 42 | 5 | | 1 | 1 | 49 | | 5 | | | 4 | | | | | | 9 |
| M34/f860 | MW135 | 105.32 | | 76 | 18 | | | 3 | 97 | | 2 | | | 4 | | | | | | 6 |
| M34/f859 | MW134 | 104.23 | | 49 | 44 | | | 5 | 98 | | 7 | | | 11 | | | | | | 18 |
| M34/f858 | MW133 | 103.07 | | 52 | 18 | 1 | 1 | 5 | 77 | | 2 | | | | | | | | | 2 |
| M34/f857 | MW132 | 102.05 | | 42 | 31 | | 3 | 4 | 80 | 1 | 3 | | | 6 | | | | | | 10 |
| M34/f856 | MW131 | 101.32 | | 20 | 33 | | 3 | 12 | 68 | | 14 | | | 7 | | | | | | 21 |
| M34/f855 | MW130 | 100.58 | | 13 | 27 | | 1 | 5 | 46 | 1 | 7 | | | 10 | | | | | | 18 |
| M34/f854 | MW129 | 99.47 | | 43 | 29 | | 3 | 5 | 80 | | 20 | | | 7 | | | | | | 27 |
| M34/f853 | MW128 | 98.35 | | 27 | 34 | | 3 | 11 | 75 | | 10 | | | 13 | | | | | | 23 |
| M34/f852 | MW127 | 97.23 | | 25 | 29 | 2 | 3 | 5 | 64 | | 4 | | | 12 | | | | | | 16 |
| M34/f851 | MW126 | 96.11 | | 43 | 78 | | 16 | 34 | 171 | 2 | 43 | | 1 | 19 | | | | | | 65 |
| M34/f850 | MW125 | 95 | | 22 | 31 | | 1 | 5 | 59 | | 23 | | 1 | 14 | | | | | | 38 |
| M34/f849 | MW124 | 93.88 | | 20 | 47 | 5 | 3 | 20 | 95 | 4 | 9 | | 2 | 10 | | | | | | 25 |
| M34/f848 | MW123 | 92.76 | | 17 | 36 | | 3 | 6 | 62 | 3 | 8 | | 1 | 12 | | | | | | 24 |
| M34/f847 | MW122 | 91.64 | | 17 | 42 | | 3 | 19 | 81 | 2 | 12 | | 4 | 13 | | | | | | 31 |
| M34/f846 | MW121 | 90.53 | | 1 | 42 | | 3 | 21 | 67 | 6 | 28 | | | 16 | | | | | | 50 |
| M34/f845 | MW120 | 89.41 | | 2 | 94 | 4 | 5 | 49 | 154 | 8 | 35 | | 4 | 11 | | | | | | 58 |
| M34/f844 | MW119 | 88.29 | | 3 | 62 | | 7 | 30 | 102 | 10 | 30 | | 8 | 13 | | | | | | 61 |
| M34/f843 | MW118 | 87.17 | | 5 | 45 | | 4 | 16 | 70 | 5 | 39 | 2 | 15 | 24 | | 6 | | | | 91 |
| M34/f842 | MW117 | 86.05 | | 7 | 70 | | 4 | 20 | 101 | 2 | 43 | | 4 | 47 | | | | | | 96 |
| M34/f841 | MW116 | 84.94 | | 3 | 60 | 3 | 3 | 23 | 92 | 4 | 31 | | 7 | 37 | | | | | | 79 |
| M34/f840 | MW115 | 83.82 | | 0 | 24 | 1 | 3 | 26 | 54 | 3 | 16 | | 3 | 20 | | | | | | 42 |
| M34/f839 | MW114 | 82.7 | | 2 | 42 | 4 | 1 | 26 | 75 | | 32 | | 10 | 10 | | 8 | | | | 60 |
| M34/f838 | MW113 | 81.58 | | 1 | 22 | 5 | 11 | 25 | 64 | | 44 | 1 | 12 | 4 | | | | | | 61 |
| M34/f837 | MW112 | 80.47 | | 4 | 38 | 1 | 4 | | 47 | | 29 | 1 | 12 | 23 | | 6 | | | | 71 |
| M34/f836 | MW111 | 79.35 | | 3 | 36 | 143 | 1 | | 183 | 1 | 41 | 3 | 8 | 7 | | 1 | | | | 61 |
| M34/f835 | MW110 | 78.23 | | 3 | 12 | 93 | 2 | | 110 | 1 | 12 | 2 | 22 | 15 | | | | | | 52 |
| M34/f834 | MW109 | 77.11 | | 6 | 50 | 1 | 10 | | 67 | 1 | 27 | 1 | 17 | 13 | | 2 | | | 4 | 65 |
| M34/f833 | MW108 | 76 | | 4 | 65 | | 6 | | 75 | 6 | 42 | 6 | 19 | 9 | | 3 | | 1 | | 86 |
| M34/f832 | MW107 | 74.88 | | 13 | 206 | 21 | 33 | | 273 | 5 | 146 | 23 | 61 | 97 | 8 | 3 | | 3 | | 346 |
| M34/f831 | MW106 | 73.76 | | 4 | 54 | 3 | 7 | | 68 | | 21 | 4 | 11 | 16 | | 4 | | | | 56 |
| M34/f830 | MW105 | 72.64 | | 2 | 25 | | | | 27 | | 37 | 13 | 21 | 18 | | 8 | | | | 97 |
| M34/f829 | MW104 | 71.39 | | 3 | 38 | 4 | 6 | | 51 | | 45 | 4 | 39 | 11 | | 12 | | | | 111 |
| M34/f828 | MW103 | 70.41 | | 1 | 39 | 3 | | | 43 | 1 | 12 | 2 | 9 | 19 | | | | | | 43 |
| M34/f827 | MW102 | 69.29 | | 2 | 25 | | | | 27 | | 50 | 16 | 35 | 15 | | 20 | | 2 | | 138 |
| M34/f826 | MW101 | 68.17 | | 1 | 20 | | | | 21 | | 70 | 6 | 26 | 12 | | 3 | | | | 117 |
| M34/f825 | MW100 | 67.05 | | 5 | 21 | | | | 26 | 1 | 49 | 1 | 10 | 24 | | 14 | | | | 99 |
| M34/f824 | MW99 | 65.94 | | 4 | 81 | | | | 85 | | 59 | 5 | 14 | 12 | | 10 | 1 | | | 101 |
| M34/f823 | MW98 | 64.82 | | 1 | 9 | | 7 | | 17 | 1 | 38 | 16 | 18 | 10 | | 14 | | | | 97 |
| M34/f822 | MW97 | 63.7 | | 6 | 10 | | | | 16 | | 31 | 9 | 21 | | | 17 | | | | 78 |

| Fossil record number | Benthic paleodepth indicators | Allomorphina conica | Allomorphina spp. | Anomalina aotea | Anomalina visenda | Bulimina "striate sp." | Buliminella browni | Chilostomella ovoidea | Chilostomelloides sp. | Cibicidoides collinsi | Cibicidoides "preparki" | Elphidium hampdenense | Gaudryina | Kalamopsis grzybowskii | Karreriella "chilostoma" | Matanzia spp. | Nodosarella sp. | Nuttallides carinotruempyi | Oridorsalis spp. | Osangularia sp. | Pleurostomella spp. | Pullenia spp. | Rectoglandulina sp. | Semivulvulina sp. | Stainforthia sp. | Stilostomella spp. | Tritaxia instar | Tritaxilina zealandica | Vulvulina zespinosa |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M34/f868 | | | | | | | | * | | | * | * | | | | | | | | | | | | * | | * | | | |
| M34/f867 | | | * | | | | | | | | * | * | | | * | * | | | | | * | | | | | * | | | |
| M34/f866 | | | | | | | | | | | * | * | | | | * | | | | * | | | | * | | * | | * | |
| M34/f865 | | | | | | | | | | | * | * | | * | | | | | | | | | | * | | * | | * | |
| M34/f864 | | | | | | | | | | | * | * | | * | | ? | | | | | | | | * | | * | | | |
| M34/f863 | | | | | | | | | | | | | | | | | | | | | | | | * | | | | ? | |
| M34/f862 | | | | | | | | * | | * | * | * | | | | | | | | | | | | | | | | * | |
| M34/f861 | | | | | | | | | * | | * | * | | * | | ? | | | | | | | | | | | | | |
| M34/f860 | | | | | * | | | | | | * | * | | * | | * | | | | | | * | | | | | ? | | |
| M34/f859 | | | | | * | | | | * | | * | * | | * | | * | | * | | | | | | * | | * | ? | | |
| M34/f858 | | | | | * | | | | | | * | * | | | | * | | | * | | | | | * | | * | ? | | |
| M34/f857 | | | | * | | | | | | | * | * | | | | | | | | | * | | | | | | | | |
| M34/f856 | | | | | | | | * | | | | * | | | | | | | | | | * | | | | * | ? | | |
| M34/f855 | | | | | | | | | | | * | * | | | | * | | | | | | * | | * | | * | ? | * | |
| M34/f854 | | | | | | | | | * | | * | * | | | | | | | | | * | | | | | * | | | |
| M34/f853 | | | | | | | | | | | * | * | | | * | | | | | | | | | | | * | | | |
| M34/f852 | | | | | | | | | * | | * | * | | | | ? | | | | | | | | | | * | * | | |
| M34/f851 | | | | | | | | | * | | * | * | | | | * | | | | | | * | | * | | | * | | |
| M34/f850 | | | | | | | | * | | | * | * | * | | | * | | | | | | | | * | | | | | |
| M34/f849 | | | | | * | | | | * | | | * | * | | | ? | | | | | | * | | | | * | ? | | |
| M34/f848 | | | | | * | | | | * | | * | * | | | | * | | | | | | | | | | * | * | | |
| M34/f847 | | | | | | | * | | | | | * | | * | | | | | | | | * | | | | * | | | |
| M34/f846 | | | | | | | | * | | | * | * | | | | | | | | | | * | | | | * | | | |
| M34/f845 | | | | | | | | | | | * | * | | | | * | | | | | * | * | | | | * | | | |
| M34/f844 | | | * | | | | | * | | * | * | * | | | | | | * | | | | * | | * | | * | | | |
| M34/f843 | | | * | | * | | * | * | | | * | * | | | | * | | * | | | * | * | | | | * | * | * | |
| M34/f842 | | | * | * | * | | * | * | | | * | * | | | | * | * | | | | * | * | | | | * | | | |
| M34/f841 | | | * | | * | | | * | | | * | * | | | | | | | | | * | * | | | | * | | * | |
| M34/f840 | | | * | * | | | | * | | | * | * | | | | * | * | | | | | * | | | | * | | | |
| M34/f839 | | | * | | * | | | * | | | * | * | | | | | | | | | | * | | | | * | | ? | |
| M34/f838 | | | * | | | | | * | | | * | * | | * | | * | | * | | | | * | * | | * | | | | |
| M34/f837 | | * | * | | * | | | * | | | * | | | | | * | | * | * | | * | * | * | | | * | | | |
| M34/f836 | | | * | * | * | | | * | | | * | | | | | * | | | * | | | | | | * | * | * | * | |
| M34/f835 | | | * | * | * | | | * | | | * | | | | | | | | | | | * | | | | * | | | * |
| M34/f834 | | ? | * | | * | | | * | | * | * | | | | * | | * | | | | * | * | | | | * | * | * | |
| M34/f833 | | | * | * | * | | * | * | | | * | | | | * | * | * | | | | * | * | | | * | | * | * | * |
| M34/f832 | | * | * | * | * | | | * | | | * | | | | | ? | | | | | | * | * | | | * | * | ? | * |
| M34/f831 | | * | * | * | * | * | | | * | | * | | | * | | | | | * | | | * | | | | * | | * | |
| M34/f830 | | | * | | | | | * | | | * | | | | | | | | | * | | * | | * | * | * | * | |
| M34/f829 | | | * | | | | | | | | * | | | | | | | | | | * | * | | * | * | * | | |
| M34/f828 | | * | * | * | | | | * | | | * | | | | * | ? | | | * | | * | * | | | * | * | * | ? | |
| M34/f827 | | * | * | * | | | | * | | | | | | | | | | | | * | | | | | * | * | * | | |
| M34/f826 | | | * | | | | | * | | | | | | | | | | | | | | | | | * | * | | | |
| M34/f825 | | * | * | * | | | | * | | | | | | | | | | | | * | * | | | | * | * | | * | |
| M34/f824 | | * | * | * | * | | * | | | | * | | | | | ? | | | | | * | * | * | | * | * | ? | ? | |
| M34/f823 | | * | * | | | | | * | | | * | | | | * | | | * | * | * | | * | * | | * | * | | | |
| M34/f822 | | | | | | | | * | * | | | | | | * | | | * | * | | * | * | | | * | * | | | |

**Table DR4**. Radiolarian distribution chart.

| Fossil Record Number | Radio-larian curation number | Abundance (specimens/gram) | Preservation | % Sand | Spumellaria spp. | Actinommids | Amphisphaera spp. | Stylosphaerins | Thecosphaera spp. | Spongurid spp. | Amphicraspedum gracilis | Amphicraspedum ignorabilis | Amphicraspedum prolixum | Middourium regulare | Monobracchium irregulare | Spongodiscids | Spongodiscus spp. | Spongotrochus spp. | Porodiscus spp. | Stylodictya sexispinata | Staurodictya targaeformis | Stylotrochus nitidus spp. | Tholodiscus densus? | Uncertain | Nassellarian spp. | Plagiacanthid spp. | Lithomelissa spp. | Theoperid spp, | Calocyclas sp.? | Calocyclas spp. | Clathrocyclas spp. | Eusyringium fistuligerum | Lithostrobus sp. | Lychnocanium babylonis | Lychnocanium bellum | Lychnocanium ceratium? | Lychnocanium spp? | Mita sp. | Peripyramis sp? | Pterocorythid spp. | Podocyrtis aphorma | Podocyrtis spp. | Eusyringium cf. lagena | Amphipternis clava | Theocampe urceolus | Phromocyrtis striata striata | Thyrsocyrtis rhizodon | Lophophaenia auriculaleporus | Spyrids | Theocorys acroria | Tripodiscinus sp. | Nassellaria sp. H (02)' | Totals |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M34/f868 | RD2498 | 1103 | good | 5.07 | 1 | 100 | 19 | 1 | 60 | 14 | 12 | 8 | 5 | 6 | | 154 | 100 | 7 | 53 | | | 3 | | | | | | | | | | | | 1 | 3 | | 1 | 1 | 5 | | | 1 | 11 | 1 | | | | 1 | 2 | 2 | | 571 |
| M34/f867 | RD2499 | 2464 | good | 13.15 | | 195 | 10 | | 23 | 32 | 14 | 12 | 26 | 2 | 3 | 64 | 112 | 1 | 36 | | | 1 | 1 | | 2 | | | 3 | 3 | | 2 | | | 2 | 2 | 2 | 1 | | | 1 | | 1 | | | | | | | 1 | | | | 552 |
| M34/f864 | RD2500 | 2725 | good | 10.65 | | 144 | 17 | 21 | 41 | 11 | 10 | 31 | 2 | 18 | 7 | 85 | 93 | 1 | 22 | | | 5 | 3 | 1 | 1 | 2 | | 1 | | 1 | 1 | | | 1 | 1 | 1 | 1 | | | | | | | | | | 1 | | | | | 523 |
| M34/f861 | RD2501 | 123 | good | 1.59 | 5 | 105 | 1 | | 2 | 21 | 1 | 3 | 1 | 6 | 3 | 50 | 17 | 2 | 14 | 1 | | 1 | 1 | | 2 | | | 1 | | | | | | | | | 5 | | | | | | | | | | | 2 | | | | 244 |
| M34/f860 | RD2502 | 322 | good | 1.38 | 5 | 166 | 2 | 7 | 12 | 40 | 7 | 9 | 2 | 17 | 6 | 119 | 72 | 10 | 31 | | | 2 | | | 2 | | | 8 | 1 | | | | 1 | 1 | 1 | | | 4 | | | | | | | | | | 2 | | | | 527 |
| M34/f858 | RD2503 | 717 | good | 5.91 | 16 | 192 | 13 | 2 | 1 | 42 | 8 | 13 | 37 | 13 | 4 | 156 | 45 | 4 | 13 | | | | | | | | 1 | 4 | | | | | | 1 | | 1 | 1 | 4 | | | | 1 | | | | | | | 3 | | | 1 | 575 |
| M34/f855 | RD2504 | 338 | poor | 4.32 | 2 | 195 | | 6 | 1 | 22 | | 2 | 1 | 9 | 2 | 117 | 5 | 2 | 15 | | | 2 | | | 6 | | | 6 | | | | | | | | | 1 | | | | | | | | | | | | | | | 394 |
| M34/f852 | RD2505 | 547 | fair | 2.75 | 7 | 180 | 6 | 2 | | 40 | 5 | 6 | 20 | 8 | | 145 | 71 | 1 | 28 | 1 | 1 | | 1 | | 2 | | | 5 | | | | | | | 1 | | 4 | 1 | | | 2 | 3 | | | | | | 2 | | | | 542 |
| M34/f849 | RD2506 | 785 | fair | 3.86 | 39 | 228 | 2 | | 2 | 30 | 2 | 1 | 3 | 7 | 2 | 101 | 17 | 2 | 17 | | | | | | 3 | 2 | | 7 | | | | | | 2 | | | 2 | | | | | | | | | | | 1 | | | | 470 |
| M34/f846 | RD2507 | 215 | poor | 2.89 | 2 | 258 | 3 | | 10 | 23 | | 2 | | 2 | | 25 | 7 | 1 | 20 | | | | | | | | | | | 2 | | | | | | | | | | | | | | | 1 | | | | | | | 356 |
| M34/f843 | RD2508 | 202 | poor | 4.49 | 1 | 277 | 1 | | | 16 | | 1 | 1 | 1 | | 128 | 5 | | 11 | | | | | | 1 | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | 444 |
| M34/f840 | RD2509 | 25 | poor | 0.77 | | 192 | | | | | | | | | | 3 | 8 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 203 |
| M34/f837 | RD2510 | 22 | poor | 0.46 | | 139 | | | | | | | | | | 3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 142 |
| M34/f834 | RD2511 | 201 | poor | 3.08 | | 354 | | | | | | | | | 1 | 64 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 419 |
| M34/f831 | RD2512 | 284 | fair | 3.58 | 2 | 295 | | | | 41 | | | | | | 146 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 484 |
| M34/f828 | RD2513 | 372 | fair | 1.86 | | 214 | | | | 17 | | | | 11 | | 229 | | | | | | | | | | | | 4 | | | | | | | | | | | | | | | | | | | | | | | | | 475 |
| M34/f825 | RD2514 | 1322 | poor | 2.54 | 80 | 141 | 1 | | | 15 | | | | | | 104 | 4 | | | | | | | | 2 | | | 3 | | 2 | | | | | | | | | | | | | | | | | | | 1 | | | | 353 |
| M34/f823 | RD2515 | 1025 | good | 1.89 | 27 | 157 | 14 | | 49 | 40 | 5 | | 3 | | | 31 | 93 | 8 | 53 | 3 | | | | | 6 | | | 9 | | 5 | 1 | | | 5 | 2 | | 3 | | | | 3 | | | | | 1 | | 4 | 1 | | | 523 |
| M34/f822 | RD2516 | 323 | good | 1.43 | 5 | 110 | 5 | | 92 | 50 | 8 | | | | 1 | 10 | 63 | 10 | 75 | | | 1 | | | | | 1 | 1 | | 1 | | 11 | | 4 | 2 | | 3 | | | 1 | 2 | 8 | | | | | | 1 | 3 | | | | 468 |

**Table DR5**. Palynomorph distribution chart.

| Fossil Record File Number | Palynology curation number | Stratigraphic height (m) | Age (Ma) | Achilleodinium biformoides | Apectodinium spp. | ?Areosphaeridium spp. | Batiacasphaera sp. A | Cerodinium medcalfii type | Charlesdowniea coleothrypta | Charlesdowniea edwardsii | Cordosphaeridium fibrospinosum | Damassadinium crassimurata | Deflandrea spp. | Diphyes colligerum | Glaphyrocysta retiintexta | Homotryblium spp. | Hystrichokolpoma spp. | Hystrichosphaeridium sp. A | Hystrichosphaeridium tubiferum | Impagidinium spp. | Lingulodinium machaerophorum | Membranophoridium perforatum | Membranosphaera sp. B | Operculodinium spp. | Pthanoperidinium spp. | Pyxidinopsis spp. | Senegalinium spp. | Spinidinium spp. | Spiniferites spp. | Systematophora ancyrea type | Wilsonidium ornatum | Other gonyaulacoids | Dinocysts indeterminate/unknown | Total Dinocyst Count | Monolete Spores | Trilete Spores | Bisaccatte Gymnosperms | Other Gymnosperms | Monocotyledons | Angiosperms | Miospores Indeterminate | Dinoflagellate Cysts | Acritarchs | Foraminiferal Linings | Indeterminate Algae | Fungal Remains | Total Palynomorph Count | Terrestrial Count | Marine Count | Terrestrial % | Marine % | Gymnosperms % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M34/f869 | L21166 | 123.11 | 42.5 | | | 18 | | | | | 3 | | 5 | | | | 10 | | 10 | 3 | 6 | | 35 | 4 | | 3 | 6 | | 94 | | | 3 | 3.5 | 206 | 0 | 14 | 11 | 24 | 0 | 14 | 2 | 68 | 17 | 1 | 7 | 5 | 163 | 70 | 93 | 43 | 57 | 50 |
| M34/f868 | L21649 | 113.06 | 46.5 | 1 | | | | | | | 1 | | 1 | | 2 | 6 | | 13 | 12 | 20 | 4 | 19 | 15 | 7 | 31 | 8.5 | 3 | 7 | 54 | | | 2 | 4 | 210 | 2 | 14 | 7 | 10 | 1 | 41 | 1 | 43 | 23 | 1 | 5 | 5 | 153 | 81 | 72 | 53 | 47 | 21 |
| M34/f867 | L21648 | 112.46 | 46.6 | 1 | | | | 1 | | | | | 11 | | | 3 | | 2 | 8 | 13 | | 30 | 16 | 11 | 13 | 18 | 3 | 10 | 63 | | | 1 | 5 | 208 | 2 | 16 | 9 | 16 | 1 | 40 | 0 | 42 | 23 | 0 | 4 | 4 | 157 | 88 | 69 | 56 | 44 | 28 |
| M34/f864 | L21647 | 109.71 | 46.8 | | | | | 12 | | | 2 | 1 | 4 | | 5 | | | 4 | 3 | 18 | 3 | 22 | 29 | 6 | | 22 | 8 | 7 | 60 | | | 5 | 5 | 215 | 3 | 18 | 5 | 8 | 2 | 40 | 2 | 42 | 26 | 1 | 4 | 5 | 156 | 83 | 73 | 53 | 47 | 16 |
| M34/f861 | L21646 | 106.4 | 47.1 | 1 | | | | 1 | | | 1 | | 4 | | 2 | | 2 | 7 | 3 | 14 | 1 | 12 | 51 | 3 | | 19 | 6 | 15 | 53 | | | 1 | 6 | 202 | 3 | 18 | 5 | 18 | 2 | 55 | 0 | 25 | 16 | 1 | 5 | 5 | 153 | 106 | 47 | 69 | 31 | 22 |
| M34/f860 | L21165 | 105.31 | 47.2 | | | | | 0.5 | | | 2 | 1 | 2 | 4 | 1.5 | 4 | 2.5 | | 2 | 18 | | 46 | 36 | 2 | | 13 | | 13 | 62 | | | 3 | 4 | 216 | 1 | 18 | 9 | 13 | 0 | 33 | 1 | 50 | 18 | 0 | 6 | 5 | 154 | 80 | 74 | 52 | 48 | 28 |
| M34/f858 | L21645 | 103.06 | 47.3 | 1 | | | | | | | | | 9.5 | | | 1 | 1 | 3 | 2 | 7.5 | | 43 | 25 | 5.5 | | 14 | 7 | 16 | 79 | | | 1 | 2.5 | 217 | 3 | 16 | 4 | 17 | 1 | 38 | 0 | 43 | 21 | 1 | 4 | 5 | 153 | 84 | 69 | 55 | 45 | 25 |
| M34/f855 | L21164 | 100.57 | 47.6 | | | | | 4 | | | 6 | | 5.5 | 2 | 1.5 | 1 | 3 | | 5 | 9.5 | | 9 | 35 | 4 | | 13 | | 76 | 45 | | | 3 | 7 | 230 | 2 | 17 | 6 | 18 | 1 | 22 | 2 | 52 | 22 | 0 | 6 | 3 | 151 | 71 | 80 | 47 | 53 | 34 |
| M34/f852 | L21644 | 97.22 | 47.8 | | | | | 1 | | | 2 | | 7 | | 4 | | 1 | 32 | 10 | 5 | 1 | 24 | 19 | 13 | 1 | 9 | 6 | 15 | 53 | 1 | | 1 | 2.5 | 207 | 3 | 12 | 8 | 13 | 3 | 42 | 0 | 34 | 25 | 1 | 7 | 8 | 156 | 89 | 67 | 57 | 43 | 24 |
| M34/f849 | L21643 | 93.87 | 48.1 | | | | | 2 | | | 1 | | 17 | | 1 | | 1 | | 11 | 8.5 | 5 | 25 | 6 | 10 | | 22 | | 12 | 79 | 1 | | | 3 | 205 | 1 | 16 | 5 | 11 | 1 | 42 | 0 | 40 | 29 | 0 | 4 | 4 | 153 | 80 | 73 | 52 | 48 | 20 |
| M34/f846 | L21642 | 90.52 | 48.4 | 3 | | | 1 | 8 | | | 3 | 1 | 2 | | 0.5 | | 5 | | 6 | 17 | 4 | | 4 | 15 | 14 | 22 | 3 | 5 | 90 | | | 1 | 4 | 208 | 2 | 12 | 4 | 12 | 3 | 46 | 1 | 38 | 25 | 0 | 5 | 6 | 154 | 86 | 68 | 56 | 44 | 19 |
| M34/f843 | L21641 | 87.16 | 48.7 | 3 | | | 25 | | | 4 | 3 | 2 | 3 | | 1 | | 8 | | 9.5 | 9 | | | 4 | 7 | | 29 | | 4 | 76 | 12 | | 2 | 8.5 | 210 | 3 | 16 | 9 | 6 | 0 | 27 | 1 | 65 | 23 | 1 | 5 | 7 | 163 | 69 | 94 | 42 | 58 | 22 |
| M34/f840 | L21163 | 83.81 | 49.0 | | | | | | | 1 | 2 | | 1.5 | 1 | 2 | 1 | | | 2 | 13 | 5 | | 24 | 14 | | 25 | | 7 | 98 | 7.5 | | 3 | 7 | 214 | 1 | 18 | 7 | 14 | 0 | 21 | 0 | 58 | 21 | 1 | 5 | 6 | 152 | 67 | 85 | 44 | 56 | 31 |
| M34/f837 | L21640 | 80.46 | 49.3 | 2 | | | 1 | | 12 | 1 | 3 | | 1 | | 1 | 1 | 19 | | 3 | 12 | | | 18 | 13 | | 28 | | 3 | 81 | 2 | | 2 | 7.5 | 208 | 2 | 12 | 3 | 8 | 2 | 30 | 0 | 60 | 31 | 1 | 2 | 4 | 155 | 61 | 94 | 39 | 61 | 18 |
| M34/f834 | L21639 | 77.1 | 49.5 | | | | | | 5 | 4 | 1 | 2 | 3.5 | | 5.5 | 27 | 10 | | 7 | 17 | 2 | | 8 | 3 | | 24 | | 9 | 57 | 29 | | 3 | 9 | 226 | 4 | 13 | 7 | 3 | 0 | 27 | 2 | 60 | 32 | 1 | 6 | 4 | 159 | 60 | 99 | 38 | 62 | 17 |
| M34/f831 | L21638 | 73.75 | 49.8 | | | | | | 2 | | 3 | | 4.5 | | 3 | 4 | 12 | | 15 | 12 | 6 | | 4 | | | 20 | | 6 | 117 | | | 3 | 7 | 218 | 1 | 13 | 2 | 8 | 2 | 26 | 1 | 56 | 36 | 0 | 4 | 4 | 153 | 57 | 96 | 37 | 63 | 18 |
| M34/f828 | L21637 | 70.4 | 50.1 | | 2 | | | 75 | | | 2 | 2 | 2.5 | 9.5 | | 5 | | | 8 | 7 | 3 | | 4 | 1 | | 9.5 | | 2 | 68 | | | 2 | 4 | 206 | 2 | 8 | 1 | 7 | 1 | 26 | 3 | 68 | 26 | 2 | 3 | 5 | 152 | 53 | 99 | 35 | 65 | 15 |
| M34/f825 | L21636 | 67.04 | 50.4 | | 6 | | | 1 | | | 8.5 | | 5 | 4 | | | 20 | | 9 | 4 | 4 | 2 | 2 | 9 | 1 | 4 | | 2 | 131 | | 1 | 4 | 8 | 225 | 2 | 8 | 2 | 5 | 1 | 28 | 1 | 74 | 24 | 1 | 6 | 2 | 154 | 49 | 105 | 32 | 68 | 14 |
| M34/f823 | L21635 | 64.81 | 50.6 | | 2 | | | | | | | 1 | 2 | 6 | 1 | 28 | 5 | | 5 | 14 | 1.5 | 5 | 4 | 6 | 8 | 13 | | 18 | 78 | | 6 | 11 | 4.5 | 218 | 3 | 11 | 3 | 8 | 2 | 20 | 1 | 68 | 28 | 1 | 4 | 2 | 151 | 50 | 101 | 33 | 67 | 22 |
| M34/f822 | L21162 | 63.67 | 50.7 | | 1 | | | | | | 2.5 | | 1 | 3 | | 16 | 15 | | 6.5 | 18 | 5 | 12 | 2 | 7 | 11 | 9.5 | | 8.5 | 81 | | 14 | 8.5 | 7 | 230 | 1 | 10 | 4 | 6 | 1 | 16 | 2 | 74 | 26 | 3 | 4 | 5 | 152 | 45 | 107 | 30 | 70 | 22 |