

8. DATA REPORT: CALCAREOUS NANNOFOSSIL DATA FROM THE EOCENE TO OLIGOCENE, LEG 177, HOLE 1090B¹

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INTRODUCTION

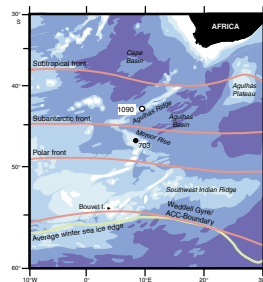
Hole 1090B is located in the central part of the Subantarctic Zone on the southern flank of the Agulhas Ridge (42°54'S, 8°53'E) (Fig. F1). Hole 1090B was drilled to 397.5 meters below seafloor (mbsf), and Holocene to middle Eocene sediments were recovered. Core recovery of the Eocene to lower Oligocene interval was generally good, even though sediments were recovered by the extended core barrel (XCB) system (Shipboard Scientific Party, 1999). Because the paleomagnetic signal and nannofossil assemblages are well documented in this interval, Hole 1090B may represent a reference record to improve knowledge of the Eocene–Oligocene transition (Shipboard Scientific Party, 1999).

We analyzed the calcareous nannofossil assemblages of the middle Eocene to lower Oligocene interval, focusing especially on the Eocene–Oligocene transition, with quantitative investigations of nannofossil assemblages.

MATERIALS AND METHODS

Cores from 177-1090B-23X to 43X were examined for calcareous nannofossil biostratigraphy. Quantitative analyses were carried out on one to two samples per core section (1.5 m) collected from upper Eocene to lower Oligocene sediments (Cores 177-1090B-23X through 31X) in order to obtain detailed abundance patterns of marker species through the Eocene–Oligocene transition. Semiquantitative analyses were performed on one to two samples per section of middle-lower up-

F1. Location map of sites drilled, p. 7.



¹Marino, M., and Flores, J.A., 2002. Data report: Calcareous nannofossil data from the Eocene to Oligocene, Leg 177, Hole 1090B. In Gersonde, R., Hodell, D.A., and Blum, P. (Eds.), *Proc. ODP, Sci. Results, 177*, 1–9 [Online]. Available from World Wide Web: <http://www-odp.tamu.edu/publications/177_SR/VOLUME/CHAPTERS/SR177_08.PDF>. [Cited YYYY-MM-DD]

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per Eocene sediments (Cores 177-1090B-32H through 43X) to improve the biozonal attribution established in Shipboard Scientific Party (1999).

Smear slides were prepared according to standard technical preparation methods from unprocessed sediment; analyses were performed using a light microscope (Zeiss Axioskop) with 1000× magnification. About 2.64 mm² of each smear slide (150 fields of view) were examined to determine semiquantitative abundances of middle–lower upper Eocene species (Table T1) and to count a significant number of specimens of the marker species whose quantitative distributions improve nannofossil biostratigraphy through the Eocene–Oligocene transition. Moreover, two additional traverses of each slide were scanned in order to recognize the presence of very rare species (“X” in Table T1). Six calcareous nannofossil abundance levels were recorded, as follows:

- VA = very abundant (>50 specimens per field of view).
- A = abundant (11–50 specimens per field of view).
- C = common (1–10 specimens per field of view).
- F = few (0.1 to <1 specimens per field of view).
- R = rare (0.02 to <0.1 specimens per field of view).
- RR = very rare (<0.02 specimens per field of view).

Preservation of nannofossils was recorded as good (G), moderate (M), poor (P), and very poor (VP). Some samples were barren (“B” in Table T1) of calcareous nannofossils. Reworking phenomena were noted in some Eocene intervals.

Depths of samples in the range chart are reported both in meters below seafloor (mbsf) and meters composite depth (mcd). The mcd scale was constructed by correlating cores from multiple holes (typically three) drilled at one site using closely spaced measurements of physical properties. The mcd scale allows splicing of an almost complete stratigraphic section at a site by eliminating coring gaps that usually occur between cores in one hole (Shipboard Scientific Party, 1999).

BIOSTRATIGRAPHIC RESULTS

The standard scheme of Okada and Bukry (1980) was adopted in this study. Detailed biostratigraphic comments are reported in Marino and Flores (in press), to whom the reader is referred for accurate discussion on nannofossil events and quantitative abundance patterns of marker species detected in Hole 1090B. Below, we briefly discuss the zones recognized at Hole 1090B according to standard events (Table T1).

The base of Hole 1090B is characterized by the presence of *Reticulofenestra umbilica* and *Nannotetrina* spp., thus allowing the attribution of Samples 177-1090B-43X-CC, 29–39 cm, through 40X-1, 130 cm, to Subzone CP14a. The first occurrence (FO) of *Reticulofenestra reticulata* is recorded at 372.84 mcd in the uppermost part of Subzone CP14a.

The base of Subzone CP14b is tentatively approximated by the last occurrence (LO) of *Discoaster bifax* (according to the suggestion of Bukry, 1973), even though the species was recorded only in a few samples (Table T1) up to 371.41 mcd. The LO of *Chiasmolithus solitus* used in standard zonation for the definition of this zone is not clear at Site 1090 because of poor preservation (see discussion in Marino and Flores, in press). The first occurrence of *Reticulofenestra bisecta* is recorded just above the LO of *D. bifax* (Table T1). The base of Subzone CP15a is ap-

T1. Distribution of calcareous nannofossils, p. 8.

proximated by the FO of *Chiasmolithus oamaruensis* (Pl. P1, fig. 16) that occurs just above the extinction of *Chiasmolithus grandis* between Samples 177-1090B-37X-CC, 40–45 cm, and 37X-5, 30 cm; the latter species is scattered and rare in its final range, thus preventing the recognition of its last occurrence to define the base of Subzone CP15a according to the standard scheme of Okada and Bukry (1980).

The base of Subzone CP15b was recognized based on the FO of *Isthmolithus recurvus*, between Samples 177-1090B-31X-CC, 21–32 cm, and 32X-1, 78–79 cm. The FO of *Reticulofenestra oamaruensis* is present within this zone at 289.96 mcd.

The LO of *Discoaster saipanensis* allowed us to recognize the base of Subzone CP16a. Within this biozonal interval several nannofossil events occur: the LO of *R. oamaruensis* at 258.69 mcd, the FO of *Reticulofenestra circus* at 234.81 mcd, together with the base of acmes of *Clausicoccus* spp., *Blackites* spp., and *Chiasmolithus* spp. In particular, a significant high abundance of *Clausicoccus* spp. and *Blackites* spp. is recorded from 234.81 to 230.06 mcd; for these taxa we defined the end of the acme at 230.06 mcd (Table T1). The end of the acme of *Clausicoccus* spp., which includes both specimens referable to *C. fenestratus* and *C. obruptus* as well as to *C. subdistichus* (see Marino and Flores, in press), allowed us to recognize the base of Subzone CP16b.

The Eocene/Oligocene boundary may be placed close to the last occurrences of *D. saipanensis*, considered the classical nannofossil event for the approximation of this boundary, and the last occurrence of *R. oamaruensis*, near the CP15b/CP16a biozonal boundary.

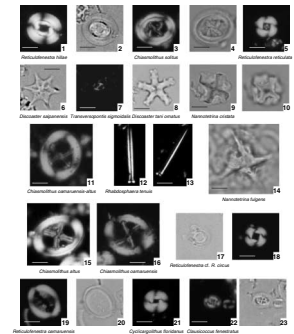
The last occurrences of *Ericsonia formosa* and *R. umbilica* provide the recognition of Biozones CP16c and CP17, respectively. The reliability of these zonal attributions is low because a hiatus may occur in this stratigraphic interval (see discussion in Marino and Flores, in press). Moreover, a significant change can be noted in the nannofossil assemblages at this level because the species diversity drops and an enhancement of dissolution occurs, thus producing a very high abundance of single cycles of *Cyclicargolithus* (Marino and Flores, in press). Nevertheless, *R. bisecta*, *Cyclicargolithus floridanus*, *Coccolithus pelagicus*, and *Reticulofenestra daviesi* group (sensu Wei and Wise, 1990) become the main component of nannoflora (Table T1). The FO of *Cyclicargolithus abisectus* (>10 µm, according to Fornaciari et al., 1990) occurs with very rare specimens contemporaneously with the LO of *R. umbilica* in Hole 1090B, in agreement with data of Wei (1991) for the south high latitude Site 703.

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P1. Calcareous nannofossils, light micrography, p. 9.



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APPENDIX

Taxonomic List

Calcareous nannofossils considered in this study are listed by alphabetical order of generic epithet. Bibliographic references for most of taxa can be found in Perch-Nielsen (1985). Any references not cited therein are included in the bibliography. Biometric definition of problematic species adopted in this study is also reported.

- Bicolumnus ovatus* Wei and Wise, 1990
Blackites spinosus (Deflandre and Fert, 1954) Hay and Towe, 1962
Braarudosphaera bigelowii (Gran and Braarud, 1935)
Bramletteius serraculoides Gartner, 1969
Chiasmolithus altus Bukry and Percival, 1971
Chiasmolithus consuetus (Bramlette and Sullivan, 1961)
Chiasmolithus expansus (Bramlette and Sullivan, 1961)
Chiasmolithus gigas (Bramlette and Sullivan, 1961)
Chiasmolithus grandis (Bramlette and Riedel, 1954)
Chiasmolithus oamaruensis (Deflandre, 1954)
Chiasmolithus solitus (Bramlette and Sullivan, 1961)
Clausicoccus fenestratus (Deflandre and Fert, 1954)
Clausicoccus obruptus (Perch-Nielsen, 1971)
Clausicoccus subdistichus (Roth and Hay, in Hay et al., 1967)
Coccolithus pelagicus (Wallich, 1977)
Cyclicargolithus floridanus (Roth and Hay, in Hay et al., 1967)
Cyclicargolithus abisectus (Müller, 1970) (>10 µm)
Dictyococcites scrippsae Bukry and Percival, 1971
Discoaster bifax Bukry, 1971
Discoaster barbadiensis Tan, 1927
Discoaster bifax Bukry, 1971
Discoaster binodosus Martini, 1958
Discoaster deflandrei Bramlette and Riedel, 1954
Discoaster saipanensis Bramlette and Riedel, 1954
Discoaster tani Bramlette and Riedel, 1954
Discoaster tani ornatus Bramlette and Wilcoxon, 1967
Discoaster nodifer Bramlette and Riedel, 1954
Ericsonia formosa (Kamptner, 1963)
Helicosphaera compacta Bramlette and Wilcoxon, 1967
Helicosphaera reticulata Bramlette and Wilcoxon, 1967
Isthmolithus recurvus (Deflandre in Deflandre and Fert, 1954)
Markalius nudus Perch-Nielsen, 1971
Markalius inversus (Deflandre in Deflandre and Fert, 1954)
Nannotetrina cristata (Martini, 1958)
Nannotetrina fulgens (Stradner, 1960)
Neococcolithes dubius (Deflandre, 1954)
Pontosphaera multipora (Kamptner, 1958)
Reticulofenestra bisecta (Hay, Mohler and Wade, 1967)
Reticulofenestra circus de Kaenel and Villa, 1996
Reticulofenestra daviesi (Haq, 1968)
Reticulofenestra hillae Bukry and Percival, 1971
Reticulofenestra oamaruensis (Deflandre in Deflandre and Fert, 1954)
Reticulofenestra reticulata (Gartner and Smith, 1967)
Reticulofenestra samodurovi (Hay, Molher and Wade, 1966)
Reticulofenestra umbilica (Levin and Joerger, 1967)
Sphenolithus spiniger Bukry, 1971
Sphenolithus furcatulinoides Locker, 1967
Sphenolithus moriformis (Brönnimann and Stradner, 1960)
Sphenolithus obtusus Bukry, 1971
Sphenolithus pseudoradians Bramlette and Wilcoxon, 1967

Sphenolithus radians Deflandre in Grassé (1962)

Transversopontis obliquipons (Deflandre in Deflandre and Fert, 1954)

Transversopontis sigmoidalis Locker, 1967

Zygrhablithus bijugatus (Deflandre in Deflandre and Fert, 1954)

Figure F1. Location map of Hole 1090B and DSDP Site 703 (modified from Shipboard Scientific Party, 1999).

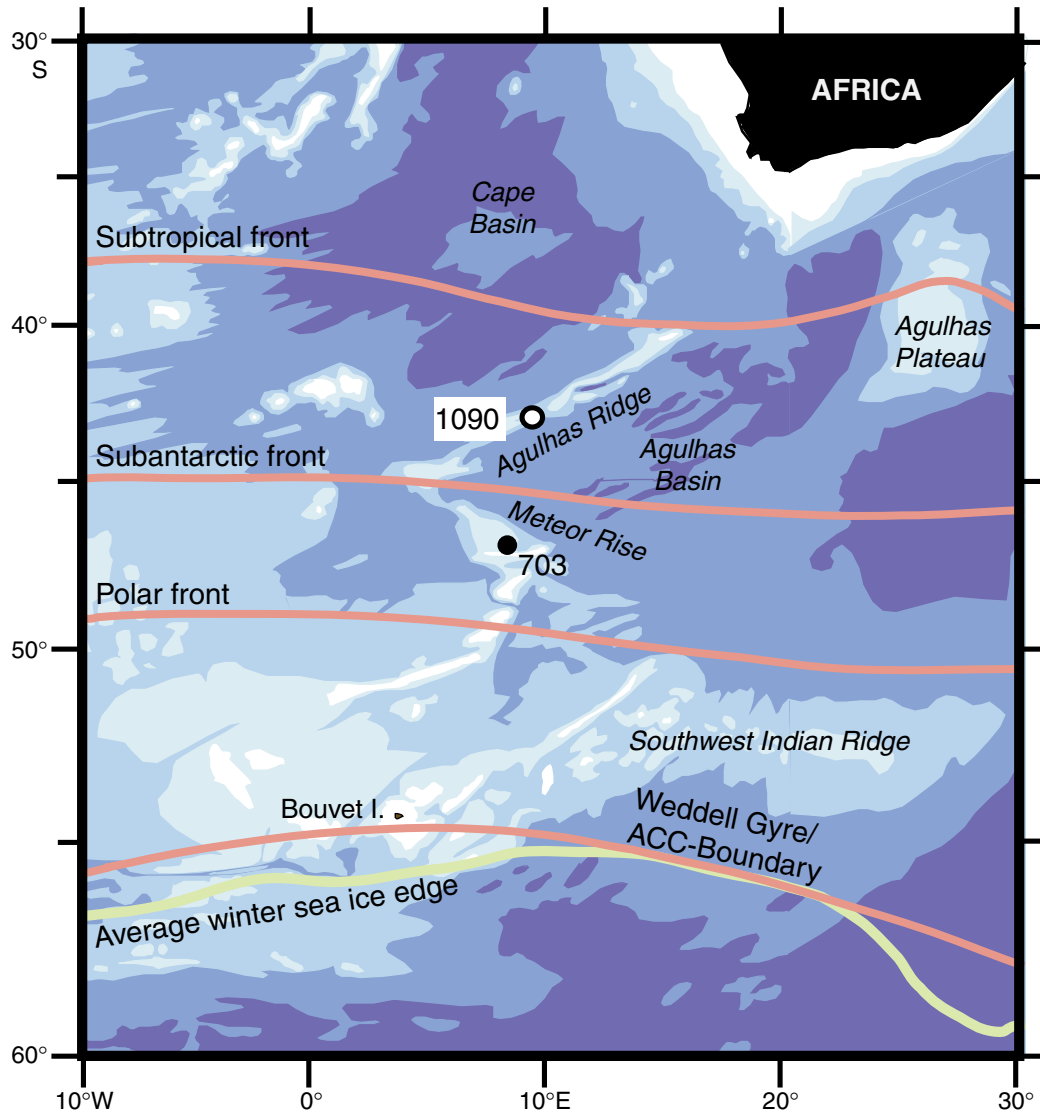


Table T1. Distribution of Eocene to Oligocene calcareous nannofossils in Hole 1090B. (This table is available in an [oversized format](#) and [ASCII format](#).)

Plate P1. Light micrography: XP = cross-polarized light, PL = plain transmitted light. Scale bar = 5 μ m. 1, 2. *Reticulofenestra hillae* (Sample 177-1090B-25X-2, 120 cm); (1) XP and (2) PL. 3, 4. *Chiasmolithus solitus* (Sample 177-1090B-43X-7, 30 cm); (3) XP and (4) PL. 5. *Reticulofenestra reticulata* (Sample 177-1090B-31X-6, 30 cm); XP. 6. *Discoaster saipanensis* (Sample 177-1090B-31X-3, 30 cm); PL. 7. *Transversopontis sigmoidalis* (Sample 177-1090B-30X-1, 30 cm); XP. 8. *Discoaster tani ornatus* (Sample 177-1090B-28X-3, 30 cm); PL. 9, 10. *Nannotetrina cristata* (Sample 177-1090B-43X-7, 30 cm); PL. 11. Intermediate *Chiasmolithus* between *C. oamaruensis* and *C. altus* (Sample 177-1090B-29X-5, 120 cm); XP. 12, 13. *Rhabdosphaera tenuis* (Sample 177-1090B-30X-1, 30 cm); XP. 14. *Nannotetrina fulgens* (Sample 177-1090B-43X-7, 30 cm); PL. 15. *Chiasmolithus altus* (Sample 177-1090B-24X-7, 10 cm); XP. 16. *Chiasmolithus oamaruensis* (Sample 177-1090B-30X-1, 30 cm); XP. 17, 18. *Reticulofenestra* cf. *R. circus* (Sample 177-1090B-28X-CC, 16–21 cm); (17) PL and (18) XP. 19, 20. *Reticulofenestra oamaruensis* (Sample 177-1090B-27X-3, 120 cm); (19) XP and (20) PL. 21. *Cycliscardolithus floridanus* (Sample 177-1090B-31X-CC, 21–32 cm); XP. 22, 23. *Clausicoccus fenestratus* (Sample 177-1090B-24X-6, 130 cm); (22) XP and (23) PL.

