# Data report: calcareous nannofossil assemblages at IODP Expedition 303 Site U1308 during the last 550,000 years[1]

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## Chapter contents



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## Abstract

Late Quaternary calcareous nannofossil assemblages at Integrated Ocean Drilling Program Site U1308, located in the North Atlantic Ocean, were analyzed in sediments covering the last 550,000 y. The uppermost Quaternary sediments at this site contain abundant nannofossils, and their assemblages are characterized by high species diversity. Nannofossil assemblages are characterized by abundant small specimens (<4 µm) of *Gephyrocapsa* throughout the sequence. Conversely, the upper part of the sequence is dominated by *Coccolithus pelagicus*, *Calcidiscus leptoporus*, and *Emiliania huxleyi*.

## Introduction

Coccolithophores are a major group of marine, unicellular phytoplankton, composed of calcareous plates (coccoliths) that form an important part of the fine-grained deep-sea sedimentary record and therefore are extensively used in biostratigraphic, paleoecologic, and paleoceanographic studies (e.g., Sato et al., 1999). In addition, coccolithophores have recently gained increased attention, as they make an important contribution to oceanic primary production. Their biogeographical distribution appears to be especially related to water temperature and nutrient concentration, as does their preservation (e.g., Okada and Honjo, 1973). In addition, shifts in species composition observed in several sediment cores have been attributed to changes in upwelling and sea-surface current systems.

In the present report, we present coccolith data over the last 550,000 y from Integrated Ocean Drilling Program (IODP) Site U1308 in the North Atlantic Ocean. This time interval contains a globally expressed climatic change, the Mid-Brunhes Event (MBE), centered at ~400 ka and likely forced by orbital eccentricity (Jansen et al., 1986; Pisias and Rea, 1988; Crowley and North, 1991).

## Materials and methods

The uppermost Quaternary samples used in this study were collected from Site U1308. Site U1308 is a reoccupation of Deep Sea Drilling Project (DSDP) Leg 94 Site 609 and is located at 49°52.666′N, 24°14.287′W (Fig. F1). The uppermost Quaternary


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sediments at this site are composed mainly of nannofossil and foraminifer ooze. Samples were analyzed at ~10–20 cm intervals.

All samples were processed as follows:

1. Powdered sample (0.04 g) was put into a small beaker, and 50 mL of water was added to make a suspension.
2. Suspension medium (0.5 mL) was placed on a coverslip (18 mm × 18 mm) with a pipette.
3. The coverslip was dried on a hotplate.
4. Samples were mounted on a microslide using Norland optical adhesive.

Microslides were observed under a binocular polarizing microscope at 1500× magnification. A total of 200 nannofossil specimens, excluding *Florisphaera profunda,* were counted at random to determine their relative frequencies.

Preservation quality was assessed using five categories: very good and good for little or no evidence of dissolution and/or overgrowth, moderate for minor dissolution or crystal overgrowth, and poor and very poor for strong dissolution or crystal overgrowth, in which case many specimens are unidentifiable (Fig. F2). Reworked calcareous nannofossils were not documented in any of the samples.

## Taxonomy of Gephyrocapsids

Most of the species identified in this study belong to the family Noelaerhabdaceae (reticulofenestrids including the genera *Emiliania*, *Pseudoemiliania*, *Reticulofenestra*, and *Gephyrocapsa*) (Thierstein et al., 1977; Raffi et al., 1993; Wei, 1993; Flores et al., 1999; Flores et al., 2000). Gephyrocapsid taxonomy is based on reports by Raffi et al. (1993), Flores et al. (2000), Takahashi and Okada (2000), and Baumann and Freitag (2004). The genus *Gephyrocapsa* was first divided into *Gephyrocapsa caribbeanica*, *Gephyrocapsa oceanica*, *Gephyrocapsa muellerae*, and other forms, and the latter were divided into two taxonomic groups based on coccolith length (i.e., small [2.5–3.5 µm] and very small [< 2.5 µm]). Several authors found that the angle between the lob axis and the bridge of *Gephyrocapsa* was related to temperature (e.g., Bollmann, 1997). We also classified very small *Gephyrocapsa* spp. into three groups: >45° (*Gephyrocapsa* spp. [small] and *G. oceanica*), 0°–25° (*G. muellerae*), and 0°–45° (*G. caribbeanica*), which indicate warm, cold, and intermediate temperature, respectively. In particular, the very small forms of *Gephyrocapsa* spp. and *Reticulofenestra* spp. are mainly represented by specimens smaller than 2.5 µm (Table T1).

## Results

The age model in this study is established primarily on the oxygen isotope stratigraphy and some well-known calcareous nannofossil biostratigraphic events for Site U1308 based on Sato et al.

Fourteen genera and 15 species were recognized at Site U1308. Almost all samples contain well-preserved nannofossils throughout the sequence except in the ice-rafted detritus (IRD) intervals where some samples contain poorly preserved nannofossils or are barren (Fig. F2). Badly dissolved specimens characterize these intervals.

Genus *Gephyrocapsa*, which includes *Gephyrocapsa aperta*, *Gephyrocapsa sinousa*, *G. caribbeanica*, *G. muellerae*, and *G. oceanica,* is dominant throughout the sequence (Fig. F3). The upper part of the sequence is characterized by abundant occurrences of *Calcidiscus leptoporus*, *Coccolithus pelagicus*, and *Emiliania huxleyi*. *Gephyrocapsa parallela*, *Helicosphaera carteri*, small specimens (<4 µm) of *Reticulofenestra*, and *Umbilicosphaera sibogae* are present throughout the sequence; however, these taxa are low in abundance (a few percent) in the examined interval. *Phontosphaera* spp., *Syracosphaera pulchra*, and *Umbellosphaera* spp. exhibit sporadic occurrences throughout the sequence (Fig. F3). *F. profunda* is nearly absent throughout the sequence at Site U1308.

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**Figure F1.** Area of study and location of the Site U1308. NAC = North Atlantic Current, AZC = Azores Current, EGC = East Greenland Current, NC = Norwegian Current, GS = Gulf Stream, CC = Canary Current.

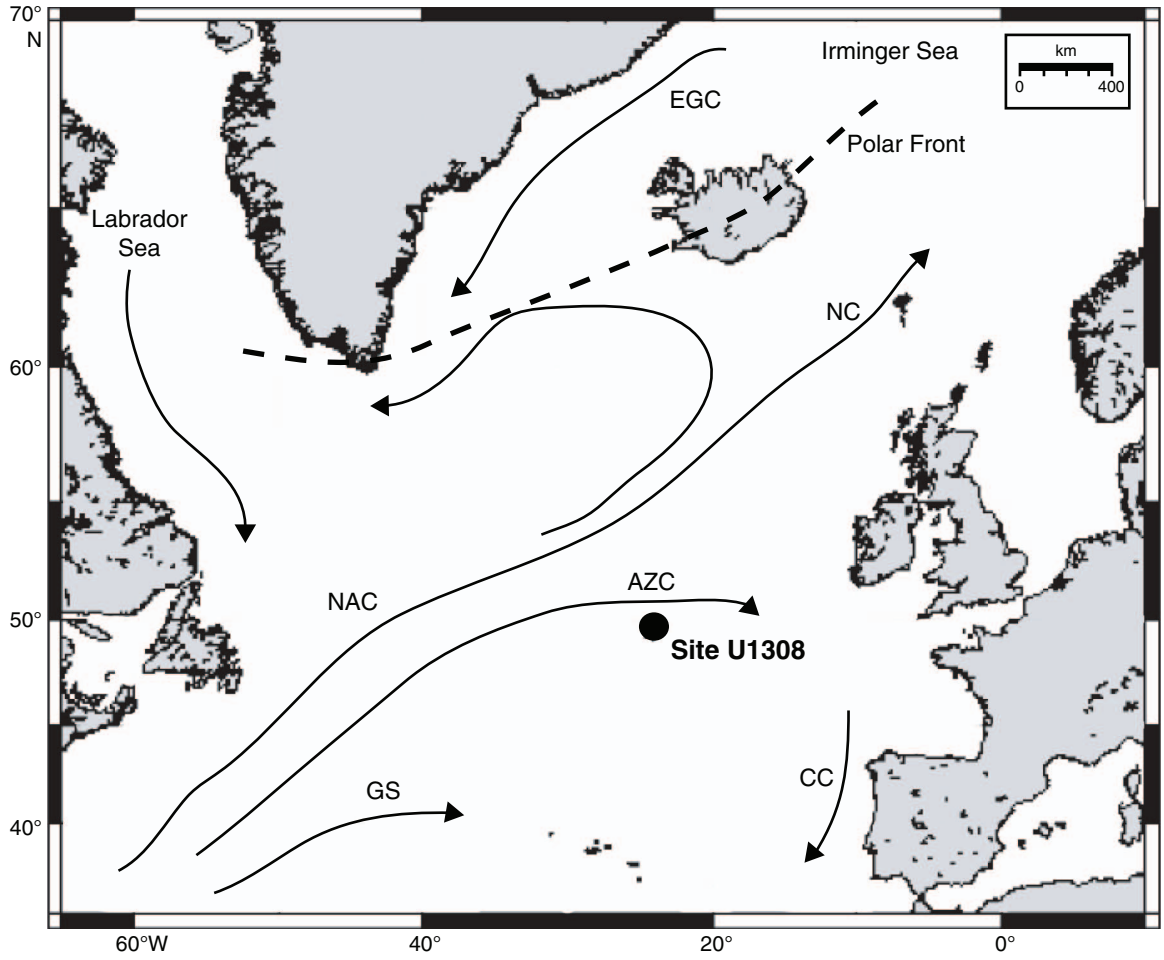

**Figure F2.** Downhole preservation of calcareous nannofossils, Site U1308.

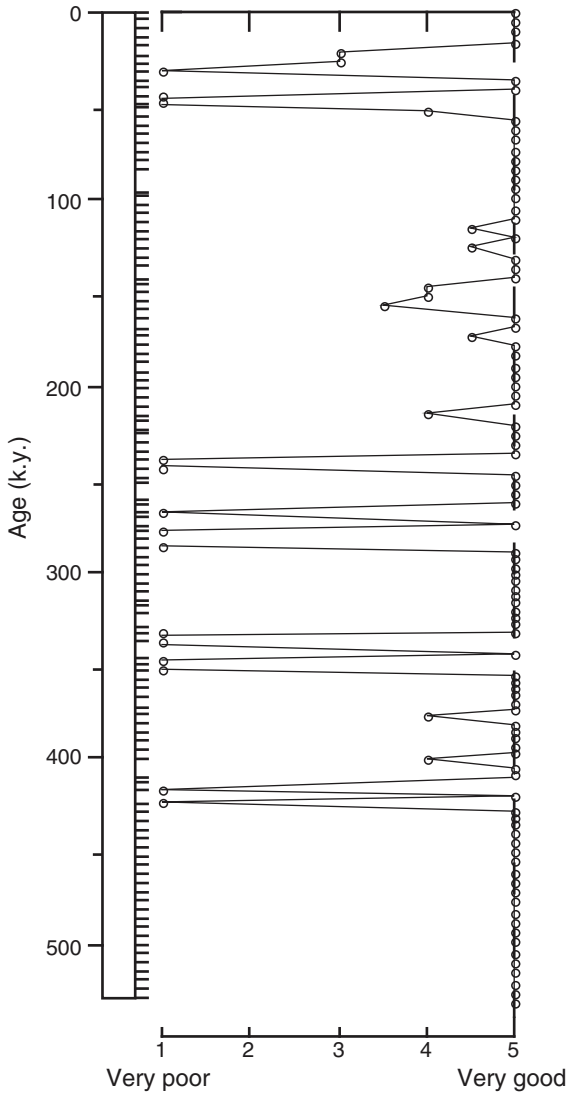

**Figure F3.** Stratigraphic distribution of calcareous nannofossils, Site U1308. Includes calcareous nannofossil datums *Emiliania huxleyi* (first occurrence = 265 ka) and *Pseudoemiliania lacunosa* (last occurrence = 451 ka) from **Sato et al.**

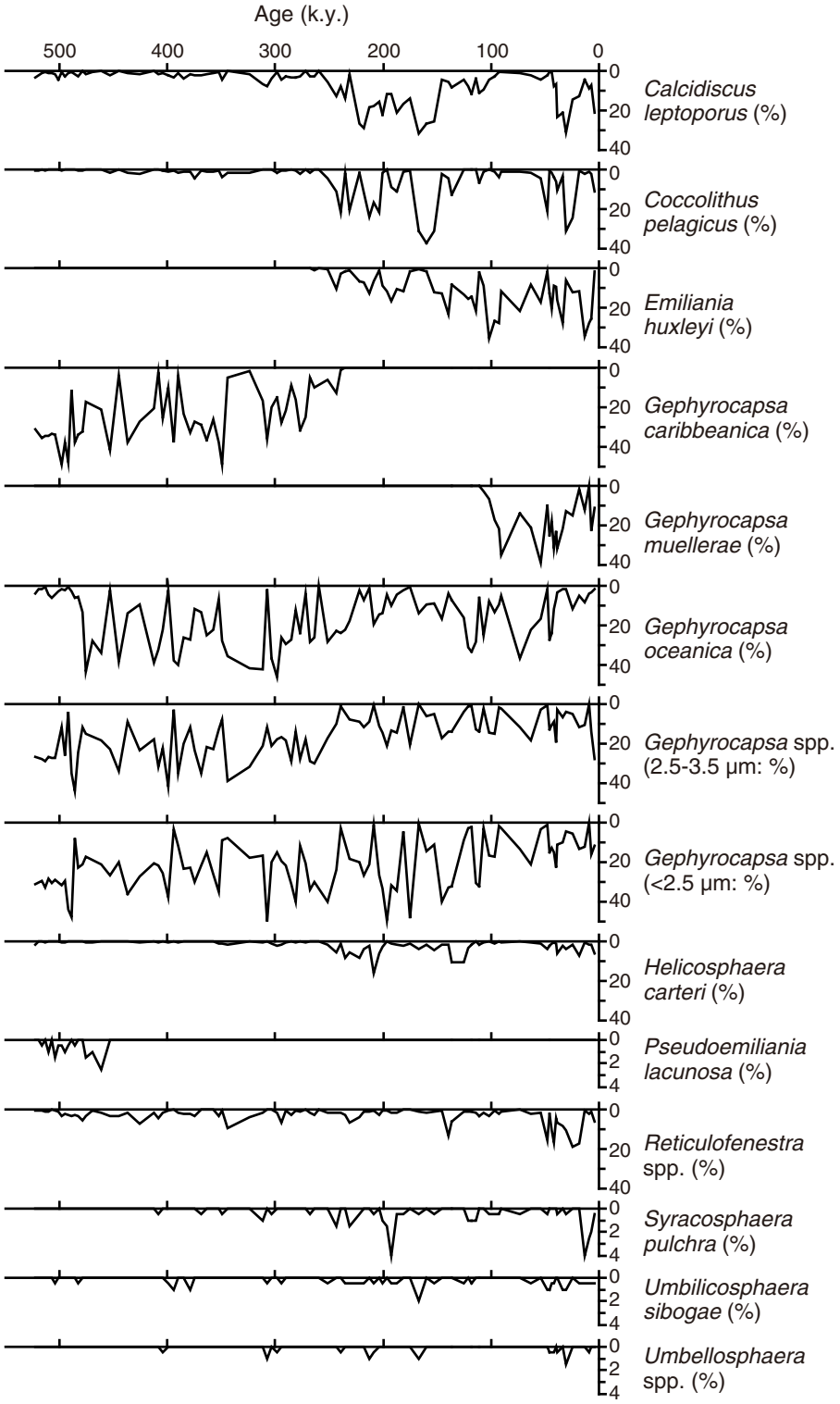

**Table T1.** Terminology for *Gephyrocapsa* spp. (See table note.)

| This study | *Gephyrocapsa* spp. (very small) | *Gephyrocapsa* spp. (small) | *Gephyrocapsa muellerae* | *Gephyrocapsa caribbeanica* | *Gephyrocapsa oceanica* |
|---|---|---|---|---|---|
| Coccolith size (µm) | <2.5 | 2.5–3.5 | 2.5–4 | >3.5 | >3.5 |
| Bridge angle (°) | 0–90 | >45 | 0–25 | 0–45 | >45 |
| Other authors | | | | | |
| Bollmann (1997) | *Gephyrocapsa* minute | *Gephyrocapsa* equatorial | *Gephyrocapsa* cold | *Gephyrocapsa* oligotrophic/*Gephyrocapsa* transitional | *Gephyrocapsa* large/*Gephyrocapsa* equatorial |
| Flores et al. (2000) | Small *Gephyrocapsa* | *Gephyrocapsa oceanica* | *Gephyrocapsa muellerae* | *Gephyrocapsa caribbeanica* | *Gephyrocapsa oceanica* |
| Takahashi and Okada (2000) | Small *Gephyrocapsa* | Medium *Gephyrocapsa;* high/intermediate bridge angle (warm) | Medium *Gephyrocapsa;* low bridge angle (cold) | *Gephyrocapsa caribbeanica* | Medium/Large *Gephyrocapsa;* high/intermediate bridge angle (warm) |
| Bauman and Freitag (2004) | *Gephyrocapsa ericsonii*/*Gephyrocapsa aperta* | *Gephyrocapsa muellerae*/*Gephyrocapsa caribbeanica* | *Gephyrocapsa muellerae* | *Gephyrocapsa caribbeanica* | *Gephyrocapsa oceanica* |

Note: Other authors' equivalents mainly adopted from Baumann and Freitag (2004).