Data report: calcareous nannofossil biostratigraphy of Site C0009, Expedition 319[1]

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Chapter contents

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Abstract

Calcareous nannofossils were examined in cuttings samples from 715.7 to 1603.7 m mud depth below seafloor in Hole C0009A, offshore Kii Peninsula, central Japan. After a counting method was applied, a total of 13 Neogene and Quaternary calcareous nannofossil datums were recognized in the hole, most of which are consistent with the shipboard study. A major unconformity (spanning from ~5.6 to 3.8 Ma) and condensed intervals (from ~2.5 to ~1 Ma) were characteristically recognized.

Introduction

During Integrated Ocean Drilling Program (IODP) Expedition 319, three sites (C0009, C0010, and C0011) were drilled offshore Kii Peninsula, located in the Kumano Basin; the top of the slope; and near the Nankai Trench, respectively, to achieve several scientific objectives using both riser and riserless drilling (see the **"Expedition 319 summary"** chapter [Expedition 319 Scientists, 2010a]). Among these, Site C0009 (Fig. **F1**) was the first attempt to retrieve cuttings samples as primary materials for research in scientific deep-sea drilling history. In this study, calcareous nannofossil assemblages were investigated based on the counting method, and the biostratigraphy was established to provide an age model for Hole C0009A.

Materials and methods

In this study, calcareous nannofossils in 32 cuttings samples from 715.7 to 1603.7 m mud depth below seafloor (MSF) in Hole C0009A were investigated. Smear slides prepared on board (see the **"Site C0009"** chapter [Expedition 319 Scientists, 2010b]) were used and the counting method was applied in order to characterize quantitatively the overall fossil assemblage changes throughout the section. This study aims to provide quantitative data of fossil assemblages and further refine the shipboard nannofossil biostratigraphic results. Calcareous nannofossils were observed at 1500× magnification under an Olympus BX51 polarized light microscope. We collected quantitative assemblage data by counting ~200 specimens in each sample and also searched for stratigraphically important but rare species beyond the counting effort. This counting method has not been applied during offshore examina-

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tion and can accurately show relative abundance of each nannofossil taxon.

Calcareous nannofossil datums summarized by Lourens et al. (2004) and Raffi et al. (2006) are applied in order to determine the numerical age of sediment. Downhole contamination of specimens was commonly observed, and, to avoid misinterpretation of ages, we basically utilized last occurrences of index species.

This study mostly followed the taxonomy of nannofossils by Young (1998) as well as Raffi's subdivision of *Gephyrocapsa* (Raffi, 2002), an important age-diagnostic genus in the Quaternary. Coccolith sizes of both *Gephyrocapsa* and *Reticulofenestra* varied throughout the Cenozoic (e.g., Young, 1990), and sudden changes of maximum size of their specimens can be used as important datums (e.g., Raffi et al., 2006). To provide biostratigraphic markers based on size variations, maximum sizes of both *Gephyrocapsa* and *Reticulofenestra* specimens were measured using an eyepiece graticule with an intermediate magnification changer 0.5 µm in diameter. *Gephyrocapsa* specimens are divided into four taxa, large *Gephyrocapsa* (>5.5 µm in diameter), medium *Gephyrocapsa* (≥4 µm, *Gephyrocapsa omega* morphotype), other medium *Gephyrocapsa* (4–5.5 µm), and small *Gephyrocapsa* (<4 µm). On the other hand, *Reticulofenestra* specimens are divided into *Reticulofenestra pseudoumbilicus* (elliptical coccolith ≥7 µm), *Reticulofenestra asanoi* (circular and/or subcircular coccolith ≥6 µm), and other *Reticulofenestra* specimens. Stratigraphic distributions of other *Reticulofenestra* specimens are shown in every one-micron (Fig. F2).

Results

Eighteen genera and 41 species were recognized in the Neogene and Quaternary sequences of Hole C0009A except for some *Noelaerhabdaceae* taxa. Generally speaking, abundant nannofossils occurred throughout the section and preservation of specimens is good. *Florisphaera, Reticulofenestra,* and *Gephyrocapsa* occupied ~80%–90% of total flora throughout the section (Fig. F2). Other taxa are rare although it was easy to find some stratigraphically important species. Thirteen nannofossil datums were recognized in the sediment in Hole C0009A (Figs. F2, F3). Most of the datums determined in this study are consistent with those observed by Expedition 319 Scientists (see the "Site C0009" chapter [Expedition 319 Scientists, 2010b]), further confirming previous results. Moreover, the disappearance of comparatively larger *Reticulofenestra* specimens (≥6 µm) at 1147.7 m MSF seems to correspond to one of the upper Pliocene datums that were defined by sudden reduction of maximum size *Reticulofenestra* specimens (Kameo and Takayama, 1999).

There are some unconformities and/or intervals of substantially slow sedimentation in the Neogene sediment in Hole C0009A. As already mentioned by Expedition 319 Scientists (see the "Site C0009" chapter [Expedition 319 Scientists, 2010b]), a major unconformity exists that corresponds to the boundary between lithostratigraphic Units III and IV (5.6–3.8 Ma). In addition, minor unconformities and/or condensed sections should be present between 842.7 and 852.7 (~1 Ma), 900.2 and 907.7 (~1.3 to ~1.6 Ma), and 930.2 and 955.2 m MSF (2–2.5 Ma). According to the correlation with previous NanTroSEIZE drilling sites, sediment ages at Site C0009 are mostly consistent with those at Site C0002 (Fig. F2). However, the Pleistocene sediment (Unit II at Site C0002) is much thicker than at Site C0009 but reversed for the Pliocene. The ages right above the unconformity (between Units IV and III) are different at both sites, and the base of Unit III at Site C0009 is younger. This implies that the sedimentation at Site C0002 resumed earlier than Site C0009 at the Kumano Basin.

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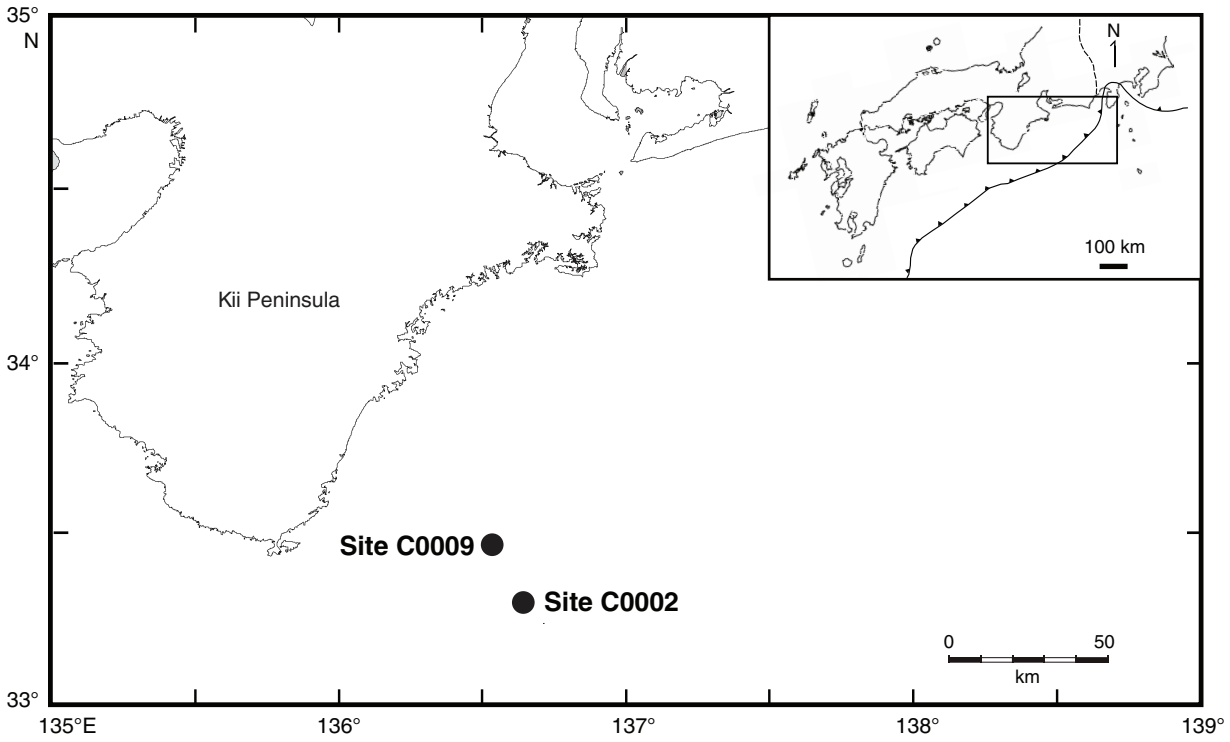
Figure F1. Location map for Sites C0002 and C0009 (modified after Expedition 319 Scientists, 2010a; Expedition 315 Scientists, 2009; and Shipboard Scientific Party, 2001).



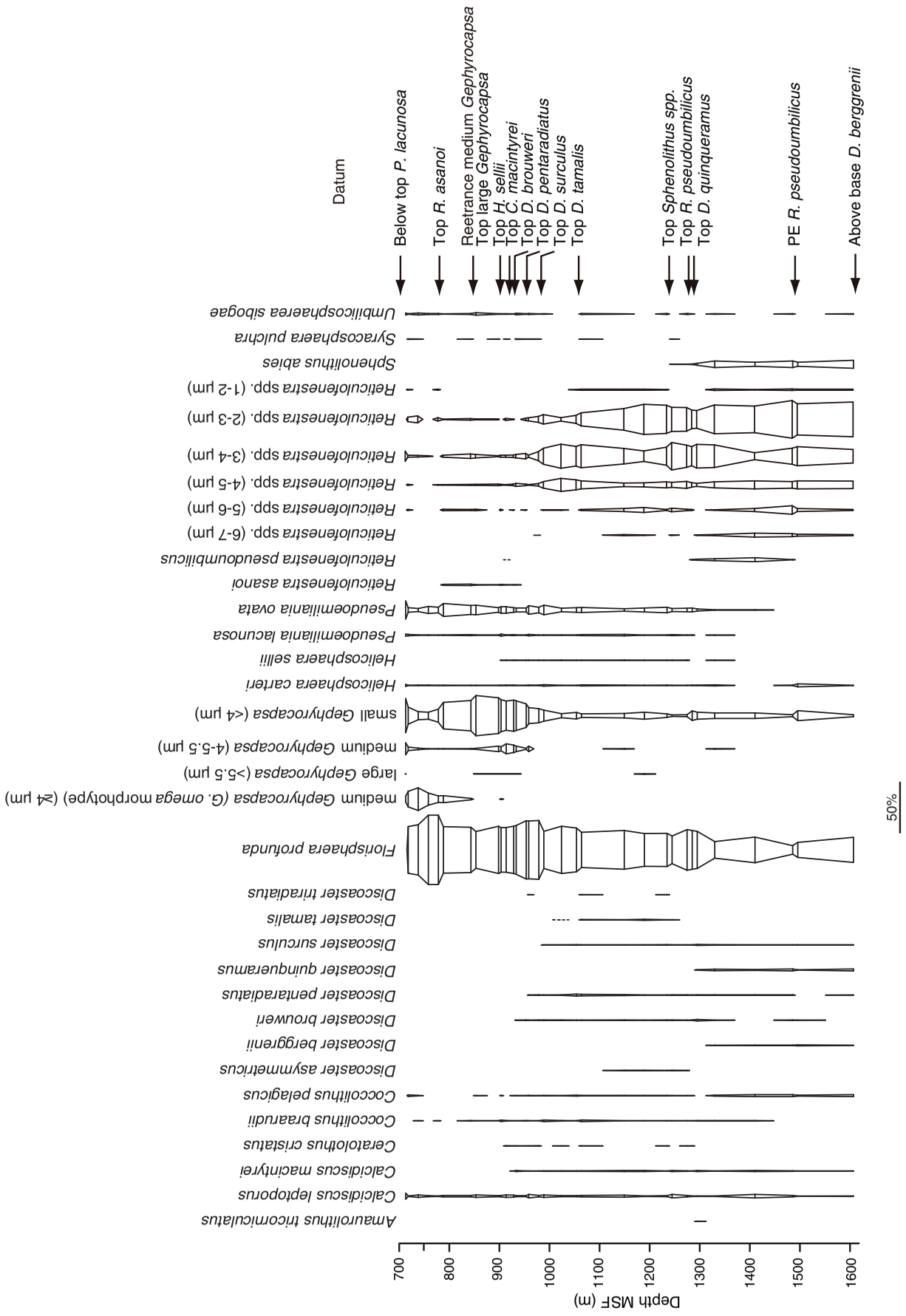


Figure F2. Stratigraphic distribution of the main calcareous nannofossils and recognized datums, Hole C0009A. PE = paracme end.

Figure F3. Correlation between Sites C0009 and C0002 based on calcareous nannofossils. Data from Site C0002 are from Expedition 315 Scientists (2009). Ages of datums are based on Lourens et al. (2004), and the calcareous nannofossil zonation of Okada and Bukry (1980) is applied. PE = paracme end.