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Calcareous nannofossil biochronology from the upper Pliocene to lower Pleistocene in the southernmost Boso Peninsula, central part of the Pacific side of Japan

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ABSTRACT

The calcareous nannofossil biostratigraphy in the southernmost Boso Peninsula, central part of the Pacific side of Japan, was examined to calibrate nannofossil biohorizons to an existing oxygen isotope stratigraphy for the northwestern Pacific. Five nannofossil biohorizons were detected in the uppermost Pliocene and the lower Pleistocene Mera and Minamiasai Formations. Each biohorizon can be correlated with a previously presented magnetic reversal and a corresponding marine isotope stage (MIS) in both formations. They are from bottom to top: last occurrence (LO) of *Discoaster asymmetricus* (MIS G8–G9 transition), LO of *Reticulofenestra minutula* var. B (MIS G8–G9 transition), LO of *Discoaster tamalis* (MIS G7–G8 transition), LO of *Discoaster surculus* (MIS 100), and LO of *Discoaster pentaradiatus* (MIS 95). Based on a comparison with previous studies, most of these biohorizons are traceable events, although the degree of synchrony varies depending on the biohorizons. Moreover, the LO of *R. minutula* var. B, an abrupt disappearance event of larger *Reticulofenestra* specimens in the lower part of the Minamiasai Formation, is also traceable to other regions.

1. Introduction

Many calcareous nannofossils can be used to assign geologic ages to marine sediments (e.g., Raffi et al., 2006; Anthonissen and Ogg, 2012; Backman et al., 2012) and calcareous nannofossil biostratigraphy has been a primary chronostratigraphic tool in various geological studies, such as the Deep Sea Drilling Project (DSDP), Ocean Drilling Program (ODP) and International Ocean Discovery Program (IODP) (many examples are shown in the IODP websites; http://www.iodp.org/). A few key biostratigraphic studies of calcareous nannofossils have established standard biohorizons (datums) and zonations (e.g., Martini, 1971; Bukry, 1973, 1975; Okada and Bukry, 1980). The synchrony or diachrony of the Miocene to Pleistocene calcareous nannofossil biohorizons has been evaluated by comparison with astronomically tuned timescales based on global marine oxygen isotopes (Raffi, 2002), GRAPE (Gamma-Ray Attenuation Porosity Evaluator) density fluctuations in equatorial deep sea cores (Shackleton et al., 1995), and lithological carbonate cycles in Mediterranean marine sediments (Lourens et al., 1996). Numerical (absolute) ages of late Cenozoic calcareous nannofossil biohorizons have been calibrated in some key biostratigraphic studies and the representative ages of each ocean were described in review papers by Anthonissen and Ogg (2012) and Raffi et al. (2006). However, most of these basic data were obtained from low latitudes and there are also few data for Pacific regions, except for equatorial areas. Biohorizons based on appearances or disappearances of warm water species are sometimes difficult to recognize outside equatorial regions because nannofossil diversity is lower in middle latitude areas than in low latitudes (e.g., Young, 1998). Therefore, a biochronology of calcareous nannofossils should be established to provide available age data for nannofossil biohorizons outside equatorial Pacific regions.

The Boso Peninsula, situated in the central part of the Japanese islands, is one potential location to construct a chronostratigraphy of the Neogene and Quaternary for the middle latitude of the Pacific region (Fig. 1). Thick and continuous marine strata, composed of forearc and related sediments, are widely distributed on the peninsula, and they contain microfossils. Trench and trench-slope basin deposits from the Pliocene-Pleistocene are present especially in the southernmost part of the Boso Peninsula (Kotake, 1988; Kotake

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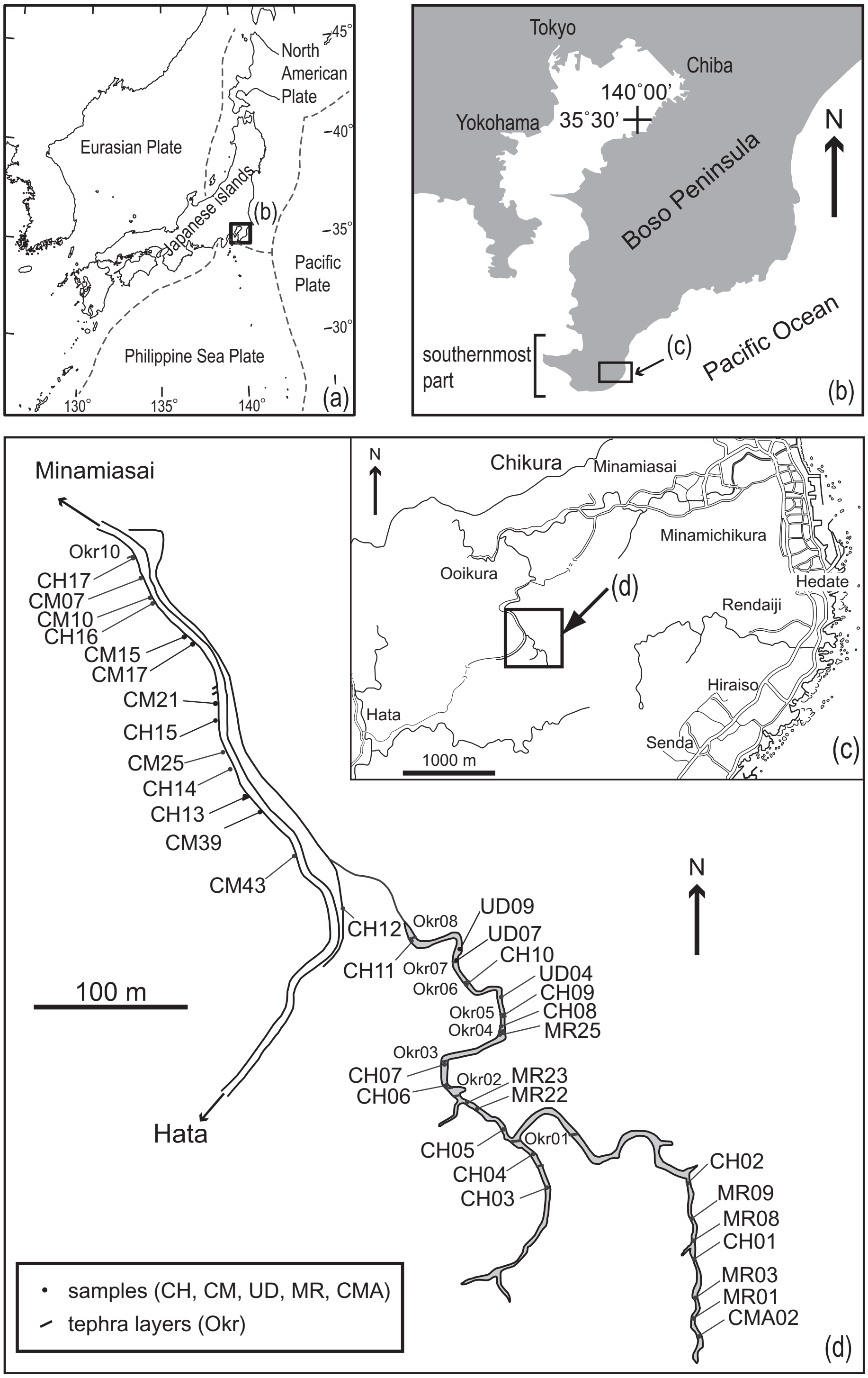

Fig. 1. Location of the study area. (a) location of the Boso Peninsula (indicated with a rectangular box) and plate boundaries around the Japanese islands (Seno, 1985; Nakamura, 1983), (b) location of the study area, (c) location of sampling route, the Chikura Pathway and (d) location of samples for calcareous nannofossils along the Chikura pathway and adjacent rivers. The base map for (c) is from the 1:25,000 "Tateyama" topographic map published by the Geospatial Information Authority of Japan (GSI). Part of the samples (sample codes CM, UD, MR) obtained by Okada et al. (2012) and additional samples (codes CH and CMA) newly acquired alongside the Chikura pathway and small rivers are also used.

et al., 1995). Recently, Okada et al. (2012) presented an oxygen isotope record and magnetostratigraphic data for these sediments, from the middle Gauss (Chron C2An.2n) to the lower Matuyama (Chron C2r.2r). Thus, these sediments are useful to construct an integrated chronostratigraphy in combination with biostratigraphy, magnetostratigraphy, and oxygen isotope stratigraphy. The calcareous nannofossil biostratigraphy from the upper Pliocene to lower Pleistocene in the southernmost part of the Boso Peninsula is presented here. Calibrated ages for calcareous nannofossil biohorizons in the northwestern Pacific are provided for the first time. Their synchrony or diachrony is also discussed by comparison with other areas.