Data report: early Pleistocene calcareous nannofossils, IODP Expedition 339, Site U1387[1]

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Chapter contents

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Abstract

We present a revision and refinement of semiquantitative analyses of calcareous nannofossil assemblages in early Pleistocene samples from Holes U1387A and U1387C recovered toward the eastern end of the Faro Drift (36°48.3210′N, 7°43.1321′W) during Integrated Ocean Drilling Program Expedition 339, Mediterranean Outflow (November 2011–January 2012). The record is characterized by intervals very rich in calcareous nannofossils that are in general moderately to well preserved. On the other hand, the record contains an interval directly above the youngest dolomite layer in Section 339-U1387C-19R-4 (~0.7 m) where no coccoliths were preserved. The new stratigraphic constraints of events such as the lowest occurrence (LO) of large *Gephyrocapsa*, the highest occurrence (HO) of *Calcidiscus macintyrei* (1.66 Ma), the LO of medium-sized *Gephyrocapsa* group, and the HO of *Discoaster brouweri* (1.95 Ma) allow better interpretation of the isotope stratigraphy applied to this interval.

Introduction

Integrated Ocean Drilling Program (IODP) Expedition 339 was targeted to study the Mediterranean Outflow Water (MOW) and to identify the role of salt injection from it in the dynamics of North Atlantic Deep Water spanning the early Pleistocene, Pliocene, and latest Miocene. In this context, Site U1387, located toward the eastern end of the Faro Drift (36°48.3210′N, 7°43.1321′W), was one of the most critical sites of Expedition 339 (Figure **F1**), giving the possibility to study the entire time period. In fact, the major objective for Site U1387 was to recover a complete sedimentary record for at least the last 5.3 Ma on the Faro Drift, which was deposited under the influence of the upper core of MOW (see the "**Methods**" chapter [Expedition 339 Scientists, 2013a]). In this study, we focused on analyzing the calcareous nannofossil assemblage to revise their biostratigraphic events from the early Pleistocene, spanning from ~1.95 to 1.40 Ma. For this time frame, a postexpedition revision of the Site U1387 splice was also performed (**Voelker et al.**, 2018).

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Materials and methods

Of the three holes drilled at Site U1387, we analyzed Holes U1387A and U1387C. The intervals analyzed for Hole U1387A (344.34–345.67, 350.44–351.31, and 351.42–351.53 meters below seafloor [mbsf]) were cored using the extended core barrel (XCB) system. Hole U1387C was cored using the rotary core barrel (RCB) system for the intervals analyzed (347.64–349.85, 351.36, and 352.7 to ~460 mbsf). Stratigraphic correlation at this site was revised in the early to middle Pleistocene sequence based on stable isotope data and supported by X-ray fluorescence (XRF) data, resulting in a corrected meters composite depth (mcd) scale (**Voelker et al.**, 2018). In general, the stable isotope data show that the sequence of the revised splice does not contain a hiatus (see the "**Methods**" chapter [Expedition 339 Scientists, 2013a]) but just small coring gaps (**Voelker et al.**, 2018). The calcareous nannofossil events identified here were observed in smear slides prepared using microscope slides and coverslips that were mounted with Norland optical adhesive. These slides were observed using standard light microscope techniques on a Zeiss Axiophot and with a polarizing microscope Leica DMRP at ×1250 and ×1000 magnification. A minimum of 200 fields of view (FOVs) were examined for each sample in cross-polarized and plane-transmitted light.

Bioevent ages were assigned based on the occurrence of calcareous nannofossils in the samples analyzed. Estimates of the abundance of calcareous nannofossils were determined as follows:

VA = very abundant (>100 specimens per FOV).
A = abundant (11–100 specimens per FOV).
C = common (1–10 specimens per FOV).
F = few (1 specimen per 2–10 FOVs).
R = rare (1 specimen per ≥11 FOVs).
B = barren.

Abundances of individual taxa or groups of calcareous nannofossils were categorized as follows:

D = dominant (>20 specimens per FOV).
A = abundant (11–20 specimens per FOV).
C = common (1–10 specimens per FOV).
F = few (1 specimen per 2–10 FOVs).
R = rare (1 specimen per ≥11 FOVs).
P = present (abundance not quantitatively determined).

Calcareous nannofossil events were defined based on abundance patterns of the index species and recognized as lowest occurrence (LO), lowest common occurrence (LcO), highest common occurrence (HcO), and highest occurrence (HO).

Table **T1** provides details on all data collected.

Taxonomic remarks

Gephyrocapsa species were grouped in several size categories, and the classification followed the morphometric criteria adopted in the "**Site U1387**" chapter [Expedition 339 Scientists, 2013b]. Specimens <3 µm, mainly *Gephyrocapsa ericsonii* and *Gephyrocapsa aperta*, were classified as small *Gephyrocapsa*. Specimens of *Gephyrocapsa muellerae* and *Gephyrocapsa margerelii* and other identified specimens of gephyrocapsids in the 3–5.5 µm size range are referred to as medium *Gephyrocapsa* group. The large *Gephyrocapsa* category includes forms >5.5 µm. *Gephyrocapsa caribbeanica* included midsized specimens (3–5.5 µm) with a closed central area.

Reticulofenestra specimens were also considered, following the morphometric criteria adopted in the "**Site U1387**" chapter [Expedition 339 Scientist (2013b]) and size concepts by Marino (1996) and Marino et al. (2003). Elliptical forms <3 µm were named "small *Reticulofenestra*," mainly corresponding to *Reticulofenestra minuta*. *Reticulofenestra haqii* and *Reticulofenestra minutula* were considered "medium *Reticulofenestra*," ranging between 3 and 5 µm. Otherwise, taxonomic concepts for Neogene taxa were adopted from Perch-Nielsen (1985) and Bown and Young (1998). Table **T2** is a complete list of species identified in samples.

Calcareous nannofossil stratigraphy

In general, calcareous nannofossil assemblages are abundant and indicative of the early Pleistocene, corroborating the shipboard results (see the "**Methods**" chapter [Expedition 339 Scientists, 2013a]). Small placolith taxa (<3 µm) dominated the assemblages. Reworking of lower Neogene and Paleogene species were observed in the analyzed record but mostly in low proportion. The preservation was good to moderate with weak dissolution and overgrowth in some samples. In total, four calcareous nannofossil datums defined and calibrated by Raffi et al. (2006) were newly identified in the analyzed samples (Table **T1**). In the shipboard analysis, the LO of large *Gephyrocapsa* (>5.5 µm; 1.61 Ma) and the HO of *Calcidiscus macintyrei* (1.66 Ma) were identified between Samples 339-U1387C-7R-CC and 8R-CC (346.05–357.52 mbsf) (see the "**Methods**" chapter [Expedition 339 Scientists 2013a]). However, the significantly higher sampling resolution revealed an abundance pattern that suggests repositioning both these datums to greater depth. Thus, the LO of large *Gephyrocapsa* (>5.5 µm; 1.61 Ma) was identified between Samples 10R-1, 75–77 cm, and 10R-1, 48–50 cm, (367.55–367.28 mbsf),

whereas the HO of *Calcidiscus macintyrei* (1.66 Ma) was identified between Samples 11R-2, 48–50 cm, and 11R-2, 14–16 cm (378.38–378.04 mbsf). Finally, both the LO of medium *Gephyrocapsa* group (1.73 Ma) and the HO of *Discoaster brouweri* (1.95 Ma), which during the shipboard analysis were not possible to place because of the lower sampling resolution, are now constrained. The LO of medium *Gephyrocapsa* group (1.73 Ma) was placed between Samples 14R-1, 88–90 cm, and 14R-1, 80–82 cm, (406.08–405 mbsf). However, this event should be taken with caution because of the irregular and intermittent record observed, sometimes related to dissolution. The HO of *D. brouweri* (1.95 Ma) was identified between Samples 19R-2, 88–90 cm, and 19R-2, 14–16 cm (455.38–454.63 mbsf). Between Samples 19R-3, 129–131 cm, and 19R-4, 49–51 cm (457.25–457.9 mbsf), no coccoliths were preserved.

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Figure F1. Northern Gulf of Cadiz Current (GCC) and location of Site U1387. u-MOW = upper Mediterranean Outflow Water (from Voelker et al., 2018).

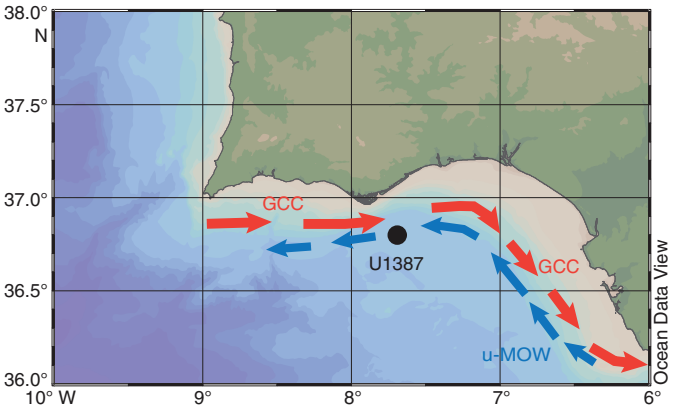

Table T1. Calcareous nannofossil abundance, Site U1387. This table is available in **CSV format.**

Table T2. List of species found in analyzed samples, Site U1387. This table is available in **CSV format.**