Data report: planktonic and benthic foraminifers from IODP Hole U1322B[1]

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Chapter contents

[1] Li, Q., Xiang, R., and Zheng, F., 2007. Data report: planktonic and benthic foraminifers from IODP Hole U1322B. *In* Flemings, P.B., Behrmann, J.H., John, C.M., and the Expedition 308 Scientists, *Proc. IODP,* 308: College Station, TX (Integrated Ocean Drilling Program Management International, Inc.). doi:10.2204/iodp.proc.308.202.2007
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Abstract

Analyses of planktonic and benthic foraminifers in 141 samples from Integrated Ocean Drilling Program Hole U1322B reveal some distinct distribution patterns relating to climate and sea level changes in the northern Gulf of Mexico region. The sediment section is divided into planktonic foraminifer Zone Z, which features *Globorotalia menardii,* and Subzones Y1–Y5, which do not. Several benthic foraminifer assemblages show repeated occurrences, indicating waxing and waning of favorable environments for dominant species in marine isotope Stages 1–4.

Introduction

Integrated Ocean Drilling Program (IODP) Expedition 308 Site U1322 is located on the Mississippi slope in the northern Gulf of Mexico, at a water depth of 1319 m. The deepest of three sites drilled in the Ursa Basin, Site U1322, was designed to recover a continuous sediment section for studying fluid migration and mass flow dynamics in the late Quaternary (Expedition 308 Scientists, 2005). Early work indicates that the modern foraminifer biofacies around Site U1322 is dominated by benthic *Bulimina-Brizalina* assemblages plus a *Glomospira* biofacies in an oxygen-poor environment induced by rapid sedimentation offshore from the Mississippi River mouth (Fig. **F1**) (Poag, 1981).

We investigated planktonic and benthic foraminifers in samples from Hole U1322B. The primary objective of this study was to record the abundance and distribution patterns of foraminifers and to provide information for interpreting late Quaternary environmental changes in the Ursa Basin region.

Materials and methods

During IODP Expedition 308, a total of eight holes at three sites (Sites U1322, U1323, and U1324) were drilled in the Ursa Basin, northern Gulf of Mexico. Hole U1322B (28°5.9642′N, 89°1.4995′W; water depth = 1319.5 m) was the only hole drilled at Site U1322 for retrieving sediment cores without logging. The 234.5 m sediment sequence recovered in Hole U1322B is dominated by dark, organic-rich mud truncated by frequent mass flow layers and fine-grained turbidites (Expedition 308 Scientists, 2005). Preliminary shipboard paleontological investigation indicates that the

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sediment was deposited in a rapid depositional environment over the last 65 k.y., in marine isotopic Stages (MIS) 1–4 (Expedition 308 Scientists, 2005).

For this study, we collected 141 samples (20 cm^3) with a resolution of 1.5 m from Hole U1322B. Samples were oven-dried at 60°C, weighed, and washed through a 63 µm sieve. Dry residues were weighed again for the purpose of calculating the >63 µm coarse fraction. All planktonic and benthic foraminifers in the dry residues were counted and identified under a binocular microscope. *Globigerina ruber* specimens were picked for measuring stable isotopes as reported elsewhere (**Li et al.,** this volume), and their numbers were included in the calculation of relative abundance of planktonic species. Apart from calculating the percent abundances of most foraminifer species, planktonic and benthic group abundances were also estimated by converting their counted number to a total sum in a dry sediment volume of 50 g. For early biostratigraphic work in the region, we mainly refer to Kennett and Huddlestun (1972) and Healy-Williams (1984). The modern benthic foraminifer work of Poag (1981) also provides a valuable reference for comparison and paleoenvironmental interpretation of various benthic foraminifer assemblages.

Results

The original census data of planktonic and benthic foraminifers are shown in Tables **T1** and **T2.** In general, both planktonic and benthic foraminifers are relatively rare in most samples. As shown in Figure **F2,** only a few samples from between 150 and 200 meters below seafloor (mbsf) have more than 0.5% of the >63 µm coarse fraction, indicating a mud-dominated lithology throughout. Counts of planktonic foraminifer individuals are usually fewer than 25 per 50 g dry sediment and only occasionally reach 100 or more. As at other Gulf of Mexico settings, benthic foraminifers are relatively more abundant, usually 25–200 individuals per 50 g dry sediment. Samples with 400 or more benthic foraminifer specimens are from two intervals: 0–11 and 85–183 mbsf (Fig. **F2**).

A number of slumped intervals found in Hole U1322B (Fig. **F2**) represent mass flow deposits (Expedition 308 Scientists, 2005). About 50 samples from these intervals are not considered in situ, and therefore these results should be excluded from discussion about environmental changes. However, a common feature of these samples is that both planktonic and benthic foraminifers are much less abundant than in nonturbidite layers, probably as a result of rapid redeposition of shallower water sediments. These intervals appear to have been associated more closely with sea level lowstands at or close to MIS 2 and MIS 4 (**Li et al.,** this volume).

Planktonic foraminifer zonation

Figure **F3** illustrates the relative abundance of some common planktonic foraminifer species. It is obvious that the assemblage is dominated by *Globigerinoides ruber* and *Globorotalia inflata,* with frequent *Globigerinoides sacculifer, Globorotalia crassaformis,* and *Globigerina bulloides* and its allied *Globigerina falconensis,* forming a typical subtropical to warm temperate association. Species restricted to the tropics, such as *Globorotalia menardii* and *Pulleniatina obliquiloculata* are rare, as are cool-water species that live at high latitudes, such as *Neogloboquadrina pachyderma* and *Globigerina quinqueloba*.

The typical warm-water species *G. menardii* is found in samples from Core 308-U1322B-1H (0–4 mbsf) only, whereas *P. obliquiloculata* occurs at 0.8, 136.6, 150, 158, and 167 mbsf. Moderately abundant *G. sacculifer* (~10% or more) occurs in three intervals: 0–2, 15–21, and 70–92 mbsf (Fig. **F3**). Over 50% abundance of *G. ruber* occurs at 0–20 mbsf and at 90 and 196 mbsf. *Globorotalia truncatulinoides,* a deep-dwelling species, has >10% abundance at 37 and 132–141 mbsf. In contrast, *G. inflata* and *G. bulloides* groups, both representing the temperate assemblage, show high abundances of ~20% in the intervals 20–70, 13–155, and 198–230 mbsf (Fig. **F3**).

These distribution patterns of planktonic foraminifers suggest that several Gulf of Mexico faunal (sub)zones, as modified by Kennett and Huddlestun (1972), can be recognized.

Zone Z (0–4 mbsf) is defined by the presence of *G. menardii, G. sacculifer, G. crassaformis, P. obliquiloculata,* and other warm species. The cool-water species *G. inflata* is absent from this zone.

Subzone Y1 (4–25 mbsf) contains no *G. menardii* but abundant *G. sacculifer* and low *G. inflata*. According to Kennett and Huddlestun (1972), Subzone Y1 represents an interval of meltwater deposition at the MIS 1/2 transition ~10.5–16 k.y. ago. Subzone Y2 (25–69 mbsf) has abundant *G. inflata* decreasing upward and represents deposition during MIS 2. Subzone Y3 (69–141 mbsf) is characterized by abundant *G. sacculifer* and *G. crassaformis,* with an abundance peak of *G. truncatulinoides* at the base. According to Kennett and Huddlestun (1972), Subzone Y3 corresponds to the later part of MIS 3, with an updated age of ~25–40 ka (**Li et al.,** this volume). Below 141 mbsf is an assemblage with strongly variable abundances of *G. ruber, G. crassaformis,* and *G. inflata* probably representing Subzones Y4 and Y5, but their

division is hampered by frequent slumping (Fig. F3). However, several specimens of the warm-water species *P. obliquiloculata* occurring in the interval 150–167 mbsf appear to represent in situ deposition at warm spells in the early part of MIS 3.

Benthic foraminifer assemblages

Benthic foraminifers are dominated by infaunal species living below the sediment/water interface. They often possess a small, elongate test, such as *Bolivina* (including *Brizalina*), *Bulimina, Uvigerina,* and *Virgulina*. Some are larger and ovular in shape, including *Globobulimina* and *Chilostomella*. Typical epifaunal taxa, such as *Cibicides, Cibicidoides, Gyroidina, Gyroidinoides,* and *Oridorsalis,* are rare except in the uppermost 5 m of the core (20% or more) and a few >10% peaks close to 20, 130, and 155 mbsf (Fig. F4). Miliolids (mainly *Pyrgo, Triloculina,* and *Quinqueloculina*) and *Ammonia beccarii* occur sporadically throughout the sediment section, with high frequencies in slumped intervals, especially at 100–121 mbsf (miliolids) and close to 201 mbsf (*A. beccarii*), suggesting they are probably reworked (Table T2). On the basis of dominant taxa, four infaunal assemblages and one epifaunal assemblage can be recognized.

The four infaunal assemblages are the *Bolivina* assemblage, *Bulimina* assemblage, *Uvigerina* assemblage, and *Globobulimina* assemblage. The *Bolivina* assemblage features abundant *B. alata* and *B. striatala* and occurs mainly in the intervals 35–85 and 150–162 mbsf. The *Bulimina* assemblage contains abundant *B. aculeata, B. mexicana,* and *B. exilis* and occurs mainly in the intervals 4–90 and 141–183 mbsf. The *Uvigerina* assemblage is characterized by frequent *U. peregrina* and *U. globulosa* in three intervals: 0–1, 10–15, and 127–132 mbsf. The *Globobulimina* assemblage, with 20% or more *G. affinis,* is found at 7–26, 68–70, and 165–172 mbsf, with more than 60% abundance in the upper two intervals. In addition, the concentration of *Chilostomella ovoidea* (5%–15%) between 80 and 171 mbsf is also significant. The epifaunal assemblage is characterized by 10% or more *Cibicides, Gyroidina, Oridorsalis,* and allied forms, found mainly at 0–8, ~20, ~130, and ~155 mbsf (Fig. F4).

Modern benthic foraminifer assemblages from the northern Gulf of Mexico show distinct depth-dependent characteristics (Poag, 1981). Offshore from the Mississippi River mouth, *Uvigerina* facies occurs at ~180 m, *Brizalina* (= *Bolivina*) facies at ~180–900 m, *Bulimina* facies at ~900–2200 m, and *Nuttallides* facies and *Cibicides* facies in waters below 2200 m (Fig. F1). Therefore, changes in the abundance and distribution of benthic foraminifer assemblages in Hole U1322B could have been affected by river discharge and slumping intensities, as well as by water depth fluctuations due to sea level changes in late Pleistocene glacial–interglacial cycles.

Summary

Planktonic foraminifer Zone Z and Subzones Y1–Y5 and several benthic foraminifer assemblages are recognized in samples from IODP Hole U1322B. Respectively, these faunal (sub)zones and assemblages characterize sediment intervals corresponding to MIS 1–4.

The bases of Zone Z and Subzone Y1–Y3 lie close to subbottom depths of 4, 25, 69, and 141 m, respectively. The separation of Subzones Y4 and Y5, however, is hampered by frequent slumping below 173 mbsf.

Benthic foraminifer assemblages are generally distributed in more than one interval: *Bolivina* assemblage at 35–85 and 150–162 mbsf, *Bulimina* assemblage at 4–90 and 141–183 mbsf, *Uvigerina* assemblage at 0–1, 10–15, and 127–132 mbsf, *Globobulimina* assemblage at 7–26, 68–70, and 165–172 mbsf, and the epifaunal *Cibicides* assemblage at 0–8 and ~20, ~130, and ~155 mbsf.

Acknowledgments

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Figure F1. Distribution of modern benthic foraminifer biofacies in the northern Gulf of Mexico (modified from Poag, 1981), and location of IODP Site U1322. Also shown are 200 and 2000 m isobaths.

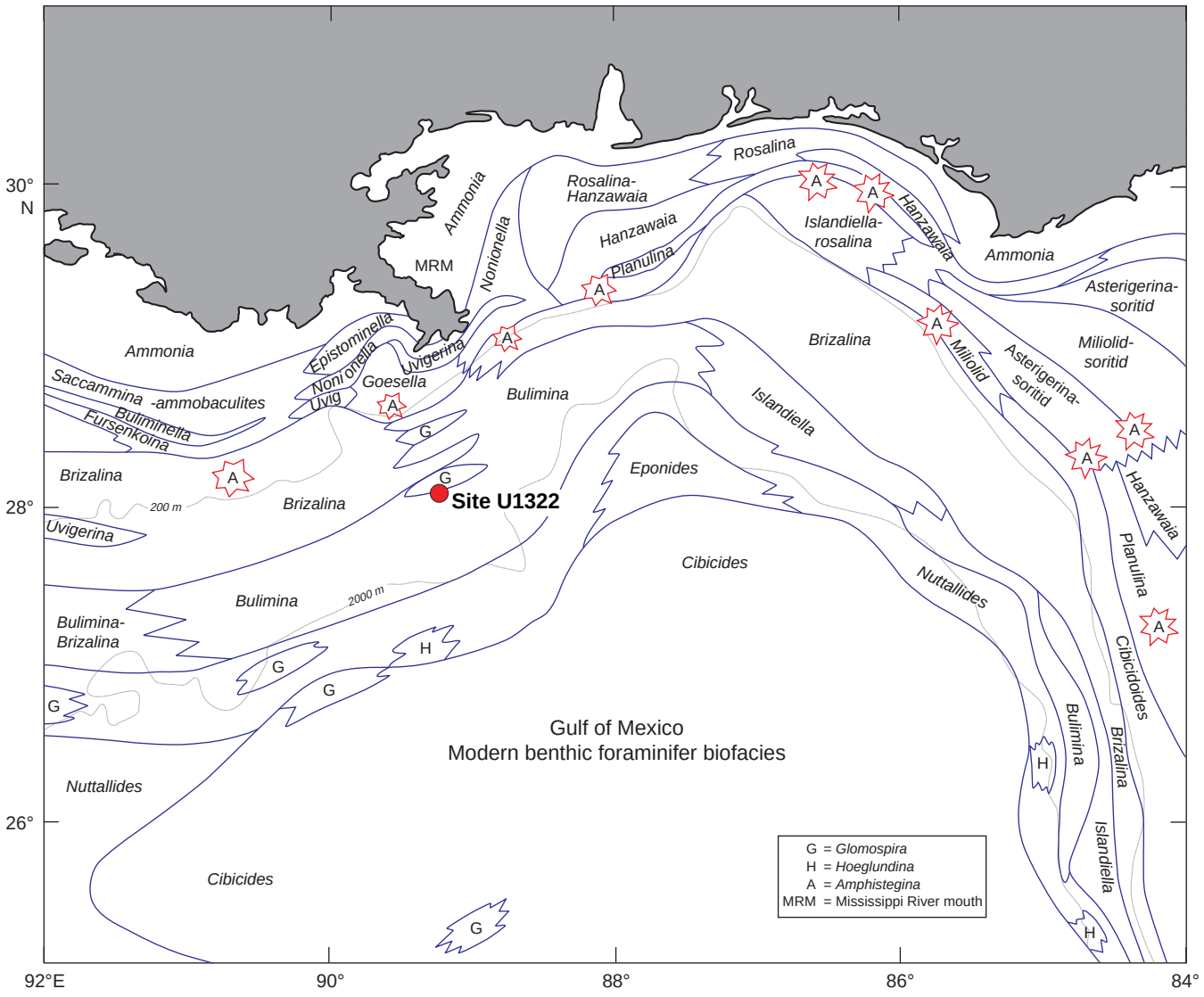

Figure F2. Core recovery, lithology, gamma radiation, and resistivity logs of Hole U1322B (Expedition 308 Scientists, 2005), abundance of planktonic and benthic foraminifer groups, and >63 µm coarse fraction (solid lines). Horizontal green bars = slumped intervals. MIS = marine isotopic stage.

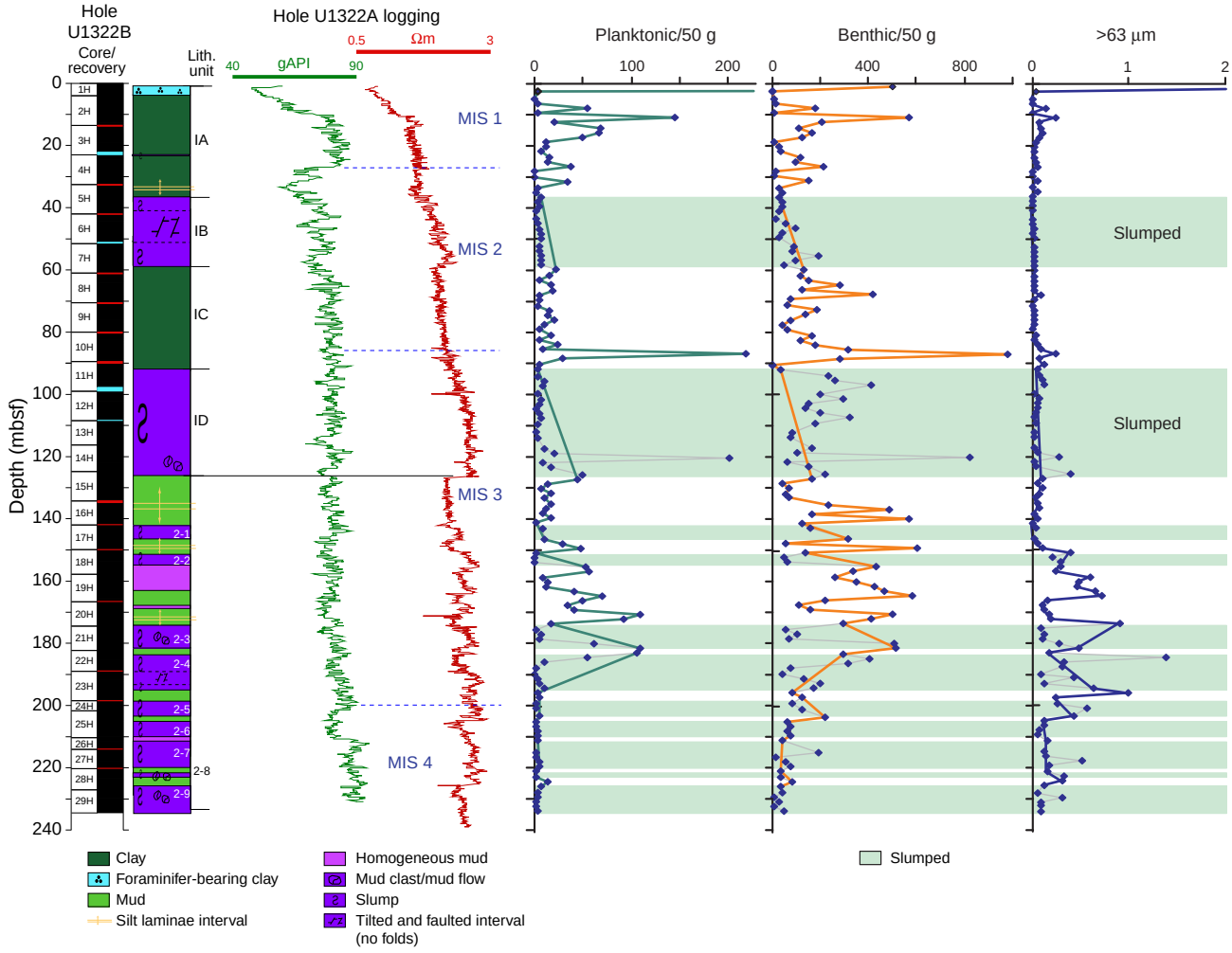

Figure F3. Downhole distribution of common planktonic foraminifers in Hole U1322B and zonation (solid lines). Ind = individual. Gray lines = data collected from slumped intervals (horizontal green bars).

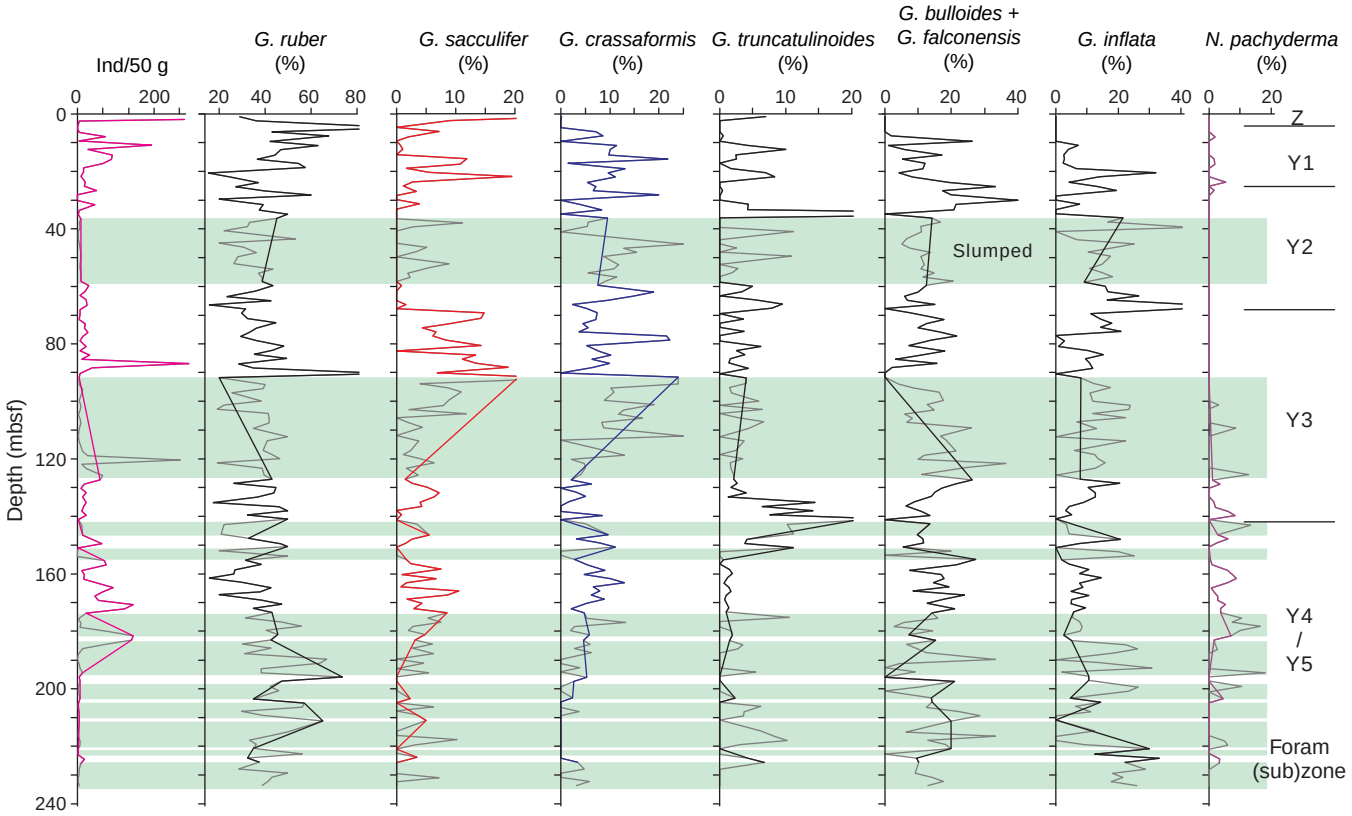

Figure F4. Downhole distribution of common benthic foraminifers in Hole U1322B (solid lines). Ind = individual. Gray lines = data collected from slumped intervals (horizontal green bars).

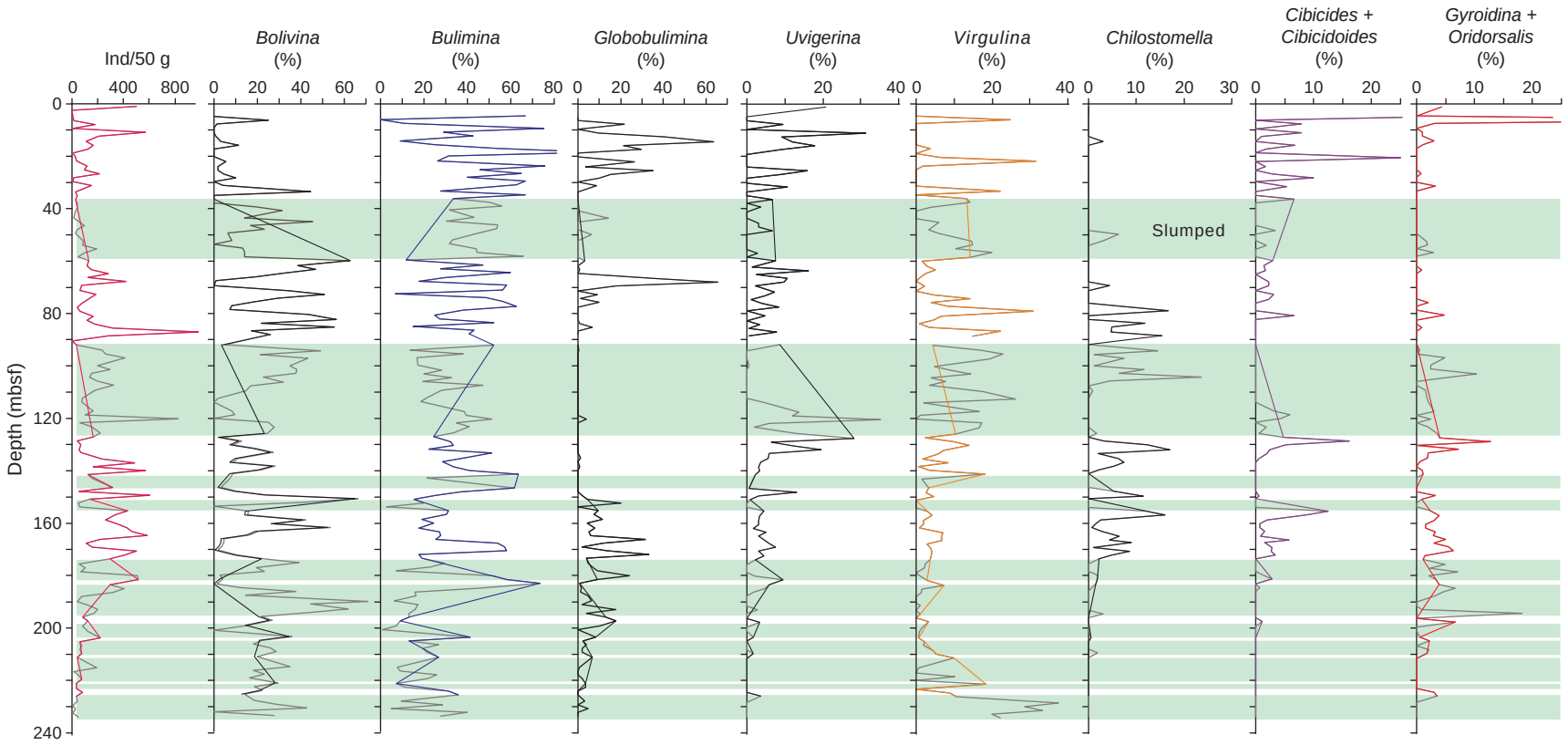

Table T1. Planktonic foraminifer census data, Hole U1322B. This table is available in an **oversized format.**

Table T2. Benthic foraminifer census data, Hole U1322B. This table is available in an **oversized format.**