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## Introduction

This report contains data and initial interpretations from a reconnaissance study of Holocene marine sediments recovered from the Pigmy Basin on the continental slope off Louisiana (Fig. 1). The Gulf of Mexico (GOM) is closely linked to and influenced by processes and conditions on adjacent continental areas. The Mississippi and other major rivers transport large amounts of fresh water and sediment into the GOM. Thus, the marine sediments in the GOM contain information on changing conditions within the GOM and on changing conditions on the adjacent land areas. Previous studies show that major hydrologic events within the Mississippi Basin are recorded in GOM sediments. For example, during the last deglaciation, large amounts of meltwater flowed down the Mississippi River resulting in lower surface water salinities. The reduced surface water salinities are reflected in anomalously low (light) oxygen isotope ratios in the shells of surface dwelling planktic foraminifers that were deposited in the GOM at the time of the meltwater event (e.g. Kennett and Shackleton, 1975; Kennett and others, 1985). The isotopic meltwater signal is largest near the mouth of the Mississippi River, but is still evident, albeit subdued, in cores off the coast of Mexico (Kennett and Shackleton, 1975; Leventer and others, 1982). In addition to the deglacial meltwater event, data from piston cores recovered in the Orca Basin, which is adjacent to the Pigmy Basin, suggest that a series of major continental flood events or prolonged wet periods occurred within the Mississippi Basin during the last 5,000 years. The "megafloods" are recorded in Orca Basin sediments by a combination of changes in the planktic foraminifer assemblages, carbon isotopic values in surface dwelling planktic foraminifers, and increases in the grain size of the siliciclastic mud component of the sediments (Brown and others, 1999). Our general purpose in this study is to assess the overall potential of the sediments of the Pigmy Basin for developing a detailed record of environmental changes in the GOM and specifically to see if the sediments contain evidence for Holocene continental flood events.

## Materials and Methods

The Pigmy Basin is a narrow intraslope basin on the continental slope off Louisiana (Fig. 1). The basin is bounded on the northwest and southeast by steep slopes that show signs of submarine slides. In 1983, the Ocean Drilling Program drilled two holes, 619 and 619A, near the axis of the basin. Hole 619 was continuously cored to 208.7 meters subbottom. The shipboard scientific party concluded that the first core of Hole 619 began below the sediment-water interface and did not recover the top portion of the sedimentary column. Thus, at the conclusion of Hole 619, a single core (619A) was taken to recover the upper portion of the sedimentary sequence. Core 619A recovered approximately 5.2 meters of hemipelagic gray mud. The entire core shows signs of drilling disturbance; the disturbance is most severe at the top of the core and becomes less severe towards the base of the recovered section. The drilling disturbance precluded high density sampling. In general, we tried to obtain samples every 10 to 20cm and avoid the most severely disturbed intervals. Distribution of samples along with estimated abundance of microfossils and selected non-organic sediment constituents and drilling disturbance are summarized in Figure 2.

Sample processing

Samples for foraminifer and isotope analyses and Accelerator Mass Spectrometry (AMS) $^{14}C$ dating were dried at <50°C, disaggregated in deionized water and wet sieved at 63μm. The >63μm fraction was dry sieved into 63-150μm and >150μm fractions. All samples were screened to estimate abundances of benthic and planktic foraminifers and siliceous microfossils. (Fig 2). Abundances were estimated on an arbitrary scale. Constituents with one or two individuals per sample were termed "trace"; constituents that appeared to compose over 50% of the sample were termed "abundant". "Rare" and "common" were gradations between the two endpoints.

Chronology

Three samples from the least disturbed area of the 619A were selected for AMS $^{14}C$ dating. The dates were obtained on mixed planktic foraminifers hand picked from the >150μm washed residue. The picked specimens were cleaned in an ultrasonic bath to remove any fine sediment and other debris in sutures and apertures. The carbon from these samples was first captured as $CO_2$ by acidification of the entire sample with 85% phosphoric acid ($H_2PO_4$) in a vacuum chamber. The $CO_2$ was then dried by forcing the gas through a water trap cooled to approximately 80°C. The dried $CO_2$ was converted to pure carbon in the form of graphite by placing a measured volume (equivalent to 1 mg carbon) in a chamber with iron powder, hydrogen, and zinc as a catalyst at 575$^0$C for ten hours. The sample carbon (precipitated on the iron) was pressed into aluminum targets for AMS analysis. Dating was done at the Lawrence Livermore Laboratory Center for Accelerator Mass Spectrometry (CAMS) in Livermore, CA (see Roberts, M. L., and others, 1997, for a detailed description of the CAMS facility and operation. AMS $^{14}C$ dates are corrected by 400 years for reservoir effects, (Brown and others, 1999). An age model for the core was constructed by assuming constant accumulation rates between AMS $^{14}C$ dates (Table 1) and a modern age for the core top.

Stable isotopes

We obtained oxygen and carbon isotope values for *Globigerinoides ruber* (white variety) and *G. sacculifer* from all samples that contained enough material for analyses. In general, we analyzed 5 specimens of *G. ruber* from the 212-250μm fraction and 5 specimens of *G. sacculifer* from the 250 – 350 μm fraction. Isotopic measurements were done using the Woods Hole Oceanographic Institution Finnigan MAT252 mass spectrometer equipped with a "Kiel" automated carbonate analytical device containing two parallel extraction lines. The system is designed to analyze each sample in a separate reaction vessel, which is placed on the vacuum system for the 10 minute reaction with 70°C, 100% phosphoric acid made using a modified Coplen and others (1983) formula. During the ten minute reaction time, all evolved gases are trapped at liquid nitrogen temperatures. When the reaction is over, the non-condensables are pumped away and the first trap is warmed to -100°C, releasing the $CO_2$, but trapping the water. The pressure of evolved $CO_2$ is measured and recorded and the second trap temperature is lowered to –190°C. At the end of the $CO_2$ transfer from the first trap to the second, the second trap is warmed to room temperature and the gas is introduced into the mass spectrometer through a capillary and expanded if necessary. All traps are baked at +130°C after each reaction to remove contaminating water vapor.

Isotopic values are reported relative to Vienna Pee Dee Belemnite (VPDB) in delta notation and expressed in per mil using the intermediate standard NBS 19. The precision of

2,200 NBS 19 analyses run during the interval between March 1993 and June 1998 (all sizes from 10 to 300 μg) is 0.07 for $\delta^{18}O$ and 0.03 for $\delta^{13}C$. Small sample (10-20 μg and under, all laboratory conditions) precision is 0.14 for $\delta^{18}O$ and 0.06 for $\delta^{13}C$. Since standard material is weighed, we use the relationship between weight and voltage of standard material to assess unknown data based upon its mass 44 voltage. We only accept data which has a mass 44 sample voltage greater than 0.6 volts and whose ratio between sample and standard voltage (efficiency of bellows balancing) is between 0.8 and 1. Isotopic data from our samples are listed in Table 2.

Planktic foraminifer census

A census of the planktic foraminifer assemblage >150μm was obtained for samples below Section 1 that had common planktic foraminifers (see Fig 2 and Table 3). Samples from Section 1 had sparse planktic assemblages and were from highly disturbed areas of the core. The washed residues (>150μm) were mechanically split to obtain a sub-sample of ~ 300 planktic foraminifers for the faunal census. Individual specimens were identified and counted on standard 60 square microfossil slides. We follow the taxonomy of Parker (1962) as modified by Poore, (1979). Census results are in Table 3. List of taxa in Table 3 are in the taxonomic notes section.

## Results

Our isotopic and faunal data from the Pigmy Basin suggest changes in average sea surface temperature conditions in the GOM during the Holocene and also show evidence for several Holocene flood events (Fig. 3). The $\delta^{18}O$ value in planktic foraminifers generally reflects the temperature and the isotopic composition of the sea water in which the foraminifer forms its shell. Colder temperatures result in more positive (heavier) $\delta^{18}O$ values whereas warmer temperatures result in more negative (lighter) $\delta^{18}O$. On glacial – interglacial time-scales, the overall isotopic composition of the ocean water reflects the amount of freshwater stored on the continents as ice. More continental ice volume results in more positive sea water $\delta^{18}O$ while less continental ice results in more negative sea water $\delta^{18}O$. Variations in the input of freshwater to marine waters also affects the isotopic values of sea water since freshwater has more negative $\delta^{18}O$ and $\delta^{13}C$ than sea water.

*Globigerinoides ruber* (white variety) is a surface dwelling form that tends to live year-round in the GOM (Flower and Kennett, 1990) and is a good recorder of average annual temperature. *Globigerinoides ruber* is also more euryhaline than other planktic foraminifers and thus remains near the surface even when salinity is reduced (see discussion in Flower and Kennett, 1990). *Globigerinoides sacculifer* is a surface dwelling form that yields isotopic values that are more positive than *G. ruber* throughout our record at 619A (Fig 3). In the GOM, *G. sacculifer* is most common in sediments underlying the loop current that brings open marine tropical surface waters into the GOM. The more positive $\delta^{18}O$ of *G. sacculifer* with respect to *G. ruber* in our data set from 619A indicates that *G. sacculifer* lives slightly deeper in the water column or is more abundant during the winter months, thus accounting for the more positive isotopic values.

The $\delta^{18}O$ plots for *G. ruber* and *G. sacculifer* and faunal abundance data (Fig 3) show a general three fold division of the Holocene. In the earliest part of the Holocene, both taxa show more positive values, indicating cooler surface water conditions. The middle part of the Holocene, from about 7 to 2 kya has more negative (although variable) $\delta^{18}O$ values in both taxa indicating overall warmer surface waters with the warmest intervals being between about 2.0 to 2.5 kya and 4.5 to 6.5 kya. The youngest part of the Holocene shows a trend towards cooler temperatures as evidenced by the more positive isotopic values. The faunal census data supports the temperature changes suggested by the isotopic trends. In the GOM, *Globorotalia crassaformis* is considered a cool water indicator (Kennett and others, 1985). *Neogloboquadrina pachyderma* (right-coiling) is a sub-polar North Atlantic form (Kipp, 1976) and *Neogloboquadrina* "dupac", an informal taxon representing specimens transitional between right-coiling *Neogloboquadrina pachyderma* and *N. dutertrei*, is primarily a sub-polar North Atlantic form (Kipp, 1976). Note that the sub-polar representatives of *Neogloboquadrina* and the cool water *G. crassaformis* are present in the oldest part of the Holocene record, but are absent from the samples between 4.5 and 6.5 kya that show more negative isotopic values and, hence, warmer temperatures. The interval between 4.5 and 6.5 kya also has the highest percent of the *G. sacculifer*, which is indicative of higher temperatures or stronger influence of the tropical loop current. *Globorotalia crassaformis* reappears in samples between 2.5 and 3.5 kya when isotope values become more positive, but not as positive as the values at the beginning of the Holocene. Aside from two minor occurrences, the sub-polar species are absent from assemblages between 2.5 and 3.5 kya, thus supporting the interpretation of somewhat cooler temperatures, but not as cool as the early Holocene interval. The temperature trends indicated by the isotopic data in 619A are consistent with a number of studies that suggest that the middle part of the Holocene was the warmest interval of the last 10,000 years (e.g. see discussion in Dwyer and others, 1996).

Two anomalous excursions to negative values below – 2.3 per mil occur in the *G. ruber* $\delta^{18}O$ record between 7 and 8 kya. The $\delta^{18}O$ excursions stand out from the rest of the *G. ruber* $\delta^{18}O$ data, which generally have values more positive than about –1.9 per mil. In addition, the two excursions in $\delta^{18}O$ are accompanied by negative excursions in the $\delta^{13}C$ record (Fig. 3). We interpret the strong negative excursions in both $\delta^{18}O$ and $\delta^{13}C$ as evidence for floodwater events that caused a low salinity surface water layer with negative $\delta^{18}O$ and $\delta^{13}C$ isotopic values to develop in the Pigmy Basin area. We do not believe the prominent excursions in the *G. ruber* isotopic values between 7 and 8 kya are temperature events because the *G. sacculifer* $\delta^{18}O$ record does not show indications of a significant temperature change at these levels and a temperature increase would not explain the negative excursion in the *G. ruber* $\delta^{13}C$. Since our samples span ~ 2cm of core, the samples average at least 40 to 50 years of time. Thus, we cannot determine if the excursions represent one large event or a series of events occurring over a multiyear period. The development of a thin (ca <50m) low salinity surface layer best explains the isotopic data. The euryhaline *G. ruber* would be able to remain in the uppermost surface waters whereas *G. sacculifer*, which prefers more normal marine salinities, would likely sink below the low salinity layer or be excluded from the area if the low salinity layer was a short term or seasonal feature.

In a study of the last 5 ka in the nearby Orca Basin, Brown and others (1999), suggest that prominent negative excursions in $\delta^{13}C$ from surface dwelling planktic foraminifers in conjunction with changes in planktic foraminifer assemblages may be better markers for floodwater events in the GOM than $\delta^{18}O$. One of the reasons that $\delta^{13}C$ may be a better proxy for floodwater events is that the $\delta^{18}O$ record is complicated by temperature changes. The lower temperatures of the floodwaters might cancel out small changes in surface salinity due to influx of the floodwaters. The suggestion requires further study. We have noted two levels at 1.2 kya and 4.0 kya in Figure 3 that show strong negative excursions in $\delta^{13}C$ that are associated with small negative excursions in $\delta^{18}O$. These levels may also represent floodwater events.

Although drilling disturbance complicates details of the environmental record in 619A, the core disturbance cannot be used to explain the features we have noted. Mixing due to drilling disturbance would tend to average out extremes in values and thus diminish the magnitude of the isotopic excursions indicating floodwater events. Thus, the overall observations and interpretations we have made on the 619A record are considered conservative and they demonstrate that a record of continental floodwater events is present in sediments of the Pigmy Basin.

## Summary and Conclusions

AMS $^{14}C$ dates demonstrate that the Pigmy Basin has a thick Holocene sequence with an accumulation rate of ~ 50cm/kyr. Isotopic and faunal data from Hole 619A shows clear evidence for changes in average sea surface temperature during the Holocene and at least two significant floodwater events at about 7 kya and 7.8 kya. Our reconnaissance study shows that the sediments of the Pigmy Basin hold the potential for developing decadal to century scale records that will contain information on major floods in the Mississippi Basin as well as environmental conditions in the GOM.

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## Taxonomic Notes

List of taxa included in Table 3 follow below. Illustrations of most taxa can be found in Parker (1962) or Poore (1979).

*Candeina nitida* d'Orbigny
*Globigerina bulloides* d'Orbigny

*G. calida* Parker

*G. digitata* Brady

*G. falconensis* Blow

*G. rubescens* Hofker

*Globigerinella aequilateralis* (Brady)

*Globigerinita glutinata* (Egger)

*G. iota* Parker

*Globigerinoides conglobatus* (Brady)

*G. sacculifer* (Brady)

*G. ruber* (d'Orbigny)

We recognize two informal categories of *G. ruber*: red and white varieties. Red variety is characterized by the presence, regardless of how slight, of red, or pink, pigmentation. White variety is characterized by the complete absence of such pigmentation.

*G. tenellus* Parker

*Globorotalia crassaformis* (Galloway and Wissler)

*G. hirsuta* (d'Orbigny)

*G. menardii* (Parker, Jones, and Brady)

*G. scitula (Brady)*

*G. tosaensis* Takayanagi and Saito

*G. truncatulinoides* (d'Orbigny)

*G. tumida* (Brady)

*G. ungulata* Bermudez

*Hastigerina pelagica* (d'Orbigny)

*Neogloboquadrina dutertrei* (d'Orbigny)

*N. pachyderma* (Ehrenberg)

We separated *N. pachyderma* into right-coiling and left-coiling varieties. In addition, right-coiling specimens with >4 chambers in the last whorl are classified under the informal category of *N.* "dupac" and are considered to be gradational forms between *N. pachyderma* and *N. dutertrei.*

*Orbulina universa* d'Orbigny

*Pulleniatina* Banner and Blow

We separated *Pulleniatina* into two different species, depending on the position of the primary aperture. *Pulleniatina finalis* is characterized by the aperture positioned directly over a previous chamber. The aperture positioned over multiple previous chambers characterizes *Pulleniatina obliquiloculata.*

*Sphaeroidinella dehiscens* (Parker and Jones)

Other = species that were unidentified or not listed above.

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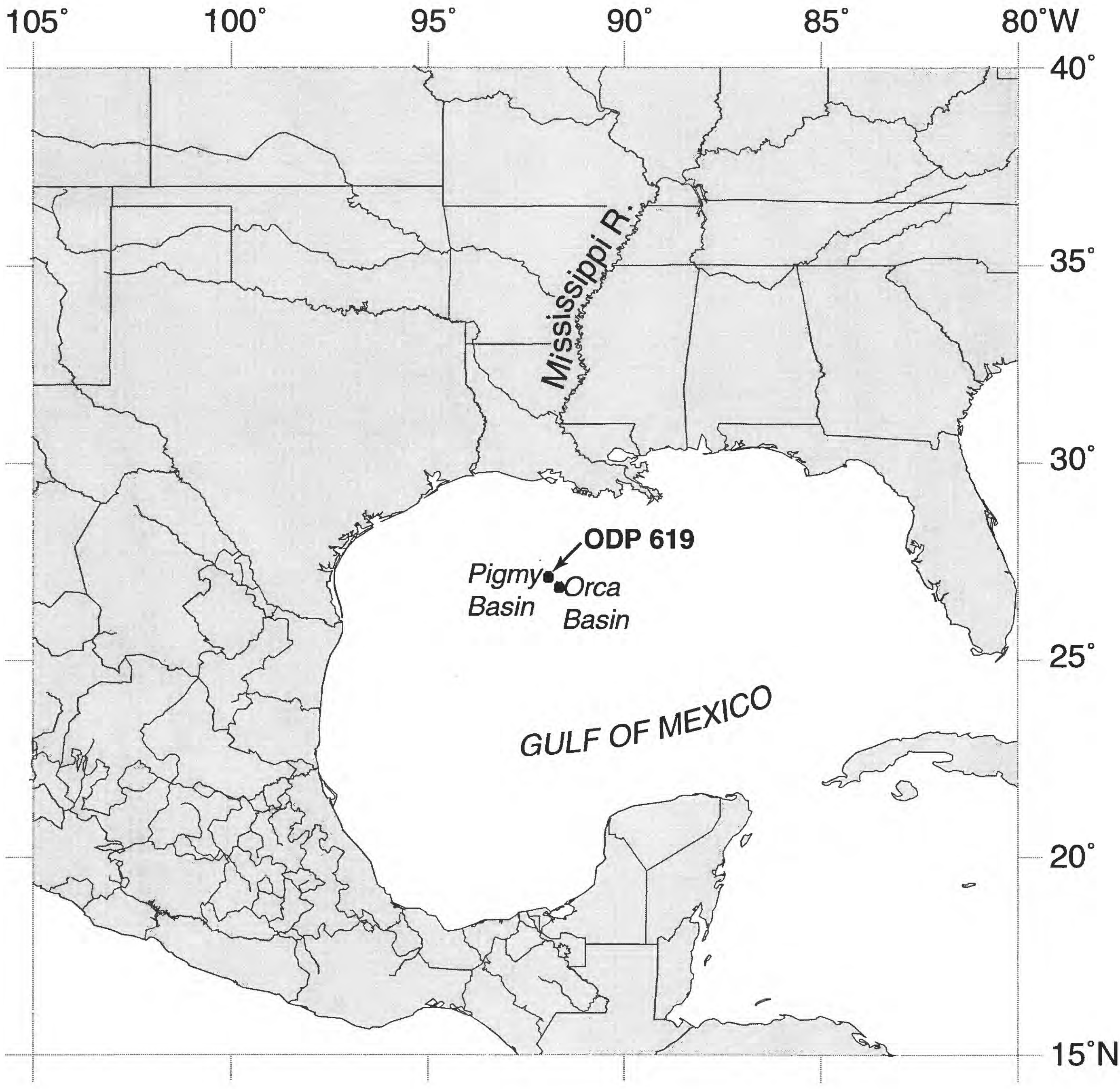


**Figure 1.** Map showing location of Pigmy and Orca Basins. ODP Site 619A is in the Pigmy Basin

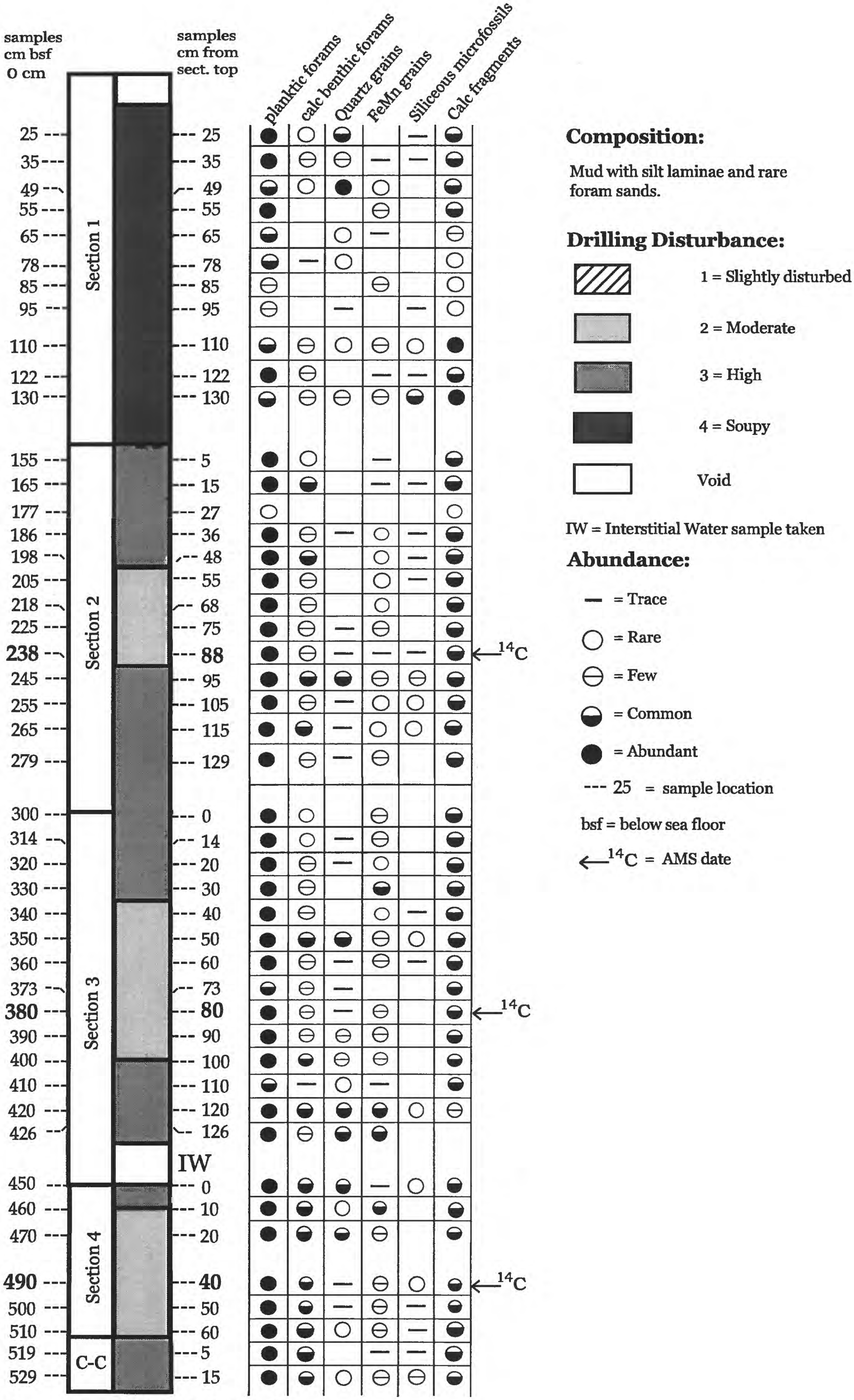


**Figure 2.** ODP Hole 619A Core 1

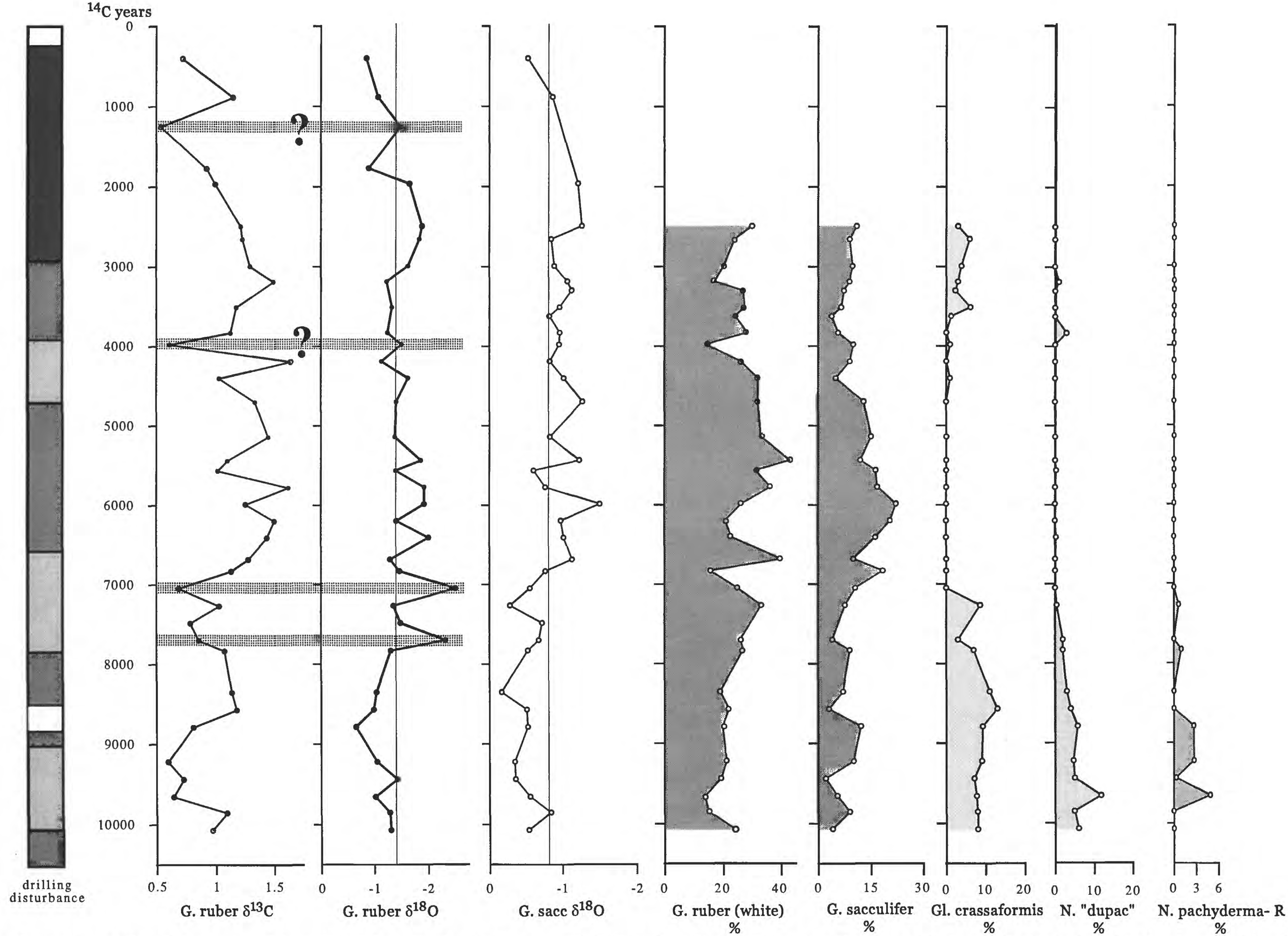


**Figure 3:** Selected isotope and faunal data from ODP 619A. Extent of drilling disturbance shown by column on left; interval with darker shading is more disturbed. Unshaded areas represent voids. Continental flood events are shown by stippled pattern on *G. ruber* isotope curve. **?** = possible flood events.

| Sample | Material | $^{14}C$ age | $^{14}C$ age (corrected) |
|---|---|---|---|
| 0619A 1,2W 88-90 cm | Mixed planktics, mostly *G. tumida* | 4230 | 3830 |
| 0619A 1,3W 80-82 cm | Mixed planktics, mostly *G. tumida* | 7230 | 6830 |
| 0619A 1,4W 40-42 cm | Mixed planktics, mostly *G. tumida* | 9620 | 9220 |
| ODP Core 0619A | Latitude: 27°11.61'N | Longitude: 91°24.54' W | Water depth = 2259 m |

**Table 1.** AMS Dates from ODP Hole 619A

| Sample | Depth (cm) | Age (corr) | *Globigerinoides ruber* (white) $\delta^{13}C$ | $\delta^{13}C$ SD | $\delta^{18}O$ | $\delta^{18}O$ SD | *Globigerinoides sacculifer* $\delta^{13}C$ | $\delta^{13}C$ SD | $\delta^{18}O$ | $\delta^{18}O$ SD |
|---|---|---|---|---|---|---|---|---|---|---|
| 619A 1H, 1 25-27 | 25 | 402 | 0.72 | 0.02 | -0.86 | 0.03 | 1.63 | 0.01 | -0.53 | 0.02 |
| 619A 1H, 1 55-57 | 55 | 885 | 1.15 | 0.01 | -1.08 | 0.02 | 2.16 | 0.00 | -0.87 | 0.02 |
| 619A 1H, 1 78-80 | 78 | 1255 | 0.54 | 0.01 | -1.49 | 0.01 | | | | |
| 619A 1H, 1 110-112 | 110 | 1770 | 0.92 | 0.02 | -0.90 | 0.02 | | | | |
| 619A 1H, 1 122-124 | 122 | 1963 | 1.00 | 0.01 | -1.66 | 0.01 | 1.72 | 0.01 | -1.22 | 0.02 |
| 619A 1H, 2 5-7 | 155 | 2494 | 1.22 | 0.01 | -1.89 | 0.01 | 1.91 | 0.01 | -1.27 | 0.02 |
| 619A 1H, 2 15-17 | 165 | 2655 | 1.23 | 0.02 | -1.84 | 0.03 | 1.89 | 0.01 | -0.85 | 0.03 |
| 619A 1H, 2 36-38 | 186 | 2993 | 1.29 | 0.01 | -1.63 | 0.02 | 1.49 | 0.01 | -0.89 | 0.02 |
| 619A 1H, 2 48-50 | 198 | 3186 | 1.49 | 0.01 | -1.23 | 0.01 | 2.22 | 0.01 | -1.07 | 0.02 |
| 619A 1H, 2 55-57 | 205 | 3299 | | | | | 2.09 | 0.01 | -1.13 | 0.02 |
| 619A 1H, 2 68-70 | 218 | 3508 | 1.18 | 0.00 | -1.33 | 0.01 | 2.07 | 0.01 | -0.97 | 0.01 |
| 619A 1H, 2 75-77 | 225 | 3621 | | | | | 2.13 | 0.01 | -0.83 | 0.01 |
| 619A 1H, 2 88-90 | 238 | 3830 | 1.13 | 0.01 | -1.25 | 0.02 | 1.83 | 0.01 | -0.97 | 0.01 |
| 619A 1H, 2 95-97 | 245 | 3978 | 0.61 | 0.01 | -1.51 | 0.02 | 1.74 | 0.01 | -0.96 | 0.02 |
| 619A 1H, 2 105-107 | 255 | 4189 | 1.65 | 0.02 | -1.14 | 0.02 | 1.72 | 0.01 | -0.83 | 0.02 |
| 619A 1H, 2 115-117 | 265 | 4400 | 1.03 | 0.01 | -1.63 | 0.02 | 1.86 | 0.01 | -1.02 | 0.01 |
| 619A 1H, 2 129-130 | 279 | 4696 | 1.34 | 0.02 | -1.41 | 0.01 | 1.68 | 0.01 | -1.28 | 0.01 |
| 619A 1H, 3 0-2 | 300 | 5140 | 1.45 | 0.01 | -1.38 | 0.02 | 1.69 | 0.01 | -0.83 | 0.03 |
| 619A 1H, 3 14-16 | 314 | 5436 | 1.10 | 0.01 | -1.87 | 0.02 | 1.79 | 0.01 | -1.23 | 0.03 |
| 619A 1H, 3 20-22 | 320 | 5562 | 1.02 | 0.01 | -1.40 | 0.04 | 1.68 | 0.01 | -0.61 | 0.02 |
| 619A 1H, 3 30-32 | 330 | 5774 | 1.63 | 0.01 | -1.93 | 0.02 | 1.42 | 0.01 | -0.77 | 0.02 |
| 619A 1H, 3 40-42 | 340 | 5985 | 1.26 | 0.01 | -1.93 | 0.03 | 1.73 | 0.01 | -1.51 | 0.01 |
| 619A 1H, 3 50-52 | 350 | 6196 | 1.50 | 0.01 | -1.42 | 0.02 | 1.73 | 0.01 | -0.98 | 0.02 |
| 619A 1H, 3 60-62 | 360 | 6407 | 1.44 | 0.01 | -2.01 | 0.03 | 1.74 | 0.02 | -1.02 | 0.03 |
| 619A 1H, 3 73-75 | 373 | 6682 | 1.28 | 0.01 | -1.30 | 0.01 | 2.19 | 0.01 | -1.13 | 0.02 |
| 619A 1H, 3 80-82 | 380 | 6830 | 1.13 | 0.02 | -1.47 | 0.03 | 1.65 | 0.01 | -0.77 | 0.02 |
| 619A 1H, 3 90-92 | 390 | 7047 | 0.69 | 0.01 | -2.51 | 0.01 | 1.60 | 0.01 | -0.56 | 0.01 |
| 619A 1H, 3 100-102 | 400 | 7265 | 1.03 | 0.01 | -1.36 | 0.02 | 1.61 | 0.02 | -0.29 | 0.02 |
| 619A 1H, 3 110-112 | 410 | 7482 | 0.79 | 0.00 | -1.49 | 0.01 | 2.05 | 0.01 | -0.73 | 0.02 |
| 619A 1H, 3 120-122 | 420 | 7699 | 0.86 | 0.01 | -2.32 | 0.01 | 1.92 | 0.00 | -0.68 | 0.02 |
| 619A 1H, 3 126-127 | 426 | 7829 | 1.07 | 0.00 | -1.31 | 0.03 | 1.61 | 0.02 | -0.53 | 0.02 |
| 619A 1H, 4 0-2 | 450 | 8351 | 1.14 | 0.01 | -1.04 | 0.01 | 1.69 | 0.02 | -0.17 | 0.02 |
| 619A 1H, 4 10-12 | 460 | 8568 | 1.18 | 0.02 | -0.99 | 0.01 | 1.72 | 0.01 | -0.51 | 0.01 |
| 619A 1H, 4 20-22 | 470 | 8785 | 0.81 | 0.01 | -0.66 | 0.03 | 1.94 | 0.01 | -0.53 | 0.01 |
| 619A 1H, 4 40-42 | 490 | 9220 | 0.60 | 0.01 | -1.05 | 0.01 | 1.54 | 0.01 | -0.35 | 0.02 |
| 619A 1H, 4 50-52 | 500 | 9437 | 0.73 | 0.01 | -1.43 | 0.02 | 1.51 | 0.01 | -0.36 | 0.01 |
| 619A 1H, 4 60-62 | 510 | 9655 | 0.64 | 0.01 | -1.02 | 0.02 | 1.53 | 0.00 | -0.56 | 0.01 |
| 619A 1H, CC 5-7 | 519 | 9850 | 1.10 | 0.01 | -1.29 | 0.02 | 1.49 | 0.01 | -0.85 | 0.02 |
| 619A 1H, CC 15-17 | 529 | 10067 | 0.97 | 0.01 | -1.31 | 0.01 | 1.56 | 0.00 | -0.54 | 0.01 |

**Table 2.** Isotope values from ODP Hole 619A

| Sct | Top | Bot (cm) | Orbulina universa | Globigerinoides ruber (red) | Globigerinoides ruber (white) | Globigerinoides conglobatus | Globigerinoides sacculifer | Sphaeroidinella dehiscens | Globigerinella aequilateralis | Globigerina bulloides | Globigerina falconensis | Globigerina rubescens | Neogloboquadrina pachyderma- d | Neogloboquadrina dutertrei | Globorotalia crassaformis | Neogloboquadrina "dupac" | Globorotalia hirsuta | Globorotalia scitula | Globorotalia menardii | Globorotalia tumida | Globorotalia truncatulinoides | Globigerinita glutinata | Globigerina digitata | Globigerinoides tenellus | Globorotalia ungulata | Globigerina calida | Pulleniatina | Hastigerina pelagica | Globorotalia tosaensis | Candeina nitida | Globigerinita iota | Other | Benthic foraminifers | Total planktics | **Total** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1, 2W | 5 | 7 | 7 | 18 | 101 | 1 | 37 | 0 | 2 | 11 | 9 | 3 | 0 | 29 | 9 | 0 | 2 | 2 | 19 | 8 | 17 | 17 | 2 | 2 | 6 | 4 | 29 | 0 | 0 | 0 | 3 | 2 | 5 | 340 | 345 |
| 1, 2W | 15 | 17 | 3 | 17 | 70 | 3 | 25 | 0 | 3 | 8 | 8 | 3 | 0 | 22 | 16 | 1 | 0 | 0 | 24 | 4 | 17 | 27 | 0 | 0 | 0 | 1 | 34 | 0 | 0 | 0 | 1 | 3 | 63 | 290 | 353 |
| 1, 2W | 36 | 38 | 19 | 12 | 62 | 0 | 30 | 0 | 3 | 9 | 12 | 7 | 0 | 22 | 12 | 0 | 0 | 3 | 28 | 6 | 17 | 34 | 0 | 3 | 3 | 5 | 16 | 0 | 0 | 0 | 0 | 2 | 14 | 291 | 305 |
| 1, 2W | 48 | 50 | 5 | 24 | 52 | 2 | 27 | 0 | 17 | 19 | 25 | 3 | 0 | 14 | 9 | 3 | 0 | 1 | 24 | 3 | 13 | 26 | 1 | 10 | 4 | 6 | 14 | 0 | 0 | 1 | 1 | 4 | 21 | 309 | 330 |
| 1, 2W | 55 | 57 | 11 | 16 | 81 | 3 | 22 | 0 | 7 | 5 | 8 | 1 | 0 | 13 | 7 | 0 | 0 | 0 | 30 | 9 | 22 | 20 | 2 | 6 | 0 | 10 | 21 | 1 | 0 | 0 | 0 | 6 | 14 | 287 | 301 |
| 1, 2W | 68 | 70 | 3 | 24 | 80 | 1 | 19 | 1 | 1 | 6 | 6 | 0 | 0 | 20 | 18 | 0 | 0 | 0 | 29 | 1 | 21 | 32 | 0 | 1 | 0 | 2 | 20 | 0 | 0 | 0 | 2 | 4 | 13 | 278 | 291 |
| 1, 2W | 75 | 77 | 1 | 12 | 76 | 2 | 12 | 2 | 2 | 8 | 10 | 0 | 0 | 19 | 4 | 0 | 0 | 2 | 10 | 3 | 19 | 74 | 2 | 4 | 9 | 10 | 19 | 0 | 1 | 0 | 3 | 10 | 12 | 302 | 314 |
| 1, 2W | 88 | 90 | 8 | 57 | 146 | 2 | 29 | 0 | 11 | 15 | 25 | 3 | 0 | 33 | 0 | 15 | 0 | 0 | 16 | 2 | 28 | 57 | 3 | 7 | 11 | 17 | 23 | 0 | 0 | 1 | 0 | 5 | 21 | 493 | 514 |
| 1, 2W | 95 | 97 | 15 | 38 | 43 | 1 | 32 | 1 | 11 | 9 | 26 | 4 | 0 | 22 | 2 | 0 | 0 | 1 | 2 | 4 | 13 | 43 | 2 | 11 | 6 | 9 | 16 | 0 | 0 | 2 | 2 | 0 | 12 | 315 | 327 |
| 1, 2W | 105 | 107 | 9 | 31 | 63 | 0 | 21 | 0 | 0 | 7 | 10 | 0 | 0 | 23 | 0 | 0 | 0 | 0 | 16 | 8 | 6 | 31 | 3 | 3 | 1 | 2 | 7 | 0 | 0 | 0 | 2 | 3 | 6 | 246 | 252 |
| 1, 2W | 115 | 117 | 4 | 36 | 91 | 0 | 14 | 0 | 4 | 8 | 20 | 0 | 0 | 39 | 3 | 0 | 0 | 0 | 5 | 3 | 12 | 11 | 1 | 3 | 1 | 11 | 13 | 0 | 0 | 0 | 1 | 3 | 7 | 283 | 290 |
| 1, 2W | 129 | 130 | 6 | 44 | 90 | 2 | 36 | 0 | 11 | 7 | 9 | 1 | 0 | 23 | 0 | 0 | 0 | 0 | 8 | 4 | 6 | 15 | 1 | 5 | 1 | 3 | 6 | 0 | 0 | 0 | 0 | 0 | 6 | 278 | 284 |
| 1, 3W | 0 | 2 | 4 | 15 | 79 | 1 | 35 | 0 | 0 | 6 | 15 | 0 | 0 | 14 | 0 | 0 | 0 | 0 | 5 | 2 | 10 | 15 | 1 | 6 | 4 | 8 | 17 | 0 | 0 | 0 | 0 | 1 | 4 | 238 | 242 |
| 1, 3W | 14 | 16 | 3 | 11 | 123 | 5 | 34 | 0 | 7 | 4 | 25 | 1 | 0 | 24 | 1 | 0 | 0 | 0 | 2 | 3 | 9 | 12 | 2 | 1 | 0 | 5 | 10 | 0 | 0 | 0 | 0 | 4 | 4 | 286 | 290 |
| 1, 3W | 20 | 22 | 0 | 22 | 103 | 2 | 54 | 0 | 5 | 1 | 25 | 4 | 0 | 33 | 0 | 1 | 0 | 0 | 1 | 0 | 11 | 26 | 1 | 9 | 4 | 7 | 7 | 6 | 0 | 0 | 4 | 4 | 3 | 327 | 330 |
| 1, 3W | 30 | 32 | 3 | 6 | 121 | 2 | 56 | 0 | 8 | 1 | 15 | 0 | 0 | 26 | 0 | 0 | 0 | 0 | 10 | 2 | 21 | 25 | 1 | 4 | 7 | 9 | 11 | 0 | 0 | 0 | 0 | 5 | 2 | 331 | 333 |
| 1, 3W | 40 | 42 | 6 | 13 | 75 | 1 | 63 | 0 | 10 | 0 | 11 | 0 | 0 | 41 | 0 | 0 | 0 | 0 | 4 | 2 | 8 | 19 | 0 | 1 | 5 | 12 | 9 | 0 | 0 | 0 | 0 | 4 | 13 | 271 | 284 |
| 1, 3W | 50 | 52 | 11 | 35 | 71 | 0 | 70 | 0 | 5 | 1 | 12 | 1 | 0 | 43 | 0 | 0 | 0 | 0 | 12 | 3 | 23 | 18 | 1 | 2 | 2 | 8 | 20 | 0 | 1 | 1 | 0 | 1 | 19 | 322 | 341 |
| 1, 3W | 60 | 62 | 12 | 38 | 76 | 0 | 54 | 0 | 10 | 2 | 30 | 1 | 0 | 32 | 0 | 1 | 0 | 0 | 4 | 2 | 12 | 27 | 2 | 9 | 3 | 3 | 11 | 0 | 0 | 0 | 0 | 2 | 17 | 314 | 331 |
| 1, 3W | 73 | 75 | 6 | 21 | 109 | 0 | 27 | 1 | 13 | 0 | 8 | 0 | 0 | 30 | 0 | 1 | 0 | 0 | 5 | 1 | 13 | 16 | 1 | 2 | 2 | 9 | 8 | 0 | 0 | 1 | 0 | 1 | 16 | 275 | 291 |
| 1, 3W | 80 | 82 | 6 | 52 | 44 | 0 | 52 | 0 | 4 | 0 | 4 | 2 | 0 | 50 | 0 | 0 | 0 | 0 | 4 | 2 | 9 | 15 | 2 | 10 | 1 | 15 | 4 | 0 | 0 | 0 | 0 | 7 | 7 | 276 | 283 |
| 1, 3W | 90 | 92 | 6 | 38 | 80 | 0 | 34 | 0 | 18 | 2 | 15 | 2 | 0 | 43 | 0 | 0 | 0 | 1 | 2 | 1 | 6 | 21 | 1 | 11 | 4 | 15 | 16 | 0 | 0 | 2 | 0 | 3 | 5 | 316 | 321 |
| 1, 3W | 100 | 102 | 17 | 11 | 157 | 0 | 36 | 1 | 8 | 9 | 6 | 1 | 3 | 68 | 41 | 2 | 5 | 0 | 0 | 10 | 10 | 40 | 0 | 1 | 3 | 11 | 28 | 0 | 0 | 1 | 0 | 5 | 26 | 448 | 474 |
| 1, 3W | 120 | 122 | 8 | 12 | 76 | 0 | 11 | 0 | 12 | 10 | 19 | 4 | 0 | 33 | 10 | 7 | 0 | 6 | 1 | 1 | 7 | 33 | 1 | 1 | 8 | 6 | 17 | 0 | 0 | 1 | 0 | 4 | 13 | 288 | 301 |
| 1, 3W | 126 | 127 | 5 | 17 | 81 | 0 | 28 | 0 | 4 | 13 | 15 | 2 | 4 | 30 | 21 | 5 | 0 | 3 | 1 | 4 | 4 | 33 | 0 | 5 | 4 | 10 | 6 | 0 | 1 | 1 | 0 | 3 | 7 | 300 | 307 |
| 1, 4W | 0 | 2 | 6 | 26 | 60 | 1 | 22 | 0 | 2 | 12 | 22 | 0 | 0 | 32 | 34 | 8 | 3 | 1 | 2 | 8 | 12 | 41 | 1 | 2 | 3 | 10 | 9 | 0 | 0 | 2 | 0 | 0 | 26 | 319 | 345 |
| 1, 4W | 10 | 12 | 2 | 39 | 69 | 0 | 9 | 0 | 6 | 18 | 16 | 1 | 0 | 33 | 41 | 13 | 1 | 1 | 2 | 3 | 7 | 27 | 0 | 4 | 7 | 7 | 12 | 0 | 0 | 0 | 0 | 2 | 0 | 320 | 320 |
| 1, 4W | 20 | 22 | 8 | 59 | 90 | 0 | 55 | 1 | 13 | 17 | 20 | 3 | 12 | 33 | 42 | 26 | 0 | 3 | 3 | 7 | 7 | 27 | 0 | 2 | 0 | 9 | 7 | 0 | 0 | 0 | 0 | 9 | 22 | 431 | 453 |
| 1, 4W | 40 | 42 | 6 | 33 | 63 | 0 | 30 | 2 | 13 | 12 | 5 | 0 | 8 | 31 | 27 | 14 | 1 | 2 | 2 | 5 | 6 | 20 | 0 | 0 | 2 | 7 | 7 | 0 | 0 | 0 | 0 | 1 | 22 | 275 | 297 |
| 1, 4W | 50 | 52 | 7 | 41 | 65 | 0 | 7 | 1 | 10 | 9 | 15 | 1 | 1 | 47 | 24 | 17 | 0 | 0 | 2 | 13 | 15 | 28 | 1 | 0 | 3 | 1 | 19 | 0 | 0 | 0 | 0 | 9 | 41 | 295 | 336 |
| 1, 4W | 60 | 62 | 11 | 44 | 48 | 0 | 19 | 0 | 1 | 7 | 9 | 2 | 17 | 55 | 27 | 41 | 0 | 0 | 0 | 0 | 11 | 21 | 0 | 5 | 0 | 3 | 18 | 0 | 0 | 0 | 0 | 9 | 26 | 322 | 348 |
| 1, CC | 5 | 7 | 2 | 49 | 34 | 0 | 22 | 1 | 6 | 11 | 21 | 2 | 0 | 19 | 19 | 11 | 0 | 2 | 1 | 1 | 4 | 20 | 0 | 1 | 0 | 3 | 0 | 0 | 0 | 3 | 0 | 2 | 25 | 234 | 259 |
| 1, CC | 15 | 17 | 2 | 48 | 70 | 0 | 11 | 1 | 11 | 10 | 24 | 0 | 0 | 26 | 24 | 16 | 2 | 2 | 3 | 0 | 5 | 25 | 0 | 3 | 0 | 5 | 1 | 0 | 0 | 0 | 0 | 1 | 27 | 290 | 317 |

**Table 3a.** ODP Hole 619A. Raw counts from faunal census splits. Sample designation 1, 2W 5-7cm stands for: core 1, section 2 working half, 5-7cm below top of section.

| Sct | Top | Bot (cm) | Orbulina universa | Globigerinoides ruber (red) | Globigerinoides ruber (white) | Globigerinoides conglobatus | Globigerinoides sacculifer | Sphaeroidinella dehiscens | Globigerinella aequilateralis | Globigerina bulloides | Globigerina falconensis | Globigerina rubescens | Neogloboquadrina pachyderma- d | Neogloboquadrina dutertrei | Globorotalia crassaformis | Neogloboquadrina "dupac" | Globorotalia hirsuta | Globorotalia scitula | Globorotalia menardii | Globorotalia tumida | Globorotalia truncatulinoides | Globigerinita glutinata | Globigerina digitata | Globigerinoides tenellus | Globorotalia ungulata | Globigerina calida | Pulleniatina | Hastigerina pelagica | Globorotalia tosaensis | Candeina nitida | Globigerinita iota | Other | Benthic foraminifers |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1, 2W | 5 | 7 | 2 | 5 | 30 | 0 | 11 | 0 | 1 | 3 | 3 | 1 | 0 | 9 | 3 | 0 | 1 | 1 | 6 | 2 | 5 | 5 | 1 | 1 | 2 | 1 | 9 | 0 | 0 | 0 | 1 | 1 | 1 |
| 1, 2W | 15 | 17 | 1 | 6 | 24 | 1 | 9 | 0 | 1 | 3 | 3 | 1 | 0 | 8 | 6 | 0 | 0 | 0 | 8 | 1 | 6 | 9 | 0 | 0 | 0 | 0 | 12 | 0 | 0 | 0 | 0 | 1 | 18 |
| 1, 2W | 36 | 38 | 7 | 4 | 21 | 0 | 10 | 0 | 1 | 3 | 4 | 2 | 0 | 8 | 4 | 0 | 0 | 1 | 10 | 2 | 6 | 12 | 0 | 1 | 1 | 2 | 5 | 0 | 0 | 0 | 0 | 1 | 5 |
| 1, 2W | 48 | 50 | 2 | 8 | 17 | 1 | 9 | 0 | 6 | 6 | 8 | 1 | 0 | 5 | 3 | 1 | 0 | 0 | 8 | 1 | 4 | 8 | 0 | 3 | 1 | 2 | 5 | 0 | 0 | 0 | 0 | 1 | 6 |
| 1, 2W | 55 | 57 | 4 | 6 | 28 | 1 | 8 | 0 | 2 | 2 | 3 | 0 | 0 | 5 | 2 | 0 | 0 | 0 | 10 | 3 | 8 | 7 | 1 | 2 | 0 | 3 | 7 | 0 | 0 | 0 | 0 | 2 | 5 |
| 1, 2W | 68 | 70 | 1 | 9 | 29 | 0 | 7 | 0 | 0 | 2 | 2 | 0 | 0 | 7 | 6 | 0 | 0 | 0 | 10 | 0 | 8 | 12 | 0 | 0 | 0 | 1 | 7 | 0 | 0 | 0 | 1 | 1 | 4 |
| 1, 2W | 75 | 77 | 0 | 4 | 25 | 1 | 4 | 1 | 1 | 3 | 3 | 0 | 0 | 6 | 1 | 0 | 0 | 1 | 3 | 1 | 6 | 25 | 1 | 1 | 3 | 3 | 6 | 0 | 0 | 0 | 1 | 3 | 4 |
| 1, 2W | 88 | 90 | 2 | 12 | 30 | 0 | 6 | 0 | 2 | 3 | 5 | 1 | 0 | 7 | 0 | 3 | 0 | 0 | 3 | 0 | 6 | 12 | 1 | 1 | 2 | 3 | 5 | 0 | 0 | 0 | 0 | 1 | 4 |
| 1, 2W | 95 | 97 | 5 | 12 | 14 | 0 | 10 | 0 | 3 | 3 | 8 | 1 | 0 | 7 | 1 | 0 | 0 | 0 | 1 | 1 | 4 | 14 | 1 | 3 | 2 | 3 | 5 | 0 | 0 | 1 | 1 | 0 | 4 |
| 1, 2W | 105 | 107 | 4 | 13 | 26 | 0 | 9 | 0 | 0 | 3 | 4 | 0 | 0 | 9 | 0 | 0 | 0 | 0 | 7 | 3 | 2 | 13 | 1 | 1 | 0 | 1 | 3 | 0 | 0 | 0 | 1 | 1 | 2 |
| 1, 2W | 115 | 117 | 1 | 13 | 32 | 0 | 5 | 0 | 1 | 3 | 7 | 0 | 0 | 14 | 1 | 0 | 0 | 0 | 2 | 1 | 4 | 4 | 0 | 1 | 0 | 4 | 5 | 0 | 0 | 0 | 0 | 1 | 2 |
| 1, 2W | 129 | 130 | 2 | 16 | 32 | 1 | 13 | 0 | 4 | 3 | 3 | 0 | 0 | 8 | 0 | 0 | 0 | 0 | 3 | 1 | 2 | 5 | 0 | 2 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 2 |
| 1, 3W | 0 | 2 | 2 | 6 | 33 | 0 | 15 | 0 | 0 | 3 | 6 | 0 | 0 | 6 | 0 | 0 | 0 | 0 | 2 | 1 | 4 | 6 | 0 | 3 | 2 | 3 | 7 | 0 | 0 | 0 | 0 | 0 | 2 |
| 1, 3W | 14 | 16 | 1 | 4 | 43 | 2 | 12 | 0 | 2 | 1 | 9 | 0 | 0 | 8 | 0 | 0 | 0 | 0 | 1 | 1 | 3 | 4 | 1 | 0 | 0 | 2 | 3 | 0 | 0 | 0 | 0 | 1 | 1 |
| 1, 3W | 20 | 22 | 0 | 7 | 31 | 1 | 17 | 0 | 2 | 0 | 8 | 1 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 8 | 0 | 3 | 1 | 2 | 2 | 2 | 0 | 0 | 1 | 1 | 1 |
| 1, 3W | 23 | 25 | 2 | 8 | 40 | 0 | 10 | 0 | 5 | 0 | 3 | 0 | 0 | 11 | 0 | 0 | 0 | 0 | 2 | 0 | 5 | 6 | 0 | 1 | 1 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 5 |
| 1, 3W | 30 | 32 | 1 | 2 | 37 | 1 | 17 | 0 | 2 | 0 | 5 | 0 | 0 | 8 | 0 | 0 | 0 | 0. | 3 | 1 | 6 | 8 | 0 | 1 | 2 | 3 | 3 | 0 | 0 | 0 | 0 | 2 | 1 |
| 1, 3W | 40 | 42 | 2 | 5 | 28 | 0 | 23 | 0 | 4 | 0 | 4 | 0 | 0 | 15 | 0 | 0 | 0 | 0 | 1 | 1 | 3 | 7 | 0 | 0 | 2 | 4 | 3 | 0 | 0 | 0 | 0 | 1 | 5 |
| 1, 3W | 50 | 52 | 3 | 11 | 22 | 0 | 22 | 0 | 2 | 0 | 4 | 0 | 0 | 13 | 0 | 0 | 0 | 0 | 4 | 1 | 7 | 6 | 0 | 1 | 1 | 2 | 6 | 0 | 0 | 0 | 0 | 0 | 6 |
| 1, 3W | 60 | 62 | 4 | 12 | 24 | 0 | 17 | 0 | 3 | 1 | 10 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 1 | 1 | 4 | 9 | 1 | 3 | 1 | 1 | 4 | 0 | 0 | 0 | 0 | 1 | 5 |
| 1, 3W | 80 | 82 | 2 | 19 | 16 | 0 | 19 | 0 | 1 | 0 | 1 | 1 | 0 | 18 | 0 | 0 | 0 | 0 | 1 | 1 | 3 | 5 | 1 | 4 | 0 | 5 | 1 | 0 | 0 | 0 | 0 | 3 | 2 |
| 1, 3W | 90 | 92 | 2 | 12 | 25 | 0 | 11 | 0 | 6 | 1 | 5 | 1 | 0 | 14 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 7 | 0 | 3 | 1 | 5 | 5 | 0 | 0 | 1 | 0 | 1 | 2 |
| 1, 3W | 100 | 102 | 4 | 2 | 35 | 0 | 8 | 0 | 2 | 2 | 1 | 0 | 1 | 15 | 9 | 0 | 1 | 0 | 0 | 2 | 2 | 9 | 0 | 0 | 1 | 2 | 6 | 0 | 0 | 0 | 0 | 1 | 5 |
| 1, 3W | 120 | 122 | 3 | 4 | 26 | 0 | 4 | 0 | 4 | 3 | 7 | 1 | 0 | 11 | 3 | 2 | 0 | 2 | 0 | 0 | 2 | 11 | 0 | 0 | 3 | 2 | 6 | 0 | 0 | 0 | 0 | 1 | 4 |
| 1, 3W | 126 | 127 | 2 | 6 | 27 | 0 | 9 | 0 | 1 | 4 | 5 | 1 | 1 | 10 | 7 | 2 | 0 | 1 | 0 | 1 | 1 | 11 | 0 | 2 | 1 | 3 | 2 | 0 | 0 | 0 | 0 | 1 | 2 |
| 1, 4W | 0 | 2 | 2 | 8 | 19 | 0 | 7 | 0 | 1 | 4 | 7 | 0 | 0 | 10 | 11 | 3 | 1 | 0 | 1 | 3 | 4 | 13 | 0 | 1 | 1 | 3 | 3 | 0 | 0 | 1 | 0 | 0 | 8 |
| 1, 4W | 10 | 12 | 1 | 12 | 22 | 0 | 3 | 0 | 2 | 6 | 5 | 0 | 0 | 10 | 13 | 4 | 0 | 0 | 1 | 1 | 2 | 8 | 0 | 1 | 2 | 2 | 4 | 0 | 0 | 0 | 0 | 1 | 0 |
| 1, 4W | 20 | 22 | 2 | 14 | 21 | 0 | 13 | 0 | 3 | 4 | 5 | 1 | 3 | 8 | 10 | 6 | 0 | 1 | 1 | 2 | 2 | 6 | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 2 | 5 |
| 1, 4W | 40 | 42 | 2 | 12 | 23 | 0 | 11 | 1 | 5 | 4 | 2 | 0 | 3 | 11 | 10 | 5 | 0 | 1 | 1 | 2 | 2 | 7 | 0 | 0 | 1 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 7 |
| 1, 4W | 50 | 52 | 2 | 14 | 22 | 0 | 2 | 0 | 3 | 3 | 5 | 0 | 0 | 16 | 8 | 6 | 0 | 0 | 1 | 4 | 5 | 9 | 0 | 0 | 1 | 0 | 6 | 0 | 0 | 0 | 0 | 3 | 12 |
| 1, 4W | 60 | 62 | 3 | 14 | 15 | 0 | 6 | 0 | 0 | 2 | 3 | 1 | 5 | 17 | 8 | 13 | 0 | 0 | 0 | 0 | 3 | 7 | 0 | 2 | 0 | 1 | 6 | 0 | 0 | 0 | 0 | 3 | 7 |
| 1, CC | 5 | 7 | 1 | 21 | 15 | 0 | 9 | 0 | 3 | 5 | 9 | 1 | 0 | 8 | 8 | 5 | 0 | 1 | 0 | 0 | 2 | 9 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 10 |
| 1, CC | 15 | 17 | 1 | 17 | 24 | 0 | 4 | 0 | 4 | 3 | 8 | 0 | 0 | 9 | 8 | 6 | 1 | 1 | 1 | 0 | 2 | 9 | 0 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 9 |

**Table 3b.** 619A Faunal percentage data from faunal census. Planktic foraminifer percentage calculated as percentage of total planktics. Benthic percentages calculated from percentage of total foraminifers.