
DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

**Pliocene benthic foraminifer census
data from
Deep Sea Drilling Project Hole 610A**

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INTRODUCTION

The U.S. Geological Survey's PRISM Project is investigating climatic and oceanographic conditions of the Pliocene. This study includes several elements: 1.) determination of sea surface temperatures using quantitative analysis of planktic foraminifer census data and stable isotopic analyses, and 2.) identification of major oceanographic boundaries and water masses within the North Atlantic Basin using quantitative analysis of planktic and benthic foraminifer census data and stable isotopic analyses. This report is part of a series of open-file reports that have been, and will be compiled to provide the basic faunal data for future work. This report includes benthic foraminifer census data for 13 samples from DSDP Leg 94, Hole 610A (Fig. 1). Latitude, longitude, and water depth of DSDP Site 610A are included in Table 1.

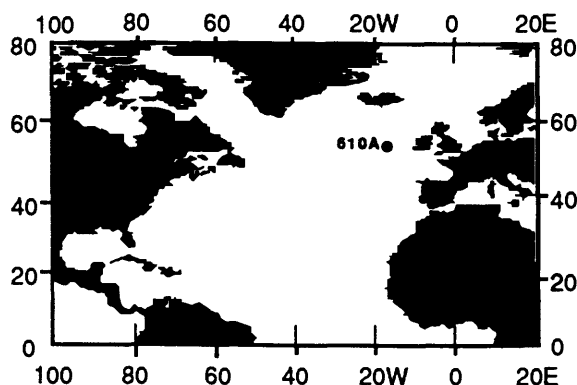


Figure 1 - Location of DSDP Site 610A.

Table 1 - Latitude, longitude, and water depth (in corrected meters) for DSDP Hole 610A shown in Figure 1.

Latitude	Longitude	Water Depth
53°13.29'N	18°53.21'W	2417 m

METHODS

The samples used in this study were processed at the U.S. Geological Survey, Reston using low temperature (isotope) techniques. Sediment samples were dried in an oven at $\leq 50^{\circ}$ C. The dried sample was disaggregated and wet sieved at 63μ m with warm tap water and about 2 ml of dilute Calgon solution. The $>63\mu$ m residue was dried in an oven at $\leq 50^{\circ}$ C. Many of the samples were treated with an additional wash of 10% H_2O_2 to further clean the specimens.

A split of 300-350 planktic foraminifer specimens was obtained from the $>149\mu$ m size fraction using a Carpo sample splitter. The remaining residue ($>149\mu$ m) was picked of benthic foraminifers (on which this report refers). The benthic foraminifer specimens were identified, sorted and glued to a standard 60-square micropaleontological slide.

BACKGROUND

Analyses of core-top samples from the North Atlantic Ocean, North and Norwegian Seas (Weston, 1985; Weston and Murray, 1984; Schnitker, 1974; Jarke, 1961; Gabel, 1971) provide a comprehensive modern data base of benthic foraminifer distribution. Associations made between intermediate and deep water

masses and benthic foraminifer distributions provide the basis for deep circulation paleoceanographic interpretations.

Age constraints for Hole 610A are based on a composite age model that includes DSDP Holes 502, 516A, 573A, 577A, 590A, 606, and 610A (Dowsett, 1989). The samples chosen for the benthic foraminifer analyses are late early Pliocene to middle late Pliocene in age.

The modern benthic foraminifer associations will be applied to the faunal associations in Pliocene sediments from DSDP Hole 610A, as well as additional DSDP Sites in the North Atlantic. The benthic foraminifer census data presented here will be used to help reconstruct the deep ocean circulation in the North Atlantic.

BENTHIC FORAMINIFER TAXONOMY

The taxonomy used to identify the benthic foraminifers from Hole 610A adheres in part to that of Loeblich and Tappan, 1988. Where possible, the identifications are based on comparisons made with previously published North Atlantic taxa. A number of taxa are not identified to species level and are referred herein as "*sp.*" or "*sp. #*", to be identified later. In two cases species groups are referred to. The benthic foraminifer taxa and their abundance (number of occurrences) in DSDP Hole 610A are listed in Table 2. Codes assigned to the taxa listed in Table 2 are as follows:

Bpseud - *Bolivina pseudopunctata* Höglund.
 Bdecus - *Bolivina decussata* Brady
 Bsp2 - *Bolvina sp. 2*
 Bstria - *Bolivina striatula* Cushman
 Bsilv - *Bolivina silvestrina* Cushman
 Bmacul - *Bulimina aculeata* d'Orbigny
 Bmala - *Bulimina alazanensis* Nuttall
 Bmmarg - *Bulimina marginata* d'Orbigny
 Bmmex - *Bulimina mexicana striata* Cushman
 Bmsp2 - *Bulimina sp. 2*
 Casslaev - *Cassidulina laevigata* d'Orbigny
 Cassdpor - *Cassiduloides porrectus* Heron-Allen and Earland
 Ciblob - *Cibicides lobatulus* (Walker and Jacobs)

Cibsrob - *Cibicidoides robertsoniana* (Brady)
 Cibskull - *Cibicidoides kullenbergi* (Parker)
 Cibscic - *Cibicidoides cicatricosus* (Schwager)
 Eggbrad - *Eggerella bradyi* (Cushman)
 Ehrtrig - *Ehrenbergina trigona* Goës
 Ehrsp1 - *Ehrenbergina sp. 1*
 Episex - *Epistominella exigua* (Brady)
 Fontw - *Fontbotia wuellerstorfi* (Schwager)
 Fursspp - This is used to define species of *Fursenkoina* that have rare occurrences at DSDP Site 610A.
 Glcasssub - *Golobocassidulina subglobosa* (Brady)
 Gyrssol - *Gyroidina soldanii* d'Orbigny
 Gyrneo - *Gyroidinoides noesoldanii* (Brotzen)
 Lent - *Lenticulina sp.*
 Latipau - *Laticarinina pauperata* (Parker and Jones)
 Melbar - *Melonis barleeianum* (Williamson)
 Melpomp - *Melonis pompilioides* (Fichtel and Moll)
 Nonsp1 - *Nonion sp. 1*
 Nonisp1 - *Nonionella sp. 1*
 Nod - This group includes the unilocular and uniserial nodosarids identified from Hole 610A. They provide little biostratigraphic or ecologic information and thus are placed into a single counting group.
 Nuttru - *Nuttallides truempyi* (Nuttall)
 Orum - *Oridorsalis umbonatus* (Reuss)
 Orten - *Orisorsalis tener* (Brady)
 Pleuro - *Pleurostomella sp.*
 Pulbul - *Pullenia bulloides* (d'Orbigny)
 Pulquin - *Pullenia quinqueloba* (Reuss)
 Pulsab - *Pullenia subcarinata* (d'Orbigny)
 Pymur - *Pyrgo murrhina* (Schwager)
 Pyob - *Pyrgo oblonga* (d'Orbigny)
 Praeglob - *Praeglobobulimina sp.*
 Qob - *Quinqueloculina oblonga* (Montagu)
 Qven - *Quinqueloculina venusta* Karrer
 Sigschl - *Sigmoilopsis schlumbergeri* (Silvestri)
 Siphos - *Siphotextularia sp.*
 Spiropus - *Spiroloculina pusilla* Earland
 Sphaer - *Sphaeroidina sp.*
 Stilo - *Stilostomella sp.*
 Txabb - *Textularia abbreviata* d'Orbigny
 Uvholm - *Uvigerina hollicki* Thalmann
 Uvpyg - *Uvigerina pygmaea* d'Orbigny
 Uvpere - *Uvigerina peregrina* Cushman
 Valc - *Valvulineria complanata* (d'Orbigny)

Counts of the variables (species) tabulated for each sample are listed in Table 2. Also included is the total number of benthic foraminifers, sample number, depth in core, and age. Samples are designated as Core Number, Section Number-Depth in Section (cm) (eg. 9-1,34 represents core 9-section 1, 34 cm depth). Depth in core represents depth of sample below the sea floor in meters.

ACKNOWLEDGEMENTS

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Table 2 - DSDP 610A

Sample	Depth In Core (m)	AGE (Ma)	Bpseud	Bdecus	Bsp2	Bstria	Bsiv	Bmacul	Bmala	Bmmarg	Bmmex	Bmsp2	Cassiaev
13-1,50	115.10	2.220	0	0	0	0	0	0	0	0	0	0	0
13-3,126	118.86	2.290	0	0	0	0	0	0	0	0	0	0	0
16-4,39	148.29	2.850	0	1	0	0	0	0	0	1	0	0	0
16-4,95	148.85	2.860	0	2	0	0	0	0	0	0	0	0	0
16-5,18	149.58	2.860	0	0	0	0	0	0	0	0	0	0	0
16-5,56	149.96	2.880	0	3	0	0	0	0	0	0	0	0	0
16-5,111	150.51	2.890	0	8	0	0	0	0	0	0	0	0	0
16-6,18	151.08	2.900	0	10	0	0	0	1	1	0	0	0	0
16-6,72	151.62	2.910	0	10	0	0	0	0	0	0	0	0	0
16-6,130	152.20	2.920	0	8	0	0	0	0	0	0	0	0	0
16cc,12	152.52	2.930	1	18	0	0	0	0	0	0	0	0	0
17-1,24	153.24	2.950	0	6	0	0	0	0	0	0	0	0	0
17-1,60	153.60	2.960	0	11	0	0	0	0	0	0	0	0	0
17-1,95	153.95	2.970	0	10	0	0	0	0	0	0	0	0	0
17-1,128	154.28	2.980	0	14	0	0	0	0	0	0	0	0	0
17-2,17	154.67	2.990	0	0	0	0	0	0	0	0	0	0	0
17-2,68	155.18	3.010	0	9	0	0	0	0	0	0	0	0	5
17-2,100	155.50	3.020	0	6	0	0	0	0	0	0	0	1	28
17-2,130	155.80	3.030	0	8	0	0	1	0	0	0	0	0	10
17-3,19	156.19	3.040	0	6	0	0	0	0	3	0	0	0	3
17-3,36	156.94	3.070	0	16	0	0	0	0	6	0	1	0	9
17-3,64	157.23	3.080	0	0	0	0	0	0	5	1	0	0	12
17-3,94	157.36	3.081	0	0	0	0	0	0	2	1	0	0	26
17-3,123	157.64	3.090	0	0	0	0	0	0	1	0	0	0	11
17-4,16	157.66	3.091	0	0	0	0	0	0	5	0	1	0	0
17-4,33	157.83	3.100	0	0	0	0	0	0	5	0	0	0	0
17-4,59	158.09	3.110	0	0	0	0	0	0	4	0	1	0	3
17-4,87	158.37	3.120	0	0	0	0	0	0	1	0	2	0	4
17-4,117	158.67	3.130	0	0	0	0	0	0	1	0	0	0	2
17-4,143	158.93	3.131	0	0	0	0	0	0	2	1	0	0	0
17-5,23	159.23	3.150	0	0	0	0	0	0	5	2	0	0	0
21-5,106	198.46	4.510	0	6	0	2	0	0	9	0	0	0	0
21-6,52	199.42	4.540	0	1	1	0	0	0	9	3	0	0	0

Table 2 - DSDP 610A

Sample	Depth In Core (m)	AGE (Ma)	Cassdporr	Ciblob	Cibsirob	Cibscic	Cibskull	Eggbrad	Ehrtrig	Enrsp1	Episex	Fontw	Fursspp
13-1,50	115.10	2.220	0	0	0	0	0	15	0	0	1	0	0
13-3,126	118.86	2.290	0	0	0	0	2	0	0	0	1	13	0
16-4,39	148.29	2.850	0	0	0	0	6	2	0	0	0	7	0
16-4,95	148.85	2.860	0	0	0	0	11	5	0	0	0	25	0
16-5,18	149.58	2.860	0	0	0	0	1	6	0	0	0	12	0
16-5,56	149.96	2.880	0	0	0	0	2	3	0	0	0	21	0
16-5,111	150.51	2.890	0	0	0	0	0	12	0	0	0	29	0
16-6,18	151.08	2.900	0	0	0	0	9	17	1	0	1	57	0
16-6,72	151.62	2.910	0	0	5	0	2	7	0	0	1	43	0
16-6,130	152.20	2.920	0	0	0	0	16	12	1	0	4	43	0
16cc,12	152.52	2.930	0	0	0	0	5	3	4	0	0	48	0
17-1,24	153.24	2.950	0	0	3	0	0	3	0	0	1	32	4
17-1,60	153.60	2.960	0	0	1	0	0	9	0	0	0	20	0
17-1,95	153.95	2.970	0	0	2	0	0	6	0	0	0	37	0
17-1,128	154.28	2.980	0	0	0	0	1	2	0	0	0	40	0
17-2,17	154.67	2.990	0	0	0	0	0	4	0	0	0	0	1
17-2,68	155.18	3.010	0	0	0	0	1	3	0	0	1	38	0
17-2,100	155.50	3.020	0	0	0	0	7	14	0	0	0	45	0
17-2,130	155.80	3.030	0	0	0	0	2	7	0	0	3	32	0
17-3,19	156.19	3.040	0	0	0	0	7	6	1	0	0	35	0
17-3,36	156.94	3.070	0	0	2	0	16	6	1	0	1	24	0
17-3,64	157.23	3.080	0	0	0	2	39	8	1	0	2	34	0
17-3,94	157.36	3.081	0	1	0	0	34	3	0	0	1	35	0
17-3,123	157.64	3.090	0	0	1	4	27	8	0	0	0	23	0
17-4,16	157.66	3.091	0	0	0	0	33	6	0	0	0	66	0
17-4,33	157.83	3.100	0	0	0	0	31	12	0	0	1	91	0
17-4,59	158.09	3.110	0	0	0	3	20	6	2	0	1	63	0
17-4,87	158.37	3.120	1	0	0	4	19	12	1	0	1	40	0
17-4,117	158.67	3.130	0	0	0	5	10	11	0	0	5	40	0
17-4,143	158.93	3.131	0	0	0	0	7	5	0	0	2	0	0
17-5,23	159.23	3.150	0	0	0	0	5	6	0	0	1	20	0
21-5,106	198.46	4.510	0	0	4	0	16	7	36	1	0	28	5
21-6,52	199.42	4.540	0	0	4	1	10	6	0	0	12	16	3

Table 2 - DSDP 610A

Sample	Depth In Core (m)	AGE (Ma)	Glcassub	Gyrssol	Gyrneo	Lent	Latipau	Melbar	Melpomp	Nonsp1	Nonlsp1	Nod	Nuttru
13-1,50	115.10	2.220	2	4	3	0	0	20	40	0	0	10	0
13-3,126	118.86	2.290	0	4	2	0	0	10	36	0	0	4	6
16-4,39	148.29	2.850	0	4	6	1	2	12	5	1	0	12	4
16-4,95	148.85	2.860	1	10	5	1	7	17	1	0	10	0	0
16-5,18	149.58	2.860	3	1	3	1	0	3	5	0	0	6	0
16-5,56	149.96	2.880	3	5	4	1	0	13	6	0	1	11	0
16-5,111	150.51	2.890	3	5	15	0	0	16	8	0	1	6	5
16-6,18	151.08	2.900	8	23	5	1	12	14	0	0	0	19	40
16-6,72	151.62	2.910	33	22	0	0	3	11	12	0	3	9	30
16-6,130	152.20	2.920	2	25	11	1	8	25	0	0	0	18	45
16cc,12	152.52	2.930	2	19	22	1	7	14	0	0	1	17	3
17-1,24	153.24	2.950	0	10	2	0	2	9	15	0	0	17	2
17-1,60	153.60	2.960	0	9	12	0	1	9	11	0	1	13	2
17-1,95	153.95	2.970	3	13	16	1	1	1	4	0	3	12	0
17-1,128	154.28	2.980	7	7	13	0	1	6	5	0	0	5	1
17-2,17	154.67	2.990	5	22	25	0	11	7	13	0	0	25	1
17-2,68	155.18	3.010	8	1	4	0	0	3	20	0	0	11	1
17-2,100	155.50	3.020	18	2	12	1	0	29	0	0	7	17	4
17-2,130	155.80	3.030	5	3	8	1	8	7	0	0	1	14	8
17-3,19	156.19	3.040	5	13	4	0	7	10	0	0	0	10	8
17-3,36	156.94	3.070	9	12	12	0	5	10	0	0	2	24	11
17-3,64	157.23	3.080	0	14	9	1	4	7	0	0	0	24	20
17-3,94	157.36	3.081	0	15	5	1	4	5	0	0	0	8	7
17-3,123	157.64	3.090	0	14	16	1	2	1	0	0	0	8	8
17-4,16	157.66	3.091	0	15	2	1	5	2	0	0	3	12	3
17-4,33	157.83	3.100	2	24	9	2	5	2	0	0	0	21	7
17-4,59	158.09	3.110	1	30	10	0	7	3	0	0	0	15	5
17-4,87	158.37	3.120	4	18	0	2	4	5	0	0	1	14	4
17-4,117	158.67	3.130	1	17	7	2	4	1	0	0	1	24	0
17-4,143	158.93	3.131	3	0	0	0	0	0	0	0	0	0	0
17-5,23	159.23	3.150	4	6	5	1	6	3	0	0	0	18	5
21-5,106	198.46	4.510	14	3	6	1	8	8	9	0	0	54	5
21-6,52	199.42	4.540	10	3	15	0	2	24	23	0	2	76	4

Table 2 - DSDP 610A

Sample	Depth In Core (m)	AGE (Ma)	Orum	Orten	Pleuro	Pulbul	Pulquin	Pulsub	Pymur	Pyob	Praeglob	Qob	Qven
13-1,50	115.10	2.220	11	0	0	5	2	6	4	2	0	1	3
13-3,126	118.86	2.290	15	0	0	1	3	6	5	0	3	1	0
16-4,39	148.29	2.850	6	0	1	2	0	0	0	0	0	1	5
16-4,95	148.85	2.860	22	0	0	2	4	1	2	0	0	1	4
16-5,18	149.58	2.860	9	0	0	0	1	2	0	0	0	2	0
16-5,56	149.96	2.880	30	0	0	1	2	1	1	0	0	1	0
16-5,111	150.51	2.890	35	0	2	1	1	0	8	0	0	0	0
16-6,18	151.08	2.900	36	0	0	5	5	0	11	2	0	0	2
16-6,72	151.62	2.910	17	0	0	1	6	0	6	2	0	0	0
16-6,130	152.20	2.920	23	0	4	1	0	0	8	0	0	1	7
16cc,12	152.52	2.930	23	0	6	0	5	1	1	0	6	0	2
17-1,24	153.24	2.950	14	0	0	2	1	0	2	0	0	0	4
17-1,60	153.60	2.960	11	0	0	3	1	1	0	0	0	0	0
17-1,95	153.95	2.970	3	0	3	3	1	1	1	0	0	0	6
17-1,128	154.28	2.980	6	0	2	0	2	1	1	0	0	1	3
17-2,17	154.67	2.990	23	0	3	1	0	0	7	0	0	1	0
17-2,68	155.18	3.010	8	0	0	2	1	0	2	1	0	1	2
17-2,100	155.50	3.020	18	0	0	1	6	0	6	0	3	0	1
17-2,130	155.80	3.030	21	0	2	2	2	0	2	0	1	0	4
17-3,19	156.19	3.040	36	0	0	0	0	1	2	2	3	0	7
17-3,36	156.94	3.070	40	0	1	0	8	0	4	0	0	0	8
17-3,64	157.23	3.080	51	0	0	2	2	3	3	0	3	0	1
17-3,94	157.36	3.081	58	0	0	0	1	3	3	0	1	0	1
17-3,123	157.64	3.090	73	0	0	2	1	0	6	0	0	0	1
17-4,16	157.66	3.091	28	0	0	1	1	3	6	0	0	0	2
17-4,33	157.83	3.100	44	0	0	0	1	2	4	0	0	0	2
17-4,59	158.09	3.110	46	0	2	0	2	0	6	0	0	0	1
17-4,87	158.37	3.120	29	0	2	1	1	3	3	1	0	0	1
17-4,117	158.67	3.130	22	0	1	2	1	0	2	0	0	0	0
17-4,143	158.93	3.131	0	0	0	0	0	0	0	0	0	0	0
17-5,23	159.23	3.150	16	5	0	0	1	0	1	0	0	0	1
21-5,106	198.46	4.510	20	6	0	2	1	0	3	0	0	0	2
21-6,52	199.42	4.540	24	0	6	9	0	0	1	0	0	1	4

Table 2 - DSDP 610A

Sample	Depth in Core (m)	AGE (Ma)	Sigschl	Sipho	Spirpus	Sphaer	Silo	Txabb	Uvholl	Uvpyg	Uvpere	Valc	TOTAL
13-1,50	115.10	2.220	3	0	0	0	2	0	9	1	0	0	144
13-3,126	118.86	2.290	6	0	0	0	5	0	0	0	0	0	123
16-4,39	148.29	2.850	3	0	1	0	0	0	0	0	0	0	83
16-4,95	148.85	2.860	13	0	1	0	2	0	0	1	0	0	148
16-5,18	149.58	2.860	5	0	1	0	0	0	2	0	0	0	63
16-5,56	149.96	2.880	2	0	0	0	5	0	31	0	0	0	147
16-5,111	150.51	2.890	0	0	1	0	0	0	4	0	0	0	160
16-6,18	151.08	2.900	7	0	0	0	3	0	4	0	0	0	294
16-6,72	151.62	2.910	0	0	0	0	5	0	6	0	0	2	236
16-6,130	152.20	2.920	5	0	1	0	3	0	6	0	0	0	278
16cc,12	152.52	2.930	4	0	1	0	1	0	4	0	0	0	219
17-1,24	153.24	2.950	6	0	4	0	6	0	1	0	0	0	146
17-1,60	153.60	2.960	10	0	0	0	2	0	3	0	0	1	131
17-1,95	153.95	2.970	5	0	0	0	6	0	3	0	0	1	142
17-1,128	154.28	2.980	7	0	0	0	0	0	16	0	0	2	143
17-2,17	154.67	2.990	0	0	1	0	10	0	12	0	3	0	175
17-2,68	155.18	3.010	7	0	1	0	3	0	3	0	0	0	136
17-2,100	155.50	3.020	4	0	0	0	7	0	27	0	3	1	268
17-2,130	155.80	3.030	7	0	2	0	3	0	21	0	2	2	189
17-3,19	156.19	3.040	2	0	0	0	0	0	15	1	0	0	187
17-3,36	156.94	3.070	8	0	2	0	5	0	27	1	3	1	275
17-3,64	157.23	3.080	5	0	0	1	6	3	41	0	0	0	304
17-3,94	157.36	3.081	10	0	0	1	6	3	69	0	7	0	311
17-3,123	157.64	3.090	3	0	2	0	8	2	71	0	1	0	295
17-4,16	157.66	3.091	4	0	0	0	5	3	96	0	8	0	311
17-4,33	157.83	3.100	2	0	0	1	6	4	56	0	4	1	340
17-4,59	158.09	3.110	9	0	4	1	6	1	50	0	0	0	302
17-4,87	158.37	3.120	10	0	4	1	3	1	100	0	4	0	301
17-4,117	158.67	3.130	3	3	2	3	13	0	41	0	0	0	224
17-4,143	158.93	3.131	0	0	0	0	5	0	0	0	0	0	25
17-5,23	159.23	3.150	8	0	0	0	9	1	43	0	0	0	172
21-5,106	198.46	4.510	4	10	0	0	0	0	29	14	0	8	321
21-6,52	199.42	4.540	7	14	0	2	0	0	15	19	0	8	335