Winterer, E.L., Sager, W.W., Firth, J.V., and Sinton, J.M. (Eds.), 1995
Proceedings of the Ocean Drilling Program, Scientific Results, Vol. 143

36. *DATA REPORT:* STABLE ISOTOPIC STRATIGRAPHY OF THE PALEOGENE PELAGIC CAP AT SITE 865, ALLISON GUYOT[1]

Timothy J. Bralower,[2] Matthew Parrow,[2] Ellen Thomas,[3] and James C. Zachos[4]

ABSTRACT

Intensive stable isotopic investigations were conducted on the upper Paleocene to upper Eocene pelagic cap sequence recovered at Site 865, Allison Guyot, Mid-Pacific Mountains. The sequence consists of calcareous ooze with an unusually high content of well-preserved planktonic foraminifers. Benthic foraminifers, although exceptionally rare, are also nearly unaltered. Isotopic analyses were performed on three separate planktonic (species of *Acarinina, Morozovella,* and *Subbotina*) and four benthic taxa (species of *Cibicidoides* and *Lenticulina, Gavelinella beccariiformis,* and *Nuttallides truempyi*). We present results of detailed stable isotopic investigations ($\delta^{18}O$ and $\delta^{13}C$) of the uppermost Paleocene and lowermost Eocene intervals in two holes (865B and 865C) and of the entire upper Paleocene to upper Eocene in Hole 865B.

INTRODUCTION

Site 865 (18°26′N, 179°33′W) is situated at a water depth of 1530 m atop Allison Guyot in the Mid-Pacific Mountains. A relatively expanded and largely complete upper Paleocene to lower Oligocene sequence was recovered in the pelagic cap part of this site (Bralower and Mutterlose, this volume). Sediments, largely calcareous oozes, contain a sandy texture as a result of the high content of planktonic foraminifers. These microfossils are predominantly of exceptional preservation and therefore are suitable for isotopic investigations. In this report, we document the results of 586 stable isotopic measurements of planktonic and benthic foraminifers from the Paleogene section of Site 865. Detailed discussion and interpretation of these data are presented in Bralower et al. (unpubl. data) and Zachos et al. (unpubl. data). Benthic foraminiferal assemblages are discussed in detail by Thomas (unpubl. data).

METHODS AND PROCEDURES

One to three samples per core section were selected for isotopic measurement from Hole 865B, with the densest sampling in the upper Paleocene to lower Eocene interval. A more detailed sample set (one sample every 10 cm) was taken close to the benthic foraminiferal extinction horizon in the upper Paleocene in both Holes 865B and 865C. One 20-cm^3 sample was taken per section in Hole 865B for benthic foraminiferal analysis. All other samples ranged in volume between 5 and 10 cm^3. All samples were split, dried, and washed with water having a pH of 8 through sieves having screen openings of 250, 125, 63 and 38 µm. The <38-µm fraction was passed through a millipore filter and saved for future fine-fraction isotopic investigations. All other fractions were oven-dried at 60°C. The >250-µm fraction was dry-split into various size fractions: >400, 355–400, 300–355, and 250–300 µm. To reduce ontogenetic and vital effects on the interpretation of stable isotope results (e.g., Shackleton et al., 1985a; Corfield and Cartlidge, 1991; Pearson et al., 1993), almost all of our planktonic foraminiferal isotopic measurements were performed on the 300–355 µm fraction. Different size fractions were used only when the taxon of interest was not observed in large enough quantities in the 300–355 µm fraction

Various taxa have been used for Paleogene planktonic foraminifer isotope stratigraphy (e.g., Shackleton et al., 1984; Boersma et al., 1987; Stott et al., 1990; Zachos et al., 1994). Species of *Morozovella* and *Acarinina* were chosen for analysis on the basis of (1) taxonomic distinctiveness and (2) overlapping stratigraphic ranges that span the interval of interest. Based on these criteria, the following species were selected: *Morozovella velascoensis* (upper Paleocene), *Morozovella subbotinae* (uppermost Paleocene–lower Eocene), *Morozovella aragonensis* (lower to middle Eocene), and *Morozovella lehneri* (middle–upper Eocene); *Acarinina mckannai* (upper Paleocene), *Acarinina soldadoensis* (upper Paleocene–lower Eocene), and *Acarinina bullbrooki* (lower–upper Eocene). As is common practice, we have combined species of *Subbotina* because of taxonomic uncertainties. Selection of planktonic foraminifers for isotopic measurement was performed at UNC-CH largely by Parrow and Bralower. Samples of each taxon were verified by I. Premoli Silva, W. Sliter, and D.C. Kelly. Initially, 25 specimens of each species were chosen; however, the eight to 10 best-preserved specimens were selected for isotopic measurement.

Samples for benthic foraminiferal studies were first dried in an oven at 60°C, then soaked and gently shaken in distilled water overnight. If samples had not disaggregated the next day, detergent was added and the samples were again gently shaken overnight. All samples disaggregated after this treatment. Samples were then washed through a 63-µm sieve, and the coarse fraction was dried in an oven at 60°C, and weighed. The whole fraction larger than 63 µm was used, because of the importance of small specimens for paleoecological studies, and because we want to compare results with those of Thomas (1990). Preservation of benthic foraminifers is very good in most samples, although some samples contained yellowed, corroded specimens that were probably reworked from older materials. These specimens were not used for isotopic analysis. Benthic foraminiferal specimens are rare in all samples studied, with numbers varying from about 200 to 3000/g; this is about 10 to 100 times fewer specimens per gram than in samples of equivalent age and paleodepth from Maud Rise (Weddell Sea, Antarctica; Thomas, 1990). As a result, numerous samples had insufficient specimens of particular taxa for isotopic analysis. However, we have been able to isolate between five and 20 specimens of select taxa in a number of samples. We have selected *Nuttallides truempyi* and species of *Cibicidoides* throughout the investigated section, and *Gavelinella beccariiformis* and species of *Lenticulina* in samples from the uppermost Paleocene. All processing and selection of benthic foraminifers was performed by Thomas.

[1] Winterer, E.L., Sager, W.W., Firth, J.V., and Sinton, J.M. (Eds.), 1995. *Proc. ODP, Sci. Results,* 143: College Station, TX (Ocean Drilling Program).

[2] Department of Geology, University of North Carolina, Chapel Hill, NC 27599-3315, U.S.A.

[3] Department of Geology and Geophysics, Yale University, New Haven, CT 06511, U.S.A.

[4] Earth Science Board, University of California, Santa Cruz, CA 95064, U.S.A.

Isotopic analyses were performed in the Stable Isotope laboratory at the University of Michigan. Individual foraminifers were sonicated in distilled water to remove adhering particles and roasted *in vacuo* at 380°C. The specimens (8–10 individuals of planktonic foraminifers, 4–10 specimens of benthic foraminifers) were processed in a Carbo-Kiel Mat 251 carbonate digestion device. Each sample was reacted in an individual vessel with three drops of phosphoric acid at 75°C. The resulting CO_2 was isolated in a single-step distillation and then introduced directly to the MAT-251 mass-spectrometer for measurement. NBS-18, -19, and -20, as well as an in-house standard LV-2, were measured on a daily basis to monitor instrument calibration and analytical accuracy. All values are expressed in the (δ) notation where,

$$\delta(‰) = \frac{^{13}C/^{12}C(\text{samp}) - {}^{13}C/^{12}C(\text{std})}{^{13}C/^{12}C(\text{std})} \times 10^3$$

relative to the PDB standard. Average precision determined from 40 replicate analyses of planktonic foraminifers was better than ±0.1‰ for both oxygen and carbon compositions, but significantly lower than this for benthic foraminifers. Because of the significant length of time (nine months) over which analyses were made, in the third run we conducted 10 replicate analyses from the first two runs to assess possible machine "drift." Based on the results of these replicates, we determined that, on average, replicates were 0.2‰ heavier in the third run for both $\delta^{18}O$ and $\delta^{13}C$, and thus these values have been corrected accordingly.

RESULTS

Data have been compiled in Tables 1 and 2. We list, along with the sample, depth, taxon measured, and stable isotopic data, the size fraction and run number. In Table 1, we include data from Hole 865B in which we have measured samples from the entire upper Paleocene to upper Eocene interval. In Table 2, we compile data from Hole 865C that has been sampled in great detail in the interval close to the Paleocene/Eocene boundary. Interpretation of the data reported here is given in Bralower et al. (unpubl. data) and Zachos et al. (unpubl. data).

ACKNOWLEDGMENTS

We thank K.C. Lohmann for the use of the Michigan Stable Isotope Laboratory and for running analyses for us. We gratefully acknowledge discussions with Steve D'Hondt, D. Clay Kelly, Isabella Premoli Silva, and William Sliter on taxonomic concepts. Research supported by JOI-USSAC.

REFERENCES*

Boersma, A., Premoli Silva, I., and Shackleton, N.J., 1987. Atlantic Eocene planktonic foraminiferal paleohydrographic indicators and stable isotope paleoceanography. *Paleoceanography,* 2:287–331.

Corfield, R.M., and Cartlidge, J.E., 1991. Isotopic evidence for the depth stratification of fossil and Recent *Globigerinina:* a review. *Hist. Biol.,* 5:37–63.

Pearson, P.N., Shackleton, N.J., and Hall, M.A., 1993. Stable isotopic paleoecology of middle Eocene planktonic foraminifera and multi-species isotope stratigraphy, DSDP Site 523, South Atlantic. *J. Foraminiferal Res.,* 23:123–140.

Shackleton, N.J., Corfield, R.M., and Hall, M.A., 1985. Stable isotope data and the ontogeny of Paleocene planktonic foraminifera. *J. Foraminiferal Res.,* 15:321–336.

Shackleton, N.J., Hall, M.A., and Boersma, A., 1984. Oxygen and carbon isotope data from Leg 74 foraminifers. *In* Moore, T.C., Jr., Rabinowitz, P.D., et al., *Init. Repts. DSDP,* 74: Washington (U.S. Govt. Printing Office), 599–644.

Stott, L.D., Kennett, J.P., Shackleton, N.J., and Corfield, R.M., 1990. The evolution of Antarctic surface waters during the Paleogene: inferences from the stable isotopic composition of planktonic foraminifers, ODP Leg 113. *In* Barker, P.F., Kennett, J.P., et al., *Proc. ODP, Sci. Results,* 113: College Station, TX (Ocean Drilling Program), 849–863.

Thomas, E., 1990. Late Cretaceous through Neogene deep-sea benthic foraminifers (Maud Rise, Weddell Sea, Antarctica). *In* Barker, P.F., Kennett, J.P., et al., *Proc. ODP, Sci. Results,* 113: College Station, TX (Ocean Drilling Program), 571–594.

Zachos, J.C., Stott, L.D., and Lohmann, K.C., 1994. Evolution of early Cenozoic marine temperatures. *Paleoceanography,* 9:353–387.

*Abbreviations for names of organizations and publications in ODP reference lists follow the style given in *Chemical Abstracts Service Index* (published by American Chemical Society).

Date of initial receipt: 1 December 1993
Date of acceptance: 25 May 1994
Ms 143SR-215

Table 1. Stable isotopic data for Hole 865B.

Core, section, interval (cm)	Depth (mbsf)	Taxon	Size (µm)	$\delta^{13}C$ (‰)	$\delta^{18}O$ (‰)	Run
Benthic foraminifers						
3H-2, 120–125	20.70	*Cibicidoides* sp.	>125	0.92	1.03	3
3H-3, 120–125	22.20	*Cibicidoides* sp.	>125	0.77	0.62	3
3H-4, 120–125	23.70	*Cibicidoides* sp.	>125	0.88	1.01	3
3H-5, 120–125	25.20	*Cibicidoides* sp.	>125	0.46	0.91	3
3H-6, 120–125	26.70	*Cibicidoides* sp.	>125	0.39	0.85	3
4H-4, 120–125	33.20	*Cib. prae.*	>125	0.70	0.36	3
5H-2, 120–125	39.70	*Cibicidoides* sp.	>125	0.50	0.68	3
6H-2, 120–125	49.20	*Cibicidoides* sp.	>125	0.51	0.49	3
6H-4, 120–125	52.20	*Cib. prae.*	>125	0.61	0.52	3
6H-6, 111–116	55.11	*Cibicidoides* sp.	>125	0.38	0.33	3
8H-2, 120–125	68.20	*Cibicidoides* sp.	>125	0.52	0.46	3
8H-6, 106–111	74.06	*Cibicidoides* sp.	>125	0.49	0.00	3
9H-2, 120–125	77.70	*Cibicidoides* sp.	>125	1.10	–0.35	3
9H-4, 120–125	80.70	*Cibicidoides* sp.	>125	0.78	–0.12	3
10H-2, 120–125	87.70	*Cib. prae.*	>125	0.03	–0.53	3
10H-5, 111–116	91.61	*Cibicidoides* sp.	>125	0.49	–0.40	1
11H-2, 120–125	96.70	*Cibicidoides* sp.	>125	0.63	–0.10	3
11H-4, 120–125	99.70	*Cib. prae*	>125	0.85	–0.26	3
11H-6, 47–49	101.97	*Cibicidoides* sp.	>125	1.01	–0.29	3
11H-CC, 9–12	102.53	*Cibicidoides* sp.	>125	0.89	–0.04	3
12H-1, 10–12	103.60	*Cibicidoides* sp.	>125	0.04	–0.58	1
12H-1, 10–12D	103.60	*Cibicidoides* sp.	>125	–0.12	–0.21	1
12H-1, 40–42	103.90	*Cibicidoides* sp.	>125	1.28	0.02	3
12H-1, 120–125	104.70	*Cibicidoides* sp.	>125	1.47	0.08	1
12H-3, 120–125	107.70	*Cibicidoides* sp.	>125	1.69	0.17	3
3H-5, 120–125	25.20	*N. truempyi*	>125	0.35	0.92	3
3H-6, 120–125	26.70	*N. truempyi*	>125	–0.08	0.98	3
4H-2, 120–125	30.20	*N. truempyi*	>125	0.13	0.84	3
4H-6, 20–25	35.20	*N. truempyi*	>125	0.07	0.58	3
5H-2, 120–125	39.70	*N. truempyi*	>125	0.13	0.63	3
5H-4, 120–125	42.70	*N. truempyi*	>125	0.27	0.60	3
5H-6, 44–49	44.44	*N. truempyi*	>125	0.14	0.68	3
6H-2, 120–125	49.20	*N. truempyi*	>125	0.13	0.41	3
6H-4, 120–125	52.20	*N. truempyi*	>125	0.34	0.51	3
6H-6, 111–116	55.11	*N. truempyi*	>125	0.20	0.29	3
7H-2, 120–125	58.70	*N. truempyi*	>125	0.00	0.45	3
7H-4, 120–125	61.70	*N. truempyi*	>125	0.13	0.47	3
7H-6, 79–84	63.79	*N. truempyi*	>125	–0.01	0.43	3
8H-2, 120–125	68.20	*N. truempyi*	>125	0.04	0.26	3
8H-4, 120–125	71.20	*N. truempyi*	>125	0.67	–0.21	1
8H-4, 120–125D	71.20	*N. truempyi*	>125	0.08	0.22	1
8H-6, 106–111	74.06	*N. truempyi*	>125	0.03	–0.44	3
9H-2, 120–125	77.70	*N. truempyi*	>125	0.59	–0.55	3
9H-4, 120–125	80.70	*N. truempyi*	>125	0.62	–0.56	3
9H-6, 6–11	82.56	*N. truempyi*	>125	–0.02	–0.56	3
10H-2, 120–125	87.70	*N. truempyi*	>125	–0.17	–0.45	3
10H-5, 111–116	91.61	*N. truempyi*	>125	–0.15	–0.45	1
11H-2, 120–125	96.70	*N. truempyi*	>125	0.22	–0.16	3
11H-6, 47–49	101.97	*N. truempyi*	>125	1.09	–0.18	1
11H-CC, 9–12	102.53	*N. truempyi*	>125	0.39	–0.13	3
12H-1, 120–125	104.70	*N. truempyi*	>125	0.93	–0.36	1
12H-3, 120–125	107.70	*N. truempyi*	>125	1.34	0.26	3
13H-, 117–121	114.17	*N. truempyi*	>125	1.77	0.13	1
15X–1, 120–125	133.20	*N. truempyi*	>125	0.27	–0.64	1
12H-3, 120–125	107.70	*Gavelinella bec.*	>125	1.71	0.13	3
13H-1, 117–121	114.17	*Gavelinella bec.*	>125	1.75	–0.02	3
14H-1, 120–125	123.70	*Gavelinella bec.*	>125	1.87	0.25	3
15X–1, 120–125	133.20	*Gavelinella bec.*	>125	0.68	0.33	3
15X–3, 52–57	135.52	*Gavelinella bec.*	>125	0.50	–0.13	3
Planktonic foraminifers						
3H-1, 70–72	18.70	*M. lehneri*	300-355	2.60	–0.30	3
3H-2, 84–86	20.34	*M. lehneri*	300-355	2.61	–0.23	3
3H-3, 78–80	21.78	*M. lehneri*	300-355	2.69	–0.43	3
3H-4, 80–82	23.30	*M. lehneri*	300-355	2.84	–0.46	3
3H-5, 69–71	24.69	*M. lehneri*	300-355	2.83	–0.47	3
3H-6, 69–71	26.19	*M. lehneri*	300-355	2.72	–0.50	3
3H-7, 12–14	27.12	*M. lehneri*	300-355	2.69	–0.40	3
4H-1, 70–72	28.20	*M. lehneri*	300-355	2.71	–0.59	3
4H-2, 84–86	29.84	*M. lehneri*	300-355	3.01	–0.63	3
4H-3, 84–86	31.34	*M. lehneri*	300-355	3.04	–0.70	3
4H-4, 70–72	32.70	*M. lehneri*	300-355	2.74	–0.65	3
4H-5, 70–72	34.20	*M. lehneri*	300-355	2.62	–0.54	3
4H-6, 20–22	35.20	*M. lehneri*	300-355	2.95	–0.62	3
5H-1, 70–72	37.70	*M. lehneri*	300-355	2.99	–0.49	3
5H-2, 70–72	39.20	*M. lehneri*	300-355	2.63	–0.47	3
5H-3, 70–72	40.70	*M. lehneri*	300-355	2.70	–0.50	3
5H-4, 70–72	42.20	*M. lehneri*	300-355	2.89	–0.64	3
5H-5, 70–72	43.70	*M. lehneri*	300-355	2.85	–0.71	3
5H-6, 50–52	44.50	*M. lehneri*	300-355	2.78	–0.68	3
5H-6, 50–52D	44.50	*M. lehneri*	300-355	2.80	–0.69	3
6H-1, 81–83	47.31	*M. lehneri*	300-355	2.94	–0.71	3
6H-2, 73–75	48.73	*M. lehneri*	300-355	2.78	–0.46	3
6H-3, 70–72	50.20	*M. lehneri*	300-355	2.89	–0.76	3
6H-4, 70–72	51.70	*M. lehneri*	300-355	2.97	–0.76	3
6H-5, 70–72	53.20	*M. lehneri*	300-355	3.05	–0.73	3
6H-6, 70–72	54.70	*M. lehneri*	300-355	3.20	–1.04	3
7H-1, 118–120	57.18	*M. lehneri*	300-355	3.17	–0.78	3
6H-4, 70–72	51.70	*M. aragonensis*	300-355	2.97	–1.14	1
6H-5, 70–72	53.20	*M. aragonensis*	300-355	2.96	–0.97	1
7H-1, 120–125	57.20	*M. aragonensis*	300-355	2.94	–1.18	1
7H-4, 68–70	61.18	*M. aragonensis*	300-355	3.31	–1.01	1
8H-1, 89–91	66.39	*M. aragonensis*	300-355	3.23	–1.53	1
8H-2, 70–72	67.70	*M. aragonensis*	300-355	3.19	–1.60	3
8H-3, 70–72	69.20	*M. aragonensis*	300-355	2.80	–1.32	1
8H-4, 67–69	70.67	*M. aragonensis*	300-355	3.41	–1.38	1
8H-5, 70–72	72.20	*M. aragonensis*	300-355	2.80	–1.53	1
8H-6, 70–72	73.70	*M. aragonensis*	300-355	3.25	–1.50	3
9H-1, 20–22	75.20	*M. aragonensis*	300-355	3.08	–1.59	1
9H-1, 70–72	75.70	*M. aragonensis*	300-355	2.78	–1.44	1
9H-1, 120–125	76.20	*M. aragonensis*	300-355	2.51	–1.31	3
9H-2, 20–22	76.70	*M. aragonensis*	300-355	2.81	–1.75	1
9H-2, 70–72	77.20	*M. aragonensis*	300-355	2.81	–1.54	1
9H-2, 120–125	77.70	*M. aragonensis*	300-355	2.63	–1.34	3
9H-3, 20–22	78.20	*M. aragonensis*	300-355	2.56	–1.67	1
9H-3, 70–72	78.70	*M. aragonensis*	300-355	2.46	–1.73	3
9H-3, 120–125	79.20	*M. aragonensis*	300-355	2.36	–1.54	3
9H-4, 10–12	79.60	*M. aragonensis*	300-355	2.78	–1.66	1
9H-4, 70–72	80.20	*M. aragonensis*	300-355	2.99	–1.59	1
9H-4, 120–125	80.70	*M. aragonensis*	300-355	2.09	–1.14	3
9H-5, 18–19	81.18	*M. aragonensis*	300-355	2.95	–1.51	3
9H-5, 70–72	81.70	*M. aragonensis*	300-355	2.26	–1.37	1
9H-5, 120–125	82.20	*M. aragonensis*	300-355	2.12	–1.44	3
9H-6, 6–11	82.56	*M. aragonensis*	300-355	2.65	–1.87	3
9H-6, 20–22	82.70	*M. aragonensis*	300-355	2.00	–1.60	3
9H-6, 70–72	83.20	*M. aragonensis*	300-355	2.36	–1.85	1
10H-1, 4–6	84.54	*M. aragonensis*	300-355	2.49	–2.00	3
10H-1, 83–85	85.33	*M. aragonensis*	300-355	2.24	–2.09	1
10H-2, 4–6	86.04	*M. aragonensis*	300-355	2.65	–2.28	1
10H-2, 60–62	86.60	*M. aragonensis*	>355	2.54	–2.05	1
10H-2, 120–125	87.20	*M. aragonensis*	300-355	2.66	–1.96	1
10H-3, 4–6	87.54	*M. aragonensis*	>355	2.74	–1.91	1
10H-2, 60–62	86.60	*M. subbotinae*	300-355	3.02	–2.21	1
10H-2, 120–125	87.20	*M. subbotinae*	300-355	2.88	–1.83	1
10H-3, 4–6	87.54	*M. subbotinae*	300-355	2.79	–2.05	1
10H-3, 60–62	88.10	*M. subbotinae*	300-355	2.81	–1.86	1
10H-3, 120–125	88.70	*M. subbotinae*	300-355	2.87	–1.92	1
10H-4, 4–6	89.04	*M. subbotinae*	300-355	2.76	–1.81	1
10H-4, 60–62	89.60	*M. subbotinae*	300-355	2.80	–2.02	1
10H-4, 120–125	90.20	*M. subbotinae*	300-355	2.59	–1.75	1
10H-5, 4–6	90.54	*M. subbotinae*	300-355	2.76	–1.93	1
10H-5, 60–62	91.10	*M. subbotinae*	300-355	3.00	–1.88	1
11H-1, 20–22	94.20	*M. subbotinae*	300-355	3.23	–1.85	1
11H-1, 85–87	94.85	*M. subbotinae*	300-355	3.34	–1.74	1
11H-1, 120–125	95.20	*M. subbotinae*	300-355	3.02	–1.68	3
11H-2, 20–22	95.70	*M. subbotinae*	300-355	3.22	–1.89	1
11H-2, 85–87	96.35	*M. subbotinae*	300-355	3.52	–2.09	1
11H-2, 120–125	96.70	*M. subbotinae*	300-355	3.66	–1.90	3
11H-3, 20–22	97.20	*M. subbotinae*	300-355	3.73	–2.02	1
11H-3, 85–87	97.85	*M. subbotinae*	300-355	3.74	–2.06	3
11H-3, 120–125	98.20	*M. subbotinae*	300-355	3.64	–2.11	3
11H-4, 20–22	98.70	*M. subbotinae*	300-355	3.61	–2.13	1
11H-4, 85–87	99.35	*M. subbotinae*	300-355	3.79	–1.99	1
11H-4, 120–125	99.70	*M. subbotinae*	300-355	3.84	–2.01	3
11H-5, 20–22	100.20	*M. subbotinae*	300-355	3.82	–2.11	1
11H-5, 85–87	100.85	*M. subbotinae*	300-355	3.60	–2.04	3
11H-5, 111–116	101.11	*M. subbotinae*	300-355	3.26	–1.97	1
11H-5, 120–125	101.20	*M. subbotinae*	300-355	3.71	–2.13	3
11H-6, 20–22	101.70	*M. subbotinae*	300-355	3.95	–1.97	1
11H-6, 43–47	101.93	*M. subbotinae*	300-355	3.89	–1.98	3
11H-6, 85–87	102.35	*M. subbotinae*	300-355	3.65	–2.00	1
11H-CC, 9–12	102.53	*M. subbotinae*	300-355	3.48	–1.97	3
12H-1,70–72	104.20	*M. subbotinae*	300-355	4.54	–1.81	1
11H-5, 85–87	100.85	*M. velascoensis*	300-355	3.92	–2.11	1
11H-6, 20–22D	101.70	*M. velascoensis*	300-355	3.87	–2.10	3
11H-6, 20–22	101.70	*M. velascoensis*	300-355	3.62	–2.00	1
11H-6, 85–87	102.35	*M. velascoensis*	300-355	3.65	–2.09	1
11H-CC, 9–12	102.53	*M. velascoensis*	300-355	3.49	–1.97	3
12H-1, 0–2	103.50	*M. velascoensis*	300-355	4.32	–2.06	1
12H-1, 2–4	103.52	*M. velascoensis*	300-355	3.38	–1.91	1
12H-1, 10–12	103.60	*M. velascoensis*	300-355	2.75	–1.66	1
12H-1, 12–14	103.62	*M. velascoensis*	300-355	2.49	–1.85	1
12H-1, 20–22D	103.70	*M. velascoensis*	300-355	4.10	–2.01	1
12H-1, 20–22D	103.70	*M. velascoensis*	300-355	4.27	–1.92	1
12H-1, 20–22	103.70	*M. velascoensis*	300-355	4.07	–1.87	1
12H-1, 30–32	103.80	*M. velascoensis*	300-355	4.11	–1.97	1
12H-1, 30–32D	103.80	*M. velascoensis*	300-355	4.25	–1.85	1
12H-1, 40–42	103.90	*M. velascoensis*	300-355	4.35	–1.96	1
12H-1, 40–42D	103.90	*M. velascoensis*	300-355	4.22	–1.86	1
12H-1, 70–72D	104.20	*M. velascoensis*	300-355	4.59	–1.93	3
12H-1, 70–72D	104.20	*M. velascoensis*	300-355	4.50	–1.78	3
12H-1, 70–72	104.20	*M. velascoensis*	300-355	4.38	–1.84	1
12H-1,120–125D	104.70	*M. velascoensis*	300-355	4.33	–1.75	3
12H-1, 120–125	104.70	*M. velascoensis*	300-355	4.48	–1.85	1

Table 1 (continued).

Core, section, interval (cm)	Depth (mbsf)	Taxon	Size (µm)	$\delta^{13}C$ (‰)	$\delta^{18}O$ (‰)	Run
12H-2, 20–22	105.20	*M. velascoensis*	300-355	3.91	–1.75	3
12H-2, 70–72D	105.70	*M. velascoensis*	300-355	4.55	–1.81	3
12H-2, 70–72	105.70	*M. velascoensis*	300-355	4.20	–1.80	1
12H-2, 120–125	106.20	*M. velascoensis*	300-355	4.38	–1.96	1
12H-3, 20–22	106.70	*M. velascoensis*	300-355	4.39	–1.75	3
12H-3, 70–72	107.20	*M. velascoensis*	300-355	4.36	–1.73	1
12H-3, 120–125	107.70	*M. velascoensis*	300-355	4.78	–1.81	1
12H-4, 70–72	108.70	*M. velascoensis*	300-355	4.50	–1.82	1
12H-4, 120–125	109.20	*M. velascoensis*	300-355	4.54	–1.91	1
12H-5, 20–22	109.70	*M. velascoensis*	300-355	4.52	–1.76	3
12H-5, 70–72	110.20	*M. velascoensis*	300-355	4.45	–2.31	1
12H-5, 120–125	110.70	*M. velascoensis*	300-355	4.78	–1.81	1
12H-6, 20–22	111.20	*M. velascoensis*	300-355	4.77	–1.87	1
12H-6, 70–72	111.70	*M. velascoensis*	300-355	5.01	–1.75	1
12H-6, 102–104	112.02	*M. velascoensis*	300-355	4.75	–1.70	1
13H-1, 21–23D	113.21	*M. velascoensis*	300-355	4.58	–1.87	3
13H-1, 21–23D	113.21	*M. velascoensis*	300-355	4.59	–1.82	1
13H-1, 21–23	113.21	*M. velascoensis*	300-355	4.63	–1.76	1
13H-1, 70–72	113.70	*M. velascoensis*	300-355	4.50	–1.80	1
13H-1, 117–121	114.17	*M. velascoensis*	300-355	4.86	–1.71	3
13H-2, 17–19D	114.67	*M. velascoensis*	300-355	4.79	–1.66	3
13H-2, 17–19	114.67	*M. velascoensis*	300-355	4.88	–1.57	1
13H-2, 70–72	115.20	*M. velascoensis*	300-355	4.64	–1.59	1
13H-2, 123–128	115.73	*M. velascoensis*	300-355	4.55	–1.73	3
13H-3, 21–23	116.21	*M. velascoensis*	300-355	4.52	–1.92	1
13H-3, 70–72	116.70	*M. velascoensis*	300-355	4.86	–1.98	1
13H-3, 121–126	117.21	*M. velascoensis*	300-355	4.93	–1.79	3
13H-4, 18–20	117.68	*M. velascoensis*	300-355	5.12	–1.74	1
13H-4, 70–72	118.20	*M. velascoensis*	300-355	4.80	–1.67	1
13H-4, 123–128	118.73	*M. velascoensis*	300-355	4.71	–1.68	3
13H-5, 20–22	119.20	*M. velascoensis*	300-355	4.87	–1.63	1
13H-5, 70–72	119.70	*M. velascoensis*	300-355	4.74	–1.60	1
13H-5, 123–128	120.23	*M. velascoensis*	300-355	4.95	–1.86	3
13H-6, 70–72	121.20	*M. velascoensis*	300-355	4.42	–1.64	1
13H-6, 89–93	121.39	*M. velascoensis*	300-355	4.27	–1.47	3
14H-1, 20–22	122.70	*M. velascoensis*	300-355	4.48	–1.58	1
14H-1, 70–72	123.20	*M. velascoensis*	300-355	4.42	–1.63	1
14H-1, 130–132	123.80	*M. velascoensis*	300-355	4.33	–1.29	1
14H-1, 144–146	123.94	*M. velascoensis*	300-355	4.24	–1.65	3
14H-2, 20–22	124.20	*M. velascoensis*	300-355	4.30	–1.44	1
14H-2, 66–68	124.66	*M. velascoensis*	300-355	4.52	–1.45	1
14H-3, 25–27	125.75	*M. velascoensis*	300-355	4.29	–1.41	1
14H-3, 76–78	126.26	*M. velascoensis*	300-355	4.28	–1.56	1
14H-3, 138–140	126.88	*M. velascoensis*	300-355	4.03	–1.09	3
14H-4, 23–25	127.23	*M. velascoensis*	300-355	4.30	–1.32	1
14H-4, 65–67	127.65	*M. velascoensis*	300-355	4.30	–1.39	1
14H-4, 65–67D	127.65	*M. velascoensis*	300-355	4.19	–1.27	1
14H-5, 22–24	128.72	*M. velascoensis*	300-355	3.93	–1.50	1
14H-5, 66–68	129.16	*M. velascoensis*	300-355	3.83	–1.39	1
14H-5, 136–138	129.86	*M. velascoensis*	300-355	3.77	–1.42	3
3H-1, 70–72	18.70	*Subbotina* spp.	300-355	1.32	0.82	3
3H-2, 84–86	20.34	*Subbotina* spp.	300-355	1.30	0.73	3
3H-3, 78–80	21.78	*Subbotina* spp.	300-355	1.42	0.50	3
3H-4, 80–82	23.30	*Subbotina* spp.	300-355	1.56	0.84	3
3H-5, 69–71	24.69	*Subbotina* spp.	300-355	1.49	1.21	3
3H-6, 69–71	26.19	*Subbotina* spp.	300-355	1.34	0.70	3
3H-7, 12–14	27.12	*Subbotina* spp.	300-355	1.28	0.84	3
4H-1, 70–72	28.20	*Subbotina* spp.	300-355	1.26	0.59	3
4H-1, 70–72D	28.20	*Subbotina* spp.	300-355	1.22	0.72	3
4H-2, 84–86	29.84	*Subbotina* spp.	300-355	1.34	0.46	3
4H-3, 84–86	31.34	*Subbotina* spp.	300-355	1.38	0.58	3
4H-4, 70–72	32.70	*Subbotina* spp.	300-355	1.62	0.26	3
4H-5, 70–72	34.20	*Subbotina* spp.	300-355	1.51	0.19	3
4H-6, 20–22	35.20	*Subbotina* spp.	300-355	1.63	–0.08	3
5H-1, 70–72	37.70	*Subbotina* spp.	300-355	1.66	–0.02	3
5H-2, 70–72	39.20	*Subbotina* spp.	255-300	1.66	–0.06	3
5H-3, 70–72	40.70	*Subbotina* spp.	300-355	1.56	–0.14	3
5H-4, 70–72	42.20	*Subbotina* spp.	300-355	1.63	0.12	3
5H-5, 70–72	43.70	*Subbotina* spp.	300-355	1.68	–0.02	3
5H-6, 50–52	44.50	*Subbotina* spp.	300-355	1.62	–0.09	3
6H-1, 81–83	47.31	*Subbotina* spp.	300-355	1.53	–0.11	3
6H-2, 73–75	48.73	*Subbotina* spp.	300-355	1.56	–0.01	3
6H-3, 70–72	50.20	*Subbotina* spp.	300-355	1.84	0.00	3
6H-4, 70–72	51.70	*Subbotina* spp.	300-355	1.81	–0.13	3
6H-5, 70–72	53.20	*Subbotina* spp.	300-355	1.76	0.05	3
6H-6, 70–72	54.70	*Subbotina* spp.	300-355	1.58	–0.01	3
7H-1, 118–120	57.18	*Subbotina* spp.	300-355	1.61	0.04	3
7H-2, 78–80	58.28	*Subbotina* spp.	300-355	1.71	0.15	3
7H-2, 78–80D	58.28	*Subbotina* spp.	300-355	1.51	0.30	3
7H-3, 69–71	59.69	*Subbotina* spp.	300-355	1.51	0.09	3
7H-4, 68–70	61.18	*Subbotina* spp.	300-355	1.62	0.03	3
7H-5, 70–72	62.70	*Subbotina* spp.	300-355	2.11	–0.53	3
7H-6, 76–78	63.76	*Subbotina* spp.	300-355	2.12	–0.54	3
8H-1, 89–91	66.39	*Subbotina* spp.	300-355	1.92	–0.32	3
8H-2, 70–72	67.70	*Subbotina* spp.	300-355	1.55	–0.27	3
8H-3, 70–72	69.20	*Subbotina* spp.	300-355	1.44	0.07	3
8H-4, 67–69	70.67	*Subbotina* spp.	300-355	1.27	0.08	3
8H-4, 70–72	70.70	*Subbotina* spp.	300-355	1.64	–0.28	1
8H-5, 70–72	72.20	*Subbotina* spp.	300-355	1.66	–0.41	1
8H-6, 70–72	73.70	*Subbotina* spp.	300-355	1.70	–0.26	1
9H-1, 13–15	75.13	*Subbotina* spp.	300-355	1.65	–0.27	3
9H-1, 70–72	75.70	*Subbotina* spp.	300-355	1.97	–0.55	3
9H-1, 120–125	76.20	*Subbotina* spp.	300-355	1.60	–0.40	3
9H-2, 20–22	76.70	*Subbotina* spp.	300-355	1.82	–0.29	3
9H-2, 70–72	77.20	*Subbotina* spp.	300-355	2.05	–0.42	1
9H-2, 120–125	77.70	*Subbotina* spp.	300-355	1.68	–0.37	3
9H-3, 20–22	78.20	*Subbotina* spp.	300-355	1.62	–0.20	3
9H-3, 70–72	78.70	*Subbotina* spp.	300-355	1.73	–0.41	3
9H-3, 120–125	79.20	*Subbotina* spp.	300-355	1.61	–0.39	3
9H-4, 10–12	79.60	*Subbotina* spp.	300-355	1.64	–0.58	1
9H-4, 70–72	80.20	*Subbotina* spp.	300-355	1.70	–0.42	3
9H-4, 120–125	80.70	*Subbotina* spp.	300-355	1.58	–0.29	3
9H-5, 18–19	81.18	*Subbotina* spp.	300-355	1.62	–0.21	3
9H-5, 70–72	81.70	*Subbotina* spp.	300-355	1.67	–0.48	1
9H-5, 70–72D	81.70	*Subbotina* spp.	300-355	2.04	–0.69	1
9H-5, 120–125	82.20	*Subbotina* spp.	300-355	1.47	–0.60	3
9H-6, 20–22	82.70	*Subbotina* spp.	300-355	1.90	–0.87	1
9H-6, 70–72	83.20	*Subbotina* spp.	300-355	1.61	–0.87	1
10H-1, 4–6	84.54	*Subbotina* spp.	300-355	1.68	–0.50	3
10H-1, 83–85	85.33	*Subbotina* spp.	250-300	1.28	–0.89	1
10H-1, 120–125	85.70	*Subbotina* spp.	250-300	1.23	–0.73	1
10H-2, 4–6	86.04	*Subbotina* spp.	300-355	1.36	–1.20	1
10H-2, 60–62	86.60	*Subbotina* spp.	300-355	1.91	–1.79	3
10H-2, 120–125	87.20	*Subbotina* spp.	300-355	1.53	–1.23	1
10H-3, 4–6	87.54	*Subbotina* spp.	300-355	2.13	–1.70	1
10H-3, 60–62	88.10	*Subbotina* spp.	300-355	1.79	–1.37	1
10H-3, 120–125	88.70	*Subbotina* spp.	300-355	1.36	–0.93	1
10H-4, 4–6	89.04	*Subbotina* spp.	300-355	1.10	–0.79	1
10H-4, 60–62	89.60	*Subbotina* spp.	300-355	1.17	–0.69	3
10H-4, 120–125	90.20	*Subbotina* spp.	300-355	1.22	–0.83	1
10H-5, 4–6	90.54	*Subbotina* spp.	250-300	1.18	–0.75	1
10H-5, 60–62	91.10	*Subbotina* spp.	300-355	1.05	–0.53	1
10H-5, 111–116	91.61	*Subbotina* spp.	250-300	1.16	–0.73	1
11H-1, 20–22	94.20	*Subbotina* spp.	300-355	1.35	–1.01	1
11H-1, 85–87	94.85	*Subbotina* spp.	300-355	1.53	–0.79	1
11H-2, 20–22	95.70	*Subbotina* spp.	300-355	1.54	–0.90	1
11H-2, 85–87	96.35	*Subbotina* spp.	300-355	1.43	–1.21	1
11H-3, 20–22	97.20	*Subbotina* spp.	300-355	1.92	–1.39	1
11H-3, 85–87	97.85	*Subbotina* spp.	300-355	2.00	–1.18	3
11H-4, 20–22	98.70	*Subbotina* spp.	300-355	1.58	–1.01	1
11H-4, 85–87	99.35	*Subbotina* spp.	300-355	1.85	–1.23	1
11H-5, 20–22	100.20	*Subbotina* spp.	300-355	1.74	–1.51	3
11H-5, 85–87	100.85	*Subbotina* spp.	300-355	1.73	–1.09	1
11H-6, 20–22	101.70	*Subbotina* spp.	300-355	1.94	–1.56	3
11H-CC, 9–12	102.53	*Subbotina* spp.	250-300	2.24	–1.42	1
12H-1, 00–02	103.50	*Subbotina* spp.	300-355	1.88	–1.27	3
12H-1, 10–12	103.60	*Subbotina* spp.	300-355	2.15	–1.51	1
12H-1, 20–22	103.70	*Subbotina* spp.	300-355	2.51	–1.19	1
12H-1, 30–32	103.80	*Subbotina* spp.	300-355	2.55	–1.63	1
12H-1, 40–42	103.90	*Subbotina* spp.	300-355	2.33	–0.92	1
12H-1, 70–72	104.20	*Subbotina* spp.	300-355	2.19	–1.01	1
12H-1, 120–125	104.70	*Subbotina* spp.	300-355	2.77	–1.58	1
12H-2, 20–22	105.20	*Subbotina* spp.	300-355	2.44	–1.50	1
12H-2, 70–72	105.70	*Subbotina* spp.	300-355	2.61	–1.47	1
12H-2, 120–125	106.20	*Subbotina* spp.	300-355	2.39	–1.38	3
12H-3, 20–22	106.70	*Subbotina* spp.	300-355	1.92	–3.14	1
12H-3, 70–72	107.20	*Subbotina* spp.	300-355	2.81	–1.47	1
12H-3, 120–125	107.70	*Subbotina* spp.	300-355	2.83	–1.48	1
12H-4, 70–72	108.70	*Subbotina* spp.	300-355	1.38	–2.43	1
12H-4, 120–125	109.20	*Subbotina* spp.	300-355	2.42	–0.83	1
12H-5, 20–22	109.70	*Subbotina* spp.	300-355	2.28	–1.34	1
12H-5, 70–72	110.20	*Subbotina* spp.	300-355	2.22	–1.50	1
12H-5, 120–125	110.70	*Subbotina* spp.	300-355	2.65	–1.18	1
12H-6, 20–22	111.20	*Subbotina* spp.	300-355	2.75	–1.12	1
12H-6, 70–72	111.70	*Subbotina* spp.	300-355	2.93	–1.21	1
12H-6, 102–104	112.02	*Subbotina* spp.	300-355	2.42	–0.60	1
13H-1, 21–23	113.21	*Subbotina* spp.	300-355	2.42	–2.22	1
13H-1, 70–72	113.70	*Subbotina* spp.	300-355	2.62	–1.31	1
13H-1, 117–121	114.17	*Subbotina* spp.	300-355	2.58	–1.00	3
13H-2, 17–19	114.67	*Subbotina* spp.	300-355	2.58	–0.24	1
13H-2, 70–72	115.20	*Subbotina* spp.	250-300	2.45	–0.52	1
13H-2, 123–128	115.73	*Subbotina* spp.	300-355	2.67	–1.27	3
13H-3, 21–23	116.21	*Subbotina* spp.	250-300	2.29	–0.54	1
13H-3, 70–72	116.70	*Subbotina* spp.	250-300	2.69	–1.24	1
13H-3, 121–126	117.21	*Subbotina* spp.	300-355	2.76	–0.96	3
13H-4, 18–20	117.68	*Subbotina* spp.	300-355	2.84	–0.55	1
13H-4, 70–72	118.20	*Subbotina* spp.	300-355	3.01	–1.18	1
13H-4, 123–128	118.73	*Subbotina* spp.	300-355	2.64	–0.56	3
13H-5, 20–22	119.20	*Subbotina* spp.	300-355	2.59	–0.87	3
13H-5, 70–72	119.70	*Subbotina* spp.	300-355	2.84	–0.91	1
13H-5, 123–128	120.23	*Subbotina* spp.	300-355	2.60	–0.33	3
13H-6, 20–22	120.70	*Subbotina* spp.	300-355	2.69	–1.04	1
13H-6, 89–93	121.39	*Subbotina* spp.	300-355	2.64	–0.82	3
14H-1, 130–132	123.80	*Subbotina* spp.	300-355	2.40	0.08	1
14H-1, 144–146	123.94	*Subbotina* spp.	300-355	2.21	0.33	3

Table 1 (continued).

Core, section, interval (cm)	Depth (mbsf)	Taxon	Size (µm)	$\delta^{13}C$ (‰)	$\delta^{18}O$ (‰)	Run
14H-2, 66–68	124.66	*Subbotina* spp.	300-355	2.45	0.13	1
14H-3, 76–78	126.26	*Subbotina* spp.	250-300	2.29	0.02	1
14H-3, 138–140	126.88	*Subbotina* spp.	300-355	2.20	0.14	3
14H-4, 65–67	127.65	*Subbotina* spp.	300-355	2.24	0.12	1
14H-5, 66–68	129.16	*Subbotina* spp.	300-355	2.51	–0.87	1
14H-5, 136–138	129.86	*Subbotina* spp.	300-355	2.16	–0.70	3
14H-6, 17–19	130.17	*Subbotina* spp.	250-300	2.19	–0.60	3
15X–1, 73–75	132.73	*Subbotina* spp.	250-300	2.01	–0.24	1
15X–2, 21–23	133.71	*Subbotina* spp.	250-300	1.81	–0.20	1
3H-1, 70–72	18.70	*A. bullbrooki*	300-355	1.48	0.20	3
3H-2, 84–86	20.34	*A. bullbrooki*	300-355	1.61	0.25	3
3H-3, 78–80	21.78	*A. bullbrooki*	300-355	1.66	0.01	3
3H-4, 80–82	23.30	*A. bullbrooki*	300-355	2.08	–0.10	3
3H-5, 69–71	24.69	*A. bullbrooki*	300-355	1.62	0.14	3
3H-6, 69–71	26.19	*A. bullbrooki*	300-355	2.21	–0.27	3
3H-7, 12–14	27.12	*A. bullbrooki*	300-355	1.95	–0.30	3
4H-1, 70–72	28.20	*A. bullbrooki*	300-355	2.85	–0.21	3
4H-2, 84–86	29.84	*A. bullbrooki*	300-355	2.86	–0.44	3
4H-3, 84–86	31.34	*A. bullbrooki*	300-355	3.20	–0.59	3
4H-4, 70–72	32.70	*A. bullbrooki*	300-355	3.23	–0.58	3
4H-5, 70–72	34.20	*A. bullbrooki*	300-355	2.05	–0.59	3
4H-6, 20–22	35.20	*A. bullbrooki*	300-355	1.59	–0.48	3
5H-1, 70–72	37.70	*A. bullbrooki*	300-355	2.01	–0.38	3
5H-2, 70–72	39.20	*A. bullbrooki*	300-355	1.59	–0.33	3
5H-3, 70–72	40.70	*A. bullbrooki*	300-355	1.41	–0.10	3
5H-4, 70–72	42.20	*A. bullbrooki*	300-355	2.11	–0.30	3
5H-5, 70–72	43.70	*A. bullbrooki*	300-355	3.33	–0.98	3
5H-6, 50–52	44.50	*A. bullbrooki*	300-355	3.08	–0.77	3
6H-1, 81–83	47.31	*A. bullbrooki*	300-355	3.00	–0.63	3
6H-2, 73–75	48.73	*A. bullbrooki*	300-355	1.71	–0.26	3
6H-3, 70–72	50.20	*A. bullbrooki*	300-355	3.06	–0.78	3
6H-4, 70–72	51.70	*A. bullbrooki*	300-355	3.13	–0.96	3
6H-4, 70–72D	51.70	*A. bullbrooki*	300-355	3.17	–0.85	3
6H-5, 70–72	53.20	*A. bullbrooki*	300-355	3.18	–0.57	3
6H-6, 70–72	54.70	*A. bullbrooki*	300-355	3.14	–0.58	3
7H-1, 118–120	57.18	*A. bullbrooki*	300-355	3.26	–0.69	3
7H-2, 78–80	58.28	*A. bullbrooki*	300-355	3.08	–0.67	3
7H-3, 69–71	59.69	*A. bullbrooki*	300-355	3.10	–0.77	3
7H-4, 66–68	61.18	*A. bullbrooki*	300-355	3.15	–0.68	3
7H-4, 66–68D	61.18	*A. bullbrooki*	300-355	3.03	–0.69	3
7H-5, 70–72	62.70	*A. bullbrooki*	300-355	3.08	–0.88	3
7H-6, 76–78	63.76	*A. bullbrooki*	300-355	2.70	–0.85	3
8H-1, 89–91	66.39	*A. bullbrooki*	300-355	3.20	–1.03	3
8H-2, 70–72	67.70	*A. bullbrooki*	300-355	3.41	–1.10	3
8H-3, 70–72	69.20	*A. bullbrooki*	300-355	3.19	–1.17	3
8H-4, 67–69	70.67	*A. bullbrooki*	300-355	3.24	–0.96	3
8H-5, 70–72	72.20	*A. bullbrooki*	300-355	2.95	–1.28	3
8H-5, 70–72D	72.20	*A. bullbrooki*	300-355	2.80	–1.28	3
8H-6, 70–72	73.70	*A. bullbrooki*	300-355	2.91	–1.55	3
9H-1, 13–15	75.13	*A. bullbrooki*	300-355	2.84	–0.98	3
9H-1, 70–72	75.70	*A. bullbrooki*	300-355	2.56	–1.22	3
9H-1, 70–72D	75.70	*A. bullbrooki*	300-355	2.95	–1.10	3
9H-1, 120–125	76.20	*A. bullbrooki*	300-355	2.90	–1.11	3
9H-2, 20–22	76.70	*A. bullbrooki*	300-355	2.92	–1.01	3
9H-2, 70–72	77.20	*A. bullbrooki*	300-355	2.77	–1.16	3
9H-2, 120–122	77.70	*A. bullbrooki*	300-355	2.92	–1.23	3
9H-3, 20–22	78.20	*A. bullbrooki*	300-355	3.05	–1.16	3
9H-3, 70–72	78.70	*A. bullbrooki*	300-355	3.08	–1.47	3
9H-3, 120–125	79.20	*A. bullbrooki*	300-355	2.89	–1.46	3
9H-4, 10–12	79.60	*A. bullbrooki*	300-355	2.56	–1.16	3
9H-4, 70–72	80.20	*A. bullbrooki*	300-355	3.04	–1.36	3
9H-3, 120–125	79.20	*A. soldadoensis*	300-355	3.19	–1.16	3
9H-4, 10–12	79.60	*A. soldadoensis*	300-355	1.95	–1.01	3
9H-4, 70–72	80.20	*A. soldadoensis*	300-355	2.63	–1.44	3
9H-4, 120–125	80.70	*A. soldadoensis*	300-355	2.55	–1.41	3
9H-5, 18–19	81.18	*A. soldadoensis*	300-355	2.88	–1.32	3
9H-5, 70–72	81.70	*A. soldadoensis*	300-355	2.32	–0.99	3
9H-5, 70–72D	81.70	*A. soldadoensis*	300-355	2.40	–1.04	3
9H-5, 120–125	82.20	*A. soldadoensis*	300-355	2.16	–1.06	3
9H-6, 6–11	82.56	*A. soldadoensis*	300-355	2.57	–1.62	3
9H-6, 20–22	82.70	*A. soldadoensis*	300-355	2.32	–1.23	3
9H-6, 70–72	83.20	*A. soldadoensis*	300-355	2.63	–1.79	3
10H-1, 4–6	84.54	*A. soldadoensis*	300-355	2.44	–2.09	3
10H-1, 83–85	85.33	*A. soldadoensis*	300-355	2.55	–1.96	3
10H-1, 120–125	85.70	*A. soldadoensis*	300-355	2.49	–2.02	3
10H-2, 4–6	86.04	*A. soldadoensis*	300-355	2.52	–1.93	3
10H-2, 60–62	86.60	*A. soldadoensis*	300-355	2.69	–2.08	3
10H-2, 120–125	87.20	*A. soldadoensis*	300-355	2.79	–1.84	3
10H-3, 4–6	87.54	*A. soldadoensis*	300-355	2.62	–2.03	3
10H-3, 4–6D	87.54	*A. soldadoensis*	300-355	2.26	–2.29	3
10H-3, 60–62	88.10	*A. soldadoensis*	300-355	2.94	–1.82	2
10H-3, 120–125	88.70	*A. soldadoensis*	300-355	3.20	–1.87	2
10H-4, 4–6	89.04	*A. soldadoensis*	300-355	2.91	–1.94	2
10H-4, 60–62	89.60	*A. soldadoensis*	300-355	3.06	–1.94	2
10H-4, 120–125	90.20	*A. soldadoensis*	300-355	2.96	–1.96	2
10H-5, 4–6	90.54	*A. soldadoensis*	300-355	2.97	–1.90	2
10H-5, 60–62	91.10	*A. soldadoensis*	300-355	2.43	–1.87	3
10H-5, 111–116	91.61	*A. soldadoensis*	300-355	2.89	–2.03	2
11H-1, 20–22	94.20	*A. soldadoensis*	300-355	2.98	–2.14	2
11H-1, 85–87	94.85	*A. soldadoensis*	300-355	3.46	–2.01	2
11H-1, 120–125	95.20	*A. soldadoensis*	300-355	3.06	–2.06	3
11H-2, 20–22	95.70	*A. soldadoensis*	300-355	3.26	–2.07	2
11H-2, 85–87	96.35	*A. soldadoensis*	300-355	3.39	–2.23	2
11H-2, 85–87D	96.35	*A. soldadoensis*	300-355	3.28	–2.15	2
11H-2, 120–125	96.70	*A. soldadoensis*	300-355	3.24	–2.13	3
11H-3, 20–22	97.20	*A. soldadoensis*	300-355	3.68	–2.14	2
11H-3, 85–87	97.85	*A. soldadoensis*	300-355	3.58	–2.21	2
11H-3, 120–125	98.20	*A. soldadoensis*	300-355	3.57	–2.26	3
11H-4, 20–22	98.70	*A. soldadoensis*	300-355	3.38	–2.12	2
11H-4, 85–87	99.35	*A. soldadoensis*	300-355	3.75	–2.22	2
11H-4, 120–125	99.70	*A. soldadoensis*	300-355	3.58	–2.25	3
11H-5, 20–22	100.20	*A. soldadoensis*	300-355	3.65	–1.80	2
11H-5, 85–87	100.85	*A. soldadoensis*	300-355	3.37	–2.18	2
11H-5, 120–125	101.20	*A. soldadoensis*	300-355	3.23	–2.14	3
11H-6, 20–22D	101.70	*A. soldadoensis*	300-355	3.43	–2.16	3
11H-6, 20–22	101.70	*A. soldadoensis*	300-355	3.40	–2.11	2
11H-6, 43–47	101.93	*A. soldadoensis*	300-355	3.42	–2.19	3
11H-6, 85–87	102.35	*A. soldadoensis*	300-355	3.29	–2.12	2
11H-CC, 9–12D	102.53	*A. soldadoensis*	300-355	3.24	–2.02	3
11H-CC, 9–12D	102.53	*A. soldadoensis*	300-355	3.34	–2.05	2
11H-CC, 9–12	102.53	*A. soldadoensis*	300-355	3.24	–2.05	2
12H-1, 0–2	103.50	*A. soldadoensis*	300-355	2.66	–1.93	2
12H-1, 10–12	103.60	*A. soldadoensis*	300-355	1.29	–1.94	2
12H-1, 20–22	103.70	*A. soldadoensis*	300-355	3.94	–2.02	2
12H-1, 30–32	103.80	*A. soldadoensis*	300-355	3.24	–1.93	2
12H-1, 40–42	103.90	*A. soldadoensis*	300-355	3.90	–2.09	2
12H-1, 40–42D	103.90	*A. soldadoensis*	300-355	3.98	–2.07	2
12H-1, 70–72D	104.20	*A. soldadoensis*	300-355	4.10	–2.08	3
12H-1, 70–72D	104.20	*A. soldadoensis*	300-355	4.18	–2.03	3
12H-1, 70–72	104.20	*A. soldadoensis*	300-355	4.11	–2.00	2
12H-1, 120–125	104.70	*A. soldadoensis*	300-355	4.32	–2.02	2
12H-2, 20–22	105.20	*A. soldadoensis*	300-355	3.91	–1.90	2
12H-2, 70–72D	105.70	*A. soldadoensis*	300-355	4.04	–1.88	3
12H-2, 70–72	105.70	*A. soldadoensis*	300-355	4.08	–1.98	2
12H-2, 120–125	106.20	*A. soldadoensis*	300-355	4.07	–1.97	2
12H-3, 20–22	106.70	*A. soldadoensis*	300-355	4.35	–1.95	2
12H-3, 70–72	107.20	*A. soldadoensis*	300-355	4.47	–1.84	2
12H-3, 120–125	107.70	*A. soldadoensis*	300-355	4.62	–2.01	2
12H-4, 70–72	108.70	*A. soldadoensis*	300-355	4.29	–1.74	3
12H-5, 20–22	109.70	*A. soldadoensis*	300-355	4.19	–1.82	3
12H-3, 70–72	107.20	*A. mckannai*	300-355	4.43	–1.89	2
12H-3, 120–125	107.70	*A. mckannai*	300-355	4.52	–2.06	2
12H-4, 70–72	108.70	*A. mckannai*	300-355	4.26	–1.86	2
12H-4, 120–125	109.20	*A. mckannai*	300-355	4.43	–2.04	2
12H-5, 20–22	109.70	*A. mckannai*	300-355	4.28	–1.83	2
12H-5, 70–72	110.20	*A. mckannai*	300-355	4.40	–1.86	2
12H-5, 120–125	110.70	*A. mckannai*	300-355	4.31	–1.73	3
12H-6, 20–22	111.20	*A. mckannai*	300-355	4.51	–1.80	2
12H-6, 70–72	111.70	*A. mckannai*	300-355	4.77	–1.81	2
12H-6, 102–104	112.02	*A. mckannai*	300-355	4.63	–1.89	2
12H-6, 102–104D	112.02	*A. mckannai*	300-355	4.42	–1.66	2
13H-1, 21–23D	113.21	*A. mckannai*	300-355	4.37	–1.75	3
13H-1, 21–23	113.21	*A. mckannai*	300-355	4.43	–1.94	2
13H-1, 70–72	113.70	*A. mckannai*	300-355	4.44	–1.57	2
13H-2, 17–19D	114.67	*A. mckannai*	300-355	4.47	–1.83	3
13H-2, 17–19	114.67	*A. mckannai*	300-355	4.73	– 1.84	2

Notes: D after cm interval refers to duplicate analysis. Run 1 took place in June 1993; Run 2 occurred in November 1993; Run 3 took place in March 1994. All analyses are reported with respect to PDB.

Table 2. Stable isotopic data for Hole 865C.

Core, section, interval (cm)	Depth (mbsf)	Taxon	Size (µm)	$\delta^{13}C$ (‰)	$\delta^{18}O$ (‰)	Run
Benthic foraminifers						
11H-5, 130–132	96.10	*Cibicidoides* sp.	>125	0.78	–0.15	1
12H-1, 111–113	99.41	*Cibicidoides* sp.	>125	0.98	–0.49	1
12H-2, 20–22	100.00	*Cibicidoides* sp.	>125	1.07	–0.42	1
12H-2, 111–113	100.91	*Cibicidoides* sp.	>125	1.13	–0.36	1
12H-3, 20–22	101.50	*Cibicidoides* sp.	>125	1.04	–0.19	1
12H-3, 100–102	102.30	*Cibicidoides* sp.	>125	0.51	–0.44	1
12H-3, 111–113	102.41	*Cibicidoides* sp.	>125	0.61	–0.27	1
12H-3, 120–122	102.50	*Cibicidoides* sp.	>125	0.00	–1.16	1
12H-3, 130–132	102.60	*Cibicidoides* sp.	>125	0.38	–0.45	1
12H-3, 130–132D	102.60	*Cibicidoides* sp.	>125	0.23	–0.47	1
12H-3, 140–142	102.70	*Cibicidoides* sp.	>125	–0.76	–2.59	1
12H-3, 140–142D	102.70	*Cibicidoides* sp.	>125	0.26	–0.85	1
12H-3, 140–142D	102.70	*Cibicidoides* sp.	>125	-0.01	–0.49	3
12H-4, 0–2	102.80	*Cibicidoides* sp.	>125	–0.07	–0.76	1
12H-4, 0–2D	102.80	*Cibicidoides* sp.	>125	0.32	–0.58	3
12H-4, 10–12	102.90	*Cibicidoides* sp.	>125	1.47	0.02	1
12H-2, 111–113	100.91	*Lenticulina* sp.	>125	0.21	–0.19	1
12H-3, 140–142	102.70	*Lenticulina* sp.	>125	–0.45	–0.43	1
12H-4, 10–12	102.90	*Lenticulina* sp.	>125	–1.69	–1.01	1
12H-4, 30–32	103.10	*Lenticulina* sp.	>125	–0.57	–0.31	1
12H-4, 20–22	103.00	*N. truempyi*	>125	0.78	–0.14	1
Planktonic foraminifers						
11H-6, 52–54	96.82	*M. subbotinae*	300-355	3.78	–1.92	1
12H-1, 10–12	98.40	*M. subbotinae*	300–355	3.86	–1.97	1
12H-1, 60–62	98.90	*M. subbotinae*	300-355	3.80	–2.10	1
12H-2, 70–72	100.50	*M. subbotinae*	300-355	3.86	–2.03	1
12H-3, 0–2	101.30	*M. subbotinae*	300-355	3.84	–2.01	1
12H-2, 70–72	100.50	*M. velascoensis*	300–355	3.65	–2.05	1
12H-2, 70–72D	100.50	*M. velascoensis*	300–355	3.62	–2.09	1
12H-3, 0–2	101.30	*M. velascoensis*	300–355	3.73	–2.17	1
12H-3, 10–12	101.40	*M. velascoensis*	300–355	3.58	–2.02	1
12H-3, 30–32	101.60	*M. velascoensis*	300–355	3.60	–1.91	1
12H-3, 50–52	101.80	*M. velascoensis*	300–355	3.68	–2.08	1
12H-3, 60–62	101.90	*M. velascoensis*	300–355	3.54	–1.89	1
12H-3, 70–72	102.00	*M. velascoensis*	300–355	3.53	–2.09	1
12H-3, 80–82	102.10	*M. velascoensis*	300–355	3.38	–2.04	1
12H-3, 90–92	102.20	*M. velascoensis*	300–355	3.33	–1.96	1
12H-3, 110–112	102.40	*M. velascoensis*	300–355	3.16	–1.99	1
12H-3, 120–122	102.50	*M. velascoensis*	300–355	3.08	–2.03	1
12H-3, 130–132	102.60	*M. velascoensis*	300–355	3.00	–2.14	1
12H-3, 140–142	102.70	*M. velascoensis*	300–355	4.00	–1.88	1
12H-3, 140–142D	102.70	*M. velascoensis*	300–355	4.00	–1.76	1
12H-4, 0–2	102.80	*M. velascoensis*	300–355	2.11	–1.83	1
12H-4, 10–12	102.90	*M. velascoensis*	300–355	3.39	–1.78	1
12H-4, 20–22	103.00	*M. velascoensis*	300-355	4.08	–1.93	1
12H-4, 20–22D	103.00	*M. velascoensis*	300–355	3.87	–1.87	1
12H-4, 30–32	103.10	*M. velascoensis*	300-355	4.00	–1.90	1
12H-4, 40–42	103.20	*M. velascoensis*	300-355	4.28	–1.89	1
12H-4, 50–52	103.30	*M. velascoensis*	300-355	4.41	–1.94	1
12H-4, 60–62	103.40	*M. velascoensis*	300-355	4.36	–1.79	1
12H-4, 70–72	103.50	*M. velascoensis*	300-355	4.28	–1.83	1
12H-4, 80–82	103.60	*M. velascoensis*	300-355	4.43	–1.94	1
12H-4, 90–92	103.70	*M. velascoensis*	300-355	4.51	–1.80	1
12H-4, 110–112	103.90	*M. velascoensis*	300-355	4.46	–1.77	1
12H-4, 110–112D	103.90	*M. velascoensis*	300-355	4.35	–1.76	1
12H-4, 120–122	104.00	*M. velascoensis*	300-355	4.45	–1.84	1
12H-4, 130–132	104.10	*M. velascoensis*	300-355	4.30	–1.78	1
12H-4, 140–142	104.20	*M. velascoensis*	300-355	4.55	–1.84	1
12H-5, 0–2	104.30	*M. velascoensis*	300-355	4.48	–1.86	1
12H-5, 70–72	105.00	*M. velascoensis*	300-355	4.36	–1.84	1
12H-5, 130–132	105.60	*M. velascoensis*	300-355	4.47	–1.68	1
12H-6, 70–72	106.50	*M. velascoensis*	300-355	4.65	–1.81	1
11H-6, 52–54	96.82	*A. soldadoensis*	300-355	3.32	–2.10	2
12H-1, 10–12	98.40	*A. soldadoensis*	300-355	3.40	–2.04	2
12H-1, 10–12D	98.40	*A. soldadoensis*	300-355	3.40	-2.04	2
12H-1, 60–62	98.90	*A. soldadoensis*	300-355	3.40	2.12	2
12H-2, 70–72	100.50	*A. soldadoensis*	300-355	3.21	–2.24	2
12H-3, 0–2	101.30	*A. soldadoensis*	300-355	3.30	–2.14	2
12H-3, 10–12	101.40	*A. soldadoensis*	300-355	3.20	–2.29	2
12H-3, 30–32	101.60	*A. soldadoensis*	300-355	3.32	–1.94	2
12H-3, 40–42	101.70	*A. soldadoensis*	300-355	3.42	–2.10	2
12H-3, 50–52	101.80	*A. soldadoensis*	300-355	3.39	–1.98	2
12H-3, 60–62	101.90	*A. soldadoensis*	300-355	3.21	–1.94	2
12H-3, 70–72	102.00	*A. soldadoensis*	300-355	3.54	–2.27	2
12H-3, 70–72D	102.00	*A. soldadoensis*	300-355	3.12	–2.05	2
12H-3, 80–82	102.10	*A. soldadoensis*	300-355	3.26	–2.05	2
12H-3, 90–92	102.20	*A. soldadoensis*	300-355	2.99	–1.95	2
12H-3, 140–142	102.70	*A. soldadoensis*	300-355	2.05	–1.80	2
12H-4, 0–2	102.80	*A. soldadoensis*	300-355	1.91	–1.90	2
12H-4, 10–12	102.90	*A. soldadoensis*	300-355	1.60	–2.12	2
12H-4, 50–52	103.30	*A. soldadoensis*	300-355	4.23	–2.04	2
12H-4, 60–62	103.40	*A. soldadoensis*	300-355	4.14	–2.05	2
12H-4, 70–72	103.50	*A. soldadoensis*	300-355	3.93	–1.86	2
12H-4, 80–82	103.60	*A. soldadoensis*	300-355	4.34	–2.05	2
12H-4, 90–92	103.70	*A. soldadoensis*	300-355	4.32	–2.04	2
12H-4, 110–112	103.90	*A. soldadoensis*	300-355	4.30	–1.94	2
12H-4, 120–122	104.00	*A. soldadoensis*	300-355	4.26	–2.01	2
12H-4, 130–132	104.10	A. *soldadoensis*	300-355	4.25	–2.00	2
12H-5, 0–2	104.30	*A. soldadoensis*	300-355	4.26	–1.96	2
12H-5, 70–72	105.00	*A. soldadoensis*	300-355	4.30	–1.88	2
12H-5, 70–72D	105.00	*A. soldadoensis*	300-355	4.36	–1.90	2
12H-5, 130–132	105.60	*A. soldadoensis*	300-355	4.10	–1.92	2
12H-6, 70–72	106.50	*A. soldadoensis*	300-355	4.44	–1.97	2

Notes: D after cm interval refers to duplicate analysis. Run 1 took place in June 1993; Run 2 occurred in November 1993; Run 3 took place in March 1994. All analysesare reported with respect to PDB.