Data report: late Quaternary calcareous nannofossil assemblages at Site U1304[1]

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Chapter contents

Abstract

Calcareous nannofossils can reflect millennial timescale climate changes in the North Atlantic Ocean. Using Système de Reconnaissance Automatique de Coccolithes, quantitative analysis of nannofossil assemblages were carried out on the samples from the uppermost 30.08 meters composite depth of Integrated Ocean Drilling Program Expedition 303 Site U1304. We find that calcareous nannofossils are very abundant in all samples. The assemblages are dominated by *Emiliania huxleyi, Gephyrocapsa ericsonii, Gephyrocapsa muellerae,* and *Gephyrocapsa oceanica*. Compared with a composite oxygen isotope curve composed of data from gravity Core GGC-12, piston Core JPC-13, and Site U1304, the downcore variations in relative abundance of each species are more complex.

Introduction

Integrated Ocean Drilling Program (IODP) Expedition 303 Site U1304 is located in a partially enclosed basin at the southern limit of the Gardar Drift just to the north of the Charlie Gibbs Fracture Zone in the central Atlantic. Drilling objectives at the site were to obtain a high-resolution Pliocene–Quaternary environmental record. Preliminary shipboard investigation indicated that the mean sedimentation rate at Site U1304 is very high (14.9 cm/k.y.) and calcareous nannofossils are abundant and show excellent preservation (see the **"Expedition 303 summary"** chapter).

We investigated calcareous nannofossils in samples from the uppermost 30.08 meters composite depth (mcd). The primary objective of this study is to record the variations in relative abundance of calcareous nannofossils and to provide information for interpreting late Quaternary environmental changes in the region.

Materials and methods

Four holes were drilled at Site U1304 to a total depth of 264 mcd. All cores were recovered using the advanced piston corer (APC). Recovery was excellent in Holes U1304A and U1304B but decreased in Holes U1304C and U1304D. The sediments at Site U1304 are predominantly interbedded nannofossil oozes and diatom oozes, with less common intervals of clay and silty clay, which also contain abundant nannofossils and/or diatoms.

[1] Liu, C., 2009. Data report: late Quaternary calcareous nannofossil assemblages at Site U1304. *In* Channell, J.E.T., Kanamatsu, T., Sato, T., Stein, R., Alvarez Zarikian, C.A., Malone, M.J., and the Expedition 303/306 Scientists, *Proc. IODP,* 303/306: College Station, TX (Integrated Ocean Drilling Program Management International, Inc.). doi:10.2204/iodp.proc.303306.202.2009
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doi:10.2204/iodp.proc.303306.202.2009

For this study, we collected 298 samples with a resolution of 10 cm from the uppermost 30.08 mcd of Holes U1304A and U1304B. An automated coccolith recognition system called Système de Reconnaissance Automatique de Coccolithes (SYRACO) (Beaufort and Dollfus, 2004) was used in this study. A total of 14 coccolith species were recognized using this system. These species are *Calcidiscus leptoporus, Coccolithus pelagicus, Emiliania huxleyi, Florisphaera elongata, Florisphaera profunda, Helicosphaera carteri, Gephyrocapsa ericsonii, Gephyrocapsa muellerae, Gephyrocapsa oceanica, Scapholithus fossilis, Syracosphaera* spp., *Syracosphaera pulchra, Umbilicosphaera sibogae,* and *Umbellosphaera tenuis*. Smear slides were prepared and viewed with an optical microscope (Leica DM6000B) with an automatic stage. A computer connected to the microscope controls motion and focus on the smear slides. A 50× lens and a digital camera (Spot Insight 1420) permit grabbing the frames in which the coccoliths are recognizable and taking images of them. In this study, 40 frames were grabbed for each sample. The output images were analyzed by SYRACO to obtain the relative abundance of coccoliths.

Results

The original census data of calcareous nannofossils are shown in Table **T1.** In general, calcareous nannofossils are very abundant in all samples. The assemblages are dominated by *E. huxleyi, G. ericsonii, G. muellerae,* and *G. oceanica*. The percent abundance of *H. carteri* and *C. pelagicus* is high in some samples. Compared with a composite oxygen isotope curve composed of data from gravity Core GGC-12, piston Core JPC-13, and Site U1304, the downcore variations in relative abundance of each species are more complex (Fig. **F1**) (oxygen isotope data provided by D.A. Hodell, pers. comm., 2008). The percent abundances of *E. huxleyi* and *G. muellerae* are high during marine isotope Stages (MIS) 6, 4, 3, and most of MIS 5 and low during MIS 1, 2, 7, and part of MIS 5. The percent abundance of *G. ericsonii* and *G. oceanica* are high during MIS 7 and late MIS 1 but low during MIS 2, 3, 4, and 5. The relative abundances of *H. carteri*, *U. sibogae* and *C. pelagicus* are high in MIS 2, 4, and 7 but low in MIS 3, 6, and most of MIS 5.

Acknowledgments

This research used samples and data provided by the Integrated Ocean Drilling Program (IODP). Expedition 308 scientists and technicians helped with sampling and provided logistical support. We thank Dr. Luc Beaufort for a great deal of help in using SYRACO. Funding for this research was provided by IODP China Secretariat and the National Natural Science Foundation of China (grant Numbers 40676029 and 40621063) and the National Key Basic Research Special Foundation Project of China (2007CB815901).

Reference

Beaufort, L., and Dollfus, D., 2004. Automatic recognition of coccoliths by dynamical neural networks. *Mar. Micropaleontol.,* 51(1–2):57. **doi:10.1016/j.marmicro.2003.09.003**

Initial receipt: 6 May 2008
Acceptance: 12 May 2009
Publication: 8 July 2009
MS 303306-202

Figure F1. Downcore variations in relative abundance of nannofossils and their comparison with oxygen isotope. PDB = Peedee belemnite, MIS = marine isotope stage.

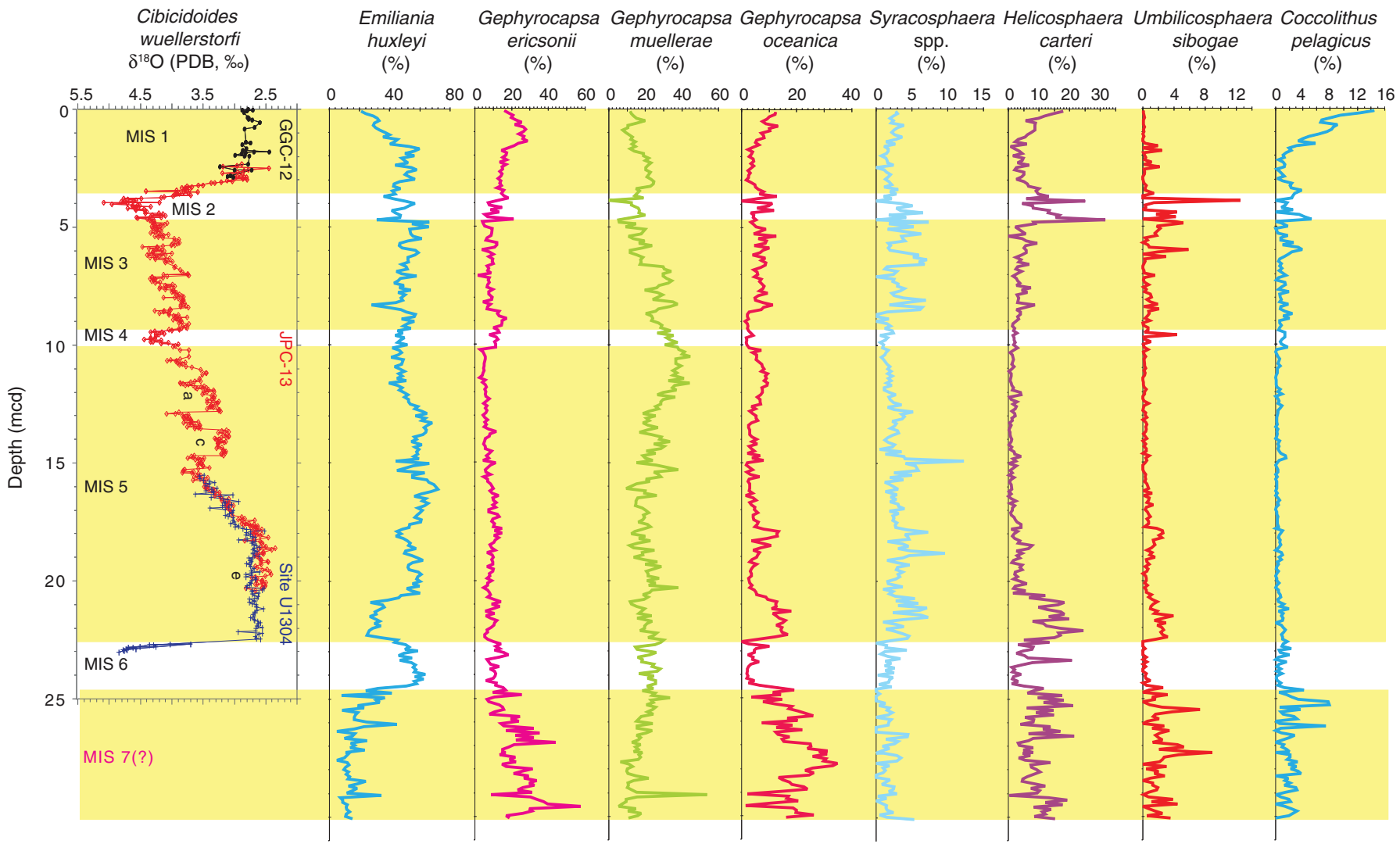

Table T1. Calcareous nannofossil data, Site U1304. (**Continued on next four pages.**)

Core, sample, interval (cm)	Depth (mbsf)	Depth (mcd)	Nannofossils (%) *Emiliania huxleyi*	*Gephyrocapsa ericsonii*	*Gephyrocapsa muellerae*	*Gephyrocapsa oceanica*	*Syracosphaera* spp.	*Helicosphaera carteri*	*Umbilicosphaera sibogae*	*Coccolithus pelagicus*
303-U1304A-										
1H-1, 9–10	0.09	3.79	42.65	18.28	19.00	5.38	2.15	5.91	0.00	2.33
1H-1, 19–20	0.19	3.89	50.00	12.50	0.00	0.00	0.00	25.00	12.50	0.00
1H-1, 29–30	0.29	3.99	56.70	7.22	12.37	11.00	3.44	4.47	1.37	1.72
1H-1, 39–40	0.39	4.09	52.69	7.93	12.18	9.92	5.10	7.93	0.28	1.42
1H-1, 49–50	0.49	4.19	49.60	14.92	16.13	5.65	2.82	8.06	0.40	0.81
1H-1, 59–60	0.59	4.29	41.18	8.40	16.81	11.76	3.36	13.45	0.00	2.52
1H-1, 69–70	0.69	4.39	43.48	13.04	16.30	3.26	6.52	13.04	4.35	0.00
1H-1, 79–80	0.79	4.49	46.96	5.22	20.00	4.35	1.74	16.52	1.74	3.48
1H-1, 89–90	0.89	4.59	46.85	6.99	12.59	4.20	4.20	15.38	4.20	4.20
1H-1, 99–100	0.99	4.69	31.58	21.05	5.26	5.26	0.00	31.58	0.00	5.26
1H-1, 109–110	1.09	4.79	66.39	4.10	5.74	3.28	7.38	8.20	4.10	0.00
1H-1, 117–118	1.17	4.87	54.78	4.35	14.78	4.35	1.74	8.70	5.22	0.87
1H-1, 129–130	1.29	4.99	65.70	5.23	9.30	5.23	5.23	2.33	1.74	1.74
1H-1, 139–140	1.39	5.09	53.30	9.34	19.78	8.79	1.65	3.30	2.20	0.00
1H-2, 9–10	1.59	5.29	53.94	9.15	17.67	4.42	6.31	5.68	1.58	0.32
1H-2, 19–20	1.69	5.39	55.36	8.93	10.71	12.50	3.57	0.00	1.79	1.79
1H-2, 29–30	1.79	5.49	61.23	6.61	13.22	6.02	3.67	4.55	0.29	0.73
1H-2, 39–40	1.89	5.59	51.93	5.98	19.50	9.07	4.05	5.79	0.58	0.77
1H-2, 49–50	1.99	5.69	46.55	12.07	16.38	8.62	1.72	9.48	0.00	2.59
1H-2, 59–60	2.09	5.79	46.36	11.92	23.84	4.64	1.99	5.63	0.66	0.99
1H-2, 69–70	2.19	5.89	48.33	10.83	18.33	10.00	1.67	5.00	0.83	3.33
1H-2, 79–80	2.29	5.99	56.86	3.92	11.76	7.84	1.96	5.88	5.88	3.92
1H-2, 89–90	2.39	6.09	58.82	7.84	11.76	6.67	3.92	5.88	1.96	2.35
1H-2, 99–100	2.49	6.19	56.76	9.95	15.46	3.89	5.95	4.32	0.00	1.84
1H-2, 109–110	2.59	6.29	52.09	7.62	18.67	8.60	5.16	2.46	2.95	1.23
1H-2, 119–120	2.69	6.39	51.91	9.86	17.38	7.16	7.11	4.11	0.23	0.59
1H-2, 129–130	2.79	6.49	52.58	9.52	17.66	8.73	5.95	3.37	0.26	0.40
1H-2, 139–140	2.89	6.59	47.86	9.99	17.15	8.66	6.76	6.81	0.12	0.87
1H-2, 149–150	2.99	6.69	50.90	6.63	29.82	6.93	1.51	3.01	0.00	0.60
1H-3, 9–10	3.09	6.79	51.80	7.49	30.24	4.49	1.20	2.40	0.00	0.90
1H-3, 19–20	3.19	6.89	44.47	6.96	34.11	5.73	2.86	4.37	0.14	0.55
1H-3, 29–30	3.29	6.99	47.81	8.89	29.67	5.91	2.46	2.87	0.12	1.05
1H-3, 39–40	3.39	7.09	57.81	1.56	29.69	4.69	0.00	1.56	1.56	1.56
1H-3, 49–50	3.49	7.19	47.22	7.91	31.45	7.16	2.47	2.65	0.13	0.40
1H-3, 59–60	3.59	7.29	45.63	7.31	34.42	6.52	2.31	2.94	0.08	0.08
1H-3, 69–70	3.69	7.39	42.99	7.74	32.59	7.41	3.09	3.80	0.24	1.38
1H-3, 79–80	3.79	7.49	49.43	6.84	27.44	8.14	3.01	2.61	0.73	1.47
1H-3, 89–90	3.89	7.59	46.24	6.65	26.35	7.64	3.92	7.27	0.06	0.81
1H-3, 99–100	3.99	7.69	54.04	9.70	19.52	6.58	3.35	4.39	0.46	0.46
1H-3, 109–110	4.09	7.79	45.45	7.62	26.54	9.34	2.21	6.14	0.25	1.97
1H-3, 119–120	4.19	7.89	50.00	7.42	29.30	6.05	2.54	2.73	0.98	0.59
1H-3, 129–130	4.29	7.99	47.56	9.33	26.89	4.89	3.78	3.33	1.11	0.67
1H-3, 139–140	4.39	8.09	48.62	9.15	24.15	5.07	6.95	3.20	0.55	0.88
1H-3, 149–150	4.49	8.19	43.99	4.25	34.97	7.77	4.11	3.01	0.95	0.59
1H-4, 9–10	4.59	8.29	28.03	8.33	37.50	11.36	1.89	8.71	1.89	1.89
1H-4, 19–20	4.69	8.39	38.32	6.77	33.33	7.87	6.43	5.58	0.17	0.76
1H-4, 29–30	4.79	8.49	47.62	6.46	27.21	7.14	6.12	2.72	2.04	0.68
1H-4, 39–40	4.89	8.59	50.92	13.04	25.46	2.67	1.54	3.90	0.72	1.33
1H-4, 49–50	4.99	8.69	57.17	12.40	20.13	2.09	0.16	4.03	0.81	2.42
1H-4, 59–60	5.09	8.79	56.20	13.25	23.44	2.09	0.12	2.94	0.61	1.10
1H-4, 69–70	5.19	8.89	47.99	17.42	24.03	2.42	1.75	3.45	0.28	2.00
1H-4, 79–80	5.29	8.99	56.36	14.70	23.43	1.23	0.00	2.45	0.92	0.61
1H-4, 89–90	5.39	9.09	51.65	14.77	27.04	2.07	1.54	1.48	0.03	0.62
1H-4, 99–100	5.49	9.19	49.18	14.54	28.97	2.40	2.04	1.32	0.08	0.87
1H-4, 109–110	5.59	9.29	53.93	9.97	28.50	2.07	1.23	2.11	0.69	0.61
1H-4, 119–120	5.69	9.39	45.24	12.64	33.86	2.51	2.25	1.64	0.64	0.39
1H-4, 129–130	5.79	9.49	48.56	13.25	26.65	3.34	2.45	2.79	0.25	1.33
1H-4, 139–140	5.89	9.59	43.79	7.89	35.31	4.14	0.59	1.58	4.34	1.38
1H-4, 149–150	5.99	9.69	49.64	11.51	31.62	1.75	1.61	1.84	0.14	1.36
1H-5, 9–10	6.09	9.79	47.24	12.58	33.67	1.85	1.32	1.91	0.21	0.95
1H-5, 19–20	6.19	9.89	45.13	10.68	37.55	1.71	0.57	2.28	1.01	0.70
1H-5, 29–30	6.29	9.99	51.73	11.28	30.72	1.95	1.08	1.75	0.09	0.88
2H-2, 59–60	10.29	10.11	41.69	11.35	37.46	2.77	0.87	3.09	0.12	1.82
2H-2, 69–70	10.39	10.21	46.47	2.94	38.31	7.10	1.67	1.73	0.66	0.20
2H-2, 79–80	10.49	10.31	47.91	4.35	41.47	4.01	1.34	0.59	0.08	0.00
2H-2, 89–90	10.59	10.41	45.57	5.18	40.26	5.37	1.23	1.36	0.13	0.13

Table T1 (continued). (Continued on next page.)

Core, sample, interval (cm)	Depth (mbsf)	Depth (mcd)	Nannofossils (%) *Emiliania huxleyi*	*Gephyrocapsa ericsonii*	*Gephyrocapsa muellerae*	*Gephyrocapsa oceanica*	*Syracosphaera* spp.	*Helicosphaera carteri*	*Umbilicosphaera sibogae*	*Coccolithus pelagicus*
2H-2, 99–100	10.69	10.51	40.99	5.77	44.59	5.53	0.72	1.44	0.36	0.36
2H-2, 109–110	10.79	10.61	48.83	5.76	36.66	5.18	1.04	1.62	0.13	0.58
2H-2, 129–130	10.99	10.81	47.98	4.88	36.48	7.41	1.57	1.12	0.22	0.34
2H-2, 139–140	11.09	10.91	43.15	5.16	39.35	7.53	1.94	1.94	0.22	0.65
2H-2, 149–150	11.19	11.01	46.65	4.64	37.16	8.13	1.64	1.07	0.36	0.21
2H-1, 99–100	10.49	15.51	55.22	8.40	27.05	3.17	5.04	0.19	0.37	0.00
2H-1, 109–110	10.59	15.61	54.95	4.67	28.57	6.59	1.92	1.92	0.27	0.27
2H-1, 119–120	10.69	15.71	64.68	7.02	20.33	2.73	3.80	0.71	0.36	0.00
2H-1, 129–130	10.79	15.81	65.72	6.90	22.31	2.23	1.22	0.41	0.20	0.20
2H-1, 139–140	10.89	15.91	69.11	8.47	15.19	2.89	1.96	1.03	0.52	0.21
2H-2, 9–10	11.09	16.11	71.84	10.11	9.47	2.99	3.07	1.21	0.73	0.16
2H-2, 19–20	11.19	16.21	67.19	8.08	19.96	2.73	1.27	0.10	0.10	0.00
2H-2, 29–30	11.29	16.31	60.98	9.54	19.65	4.05	2.89	0.87	1.16	0.29
2H-2, 39–40	11.39	16.41	56.39	12.77	26.17	1.40	2.02	0.00	0.16	0.00
2H-2, 49–50	11.49	16.51	63.92	9.72	15.82	4.28	2.80	0.99	0.82	0.33
2H-2, 59–60	11.59	16.61	61.76	10.15	14.71	5.29	1.91	2.50	0.74	0.59
2H-2, 69–70	11.69	16.71	65.29	11.75	14.80	2.83	3.05	0.65	0.54	0.22
2H-2, 79–80	11.79	16.81	63.24	9.88	14.46	3.56	3.16	2.14	1.32	0.41
2H-2, 89–90	11.89	16.91	58.49	11.39	18.18	4.87	3.95	1.38	0.46	0.09
2H-2, 99–100	11.99	17.01	61.72	7.50	20.16	4.53	1.88	1.41	0.31	0.00
2H-2, 109–110	12.09	17.11	59.96	7.60	21.85	5.77	3.18	0.67	0.58	0.19
2H-2, 119–120	12.19	17.21	58.35	12.27	18.91	4.12	2.31	0.91	0.70	0.20
2H-2, 129–130	12.29	17.31	56.82	13.07	19.51	4.17	2.46	1.89	0.95	0.38
2H-2, 139–140	12.39	17.41	60.99	9.86	18.65	4.39	2.36	2.25	0.54	0.21
2H-2, 149–150	12.49	17.51	60.34	9.22	16.14	6.07	2.92	2.84	0.77	0.23
2H-3, 9–10	12.59	17.61	53.25	10.72	21.20	5.66	2.65	4.22	0.72	0.24
2H-3, 9–10	12.7	17.72	52.76	9.91	22.81	4.84	2.76	4.15	0.23	0.46
2H-3, 29–30	12.79	17.81	48.47	14.85	18.78	7.86	4.37	0.87	1.75	0.00
2H-3, 39–40	12.89	17.91	44.90	10.62	14.16	13.31	7.22	2.97	2.55	0.99
2H-3, 49–50	12.99	18.01	47.46	14.69	12.22	12.87	4.03	1.95	2.60	0.78
2H-3, 59–60	13.09	18.11	44.21	10.26	20.00	12.89	4.47	1.32	2.11	0.53
2H-3, 69–70	13.19	18.21	48.84	12.76	16.28	9.13	4.62	2.09	2.42	0.44
2H-3, 79–80	13.29	18.31	51.81	10.86	22.62	3.62	1.58	3.85	1.36	0.68
2H-3, 89–90	13.39	18.41	53.55	10.51	15.91	7.39	3.69	3.13	1.42	0.57
2H-3, 99–100	13.49	18.51	52.32	8.30	11.39	10.62	4.54	7.72	1.54	0.77
2H-3, 109–110	13.59	18.61	57.33	9.19	13.57	7.00	3.06	6.56	1.09	0.44
2H-3, 119–120	13.69	18.71	50.56	10.93	24.81	4.26	4.81	2.59	0.56	0.00
2H-3, 129–130	13.79	18.81	49.83	6.70	18.38	6.53	9.62	4.47	1.20	0.86
2H-3, 139–140	13.89	18.91	54.77	9.54	18.50	5.78	4.62	2.89	0.87	1.01
2H-3, 149–150	13.99	19.01	58.67	9.96	13.61	5.48	3.73	3.82	1.58	0.50
2H-4, 9–10	14.09	19.11	61.97	9.19	19.02	3.85	1.50	1.71	0.43	0.85
2H-4, 19–20	14.19	19.21	55.12	9.69	26.47	3.00	2.86	1.09	0.55	0.27
2H-4, 29–30	14.29	19.31	52.47	9.62	19.87	5.40	4.67	4.58	0.82	0.46
2H-4, 39–40	14.39	19.41	52.08	6.58	28.72	4.16	2.95	3.76	0.27	0.13
2H-4, 49–50	14.49	19.51	52.75	10.06	24.56	3.51	2.81	4.56	0.70	0.12
2H-4, 59–60	14.59	19.61	58.98	9.81	20.58	3.04	3.73	2.21	0.55	0.41
2H-4, 69–70	14.69	19.71	60.72	7.84	21.44	3.51	3.09	2.06	0.00	0.21
2H-4, 79–80	14.79	19.81	58.53	8.27	21.60	3.60	3.33	2.93	0.40	0.00
2H-4, 89–90	14.89	19.91	57.84	6.55	27.42	2.46	2.73	1.64	0.41	0.14
2H-4, 99–100	14.99	20.01	60.27	9.11	20.96	2.74	1.58	3.97	0.48	0.14
2H-4, 109–110	15.09	20.11	55.08	7.02	25.63	2.88	1.69	6.01	0.25	0.51
2H-4, 119–120	15.19	20.21	59.85	6.98	21.92	3.69	3.69	2.30	0.57	0.16
2H-4, 129–130	15.29	20.31	51.42	4.74	37.91	2.84	0.95	1.66	0.24	0.00
2H-4, 139–140	15.39	20.41	54.30	6.81	23.61	4.56	2.31	5.56	0.46	0.46
2H-4, 149–150	15.49	20.51	60.17	7.76	22.43	5.24	1.89	1.47	0.42	0.42
2H-5, 9–10	15.59	20.61	47.48	8.37	18.69	5.50	2.64	12.04	1.15	0.69
2H-5, 19–20	15.69	20.71	45.83	7.05	21.34	8.72	5.38	6.86	0.74	0.74
2H-5, 29–30	15.79	20.81	38.48	10.30	19.39	9.39	2.73	13.33	1.21	0.30
2H-5, 39–40	15.89	20.91	27.27	14.09	11.82	12.73	5.91	18.18	1.82	0.45
2H-5, 49–50	15.99	21.01	35.38	9.04	12.31	12.31	3.08	16.15	1.35	1.15
2H-5, 59–60	16.09	21.11	36.27	13.56	15.25	12.54	7.12	9.83	1.02	0.68
2H-5, 69–70	16.19	21.21	33.23	9.68	19.68	10.97	6.13	12.58	0.97	1.94
2H-5, 79–80	16.29	21.31	30.09	5.56	18.06	18.06	2.31	17.13	1.85	0.46
2H-5, 89–90	16.39	21.41	30.91	10.55	16.36	11.27	6.18	18.18	1.45	1.09
2H-5, 99–100	16.49	21.51	26.61	5.88	23.25	12.61	7.28	13.17	3.92	0.84
2H-5, 109–110	16.59	21.61	30.15	8.46	15.40	13.67	3.69	19.74	2.60	1.08
2H-5, 119–120	16.69	21.71	33.17	11.88	23.76	15.84	0.99	7.92	1.49	0.99
2H-5, 129–130	16.79	21.81	29.85	10.70	20.90	14.93	2.74	11.44	2.99	0.00

Table T1 (continued). (Continued on next page.)

Core, sample, interval (cm)	Depth (mbsf)	Depth (mcd)	Nannofossils (%) *Emiliania huxleyi*	*Gephyrocapsa ericsonii*	*Gephyrocapsa muellerae*	*Gephyrocapsa oceanica*	*Syracosphaera* spp.	*Helicosphaera carteri*	*Umbilicosphaera sibogae*	*Coccolithus pelagicus*
2H-5, 139–140	16.89	21.91	34.12	10.47	19.43	12.50	3.89	12.33	1.86	0.84
2H-5, 149–150	16.99	22.01	28.84	8.89	19.68	14.56	1.35	16.98	2.43	1.08
2H-6, 9–10	17.09	22.11	26.50	6.63	17.18	14.29	2.69	24.43	2.69	1.45
2H-6, 19–20	17.19	22.21	25.65	6.92	26.22	14.70	3.75	16.43	2.31	1.15
2H-6, 29–30	17.29	22.31	24.69	5.33	24.69	16.70	4.62	16.87	2.49	0.89
2H-6, 39–40	17.39	22.41	33.92	5.24	21.54	12.23	4.37	15.14	3.20	1.02
2H-6, 49–50	17.49	22.51	45.27	6.76	30.07	6.08	2.03	5.07	1.69	1.01
2H-6, 59–60	17.59	22.61	43.33	10.00	28.33	0.00	0.00	13.33	0.00	1.67
2H-6, 69–70	17.69	22.71	50.36	14.29	25.36	2.50	1.43	3.21	0.00	1.07
2H-6, 79–80	17.79	22.81	52.94	11.31	14.48	9.95	1.36	8.14	0.00	0.90
2H-6, 89–90	17.89	22.91	50.29	13.51	15.52	5.17	4.31	7.76	0.29	2.30
3H-6, 99–100	26.19	27.06	13.62	18.58	14.55	25.08	1.86	8.05	5.26	0.93
3H-6, 109–110	26.29	27.16	23.46	15.23	16.05	23.87	0.82	4.94	2.06	1.65
3H-6, 119–120	26.39	27.26	10.88	14.97	13.61	31.29	0.00	8.16	6.12	2.04
3H-2, 9–10	20.59	27.28	13.02	16.67	18.23	28.13	1.04	4.69	8.85	0.00
3H-2, 19–20	20.69	27.38	11.51	13.43	16.31	30.94	2.88	7.19	4.56	2.16
3H-2, 29–30	20.79	27.48	10.07	21.88	17.36	25.69	3.47	3.47	2.78	2.08
3H-2, 39–40	20.89	27.58	5.04	18.91	15.97	30.67	2.94	5.46	2.52	1.68
3H-2, 49–50	20.99	27.68	11.70	22.34	6.38	29.79	0.00	13.83	2.13	3.19
3H-2, 59–60	21.09	27.78	12.84	14.68	11.01	34.86	1.83	7.34	0.00	1.83
3H-2, 69–70	21.19	27.88	10.55	17.09	13.07	33.17	1.01	7.54	3.02	3.02
3H-2, 79–80	21.29	27.98	9.73	31.42	10.18	25.66	1.33	9.29	0.44	2.21
3H-2, 89–90	21.39	28.08	12.67	25.67	9.67	23.00	1.00	10.33	2.00	3.33
3H-2, 99–100	21.49	28.18	11.19	20.90	10.45	26.12	0.00	8.21	1.49	3.73
3H-2, 109–110	21.59	28.28	13.29	29.37	14.69	24.48	0.00	6.29	2.80	0.00
3H-2, 119–120	21.69	28.38	12.38	26.67	21.90	13.33	1.90	4.76	0.95	1.90
3H-2, 129–130	21.79	28.48	23.98	33.48	13.57	14.93	1.36	4.52	0.00	1.36
3H-2, 139–140	21.89	28.58	19.09	29.46	10.37	17.43	0.83	8.30	1.24	2.07
3H-2, 149–150	21.99	28.68	12.45	32.37	10.79	18.26	2.49	12.03	1.24	1.24
3H-3, 9–10	22.09	28.78	18.21	26.09	10.05	22.55	2.45	7.34	1.90	2.99
3H-3, 19–20	22.19	28.88	15.14	23.24	12.68	23.94	1.76	10.21	1.76	3.17
3H-3, 29–30	22.29	28.98	11.59	31.16	15.22	13.77	2.90	9.42	0.72	1.45
3H-3, 39–40	22.39	29.08	34.60	8.66	53.65	2.18	0.23	0.41	0.05	0.09
3H-3, 49–50	22.49	29.18	7.35	30.15	15.44	16.91	1.47	13.24	0.74	0.74
3H-3, 59–60	22.59	29.28	8.65	33.65	9.62	16.35	0.00	19.23	3.85	1.92
3H-3, 69–70	22.69	29.38	8.76	37.23	9.49	20.44	0.73	12.04	1.09	2.19
3H-3, 79–80	22.79	29.48	11.76	39.71	7.35	10.29	1.47	17.65	4.41	0.00
3H-3, 89–90	22.89	29.58	10.96	57.53	5.48	1.37	1.37	8.22	0.00	1.37
3H-3, 99–100	22.99	29.68	11.63	29.46	14.73	18.60	1.55	13.95	0.78	2.33
3H-3, 109–110	23.09	29.78	13.49	30.95	10.32	19.84	2.38	11.11	1.59	3.17
3H-3, 119–120	23.19	29.88	11.06	26.13	17.59	19.60	0.50	12.06	2.51	2.51
3H-3, 129–130	23.29	29.98	10.89	16.83	15.84	26.24	1.49	8.42	0.50	1.98
3H-3, 139–140	23.39	30.08	15.18	18.75	10.71	16.07	5.36	15.18	3.57	0.00
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1H-1, 9–10	0.09	0.09	21.03	16.15	11.80	12.32	2.73	17.88	0.05	14.47
1H-1, 19–20	0.19	0.19	23.97	18.36	12.27	12.05	3.00	14.75	0.09	12.40
1H-1, 29–30	0.29	0.29	29.23	20.62	13.58	10.05	2.43	11.79	0.12	9.47
1H-1, 39–40	0.39	0.39	31.70	19.93	15.01	9.18	1.95	9.73	0.19	8.16
1H-1, 49–50	0.49	0.49	32.73	22.32	19.87	7.60	2.39	5.63	0.06	6.76
1H-1, 59–60	0.59	0.59	30.03	25.37	15.45	8.87	2.11	8.87	0.09	6.58
1H-1, 69–70	0.69	0.69	29.28	21.82	10.47	13.23	3.89	8.59	0.06	9.09
1H-1, 79–80	0.79	0.79	30.57	26.29	10.57	9.95	2.95	8.62	0.19	8.43
1H-1, 89–90	0.89	0.89	33.28	27.79	7.48	10.31	2.52	8.63	0.08	8.24
1H-1, 99–100	0.99	0.99	36.75	26.35	9.23	7.08	2.21	7.60	0.15	7.53
1H-1, 109–110	1.09	1.09	39.76	24.00	10.97	7.93	2.55	6.27	0.00	6.37
1H-1, 119–120	1.19	1.19	35.43	26.62	12.94	8.07	3.59	5.36	0.15	4.92
1H-1, 129–130	1.29	1.29	44.98	25.95	11.94	5.36	2.77	3.29	0.00	3.98
1H-1, 139–140	1.39	1.39	43.17	28.45	14.65	4.98	1.40	2.24	0.00	3.29
1H-1, 149–150	1.49	1.49	40.18	23.67	12.57	6.33	2.66	6.06	0.28	5.87
1H-2, 9–10	1.59	1.59	52.67	21.37	14.50	4.20	1.15	0.76	1.91	3.05
1H-2, 19–20	1.69	1.69	59.85	17.99	11.77	2.38	1.65	2.05	0.00	1.98
1H-2, 29–30	1.79	1.79	56.14	14.56	13.99	3.97	1.70	3.59	2.46	2.27
1H-2, 39–40	1.89	1.89	50.22	17.19	18.89	3.48	1.48	4.52	0.07	1.56
1H-2, 49–50	1.99	1.99	56.39	16.83	18.91	2.73	0.77	1.42	0.22	1.09
1H-2, 59–60	2.09	2.09	47.83	15.16	21.86	4.22	1.37	4.84	0.37	1.24
1H-2, 69–70	2.19	2.19	49.68	17.20	19.89	4.41	1.51	4.52	0.22	0.43
1H-2, 79–80	2.29	2.29	52.05	13.42	23.01	3.29	1.64	3.01	1.10	1.10
1H-2, 89–90	2.39	2.39	43.51	17.10	21.48	4.38	2.41	6.85	0.16	1.37

Table T1 (continued). (Continued on next page.)

Core, sample, interval (cm)	Depth (mbsf)	Depth (mcd)	Nannofossils (%) *Emiliania huxleyi*	*Gephyrocapsa ericsonii*	*Gephyrocapsa muellerae*	*Gephyrocapsa oceanica*	*Syracosphaera* spp.	*Helicosphaera carteri*	*Umbilicosphaera sibogae*	*Coccolithus pelagicus*
1H-2, 99–100	2.49	2.49	54.31	14.66	20.26	3.45	0.00	2.59	2.16	1.29
1H-2, 109–110	2.59	2.59	57.62	15.01	20.06	2.34	1.13	2.11	0.15	0.15
1H-2, 119–120	2.69	2.69	51.48	13.64	22.74	3.22	1.45	4.99	0.19	0.57
1H-2, 129–130	2.79	2.79	49.97	14.82	21.73	2.49	2.04	5.11	0.26	0.96
1H-2, 139–140	2.89	2.89	53.04	14.05	20.74	2.57	1.71	4.28	0.00	1.29
1H-2, 149–150	2.99	2.99	56.65	12.52	23.19	1.76	1.27	2.54	0.00	0.29
1H-3, 9–10	3.09	3.09	46.67	14.23	24.49	3.33	1.76	4.99	0.09	1.02
1H-3, 19–20	3.19	3.19	42.81	13.59	24.38	4.84	2.19	6.25	0.16	2.34
1H-3, 29–30	3.29	3.29	42.46	14.39	22.74	5.10	1.16	6.50	0.46	2.09
1H-3, 39–40	3.39	3.39	47.23	12.00	14.77	6.15	3.08	10.00	0.31	2.31
1H-3, 49–50	3.49	3.49	41.68	15.69	16.64	7.92	1.90	9.03	0.32	3.80
1H-3, 59–60	3.59	3.59	43.46	14.49	15.42	6.54	2.80	9.81	1.40	2.80
1H-3, 69–70	3.69	3.69	36.04	15.74	14.21	12.69	1.02	13.20	0.00	2.54
2H-3, 9–10	11.29	11.11	49.84	5.15	35.13	7.08	2.11	0.25	0.12	0.25
2H-3, 19–20	11.39	11.21	45.74	4.26	37.34	9.39	1.64	0.87	0.33	0.22
2H-3, 29–30	11.49	11.31	48.36	4.22	35.01	8.57	2.30	0.87	0.25	0.12
2H-3, 39–40	11.59	11.41	44.74	2.56	40.91	9.09	1.70	0.71	0.00	0.00
2H-3, 49–50	11.69	11.51	50.89	5.54	32.59	8.20	2.11	0.55	0.00	0.11
2H-3, 59–60	11.79	11.61	39.50	4.13	44.15	9.47	1.46	0.95	0.09	0.09
2H-3, 69–70	11.89	11.71	45.15	5.78	36.10	9.16	2.18	1.09	0.11	0.11
2H-3, 79–80	11.99	11.81	48.27	6.22	34.89	7.25	1.12	1.64	0.17	0.17
2H-3, 89–90	12.09	11.91	46.36	5.30	37.09	7.51	1.10	1.32	0.44	0.66
2H-3, 99–100	12.19	12.01	49.57	5.93	29.54	7.54	1.85	3.96	0.25	0.37
2H-3, 109–110	12.29	12.11	52.18	5.57	26.66	6.85	2.71	4.22	0.23	0.90
2H-3, 119–120	12.39	12.21	49.65	6.12	36.30	5.70	1.81	0.42	0.00	0.00
2H-3, 129–130	12.49	12.31	52.30	7.80	29.60	6.80	1.90	1.00	0.00	0.30
2H-3, 139–140	12.59	12.41	52.47	6.22	28.39	6.70	2.39	2.87	0.16	0.48
2H-3, 149–150	12.69	12.51	53.71	4.77	28.45	6.89	3.53	1.41	0.71	0.35
2H-4, 9–10	12.79	12.61	58.50	6.69	25.70	3.48	1.61	2.54	0.13	0.94
2H-4, 19–20	12.89	12.71	56.55	5.58	27.01	5.08	2.54	2.23	0.10	0.71
2H-4, 29–30	12.99	12.81	61.28	6.61	22.20	2.94	5.14	1.10	0.00	0.37
2H-4, 39–40	13.09	12.91	64.79	5.93	18.50	3.96	3.56	2.08	0.40	0.30
2H-4, 49–50	13.19	13.01	57.18	4.40	25.51	5.28	3.96	2.35	0.29	0.29
2H-4, 59–60	13.29	13.11	63.39	5.21	20.50	5.21	3.64	1.07	0.50	0.17
2H-4, 69–70	13.39	13.21	61.13	7.07	22.08	5.83	2.30	1.24	0.00	0.18
2H-4, 79–80	13.49	13.31	68.15	5.33	18.77	3.58	2.85	0.29	0.37	0.15
2H-4, 89–90	13.59	13.41	65.19	6.25	21.53	2.43	2.60	0.87	0.52	0.26
2H-4, 99–100	13.69	13.51	62.80	5.07	26.69	2.54	2.05	0.48	0.36	0.00
2H-4, 109–110	13.79	13.61	64.12	7.54	21.01	3.02	3.02	0.22	0.43	0.32
2H-4, 119–120	13.89	13.71	64.04	11.54	16.88	3.00	3.14	0.53	0.33	0.20
2H-4, 129–130	13.99	13.81	62.06	8.07	23.38	3.00	2.25	0.58	0.08	0.25
2H-4, 139–140	14.09	13.91	56.41	7.83	28.61	3.78	1.62	0.81	0.27	0.13
2H-4, 149–150	14.19	14.01	57.77	5.58	27.92	5.41	1.22	1.05	0.52	0.00
2H-5, 9–10	14.29	14.11	54.18	5.19	33.43	3.75	1.73	0.86	0.00	0.58
2H-5, 19–20	14.39	14.21	61.27	4.73	24.55	5.64	2.55	0.18	0.36	0.36
2H-5, 29–30	14.49	14.31	56.65	5.70	30.40	2.76	2.25	1.21	0.17	0.52
2H-5, 39–40	14.59	14.41	59.21	5.71	28.57	3.65	0.48	0.63	0.48	0.32
2H-5, 49–50	14.69	14.51	57.80	9.05	20.52	4.66	3.58	1.88	0.45	0.54
2H-5, 59–60	14.79	14.61	58.63	7.87	25.63	2.03	1.27	2.03	0.00	0.76
2H-5, 69–70	14.89	14.71	55.81	6.43	18.52	6.63	3.87	4.07	0.79	1.44
2H-5, 79–80	14.99	14.81	59.30	7.46	19.88	3.86	4.03	1.46	0.34	1.54
2H-5, 89–90	15.09	14.91	44.07	4.25	24.10	7.86	12.24	2.45	0.52	0.52
2H-5, 99–100	15.19	15.01	66.39	11.20	15.30	2.19	4.10	0.27	0.27	0.27
2H-5, 109–110	15.29	15.11	55.58	8.55	25.89	1.66	5.46	2.61	0.00	0.00
2H-5, 129–130	15.49	15.31	44.72	5.59	37.89	4.04	5.90	0.62	0.00	0.31
2H-5, 139–140	15.59	15.41	63.15	5.90	24.51	1.97	2.50	1.25	0.18	0.36
3H-3, 139–140	22.09	22.96	58.60	10.65	17.92	4.60	1.21	4.84	0.00	0.48
3H-3, 149–150	22.19	23.06	49.35	15.58	25.97	4.55	0.65	2.60	0.00	0.65
3H-4, 9–10	22.29	23.16	45.82	18.33	22.31	2.39	1.59	5.18	0.00	1.99
3H-4, 19–20	22.39	23.26	54.66	13.14	15.68	4.24	3.39	6.36	0.42	0.42
3H-4, 29–30	22.49	23.36	46.75	6.49	18.18	3.90	1.30	20.78	0.00	0.00
3H-4, 39–40	22.59	23.46	54.50	7.41	17.99	6.35	2.12	7.94	0.53	1.59
3H-4, 49–50	22.69	23.56	57.04	8.35	24.58	3.34	1.19	4.30	0.00	0.48
3H-4, 59–60	22.79	23.66	55.47	13.12	23.66	2.58	2.58	1.19	0.40	0.20
3H-4, 69–70	22.89	23.76	57.55	8.07	28.13	2.08	1.30	2.08	0.00	0.78
3H-4, 79–80	22.99	23.86	56.23	10.75	26.64	2.18	2.49	1.40	0.00	0.16
3H-4, 89–90	23.09	23.96	63.72	11.34	16.55	1.81	0.23	4.08	0.45	0.91
3H-4, 99–100	23.19	24.06	56.66	10.87	24.73	2.31	2.31	1.77	0.27	0.14

Table T1 (continued).

Core, sample, interval (cm)	Depth (mbsf)	Depth (mcd)	Nannofossils (%) *Emiliania huxleyi*	*Gephyrocapsa ericsonii*	*Gephyrocapsa muellerae*	*Gephyrocapsa oceanica*	*Syracosphaera* spp.	*Helicosphaera carteri*	*Umbilicosphaera sibogae*	*Coccolithus pelagicus*
3H-4, 109–110	23.29	24.16	62.47	10.05	21.25	1.96	1.85	1.27	0.35	0.12
3H-4, 119–120	23.39	24.26	56.11	6.11	25.44	4.67	1.78	3.11	1.00	0.22
3H-4, 129–130	23.49	24.36	57.83	11.65	25.70	2.41	0.40	1.20	0.00	0.80
3H-4, 139–140	23.59	24.46	51.02	11.30	20.88	6.59	2.20	5.02	0.47	0.31
3H-4, 149–150	23.69	24.56	32.05	15.38	24.36	12.82	0.00	11.54	2.56	1.28
3H-5, 9–10	23.79	24.66	23.97	16.53	18.18	19.01	0.00	8.26	0.83	4.13
3H-5, 19–20	23.89	24.76	41.24	9.79	25.26	11.34	0.52	6.19	0.00	0.52
3H-5, 29–30	23.99	24.86	7.94	25.40	23.81	14.29	0.00	17.46	3.17	1.59
3H-5, 39–40	24.09	24.96	36.90	10.71	33.33	3.57	0.00	9.52	1.19	2.38
3H-5, 49–50	24.19	25.06	31.15	6.56	22.95	14.75	0.00	18.03	1.64	3.28
3H-5, 59–60	24.29	25.16	33.33	7.69	24.36	7.69	1.28	11.54	0.00	7.69
3H-5, 69–70	24.39	25.26	18.86	13.16	20.61	12.28	0.44	21.05	0.88	7.89
3H-5, 79–80	24.49	25.36	23.03	15.15	25.45	18.18	1.82	6.06	2.42	0.61
3H-5, 89–90	24.59	25.46	8.38	15.71	24.08	17.28	1.57	14.66	7.33	3.66
3H-5, 99–100	24.69	25.56	18.94	10.61	21.21	20.45	2.27	9.09	3.79	0.76
3H-5, 109–110	24.79	25.66	17.13	7.73	24.31	23.20	1.66	14.92	1.66	1.10
3H-5, 119–120	24.89	25.76	16.44	24.66	17.81	26.03	0.00	5.48	1.37	2.74
3H-5, 129–130	24.99	25.86	16.49	19.59	16.49	16.49	2.06	8.25	2.06	3.09
3H-5, 139–140	25.09	25.96	24.42	23.84	15.12	20.35	1.74	8.14	0.58	0.00
3H-5, 149–150	25.19	26.06	44.89	14.20	23.86	7.39	1.70	3.98	0.00	0.57
3H-6, 9–10	25.29	26.16	22.94	15.60	15.60	18.35	0.00	13.76	2.75	7.34
3H-6, 19–20	25.39	26.26	16.41	32.03	15.63	12.50	0.00	11.33	1.17	0.78
3H-6, 29–30	25.49	26.36	5.08	16.95	23.73	22.03	0.00	16.95	3.39	0.00
3H-6, 39–40	25.59	26.46	16.89	35.11	20.44	12.44	4.44	6.67	2.22	0.89
3H-6, 49–50	25.69	26.56	15.14	21.91	15.14	13.15	4.38	21.51	1.59	2.79
3H-6, 59–60	25.79	26.66	10.00	32.00	17.33	17.33	1.33	8.00	2.00	2.00
3H-6, 69–70	25.89	26.76	24.87	22.34	16.24	14.72	3.05	6.60	2.54	1.02
3H-6, 79–80	25.99	26.86	14.01	43.95	12.74	15.29	2.55	3.18	1.27	0.00
3H-6, 89–90	26.09	26.96	16.67	21.43	17.26	25.00	0.89	3.57	4.46	1.19