Mikada, H., Moore, G.F., Taira, A., Becker, K., Moore, J.C., and Klaus, A. (Eds.)
*Proceedings of the Ocean Drilling Program, Scientific Results* Volume 190/196

# 13. Data Report: Organic Carbon and Alkenone Sea-Surface Temperature from Sites 1175, 1176, and 1178, Nankai Trough[1]

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## INTRODUCTION

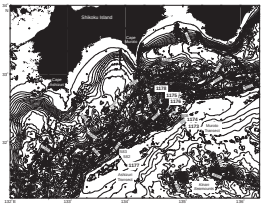
We have preliminarily generated the downcore records of total organic carbon (TOC) content, total alkenone concentration, alkenone unsaturation index, and the estimated sea-surface temperature (SST) in the northern three sites (Sites 1175, 1176, and 1178) of the Muroto Transect, Nankai Trough. The TOC content will be used for the evaluation of the burial of organic matter, which plays a role in the generation of natural gas and the formation of gas hydrate in this region. The downcore records of alkenone SST will benefit studies for the paleoceanography of the northwestern Pacific. Because those sites are located in the main path of the Kuroshio Current, the records provide the temperature change of the Kuroshio water, which is an end-member water mass in the northwestern Pacific.

## SAMPLES AND METHODS

### Samples

Three holes were sampled from the Muroto Transect: Holes 1175A, 1176A, and Hole 1178A (Fig. F1) (Moore, Taira, Klaus, et al., 2001; Moore et al., 2001). Hole 1175A is located at 32°36′N, 134°39′E, in 2998 m water depth. Samples were taken from 2.47 to 8.31 meters below seafloor (mbsf). Because the sedimentation rate of the uppermost 23.42 m is 28 cm/k.y. (Shipboard Scientific Party, 2001a), the sampling interval

F1. Location of studied sites, p. 6.



[1]Yamamoto, M., 2004. Data report: Organic carbon and alkenone sea-surface temperature from Sites 1175, 1176, and 1178, Nankai Trough. *In* Mikada, H., Moore, G.F., Taira, A., Becker, K., Moore, J.C., and Klaus, A. (Eds.), *Proc. ODP, Sci. Results,* 190/196, 1–10 [Online]. Available from World Wide Web: <http://www-odp.tamu.edu/publications/190196SR/VOLUME/CHAPTERS/207.PDF>. [Cited YYYY-MM-DD]
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Initial receipt: 12 November 2002
Acceptance: 5 August 2003
Web publication: 2 February 2004
Ms 190SR-207

ranges from 8.8 to 29.7 ka. The sediments consist predominantly of massive gray-brown to olive-gray hemipelagic clayey silt intercalated with volcanic ash layers at 1.10 and 6.40 mbsf (Shipboard Scientific Party, 2001a). Hole 1176A is located at 32°35′N, 134°40′E, in 3020 m water depth. Samples were taken from 0.05 to 10.21 mbsf. Because the sedimentation rate of the uppermost 11.94 m is 14 cm/k.y. (Shipboard Scientific Party, 2001b), the sampling interval ranges from 0.4 to 72.9 ka. The sediments consist predominantly of massive to faintly laminated gray to greenish gray hemipelagic silty clay intercalated with thin beds of sand (Shipboard Scientific Party, 2001b). Hole 1178A is located at 32°44′N, 134°29′E, in 1742 m water depth. Samples were taken from 0.03 to 10.00 mbsf. Because the sedimentation rate of the uppermost 7.60 m is 3 cm/k.y. (Shipboard Scientific Party, 2001c), the sampling interval ranges from 1 to 333 ka. The sediments consist of alternating hemipelagic beds of faintly laminated greenish brown silty clay and greenish brown sand-silt-clay intercalated with thin beds of sand and volcanic ash (Shipboard Scientific Party, 2001c).

Samples of ~20 $cm^3$ in volume were taken on board and immediately frozen at –20°C.

## Analytical Method

Total of 123 freeze-dried sediment samples were analyzed for TOC using a LECO WR-112 carbon analyzer. The analyzer was attached to a halogen trap (antimony and potassium iodide). To remove carbonate carbon, the sample was acidified according to the following procedure. The sample (~0.1 g) was soaked in 1-M HCl solution in a ceramic crucible overnight and was heated at 110°C for 3 hr after adding new 1-M HCl. The sample was rinsed to remove chlorides by adding pure water twice and was heated again at 110°C for 3 hr. The precision of measurement was better than 0.01 wt%.

Total of 121 wet sediment samples (~2 g dry weight) were extracted five times by ultrasonication with 10 mL of dichloromethane/methanol (6/4 v/v). The lipid extract was separated into four fractions (F1: 3 mL of hexane; F2: 3 mL of hexane/toluene [3/1 v/v]; F3: 4 mL of toluene; F4: 3 mL of toluene/methanol [3/1 v/v]) by column chromatography ($SiO_2$ with 5% distilled water, 5.5 mm × 45 mm). *n*-$C_{36}H_{74}$ was added as an internal standard into the F3 fraction.

Gas chromatography for the F3 fraction was conducted using a Hewlett-Packard 6890 gas chromatograph (GC) with on-column injection and electronic pressure control systems and a flame ionization detector. The column used was a capillary column coated with Chrompack CP-Sil5CB (60 m × 0.25 mm, 0.25-mm coating). The oven temperature was programmed from 70° to 290°C at 20°C/min, from 290° to 310°C at 0.5°C/min, and then was held at 310°C for 60 min. Helium was used as a carrier gas, and the flow velocity was maintained at 30 cm/s.

Gas chromatography–mass spectrometry was conducted using a Hewlett-Packard 5973 gas chromatograph-mass selective detector (MSD) with on-column injection and electronic pressure control systems and quadrupole MSD. The GC column and oven temperature and carrier pressure programs are the same as above. The MSD was run in the full scan ion monitoring mode (*m*/*z* 50–650). Electron impact spectra were obtained at 70 eV. Identification of compounds was achieved by comparison of their mass spectra and retention times with those in

the literature and the lipid extracts from *Emiliania huxleyi* and *Gephyrocapsa oceanica* (Yamamoto et al., 2000).

The alkenone unsaturation index $U^{k'}_{37}$ was calculated from the concentrations of di- and tri-unsaturated $C_{37}$ alken-2-ones ($C_{37}$MK) using the expression (Brassell et al., 1986):

$$U^{k'}_{37} = [C_{37:2}MK]/([C_{37:2}MK]+[C_{37:3}MK]).$$

The calculation of temperature was conducted according to the equation:

$$U^{k'}_{37} = 0.034T + 0.039$$

(T = temperature [°C]), based on an experimental result for cultured strain 55a of *E. huxleyi* (Prahl et al., 1988) with an estimated analytical accuracy of 0.5°C (Prahl and Wakeham, 1987).

# RESULTS

## Total Organic Carbon Content

Table **T1** and Figure **F2** show the variations of TOC contents of Hole 1175A, 1176A, and 1178A sediments.

In Hole 1175A, TOC varies between 0.48 and 0.88 wt% of dry sediment (average = 0.74 wt%). Low TOC contents occur at 5.37 mbsf (just above an ash layer) and 7.31 mbsf. In Hole 1176A, TOC varies between 0.53 and 0.92 wt% (average = 0.76 wt%). Low TOC contents occur at 0.82 mbsf (just above an ash layer), 6.25 mbsf (just below an ash layer), and 7.13 mbsf. In Hole 1178A, TOC varies between 0.33 and 0.70 wt%, (average = 0.56 wt%). A low TOC content occurs at 9.55 mbsf. The TOC contents in Hole 1178A are lower in average than those in Holes 1175A and 1176A.

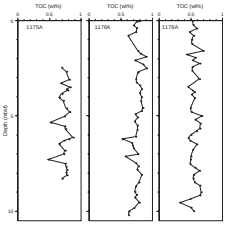
## Total Alkenone Concentration and Unsaturation Index

In Hole 1175A, total alkenone ($C_{37}$–$C_{39}$ alkenones) concentration in dry sediment varies between 1.2 and 3.6 µg/g (average = 1.8 µg/g) (Table **T1;** Fig. **F3**). In Hole 1176A, total alkenone concentration varies between 0.4 and 2.0 µg/g (average = 1.1 µg/g). In Hole 1178A, the concentration varies between 0.5 and 4.8 µg/g (average = 1.9 µg/g). The concentration shows a downward-increasing trend with high-amplitude fluctuation in Holes 1175A and 1176A and the uppermost 6.00 m of Hole 1178A.

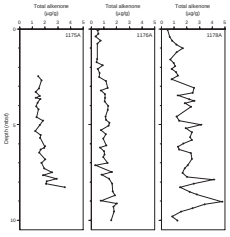
Paleotemperature estimated from $U^{k'}_{37}$ varies from 20.0° to 24.6°C in Hole 1175A (Table **T1;** Fig. **F4**). In Hole 1176A, the estimated paleotemperature varies from 20.0° to 23.9°C. The temperature change in Hole 1176A possibly shows the last glacial to Holocene change of SST. The core-top (0.05–1.60 mbsf) temperature ranges between 23.2° and 23.9°C, which agrees with the present mean annual SST at this site (National Oceanic and Atmospheric Administration, 1998). The temperature difference between the core-top and glacial interval is ~3°C. In Hole 1178A, the estimated paleotemperature varies from 19.1° to 24.4°C. The temperature change in Hole 1178A possibly shows five gla-

**T1.** TOC, alkenones, $U^{k'}_{37}$, and SST, p. 10.

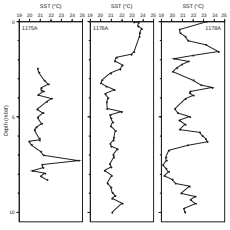
**F2.** TOC contents, p. 7.



**F3.** Total alkenone concentrations, p. 8.



**F4.** $U^{K'}_{37}$-based SST, p. 9.



cial–interglacial cycles (marine isotope Stages 1 to 11). The temperature difference between glacial and interglacial intervals is ~4°C.

## ACKNOWLEDGMENTS

We thank Ms. Noriko Edasawa (Hokkaido University) for analytical assistance in the laboratory. Special thanks are due to Professors Masao Minagawa, Noriyuki Suzuki (Hokkaido University), Asahiko Taira, and Hiroshi Kitazato (Japan Marine Science and Technology Center) for their valuable inputs. This research used samples and data provided by the Ocean Drilling Program (ODP). ODP is sponsored by the U.S. National Science Foundation (NSF) and participating countries under management of Joint Oceanographic Institution (JOI), Inc.

## REFERENCES

Brassell, S.C., Brereton, R.G., Eglinton, G., Grimalt, J., Liebezeit, G., Marlower, I.T., Pfaumann, U., and Sarntheim, M., 1986. Palaeoclimatic signals recognised by chemometric treatment of molecular stratigraphic data. *In* Leythaeuser, D., and Rullkötter, J. (Eds.), *Advances in Organic Geochemistry 1985*. Org. Geochem., 10:649–660.

Moore, G.F., Taira, A., Klaus, A., et al., 2001. *Proc. ODP, Init. Repts.,* 190 [CD-ROM]. Available from: Ocean Drilling Program, Texas A&M University, College Station TX 77845-9547, USA.

Moore, G.F., Taira, A., Klaus, A., and Leg 190 Scientific Party, 2001. New insights into deformation and fluid flow processes in the Nankai Trough accretionary prism: results of Ocean Drilling Program Leg 190. *Geochem. Geophys. Geosyst.,* 2:10.129/2001GC000166.

National Oceanic and Atmospheric Administration, 1998. *World Ocean Database 1998, CD-ROM:* Silver Spring, Maryland (U. S. Department of Commerce).

Prahl, F.G., Muehlhausen, L.A., and Zahnle, D.L., 1988. Further evaluation of long-chain alkenones as indicators of paleoceanographic conditions. *Geochim. Cosmochim. Acta,* 52:2303–2310.

Prahl, F.G., and Wakeham, S.G., 1987. Calibration of unsaturation patterns in long-chain ketone compositions for paleotemperature assessment. *Nature,* 330:367–369.

Shipboard Scientific Party, 2001a. Site 1175. *In* Moore, G.F., Taira, A., Klaus, A., et al., *Proc. ODP, Init. Repts.,* 190, 1–92 [CD-ROM]. Available from: Ocean Drilling Program, Texas A&M University, College Station TX 77845-9547, USA.

————, 2001b. Site 1176. *In* Moore, G.F., Taira, A., Klaus, A., et al., *Proc. ODP, Init. Repts.,* 190, 1–80 [CD-ROM]. Available from: Ocean Drilling Program, Texas A&M University, College Station TX 77845-9547, USA.

————, 2001c. Site 1178. *In* Moore, G.F., Taira, A., Klaus, A., et al., *Proc. ODP, Init. Repts.,* 190, 1–108 [CD-ROM]. Available from: Ocean Drilling Program, Texas A&M University, College Station TX 77845-9547, USA.

Yamamoto, M., Shiraiwa, Y., and Inoue, I., 2000. Physiological responses of lipids in *Emiliania huxleyi* and *Gephyrocapsa oceanica* (Haptophyceae) to growth status and their implications for alkenone paleothermometry. *Org. Geochem.,* 31:799–811.

**Figure F1.** Map showing the location of studied sites (Moore, Taira, Klaus, et al., 2001).

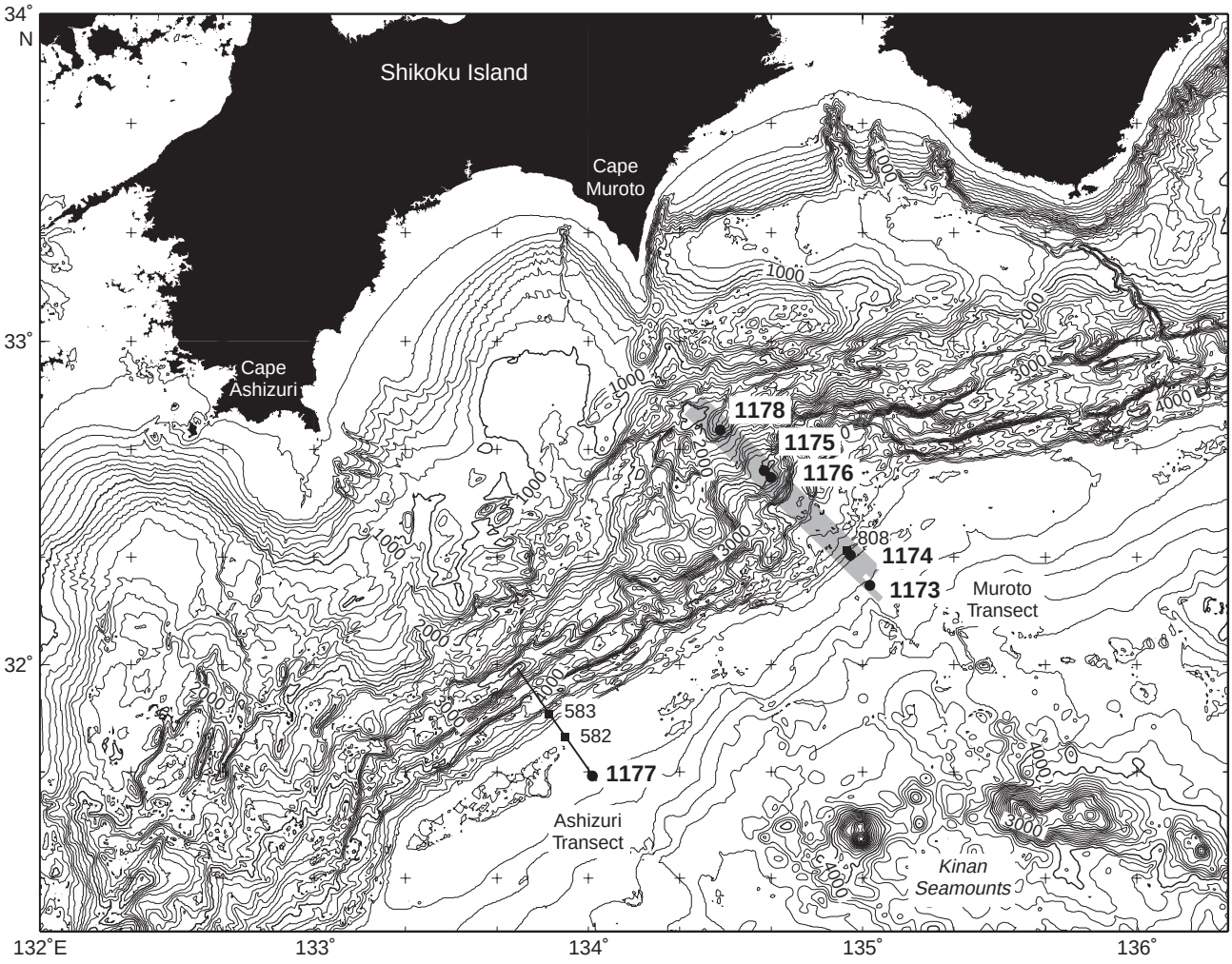


**Figure F2.** Depth profiles of total organic carbon (TOC) contents of Hole 1175A, 1176A, and 1178A sediments. The preliminary age-depth models based on shipboard microfossil occurrence (Moore, Taira, Klaus, et al., 2001) indicate that the sampling intervals range from 8.8 to 29.7 ka in Hole 1175A, 0.4 to 72.9 ka in Hole 1176A, and 1 to 333 ka in Hole 1178A.

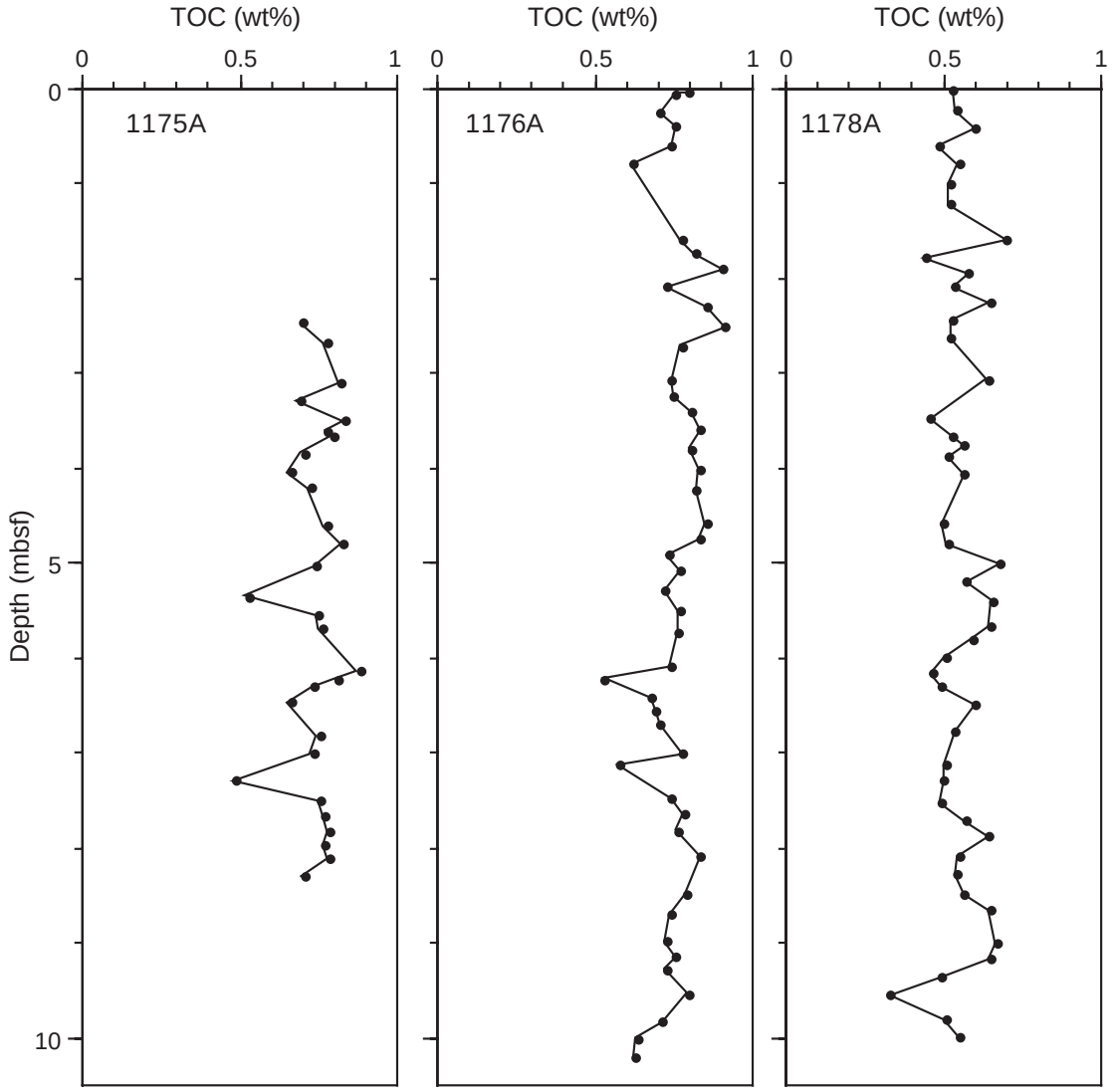


**Figure F3.** Depth profiles of total alkenone concentrations in Hole 1175A, 1176A, and 1178A sediments.

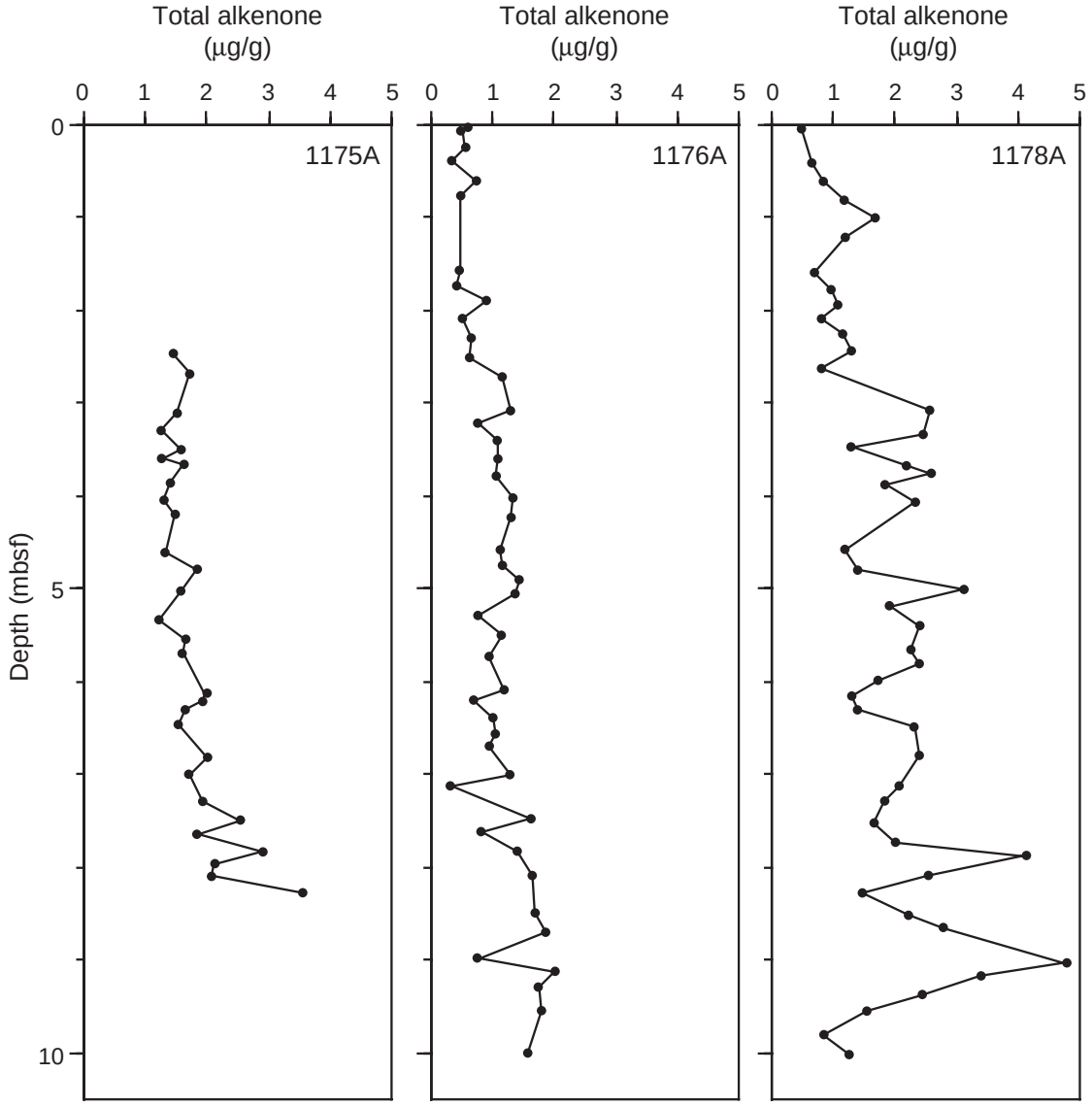


**Figure F4.** Depth profiles of $U^{k'}_{37}$-based estimated sea-surface temperatures (SST) in Hole 1175A, 1176A, and 1178A sediments.

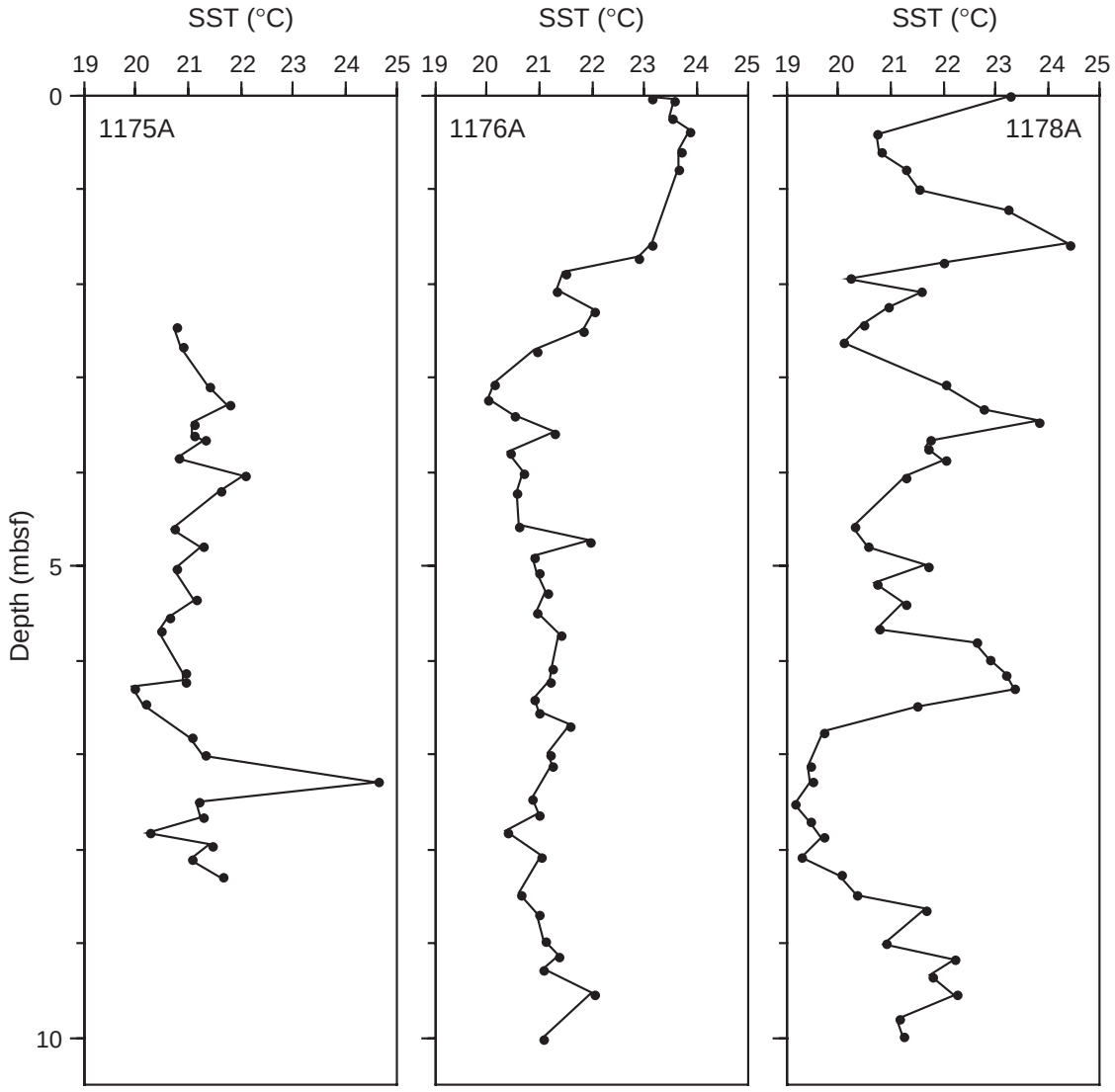


**Table T1.** Total organic carbon contents, alkenone concentrations, total alkenone unsaturation index, and the $U^{k'}_{37}$-based estimated sea-surface temperatures in Hole 1175A, 1176A and 1178A sediments.

| Core, section, interval (cm) | Depth (mbsf) | TOC (wt%) | Alkenone (µg/g) | $U^{k'}_{37}$ | SST (°C) |
|---|---|---|---|---|---|
| 190-1175A- | | | | | |
| 1H-2, 96–98 | 2.47 | 0.70 | 1.45 | 0.745 | 20.8 |
| 1H-2, 119–121 | 2.70 | 0.77 | 1.73 | 0.750 | 20.9 |
| 1H-3, 10–12 | 3.11 | 0.81 | 1.56 | 0.767 | 21.4 |
| 1H-3, 29–31 | 3.30 | 0.69 | 1.27 | 0.781 | 21.8 |
| 1H-3, 51–53 | 3.52 | 0.83 | 1.61 | 0.757 | 21.1 |
| 1H-3, 63–65 | 3.64 | 0.77 | 1.36 | 0.757 | 21.1 |
| 1H-3, 66–68 | 3.67 | 0.79 | 1.65 | 0.764 | 21.3 |
| 1H-3, 86–88 | 3.87 | 0.70 | 1.41 | 0.747 | 20.8 |
| 1H-3, 105–107 | 4.06 | 0.66 | 1.32 | 0.791 | 22.1 |
| 1H-3, 122–124 | 4.23 | 0.72 | 1.51 | 0.775 | 21.7 |
| 1H-4, 10–12 | 4.61 | 0.77 | 1.39 | 0.745 | 20.8 |
| 1H-4, 29–31 | 4.80 | 0.82 | 1.88 | 0.763 | 21.3 |
| 1H-4, 52–54 | 5.03 | 0.74 | 1.62 | 0.746 | 20.8 |
| 1H-4, 86–88 | 5.37 | 0.53 | 1.24 | 0.759 | 21.2 |
| 1H-4, 106–108 | 5.57 | 0.74 | 1.66 | 0.742 | 20.7 |
| 1H-4, 118–120 | 5.69 | 0.76 | 1.67 | 0.736 | 20.5 |
| 1H-5, 13–15 | 6.14 | 0.88 | 2.01 | 0.751 | 21.0 |
| 1H-5, 22–24 | 6.23 | 0.81 | 1.95 | 0.752 | 21.0 |
| 1H-5, 31–33 | 6.32 | 0.73 | 1.71 | 0.719 | 20.0 |
| 1H-5, 46–48 | 6.47 | 0.66 | 1.55 | 0.726 | 20.2 |
| 1H-6, 5–7 | 6.84 | 0.75 | 2.07 | 0.757 | 21.1 |
| 1H-CC, 10–12 | 7.01 | 0.73 | 1.79 | 0.764 | 21.3 |
| 2H-1, 18–20 | 7.31 | 0.48 | 1.99 | 0.877 | 24.6 |
| 2H-1, 38–40 | 7.51 | 0.75 | 2.55 | 0.761 | 21.2 |
| 2H-1, 54–56 | 7.67 | 0.76 | 1.93 | 0.763 | 21.3 |
| 2H-1, 71–73 | 7.84 | 0.78 | 2.94 | 0.729 | 20.3 |
| 2H-1, 84–86 | 7.97 | 0.77 | 2.17 | 0.769 | 21.5 |
| 2H-1, 99–101 | 8.12 | 0.78 | 2.13 | 0.755 | 21.1 |
| 2H-1, 118–120 | 8.31 | 0.70 | 3.62 | 0.776 | 21.7 |
| 190-1176A- | | | | | |
| 1H-1, 4–6 | 0.05 | 0.80 | 0.60 | 0.827 | 23.2 |
| 1H-1, 8–10 | 0.09 | 0.76 | 0.55 | 0.841 | 23.6 |
| 1H-1, 25–27 | 0.26 | 0.71 | 0.58 | 0.840 | 23.6 |
| 1H-1, 40–42 | 0.41 | 0.76 | 0.36 | 0.851 | 23.9 |
| 1H-1, 60–62 | 0.61 | 0.75 | 0.77 | 0.845 | 23.7 |
| 1H-1, 81–83 | 0.82 | 0.62 | 0.52 | 0.843 | 23.7 |
| 1H-2, 9–11 | 1.60 | 0.78 | 0.51 | 0.826 | 23.2 |
| 1H-2, 25–27 | 1.76 | 0.82 | 0.42 | 0.818 | 22.9 |
| 1H-2, 41–43 | 1.92 | 0.91 | 0.94 | 0.771 | 21.5 |
| 1H-2, 60–62 | 2.11 | 0.73 | 0.55 | 0.765 | 21.4 |
| 1H-2, 80–82 | 2.31 | 0.85 | 0.68 | 0.789 | 22.1 |
| 1H-2, 101–103 | 2.52 | 0.92 | 0.66 | 0.782 | 21.9 |
| 1H-2, 123–125 | 2.74 | 0.78 | 1.18 | 0.752 | 21.0 |
| 1H-3, 8–10 | 3.09 | 0.74 | 1.33 | 0.724 | 20.2 |
| 1H-3, 24–26 | 3.25 | 0.75 | 0.78 | 0.720 | 20.0 |
| 1H-3, 41–43 | 3.42 | 0.81 | 1.12 | 0.738 | 20.5 |
| 1H-3, 59–61 | 3.60 | 0.84 | 1.10 | 0.763 | 21.3 |
| 1H-3, 80–82 | 3.81 | 0.80 | 1.07 | 0.735 | 20.5 |
| 1H-3, 101–103 | 4.02 | 0.83 | 1.39 | 0.744 | 20.7 |
| 1H-3, 123–125 | 4.24 | 0.82 | 1.31 | 0.738 | 20.6 |
| 1H-4, 8–10 | 4.59 | 0.85 | 1.16 | 0.740 | 20.6 |
| 1H-4, 24–26 | 4.75 | 0.83 | 1.17 | 0.786 | 22.0 |
| 1H-4, 41–43 | 4.92 | 0.74 | 1.44 | 0.750 | 20.9 |
| 1H-4, 59–61 | 5.10 | 0.77 | 1.39 | 0.754 | 21.0 |
| 1H-4, 80–82 | 5.31 | 0.72 | 0.78 | 0.758 | 21.2 |
| 1H-4, 101–103 | 5.52 | 0.77 | 1.18 | 0.751 | 20.9 |
| 1H-4, 123–125 | 5.74 | 0.76 | 0.95 | 0.768 | 21.4 |
| 1H-5, 8–10 | 6.09 | 0.74 | 1.22 | 0.762 | 21.3 |
| 1H-5, 24–26 | 6.25 | 0.53 | 0.73 | 0.761 | 21.2 |
| 1H-5, 41–43 | 6.42 | 0.68 | 1.04 | 0.751 | 20.9 |
| 1H-5, 55–57 | 6.56 | 0.69 | 1.09 | 0.754 | 21.0 |
| 1H-5, 70–72 | 6.71 | 0.71 | 0.97 | 0.773 | 21.6 |
| 1H-6, 6–8 | 7.02 | 0.78 | 1.32 | 0.760 | 21.2 |
| 1H-6, 17–19 | 7.13 | 0.58 | 0.37 | 0.761 | 21.2 |
| 2H-1, 6–8 | 7.48 | 0.74 | 1.62 | 0.749 | 20.9 |
| 2H-1, 24–26 | 7.66 | 0.78 | 0.85 | 0.754 | 21.0 |
| 2H-1, 41–43 | 7.83 | 0.76 | 1.43 | 0.733 | 20.4 |
| 2H-1, 68–70 | 8.10 | 0.84 | 1.65 | 0.755 | 21.1 |
| 2H-1, 108–110 | 8.50 | 0.79 | 1.70 | 0.742 | 20.7 |
| 2H-1, 128–130 | 8.70 | 0.74 | 1.88 | 0.753 | 21.0 |
| 2H-2, 8–10 | 8.99 | 0.73 | 0.84 | 0.758 | 21.1 |
| 2H-2, 24–26 | 9.15 | 0.76 | 2.03 | 0.766 | 21.4 |
| 2H-2, 40–42 | 9.31 | 0.73 | 1.83 | 0.755 | 21.1 |
| 2H-2, 64–66 | 9.55 | 0.80 | 1.82 | 0.789 | 22.1 |
| 2H-2, 94–96 | 9.85 | 0.71 | NA | NA | NA |
| 2H-2, 112–114 | 10.03 | 0.64 | 1.60 | 0.756 | 21.1 |
| 2H-2, 130–132 | 10.21 | 0.63 | NA | NA | NA |
| 190-1178A- | | | | | |
| 1H-1, 2–4 | 0.03 | 0.53 | 0.50 | 0.831 | 23.3 |
| 1H-1, 24–26 | 0.25 | 0.55 | NA | NA | NA |
| 1H-1, 43–45 | 0.44 | 0.60 | 0.73 | 0.745 | 20.8 |
| 1H-1, 62–64 | 0.63 | 0.49 | 0.89 | 0.747 | 20.8 |
| 1H-1, 79–81 | 0.80 | 0.55 | 1.26 | 0.763 | 21.3 |
| 1H-1, 100–102 | 1.01 | 0.52 | 1.75 | 0.771 | 21.5 |
| 1H-1, 121–123 | 1.22 | 0.53 | 1.24 | 0.829 | 23.2 |
| 1H-2, 10–12 | 1.61 | 0.70 | 0.74 | 0.870 | 24.4 |
| 1H-2, 28–30 | 1.79 | 0.45 | 1.03 | 0.788 | 22.0 |
| 1H-2, 45–47 | 1.96 | 0.58 | 1.11 | 0.727 | 20.2 |
| 1H-2, 60–62 | 2.11 | 0.54 | 0.84 | 0.774 | 21.6 |
| 1H-2, 76–78 | 2.27 | 0.65 | 1.19 | 0.752 | 21.0 |
| 1H-2, 95–97 | 2.46 | 0.53 | 1.35 | 0.735 | 20.5 |
| 1H-2, 113–115 | 2.64 | 0.52 | 0.85 | 0.723 | 20.1 |
| 2H-1, 18–20 | 3.09 | 0.64 | 2.59 | 0.789 | 22.0 |
| 2H-1, 45–47 | 3.36 | NA | 2.48 | 0.813 | 22.8 |
| 2H-1, 58–60 | 3.49 | 0.46 | 1.40 | 0.849 | 23.8 |
| 2H-1, 76–79 | 3.67 | 0.53 | 2.15 | 0.779 | 21.8 |
| 2H-1, 86–88 | 3.77 | 0.57 | 2.62 | 0.778 | 21.7 |
| 2H-1, 99–101 | 3.90 | 0.52 | 1.93 | 0.789 | 22.0 |
| 2H-1, 116–118 | 4.07 | 0.56 | 2.34 | 0.763 | 21.3 |
| 2H-2, 19–21 | 4.60 | 0.51 | 1.23 | 0.731 | 20.3 |
| 2H-2, 40–42 | 4.81 | 0.52 | 1.41 | 0.739 | 20.6 |
| 2H-2, 60–62 | 5.01 | 0.68 | 3.14 | 0.778 | 21.7 |
| 2H-2, 80–82 | 5.21 | 0.58 | 1.97 | 0.744 | 20.7 |
| 2H-2, 100–102 | 5.41 | 0.66 | 2.41 | 0.763 | 21.3 |
| 2H-2, 126–129 | 5.67 | 0.65 | 2.27 | 0.746 | 20.8 |
| 2H-2, 140–142 | 5.81 | 0.59 | 2.40 | 0.810 | 22.7 |
| 2H-3, 9–11 | 6.00 | 0.51 | 1.79 | 0.818 | 22.9 |
| 2H-3, 25–27 | 6.16 | 0.47 | 1.36 | 0.828 | 23.2 |
| 2H-3, 40–42 | 6.31 | 0.50 | 1.44 | 0.834 | 23.4 |
| 2H-3, 60–62 | 6.51 | 0.60 | 2.39 | 0.770 | 21.5 |
| 2H-3, 88–90 | 6.79 | 0.54 | 2.41 | 0.710 | 19.7 |
| 2H-3, 123–125 | 7.14 | 0.51 | 2.12 | 0.702 | 19.5 |
| 2H-3, 139–141 | 7.30 | 0.50 | 1.84 | 0.703 | 19.5 |
| 2H-4, 12–14 | 7.53 | 0.50 | 1.69 | 0.691 | 19.2 |
| 2H-4, 32–34 | 7.73 | 0.57 | 2.01 | 0.702 | 19.5 |
| 2H-4, 47–49 | 7.88 | 0.65 | 4.06 | 0.709 | 19.7 |
| 2H-4, 68–70 | 8.09 | 0.55 | 2.54 | 0.695 | 19.3 |
| 2H-4, 87–89 | 8.28 | 0.55 | 1.49 | 0.721 | 20.1 |
| 2H-4, 109–111 | 8.50 | 0.56 | 2.26 | 0.731 | 20.4 |
| 2H-4, 125–127 | 8.66 | 0.65 | 2.79 | 0.777 | 21.7 |
| 2H-5, 10–12 | 9.01 | 0.67 | 4.77 | 0.750 | 20.9 |
| 2H-5, 28–30 | 9.19 | 0.65 | 3.44 | 0.795 | 22.2 |
| 2H-5, 47–49 | 9.38 | 0.50 | 2.43 | 0.781 | 21.8 |
| 2H-5, 64–66 | 9.55 | 0.33 | 1.57 | 0.796 | 22.3 |
| 2H-5, 90–92 | 9.81 | 0.51 | 0.85 | 0.759 | 21.2 |
| 2H-5, 109–111 | 10.00 | 0.55 | 1.29 | 0.761 | 21.2 |

Notes: TOC = total organic carbon. $U^{k'}_{37}$ = total alkenone unsaturation index. SST = sea-surface temperature. NA = not analyzed.