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Supporting Online Material for

Deepwater Formation in the North Pacific During the Last Glacial Termination

Y. Okazaki, A. Timmermann,* L. Menviel, N. Harada, A. Abe-Ouchi, M. O. Chikamoto, A. Mouchet, H. Asahi

*To whom correspondence should be addressed. E-mail: axel@hawaii.edu

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1. Material and Methods

Model description and experimental design

The LOVECLIM model (version 1.1) is an earth system model of intermediate complexity (EMIC) (*S1*). It consists of five coupled subsystems: a simplified 3-layer global atmosphere (ECBilt), a 3-d global ocean and thermodynamic-dynamic sea-ice model (CLIO), a simplified vegetation model (VECODE) and a global carbon cycle model (LOCH) which also includes ^{14}C and ^{13}C tracers. The physical components of the model version employed here are based on version 3 of the coupled model ECBilt-CLIO.

The global atmospheric model ECBilt is based on a quasi-geostrophic adiabatic core extended by ageostrophic corrections in T21 resolution (~5.6 ^{o} x 5.6^{o}) and three vertical layers. The daily mean irradiance used by ECBilt is calculated following Berger (*S2*).

The ocean model CLIO is a three-dimensional primitive equation model on z-coordinates with a free surface. It is coupled to a thermodynamic-dynamic sea ice model. The horizontal resolution is 3 ^{o} x3 ^{o}. The globe is covered by a partly-rotated grid in the North Atlantic sector. In vertical direction, the model is divided into 20 unevenly spaced levels. Vertical mixing, mixing along isopycnals, the effect of mesoscale eddies on transports and mixing, and downsloping currents at the bottom of continental slopes are parameterized. Bering Strait is closed in both, the pre-industrial and the Last Glacial Maximum control and freshwater perturbation simulations.

The three physical components of LOVECLIM are coupled by exchange of momentum, heat, and freshwater. The hydrological cycle is closed over land by a bucket model for soil moisture, and river runoff into the ocean.

The terrestrial vegetation module of LOVECLIM, VECODE Brovkin et al. (*S3*), computes once a year the evolution of the vegetation cover based on annual mean values of several climatic variables. The vegetation cover is described as a fractional distribution of desert, tree, and grass in each land grid cell.

LOCH is a 3-dimensional global model of the oceanic carbon cycle simulating dissolved inorganic carbon (DIC), total alkalinity, ^{14}C, phosphate, organic products, oxygen and silica (*S4*). LOCH is fully coupled to CLIO, with the same time step. In addition to their biogeochemical transformations, tracers in LOCH fully experience the circulation field predicted by CLIO. For the purpose of the simulations presented in this work the ^{14}C content at any point in the ocean is expressed as a $^{14}C/^{12}C$ ratio. Because we are focusing on timeslice experiments with fixed orbital and greenhouse gas forcing, rather than on transient deglacial runs, the production rate of ^{14}C is held constant for our experiments.

The radiocarbon tracer is only used in our pre-industrial control and freshwater perturbation simulations.

The following 2 control simulations were conducted with LOVECLIM:

1. A 10,000-year-long spin-up run was conducted using an atmospheric CO_2 concentrations of 280ppm and an atmospheric $\Delta^{14}C$ of 0 permil. The spin-up adjusts the carbon isotopes in the ocean and the global carbon cycle. The forcing is released and a fully-coupled 1500-year control run (CTR) is conducted with prognostic CO_2. Radiocarbon ages are computed from the output of this run using the computed $^{14}C/^{12}C$ ratio. In this experiment Bering Strait is closed.
2. A 3500-year-long Last Glacial Maximum Control run (LGM) using the ice-sheet topography ICE-4G of Peltier (1994), orbital forcing conditions corresponding to 21 ka B.P., greenhouse gas concentrations from 21 ka B.P. (*S5*). This model simulation does not include carbon isotope tracers. Bering Strait is closed in this experiment.

The following two freshwater perturbation experiments were conducted with LOVECLIM

1. A 1000-year long idealized freshwater perturbation experiment (FW-CTR) under pre-industrial conditions. By linearly increasing the freshwater forcing in the northern North Atlantic (between 50^{o}N-70^{o}N) for 100 years to 2 Sv, a collapse of the AMOC is triggered. Thereafter, the freshwater forcing decreases linearly for another 100 years. This experiment, although done for pre-industrial conditions (initialized from experiment CTR), mimics certain features of the climate response to Heinrich event I. In this experiment Bering Strait is closed. The carbon cycle, as well as the radiocarbon tracers are activated.
2. An LGM freshwater perturbation experiment (FW-LGM) similar to FW-CTR is conducted using glacial boundary conditions. It was initialized from experiment

LGM. For this experiment radiocarbon has not been used as a tracer. Spinning up the fully coupled carbon-cycle-climate system under LGM conditions is a major challenge that would be beyond the scope of our study. The experiment FW-LGM is used here mainly to demonstrate that also under LGM conditions the model simulates a PMOC in response to a North Atlantic freshwater pulse (Figure S2, right panel) that is very similar to the one obtained in experiment FW-CTR (Figure S2, left panel). Hence, we would expect very similar radiocarbon age anomalies in the North Pacific.

Sediment core sites information and choice of reservoir ages

Information on sediment cores sites is compiled in Table S1. The regional marine reservoir age (ΔR) is defined as the deviation of the local radiocarbon age from the globally averaged reservoir age (~400 yr). In the modern subarctic Pacific, ΔR ranges from ~200 to 500 yr (*S6-10*). Past marine reservoir ages may have changed significantly but are not well constrained. Therefore, we choose a constant reservoir age with a relatively large uncertainty, following a strategy proposed by Galbraith et al. (*S11*). For sediment cores in the subarctic Pacific and most of the eastern mid-latitudinal Pacific sediment cores, we choose ΔR=500±300 yr, which covers both, modern values and estimates of past ΔR (*S7*) in this region. This estimation enables us to evaluate calculated ventilation values in the subarctic Pacific uniformly. For core KT89-18-P4 from mid-latitudinal northwestern Pacific, we choose ΔR=100±200 yr based on Shishikura et al. (*S12*) and Yoneda et al. (*S10*). Note, that freshwater perturbation experiments that mimic the Heinrich event I suggest no considerable changes in surface

^{14}C ages (*S13*). Our modeling simulations conducted with LOVECLIM1.1 confirm that surface age anomalies in the North Pacific are within 200 years during a freshwater discharge experiment with an intensified Pacific Meridional Overturning Circulation (PMOC) (Figure S4). Reduction of North Atlantic surface water radiocarbon ages (Figure S4) results from an increased stratification and reduced mixing of deeper and older waters. We used ΔR=160±150 yr for western equatorial Pacific cores after Broecker et al. (*S14*) and ΔR=180±300 yr for eastern equatorial Pacific cores after Skinner and Shackleton (*S15*).

Age models

Age models for sediment cores PAR87-10, GH02-1030, MR01-K03-PC4, and BOW-9A were established based on recalculated ^{14}C dating of planktonic foraminifers (Table S2). For BOW-9A, magnetic paleointensity was used to obtain an additional age control point (21.3 ka at 305 cm (*S16*)). We converted radiocarbon ages to calendar ages with Calib 6.0 using constant reservoir age of ΔR=500±300 yr. We basically selected median probability of the probability distribution along the calendar year axis as age control point. Note that we have chosen age control points to minimize sedimentation rates within ±1σ only in case of ^{14}C age reversals (MR01K03-PC4/5, and GH02-1003; Table S2).

Calculation for past ventilation

There are two methods of calculating paleo-ventilation ages: they can be determined

a. by calculating the ^{14}C age difference between planktonic and benthic foraminifers (BF-PF age),

b. by calculating the projection age, proposed by Adkins and Boyle (*S17*), which takes into account atmospheric $\Delta^{14}C$ changes.

Similarly, two methods to calculate paleo-^{14}C activity for the comparison of the reconstructed benthic ^{14}C activity with the atmospheric $\Delta^{14}C$ are proposed by Galbraith et al. (*S11*):

a. simply use the contemporary atmospheric $\Delta^{14}C$ at the time of calcification, ($\Delta^{14}C_{cont\text{-}atm}$), and

b. estimate the atmospheric $\Delta^{14}C$ at the time of bottom-water formation by tracing back along the radiocarbon decay trajectory until it intersected the surface ocean $\Delta^{14}C$ record ($\Delta^{14}C_{proj\text{-}atm}$).

We used the atmospheric and surface ocean $\Delta^{14}C$ records (IntCal09 and Marine09, respectively) from Reimer et al. (*S18*). To compare these paleo-$\Delta^{14}C$ values with modern $\Delta^{14}C$ values, both $\Delta^{14}C_{cont\text{-}atm}$ and $\Delta^{14}C_{proj\text{-}atm}$ were converted to $\Delta^{14}C'_{cont\text{-}atm}$ and $\Delta^{14}C'_{proj\text{-}atm}$ as proposed by Galbraith et al. (*S11*), respectively. Definition of $\Delta^{14}C'$ is as follows:

$$\Delta^{14}C' = (\Delta^{14}C_{bot} - \Delta^{14}C_{atm}) / (\Delta^{14}C_{atm} + 1000) \times 1000‰$$

Where $\Delta^{14}C_{bot}$ is the reconstructed bottom water $\Delta^{14}C$ (calculate from ^{14}C age of benthic foraminifer (*S17*)), and $\Delta^{14}C_{atm}$ is the reference paleo-atmospheric $\Delta^{14}C$ (*S18*).

We compiled available ^{14}C ages of coexisting benthic and planktonic foraminifers in the North Pacific (Tables S3 and S5). We ruled out interpolated calendar ages in original references (*S19-21*) and selected new calendar ages based on planktonic foraminifera ^{14}C data except for Core MV99-GC31/PC08 (*S22*). Projection ages and reconstructed benthic ^{14}C activity in Core MV99-GC31/PC08 are calculated under different conditions than for the other cores. We omitted several ^{14}C records in Core VM21-30 (*S21*) which showed highly varied ^{14}C ages by multispecies planktonic foraminifers, suggesting substantial bioturbation impact (*S14*). We also omitted two ^{14}C records during the H1 interval in Core MD01-2416 (*S20*), which exhibit a large age reversal, suggesting bioturbation impact and/or unstable sedimentation. Planktonic foraminiferal ^{14}C ages were converted to calendar ages with Calib 6.0 using constant reservoir age as described in the previous section. We selected median probability of the probability distribution along the calendar year axis as age control point. Durations of Heinrich event 1 (H1) and Last Glacial Maximum (LGM) are 15-17.5 kyr B.P. and 19-23 kyr B.P., respectively. Reconstructed ventilation changes (^{14}C age offset between planktonic and benthic foraminifers, projection age, and intermediate-deep water $\Delta^{14}C$) in the NW Pacific and NE Pacific during 10 to 23 kyr B.P. are shown in Figs. S5 and S6, respectively. These results indicate that significant ventilation changes occurred in the NW Pacific, whereas no significant changes are found in the NE Pacific. Calculation for weighted average and uncertainty of BF–PF age, projection age, $\Delta^{14}C'_{cont\text{-}atm}$, and $\Delta^{14}C'_{proj\text{-}atm}$ follow the approach by Bevington (*S23*).

Stable isotope analysis of benthic foraminifer in core BOW9A

Stable isotope analyses were performed on benthic foraminifera shells (*Uvigerina* spp.) from sediment samples collected at 2.0-cm intervals in core BOW-9A. The samples were washed on a 63-μm-mesh sieve and dried in an oven at 40 °C. The dry samples were sieved through a 125-μm-mesh sieve. We then picked benthic foraminifera shells from the >125-μm fraction of each sample under a stereomicroscope. Since brownish foraminifera shells gives abnormally positive $\delta^{18}O$ and negative $\delta^{13}C$ values due to their postdepositional alterations (*S24*), brownish colored shells were excluded as part of our picking process. The foraminifera shells were cleaned by soaking them in 99.5% ethyl alcohol, followed by ultrasonication until all chambers were open. After confirming that all dirt had been removed, we washed the shells in 99.5% ethyl alcohol and dried them in a desiccator for 24 hours. The stable isotope measurements were performed using an IsoPrime isotope ratio mass spectrometer (GV Instruments, Manchester, United Kingdom) at the Center for Advanced Marine Core Research, Kochi University. Analyses were calibrated to the NBS-19 PDB standard, and the average analytical error to the standard was less than 0.08‰.

2. Figures

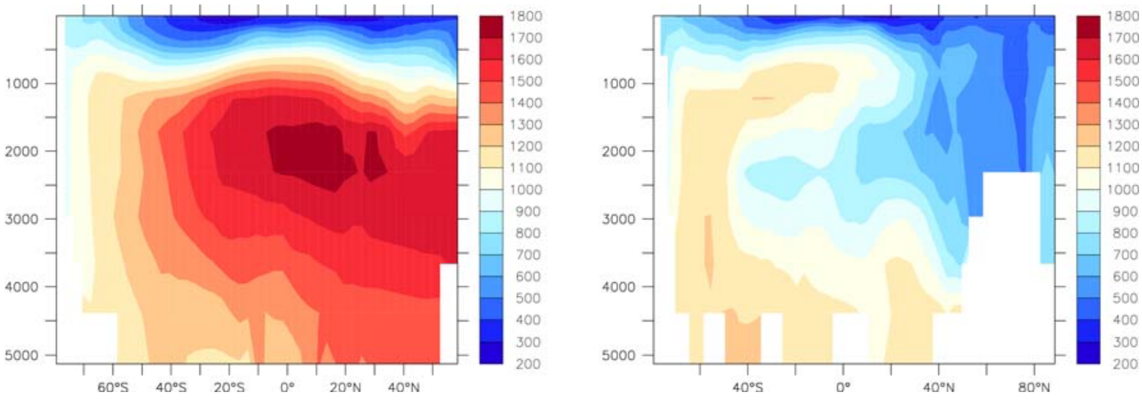

Fig. S1: Left: Pacific zonal mean section of simulated pre-bomb radiocarbon ages [years] in experiment CTR; Right: same as left, but for the Atlantic**.**

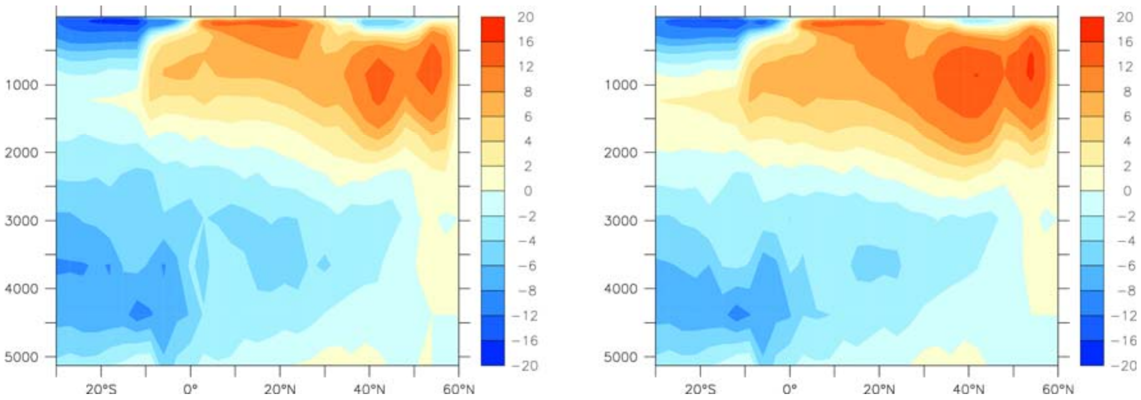

Fig. S2: Left: Pacific meridional streamfunction [Sv=10^6 m^3/s] averaged over years 400-500 in experiment FW-CTR (left) and FW-LGM (right)**.**

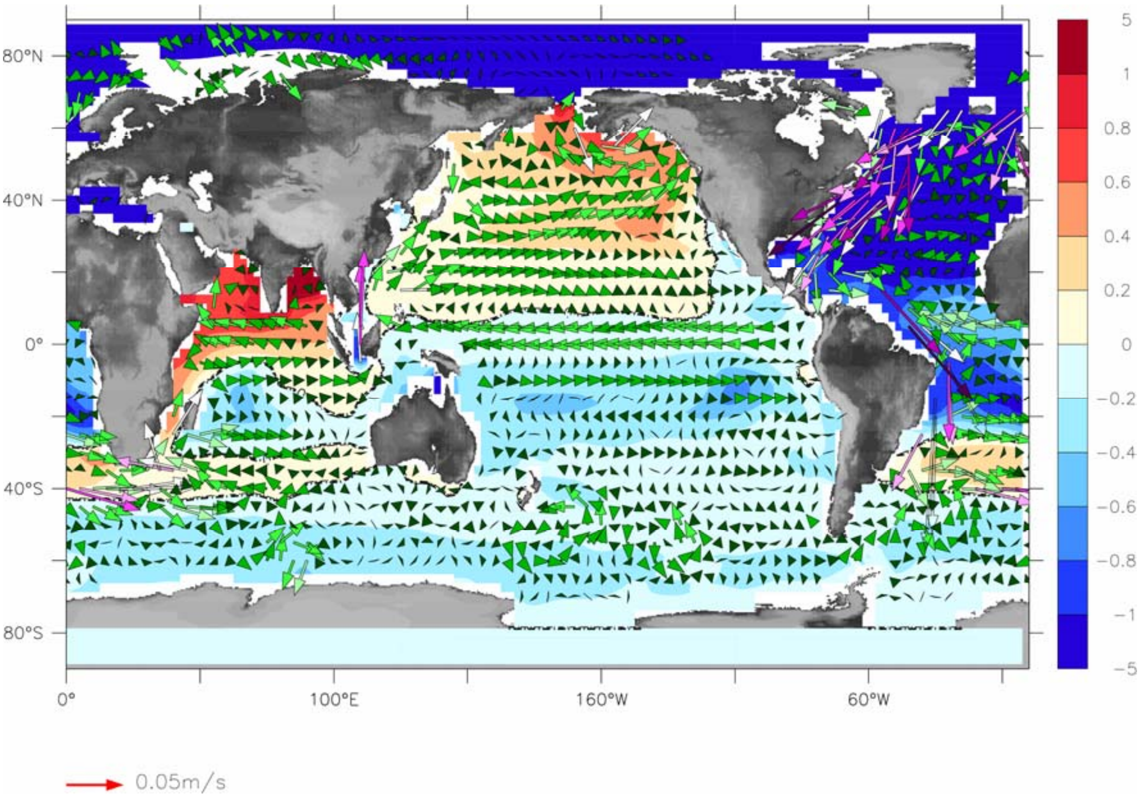

Fig. S3: Upper ocean (average over the upper 65m) currents (arrows, [cm/s]) and salinity change [psu] averaged between years 400-500 in experiment FW-CTR**.** Purple arrows indicate current speeds that are much larger than 0.05m/s.

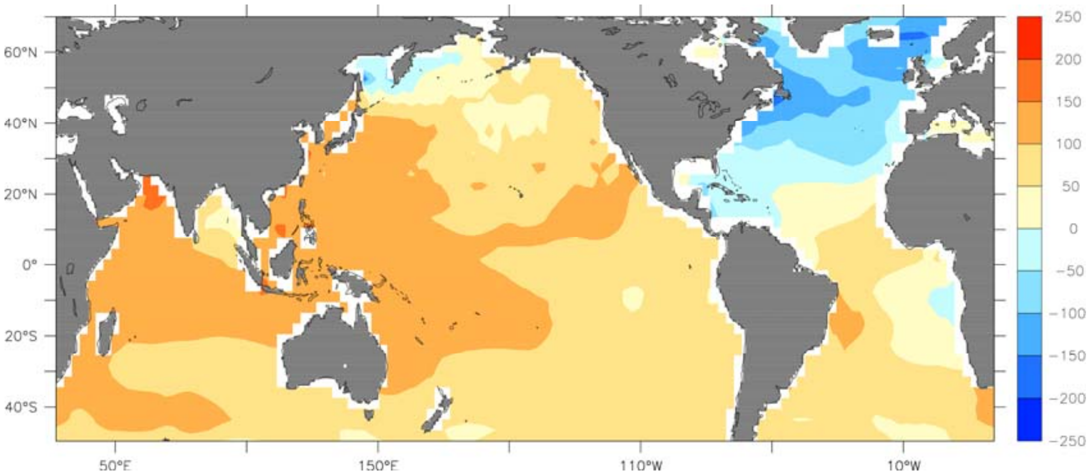

Figure S4: Upper ocean (average over the upper 50m) radiocarbon age anomalies [years] for experiment FW-CTR averaged over years 300-400**.**

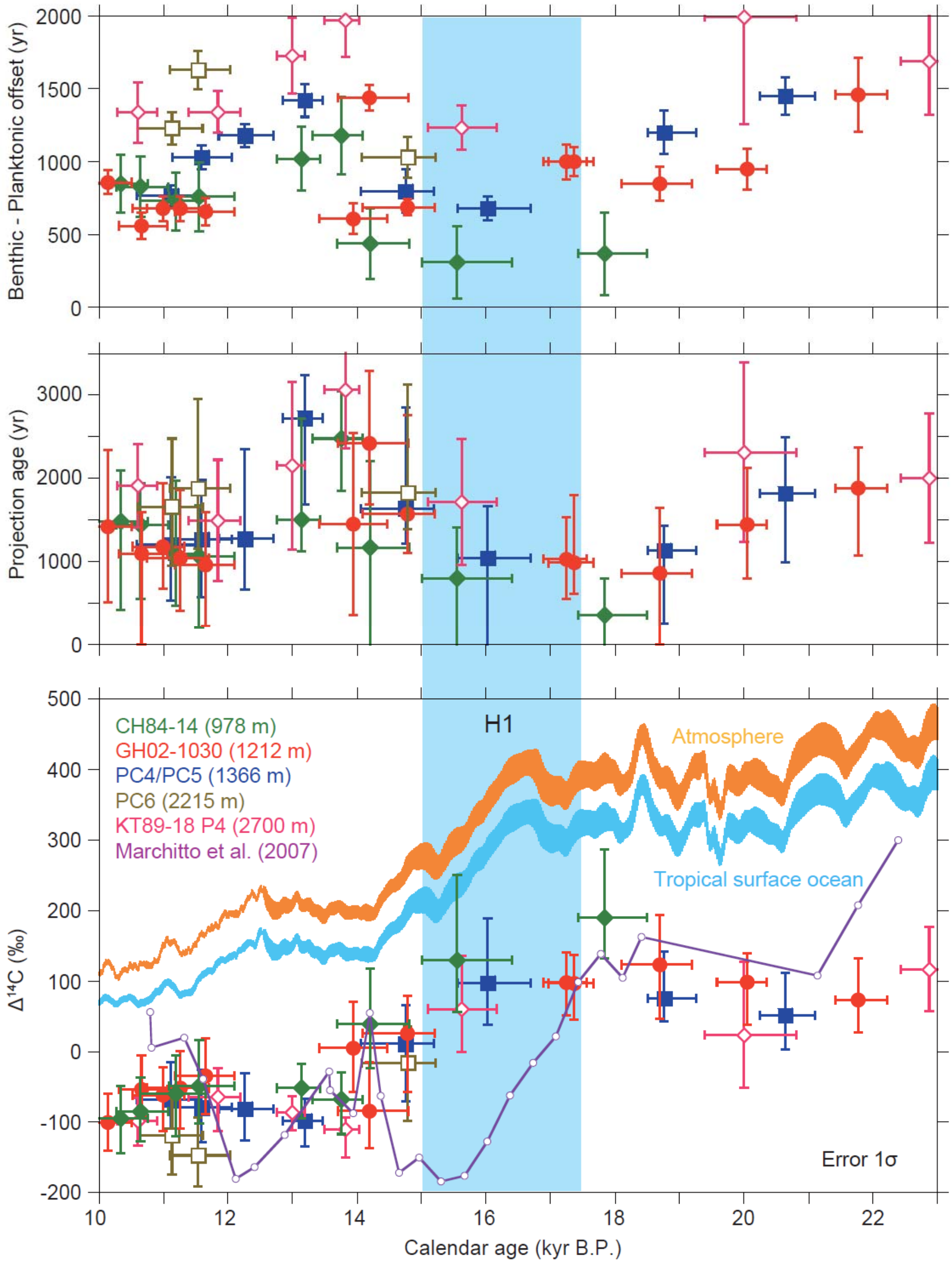

Figure S5. Ventilation changes based on BF-PF age, projection age, and $\Delta^{14}C$ in the western North Pacific ranging from 900 to 2800 m water depths. Orange and light blue curves are atmospheric (Intcal09) and surface ocean (Marine09) $\Delta^{14}C$ records (*S18*). Purple curve is eastern Pacific $\Delta^{14}C$ records (*S22*).

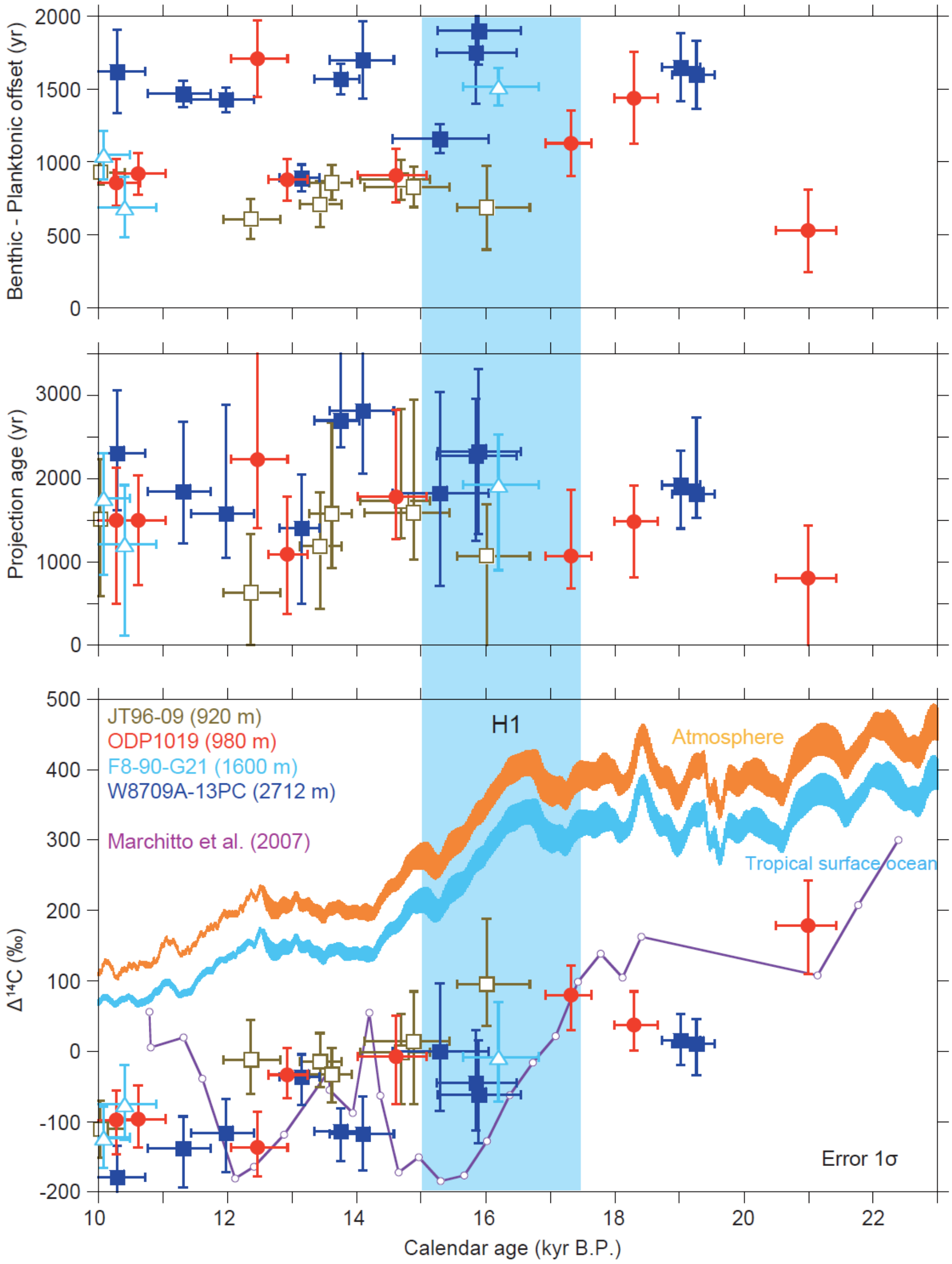

Figure S6. Ventilation changes based on BF-PF age, projection age, and $\Delta^{14}C$ in the eastern North Pacific ranging from 900 to 2800 m water depths.

3. Tables

Table S1. Sediment core lists used in this study (*S11, S14, S19-22, S25-41*).

Core ID	Latitude	Longitude	Water depth (m)	Area	ΔR (yr)	Error (±1σ)	Reference	Core No.*
F2-92-P3	35.62°N	121.61°W	799	NE Pacific	500	300	van Geen et al. (1996)	
F8-90-G21	37.22°N	123.24°W	1605	NE Pacific	500	300	van Geen et al. (1996)	
JPC56	27.47°N	112.10°W	818	NE Pacific	500	300	Keigwin (2002)	
JT96-09	48.91°N	126.90°W	920	NE Pacific	500	300	McKay et al. (2005)	
ODP1019	41.68°N	124.93°W	980	NE Pacific	500	300	Mix et al. (1999)	7
ODP887	54.37°N	148.45°W	3647	NE Pacific	500	300	Galbraith et al. (2007)	5
ODP893	34.29°N	120.04°W	577	NE Pacific	500	300	Kennett and Ingram (1995)	8
PAR87-10	54.36°N	148.47°W	3664	NE Pacific	500	300	Zahn et al. (1991), de Vernal and Pedersen (1997)	
W8709A-13PC	42.12°N	125.75°W	2712	NE Pacific	500	300	Mix et al. (1999)	6
CH84-14	41.73°N	142.55°E	978	NW Pacific	500	300	Duplessy et al. (1989)	
GH02-1030	42.23°N	144.21°E	1212	NW Pacific	500	300	Ikehara et al. (2006), Sagawa and Ikehara (2008)	1
KR02-15-PC6	40.40°N	143.50°E	2215	NW Pacific	500	300	Minoshima et al. (2007)	
KT89-18-P4	32.15°N	133.90°E	2700	NW Pacific	100	200	Murayama et al. (1992)	3
MD01-2416	51.27°N	167.73°E	2317	NW Pacific	500	300	Sarnthein et al. (2006)	
MR01K03-PC4/5	41.12°N	142.40°E	1366	NW Pacific	500	300	Ahagon et al. (2003), Hoshiba et al. (2006)	2
ODP883	51.20°N	167.77°E	2385	NW Pacific	500	300	Sarnthein et al. (2006)	
BOW9A	54.04°N	178.68°E	2391	Bering Sea	500	300	Okazaki et al. (2005)	
B34-91	49.0°N	150.3°E	1227	Okhotsk Sea	500	300	Keigwin (2002)	
GGC15	48.6°N	150.4°E	1980	Okhotsk Sea	500	300	Keigwin (2002)	
GGC18	48.8°N	150.4°E	1700	Okhotsk Sea	500	300	Keigwin (2002)	
GGC20	48.9°N	150.4°E	1510	Okhotsk Sea	500	300	Keigwin (2002)	
GGC27	49.6°N	150.2°E	995	Okhotsk Sea	500	300	Keigwin (2002)	
MV99-GC31/PC08	23.5°N	111.6°W	705	E Pacific	200	100	Marchitto et al. (2007)	9
TR163-31	3.62°S	83.97°W	3210	E Pacific	150	300	Shackleton et al. (1988)	
VM21-30	1.22°S	89.68°W	617	E Pacific	150	300	Stott et al. (2009)	10
50-37KL	18.9°N	115.77°E	2695	W Pacific	160	150	Broecker et al. (1990)	
MD01-2386	1°N	130°E	2800	W Pacific	160	150	Broecker et al. (2008)	4
MD97-2138	1°S	146°E	1900	W Pacific	160	150	Broecker et al. (2004)	
MD98-2181	6°N	126°E	2100	W Pacific	160	150	Broecker et al. (2004)	

*Numbers are as same as the numbers in symbols in Figures 3.

Table S2. Age control points for cores PAR87A-10, MR01K03-PC4/5, GH02-1030, and BOW9A (*S31, S33, S38*).
Selected ages are the probability median values except for ages with asterisk which were determined to minimize sedimentation rates.

Core ID	Depth (cm)	Planktonic ^{14}C age (yr B.P.)	Error ±1σ (yr)	Calendar age (yr B.P.) Probability median	-1σ	+1σ	Selected age (yr B.P.)	Species	Lab Code**	Original reference
PAR87A-10	23	6640	300	6589	6166	7099	6589	*N. pachyderma*	RIDDL	Zahn et al. (1991)
PAR87A-10	50	12490	230	13476	13083	13881	13476	*G. bulloides*	RIDDL	Zahn et al. (1991)
PAR87A-10	121	16670	560	18963	18088	19570	18963	*N. pachyderma*	RIDDL	Zahn et al. (1991)
PAR87A-10	213	31600		34699	32232	36634	34699	*N. pachyderma*	RIDDL	Zahn et al. (1991)
MR01K03-PC4/5	16.9	3290	40	2515	2125	2866	2515	*N. pachyderma*	IAA	Hoshiba et al. (2006)
MR01K03-PC4/5	39.6	4270	100	3735	3332	4141	3735	*N. pachyderma*	IAA	Hoshiba et al. (2006)
MR01K03-PC4/5	62.8	5450	110	5236	4842	5601	5236	*N. pachyderma*	IAA	Hoshiba et al. (2006)
MR01K03-PC4/5	100.7	7500	110	7487	7184	7816	7487	*N. pachyderma*	IAA	Hoshiba et al. (2006)
MR01K03-PC4/5	144.4	8720	50	8775	8392	9115	8775	*N. pachyderma*	IAA	Hoshiba et al. (2006)
MR01K03-PC4/5	185	9280	40	9458	9060	9858	9458	*N. pachyderma*	NIES-TERRA	Hoshiba et al. (2006)
MR01K03-PC4/5	230.2	10600	50	11115	10588	11414	11115	*N. pachyderma*	IAA	Hoshiba et al. (2006)
MR01K03-PC4/5	262.1	10900	60	11589	11134	12060	11589	Mixed planktonic	NOSAMS	Hoshiba et al. (2006)
MR01K03-PC4/5	292.5	11420	60	12263	11857	12705	12263	*N. pachyderma*	IAA	Hoshiba et al. (2006)
MR01K03-PC4/5	313.2	12230	50	13191	12846	13470	13191	*N. pachyderma*	IAA	Hoshiba et al. (2006)
MR01K03-PC4/5	335.8	12400	50	13367	13099	13715	13367	*N. pachyderma*	NOSAMS	Hoshiba et al. (2006)
MR01K03-PC4/5	363.3	13450	90	14757	14059	15188	14757	Mixed planktonic	NOSAMS	Hoshiba et al. (2006)
MR01K03-PC4/5	405.5	14150	60	16028	15567	16692	15780*	Mixed planktonic	NOSAMS	Hoshiba et al. (2006)
MR01K03-PC4/5	413	13690	60	15263	14534	15957	15957*	*N. pachyderma*	IAA	Hoshiba et al. (2006)
MR01K03-PC4/5	540	16450	110	18763	18513	19262	18763	Mixed planktonic	NOSAMS	Hoshiba et al. (2006)
MR01K03-PC4/5	642	18200	70	20638	20244	21102	20638	Mixed planktonic	NOSAMS	Hoshiba et al. (2006)
MR01K03-PC4/5	844.7	21500	110	24587	24219	24996	24587	Mixed planktonic	NOSAMS	Hoshiba et al. (2006)
MR01K03-PC4/5	945.6	23560	110	27316	26901	27810	27316	Mixed planktonic	IAA	Hoshiba et al. (2006)
MR01K03-PC4/5	1082.3	25700	150	29677	29398	30166	29677	Mixed planktonic	NOSAMS	Hoshiba et al. (2006)
MR01K03-PC4/5	1322	30130	180	33874	33500	34454	33874	Mixed planktonic	IAA	Hoshiba et al. (2006)

**AA, NSF-Arizona AMS Laboratory, University of Arizona; OS, National Ocean Sciences AMS facility, Woods Hole Oceanographic Institution
RIDDL, Radio-Isotope Direct Detection Laboratory at Simon Fraser University; IAA, Institute of Accelerator Analysis Ltd., Shirakawa, Japan
NIES-TERRA: National Institute for Environmental Studies, Tsukuba, Japan.; Beta, Beta Analytic Inc.

Table S2. (cont.)

Selected ages are the probability median values except for ages with asterisk which were determined to minimize sedimentation rates.

Core ID	Depth (cm)	Planktonic ^{14}C age (yr B.P.)	Error ±1σ (yr)	Calendar age (yr B.P.) Probability median	-1σ	+1σ	Selected age (yr B.P.)	Species	Lab Code**	Original reference
GH02-1030	210	9840	40	10134	9751	10506	10134	Mixed planktonic	Beta188642	Ikehara et al. (2006)
GH02-1030	220	10240	60	10656	10310	11065	10656	Mixed planktonic	Beta175956	Ikehara et al. (2006)
GH02-1030	235	10510	60	10986	10524	11329	10986	Mixed planktonic	Beta175958	Ikehara et al. (2006)
GH02-1030	244	10690	60	11261	10743	11703	11261	Mixed planktonic	Beta175960	Ikehara et al. (2006)
GH02-1030	261	10950	60	11654	11181	12100	11654	*N. pachyderma*	Beta175962	Ikehara et al. (2006)
GH02-1030	290	12900	70	13943	13412	14241	13943	*N. pachyderma*	Beta175964	Ikehara et al. (2006)
GH02-1030	307.5	13270	70	14498	13981	14970	14208*	*N. pachyderma*	Beta175966	Ikehara et al. (2006)
GH02-1030	323.5	13060	70	14193	13702	14647	14450*	Mixed planktonic	Beta175968	Ikehara et al. (2006)
GH02-1030	345.5	13470	40	14783	14082	15204	14783	*N. pachyderma*	Beta175970	Ikehara et al. (2006)
GH02-1030	403.5	15090	50	17323	16946	17619	16946*	Mixed planktonic	Beta175973	Ikehara et al. (2006)
GH02-1030	435.5	15010	80	17245	16889	17560	17318*	Mixed planktonic	Beta175975	Ikehara et al. (2006)
GH02-1030	465.5	15140	60	17369	16976	17666	17666*	Mixed planktonic	Beta188643	Ikehara et al. (2006)
GH02-1030	523	16380	60	18692	18477	18961	18692	Mixed planktonic	Beta175979	Ikehara et al. (2006)
GH02-1030	558	17780	70	20051	19772	20352	20051	Mixed planktonic	Beta175981	Ikehara et al. (2006)
GH02-1030	630	19130	180	21770	21413	22214	21770	Mixed planktonic	Beta175429	Ikehara et al. (2006)
BOW9A	49	4025	41	3419	3037	3805	3419	*N. pachyderma*	AA68045	This study
BOW9A	73	5662	46	5494	5177	5883	5494	*N. pachyderma*	AA68046	This study
BOW9A	104	8480	260	8516	8055	8965	8516	*N. pachyderma*	AA68044	This study
BOW9A	136	10519	91	11001	10517	11359	11001	*N. pachyderma*	AA68040	This study
BOW9A	140	10850	60	11521	11087	12031	11521	*N. pachyderma*	OS57380	This study
BOW9A	168	12850	50	13869	13389	14181	13869	*N. pachyderma*	OS57381	This study
BOW9A	176	13018	69	14124	13616	14593	14124	*N. pachyderma*	AA68041	This study
BOW9A	192	13209	74	14420	13910	14895	14420	*N. pachyderma*	AA68042	This study

**AA, NSF-Arizona AMS Laboratory, University of Arizona; OS, National Ocean Sciences AMS facility, Woods Hole Oceanographic Institution
RIDDL, Radio-Isotope Direct Detection Laboratory at Simon Fraser University; IAA, Institute of Accelerator Analysis Ltd., Shirakawa, Japan
NIES-TERRA: National Institute for Environmental Studies, Tsukuba, Japan.; Beta, Beta Analytic Inc.

Table S3. Radiocarbon measurements on paired planktonic and benthic foraminifers in the North Pacific sediments.
Durations of BA, H1, and LGM are 13-14.5 ka, 15-17.5 ka, and 19-23 ka, respectively.

Core ID	Water depth (m)	Core depth (cm)	Calendar age (yr)	-1σ (yr)	+1σ (yr)	PF ^{14}C (yr)	±1σ (yr)	BF ^{14}C (yr)	±1σ (yr)	BF-PF (yr)	±1σ (yr)	Projection (yr)	-1σ (yr)	+1σ (yr)	Era
50-37KL	2695	160-165	17832	282	587	15220	105	17100	200	1880	226	1628	582	637	
50-37KL	2695	175-180	18582	403	208	15900	80	17430	140	1530	161	1508	269	564	
50-37KL	2695	195-200	19946	351	252	17360	110	18940	160	1580	194	2114	535	394	LGM
50-37KL	2695	205-210	20043	426	256	17455	115	19445	190	1990	222	2337	204	1004	LGM
CH84-14	978	230	10341	465	411	10000	140	10850	140	850	198	1489	1063	607	
CH84-14	978	280	10644	383	432	10230	140	11060	150	830	205	1446	884	505	
CH84-14	978	310	11190	547	461	10640	150	11370	130	730	198	1100	629	875	
CH84-14	978	340	11550	467	551	10870	150	11630	180	760	234	1070	859	615	
CH84-14	978	400	13142	386	289	12180	160	13200	150	1020	219	1508	381	1218	BA
CH84-14	978	480	13756	454	336	12750	150	13930	220	1180	266	2484	627	565	BA
CH84-14	978	510	14207	511	604	13060	140	13500	200	440	244	1173	1256	1043	BA
CH84-14	978	550	15554	550	844	13830	150	14140	200	310	250	806	2000	616	H1
CH84-14	978	690	17839	409	651	15570	210	15940	190	370	283	361	1084	442	
F2-92-P3	800	120	10367	456	385	10020	100	11710	230	1690	251	2333	658	679	
F2-92-P3	800	140	11151	542	467	10620	100	11600	100	980	141	1459	731	786	
F2-92-P3	800	163	12733	380	488	11790	230	12581	91	791	247	787	767	1019	
F2-92-P3	800	160	12783	378	391	11810	110	12590	110	780	156	737	497	1064	
F2-92-P3	800	170	13112	362	285	12150	140	13020	160	870	213	1388	938	465	BA
F2-92-P3	800	200	14072	569	459	12975	141	13680	120	705	185	1868	1400	700	BA
F2-92-P3	800	214	14330	520	516	13140	110	13720	110	580	156	1670	1525	579	BA
F2-92-P3	800	298	18959	307	371	16650	220	17590	18	940	221	901	597	443	
F8-90-G21	1600	75	10084	412	401	9800	140	10850	90	1050	166	1766	918	539	
F8-90-G21	1600	83	10406	460	485	10050	190	10740	80	690	206	1214	1097	712	
F8-90-G21	1600	155	16192	540	627	14280	90	15800	90	1520	127	1928	1024	607	H1
B34-91	1227	225	19449	490	383	17200	80	18650	110	1450	136	1651	401	1028	LGM
GGC15	1980	170	19920	362	305	17650	80	19200	110	1550	136	1960	460	557	LGM
GGC18	1700	214-216	18547	487	314	16250	120	17800	140	1550	184	1473	330	1143	
GGC20	1510	230	19635	295	451	17350	100	18700	140	1350	172	1675	721	565	LGM
GGC27	995	70	19050	295	343	16750	200	18200	95	1450	221	1770	965	327	LGM
GH02-1030	1212	210	10134	383	372	9840	40	10700	70	860	81	1426	912	913	
GH02-1030	1212	220	10656	346	409	10240	60	10800	70	560	92	1104	1095	492	
GH02-1030	1212	235	10986	462	343	10510	60	11190	60	680	85	1184	500	759	
GH02-1030	1212	244	11261	518	442	10690	60	11370	60	680	85	1049	633	819	
GH02-1030	1212	261	11654	473	446	10950	60	11610	70	660	92	966	742	629	
GH02-1030	1212	290	13943	531	518	12900	70	13510	80	610	106	1457	1096	1089	BA
GH02-1030	1212	323.5	14193	491	598	13060	70	14500	50	1440	86	2427	731	864	BA
GH02-1030	1212	345.5	14783	701	421	13470	40	14160	40	690	57	1577	470	1180	
GH02-1030	1212	435.5	17245	356	315	15010	80	16010	90	1000	120	1035	475	506	H1
GH02-1030	1212	465.5	17369	393	297	15140	60	16140	80	1000	100	991	370	806	H1
GH02-1030	1212	523	18692	587	503	16380	60	17230	100	850	117	868	862	786	
GH02-1030	1212	558	20051	471	301	17780	70	18730	120	950	139	1449	649	679	LGM
GH02-1030	1212	630	21770	357	444	19130	180	20590	180	1460	255	1890	817	490	LGM
JPC56	818	649-651	10504	350	491	10125	80	10550	60	425	100	736	875	754	
JPC56	818	899-901	11648	474	453	10945	75	11350	45	405	87	612	615	796	
JPC56	818	999-1001	12355	422	438	11490	90	12050	45	560	101	585	596	700	
JPC56	818	1099-1101	13362	270	362	12395	80	12950	60	555	100	1058	1084	342	BA
JPC56	818	1399-1401	14680	624	445	13400	90	13950	55	550	105	1580	1019	738	
JPC56	818	1599-1601	15253	986	771	13685	100	14150	55	465	114	1107	1551	1476	H1
JPC56	818	1699-1701	16688	493	495	14580	100	14700	65	120	119	252	812	770	H1
JPC56	818	1849-1851	17093	310	398	14870	100	15550	60	680	117	937	847	309	H1
JT96-09	920	47.5	10034	387	370	9760	70	10692	50	932	86	1516	919	716	
JT96-09	920	87.5	12365	422	454	11500	110	12110	80	610	136	635	637	705	
JT96-09	920	112.5	13432	314	333	12460	120	13170	100	710	156	1188	747	648	BA
JT96-09	920	142.5	13619	347	307	12640	90	13500	80	860	120	1581	651	1091	BA
JT96-09	920	261.5	14693	629	440	13410	80	14290	110	880	136	1737	454	1103	
JT96-09	920	286.5	14880	761	560	13520	70	14350	120	830	139	1590	560	1361	
JT96-09	920	346.5	16015	464	669	14140	70	14830	280	690	289	1075	1109	614	H1
KR02-15 PC6	2215	539.2	11134	537	472	10610	90	11840	60	1230	108	1666	712	817	
KR02-15 PC6	2215	555.1	11535	439	506	10860	70	12490	110	1630	130	1885	729	1072	
KR02-15 PC6	2215	575.6	14788	720	423	13470	70	14500	120	1030	139	1832	439	1296	
KT89-18-P4	2700	185-190	10603	323	299	9800	133	11140	159	1340	207	1917	432	496	
KT89-18-P4	2700	200-204	11841	453	344	10692	108	12034	94	1342	143	1499	419	728	
KT89-18-P4	2700	236-240	12991	238	203	11622	101	13350	238	1728	259	2159	201	1006	
KT89-18-P4	2700	268-272	13816	319	211	12450	91	14423	237	1973	254	3064	193	701	BA
KT89-18-P4	2700	338-342	15618	519	545	13447	113	14681	103	1234	153	1722	841	755	H1
KT89-18-P4	2700	449-453	20003	609	813	17275	478	19267	557	1992	734	2317	1282	1078	LGM
KT89-18-P4	2700	534-538	22874	447	440	19655	303	21344	205	1689	366	2006	708	775	LGM

Table S3. cont.

Durations of BA, H1, and LGM are 13-14.5 ka, 15-17.5 ka, and 19-23 ka, respectively.

Core ID	Water depth (m)	Core depth (cm)	Calendar age (yr)	-1σ (yr)	+1σ (yr)	PF ^{14}C (yr)	±1σ (yr)	BF ^{14}C (yr)	±1σ (yr)	BF-PF (yr)	±1σ (yr)	Projection (yr)	-1σ (yr)	+1σ (yr)	Era
MD97-2138	1900	207-210	21624	272	345	18636	150	20590	140	1954	205	2336	559	406	LGM
MD97-2138	1900	211-215	21917	325	283	18950	200	20590	150	1640	250	2063	455	477	LGM
MD98-2181	2100	1262-1268	19265	307	190	16725	150	18050	130	1325	198	1755	649	396	LGM
MD98-2181	2100	1270-1276	19122	190	243	16520	150	17690	130	1170	198	1148	342	259	LGM
MD98-2181	2100	1279-1285	19660	245	223	17025	150	18350	120	1325	192	1610	320	302	LGM
MD01-2386	2800	198-203	10112	225	255	9473	91	10750	110	1277	143	1848	511	511	
MD01-2386	2800	223-228	10938	211	221	10166	91	11550	70	1384	115	2002	459	259	
MD01-2386	2800	248-253	12403	190	225	11120	72	12550	55	1430	91	1417	342	307	
MD01-2386	2800	273-278	12974	206	165	11662	93	12900	70	1238	116	1496	489	530	
MD01-2386	2800	298-303	13973	269	215	12644	94	14100	210	1456	230	2687	270	364	BA
MD01-2386	2800	323-328	14180	367	341	12761	122	14200	75	1439	143	2540	393	509	BA
MD01-2386	2800	348-353	15560	484	492	13480	126	15100	85	1620	152	2180	877	799	H1
MD01-2386	2800	373-378	16791	194	223	14250	117	15350	250	1100	276	1109	239	550	H1
MD01-2386	2800	398-403	16911	176	178	14362	102	16000	95	1638	139	1699	275	243	H1
MD01-2386	2800	423-428	17553	310	260	15001	117	16450	90	1449	148	1647	600	260	
MD01-2386	2800	448-453	17672	254	299	15098	114	16900	80	1802	139	1728	326	471	
MD01-2386	2800	473-478	18346	284	302	15760	147	17550	90	1790	172	1824	417	369	
MD01-2386	2800	498-503	18978	250	282	16338	105	17850	60	1512	121	1402	301	779	
MD01-2386	2800	523-528	19429	442	157	16849	111	18550	65	1701	129	1951	62	967	LGM
MD01-2416	2317	88	13670	361	290	12690	50	13655	55	965	74	2230	1205	536	BA
MD01-2416	2317	96	13530	318	293	12555	60	14030	70	1475	92	2770	514	439	BA
MD01-2416	2317	115	14413	503	473	13205	55	14920	70	1715	89	2747	839	709	BA
MD01-2416	2317	136	14242	494	565	13090	60	15460	80	2370	100	3428	826	775	BA
MD01-2416	2317	163	15497	536	827	13795	60	15960	100	2165	117	2723	1241	830	H1
MD01-2416	2317	177	17615	427	345	15380	70	17860	100	2480	122	2445	390	1052	
ODP1019	980	175	10277	457	373	9950	110	10810	120	860	163	1503	999	633	
ODP1019	980	251	10617	372	428	10210	120	11130	80	920	144	1503	777	541	
ODP1019	980	340	12467	415	467	11580	140	13290	220	1710	261	2233	825	1353	
ODP1019	980	380	12924	288	317	11950	110	12830	90	880	142	1096	718	689	
ODP1019	980	476	14614	589	471	13350	120	14260	140	910	184	1786	515	1043	
ODP1019	980	580	17317	393	312	15080	120	16210	190	1130	225	1073	392	793	H1
ODP1019	980	713	18294	304	366	16040	140	17480	280	1440	313	1486	665	433	
ODP1019	980	814	20992	499	433	18550	210	19080	190	530	283	808	889	625	LGM
ODP883	2385	51	13698	373	292	12715	50	13420	90	705	103	1342	523	1224	BA
ODP887	3647	52	12790	373	365	11810	30	13070	40	1260	50	1770	1042	650	
ODP887	3647	57.9	13503	306	292	12530	30	13565	45	1035	54	2147	1065	649	BA
ODP887	3647	63	14083	483	470	12995	30	13940	70	945	76	2167	1138	501	BA
ODP887	3647	97	17244	351	308	15010	50	16880	70	1870	86	1806	355	748	H1
ODP887	3647	107	18952	281	313	16640	45	18290	120	1650	128	1938	555	393	
ODP887	3647	112	18718	562	515	16405	45	18290	50	1885	67	2182	1077	934	
ODP887	3647	118	20298	686	577	17970	70	19580	180	1610	193	1862	626	1395	LGM
ODP893	588	1606	10550	353	459	10160	70	10860	110	700	130	1310	1208	422	
ODP893	588	1652	10731	353	397	10300	80	10670	110	370	136	769	937	703	
ODP893	588	1684	10707	343	405	10280	70	10630	70	350	99	733	914	742	
ODP893	588	1696	10564	353	447	10170	70	10890	90	720	114	1316	1006	452	
ODP893	588	1860	11942	530	586	11180	180	11290	100	110	206	278	924	808	
ODP893	588	2005	12763	425	528	11830	290	11950	110	120	310	117	802	639	
ODP893	588	2040	12947	325	344	11980	180	12020	100	40	206	-17	513	584	
ODP893	588	2194	13315	337	355	12350	60	12820	80	470	100	425	494	1016	BA
ODP893	588	2412	14317	520	528	13130	120	13580	100	450	156	1363	1320	822	BA
ODP893	588	2558	16766	475	599	14630	120	15190	150	560	192	714	1078	764	H1
ODP893	588	2680	17443	416	351	15210	150	15530	180	320	234	577	761	456	H1
ODP893	588	2873	18016	309	487	15720	140	16270	100	550	172	404	630	642	
ODP893	588	3034	19101	297	314	16820	180	17200	100	380	206	409	654	477	LGM
ODP893	588	3139	19703	301	424	17410	150	17510	90	100	175	117	766	383	LGM
GC31	705	325.5	10790	200	200	N/A	N/A	10050	410	N/A	N/A	110	1043	163	
GC31	705	349.5	11610	100	100	N/A	N/A	11600	70	N/A	N/A	1300	219	139	
GC31	705	375.5	12410	200	200	N/A	N/A	13500	70	N/A	N/A	3090	539	799	
GC31	705	411.5	13580	300	300	N/A	N/A	13650	150	N/A	N/A	2630	1214	404	BA
PC08	705	326	10810	200	200	N/A	N/A	10460	30	N/A	N/A	450	302	562	
PC08	705	341	11320	200	200	N/A	N/A	10845	30	N/A	N/A	820	443	313	
PC08	705	366	12120	200	200	N/A	N/A	13380	35	N/A	N/A	3140	363	843	
PC08	705	391	12880	100	100	N/A	N/A	13530	30	N/A	N/A	2830	364	494	
PC08	705	411	13570	100	100	N/A	N/A	13420	25	N/A	N/A	1770	348	388	BA
PC08	705	422	13940	100	100	N/A	N/A	14285	35	N/A	N/A	2780	134	174	BA
PC08	705	431	14200	200	200	N/A	N/A	13370	30	N/A	N/A	870	188	898	BA
PC08	705	437.5	14370	200	200	N/A	N/A	14485	35	N/A	N/A	2530	283	273	BA
PC08	705	447.5	14650	100	100	N/A	N/A	15755	40	N/A	N/A	3760	143	153	

Table S3. cont.

Durations of BA, H1, and LGM are 13-14.5 ka, 15-17.5 ka, and 19-23 ka, respectively.

Core ID	Water depth (m)	Core depth (cm)	Calendar age (yr)	-1σ (yr)	+1σ (yr)	PF ^{14}C (yr)	±1σ (yr)	BF ^{14}C (yr)	±1σ (yr)	BF-PF (yr)	±1σ (yr)	Projection (yr)	-1σ (yr)	+1σ (yr)	Era
PC08	705	456.5	14960	200	200	N/A	N/A	15850	40	N/A	N/A	3490	214	294	
PC08	705	466	15300	300	300	N/A	N/A	16505	40	N/A	N/A	3900	651	201	H1
PC08	705	476.5	15670	300	300	N/A	N/A	16785	45	N/A	N/A	3580	285	385	H1
PC08	705	486.5	16020	300	300	N/A	N/A	16665	40	N/A	N/A	3210	594	284	H1
PC08	705	496.5	16370	300	300	N/A	N/A	16425	45	N/A	N/A	2730	587	277	H1
PC08	705	506.5	16730	300	300	N/A	N/A	16390	40	N/A	N/A	2100	327	537	H1
PC08	705	516.5	17080	300	300	N/A	N/A	16425	50	N/A	N/A	2020	579	279	H1
PC08	705	526.5	17430	300	300	N/A	N/A	16185	45	N/A	N/A	1250	332	612	H1
PC08	705	536.5	17780	300	300	N/A	N/A	16235	40	N/A	N/A	920	322	622	
PC08	705	547	18120	300	300	N/A	N/A	16810	40	N/A	N/A	1140	221	561	
PC08	705	556	18410	300	300	N/A	N/A	16680	40	N/A	N/A	820	569	289	
PC08	705	641.5	21140	200	200	N/A	N/A	19720	60	N/A	N/A	1680	462	412	LGM
PC08	705	661.5	21770	300	300	N/A	N/A	19640	60	N/A	N/A	990	589	519	LGM
PC08	705	680.8	22390	300	300	N/A	N/A	19650	80	N/A	N/A	370	579	529	LGM
PC4/PC5	1366	231-232	11115	527	462	10600	50	11370	50	770	71	1205	667	812	
PC4/PC5	1366	262-264	11589	454	469	10900	55	11930	60	1030	81	1271	692	717	
PC4/PC5	1366	291-293	12263	406	442	11420	60	12600	50	1180	78	1277	607	1081	
PC4/PC5	1366	311-313	13191	345	279	12230	50	13650	100	1420	112	2729	1039	515	BA
PC4/PC5	1366	363-365	14756	694	430	13450	85	14250	120	800	147	1644	424	1208	
PC4/PC5	1366	405-407	16029	461	662	14150	55	14830	60	680	81	1051	1093	622	H1
PC4/PC5	1366	540-542	18763	250	499	16450	110	17650	100	1200	149	1137	873	304	
PC4/PC5	1366	642-644	20638	393	462	18200	65	19650	110	1450	128	1822	826	677	LGM
TR163-31	3210	83-87	17291	429	381	14728	222	15660	270	932	349	1099	761	519	H1
TR163-31	3210	114	19269	446	492	16700	260	19510	330	2810	420	3151	574	998	LGM
VM21-30	617	139	10848	369	351	10079	26	15350	360	5271	361	7032	471	749	
VM21-30	617	143	10587	369	461	9867	145	16550	390	6683	416	8643	882	370	
VM21-30	617	177	13233	334	335	11952	25	20027	406	8075	407	10047	647	576	BA
VM21-30	617	182	13594	486	423	12265	272	18650	380	6385	468	7846	471	994	BA
VM21-30	617	201-202	16506	864	683	14216	356	20320	80	6104	365	7134	1068	1409	H1
VM21-30	617	236	20087	506	303	17490	85	19120	110	1630	139	2063	368	931	LGM
VM21-30	617	241	19546	586	417	16950	302	21505	137	4554	332	5354	645	1194	LGM
W8709A-13PC	2712	126.25	10291	553	432	9960	230	11580	170	1620	286	2309	687	758	
W8709A-13PC	2712	139	11313	549	430	10720	70	12190	60	1470	92	1847	620	839	
W8709A-13PC	2712	154	11979	543	436	11200	60	12630	60	1430	85	1581	527	1314	
W8709A-13PC	2712	170.5	13151	343	272	12190	60	13080	70	890	92	1409	914	645	BA
W8709A-13PC	2712	191.5	13752	409	294	12760	60	14330	90	1570	108	2698	320	815	BA
W8709A-13PC	2712	198.75	14099	508	477	13000	90	14700	250	1700	266	2821	755	826	BA
W8709A-13PC	2712	212.5	15289	730	760	13700	70	14860	70	1160	99	1831	1116	1216	H1
W8709A-13PC	2712	221.25	15889	633	650	14050	140	15950	180	1900	228	2331	989	982	H1
W8709A-13PC	2712	223.75	15849	607	621	14020	140	15770	320	1750	349	2271	1012	688	H1
W8709A-13PC	2712	301.25	19018	291	304	16710	120	18360	200	1650	233	1922	517	414	LGM
W8709A-13PC	2712	303.75	19261	376	282	17030	150	18630	180	1600	234	1819	290	914	LGM

Table S4. Reconstructed ventilation ages and bottom-water Δ14C values in the North Pacific sediments.
Durations of BA, H1, and LGM are 13-14.5 ka, 15-17.5 ka, and 19-23 ka, respectively.

Core ID	Water depth (m)	Core depth (cm)	Calendar age (yr)	-1σ (yr)	+1σ (yr)	Bottom $\Delta^{14}C$ (‰)	-1σ (yr)	+1σ (yr)	$\Delta^{14}C'$ cont-atm (‰)	-1σ (yr)	+1σ (yr)	$\Delta^{14}C'$ proj-atm (‰)	-1σ (yr)	+1σ (yr)	Era
50-37KL	2695	160-165	17832	282	587	29	35	76	-266	57	91	-234	79	68	
50-37KL	2695	175-180	18582	403	208	81	51	28	-234	78	59	-223	55	44	
50-37KL	2695	195-200	19946	351	252	57	44	33	-235	62	54	-276	49	50	LGM
50-37KL	2695	205-210	20043	426	256	4	50	32	-279	60	56	-297	96	56	LGM
CH84-14	978	230	10341	465	411	-95	50	46	-185	62	51	-257	62	90	
CH84-14	978	280	10644	383	432	-85	41	49	-188	57	64	-249	49	67	
CH84-14	978	310	11190	547	461	-60	60	54	-185	68	79	-217	75	57	
CH84-14	978	340	11550	467	551	-49	52	66	-181	78	83	-214	57	74	
CH84-14	978	400	13142	386	289	-52	43	34	-215	48	41	-254	105	64	BA
CH84-14	978	480	13756	454	336	-68	50	39	-225	50	46	-337	57	58	BA
CH84-14	978	510	14207	511	604	39	62	79	-131	102	88	-223	131	152	BA
CH84-14	978	550	15554	550	844	129	73	121	-131	144	153	-186	113	184	H1
CH84-14	978	690	17839	409	651	190	57	97	-151	86	115	-143	100	114	
F2-92-P3	800	120	10367	456	385	-184	44	39	-269	53	47	-324	49	49	
F2-92-P3	800	140	11151	542	467	-91	58	53	-213	63	80	-250	60	65	
F2-92-P3	800	163	12783	378	391	-21	44	47	-184	62	49	-182	92	65	
F2-92-P3	800	160	13112	362	285	-34	41	34	-203	43	44	-244	56	93	BA
F2-92-P3	800	170	14330	520	516	26	63	66	-150	98	86	-269	100	164	BA
F2-92-P3	800	200	18959	307	371	109	40	51	-185	72	53	-197	55	58	
F2-92-P3	800	214	12733	380	488	-25	44	59	-188	63	60	-186	89	76	
F2-92-P3	800	298	14072	569	459	-1	66	57	-164	83	64	-287	105	153	BA
F8-90-G21	1600	75	10084	412	401	-123	43	44	-219	45	67	-282	52	79	
F8-90-G21	1600	83	10406	460	485	-75	50	56	-172	59	62	-226	80	97	
F8-90-G21	1600	155	16192	540	627	-8	63	78	-279	104	119	-292	93	104	H1
B34-91	1227	225	19449	490	383	32	59	49	-251	83	72	-267	97	56	LGM
GGC15	1980	170	19920	362	305	20	44	38	-261	63	58	-294	57	55	LGM
GGC18	1700	214-216	18547	487	314	28	59	40	-278	76	81	-251	114	58	
GGC20	1510	230	19635	295	451	49	37	59	-219	81	56	-268	66	76	LGM
GGC27	995	70	19050	295	343	40	36	44	-240	68	52	-278	59	84	LGM
GH02-1030	1212	210	10134	383	372	-101	41	41	-201	41	63	-248	71	79	
GH02-1030	1212	220	10656	346	409	-54	39	48	-159	55	60	-216	61	92	
GH02-1030	1212	235	10986	462	343	-62	51	40	-185	56	67	-221	66	45	
GH02-1030	1212	244	11261	518	442	-52	58	52	-168	78	64	-211	72	56	
GH02-1030	1212	261	11654	473	446	-35	54	54	-172	78	76	-202	57	63	
GH02-1030	1212	290	13943	531	518	5	63	65	-161	73	71	-249	134	137	BA
GH02-1030	1212	323.5	14193	491	598	-84	53	69	-234	90	80	-332	74	74	BA
GH02-1030	1212	345.5	14783	701	421	26	83	54	-187	100	107	-260	96	75	
GH02-1030	1212	435.5	17245	356	315	98	46	43	-195	65	46	-210	59	60	H1
GH02-1030	1212	465.5	17369	393	297	96	51	40	-207	60	56	-205	72	55	H1
GH02-1030	1212	523	18692	587	503	123	77	70	-191	111	97	-194	82	95	
GH02-1030	1212	558	20051	471	301	99	61	41	-212	69	68	-249	70	78	LGM
GH02-1030	1212	630	21770	357	444	73	45	59	-249	76	76	-287	52	69	LGM
JPC56	818	649-651	10504	350	491	-42	40	59	-146	51	68	-186	70	90	
JPC56	818	899-901	11648	474	453	-4	56	56	-146	80	79	-169	73	57	
JPC56	818	999-1001	12355	422	438	-5	50	54	-189	51	80	-168	60	54	
JPC56	818	1099-1101	13362	270	362	4	32	45	-163	41	49	-212	49	109	BA
JPC56	818	1399-1401	14680	624	445	40	76	58	-164	104	102	-260	85	96	
JPC56	818	1599-1601	15253	986	771	87	122	106	-138	167	149	-216	148	152	H1
JPC56	818	1699-1701	16688	493	495	208	70	75	-143	76	102	-131	80	91	H1
JPC56	818	1849-1851	17093	310	398	141	42	56	-167	59	61	-198	66	93	H1
JT96-09	920	47.5	10034	387	370	-110	41	41	-202	49	60	-256	71	82	
JT96-09	920	87.5	12365	422	454	-12	49	56	-195	50	81	-171	61	54	
JT96-09	920	112.5	13432	314	333	-14	37	41	-176	47	41	-226	55	67	BA
JT96-09	920	142.5	13619	347	307	-32	40	37	-195	42	43	-261	128	94	BA
JT96-09	920	261.5	14693	629	440	-1	73	55	-199	101	99	-275	89	69	
JT96-09	920	286.5	14880	761	560	14	89	71	-204	103	127	-262	109	81	
JT96-09	920	346.5	16015	464	669	96	60	92	-190	116	128	-214	72	106	H1
KR02-15 PC6	2215	539.2	11134	537	472	-119	55	52	-237	61	78	-266	64	57	
KR02-15 PC6	2215	555.1	11535	439	506	-147	44	54	-264	69	71	-288	80	70	
KR02-15 PC6	2215	575.6	14788	720	423	-16	82	52	-221	99	107	-282	98	62	
KT89-18-P4	2700	185-190	10603	323	299	-99	35	33	-194	42	38	-256	48	45	
KT89-18-P4	2700	200-204	11841	453	344	-64	49	40	-205	69	62	-217	58	42	
KT89-18-P4	2700	236-240	12991	238	203	-86	26	23	-244	32	29	-276	103	48	
KT89-18-P4	2700	268-272	13816	319	211	-110	40	16	-257	43	21	-352	48	28	BA
KT89-18-P4	2700	338-342	15618	519	545	60	61	76	-185	110	111	-238	73	91	H1
KT89-18-P4	2700	449-453	20003	609	813	23	74	104	-264	90	121	-289	113	123	LGM
KT89-18-P4	2700	534-538	22874	447	440	117	59	61	-237	90	97	-264	73	81	LGM

Table S4. cont.
Durations of BA, H1, and LGM are 13-14.5 ka, 15-17.5 ka, and 19-23 ka, respectively.

Core ID	Water depth (m)	Core depth (cm)	Calendar age (yr)	-1σ (yr)	+1σ (yr)	Bottom $\Delta^{14}C$ (‰)	-1σ (yr)	+1σ (yr)	$\Delta^{14}C'$ cont-atm (‰)	-1σ (yr)	+1σ (yr)	$\Delta^{14}C'$ proj-atm (‰)	-1σ (yr)	+1σ (yr)	Era
MD97-2138	1900	207-210	21624	272	345	54	34	45	-252	63	49	-298	43	54	LGM
MD97-2138	1900	211-215	21917	325	283	92	42	38	-247	61	66	-273	49	51	LGM
MD98-2181	2100	1262-1268	19265	307	190	87	40	25	-226	51	58	-247	60	74	LGM
MD98-2181	2100	1270-1276	19122	190	243	118	25	33	-193	52	54	-189	34	39	LGM
MD98-2181	2100	1279-1285	19660	245	223	99	32	30	-186	64	36	-234	42	42	LGM
MD01-2386	2800	198-203	10112	225	255	-109	24	28	-210	24	49	-254	51	46	
MD01-2386	2800	223-228	10938	211	221	-108	22	24	-215	43	40	-266	25	33	
MD01-2386	2800	248-253	12403	190	225	-60	21	26	-231	29	37	-216	22	27	
MD01-2386	2800	273-278	12974	206	165	-36	24	19	-201	31	25	-222	64	61	
MD01-2386	2800	298-303	13973	269	215	-63	30	25	-218	33	28	-328	44	44	BA
MD01-2386	2800	323-328	14180	367	341	-51	41	40	-207	60	49	-314	59	57	BA
MD01-2386	2800	348-353	15560	484	492	3	57	61	-228	95	95	-284	82	88	H1
MD01-2386	2800	373-378	16791	194	223	128	26	31	-194	42	52	-184	78	51	H1
MD01-2386	2800	398-403	16911	176	178	56	22	23	-234	43	37	-240	27	28	H1
MD01-2386	2800	423-428	17553	310	260	79	40	34	-226	46	48	-235	48	70	
MD01-2386	2800	448-453	17672	254	299	35	31	38	-256	39	39	-243	54	52	
MD01-2386	2800	473-478	18346	284	302	35	35	39	-277	59	80	-253	45	48	
MD01-2386	2800	498-503	18978	250	282	77	32	37	-209	62	42	-214	92	55	
MD01-2386	2800	523-528	19429	442	157	42	54	20	-251	69	50	-262	88	37	LGM
MD01-2416	2317	88	13670	361	290	-45	41	34	-207	41	42	-317	85	129	BA
MD01-2416	2317	96	13530	318	293	-104	34	32	-250	42	34	-360	48	49	BA
MD01-2416	2317	115	14413	503	473	-107	53	53	-269	85	83	-358	64	68	BA
MD01-2416	2317	136	14242	494	565	-183	47	58	-316	85	72	-408	83	71	BA
MD01-2416	2317	163	15497	536	827	-106	56	94	-310	121	130	-356	92	110	H1
MD01-2416	2317	177	17615	427	345	-88	46	39	-345	56	54	-333	103	57	
ODP1019	980	175	10277	457	373	-97	49	42	-184	64	45	-255	66	83	
ODP1019	980	251	10617	372	428	-96	40	48	-192	58	57	-254	52	60	
ODP1019	980	340	12467	415	467	-136	42	50	-293	47	69	-317	129	101	
ODP1019	980	380	12924	288	317	-33	33	38	-199	40	43	-216	73	80	
ODP1019	980	476	14614	589	471	-7	68	58	-198	101	98	-280	86	74	
ODP1019	980	580	17317	393	312	80	50	42	-215	63	53	-215	73	54	H1
ODP1019	980	713	18294	304	366	38	37	47	-266	67	80	-253	45	55	
ODP1019	980	814	20992	499	433	179	69	63	-177	93	106	-189	80	88	LGM
ODP883	2385	51	13698	373	292	-13	44	35	-181	43	44	-240	136	88	BA
ODP887	3647	52	12790	373	365	-77	41	42	-231	58	44	-277	63	99	
ODP887	3647	57.9	13503	306	292	-54	34	34	-206	46	33	-308	95	122	BA
ODP887	3647	63	14083	483	470	-31	55	57	-190	74	64	-311	71	97	BA
ODP887	3647	97	17244	351	308	-15	41	37	-278	58	42	-282	61	54	H1
ODP887	3647	107	18952	281	313	16	34	39	-254	62	44	-293	44	50	
ODP887	3647	112	18718	562	515	-12	65	63	-288	101	89	-312	90	99	
ODP887	3647	118	20298	686	577	18	81	74	-267	95	94	-286	129	85	LGM
ODP893	588	1606	10550	353	459	-73	39	53	-174	50	64	-244	49	106	
ODP893	588	1652	10731	353	397	-30	41	48	-136	62	58	-187	72	90	
ODP893	588	1684	10707	343	405	-28	40	49	-135	59	60	-187	68	94	
ODP893	588	1696	10564	353	447	-75	39	51	-176	50	62	-245	46	89	
ODP893	588	1860	11942	530	586	40	65	76	-131	88	107	-133	83	78	
ODP893	588	2005	12763	425	528	58	53	70	-118	72	69	-118	65	72	
ODP893	588	2040	12947	325	344	72	41	46	-111	48	50	-103	51	46	
ODP893	588	2194	13315	337	355	15	41	45	-155	51	51	-151	105	60	BA
ODP893	588	2412	14317	520	528	42	64	69	-135	101	87	-241	116	156	BA
ODP893	588	2558	16766	475	599	147	64	86	-184	75	111	-178	93	107	H1
ODP893	588	2680	17443	416	351	194	59	52	-142	65	71	-166	73	95	H1
ODP893	588	2873	18016	309	487	167	43	71	-160	83	85	-147	76	72	
ODP893	588	3034	19101	297	314	185	42	46	-141	68	62	-147	56	69	LGM
ODP893	588	3139	19703	301	424	226	44	65	-104	70	74	-116	55	70	LGM
GC31	705	325.5	10790	200	200	56	25	26	-59	39	30	-85	24	66	
GC31	705	349.5	11610	100	100	-39	12	12	-176	19	20	-207	18	18	
GC31	705	375.5	12410	200	200	-164	20	20	-315	29	32	-362	103	83	
GC31	705	411.5	13580	300	300	-55	34	35	-214	37	41	-324	81	133	BA
PC08	705	326	10810	200	200	6	24	25	-103	41	30	-126	58	39	
PC08	705	341	11320	200	200	20	24	25	-106	38	26	-164	34	48	
PC08	705	366	12120	200	200	-181	20	20	-315	31	26	-366	92	68	
PC08	705	391	12880	100	100	-118	11	11	-270	12	15	-342	68	59	
PC08	705	411	13570	100	100	-29	12	12	-191	16	19	-251	51	49	BA
PC08	705	422	13940	100	100	-88	11	11	-238	12	12	-338	15	17	BA
PC08	705	431	14200	200	200	55	25	26	-118	36	30	-164	103	44	BA
PC08	705	437.5	14370	200	200	-63	22	23	-228	42	43	-316	25	27	BA

Table S4. cont.
Durations of BA, H1, and LGM are 13-14.5 ka, 15-17.5 ka, and 19-23 ka, respectively.

Core ID	Water depth (m)	Core depth (cm)	Calendar age (yr)	-1σ (yr)	+1σ (yr)	Bottom $\Delta^{14}C$ (‰)	-1σ (yr)	+1σ (yr)	$\Delta^{14}C'$ cont-atm (‰)	-1σ (yr)	+1σ (yr)	$\Delta^{14}C'$ proj-atm (‰)	-1σ (yr)	+1σ (yr)	Era
PC08	705	447.5	14650	100	100	-172	10	10	-333	20	18	-411	17	20	
PC08	705	456.5	14960	200	200	-151	20	21	-334	24	29	-392	28	32	
PC08	705	466	15300	300	300	-184	29	30	-356	51	38	-419	45	61	H1
PC08	705	476.5	15670	300	300	-176	29	30	-369	58	53	-402	46	52	H1
PC08	705	486.5	16020	300	300	-128	31	32	-355	62	62	-373	52	58	H1
PC08	705	496.5	16370	300	300	-62	33	35	-329	50	56	-332	47	65	H1
PC08	705	506.5	16730	300	300	-16	35	36	-301	46	59	-279	69	46	H1
PC08	705	516.5	17080	300	300	22	36	38	-254	52	46	-273	49	68	H1
PC08	705	526.5	17430	300	300	98	39	41	-210	48	57	-202	63	53	H1
PC08	705	536.5	17780	300	300	139	41	42	-185	44	50	-172	66	54	
PC08	705	547	18120	300	300	105	39	41	-199	79	54	-192	63	57	
PC08	705	556	18410	300	300	163	41	43	-197	52	93	-164	60	68	
PC08	705	641.5	21140	200	200	108	26	27	-232	30	35	-243	66	63	LGM
PC08	705	661.5	21770	300	300	208	43	45	-155	69	65	-177	76	84	LGM
PC08	705	680.8	22390	300	300	300	46	48	-100	62	64	-114	78	87	LGM
PC4/PC5	1366	231-232	11115	527	462	-68	58	54	-193	62	80	-210	87	43	
PC4/PC5	1366	262-264	11589	454	469	-80	49	54	-213	69	78	-233	59	58	
PC4/PC5	1366	291-293	12263	406	442	-81	44	50	-239	60	65	-232	94	69	
PC4/PC5	1366	311-313	13191	345	279	-98	37	31	-253	43	39	-356	77	109	BA
PC4/PC5	1366	363-365	14756	694	430	11	81	54	-196	101	106	-267	95	71	
PC4/PC5	1366	405-407	16029	461	662	97	60	92	-189	115	126	-212	72	105	H1
PC4/PC5	1366	540-542	18763	250	499	75	32	67	-226	57	83	-220	51	68	
PC4/PC5	1366	642-644	20638	393	462	52	49	60	-233	96	74	-283	81	95	LGM
TR163-31	3210	83-87	17291	429	381	153	58	54	-159	74	62	-186	80	90	H1
TR163-31	3210	114	19269	446	492	-93	48	56	-355	59	90	-365	94	74	LGM
VM21-30	617	139	10848	369	351	-450	24	24	-513	45	40	-602	63	49	
VM21-30	617	143	10587	369	461	-541	20	26	-590	37	39	-673	39	53	
VM21-30	617	177	13233	334	335	-590	16	17	-661	24	27	-724	29	28	BA
VM21-30	617	182	13594	486	423	-492	29	27	-577	34	33	-639	61	44	BA
VM21-30	617	201-202	16506	864	683	-413	58	51	-582	85	98	-607	70	65	H1
VM21-30	617	236	20087	506	303	51	62	39	-247	69	66	-276	72	62	LGM
VM21-30	617	241	19546	586	417	-268	50	38	-467	74	58	-514	80	61	LGM
W8709A-13PC	2712	126.25	10291	553	432	-178	53	44	-257	67	12	-324	54	57	
W8709A-13PC	2712	139	11313	549	430	-138	55	46	-244	76	59	-284	56	53	
W8709A-13PC	2712	154	11979	543	436	-116	56	48	-259	76	78	-261	111	69	
W8709A-13PC	2712	170.5	13151	343	272	-37	39	32	-202	45	39	-246	59	86	BA
W8709A-13PC	2712	191.5	13752	409	294	-113	43	32	-263	43	40	-355	52	43	BA
W8709A-13PC	2712	198.75	14099	508	477	-117	53	52	-263	71	61	-365	64	69	BA
W8709A-13PC	2712	212.5	15289	730	760	0	85	96	-208	133	120	-282	108	116	H1
W8709A-13PC	2712	221.25	15889	633	650	-61	69	77	-298	126	132	-324	102	98	H1
W8709A-13PC	2712	223.75	15849	607	621	-45	68	75	-284	123	128	-319	97	103	H1
W8709A-13PC	2712	301.25	19018	291	304	15	35	38	-256	65	45	-291	50	52	LGM
W8709A-13PC	2712	303.75	19261	376	282	11	45	35	-281	55	69	-282	84	46	LGM

Table S5. Averaged ventilation proxies during LGM, H1, and BA in the eastern and western North Pacific (water depths ranging 900 to 2800 m)

Area	Era	BF-PF (yr)	±1σ (yr)	Projection (yr)	±1σ (yr)	$\Delta^{14}C'$ cont-atm (‰)	±1σ (‰)	$\Delta^{14}C'$ proj-atm (‰)	±1σ (‰)	
NW Pacific	LGM	1283	303	1767	335	-235	37	-267	35	n=5
NW Pacific	H1	870	250	1105	385	-198	35	-209	34	n=5
NW Pacific	BA	1181	442	2573	717	-238	37	-335	40	n=7
NE Pacific	LGM	1347	585	1721	638	-255	43	-274	52	n=3
NE Pacific	H1	1317	316	1585	532	-235	40	-260	51	n=6
NE Pacific	BA	1074	387	2111	898	-217	39	-303	72	n=5

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