Supplementary Information

Geochemical evidence of the 8.2 ka event and other Holocene environmental changes recorded in paleolagoon sediments, southeastern Brazil

Alethéa E.M. Sallun, William Sallun Filho, Kenitiro Suguio, Marly Babinski, Simone M.C.L. Gioia, Benjamin A. Harlow, Wania Duleba, Paulo E. De Oliveira, Maria Judite Garcia, Cinthia Z. Weber, Sérgio R. Christofoletti, Camilla da S. Santos, Vanda B. de Medeiros, Juliana B. Silva, Maria Cristina Santiago-Hussein, Rosana S. Fernandes

Methods

Topographic Survey

A geo-referenced high-precision topographic survey was conducted in S03 to calibrate the height of the analyzed sediments as compared to the present relative sea level, with one pair of three-point Geodetic GPS and the positioning of two HIPER model receptors over the points. The parameters were obtained from the Brazilian Geodetic System (SBG), datum SAD69 (South American Datum established in 1969), linear unit in meters, angular unit DMS, UTM projection South-Zone 23: 48W to 42W, coordinates in UTM projection. The altimetry datum of the SGB agrees with the equipotential surface value, which consists of the mean sea level, defined in 1959 through the average of annual sea level means in the period from 1949 to 1957 in Imbituba Port (48°40,2’ W; 28°14,4’ S) on the coast of the State of Santa Catarina, Brazil, by a tide gauge station installed by the Inter-American Geodetic Survey (IAGS) and by Brazilian port officials.

Analytical Methods

The C, N and S content and isotopic composition of sediment samples were measured at the Stable Isotope Core Laboratory, Washington State University, USA. Acetanilide was used in a multi-point correction to estimate C% and N%. Sulfanilamide was used in a multi-point correction (varying amplitude) to estimate S%. Samples for carbon and nitrogen isotopic analysis were converted to N_2 and CO_2 with an elemental analyzer (ECS 4010, Costech Analytical, Valencia, CA). These two gases were separated with a 3 m GC column and analyzed with a continuous-flow isotope ratio mass spectrometer (Delta PlusXP, Thermofinnigan, Bremen) (Brenna et al., 1997; Qi et al., 2003). At least three different isotopic reference materials were interspersed with the samples for calibration. The contribution of ^{17}O is corrected by the IRMS software using the Santrock correction (Santrock et al., 1985).

Carbon isotopic results are reported in parts per thousand (per mil) relative to Vienna Peedee Belemnite (VPDB) by assigning a value of +1.95 per mil to NBS 19 $CaCO_3$ and -46.6 per mil to L-SVEC $LiCO_3$ (Coplen et al, 2006). The samples were normalized using three internal running standards previously calibrated to NBS 19, RM 8542, and IAEA-CO-9 as currently defined by the Commission on Isotopic Abundances and Atomic weights (CIAAW, http://www.ciaaw.org/). The nitrogen isotope ratios are reported in parts per mil relative to N_2 in air (Coplen, 1994).

The typical precision (1SD) of carbon and nitrogen isotopic analyses was <0.2 per mil $\delta^{13}C_{VPDB}$ and <0.4 per mil $\delta^{15}N_{AIR}$. The laboratory running standards were calibrated to USGS 32, USGS 25, and USGS 26 as currently defined by the Commission on Isotopic Abundances and Atomic weights (CIAAW, http://www.ciaaw.org/).

Instrument stability checks and necessary instrument calibrations were performed prior to all analyses. A linearity check prior to analysis indicated ^{13}C linearity of 0.045 per mil per V and ^{15}N linearity of 0.04 per mil per volt. A blind reference material was analyzed with the samples as a check of the normalization. In this case, independent replicates of local top soil were included in each sequence.

Samples for sulfur isotopic analysis were combusted with an elemental analyzer (ECS 4010, Costech Analytical, Valencia, CA). SO_2 gases were separated with a 0.8 m GC column (105°C) and analyzed with a continuous flow isotope ratio mass spectrometer (Delta PlusXP, Thermofinnigan, Bremen) (Brenna et al., 1997). The final determination of the ^{34}S was based on collection of 64 and 66 ions. The laboratory used a dual reactor configuration (Fry et al., 2002), which added niobium pentoxide to each sample (~5 mg) and used a full reactor of quartz chips to buffer ^{18}O contribution to the SO_2. No correction for oxygen isotope contribution was made.

Sulfur isotopic ratios are reported per mil relative to Vienna Cañon Diablo Troilite (VCDT) by assigning a value of -0.3 per mil to IAEA S-1 silver sulfide (Coplen and Krouse, 1998). The data were normalized using IAEA S-2, IAEA S-3, IAEA SO5 and two internal running standards calibrated to a suite of international reference materials, which are currently defined by the Commission on Isotopic Abundances and Atomic weights (CIAAW, http://www.ciaaw.org/). The typical precision (1SD) of ^{34}S analyses was <0.5 per mil.

Figures

Figure S1. Juréia-Itatins Ecological Station, the State of São Paulo, Brazil (A), with the location of core S03. Sampling was performed using a vibracore system (B). Oblique view (looking east-south) of the cross-section through the Juréia (C); the digital elevation model (DEM) highlights the extent and elevation of the paleolagoon deposits within the shoreline (generated using SRTM and LANDSAT data).

Figure S2. Massive dark mud paleolagoon sediments from core S03, with calibrated radiocarbon ages, composed of three plastic silty clay units with vegetable fragments in the following depths: top down to 0.24m (brown), 0.24 up to 0.42m (dark yellow) and 0.42m down to the base (dark gray).

Figure S3. Interpretation of the sources of the organic matter on a binary diagram of $\delta^{13}C_{VPDB}$ and C:N ratios obtained from core S03 (Bengtsson and Enell, 1986; Meyers, 1994; Meyers, 1997; Meyers and Teranes, 2001; Meyers 2003 and references therein).

Movie

This movie shows the fieldwork and drilling: the first part shows the path to the drilling place in the Jureia-Itatins Ecological Station, followed by the vibracore drilling and the return with the core S03.

Tables

Table S1. The Clay minerals identified on the paleolagoon sediments of the core S03.

Depth (m)	Calendar age (cal yr BP)	Clay minerals							Depht (m)	Calendar age (cal yr BP)	Clay minerals					
		K	I	M	H	V	P	C			K	I	M	V	P	C
0.00-0.02	108	x	x						2.90-2.92	8384.0	x	x	x			
0.10-0.12	305	x	x		x	x			3.00-3.02	8385.0	x	x	x			
0.20-0.22	1213	x	x		x	x			3.10-3.12	8401.0	x	x	x			
0.30-0.32	2120.0	x	x	x	x	x			3.20-3.22	8417.0	x	x	x			
0.40-0.42	4240.0	x	x	x					3.30-3.32	8433.0	x	x	x			
0.50-0.52	4640.0	x	x	x					3.40-3.42	8449.0	x	x	x			
0.60-0.62	6205.0	x	x	x					3.50-3.52	8465.0	x	x	x			x
0.70-0.72	6828	x	x	x					3.60-3.62	8481.0	x	x	x			
0.80-0.82	7450.0	x	x	x					3.70-3.72	8497.0	x	x	x			x
0.90-0.92	7575.0	x	x	x					3.80-3.82	8513.0	x	x	x			
1.00-1.02	7615.0	x	x	x					3.90-3.92	8529.0	x	x	x			
1.10-1.12	7666	x	x	x					4.00-4.02	8545.0	x	x	x			
1.20-1.22	7718	x	x	x					4.10-4.12	8561	x	x	x			x
1.30-1.32	7769.3	x	x	x					4.20-4.22	8576.0	x	x	x			
1.40-1.42	7821	x	x	x					4.30-4.32	8592	x	x	x			
1.50-1.52	7872	x	x	x					4.40-4.42	8607.0	x	x	x			
1.60-1.62	7924	x	x						4.50-4.52	8623	x	x	x			x
1.70-1.72	7975.0	x	x						4.60-4.62	8638.0	x	x	x			
1.80-1.82	8108.3	x	x	x					4.70-4.72	8654	x	x	x			
1.90-1.92	8242	x	x	x					4.80-4.82	8669.0	x	x	x			
2.00-2.02	8375.0	x	x	x				x	4.90-4.92	8685	x	x	x			x
2.10-2.12	8376.0	x	x	x			x		5.00-5.02	8700.0	x	x	x			
2.20-2.22	8377.0	x	x	x					5.10-5.12	8789	x	x	x			
2.30-2.32	8378.0	x	x	x					5.20-5.22	8877.2	x	x	x			
2.40-2.42	8379.0	x	x	x					5.30-5.32	8966	x	x	x			
2.50-2.52	8380.0	x	x	x					5.40-5.42	9054.4	x	x	x		x	
2.60-2.62	8381.0	x	x	x					5.50-5.52	9143.0	x	x	x			
2.70-2.72	8382.0	x	x	x					5.72-5.74	9338.0	x	x	x			
2.80-2.82	8383.0	x	x	x												

K= kaolinite; I= illite; M= montmorillonite; H= hydrobiotite; V= vermiculite; P= pyrofilite; C= chlorite

Table S2. The sedimentological parameters from the paleolagoon sediments of core S03.

Depth (m)	Calendar age (cal yr BP)	Granulometric Range (%)								
		Sand						Mud		fine/coarse
		very coarse	coarse	medium	fine	very fine	total	clay	total	
0.00-0.02	108	0.30	0.30	0.98	2.06	3.79	4.92	24.74	36.49	25.20
0.12-0.14	487	0.14	0.14	0.15	0.43	1.28	5.11	21.83	28.80	32.72
0.22-0.24	1394.0	0.23	0.23	0.17	0.21	0.42	1.05	9.81	11.66	65.22
0.32-0.34	2544.0	0.34	0.34	0.08	0.23	0.40	2.04	17.04	19.80	50.29
0.42-0.44	4320.0	0.01	0.01	0.11	0.16	0.33	1.12	21.58	23.30	50.22
0.52-0.54	4953.0	0.96	0.96	0.07	0.37	0.61	2.88	23.48	27.42	38.61
0.62-0.64	6330	0.15	0.15	0.21	0.43	1.02	4.32	18.95	24.93	34.29
0.72-0.74	6952.0	0.11	0.11	0.20	0.36	0.73	2.64	10.94	14.87	52.99
0.82-0.84	7475.0	0.61	0.61	0.56	0.76	1.16	4.99	12.64	20.11	50.79
0.92-0.94	7583.0	0.00	0.00	0.09	0.25	0.48	1.64	5.31	7.77	56.03
1.02-1.04	7625.3	0.27	0.27	0.36	0.45	0.85	2.55	6.32	10.54	43.64
1.12-1.14	7677	0.05	0.05	0.22	0.47	1.16	2.26	13.87	17.98	48.06
1.22-1.24	7728.1	0.49	0.49	0.53	1.35	1.62	2.91	17.63	24.05	41.63
1.32-1.34	7780	0.84	0.84	2.55	3.66	3.74	4.38	12.12	26.46	37.97
1.42-1.44	7831.0	0.43	0.43	1.44	1.55	2.12	4.16	13.64	22.92	50.24
1.52-1.54	7882.4	0.15	0.15	0.37	0.90	1.85	2.56	17.33	23.00	43.82
1.62-1.64	7934	0.27	0.27	0.41	0.97	1.67	3.61	18.68	25.34	42.71
1.72-1.74	8002	0.05	0.05	0.26	1.05	1.74	3.35	14.44	20.83	35.15
1.82-1.84	8135.0	0.14	0.14	0.66	1.99	1.99	2.26	18.72	25.63	44.03
1.92-1.94	8268.3	0.65	0.65	1.01	2.49	2.40	3.68	14.03	23.62	41.01
2.02-2.04	8375.2	0.21	0.21	1.12	1.67	2.50	5.05	16.33	26.66	42.25
2.12-2.14	8376.2	0.65	0.65	2.88	4.66	3.72	2.76	9.83	23.85	38.20
2.22-2.24	8377.2	0.05	0.05	0.65	1.16	2.09	4.22	15.24	23.35	42.19
2.32-2.34	8378.2	0.18	0.18	0.64	0.81	1.37	3.99	19.31	26.12	35.69
2.42-2.44	8379.2	0.13	0.13	0.85	1.35	2.73	3.90	15.29	24.12	39.27
2.52-2.54	8380.2	0.27	0.27	1.34	1.70	2.35	4.02	14.96	24.37	38.57
2.62-2.64	8381.2	0.07	0.07	0.15	0.40	0.51	1.20	23.74	25.99	39.75
2.72-2.74	8382.2	0.10	0.10	0.20	0.59	1.04	3.38	22.24	27.46	39.71
2.82-2.84	8383.2	0.16	0.16	0.23	0.56	1.07	3.39	23.37	28.63	38.93
2.92-2.94	8384.2	0.45	0.45	0.38	0.64	0.85	2.79	23.24	27.91	39.28
3.02-3.04	8388.2	0.54	0.54	0.74	1.42	1.86	5.06	27.22	36.30	34.10
3.12-3.14	8404.2	0.53	0.53	0.52	1.13	1.98	5.25	21.70	30.59	34.40
3.22-3.24	8420.2	0.56	0.56	0.35	0.50	0.67	3.58	30.66	35.75	34.92
3.32-3.34	8436.2	0.40	0.40	0.31	0.76	1.88	6.12	28.07	37.14	34.74
3.42-3.44	8452.2	0.39	0.39	0.36	0.44	0.57	3.09	33.90	38.35	34.12
3.52-3.54	8468.2	0.45	0.45	0.34	0.48	1.15	5.98	39.06	47.00	28.96
3.62-3.64	8484.2	0.11	0.11	0.65	0.77	1.68	9.80	31.71	44.61	30.15
3.72-3.74	8500.2	0.19	0.19	0.38	1.11	2.80	8.04	45.81	58.14	25.30
3.82-3.84	8516.2	0.32	0.32	0.29	0.82	1.37	5.85	44.59	52.92	20.83
3.92-3.94	8532.2	0.39	0.39	0.17	0.52	0.98	5.62	45.45	52.74	23.53
4.02-4.04	8548.1	0.08	0.08	0.67	0.50	1.22	3.70	35.87	41.96	23.87
4.12-4.14	8564	0.24	0.24	0.22	0.37	0.78	5.72	50.75	57.85	17.64

Table S2 (cont.)

Depth (m)	Calendar age (cal yr BP)	Granulometric Range (%)								
		Sand						Mud		fine/coarse
		very coarse	coarse	medium	fine	very fine	total	clay	total	
4.22-4.24	8579.1	0.08	0.08	0.06	0.14	0.33	3.05	52.87	56.46	7.46
4.32-4.34	8595	0.23	0.23	0.27	0.44	1.09	6.33	37.46	45.58	24.04
4.42-4.44	8610.1	0.15	0.15	0.16	0.30	0.82	4.04	39.40	44.72	10.36
4.52-4.54	8626	0.14	0.14	0.20	0.32	0.95	4.17	47.37	53.01	20.26
4.62-4.64	8641.1	0.21	0.21	0.19	0.57	0.95	2.90	41.08	45.69	26.09
4.72-4.74	8657	0.37	0.37	0.26	0.35	0.85	4.53	32.84	38.83	9.72
4.82-4.84	8672.1	0.20	0.20	0.17	0.51	1.54	7.22	37.62	47.06	26.38
4.92-4.94	8688	0.20	0.20	0.15	0.37	1.12	4.04	43.98	49.66	21.60
5.02-5.04	8718	0.22	0.22	0.25	0.61	1.70	5.60	44.63	52.79	23.56
5.12-5.14	8806.3	0.04	0.04	0.11	0.35	1.53	6.66	35.20	43.85	29.80
5.22-5.24	8895	0.54	0.54	0.35	0.52	1.18	3.52	23.21	28.77	38.21
5.32-5.34	8984	0.98	0.98	0.37	0.41	0.72	4.27	19.21	24.97	41.70
5.42-5.44	9072.2	0.31	0.31	0.32	0.88	1.71	4.88	27.34	35.13	35.11
5.52-5.54	9161	0.25	0.25	0.17	0.47	1.05	4.07	17.26	23.04	45.66

Table S3. The statistics parameters (phi) from the paleolagoon sediments of core S03.

Depth (m)	Calendar age (cal yr BP)	Statistics Parameters (phi)				Depth (m)	Calendar age (cal yr BP)	Statistics Parameters (phi)			
		md	σ	sk	k			md	σ	sk	k
0.00-0.02	108.0	5.46	2.59	0.05	1.96	2.82-2.84	8383.2	6.33	2.48	-0.24	1.70
0.12-0.14	487	6.08	2.46	-0.09	1.64	2.92-2.94	8384.2	6.37	2.52	-0.37	1.95
0.22-0.24	1394.0	7.58	2.16	-1.27	3.53	3.02-3.04	8388.2	5.80	2.66	-0.07	1.85
0.32-0.34	2544.0	6.99	2.38	-0.76	2.27	3.12-3.14	8404.2	6.04	2.60	-0.25	1.94
0.42-0.44	4320.0	6.90	2.39	-0.55	1.72	3.22-3.24	8420.2	6.04	2.56	-0.13	1.75
0.52-0.54	4953.0	6.35	2.54	-0.41	2.05	3.32-3.34	8436.2	5.86	2.63	-0.01	1.65
0.62-0.64	6330	6.36	2.39	-0.34	1.87	3.42-3.44	8452.2	5.96	2.55	-0.03	1.66
0.72-0.74	6952.0	7.24	2.24	-1.01	2.88	3.52-3.54	8468.2	5.52	2.58	0.24	1.70
0.82-0.84	7475.0	6.88	2.57	-0.87	2.61	3.62-3.64	8484.2	5.60	2.65	0.13	1.59
0.92-0.94	7583.0	7.52	1.99	-1.14	3.28	3.72-3.74	8500.2	5.07	2.60	0.52	1.84
1.02-1.04	7625.3	7.17	2.14	-1.13	3.68	3.82-3.84	8516.2	5.05	2.39	0.61	2.20
1.12-1.14	7677	6.98	2.32	-0.76	2.36	3.92-3.94	8532.2	5.19	2.45	0.53	1.97
1.22-1.24	7728.1	6.45	2.58	-0.53	2.16	4.02-4.04	8548.1	5.63	2.35	0.21	1.93
1.32-1.34	7780	6.06	2.92	-0.58	2.20	4.12-4.14	8564	4.78	2.21	0.99	2.84
1.42-1.44	7831.0	6.81	2.69	-0.94	2.72	4.22-4.24	8579.1	4.39	1.62	1.74	5.67
1.52-1.54	7882.4	6.71	2.47	-0.66	2.24	4.32-4.34	8595	5.35	2.42	0.42	1.89
1.62-1.64	7934	6.54	2.55	-0.53	2.05	4.42-4.44	8610.1	4.59	1.75	1.34	4.80
1.72-1.74	8002	6.56	2.38	-0.57	2.18	4.52-4.54	8626	5.09	2.32	0.69	2.12
1.82-1.84	8135.0	6.53	2.61	-0.58	2.14	4.62-4.64	8641.1	5.45	2.44	0.41	1.81
1.92-1.94	8268.3	6.41	2.71	-0.69	2.46	4.72-4.74	8657	4.70	1.85	0.98	3.99
2.02-2.04	8375.2	6.39	2.70	-0.55	2.07	4.82-4.84	8672.1	5.38	2.51	0.40	1.73
2.12-2.14	8376.2	6.08	2.94	-0.63	2.32	4.92-4.94	8688	5.15	2.33	0.65	2.12
2.22-2.24	8377.2	6.51	2.55	-0.54	2.10	5.02-5.04	8718	5.18	2.45	0.55	1.97
2.32-2.34	8378.2	6.11	2.51	-0.16	1.86	5.12-5.14	8806.3	5.58	2.52	0.31	1.56
2.42-2.44	8379.2	6.35	2.60	-0.47	2.05	5.22-5.24	8895	6.23	2.55	-0.27	1.88
2.52-2.54	8380.2	6.26	2.65	-0.48	2.16	5.32-5.34	8984	6.45	2.58	-0.52	2.21
2.62-2.64	8381.2	6.59	2.32	-0.36	1.82	5.42-5.44	9072.2	5.92	2.62	-0.04	1.63
2.72-2.74	8382.2	6.43	2.46	-0.32	1.73	5.52-5.54	9161	6.79	2.44	-0.67	2.19

md= median diameter; σ= deviation; k= kurtosis; sk= asymmetry

Table S4. Heavy minerals contents (%) from the paleolagoon sediments of core S03.

Depth (m)	Calendar age (cal yr BP)	Sand		Depth (m)	Calendar age (cal yr BP)	Sand	
		fine	very fine			fine	very fine
0.00-0.02	108.0	1.07	0.35	0.00-0.02	108	1.07	0.35
0.12-0.14	487	1.10	1.12	0.12-0.14	487	1.10	1.12
0.22-0.24	1394.0	1.51	0.76	0.22-0.24	1394	1.51	0.76
0.32-0.34	2544.0	0.72	0.34	0.32-0.34	2544	0.72	0.34
0.42-0.44	4320.0	1.43	0.56	0.42-0.44	4320	1.43	0.56
0.52-0.54	4953.0	0.78	0.49	0.52-0.54	4953	0.78	0.49
0.62-0.64	6330	1.05	0.48	0.62-0.64	6330	1.05	0.48
0.72-0.74	6952.0	1.42	0.98	0.72-0.74	6952	1.42	0.98
0.82-0.84	7475.0	1.15	0.66	0.82-0.84	7475	1.15	0.66
0.92-0.94	7583.0	1.29	0.81	0.92-0.94	7583	1.29	0.81
1.02-1.04	7625.3	1.25	1.27	1.02-1.04	7625.3	1.25	1.27
1.32-1.34	7780	0.70	0.69	1.32-1.34	7780	0.70	0.69
1.52-1.54	7882.4	0.71	0.37	1.52-1.54	7882.4	0.71	0.37
1.72-1.74	8002	0.68	1.75	1.72-1.74	8002	0.68	1.75
2.02-2.04	8375.2	0.36	0.42	2.02-2.04	8375.2	0.36	0.42
2.32-2.34	8378.2	0.59	0.42	2.32-2.34	8378.2	0.59	0.42
2.72-2.74	8382.2	1.81	0.28	2.72-2.74	8382.2	1.81	0.28
3.02-3.04	8388.2	0.92	0.56	3.02-3.04	8388.2	0.92	0.56
4.02-4.04	8548.1	1.13	0.46	4.02-4.04	8548.1	1.13	0.46
4.32-4.34	8595	0.51	0.43	4.32-4.34	8595	0.51	0.43
4.72-4.74	8657	1.18	0.19	4.72-4.74	8657	1.18	0.19
5.02-5.04	8718	0.88	0.44	5.02-5.04	8718	0.88	0.44
5.32-5.34	8984	2.04	0.33	5.32-5.34	8984	2.04	0.33
5.52-5.54	9161	0.84	0.23	5.52-5.54	9161	0.84	0.23

Table S5. The major elemental components of the paleolagoon sediments of core S03.

Depth (m)	Calendar age (cal yr BP)	Al_2O_3 (%)	CaO (%)	Fe_2O_3 (%)	K_2O (%)	MgO (%)	MnO (%)	Na_2O (%)	P_2O_5 (%)	SiO_2 (%)	TiO_2 (%)	LOI (%)*
0.00-0.02	108	16.00	0.12	5.27	1.95	0.37	0.04	0.21	0.11	62.00	0.85	11.93
0.10-0.12	305	18.40	0.12	4.46	1.95	0.41	0.03	0.25	0.12	60.3	0.96	12.07
0.12-0.14	487	19.37	0.12	3.87	1.88	0.49	0.01	0.30	0.123	60.02	0.99	12.73
0.14-0.16	668.0	19.72	0.13	3.66	1.81	0.5	BLD†	0.41	0.133	59.34	1.02	12.31
0.16-0.18	850	20.30	0.12	3.81	1.8	0.49	0.01	0.34	0.122	58.6	1.05	12.45
0.18-0.20	1031.0	21.56	0.12	3.78	1.9	0.49	BLD†	0.32	0.113	58.12	1.06	12.13
0.20-0.22	1213	22.00	0.12	3.94	1.85	0.44	0.02	0.25	0.11	57.3	1.10	11.62
0.22-0.24	1394.0	22.43	0.12	4.12	1.89	0.5	BLD†	0.38	0.099	57.59	1.13	11.20
0.24-0.26	1576	22.58	0.11	3.98	1.81	0.42	BLD†	0.37	0.088	58.9	1.17	10.28
0.26-0.28	1757.0	21.35	0.12	3.82	1.79	0.42	BLD†	0.31	0.078	60.23	1.07	9.72
0.28-0.30	1939	20.82	0.12	3.30	1.83	0.55	BLD†	0.37	0.074	61.85	1.09	9.27
0.30-0.32	2120.0	20.30	0.13	3.56	1.8	0.42	0.02	0.29	0.07	63.1	1.05	9.03
0.32-0.34	2544.0	17.88	0.13	3.94	1.8	0.64	BLD†	0.43	0.058	65.02	0.95	7.83
0.34-0.36	2968.0	17.18	0.16	4.32	1.84	0.49	BLD†	0.55	0.05	65.91	0.92	7.48
0.36-0.38	3392.0	17.08	0.18	4.97	1.86	0.54	BLD†	0.49	0.055	67.33	0.90	7.59
0.38-0.40	3816.0	16.61	0.18	4.76	1.81	0.74	BLD†	0.45	0.046	68.85	0.89	7.25
0.40-0.42	4240.0	16.60	0.17	5.61	1.78	0.48	0.02	0.35	0.06	65.2	0.86	7.81
0.42-0.44	4320.0	17.06	0.18	5.58	1.79	0.59	BLD†	0.56	0.066	65.1	0.90	8.24
0.44-0.46	4400.0	15.74	0.23	5.34	1.75	0.7	BLD†	0.51	0.066	65.21	0.84	10.39
0.46-0.48	4480.0	14.69	0.26	4.54	1.78	0.74	0.01	0.60	0.046	65.51	0.73	11.48
0.48-0.50	4560.0	14.84	0.28	4.5	1.74	0.7	BLD†	0.58	0.057	65.18	0.73	12.36
0.50-0.52	4640.0	15.30	0.26	4.71	1.76	0.61	0.03	0.37	0.06	62.4	0.77	12.10
0.52-0.54	4953.0	14.69	0.27	4.38	1.82	0.84	BLD†	0.51	0.054	64.01	0.70	13.29
0.54-0.56	5266.0	15.55	0.3	4.93	1.75	0.88	0.02	0.54	0.048	60.53	0.80	14.38
0.56-0.58	5579.0	15.18	0.31	4.91	1.76	0.85	0.01	0.46	0.052	62.29	0.72	13.42
0.58-0.60	5892.0	15.12	0.32	4.67	1.67	0.72	0.01	0.56	0.049	62.81	0.66	11.74
0.60-0.62	6205.0	15.50	0.33	5.75	1.76	0.72	0.03	0.40	0.06	60.2	0.75	12.86
0.62-0.64	6330	12.77	0.31	4.63	1.67	0.76	0.01	0.53	0.045	64.07	0.67	12.75
0.64-0.66	6454.0	13.93	0.32	4.91	1.62	0.70	0.02	0.48	0.047	64.15	0.69	12.44
0.66-0.68	6579	12.64	0.31	4.43	1.67	0.84	0.02	0.53	0.041	67.23	0.65	11.73
0.68-0.70	6703.0	13.73	0.35	4.87	1.64	1.03	0.02	0.49	0.044	65.11	0.70	11.66
0.70-0.72	6828	14.80	0.35	5.75	1.7	0.82	0.04	0.36	0.05	61.3	0.75	12.54
0.72-0.74	6952.0	15.90	0.34	6.03	1.71	0.99	0.03	0.49	0.049	56.63	0.79	16.36
0.74-0.76	7077	16.35	0.34	5.78	1.74	1.12	0.03	0.52	0.05	57.61	0.76	15.05
0.76-0.78	7201.0	16.77	0.37	6.00	1.65	0.95	0.03	0.42	0.054	58.7	0.83	14.51
0.78-0.80	7326	15.46	0.35	5.82	1.72	1.13	0.03	0.48	0.049	56.7	0.77	16.58
0.80-0.82	7450.0	19.10	0.34	6.60	1.74	1.20	0.07	0.33	0.07	53.6	0.87	15.52
Limit of detection		0.10	0.01	0.01	0.01	0.1	0.01	0.1	0.01	0.1	0.01	0.0

*LOI= Loss on ignition; †BLD= below the limit of detection.

Table S5 (cont.)

Depth (m)	Calendar age (cal yr BP)	Al_2O_3 (%)	CaO (%)	Fe_2O_3 (%)	K_2O (%)	MgO (%)	MnO (%)	Na_2O (%)	P_2O_5 (%)	SiO_2 (%)	TiO_2 (%)	LOI (%)*
0.82-0.84	7475	17.17	0.37	6.03	1.72	1.16	0.04	0.49	0.055	55.45	0.82	15.94
0.84-0.86	7500.0	ND†	ND†	ND†	ND†	ND†	ND†	ND†	ND†	ND†	ND†	15.21
0.86-0.88	7525.0	ND†	ND†	ND†	ND†	ND†	ND†	ND†	ND†	ND†	ND†	15.98
0.88-0.90	7550.0	ND†	ND†	ND†	ND†	ND†	ND†	ND†	ND†	ND†	ND†	15.47
0.90-0.92	7575.0	18.7	0.38	6.3	1.79	1.19	0.06	0.36	0.06	56.2	0.89	14.21
0.92-0.94	7583.0	ND†	ND†	ND†	ND†	ND†	ND†	ND†	ND†	ND†	ND†	16.32
0.94-0.96	7591.0	ND†	ND†	ND†	ND†	ND†	ND†	ND†	ND†	ND†	ND†	15.04
0.96-0.98	7599.0	ND†	ND†	ND†	ND†	ND†	ND†	ND†	ND†	ND†	ND†	14.8
0.98-1.00	7607.0	ND†	ND†	ND†	ND†	ND†	ND†	ND†	ND†	ND†	ND†	15.72
1.00-1.02	7615.0	18.5	0.39	6.92	1.77	1.16	0.06	0.36	0.07	54.1	0.87	14.95
1.10-1.12	7666.4	16.5	0.42	6.71	1.79	1.07	0.05	0.42	0.06	58.1	0.84	14.06
1.20-1.22	7718	15.8	0.43	5.74	1.77	1.05	0.05	0.42	0.06	59.1	0.8	13.5
1.30-1.32	7769.3	15.6	0.45	5.88	1.73	1.01	0.06	0.4	0.06	58	0.78	14.91
1.40-1.42	7821	15.7	0.46	6.14	1.73	1.07	0.06	0.4	0.06	56.3	0.8	16.25
1.50-1.52	7872.1	16.5	0.46	5.96	1.79	1.16	0.05	0.42	0.07	58.2	0.8	13.87
1.60-1.62	7924	14.9	0.49	5.56	1.79	1.01	0.05	0.45	0.07	60.1	0.77	12.82
1.70-1.72	7975.0	15.9	0.49	5.61	1.81	1.07	0.04	0.43	0.07	59.2	0.81	13.23
1.80-1.82	8108.3	15.0	0.51	5.36	1.81	1.05	0.04	0.45	0.07	60.9	0.78	12.56
1.90-1.92	8242	16.0	0.5	5.55	1.82	1.1	0.05	0.44	0.07	59.5	0.8	12.84
2.00-2.02	8375.0	16.3	0.5	5.46	1.84	1.18	0.04	0.46	0.07	60.3	0.8	12.72
2.10-2.12	8376.0	16.5	0.55	5.63	1.84	1.23	0.05	0.44	0.08	59.0	0.8	13.6
2.20-2.22	8377.0	16.0	0.54	5.12	1.87	1.13	0.04	0.45	0.08	61.0	0.8	11.61
2.30-2.32	8378.0	16.0	0.49	4.86	1.83	1.08	0.04	0.49	0.08	61.0	0.78	11.62
2.40-2.42	8379.0	15.7	0.51	5.04	1.85	1.09	0.04	0.49	0.08	61.2	0.78	12.24
2.50-2.52	8380.0	15.6	0.54	4.9	1.89	1.13	0.05	0.50	0.08	61.8	0.8	11.39
2.60-2.62	8381.0	16.4	0.57	5.01	1.88	1.25	0.04	0.46	0.09	59.8	0.82	11.73
2.70-2.72	8382.0	13.8	0.58	4.56	1.86	0.97	0.04	0.53	0.08	65.5	0.71	10.41
2.80-2.82	8383.0	14.9	0.58	4.95	1.84	1.13	0.05	0.47	0.08	61.3	0.75	12.45
2.90-2.92	8384.0	14.9	0.59	4.76	1.85	1.09	0.05	0.51	0.08	63.7	0.74	10.94
3.00-3.02	8385.0	14.5	0.54	4.55	1.82	1.02	0.04	0.53	0.08	62.9	0.73	11.86
3.10-3.12	8401.0	13.6	0.58	4.59	1.83	0.98	0.04	0.54	0.07	64.6	0.71	11.05
3.20-3.22	8417.0	13.3	0.54	4.46	1.81	0.94	0.04	0.54	0.07	66.5	0.7	10.91
3.30-3.32	8433.0	13.5	0.56	4.62	1.85	0.94	0.04	0.56	0.07	66.6	0.71	9.99
3.40-3.42	8449.0	13.2	0.56	4.23	1.83	0.92	0.04	0.55	0.07	66.7	0.71	9.42
3.50-3.52	8465.0	11.6	0.52	3.89	1.74	0.74	0.03	0.54	0.06	70.2	0.62	8.87
3.60-3.62	8481.0	12.5	0.56	3.89	1.77	0.81	0.04	0.54	0.07	69.2	0.66	9.02
3.70-3.72	8497.0	9.72	0.5	3.45	1.64	0.54	0.04	0.54	0.06	73.7	0.57	7.51
3.80-3.82	8513	9.54	1.97	3.19	1.76	0.57	0.04	0.62	1.01	72.6	0.51	6.42
Limit of detection		0.10	0.01	0.01	0.01	0.1	0.01	0.1	0.01	0.1	0.01	0.0

*LOI= Loss on ignition; †ND= not determined.

Table S5 (cont.)

Depth (m)	Calendar age (cal yr BP)	Al_2O_3 (%)	CaO (%)	Fe_2O_3 (%)	K_2O (%)	MgO (%)	MnO (%)	Na_2O (%)	P_2O_5 (%)	SiO_2 (%)	TiO_2 (%)	LOI (%)*
3.90-3.92	8529	10.2	0.68	3.23	1.99	0.6	0.04	0.72	0.06	76.2	0.46	5.51
4.00-4.02	8545	9.9	0.8	3.32	2.02	0.57	0.04	0.74	0.1	76.7	0.47	4.94
4.10-4.12	8561	11.1	0.78	3.43	2.04	0.69	0.04	0.76	0.06	74.7	0.5	6
4.20-4.22	8576	9.94	0.86	2.94	2.08	0.56	0.04	0.81	0.05	77.3	0.44	4
4.30-4.32	8592	11.2	0.88	3.28	2.08	0.66	0.04	0.79	0.07	74.9	0.51	5.19
4.40-4.42	8607.0	11.1	0.96	3.57	2.08	0.66	0.04	0.76	0.09	74.5	0.52	5.21
4.50-4.52	8623	10.6	1.14	3.69	2.17	0.63	0.05	0.83	0.08	76	0.53	4.57
4.60-4.62	8638.0	11.7	1.05	3.55	2.15	0.79	0.04	0.8	0.08	73.3	0.54	5.62
4.70-4.72	8654	11.3	1	3.5	2.16	0.66	0.04	0.8	0.07	74.3	0.52	5.15
4.80-4.82	8669.0	12.9	0.93	4.24	2.14	0.94	0.05	0.75	0.09	69.7	0.61	7.02
4.90-4.92	8685	11.9	0.93	3.76	2.15	0.81	0.05	0.8	0.08	73.2	0.54	5.57
5.00-5.02	8700.0	10.5	0.89	3.14	2.11	0.64	0.04	0.77	0.06	74.4	0.49	5.22
5.10-5.12	8789	12.7	0.78	4.06	2.06	0.88	0.05	0.72	0.08	69.3	0.6	7.31
5.20-5.22	8877.2	12.1	0.81	4.73	1.97	0.87	0.05	0.71	0.08	70.1	0.6	6.68
5.30-5.32	8966	15.6	0.61	4.92	2.04	1.19	0.06	0.71	0.09	62.6	0.72	9.77
5.40-5.42	9054.4	14.9	0.84	4.53	2.1	1.15	0.05	0.68	0.09	65.5	0.71	8.76
5.50-5.52	9143.0	14.7	0.8	4.5	2.06	1.14	0.06	0.73	0.09	66.9	0.71	8.04
5.72-5.74	9338.0	18.1	0.57	7.11	1.87	1.57	0.06	0.61	0.11	51.8	0.85	16.17
Limit of detection		0.10	0.01	0.01	0.01	0.1	0.01	0.1	0.01	0.1	0.01	0.0

*LOI= Loss on ignition.

Table S6. The elemental content of the paleolagoon sediments of core S03.

Depth (m)	Calendar age (cal yr BP)	Al (%)	As (ppm)	B (ppm)	Ba (ppm)	Be (ppm)	Ca (%)	Co (ppm)	Cr (ppm)	Cu (ppm)	Fe (%)
0.00-0.02	108	2	BLD*	BLD*	54	BLD*	0.02	BLD*	40	18	2.7
0.10-0.12	305.0	1.8	BLD*	BLD*	44	BLD*	0.01	BLD*	121	16	2.1
0.12-0.14	487	2.55	BLD*	BLD*	41.1	BLD*	0.01	BLD*	23.9	7.1	2.14
0.14-0.16	668.0	2.36	BLD*	BLD*	40.6	BLD*	0.01	BLD*	23.2	8.1	1.91
0.16-0.18	850	2.48	5	BLD*	39.3	BLD*	0.01	BLD*	22.1	4.4	1.92
0.18-0.20	1031.0	2.19	5	BLD*	37.4	BLD*	0.01	BLD*	20.8	3.3	1.84
0.20-0.22	1213	1.2	BLD*	BLD*	33	BLD*	BLD*	BLD*	30	3.7	1.5
0.22-0.24	1394.0	2.09	5	BLD*	37.8	BLD*	BLD*	BLD*	21.3	1.4	1.92
0.24-0.26	1576	2.02	5	BLD*	36.2	BLD*	0.01	BLD*	20.9	1.6	1.86
0.26-0.28	1757.0	1.85	BLD*	BLD*	34.3	BLD*	BLD*	BLD*	19.9	1.4	1.73
0.28-0.30	1939	1.63	BLD*	BLD*	31.4	BLD*	BLD*	BLD*	18.9	3.5	1.33
0.30-0.32	2120.0	1.1	BLD*	BLD*	30	BLD*	0.01	BLD*	40	4.3	1.1
0.32-0.34	2544.0	1.58	BLD*	BLD*	29.8	BLD*	0.01	BLD*	24.5	2.4	1.74
0.34-0.36	2968.0	1.81	6	BLD*	30.1	BLD*	0.01	BLD*	29.3	6	2.05
0.36-0.38	3392.0	1.98	7	BLD*	31	BLD*	0.01	BLD*	33.3	3.7	2.45
0.38-0.40	3816.0	1.45	7	BLD*	27.1	BLD*	0.01	BLD*	33.8	5	2.11
0.40-0.42	4240.0	1.1	9	BLD*	26	BLD*	0.02	BLD*	48	6.4	2.3
0.42-0.44	4320.0	1.82	11	BLD*	26.5	BLD*	0.02	BLD*	32.4	5.1	2.73
0.44-0.46	4400.0	1.56	15	BLD*	30	BLD*	0.04	6.5	32.2	7.9	2.63
0.46-0.48	4480.0	1.65	19	BLD*	34.6	BLD*	0.05	12	33.2	9.2	2.17
0.48-0.50	4560.0	1.46	18	BLD*	35.8	BLD*	0.06	10	33.2	9.6	2.04
0.50-0.52	4640.0	1.1	14	BLD*	30	BLD*	0.06	11	84	14	1.8
0.52-0.54	4953.0	1.42	17	BLD*	33.5	BLD*	0.05	11	31.4	9.7	1.87
0.54-0.56	5266.0	1.64	16	BLD*	35.1	BLD*	0.07	12	34.2	9.6	2.21
0.56-0.58	5579.0	1.88	19	BLD*	39.5	1	0.07	12	35.6	9.1	2.28
0.58-0.60	5892.0	1.42	18	BLD*	35.2	BLD*	0.07	11	28.2	8.2	2.11
0.60-0.62	6205.0	1.2	17	BLD*	28	1.1	0.09	11	88	14	2.3
0.62-0.64	6329.5	1.23	17	BLD*	32.9	1.1	0.07	8.3	26.8	7.2	2.2
0.64-0.66	6454.0	1.54	18	BLD*	36.9	1.5	0.09	9.1	28.2	8	2.4
0.66-0.68	6579	1.3	16	BLD*	33.2	1.4	0.09	7.9	25.2	6.1	2.11
0.68-0.70	6703.0	1.39	16	BLD*	34.7	1.3	0.1	7.5	26.3	6.8	2.25
0.70-0.72	6827.5	1	15	BLD*	29	1.4	0.11	9	124	14	2.3
0.72-0.74	6952.0	1.74	20	BLD*	39.8	1.5	0.12	8.5	30.4	11.2	2.85
0.74-0.76	7077	1.82	18	BLD*	39.2	1.5	0.12	8.2	30.7	8.2	2.76
0.76-0.78	7201.0	1.63	20	BLD*	36.5	1.4	0.12	8.5	28.7	7.3	2.79
0.78-0.80	7326	1.59	19	BLD*	32.3	1.2	0.11	8	29.3	7.8	2.73
0.80-0.82	7450	1.3	15	BLD*	29	1.3	0.14	8.1	53	12	2.3
Limit of detection		0.01	5	10	1	1	0.01	3.0	1.0	1.0	0.01

*BLD= below the limit of detection.

Table S6 (cont.)

Depth (m)	Calendar age (cal yr BP)	Al (%)	As (ppm)	B (ppm)	Ba (ppm)	Be (ppm)	Ca (%)	Co (ppm)	Cr (ppm)	Cu (ppm)	Fe (%)
0.82-0.84	7475	1.83	16	BLD*	34.7	1.3	0.12	7.9	29.8	8.3	2.67
0.84-0.86	7500.0	1.83	17	BLD*	37.9	1.3	0.14	8.8	30.7	8.9	2.8
0.86-0.88	7525.0	1.95	19	BLD*	35.6	1.3	0.14	8.5	32.1	7.9	2.95
0.88-0.90	7550.0	1.82	18	BLD*	32.4	1.1	0.14	8.2	29.3	8.4	2.73
0.90-0.92	7575.0	3	7	BLD*	48	BLD*	0.09	4	42	8.6	2.5
0.92-0.94	7583.0	1.93	17	BLD*	30.8	1.1	0.12	8.3	32.2	16.8	2.9
0.94-0.96	7591.0	1.67	18	BLD*	29.1	1	0.13	8.6	29.4	8.3	2.74
0.96-0.98	7599.0	1.71	15	BLD*	27.5	1	0.14	7.4	29	7.9	2.56
0.98-1.00	7607.0	1.84	21	BLD*	26.6	1	0.13	8.1	30.3	7.9	2.92
1.00-1.02	7615.0	1.1	20	BLD*	19	BLD*	0.14	7.7	53	11	2.4
1.10-1.12	7666.4	1	19	BLD*	21	BLD*	0.14	7	101	12	2.7
1.20-1.22	7718	0.78	15	BLD*	15	BLD*	0.14	6.4	84	12	2.1
1.30-1.32	7769.3	0.97	16	BLD*	16	BLD*	0.17	6.8	85	12	2.4
1.40-1.42	7821	0.96	16	BLD*	18	BLD*	0.18	7.4	110	13	2.5
1.50-1.52	7872.1	1.1	12	BLD*	18	BLD*	0.18	7	117	14	2.3
1.60-1.62	7924	0.98	11	BLD*	19	BLD*	0.18	6.6	131	12	2.3
1.70-1.72	7975.0	0.97	10	BLD*	17	BLD*	0.17	5.9	113	13	2
1.80-1.82	8108.3	0.87	11	BLD*	17	BLD*	0.19	6	84	10	2
1.90-1.92	8242	1.2	10	BLD*	18	BLD*	0.2	5.9	87	12	2.1
2.00-2.02	8375.0	0.81	11	BLD*	17	BLD*	0.21	6.1	81	11	2
2.10-2.12	8376.0	1.1	10	BLD*	18	BLD*	0.23	6.1	63	11	2.1
2.20-2.22	8377.0	1.2	8	BLD*	18	BLD*	0.21	6	55	9.5	1.8
2.30-2.32	8378.0	1.2	10	BLD*	19	BLD*	0.19	5.4	60	10	1.7
2.40-2.42	8379.0	1	8	BLD*	17	BLD*	0.19	5.8	66	9.4	1.8
2.50-2.52	8380.0	0.89	7	BLD*	17	BLD*	0.21	5.4	46	8.7	1.6
2.60-2.62	8381.0	1	8	BLD*	18	BLD*	0.23	5.6	58	9.3	1.7
2.70-2.72	8382.0	0.86	10	BLD*	16	BLD*	0.2	5.4	63	9.6	1.7
2.80-2.82	8383.0	1.2	7	BLD*	20	BLD*	0.24	6.1	75	9.7	1.8
2.90-2.92	8384.0	1.2	8	BLD*	17	BLD*	0.23	5.8	75	9.7	1.7
3.00-3.02	8385.0	2.8	9	BLD*	35	BLD*	0.15	7.6	165	8.3	2.3
3.10-3.12	8401.0	0.91	9	BLD*	17	BLD*	0.21	5.4	84	9.1	1.7
3.20-3.22	8417.0	0.77	7	BLD*	15	BLD*	0.19	5	83	8.2	1.6
3.30-3.32	8433.0	0.93	7	BLD*	18	BLD*	0.2	5.5	108	9.6	1.7
3.40-3.42	8449.0	0.95	7	BLD*	18	BLD*	0.19	5	95	8.8	1.5
3.50-3.52	8465.0	0.75	7	BLD*	13	BLD*	0.16	4.7	97	7.6	1.4
3.60-3.62	8481.0	0.97	6	BLD*	15	BLD*	0.2	5.1	86	8	1.4
3.70-3.72	8497.0	0.69	6	BLD*	16	BLD*	0.15	5	152	9.5	1.4
3.80-3.82	8513.0	0.76	7	BLD*	15	BLD*	1.2	4.5	87	6.6	1.3
Limit of detection		0.01	5	10	1	1	0.01	3.0	1.0	1.0	0.01

*BLD= below the limit of detection.

Table S6 (cont.)

Depth (m)	Calendar age (cal yr BP)	Al (%)	As (ppm)	B (ppm)	Ba (ppm)	Be (ppm)	Ca (%)	Co (ppm)	Cr (ppm)	Cu (ppm)	Fe (%)
3.90-3.92	8529.0	0.6	BLD*	BLD*	15	BLD*	0.23	4.1	105	7.4	1.2
4.00-4.02	8545.0	0.57	BLD*	BLD*	18	BLD*	0.31	4.4	121	8.8	1.3
4.10-4.12	8560.5	0.66	BLD*	BLD*	15	BLD*	0.31	4.4	93	7.5	1.3
4.20-4.22	8576.0	0.6	BLD*	BLD*	17	BLD*	0.33	4.1	83	6.9	1.1
4.30-4.32	85921	0.69	BLD*	BLD*	14	BLD*	0.35	4.1	66	6.4	1.2
4.40-4.42	8607.0	0.98	BLD*	BLD*	23	BLD*	0.44	4.9	112	9.7	1.5
4.50-4.52	8623	0.9	BLD*	BLD*	25	BLD*	0.49	4.8	127	13	1.5
4.60-4.62	8638.0	0.68	BLD*	BLD*	16	BLD*	0.5	4.3	61	6.4	1.3
4.70-4.72	8654	0.9	BLD*	BLD*	18	BLD*	0.45	4.5	79	7.9	1.3
4.80-4.82	8669.0	1.3	6	BLD*	30	BLD*	0.45	5.9	113	11	1.8
4.90-4.92	8685	0.87	BLD*	BLD*	22	BLD*	0.4	4.9	108	10	1.5
5.00-5.02	8700.0	0.59	BLD*	BLD*	16	BLD*	0.39	4.6	64	5.8	1.2
5.10-5.12	8789	2	5	BLD*	31	BLD*	0.29	7	142	7	1.9
5.20-5.22	8877.2	0.68	6	BLD*	15	BLD*	0.36	4.9	58	7.2	1.4
5.30-5.32	8966	1.1	8	BLD*	17	BLD*	0.24	5.6	47	8.3	1.5
5.40-5.42	9054.4	0.9	7	BLD*	16	BLD*	0.39	5.6	48	7.9	1.5
5.50-5.52	9143.0	0.97	6	BLD*	19	BLD*	0.38	5.8	60	8.6	1.6
5.72-5.74	9338.0	1.1	27	10	17	BLD*	0.31	9.5	33	9.8	2.8
Limit of detection		0.01	5	10	1	1	0.01	3.0	1.0	1.0	0.01

*BLD= below the limit of detection.

Table S6 (cont.)

Depth (m)	Calendar age (cal yr BP)	K (%)	La (ppm)	Li (ppm)	Mg (%)	Mn (%)	Mo (ppm)	Na (%)	Ni (ppm)	P (%)
0.00-0.02	108.0	0.22	BLD*	10	0.16	0.01	BLD*	0.02	15	0.02
0.10-0.12	305.0	0.17	BLD*	8.8	0.14	BLD*	1.8	0.01	19	0.02
0.12-0.14	487	0.15	15.2	14.2	0.17	BLD*	BLD*	BLD*	6.1	0.04
0.14-0.16	668.0	0.13	14.2	13	0.16	BLD*	BLD*	BLD*	5.7	0.03
0.16-0.18	850	0.12	13.8	12.5	0.14	BLD*	BLD*	BLD*	5.1	0.03
0.18-0.20	1031.0	0.11	11.9	10.8	0.12	BLD*	BLD*	BLD*	4.1	0.03
0.20-0.22	1213	0.09	BLD*	5	0.07	BLD*	BLD*	BLD*	4.7	0.02
0.22-0.24	1394.0	0.11	12	10.9	0.12	BLD*	BLD*	BLD*	4.1	0.02
0.24-0.26	1576	0.1	11.7	9.8	0.1	BLD*	BLD*	BLD*	3.6	0.02
0.26-0.28	1757.0	0.09	10.9	8.6	0.09	BLD*	BLD*	BLD*	3.1	0.02
0.28-0.30	1939	0.08	10.4	7.4	0.08	BLD*	BLD*	BLD*	2.6	0.01
0.30-0.32	2120.0	0.09	BLD*	3.1	0.04	BLD*	1.2	BLD*	5.6	BLD*
0.32-0.34	2544.0	0.1	10.9	6.8	0.1	BLD*	BLD*	BLD*	2.4	0.01
0.34-0.36	2968.0	0.1	11.3	6.8	0.12	BLD*	BLD*	BLD*	2.4	0.01
0.36-0.38	3392.0	0.12	13.4	8	0.15	BLD*	BLD*	BLD*	3	0.01
0.38-0.40	3816.0	0.11	11.4	6	0.12	BLD*	BLD*	BLD*	2.3	BLD*
0.40-0.42	4240.0	0.09	BLD*	2.4	0.05	BLD*	BLD*	BLD*	5.7	BLD*
0.42-0.44	4320.0	0.11	12.7	6.7	0.13	BLD*	BLD*	BLD*	2.6	0.02
0.44-0.46	4400.0	0.12	16.1	7.2	0.15	BLD*	BLD*	0.01	7.7	0.02
0.46-0.48	4480.0	0.15	19.1	8.8	0.19	BLD*	BLD*	0.01	13.4	0.01
0.48-0.50	4560.0	0.15	21.9	9.1	0.2	BLD*	BLD*	0.01	12.9	0.02
0.50-0.52	4640.0	0.14	20	4	0.12	BLD*	1.4	0.02	19	0.01
0.52-0.54	4953.0	0.16	21.8	9.3	0.19	BLD*	BLD*	0.02	14	0.01
0.54-0.56	5266.0	0.17	28.7	11.2	0.24	BLD*	BLD*	0.02	15.8	0.02
0.56-0.58	5579.0	0.17	31.4	13	0.24	0.01	BLD*	0.02	16.8	0.02
0.58-0.60	5892.0	0.16	30.7	9.3	0.22	0.01	BLD*	0.02	14.9	0.01
0.60-0.62	6205.0	0.14	37	4.8	0.17	0.01	1.2	0.02	22	0.01
0.62-0.64	6330	0.16	27.7	9.7	0.22	0.01	BLD*	0.01	12.7	0.01
0.64-0.66	6454.0	0.18	30.6	11.6	0.26	0.01	BLD*	0.02	13	0.01
0.66-0.68	6579	0.17	24.1	10.6	0.25	0.01	BLD*	0.02	10.6	0.01
0.68-0.70	6703.0	0.19	22.2	12	0.27	0.02	BLD*	0.02	10.4	0.01
0.70-0.72	6828	0.19	22	5.8	0.2	0.02	2.5	0.02	22	BLD*
0.72-0.74	6952.0	0.23	25.2	15.4	0.34	0.03	BLD*	0.02	12.6	0.01
0.74-0.76	7077	0.24	26.8	16.7	0.36	0.02	BLD*	0.02	12.8	0.01
0.76-0.78	7201.0	0.22	28	15.2	0.35	0.02	BLD*	0.02	13.1	0.01
0.78-0.80	7326	0.2	26.5	14	0.32	0.02	BLD*	0.02	13.2	0.01
0.80-0.82	7450.0	0.21	26	7.5	0.26	0.04	1.6	0.03	15	0.01
0.82-0.84	7475.0	0.25	24.5	18	0.39	0.03	BLD*	0.03	13.4	0.01
Limit of detection		0.01	10	1.0	0.01	0.01	1.0	0.01	1.0	0.01

*BLD= below the limit of detection.

Table S6 (cont.)

Depth (m)	Calendar age (cal yr BP)	K (%)	La (ppm)	Li (ppm)	Mg (%)	Mn (%)	Mo (ppm)	Na (%)	Ni (ppm)	P (%)
0.84-0.86	7500.0	0.25	27.7	17.6	0.41	0.04	BLD*	0.03	14.1	0.02
0.86-0.88	7525.0	0.27	26.3	19.3	0.42	0.03	1.2	0.03	14	0.02
0.88-0.90	7550.0	0.25	22.4	17.9	0.4	0.03	BLD*	0.02	13.2	0.02
0.90-0.92	7575.0	0.32	BLD*	26	0.41	0.03	BLD*	0.03	9	BLD*
0.92-0.94	7583.0	0.26	22.1	19.4	0.41	0.03	BLD*	0.02	14	0.02
0.94-0.96	7591.0	0.24	21.6	16.5	0.38	0.03	BLD*	0.02	13.2	0.01
0.96-0.98	7599.0	0.24	21.4	17.3	0.38	0.03	BLD*	0.03	11.6	0.01
0.98-1.00	7607.0	0.24	22.3	18	0.37	0.03	1.4	0.02	12.8	0.01
1.00-1.02	7615.0	0.19	20	6.8	0.25	0.03	2	0.02	14	0.01
1.10-1.12	7666.4	0.21	22	7	0.27	0.02	4.3	0.03	18	0.01
1.20-1.22	7718	0.18	21	6.3	0.25	0.03	5	0.02	15	0.01
1.30-1.32	7769.3	0.17	21	6.6	0.27	0.04	5.2	0.03	16	0.01
1.40-1.42	7821	0.2	22	7.3	0.29	0.03	5.9	0.03	19	0.01
1.50-1.52	7872.1	0.21	22	8.2	0.31	0.03	3.6	0.03	21	0.01
1.60-1.62	7924	0.22	21	8.2	0.31	0.02	3.3	0.03	19	0.01
1.70-1.72	7975.0	0.2	19	8	0.29	0.02	2.8	0.03	19	0.01
1.80-1.82	8108.3	0.2	19	7.4	0.31	0.02	2.4	0.03	15	0.02
1.90-1.92	8242	0.22	20	8.5	0.32	0.02	2.4	0.03	16	0.02
2.00-2.02	8375.0	0.21	21	7.3	0.33	0.02	2.1	0.04	14	0.02
2.10-2.12	8376.0	0.23	20	8.7	0.35	0.02	2.8	0.04	14	0.02
2.20-2.22	8377.0	0.23	20	8.5	0.34	0.02	1.5	0.04	13	0.02
2.30-2.32	8378.0	0.2	19	7.2	0.3	0.02	1.6	0.04	13	0.02
2.40-2.42	8379.0	0.2	19	7.5	0.3	0.02	1.6	0.04	13	0.02
2.50-2.52	8380.0	0.22	20	7.8	0.33	0.02	1.2	0.04	11	0.02
2.60-2.62	8381.0	0.24	20	9.1	0.36	0.02	1.5	0.05	13	0.02
2.70-2.72	8382.0	0.22	17	7.7	0.31	0.02	1.6	0.04	13	0.02
2.80-2.82	8383.0	0.27	19	9.6	0.37	0.02	1.9	0.05	14	0.02
2.90-2.92	8384.0	0.24	18	9	0.34	0.02	2	0.05	15	0.02
3.00-3.02	8385.0	0.36	21	27	0.47	0.02	3.5	0.05	20	0.02
3.10-3.12	8401.0	0.23	17	7.9	0.31	0.02	2.5	0.05	14	0.02
3.20-3.22	8417.0	0.21	16	6.9	0.28	0.02	2.1	0.05	14	0.02
3.30-3.32	8433.0	0.24	17	8	0.31	0.02	2.2	0.06	17	0.02
3.40-3.42	8449.0	0.23	16	8.3	0.3	0.02	1.7	0.06	15	0.02
3.50-3.52	8465.0	0.18	14	6	0.23	0.01	2.5	0.05	14	0.01
3.60-3.62	8481.0	0.2	15	7.1	0.27	0.02	2.2	0.06	14	0.02
3.70-3.72	8497.0	0.17	13	5.4	0.2	0.02	3	0.05	19	0.02
3.80-3.82	8513.0	0.18	12	7.4	0.26	0.03	1.8	0.07	13	0.46
3.90-3.92	8529.0	0.17	11	5.2	0.19	0.02	1.7	0.05	15	0.01
Limit of detection		0.01	10	1.0	0.01	0.01	1.0	0.01	1.0	0.01

*BLD= below the limit of detection.

Table S6 (cont.)

Depth (m)	Calendar age (cal yr BP)	K (%)	La (ppm)	Li (ppm)	Mg (%)	Mn (%)	Mo (ppm)	Na (%)	Ni (ppm)	P (%)
4.00-4.02	8545.0	0.18	11	5.4	0.2	0.02	1.8	0.06	17	0.03
4.10-4.12	8561	0.18	13	6	0.22	0.02	1.5	0.07	14	0.02
4.20-4.22	8576.0	0.17	10	5.1	0.19	0.02	1	0.06	13	0.01
4.30-4.32	8592	0.18	12	5.8	0.22	0.02	BLD*	0.07	12	0.02
4.40-4.42	8607.0	0.23	12	7.2	0.26	0.02	1.6	0.09	17	0.03
4.50-4.52	8623	0.24	11	7.1	0.24	0.02	1.7	0.09	21	0.02
4.60-4.62	8638.0	0.21	13	6.8	0.27	0.02	BLD*	0.1	11	0.03
4.70-4.72	8654	0.21	13	6.6	0.25	0.02	1.1	0.1	13	0.02
4.80-4.82	8669.0	0.34	16	11	0.36	0.03	1.4	0.14	19	0.03
4.90-4.92	8685	0.24	13	7.8	0.28	0.03	1.4	0.12	18	0.02
5.00-5.02	8700.0	0.2	12	6.3	0.25	0.02	BLD*	0.11	11	0.02
5.10-5.12	8789	0.35	17	22	0.43	0.03	1.4	0.13	18	0.02
5.20-5.22	8877.2	0.22	15	7.2	0.29	0.02	BLD*	0.14	12	0.02
5.30-5.32	8966	0.28	19	8.8	0.38	0.03	BLD*	0.18	11	0.03
5.40-5.42	9054.4	0.27	18	8.8	0.37	0.03	BLD*	0.17	12	0.02
5.50-5.52	9143.0	0.28	17	8.9	0.37	0.03	BLD*	0.19	13	0.03
5.72-5.74	9338.0	0.37	21	9.8	0.47	0.04	18	0.26	13	0.03
Limit of detection		0.01	10	1.0	0.01	0.01	1.0	0.01	1.0	0.01

*BLD= below the limit of detection.

Table S6 (cont.)

Depth (m)	Calendar age (cal yr BP)	Pb (ppm)	Sc (ppm)	Sr (ppm)	Ti (%)	V (ppm)	W (ppm)	Y (ppm)	Zn (ppm)	Zr (ppm)
0.00-0.02	108.0	32	BLD*	3.9	0.03	21	BLD*	3.1	23	2.4
0.10-0.12	305.0	28	BLD*	3.1	0.03	23	BLD*	2.8	19	2.1
0.12-0.14	487	33	BLD*	5.6	0.04	38	BLD*	3.5	27	BLD*
0.14-0.16	668.0	27	BLD*	5.2	0.03	37	BLD*	3.3	24.5	BLD*
0.16-0.18	850	26	BLD*	5.6	0.03	37	BLD*	3	21.7	BLD*
0.18-0.20	1031.0	21	BLD*	4.9	0.02	36	BLD*	2.7	18	BLD*
0.20-0.22	1213	16	BLD*	2.6	0.01	23	BLD*	1.8	8.8	2
0.22-0.24	1394.0	16	BLD*	5.2	0.02	35	BLD*	2.4	16.6	BLD*
0.24-0.26	1576	16	BLD*	5.5	0.02	35	BLD*	2.2	14.9	BLD*
0.26-0.28	1757.0	14	BLD*	5.4	0.01	32	BLD*	2	12.5	BLD*
0.28-0.30	1939	13	BLD*	5.3	0.01	28	BLD*	1.8	12.3	BLD*
0.30-0.32	2120.0	12	BLD*	3.2	BLD*	20	BLD*	1.5	5.1	1.9
0.32-0.34	2544.0	12	BLD*	6	0.02	31	BLD*	2.1	11.7	BLD*
0.34-0.36	2968.0	13	3.5	6.3	0.02	35	BLD*	2.4	15.3	1.2
0.36-0.38	3392.0	13	4.2	7.3	0.02	43	BLD*	2.7	16.3	1.6
0.38-0.40	3816.0	14	4.2	6.2	0.02	40	BLD*	2.6	15.6	2.2
0.40-0.42	4240.0	13	BLD*	4.1	BLD*	30	BLD*	2.4	5.2	3.7
0.42-0.44	4320.0	15	3.7	6.7	0.02	46	BLD*	3.2	15.8	1.1
0.44-0.46	4400.0	19	4.1	8.7	0.02	43	BLD*	5.6	19.1	1.9
0.46-0.48	4480.0	17	4.7	10.8	0.02	41	BLD*	7.9	24	6.2
0.48-0.50	4560.0	16	4.9	11.8	0.02	41	BLD*	8.9	24.5	6.5
0.50-0.52	4640.0	17	3.4	10	BLD*	25	BLD*	9.3	16	4.8
0.52-0.54	4953.0	17	4.5	11	0.02	35	BLD*	9.2	33.5	7.7
0.54-0.56	5266.0	13	5	13.4	0.03	37	BLD*	11.3	60.9	8.8
0.56-0.58	5579.0	16	5.3	14.8	0.03	41	BLD*	12.5	85.3	9.2
0.58-0.60	5892.0	14	4	13.3	0.02	32	BLD*	12.3	63.6	6.6
0.60-0.62	6205.0	16	3.3	13	0.01	26	BLD*	16	53	5.8
0.62-0.64	6330	10	3.8	11.4	0.02	31	BLD*	12.3	34.2	6.5
0.64-0.66	6454.0	13	4.3	15.4	0.02	37	BLD*	13.9	41.1	8.4
0.66-0.68	6579	12	3.7	14.7	0.02	33	BLD*	11.1	34.8	7.5
0.68-0.70	6703.0	12	4	16.3	0.02	35	BLD*	10.1	30.7	8
0.70-0.72	6828	14	3.3	16	BLD*	23	BLD*	11	22	6.8
0.72-0.74	6952.0	16	4.8	19	0.02	42	BLD*	11.7	37.5	9.9
0.74-0.76	7077	15	5	19.4	0.02	40	BLD*	12.2	41.2	9.3
0.76-0.78	7201.0	15	4.6	19.8	0.02	40	BLD*	12.8	37	8.7
0.78-0.80	7326	13	4.2	16.2	0.02	36	BLD*	12.5	37.5	8.9
0.80-0.82	7450.0	16	3.6	18	BLD*	23	BLD*	13	35	7.4
0.82-0.84	7475.0	15	5.1	19.3	0.02	37	BLD*	11.7	57.9	8.3
Limit of detection		3.0	3.0	1.0	0.01	3.0	10	1.0	10	1.0

*BLD= below the limit of detection.

Table S6 (cont.)

Depth (m)	Calendar age (cal yr BP)	Pb (ppm)	Sc (ppm)	Sr (ppm)	Ti (%)	V (ppm)	W (ppm)	Y (ppm)	Zn (ppm)	Zr (ppm)
0.84-0.86	7500.0	17	5.3	21.5	0.02	41	BLD*	13.1	54.1	9.2
0.86-0.88	7525.0	17	5.3	21.9	0.02	42	BLD*	12.8	68.5	9.3
0.88-0.90	7550.0	15	4.9	20.8	0.02	37	BLD*	11.2	40.7	8.5
0.90-0.92	7575.0	10	BLD*	22	0.04	27	BLD*	6.5	29	5.6
0.92-0.94	7583.0	17	5.2	19.3	0.02	40	BLD*	11.2	45.7	8.5
0.94-0.96	7591.0	15	4.8	20.5	0.02	40	BLD*	10.5	43.7	8.7
0.96-0.98	7599.0	16	4.9	21.3	0.02	38	BLD*	10.5	38.2	8.3
0.98-1.00	7607.0	16	4.9	19.6	0.02	40	BLD*	11.2	43.4	10.2
1.00-1.02	7615.0	15	3	17	BLD*	21	BLD*	10	27	6.7
1.10-1.12	7666.4	15	3.2	18	0.01	22	BLD*	11	26	6.9
1.20-1.22	7718	14	BLD*	17	0.01	20	BLD*	10	32	6.2
1.30-1.32	7769.3	15	BLD*	19	0.01	24	BLD*	10	33	6.9
1.40-1.42	7821	16	3.1	20	0.01	30	BLD*	11	33	9
1.50-1.52	7872.1	14	3	21	0.01	22	BLD*	11	35	7.6
1.60-1.62	7924	13	3.1	21	0.01	23	11	10	31	7.6
1.70-1.72	7975.0	14	BLD*	19	0.01	21	BLD*	9.5	30	6.6
1.80-1.82	8108.3	14	BLD*	21	0.01	21	BLD*	9.6	29	6.7
1.90-1.92	82482	13	BLD*	22	0.01	19	BLD*	9.7	30	6.6
2.00-2.02	8375.0	15	BLD*	23	0.01	21	BLD*	10	31	5.7
2.10-2.12	8376.0	14	BLD*	24	0.01	22	BLD*	10	31	7.7
2.20-2.22	8377.0	14	BLD*	23	0.01	16	BLD*	9.7	30	5.8
2.30-2.32	8378.0	14	BLD*	21	0.01	20	BLD*	9.1	27	5.2
2.40-2.42	8379.0	13	BLD*	21	0.01	17	BLD*	9.5	29	5.6
2.50-2.52	8380.0	14	BLD*	22	0.01	16	BLD*	9.6	29	5.6
2.60-2.62	8381.0	13	3.1	25	0.01	18	BLD*	9.8	30	6
2.70-2.72	8382.0	11	BLD*	22	0.01	15	BLD*	8.5	27	6.1
2.80-2.82	8383.0	13	BLD*	25	0.01	19	BLD*	9.6	31	7.1
2.90-2.92	8384.0	12	BLD*	24	0.01	17	BLD*	9	29	6.5
3.00-3.02	8385.0	12	5.6	26	0.05	39	BLD*	6.7	49	12
3.10-3.12	8401.0	12	BLD*	23	0.01	16	BLD*	8.5	27	5.8
3.20-3.22	8417.0	12	BLD*	20	BLD*	17	BLD*	8	27	5.6
3.30-3.32	8433.0	12	BLD*	22	BLD*	16	BLD*	8.2	26	5.7
3.40-3.42	8449.0	10	BLD*	21	BLD*	14	BLD*	7.8	27	5.4
3.50-3.52	8465.0	9.2	BLD*	17	BLD*	12	BLD*	6.9	23	4.3
3.60-3.62	8481.0	11	BLD*	21	BLD*	15	BLD*	7.6	25	5.6
3.70-3.72	8497.0	8.1	BLD*	16	BLD*	12	15	6.2	20	4.9
3.80-3.82	8513.0	7.7	BLD*	94	BLD*	13	BLD*	6.4	20	10
3.90-3.92	8529.0	6.9	BLD*	18	BLD*	8.4	BLD*	5.6	19	3.7
Limit of detection		3.0	3.0	1.0	0.01	3.0	10	1.0	10	1.0

*BLD= below the limit of detection.

Table S6 (cont.)

Depth (m)	Calendar age (cal yr BP)	Pb (ppm)	Sc (ppm)	Sr (ppm)	Ti (%)	V (ppm)	W (ppm)	Y (ppm)	Zn (ppm)	Zr (ppm)
4.00-4.02	8545	6.9	BLD*	23	BLD*	9.1	11	5.4	19	4.3
4.10-4.12	8561	7.7	BLD*	22	BLD*	9.7	BLD*	6.1	21	5
4.20-4.22	8576.0	5.8	BLD*	21	BLD*	7.6	BLD*	5	18	3.9
4.30-4.32	8592	7.2	BLD*	23	BLD*	8.6	BLD*	5.9	20	4.4
4.40-4.42	8607.0	7.8	BLD*	29	0.01	11	BLD*	6.2	21	5.5
4.50-4.52	8623	6.7	BLD*	29	0.01	11	10	5.5	20	5
4.60-4.62	8638.0	7.9	BLD*	31	0.01	9.8	BLD*	6.5	23	5
4.70-4.72	8654	7.3	BLD*	28	0.01	9.7	BLD*	6.1	21	5
4.80-4.82	8669.0	10	3.1	33	0.01	17	BLD*	8	31	7.8
4.90-4.92	8685	8.3	BLD*	28	0.01	11	BLD*	6.6	23	5.7
5.00-5.02	8700.0	7.8	BLD*	26	0.01	9.7	BLD*	5.8	22	5.1
5.10-5.12	8789	10	4.6	29	0.04	32	BLD*	5.7	42	11
5.20-5.22	8877	9.3	BLD*	27	0.01	11	BLD*	7.3	24	5.8
5.30-5.32	8966	12	BLD*	27	0.01	14	BLD*	9.1	29	7.2
5.40-5.42	9054	12	BLD*	31	0.01	14	BLD*	8.9	29	7
5.50-5.52	9143	11	BLD*	30	0.01	14	BLD*	8.9	29	7
5.72-5.74	9338	16	3.4	37	0.01	25	BLD*	10	35	11
Limit of detection		3.0	3.0	1.0	0.01	3.0	10	1.0	10	1.0

*BLD= below the limit of detection.

Table S7. The organic isotopic compositions and content of the paleolagoon sediments of core S03.

Depth (m)	Calendar age (cal yr BP)	$\delta^{13}C_{VPDB}$ x 1000*	TOC (%)†	$\delta^{15}N_{AIR}$ x 1000§	TON (%)†	TC (%)†	TN (%)†	TOC/TN
0.00-0.02	108	-25.1	3.40	6.59	0.31	3.56	0.31	10.97
0.10-0.12	305	-24.9	2.17	5.67	0.11	1.71	0.1	21.70
0.12-0.14	487	-24.6	2.46	6.6	0.21	3.05	0.27	9.11
0.14-0.16	668.0	-24.6	2.48	6.84	0.22	2.54	0.21	11.81
0.16-0.18	850	-25.0	2.32	6.81	0.2	3.08	0.27	8.59
0.18-0.20	1031.0	-25.3	1.74	7.54	0.15	2.67	0.23	7.57
0.20-0.22	1213	-25.4	2.22	7.94	0.21	1.98	0.2	11.10
0.22-0.24	1394.0	-25.5	1.33	7.85	0.13	1.78	0.17	7.82
0.24-0.26	1576	-25.5	1.36	8.85	0.14	1.53	0.14	9.71
0.26-0.28	1757.0	-26.7	0.93	8.4	0.09	1.23	0.12	7.75
0.28-0.30	1939	-26.3	0.92	8.12	0.1	1.27	0.13	7.08
0.30-0.32	2120.0	-26.8	1.00	8.05	0.11	0.99	0.11	9.09
0.32-0.34	2544.0	-26.3	0.77	7.76	0.08	0.99	0.09	8.56
0.36-0.38	3392.0	-25.5	0.65	7.24	0.07	0.88	0.08	8.13
0.38-0.40	3816.0	-25.9	0.65	7.32	0.07	0.99	0.09	7.22
0.40-0.42	4240.0	-25.6	0.82	7.24	0.09	0.85	0.09	9.11
0.42-0.44	4320.0	-26.0	1.21	6.4	0.11	2.29	0.2	6.05
0.44-0.46	4400.0	-26.4	1.79	6.22	0.12	2.27	0.15	11.93
0.46-0.48	4480.0	-26.2	2.07	5.32	0.1	2.14	0.1	20.70
0.48-0.50	4560.0	-26.2	2.34	5.46	0.11	3.13	0.14	16.71
0.50-0.52	4640.0	-26.3	2.75	5.63	0.14	2.48	0.14	19.64
0.52-0.54	4953.0	-25.9	2.54	5.55	0.14	2.63	0.14	18.14
0.54-0.56	5266.0	-25.9	2.40	5.51	0.13	2.75	0.15	16.00
0.56-0.58	5579.0	-26.2	2.15	5.71	0.11	2.44	0.13	16.54
0.58-0.60	5892.0	-25.9	1.82	5.63	0.1	2.05	0.11	16.55
0.60-0.62	6205.0	-26.4	2.97	5.39	0.14	2.66	0.14	21.21
0.62-0.64	6330	-25.8	2.52	5.55	0.13	2.6	0.13	19.38
0.64-0.66	6454.0	-26.0	3.99	5.74	0.14	4.21	0.14	28.50
0.66-0.68	6579	-25.5	1.20	5.48	0.07	1.78	0.09	13.33
0.68-0.70	6703.0	-25.6	1.39	5.98	0.07	1.69	0.08	17.38
0.70-0.72	6828	-25.4	2.58	5.59	0.13	2.24	0.13	19.85
0.72-0.74	6952.0	-26.0	0.72	7.54	0.08	1.94	0.1	7.20
0.74-0.76	7077	-25.1	2.15	6.02	0.12	2.3	0.13	16.54
0.76-0.78	7201.0	-25.7	2.48	5.62	0.13	2.62	0.13	19.08
0.78-0.80	7326	-25.0	2.47	5.68	0.14	2.58	0.14	17.64
0.80-0.82	7450.0	-24.9	2.49	5.66	0.14	2.19	0.14	17.79
0.82-0.84	7475.0	-24.8	2.29	5.48	0.13	2.34	0.14	16.36
0.84-0.86	7500.0	-24.5	2.42	6.01	0.14	2.41	0.14	17.29
0.86-0.88	7525.0	-24.7	2.17	6.02	0.13	2.19	0.13	16.69

*The carbon isotope results were reported in parts per mil relative to Vienna Peedee Belemnite (VPDB).
†TOC= total organic carbon; TON= total organic nitrogen; TC= total carbon; TN= total nitrogen.
§ The nitrogen isotope ratios are reported in parts per mil relative to N_2 in air.

Table S7 (cont.)

Depth (m)	Calendar age (cal yr BP)	$\delta^{13}C_{VPDB}$ x 1000*	TOC (%)†	$\delta^{15}N_{AIR}$ x 1000§	TON (%)†	TC (%)†	TN (%)†	TOC/TN
0.88-0.90	7550.0	-25.5	2.54	5.71	0.13	2.57	0.13	19.54
0.90-0.92	7575.0	-25.0	2.71	5.63	0.15	2.46	0.15	18.07
0.92-0.94	7583.0	-24.9	2.53	5.94	0.13	2.69	0.14	18.07
0.94-0.96	7591.0	-25.3	2.88	5.21	0.14	2.9	0.15	19.20
0.96-0.98	7599.0	-25.0	2.41	5.02	0.13	2.48	0.14	17.21
0.98-1.00	7607.0	-25.2	2.46	5.14	0.13	2.51	0.13	18.92
1.00-1.02	7615.0	-24.6	2.54	5.7	0.14	2.16	0.15	16.93
1.10-1.12	7666.4	-25.3	2.69	5.50	0.14	2.34	0.14	19.21
1.20-1.22	7718	-25.3	3.06	6.00	0.14	2.80	0.15	20.40
1.30-1.32	7769.3	-26.0	5.99	5.24	0.19	2.89	0.15	39.93
1.32-1.34	7780	-25.2	5.03	4.68	0.18	4.45	0.17	29.59
1.40-1.42	7821	-25.1	3.98	5.22	0.15	3.80	0.17	23.41
1.50-1.52	7872.1	-25.2	2.84	5.08	0.13	2.57	0.14	20.29
1.60-1.62	7924	-25.5	3.33	5.30	0.15	3.11	0.16	20.81
1.70-1.72	7975.0	-25.1	3.04	5.41	0.13	3.17	0.13	23.38
1.80-1.82	8108.3	-25.3	3.11	5.25	0.13	3.43	0.14	22.21
1.90-1.92	8242	-25.2	3.21	6.06	0.14	3.25	0.14	22.93
2.00-2.02	8375.0	-25.4	3.15	5.93	0.14	3.31	0.14	22.50
2.10-2.12	8376.0	-25.2	3.24	6.07	0.14	3.16	0.13	24.92
2.20-2.22	8377.0	-24.7	2.43	6.04	0.13	2.55	0.13	18.69
2.30-2.32	8378.0	-25.3	2.75	5.66	0.12	2.84	0.13	21.15
2.40-2.42	8379.0	-25.5	2.43	5.76	0.12	2.58	0.13	18.69
2.50-2.52	8380.0	-25.1	2.24	5.84	0.12	2.36	0.12	18.67
2.60-2.62	8381.0	-24.8	1.93	5.86	0.11	2.05	0.11	17.55
2.70-2.72	8382.0	-25.1	2.19	5.22	0.11	2.28	0.11	19.91
2.80-2.82	8383.0	-25.1	2.29	5.74	0.11	2.46	0.12	19.08
2.90-2.92	8384.0	-25.0	2.46	5.98	0.11	2.64	0.12	20.50
3.00-3.02	8385.0	-25.0	3.60	6.78	0.32	3.63	0.31	11.61
3.10-3.12	8401.0	-24.5	1.53	5.80	0.09	1.61	0.09	17.00
3.20-3.22	8417.0	-24.5	1.55	5.54	0.09	2.5	0.1	15.50
3.30-3.32	8433.0	-24.4	1.52	5.57	0.08	1.67	0.09	16.89
3.40-3.42	8449.0	-24.4	1.46	5.74	0.08	1.27	0.08	18.25
3.50-3.52	8465.0	-24.9	1.48	5.52	0.08	1.4	0.08	18.50
3.60-3.62	8481.0	-24.8	1.14	5.38	0.06	0.98	0.06	19.00
3.70-3.72	8497.0	-25.8	1.75	5.64	0.07	1.99	0.09	19.44
3.80-3.82	8513.0	-25.2	1.30	5.26	0.06	1.44	0.07	18.57
3.90-3.92	8529.0	-24.8	0.76	7.48	0.04	0.73	0.04	19.00
4.00-4.02	8545.0	-24.5	0.95	5.80	0.06	0.92	0.06	15.83
4.10-4.12	8561	-24.7	0.72	6.79	0.04	0.73	0.04	18.00
4.20-4.22	8576.0	-24.9	0.86	5.60	0.05	0.87	0.06	14.33
4.30-4.32	8592	-24.5	0.73	5.88	0.05	0.74	0.05	14.60
4.40-4.42	8607.0	-24.4	0.87	5.91	0.05	0.94	0.06	14.50
4.50-4.52	8623	-24.4	0.91	6.34	0.05	0.99	0.06	15.17

*The carbon isotope results were reported in parts per mil relative to Vienna Peedee Belemnite (VPDB).
†TOC= total organic carbon; TON= total organic nitrogen; TC= total carbon; TN= total nitrogen.
§ The nitrogen isotope ratios are reported in parts per mil relative to N_2 in air.

Table S7 (cont.)

Depth (m)	Calendar age (cal yr BP)	$\delta^{13}C_{VPDB}$ x 1000*	TOC (%)†	$\delta^{15}N_{AIR}$ x 1000§	TON (%)†	TC (%)†	TN (%)†	TOC/TN
4.60-4.62	8638.0	-24.4	0.79	5.9	0.06	0.88	0.06	13.17
4.70-4.72	8654	-24.2	0.89	6.08	0.05	0.93	0.06	14.83
4.80-4.82	8669.0	-24.2	1.03	6.15	0.07	0.74	0.05	20.60
4.90-4.92	8685	-24.1	1.01	6.39	0.07	1.07	0.08	12.63
5.00-5.02	8700.0	-24.8	0.72	5.73	0.04	0.81	0.05	14.40
5.10-5.12	8789	-24.3	0.75	5.63	0.05	0.76	0.06	12.50
5.20-5.22	8877.2	-24.7	1.46	6.04	0.10	1.54	0.11	13.27
5.30-5.32	8966	-24.4	1.75	6.28	0.10	1.8	0.13	13.46
5.40-5.42	9054.4	-24.8	1.55	6.05	0.08	1.54	0.1	15.50
5.50-5.52	9143.0	-24.8	1.55	6.52	0.09	1.61	0.11	14.09
5.58-5.59	9214	-25.0	1.61	5.66	0.08	1.79	0.1	16.10
5.72-5.74	9338	-25.2	2.74	6.59	0.13	2.59	0.15	18.27

*The carbon isotope results were reported in parts per mil relative to Vienna Peedee Belemnite (VPDB).
†TOC= total organic carbon; TON= total organic nitrogen; TC= total carbon; TN= total nitrogen.
§ The nitrogen isotope ratios are reported in parts per mil relative to N_2 in air.

Table S8. The sulfur isotopic compositions and content of the paleolagoon sediments of core S03.

Depth (m)	Calendar age (cal yr BP)	$\delta^{34}S_{VCDT}$(‰)*	Sulfur (%)	Depth (m)	Calendar age (cal yr BP)	$\delta^{34}S_{VCDT}$(‰)*	Sulfur (%)
0.00-0.02	108.0	-0.29	0.039	0.90-0.92	7575.0	-8.68	1.95
0.10-0.12	305.0	-9.49	1.14	0.92-0.94	7583.0	-8.56	2.035
0.12-0.14	487	1.55	0.032	0.94-0.96	7591.0	-9.38	2.01
0.14-0.16	668.0	2.29	0.03	0.96-0.98	7599.0	-5.66	1.908
0.16-0.18	850	2.99	0.029	0.98-1.00	7607.0	-11.63	2.094
0.18-0.20	1031.0	3.36	0.024	1.00-1.02	7615.0	-11.27	1.889
0.20-0.22	1213	4.30	0.031	1.10-1.12	7666.4	-16.57	2.378
0.22-0.24	1394.0	3.13	0.023	1.20-1.22	7717.9	-12.88	1.659
0.24-0.26	1576	1.77	0.02	1.30-1.32	7769.3	-11.91	2.635
0.26-0.28	1757.0	1.68	0.017	1.32-1.34	7779.6	-12.37	2.868
0.28-0.30	1939	1.60	0.017	1.40-1.42	7820.7	-11.69	1.84
0.30-0.32	2120.0	2.35	0.018	1.50-1.52	7872.1	-10.94	1.46
0.32-0.34	2544.0	0.08	0.015	1.60-1.62	7923.6	-8.18	1.69
0.34-0.36	2968.0	1.01	0.018	1.70-1.72	7975.0	-7.40	1.56
0.36-0.38	3392.0	-1.58	0.016	1.72-1.74	8001.7	-6.77	1.76
0.38-0.40	3816.0	-0.30	0.02	1.80-1.82	8108.3	-7.77	1.35
0.40-0.42	4240.0	-0.87	0.025	1.90-1.92	8241.7	-8.01	1.68
0.42-0.44	4320.0	-4.29	0.036	2.00-2.02	8375.0	-9.46	1.45
0.44-0.46	4400.0	-14.55	0.389	2.10-2.12	8376.0	-10.61	2.05
0.46-0.48	4480.0	-15.88	0.846	2.20-2.22	8377.0	-7.26	1.39
0.48-0.50	4560.0	-17.09	1.13	2.30-2.32	8378.0	-8.18	1.51
0.50-0.52	4640.0	-15.74	1.50	2.40-2.42	8379.0	-9.96	1.14
0.52-0.54	4953.0	-17.54	1.575	2.50-2.52	8380.0	-9.66	1.16
0.54-0.56	5266.0	-12.91	1.647	2.60-2.62	8381.0	-11.00	1.14
0.56-0.58	5579.0	-14.14	1.24	2.70-2.72	8382.0	-9.44	1.51
0.58-0.60	5892.0	-16.53	1.13	2.80-2.82	8383.0	-10.08	1.69
0.60-0.62	6205.0	-14.36	1.69	2.90-2.92	8384.0	-9.04	1.32
0.62-0.64	6330	-16.69	2.023	3.00-3.02	8385.0	-1.99	0.052
0.64-0.66	6454.0	-15.93	2.194	3.10-3.12	8401.0	-7.08	1.08
0.66-0.68	6579	-16.45	1.463	3.20-3.22	8417.0	-6.62	1.36
0.68-0.70	6703.0	-14.18	1.443	3.30-3.32	8433.0	-4.97	1.18
0.70-0.72	6828	-12.01	2.355	3.40-3.42	8449.0	-5.01	0.929
0.72-0.74	6952.0	-8.29	1.844	3.50-3.52	8465.0	-6.42	0.743
0.74-0.76	7077	-6.37	1.755	3.60-3.62	8481.0	-6.00	0.742
0.76-0.78	7201.0	-8.12	2.029	3.70-3.72	8497.0	-10.76	0.981
0.78-0.80	7326	-7.89	1.926	3.80-3.82	8513.0	-11.17	0.666
0.80-0.82	7450.0	-10.82	1.936	3.90-3.92	8529.0	-4.03	0.857
0.82-0.84	7475.0	-7.45	1.759	4.00-4.02	8545.0	-4.61	0.916
0.84-0.86	7500.0	-7.83	1.896	4.10-4.12	8560.5	-2.85	0.668
0.86-0.88	7525.0	-6.14	1.876	4.20-4.22	8576.0	-3.94	0.71
0.88-0.90	7550.0	-8.14	2.045	4.30-4.32	8591.5	-0.87	0.812

*The sulfur isotopic ratios are reported in parts per mil relative to Vienna Cañon Diablo Troilite (VCDT)

Table S8 (cont.)

Depth (m)	Calendar age (cal yr BP)	$\delta^{34}S_{VCDT}$(‰)*	Sulfur (%)
4.40-4.42	8607.0	-1.04	0.961
4.50-4.52	8623	-2.04	0.888
4.60-4.62	8638.0	-2.27	0.636
4.70-4.72	8654	-1.72	1.01
4.80-4.82	8669.0	1.28	0.964
4.90-4.92	8685	2.91	0.948
5.00-5.02	8700.0	1.07	0.655
5.10-5.12	8789	-0.72	0.721
5.20-5.22	8877.2	-1.38	1.07
5.30-5.32	8966	-3.91	1.16
5.40-5.42	9054.4	-2.87	0.986
5.50-5.52	9143.0	-4.04	1.05
5.58-5.59	9338.0	-4.99	0.885
5.72-5.74	8607.0	-18.94	1.89

*The sulfur isotopic ratios are reported in parts per mil relative to Vienna Cañon Diablo Troilite (VCDT)

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Figure S1

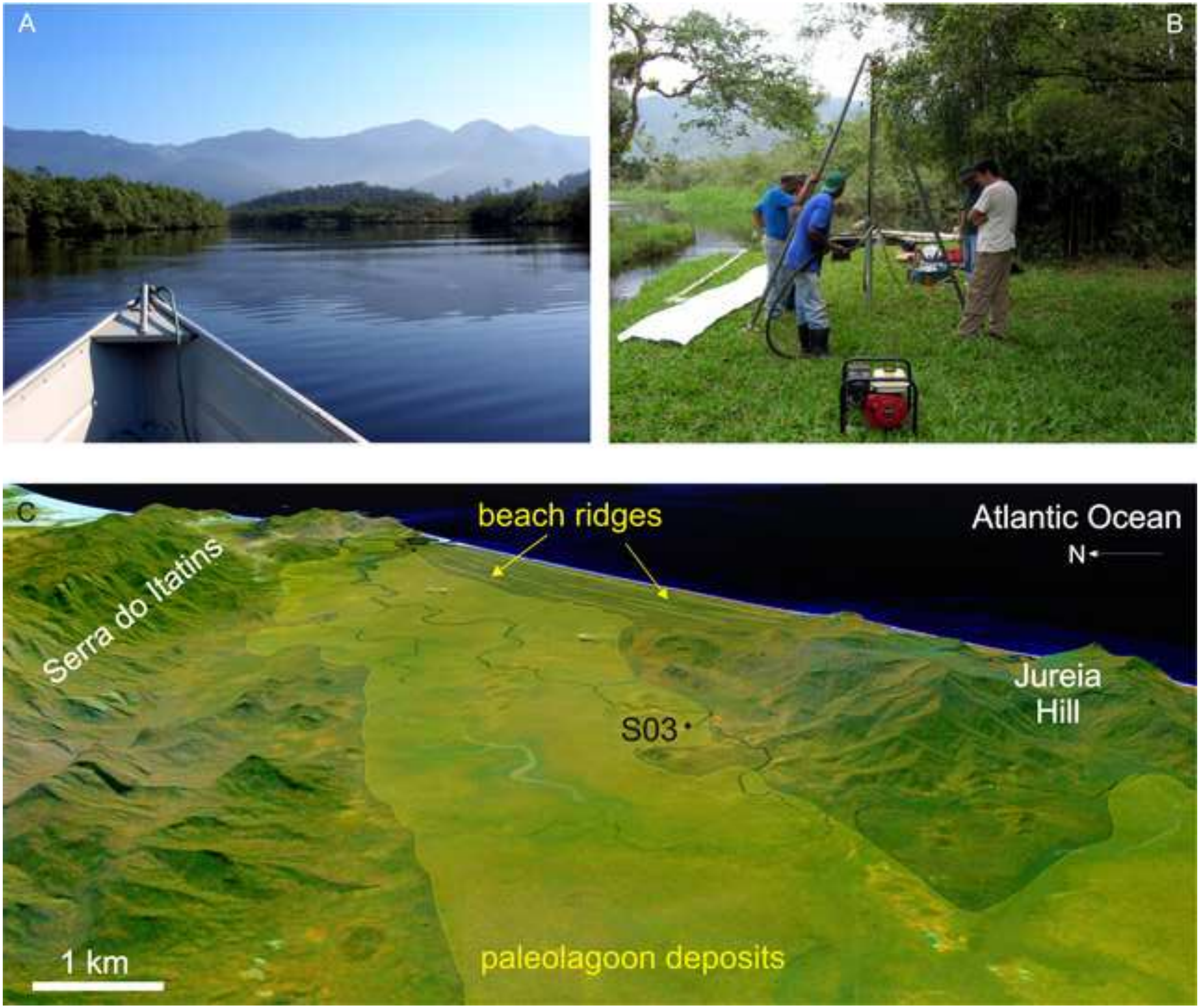
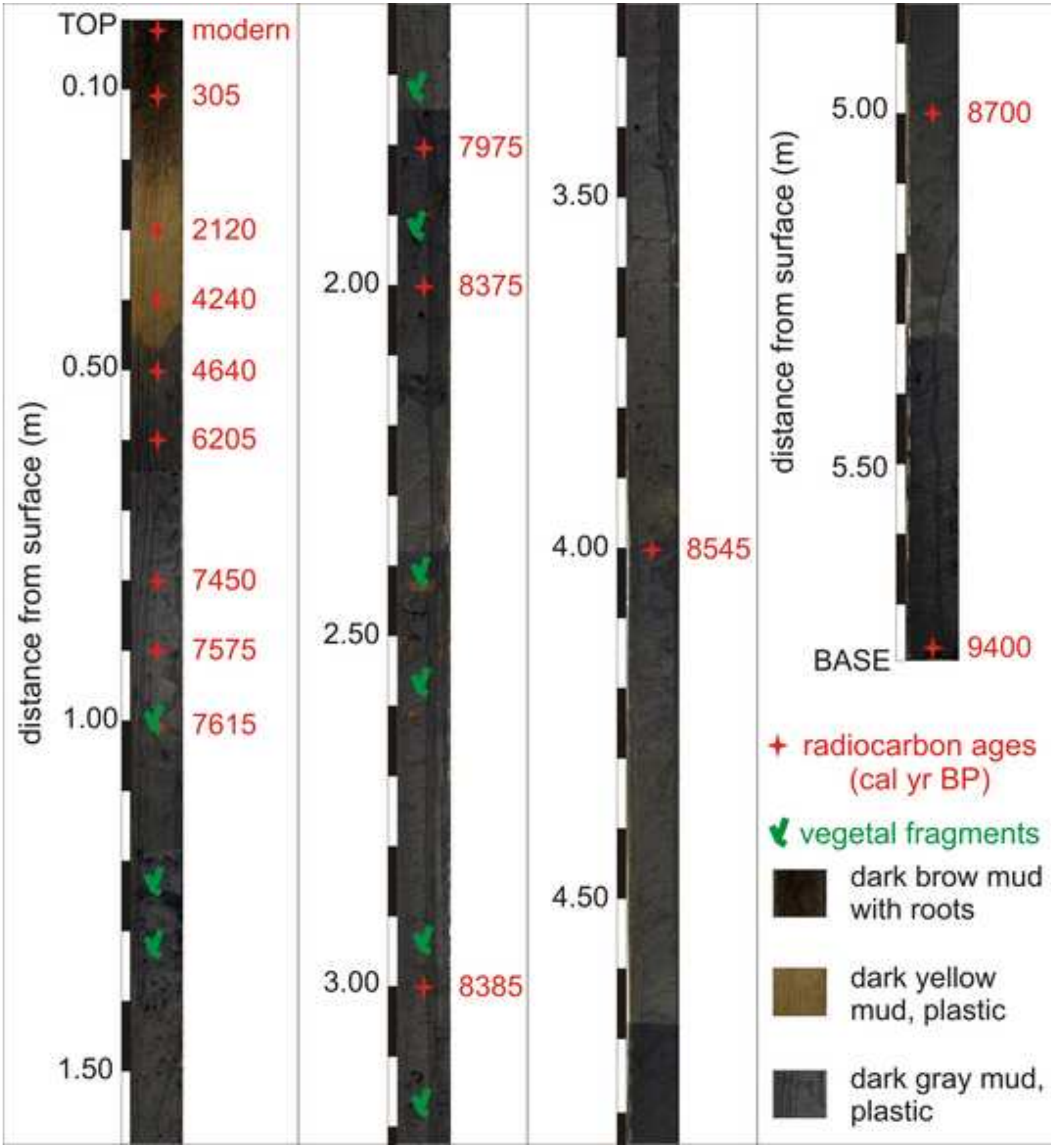
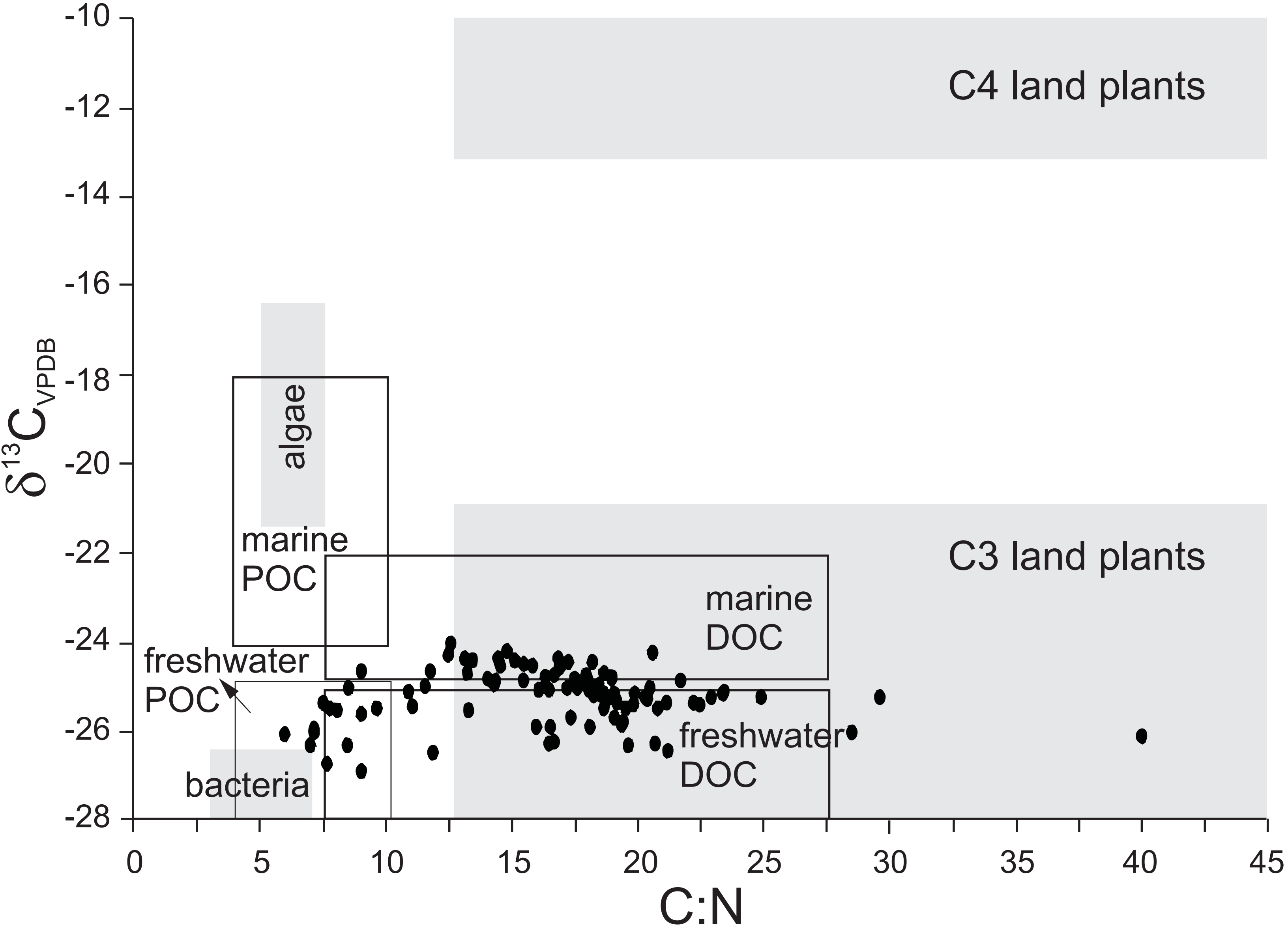

A
B
C
beach ridges
Atlantic Ocean
N
Serra do Itatins
Jureia Hill
S03
1 km
paleolagoon deposits

Figure S2



TOP
modern
0.10
305
2120
4240
0.50
4640
6205
7450
7575
1.00
7615
1.50
distance from surface (m)
7975
2.00
8375
2.50
3.00
8385
3.50
4.00
8545
4.50
5.00
8700
5.50
distance from surface (m)
BASE
9400
radiocarbon ages (cal yr BP)
vegetal fragments
dark brow mud with roots
dark yellow mud, plastic
dark gray mud, plastic

Figure S3


C4 land plants
algae
marine
POC
C3 land plants
marine
DOC
freshwater
POC
freshwater
DOC
bacteria
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
$\delta^{13}C_{VPDB}$
0
5
10
15
20
25
30
35
40
45
C:N