

Supplementary Materials to the manuscript:

Holocene environmental change in Rotsee and its impact on sedimentary carbon storage

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(A) labID	Type	^{210}Pb (Bq/kg)	2σ sd(^{210}Pb)	composite depth (cm blf)	thickness(cm)	^{226}Ra (Bq/kg)	2σ sd(^{226}Ra)
ROT21-9C_01	^{210}Pb	150	19.1	1	1	0.027	3.97
ROT21-9C_02	^{210}Pb	122.6	16.9	2	1	0.0244	4.68
ROT21-9C_03	^{210}Pb	120.1	15.2	3	1	0.0219	4.27
ROT21-9C_04	^{210}Pb	126.4	18.2	4	1	0.0226	4.98
ROT21-9C_05	^{210}Pb	145.1	17	5	1	0.0229	3.59
ROT21-9C_06	^{210}Pb	143.8	20.3	6	1	0.0232	4.94
ROT21-9C_07	^{210}Pb	134.5	17.6	7	1	0.0215	4.2
ROT21-9C_08	^{210}Pb	132.2	16.6	8	1	0.0238	3.87
ROT21-9C_09	^{210}Pb	124.2	16.5	9	1	0.0258	4.07
ROT21-9C_11	^{210}Pb	76.4	11.5	11	1	0.021	5
ROT21-9C_13	^{210}Pb	75.1	11	13	1	0.0208	4.32
ROT21-9C_14	^{210}Pb	72.4	9.8	14	1	0.0251	3.74
ROT21-9C_15	^{210}Pb	64.4	9.4	15	1	0.026	3.91
ROT21-9C_16	^{210}Pb	53.8	5.5	16	1	0.0236	2.57
ROT21-9C_17	^{210}Pb	48.5	8	17	1	0.0284	4.77
ROT21-9C_19	^{210}Pb	21.7	3.9	19	1	0.0217	3.85
ROT21-9C_20	^{210}Pb	34.9	5.4	20	1	0.0249	4.49
ROT21-9C_21	^{210}Pb	28.3	5.5	21	1	0.0221	5.18
ROT21-9C_22	^{210}Pb	24.5	4.3	22	1	0.0227	4.73
ROT21-9C_23	^{210}Pb	26.6	3.7	23	1	0.0238	4.18
ROT21-9C_25	^{210}Pb	19.3	3.7	25	1	0.0218	4.09
ROT21-9C_27	^{210}Pb	18.6	3.8	27	1	0.0226	5.02
ROT21-9C_29	^{210}Pb	20.8	4.2	29	1	0.0218	5.01
ROT21-9C_31	^{210}Pb	6.9	1.7	31	1	0.0237	4.06
ROT21-9C_33	^{210}Pb	8.1	2.1	33	1	0.0194	5.29
ROT21-9C_35	^{210}Pb	8.9	2.4	35	1	0.0199	4.7
ROT21-9C_37	^{210}Pb	2.8	0.5	37	1	0.0232	3.46
ROT21-9C_38	^{210}Pb	8.4	1.7	38	1	0.0244	3.59
ROT21-9C_39	^{210}Pb	4.3	0.9	39	1	0.0249	3.55
ROT21-9C_40	^{210}Pb	2.4	0.5	40	1	0.024	3.44
ROT21-9C_42	^{210}Pb	10.5	2.2	42	1	0.024	4.71
ROT21-9C_45	^{210}Pb	12	2	45	1	0.0238	3.29
ROT21-9C_48	^{210}Pb	2.9	0.7	48	1	0.0229	3.48
ROT21-9C_50	^{210}Pb	10.6	2	50	1	0.023	3.5

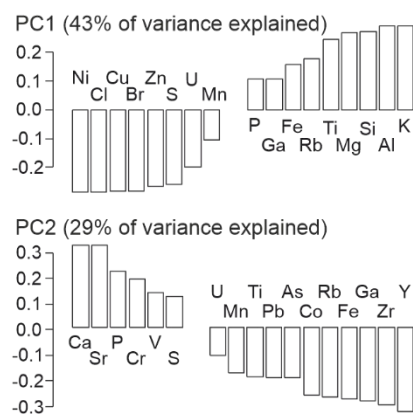
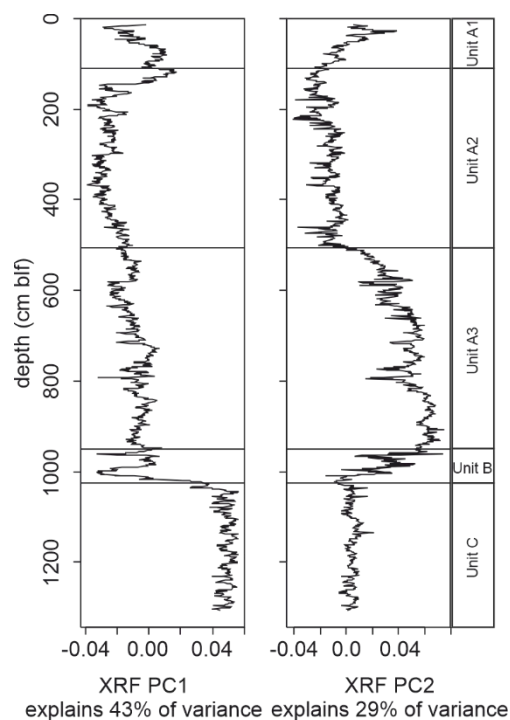
(B) labID	Type	age	error (yr)	composite depth (cm blf)
Cs_1	^{137}Cs peak	35	1	14.5
Cs_2	^{137}Cs peak	58	1	19.5
ROT21_1_A_45	^{14}C , leaf fragment	77	68	55.3
ROT21_1_B_66	^{14}C , leaf fragment	2008	72	176.8
ROT21_1_C_30.5	^{14}C , leaf fragment	3656	81	241.3
ROT21_1_C_55	^{14}C , conifer needle	3353	74	265.8
ROT21_1_C_56.5	^{14}C , leaf fragment	3866	184	267.3
ROT21_1_C_80	^{14}C , beech nut	3436	75	290.8
ROT21_2_B_45	^{14}C , leaf fragment, fragment of beech nut	5233	81	430.8
ROT21_2_C_64	^{14}C , leaf and twig fragments	6806	88	549.8
ROT21_3_B_15	^{14}C , seedpods of grass	8016	92	673.8
ROT21_3_B_84	^{14}C , leaf fragment	10047	98	742.8
ROT21_4_B_3.5	^{14}C , leaf fragments	8860	103	838.8
ROT21_4_C_5	^{14}C , fibrous material	8840	108	940.8
ROT21_4_C_65.5	^{14}C , Chara stem *	9680	268	984.8
ROT21_4_C_70	^{14}C , Chara stem *	10296	252	989.3
ROT21_4_C_76	^{14}C , Chara stem *	10229	257	995.3
ROT21_4_C_81	^{14}C , Chara stem *	11005	264	1000.3
ROT21_4_C_87	^{14}C , Chara stem *	11425	262	1006.3
ROT21_4_C_90.5	^{14}C , Chara stem *	11311	290	1009.8
ROT21_4_C_92	^{14}C , Chara stem *	10926	259	1011.3

(C) labID	Reservoir derived ^{14}C age	Reservoir derived ^{14}C error	Atmosphere derived ^{14}C age	Atmosphere derived ^{14}C error	Reservoir age offset	Reservoir age offset error
Shallow (1-B-66, 1-B-63)	2686	71	2008	72	678	101
Deep (4-C-5, 4-C-14)	10169	98	8840	108	1329	146

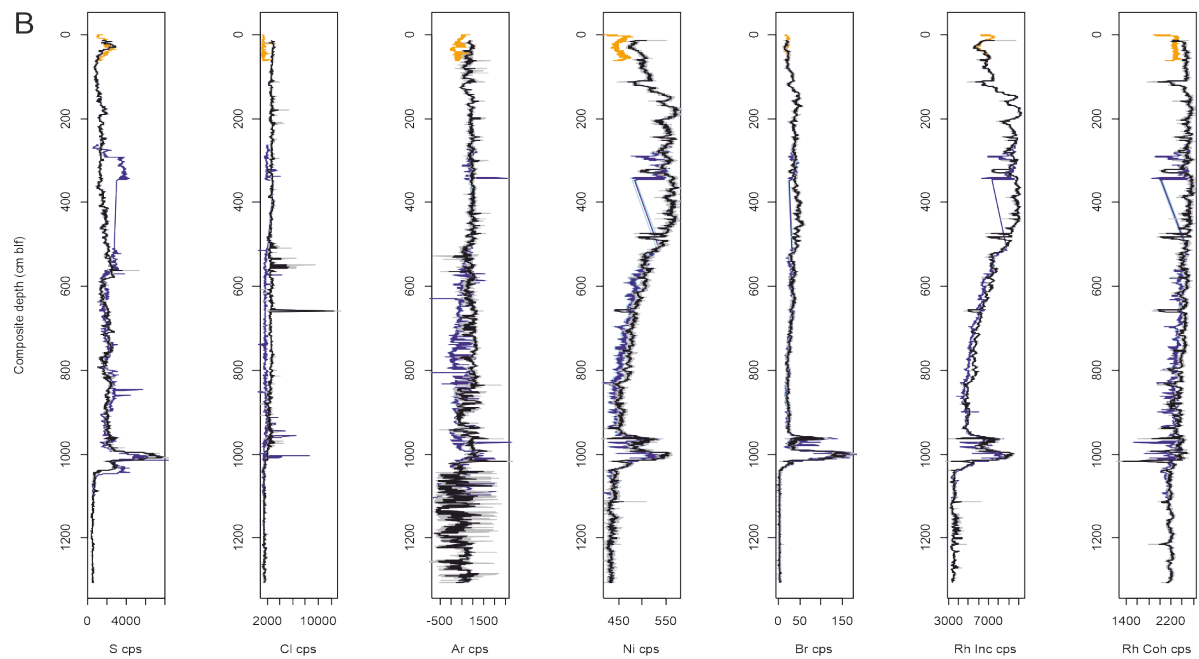
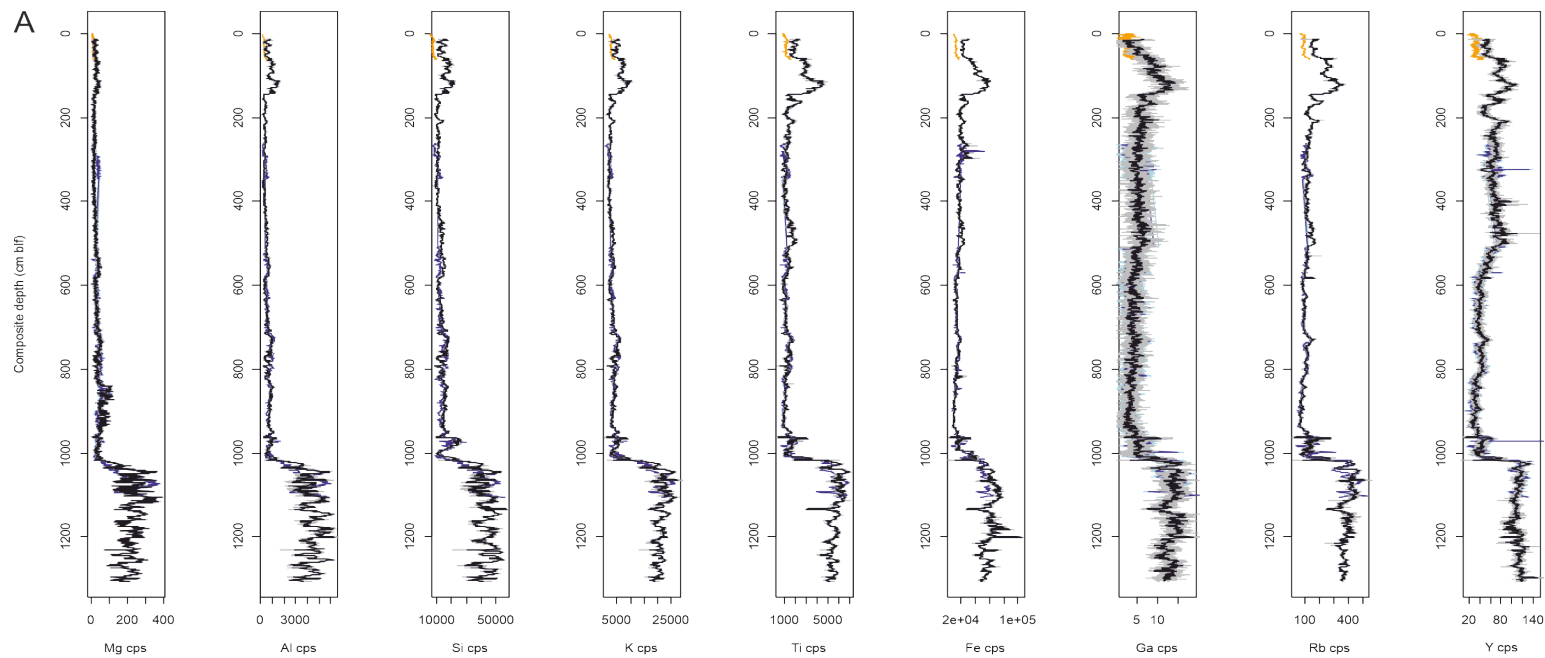
Supp. Table 1. The ages and associated offsets of the ^{210}Pb , ^{137}Cs and ^{14}C dates used for the age model (Fig. 1A). The estimated reservoir ages of section 4C (C) are used to correct for the ^{14}C ages of the macrophyte macrofossil remains.

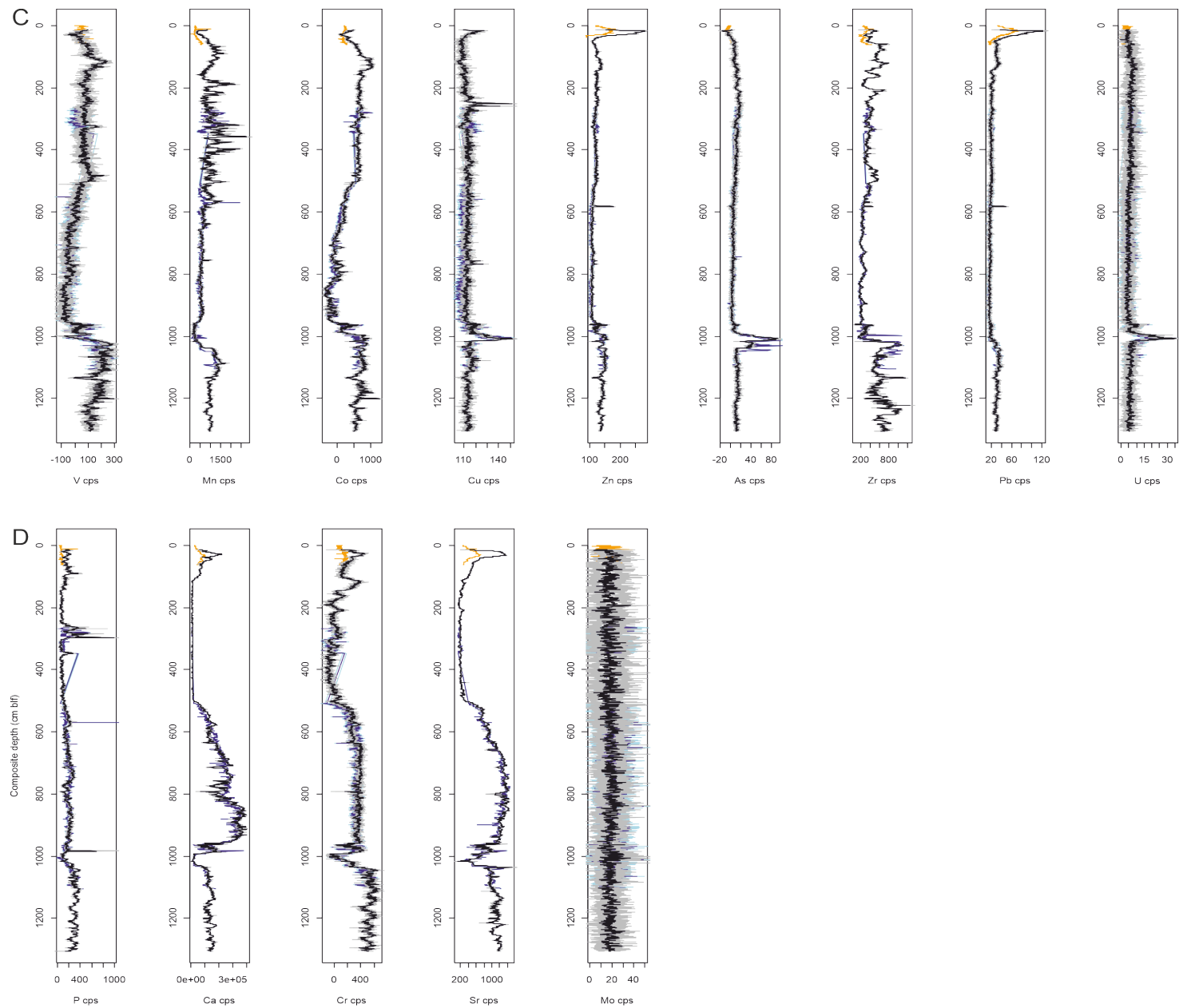
Compound class	Compound	Compound class	Compound
Alcohol	1-Dodecanol, 2-hexyl- (C18:0)		1H-Pyrrole-2,5-dione
	Behenic alcohol		Benzyl nitrile
	Ethanol, 2-(octadecyloxy)-		3-Pyridinol, 6-methyl-
Aldehyde	Tetradecanal		Benzenepropanenitrile
Alkane	Heneicosane (C22:0)		Indole
Alkene	6-Tridecene (C13:1)		Diketodipyrrole
	1-Docosene (C22:1)		cis-Cyclo(L-Ala-L-Pro)
Carbohydrate	Furfural		Cyclo(Pro-Gly)
	Furan, 2,3-dihydro-2,5-dimethyl-		Cyclo(Pro-Pro)
	2-Furancarboxaldehyde, 5-methyl-		Alkylamide2
	2-Furancarboxaldehyde, 5-methyl-		Cyclo(Pro-Lys-NH3)
	2-Cyclohexen-1-one, 4-hydroxy-	PAHs	p-Xylene
	4-hydroxy-5,6-dihydro(2H)-pyran-2-one		Ethanone, 2,2-dihydroxy-1-phenyl-
	D-Limonene		1H-Indole, 3-methyl-
	Dianhydrorhamnose		2H-1-Benzopyran-3,4-diol, 2-(3,4dimethoxyphenyl)-3,4-dihydro-6-methyl-, (2 α ,3 α ,4 α)-
	Benzofuran, 2,3-dihydro-		Butan-2-one, 4-(3-hydroxy-2-methoxyphenyl)-
	3-Acetamidofuran	Phenol	Phenol
	Methyl- α -d-ribofuranoside		p-Cresol
	1,6-Anhydro- β -d-talopyranose		Phenol, 2-methoxy-
	Levoglucozan		Phenol, 3-ethyl-
	Methyl N-acetyl-d-glucosamide		Creosol
Ester	Decanoic acid, decyl ester		Phenol, 4-ethyl-2-methoxy-
	Dodecanoic acid, tetradecyl ester		2-Methoxy-4-vinylphenol
	Decanoic acid, decyl ester		Phenol, 2,6-dimethoxy-
	Dodecanoic acid, tetradecyl ester		Phenol, 2-methoxy-5-(1-propenyl)-, (E)-
	Dodecanoic acid, hexadecyl ester		Phenol, 2-methoxy-4-(1-propenyl)-
	Dodecanoic acid, tetradecyl ester		Phenol, 2,6-dimethoxy-4-(2-propenyl)-
	Tetradecanoic acid, hexadecyl ester		4-((1E)-3-Hydroxy-1-propenyl)-2-methoxyphenol
Fatty Acid	2-Pentenoic acid (C5:1)	Chlorophyll	Prist-1-ene
	n-Hexadecanoic acid (C16:0)	Sterane	Cholesta-3,5-diene
	Octadecanoic acid (C18:0)		Stigmastan-3,5-diene
	2-Heptadecanone (C17:1)	Other	Friedelan-3-one
Hopene	22,29,30 trisnorhop17(21)-ene		γ -Tocopherol
	Urs-20-en-16-one		
Ketone	2-Heptadecanone (C17:1)		
	2-Pentadecanone		
	2-Nonadecanone		
Lignin	Syringaldehyde		
N-compound	1H-Pyrrole, 3-methyl-		
	dl- α -Methylglutamic acid		
	4(3H)-Pyrimidinone, 3-methyl-		

Supp. Table 2. The molecular composition (compound diversity) of the Py-GC/MS compound classes.

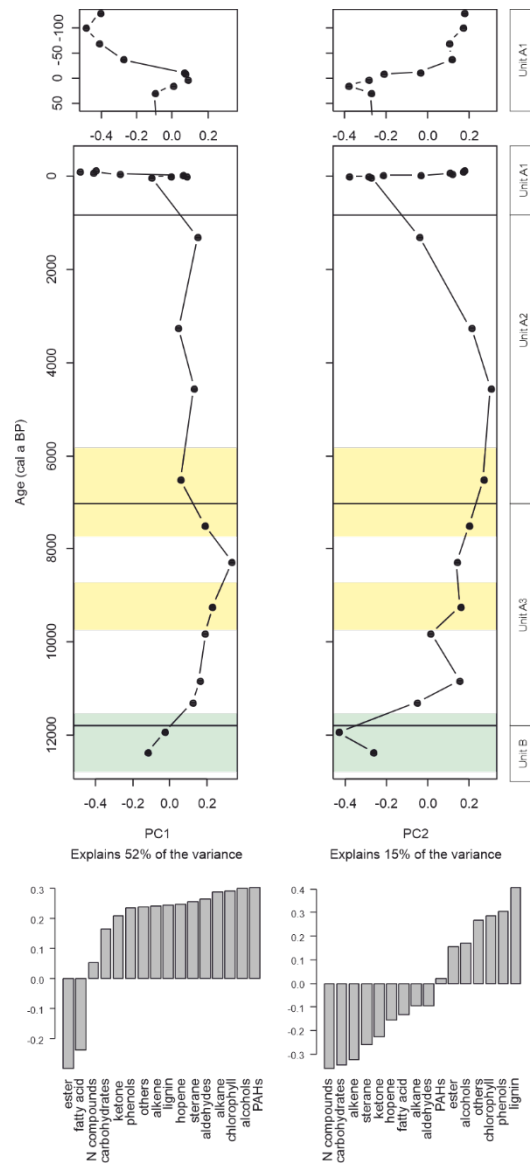


Supp. Fig. 1. The downcore scores of the principal components of variation (PC1, PC2), based on a principal component analysis of the scaled clr-transformed XRF counts, with the loading of the individual elements on PC1 and PC2 represented by barplots, using a cut-off value (score>0.1).

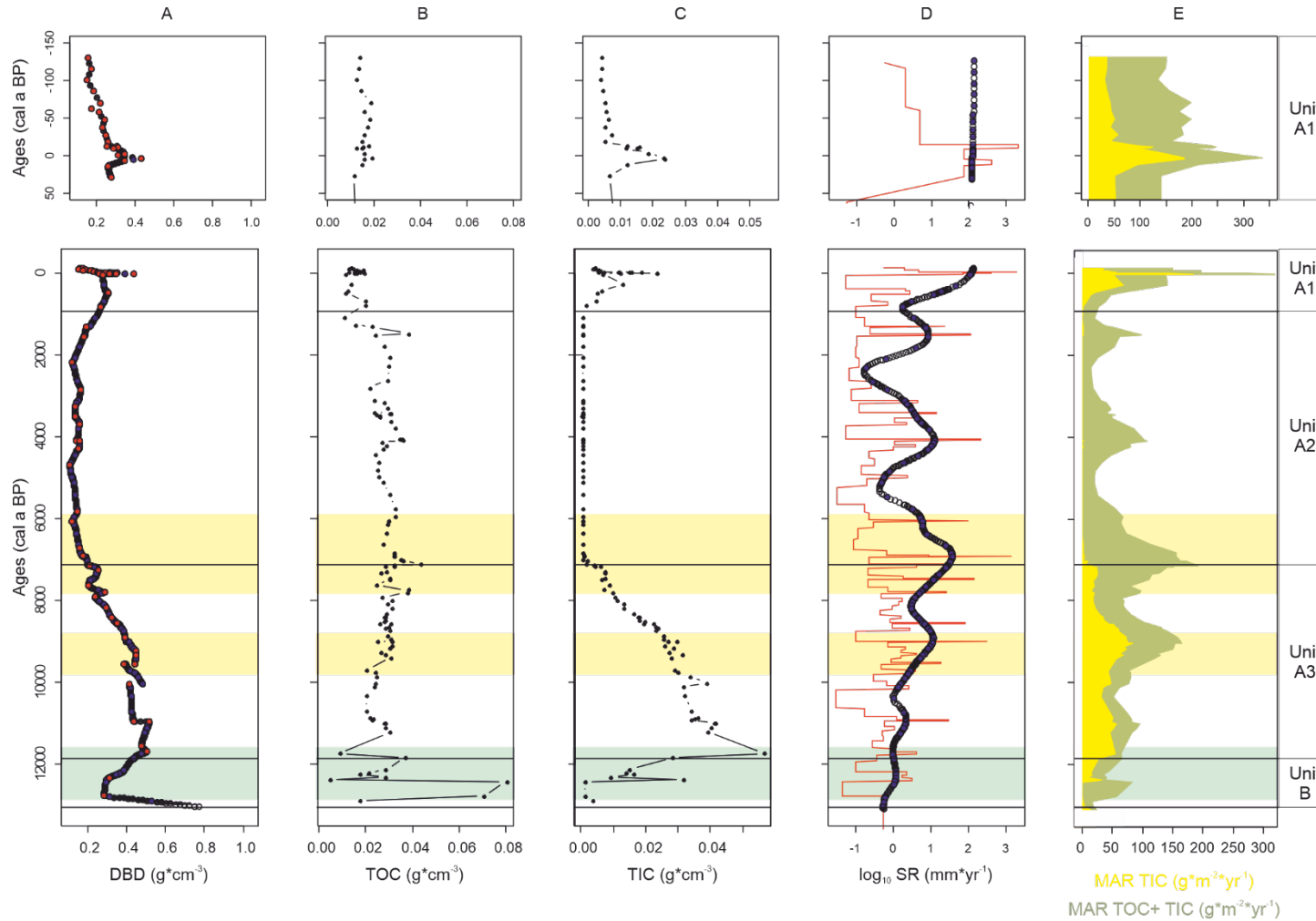




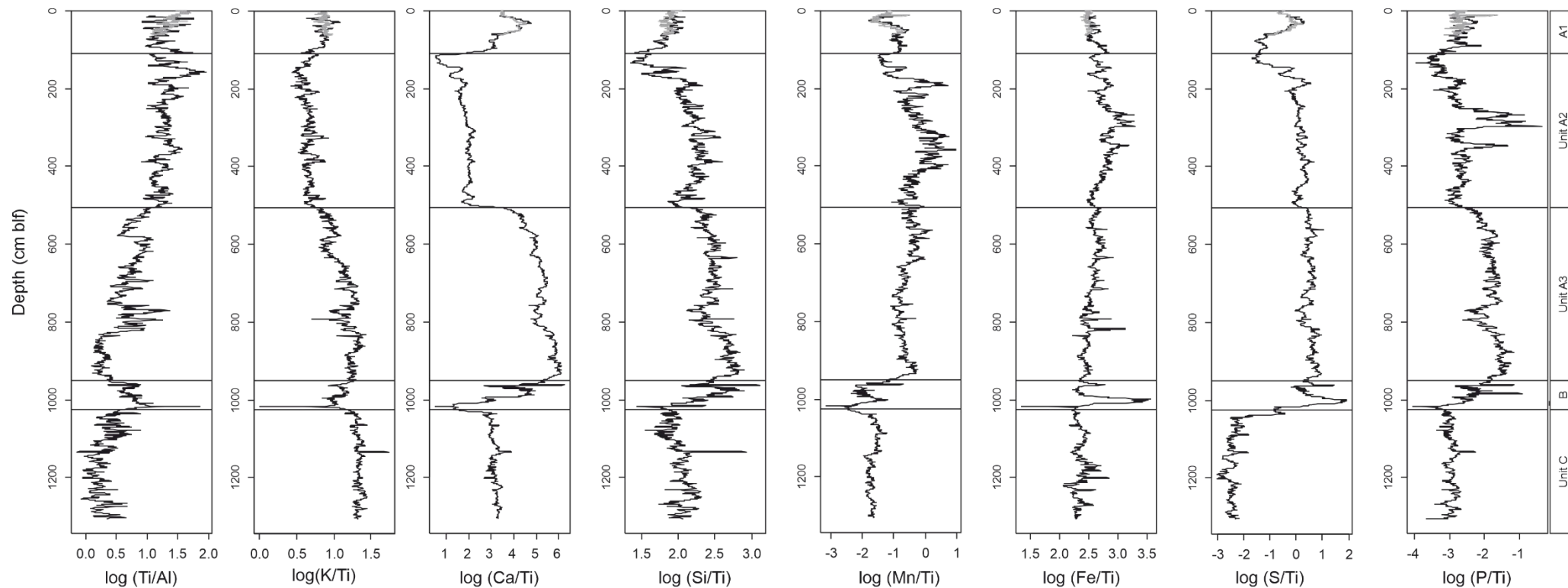
Supp. Fig. 2. The XRF counts of all analysed elements, plotted as a 2-point average. Black indicates XRF measurements done on the first borehole, blue indicates measurements done on the second borehole. Grey indicates the standard deviation of the measurements.



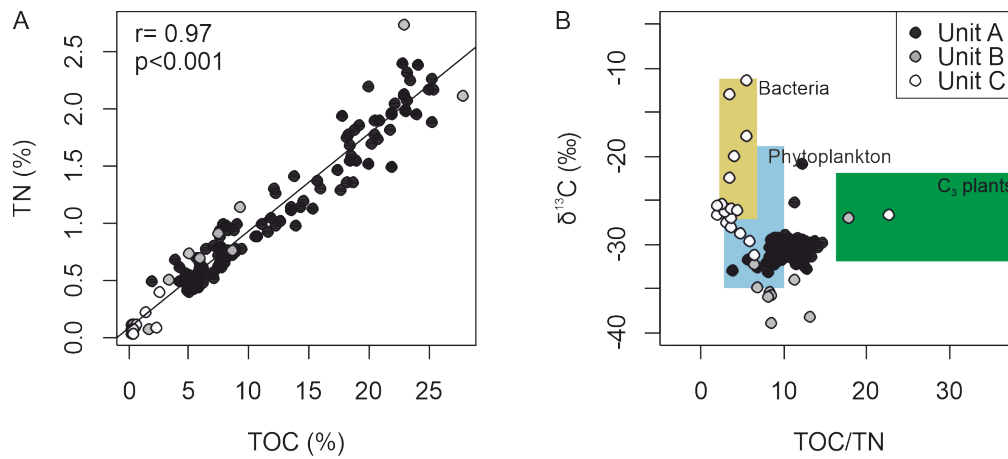
Supp. Fig. 3. The downcore scores of the principal components of variation (PC1, PC2) based on the standardized relative abundances of the compound classes (Fig. 4), with the loading of the individual compound classes on PC1 and PC2 represented by barplots. Background colors indicate climate periods, with Younger Dryas indicated in green and Holocene warm periods indicated in yellow. The most recent 100 years are replotted on a more detailed scale.



Supp. Fig. 4. The downcore values of the A) measured (red symbol) and interpolated (black and blue symbols, with blue symbols indicating depths selected for downstream calculations) dry bulk density values (g cm⁻³), B) calculated total organic carbon and C) total inorganic carbon density (g cm⁻³), D) the sedimentation rate (red line), with smoothed trend (black and blue symbols, with blue symbols indicating depths selected for downstream calculations). These parameters (B-D) are at the basis of the calculated MAR rates for total inorganic carbon (TIC) [yellow area] and summed TIC and total organic carbon (TOC) [green area], plotted in panel E. Background colors indicate climate periods, with Younger Dryas indicated in green and Holocene warm periods indicated in yellow. For all parameters, the most recent 100 years are replotted on a more detailed scale.



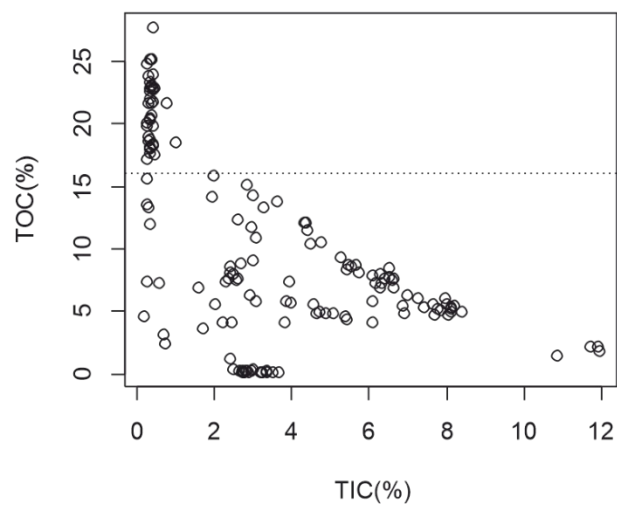
Supp. Fig. 5. Selected XRF log-ratios, plotted against depth. The grey data points reflect the XRF ratio values measured on the short core.



Supp. Fig. 6. Bulk organic matter parameters, A) scatterplot of total organic carbon (TOC, %) and total nitrogen (TN, %) and B) $\delta^{13}\text{C}_{\text{TOC}}$ and C/N plot after Meyers et al. (1997). Colored areas indicate organic matter provenance brackets after Lamb et al. (2006). Symbol colors reflect the lithological Units A-C (see legend).

Meyers PA (1997) Organic geochemical proxies of paleoceanographic, paleolimnologic, and paleoclimatic processes. *Organic Geochemistry* 27:213–250. [https://doi.org/10.1016/S0146-6380\(97\)00049-1](https://doi.org/10.1016/S0146-6380(97)00049-1)

Lamb AL, Wilson GP, Leng MJ (2006) A review of coastal palaeoclimate and relative sea-level reconstructions using $\delta^{13}\text{C}$ and C/N ratios in organic material. *Earth-Science Reviews* 75:29–57. <https://doi.org/10.1016/j.earscirev.2005.10.00>



Supp. Fig. 7. A scatterplot showing the dependency between total inorganic carbon (TIC) and total organic carbon (TOC) content of the lacustrine sediments. The horizontal line indicates the cut-off value of 16% TOC.