Supplementary Material for

Quantification of allochthonous and autochthonous organic carbon in large and shallow Lake Wuliangsu based on distribution patterns and $\delta^{13}C$ signatures of *n*-alkanes

Qingfeng Zhao[1], Aifeng Zhou[2], Yuxin He[1*]

[1] Organic Geochemistry Unit, Key Laboratory of Geoscience Big Data and Deep Resource of Zhejiang Province, School of Earth Sciences, Zhejiang University, Hangzhou, 310058, China

[2] Key Laboratory of Western China's Environmental Systems (Ministry of Education), College of Earth and Environmental Sciences, Lanzhou University, Lanzhou, 730000, China

Contents of this file:

1. Supplementary equations for end-members mixing models

2. Supplementary figures: Figure S1

3. Supplementary tables: Table S1 to S4

1. Supplementary equations for end-members mixing models

1.1 Proxies:

$P_{aq} = (C_{23} + C_{25}) / (C_{23} + C_{25} + C_{29} + C_{31})$ (Ficken et al. 2000) (1)

CPI $=0.5 \times ((C_{23} + C_{25} + C_{27} + C_{29}) + (C_{25} + C_{27} + C_{29} + C_{31})) / (C_{24} + C_{26} + C_{28} + C_{30})$ (Eglinton and Hamilton, 1967) (2)

where C_i are the concentration of *n*-C_i alkane in samples.

1.2 Equations for Model #1

$F_{sub} \times \%C_{23+25\text{-}sub} + F_{eme} \times \%C_{23+25\text{-}emer} + F_{riv} \times \%C_{23+25\text{-}riv} = \%C_{23+25\text{-}sample}$ (3);

$F_{sub} \times \%C_{27+29\text{-}sub} + F_{emer} \times \%C_{27+29\text{-}emer} + F_{riv} \times \%C_{27+29\text{-}riv} = \%C_{27+29\text{-}sample}$ (4);

$F_{sub} \times \%C_{31\text{-}sub} + F_{riv} \times \%C_{31\text{-}riv} = \%C_{31\text{-}sample}$ (5);

$F_{sub} + F_{emer} + F_{riv} = 1$ (6).

where F_{sub}, F_{emer}, and F_{riv} are relative contributions to sedimentary *n*-$C_{23+25+27+29+31}$ alkanes from submerged macrophytes, emergent plants, and riverine sources, respectively. $\%C_{x\text{-}sub}$, $\%C_{x\text{-}emer}$, $\%C_{x\text{-}riv}$, and $\%C_{x\text{-}sample}$ denotes the relative proportions of *n*-C_x alkanes to total *n*-$C_{23+25+27+29+31}$ alkanes from submerged macrophytes, emergent plants, riverine sediment, and samples, respectively.

1.3 Equations for CPI_{est} and $\delta^{13}C_{i\text{-}est}$

CPI_{est}=((1+%$C_{25+27+29\text{-}sub}$)×F_{sub}+(1+%$C_{25+27+29\text{-}emer}$)×F_{emer}+(1+%$C_{25+27+29\text{-}sub}$)×F_{riv})/ ((1+ %$C_{25+27+29\text{-}sub}$) × F_{sub} / CPI_{sub} + (1+%$C_{25+27+29\text{-}emer}$) × F_{emer} / CPI_{emer} + (1 + %$C_{25+27+29\text{-}sub}$)× F_{riv} / CPI_{riv}) (7) ;

$\delta^{13}C_{i\text{-}est}$ = (F_{sub} × %$C_{i\text{-}sub}$ × $\delta^{13}C_{i\text{-}sub}$ + F_{emer} × %$C_{i\text{-}emer}$ × $\delta^{13}C_{i\text{-}emer}$ + F_{riv} × %$C_{i\text{-}riv}$ × $\delta^{13}C_{i\text{-}riv}$) / (F_{sub} × %$C_{i\text{-}sub}$+ F_{emer} × %$C_{i\text{-}emer}$+ F_{riv} × %$C_{i\text{-}riv}$) (8);

where F_{sub}, F_{emer}, and F_{riv} are relative contributions to sedimentary n-$C_{23+25+27+29+31}$ alkanes from submerged macrophytes, emergent plants, and riverine sources calculated by the end-member mixing model. $\delta^{13}C_{i\text{-}sub}$, $\delta^{13}C_{i\text{-}emer}$, and $\delta^{13}C_{i\text{-}riv}$ are the $\delta^{13}C$ values of n-C_i alkane of submerged macrophytes, emergent plants, and riverine sediment, respectively. %$C_{x\text{-}sub}$, %$C_{x\text{-}emer}$, and %$C_{x\text{-}riv}$ denotes the relative proportions of n-C_x alkanes to total n-$C_{23+25+27+29+31}$ alkanes from submerged macrophytes, emergent plants, and riverine sediment, respectively. CPI_{sub}, CPI_{emer}, and CPI_{riv} are the CPI values of submerged macrophytes, emergent plants, and riverine sediment, respectively.

1.4 Equations for Model #2

$X_{i\text{-}riv+emer} = f_{emer} / (f_{emer} + f_{riv}) \times \%C_{i\text{-}emer} \times \delta^{13}C_{i\text{-}emer} + f_{riv} / (f_{emer} + f_{riv}) \times \%C_{i\text{-}riv} \times \delta^{13}C_{i\text{-}riv}$ (9)

$X_{i\text{-}riv+emer} + F_{i\text{-}sub} \times \delta^{13}C_{i\text{-}sub} = \delta^{13}C_{i\text{-}sample}$ (10)

$F_{sub} = \sum F_{i\text{-}sub} \times \%C_{i\text{-}sample}$ (11)

$X_{i\text{-}riv+sub} = f_{sub} / (f_{sub} + f_{riv}) \times \%C_{i\text{-}sub} \times \delta^{13}C_{i\text{-}sub} + f_{riv} / (f_{sub} + f_{riv}) \times \%C_{i\text{-}riv} \times \delta^{13}C_{i\text{-}riv}$ (12)

$X_{i\text{-}riv+sub} + F_{i\text{-}emer} \times \delta^{13}C_{i\text{-}emer} = \delta^{13}C_{i\text{-}sample}$ (13)

$F_{emer} = \sum F_{i\text{-}emer} \times \%C_{i\text{-}sample}$ (14)

$F_{riv} = 1 - F_{emer} - F_{sub}$ (15)

Where $\delta^{13}C_{i\text{-}sub}$, $\delta^{13}C_{i\text{-}emer}$, $\delta^{13}C_{i\text{-}riv}$, and $\delta^{13}C_{i\text{-}sample}$ are the $\delta^{13}C$ values of n-C_i alkane of submerged macrophytes, emergent plants, riverine soil, and lake sediments, respectively. $X_{i\text{-}riv+emer}$ is mixture $\delta^{13}C$ signature of n-C_i alkane of riverine source and emergent plants. $X_{i\text{-}riv+sub}$ is mixture $\delta^{13}C$ signature of n-C_i alkane of riverine source and submerged macrophytes.

1.5 Equations for Model #3

$F_{emer} = (1 - F_{sub}) \times f_{emer} / (f_{emer} + f_{riv})$ (16)

$F_{riv} = 1 - F_{emer} - F_{sub}$ (17)

1.6 Equations for absolute contributions to sedimentary OC

$TOC_{sub\text{-}sample} = TOC_{sample} \times (F_{sub\text{-}sample} / n\text{-}C_{23+25+27+29+31\text{-}sub} \times TOC_{sub}) / ((F_{sub\text{-}sample} / n\text{-}C_{23+25+27+29+31\text{-}sub} \times TOC_{sub}) + (F_{emer\text{-}sample} / n\text{-}C_{23+25+27+29+31\text{-}emer} \times TOC_{emer}) + (F_{riv\text{-}sample} / n\text{-}C_{23+25+27+29+31\text{-}riv} \times TOC_{riv}))$ (18)

$TOC_{emer\text{-}sample} = TOC_{sample} \times (F_{emer\text{-}sample} / n\text{-}C_{23+25+27+29+31\text{-}emer} \times TOC_{emer}) / ((F_{sub\text{-}sample} / n\text{-}C_{23+25+27+29+31\text{-}sub} \times TOC_{sub}) + (F_{emer\text{-}sample} / n\text{-}C_{23+25+27+29+31\text{-}emer} \times TOC_{emer}) + (F_{riv\text{-}sample} / n\text{-}C_{23+25+27+29+31\text{-}riv} \times TOC_{riv}))$ (19)

$TOC_{riv\text{-}sample} = TOC_{sample} \times (F_{riv\text{-}sample} / n\text{-}C_{23+25+27+29+31\text{-}riv} \times TOC_{riv}) / ((F_{sub\text{-}sample} / n\text{-}C_{23+25+27+29+31\text{-}sub} \times TOC_{sub})+(F_{emer\text{-}sample} / n\text{-}C_{23+25+27+29+31\text{-}emer} \times TOC_{emer}) + (F_{riv\text{-}sample} / n\text{-}C_{23+25+27+29+31\text{-}riv} \times TOC_{riv}))$ (20)

Where $n\text{-}C_{23+25+27+29+31\text{-}sub}$, $n\text{-}C_{23+25+27+29+31\text{-}emer}$, $n\text{-}C_{23+25+27+29+31\text{-}riv}$ are the concentrations of $n\text{-}C_{23+25+27+29+31}$ alkanes in three sources. TOC_{sub}, TOC_{emer}, and TOC_{riv} are the TOC values of $n\text{-}C_{23+25+27+29+31}$ alkanes in three sources.

References:

Ficken, K.J., Li, B., Swain, D. L., and Eglinton, G.: An *n*-alkane proxy for the sedimentary input of submerged/floating freshwater aquatic macrophytes. Org. Geochem., 31, 745–749, https://doi.org/10.1016/S0146-6380(00)00081-4, 2000.

Eglinton, G., and Hamilton, R. J.:. Leaf epicuticular waxes. Science, 156, 1322-1335, doi: 10.1126/science.156.3780.1322, 1967.

2. Supplementary Figure:

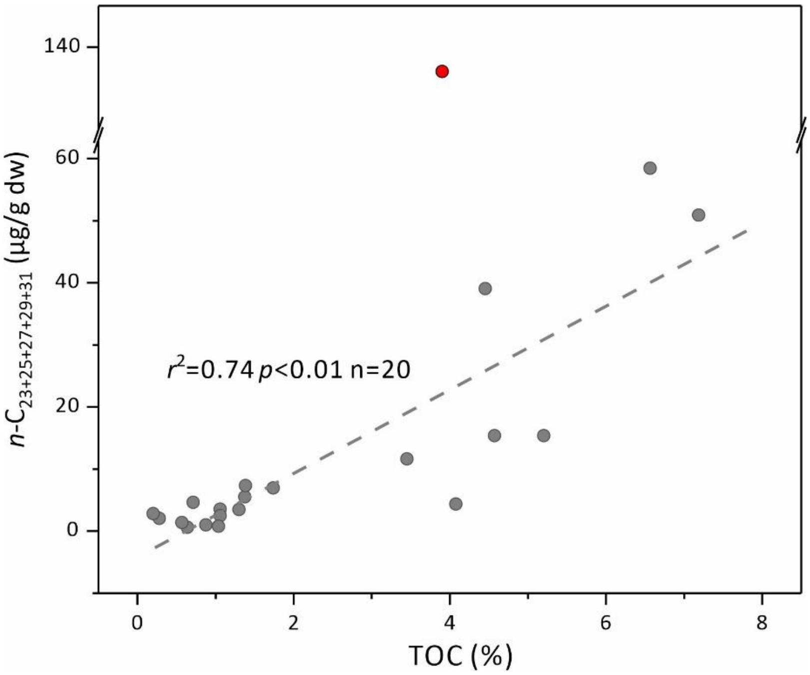

Figure S1 Plot of TOC vs. concentrations of odd-chain *n*-C_{23} to *n*-C_{31} measured for sedimentary OC in lake sediments and lakeshore sediments in Lake Wuliangsu. Correlation line was shown for sediments excluding sample S3 due to extremely high *n*-alkane concentrations.

2. Supplementary tables

Table S1. TOC values and n-alkanes concentration and indices of sediments and plants

Sample	TOC (%)	*n*-C_{23} (μg/g)	*n*-C_{24} (μg/g)	*n*-C_{25} (μg/g)	*n*-C_{26} (μg/g)	*n*-C_{27} (μg/g)	*n*-C_{28} (μg/g)	*n*-C_{29} (μg/g)	*n*-C_{30} (μg/g)	*n*-C_{31} (μg/g)	*n*-C_{32} (μg/g)	*n*-C_{33} (μg/g)	*n*-$C_{23+25+27+29+31}$ (μg/g)	P_{aq}
S1	0.64	0.04	0.03	0.07	0.03	0.13	0.03	0.26	0.01	0.12	0.01	0.00	0.62	0.24
S2	0.88	0.11	0.09	0.17	0.04	0.19	0.04	0.42	0.01	0.15	0.01	0.04	1.03	0.34
S3	3.90	14.04	1.44	42.59	1.72	25.67	2.50	35.66	0.62	19.09	0.05	6.52	137.05	0.51
S4	0.71	0.40	0.18	0.67	0.16	0.97	0.25	1.81	0.01	0.80	0.01	0.01	4.64	0.29
S5	1.37	0.49	0.21	0.84	0.20	1.20	0.29	2.09	0.04	0.90	0.01	0.26	5.52	0.31
S6	4.08	0.30	0.09	0.48	0.12	0.74	0.24	1.79	0.05	1.07	0.03	0.02	4.38	0.21
S7	5.20	1.24	0.41	2.04	0.45	2.60	0.84	6.46	0.14	3.05	0.02	2.53	15.39	0.26
S8	4.57	1.47	0.48	2.76	0.48	2.93	0.78	5.25	0.19	2.96	0.03	0.04	15.37	0.34
S9	3.45	1.01	0.32	1.83	0.36	2.44	0.63	4.56	0.21	1.79	0.09	1.71	11.63	0.31
S10	1.74	0.72	0.29	1.21	0.24	1.53	0.35	2.49	0.05	1.02	0.00	0.45	6.96	0.36
S11	6.57	6.82	0.76	15.07	1.13	12.50	1.68	17.60	0.76	6.48	0.04	10.34	58.48	0.48
S12	7.19	4.82	0.74	12.34	0.98	11.84	1.43	16.22	0.56	5.70	0.06	8.15	50.91	0.44
S13	4.45	4.94	0.55	10.50	0.72	8.61	0.97	10.63	0.53	4.40	0.05	4.57	39.08	0.51
S14	1.38	0.84	0.21	1.72	0.18	1.56	0.23	2.20	0.05	1.06	0.00	0.58	7.37	0.44
SS1	0.28	0.21	0.19	0.07	0.12	0.42	0.10	0.64	0.04	0.47	0.03	0.09	1.82	0.32
SS2	1.30	0.26	0.17	0.17	0.16	0.81	0.16	1.13	0.04	0.74	0.03	0.09	3.12	0.30
SS3	0.57	0.21	0.14	0.25	0.08	0.30	0.06	0.38	0.04	0.24	0.01	0.02	1.38	0.43
SS4	1.06	0.62	0.74	0.85	0.16	0.67	0.11	0.80	0.02	0.59	0.02	0.13	3.54	0.51
SS5	1.04	0.10	0.02	0.13	0.03	0.17	0.03	0.22	0.01	0.17	0.00	0.03	0.79	0.37
SS6	0.15	0.19	0.07	0.37	0.09	0.50	0.11	0.95	0.07	0.73	0.02	0.05	2.74	0.25
SS7	1.06	0.41	0.16	0.48	0.10	0.61	0.09	0.58	0.02	0.41	0.00	0.06	2.50	0.47

Table S1. TOC values and n-alkanes concentration and indices of sediments

Sample	CPI	%(n-C_{23}+n-C_{25})	%(n-C_{27}+n-C_{29})	%n-C_{31}	$\delta^{13}n$-C_{23} (‰)	$\delta^{13}n$-C_{25} (‰)	$\delta^{13}n$-C_{27} (‰)	$\delta^{13}n$-C_{29} (‰)	$\delta^{13}n$-C_{31} (‰)
S1	5.79	19.1	62.2	18.7	-30.6	-30.9	-32.1	-32.5	-32.1
S2	4.99	27.5	58.3	14.1	-31.2	-31.2	-32.1	-32.6	-32.4
S3	19.18	41.3	44.7	13.9	-25.0	-24.0	-25.9	-25.8	-27.4
S4	6.69	23.0	60.1	16.9	-32.4	-31.0	-32.6	-32.7	-32.7
S5	6.48	24.1	59.7	16.3	-30.5	-29.7	-31.8	-32.4	-32.8
S6	7.32	17.8	57.9	24.4	-31.5	-30.5	-33.5	-33.8	-34.8
S7	7.22	21.3	58.9	19.8	-30.6	-29.0	-32.4	-32.9	-34.1
S8	6.82	27.5	53.1	19.4	-28.5	-27.3	-29.7	-30.9	-33.6
S9	6.75	24.5	60.2	15.4	-30.2	-29.5	-31.4	-32.1	-32.8
S10	6.61	27.7	57.7	14.6	-31.4	-30.8	-32.0	-32.0	-32.4
S11	11.98	37.4	51.5	11.1	-28.5	-26.6	-28.2	-28.9	-31.0
S12	12.28	33.7	55.1	11.2	-28.1	-26.3	-27.9	-29.2	-30.4
S13	12.40	39.5	49.2	11.3	-28.4	-25.5	-27.5	-28.1	-29.2
S14	9.67	34.6	51.0	14.3	-26.9	-25.4	-26.9	-27.9	-29.5
SS1	3.84	25.9	51.2	22.9	-31.9	-31.5	-32.5	-33.4	-34.2
SS2	5.55	22.9	55.8	21.3	-30.1	-31.3	-33.6	-33.7	-33.0
SS3	3.62	33.8	49.1	17.1	-30.1	-31.2	-33.5	-34.8	-36.5
SS4	2.83	41.6	41.7	16.7	-34.4	-34.3	-33.4	-33.3	-34.2
SS5	7.26	29.1	49.0	21.9	-26.0	-26.8	-30.4	-31.4	-32.1
SS6	6.78	20.5	52.9	26.6	-27.2	-28.3	-27.5	-30.2	-33.4
SS7	5.55	35.7	47.8	16.5	-28.5	-28.2	-29.8	-30.5	-30.3

Table S1. TOC values and n-alkanes concentration and indices of sediments and plants

Sample	TOC (%)	*n*-C_{23} (μg/g)	*n*-C_{24} (μg/g)	*n*-C_{25} (μg/g)	*n*-C_{26} (μg/g)	*n*-C_{27} (μg/g)	*n*-C_{28} (μg/g)	*n*-C_{29} (μg/g)	*n*-C_{30} (μg/g)	*n*-C_{31} (μg/g)	*n*-C_{32} (μg/g)	*n*-C_{33} (μg/g)	*n*-$C_{23+25+27+29+31}$ (μg/g)	P_{aq}
Riverine soil	0.20	0.17	0.16	0.29	0.11	0.65	0.13	0.92	0.04	0.82	0.10	0.25	2.84	0.21
Submerged macrophytes	33.73	31.48	2.87	56.59	1.86	24.27	1.04	15.40	0.55	5.01	n.a.	n.d.	132.75	0.82
Emergent Plants	37.08	6.24	2.05	14.18	2.70	21.66	1.52	25.20	n.d.	n.d.	n.d.	n.d.	67.29	0.45

Sample	CPI	%(*n*-C_{23}+*n*-C_{25})	%(*n*-C_{27}+*n*-C_{29})	%*n*-C_{31}	δ^{13}*n*-C_{23} (‰)	δ^{13}*n*-C_{25} (‰)	δ^{13}*n*-C_{27} (‰)	δ^{13}*n*-C_{29} (‰)	δ^{13}*n*-C_{31} (‰)
Riverine soil	6.03	15.9	55.3	28.8	-30.7	-31.1	-31.6	-32.1	-33.1
Submerged macrophytes	18.02	67.6	28.9	3.5	-25.0	-24.6	-24.6	-26.1	-26.5
Emergent Plants	10.24	30.4	69.6	0.0	-34.1	-35.4	-35.8	-36.6	n.d.

Table S2. The results of end-member mixing Model #1 based on n-alkanes indices

Sample	TOC(%)	%Riverine-alkane	%Sub-alkane	%Emer-alkane	CPIest	δ^{13}*n*-C_{23}-est (‰)	δ^{13}*n*-C_{25}-est (‰)	δ^{13}*n*-C_{27}-est (‰)	δ^{13}*n*-C_{29}-est (‰)	δ^{13}*n*-C_{31}-est (‰)
S1	0.64	65.6	0.0	34.4	7.14	-32.2	-34.2	-33.3	-33.7	-33.1
S2	0.88	47.7	10.6	41.7	8.10	-30.6	-31.6	-33.2	-34.0	-32.9
S3	3.90	42.8	42.9	14.3	9.32	-26.9	-26.5	-30.0	-31.9	-32.3
S4	0.71	59.3	3.7	37.0	7.46	-31.5	-33.1	-33.3	-33.8	-33.0
S5	1.37	56.0	5.1	38.9	7.62	-31.3	-32.8	-33.3	-33.9	-33.0
S6	4.08	84.7	0.0	15.3	6.49	-31.4	-32.3	-32.4	-32.9	-33.1
S7	5.20	68.6	2.7	28.7	7.09	-31.4	-32.9	-32.9	-33.4	-33.0
S8	4.57	64.6	16.7	18.7	7.53	-29.0	-29.0	-31.7	-32.7	-32.8
S9	3.45	52.7	4.7	42.6	7.74	-31.5	-33.1	-33.5	-34.1	-33.0
S10	1.74	49.0	11.6	39.4	8.07	-30.3	-31.3	-33.0	-33.8	-32.9
S11	6.57	34.6	30.2	35.2	9.34	-28.3	-28.7	-31.9	-33.4	-32.4
S12	7.19	36.1	21.6	42.3	8.97	-29.3	-30.0	-32.7	-33.9	-32.6
S13	4.45	34.5	35.3	30.2	9.53	-27.8	-28.0	-31.4	-33.0	-32.3
S14	1.38	46.5	27.4	26.1	8.62	-28.3	-28.4	-31.6	-32.9	-32.6
SS1	0.28	77.4	17.4	5.2	7.05	-28.4	-27.4	-30.9	-32.0	-32.9
SS2	1.30	73.0	8.4	18.6	7.04	-30.0	-30.5	-32.2	-32.9	-33.0
SS3	0.57	55.5	29.0	15.5	8.22	-27.8	-27.4	-30.9	-32.3	-32.7
SS4	1.06	51.8	46.9	0.0	8.91	-26.3	-25.2	-28.7	-30.7	-32.4
SS5	1.04	73.1	23.8	3.1	7.34	-27.7	-26.5	-30.4	-31.7	-32.8
SS6	0.15	91.0	9.0	0.0	6.43	-29.1	-27.9	-31.1	-31.9	-33.0
SS7	1.06	53.1	32.7	14.2	8.44	-27.5	-27.0	-30.6	-32.1	-32.6

Table S3. The results of end-member mixing Model #2 and Model #3 based on *n*-alkanes indices

Sample	TOC(%)	%Riverine- alkane	%Sub-alkane	%Emer-alkane	CPI_{est}	%Riverine-OC	%Sub-OC	%Emer-OC	Riverine source TOC (%)	Sub-derived TOC (%)	Emer-derived TOC (%)
Model #2											
S1	0.64	41.1	21.3	37.6	8.69	10.6	18.5	70.8	0.07	0.12	0.45
S2	0.88	43.1	24.2	32.7	8.67	11.9	22.4	65.7	0.10	0.20	0.58
S3	3.90	2.6	95.5	1.9	16.92	0.8	95.1	4.1	0.03	3.71	0.16
S4	0.71	38.5	22.4	39.2	8.85	9.6	18.8	71.5	0.07	0.13	0.51
S5	1.37	43.6	23.9	32.5	8.64	12.1	22.2	65.7	0.17	0.31	0.90
S6	4.08	42.6	14.0	43.4	8.40	10.5	11.6	77.9	0.43	0.47	3.17
S7	5.20	43.2	21.2	35.6	8.58	11.5	19.0	69.4	0.60	0.99	3.61
S8	4.57	39.9	39.8	20.3	9.35	12.4	41.5	46.0	0.57	1.90	2.11
S9	3.45	44.5	26.1	29.4	8.65	12.9	25.3	61.8	0.44	0.87	2.13
S10	1.74	40.4	25.2	34.4	8.84	10.7	22.5	66.7	0.19	0.39	1.16
S11	6.57	19.5	62.2	18.2	11.86	5.4	57.8	36.7	0.35	3.80	2.41
S12	7.19	20.0	64.0	16.1	11.92	5.7	61.1	33.3	0.41	4.39	2.39
S13	4.45	13.0	73.1	14.0	13.24	3.6	68.1	28.3	0.16	3.04	1.26
S14	1.38	13.6	76.4	9.9	13.43	4.0	74.9	21.1	0.06	1.04	0.29
SS1	0.28	47.9	13.0	39.1	8.13	12.1	11.7	76.3	0.03	0.03	0.21
SS2	1.30	43.0	12.9	44.1	8.35	10.0	10.7	79.3	0.13	0.14	1.03
SS3	0.57	34.5	14.9	50.6	8.82	7.2	11.1	81.7	0.04	0.06	0.46
SS4	1.06	30.5	7.7	61.8	8.81	5.7	5.1	89.2	0.06	0.05	0.95
SS5	1.04	39.7	43.9	16.4	9.51	12.3	48.5	39.3	0.13	0.50	0.41
SS6	0.15	43.9	42.3	13.8	9.21	14.5	50.1	35.4	0.02	0.07	0.05
SS7	1.06	30.9	48.5	20.6	10.26	8.5	47.6	43.9	0.09	0.51	0.47

Table S3. The results of end-member mixing Model #2 and Model #3 based on *n*-alkanes indice

Sample	TOC(%)	%Riverine- alkane	%Sub-alkane	%Emer-alkane	CPI_{est}	%Riverine-OC	%Sub-OC	%Emer-OC	Riverine source TOC (%)	Sub-derived TOC (%)	Emer-derived TOC (%)
Model #3											
S1	0.64	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
S2	0.88	42.6	20.3	37.2	8.58	11.2	17.9	71.0	0.10	0.16	0.62
S3	3.90	3.5	95.3	1.2	16.72	1.1	96.3	2.6	0.04	3.76	0.10
S4	0.71	53.1	13.7	33.1	7.92	15.6	13.5	70.9	0.11	0.10	0.51
S5	1.37	46.1	21.9	32.0	8.46	13.1	20.9	66.1	0.18	0.29	0.91
S6	4.08	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
S7	5.20	61.3	13.0	25.7	7.56	21.0	15.0	64.0	1.09	0.78	3.33
S8	4.57	50.7	34.6	14.7	8.59	18.5	42.4	39.0	0.85	1.94	1.79
S9	3.45	40.5	26.7	32.8	8.88	11.0	24.3	64.7	0.38	0.84	2.23
S10	1.74	42.8	22.9	34.4	8.65	11.6	20.7	67.7	0.20	0.36	1.18
S11	6.57	18.1	63.4	18.5	12.05	5.0	58.2	36.8	0.33	3.82	2.42
S12	7.19	15.6	66.0	18.3	12.46	4.2	59.8	36.0	0.30	4.30	2.59
S13	4.45	14.1	73.5	12.4	13.15	4.0	70.3	25.6	0.18	3.13	1.14
S14	1.38	15.4	75.9	8.7	13.18	4.6	76.4	19.0	0.06	1.06	0.26
SS1	0.28	73.5	21.6	4.9	7.27	38.9	40.9	20.3	0.11	0.11	0.06
SS2	1.30	63.1	20.8	16.1	7.66	24.1	28.3	47.6	0.31	0.37	0.62
SS3	0.57	60.4	22.7	16.9	7.82	22.2	29.8	48.0	0.13	0.17	0.27
SS4	1.06	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
SS5	1.04	46.7	51.3	2.0	9.37	19.1	74.8	6.2	0.20	0.78	0.06
SS6	0.15	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
SS7	1.06	34.4	56.4	9.2	10.38	11.2	65.7	23.2	0.12	0.70	0.25

Table S4. GDGTs indices and results from Model #2 and Model #3 of lake sediments and lakeshore sediments

Sample	Riverine source TOC (%)	Sub-derived TOC (%)	Emer-derived TOC (%)	GDGT-0 (ug/g TOC)	in-situ brGDGTS (ug/g TOC)	allocholl brGDGTS (ug/g TOC)	BIT	MBT	CBT	$R_{0/5}$	BR $_{\textit{in-situ}/\text{soil}}$
Model #2											
S1	0.07	0.12	0.45	1.39	8.34	5.19	0.92	0.22	0.25	1.65	1.61
S2	0.10	0.20	0.58	1.72	6.21	0.97	0.97	0.22	0.32	10.50	6.37
S3	0.03	3.71	0.16	7.39	34.02	0.24	1.00	0.31	0.41	175.75	141.76
S4	0.07	0.13	0.51	7.76	61.51	4.34	0.99	0.25	0.37	21.09	15.16
S5	0.17	0.31	0.90	14.07	31.71	1.54	0.99	0.24	0.37	16.88	20.53
S6	0.43	0.47	3.17	1.51	6.21	0.21	0.99	0.28	0.39	40.63	28.92
S7	0.60	0.99	3.61	3.12	21.23	0.37	1.00	0.28	0.31	50.24	56.64
S8	0.57	1.90	2.11	1.72	11.93	0.21	1.00	0.28	0.39	47.31	56.80
S9	0.44	0.87	2.13	1.55	8.78	0.30	0.99	0.27	0.34	30.50	29.09
S10	0.19	0.39	1.16	2.29	17.06	0.81	0.99	0.26	0.37	16.37	21.06
S11	0.35	3.80	2.41	5.26	32.12	0.33	1.00	0.31	0.37	92.45	106.65
S12	0.41	4.39	2.39	0.06	1.15	0.00	1.00	0.30	0.37	n.a	n.a
S13	0.16	3.04	1.26	0.63	7.04	0.09	1.00	0.32	0.37	39.76	76.69
S14	0.06	1.04	0.29	0.55	5.34	0.38	0.98	0.29	0.33	8.71	14.17
SS1	0.02	0.03	0.23	0.06	4.79	1.20	0.93	0.24	0.38	6.94	2.25
SS2	0.04	0.39	0.88	0.84	0.10	0.05	0.96	0.36	0.29	4.54	3.99
SS3	0.04	0.06	0.46	1.70	5.59	1.25	0.96	0.26	0.37	8.05	4.48
SS4	0.12	0.07	0.87	0.08	0.65	0.12	0.96	0.27	0.24	4.03	5.25
SS5	0.01	0.29	0.75	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
SS6	0.02	0.07	0.05	1.16	2.23	4.38	0.87	0.36	0.18	1.89	0.51
SS7	0.05	0.58	0.43	0.02	0.02	0.06	0.85	0.38	0.19	1.46	0.34

Table S4. GDGTs indices and results from Model #2 and Model #3 of lake sediments and lakeshore

Sample	Riverine source TOC (%)	Sub-derived TOC (%)	Emer-derived TOC (%)	GDGT-0 (ug/g TOC)	in-situ brGDGTS (ug/g TOC)	allocholl brGDGTS (ug/g TOC)	BIT	MBT	CBT	$R_{0/5}$	BR $_{\textit{in-situ}/\text{soil}}$
Model #3											
S2	0.10	0.16	0.62	1.72	6.21	0.97	0.97	0.22	0.32	10.50	6.37
S3	0.04	3.76	0.10	7.39	34.02	0.24	1.00	0.31	0.41	175.75	141.76
S4	0.11	0.10	0.51	7.76	61.51	4.34	0.99	0.25	0.37	21.09	15.16
S5	0.18	0.29	0.91	14.07	31.71	1.54	0.99	0.24	0.37	16.88	20.53
S6	n.a	n.a	n.a	1.51	6.21	0.21	0.99	0.28	0.39	40.63	28.92
S7	1.09	0.78	3.33	3.12	21.23	0.37	1.00	0.28	0.31	50.24	56.64
S8	0.85	1.94	1.79	1.72	11.93	0.21	1.00	0.28	0.39	47.31	56.80
S9	0.38	0.84	2.23	1.55	8.78	0.30	0.99	0.27	0.34	30.50	29.09
S10	0.20	0.36	1.18	2.29	17.06	0.81	0.99	0.26	0.37	16.37	21.06
S11	0.33	3.82	2.42	5.26	32.12	0.33	1.00	0.31	0.37	92.45	106.65
S12	0.30	4.30	2.59	0.06	1.15	0.00	1.00	0.30	0.37	n.a	n.a
S13	0.18	3.13	1.14	0.63	7.04	0.09	1.00	0.32	0.37	39.76	76.69
S14	0.06	1.06	0.26	0.55	5.34	0.38	0.98	0.29	0.33	8.71	14.17
SS1	0.11	0.11	0.06	0.06	4.79	1.20	0.93	0.24	0.38	6.94	2.25
SS2	0.31	0.37	0.62	0.84	0.10	0.05	0.96	0.36	0.29	4.54	3.99
SS3	0.13	0.17	0.27	1.70	5.59	1.25	0.96	0.26	0.37	8.05	4.48
SS4	n.a	n.a	n.a	0.08	0.65	0.12	0.96	0.27	0.24	4.03	5.25
SS5	0.20	0.78	0.06	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
SS6	n.a	n.a	n.a	1.16	2.23	4.38	0.87	0.36	0.18	1.89	0.51
SS7	0.12	0.70	0.25	0.02	0.02	0.06	0.85	0.38	0.19	1.46	0.34

Note: $\%(n\text{-}C_{23}+n\text{-}C_{25})=(n\text{-}C_{23}+n\text{-}C_{25})/(n\text{-}C_{23}+n\text{-}C_{25}+n\text{-}C_{27}+n\text{-}C_{29}+n\text{-}C_{31})$

$\%(n\text{-}C_{27}+n\text{-}C_{29})=(n\text{-}C_{27}+n\text{-}C_{29})/(n\text{-}C_{23}+n\text{-}C_{25}+n\text{-}C_{27}+n\text{-}C_{29}+n\text{-}C_{31})$

$\%n\text{-}C_{31}=(n\text{-}C_{31})/(n\text{-}C_{23}+n\text{-}C_{25}+n\text{-}C_{27}+n\text{-}C_{29}+n\text{-}C_{31})$

$P_{aq}=(n\text{-}C_{23}+n\text{-}C_{25})/(n\text{-}C_{23}+n\text{-}C_{25}+n\text{-}C_{29}+n\text{-}C_{31})$

$CPI=(n\text{-}C_{23}+n\text{-}C_{25}+n\text{-}C_{27}+n\text{-}C_{29})+(n\text{-}C_{25}+n\text{-}C_{27}+n\text{-}C_{29}+n\text{-}C_{31})/(2*((n\text{-}C_{24}+n\text{-}C_{26}+n\text{-}C_{28}+n\text{-}C_{30}))$

%Riverine-alkane: relative n-alkane contribution derived from riverine soil

%Sub-alkane: relative n-alkane contribution derived from submerged macrophytes

%Emer-alkane: relative n-alkane contribution derived from emergent plants

%Riverine-OC: relative OC contribution derived from riverine soil

%Sub-OC: relative OC contribution derived from submerged macrophytes

%Emer-OC: relative OC contribution derived from emergent plants

CPI_{est}: CPI values caculated based on the results of mixing models

n.d.: not detected

n.a.: not available