Supplementary Information

Table S1. Sediment and pore water geochemistry data from C2, C3, C7 and C8. All isotope values are in units of per mil (‰) as described in the manuscript.

Core ID	Pore Water Depth Below Sea Floor (cm)	DIC (mM)	$\delta^{13}C_{DIC}$	%OC	$\delta^{13}C_{SOC}$	$\%CaCO_3$	$\delta^{13}C_{TIC}$	DOC (mM)	$\delta^{13}C_{DOC}$	$\Delta^{14}C_{SOC}$	Gas Sample Depth Below Sea Floor (cm)	CH_4 (mM)	Sediment $\delta^{13}C_{CH4}$	Gas $\delta^{13}C_{CH4}$	C1/C2	Gas $\Delta^{14}C_{CH4}$
C2	5	2.8	−9.4	0.91	−20.5	13.04	1.8	0.95	−22.9	−283	0	6.00×10^{-4}	ND	ND	ND	ND
	35	3.3	−14.6	0.67	−21.1	11.55	1.6	0.91	−20.8	−561	30	9.34×10^{-4}	ND	ND	ND	ND
	70	4.2	−19.9	0.52	−22.7	8.82	−2.2	0.82	−20.1	−665	65	8.13×10^{-4}	ND	ND	ND	ND
	105	5.0	−23.3	0.70	−22.8	2.71	−4.9	0.85	−23.2	−652	100	8.73×10^{-4}	ND	ND	ND	ND
	140	5.2	−25.8	0.76	−22.8	2.4	−5.8	1.30	−25.3	−650	135	1.01×10^{-3}	ND	ND	ND	ND
	165	5.9	−28.6	0.72	−22.7	2.36	−5.8	1.16	−26.2	−647	160	1.10×10^{-3}	ND	ND	ND	ND
	190	7.3	−31.9	0.71	−22.6	2.42	−6.1	1.23	−25.4	−647	185	1.00×10^{-3}	ND	ND	ND	ND
	215	8.2	−32.7	0.73	−22.4	2.52	−5.9	0.88	−24.4	−657	210	1.31×10^{-3}	ND	ND	ND	ND
	240	8.4	−33.8	0.75	−22.4	2.54	−6	1.13	−24.6	−643	235	1.45×10^{-3}	ND	ND	ND	ND
	265	9.5	−36.2	0.72	−22.4	2.33	−5.9	1.47	−24.2	−651	260	1.38×10^{-3}	−48.8	ND	ND	ND
	290	12.0	−40.4	0.73	−22.4	2.47	−6.2	1.88	−24.0	−645	285	2.86×10^{-3}	−62.3	ND	ND	ND
	310	15.6	−43.7	0.64	−22.9	2.53	−4.3	2.24	−23.9	−679	305	1.13×10^{-2}	−66.8	ND	ND	ND
	330	19.5	−47.1	0.66	−22.9	2.68	−4	2.78	−25.3	−673	325	3.46×10^{-2}	−81.1	ND	ND	ND
	350	20.0	−41.5	0.78	−22.7	4.13	−5.3	3.59	−23.8	−624	345	1.39×10^{0}	−86.9	ND	ND	ND
	375	16.9	−30.8	0.76	−22.6	4.47	−5.1	3.53	−23.7	−631	370	8.42×10^{0}	−82.4	ND	26555	ND
	400	14.3	−22.4	0.77	−22.8	4.31	−5.3	3.60	−23.6	−640	395	8.91×10^{0}	−79.7	ND	26926	ND
	420	13.0	−17.7	0.72	−22.9	4.61	−4.9	3.65	−24.0	−678	415	1.20×10^{1}	−78.3	ND	29430	ND
	440	11.9	−13.4	0.71	−23.0	4.02	−5.1	3.59	−24.4	−659	435	1.25×10^{1}	−77.9	ND	ND	ND
	465	10.3	−10.3	0.70	−22.9	4.07	−5.3	3.64	−25.1	−662	460	9.96×10^{0}	−76.5	ND	30494	ND
C3	5	13.6	−42.9	ND	ND	ND	ND	ND	ND	ND	0	6.87×10^{-2}	−75.4	ND	ND	ND
	25	15.6	−16.6	ND	ND	ND	ND	ND	ND	ND	20	6.96×10^{0}	−75.2	ND	6033	ND

Table S1. *Cont.*

Core ID	Pore Water Depth Below Sea Floor (cm)	DIC (mM)	$\delta^{13}C_{DIC}$	%OC	$\delta^{13}C_{SOC}$	%$CaCO_3$	$\delta^{13}C_{TIC}$	DOC (mM)	$\delta^{13}C_{DOC}$	$\Delta^{14}C_{SOC}$	Gas Sample Depth Below Sea Floor (cm)	CH_4 (mM)	Sediment $\delta^{13}C_{CH4}$	Gas $\delta^{13}C_{CH4}$	C1/C2	Gas $\Delta^{14}C_{CH4}$
	50	9.4	−1.8	ND	ND	ND	ND	ND	ND	ND	45	3.52×10^0	−75.3	ND	5244	ND
	75	9.7	2.1	ND	ND	ND	ND	ND	ND	ND	70	7.87×10^0	−73.0	ND	7313	ND
	100	9.1	3.0	ND	ND	ND	ND	ND	ND	ND	95	3.74×10^0	−73.1	ND	6122	ND
	125	9.2	3.4	ND	ND	ND	ND	ND	ND	ND	120	3.36×10^0	−73.5	ND	6873	ND
	155	10.5	2.7	ND	ND	ND	ND	ND	ND	ND	150	3.61×10^0	−73.1	−72.5 ± 0.1, $n = 3$	6021	−958
	200	8.0	0.7	ND	ND	ND	ND	ND	ND	ND	195	3.80×10^0	−72.8	−72.0	6970	−963 ± 3, $n = 5$
	225	8.9	−2.0	ND	ND	ND	ND	ND	ND	ND	220	4.28×10^0	−73.2	−72.4	6397	−960
	250	9.2	3.3	ND	ND	ND	ND	ND	ND	ND	245	4.98×10^0	−73.6	−72.1	6686	−957
	285	8.2	1.7	ND	ND	ND	ND	ND	ND	ND	280	3.69×10^0	−73.2	ND	7461	ND
	310	8.3	0.8	ND	ND	ND	ND	ND	ND	ND	305	4.14×10^0	−73.4	ND	7033	ND
	340	8.9	3.7	ND	ND	ND	ND	ND	ND	ND	335	4.37×10^0	−73.3	ND	7299	ND
	365	6.7	0.1	ND	ND	ND	ND	ND	ND	ND	360	4.28×10^0	−73.7	ND	7380	ND
C7	5	5.8	3.2	0.63	−28.2	13.04	−12.6	3.83	−25.7	−890	0	8.34×10^0	−82.0	ND	9162	ND
	34	12.1	−48.1	0.66	−26.4	10.36	−3.99	2.05	−27.6	−907	29	4.71×10^0	−73.0	ND	10602	ND
	104	9.7	−25.4	0.64	−25.1	9.89	−1.93	3.01	−25.6	−939	99	3.29×10^0	−71.6	ND	7936	ND
	144	8.3	−15.0	0.62	−25.0	9.93	−1.5	3.55	−25.4	−939	139	5.61×10^0	−69.3	ND	11753	ND
	184	7.3	−0.7	0.58	−25.6	11.36	−2.4	3.67	−25.4	−950	179	5.85×10^0	−69.4	ND	8978	ND
	224	7.1	3.0	0.57	−26.6	12.68	−1.7	3.77	−25.5	−955	219	4.82×10^0	−69.1	ND	7017	ND
	322	7.3	3.1	0.57	−25.6	13.81	−2.4	3.76	−25.7	−950	317	7.75×10^0	−69.7	ND	8056	ND
	372	7.4	2.5	0.58	−25.3	12.08	−1.1	3.69	−26.1	−947	367	6.06×10^0	−69.3	ND	5716	ND
	422	7.1	4.5	0.63	−26.5	10.71	−3.9	3.79	−25.9	−899	417	4.89×10^0	−69.1	ND	7335	ND

Table S1. *Cont.*

Core ID	Pore Water Depth Below Sea Floor (cm)	DIC (mM)	$\delta^{13}C_{DIC}$	%OC	$\delta^{13}C_{SOC}$	$\%CaCO_3$	$\delta^{13}C_{TIC}$	DOC (mM)	$\delta^{13}C_{DOC}$	$\Delta^{14}C_{SOC}$	Gas Sample Depth Below Sea Floor (cm)	CH_4 (mM)	Sediment $\delta^{13}C_{CH4}$	Gas $\delta^{13}C_{CH4}$	C1/C2	Gas $\Delta^{14}C_{CH4}$
	472	7.0	3.8	0.64	−25.2	10.32	−1.6	3.83	−26.0	−922	467	1.06×10^{1}	−69.4	ND	5210	ND
	522	6.5	3.4	0.58	−25.3	11.71	−1.3	3.92	−26.7	−950	517	7.77×10^{0}	−68.5	ND	5836	ND
	572	6.0	4.6	0.6	−26.3	10.69	−2.3	3.49	−25.2	−896	567	5.13×10^{0}	−68.5	−71.3 ± 0.1, $n = 3$	5967	ND
	682	6.2	3.1	0.57	−25.5	11.01	−2.1	3.37	−24.8	−927	677	5.69×10^{0}	−69.0	ND	3106	ND
	732	6.8	−1.5	0.58	−25.3	11.46	−1.6	3.73	−24.7	−929	727	5.29×10^{0}	−69.0	ND	6213	ND
	782	6.1	3.0	0.58	−25.6	12.19	−1.5	3.67	−24.7	−951	777	6.79×10^{0}	−69.6	ND	5320	ND
	842	5.6	2.5	0.63	−25.3	10.9	−1.2	3.41	−24.8	−918	837	6.57×10^{0}	−69.2	ND	3572	ND
C8	5	5.5	−38.3	ND	ND	ND	ND	ND	ND	ND	0	2.71×10^{-2}	−73.3	ND	ND	ND
	30	11.3	−54.7	ND	ND	ND	ND	ND	ND	ND	25	8.76×10^{-2}	−78.9	ND	ND	ND
	60	13.8	−44.3	ND	ND	ND	ND	ND	ND	ND	55	7.10×10^{0}	−85.2	ND	6777	ND
	85	12.1	−37.9	ND	ND	ND	ND	ND	ND	ND	80	9.92×10^{0}	−81.8	ND	9108	ND
	115	12.0	−29.3	ND	ND	ND	ND	ND	ND	ND	110	1.30×10^{1}	−80.1	ND	10562	ND
	150	11.5	−18.1	ND	ND	ND	ND	ND	ND	ND	145	9.77×10^{0}	−78.6	ND	10021	ND
	185	11.2	−7.4	ND	ND	ND	ND	ND	ND	ND	180	7.23×10^{0}	−76.9	ND	9691	ND
	220	11.5	−4.7	ND	ND	ND	ND	ND	ND	ND	215	5.21×10^{0}	−76.0	−65.8	7994	−903
	260	9.8	0.2	ND	ND	ND	ND	ND	ND	ND	255	5.32×10^{0}	−74.5	−70.9	6802	−905
	310	10.8	2.0	ND	ND	ND	ND	ND	ND	ND	305	5.46×10^{0}	−75.3	ND	9054	ND
	370		3.8	ND	ND	ND	ND	ND	ND	ND	365	4.96×10^{0}	−73.7	−72.3	8059	−901
	420	10.1	5.8	ND	ND	ND	ND	ND	ND	ND	415	3.95×10^{0}	−73.6	ND	8036	ND
	470	9.7	6.7	ND	ND	ND	ND	ND	ND	ND	465	2.85×10^{0}	−71.5	ND	9362	ND
	510	8.6	6.1	ND	ND	ND	ND	ND	ND	ND	505	4.11×10^{0}	−72.5	ND	5450	ND