Supporting Information for

Unveiling carbonate dissolution in coastal sediments and its influence on seawater buffering capacity with $\delta^{13}C_{DIC}$ and ^{224}Ra–^{228}Th disequilibria

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Table S1. Porosities (Φ), activities of ^{224}Ra and ^{228}Th and total inorganic carbon (TIC) in sediments at each sampling station. The errors refer to ± 1σ derived from counting statistics, which is calculated from $\frac{\sqrt{N}}{t}$.

Depth (cm)	Φ	^{224}Ra (dpm g^{-1})	^{228}Th (dpm g^{-1})	TIC (mg C g^{-1})
SSW-A; 119.94°E, 26.73°N; Depth = 4 m; T = 19.8℃; S = 29.3				
0-1	0.739	1.84 ± 0.11	2.08 ± 0.07	15.4
1-2	0.726	1.75 ± 0.11	2.29 ± 0.07	16.7
2-3	0.721	1.57 ± 0.09	1.70 ± 0.05	18.4
3-4	0.713	1.83 ± 0.11	2.05 ± 0.06	16.4
5-6	0.696	1.51 ± 0.09	1.65 ± 0.05	19.4
7-8	0.677	1.79 ± 0.12	2.00 ± 0.06	23.8
9-10	0.643	1.64 ± 0.11	1.89 ± 0.06	35.4
12-13	0.657	3.00 ± 0.20	3.25 ± 0.10	29.2
15-16	0.677	2.79 ± 0.18	2.79 ± 0.09	16.6
19-20	0.657	1.88 ± 0.12	1.86 ± 0.06	17.7
SSW-B; 119.83°E, 26.66°N; Depth = 8.7 m; T = 20.2℃; S = 28.0				
0-1	0.723	2.18 ± 0.13	2.39 ± 0.08	16.8
1-2	0.705	1.83 ± 0.10	2.01 ± 0.06	16.4
2-3	0.690	2.28 ± 0.12	2.29 ± 0.07	16.3
3-4	0.698	2.05 ± 0.11	1.94 ± 0.06	16.7
5-6	0.676	1.57 ± 0.09	1.53 ± 0.05	17.2
7-8	0.600	1.53 ± 0.09	1.61 ± 0.05	15.9
9-10	0.620	1.34 ± 0.09	1.40 ± 0.05	16.1
11-12	0.629	1.64 ± 0.11	1.83 ± 0.06	17.4
14-15	0.612	1.78 ± 0.11	1.83 ± 0.06	16.9
17-18	0.622	2.04 ± 0.12	2.01 ± 0.06	15.2
20-21	0.628	1.40 ± 0.09	1.58 ± 0.05	16.8
SSW-C; 119.86°E, 26.52°N; Depth = 6 m; T = 16.2℃; S = 31.1				
0-1	0.706	3.29 ± 0.21	3.33 ± 0.11	10.3
1-2	0.674	1.70 ± 0.10	2.01 ± 0.06	11.5
2-3	0.643	2.25 ± 0.13	2.47 ± 0.08	11.5
3-4	0.626	2.54 ± 0.15	2.81 ± 0.09	11.6
5-6	0.612	2.80 ± 0.19	3.25 ± 0.11	12.1
7-8	0.599	3.44 ± 0.24	3.96 ± 0.14	11.0
9-10	0.644	4.55 ± 0.29	4.54 ± 0.16	11.3
12-13	0.588	3.12 ± 0.20	3.19 ± 0.11	11.8

"Depth" indicates the water depth at the sampling station. "T" and "S" represent the temperature and salinity of bottom water, respectively, based on in-situ measurements.
N: ^{220}Rn counts in the RaDeCC.
t: counting time for one sample.

Table S2. Activities of dissolved ^{224}Ra (D-^{224}Ra) in bottom water and porewater at each sampling station. The errors refer to ± 1σ derived from counting statistics, which is calculated from $\frac{\sqrt{N}}{t}$.

Depth (cm)	D-^{224}Ra (dpm L^{-1})
SSW-A	
BW	0.39 ± 0.02
0-1	3.97 ± 0.77
1-2	12.80 ± 1.67
2-4	17.76 ± 1.71
4-6	19.70 ± 1.94
6-8	25.78 ± 2.35
SSW-B	
BW`	0.23 ± 0.02
0-1	7.91 ± 1.25
1-2	11.44 ± 1.39
2-4	17.40 ± 1.71
4-6	15.47 ± 1.78
6-8	15.38 ± 1.88
8-10	17.53 ± 1.93
10-14	18.14 ± 2.13
14-18	11.21 ± 1.62
18-22	17.91 ± 1.76
22-27	17.90 ± 1.99
SSW-C	
BW	0.11 ± 0.01
0-1	26.37 ± 3.07
1-2	16.17 ± 1.92
2-4	52.38 ± 3.14
4-6	36.65 ± 2.67
6-8	32.79 ± 2.80

N: ^{220}Rn counts in the RaDeCC.

t: counting time for one sample.

Table S3. Concentrations of DIC and TA (mean ± 1SD) in bottom water and porewater at each sampling station. The errors refer to the standard deviation (1SD) of duplicates at SSW-A and SSW-C, and 1SD of triplicates at SSW-B. The last column refers to the theoretical porewater $\delta^{13}C_{DIC}$ calculated as a result of TOC degradation only (data for red plots in Fig. 4b)

Depth (cm)	DIC (μmol kg^{-1})	TA (μmol kg^{-1})	$\delta^{13}C_{DIC\text{-}calculate}$ (‰)
SSW-A			
BW	2229	2357 ± 39	
0-1	2539	2650 ± 20	-5.7
1-2	2468	2499 ± 90	-5.2
2-3	2639	2467 ± 82	-6.3
3-4	2590		-6.0
4-5	—	2580 ± 26	-7.5
5-6	2843		—
6-7	—	3081 ± 79	-7.7
7-8	2868		—
9-10	2926	—	-8.0
SSW-B			
BW	1964	1982 ± 4	
0-1	2634	2455 ± 6	-7.2
1-2	2752	2588 ± 29	-7.9
2-3	2991	2749 ± 7	-9.1
3-4	3007	2675 ± 9	-9.2
5-6	2883	2626 ± 16	-8.6
7-8	2578	2426 ± 7	-6.9
9-10	2581	2341 ± 8	-6.9
11-12	2700	2326 ± 5	-7.6
14-15	2319	2333 ± 6	-5.1
17-18	2324	2607 ± 15	-5.1
20-21	2184	2800 ± 5	-4.0
SSW-C			
BW	2051	2243 ± 37	
0-1	2571	2612 ± 33	-6.7
1-2	2484	2692 ± 44	-6.1
2-3	2714	2866 ± 51	-7.5
3-4	2619		-7.0
4-5	—	2914 ± 21	—
5-6	2826		-8.1
6-7	—	2714 ± 82	—
7-8	2863		-8.3

"—" denotes that samples were not collected.

Table S4. Porewater $\delta^{13}C_{DIC}$ values and contribution proportions of $CaCO_3$ dissolution (f_{CaCO_3}) and organic carbon degradation (f_{TOC}) to the porewater DIC of each layer.

Depth (cm)	$\delta^{13}C_{DIC}$ (‰)	$\frac{[DIC]_{PW} - [DIC]_{BW}}{[DIC]_{PW}}$ (%)	f_{CaCO_3} (%)	f_{TOC} (%)	f_{CaCO_3}/f_{TOC}
SSW-A					
BW	-3.3				
1-2	-4.5	9.6	3.9	5.6	0.70
4-6	-5.0	21.5	13.4	8.1	1.65
6-8	-5.4	22.2	12.2	10.0	1.22
SSW-B					
BW	-1.8				
0-1	-4.9	25.5	12.2	13.2	0.92
1-2	-5.4	28.6	13.3	15.3	0.87
2-3	-5.8	34.3	17.5	16.8	1.04
3-4	-6.0	34.7	16.7	18.0	0.93
5-6	-5.8	31.9	14.7	17.2	0.85
7-8	-4.8	23.8	10.9	13.0	0.84
9-10	-4.9	23.9	10.4	13.5	0.77
11-12	-5.3	27.3	12.1	15.2	0.80
14-15	-3.9	15.3	6.1	9.2	0.66
17-18	-3.9	15.5	6.2	9.3	0.67
20-21	-3.3	10.1	3.6	6.5	0.55
SSW-C					
BW	-2.7				
0-1	-5.0	19.6	8.6	11.0	0.78
1-2	-5.8	16.8	1.9	14.9	0.13
2-4	-6.3	22.5	5.0	17.5	0.29
4-6	-6.7	26.9	7.7	19.2	0.40
6-8	-7.0	27.8	7.3	20.5	0.36

$\frac{[DIC]_{PW} - [DIC]_{BW}}{[DIC]_{PW}}$ represents the total contribution of $CaCO_3$ dissolution and organic carbon degradation to porewater $\delta^{13}C_{DIC}$.

Fig. S1. The detritus of benthic biota within sediments, including bivalve shells and calcareous tube fragments of polychaetes.

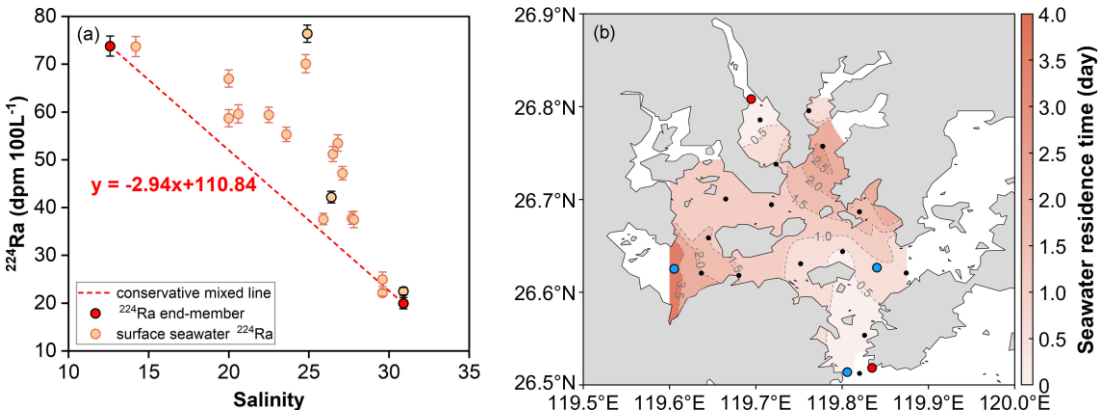

Fig. S2. (a) Conservative mixing line of ^{224}Ra versus salinity in surface seawater of Sandu Bay. Data are adapted from Wang et al. (2018). (b) Residence time of bay waters (τ) calculated from excess ^{224}Ra above the conservative line (ΔRa). Red circles represent the stations where ^{224}Ra was selected for the mixing line. Blue circles mark the locations where representative τ was used.

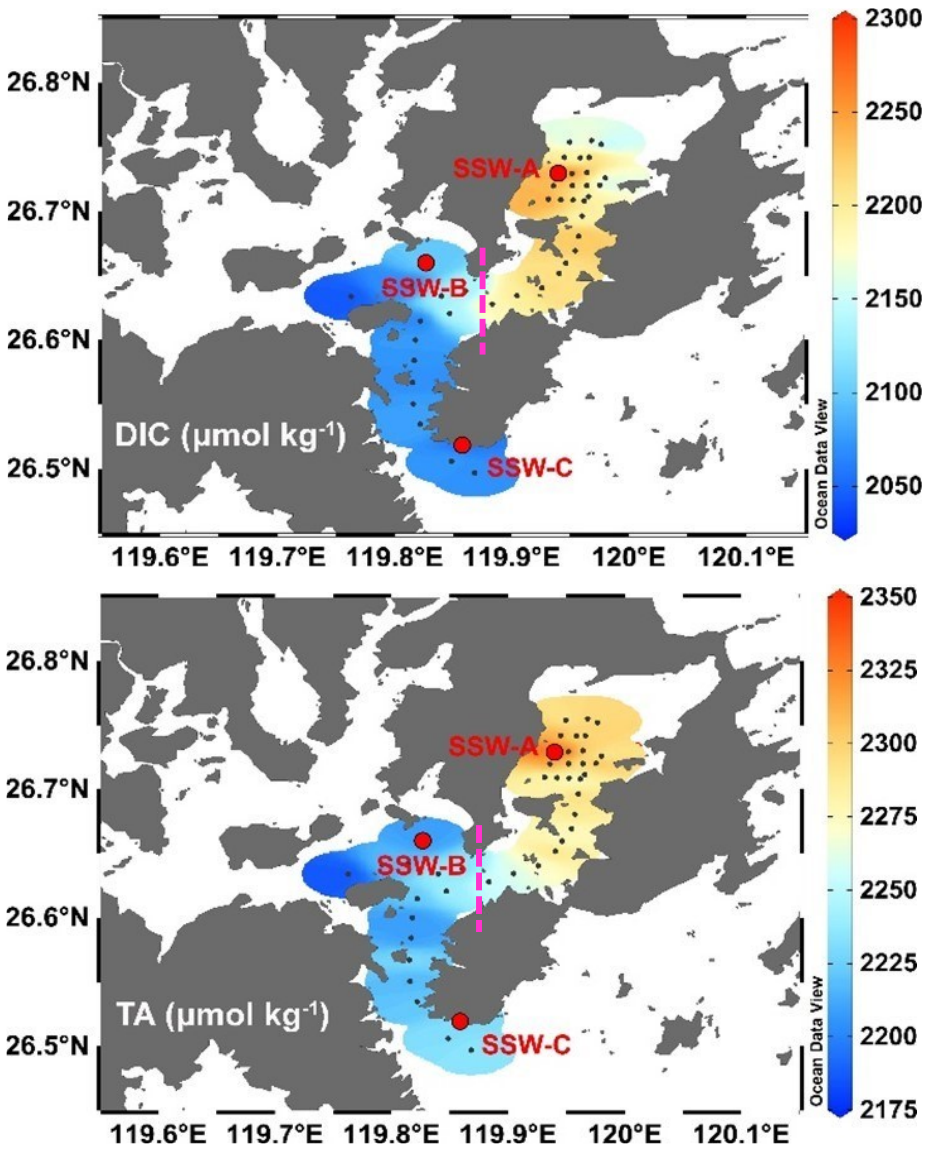

Fig. S3. Distributions of DIC (upper) and TA (lower) in surface seawater of Sansha Bay in April 2024. Data for the figures have been published in Liu et al. (2025). Data are available in the Mendeley Data repository (https://data.mendeley.com/datasets/ykd3kv453d/1). The pink dash line represents the edge of Dongwuyang. In Section 4.2, the average DIC and TA concentrations in Dongwuyang (2205 μmol kg^{-1} and 2290 μmol kg^{-1}, respectively) were calculated from all stations on the right side of the dash. The average levels of DIC and TA in the main channel were derived from the stations on the left side, as a result of 2081 μmol kg^{-1} and 2226 μmol kg^{-1}, respectively.