Evaluation of flushing time, groundwater discharge and associated nutrient fluxes in Daya Bay, China

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Table S1. Environmental parameters and radium activities for surface and bottom seawater.

Station	Longitude	Latitude	Salinity	pH	Temperature (ºC)	Sampling depth m	Water depth m	^{223}Ra	^{224}Ra	^{226}Ra	^{228}Ra
								(dpm 100 L^{-1})			
S1-1	114.71	22.75	23.49	8.53	31.1	1.5	8	4.41±0.53	105.94±12.71	19.39±3.46	58.24±4.08
S1-2			28.57	8.33	29.8	6.5		3.49±0.42	47.02±5.64	24.38±3.84	29.79±2.09
S2-1	114.64	22.73	27.61	8.47	30.8	1.5	6.9	6.73±0.81	85.36±10.24	31.42±4.48	47.68±3.34
S3-1	114.59	22.72	17.00	8.25	30.7	1.5	4.5	3.60±0.43	83.06±9.97	19.90±3.46	49.60±3.47
S4-1	114.72	22.70	30.15	8.28	30.4	1.5	9.3	2.35±0.28	55.32±6.64	26.43±3.84	38.00±2.66
S4-2			31.38	7.99	28.2	7		3.17±0.38	83.21±9.99	30.72±4.48	31.20±2.18
S5-1	114.68	22.67	30.59	8.37	29.6	1.5	12.2	1.09±0.13	32.22±3.87	17.60±2.75	29.71±2.08
S5-2			31.64	8.11	27.6	10		3.31±0.40	103.16±12.38	31.62±3.71	79.99±5.60
S6-1	114.62	22.68	30.59	8.75	30.3	1.5	9	2.97±0.36	64.55±7.75	18.08±2.24	39.47±2.76
S6-2			31.03	7.98	28.1	7		5.34±0.64	91.94±11.03	16.86±2.24	33.10±2.32
S7-1	114.55	22.69	28.30	8.5	30.4	1.5	7.5	4.96±0.60	82.03±9.84	13.95±2.24	46.48±3.25
S8-1	114.72	22.61	31.03	8.24	29.9	1.5	8.5	2.62±0.31	47.70±5.72	16.70±2.24	35.14±2.46
S8-2			32.34	8.05	26.5	7		1.95±0.23	59.38±7.13	12.48±1.92	18.90±1.32
S9-1	114.67	22.61	30.59	8.31	29.8	1.5	14.1	1.36±0.16	31.20±3.74	9.34±1.66	34.12±2.39
S9-2			31.73	8.12	26.6	11		1.34±0.16	25.66±3.08	6.34±1.47	14.13±0.99
S10-1	114.62	22.60	31.38	8.3	29.8	1.5	15.1	3.81±0.46	28.27±3.39	10.69±2.56	30.74±2.15
S10-2			32.34	8.07	25.9	13		1.68±0.20	53.21±6.38	13.31±2.94	21.02±1.47
S11-1	114.58	22.61	31.30	8.24	32.2	1.5	10.7	3.98±0.48	46.43±5.57	15.10±2.24	35.11±2.46
S11-2			32.10	8.09	27.6	8		3.55±0.43	53.43±6.41	11.90±1.92	25.16±1.76
S12-1	114.52	22.58	33.30	8.43	30.4	1.5	8	3.52±0.42	75.36±9.04	15.04±2.24	38.59±2.70
S12-2			31.70	8.03	27.3	6		2.00±0.24	75.47±9.06	8.00±1.28	39.01±2.73
S13-1	114.76	22.53	31.64	8.25	29.3	1.5	19.7	1.23±0.15	17.83±2.14	18.08±2.24	20.63±1.44

S13-2			32.52	8.05	24.7	13		1.06±0.13	30.37±3.64	5.92±1.47	14.72±1.03
S14-1	114.64	22.53	31.38	8.28	29.4	1.5	20.4	2.32±0.28	15.09±1.81	9.15±1.66	29.42±2.06
S14-2			32.17	8.12	26.1	13		1.63±0.20	31.92±3.83	8.29±1.60	14.10±0.99
S15-1	114.81	22.78	24.52	7.74	30.3	0.5	7.5	8.74±1.05	294.05±35.29	31.34±4.11	100.46±7.03
S16-1	114.77	22.79	16.16	8.73	31.7	0.5	7.5	6.76±0.81	213.21±25.59	18.79±3.50	73.68±5.16
S17-1	114.66	22.76	19.33	7.78	30.4	0.5	4.5	5.25±0.63	173.86±20.86	27.91±4.80	60.11±4.21
S18-1	114.70	22.74	23.40	8.47	31.4	1.5	8.6	4.06±0.49	59.26±7.11	22.66±4.48	39.58±2.77
S18-2			29.80	8.19	29.1	6.5		7.06±0.85	119.39±14.33	27.65±3.84	32.08±2.25
S19-1	114.62	22.64	29.63	8.53	30.3	1.5	7	4.74±0.57	67.33±8.08	20.06±1.89	44.14±3.09
S20-1	114.64	22.65	29.80	8.46	30.8	1.5	12.4	2.22±0.27	52.63±6.32	22.40±3.33	34.87±2.44
S20-2			30.94	8.29	28.9	11		1.81±0.22	55.52±6.66	17.41±3.26	25.27±1.77
S21-1	114.70	22.65	30.85	8.24	30.1	1.5	11.5	2.02±0.24	31.93±3.83	15.36±2.24	35.34±2.47
S21-2			31.64	8.15	28.6	10		3.50±0.42	55.80±6.70	11.74±1.50	25.74±1.80
S22-1	114.72	22.66	30.77	8.21	30.5	1.5	9.3	1.99±0.24	54.52±6.54	8.86±1.73	13.65±0.96
S22-2			31.99	7.98	27.3	7		3.92±0.47	70.10±8.41	8.38±1.41	30.09±2.11
S23-1	114.56	22.56	30.85	8.35	30.2	1.5	12.2	1.66±0.20	32.81±3.94	13.44±0.94	18.11±1.27
S23-2			31.64	8.2	27.9	10		3.09±0.37	57.78±6.93	10.34±2.24	27.74±1.94
S24-1	114.60	22.55	30.85	8.35	30.1	1.5	14.3	3.21±0.39	36.44±4.37	11.74±1.89	29.63±2.07
S24-2			31.73	8.18	27.1	10		2.46±0.29	42.57±5.11	7.07±1.54	22.29±1.56
S25-1	114.67	22.57	30.68	8.33	30.7	1.5	16.8	2.51±0.30	29.62±3.55	8,29±1.66	27.95±1.96
S25-2			31.38	8.21	28.1	11		1.77±0.21	37.77±4.53	7.81±1.63	1.49±0.10
S26-1	114.69	22.55	31.73	8.3	30.4	1.5	18.4	2.49±0.30	35.04±4.20	11.17±1.92	29.83±2.09
S26-2			32.26	8.03	24.5	13		1.19±0.14	28.57±3.43	6.78±1.44	15.74±1.10
S27-1	114.75	22.56	31.12	8.24	29.9	1.5	13.2	2.51±0.30	39.24±4.71	8.86±1.66	31.46±2.20
S27-2			32.34	8	24.7	10		2.32±0.28	48.64±5.84	10.05±1.86	20.63±1.44

"-1" and "-2" denote surface seawater and bottom seawater, respectively.

Table S2. Concentrations of nutrients in surface seawater, groundwater and river water in Daya Bay, respectively.

Station	NO_3	NO_2	NH_4	DIN	DIP	DIN/DIP
			($\mu mol\ L^{-1}$)			
Surface seawater						
S15	34.29	10.87	ND	45.16	1.49	30.20
S16	34.29	21.74	ND	56.02	2.98	18.80
S17	92.14	43.48	ND	135.62	1.29	105.00
S18	57.14	43.48	ND	100.62	1.74	57.82
S19	22.14	8.70	ND	30.84	0.67	46.36
S20	1.43	10.87	ND	12.30	0.37	33.41
S21	ND	0.09	ND	0.09	0.26	0.34
S22	41.43	0.09	ND	41.52	0.44	93.85
S23	ND	0.09	ND	0.09	0.21	0.41
S24	30.00	6.52	ND	36.52	0.27	136.27
S25	ND	0.09	ND	0.09	0.18	0.48
S26	ND	0.13	ND	0.13	0.20	0.66
S27	ND	0.43	ND	0.43	0.31	1.40
Groundwater						
GW1	18.57	2.17	ND	20.75	0.33	63.61
GW2	344.29	0.13	97.78	442.19	1.16	380.41
GW3	62.86	65.22	ND	128.07	3.32	38.51
GW4	3.57	1.30	ND	4.88	2.4	2.03
GW5	7.86	0.43	ND	8.29	0.73	11.36
GW6	13.57	8.70	ND	22.27	3.45	6.44
GW7	103.57	2.61	ND	106.18	1.84	57.69
GW8	41.43	0.87	ND	42.3	0.69	61.50
GW9	18.57	1.30	ND	19.88	1.69	11.72
River water						
R1	67.91	32.16	ND	100.07	3.40	29.4
R2	206.38	0.26	ND	206.64	0.33	618.5
R3	22.89	7.96	ND	30.84	2.35	13.15
R4	41.04	12.21	ND	53.26	0.87	61.10

"ND" denotes not determined.

Table S3. Statistical summary of the four data sets ($^{22n}Ra_{gw}$, $^{22n}Ra_{ns}$, $^{22j/22i}Ra_{gw\text{-}ns}$ and $^{22n}Ra_{gw\text{-}ns}$) from the 9 groundwater samples and corresponding nearshore seawater samples.

Groundwater Stations	$^{22n}Ra_{gw}$ (dpm 100 L^{-1})				Corresponding seawater stations	$^{22n}Ra_{ns}$ (dpm 100 L^{-1})[c]				$^{22j/22i}Ra_{gw-ns}$				$^{22n}Ra_{gw\text{-}ns}$ (dpm 100 L^{-1})			
	^{223}Ra	^{224}Ra	^{226}Ra	^{228}Ra		^{223}Ra	^{224}Ra	^{226}Ra	^{228}Ra	$^{223/226}$Ra$_{gw\text{-}ns}$	$^{223/228}$Ra$_{gw\text{-}ns}$	$^{224/226}$Ra$_{gw\text{-}ns}$	$^{224/228}$Ra$_{gw\text{-}ns}$	^{223}Ra$_{gw\text{-}ns}$	^{224}Ra$_{gw\text{-}ns}$	^{226}Ra$_{gw\text{-}ns}$	^{228}Ra$_{gw\text{-}ns}$
GW1	0.64[a]	6.82[a]	16.42[a]	2.2[a]	S23 (3.8[b]), S24 (1.52[b]), S14 (5.26[b])	2.58	38.14	9.88	24.52								
GW2	9.64	374.09	68.86	113.55	S11 (6.56[b]), S12 (1.11[b])	2.91	71.72	11.81	37.55	0.08	0.03	5.02	1.97	1.28	78.00	15.55	39.67
GW3	614.43	7794.91	148.30	1402.72	S7 (6.06[b]), S19 (11.36[b])	4.88	76.92	16.08	45.67	0.12	0.09	5.31	3.93	6.88	305.95	57.64	77.88
GW4	37.15	968.53	42.11	93.81	S2 (4.57[b]), S17 (1.51[b])	5.62	151.88	28.68	57.02	0.59	0.53	25.00	22.16	26.51	1115.57	44.62	50.34
GW5	30.26	1188.23	65.41	92.15	S1 (4.57[b])	3.95	76.48	21.89	44.01	2.07		50.95		30.80	757.86	14.87	
GW6	8.01	293.15	35.35	113.84	S15 (5.25[b]), S16 (1.03[b])	7.08	226.47	20.85	78.07	2.14	0.80	55.47	20.80	31.82	824.24	14.86	39.63
GW7	39.08	1199.56	28.20	102.51	S1 (4.11[b]),S4 (6.36[b])	3.48	73.65	24.51	40.32	7.27	0.56	229.66	17.59	35.77	1129.59	4.92	64.21
GW8	170.57	5196.32	30.46	102.51	S21 (4.26[b]), S22 (3.03[b]), S8 (3.92[b])	2.69	54.30	11.89	25.96	8.77	2.16	268.51	66.08	168.01	5144.73	19.16	77.85
GW9	32.96	808.72	28.73	5.09[a]	S8 (3.8[b])	2.28	53.54	14.59	27.02	4.58	0.45	58.05	5.68	609.79	7721.84	133.03	1359.34
Q1[d]	25.10	700.06	30.02	98.16		2.69	54.30	11.89	27.02	0.48	0.27	20.08	4.80	21.60	644.88	14.87	45.01
Q2[e]	35.06	1078.38	38.73	102.51		3.48	73.65	16.08	40.32	2.11	0.53	53.21	17.59	31.31	969.91	17.35	64.21
Q3[f]	71.95	2198.75	66.27	113.69		4.88	76.92	21.89	45.67	3.20	0.66	87.25	19.74	113.86	2134.72	38.08	244.13

[a]Activities of radium are excluded in the calculations of mass balance models due to lower values compared to those in the open sea water.

[b]The distance between groundwater station and corresponding nearshore seawater station.

[c]The activity of nearshore seawater corresponding to each groundwater sample is calculated based on the distance-weighted activity.

[d, e, f]The first, second (median) and third quartiles for corresponding data sets, respectively.

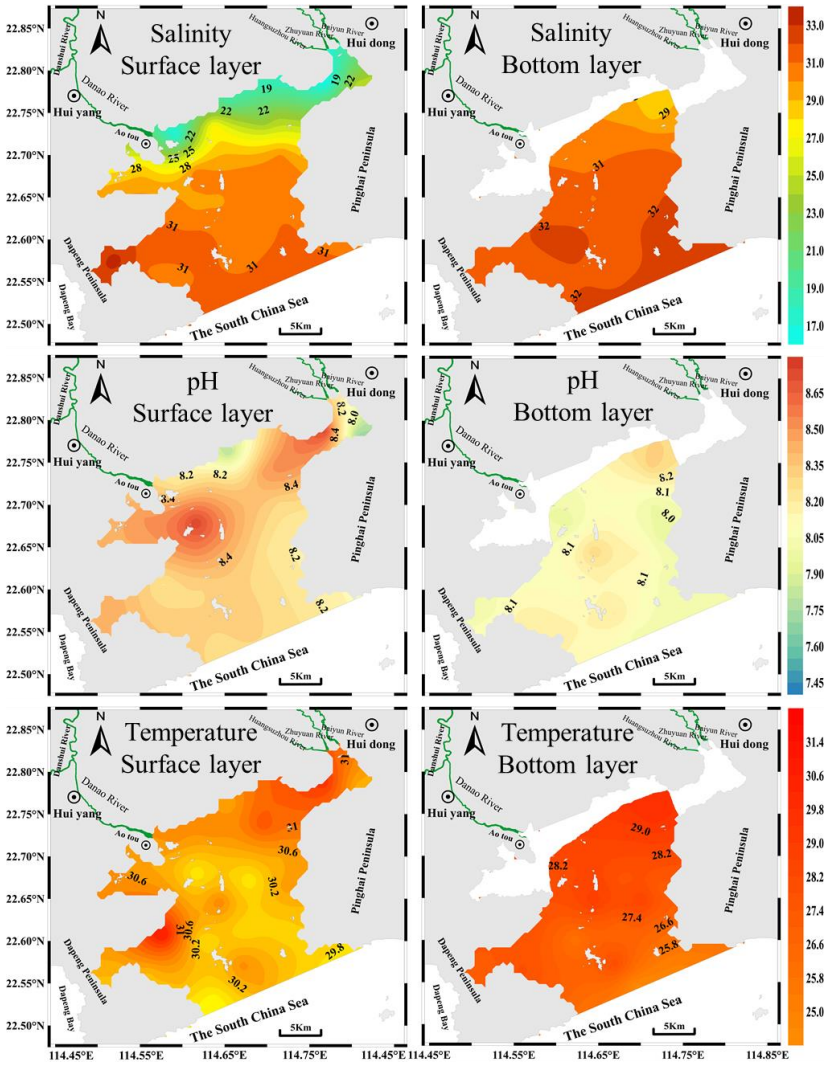

Figure S1. Spatial distributions of salinity, pH and temperature in surface and bottom layers of Daya Bay in July 2015.

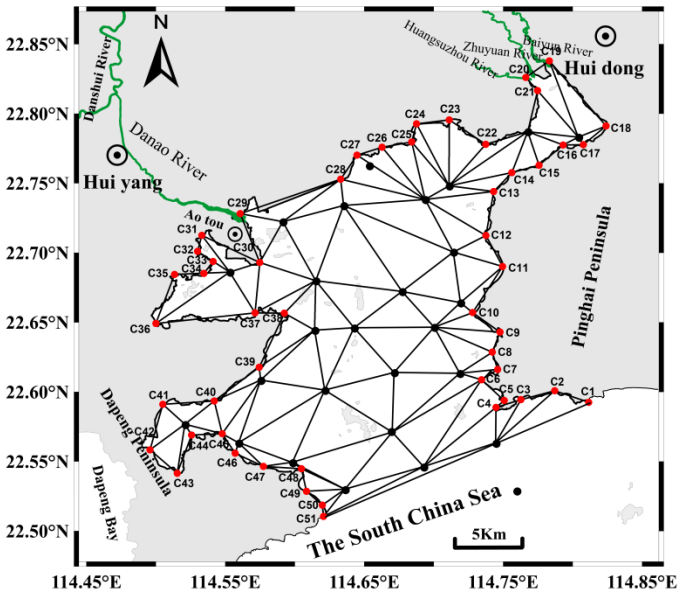

Figure S2. Triangle elements for calculations of the area, water volume, and radium inventories in Daya Bay**.** The radium activity at each triangle node on the coastline (stations C1-C51) was approximated by those at the nearest seawater station and the water depths at these nodes are set to be zero.