Electronic Supplemental Material – 02.05.2022

Estuaries and Coasts

Benthic foraminiferal response to trace elements in a tropical mesotidal Brazilian estuary

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Table S1 Sampling stations latitude (Lat) and longitude (Long) and parameters analyzed in the water and in the sediment. Water parameters: pH, salinity, temperature (Temp), dissolved oxygen (DO), chlorophyll (Chl), turbidity (Turbid), total dissolved solids (TDS). Sediment parameters: Organic matter (OM), Carbonate (CO3), Total Organic Carbon (TOC), Total Sulphur (TS), C/S ratio, trace elements Al, As, Cd, Cr, Cs, Cu, Fe, Hg, Mg, Mn, Ni, Pb, Sr, Zn, their Contamination Factor (CF), Pollution Load Index (PLI) and Modified Contamination Degree (mCd). Trace element concentrations are colored on the basis of their comparisons to the US-EPA ER-L and ER-M levels: when it is lower than ER-L, the color is green; if it is between ER-L and ER-M, the color is yellow; if it is greater than ER-M, the color is red

Station	Lat (S)	Long (W)	Depth and transparency (m)	pH	Salinity	Temp (°C)	DO (mg/L)	Chl (µg/L)	Turbid (NTU+)	TDS (g/L)	OM	TOC (%)	TS	C/S	Sand	Silt (%)	Clay	Mud (silt + clay) (%)
CH01-C	14°48'15.1"	039°01'30.5"	1.12 - 0.8	8.68	36.7	27.8	6.53	0.90	6.40	36.0	7.75	0.67	0.13	5.15	78.71	20.26	1.03	21.29
CH02-A	14°48'32.8"	039°01'56.3"	1.32 - 1.1	8.63	37.5	27.6	6.57	1.70	6.50	36.7	1.92	0.02	0.07	0.29	99.56	0.29	0.15	0.44
CH02-C	14°48'39.3"	039°01'59.9"	3.18 - 1.2	8.71	37.6	27.6	6.60	2.10	7.10	36.9	1.83	0.18	0.08	2.25	97.11	2.23	0.66	2.89
CH03-A	14°48'13.8"	039°02'25.6"	6.09 - 1.1	7.99	25.9	27.9	3.64	10.9	28.4	26.4	0.61	0.03	0.05	0.60	99.61	0.15	0.24	0.39
CH03-B	14°48'10.7"	039°02'30.0"	5.27 - 0.9	7.90	19.8	28.1	3.98	10.7	11.0	20.7	12.1	1.48	0.51	2.90	21.08	66.83	12.09	78.92
CH03-C	14°48'16.0"	039°02'22.3"	2.25 - 1.2	7.83	19.8	27.9	3.67	8.20	7.80	20.7	1.11	0.01	0.05	0.20	94.53	3.47	2.00	5.47
CH04-A	14°48'53.9"	039°02'41.9"	3.02 - 1.4	8.58	37.6	27.4	6.57	2.96	9.10	36.6	14.5	1.79	0.46	3.89	75.53	21.97	2.50	24.47
CH04-B	14°48'45.5"	039°02'44.6"	2.79 - 1.6	8.51	37.2	27.4	6.55	3.10	9.21	36.7	22.6	1.67	0.68	2.46	73.04	23.42	3.54	26.96
CH04-C	14°49'02.7"	039°02'39.3"	2.01 - 1.3	8.63	37.1	27.8	6.63	3.03	9.08	36.4	24.1	2.96	0.92	3.22	57.53	37.67	4.80	42.47
CH05-A	14°48'28.4"	039°02'50.7"	2.64 - 1.1	7.39	20.0	28.1	1.59	9.57	21.6	20.9	28.3	0.90	0.27	3.33	87.17	10.32	2.51	12.83
CH05-B	14°48'28.6"	039°02'52.7"	2.88 - 1.0	7.50	19.9	28.6	0.00	10.1	16.7	20.7	9.52	0.60	0.24	2.50	94.55	3.93	1.52	5.45
CH05-C	14°48'28.3"	039°02'48.9"	2.93 - 1.1	7.44	19.7	28.4	2.98	9.30	24.4	20.6	8.57	0.52	0.20	2.60	92.94	5.19	1.87	7.06
CH06-A	14°49'14.0"	039°02'35.9"	4.79 - 1.2	8.71	36.8	27.5	6.52	6.00	56.6	36.1	3.79	0.15	0.87	0.17	96.08	3.34	0.58	3.92
CH06-B	14°49'13.6"	039°02'38.7"	3.76 - 1.3	8.54	36.5	27.5	6.47	6.02	55.6	35.8	40.6	3.92	1.21	3.24	0.00	84.47	15.53	100.00
CH06-C	14°49'15.6"	039°02'34.3"	4.33 - 0.8	8.59	37.0	27.3	6.53	5.95	56.2	36.1	1.41	0.41	0.10	4.10	99.79	0.00	0.21	0.21
CH07-A	14°48'51.4"	039°03'17.4"	4.03 - 0.9	8.38	28.5	28.7	5.34	18.0	21.6	28.2	2.96	0.22	0.10	2.20	47.81	45.26	6.93	52.19
CH07-B	14°48'48.7"	039°03'18.7"	3.11 - 0.8	8.10	16.2	29.3	3.45	31.6	41.7	17.3	16.1	1.80	0.83	2.17	47.81	45.26	6.93	52.19
CH07-C	14°48'53.9"	039°03'16.7"	3.69 - 1.0	8.49	31.7	28.5	1.55	45.1	61.7	31.7	23.7	2.96	1.01	2.93	0.11	84.07	15.82	99.89
CH08-A	14°49'08.2"	039°03'56.6"	2.16 - 0.9	7.93	14.1	29.4	5.67	22.7	28.0	15.2	2.00	2.88	0.09	32.0	92.15	6.95	0.90	7.85
CH08-B	14°48'58.6"	039°04'00.0"	2.33 - 0.8	8.23	33.7	28.4	5.71	28.2	30.9	32.5	1.63	0.37	0.10	3.70	92.15	6.95	0.90	7.85
CH08-C	14°49'15.3"	039°03'54.5"	1.91 - 1.0	8.11	16.0	29.3	5.63	17.1	25.0	17.1	2.20	0.64	0.16	4.00	98.92	0.66	0.42	1.08
CH09-A	14°48'14.7"	039°04'29.4"	5.03 - 0.9	7.92	17.4	29.2	5.15	15.1	20.3	18.4	16.1	2.51	0.57	4.40	83.23	12.78	3.99	16.77
CH09-B	14°48'12.7"	039°04'28.7"	2.61 - 0.8	7.62	11.4	29.1	5.40	16.3	19.8	12.6	37.4	4.67	0.99	4.72	0.00	84.26	15.74	100.00
CH09-C	14°48'16.7"	039°04'30.1"	3.07 - 0.8	7.58	14.9	29.3	4.90	23.5	15.9	16.0	41.3	4.58	1.00	4.58	0.00	80.20	19.80	100.00
CH10-A	14°48'00.9"	039°05'32.4"	3.80 - 1.3	7.51	9.30	28.7	5.08	33.3	13.8	10.4	2.52	1.09	0.11	9.91	90.50	8.00	1.50	9.50
CH10-B	14°47'58.9"	039°05'31.9"	1.66 - 0.6	7.52	3.99	29.8	5.26	32.1	13.3	4.7	4.21	0.68	0.09	7.56	95.01	4.25	0.74	4.99
CH10-C	14°48'03.2"	039°05'33.0"	2.50 - 0.5	7.47	7.52	28.9	5.02	29.8	13.2	8.5	53.1	3.28	0.75	4.37	0.00	73.58	26.42	100.00
CH11-A	14°47'01.6"	039°05'42.2"	3.42 - 1.6	7.20	6.37	28.6	3.59	10.9	2.30	7.3	22.0	3.43	0.62	5.53	75.65	14.51	9.84	24.35
CH11-B	14°46'59.9"	039°05'41.4"	2.12 - 1.2	7.52	2.75	28.4	2.85	11.2	0.90	3.4	9.92	1.00	0.18	5.56	95.00	3.75	1.25	5.00
CH11-C	14°47'03.5"	039°05'43.7"	1.83 - 1.5	7.41	1.40	29.0	4.33	10.6	3.70	1.8	2.79	0.14	0.05	2.80	98.20	1.42	0.38	1.80
Mean	-	-	-	*8.02*	*22.47*	*28.38*	*4.79*	*14.53*	*21.26*	*22.75*	*13.9*	*1.52*	*0.42*	*4.44*	*69.5*	*25.18*	*5.36*	*30.54*
Max.	-	-	-	*8.7*	*37.6*	*29.8*	*6.6*	*45.1*	*61.7*	*36.9*	*53.1*	*4.67*	*1.21*	*32.0*	*99.8*	*84.47*	*26.42*	*100.0*
Min.	-	-	-	*7.20*	*1.40*	*27.34*	*0.00*	*0.90*	*0.90*	*1.77*	*0.61*	*0.01*	*0.05*	*0.17*	*0.00*	*0.00*	*0.15*	*0.21*

Station	Al	As	Cd	Cr	Cs	Cu	Fe (µg/g)	Hg	Mg	Mn	Ni	Pb	Sr	Zn
CH01-C	12545	27.7	0.05	30.6	2.57	12.6	22073	0.17	8735	488	17.6	24.2	475	60.1
CH02-A	12655	19.9	0.06	33.5	2.56	29.1	21542	0.16	6027	223	15.7	40.9	276	79.6
CH02-C	837	5.81	0.02	2.58	0.21	1.30	2186	0.04	852	25.2	1.25	6.90	16.8	8.64
CH03-A	381	1.02	0.01	1.30	0.02	0.18	1022	0.01	352	31.0	0.48	0.62	2.66	3.95
CH03-B	15434	14.3	0.08	37.2	1.25	22.9	25444	0.22	7160	338	18.8	49.0	227	92.3
CH03-C	1078	1.85	0.00	3.18	0.03	0.36	2319	0.01	637	21.7	1.06	0.71	5.03	6.78
CH04-A	11879	17.2	0.08	33.8	2.14	17.4	21757	0.12	6473	216	16.0	31.5	250	340.6
CH04-B	13092	17.0	0.04	35.6	1.98	18.6	22831	0.12	7261	229	15.9	26.3	230	169.8
CH04-C	11797	18.8	0.06	31.7	1.88	16.4	25705	0.11	6288	220	14.2	43.0	113	390.0
CH05-A	12874	15.5	0.12	32.7	1.89	22.2	24087	0.10	6232	239	16.8	44.6	229	84.2
CH05-B	11153	16.0	0.38	35.9	1.77	26.6	24448	0.15	6852	189	15.2	94.8	81.6	223.3
CH05-C	12632	24.4	0.14	34.4	2.01	22.6	27739	0.11	7656	313	16.2	34.5	181	106.0
CH06-A	578	1.60	0.01	1.86	0.05	0.70	2074	0.00	955	26.2	3.56	0.78	75.8	4.95
CH06-B	13299	19.3	0.08	39.8	2.06	25.6	25950	0.15	6450	200	15.3	42.3	89.2	206.4
CH06-C	14521	21.0	0.06	43.0	1.60	26.8	27636	0.17	7047	229	16.5	42.9	152	100.6
CH07-A	11767	15.9	0.08	33.3	1.73	19.9	24942	0.13	8084	222	14.9	91.6	164	83.2
CH07-B	12764	16.9	0.12	41.3	1.73	24.2	25311	0.16	7242	339	19.7	40.4	388	100.8
CH07-C	13478	17.6	0.13	39.2	1.98	23.2	26222	0.16	6231	332	16.2	66.1	115	92.8
CH08-A	11515	15.1	0.19	34.3	1.81	27.1	27069	0.13	8284	258	15.4	206.7	90.5	227.7
CH08-B	10336	23.2	0.22	32.8	1.12	94.7	30026	0.21	18672	497	28.7	855.8	144	335.6
CH08-C	11453	29.0	0.15	36.2	1.56	114.0	34319	0.20	8832	206	16.6	876.7	133	140.3
CH09-A	10166	6.89	0.18	29.31	1.17	21.16	17244	0.13	11479	144	11.40	60.39	81.7	81.88
CH09-B	13801	9.80	0.14	37.23	1.29	29.47	26746	0.13	7942	255	15.29	93.51	77.8	107.26
CH09-C	12011	10.1	0.22	40.1	1.20	28.9	24252	0.15	9851	254	16.4	78.2	123	145.7
CH10-A	10499	7.08	0.36	32.80	0.96	31.40	23136	0.23	12804	211	16.19	67.39	90.6	147.75
CH10-B	7233	2.09	0.08	22.92	0.37	25.28	16923	0.17	3207	175	10.01	168.79	34.2	101.61
CH10-C	11513	6.40	0.14	29.67	0.77	46.63	31718	0.15	8267	298	18.71	75.15	281	285.83
CH11-A	12544	2.96	0.57	38.60	0.42	47.70	31255	0.32	5506	483	37.58	39.56	187	161.42
CH11-B	10974	2.84	0.22	22.67	0.23	70.56	33408	0.21	4212	254	22.29	74.49	211	129.38
CH11-C	7282	1.16	0.24	22.36	0.19	41.02	14838	0.17	6693	161	15.18	304.15	53.3	170.17
Mean	*10403*	*12.9*	*0.14*	*29.7*	*1.28*	*29.6*	*22141*	*0.14*	*6876*	*236*	*15.3*	*119*	*153*	*140*
Max.	*15434*	*29.0*	*0.57*	*43.0*	*2.57*	*114*	*34319*	*0.32*	*18672*	*497*	*37.6*	*877*	*475*	*390*
Min.	*381*	*1.02*	*0.01*	*1.30*	*0.02*	*0.18*	*1022*	*0.01*	*352*	*21.7*	*0.48*	*0.62*	*2.66*	*3.95*
US-EPA ER-L	-	8.2	1.2	81	-	34	-	0.15	-	-	20.9	46.7	-	150
US-EPA ER-M	-	70	9.6	370	-	270	-	0.71	-	-	51.6	218	-	410

Station	CF As	CF Cd	CF Cr	CF Cu	CF Hg	CF Mn	CF Ni	CF Pb	CF Zn	PLI	mCd	Remarks
				CF = C element / C background								
CH01-C	1.80	1.67	0.95	3.37	22.13	1.42	2.44	2.69	2.15	2.53	4.29	Ebb tide delta; coastal drift influence
CH02-A	1.29	1.83	1.04	7.81	21.87	0.65	2.17	4.55	2.85	2.70	4.90	Flood tide delta
CH02-C	0.38	0.50	0.08	0.35	5.07	0.07	0.17	0.77	0.31	0.35	0.86	High population density
CH03-A	0.07	0.17	0.04	0.05	1.60	0.09	0.07	0.07	0.14	0.11	0.25	Proximity to the mouth; high population density; reduced mangrove vegetation at the banks
CH03-B	0.93	2.63	1.16	6.15	29.07	0.98	2.61	5.44	3.31	3.06	5.81	
CH03-C	0.12	0.33	0.10	0.10	1.07	0.06	0.15	0.08	0.24	0.16	0.25	
CH04-A	1.12	2.67	1.05	4.68	15.33	0.63	2.22	3.50	12.20	2.87	4.82	Meeting between Cachoeira and Itacanoeira and Santana estuaries.
CH04-B	1.10	1.37	1.11	5.00	16.13	0.66	2.20	2.92	6.08	2.48	4.06	
CH04-C	1.22	1.93	0.99	4.41	14.93	0.64	1.97	4.77	13.97	2.86	4.98	
CH05-A	1.01	3.93	1.02	5.96	13.60	0.69	2.33	4.95	3.02	2.71	4.06	Connection with Itacanoeira estuary; high population density upstream.
CH05-B	1.04	12.60	1.11	7.15	19.73	0.55	2.10	10.54	8.00	3.88	6.98	
CH05-C	1.58	4.73	1.07	6.06	14.93	0.91	2.25	3.83	3.80	3.03	4.35	
CH06-A	0.10	0.33	0.06	0.19	1.33	0.08	0.49	0.09	0.18	0.19	0.32	Connection with Santana estuary; mangrove vegetation at the banks
CH06-B	1.25	2.60	1.24	6.86	19.33	0.58	2.12	4.70	7.39	3.05	5.12	
CH06-C	1.37	2.13	1.34	7.20	22.27	0.67	2.29	4.77	3.60	2.94	5.07	Connection with Santana estuary; high population density.
CH07-A	1.03	2.50	1.03	5.34	16.80	0.65	2.07	10.17	2.98	2.77	4.73	High population density
CH07-B	1.10	3.90	1.29	6.49	21.20	0.99	2.74	4.49	3.61	3.18	5.09	
CH07-C	1.14	4.17	1.22	6.24	21.33	0.97	2.24	7.34	3.32	3.25	5.33	Dense mangrove vegetation at the banks.
CH08-A	0.98	6.37	1.07	7.27	17.87	0.75	2.14	22.96	8.15	4.00	7.51	
CH08-B	1.50	7.23	1.02	25.41	27.47	1.44	3.97	95.09	12.02	7.18	19.46	
CH08-C	1.89	5.00	1.13	30.61	26.27	0.60	2.31	97.41	5.02	5.64	18.91	
CH09-A	0.45	5.97	0.91	5.68	17.07	0.42	1.58	6.71	2.93	2.44	4.63	Sewage treatment plant (STP) upstream; dense mangrove vegetation at the banks.
CH09-B	0.64	4.63	1.16	7.91	17.33	0.74	2.12	10.39	3.84	3.14	5.42	
CH09-C	0.65	7.37	1.25	7.77	20.40	0.74	2.28	8.69	5.22	3.47	6.04	
CH10-A	0.46	12.03	1.02	8.43	30.93	0.61	2.25	7.49	5.29	3.51	7.61	Region of effluent discharge from the STP.
CH10-B	0.14	2.53	0.71	6.79	22.67	0.51	1.39	18.75	3.64	2.30	6.35	
CH10-C	0.42	4.50	0.92	12.52	20.13	0.87	2.59	8.35	10.24	3.52	6.73	
CH11-A	0.19	18.97	1.20	12.81	43.20	1.40	5.21	4.40	5.78	4.25	10.35	High urbanization density upstream.
CH11-B	0.18	7.33	0.70	18.94	27.33	0.74	3.09	8.28	4.63	3.27	7.92	
CH11-C	0.08	8.10	0.70	11.01	23.07	0.47	2.11	33.79	6.10	3.04	9.49	
Mean	*0.84*	*4.67*	*0.92*	*7.95*	*19.05*	*0.69*	*2.12*	*13.27*	*5.00*	*2.93*	*6.06*	
Max.	*1.89*	*19.0*	*1.34*	*30.6*	*43.2*	*1.44*	*5.21*	*97.4*	*14.0*	*7.2*	*19.5*	
Min.	*0.07*	*0.17*	*0.04*	*0.05*	*1.07*	*0.06*	*0.07*	*0.07*	*0.14*	*0.11*	*0.25*	