

The biological contributions to biological ion exchange

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1. Supplementary Information

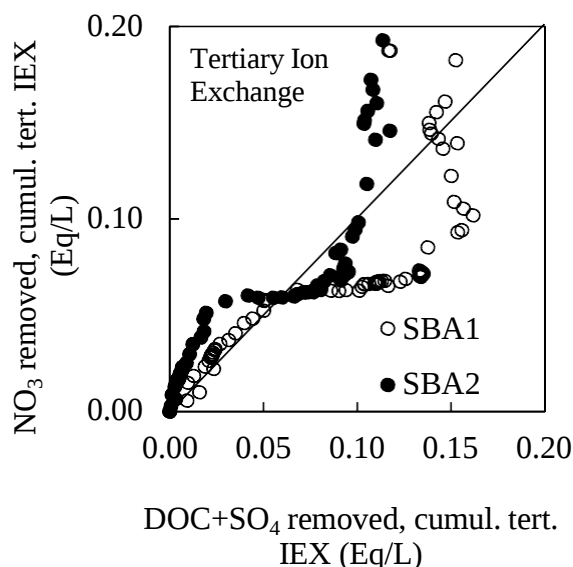


Figure S1. Following secondary IEX exhaustion, DOC removal continued, as could be hypothesized for a tertiary IEX mechanism, but there was also nitrate removal observed.

Table S1. Paired *t*-test showing statistical difference in percent DOC removal between pairings of BIEX_Exhausted, BIEX_SecIEX and BAC columns.

	BIEX_Exhausted vs. BIEX_SecIEX	BIEX_Exhausted vs. BAC	BIEX_SecIEX vs. BAC
Mean diff. in percent DOC removal	0.39	0.044	0.42
n	74	74	77
std dev	0.135	0.102	0.148
std error	0.0157	0.0119	0.0169
alpha	0.001	0.001	0.001
<i>t</i> -value	24.6	3.73	24.9
<i>t</i> -critical	3.43	3.43	3.42
difference?	TRUE	TRUE	TRUE

Table S2. Cellular ATP concentrations for influent and treated effluent waters. Duplicate BIE_Xexhausted filters were tested twice monthly from their start. Values shown are mean of duplicate cATP tests for each filter.

Date	BV from start	BIE_X1	BIE_X2	Influent_BIE_X1	Influent_BIE_X2
17-Jun-19	0	246	158	75	159

19-Jul-19	3050	84	97	136	149
2-Aug-19	5200	84	103	138	100
12-Aug-19	6400	104	76	120	94
3-Sep-19	7200	89	40	61	39
13-Sep-19	8800	137	162	70	66
23-Sep-19	9800	196	79	164	71
8-Oct-19	10400	99	84	52	85
17-Oct-19	11600	173	0	162	229
29-Oct-19	12200	184	94	196	232
12-Nov-19	13100	74	60	114	84
19-Nov-19	14200	47	31	98	167
2-Dec-19	14600	36	37	246	382
10-Dec-19	15500	93	59	484	417
16-Jan-20	16100	339	204	292	345
17-Jan-20	16852	304	413	157	129
18-Jan-20	16927	301	277	467	664
20-Jan-20	17000	317	250	218	189

Table S3. Shannon diversity and Chao1 richness parameters for filter ASV reads.

Sample_names	Filters	sample_date	Shannon	Chao1	ACE
17-BAC1-Feb4	BAC1	2020-02-04	1.99	8	8
47-BAC1-Jan4	BAC1	2020-01-04	2.95	30	30
13-BAC1-Aug27	BAC1	2020-08-27	3.56	56	56
1-BAC1-May10	BAC1	2020-05-10	4.00	104	104
73-BAC2-Aug27	BAC2	2020-08-27	1.71	6	6
18-BAC2-Feb4	BAC2	2020-02-04	2.37	14	14
30-BAC2-Nov5	BAC2	2020-11-05	2.99	27	27
2-BAC2-May10	BAC2	2020-05-10	3.74	74	74
3-BIEX1-May10	BIEX1	2020-05-10	4.27	253	253
37-BIEX1-Oct2	BIEX1	2020-10-02	4.68	344	344
31-BIEX1-Nov5	BIEX1	2020-11-05	4.67	397	397
49-BIEX1-Jan4	BIEX1	2020-01-04	3.49	435	435
76-BIEX2-Feb4	BIEX2	2020-02-04	2.90	58	58
77-BIEX1-Mar4	BIEX1	2020-03-04	2.68	37	37
78-BIEX2-Mar4	BIEX2	2020-03-04	2.29	40	40
50-BIEX2-Jan4	BIEX2	2020-01-04	4.21	443	443
38-BIEX2-Oct2	BIEX2	2020-10-02	3.70	288	288
32-BIEX2-Nov5	BIEX2	2020-11-05	4.61	404	404

A. BAC1					B. BAC2				
Firmicutes; Staphylococcus	4.9	15.4	0.9	5.8	1.1	0	8.1	0	
Bacteroidetes; Chryseobacterium	0	0	0.3	0.5	8.3	0	23	0	
Bacteroidetes; Bacteroides	0	0	0.5	9.7	0	6.9	0	10	
Proteobacteria; Aquicella	25.8	0	0	0	0	0.4	0	0	
Bacteroidetes; Chryseolinea			1.5		0	0	21.5	2.8	
Proteobacteria; Acinetobacter	0	0	0	5.7	8.3	8.3	0	0	
Proteobacteria; Gemmobacter	0	0	0	0	0	0	22.2	0	
Proteobacteria; Methylophilus	0	20	2.2	0	0	0	0	0	
Proteobacteria; Lautropia	0	20	0	0	0	0	0	0	
Proteobacteria; f_Rhodocyclaceae_ASV_1046	0	0	1.6	0	17.7	0	0	0	
Proteobacteria; Escherichia/Shigella	5.5	0	0	0	0	13.3	0	0	
Proteobacteria; Curvibacter	0	0	0	0	0	0	17.8	0	
Proteobacteria; Bradyrhizobium	5.8	0	0	1.1	0	0	0	10.6	
Proteobacteria; Massilia	0	0	0	1.2	9.9	0	0	5.4	
Proteobacteria; Rivicola	0	0	0.3	5.9	0	10.4	0	0	
k_Bacteria_ASV_1699; k_Bacteria_ASV_1699	0	0	0.6	0	15.5	0	0	0	
Proteobacteria; Kingella	5.8	7.7	0	1.7	0	0	0	0	
Proteobacteria; c_Gammaproteobacteria_ASV_2911	0	13.8	0	0	0	0	0	0	
Nitrospirae; Nitrospira	0	0	7.1	0	6.1	0	0	0	
Proteobacteria; c_Gammaproteobacteria_ASV_977	13.1	0	0	0	0	0	0	0	
Cyanobacteria/Chloroplast; Streptophyta	0	0	0	13	0	0	0	0	
k_Bacteria_ASV_1006; k_Bacteria_ASV_1006	0	0	0	0	12.2	0	0	0	
k_Bacteria_ASV_1180; k_Bacteria_ASV_1180	0	0	0	0	0	0	0	11.4	
Proteobacteria; Lacibacterium	1.6	0	1.3	0	0	0	0	8.5	
Proteobacteria; f_Burkholderiaceae_ASV_464	0	0	8.2	0	0	2.3	0	0	
	2020-01-04	2020-02-04	2020-05-10	2020-08-27	2020-02-04	2020-05-10	2020-08-27	2020-11-05	
C. BIEX1					D. BIEX2				
Proteobacteria; Janthinobacterium	0	40.6	0.1	0.1	0	37.5	33.4	0.1	0
Cyanobacteria/Chloroplast; Bacillariophyta	49.3	0	29.5	0.1	5.7	16.1	0.5	0.8	0
Bacteroidetes; Flavobacterium	0.1	7.7	0.1	1	0.2	0.3	7.1	13.7	20.1
Actinobacteria; Mycobacterium	1.2	0	3.2	2.1	1.9	11.8	4.8	0.5	2.1
Nitrospirae; Nitrospira	3.5	0	4.4	4.3	4.7	2.6	0.4	0.8	2.4
Bacteroidetes; f_Chitinophagaceae_ASV_21	1.7	0	2.2	7.1	6.5	2.5	0.5	0	2.4
Bacteroidetes; Ferruginibacter	0.8	0	0	2.3	3.2	8.1	2.5	0	2.7
Actinobacteria; Nocardia	0.9	1.4	0.2	3.4	6.7	2.7	5.3	0.3	0.9
Proteobacteria; Bradyrhizobium	2.5	0	0.8	4.2	3.1	3.3	0	0.4	3.8
Proteobacteria; c_Alphaproteobacteria_ASV_18	3.7	0	1	1.9	8.2	2.4	1	0	0.5
Proteobacteria; c_Gammaproteobacteria_ASV_28	0.8	0	0	6.1	0.8	0.6	0.5	0	6.3
Planctomycetes; Zavarzinella	0.4	0	1	4.5	4.8	1.3	0	0	1.2
Proteobacteria; f_Comamonadaceae_ASV_26	0.7	0	0	3.1	0.6	0.3	0	0.5	9.4
Bacteroidetes; Chryseolinea	0.4	1.5	1.4	3.3	1	0.3	0	0	3.9
Proteobacteria; f_Burkholderiales incertae sedis_ASV_33	0.1	0	0	0.1	0.2	0.1	0	0	8.9
Acidobacteria; Gp4	0.7	0	0.1	2.5	1.1	0.2	0	0	3.9
Proteobacteria; f_Rhodobacteraceae_ASV_50	0.9	0	0	2.1	3.7	2.3	0.5	0	1.3
Planctomycetes; f_Planctomycetaceae_ASV_56	0.1	0	0.3	0	0.1	7.5	1.6	0	0
Proteobacteria; Inquilinus	0.5	0	0	2.4	2.8	0.3	0	0	1.9
Proteobacteria; f_Burkholderiaceae_ASV_57	4	2.3	0.5	0	0.3	2.5	0	0	0
Proteobacteria; Rhizobacter	0.4	0	0	2.4	1.8	0.4	0	0	2.4
Proteobacteria; Legionella	0.6	0	0.6	1.8	1.9	1.2	0	0	0.9
Proteobacteria; Rugamonas	0	2.8	0	0	0	0	1.8	4.1	0
Atribacteria; Atribacteria genera incertae sedis	0	3.7	0	0	0	0	0	3.9	0
Proteobacteria; Polaromonas	0.5	0.9	0	1.2	1.7	0.7	0	0	0.9
	2020-01-04	2020-03-04	2020-05-10	2020-10-02	2020-11-05	2020-01-04	2020-02-04	2020-03-04	2020-10-02
									2020-11-05

Figure S2. Top 25 taxa for duplicate BAC and BIEX_Exhausted filters including *Janthinobacterium*, which was omitted from manuscript Fig. 5. Darker colour indicates a higher percent abundance. Arranged sequentially left to right.