

The following supplement accompanies the article

Bacterial communities and their hydrocarbon bioremediation potential in the Bohai Sea, China

Fenglong Yang, Jingshui Yang, Chungping Deng, Nan Chen, Shuangqing Wang, Entao Wang, HongLi Yuan*

*Corresponding author: hlyuan@cau.edu.cn

Marine Ecology Progress Series 538: 117–130 (2015)

Supplement.

Table S1. Details of sediment grab locations and general sediment properties

Sample ID	TOC (g kg ⁻¹)	TN (g kg ⁻¹)	AP (mg kg ⁻¹)	AK (g kg ⁻¹)	pH	HM (mg g ⁻¹)	BTEX (μg g ⁻¹)	Latitude (N)	Longitude (E)	Deep (m)
B1	15.53 ± 0.50	1.10 ± 0.02	28.68 ± 1.17	1.70 ± 0.00	7.93 ± 0.06	6.711	0.463	39.85	120.28	20.40
B3	15.05 ± 0.34	1.03 ± 0.02	25.28 ± 1.04	1.48 ± 0.01	7.93 ± 0.06	5.932	0.490	39.91	120.18	16.40
1	15.12 ± 0.64	0.77 ± 0.04	22.36 ± 1.29	1.44 ± 0.06	8.13 ± 0.12	5.955	0.277	39.90	120.67	30.20
5	15.01 ± 0.40	0.60 ± 0.03	21.71 ± 0.31	1.20 ± 0.02	8.13 ± 0.06	5.606	0.279	39.91	120.82	29.20
7	14.92 ± 0.21	0.64 ± 0.02	18.89 ± 0.97	1.22 ± 0.01	8.23 ± 0.12	7.260	0.219	39.98	120.83	28.20
12	15.27 ± 0.40	0.80 ± 0.02	20.77 ± 1.17	1.11 ± 0.00	8.23 ± 0.12	8.260	0.210	40.02	120.81	29.60
15	15.63 ± 0.18	0.64 ± 0.05	18.41 ± 0.55	1.08 ± 0.02	8.17 ± 0.06	5.851	0.219	39.95	120.78	28.60
16	15.18 ± 0.60	0.46 ± 0.01	17.86 ± 1.66	1.06 ± 0.01	8.27 ± 0.06	6.938	0.208	39.97	120.75	30.20
19	15.02 ± 0.44	0.40 ± 0.03	17.53 ± 1.90	0.81 ± 0.07	8.27 ± 0.06	7.706	0.187	40.02	120.67	26.80
22	15.20 ± 0.57	0.54 ± 0.01	14.97 ± 0.37	1.12 ± 0.03	8.17 ± 0.06	7.307	0.193	39.97	120.58	25.80
29	15.39 ± 0.45	0.51 ± 0.06	21.26 ± 0.52	1.20 ± 0.01	8.13 ± 0.06	7.033	0.229	39.94	120.76	31.90
35	14.84 ± 0.11	0.71 ± 0.04	24.15 ± 5.24	1.72 ± 0.04	7.97 ± 0.06	6.230	0.274	40.72	121.48	7.00
43	14.92 ± 0.25	0.77 ± 0.03	27.48 ± 0.33	1.58 ± 0.00	8.10 ± 0.17	6.206	0.302	40.57	121.38	12.00
48	15.84 ± 0.20	0.74 ± 0.04	44.62 ± 3.43	1.85 ± 0.00	8.00 ± 0.10	6.101	0.244	40.64	121.40	11.00

Key to abbreviations: TOC, total organic carbon; TN, total nitrogen; AP, available phosphorus; AK, available potassium; HM, total heavy metal contents; BTEX, total benzene homologues contents.

Table S2. Details of benzene homologues contents of the sediment samples ($\mu\text{g g}^{-1}$)

Sample ID	Benzene	Toluene	Ethylbenzene	<i>p</i>-xylene	<i>m</i>-xylene	<i>o</i>-xylene
B1	0.125	0.066	0.032	0.058	0.128	0.054
B3	0.140	0.070	0.024	0.062	0.140	0.054
1	0.061	0.040	0.020	0.039	0.077	0.041
5	0.063	0.041	0.019	0.036	0.080	0.041
7	0.048	0.026	0.013	0.040	0.056	0.038
12	0.048	0.030	0.014	0.040	0.047	0.032
15	0.053	0.029	0.016	0.031	0.058	0.032
16	0.038	0.023	0.019	0.036	0.054	0.038
19	0.041	0.026	0.015	0.024	0.049	0.032
22	0.043	0.026	0.013	0.029	0.055	0.028
29	0.083	0.033	0.006	0.035	0.053	0.019
35	0.066	0.040	0.008	0.035	0.080	0.045
43	0.075	0.045	0.008	0.044	0.082	0.047
48	0.061	0.035	0.007	0.036	0.066	0.038

Table S3. Details of heavy metal contents of the sediment samples ($\mu\text{g g}^{-1}$)

Sample ID	Ti	Mn	Ba	Sr	Rb	Zn	Cr	Zr	Ni	Cu	Pb	Ga
B1	4486.930	912.545	566.574	209.200	127.243	122.626	76.230	50.273	36.759	33.826	27.527	19.073
B3	3823.614	808.841	562.643	216.186	118.742	119.541	66.486	56.828	31.930	29.817	42.086	18.048
1	3799.028	940.283	594.349	198.237	115.714	93.664	55.108	23.871	29.056	26.383	28.125	15.890
5	3371.125	1044.265	573.172	192.101	113.394	88.037	48.261	53.136	26.629	23.290	25.263	15.105
7	4331.709	1588.694	607.410	201.274	121.153	102.117	55.445	94.451	34.362	31.379	32.733	17.280
12	3875.457	2976.675	672.666	203.767	111.166	109.911	58.274	63.550	46.145	37.308	42.805	16.294
15	3552.554	1042.850	572.854	193.917	113.525	93.519	54.047	70.432	31.077	50.530	26.462	15.445
16	4201.882	1389.651	614.180	207.041	116.986	105.525	55.634	96.755	32.392	29.203	33.362	16.164
19	3986.233	2260.541	592.789	238.638	115.772	119.255	73.031	82.739	40.701	33.655	35.771	18.517
22	4607.191	1183.910	682.262	261.319	123.984	114.445	77.662	84.868	39.735	32.753	32.160	19.643
29	4045.551	1709.024	663.999	204.542	112.901	83.624	50.892	25.945	30.395	27.551	29.186	15.286
35	4313.121	687.670	555.341	198.045	114.570	115.911	61.124	44.945	32.500	28.657	23.217	17.327
43	4288.668	606.754	589.027	200.624	115.885	129.050	66.457	67.015	33.380	28.673	25.800	17.668
48	4293.254	585.674	528.793	186.230	121.010	117.061	65.671	54.336	35.434	31.647	23.730	18.362

Table S3. continued

Sample ID	Co	Th	Cs	U	Mo	Sb	Sn	Tl	Ag	Ge	Cd	In
B1	15.030	12.048	7.822	2.033	1.189	1.143	0.634	0.617	0.505	0.429	0.375	0.071
B3	13.579	11.387	6.847	1.925	0.951	0.717	0.000	0.584	0.468	0.653	0.369	0.075
1	13.077	10.272	6.644	1.786	0.622	0.926	0.099	0.582	0.212	0.406	0.202	0.056
5	11.897	9.080	6.044	1.544	0.549	0.953	0.188	0.569	0.402	0.695	0.233	0.050
7	15.940	12.505	6.963	1.973	0.868	1.183	0.121	0.604	0.690	0.644	0.239	0.057
12	21.119	11.434	6.613	1.738	1.346	1.152	0.191	0.578	0.507	0.746	0.319	0.060
15	12.400	10.521	5.903	1.749	0.593	0.729	0.000	0.537	0.541	0.752	0.206	0.063
16	14.994	11.137	6.462	1.982	0.749	1.053	0.000	0.546	0.728	0.748	0.291	0.060
19	18.738	72.720	7.152	4.825	1.004	1.211	0.000	0.540	0.659	0.786	0.334	0.068
22	16.307	15.527	7.385	2.281	0.837	1.368	0.667	0.585	0.646	0.734	0.262	0.069
29	14.364	8.837	5.974	1.509	0.881	1.121	0.000	0.591	0.215	0.557	0.125	0.049
35	14.067	9.887	7.260	1.718	0.752	0.950	0.465	0.572	0.423	0.558	0.403	0.073
43	13.362	10.903	7.219	1.818	0.794	1.046	0.000	0.616	0.538	0.578	0.442	0.078
48	14.448	11.369	7.621	1.985	0.788	1.130	0.284	0.598	0.498	0.572	0.371	0.068

Table S4. Comparison of heavy metal contents (Zn, Cu, Pb and Cd) in Bohai Sea sediments with historical monitoring data and national coastal background standard values (mg Kg⁻¹)

Heavy metals	2011 (averaged) ^a	2003 ^b	1990s ^b	1980s ^b	Background ^c	Standard ^c	Excessive number ^d	Over-limit rate (%) ^e
Zn	108.163	98.920	-	73.6	65.15	80	14	100
Cu	31.762	27.210	32.5	26.0	22.10	30	7	50
Pb	30.588	17.340	14.6	22.4	13.96	25	12	85.71
Cd	0.298	0.120	0.16	0.15	0.088	0.5	0	0

^a Average heavy metal contents in 2011 (n=14)

^b Historical heavy metal monitoring values

^c National coastal background standard values of heavy metals

^d Number of samples which have heavy metal contents excess the standard values

^e The rate of excessive number to the total samples (n=14)

Table S5. The blastp results of representative AlkB protein sequences in each OPF:

OPF	Description	B3 ^a	5 ^a	29 ^a	Ident	Accession
1	alkane hydroxylase [<i>Marinobacter goseongensis</i>]	7	1	38	100%	AGU37344.1
2	alkane monooxygenase [uncultured bacterium]	11	10	10	84%	ACU43496.1
3	alkane monooxygenase [uncultured bacterium]	9	13	0	79%	ACU43492.1
4	alkane hydroxylase [<i>Marinobacter</i> sp. EPR21]	8	7	1	96%	AGL79974.1
5	alkane hydroxylase [<i>Alcanivorax</i> sp. S9-11]	1	7	0	96%	ACJ22692.1
6	alkane monooxygenase [uncultured bacterium]	6	1	0	91%	ACU43473.1
7	alkane monooxygenase [uncultured bacterium]	5	0	1	91%	ACU43475.1
8	alkane monooxygenase [uncultured bacterium]	2	2	0	80%	ABO61799.1
9	alkane monooxygenase [uncultured bacterium]	1	2	1	75%	ACU43512.1
10	alkane monooxygenase [uncultured bacterium]	1	2	0	79%	ACU43473.1
11	alkane monooxygenase [uncultured bacterium]	2	0	0	76%	ACU43481.1
12	alkane monooxygenase [uncultured bacterium]	0	1	1	85%	AFR68881.1
13	alkane 1-monooxygenase [<i>Dietzia</i> sp. UCD-THP]	1	0	1	99%	WP_017835122.1
14	Alkane-hydroxylase [<i>Alcanivorax</i> sp. P2S70]	0	1	0	98%	WP_022983890.1
15	alkane monooxygenase [uncultured bacterium]	0	1	0	87%	ACU43495.1
16	alkane monooxygenase [uncultured bacterium]	1	0	0	80%	ACU43479.1
17	alkane monooxygenase [uncultured bacterium]	0	1	0	80%	ACU43479.1

^aThe number of AlkB protein sequences in each OPF that retrieved from each sample.

Table S6. The blastp results of representative SDIMO protein sequences in each OPF

OPF	Description	B3 ^a	5 ^a	29 ^a	Ident	Accession
1	SDIMO alpha subunit [<i>Mycobacterium rhodesiae</i> NBB3]	39	37	14	38%	ABB70484.1
2	propane MO hydroxylase large subunit [<i>Mycobacterium</i> sp. ENV421]	8	7	7	70%	AFO66440.1
3	SDIMO alpha subunit [uncultured bacterium]	0	0	5	83%	ABB70434.1
4	epoxidase subunit [<i>Gordonia rubripertincta</i>]	1	1	0	63%	BAA07114.1
5	phenol-2 MO [<i>Marinobacter adhaerens</i>]	0	0	2	90%	WP_014579142.1
6	SDIMO alpha subunit [uncultured bacterium]	0	0	1	60%	ABB70447.1
7	SDIMO alpha subunit [<i>Patulibacter</i> sp. I11]	1	0	0	62%	WP_007576508.1
8	SDIMO alpha subunit [uncultured bacterium]	0	0	1	50%	ABB70434.1

^aThe number of SDIMO protein sequences in each OPF that retrieved from each sample.

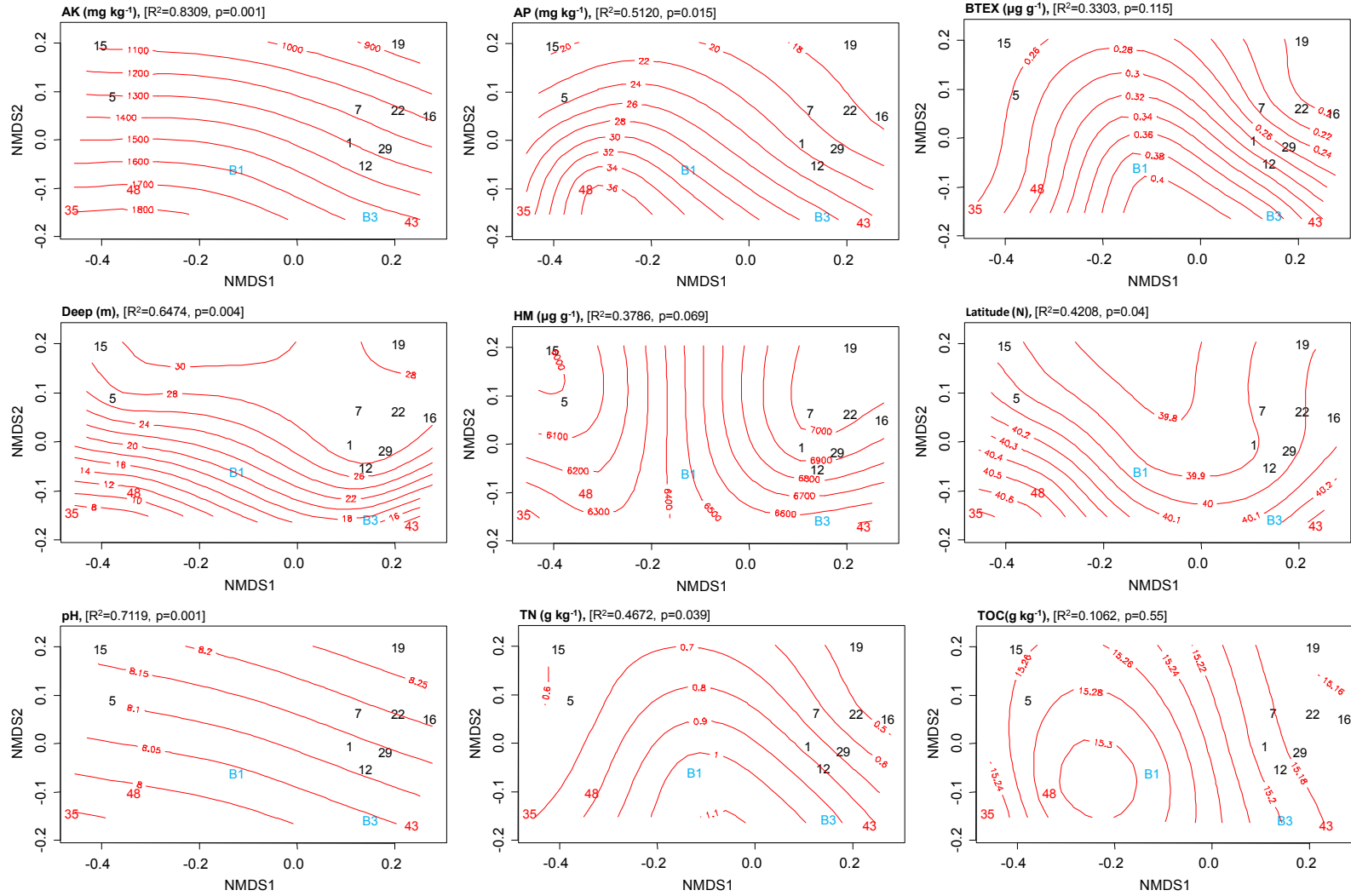


Fig. S1 Fitted surfaces of environmental variables in NMDS ordination.