

Electronic Supplementary Information

PAH Concentration Gradients and Fluxes through Sand Cap Test Cells installed *In Situ* over River Sediments containing Coal Tar

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Table S1. Average concentrations of MAHs and PAHs at different depths

Contaminants (mg/L)	S-A ^a					
	Days 40~200 in April to October, year 1			Days 350~550 in April to October, year 2		
	10 cm ^b	36 cm ^b	57 cm ^b	10 cm	36 cm	57 cm
Ethylbenzene	0.02 (0.11) ^c	0.04 (0.03)	1.07 (0.56)	0.26 (0.32)	0.12 (0.09)	0.76 (0.53)
m-xylene, p-xylene	0.01 (0.03)	0.02 (0.01)	0.18 (0.09)	0.07 (0.06)	0.03 (0.01)	0.13 (0.09)
o-xylene	0.01 (0.04)	0.02 (0.02)	0.35 (0.18)	0.09 (0.10)	0.05 (0.03)	0.25 (0.18)
1,3,5-trimethylbenzene	0.01 (0.02)	0.01 (0.00)	0.20 (0.11)	0.04 (0.06)	0.02 (0.02)	0.11 (0.09)
1,2,4-trimethylbenzene	0.01 (0.02)	0.01 (0.01)	0.25 (0.14)	0.06 (0.08)	0.03 (0.02)	0.16 (0.11)
Naphthalene	0.18 (0.59)	0.22 (0.07)	6.03 (3.14)	1.45 (2.87)	0.59 (0.43)	3.42 (3.12)
Acenaphthylene	0.01 (0.01)	0.01 (0.01)	0.06 (0.03)	0.03 (0.04)	0.02 (0.02)	0.07 (0.04)
Acenaphthene	0.02 (0.06)	0.02 (0.01)	0.35 (0.19)	0.11 (0.20)	0.07 (0.05)	0.22 (0.18)
Fluorene	0.00 (0.02)	0.00 (0.00)	0.03 (0.03)	0.04 (0.06)	0.03 (0.02)	0.08 (0.05)
Phenanthrene	0.01 (0.03)	0.01 (0.00)	0.07 (0.04)	0.04 (0.08)	0.02 (0.02)	0.07 (0.05)
Anthracene	0.00 (0.00)	0.00 (0.00)	0.02 (0.01)	0.01 (0.00)	0.01 (0.01)	0.01 (0.01)
Fluoranthene	0.00 (0.00)	0.00 (0.01)	0.03 (0.02)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Pyrene	0.00 (0.00)	0.00 (0.01)	0.01 (0.01)	0.00 (0.01)	0.00 (0.00)	0.01 (0.01)

^aSand-only cap A

^bLocation of the sampling port from sand cap-surface water interface

^cNumbers in parenthesis are standard deviation of replicates

Continued

Contaminants (mg/L)	S-B ^d					
	Days 40~200 in April to October, year 1			Days 350~550 in April to October, year 2		
	18 cm ^b	43 cm	68 cm	18 cm	43 cm	68 cm
Ethylbenzene	0.00 (0.00) ^c	0.79 (0.29)	1.14 (0.40)	0.05 (0.06)	0.28 (0.43)	0.98 (0.70)
m-xylene, p-xylene	0.00 (0.00)	0.27 (0.05)	0.40 (0.06)	0.02 (0.01)	0.09 (0.04)	0.32 (0.11)
o-xylene	0.00 (0.00)	0.20 (0.09)	0.25 (0.13)	0.02 (0.02)	0.09 (0.13)	0.20 (0.22)
1,3,5-trimethylbenzene	0.00 (0.00)	0.15 (0.08)	0.18 (0.07)	0.01 (0.01)	0.04 (0.07)	0.15 (0.11)
1,2,4-trimethylbenzene	0.00 (0.00)	0.20 (0.09)	0.25 (0.10)	0.02 (0.01)	0.09 (0.12)	0.20 (0.15)
Naphthalene	0.03 (0.02)	4.17 (1.60)	7.30 (3.30)	0.30 (0.08)	1.69 (2.29)	4.23 (3.70)
Acenaphthylene	0.01 (0.02)	0.10 (0.08)	0.10 (0.12)	0.02 (0.01)	0.03 (0.03)	0.07 (0.04)
Acenaphthene	0.01 (0.01)	0.28 (0.20)	0.42 (0.23)	0.05 (0.02)	0.12 (0.16)	0.28 (0.21)
Fluorene	0.00 (0.00)	0.04 (0.03)	0.07 (0.04)	0.02 (0.01)	0.04 (0.05)	0.09 (0.06)
Phenanthrene	0.01 (0.01)	0.07 (0.03)	0.09 (0.04)	0.02 (0.00)	0.03 (0.04)	0.07 (0.07)
Anthracene	0.00 (0.00)	0.01 (0.01)	0.02 (0.01)	0.02 (0.00)	0.00 (0.00)	0.01 (0.02)
Fluoranthene	0.01 (0.01)	0.02 (0.02)	0.02 (0.02)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Pyrene	0.00 (0.00)	0.01 (0.00)	0.01 (0.01)	0.00 (0.00)	0.00 (0.01)	0.01 (0.01)

^dSand-only cap B

Contaminants (mg/L)	O-A ^e			
	Days 40~200 in April to October, year 1		Days 350~550 in April to October, year 2	
	18 cm ^b	68 cm	18 cm	68 cm
Ethylbenzene	0.00 (0.00) ^c	0.29 (0.16)	0.07 (0.05)	0.23 (0.13)
m-xylene, p-xylene	0.00 (0.00)	0.10 (0.05)	0.02 (0.01)	0.04 (0.02)
o-xylene	0.00 (0.00)	0.09 (0.05)	0.03 (0.02)	0.06 (0.03)
1,3,5-trimethylbenzene	0.00 (0.00)	0.08 (0.04)	0.03 (0.02)	0.04 (0.03)
1,2,4-trimethylbenzene	0.00 (0.00)	0.09 (0.04)	0.03 (0.02)	0.06 (0.03)
Naphthalene	0.02 (0.01)	4.26 (1.82)	0.68 (0.33)	1.89 (1.25)
Acenaphthylene	0.02 (0.02)	0.10 (0.08)	0.03 (0.02)	0.03 (0.02)
Acenaphthene	0.01 (0.00)	0.34 (0.18)	0.07 (0.05)	0.11 (0.09)
Fluorene	0.00 (0.00)	0.07 (0.02)	0.03 (0.02)	0.04 (0.02)
Phenanthrene	0.00 (0.00)	0.09 (0.03)	0.03 (0.02)	0.03 (0.02)
Anthracene	0.00 (0.00)	0.01 (0.01)	0.00 (0.00)	0.01 (0.02)
Fluoranthene	0.00 (0.00)	0.03 (0.03)	0.00 (0.00)	0.00 (0.00)
Pyrene	0.00 (0.00)	0.01 (0.00)	0.00 (0.00)	0.00 (0.00)

^eSand cap containing sand/organoclay mixture A

Continued

Contaminants (mg/L)	O-B ^f			
	Days 40~200 in April to October, year 1		Days 350~550 in April to October, year 2	
	18 cm ^b	68 cm	18 cm	68 cm
Ethylbenzene	0.01 (0.00) ^c	0.77 (0.14)	0.04 (0.03)	0.46 (0.27)
m-xylene, p-xylene	0.00 (0.00)	0.22 (0.18)	0.01 (0.01)	0.07 (0.05)
o-xylene	0.00 (0.00)	0.18 (0.12)	0.02 (0.01)	0.08 (0.05)
1,3,5-trimethylbenzene	0.01 (0.01)	0.21 (0.11)	0.02 (0.01)	0.06 (0.03)
1,2,4-trimethylbenzene	0.00 (0.00)	0.18 (0.04)	0.02 (0.01)	0.08 (0.05)
Naphthalene	0.03 (0.01)	6.92 (1.09)	0.48 (0.21)	2.46 (1.58)
Acenaphthylene	0.01 (0.01)	0.04 (0.01)	0.02 (0.01)	0.03 (0.02)
Acenaphthene	0.01 (0.00)	0.41 (0.08)	0.05 (0.04)	0.14 (0.11)
Fluorene	0.00 (0.00)	0.07 (0.04)	0.02 (0.01)	0.05 (0.03)
Phenanthrene	0.00 (0.00)	0.09 (0.01)	0.02 (0.01)	0.03 (0.03)
Anthracene	0.01 (0.01)	0.01 (0.01)	0.00 (0.00)	0.01 (0.01)
Fluoranthene	0.00 (0.01)	0.02 (0.02)	0.00 (0.00)	0.00 (0.00)
Pyrene	0.00 (0.00)	0.01 (0.00)	0.00 (0.00)	0.00 (0.00)

^fSand cap containing sand/organoclay mixture B

Contaminants (mg/L)	P-A ^g			
	Days 40~200 in April to October, year 1		Days 350~550 in April to October, year 2	
	18 cm	68 cm	18 cm	68 cm
Ethylbenzene	0.00 (0.00)	0.54 (0.10)	0.06 (0.03)	0.67 (0.45)
m-xylene, p-xylene	0.01 (0.00)	0.18 (0.01)	0.02 (0.01)	0.21 (0.09)
o-xylene	0.00 (0.00)	0.16 (0.03)	0.02 (0.01)	0.14 (0.14)
1,3,5-trimethylbenzene	0.00 (0.00)	0.05 (0.05)	0.01 (0.02)	0.13 (0.08)
1,2,4-trimethylbenzene	0.00 (0.00)	0.16 (0.04)	0.02 (0.01)	0.14 (0.11)
Naphthalene	0.04 (0.01)	4.04 (1.17)	0.47 (0.28)	4.19 (2.50)
Acenaphthylene	0.02 (0.02)	0.12 (0.10)	0.02 (0.01)	0.06 (0.03)
Acenaphthene	0.02 (0.01)	0.33 (0.15)	0.06 (0.04)	0.26 (0.17)
Fluorene	0.00 (0.00)	0.04 (0.03)	0.02 (0.01)	0.09 (0.05)
Phenanthrene	0.01 (0.00)	0.07 (0.02)	0.02 (0.01)	0.08 (0.04)
Anthracene	0.00 (0.00)	0.01 (0.01)	0.00 (0.00)	0.02 (0.02)
Fluoranthene	0.00 (0.00)	0.01 (0.01)	0.00 (0.00)	0.00 (0.00)
Pyrene	0.00 (0.00)	0.01 (0.00)	0.00 (0.00)	0.01 (0.01)

^gSand cap containing sand/peat mixture A

Continued

Contaminants (mg/L)	P-B ^h			
	Days 40~200 in April to October, year 1		Days 350~550 in April to October, year 2	
	18 cm	68 cm	18 cm	68 cm
Ethylbenzene	0.00 (0.00)	0.36 (0.25)	0.05 (0.03)	0.51 (0.31)
m-xylene, p-xylene	0.01 (0.01)	0.13 (0.09)	0.02 (0.01)	0.16 (0.06)
o-xylene	0.00 (0.00)	0.09 (0.08)	0.02 (0.01)	0.10 (0.10)
1,3,5-trimethylbenzene	0.02 (0.02)	0.11 (0.08)	0.02 (0.02)	0.08 (0.05)
1,2,4-trimethylbenzene	0.00 (0.00)	0.09 (0.06)	0.02 (0.01)	0.10 (0.06)
Naphthalene	0.04 (0.01)	4.45 (3.07)	0.54 (0.28)	2.78 (1.49)
Acenaphthylene	0.03 (0.02)	0.06 (0.05)	0.02 (0.01)	0.06 (0.04)
Acenaphthene	0.01 (0.01)	0.34 (0.23)	0.07 (0.05)	0.22 (0.18)
Fluorene	0.00 (0.00)	0.07 (0.04)	0.03 (0.02)	0.08 (0.08)
Phenanthrene	0.01 (0.00)	0.10 (0.06)	0.03 (0.02)	0.12 (0.17)
Anthracene	0.01 (0.01)	0.02 (0.02)	0.00 (0.00)	0.02 (0.04)
Fluoranthene	0.00 (0.00)	0.02 (0.04)	0.00 (0.00)	0.01 (0.02)
Pyrene	0.00 (0.00)	0.01 (0.01)	0.00 (0.00)	0.04 (0.08)

^hSand cap containing sand/peat mixture B

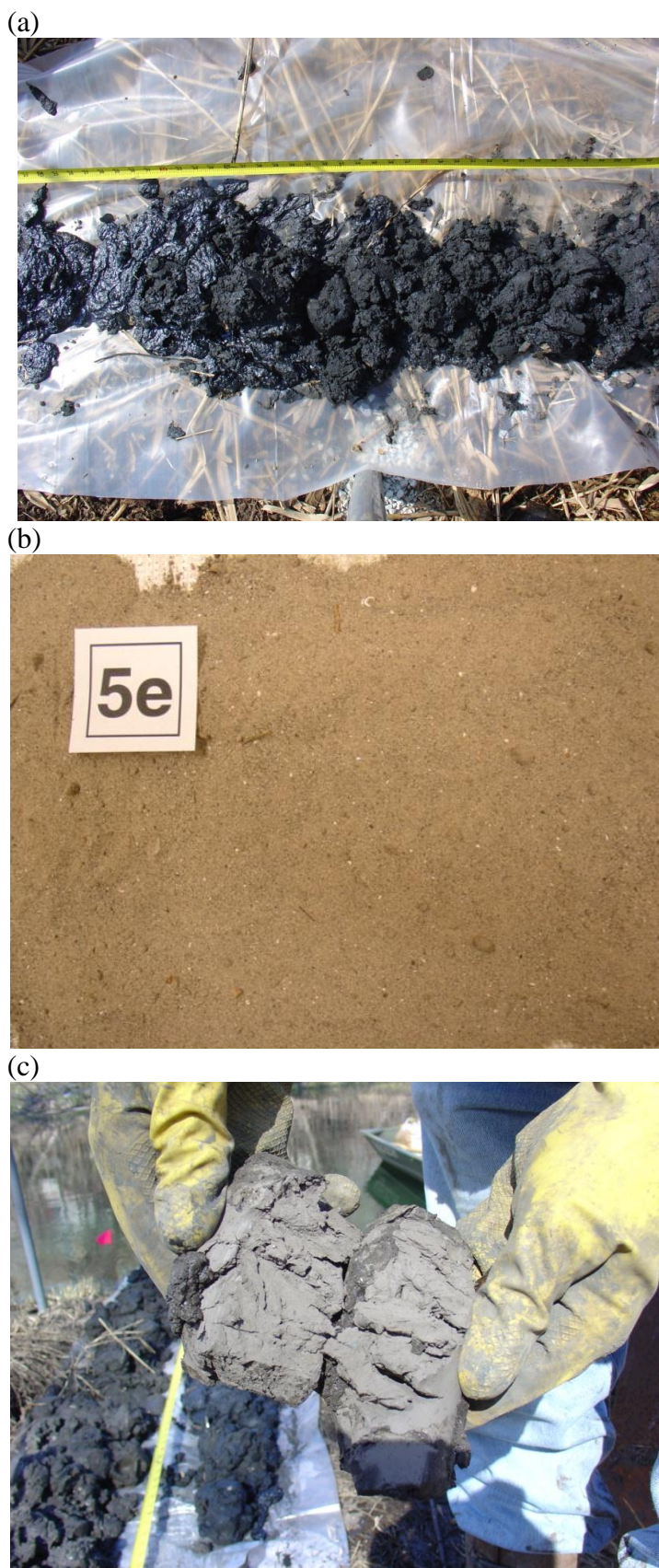


Figure S1. Photographs of (a) the organic sediment material that is > 2 m thick, (b) sand that underlies the organic sediment but is discontinuous at places and is generally < 20 cm thick, and (c) the clay material that underlies the sand and organic sediment layers

(a)



(b)



(c)



Figure S2. (a) The test cell cylinders, (b) leveling a test cell prior to attaching a collar, and (c), a long (4 ft) collar attached (with bungee cords) to the underwater test cell cylinder. The hooks on the bungee cords go through holes in the test cell cylinder and collar, keeping them aligned during installation. The collar was removed by simply removing the cords.

(a)



(b)



Figure S3. (a) The spring steel ring with geofabric attached, and (b) placing it in a cell after excavation. Notice the sheen of oil on top of the water in the collar. In this case, 3 ft long clamps were used to hold a 2 ft long collar to the test cell during excavation and sand addition

(a)



(b)



Figure S4. (a) The seepage meter flow tube, and (b) flanged cone. A water-tight seal between the two dome pieces is made by placing closed-cell foam in the u-shaped channel of the bottom (flange) piece where the rim of the top (cone) piece fits, pressing them together by attaching bungee cords.

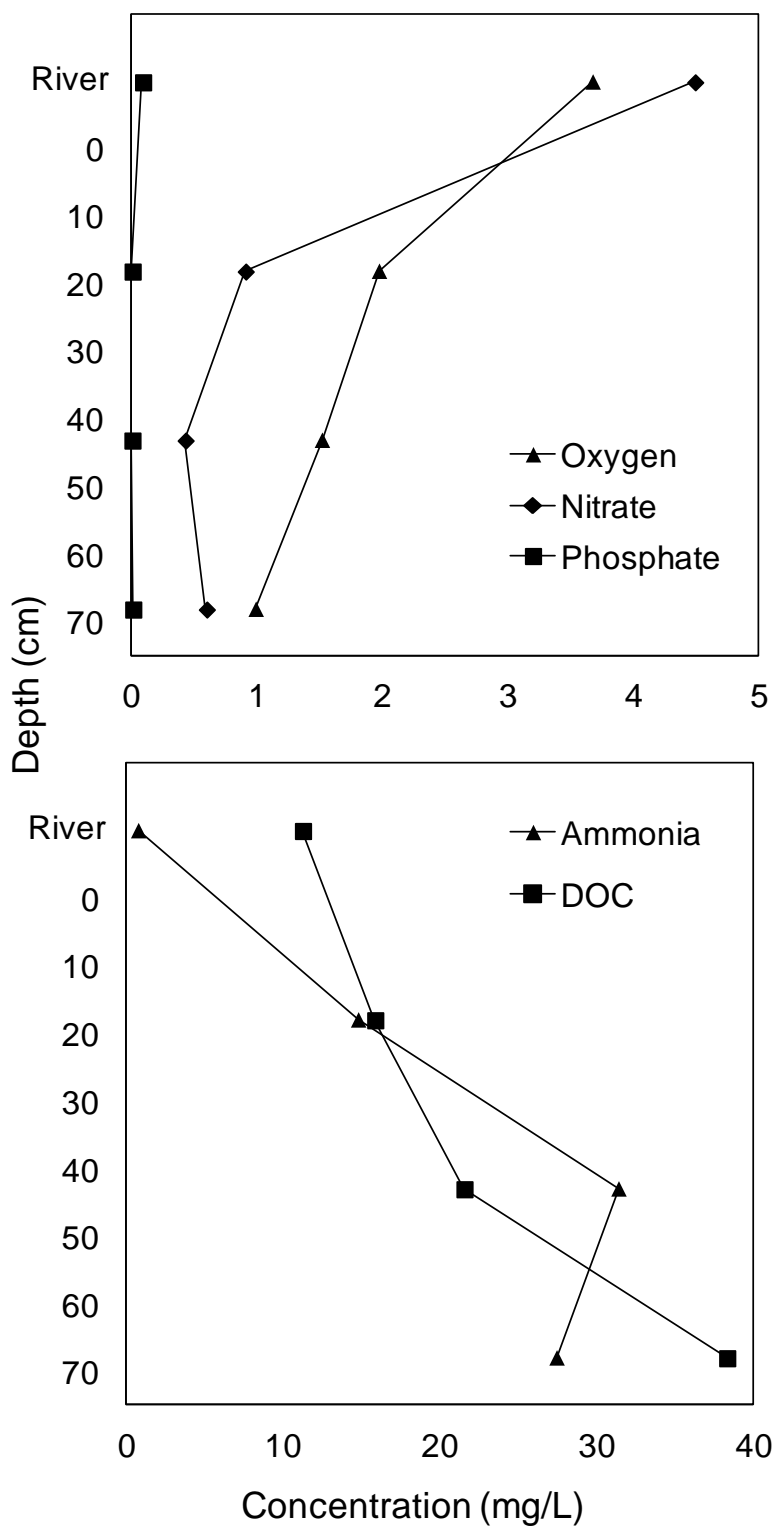


Figure S5. Average concentrations of dissolved oxygen, nitrate, phosphate, ammonia and dissolved organic carbon (DOC) as a function of sand depth in cell S-B. Data were collected one time each month from July through September of year 1.