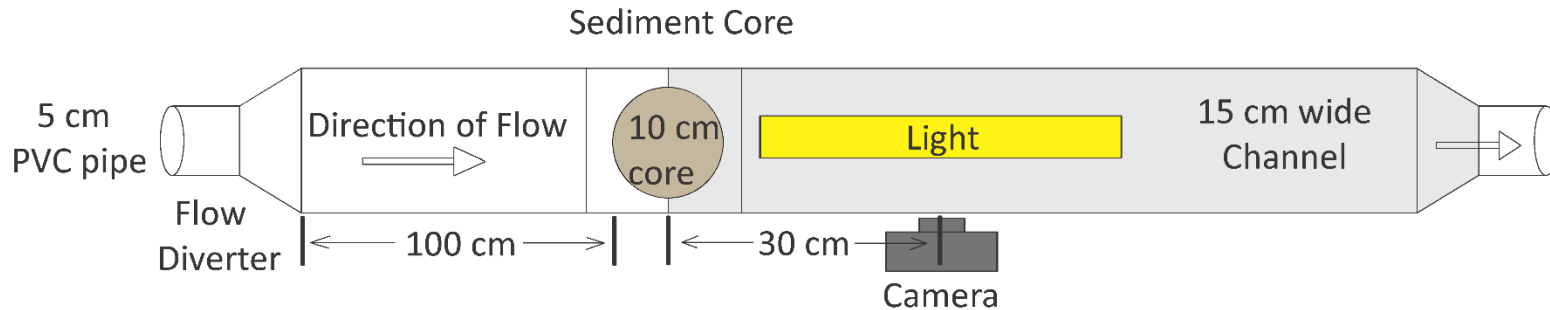
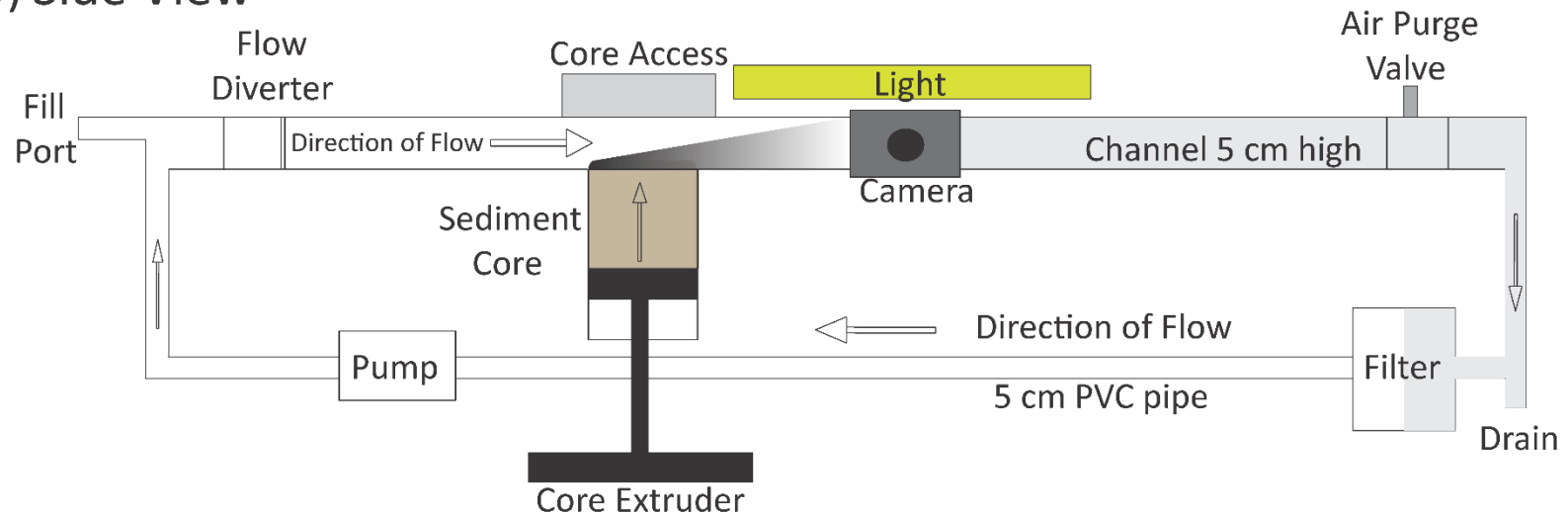


Closed Loop Resuspension Flume

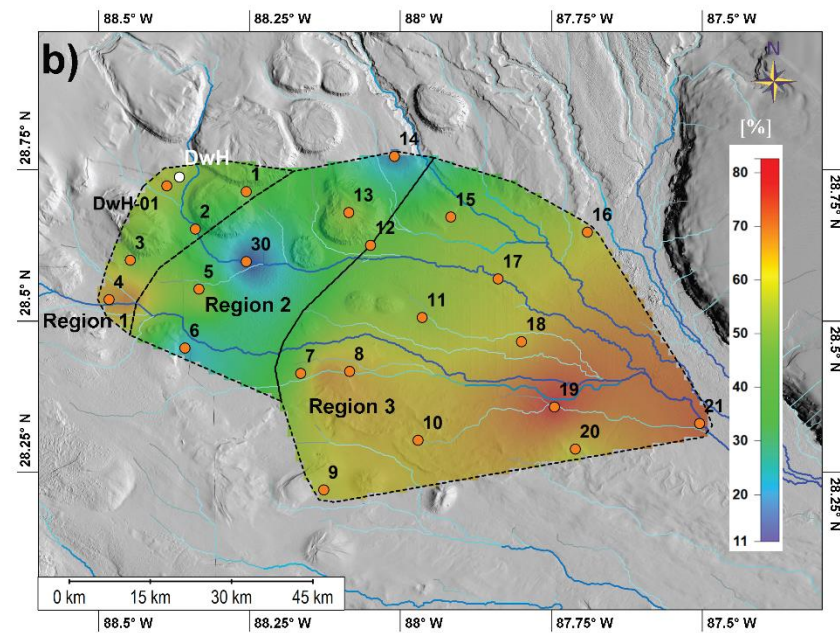
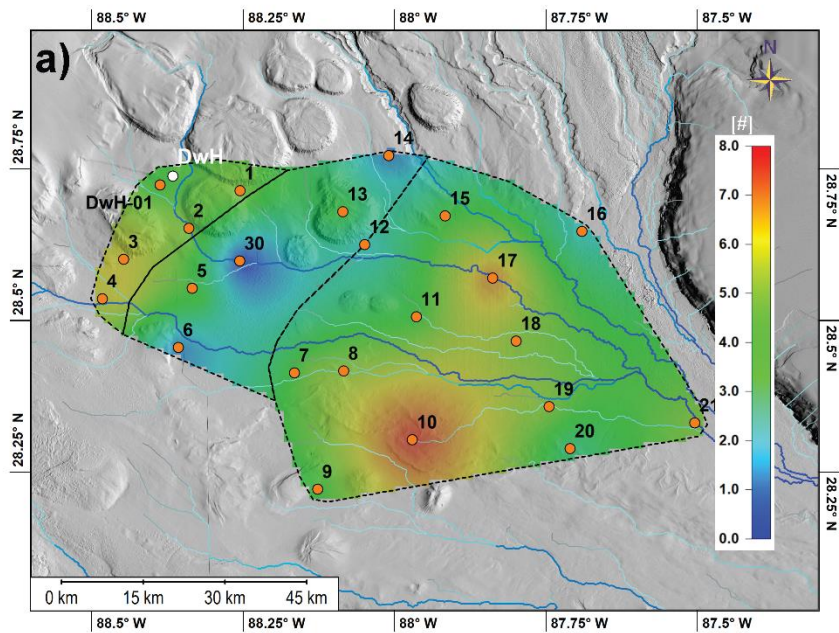
a) Top View



b) Side View

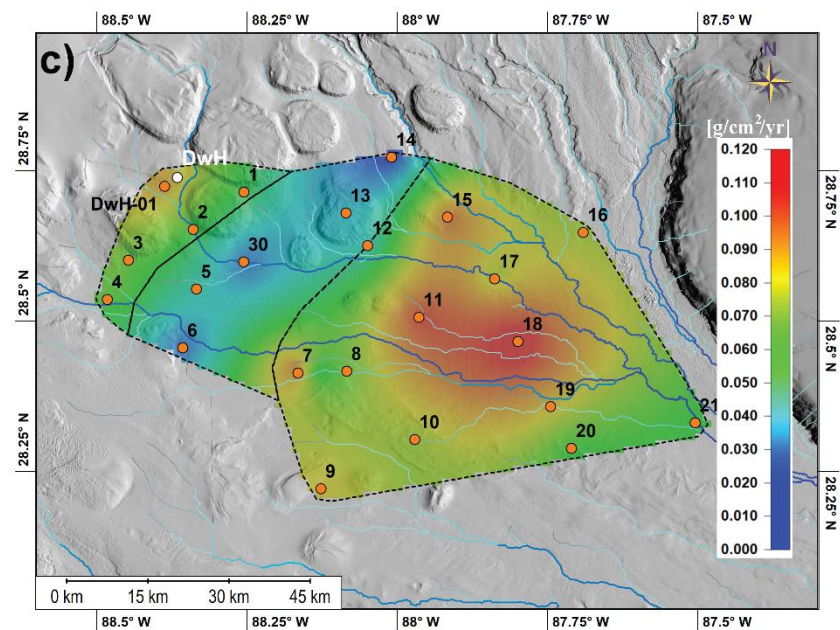


Supplemental Figure 1: Schematic diagram of the closed loop resuspension flume.

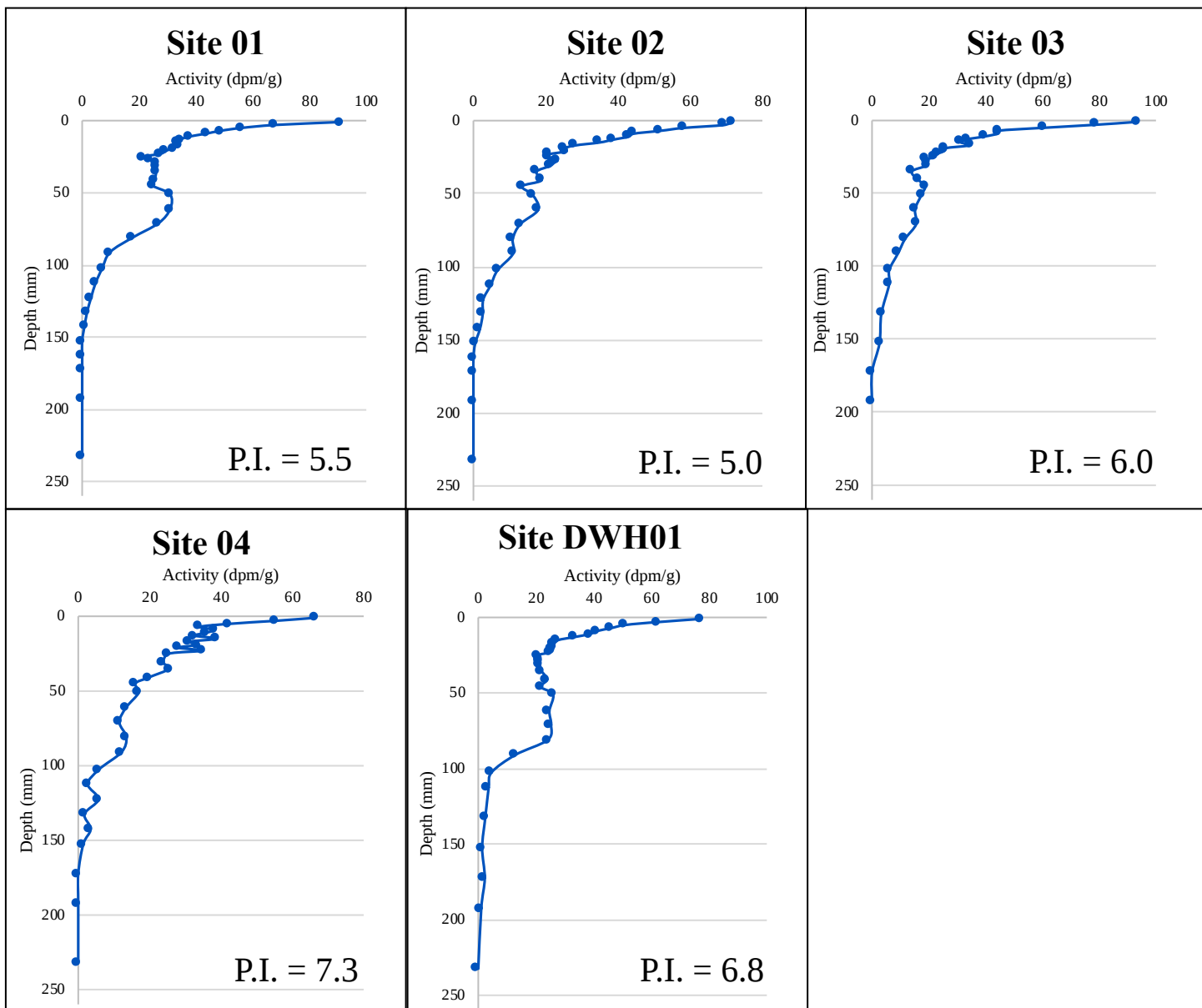


Supplemental Figure 2:

Top left (a): number of pulse events between 1950 and 2018, top right (b): percent of sediment accumulation that occurred during pulsed events between 1950 and 2018, bottom right (c): $^{210}\text{Pb}_{\text{xs}}$ average mass accumulation rates between 1950 and 2018.

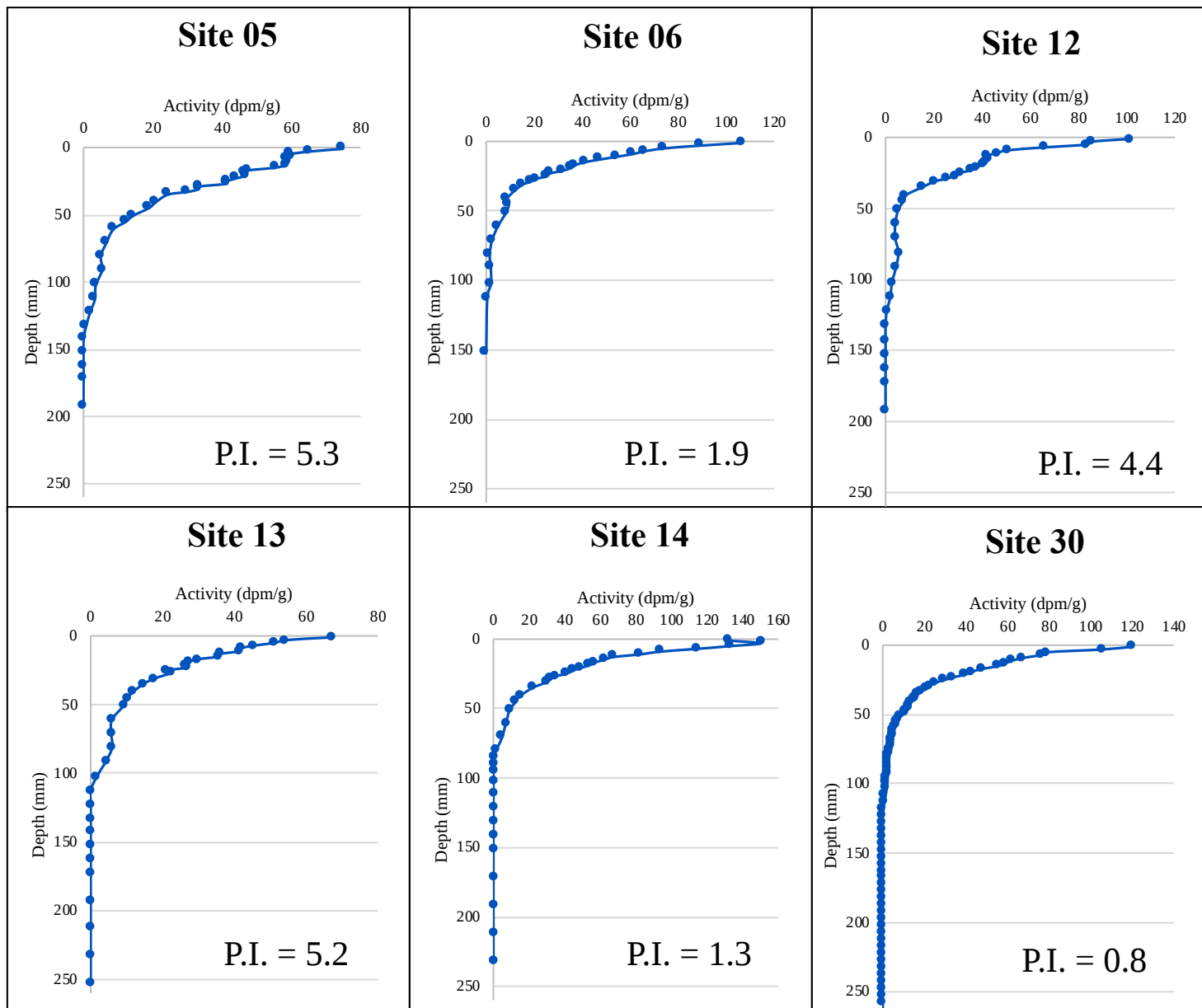


Region 1



Supplemental Figure 3a: Profiles of $^{210}\text{Pb}_{\text{xs}}$ activities with depth for Region 1. P.I. indicates pulse index.

Region 2

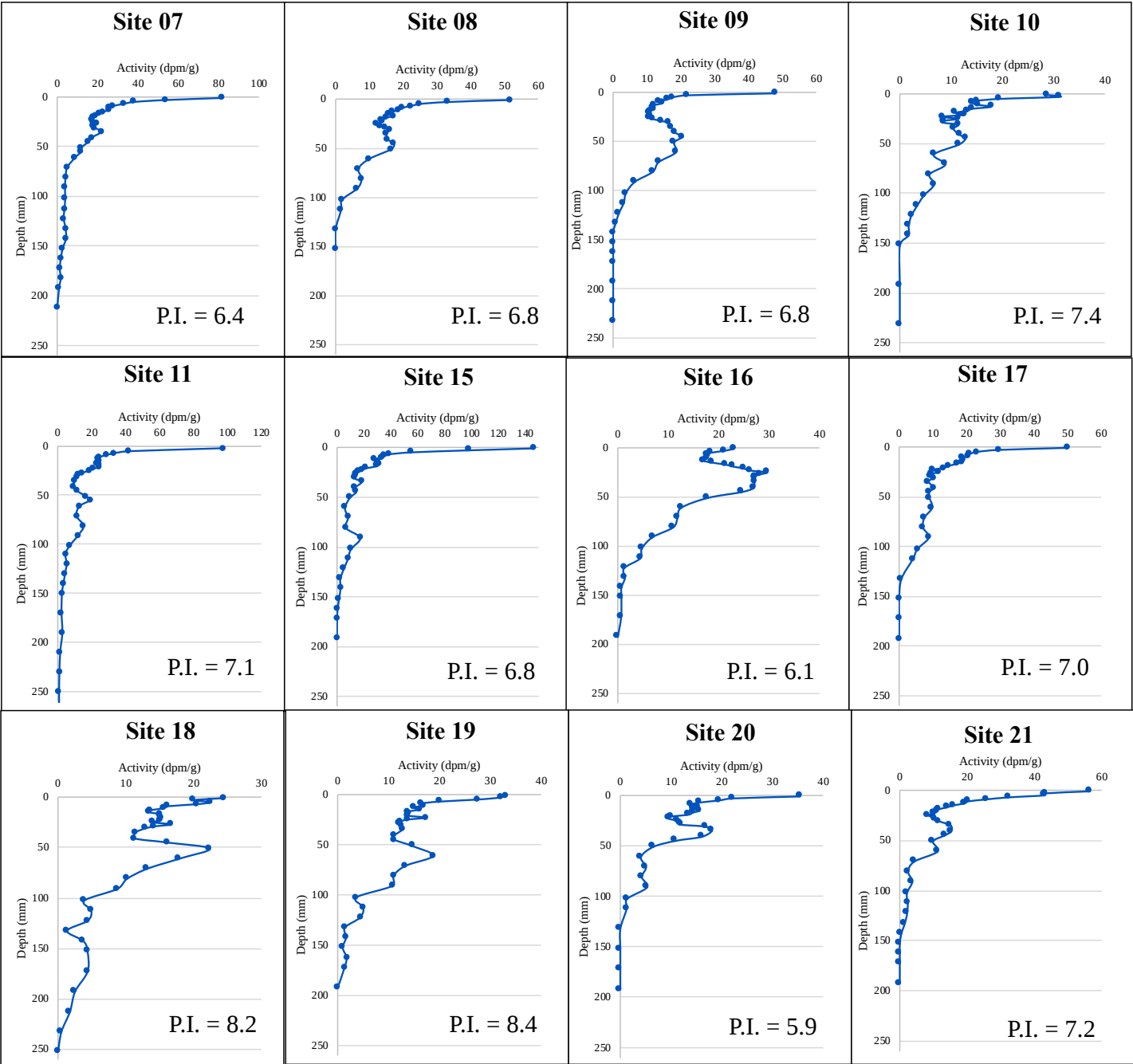


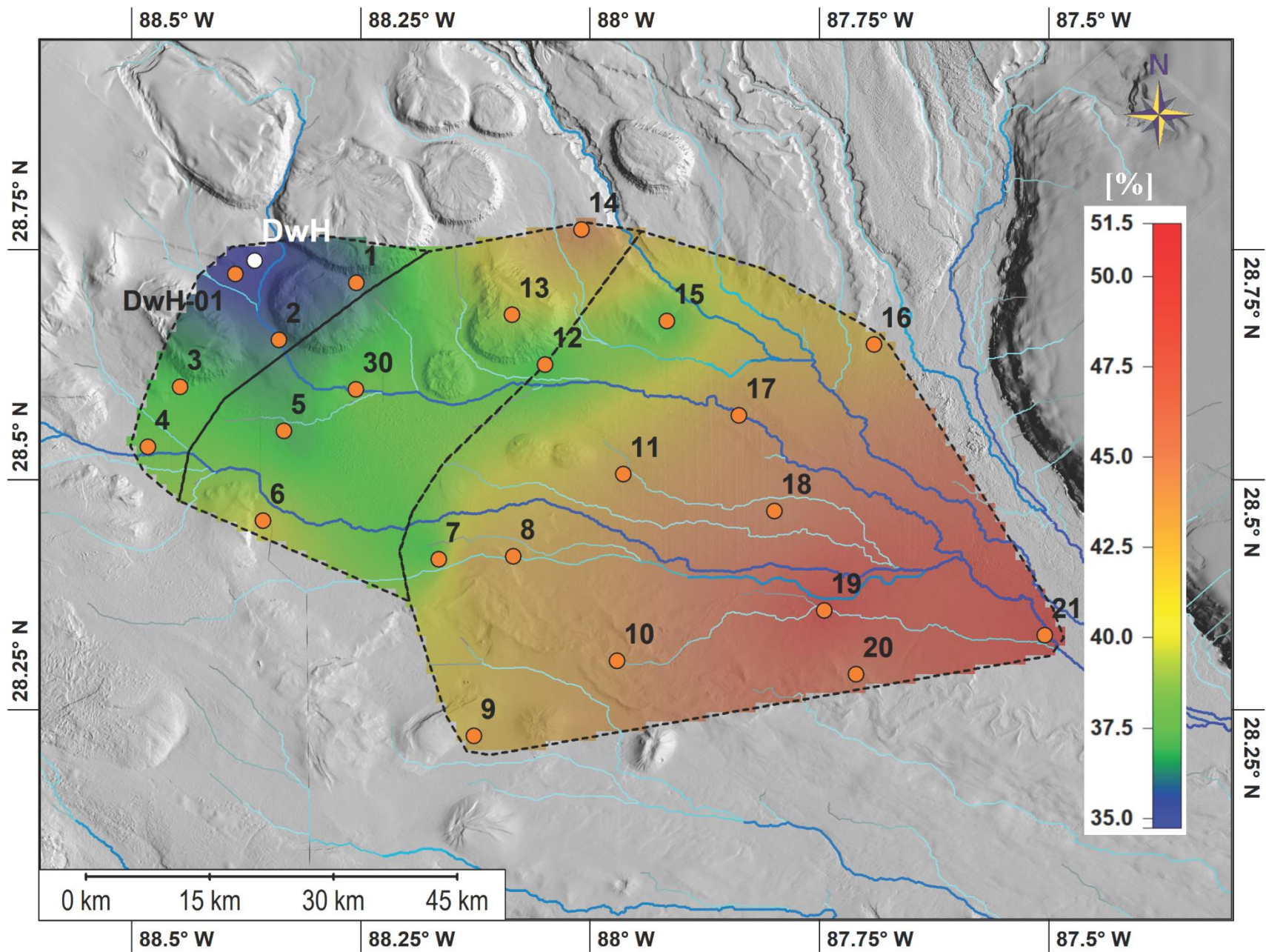
Supplemental Figure 3b: Profiles of $^{210}\text{Pb}_{\text{xs}}$ activities with depth for Region 2. P.I. indicates pulse index.

Supplemental Figure 3c:

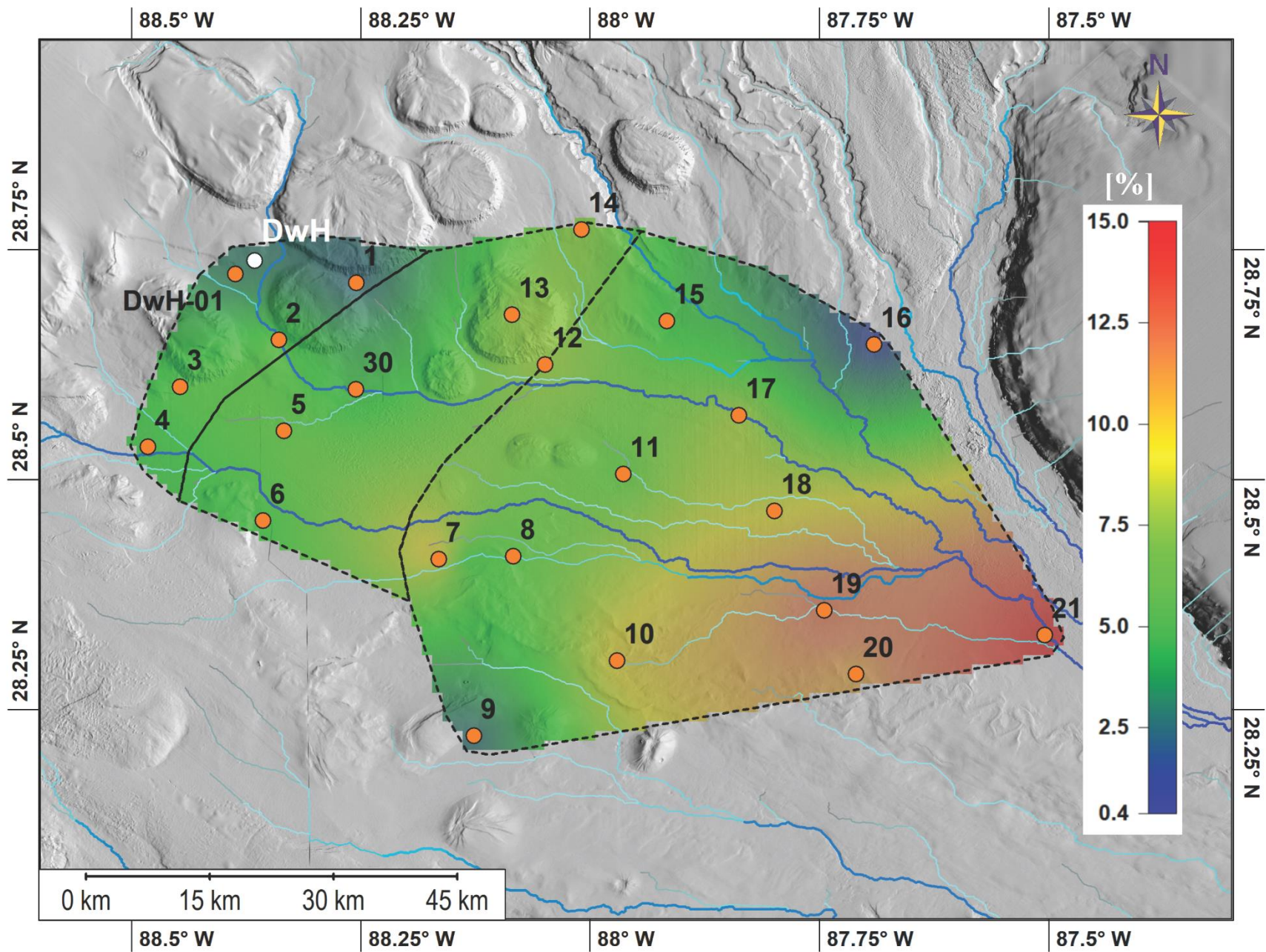
Region 3

Profiles of $^{210}\text{Pb}_{\text{XS}}$ activities with depth for Region 3. P.I. indicates pulse index.

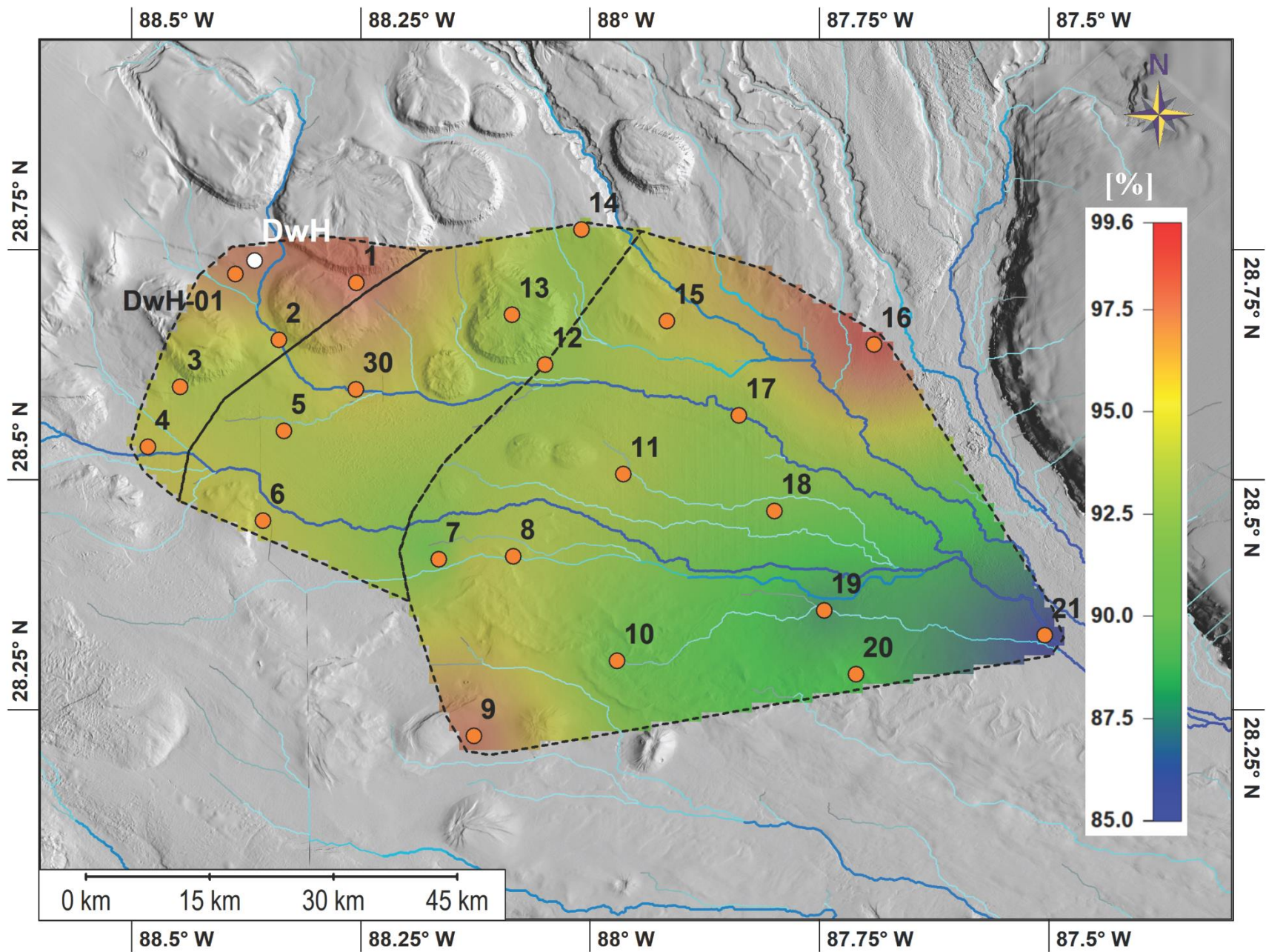




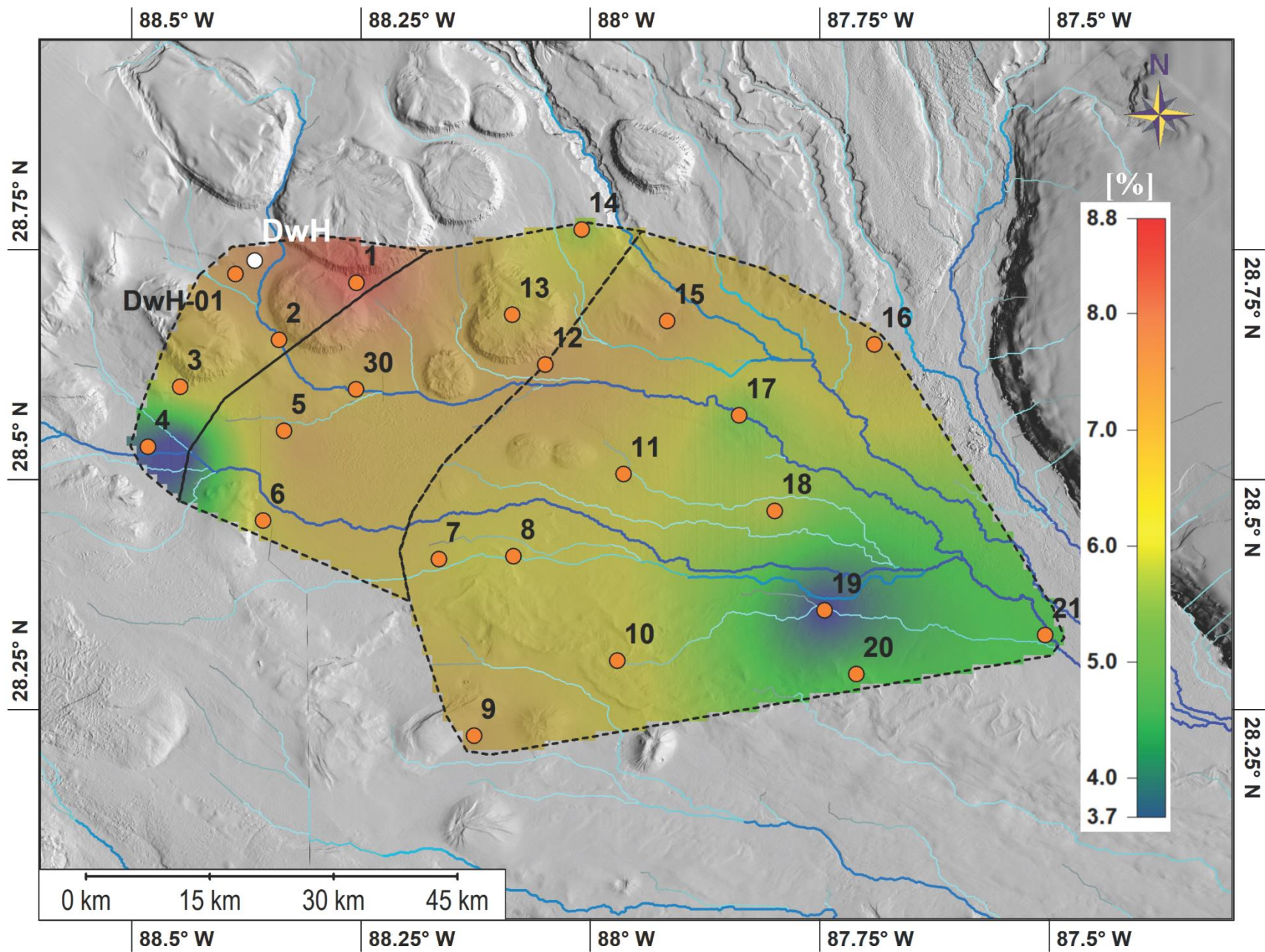
Supplemental Figure 4: Percent carbonate in surface Sediments.



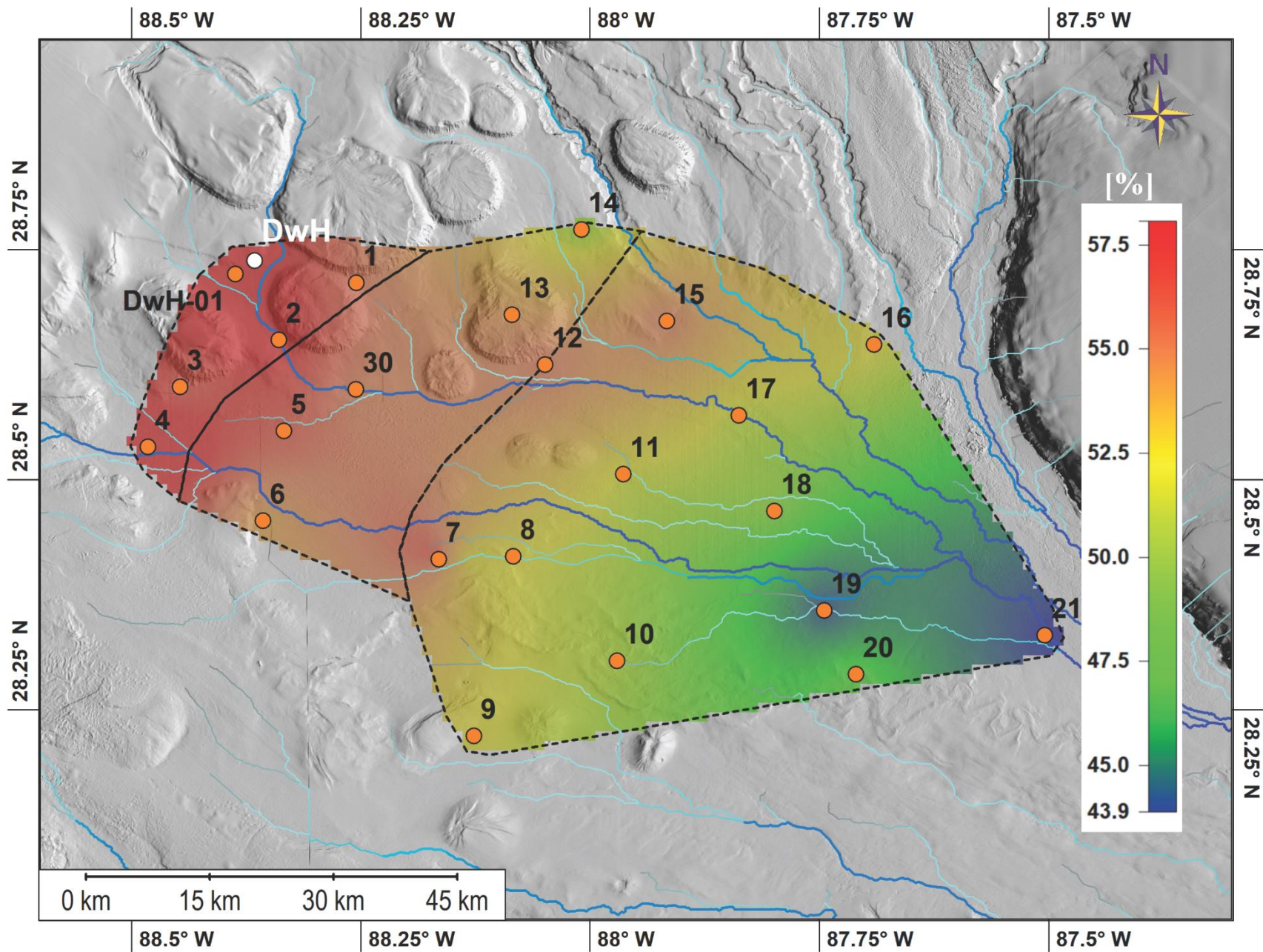
Supplemental Figure 5: Percent sand concentration in surface sediments.



Supplemental Figure 6: Percent mud in surface sediments.



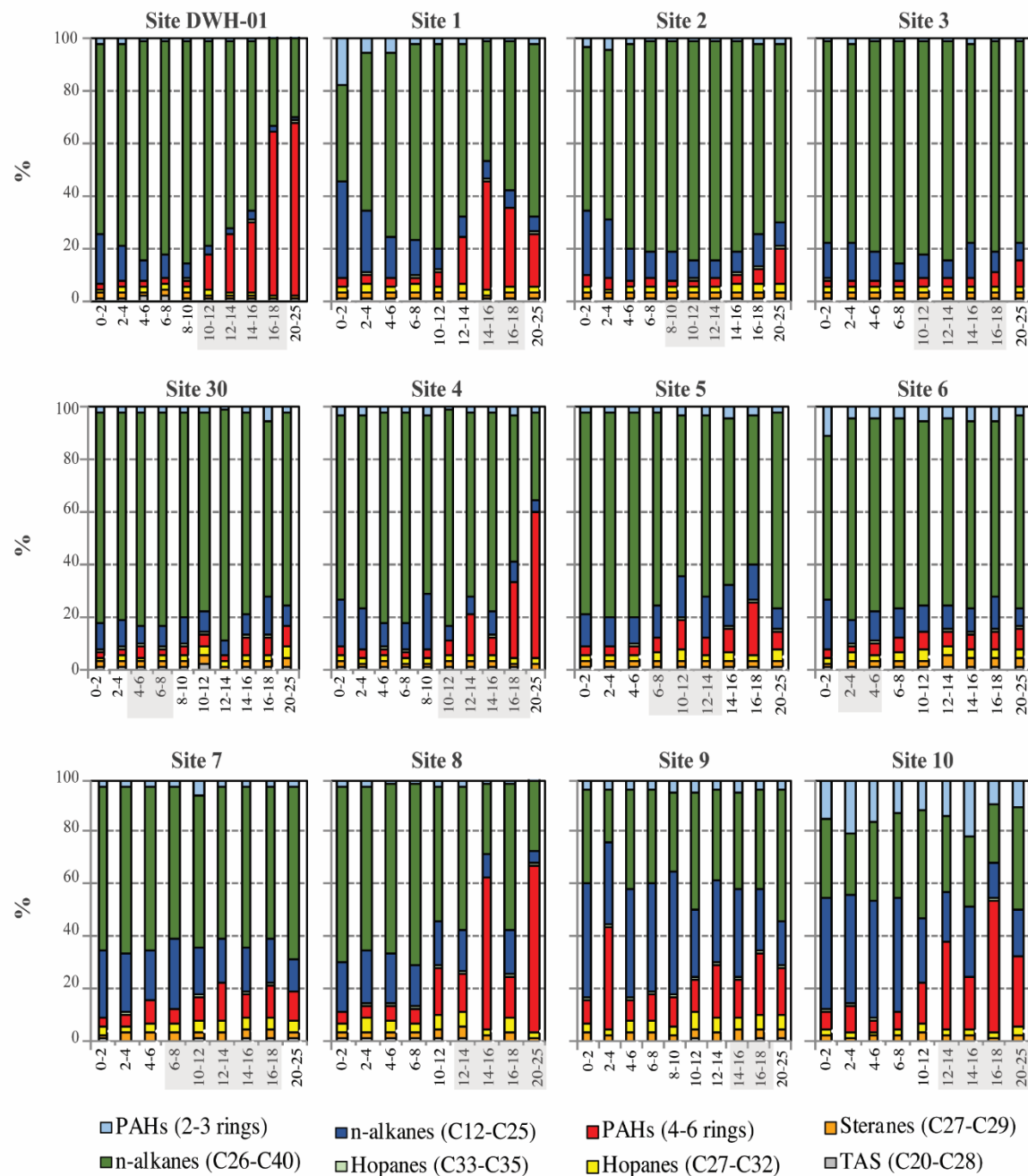
Supplemental Figure 7: Percent total organic matter in surface sediments.



Supplemental Figure 8: Percent terrigenous material in surface sediments.

Supplemental Figure 9a:

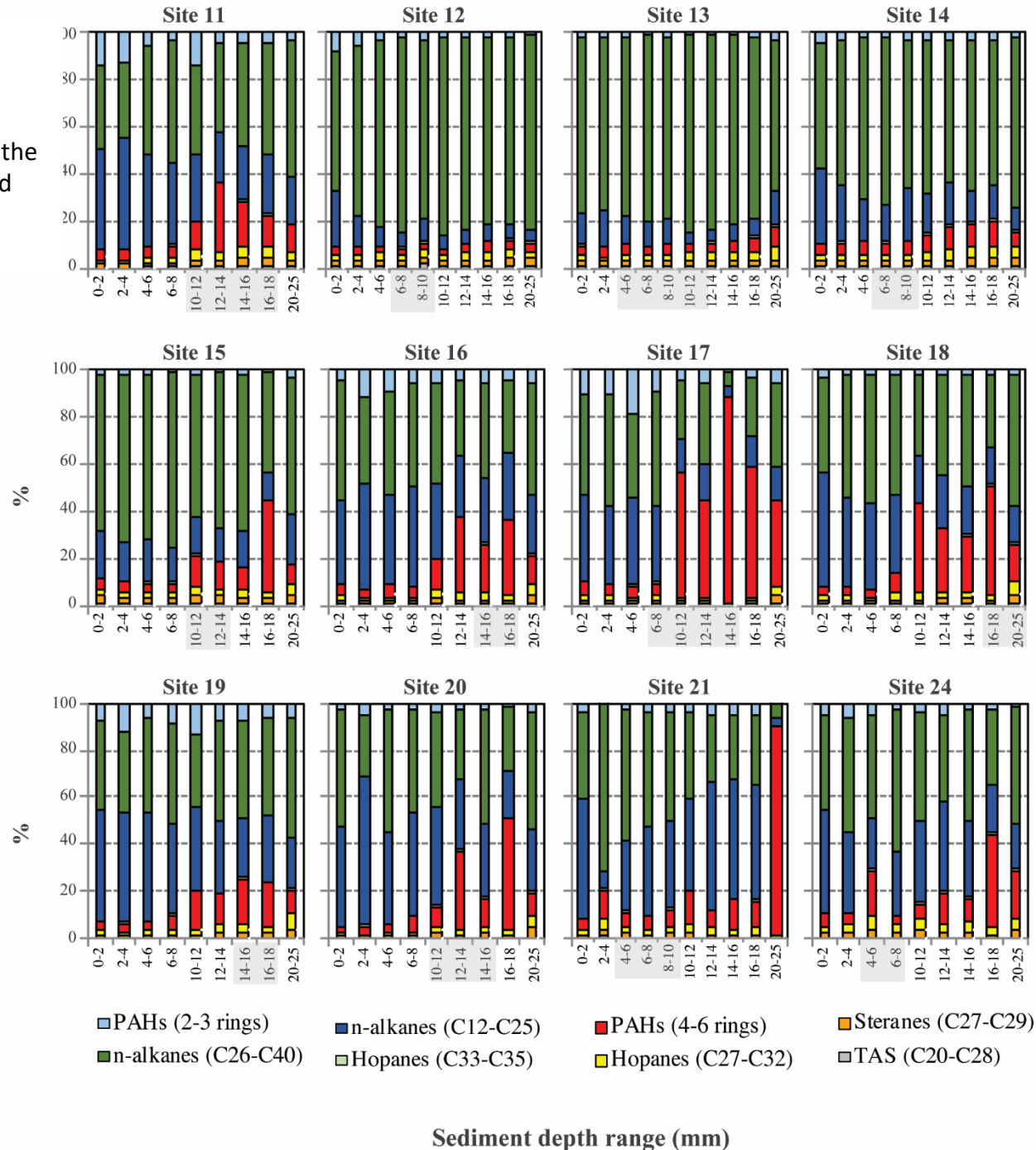
Relative abundance (%) of hydrocarbon compound groups by sediment intervals in the northern GoM (sites DWH, 30, and 1-10). Shaded areas on the x-axis correspond to the time per 2010-2013.



Sediment depth range (mm)

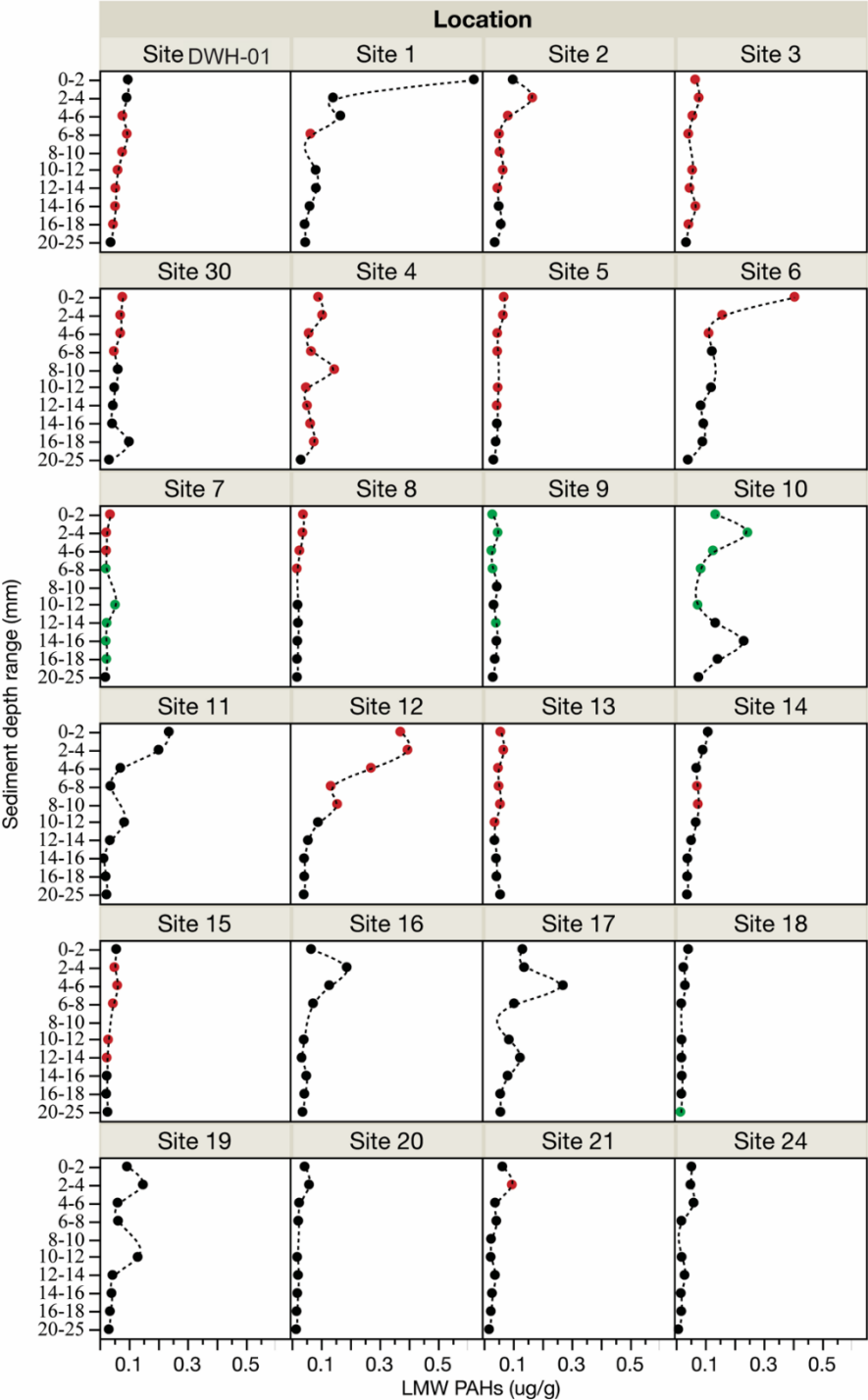
Supplemental Figure 9b:

Relative abundance (%) of hydrocarbon compound groups by sediment intervals in the northern GoM (sites 11-21, and 24). Shaded areas on the x-axis correspond to the time period 2010-2013.



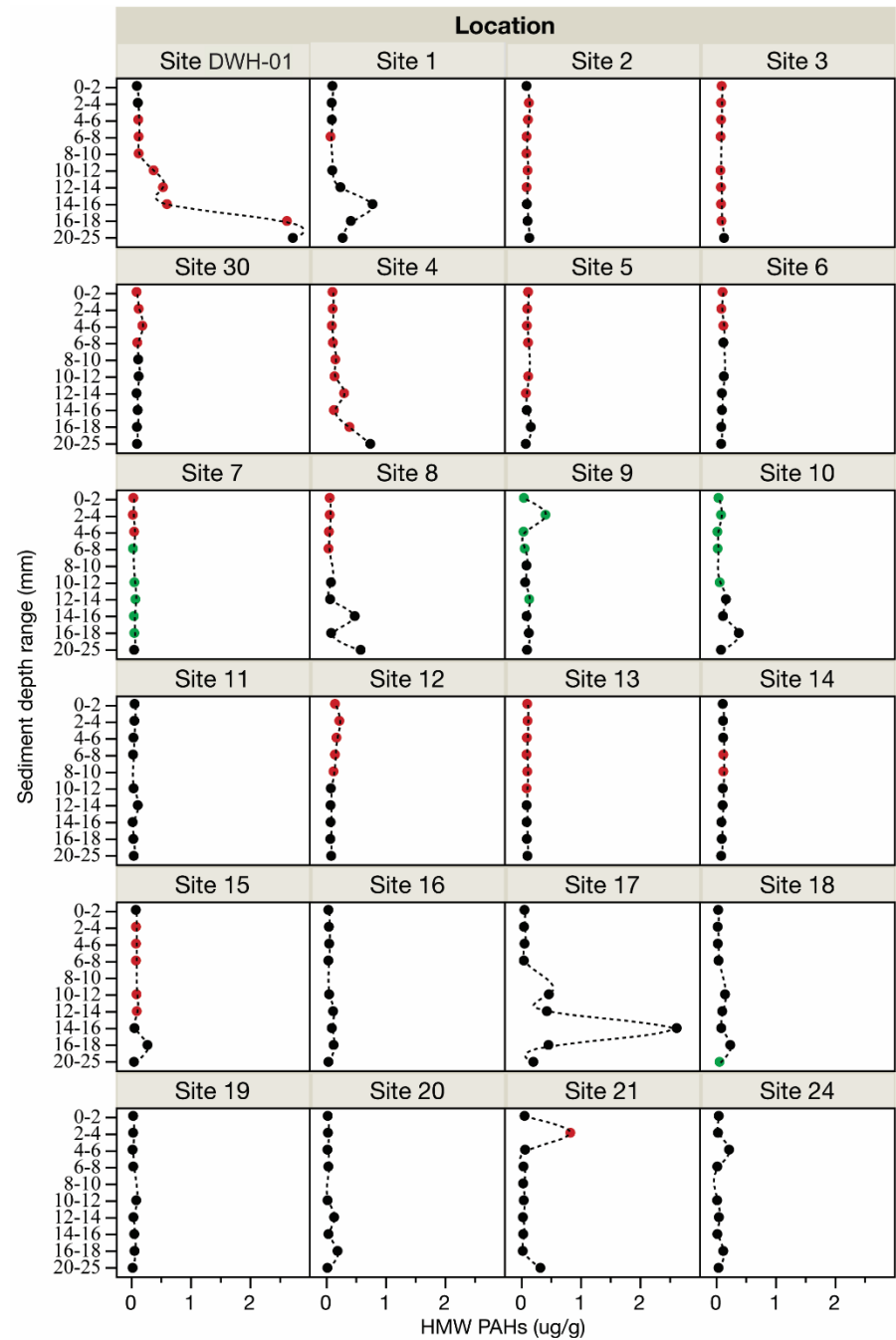
Supplemental Figure 10a:

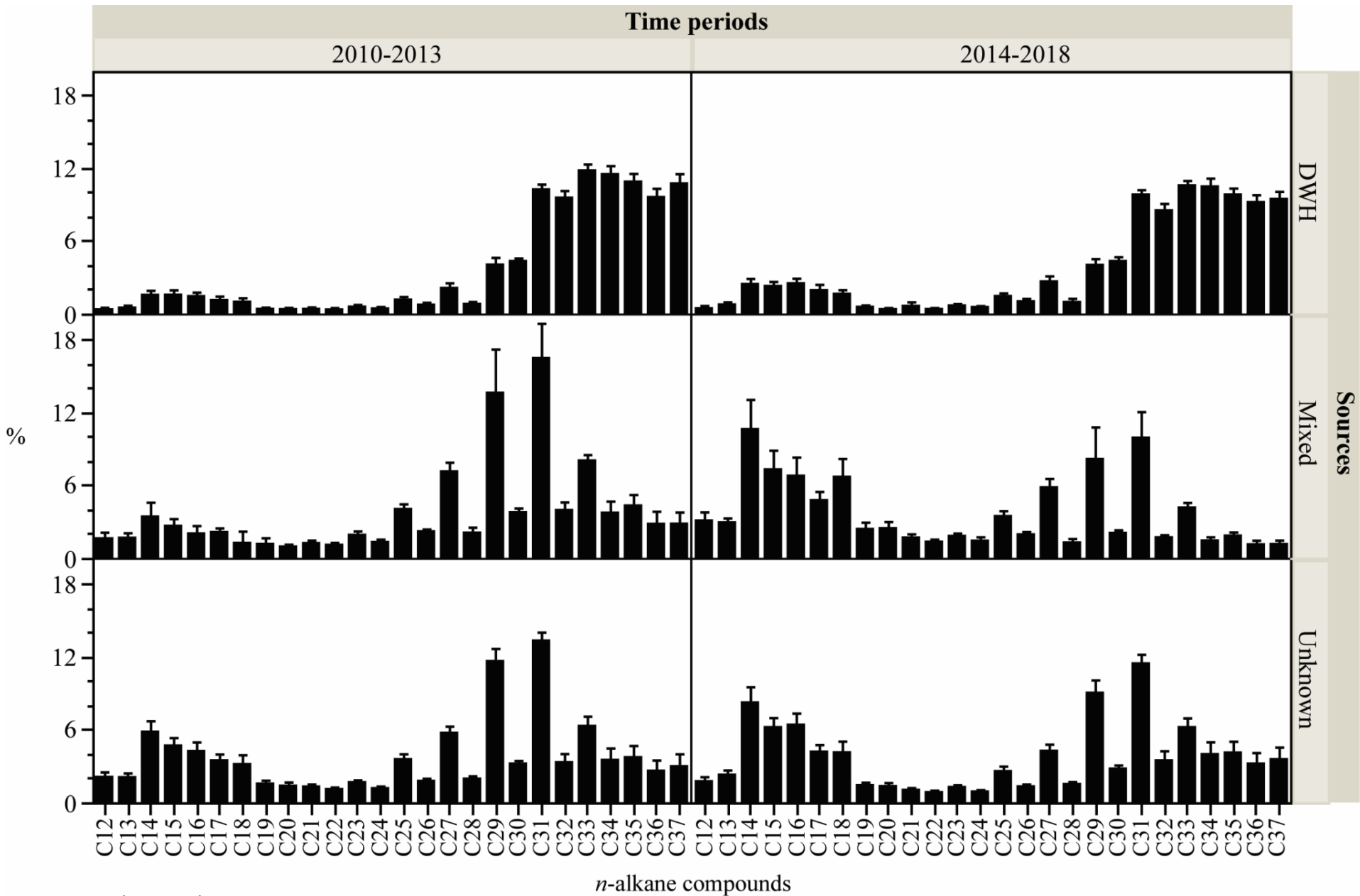
LMW PAH (2-3 rings) concentration profiles in the study sites located in the northern GoM. Red circles denote samples with DwH oil-residues as the potential major source, green circles indicate samples with mixed hydrocarbons sources including DwH oil-residues, and black circles indicate other unknown sources.



Supplemental Figure 10b:

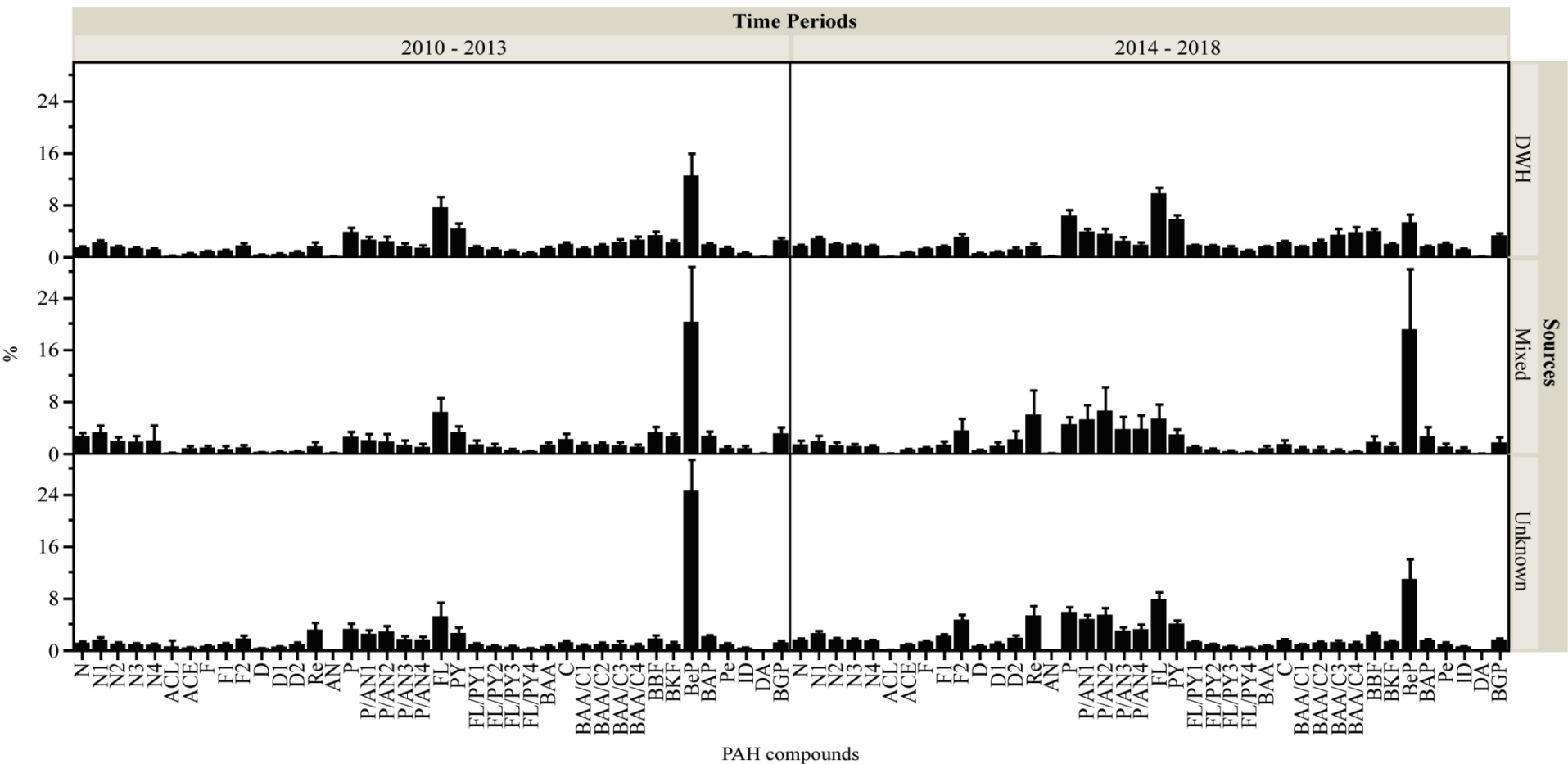
HMW PAH (4-6 rings) concentration profiles in the study sites located in the northern GoM. Red circles denote samples with DwH oil-residues as the potential major source, green circles indicate samples with mixed hydrocarbons sources including DwH oil-residues, and black circles indicate other unknown sources.





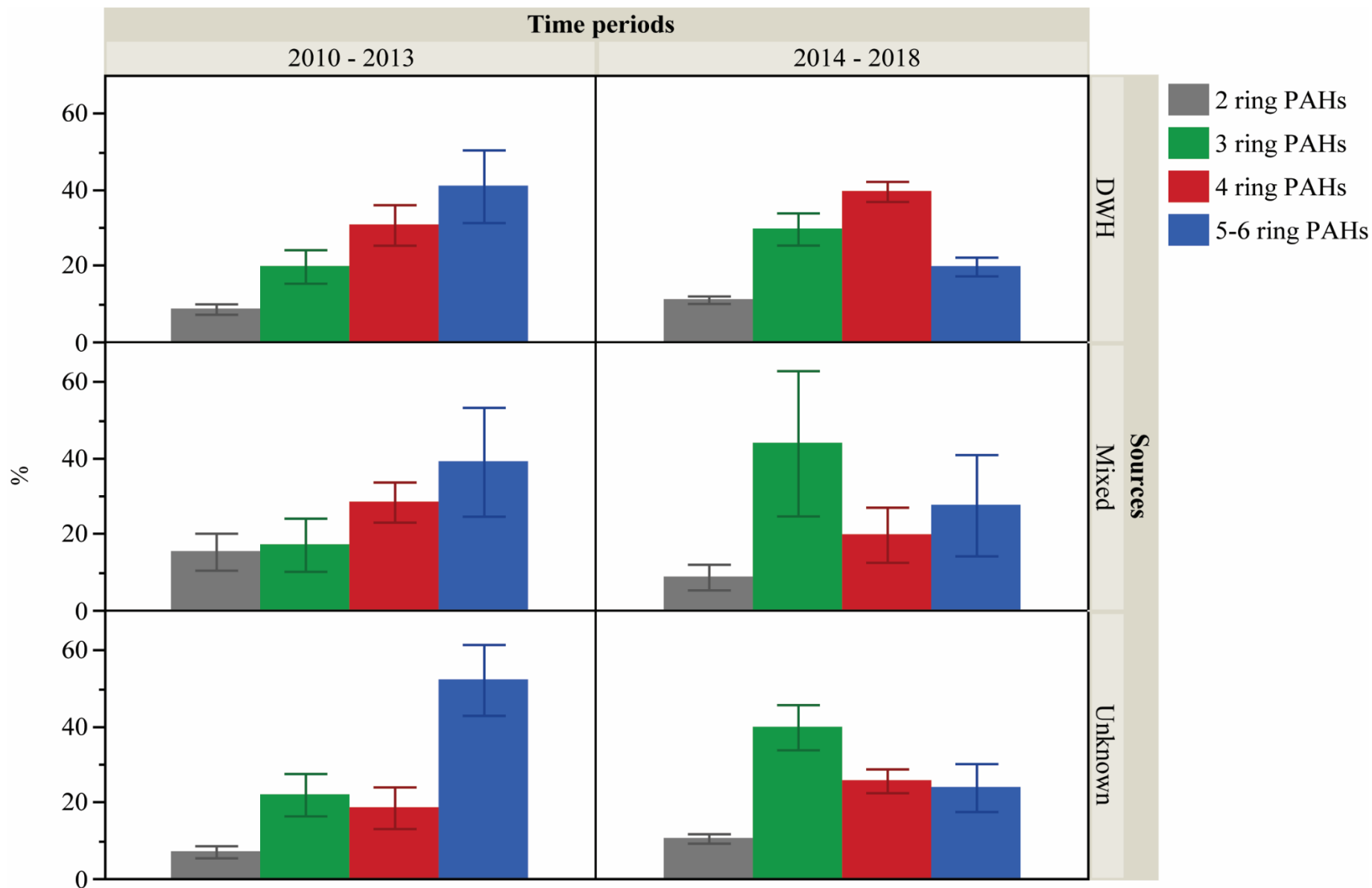
Supplemental Figure 11:

Distribution patterns of *n*-alkanes for three potential sources identified in the PCA analysis (Figure 11) and Cross plots (Figure 12) of diagnostic ratios. Data shown as mean $\pm$ 95% confidence interval.



Supplemental Figure 12:

Distribution patterns of PAHs for three potential sources identified in the PCA analysis (Figure 11) and Cross plots (Figure 12) of diagnostic ratios. Data shown as mean $\pm$ 95% confidence interval.



Supplemental Figure 13: Abundance (%) of PAHs by ring number for three potential sources identified in the PCA analysis (Figure 11) and Cross plots (Figure 12) of diagnostic ratios. Data shown as mean $\pm$ 95% confidence interval.

Supplemental Table 1:

$^{210}\text{Pb}_{\text{xs}}$ average mass
accumulation data and Pulse
Index values results

Site	Average MAR: 1950-2018	# Pulse events: 1950-2018	% of Accumulation that is pulsed: 1950-2018	Pulse Index	Average MAR: 2006-2009	Average MAR: 2010- 2013	Average MAR: 2014-2018	Region
	g/cm ² /yr	#	%		g/cm ² /yr	g/cm ² /yr	g/cm ² /yr	
1	0.057	5	47	5.5	0.093	0.081	0.054	1
2	0.060	5	38	5.0	0.064	0.049	0.039	1
3	0.065	6	48	6.0	0.082	0.063	0.04	1
4	0.062	6	72	7.3	0.067	0.062	0.056	1
5	0.042	4	54	5.3	0.034	0.034	0.035	2
6	0.027	1	14	1.9	0.02	0.019	0.017	2
7	0.096	4	46	6.4	0.087	0.073	0.048	3
8	0.057	5	68	6.8	0.089	0.08	0.056	3
9	0.082	4	59	6.8	0.098	0.157	0.117	3
10	0.073	8	62	7.4	0.112	0.091	0.075	3
11	0.107	4	53	7.1	0.102	0.092	0.053	3
12	0.042	2	46	4.4	0.03	0.023	0.021	2
13	0.039	4	54	5.2	0.032	0.031	0.028	2
14	0.020	1	8	1.3	0.018	0.016	0.014	2
15	0.098	4	51	6.8	0.066	0.069	0.03	3
16	0.074	2	58	6.1	0.07	0.096	0.138	3
17	0.074	7	57	7.0	0.092	0.072	0.057	3
18	0.119	5	61	8.2	0.15	0.142	0.137	3
19	0.083	5	82	8.4	0.124	0.118	0.093	3
20	0.060	3	59	5.9	0.086	0.077	0.06	3
21	0.059	5	75	7.2	0.063	0.045	0.032	3
30	0.028	0	0	0.8	0.021	0.026	0.019	2
DwH-01	0.089	4	57	6.8	0.108	0.078	0.052	1

Supplemental Table 2a:
Hydrocarbon compounds
(hopanes, steranes, TAS)
analyzed with analytical
parameters.

Compounds	Abbreviation	Precursor ion (m/z)	Quantitatio n ion (m/z)	CE 1 (eV)	Confirmation ion (m/z)	CE 2 (eV)	RT (min)	RT window width (± RT min)
Hopanes								
18α(H)-22,29,30-trisnorneohopane	T11	370.5	191.2	10	121.0	10	38.7	37.7-39.7
17α(H)-22,29,30-trisnorhopane	T12	370.5	191.2	10	121.0	10	39.4	38.4-40.4
17αβ,21βα 28,30-Bisnorhopane	T14a	384.5	191.2	10	121.0	10	40.8	39.8-41.8
30-norhopane; 18α(H)-30-Norneohopane	T15,T16	398.5	191.2	10	121.0	10	41.5	40.5-42.5
30-Normoretane	T17	398.5	191.2	10	121.0	10	42.4	41.4-43.4
17α(H),21β(H)-hopane	T19	412.5	191.2	10	121.0	10	42.9	41.9-43.9
17β(H),21α(H)-moretane	T20	412.5	191.2	10	121.0	10	43.5	42.5-44.5
17α(H),21β(H)-22S-homohopane	T21	426.5	191.2	10	121.0	10	44.4	43.4-45.4
17α(H),21β(H)-22R-homohopane	T22	426.5	191.2	10	121.0	10	44.6	43.6-45.6
17α(H),21β(H)-22S-bishomohopane	T26	440.5	191.2	10	121.0	10	45.6	4.5-46.5
17α(H),21β(H)-22R-bishomohopane	T27	440.5	191.2	10	121.0	10	45.8	44.7-46.7
17α(H),21β(H)-22S-trishomohopane	T30	454.5	191.2	10	121.0	10	46.7	45.7-47.7
17α(H),21β(H)-22R-trishomohopane	T31	454.5	191.2	10	121.0	10	47.0	45.9-47.9
17α(H),21β(H)-22S-tetrakishomohopane	T32	468.5	191.2	10	121.0	10	47.8	46.8-48.8
17α(H),21β(H)-22R-tetrakishomohopane	T33	468.5	191.2	10	121.0	10	48.2	47.1-49.1
17α(H),21β(H)-22S-pentakishomohopane	T34	482.5	191.2	10	121.0	10	49.0	48.0-50.0
17α(H),21β(H)-22R-pentakishomohopane	T35	482.5	191.2	10	121.0	10	49.5	48.5-50.5
Steranes								
13β(H),17α(H)-20S-diacholestane	S4	372.7	217.0	10	121.0	10	34.9	33.9-35.9
13β(H),17α(H)-20R-diacholestane	S5	372.7	217.0	10	121.0	10	35.5	34.5-36.5
24-methyl-13β(H),17α(H)-20S-diacholestane (24S+R)	S8	386.7	217.0	10	121.0	10	36.4	35.4-37.4
24-methyl-13β(H),17α(H)-20R-diacholestane (24S+R)	S8b	386.7	217.0	10	121.0	10	37.1	36.1-38.1
24-ethyl-13β(H),17α(H)-20S-diacholestane	S19	400.7	217.0	10	121.0	10	37.7	36.7-38.7
24-ethyl-13β(H),17α(H)-20R-diacholestane	S18	400.7	217.0	10	121.0	10	38.3	37.3-39.3
5α(H),14α(H),17α(H)-20S-cholestane	S12	372.7	217.0	10	121.0	10	37.5	35.5-38.5
5α(H),14α(H),17α(H)-20R-cholestane	S17	372.7	217.0	10	121.0	10	38.2	37.2-39.2
5α(H),14β(H),17β(H)-20S-cholestane	S15	372.7	217.0	10	121.0	10	37.9	36.9-38.9
5α(H),14β(H),17β(H)-20R-cholestane	S14	372.7	217.0	10	121.0	10	37.7	36.7-38.7
24-methyl-5α(H),14α(H),17α(H)-20S-cholestane (24S+R)	S20	386.7	217.0	10	121.0	10	39.2	38.2-40.2
24-methyl-5α(H),14α(H),17α(H)-20R-cholestane	S24	386.7	217.0	10	121.0	10	39.9	38.9-40.9
24-methyl-5α(H),14β(H),17β(H)-20R-cholestane	S22	386.7	217.0	10	121.0	10	39.3	38.3-40.3
24-methyl-5α(H),14β(H),17β(H)-20S-cholestane	S23	386.7	217.0	10	121.0	10	39.5	38.5-40.5
24-ethyl-5α(H),14α(H),17α(H)-20S-cholestane	S25	400.7	217.0	10	121.0	10	40.4	39.4-41.4
24-ethyl-5α(H),14α(H),17α(H)-20R-cholestane	S28	400.7	217.0	10	121.0	10	41.3	40.3-42.3
24-ethyl-5α(H),14β(H),17β(H)-20S-cholestane	S27	400.7	217.0	10	121.0	10	40.8	39.8-41.8
24-ethyl-5α(H),14β(H),17β(H)-20R-cholestane	S26	400.7	217.0	10	121.0	10	40.7	39.7-41.7
Triaromatic steroids (TAS)								
C20-triaromatic steroid	C20	231.0	203.0	10	216.0	10	30.0	29.5-30.5
C21-triaromatic steroid	C21	231.0	203.0	10	216.0	10	31.6	31.1-32.1
C26-20S-triaromatic steroid	C26S	231.0	203.0	10	216.0	10	38.3	37.8-38.8
C26-20R, C27-20S	C26R-C27S	231.0	203.0	10	216.0	10	39.3	38.8-39.8
C28-20S-triaromatic steroid	C28S	231.0	203.0	10	216.0	10	40.2	39.7-40.7
C27-20R-triaromatic steroid	C27R	231.0	203.0	10	216.0	10	40.7	40.2-41.2
C28-20R-triaromatic steroid	C28R	231.0	203.0	10	216.0	10	42.0	41.5-42.5

Supplemental Table 2b:

Hydrocarbon compounds (PAHs, aliphatics) analyzed with analytical parameters.

Compounds	Abbreviation	Precursor ion (m/z)	Quantitation ion (m/z)	CE 1 (eV)	Confirmation ion (m/z)	CE 2 (eV)	RT (min)	RT window width (± RT min)
Polycyclic aromatics hydrocarbons (PAHs)								
Naphthalene	N	128.0	102.0	20	127.0	25	10.7	10.0-11.0
C1 naphthalene	N1	142.0	141.0	20	115.0	25	12.8	11.5-14.0
C2 naphthalene	N2	156.0	141.0	20	115.0	30	14.8	13.0-16.5
C3 naphthalene	N3	170.0	155.0	20	127.0	30	16.5	13.0-20.0
C4 naphthalene	N4	184.0	169.0	20	154.0	40	18.4	16.0-21.0
Acenaphthythylene	ACL	152.0	151.0	15	150.0	20	15.4	15.0-15.7
Acenaphthene	ACE	154.0	153.0	15	152.0	30	15.8	15.5-16.2
Fluorene	F	166.0	165.0	20	163.0	30	17.3	17.0-17.7
C1 Fluorene	FC1	180.0	165.0	20	178.0	20	19.0	17.0-21.0
C2 Fluorene	FC2	194.0	179.0	20	178.0	20	20.7	19.0-22.5
Dibenzothiophene	D	184.0	152.0	30	139.0	30	19.8	19.5-20.0
C1 dibenzothiophene	D1	198.0	197.0	10	165.0	25	21.5	18.0-25.0
C2 dibenzothiophene	D2	212.0	197.0	20	178.0	20	23.0	20.5-25.5
Retene	Re	234.0	219.0	10	204.0	10	27.0	26.5-27.5
Anthracene	AN	178.0	176.0	30	152.0	30	20.3	19.8-20.8
Phenanthrene	P	178.0	176.0	30	152.0	30	20.3	19.8-20.8
C1 phenanthrene/anthracene	P/AN1	192.0	191.0	20	189.0	40	22.1	19.5-25.0
C2 phenanthrene/anthracene	P/AN2	206.0	191.0	20	189.0	40	24.3	21.5-27.0
C3 phenanthrene/anthracene	P/AN3	220.0	189.0	40	205.0	30	25.9	23.0-29.0
C4 phenanthrene/anthracene	P/AN4	234.0	219.0	10	204.0	20	27.9	25.0-30.5
Fluoranthene	FL	202.0	200.0	40	201.0	30	24.9	23.4-26.4
Pyrene	PY	202.0	200.0	40	201.0	30	24.9	23.5-26.4
C1 fluoranthene/pyrene	FL/PY1	216.0	215.0	30	213.0	40	27.5	25.0-30.0
C2 fluoranthene/pyrene	FL/PY2	230.0	215.0	40	229.0	20	29.7	27.0-32.5
C3 fluoranthene/pyrene	FL/PY3	244.0	228.0	40	229.0	40	31.7	29.0-34.5
C4 fluoranthene/pyrene	FL/PY4	258.0	243.0	20	228.0	40	34.0	31.0-36.5
Benz[a]anthracene	BAA	228.0	226.0	20	200.0	40	31.3	30.9-31.7
Chrysene	C	228.0	226.0	20	200.0	40	31.5	31.1-31.9
C1 benz[a]anthracene/chrysene	BAA/C1	242.0	239.0	40	241.0	40	33.7	29.5-38.0
C2 benz[a]anthracene/chrysene	BAA/C2	256.0	239.0	40	255.0	20	35.7	31.5-40.0
C3 benz[a]anthracene/chrysene	BAA/C3	270.0	239.0	50	255.0	20	37.9	33.5-42.0
C4 benz[a]anthracene/chrysene	BAA/C4	284.0	239.0	50	269.0	50	39.0	35.0-43.0
Benzo(b)fluoranthene	BBF	252.0	250.0	40	251.0	40	36.8	36.3-37.3
Benzo(k)fluoranthene	BKF	252.0	250.0	40	251.0	40	37.0	36.6-37.5
Benzo(e)pyrene	BeP	252.0	250.0	40	251.0	40	38.1	37.6-38.6
Benzo(a)pyrene	BAP	252.0	250.0	40	251.0	40	38.3	37.8-38.8
Perylene	Pe	252.0	250.0	40	251.0	40	38.7	38.2-39.2
Indeno(1,2,3)pyrene	ID	276.0	274.0	50	273.0	50	43.3	42.8-43.8
Dibenz[ah]anthracene	DA	278.0	279.0	40	275.0	10	43.5	43.0-44.0
Benzo(ghi)perylene	BGP	276.0	274.0	50	273.0	50	44.3	43.8-44.8
Aliphatics								
<i>n</i> -alkanes C12-C37	C12-C37	57.0	57.0	0	----	0	20.0	10.0-50.0
Pristane	Pr	57.0	57.0	0	----	0	18.9	18.8-19.0
Phytane	Phy	57.0	57.0	0	----	0	20.3	20.2-20.4

Supplemental Table 3: Carbon Isotope activities.

	^{13}C		$\Delta^{14}\text{C}$		%C	
Site	0-0.2 cm	0-1 cm	0-0.2 cm	0-1 cm	0-0.2 cm	0-1 cm
1	-22.3	-21.6	-179.4	-202.6	2.37	1.73
2	-21.9	-21.3	-252.7	-234.3	1.71	1.47
3	-21.8	-21.4	-229.3	-247.1	1.81	1.53
4	-22.4	-21.8	-194.4	-199.3	2.13	1.71
5	-21.2	-21.1	-177.3	-186.2	2.25	1.85
6	-21.6	-21.3	-180.2	-185.2	2.37	1.89
7	-21.9	-21.3	-181.4	-204.5	2.55	1.72
8	-21.2	-21	-238.7	-238.6	1.48	1.35
9	-22.1	-21.6	-314.8	-295.7	1.45	1.28
10	-21	-21	-233.1	-233.8	1.29	1.28
11	-21.1	-20.8	-243.8	-237.6	1.4	1.33
12	-22	-21.8	-201.4	-166.4	2.46	1.9
13	-21.3	-21	-165	-200	2.13	1.61
14	-21.8	-21.5	-139.9	-134.7	2.92	2.52
15	-22.5	-21.9	-207.9	-232.5	2.84	1.71
16	-22.6	-22.2	-319.3	-313.1	1.63	1.34
17	-21.5	-21.2	-227.1	-237.5	1.8	1.47
18	-21.4	-21	-255.2	-239.2	1.35	1.31
19	-20.7	-20.6	-225.2	-252.2	1.32	1.2
20	-21.3	-21.4	-258.9	-261	1.4	1.34
21	-21.3	-21	-186.6	-202.6	1.51	1.37
30	-21.9	-21.5	-167	-171	2.72	2.19
DwH-01	-21.7	-21.5	-211.2	-226.3	1.46	1.41

Supplemental Table 4:

Benthic foraminifera density (individuals per cubic centimeter) and taphonomy (fracture percentage) by sampling station and sample depth (mm).

Site	Depth (mm)			Density (indiv./cm ³)	Fracture Percentage
	Top	Bottom	mean		
1	0	2	1	15	10.6
	2	4	3	19	11.5
	4	6	5	19	9.5
	6	8	7	16	9.5
	8	10	9	17	17.2
	10	12	11	22	13.7
	20	22	21	24	11.7
9	0	2	1	22	12.7
	2	4	3	25	10.4
	4	6	5	29	9.8
	6	8	7	21	15.1
	8	10	9	30	15.3
	20	22	21	40	14.9
12	0	2	1	15	25.1
	2	4	3	26	21.0
	4	6	5	23	18.8
	6	8	7	21	21.5
	8	10	9	27	19.4
	10	12	11	22	19.7
	20	22	21	24	18.9
14	0	2	1	74	15.2
	2	4	3	18	17.2
	4	6	5	20	21.5
	6	8	7	24	16.7
	8	10	9	28	14.2
	10	12	11	61	12.9
	20	22	21	45	14.6
16	0	2	1	26	9.9
	2	4	3	18	8.4
	4	6	5	36	9.9
	6	8	7	33	12.9
	8	10	9	29	7.5
	20	22	21	16	11.5