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Newark Bay Study Area
NBSA-00084

RADIONUCLIDE ANALYSIS OF MILL CREEK AND SAW MILL CREEK SEDIMENT SAMPLES

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COVER PAGE

Sample No.

MC-1 0-2cm	MC-4 0-2cm	SMC-1 0-4cm
MC-1 2-4cm	MC-4 2-4cm	SMC-1 4-6cm
MC-1 6-8cm	MC-4 6-8cm	SMC-1 6-8cm
MC-1 10-12cm	MC-4 12-14cm	SMC-1 8-10cm
MC-1 16-18cm	MC-4 20-22cm	SMC-1 10-12cm
		SMC-1 12-14cm
MC-2 0-2cm	MC-5 0-2cm	SMC-1 16-18cm
MC-2 2-4cm	MC-5 2-4cm	SMC-1 20-22cm
MC-2 6-8cm	MC-5 4-6cm	SMC-1 24-26cm
MC-2 12-14cm	MC-5 6-8cm	
MC-2 20-22cm	MC-5 8-10cm	
MC-2 24-26cm	MC-5 12-14cm	
	MC-5 16-18cm	
	MC-5 20-22cm	

I certify that this data package is complete and accurate. Release of the data contained in this data package has been authorized by the Laboratory Director or the Director's designee, as verified by the following signature:

Signature: Richard F. Bopp
Date: 3/15/01

Name: Richard F. Bopp
Title: Laboratory Director

NARRATIVE

1. Sample Receipt:

Dried ground samples in glass vials were sent by mail from Rutgers to RPI in September 2000. All samples arrived intact.

2. Sample Analysis:

Subsamples were transferred to plastic vials and sealed for at least twenty days to allow the short-lived daughters of ^{226}Ra to grow into equilibrium.

The subsamples were analyzed for ^{137}Cs and total ^{210}Pb ($^{210}Pb_{tot}$) via gamma counting. ^{214}Pb and ^{214}Bi were also measured. These are short-lived daughters of ^{226}Ra which is also the parent of ^{210}Pb. The mean equilibrium activity of ^{214}Pb and ^{214}Bi is equal to the supported ^{210}Pb ($^{210}Pb_{sup}$), the portion of $^{210}Pb_{tot}$ "supported" by the decay of ^{226}Ra in the sediments. Subtraction of $^{210}Pb_{sup}$ from $^{210}Pb_{tot}$ yields excess ^{210}Pb ($^{210}Pb_{xs}$) which was derived from the atmosphere and decays away in the sediments with a half-life of 22.26 years.

^{137}Cs activities are reported in units of picocuries per kilogram (pCi/kg) while ^{210}Pb activities are given in decays per minute per gram (dpm/g). Dividing dpm/g by 0.00222 yields pCi/kg.

All dates for gamma counting are reported as seven-digit Julian dates.

Examples:

2000001 = January 1, 2000

2000366 = December 31, 2000

3. Instrument Calibration:

Radionuclide measurements were carried out using a gamma counter with an intrinsic germanium detector. Blank corrections were applied to each sample based on the analysis of empty sample containers. Background corrections were applied to each radionuclide based on the sample count rate at energies just above and just below each peak of interest. Detector efficiency was calibrated using an NBS sediment standard (River sediment NBS 4350B), a liquid NBS standard (NBS 4953-C) that was used to prepare spiked sediments (G-standards), and secondary standards (D-standards) prepared at the Lamont-Doherty Earth Observatory and calibrated to NBS standards.

No major problems were encountered with the gamma counter: it remained stable during the entire period of counting. Results of analyses of standards and blanks (empty sample vials) are given later in this data packege. Data on samples is reported with an

error of +/- 1 standard deviation based on counting statistics. Counting errors associated with nuclide peaks, background regions, and blanks are all included in the calculation of the reported standard deviation.

4) Additional Information

Gamma counter log books, laboratory notebooks, and liquid nitrogen log sheets are kept at the laboratory and are available on request.

Raw data sheets are kept at the laboratory and are available on request as hard copy or on disk (Excel v 7.0 spreadsheet format).

FINAL RESULTS FOR RADIONUCLIDES

MC-1

Core Interval (cm)	Count Date	^{137}Cs (pCi/kg)	1σ	$^{210}Pb_{tot}$ (dpm/g)	1σ	$^{210}Pb_{xs}$ (dpm/g)	1σ
0-2	2000306	163	65	6.00	1.05	3.99	1.08
2-4	2000306	130	67	5.69	1.04	3.49	1.07
6-8	2000307	87	41	5.14	0.67	3.38	0.69
10-12	2000307	11	53	1.36	0.81	-0.26	0.83
16-18	2000308	12	38	1.62	0.57	-0.29	0.59

MC-2

Core Interval (cm)	Count Date	^{137}Cs (pCi/kg)	1σ	$^{210}Pb_{tot}$ (dpm/g)	1σ	$^{210}Pb_{xs}$ (dpm/g)	1σ
0-2	2000301	95	45	4.96	0.70	3.22	0.72
2-4	2000304	142	42	6.15	0.71	4.18	0.73
6-8	2000304	141	51	4.37	0.79	2.65	0.81
12-14	2000305	131	46	5.36	0.72	3.61	0.74
20-22	2000305	13	59	2.81	0.88	1.21	0.90
24-26	2000306	14	41	0.90	0.63	-0.79	0.66

MC-4

Core Interval (cm)	Count Date	^{137}Cs (pCi/kg)	1σ	$^{210}Pb_{tot}$ (dpm/g)	1σ	$^{210}Pb_{xs}$ (dpm/g)	1σ
0-2	2000291	-2	38	2.36	0.59	0.38	0.61
2-4	2000291	-14	51	2.10	0.77	0.47	0.80
6-8	2000292	15	35	2.02	0.55	0.06	0.57
12-14	2000292	29	57	0.30	0.85	-1.47	0.88
20-22	2000294	-48	42	0.77	0.64	-1.24	0.67

MC-5

Core Interval (cm)	Count Date	^{137}Cs (pCi/kg)	1σ	$^{210}Pb_{tot}$ (dpm/g)	1σ	$^{210}Pb_{xs}$ (dpm/g)	1σ
0-2	2000316	75	35	5.53	0.61	3.94	0.62
2-4	2000316	171	59	4.56	0.90	2.72	0.92
4-6	2000317	120	43	5.87	0.70	3.65	0.72
6-8	2000317	23	65	5.60	1.09	3.36	1.12
8-10	2000318	138	42	5.02	0.68	3.28	0.70
12-14	2000318	94	65	5.19	0.96	3.38	1.00
16-18	2000319	78	38	4.45	0.60	2.57	0.62
20-22	2000320	84	46	4.86	0.79	3.10	0.81

SMC-1

Core Interval (cm)	Count Date	^{137}Cs (pCi/kg)	1σ	$^{210}Pb_{tot}$ (dpm/g)	1σ	$^{210}Pb_{xs}$ (dpm/g)	1σ
0-4	2000294	-16	57	2.67	0.91	1.47	0.94
4-6	2000297	6	37	1.83	0.56	0.15	0.58
6-8	2000297	13	53	2.23	0.83	0.90	0.86
8-10	2000298	-1	36	1.93	0.53	0.32	0.55
10-12	2000298	15	61	1.86	0.93	0.24	0.95
12-14	2000299	-46	37	1.39	0.55	-0.23	0.57
16-18	2000299	63	62	0.28	0.89	-1.04	0.91
20-22	2000300	25	36	1.24	0.60	-0.14	0.62
24-26	2000300	-59	58	0.63	0.97	-0.26	0.99

QUALITY CONTROL RESULTS

Blanks

Count date	Cs-137 (pCi/kg)	1σ	Pb-210 (dpm/g)	1σ
2000296	1	18	-0.18	0.26
2000353	4	16	0.25	0.23
2001056	18	18	0.22	0.25

Standards

Standard	Count Date	Cs-137 (pCi/kg)	1σ	Pb-210 (dpm/g)	1σ
G std	2000310	490	42	24.19	1.34
G std	2001064	545	66	22.86	1.49
Accepted Values:		509	51	23.55	2.4

Standard	Count Date	Cs-137 (pCi/g)	1σ	Pb-210 (dpm/g)	1σ
D std	2000301	941	47	2376.28	121.03
Dstd	2000314	942	47	2327.81	118.26
D std	2001063	952	48	2289.71	117.15
Accepted Values:		956	96	2287	229

Standard	Count Date	Cs-137 (pCi/kg)	1σ
NBS 4350B	2000282	843	60
NBS 4350B	2001065	800	69
Accepted Values:		784	50

Standard	Count Date	Cs-137 (pCi/kg)	1σ	Pb-210 (dpm/g)	1σ
LGP std	2000283	8380	437	40.35	2.23
LGP std	2001063	8685	472	41.78	2.53
Accepted Values:		8400	840	42.20	2.11

Duplicates

Core	Depth Interval (cm)	Count Date		Cs-137 (pCi/kg)	1σ		Total Pb-210 (dpm/g)	1σ
MC1	2-4	2000306		130	67		5.69	1.04
MC1	2-4 Dup	2001070		136	34		5.98	0.57
MC2	6-8	2000304		141	51		4.37	0.79
MC2	6-8 Dup	2001074		193	65		4.78	0.94
MC2	6-8 Dup	2001071		83	42		3.24	0.62

DATA INTERPRETATION

The data interpretation outlined below is based on personal communication with Victoria Hover concerning the samples and sampling sites and information supplied in the cover letter accompanying the samples.

- At no site could net particle accumulation rates be determined solely on the basis of radionuclide profiles. However, the presence of recently deposited sediment was detected in the upper layers of several of the cores. Samples with detectable levels of ^{137}Cs (i.e. levels more than $2\sigma > 0$) contain a significant component of particles deposited since the onset of atmospheric testing of large nuclear weapons in the early 1950s. The presence of detectable $^{210}Pb_{xs}$ also indicates the presence of a component of recently-deposited particles.

- In Mill Creek cores MC-1, MC-2, detectable ^{137}Cs and $^{210}Pb_{xs}$ were confined to the upper layers of "very organic rich, soupy and mucky sediment" found to a depth of about 10 cm at the MC-1 site and about 23 cm at the MC-2 site. The "more consolidated, less organic-rich gray mud" found below had no radionuclide-based evidence of recent sediment accumulation.

- In the core from Mill Creek at site MC-5, the entire length was the "very organic-rich, soupy and mucky sediment" (i.e. the more consolidated layer was not penetrated). Detectable ^{137}Cs and/or $^{210}Pb_{xs}$ was found in all the sections of this core that were analyzed.

- At Mill Creek Site MC-4, recent manipulation had occurred and the entire core consisted of the "more consolidated, less organic-rich gray mud". None of the core sections from this site contained detectable levels of ^{137}Cs or $^{210}Pb_{xs}$.

- All of these observations support the trace-metal based hypothesis that the more consolidated gray mud is old (pre-industrial) sediment, while the organic-rich upper layers represent recent deposition that occurred since site manipulation.

- In the core from the Saw Mill Creek site (SMC-1), none of the sections contained detectable levels of ^{137}Cs or $^{210}Pb_{xs}$. Consequently, based on the radionuclide analyses, there is no evidence for recent particle accumulation at this site. The fact that somewhat elevated trace metal levels were found in the upper six cm of this core attests to the fact that in this system, several metals are more sensitive tracers of recent sediment accumulation than the radionuclides. Based on past experience, I suspect that this site is near long-term equilibrium with respect to particle deposition and resuspension. Short-term deposition of more highly contaminated particles and rapid (i.e. prior to

the next resuspension event) biological or physical mixing to a depth of about six cm is the likely origin of the trace metal profile.

- Consequently, the Saw Mill Creek site is not useful for predicting trace metal levels in sediments that will accumulate at nearby sites following "manipulation". The best analog for the organic-rich muck accumulating at the Mill Creek sites would be suspended particles filtered, centrifuged, or settled from Mill Creek water.