Holocene Sediment Infill Rates at Seeley's Cove Harbour, NB

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ABSTRACT

Seeley's Cove is a small craft harbour located in southwestern New Brunswick. It has been dredged several times in the past to allow larger ships to navigate to the wharf. In 2006 Public Works and Government Services Canada commissioned a report from Martec Engineering to determine the feasibility of dredging the channel again. Martec concluded that a 2.5m channel would be infilled in less than 3 years (at approximately1m/year), based on a longshore drift sedimentation model. Tim Milligan and Gary Bugden, of Fisheries and Oceans reviewed the report and concluded, based on available data and local knowledge, that the Martec sedimentation rate was too high and that tidal pumping and flocculation were the more likely cause of sedimentation. A study was done of the area using several methods including shallow seismics, particle dynamics, bathymetry interpolation and ^{210}Pb and ^{137}Cs dating to determine a more accurate rate of sedimentation. The resulting rate calculated from this study was approximately 1cm/yr, 100 times less than the rate predicted by Martec Engineering and more in line with the observations of local fishermen.

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ACKNOWLEDGEMENTS

In the creation of this project, many helped me along the way. I would like to thank Tim Milligan and Gary Bugden of Fisheries and Oceans Canada, both of whom were very helpful, entertaining and fun to work with, as well as Paul Hill of Dalhousie University for his editing prowess. Many thanks to Dr. John Norton Smith, head of the Atlantic Environmental Radioactivity Unit of the Marine Environmental Science Division of the Bedford Institute of Oceanography, who did the geochemical analysis. I would also like to thank Charlie Walls for sharing his extensive knowledge of ArcGIS and Patrick Ryall for keeping me on the right track. Finally I would like to thank my friends and family who tolerated me during this endeavor.

1.0 Introduction

1.1 *Relevant History of Seeley's Cove*

The Seeley's Cove Small Craft Harbour Facility is located on the southwest coast of New Brunswick (Fig. 1, 2A, 2B), and serves as a staging point and wharf for several local lobster fishing operations. It has been dredged several times in the past, with the most recent operation occurring in 1964.

In April of 2006, a report was produced by Martec Engineering to estimate the sediment infill rate of Seeley's Cove harbour. This report was to assist Public Works and Government Services Canada in determining whether it would be economically feasibly to dredge the area again to allow larger hulled ships to utilize the wharf. The report concluded that dredging would not be practical because the infill rate was calculated to be approximately 1m/year. The proposed dredging depth was 2.5m, and thus, according to the consultants, the trench would be filled in within 3 years or less (Martec, 2006).

Local accounts suggested that this predicted infill rate was too large, because the results of previous dredging operations had lasted much longer. The report was reviewed by Tim Milligan and Gary Bugden of Fisheries and Oceans Canada, and it was determined that Martec used an incorrect model for their study. Martec assumed that the cove was being supplied with sediment via longshore sediment transport (Martec, 2006). This model suggests that sediment transport occurs parallel to shore and high energy wave action and currents carry coarse sediment into the cove (Cooper and Pilkey, 2004). Milligan and Bugden hypothesized that Seeley's Cove was supplied with sediment by way of tidal pumping (Chadwick and Largier, 1999) and flocculation. In this model, the energy of the system is much lower and infill is caused by the settling of fine particles as

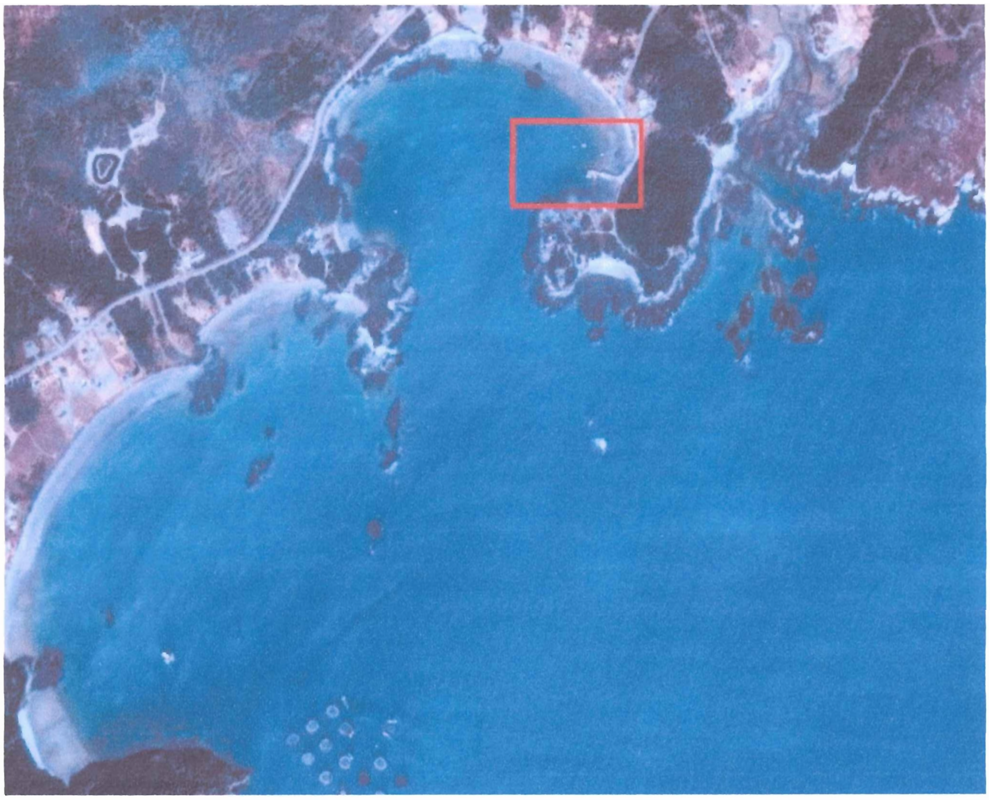


Figure 2A: Aerial photo of coastline near Seeley's Cove, with study area highlighted with red box

Figure 2B: Study area showing boat track (white), grab sites (green), core sites (red), and area to be dredged (light green polygon)

1.2.1 *Bathymetry variation*

There are bathymetry charts for Seeley's Cove dating from October 1952 to June of 2007. Several of the charts are in paper format, many of which with poorly chosen and inaccurate datums, but all charts after 1990 are in electronic format. The bathymetry measurements from the electronic data were used to tabulate infill rates by loading the files into ArcGIS Spatial Analyst and using the program to calculate the differences in the bottom profile over time.

1.2.2 *^{210}Pb and ^{137}Cs dating*

Several sediment samples collected in June were analyzed at the Bedford Institute of Oceanography, using ^{210}Pb methods. Cores taken during field work in June 2007 were subsampled. Accumulation rates of ^{210}Pb were measured in these sub-samples which were then used to identify the buried channel bottom. From this, the minimum possible sedimentation rate and estimated total rate was determined

1.2.3 *Strata box Seismics*

During field work in June, Steve Solomon accompanied Tim Milligan, Gary Bugden and myself on the research boat *Packcat* (Fig. 3) to do field trials with an ODEC Stratabox sub-bottom profiler, to test its effectiveness at obtaining sidescan mosaics and shallow seismic data in a shallow water environment. The results were analyzed and used to detect previous bottom profiles and subsurface patterns as well as present bathymetry in the harbour.

1.3 *Objectives*

By integrating the information from the sources mentioned above, an alternative model of sediment dynamics within the study area was achieved. This information will be later submitted by Fisheries and Oceans to interested parties at Public Works Canada. It will aid in the determination as to whether further dredging will be performed in Seeley's Cove. For the purposes of this study, the scope will be limited to calculating sediment infill rate, excluding factors that apply to potential for dredging but are not directly relevant to sediment dynamics. Geological principles and interpretation will be emphasized.

Figure 4: Slow corer

gravity assisted corer, launched off the bow of the boat with use of a winch and A-frame. The Ekman grab (Fig. 6) is a metal box that is dropped to the harbour floor, after which a weight is dropped down the attached rope. This weight releases the grab mechanism. After cores and samples were hauled aboard, they were labeled and stored.

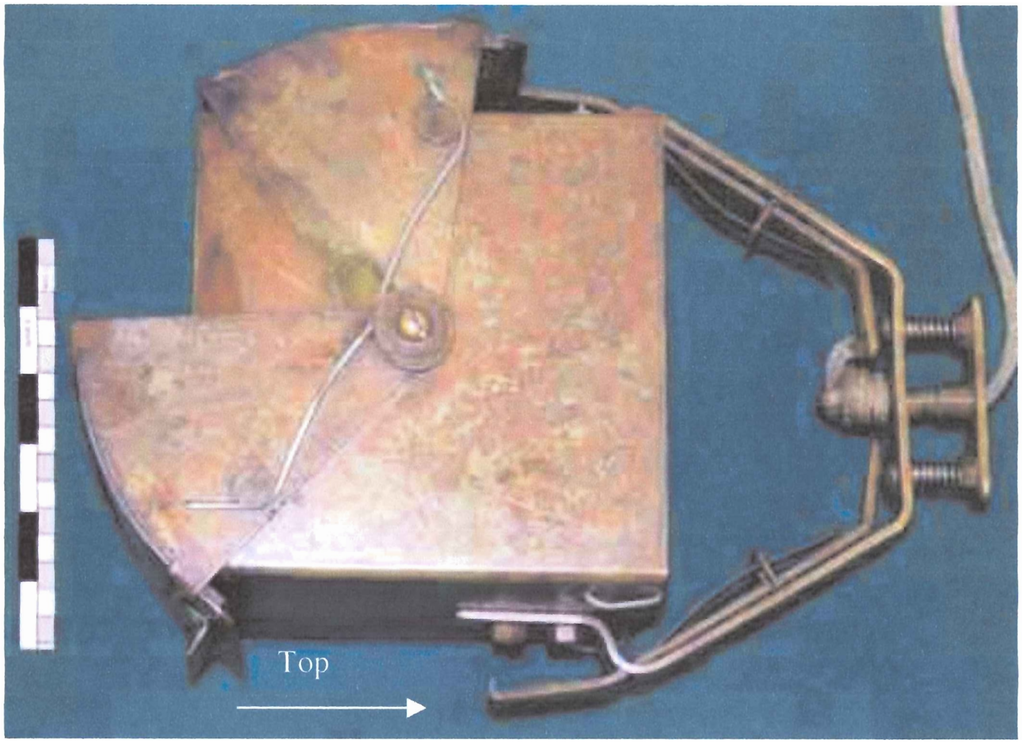


Figure 6: Ekman Grab
(After http://iodeweb5.vliz.be/oceanteacher/resources/other/AndersonBook/images/eckman.jpg)

2.2 *Laboratory Work*

2.2.1 *^{210}Pb and ^{137}Cs dating*

During the decay series of ^{238}U, ^{222}Rn escapes into the atmosphere and then decays to ^{210}Pb, which is subsequently removed from the atmosphere via meteoric precipitation and dry fallout. Depositions of ^{210}Pb can be found in soil, snow, glacial ice and water bodies, both freshwater and marine. The isotope's half-life is 22.6 years, which makes it convenient for use in Holocene depositional environments. Assuming a constant sedimentation rate, core samples can be analyzed by graphically representing the ^{210}Pb distribution measured within them. Since ^{210}Pb is strongly drawn to charged sites on sediment particles, their net accumulation serves as a good gauge of sedimentation rate (Faure and Mensing, 2005).

^{136}Cs was released into the environment solely through the detonation of nuclear weapons during testing between 1945 and 1980. The isotope can be found in lake and marine sediment deposited in this window of time; the Chernobyl nuclear accident also resulted in measurable deposition of ^{137}Cs. By correlating known peaks of ^{137}Cs deposition, such as Chernobyl, with levels found in sediment cores, very accurate dates can be assigned to certain sediment horizons (Faure and Mensing, 2005).

2.2.2 *GIS Analysis of Bathymetry*

Much of available bathymetry data exists only as hard copy maps, and the accuracy of the referenced datums for these remains questionable. The low projected sedimentation rate precluded any data that was too recent as well. Thus, only the January 1995 electronic bathymetry data was used to compare with the data collected in June 2007. Both years were loaded as shape files within ArcGIS and by using vector interpolation within the Spatial Analyst module, an average sedimentation rate was able to be calculated over the study area.

GIS analysis was also used for raster interpolation of the grain size data obtained from Coulter counter analysis (see below). Raster interpolation involved producing a series of grain size distribution maps categorized from finest to coarsest. The spline interpolation method was chosen, which uses a mathematical algorithm to minimize overall surface curvature; discrete points of data are smoothed into continuous surfaces. This method produced the most logical map distributions for the amount of data shown.

2.2.3 *Coulter Counter*

Samples analyzed by the Coulter counter must be properly prepared beforehand to achieve accurate results. For the purposes of this study, sample preparation involved sampling 1cm increments of sediment core and placing the individual samples in sealed plastic cups. These were then sub-sampled; approximately 3g sub-samples were placed in 15mL beakers, using a small scoop. Labeled by number, these were placed in a small heating apparatus. A 5mL pipette was used to add H_2O_2 to the sample and then heat was applied until all organics had burned off. After a day, more H_2O_2 was added and the sample was heated again. The sample was ready for the Coulter counter after the second day.

Analysis on the Coulter counter also includes several steps. To measure a full range of grain size distribution, sediment samples are diluted in artificial salt water and run through tubes with 30μm, 200μm, and 400μm orifices (this refers to a hole drilled through a sapphire which is embedded in the tube). Electrodes outside and inside the submerged sampling tubes establish an electric current that flows through the orifice. Passage of a particle through the orifice generates an electrical impedance that causes voltage between the electrodes to spike. Suction draws the particle-laden solution up into the tube, and the machine estimates particle volumes and concentrations by measuring the size and frequency of voltage pulses.

The samples are contained in small, 15mL beakers which are then filled with NaCl solution to dilute it. The samples are placed in a sonifying bath, which breaks down the flocculated sediment into individual grains and more thoroughly mixes it with the solution. After about 3 minutes, the sample is removed from the bath and diluted with yet more NaCl solution (until total volume is ~200mL) in hand-blown glass beakers with bell-shaped bottoms that prevent sediment from accumulating in corners. They are made especially for the Coulter counter and have an approximate volume of 230mL each. A sub-sample of this suspension is taken (5-100mL, depending on the sediment concentration), and placed into a chamber containing a sonifying probe. The suspension is sonified for 3 minutes to further break down any remaining flocculent. Once this is complete, the sample is ready for the 200 μm tube of the Coulter counter. The sample is placed in the machine in such a way so that the tube, as well as a small electrode attached to the machine, are suspended within the sediment solution but not touching the bottom of the glass. Dilution data are entered into the attached computer, and the sample is run for 3 minutes. Upon completion, data are sent to a DOS program on the computer that processes the results and outputs a graph and data file with reference to grain size distribution results.

For the 30μm tube, the initial dilution is used again, but first filtered through a 25μm screen to remove large particles that could cause the tube to clog. It is diluted again and sonified for 1 minute and run through the Coulter counter for 1 minute. Once the results are processed, the 400μm tube is run. This involves once again going back to the original dilution and filtering the water through a 16μm screen but disposing of the supernatant and re-diluting the filtrate. This sample is sonified for 1 minute and run through the Coulter counter for 1 minute.

3.0 Results

3.1 *Bathymetry Variation*

GIS analysis of the bathymetry from January 1995 and June 2002 revealed a fairly consistent sedimentation rate along the channel averaging to approximately 1cm/y over the entire surface.

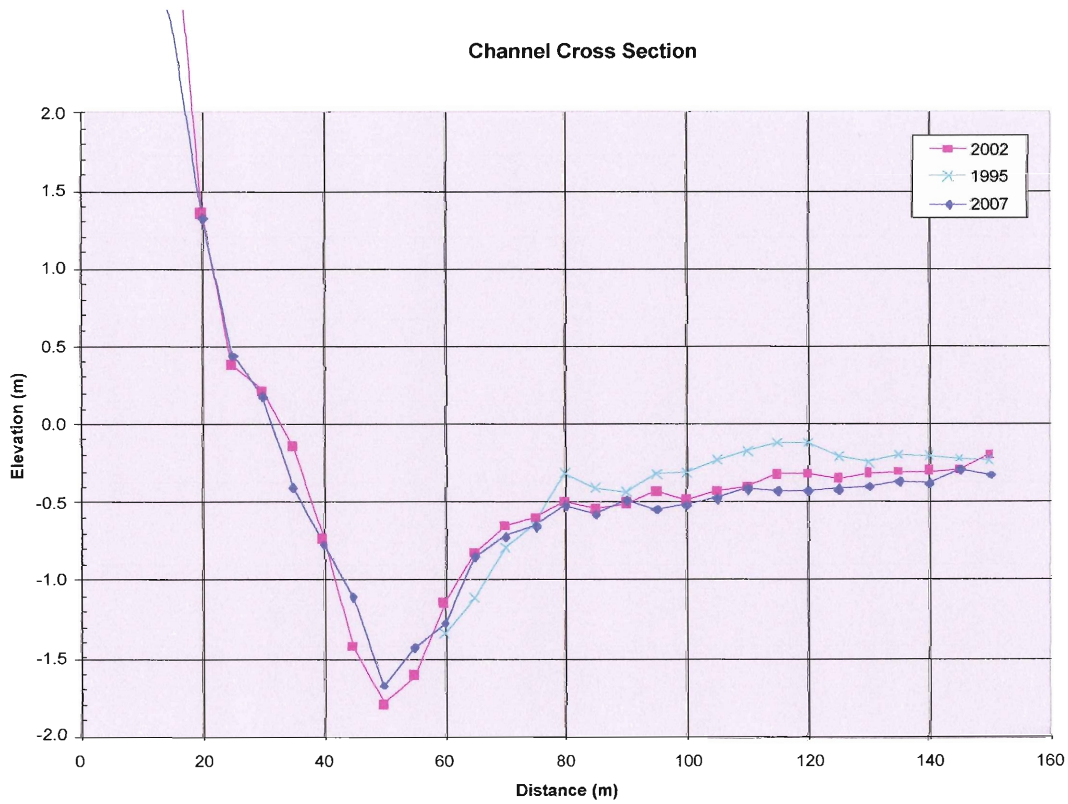


Figure 7: Plotted channel cross-section from 1995, 2002, and 2007

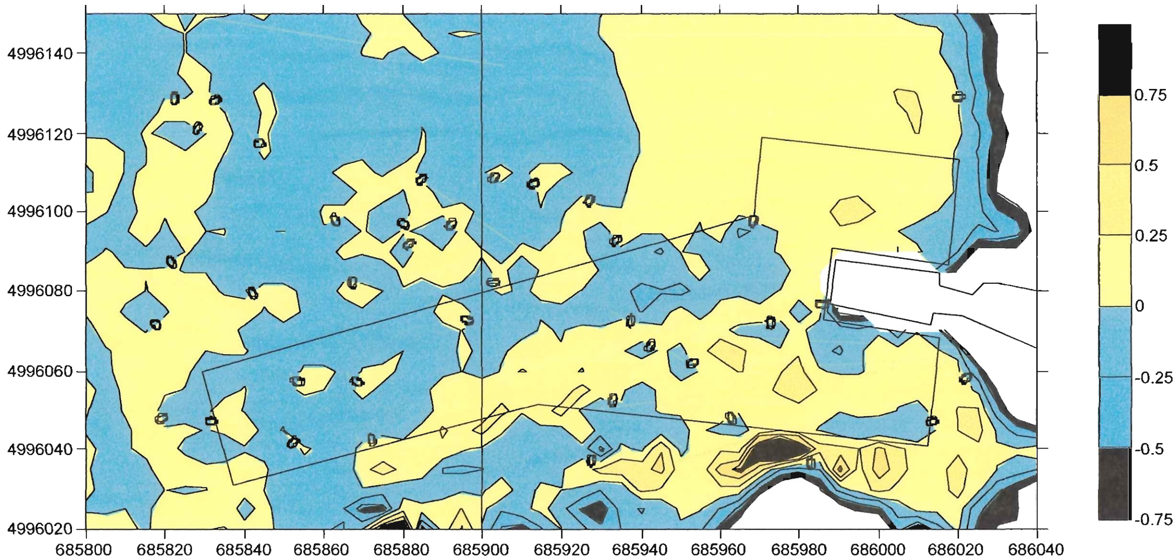
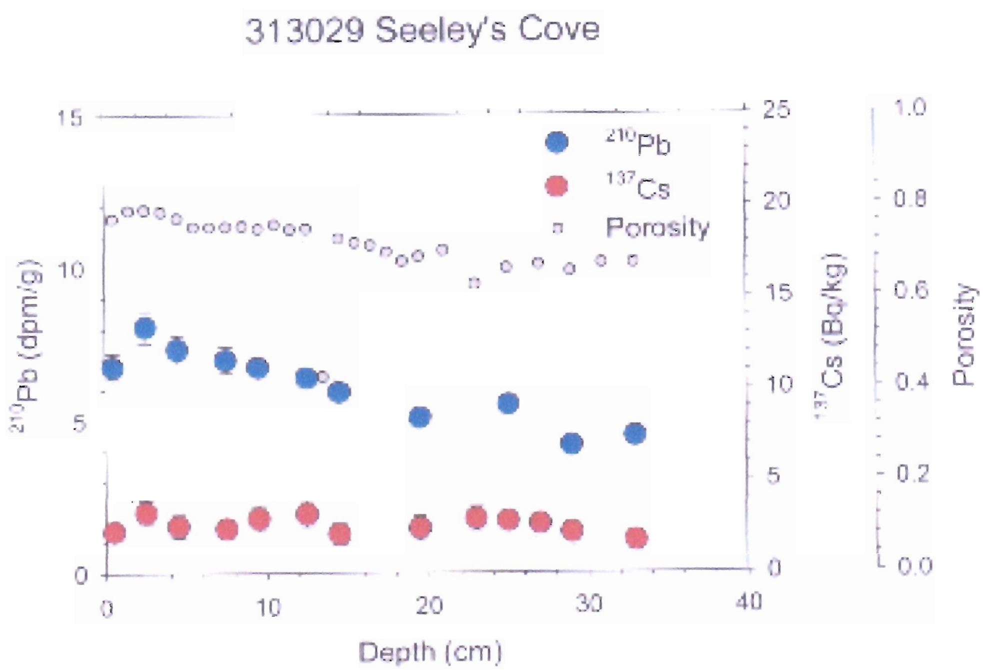


Figure 8: Bathymetry Interpolation showing difference between 1995 and 2002

3.2 *Pb^{210} and Cs^{137} Dating*

Cores (40-45cm penetration) were not deep enough to detect initial ^{137}Cs deposition (starting at 1950 in this region), however the amount present indicated a minimum sedimentation rate of 0.50-0.75cm/yr. It is estimated that the bottom of ^{137}Cs deposition is at approximately 60cm depth. Evaluation of the ^{210}Pb accumulations resulted in sedimentation rates of 1.23cm/yr (core 313025), 0.952cm/yr (core 313026), and 1.23cm/yr (core 313029). Distribution graphs are displayed in figures 9-11 from accumulation data in Appendix B.



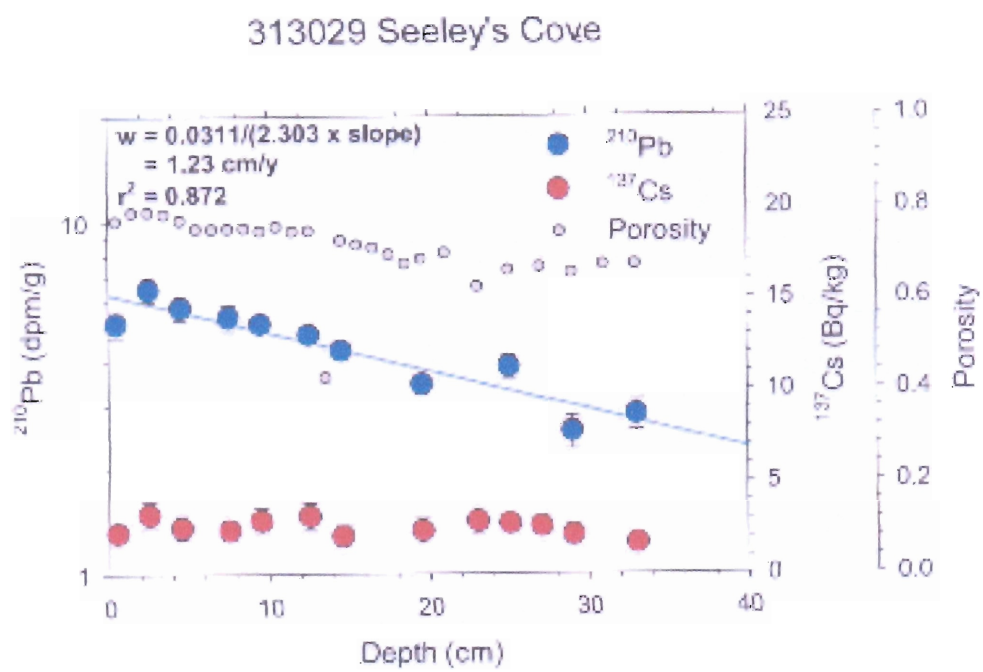
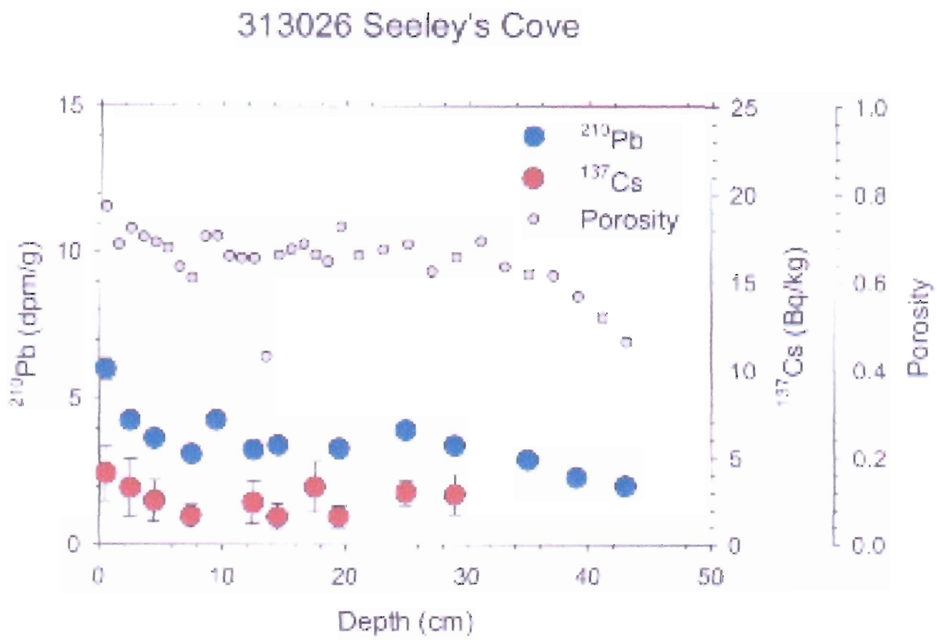


Figure 9: Linear and log plots of Pb^{210} and Cs^{137} accumulation for core sample 313025. Blue line in lower plot indicates linear fit to log (Pb) vs. depth.



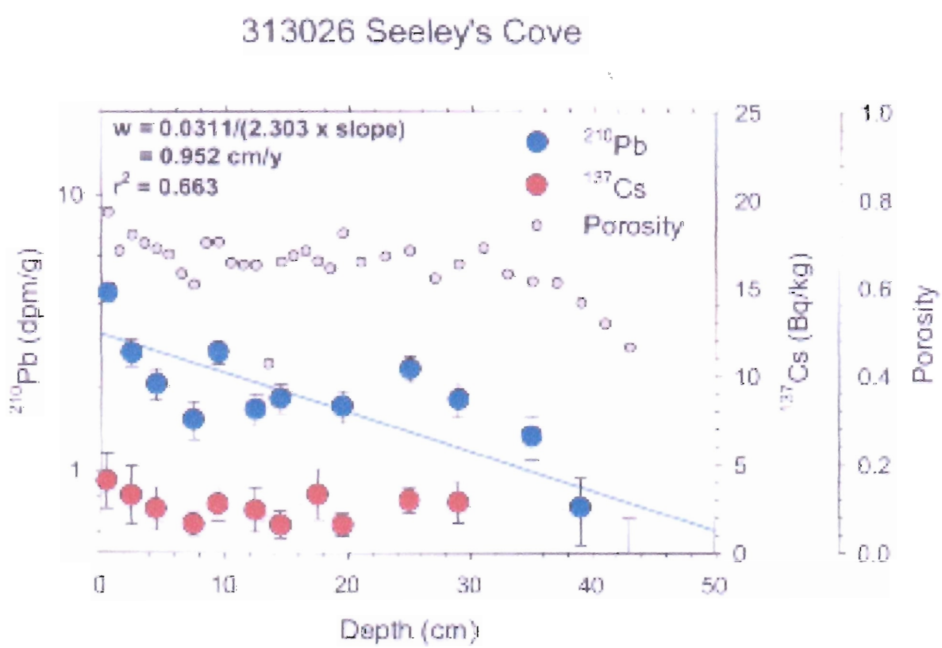
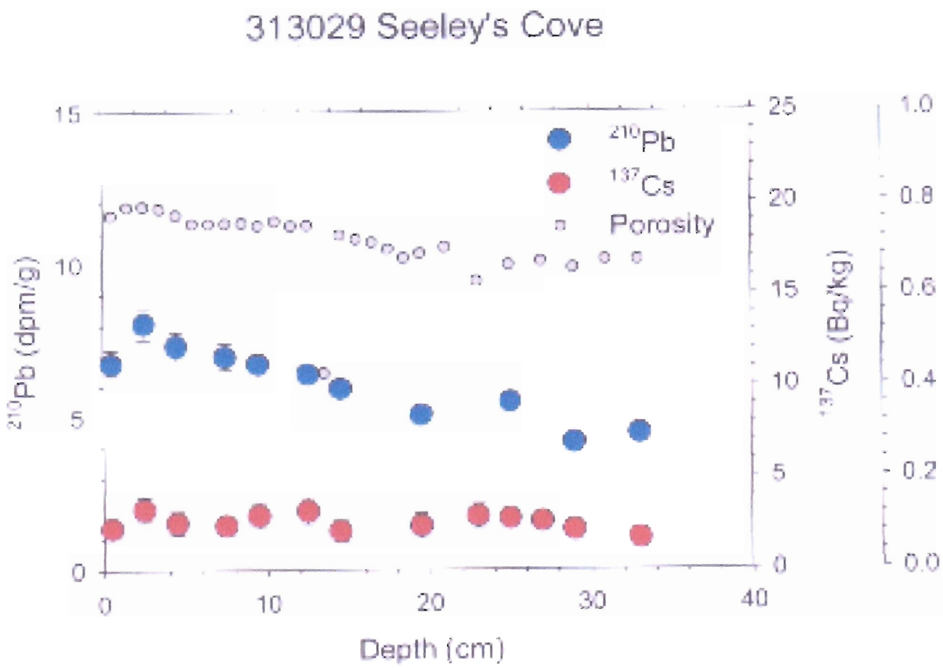


Figure 10: Linear and log plots of Pb^{210} and Cs^{137} accumulation for core sample 313026. Blue line in lower plot indicates linear fit to log (Pb) vs. depth.



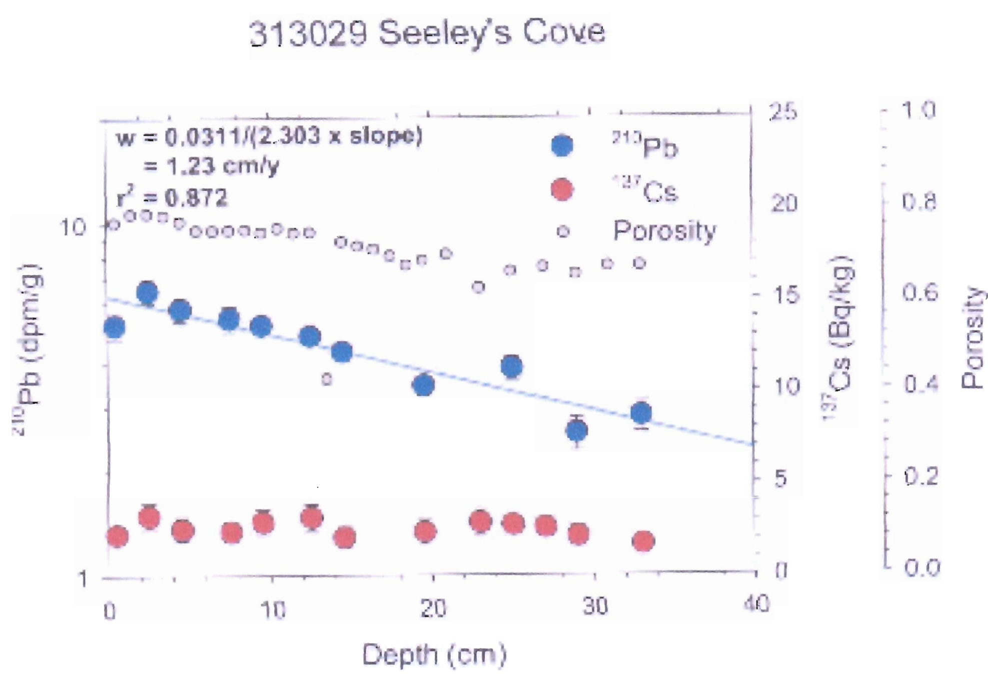


Figure 11: Linear and log plots of Pb^{210} and Cs^{137} accumulation for core sample 313029. Blue line in lower plot indicates linear fit to log (Pb) vs. depth.

3.3 *Strata box Seismics*

The strata box survey(Fig, 12-16) proved successful in detecting the old channel and producing a rough estimate of the amount of infill that has occurred (1-1.5m). Lack of signal penetration below 2m into the channel seabed indicates that there may be a hard layer of bedrock present or gas-charging occurring. Sidescan mosaic picked up several scour-like features within and parallel to the channel which were likely caused by ship propellers at low tide.

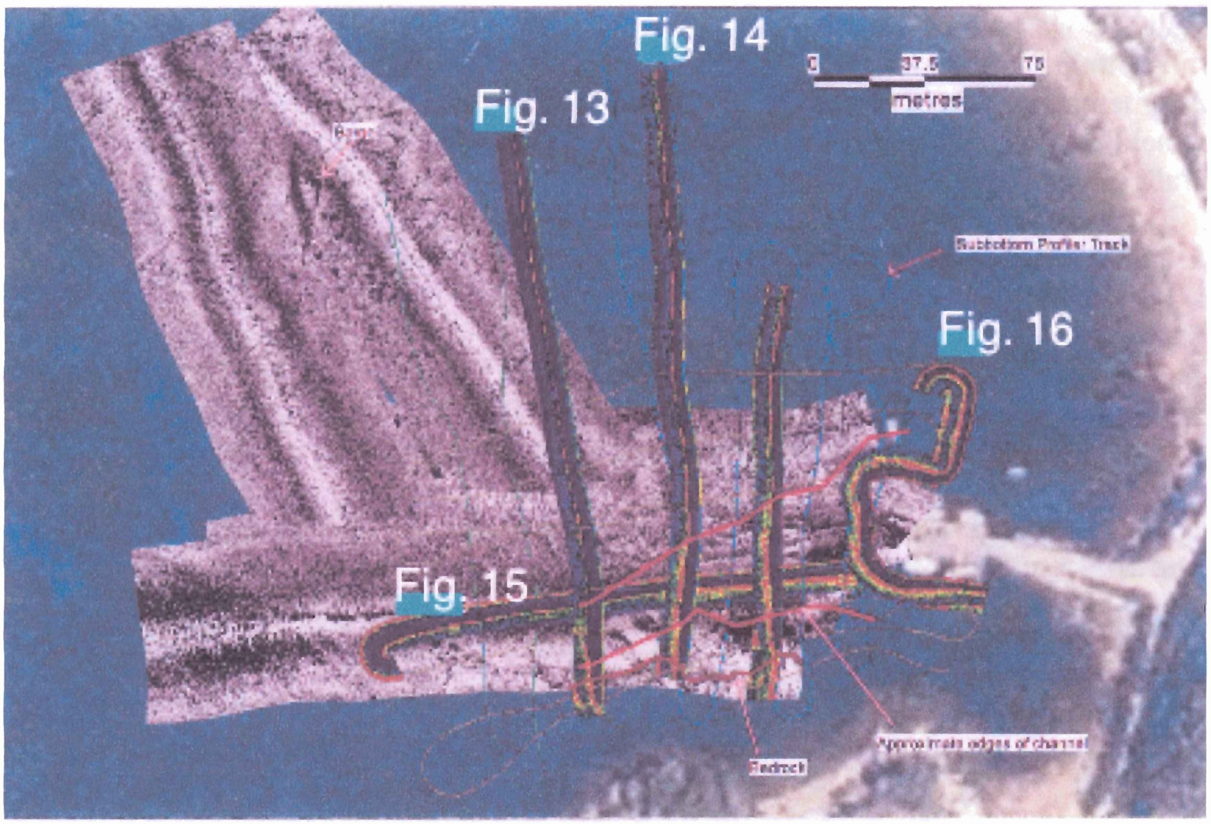


Figure 12: Sub-bottom profile and sidescan mosaic; limits of dredged channel shown in red.

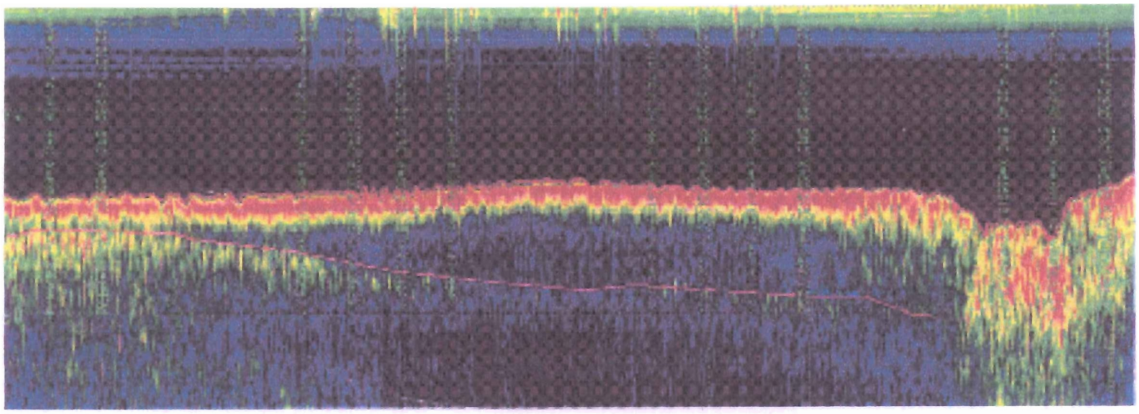


Figure 13: North-south line, as shown in Figure 12. Red surface indicates present sea floor and pink line shows potential previous sea floor after dredging

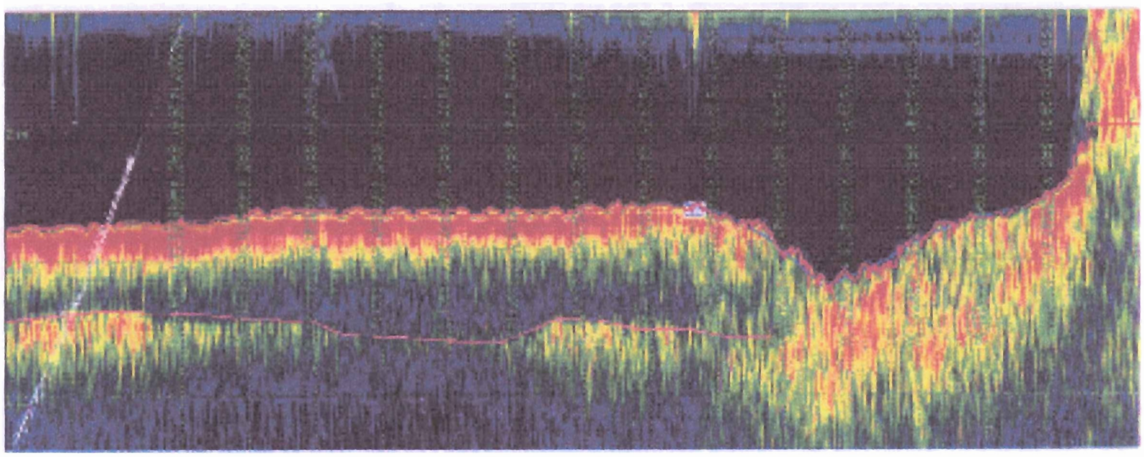


Figure 14: Another north south line, as shown in Figure 12. Red surface indicates present sea floor and pink line shows potential previous sea floor after dredging

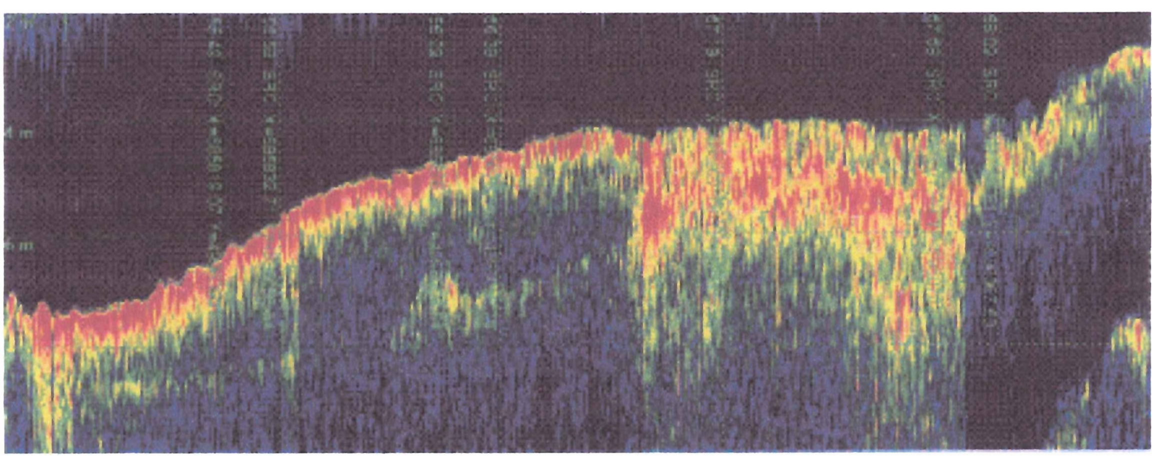


Figure 15 Longitudinal profile from seaward end of survey to wharf face along the channel axis. Upper unit thickness, 2m.

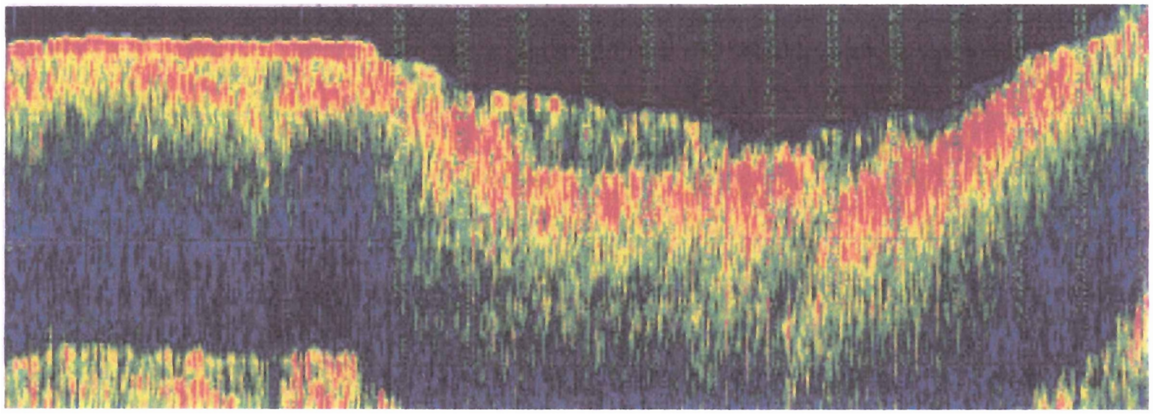


Figure 16: Line wraps around wharf and shows at least 1m of acoustically transparent material with harder, (potentially gas-charged) reflector underneath

3.4 *Particle Dynamics*

Raster interpolation attained from the Coulter counter (Table 1), (Appendix A, Appendix B) showed that the particles fined toward the center of the channel where it had been previously dredged with some coarser sediment along the boundary of the study area (Fig.13-15). d50 refers to median grain diameter in a sample, d75 describes the median diameter of the coarsest 25% of a sample and >16µm is the percentage of grains that are less than 16µm in a sample.

ID	313005	313006	313007	313009	313010	313011	313012	313013
Station	1	2	3	5	6	7	8	9
Lat	45.0941	45.0940	45.0938	45.0934	45.0936	45.0938	45.0936	45.0934
Long	-66.6375	-66.6370	-66.4702	-66.6371	-66.6372	-66.6375	-66.6376	-66.6377
Depth (m)	4.7	4.5	5.3	5.4	4.9	5.2	5.3	5.8
D50	16.24	14.12	51.55	18.88	45.91	9.97	15.97	35.98
D75	54.49	51.29	76.16	35.12	66.95	20.27	28.28	54.08
<16um	123.94	41.71	48.28	202.05	46.56	19.92	144.76	0.00

ID	313014	313015	313016	313017	313029	313026	313025
Station	13	14	15	16	core	core	core
Lat	45.0934	45.0936	45.0940	45.0941	45.0935	45.0937	45.0938
Long	-66.6382	-66.6388	-66.6384	-66.6374	-66.6373	-66.6372	-66.6366
Depth (m)	6.6	7.2	5.7	4.3			
D50	41.59	14.40	11.90	80.73	25.95	15.90	71.57
D75	84.30	27.65	37.23	122.56	42.15	25.57	94.73
<16um	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 1: Ekman grab grain size data used in raster interpolation as well as equivalent core data. Stations 4, 10, 11, 12 not used because of mistakes in processing or contamination.

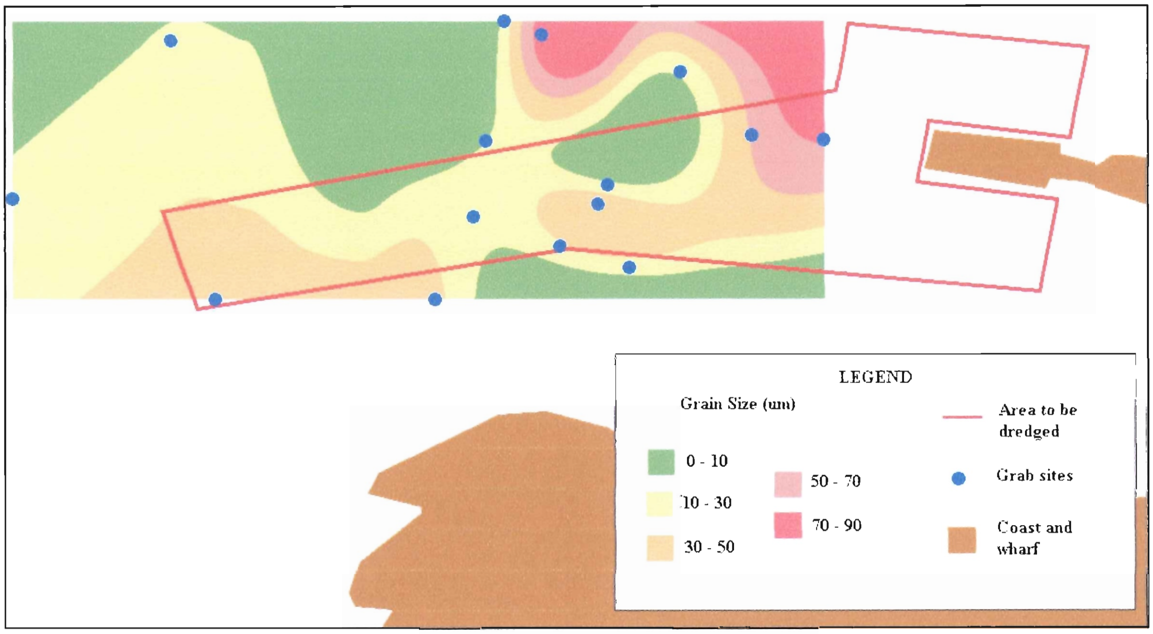


Figure 17A: Map showing distribution of median grain diameter (d50)

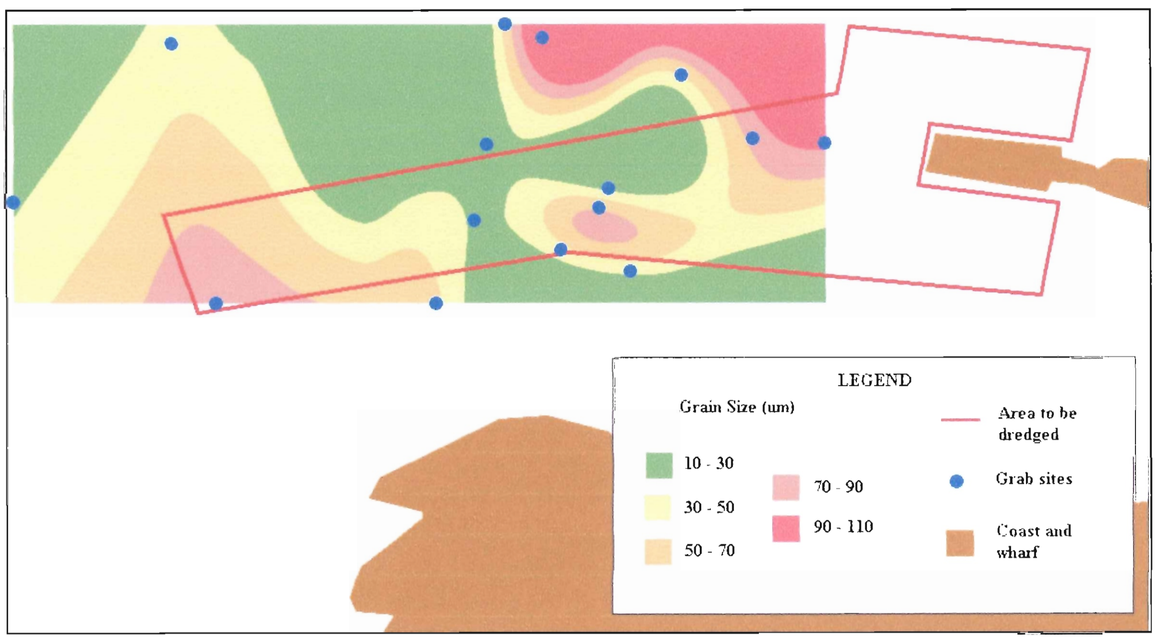


Figure 17B: Map showing distribution of median diameter of coarsest 25% of grains (d75)

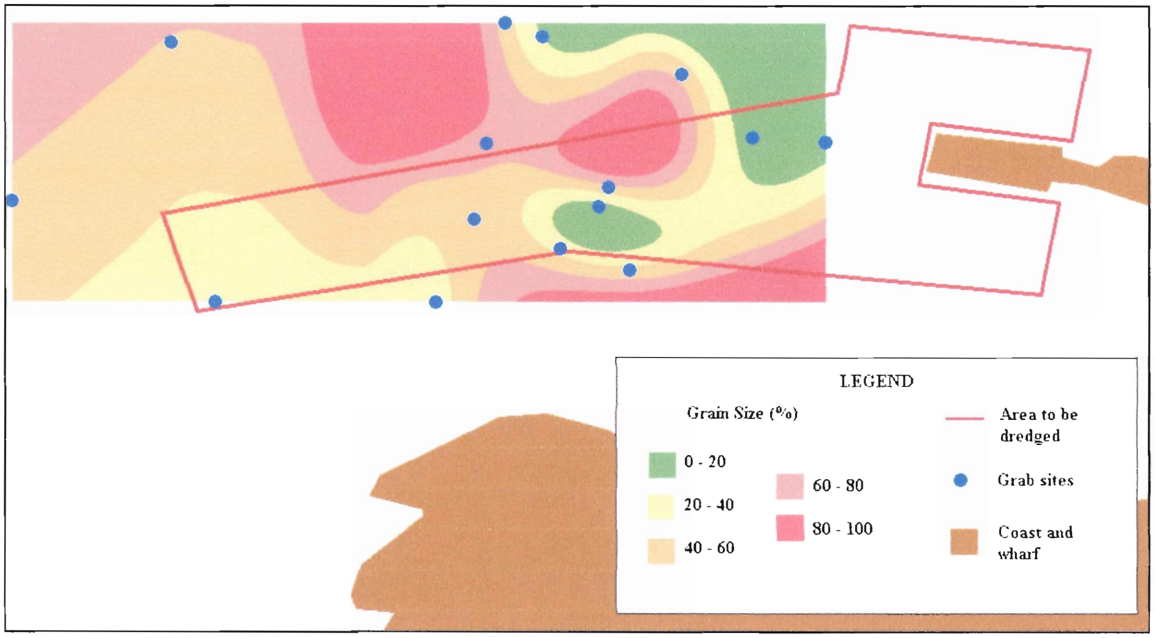


Figure 17C: Map showing distribution of the percentage of grains that are less than 16μm

4.0 Discussion and Error

Grain size analysis showed that the range of sediment graded from coarse sand near the edge of the channel, to finer silty sediment within the infilled region. This is the predominant grain texture in the study area which supports the hypothesis that infill occurred due to flocculation and tidal pumping rather than transport of suspended tidal sediment via longshore drift. Coarsening of sediments to the south of the channel suggest that wave action may have some influence in the seaward region of the harbour but not enough to drastically affect sediment infill rates.

The potential for gas-charging, indicated by the strata-box data, suggests the potential for high carbon levels. If it can be proven that it is, in fact, gas-charging and not hard substrate that is producing the strong reflectors in the seismic data, then this would further support the suggestion that flocculation is occurring. This is because the organic material could only be sealed in a fine-grained sedimentary environment.

All methods of analysis used in this study confirm that the initial findings of Martec Engineering were quite inaccurate. Instead of the 1m/yr rate they suggested, the measure rate, according to this study, is closer to 1cm/yr. By using several techniques for sedimentation rate calculation, the results were able to confirm each other and broaden the general understanding of the system. A purely model-based analysis was ineffectual because it did not take into account local knowledge of the area or the subtle variations in sediment texture and age that can only be determined by extensive core analysis. The complex nature of coastal systems defies a cursory examination of their processes.

A certain amount of error is inherent in any analysis that involves averaging. For the grain size maps and bathymetry calculations, raster interpolation required that the areas between data points be extrapolated to fit the model. However, considering the small size of the study area, any modification of the results would be negligible.

In regards to isotope accumulation measurement, both dredging and large tidal ranges can "smear" the cesium and lead, causing lead results to err too high and cesium results to err too low. As this region is known to have been dredged in the past as well as experience the extreme tidal ranges of the Bay of Fundy, it can be assumed that the rates determined from this method may be slightly high.

5.0 Conclusions

This study has provided several conclusions as to the nature of sediment infill in Seeley's Cove harbour, including several observations not noted in the Martec Engineering report.

1. The estimated sediment infill rate of Seeley's Cove harbour is approximately 1cm/yr, based on an amalgamation of results from shallow seismic interpretation, comparison of 1995 and 2002 bathymetry, and isotopic analysis of ^{210}Pb and ^{137}Cs.
2. Based on grain size analysis, sediment was probably supplied via tidal pumping, as opposed to longshore transport.
3. Seismic bottom profiling revealed a hard surface or gas-charged area at approximately 2m depth within the old channel.
4. Grain size generally decreased from the edge of the old channel inward.

6.0 References

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APPENDIX A: GRAIN SIZE DATA PER SAMPLE

ID		313005	313006	313007	313009	313010	313011	313012	313013	313014	313015	313016	313017	313029	313026	313025
Station		1	2	3	5	6	7	8	9	13	14	15	16			
Lat		45.0941	45.0940	45.0938	45.0934	45.0936	45.0938	45.0936	45.0934	45.0934	45.0936	45.0940	45.0941	45.0935	45.0937	45.0938
Long		-66.6375	-66.6370	-66.4702	-66.6371	-66.6372	-66.6375	-66.6376	-66.6377	-66.6382	-66.6388	-66.6384	-66.6374	-66.6373	-66.6372	-66.6366
Depth (m)		4.7	4.5	5.3	5.4	4.9	5.2	5.3	5.8	6.6	7.2	5.7	4.3			
D50		16.24	14.12	51.55	18.88	45.91	9.97	15.97	35.98	41.59	14.40	11.90	80.73	25.95	15.90	71.57
D75		54.49	51.29	76.16	35.12	66.95	20.27	28.28	54.08	84.30	27.65	37.23	122.56	42.15	25.57	94.73
<16um		51.35	52.68	7.51	46.38	11.81	69.13	52.80	28.78	26.22	55.97	59.21	19.38	33.56	53.40	7.05
Channel	Diameter															
4	0.7579	1.20383	3.48601	0.13436	1.03281	0.22416	1.66043	1.23866	0.70330	0.96254	1.28766	1.39528	0.94064	0.79208	1.01397	0.18387
5	0.8705506	1.23477	3.55546	0.13643	1.07738	0.22952	1.69987	1.24889	0.72977	0.96750	1.36282	1.42714	0.89114	0.82290	1.02949	0.18249
6	1	1.29006	3.30715	0.14692	1.15954	0.23951	1.79464	1.29973	0.77799	1.02206	1.44599	1.54717	0.87474	0.82585	1.07969	0.19107
7	1.1486984	1.37589	3.06032	0.15364	1.22281	0.25876	1.89754	1.30087	0.77713	1.07785	1.54032	1.64982	0.88403	0.85264	1.10983	0.20250
8	1.3195079	1.45084	2.89175	0.16092	1.30739	0.27487	1.91194	1.31907	0.78204	1.10055	1.62291	1.72824	0.87262	0.89861	1.14471	0.21182
9	1.5157166	1.51585	2.99696	0.16545	1.33759	0.28830	2.05699	1.34658	0.79111	1.21727	1.70075	1.81925	0.88715	0.93054	1.18330	0.22232
10	1.7411011	1.59295	3.15735	0.17680	1.40360	0.31058	2.06253	1.37909	0.80421	1.26131	1.76527	1.94081	0.87112	0.94536	1.21491	0.23113
11	2	1.67449	3.49470	0.18923	1.46537	0.33137	2.31220	1.43117	0.85655	1.19528	1.86671	2.03653	0.87032	0.96725	1.34262	0.23113
12	2.2973967	1.72254	3.35640	0.20534	1.53863	0.35636	2.36427	1.51033	0.88056	1.17431	1.99592	2.10998	0.89064	1.07619	1.37014	0.25428
13	2.6390158	1.90612	2.84824	0.21384	1.58801	0.37273	2.39388	1.59189	1.00223	1.18106	2.10814	2.12509	0.78482	1.02783	1.40683	0.23607
14	3.0314331	1.91419	2.49871	0.23072	1.61530	0.39387	2.78041	1.65416	1.00169	1.23094	2.19398	2.56016	0.68831	1.08091	1.58606	0.25617
15	3.4822023	1.88538	1.61779	0.21323	1.59896	0.45077	2.62741	1.72580	1.10470	1.08776	2.20530	2.35396	0.68277	1.15367	1.59311	0.23687
16	4	2.20589	1.39379	0.27844	1.64213	0.50257	3.08486	1.74572	1.12288	1.25549	2.32287	2.89344	0.66757	1.30371	1.64318	0.26158
17	4.5947934	2.27388	1.08229	0.28553	1.56433	0.51090	3.25534	1.90304	1.25723	1.04396	2.18079	2.85639	0.60002	1.23081	2.05669	0.23763
18	5.2780316	2.59433	1.14432	0.28834	1.71917	0.54461	2.65159	2.03991	1.36501	0.96154	2.26282	2.89983	0.64009	1.33944	2.19656	0.25691
19	6.0628663	2.76162	1.21054	0.33475	1.90025	0.53426	3.37131	2.29811	1.45569	1.05343	2.46882	3.17965	0.69638	1.48331	2.52338	0.28183
20	6.9644045	2.86399	1.35767	0.37629	2.14418	0.57160	3.57041	2.61622	1.61405	1.10166	2.74047	3.32128	0.75434	1.65150	2.78419	0.31270
21	8	3.13762	1.43360	0.44147	2.54420	0.65029	3.96278	2.98234	1.72339	1.16682	2.91233	3.53631	0.82909	1.87120	3.14024	0.36213
22	9.1895868	3.14430	1.52783	0.49454	2.96877	0.73637	4.12589	3.37112	1.75220	1.12544	3.22096	3.71594	0.89012	2.01557	3.49379	0.40949
23	10.556063	3.21691	1.59495	0.58269	3.51173	0.85557	4.63325	3.77112	1.97105	1.25234	3.67255	3.58322	0.97089	2.27631	4.06582	0.47055
24	12.125733	3.43756	1.79663	0.65999	3.74845	0.95753	4.96572	4.46549	2.10337	1.14899	3.86336	3.62947	1.02426	2.51850	4.64740	0.57174
25	13.928809	3.52024	1.98887	0.78358	4.02233	1.07150	4.93982	5.10004	1.93301	1.21623	4.40887	3.37665	1.08170	2.85545	5.56125	0.56507
26	16	3.42644	1.87512	0.85680	4.26750	1.14833	5.00591	5.45656	2.27349	1.41302	4.81712	3.52226	1.09170	3.64317	6.21347	0.67925
27	18.379174	3.13402	1.93636	1.22698	5.20197	1.60427	4.84028	6.04417	2.24938	1.83118	5.22135	2.94611	1.09245	4.57351	7.42369	0.82303
28	21.112127	3.31771	1.99354	1.85170	5.66629	2.29302	4.96736	6.44457	2.68759	2.33886	5.51088	2.27279	1.26479	5.32762	7.23347	0.91547
29	24.251465	3.08448	2.08515	2.94287	5.83020	3.30094	4.09454	6.39842	3.43374	2.96371	5.78724	2.20883	1.55994	6.61237	7.87441	1.15116
30	27.857618	2.92517	2.19565	4.56750	5.90542	4.96490	4.88994	5.45480	4.19444	4.00415	5.62116	2.65173	1.99199	6.52025	7.18162	1.53852
31	32	2.94364	2.82363	6.22253	5.18803	7.15625	4.12307	4.88222	5.69147	4.72796	4.62067	3.38700	2.47761	7.62504	5.57355	2.24932
32	36.758347	2.50466	3.51759	8.50651	4.83151	8.41524	3.11335	4.42796	8.57332	5.96322	4.10781	3.93147	2.80192	7.83240	4.99720	4.34348
33	42.224253	2.42900	4.11328	8.93885	4.61042	9.46966	2.21005	3.42348	9.78672	4.99076	3.28319	4.36863	3.19904	6.04214	3.44396	6.88174
34	48.50293	2.47285	4.05294	8.75880	3.88824	9.47584	2.63241	2.48464	7.72821	4.19032	2.18863	4.07236	2.56727	5.75645	2.03715	7.45854
35	55.715236	2.47363	3.69422	9.18340	2.87617	9.24156		2.20076	6.55622	4.38557	2.39465	3.08598	3.36147	4.65397	0.83434	7.06975
36	64	2.93837	4.22233	9.34880	3.22855	8.80193		1.85866	5.44983	5.21298	1.48371	2.62652	3.54618	2.84372		7.70882
37	73.516695	3.62192	3.44172	7.87057	2.22373	8.09726		1.86204	5.28355	4.57836	1.57973	2.66476	5.71672	1.87692		9.16344
38	84.448506	5.64917	5.33065	7.94789	1.99104	6.45250		1.72235	6.05218	7.38423	0.99855	3.26745	5.91911	3.84836		14.47779
39	97.00586	6.40060	5.24858	5.45152	2.17802	5.26315			3.53067	6.75440	1.23568	2.43329	9.71529	2.92442		12.69671
40	111.43047	3.39999	2.66791	4.06287		3.64917				10.05364		0.87520	8.83976			10.17215
41	128	1.35512		5.60992						4.40331			8.35940			3.16199
42	147.03339												12.00711			3.13953
43	168.89701												6.19548			

APPENDIX B: Core Physical Data

313029				BOT WAT	DRY SED		Ra-226 =	1.6	0.16		SAMPLE
	Seelley,s	Cove 2007		SAL =	DENS =						DATE =
				33	2.45						**2007.658**

Depth Interval (cm)	Depth mdpt	Depth Bottom (cm)	Depth Midpoint (cm)	Container Wt.	Wet Wt. + cont.	Dry Wt. + cont.	% Dry	%Dry (salt corr)	Porosity	Bulk Density	Mid Mass Depth (g/cm2)
0-1	0.5	1	0.5	18.05	165.27	79.25	41.57	41.43	0.77	0.557	0.279
1-2	1.5	2	0.5	18.05	126.78	60.36	38.91	38.76	0.79	0.511	0.813
2-3	2.5	3	0.5	18.05	126.75	60.19	38.77	38.62	0.79	0.509	1.323
3-4	3.5	4	0.5	18.05	128.88	61.8	39.47	39.33	0.79	0.521	1.837
4-5	4.5	5	0.5	18.05	127.29	63.2	41.33	41.19	0.77	0.553	2.374
5-6	5.5	6	0.5	18.05	136.87	70.26	43.94	43.80	0.75	0.600	2.951
6-7	6.5	7	0.5	18.05	133.29	68.75	44.00	43.86	0.75	0.601	3.551
7-8	7.5	8	0.5	18.05	132.55	68.38	43.96	43.82	0.75	0.601	4.152
8-9	8.5	9	0.5	18.05	137.28	70.28	43.81	43.67	0.76	0.598	4.752
9-10	9.5	10	0.5	18.05	132.42	69	44.55	44.41	0.75	0.612	5.356
10-11	10.5	11	0.5	18.05	134	68.37	43.40	43.26	0.76	0.590	5.957
11-12	11.5	12	0.5	18.05	130.41	68.36	44.78	44.64	0.75	0.616	6.560
12-13	12.5	13	0.5	18.05	138.11	71.59	44.59	44.46	0.75	0.612	7.174
13-14	13.5	14	0.5	18.05	140.2	76.27	76.27	76.21	0.43	1.400	8.180
14-15	14.5	15	0.5	18.05	133	72.55	47.41	47.28	0.73	0.666	9.214
15-16	15.5	16	0.5	18.05	149.67	81.85	48.47	48.35	0.72	0.687	9.890
16-17	16.5	17	0.5	18.05	131.56	74.11	49.39	49.26	0.71	0.705	10.586
17-18	17.5	18	0.5	18.05	148.32	84.7	51.16	51.04	0.70	0.742	11.310
18-19	18.5	19	0.5	18.05	140.38	83.46	53.47	53.36	0.68	0.790	12.076
19-20	19.5	20	0.5	18.05	148.25	86.1	52.27	52.15	0.69	0.765	12.853
20-22	21	22	1	18.05	195.21	107.92	50.73	50.61	0.70	0.733	13.968
22-24	23	24	1	18.05	142.18	91.18	58.91	58.81	0.63	0.913	15.614
24-26	25	26	1	18.05	181.13	107.92	55.11	55.00	0.66	0.826	17.354
26-28	27	28	1	18.05	199.57	116.62	54.30	54.19	0.67	0.808	18.989
28-30	29	30	1	18.05	203.5	121.87	55.98	55.87	0.65	0.846	20.643
30-32	31	32	1	18.05	171.27	100.84	54.03	53.92	0.67	0.803	22.291
32-34	33	34	1	18.05	171.27	100.84	54.03	53.92	0.67	0.803	23.896

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Bot Mass Depth (g/cm2)	Plate Date	Pb-210 dpm/g	error dpm/g	salt corr sed/(sed+s; %	corr Pb210 Activity (dpm/g)	corr Pb210 uncert (dpm/g)	ExPb-210 (dpm/g)	uncert (dpm/g)	ExPb-210 Sample Date	Uncert dpm/g	**Depth Interval (cm)**
0.557	2007.852	6.41	0.40	0.954	6.72	0.42	5.12	0.45	5.15	0.45	**0-1**
1.068				0.948							**1-2**
1.577	2007.852	7.61	0.47	0.948	8.03	0.50	6.43	0.52	6.47	0.52	**2-3**
2.097				0.949							**3-4**
2.651	2007.852	6.95	0.4	0.953	7.29	0.42	5.69	0.45	5.73	0.45	**4-5**
3.251				0.958							**5-6**
3.852				0.958							**6-7**
4.453	2007.852	6.65	0.39	0.958	6.94	0.41	5.34	0.44	5.37	0.44	**7-8**
5.050				0.958							**8-9**
5.662	2007.868	6.43	0.2	0.959	6.71	0.21	5.11	0.26	5.14	0.26	**9-10**
6.252				0.957							**10-11**
6.868				0.959							**11-12**
7.480	2007.868	6.09	0.21	0.959	6.35	0.22	4.75	0.27	4.78	0.27	**12-13**
8.881				0.964							**13-14**
9.547	2007.868	5.67	0.17	0.963	5.89	0.18	4.29	0.24	4.31	0.24	**14-15**
10.234				0.965							**15-16**
10.939				0.966							**16-17**
11.681				0.969							**17-18**
12.471				0.971							**18-19**
13.236	2007.868	4.88	0.15	0.970	5.03	0.15	3.43	0.22	3.45	0.22	**19-20**
14.701				0.968							**20-22**
16.528				0.977							**22-24**
18.180	2007.89	5.3	0.24	0.973	5.45	0.25	3.85	0.29	3.87	0.30	**24-26**
19.797				0.972							**26-28**
21.489	2007.89	4	0.21	0.974	4.11	0.22	2.51	0.27	2.52	0.27	**28-30**
23.094				0.972							**30-32**
24.699	2007.89	4.28	0.22	0.972	4.40	0.23	2.80	0.28	2.82	0.28	**32-34**

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Seelley,s

Pb-210 Total dpm/g	Uncert dpm/g	Cs-137 Bq/kg	Uncert.	Cs-137 Hand cal.	Uncert.		Depth mdpt	Date	**Depth Interval (cm)**
6.75	0.45	2.19	0.62	2.28	0.5		0.5	2007.3	**0-1**
							1.5	2006.4	**1-2**
8.07	0.52	3.26	0.7	3.29	0.68		2.5	2005.6	**2-3**
							3.5	2004.8	**3-4**
7.33	0.45	2.41	0.75	2.55	0.62		4.5	2004.0	**4-5**
							5.5	2003.2	**5-6**
							6.5	2002.4	**6-7**
6.97	0.44	2.4	0.6	2.41	0.52		7.5	2001.6	**7-8**
							8.5	2000.7	**8-9**
6.74	0.26	2.98	0.8	2.94	0.69		9.5	1999.9	**9-10**
							10.5	1999.1	**10-11**
							11.5	1998.3	**11-12**
6.38	0.27	3.09	0.8	3.18	0.71		12.5	1997.5	**12-13**
							13.5	1996.7	**13-14**
5.91	0.24	1.82	0.62	2.09	0.57		14.5	1995.9	**14-15**
							15.5	1995.1	**15-16**
							16.5	1994.2	**16-17**
							17.5	1993.4	**17-18**
							18.5	1992.6	**18-19**
5.05	0.22	2.29	0.72	2.37	0.66		19.5	1991.8	**19-20**
							21	1990.6	**20-22**
		2.99	0.74	2.88	0.66		23	1989.0	**22-24**
5.47	0.30	2.93	0.52	2.75	0.38		25	1987.3	**24-26**
		2.52	0.49	2.61	0.49		27	1985.7	**26-28**
4.12	0.27	2.12	0.6	2.14	0.53		29	1984.1	**28-30**
							31	1982.5	**30-32**
4.42	0.28	1.69	0.61	1.68	0.5		33	1980.8	**32-34**

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Seelley,s Cove 2007

BOT WAT SAL = 33 DRY SED DENS = 2.45 Ra-226 = 1.6 0.16 SAMPLE DATE = 2007.658

Depth Interval (cm)	Depth mdpt	Depth Bottom (cm)	Depth Midpoint (cm)	Container Wt.	Wet Wt. + cont.	Dry Wt. + cont.	% Dry	%Dry (salt corr)	Porosity	Bulk Density	Mid Mass Depth (g/cm2)
0-1	0.5	1	0.5	18.05	52.4	34.6	48.18	48.05	0.72	0.681	0.341
1-2	1.5	2	0.5	18.05	58.66	36.28	44.89	44.76	0.75	0.618	0.990
2-3	2.5	3	0.5	18.05	52.43	36.76	54.42	54.31	0.67	0.811	1.705
3-4	3.5	4	0.5	18.05	63.53	40.79	50.00	49.88	0.71	0.718	2.469
4-5	4.5	5	0.5	18.05	65.58	42.61	51.67	51.55	0.69	0.752	3.204
5-6	5.5	6	0.5	18.05	62.54	41.09	51.79	51.67	0.69	0.755	3.957
6-7	6.5	7	0.5	18.05	65.22	41.77	50.29	50.16	0.70	0.724	4.696
7-8	7.5	8	0.5	18.05	58.88	38.67	50.50	50.38	0.70	0.728	5.422
8-9	8.5	9	0.5	18.05	65.11	41.83	50.53	50.41	0.70	0.729	6.150
9-10	9.5	10	0.5	18.05	60.65	46.61	67.04	66.96	0.54	1.121	7.075
10-11	10.5	11	0.5	18.05	69.62	46.61	55.38	55.27	0.66	0.832	8.052
11-12	11.5	12	0.5	18.05	67.66	46.09	56.52	56.41	0.65	0.858	8.897
12-13	12.5	13	0.5	18.05	66.18	45.05	56.10	55.99	0.65	0.848	9.750
13-14	13.5	14	0.5	18.05	68.86	45.38	76.27	76.21	0.43	1.400	10.875
14-15	14.5	15	0.5	18.05	65.6	43.31	53.12	53.01	0.68	0.783	11.966
15-16	15.5	16	0.5	18.05	66.16	44.85	55.71	55.60	0.66	0.840	12.777
16-17	16.5	17	0.5	18.05	67.14	46.68	58.32	58.22	0.63	0.899	13.647
17-18	17.5	18	0.5	18.05	64.89	43.74	54.85	54.74	0.67	0.820	14.507
18-19	18.5	19	0.5	18.05	67.25	44.54	53.84	53.73	0.67	0.798	15.316
19-20	19.5	20	0.5	18.05	68.47	45.42	47.73	47.60	0.73	0.672	16.052
20-22	21	22	2	18.05	127.03	78.15	55.15	55.04	0.66	0.827	18.042
22-24	23	24	2	18.05	100.66	62.48	53.78	53.67	0.67	0.797	21.290
24-26	25	26	2	18.05	120.3	75.68	56.36	56.25	0.65	0.854	24.593
26-28	27	28	2	18.05	125.25	80.16	57.94	57.84	0.64	0.891	28.083
28-30	29	30	2	18.05	124.58	79.71	57.88	57.78	0.64	0.889	31.642
30-32	31	32	2	18.05	125.34	80.69	58.38	58.28	0.63	0.901	35.223
32-34	33	34	2	18.05	124.46	82.91	60.95	60.86	0.61	0.963	38.950
34-36	35	36	2	18.05	135	96.11	66.75	66.67	0.55	1.113	43.102

313025

Bot Mass Depth (g/cm2)	Count Date	Pb-210 dpm/g	error dpm/g	salt corr d/(sed+salt) %	corr Pb210 Activity (dpm/g)	corr Pb210 uncert (dpm/g)	ExPb-210 (dpm/g)	uncert (dpm/g)	ExPb-210 Sample Date	Uncert dpm/g	**Depth Interval (cm)**
0.681	2007.896	4.44	0.21	0.965	4.60	0.22	3.00	0.27	3.03	0.27	**0-1**
1.299				0.959							**1-2**
2.110	2007.904	4.34	0.19	0.972	4.46	0.20	2.86	0.25	2.89	0.25	**2-3**
2.828				0.967							**3-4**
3.580	2007.904	4.06	0.18	0.969	4.19	0.19	2.59	0.25	2.61	0.25	**4-5**
4.335				0.969							**5-6**
5.058				0.967							**6-7**
5.786	2007.904	4.31	0.18	0.968	4.45	0.19	2.85	0.25	2.88	0.25	**7-8**
6.515				0.968							**8-9**
7.636	2007.904	3.95	0.2	0.984	4.02	0.20	2.42	0.26	2.43	0.26	**9-10**
8.468				0.973							**10-11**
9.326				0.975							**11-12**
10.174				0.974							**12-13**
11.575				0.972							**13-14**
12.358	2007.907	3.89	0.27	0.971	4.01	0.28	2.41	0.32	2.43	0.32	**14-15**
13.197				0.974							**15-16**
14.097				0.976							**16-17**
14.917				0.973							**17-18**
15.715				0.972							**18-19**
16.388	2007.907	3.38	0.25	0.972	3.48	0.26	1.88	0.30	1.89	0.31	**19-20**
19.696				0.973							**20-22**
22.885				0.972							**22-24**
26.302	2007.907	3.12	0.22	0.974	3.20	0.23	1.60	0.28	1.61	0.28	**24-26**
29.864				0.976							**26-28**
33.421	2007.907	2.99	0.21	0.976	3.06	0.22	1.46	0.27	1.47	0.27	**28-30**
37.025				0.976							**30-32**
40.875				0.979							**32-34**
45.328	2007.912	2.15	0.14	0.984	2.19	0.14	0.59	0.21	0.59	0.22	**34-36**

313025

Pb-210 Total dpm/g	Uncert dpm/g	Cs-137 Bq/kg	Uncert. Bq/kg	Cs-137 Hand cal.	Uncert.	Depth mdpt	Date	**Depth Interval (cm)**
4.63	0.27	2.6	1.08	2.49	0.87	0.5	2007.3	**0-1**
						1.5	2006.4	**1-2**
4.49	0.25	2.84	1.22	2.89	1.24	2.5	2005.6	**2-3**
						3.5	2004.8	**3-4**
4.21	0.25					4.5	2004.0	**4-5**
						5.5	2003.2	**5-6**
						6.5	2002.4	**6-7**
4.48	0.25	2.16	0.95	2.59	0.78	7.5	2001.6	**7-8**
						8.5	2000.7	**8-9**
4.03	0.26	3.24	1.3	2.79	0.96	9.5	1999.9	**9-10**
						10.5	1999.1	**10-11**
						11.5	1998.3	**11-12**
		2.36	0.73	2.35	0.47	12.5	1997.5	**12-13**
						13.5	1996.7	**13-14**
4.03	0.32	3.1	1.32	3.08	0.91	14.5	1995.9	**14-15**
						15.5	1995.1	**15-16**
						16.5	1994.2	**16-17**
						17.5	1993.4	**17-18**
						18.5	1992.6	**18-19**
3.49	0.31	2.46	1.1	3.07	0.87	19.5	1991.8	**19-20**
						21	1990.6	**20-22**
						23	1989.0	**22-24**
3.21	0.28	2.46	1.17	2.72	0.82	25	1987.3	**24-26**
						27	1985.7	**26-28**
3.07	0.27					29	1984.1	**28-30**
						31	1982.5	**30-32**
						33	1980.8	**32-34**
2.19	0.22					35	1979.2	**34-36**

313026 BOT WAT DRY SED Ra-226 = 1.6 0.16

Seeley,s Cove 2007 **313026** SAL = 33 DENS = 2.45

Depth Interval (cm)	Depth mdpt	Depth Bottom (cm)	Depth Midpoint (cm)	Container Wt.	Wet Wt. + cont.	Dry Wt. + cont.	% Dry	%Dry (salt corr)	Porosity	Bulk Density	Mid Mass Depth (g/cm2)
0-1	0.5	1	0.5	18.05	65.74	37.93	41.69	41.54	0.77	0.559	0.280
1-2	1.5	2	0.5	18.05	76.27	48.71	52.66	52.55	0.68	0.773	0.946
2-3	2.5	3	0.5	18.05	53.6	35.22	48.30	48.17	0.72	0.684	1.674
3-4	3.5	4	0.5	18.05	66.72	42.68	50.61	50.49	0.70	0.730	2.381
4-5	4.5	5	0.5	18.05	63.08	41.49	52.05	51.94	0.69	0.760	3.126
5-6	5.5	6	0.5	18.05	61.45	41.3	53.57	53.46	0.68	0.793	3.903
6-7	6.5	7	0.5	18.05	67.17	46.7	58.33	58.22	0.63	0.900	4.749
7-8	7.5	8	0.5	18.05	70.69	50.09	60.87	60.77	0.61	0.961	5.679
8-9	8.5	9	0.5	18.05	65.64	42.1	50.54	50.41	0.70	0.729	6.523
9-10	9.5	10	0.5	18.05	65	41.7	50.37	50.25	0.70	0.725	7.250
10-11	10.5	11	0.5	18.05	67.73	45.69	55.64	55.53	0.66	0.838	8.032
11-12	11.5	12	0.5	18.05	63	43.31	56.20	56.09	0.65	0.851	8.876
12-13	12.5	13	0.5	18.05	68.1	46.2	56.24	56.14	0.65	0.852	9.727
13-14	13.5	14	0.5	18.05	63.93	39.57	76.27	76.21	0.43	1.400	10.853
14-15	14.5	15	0.5	18.05	65.47	44.33	55.42	55.31	0.66	0.833	11.970
15-16	15.5	16	0.5	18.05	67.58	44.73	53.87	53.75	0.67	0.799	12.786
16-17	16.5	17	0.5	18.05	64.46	42.45	52.57	52.46	0.69	0.771	13.571
17-18	17.5	18	0.5	18.05	69.9	46.7	55.26	55.15	0.66	0.829	14.371
18-19	18.5	19	0.5	18.05	67.68	46.34	57.00	56.90	0.65	0.869	15.221
19-20	19.5	20	0.5	18.05	68.4	47.73	47.73	47.60	0.73	0.672	15.991
20-22	21	22	2	18.05	120.69	74.88	55.37	55.26	0.66	0.832	17.991
22-24	23	24	2	18.05	123.15	74.74	53.94	53.83	0.67	0.801	21.256
24-26	25	26	2	18.05	117	70	52.50	52.38	0.69	0.770	24.397
26-28	27	28	2	18.05	126.95	82.63	59.30	59.20	0.62	0.923	27.781
28-30	29	30	2	18.05	121.59	75.93	55.90	55.79	0.66	0.844	31.315
30-32	31	32	2	18.05	119.37	70.51	51.78	51.66	0.69	0.754	34.511
32-34	33	34	2	18.05	128	82.09	58.24	58.14	0.63	0.898	37.815
34-36	35	36	2	18.05	127.1	83.49	60.01	59.91	0.62	0.940	41.490
36-38	37	38	2	18.05	130.31	85.71	60.27	60.17	0.61	0.946	45.261
38-40	39	40	2	18.05	133.25	92.59	64.70	64.62	0.57	1.058	49.270
40-42	41	42	2	18.05	134.36	98.26	68.96	68.89	0.52	1.175	53.737
42-44	43	44	2	18.05	127.09	98.04	73.36	73.29	0.47	1.307	58.700

SAMPLE DATE = 2007.658

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Bot Mass Depth (g/cm2)	Count Date	Pb-210 dpm/g	error dpm/g	salt corr sed/(sed+sa %)	corr Pb210 Activity (dpm/g)	corr Pb210 uncert (dpm/g)	ExPb-210 (dpm/g)	uncert (dpm/g)	ExPb-210 Sample Date	Uncert dpm/g	**Depth Interval (cm)**
0.559	2007.878	5.71	0.31	0.954	5.99	0.33	4.39	0.36	4.42	0.36	**0-1**
1.332				0.970							**1-2**
2.016	2007.878	4.1	0.24	0.965	4.25	0.25	2.65	0.30	2.67	0.30	**2-3**
2.746				0.968							**3-4**
3.506	2007.878	3.53	0.21	0.970	3.64	0.22	2.04	0.27	2.05	0.27	**4-5**
4.299				0.971							**5-6**
5.198				0.976							**6-7**
6.159	2007.878	3.05	0.17	0.979	3.12	0.17	1.52	0.24	1.53	0.24	**7-8**
6.888				0.968							**8-9**
7.613	2007.688	4.14	0.2	0.967	4.28	0.21	2.68	0.26	2.68	0.26	**9-10**
8.451				0.974							**10-11**
9.301				0.974							**11-12**
10.153	2007.688	3.18	0.15	0.974	3.26	0.15	1.66	0.22	1.67	0.22	**12-13**
11.553				0.963							**13-14**
12.386	2007.688	3.33	0.15	0.973	3.42	0.15	1.82	0.22	1.82	0.22	**14-15**
13.185				0.972							**15-16**
13.957				0.970							**16-17**
14.786				0.973							**17-18**
15.655				0.975							**18-19**
16.327	2007.688	3.23	0.16	0.977	3.31	0.16	1.71	0.23	1.71	0.23	**19-20**
19.655				0.973							**20-22**
22.857				0.972							**22-24**
25.936	2007.89	3.8	0.2	0.970	3.92	0.21	2.32	0.26	2.33	0.26	**24-26**
29.627				0.977							**26-28**
33.002	2007.895	3.31	0.2	0.974	3.40	0.21	1.80	0.26	1.81	0.26	**28-30**
36.020			0.21	0.969							**30-32**
39.611				0.976							**32-34**
43.369	2007.895	2.86	0.17	0.978	2.92	0.17	1.32	0.24	1.33	0.24	**34-36**
47.154				0.978							**36-38**
51.386	2007.895	2.29	0.12	0.982	2.33	0.12	0.73	0.20	0.74	0.20	**38-40**
56.087			0.14	0.985							**40-42**
61.313	2007.912	2.02	0.15	0.988	2.04	0.15	0.44	0.22	0.45	0.22	**42-44**

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Pb-210 Total dpm/g	Uncert dpm/g	Cs-137 Bq/kg	Uncert. Bq/kg	Cs-137 Hand cal.	Uncert.	Seeley,s Depth mdpt	Date	**Depth Interval (cm)**
6.02	0.36	4.82	2.46	4.1	1.58	**0.5**	**2007.1**	**0-1**
						1.5	**2006.1**	**1-2**
4.27	0.30	<4.54		3.27	1.66	**2.5**	**2005.0**	**2-3**
						3.5	**2004.0**	**3-4**
3.65	0.27	<3.54		2.52	1.21	**4.5**	**2002.9**	**4-5**
						5.5	**2001.9**	**5-6**
						6.5	**2000.8**	**6-7**
3.13	0.24	<2.69		1.65	0.66	**7.5**	**1999.8**	**7-8**
						8.5	**1998.7**	**8-9**
4.28	0.26					**9.5**	**1997.7**	**9-10**
						10.5	**1996.6**	**10-11**
						11.5	**1995.6**	**11-12**
3.27	0.22	<3.7		2.44	1.25	**12.5**	**1994.5**	**12-13**
						13.5	**1993.5**	**13-14**
3.42	0.22	<3.18		1.6	0.77	**14.5**	**1992.4**	**14-15**
						15.5	**1991.4**	**15-16**
						16.5	**1990.3**	**16-17**
		<3.42		3.32	1.45	**17.5**	**1989.3**	**17-18**
						18.5	**1988.2**	**18-19**
3.31	0.23	2.33	1.37	1.6	0.63	**19.5**	**1987.2**	**19-20**
						21	**1985.6**	**20-22**
						23	**1983.5**	**22-24**
3.93	0.26	3.43	1.48	3	0.72	**25**	**1981.4**	**24-26**
						27	**1979.3**	**26-28**
3.41	0.26	3.5	1.93	2.89	1.18	**29**	**1977.2**	**28-30**
						31	**1975.1**	**30-32**
						33	**1973.0**	**32-34**
2.93	0.24					**35**	**1970.9**	**34-36**
						37	**1968.8**	**36-38**
2.34	0.20					**39**	**1966.7**	**38-40**
						41	**1964.6**	**40-42**
2.05	0.22					**43**	**1962.5**	**42-44**