GEOLOGICAL SURVEY OF CANADA
OPEN FILE 7026

Cruise Report, 2011004PGC, CCGS Vector, 21-28 August 2011

P.R. Hill

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doi:10.4095/292671

Recommended citation
Hill, P.R., 2013. Cruise Report, 2011004PGC, CCGS Vector, 21-28 August 2011; Geological Survey of Canada, Open File 7026, doi:10.4095/292671

2011004PGC

CCGS Vector

August 21-28, 2011

CRUISE REPORT

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Cruise Objectives

- Obtain cores on Fraser Delta slope and Howe Sound to establish chronology of canyon-flushing turbidity currents as proxy for large submarine slides and facies analysis.
- Obtain water samples for measurement of suspended sediment concentration and calibration of VENUS ZAP and ADCP backscatter data in the Fraser Delta.
- Obtain multibeam sonar data on Fraser Delta submarine channel-fan system
- Obtain multibeam sonar data and grab samples in area of marine renewable energy potential, Boundary Pass.

Summary of Activities

1. *Positioning and Data Management*

All positioning for the scientific work was taken from the ship's DGPS receiving corrections from the Canadian Coast Guard's Richmond MF radiobeacon, providing typical accuracy of 10 metres or less.

The DGPS feed was logged continuously into a navigation file, regardless of activities. DGPS feeds were also provided to multibeam and chirp sonar systems and recorded in the data files. Event positions were recorded for all samples at the time the sampler impacted on the seabed, and for file start and end times of sonar surveys, using Regulus II software.

Navigation and sample data were archived in the Expedition Database (ED) where they can be viewed/downloaded/accessed via ED_Online at: http://gdr.nrcan.gc.ca/ed/index_e.php.

Figure 1 shows the locations of the four study areas, the Fraser Delta, Howe Sound, Boundary Pass and Boundary Bay.

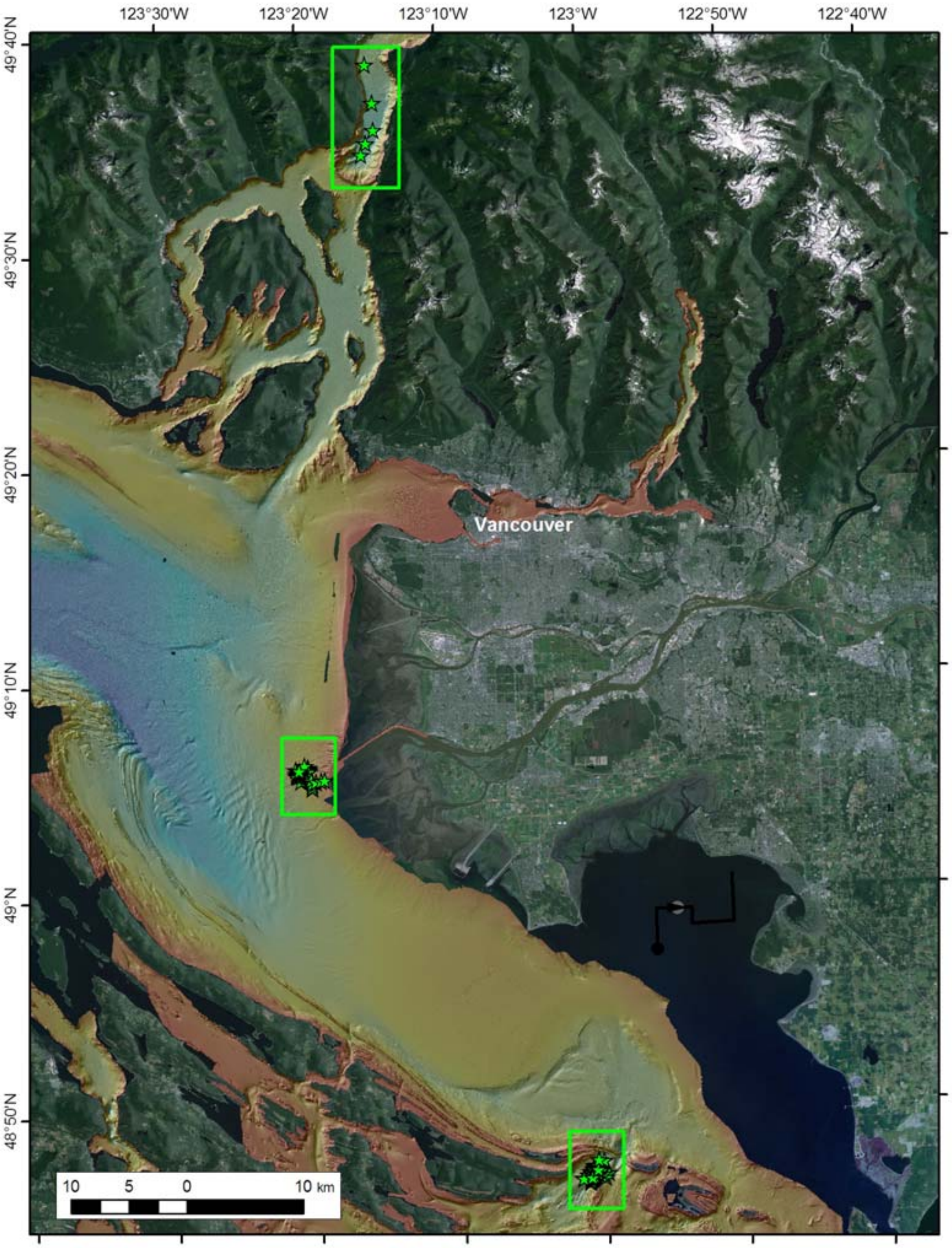

***Figure 1**. General locations covered by cruise 2011004PGC.*

2. Multibeam surveys

Multibeam surveys of two areas of the Strait of Georgia were completed:

a. Submarine channel - fan system off Main Channel of the Fraser River.
b. Subaqueous dune field in Boundary Pass

Surveys were conducted by Knut Lyngberg to hydrographic standards. Shaded relief images of the surveyed areas are provided in Figures 2 and 3.

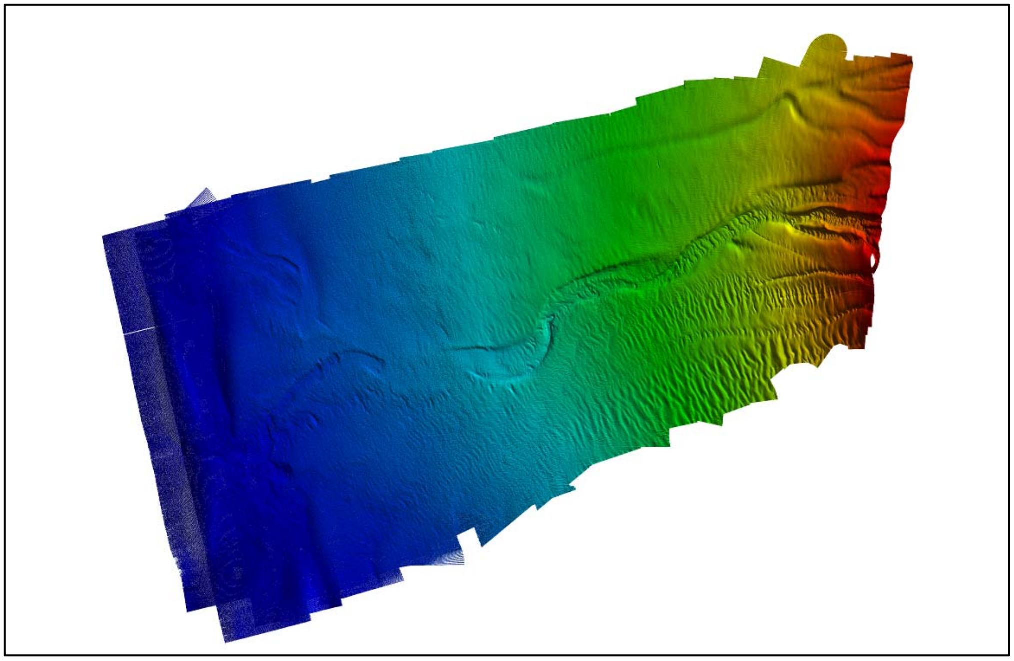

Figure 2. *Shaded relief image of Fraser submarine channel- fan system completed Monday August 22, 2011. Water depths range from approx 20 m (red) to 265 m (blue). Image length approximately 7.7km.*

The new survey of the submarine channel – fan system was conducted after the extended river freshet period of June and early July 2011 to examine if there were any major morphological changes compared to the previous year. No major changes were noted, although the survey could not include the shallowest water areas of the delta slope. The main channel continues to be incised by a thalweg emanating from the southern tributary system that has developed since 2001 (Hill, 2012).

The high quality bathymetric data provides interesting new insight into the sediment waves south of the main submarine channel. The clearly bifurcating planform is well imaged and the small gullies crossing the wave field are characterized by smoother margins that may be incipient levees. Piston core samples from both waves and channel margins were taken to determine if there were any sedimentological differences.

The upper slope in this region was also characterized by curious linear features that seem to define shallow topographic depressions between better formed gully systems. The origin of these features is unclear but their location close to the VENUS 2008 DDL site suggests that they may be associated with hyperpycnal flows.

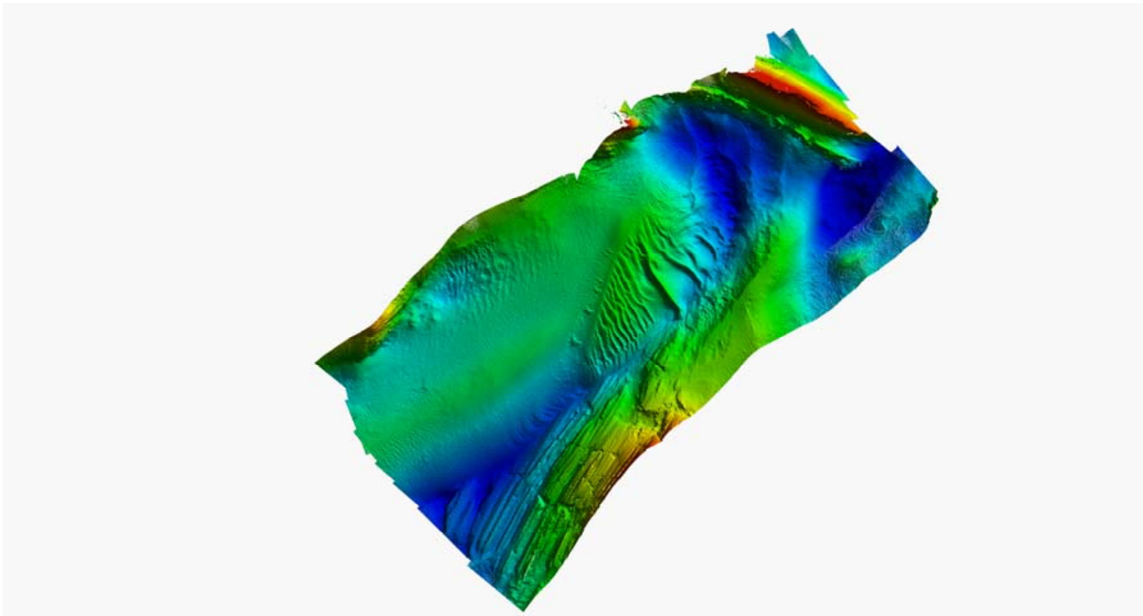

Figure 3*. Shaded relief image of Boundary Pass subaqueous dune field completed Tuesday August 23, 2011. Water depths range from 60 m (red) to 265 m (blue). Image length approx. 5.8 km.*

The Boundary Pass survey contributes an eighth survey to the suite of surveys being used by S. Mullan in a study of subaqueous dune stability. The dune field shows a similar overall pattern of variably scaled dunes as previous surveys.

Chirp sonar profiles were run at the same time as the multibeam survey and are included in the 2011004PGC data archive.

3. *Submarine Slide Chronology, Fraser Submarine Channel and Fan*

Twenty piston cores were obtained on the levee of the submarine channel off Main Channel in an effort to document the chronology of gravity flow deposits emanating from the mouth of the Fraser River (Figure 4). Cores were positioned using archive high resolution seismic records and new chirp sonar data from this cruise.

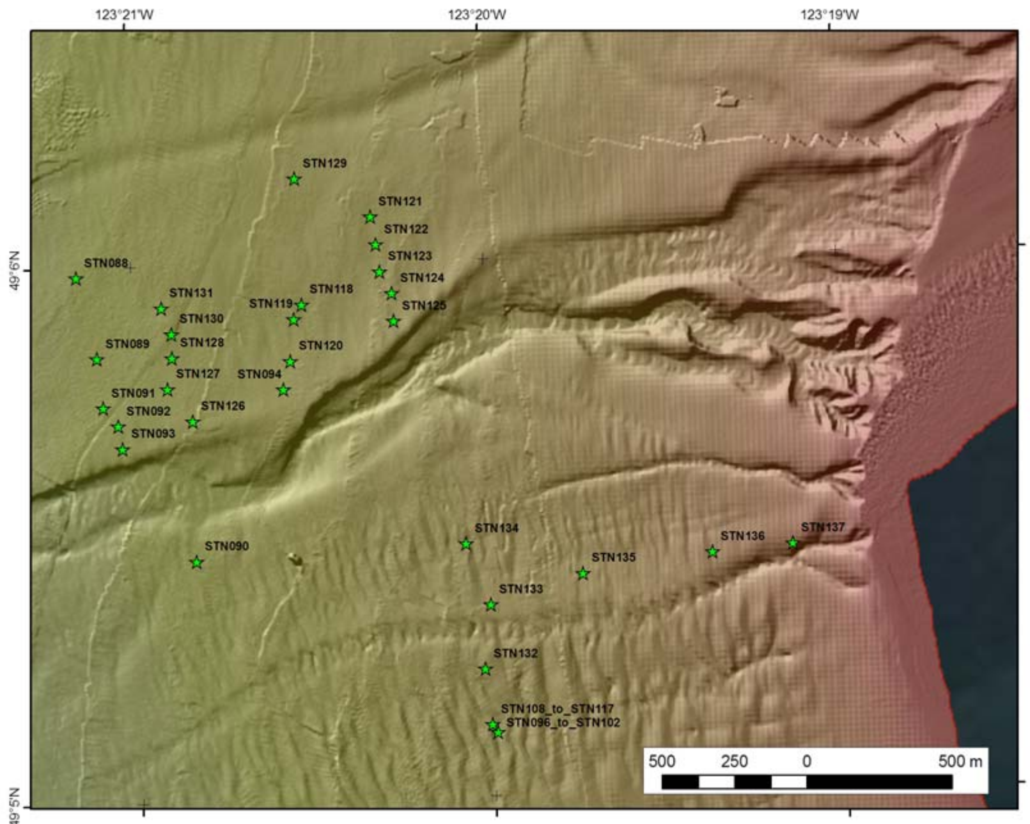

Figure 4. *Sample locations in the area of the Fraser submarine channel.*

Initial observations indicate that the levees consist of a sandy basal unit and an upper muddy unit (Figure 5), reflecting the short history of levee construction. Typical thickness to the lower sandy unit was 3 to 5 m, so coring was generally limited to 20ft barrels.

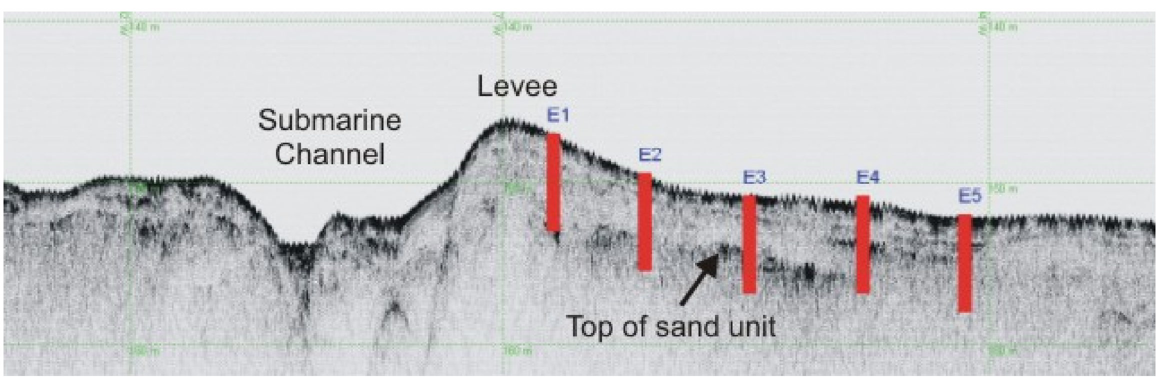

Figure 5. *Chirp sonar profile collected on the cruise showing typical levee relief and interpretation of sediment units.*

4. *Marine Renewable Energy Site Characterization Study – Boundary Pass*

A set of 87 grab samples were obtained for grain size analysis of a representative suite of the bottom sediments in the dune field (Fig. 6; Annex 1). Most of the samples on the active dune consisted of coarse sand and fine gravel (Fig. 7), which was most successfully sampled by the Shipek grab. Surprisingly, when the IKU grab was used at these sites, the grab did not trigger. The more eroded areas of the seafloor could not be sampled by the Shipek and were successfully sampled with the IKU, yielding poorly sorted gravel with a cobble lag (Fig. 8).

5. *Water Sampling to Validate VENUS Delta Dynamics Laboratory Acoustic Backscatter Measurements*

The IOS rosette sampling system was utilized to obtain CTD profiles and water samples at a single location above the VENUS Delta Dynamics Laboratory bottom platform. The VENUS platform is instrumented with a 300kHz Acoustic Doppler Current Profiler and an ASL Zooplankton Acoustic Profiler. These instruments measure acoustic backscatter which can be used as a proxy for turbidity or suspended sediment concentration. Calibration of these measurements are difficult as the backscatter depends on distance from the sensor, suspended sediment concentration and grain size. The rosette sample station information is summarized in Annex 3.

The CTD data files are included in *Data Set 1 - CTD*. The Seabird-9 instrument records raw files in hexadecimal format (2011004PGC-0xxx.hex), where xxx = the Station Number. These are then converted into engineering units in separate files (2011004PGC-0xxx.cnv). Graphic plots of the CTD data are presented in Annex 4. Water samples were stored in plastic bottles and returned to the laboratory, where they were filtered on 0.6 micron Avantec GF-75 glass fiber filters to obtain suspended sediment concentrations (Annex 5).

6. *Equipment Performance*

All equipment functioned normally, with no issues identified.

7. *References*

HILL, P.R., 2012. Changes in submarine channel morphology and strata development from repeat multibeam surveys in the Fraser River delta, western Canada. In: Sediments, Morphology and Sedimentary Processes on Continental Shelves. Li, M.Z., Sherwood, C.R. and Hill, P.R. (Eds.), Int. Assoc. Sedimentol. Spec. Publ. 44, 47–70.

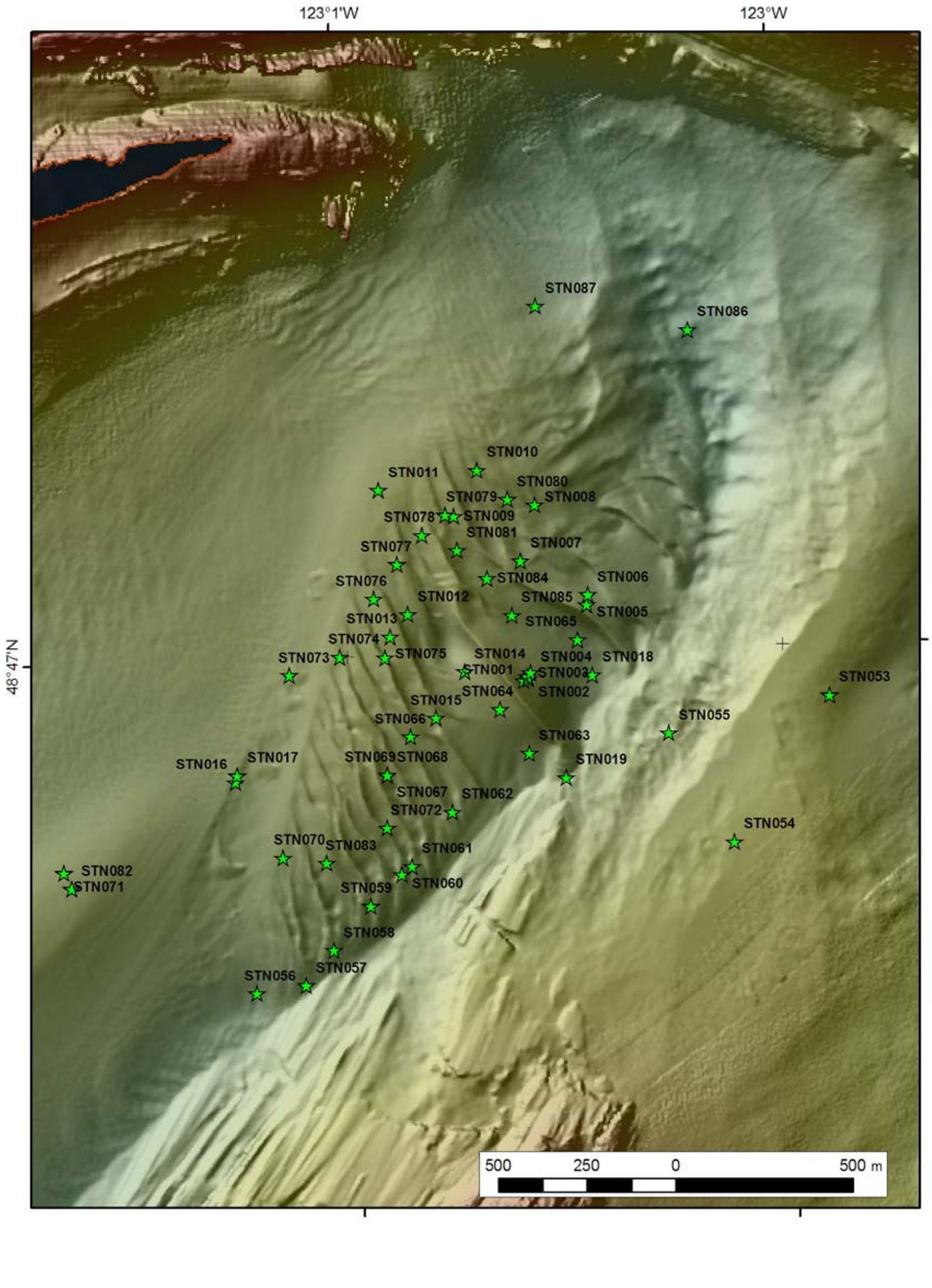

Figure 6. Grab sample locations, Boundary Pass area, Aug 21-23, 2011.

Figure 7. Typical samples from the Boundary Pass subaqueous dune field(photo: Sean Mullan).

Figure 8. Typical cobble lag from the eroded seafloor of Boundary Pass (photo: Sean Mullan).

Annex 1

Sample Locations

2011004PGC - Sample Stations						
Day	Time (UTC)	Latitude	Longitude	Station #	Type	Depth (m)
234	0204	48.782602	-123.009943	STN001	shipek	168.8
234	0224	48.782641	-123.009755	STN002	shipek	167.6
234	0233	48.782686	-123.009774	STN003	shipek	167.6
234	0244	48.782798	-123.009662	STN004	shipek	167.2
234	0300	48.784471	-123.007428	STN005	shipek	188.8
234	0307	48.784723	-123.007389	STN006	shipek	186.4
234	0319	48.785626	-123.009915	STN007	shipek	180.0
234	0339	48.787037	-123.009307	STN008	shipek	181.2
234	0402	48.786813	-123.012426	STN009	shipek	168.0
234	0415	48.787958	-123.011482	STN010	shipek	172.0
234	0428	48.787527	-123.015277	STN011	shipek	172.4
234	0440	48.784364	-123.014295	STN012	shipek	169.2
234	0448	48.783813	-123.015015	STN013	shipek	170.0
234	0504	48.782871	-123.012189	STN014	shipek	180.4
234	0516	48.781717	-123.013344	STN015	shipek	174.0
234	0530	48.780245	-123.021108	STN016	shipek	185.6
234	0539	48.780416	-123.021026	STN017	shipek	185.2
234	0558	48.782687	-123.007300	STN018	shipek	200.0
234	0616	48.780113	-123.008429	STN019	shipek	190.0
234	2207	48.794442	-123.009747	STN020	shipek	238.8
234	2233	48.792560	-123.015836	STN021	shipek	238.8
234	2239	48.791690	-123.015958	STN022	shipek	238.8
234	2256	48.788628	-123.014751	STN023	shipek	238.8
234	2310	48.787622	-123.017018	STN024	shipek	181.2
234	2326	48.787100	-123.023900	STN025	shipek	176.8
234	2345	48.784633	-123.034601	STN026	shipek	196.0
235	0000	48.784375	-123.035427	STN027	shipek	196.0
235	0023	48.780809	-123.028791	STN028	shipek	190.4

235	0040	48.778297	-123.026045	STN029	shipek	183.0
235	0100	48.778289	-123.022294	STN030	shipek	192.4
235	0117	48.782622	-123.020996	STN031	shipek	184.8
235	0130	48.785345	-123.017997	STN032	shipek	177.6
235	0201	48.783691	-123.000419	STN033	shipek	162.8
235	0214	48.782687	-123.005898	STN034	shipek	194.8
235	0220	48.782693	-123005087	STN035	shipek	194.8
235	0235	48.781437	-123.017071	STN036	shipek	172.4
235	0249	48.784903	-123.012628	STN037	shipek	172.0
235	0306	48.784115	-123.011789	STN038	shipek	168.8
235	0332	48.782360	-123.002605	STN039	shipek	178.8
235	0349	48.784468	-123.001138	STN040	shipek	200.0
235	0403	48.784448	-123.004341	STN041	shipek	209.6
235	0421	48.786163	-123.006759	STN042	shipek	194.4
235	0436	48.785933	-123.007119	STN043	shipek	194.8
235	0447	48.785931	-123.005277	STN044	shipek	204.4
235	0503	48.792015	-123.006712	STN045	shipek	220.4
235	0518	48.793469	-123.006600	STN046	shipek	234.8
235	0551	48.788244	-123.006801	STN047	shipek	192.0
235	0559	48.787890	-123.005916	STN048	shipek	202.0
235	0609	48.789135	-123.007864	STN049	shipek	196.4
235	0624	48.790417	-123.008012	STN050	shipek	201.6
235	0631	48.790721	-123.007984	STN051	shipek	203.2
235	0643	48.790395	-123.005074	STN052	shipek	211.2
235	2300	48.781996	-122.998243	STN053	IKU	161.20
235	2326	48.778363	-123.002067	STN054	IKU	153.6
235	2350	48.781159	-123.004439	STN055	IKU	185.6
236	0115	48.774887	-123.020529	STN056	shipek	219.2
236	0137	48.775049	-123.018639	STN057	shipek	205.2
236	0153	48.775916	-123.017534	STN058	shipek	198.8
236	0207	48.777010	-123.016061	STN059	shipek	194.8
236	0243	48.777784	-123.014823	STN060	shipek	192.0
236	0252	48.777985	-123.014432	STN061	shipek	192.0
236	0303	48.779332	-123.012833	STN062	shipek	187.2
236	0314	48.780750	-123.009816	STN063	shipek	197.6
236	0325	48.781884	-123.010875	STN064	shipek	182.4

236	0336	48.783591	-123.007815	STN065	shipek	198
236	0352	48.781260	-123.014342	STN066	shipek	176.8
236	0400	48.780316	-123.015284	STN067	shipek	175.2
236	0410	48.780148	-123.016697	STN068	shipek	172
236	0416	48.779464	-123.018324	STN069	shipek	178.4
236	0439	48.778301	-123.019379	STN070	shipek	185.6
236	0453	48.778081	-123.027787	STN071	shipek	183.6
236	0511	48.778969	-123.015349	STN072	shipek	180.4
236	0524	48.782904	-123.018923	STN073	shipek	180.4
236	0536	48.783333	-123.016959	STN074	shipek	174.0
236	0546	48.783281	-123.015215	STN075	shipek	171.6
236	0559	48.784779	-123.015580	STN076	shipek	170.4
236	0609	48.785636	-123.014658	STN077	shipek	168
236	0617	48.786351	-123.013660	STN078	shipek	168
236	0628	48.786846	-123.012745	STN079	shipek	169.8
236	0642	48.787197	-123.010346	STN080	shipek	177.2
236	0656	48.785945	-123.012346	STN081	shipek	174.4
236	0749	48.777681	-123.027511	STN082	shipek	183.6
236	0807	48.778132	-123.017704	STN083	shipek	185.2
236	0830	48.785203	-123.011221	STN084	shipek	178.8
236	0847	48.784260	-123.010315	STN085	shipek	184.8
236	0918	48.791345	-123.003253	STN086	shipek	250
236	0939	48.792065	-123.009049	STN087	shipek	214
236	1606	49.099714	-123.352569	STN088	Piston core	154.8
236	1734	49.097188	-123.351667	STN089	Piston core	155.6
236	2020	49.090828	-123.347210	STN090	Piston core	154.4
236	2134	49.095653	-123.351437	STN091	Piston core	155.2
236	2232	49.095085	-123.350754	STN092	Piston core	152.4
236	2319	49.094380	-123.350558	STN093	Piston core	150.0
237	0044	49.096102	-123.342888	STN094	Piston core	133.2
237	0300	49.085408	-123.332985	STN095	Rosette	118.4
237	0339	49.085307	-123.333179	STN096_surface1	Rosette	118.8
237	0346	49.085242	-123.332740	STN096_bottom	Rosette	118.8
237	0353	49.085433	-123.332699	STN096_surface2	Rosette	119.2
237	0438	49.085304	-123.333181	STN097_surface1	Rosette	118.4
237	0441	49.085474	-123.333152	STN097_bottom	Rosette	118.4

237	0448	49.085617	-123.332671	STN097_surface2	Rosette	118.4
237	0532	49.085505	-123.332728	STN098_surface1	Rosette	118.8
237	0537	49.085145	-123.332877	STN098_bottom	Rosette	118.8
237	0541	49.085164	-123.332935	STN098_surface2	Rosette	118.8
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237	0621	49.085485	-123.332738	STN099_bottom	Rosette	118.8
237	0628	49.085261	-123.332665	STN099_surface2	Rosette	118.8
237	0709	49.085437	-123.333111	STN100_surface1	Rosette	118.4
237	0713	49.085521	-123.332773	STN100_bottom	Rosette	119.2
237	0719	49.085578	-123.332955	STN100_surface2	Rosette	118.4
237	0751	49.085305	-123.332818	STN101_surface1	Rosette	117.6
237	0754	49.085507	-123.332587	STN101_bottom	Rosette	119.2
237	0800	49.085328	-123.332704	STN101_surface2	Rosette	118.4
237	0824	49.085500	-123.333190	STN102_surface1	Rosette	120.4
237	0827	49.085285	-123.333320	STN102_bottom	Rosette	120
237	0833	49.085174	-123.332860	STN102_surface2	Rosette	120.4
237	1741	49.593950	-123.241310	STN103	Piston core	282.0
237	1922	49.583700	-123.250570	STN104	Piston core	283.2
237	2035	49.575138	-123.256344	STN105	Piston core	283.6
237	2146	49.614973	-123.241598	STN106	Piston core	276
237	2237	49.644907	-123.249134	STN107	Piston core	238.8
238	0700	49.085546	-123.333423	STN108_surface1	Rosette	120.4
238	0705	49.085247	-123.333044	STN108_bottom	Rosette	120.4
238	0712	49.085430	-123.332802	STN108_surface2	Rosette	119.6
238	0743	49.085318	-123.332883	STN109_surface1	Rosette	120.4
238	0746	49.085474	-123.333405	STN109_bottom	Rosette	120.8
238	0755	49.085320	-123.332908	STN109_surface2	Rosette	118.8
238	0824	49.085622	-123.333391	STN110_surface1	Rosette	119.6
238	0826	49.085491	-123.332879	STN110_bottom	Rosette	119
238	0833	49.084589	-123.332779	STN110_surface2	Rosette	118.8
238	0919	49.085399	-123.332334	STN111_surface1	Rosette	117.2
238	0922	49.085663	-123.332692	STN111_bottom	Rosette	119.2
238	0928	49.085327	-123.333113	STN111_surface2	Rosette	119.2
238	0958	49.085548	-123.332995	STN112_surface1	Rosette	120.4
238	1000	49.085587	-123.333059	STN112_bottom	Rosette	120.8
238	1007	49.085660	-123.333357	STN112_surface2	Rosette	120.4

238	1039	49.085251	-123.332281	STN113_surface1	Rosette	116.4
238	1042	49.084751	-123.332064	STN113_bottom	Rosette	116.8
238	1049	49.085151	-123.333281	STN113_surface2	Rosette	121.2
238	1125	49.085453	-123.332739	STN114_surface1	Rosette	116.4
238	1128	49.085324	-123.332267	STN114_bottom	Rosette	118
238	1134	49.085183	-123.332632	STN114_surface2	Rosette	118.8
238	1204	49.085325	-123.333048	STN115_surface1	Rosette	120
238	1206	49.085372	-123.333432	STN115_bottom	Rosette	119.6
238	1215	49.085343	-123.333130	STN115_surface2	Rosette	119.6
238	1236	49.085217	-123.332882	STN116_surface1	Rosette	119.6
238	1238	49.085416	-123.332693	STN116_bottom	Rosette	119.2
238	1247	49.085300	-123.332733	STN116_surface2	Rosette	119.2
238	1309	49.085229	-123.332968	STN117_surface1	Rosette	117.6
238	1310	49.085295	-123.332598	STN117_bottom	Rosette	117.2
238	1318	49.085286	-123.332854	STN117_surface2	Rosette	117.2
238	1428	49.098720	-123.341950	STN118	Piston core	131.6
238	1507	49.098272	-123.342322	STN119	Piston core	133.2
238	1551	49.096980	-123.342534	STN120	Piston core	131.6
238	1637	49.101393	-123.338596	STN121	Piston core	121.6
238	1723	49.100525	-123.338357	STN122	Piston core	121.6
238	1756	49.099684	-123.338210	STN123	Piston core	120
238	1911	49.099003	-123.337658	STN124	Piston core	119.6
238	1947	49.098141	-123.337604	STN125	Piston core	116.8
238	2020	49.095183	-123.347228	STN126	Piston core	142.5
238	2045	49.096201	-123.348369	STN127	Piston core	147.7
238	2123	49.097161	-123.348133	STN128	Piston core	148.0
238	2240	49.102633	-123.342121	STN129	Piston core	133.6
239	107	49.097904	-123.348132	STN130	Piston core	149.2
239	0148	49.098718	-123.348585	STN131	Piston core	148.4
239	1523	49.087270	-123.333694	STN132	Piston core	113.2
239	1606	49.089264	-123.333364	STN133	Piston core	111.2
239	1701	49.091172	-123.334449	STN134	Piston core	112.8
239	1745	49.090161	-123.328962	STN135	Piston core	94.0
239	1818	49.090730	-123.322816	STN136	Piston core	62.0
239	1913	49.090934	-123.319019	STN137	Piston core	33.6

Annex 2

3.5 kHz Chirp Sonar Profiles

2011004PGC - 3.5 kHz chirp profiles				
Day	Time (UTC)	Latitude	Longitude	Station #
234	0911	49.06642	-123.398650	SOL0911
234	0926	49.097360	-123.40972	EOL0911_SOL0927
234	0943	49.06193	-123.392115	EOL0927_SOL0943
234	1002	49.1021	-123.40288	EOL0943
234	1008	49.09241	-123.395444	SOL1008
234	1019	49.066933	-123.386575	EOL1008_SOL1019
234	1037	49.10119	-123.394	EOL1019_SOL1037
234	1054	49.068967	-123.378899	EOL1037_SOL1054
234	1111	49.10209	-123.386153	EOL1054_SOL1111
234	1129	49.070627	-123.371282	EOL1111_SOL1129
234	1146	49.10568	-123.377312	EOL1129_SOL1149
234	1305	49.078531	-123.351016	EOL1149_SOL_1304
234	1346	49.106794	-123.347568	1304
234	1435	49.091867	-123.334319	1304
234	1519	49.106628	-123.331400	1304
234	1536	49.084448	-123.327878	EOL1304_SOL_1535
234	1639	49.096217	-123.322323	1535
234	1751	49.113733	-123.316611	1751
235	0729	48.76106	-123.031094	SOL_0729
235	0752	48.796974	-122.986237	EOL_0729_SOL_0752
235	0839	48.79797	-122.98752	EOL_0752_SOL_0839
235	0902	48.76477	-123.041742	0839
235	0954	48.770039	-123.062376	EOL_0839
235	1001	48.7737954	-123.06438	SOL_1001
235	1036	48.775886	-123.046258	1001
235	1130	48.757976	-123.031015	EOL_1001
236	1156	49.054401	-123.311059	1156
236	1233	49.090098	-123.331270	1232-Line_H
236	1248	49.090098	-123.331270	1232-1248-Line_H
236	1309	49.085867	-123.351223	1308-SOL
236	1322	49.097774	-123.365741	1308-EOL_1322-SOL

236	1340	49.089220	-123.369570	1322-EOL_1340-SOL
236	1348	49.086647	-123.367924	1348-EOL_1357_SOL
236	1409	49.085179	-213.386324	1357-EOL_1409_EOS
236	1925	49.100809	-123.354248	1925-SOL
236	1956	49.090828	-123.347210	1925-EOL
237	0912	49.080875	-123.329852	0912_SOL
237	0938	49.107899	-123.341601	0912_EOL_0938_SOL
237	1006	49.082785	-123.334259	0938_EOL_1006_SOL
237	1034	49.0106758	-123.347446	1006_EOL_1034_SOL
237	1055	49.082273	-123.339274	1034_EOL_1055_SOL
237	1125	49.10682	-123.352808	1055_EOL_1125_SOL
237	1149	49.081615	-123.344856	1125_EOL_1149_SOL
237	1228	49.105815	-123.357407	1149_EOL_1228_SOL
237	1251	49.078446	-123.348829	1228_EOL_1252_SOL
237	1323	49.095277	-123.332325	1252_EOL
237	1326	49.095182	-123.335123	1326_SOL
237	1352	49.089566	-123.362419	1326_EOL
238	0122	49.638107	-123.234241	0122_SOL
238	0137	49.650992	-123.250441	0122_EOL_0137_SOL
238	0316	49.547704	-123.278837	0137_EOL
239	1406	49.083131	-123.339560	SH_35_1406_SOL
239	2138	48.951780	-122.933949	BB_35_2137_SOL
239	2210	48.987240	-122.933884	BB_35_2137_EOL_2210_SOL
239	2244	48.985507	-122.895341	BB_35_2210_EOL_2244_SOL
239	2310	48.973321	-122.892037	BB_2244_EOL_2309_SOL
239	2347	48.974336	-122.841862	BB_2309_EOL_2347_SOL
240	0025	49.006620	-122.843108	BB_2347_EOL

Annex 3

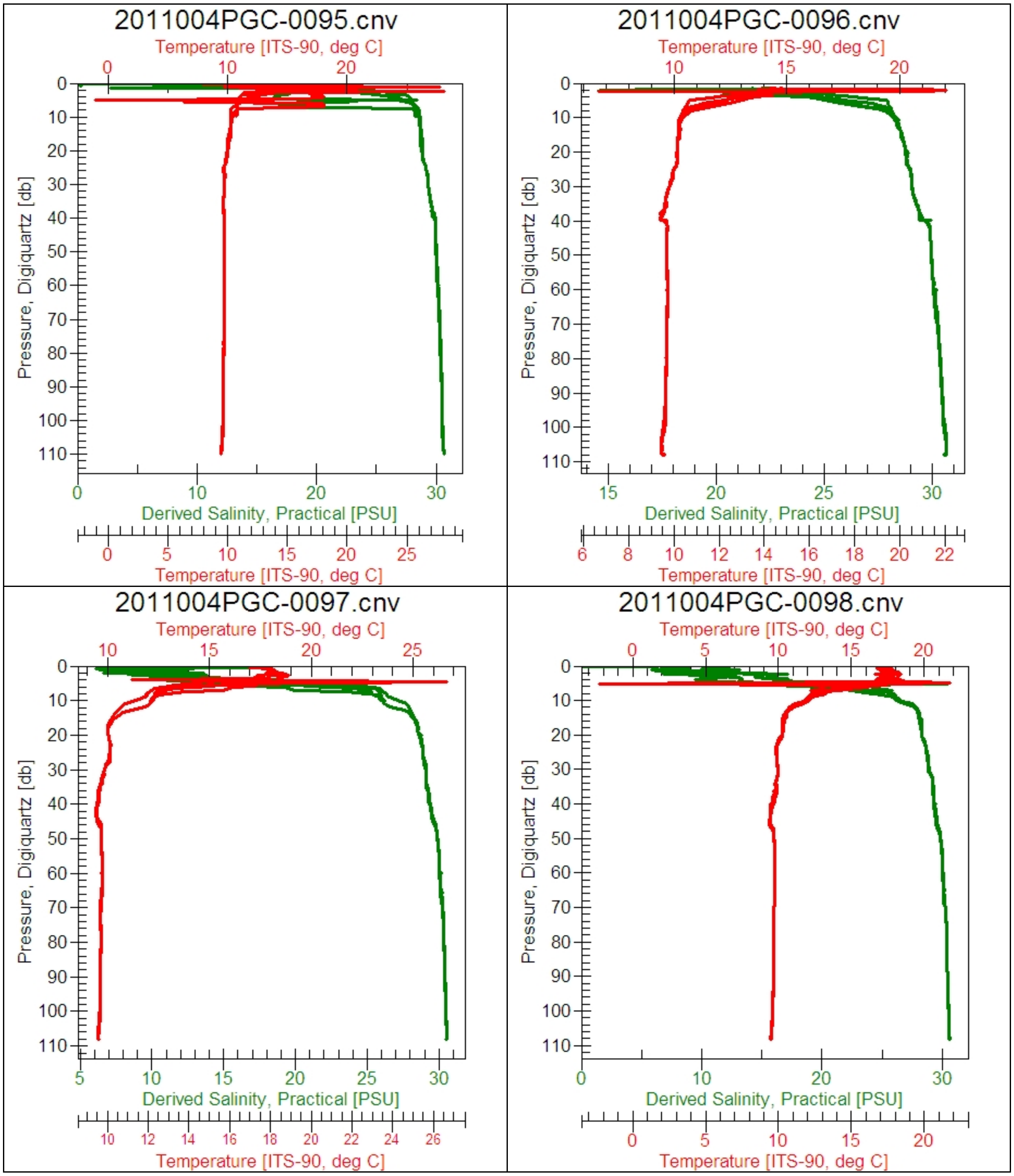
CTD (Rosette) Casts

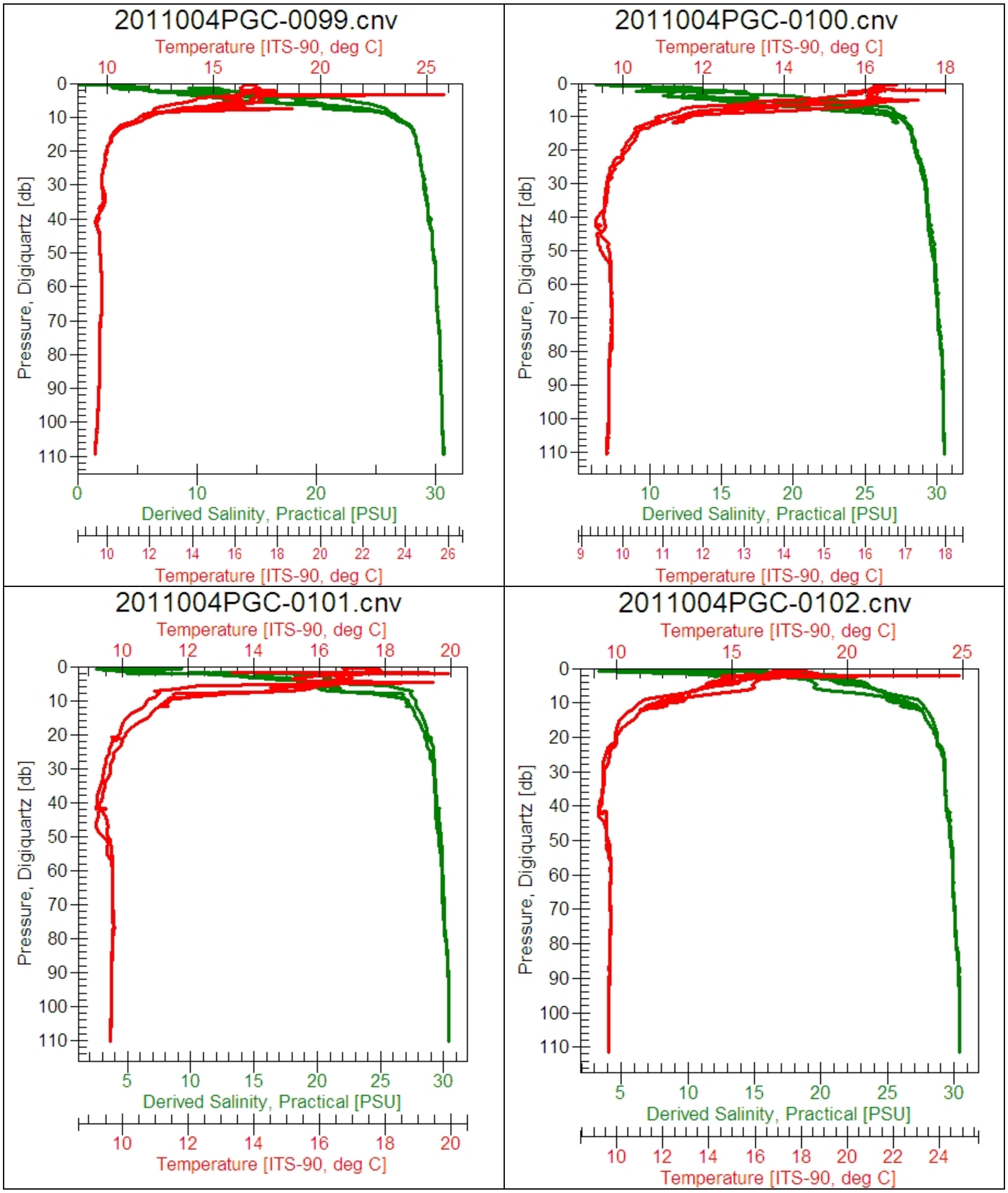
237	0339	49.085307	-123.333179	STN096_surface1	Rosette	118.8
237	0346	49.085242	-123.332740	STN096_bottom	Rosette	118.8
237	0353	49.085433	-123.332699	STN096_surface2	Rosette	119.2
237	0438	49.085304	-123.333181	STN097_surface1	Rosette	118.4
237	0441	49.085474	-123.333152	STN097_bottom	Rosette	118.4
237	0448	49.085617	-123.332671	STN097_surface2	Rosette	118.4
237	0532	49.085505	-123.332728	STN098_surface1	Rosette	118.8
237	0537	49.085145	-123.332877	STN098_bottom	Rosette	118.8
237	0541	49.085164	-123.332935	STN098_surface2	Rosette	118.8
237	0617	49.085525	-123.333132	STN099_surface1	Rosette	118.8
237	0621	49.085485	-123.332738	STN099_bottom	Rosette	118.8
237	0628	49.085261	-123.332665	STN099_surface2	Rosette	118.8
237	0709	49.085437	-123.333111	STN100_surface1	Rosette	118.4
237	0713	49.085521	-123.332773	STN100_bottom	Rosette	119.2
237	0719	49.085578	-123.332955	STN100_surface2	Rosette	118.4
237	0751	49.085305	-123.332818	STN101_surface1	Rosette	117.6
237	0754	49.085507	-123.332587	STN101_bottom	Rosette	119.2
237	0800	49.085328	-123.332704	STN101_surface2	Rosette	118.4
237	0824	49.085500	-123.333190	STN102_surface1	Rosette	120.4
237	0827	49.085285	-123.333320	STN102_bottom	Rosette	120
237	0833	49.085174	-123.332860	STN102_surface2	Rosette	120.4
238	0700	49.085546	-123.333423	STN108_surface1	Rosette	120.4
238	0705	49.085247	-123.333044	STN108_bottom	Rosette	120.4
238	0712	49.085430	-123.332802	STN108_surface2	Rosette	119.6
238	0743	49.085318	-123.332883	STN109_surface1	Rosette	120.4
238	0746	49.085474	-123.333405	STN109_bottom	Rosette	120.8
238	0755	49.085320	-123.332908	STN109_surface2	Rosette	118.8
238	0824	49.085622	-123.333391	STN110_surface1	Rosette	119.6
238	0826	49.085491	-123.332879	STN110_bottom	Rosette	119
238	0833	49.084589	-123.332779	STN110_surface2	Rosette	118.8
238	0919	49.085399	-123.332334	STN111_surface1	Rosette	117.2

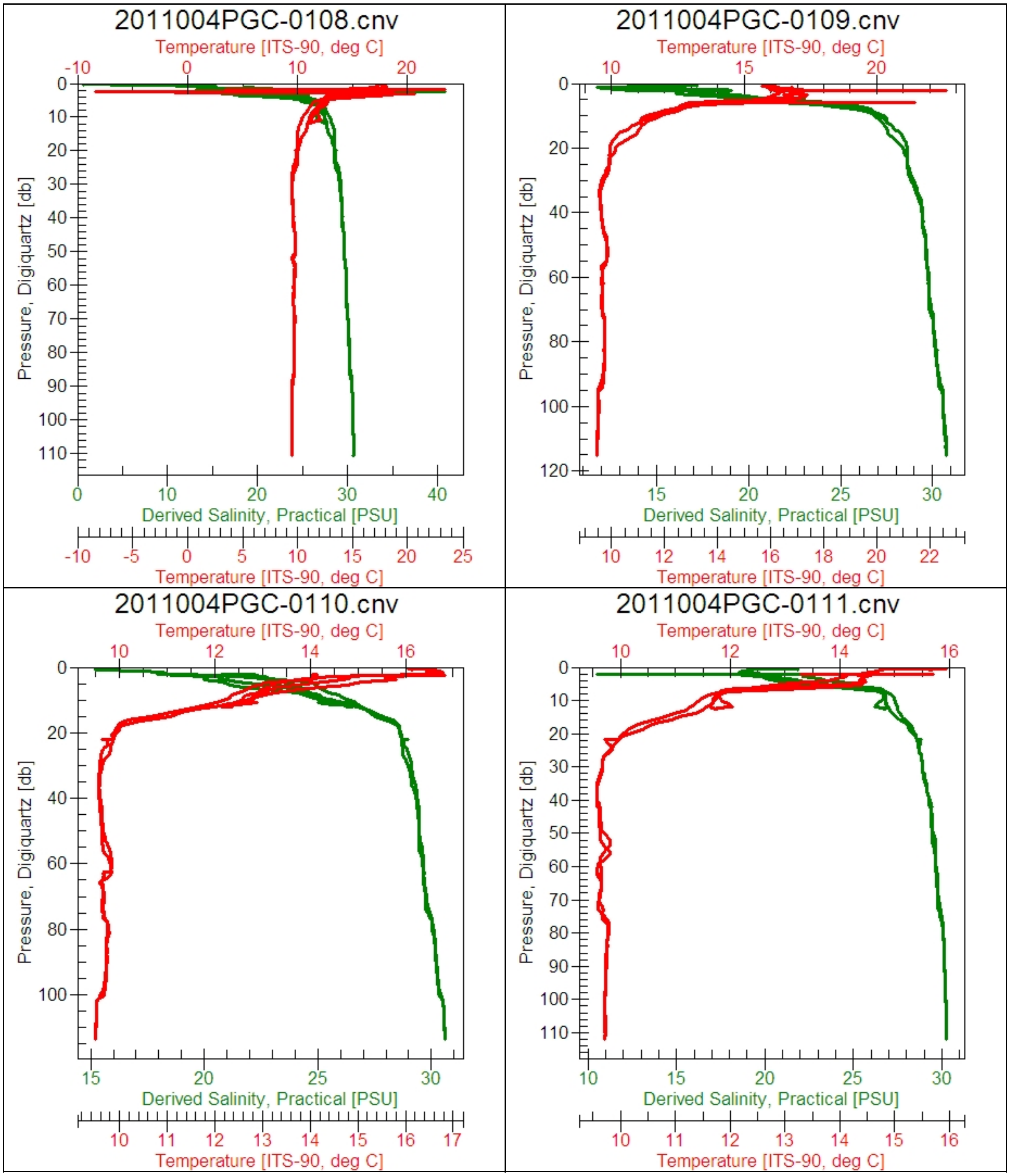
238	0922	49.085663	-123.332692	STN111_bottom	Rosette	119.2
238	0928	49.085327	-123.333113	STN111_surface2	Rosette	119.2
238	0958	49.085548	-123.332995	STN112_surface1	Rosette	120.4
238	1000	49.085587	-123.333059	STN112_bottom	Rosette	120.8
238	1007	49.085660	-123.333357	STN112_surface2	Rosette	120.4
238	1039	49.085251	-123.332281	STN113_surface1	Rosette	116.4
238	1042	49.084751	-123.332064	STN113_bottom	Rosette	116.8
238	1049	49.085151	-123.333281	STN113_surface2	Rosette	121.2
238	1125	49.085453	-123.332739	STN114_surface1	Rosette	116.4
238	1128	49.085324	-123.332267	STN114_bottom	Rosette	118
238	1134	49.085183	-123.332632	STN114_surface2	Rosette	118.8
238	1204	49.085325	-123.333048	STN115_surface1	Rosette	120
238	1206	49.085372	-123.333432	STN115_bottom	Rosette	119.6
238	1215	49.085343	-123.333130	STN115_surface2	Rosette	119.6
238	1236	49.085217	-123.332882	STN116_surface1	Rosette	119.6
238	1238	49.085416	-123.332693	STN116_bottom	Rosette	119.2
238	1247	49.085300	-123.332733	STN116_surface2	Rosette	119.2
238	1309	49.085229	-123.332968	STN117_surface1	Rosette	117.6
238	1310	49.085295	-123.332598	STN117_bottom	Rosette	117.2
238	1318	49.085286	-123.332854	STN117_surface2	Rosette	117.2

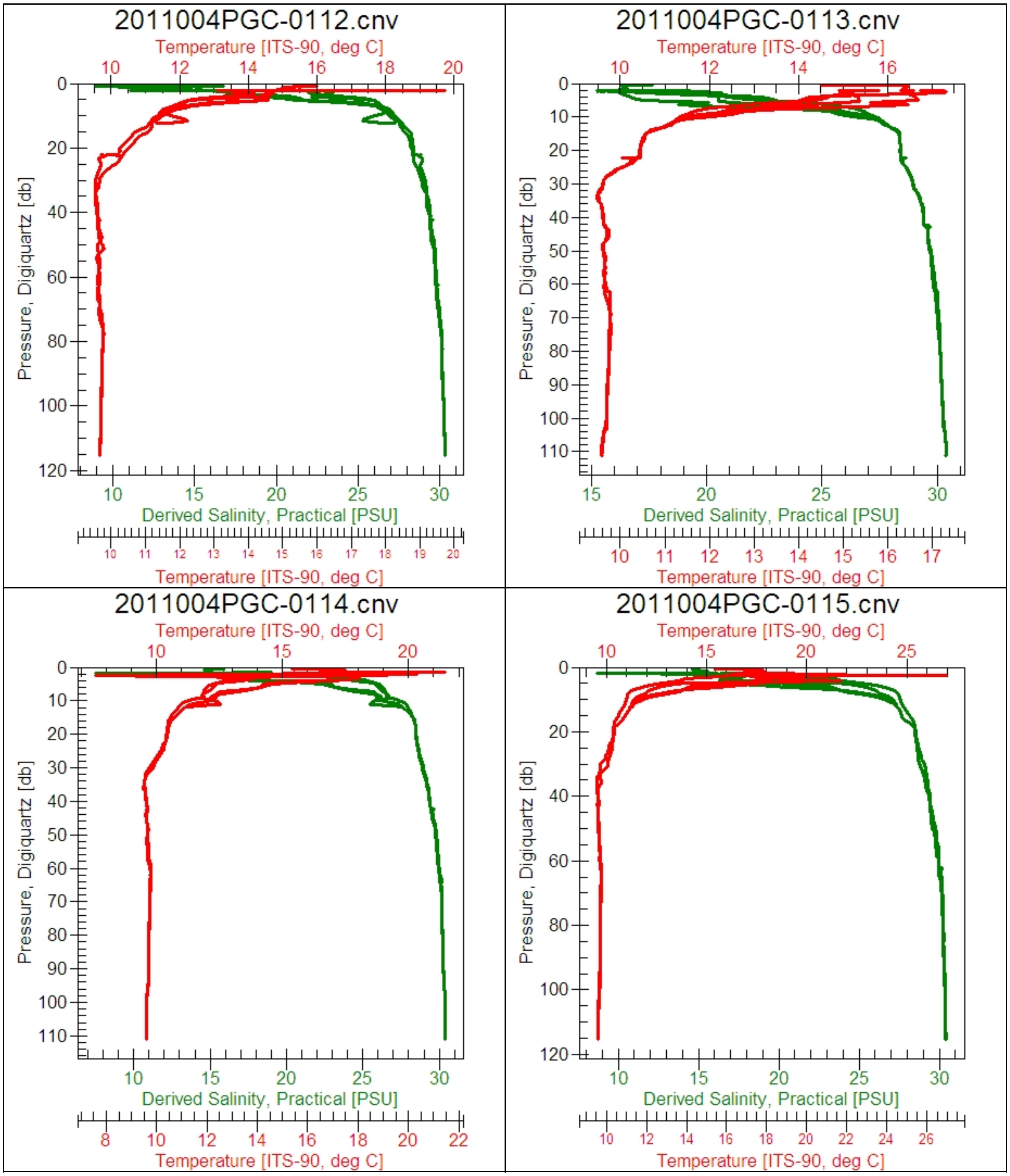
Annex 4

CTD Plots

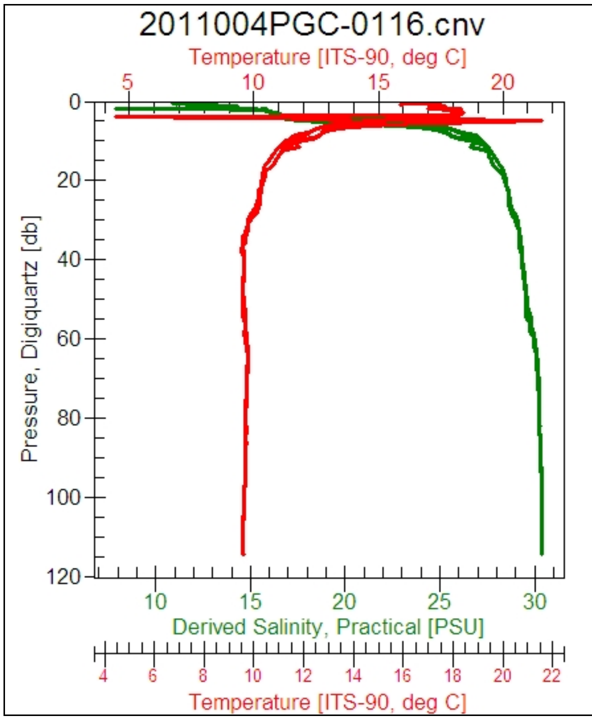



2011004PGC-0099.cnv
2011004PGC-0100.cnv
2011004PGC-0101.cnv
2011004PGC-0102.cnv
Temperature [ITS-90, deg C]
Pressure, Digiquartz [db]
Derived Salinity, Practical [PSU]

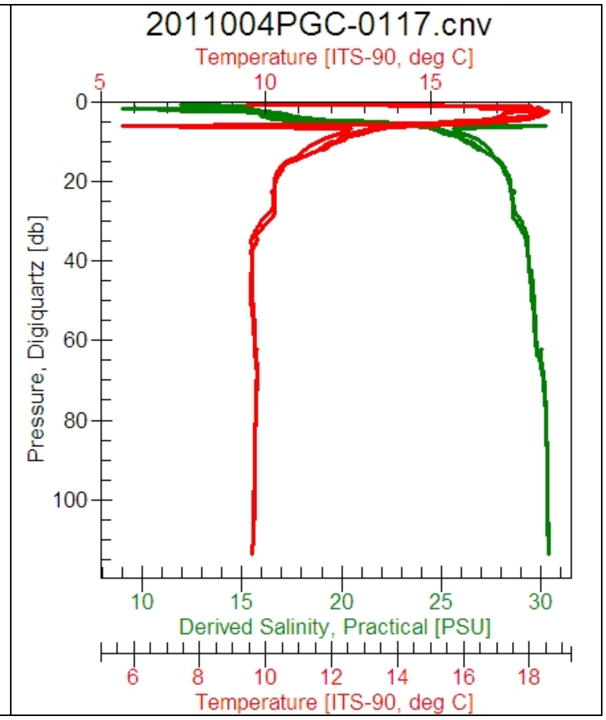

2011004PGC-0108.cnv
Temperature [ITS-90, deg C]
Pressure, Digiquartz [db]
Derived Salinity, Practical [PSU]
Temperature [ITS-90, deg C]
2011004PGC-0109.cnv
Temperature [ITS-90, deg C]
Pressure, Digiquartz [db]
Derived Salinity, Practical [PSU]
Temperature [ITS-90, deg C]
2011004PGC-0110.cnv
Temperature [ITS-90, deg C]
Pressure, Digiquartz [db]
Derived Salinity, Practical [PSU]
Temperature [ITS-90, deg C]
2011004PGC-0111.cnv
Temperature [ITS-90, deg C]
Pressure, Digiquartz [db]
Derived Salinity, Practical [PSU]
Temperature [ITS-90, deg C]



2011004PGC-0112.cnv
Temperature [ITS-90, deg C]
Pressure, Digiquartz [db]
Derived Salinity, Practical [PSU]
Temperature [ITS-90, deg C]
2011004PGC-0113.cnv
Temperature [ITS-90, deg C]
Pressure, Digiquartz [db]
Derived Salinity, Practical [PSU]
Temperature [ITS-90, deg C]
2011004PGC-0114.cnv
Temperature [ITS-90, deg C]
Pressure, Digiquartz [db]
Derived Salinity, Practical [PSU]
Temperature [ITS-90, deg C]
2011004PGC-0115.cnv
Temperature [ITS-90, deg C]
Pressure, Digiquartz [db]
Derived Salinity, Practical [PSU]
Temperature [ITS-90, deg C]



2011004PGC-0116.cnv
Temperature [ITS-90, deg C]
Pressure, Digiquartz [db]
Derived Salinity, Practical [PSU]
Temperature [ITS-90, deg C]



2011004PGC-0117.cnv
Temperature [ITS-90, deg C]
Pressure, Digiquartz [db]
Derived Salinity, Practical [PSU]
Temperature [ITS-90, deg C]

Annex5

Suspended Sediment Concentrations

201004PGC Water Samples									
Date filtered	**Time Filtered**	**Stn**	**Water Depth**	**Qty filtered**	**Pre-Weigth**	**Post-weigth**	**Concentration**	**Average [ ] from duplicate**	**Comment**
			m	**ml**	**g**	**g**	**g/ml**	**g/ml**	
30/08/2011	13:24	095A	SURFACE1	1990	0.0925	0.1052	8.99497E-06	7.76065E-06	**filtered with Gwyn's filter batch**
		095A	SURFACE1		0.0935	0.0987			
		095B	SURFACE2	1900	0.0935	0.1027	6.52632E-06		
		095B	SURFACE2		0.0925	0.0957			
		095A	20-1	1830	0.0925	0.0965	2.18579E-06	2.55566E-06	
		095A	20-2	1880	0.0933	0.0988	2.92553E-06		small amount of water leaked (lid crack)
		095A	40-1	1670	0.0925	0.1112	1.11976E-05	6.94027E-06	
		095B	40-2	1640	0.0932	0.0976	2.68293E-06		
		095A	60-1	1950	0.0922	0.1066	7.38462E-06	8.52837E-06	lid crack
		095B	60-2	1830	0.0937	0.1114	9.67213E-06		
	15:18	095A	80-1	1430	0.0930	0.0968	2.65734E-06	4.11937E-06	
		095B	80-2	1505	0.0914	0.0998	5.5814E-06		
		095A	BOTTOM1	1340	0.0936	0.0984	7.31343E-06	5.27603E-06	same bottom
		095A	BOTTOM1		0.0924	0.0974			
		095B	BOTTOM2	1760	0.0941	0.0998	3.23864E-06		
		096A	SURFACE1	1840	0.0916	0.0961	2.44565E-06	2.51816E-06	
		096B	SURFACE2	1930	0.0928	0.0978	2.59067E-06		
		096A	20-1	1890	0.0939	0.0998	3.12169E-06	3.06344E-06	
		096B	20-2	1930	0.0943	0.1001	3.00518E-06		
		096A	40-1	1670	0.0938	0.0994	3.35329E-06	2.71726E-06	
		096B	40-2	1970	0.0915	0.0956	2.08122E-06		
		096A	60-1	1900	0.0907	0.0963	2.94737E-06	3.06943E-06	
		096B	60-2	1880	0.0912	0.0972	3.19149E-06		
		096A	80-1	1870	0.0898	0.0959	3.26203E-06	3.14264E-06	
		096B	80-2	1720	0.0906	0.0958	3.02326E-06		
		096A	BOTTOM1	1790	0.0945	0.1006	3.40782E-06	3.24841E-06	
		096B	BOTTOM2	1910	0.0935	0.0994	3.08901E-06		lid crack
		097A	SURFACE1	1780	0.0931	0.0950	2.07865E-06	1.91845E-06	
		097A	SURFACE1		0.0921	0.0939			

		097B	SURFACE2	1820	0.0930	0.0962	1.75824E-06		
		097A	20-1	1900	0.0938	0.0960	1.15789E-06	1.89763E-06	
		097B	20-2	1820	0.0931	0.0979	2.63736E-06		
		097A	40-1	1850	0.0933	0.0988	2.97297E-06	2.7572E-06	
31/08/2011	11:34	097B	40-2	1810	0.0928	0.0974	2.54144E-06		
		097A	60-1	1780	0.0934	0.0970	2.02247E-06	1.74842E-06	
		097B	60-2	1560	0.0936	0.0959	1.47436E-06		
		097A	80-1	1620	0.0936	0.0967	1.91358E-06	3.32673E-06	leaked bucket
		097B	80-2	1730	0.0908	0.0990	4.73988E-06		
		097A	BOTTOM1	1660	0.0920	0.0967	2.83133E-06	3.34936E-06	
		097B	BOTTOM2	1810	0.0929	0.0999	3.8674E-06		
		098A	SURFACE1	1910	0.0927	0.1021	9.73822E-06	7.8938E-06	
		098A	SURFACE1		0.0912	0.1004			
		098B	SURFACE2	810	0.0900	0.0949	6.04938E-06		
		098A	20-1	1800	0.0909	0.0937	1.55556E-06	1.70561E-06	
		098B	20-2	1940	0.0920	0.0956	1.85567E-06		
		098A	40-1	1840	0.0910	0.0975	3.53261E-06	3.55578E-06	
		098B	40-2	1900	0.0906	0.0974	3.57895E-06		
		098A	60-1	1780	0.0905	0.0951	2.58427E-06	2.36906E-06	
		098B	60-2	1950	0.0904	0.0946	2.15385E-06		
		098A	80-1	1610	0.0912	0.0964	3.22981E-06	3.02448E-06	
		098B	80-2	1880	0.0935	0.0988	2.81915E-06		
		098A	BOTTOM1	1680	0.0939	0.0993	3.21429E-06	3.08564E-06	
		098B	BOTTOM2	1860	0.0939	0.0994	2.95699E-06		approx. 10ml spilled
		099A	SURFACE1	780	0.0939	0.1017	0.00001	6.31579E-06	
		099B	SURFACE2	760	0.0927	0.0947	2.63158E-06		
		099A	20-1	930	0.0922	0.0941	2.04301E-06	2.64122E-06	
		099B	20-2	710	0.0927	0.0950	3.23944E-06		
		099A	40-1	830	0.0937	0.0971	4.09639E-06	4.41999E-06	
		099B	40-2	780	0.0933	0.0970	4.74359E-06		
		099A	60-1	770	0.0938	0.0949	1.42857E-06	8.9881E-06	
		099B	60-2	840	0.0916	0.1055	1.65476E-05		
		099A	80-1	900	0.0899	0.0923	2.66667E-06	2.66667E-06	099B 80-2 all leaked
		099A	BOTTOM1	700	0.0909	0.0937	4E-06	6.63415E-06	
01/09/2011	9:00	099B	BOTTOM2	820	0.0912	0.0988	9.26829E-06		
		100A	SURFACE1	830	0.0896	0.0993	1.16867E-05	1.00369E-05	
		100B	SURFACE2	620	0.0916	0.0968	8.3871E-06		
01/09/2011	9:29	100A	20-1	810	0.0932	0.0950	2.22222E-06	2.9628E-06	
		100B	20-2	820	0.0925	0.0952	3.29268E-06		
		100C	20-3	830	0.0933	0.0961	3.37349E-06		
		100A	40-1	760	0.0928	0.0942	1.84211E-06	1.88259E-06	
		100B	40-2	780	0.0940	0.0955	1.92308E-06		

		100A	60-1	810	0.0934	0.0957	2.83951E-06	2.98602E-06	
		100B	60-2	830	0.0939	0.0965	3.13253E-06		
		100A	80-1	790	0.0930	0.0988	7.34177E-06	7.34177E-06	80-2 missing
		100A	BOTTOM1	770	0.0923	0.0959	4.67532E-06	4.40016E-06	
		100B	BOTTOM2	800	0.0934	0.0967	0.000004125		
		101A	SURFACE1	800	0.0928	0.0962	0.00000425	3.55357E-06	
		101B	SURFACE2	840	0.0943	0.0967	2.85714E-06		
		101A	20-1	760	0.0924	0.0941	2.23684E-06	2.59278E-06	
		101B	20-2	780	0.0921	0.0944	2.94872E-06		
		101A	40-1	780	0.0928	0.0942	1.79487E-06	1.44958E-06	
		101B	40-2	815	0.0923	0.0932	1.10429E-06		
		101A	60-1	810	0.0925	0.0942	2.09877E-06	1.98272E-06	
		101B	60-2	750	0.0924	0.0938	1.86667E-06		
		101A	80-1	790	0.0923	0.0949	3.29114E-06	2.75668E-06	
		101B	80-2	810	0.0927	0.0945	2.22222E-06		
		101A	BOTTOM1	700	0.0925	0.0939	0.000002	2.03659E-06	
		101B	BOTTOM2	820	0.0925	0.0942	2.07317E-06		
		102A	SURFACE1	820	0.0925	0.0954	3.53659E-06	3.08408E-06	
		102B	SURFACE2	760	0.0936	0.0956	2.63158E-06		
		102A	20-1	810	0.0934	0.0965	3.82716E-06	3.06223E-06	
		102B	20-2	740	0.0928	0.0945	2.2973E-06		
		102A	40-1	890	0.0929	0.0962	3.70787E-06	3.99679E-06	
		102B	40-2	840	0.0945	0.0981	4.28571E-06		
		102A	60-1	800	0.0925	0.0954	0.000003625	3.78781E-06	
		102B	60-2	810	0.0924	0.0956	3.95062E-06		
		102A	80-1	800	0.0932	0.0966	0.00000425	2.83929E-06	
		102B	80-1	770	0.0932	0.0943	1.42857E-06		
		102A	BOTTOM1	770	0.0929	0.0942	1.68831E-06	2.16946E-06	
01/09/2011	13:45	102B	BOTTOM2	830	0.0934	0.0956	2.6506E-06		
		108A	SURFACE1	880	0.0899	0.0957	6.59091E-06	5.59431E-06	
		108B	SURFACE2	870	0.0908	0.0948	4.5977E-06		
		108A	20-1	840	0.0901	0.0916	1.78571E-06	1.40422E-06	
		108B	20-2	880	0.0911	0.0920	1.02273E-06		
		108A	40-1	860	0.0906	0.0920	1.62791E-06	1.83668E-06	approx. 20ml spilled
		108B	40-2	880	0.0928	0.0946	2.04545E-06		
		108A	60-1	850	0.0917	0.0938	2.47059E-06	3.64909E-06	
		108B	60-2	870	0.0932	0.0974	4.82759E-06		
		108A	80-1	870	0.0914	0.0962	5.51724E-06	4.40419E-06	
		108B	80-1	790	0.0941	0.0967	3.29114E-06		
		108A	BOTTOM1	730	0.0946	0.0993	6.43836E-06	6.49078E-06	
		108B	BOTTOM2	810	0.0929	0.0982	6.54321E-06		
		109A	SURFACE1	880	0.0907	0.0966	6.70455E-06	7.0732E-06	
		109B	SURFACE2	860	0.0906	0.0970	7.44186E-06		
		109A	20-1	800	0.0912	0.0929	2.125E-06	2.69171E-06	
		109B	20-2	890	0.0914	0.0943	3.25843E-06		
		109A	40-1	900	0.0920	0.0956	4E-06	2.78652E-06	

		109B	40-2	890	0.0922	0.0936	1.57303E-06		
		109A	60-1	860	0.0932	0.0968	4.18605E-06	3.70413E-06	
		109B	60-2	900	0.0927	0.0956	3.22222E-06		
		109A	80-1	860	0.0919	0.0953	3.95349E-06	3.75452E-06	
		109B	80-1	900	0.0908	0.0940	3.55556E-06		
		109A	BOTTOM1	840	0.0913	0.0957	5.2381E-06	6.32493E-06	
		109B	BOTTOM2	850	0.0909	0.0972	7.41176E-06		
		110A	SURFACE1	860	0.0916	0.0976	6.97674E-06	7.5472E-06	
		110B	SURFACE2	850	0.0938	0.1007	8.11765E-06		
		110A	20-1	860	0.0940	0.0979	4.53488E-06	3.89395E-06	
		110B	20-2	830	0.0933	0.0960	3.25301E-06		
		110A	40-1	780	0.0939	0.0954	1.92308E-06	2.39904E-06	
		110B	40-2	800	0.0923	0.0946	2.875E-06		
02/09/2011	9:40	110A	60-1	830	0.0935	0.0945	1.20482E-06	1.18683E-06	
		110B	60-2	770	0.0933	0.0942	1.16883E-06		
		110A	80-1	810	0.0907	0.0927	2.46914E-06	2.8793E-06	
		110B	80-1	760	0.0904	0.0929	3.28947E-06		
		110A	BOTTOM1	890	0.0916	0.0961	5.05618E-06	5.41044E-06	
		110B	BOTTOM2	850	0.0924	0.0973	5.76471E-06		
		111A	SURFACE1	780	0.0912	0.0981	8.84615E-06	8.86058E-06	
		111B	SURFACE2	800	0.0923	0.0994	8.875E-06		
		111A	20-1	810	0.0927	0.0953	3.20988E-06	4.83279E-06	
		111B	20-2	790	0.0915	0.0966	6.4557E-06		
		111A	40-1	800	0.0925	0.0947	2.75E-06	1.9564E-06	
		111B	40-2	860	0.0931	0.0941	1.16279E-06		
		111A	60-1	800	0.0933	0.0962	0.000003625	2.95174E-06	
		111B	60-2	790	0.0917	0.0935	2.27848E-06		
		111A	80-1	800	0.0943	0.0983	0.000005	6.46104E-06	**filtered with 0.45um**
19/09/2011	10:20AM	111B	80-2	770	0.1345	0.1406	7.92208E-06		**New filters GF-75, 47mm**
	11:50AM	111A	109 (BOT)1	790	0.1355	0.1550	2.46835E-05	1.62271E-05	
		111B	109 (BOT)2	785	0.1350	0.1411	7.7707E-06		
		112A	SURFACE1	775	0.1348	0.1375	3.48387E-06	5.32218E-06	
		112B	SURFACE2	810	0.1350	0.1408	7.16049E-06		
		112A	20-1	790	0.1348	0.1397	6.20253E-06	3.94464E-06	
		112B	20-2	830	0.1342	0.1356	1.68675E-06		
		112A	40-1	780	0.1353	0.1431	0.00001	7.90541E-06	
		112B	40-2	740	0.1343	0.1386	5.81081E-06		
		112A	60-1	760	0.1331	0.1365	4.47368E-06	4.15992E-06	
		112B	60-2	780	0.1346	0.1376	3.84615E-06		
	2:30PM	112A	80-1	750	0.1344	0.1370	3.46667E-06	3.92846E-06	
		112B	80-2	820	0.1344	0.1380	4.39024E-06		
		112A	109 (BOT)1	790	0.1340	0.1391	6.4557E-06	5.44304E-06	
		112B	109 (BOT)2	790	0.1343	0.1378	4.43038E-06		
		113A	SURFACE1	810	0.1346	0.1462	1.4321E-05	1.49654E-05	

	4:00PM	113B	SURFACE2	820	0.1348	0.1476	1.56098E-05		
		113A	20-1	800	0.1336	0.1355	2.375E-06	1.16196E-05	
		113B	20-2	810	0.1332	0.1501	2.08642E-05		
		113A	40-1	790	0.1340	0.1398	7.34177E-06	5.79589E-06	
		113B	40-2	800	0.1340	0.1374	4.25E-06		
		113A	60-1	770	0.1345	0.1571	2.93506E-05	1.72753E-05	
		113B	60-2	750	0.1338	0.1377	5.2E-06		
		113A	80-1	770	0.1339	0.1390	6.62338E-06	1.26242E-05	
		113B	80-2	800	0.1335	0.1484	0.000018625		
		113A	109(BOT)1	780	0.1339	0.1381	5.38462E-06	1.49565E-05	
		113B	109 (BOT)2	795	0.1347	0.1542	2.45283E-05		
		114A	SURFACE1	780	0.1347	0.1392	5.76923E-06	8.50962E-06	
		114B	SURFACE2	800	0.1340	0.1430	0.00001125		
20/09/2011	9:45	114A	20-1	820	0.1342	0.1400	7.07317E-06	8.56803E-06	
		114B	20-2	795	0.1355	0.1435	1.00629E-05		
		114A	40-1	830	0.1337	0.1375	4.57831E-06	3.41416E-06	
		114B	40-2	800	0.1352	0.1370	2.25E-06		
		114A	60-1	830	0.1351	0.1417	7.95181E-06	5.63195E-06	
		114B	60-2	785	0.1352	0.1378	3.3121E-06		
		114A	80-1	820	0.1346	0.1564	2.65854E-05	1.50828E-05	
		114B	80-2	810	0.1353	0.1382	3.58025E-06		
		114A	109 (BOT)1	830	0.1344	0.1526	2.19277E-05	1.27764E-05	
		114B	109 (BOT)2	800	0.1343	0.1372	3.625E-06		
		115A	SURFACE1	820	0.1343	0.1460	1.42683E-05	1.38438E-05	
		115B	SURFACE2	775	0.1336	0.1440	1.34194E-05		
		115A	20-1	840	0.1343	0.1510	1.9881E-05	2.20833E-05	
		115B	20-2	770	0.1343	0.1530	2.42857E-05		
		115A	40-1	770	0.1340	0.1554	2.77922E-05	1.74937E-05	
		115B	40-2	820	0.1339	0.1398	7.19512E-06		
		115A	60-1	795	0.1337	0.1545	2.61635E-05	2.38994E-05	
		115B	60-2	795	0.1339	0.1511	2.16352E-05		
		115A	80-1	800	0.1332	0.1518	0.00002325	0.000023375	
		115B	80-2	800	0.1332	0.1520	0.0000235		
		115A	109 (BOT)1	750	0.1345	0.1546	0.0000268	2.60582E-05	
		115B	109 (BOT)2	790	0.1350	0.1550	2.53165E-05		
		116A	SURFACE1	840	0.1352	0.1467	1.36905E-05	1.32452E-05	
		116B	SURFACE2	750	0.1338	0.1434	0.0000128		
		116A	20-1	830	0.1346	0.1379	3.9759E-06	7.41478E-06	
		116B	20-2	820	0.1351	0.1440	1.08537E-05		
		116A	40-1	800	0.1348	0.1370	2.75E-06	1.25798E-05	
		116B	40-2	830	0.1363	0.1549	2.24096E-05		
		116A	60-1	800	0.1355	0.1519	0.0000205	1.3892E-05	
		116B	60-2	810	0.1347	0.1406	7.28395E-06		
		116A	80-1	790	0.1349	0.1552	2.56962E-05	2.52856E-05	
		116B	80-2	800	0.1350	0.1549	0.000024875		
	3:30PM	116A	113 (BOT)1	780	0.1353	0.1389	4.61538E-06	6.11414E-06	
		116B	113 (BOT)2	775	0.1344	0.1403	7.6129E-06		
		117A	SURFACE1	770	0.1343	0.1397	7.01299E-06	7.74892E-06	

		117B	SURFACE2	825	0.1350	0.1420	8.48485E-06		
		117A	20-1	820	0.1343	0.1388	5.4878E-06	3.89775E-06	
	4:00PM	117B	20-2	650	0.1352	0.1367	2.30769E-06		
		117A	40-1	775	0.1349	0.1388	5.03226E-06	6.19711E-06	
		117B	40-2	815	0.1346	0.1406	7.36196E-06		
		117A	60-1	640	0.1345	0.1356	1.71875E-06	1.87848E-06	
		117B	60-2	785	0.1353	0.1369	2.03822E-06		
		117A	80-1	775	0.1349	0.1547	2.55484E-05	1.50974E-05	
		117B	80-2	495	0.1350	0.1373	4.64646E-06		
		117A	BOTTOM	815	0.1352	0.1511	1.95092E-05	1.20386E-05	
		117B	BOTTOM	810	0.1345	0.1382	4.5679E-06		

Annex 6

CHIEF SCIENTIST'S LOG

All times in Pacific Daylight Savings Time (UTC – 7hrs)

Sunday August 21

10:00 Vector alongside and unloaded from previous cruise. Mobilization underway.

12:00 Weather: sunny, partly cloudy, calm.

14:15 Departed IOS. Heading to Boundary Pass

14:30 Science team meeting

1. Introductions
2. Scientific objectives of the cruise
    a. Marine renewable energy (Environmental Geoscience Program)
    b. Submarine slide hazard (Public Safety Geoscience Program)
3. Overview of operations
4. Watches
    a. Aug 21-23 Noon to midnight: Greg, Sean, Korhan, Cooper (floating). Midnight to noon: Knut, Kim, Cooper (floating).
5. Safety – included briefing on deck safety, hard-toed shoes, hard hats. Requirements for reporting injuries and near misses.

17:00 Arrived in Boundary Pass at dinner time.

17:30 Discussion on use of camera system with IKU grab. Plan was to attach the camera and tape cable to winch wire. Greg pointed out that when the IKU is triggered a length of cable is extended so that a loop of the camera cable would have to be available at the grab if taped to the wire. This would however risk snagging in the grab mechanism. Alternatively, if not taped to the wire someone would have to hold the wire under tension and keep it away from the ship's prop. Bosun was very concerned about this plan. Given that the idea behind the camera was to identify "problem" seabed conditions and that the sample was the requirement, it was decided not to use the camera unless we encountered problem seabed conditions.

18:00 First two attempts at IKU failed to trigger. Decided to try the Shipek.

18:30 First attempt at Shipek failed to trigger. Greg cleaned and lubricated the sampler.

19:10 Successful grab sample. Full bucket of fine gravel. Decided to continue with Shipek sample.

Monday August 22

00:00 Completed 19 Shipek grab samples in Boundary Pass (Stations 1-19). Heading to Fraser Delta.

02:11 Start multibeam and chirp sonar survey, Fraser Delta submarine channel-fan system.

07:00 Weather: rain with light wind.

09:00 Sean noticed an approximately 60 m offset on sample positions with respect to planned positions. Reviewed possible causes. Likely combination of (1) positions in Regulus were offset to the multibeam transducer whereas bridge is using ship's GPS antenna position; (2) likely station holding error of ± 25 m, according to the captain. Will attempt to reduce offset by using bridge position directly into Regulus.

12:00 Complete multibeam and chirp survey. Heading to Boundary Pass.

13:00 Raised issue of Internet with the Captain. Since leaving IOS, there has been no connectivity. Captain indicated that they will attempt to fix but that it has been an ongoing problem.

14:10 Arrived in Boundary Pass. Captain taking an hour to train second mate on station holding and maneuvering.

15:05 Starting Shipek grab sampling.

23:45 Last sample.

Tuesday August 23

00:29 Start multibeam and chirp survey, Boundary Pass.

04:30 End multibeam and chirp survey. Heading to IOS

06:00 Internet now working.

07:00	Weather: partly cloudy. Light breeze.
08:00	Tied up at IOS dock. Removing MVP and loading coring winch.
12:22	Departing IOS after short delay to fix hydraulic hoses. Heading to Boundary Pass.
15:00	On station for first IKU grab, Boundary Pass.
17:00	Three successful IKU's including one in bottom type where we had been previously unsuccessful. Recovered cobbles only at this site.
17:30	Crew changed sheave on A-frame while weather glassy calm.
18:05	Begin Shipek sampling, Boundary Pass.

Wednesday August 24

02:39	Final grab sample. Heading to Fraser Delta.
04:56	Starting chirp sonar lines across Fraser submarine channel and fan.
07:09	End of chirp sonar lines. Rigging piston corer. Fraser submarine channel levees.
10:00	First piston core (STN 088) recovered, processed and stowed. Greg directing operations with Peter's assistance. Peter showing students the core processing steps.
11:00	Second 40' core was (STN089) resulted in bent core barrels. Core had penetrated and recovered 3.1 m, and had evidently hit a thick sand unit, which corresponded to reflector in seismic profile. This information led to switch to 20' cores as the same reflector was present at other sites.
12:25	Ran 3.5 kHz line over the planned core stations. Strong hummocky reflector seemed to correspond to sand bed.
13:40	Core liner at STN090 imploded above piston suggesting piston jammed.
18:00	Complete piston coring. Total of seven cores obtained with variable results. Generally 2-3 m of muddy sediment overlying sand. Sand can be interpreted as the early phase of channel formation when levee height was low and core of the turbidity current overspilled. Finer section of cores represent overspill of higher levels of the turbidity current. Suggests evolution of channel to transition from fan lobe, to basal overspill incipient leveed channel to upper flow leveed channel.

18:30	Kim picked up from Steveston.
19:00	Heading to VENUS DDL site.
20:00	First rosette deployment.

Thursday 25 August

02:00	Rosettes completed. Starting chirp sonar lines.
07:00	Chirp lines completed. Weather: 25 knot winds from NW and 1 m waves. Uncomfortable for piston coring so decided to head to Howe Sound for better conditions.
10:30	Preparing to piston core at John Hughes-Clarke suggested site in outer basin of Squamish Delta deposits. Other sites re-selected from Huntec lines.
11:10	First core recovered (20 ft). Both trigger and piston core appear to have penetrated with mud around the vanes, suggesting soft sediment. Sand at very bottom of core. After discussion with Greg, decided to go for a 40 ft core.
14:30	Two 40-ft cores recovered successfully in distal ponded basin.
16:00	Two 20 ft cores recovered successfully at sites with sand present at base.
18:30	Starting rosette sampling.

Friday 26 August

06:30	Last rosette completed.
07:00	Starting piston coring, Fraser submarine channel levees.
10:00	Successful coring, but calculation of the number of core liners indicates that we will run out mid morning tomorrow. Contacted PGC and Mike Schmidt has agreed to run some more out to Steveston this afternoon.
11:30	Six 20 ft piston cores recovered before lunch!
16:00	Six more cores including one 40 footer recovered after lunch. Launch heading to Steveston to collect liner brought by Mike.

19:00 Two more cores for a total of 14 cores in the day! Long hard day for Greg and Peter but great work. Heading to grab station site for Korhan's program. These samples will not be archived and are not recorded in ED.

Saturday 27 August

07:00 Team meeting for data management.

07:30 Moving on to station for piston coring to investigate hyperpycnal flow deposits.

10:00 Three cores successfully obtained at approx 100 m water depth. Tide is ebbing so current, especially near river mouth were in excess of 2 knots making recovery difficult.

11:00 Internet which has been intermittent and slow all week is completely down today.

13:00 Final cores taken. Surprisingly good full core at DDL20078 site in 30 m water. Heading to Boundary Bay.