Marine geology of the Gulf of San Jorge (MARGES):

Habitat mapping, basin architecture and stratigraphy, gas seepage, natural hazards and harmful algal blooms

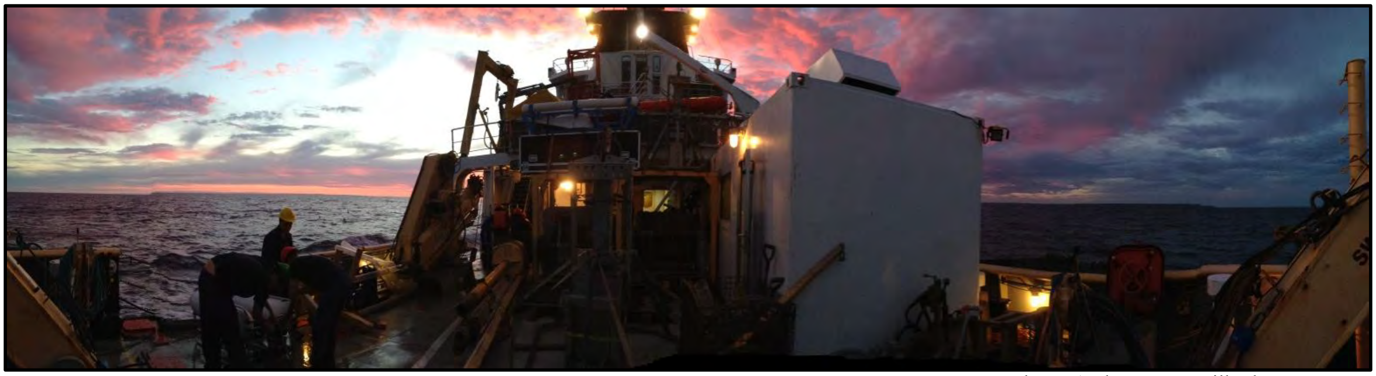

Photo: Audrey M. Rémillard

COR1404 – Expedition Report

Gulf of San Jorge, Argentina

February 17 to March 4, 2014

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Contents

List of figures

List of tables

Expedition Summary

The MARGES expedition took place from February 17th to March 4th 2014 on board the research vessel (R/V) Coriolis II. It allowed the acquisition of ~ 2000 km of geophysical lines, the collection of sediment samples at 62 stations and the profiling of the water column at 33 stations. In addition, two areas of the *Parque Interjurisdiccional Marino Costero Patagonia Austral* marine national park were mapped at high-resolution, while several pockmarks and one large submarine landslide were identified during the cruise. Finally, the expedition was also a unique opportunity for students and postdoctoral fellow (5 from Argentina and 3 from Canada) to receive hands-on training in marine geology.

Figure 1. Gulf of San Jorge location in South America.
Source: http://www.ngdc.noaa.gov/mgg/topo/globega2.html

1. Introduction – expedition background

The Gulf of San Jorge (GSJ), up to the shelf break, is a marine area opened to the South Atlantic Ocean located off the coast of Argentina in Patagonia (Fig. 1). With the potential exploitation of non-renewable resources (*i.e.,* offshore hydrocarbons) and the current exploitation of its natural resources (*e.g.,* fisheries), the GSJ is, and will become increasingly important to the regional and national economy.

Partly as a consequence of an oil spill that occurred near the city of Comodoro Rivadavia in 2007, the population and authorities were alerted on the potential risks of oil and gas exploitation on the marine ecosystem of the GSJ. Few studies have been realized throughout this region concerning the ocean circulation, the nature of the seabed and its topography, and the ecosystem structure and function. All these elements are essential for modeling and predicting the potential effects of hydrocarbon exploitation. An extensive knowledge of the GSJ was therefore necessary for a sustainable use and safe exploitation of these natural resources, and thus, the PROMESse[1] project was created by a partnership between the Ministry of Science, Technology and Innovation of Argentina (MINCyT), the Province of Chubut, the National Scientific and Technical Research Council of Argentina (CONICET), and the Institut des sciences de la mer de Rimouski (ISMER). Under this collaborative project, a bilateral research group was formed, bringing together researchers from both countries to conduct the **MAR**ine **E**cosystem health of the **S**an Jorge Gulf (**MARES**) project and **MAR**ine **GE**ology, sedimentology, stratigraphy, basin architecture and paleoceanography of the **S**an Jorge Gulf (**MARGES**) project. The R/V Coriolis II (ISMER) was used as scientific platform from January 29th to February 15th for MARES and from February 17th to March 4th 2014 for MARGES. **The aim of this report is to summarize all the activities realized during the 16-day expedition of the MARGES project in the GSJ and at the shelf break**.

[1] PROMESse is a French acronym which stands for **PRO**gramme **M**ultidisciplinaire de recherche en océanographie pour l'étude de l'**É**cosystème de la géologie marine du Golfe **S**an Jorge et de la région côtière des provinces de Chubut et **S**anta Cruz (Patagonie argentin**E**).

2. MARGES' scientific objectives

The general objective of the MARGES expedition was **to perform detailed geophysical surveys (high-resolution multibeam bathymetry and seismic profiles), and to collect different types of sediment samples in the GSJ and adjacent continental shelf edge-upper slope area on board of the Coriolis II** in order to: **(1)** generate high-resolution maps of the bottom geomorphology, bathymetry, and benthic habitat, **(2)** determine the GSJ basin architecture and stratigraphy, **(3)** determine the distribution and the geochemical and mineralogical characteristics of the surface sediments as well as the surface sedimentological processes, **(4)** identify pockmarks and gas seepage areas, **(5)** identify areas prone to natural hazards such as submarine landslides, **(6)** sample surface sediment in key locations to document the dinoflagellate cyst populations in the study area, and **(7)** determine Late Quaternary stratigraphy, tephrachronology, climate change and geomagnetic variability in the GSJ basin through core sampling and further laboratory analyses. Finally, a key of objective of the expedition was to train several students from Argentina and Canada in marine geology.

3. Shipboard participants

3.1 Co-chiefs scientists

Prof. Guillaume St-Onge, ISMER-UQAR
Dr. Miguel J. Haller, UNPSJB (PM) & CENPAT-CONICET

3.2 Scientists and students

Prof. Jean-Carlos Montero-Serrano, ISMER-UQAR
Dr. Nerina Iantanos, UNPSJB (CR)
Dr. Noela Sanchez-Carnero, postdoctoral fellow, CENPAT-CONICET
Jacques Labrie, engineer, ISMER-UQAR
Gilles Desmeules, technician, ISMER-UQAR
Pierre-Arnaud Desiage, PhD student, ISMER-UQAR
Audrey M. Rémillard, PhD student, ISMER-UQAR
Catherine Jetté, MSc student, ISMER-UQAR
Carolina Chialvo, advanced geology student, Geology Dpt. UNPSJB (CR)
Matías Juárez, advanced geology student, Geology Dpt. UNPSJB (CR)

Silvia Etienot, advanced geology student, UBA
José Ignacio Isola, advanced geology student, UBA

ISMER: *Institut des sciences de la mer de Rimouski* - Rimouski, Québec, Canada.
UBA: *University of Buenos Aires,* Buenos Aires, Argentina.
UQAR: *Université du Québec à Rimouski* - Rimouski, Québec, Canada.
CENPAT: *Centro Nacional Patagónico* - Puerto Madryn, Argentina
CONICET: *Consejo Nacional de Investigaciones Científicas y Técnicas* – Buenos Aires, Argentina.
UNPSJB: *Universidad Nacional de la Patagonia San Juan Bosco* - Puerto Madryn Campus (PM), Puerto Madryn, Argentina - Comodoro Rivadavia Campus (CR), Comodoro Rivadavia, Argentina.

3.3 Ship's crew

In addition to the scientific team, 14 crew members were on board during the entire expedition (Table 1).

Table 1. Ship's crew

Name	Role	Affiliation
Emmanuel Sevor	Captain	Reformar
Simon Gamache	1st officer	Reformar
Igor Kondratiev	Chief engineer	Reformar
Karine Simard	2nd officer	Reformar
Cvetan Dimitrov	2nd engineer	Reformar
Audrey Gauthier	Helmsman	Reformar
Thomas Dostie	Helmsman	Reformar
Michel Labrie	Cook	Reformar
Jean-François Dupont	Cook	Reformar
Gilles Pelletier	Deckhand	Reformar
André April	Deckhand	Reformar
Antoine April	Deckhand	Reformar
Claude St-Laurent	Deckhand	Reformar
Jean Carbonneau	Deckhand	Reformar

4. Cruise organization – logistics

To perform adequately both geophysical survey and core sampling, a precise work schedule including all participants has been determined ensuring data collection 24h/24 (Table 2). Scientists, technicians and postdoctoral fellow worked on a 12h/day shift, while students worked on an 8h/day shift. Sediment samples and cores were collected during the day, from 8:00 to approximately 19:00 and geophysical surveys were then conducted during the evening and night, from 20:00 to 8:00. During the first two days, only geophysical data was acquired. Meanwhile, all students on board received training in geophysical acquisition. The coring sites were chosen according to the geophysical data acquired during the night. Selection of the coring sites for the day took place around 6:00 when both chief scientists overlapped. Coring sites were then communicated to the bridge. During transit to a coring site, the multibeam echosounder stayed on in order to maximise the area of mapping.

Table 2. List of participants, role and working shifts

Name	Role	Shift
Guillaume St-Onge	Co-chief scientist	6:00-18:00
Miguel J. Haller	Co-chief scientist	18:00-8:00
Jean-Carlos Montero-Serrano	Responsible of coring and sampling operations	8:00-20:00
Nerina Iantanos	Coring and sampling operations	8:00-20:00
Noela Sanchez-Carnero	Geophysical acquisition	20:00-8:00
Gilles Desmeules	Coring and geophysical operations	8:00-20:00
Jacques Labrie	Geophysical operations and data management	20:00-8:00
Pierre-Arnaud Desiage **	Student, geophysical acquisition	00:00-8:00
Matías Juárez	Student, geophysical acquisition	00:00-8:00
Catherine Jetté **	Student, coring and sampling	8:00-16:00
Silvia Etienot	Student, coring and sampling	8:00-16:00
Carolina Chialvo	Student, coring and sampling	8:00-16:00
Audrey M. Rémillard **	Student, coring and geophysical acquisition	16:00-00:00
José Ignacio Isola	Student, coring and geophysical acquisition	16:00-00:00

** Co-responsible of the cruise report

5. Material, methods, and expedition overview

This section presents all the methods used during the expedition. For a more detailed summary of all operations, see the expedition log (Section 6, p. 38).

5.1 Rosette-CTD (Sea-Bird SB-911)

The rosette is composed of 12 Niskin-type bottles of 12 L with an automatic closing system that allows the sampling of seawater at specific depths. A CTD probe, which continuously measures the conductivity, temperature, density, dissolved oxygen, and the fluorescence is also attached to the rosette.

5.1.1 CTD profiles

In order to calibrate the multibeam echosounder (Section 5.6.3, p. 30), a total of 33 CTD profiles were acquired during the expedition (Table 3; Figs. 2 and 3). The characteristics of the water profiles are presented in Appendix I (p. 48).

Table 3. Location, date, hour, and depth of CTD-rosette deployments.

CTD-Rosette station	Date – Hour (UTC)	Lat. (S)	Long. (W)	Depth (m)
COR1402-04-01	17/02/2014 - 23:35	45°59.130'	67° 32.250'	31.5
COR1402-04-02	18/02/2014 - 11:05	45°59.050'	66°35.735'	95.2
COR1402-04-03	18/02/2014 - 16:40	45°59.131'	66°01.561'	96
COR1402-04-04	18/02/2014 - 22:05	46°22.480'	66°01.614'	97
COR1402-04-05	19/02/2014 - 7:15	46°39.728'	66°23.738'	72
COR1402-04-06	19/02/2014 - 11:08	46°39.908'	66°44.075'	84
COR1402-04-07	19/02/2014 - 19:44	45°58.526'	66°44.094'	91
COR1402-04-08	20/02/2014 - 7:19	45°43.960'	66°24.452'	80
COR1402-04-09	21/02/2014 - 7:44	45°42.534'	66°14.186'	92
COR1402-04-10	22/02/2014 - 7:31	45°26.894'	66°30.716'	87
COR1402-04-11	22/02/2014 - 11:18	45°26.903'	66°27.524'	91
COR1402-04-12	22/02/2014 - 22:50	45°05.902'	65°47.754'	66
COR1402-04-13	23/02/2014 - 3:11	45°02.730'	65°46.184'	38
COR1402-04-14	23/02/2014 - 11:18	45°06.131'	65°47.767'	67
COR1402-04-15	23/02/2014 - 11:12	45°06.995'	65°49.494'	75
COR1402-04-16	23/02/2014 - 16:15	45°04.610'	65°46.565'	56
COR1402-04-17	23/02/2014 - 19:04	45°04.470'	65°45.940'	54.3
COR1402-04-18	24/02/2014 - 11:13	45°07.574'	66°13.849'	46
COR1402-04-19	24/02/2014 - 14:40	45°06.190'	66°13.494'	40
COR1402-04-20	24/02/2014 - 19:22	45°07.140'	66°15.209'	44
COR1402-04-21	24/02/2014 - 22:46	45°06.385'	66°14.281'	39
COR1402-04-22	25/02/2014 - 10:22	45°21.439'	65°57.764'	92
COR1402-04-23	26/02/2014 - 00:09	45°28.174'	66°13.769'	87
COR1402-04-24	26/02/2014 - 7:17	45°45.162'	65°59.543'	95
COR1402-04-25	26/02/2014 - 20:36	45°45.767'	65°55.352'	96
COR1402-04-26	27/02/2014 - 7:21	45°10.866'	65°45.427'	90
COR1402-04-27	28/02/2014 - 00:46	45°43.166'	65°56.430'	96
COR1402-04-28	28/02/2014 - 12:03	45°39.862'	63°47.536'	95
COR1402-04-29	28/02/2014 - 20:38	45°36.679'	61°59.009'	108
COR1402-04-30	01/03/2014 - 8:44	45°37.500'	59°44.047'	912
COR1402-04-31	01/03/2014 - 11:26	45°37.74'	59°43.98'	590
COR1402-04-32	01/03/2014 - 13:37	45°35.297'	59°58.712'	645
COR1402-04-33	01/03/2014 - 14:35	45°33.80'	60°08.95'	135

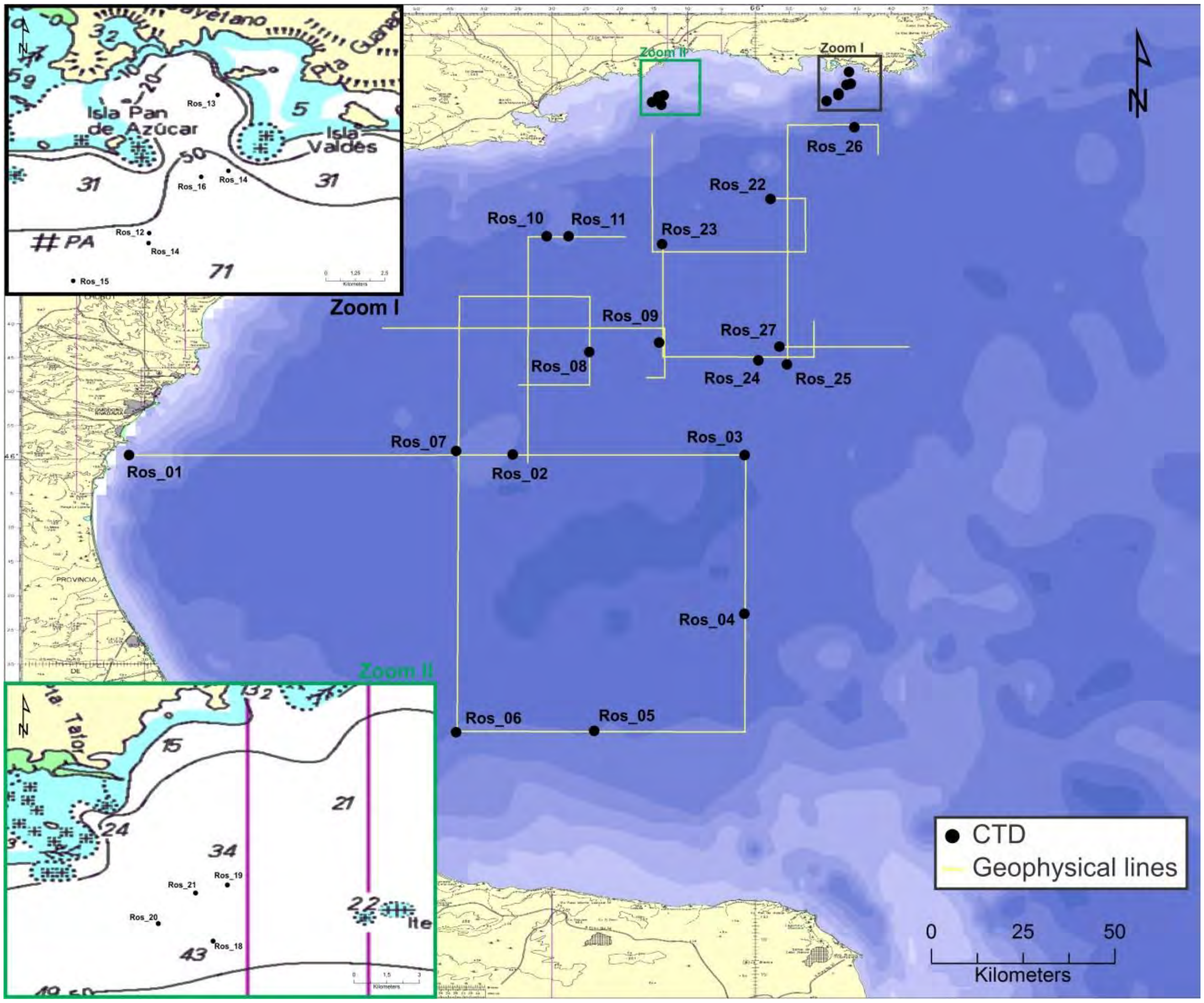

Figure 2. Location of CTD profiles in the Gulf of San Jorge. See also Figure 3.

5.1.2 Seawater sampling

Seawater sampling was carried out at 4 stations on a W-E transect. The sampling depths were determined from temperature and salinity profiles (CTD profiles) in order to collect seawater samples from the surface, intermediate (thermocline), and bottom layers of the water column. The seawater sampled with the Niskin-type bottles were transferred into 20 L acid-cleaned LDPE-collapsible cubitainers. Location and water depths are reported in Table 4. The aim of the seawater sampling is to calibrate neodymium (Nd) isotopic data derived from Fe-Mn oxyhydroxide coatings of sediment particles. This calibration will allow using this proxy to reconstruct changes in water mass provenance through time.

Table 4. Location, depth and characteristics (temperature, salinity, density, dissolved oxygen content, and water mass) of water sampling stations.

Seawater station	Latitude (S)	Longitude (W)	Water depth (m)	Temperature (°C)	Salinity (psu)	Density (kg/m^3)	Dissolved Oxygen (mL/L)	Water mass
COR1402-04-01	45°59.130'	67°32.250'	2	14.99	33.27	1024.65	5.47	Surface Layer
(depth = 31.5 m)			9	14.98	33.26	1024.68	5.46	Intermediate Layer
Date: 17/02/2014			15	13.88	33.23	1024.90	4.88	Intermediate Layer
Hour (UTC): 23:35			25	13.62	33.23	1025.02	4.678	Bottom Layer
COR1402-04-02	45°59.050'	66°35.735'	2	15.98	33.51	1024.61	4.75	Surface Layer
(depth = 95.2 m)			20	15.82	33.51	1024.74	4.78	Surface Layer
Date:18 /02/2014			40	13.68	33.45	1025.20	4.33	Intermediate Layer
Hour (UTC): 11:05			50	8.13	33.40	1026.25	3.45	Intermediate Layer
			90	7.86	33.41	1026.46	3.26	Bottom Layer
COR1402-04-03	45°59.131'	66°1.561'	2	16.18	33.53	1024.58	4.89	Surface Layer
(depth= 96 m)			40	14.68	33.44	1024.99	4.66	Intermediate Layer
Date: 18/02/2014			50	9.50	33.33	1025.96	3.48	Intermediate Layer
Hour (UTC): 16:40			90	8.39	33.36	1026.34	3.12	Bottom Layer
COR1203-04-32	45°35.297'	59°58.712'	10	12.02	33.75	1025.66	5.25	Surface layer
(depth = 645 m)			100	5.23	33.96	1027.30	5.37	Intermediate layer
Date: 01/03/2014			300	4.59	34.07	1028.39	5.49	Bottom layer
Hour (UTC): 13:37			600	4.24	34.11	1029.85	5.22	Bottom layer

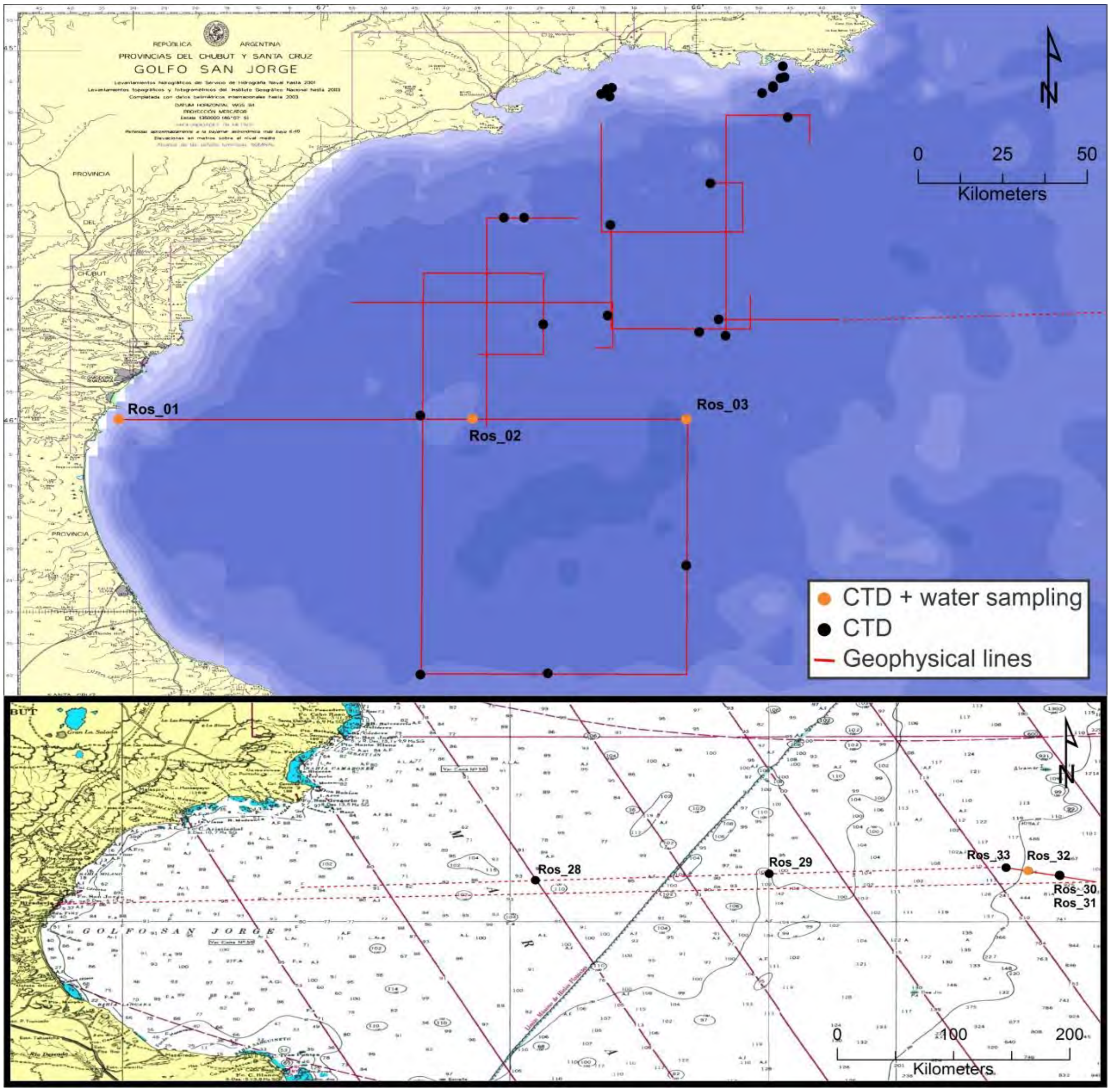

Figure 3. Location of water samples in the Gulf of San Jorge (Ros_01, Ros_02, and Ros_03) and the shelf edge (Ros_31).

Seawater samples were labelled as follow:

Example: COR140204-01

COR→ Coriolis II
14 → Year 2014
02 → Month
04 → Leg # 04
01→ Station number

* Seawater station numbers do not follow sediment station numbers (see Section 5.2.5).

5.2 Sediment sampling

5.2.1 Van Veen grab sampler

The Van Veen grab sampler is a clamshell device of 0.2x0.2x0.2 m with a maximum 0.008 m^3 capacity of sediment sampling. Its deployment is easy and quick. While the instrument goes down in the water, the two levers are spread and locked like an open scissor. When the grabber touches the seafloor it unlocks and when pulled upward, it closes grabbing the surface sediment. In total, the Van Veen grab sampler was used 55 times in the Gulf of San Jorge and the continental slope (Figs. 4 and 5). Sampling characteristics are presented in Table 5 and pictures in Appendix II (p. 67).

5.2.2 Box corer

The box corer collects up to 0.125 m^3 of soft sediments at the seafloor and is suitable for any water depths (wire length is the limit). It is used for minimum disturbance of the sediment/water interface. When the sediment volume is sufficient (which was the case for each deployment), it is possible to subsample the box core with 10-cm diameter and 60-cm long PVC tubes (push cores) using a vacuum pump to reduce compaction. During the expedition, the box corer was deployed 8 times (Fig. 6). In total, 24 push cores were subsampled (3 per box core) (Table 6, p. 26). Sample location on seismic profiles and pictures are reported in the Appendix III (p. 92).

Each Van Veen grab and box cores were subsampled once on deck. Using two truncated 60-ml syringes and a small vial, the first 1 cm of sediment was subsampled for chlorophyll-a, organic matter content, and microbial community composition analyses respectively. The sediment/water interface was also subsampled in different plastic bags for subsequent identification of dinoflagellate cysts, as well as grain size, mineralogical, geochemical and isotopic analyses. Surface sediment was also sampled with plastic cubes for magnetic analysis. Once subsampled, each Van Veen grab and box cores were sieved (0.5 mm) in order to clear out the sediment and keep benthic organisms only. The organisms were stored in plastic containers, sealed in formalin (4%) and will be used for a study on biodiversity.

Table 5. Location, date, hour, and depth of Van Veen grab samples.

Name	Date - Hour (UTC)	Latitude (S)	Longitude (W)	Depth (m)	Comment(s)
COR14_04_BV01	18/02/2014 - 22:50	46°22.541'	66°01.644'	97	Soft surface sediment; sand.; some shells, worms and worm burrows
COR14_04_BV02	19/02/2014 - 7:40	46°39.728'	66°23.738'	80	Silt; less shells than BV01, worms and worm burrows
COR14_04_BV03	19/02/2014 - 11:08	46°39.908'	66°44.075'	84	Silt; many shells
COR14_04_BV04	19/02/2014 - 20:03	45°58.553'	66°44.189'	91	Silt and sand; few organisms
COR14_04_BV05	20/02/2014 - 7:24	45°43.988'	66°24.485'	93	Silt; some shells, worms, and worm burrows
COR14_04_BV06	20/02/2014 - 22:21	45°54.496'	66°44.039'	90	Silt; some shells and worms
COR14_04_BV07	21/02/2014 - 7:35	45°42.548'	66°14.200'	95	Fine silt; some shells, worms, and worm burrows
COR14_04_BV08	21/02/2014 - 16:40	45°40.438'	66°15.292'	92	Silt; some shells, worms, and worm burrows
COR14_04_BV09	21/02/2014 - 22:29	45°58.925'	66°33.506'	95	Silt and sand; some shells, worms, and many worm burrows
COR14_04_BV10	22/02/2014 - 8:00	45°26.880'	66°30.718'	87	Silt and sand; some shells, worms, and worm burrows; manganese and iron oxyde layer
COR14_04_BV11	22/02/2014 - 22:50	45°05,897'	65°47.753'	67	Silt and sand
COR14_04_BV12	23/02/2014 - 14:04	45°05.620'	65°48.889'	71	Sand and black sediment; a lot of water in the grabber; benthos for Noela Sanchez-Carnero
COR14_04_BV13	23/02/2014 - 15:03	45°06.549'	65°46.632'	65	Sand and black sediment; a lot of water in the grabber; benthos for Noela Sanchez-Carnero
COR14_04_BV14	23/02/2014 - 16:13	45°04.640'	65°46.622'	56	Sand and black sediment; a lot of water in the grabber; benthos for Noela Sanchez-Carnero
COR14_04_BV15	23/02/2014 - 16:47	45°04.601'	65°46.382'	50	Sand and black sediment; a lot of water in the grabber; benthos for Noela Sanchez-Carnero
COR14_04_BV16	23/02/2014 - 18:19	45°03.431'	65°45.567'	41.5	Sand and black sediment; a lot of water in the grabber; benthos for Noela Sanchez-Carnero
COR14_04_BV17	23/02/2014 - 18:36	45°03.069'	65°45.537'	31.5	Sand and black sediment; a lot of water in the grabber; benthos for Noela Sanchez-Carnero
COR14_04_BV18	23/02/2014 - 19:05	45°04.889'	65°48.024'	70.5	Silt and sand
COR14_04_BV19	23/02/2014 - 20:00	45°05.100'	65°48.009’	64.1	Silt and sand
COR14_04_BV20	23/02/2014 - 20:18	45°04.863'	65°48.133’	64.7	Sandy silt
COR14_04_BV21	23/02/2014 - 20:38	45°05.058'	65°48.128’	69.9	Silt and sand
COR14_04_BV22	24/02/2014 - 11:45	45°07.619'	66°13.762'	46	Few sediment, rocks, and few organisms
COR14_04_BV23	24/02/2014 - 12:01	45°07.709'	66°13.283'	49	Silt, sand, and black sediment
COR14_04_BV24	24/02/2014 - 12:22	45°07.6719'	66°13.148'	50	Rocks and organisms; just enough sediment to fill half of a plastic cube
COR14_04_BV25	24/02/2014 - 12:45	45°07.591'	66°12.847'	52	Silt and sand
COR14_04_BV26	24/02/2014 - 13:16	45°06.768'	66°12.374'	43	Silt and sand with rocks and organisms
COR14_04_BV27	24/02/2014 - 13:46	45°06.843'	66°13.159'	43.5	Silt and clay; rocks with organisms (corals ???); many pebbles
COR14_04_BV28	24/02/2014 - 14:03	45°06.805'	66°13.475'	45	Silt and clay; rocks with organisms (corals ???); many pebbles
COR14_04_BV29	24/02/2014 - 14:22	45°06.509'	66°13.726'	44.5	Sand
COR14_04_BV30	24/02/2014 - 14:57	45°06.147'	66°13.473'	40	Few sediment; many shells
COR14_04_BV31	24/02/2014 - 15:18	45°06.189'	66°13.530'	36	Just enough sediment to fill half of a plastic cube
COR14_04_BV32	24/02/2014 - 15:32	45°06.113'	66°13.580'	42	Silt and sand
COR14_04_BV33	24/02/2014 - 16:04	45°06.872'	66°14.186'	45.5	Silt and sand
COR14_04_BV34	25/02/2014 - 10:40	45°21.489'	65°57.764'	92.53	Silt with many shells and worm burrows
COR14_04_BV35	26/02/2014 - 00:18	45°28.047'	66°13.722'	87	Silt and clay
COR14_04_BV36	26/02/2014 - 07:35	45°44.995'	65°59.400'	95	Silt and clay

COR14_04_BV37	26/02/2014 - 18:00	45°44.969'	66°01.026'	99.35	Silt
COR14_04_BV38	26/02/2014 - 20:46	45°45.846'	65°55.290'	97	Silt and clay
COR14_04_BV39	27/02/2014 - 7:21	45°10.845'	65°45.301'	90	Silt and coarse sand
COR14_04_BV40	27/02/2014 - 11:11	45°18.370'	65°46.452'	90	Silt and coarse sand; two sieves were used for the benthos sampling
COR14_04_BV41	27/02/2014 - 12:16	45°18.149'	65°38.577'	90.68	Silt and coarse black sand; Fe-Mn nodules; two sieves were used for the benthos sampling
COR14_04_BV42	27/02/2014 - 13:05	45°17.883'	65°30.710'	91.7	Silt and sand
COR14_04_BV43	27/02/2014 - 15:21	45°25.945'	65°30.234'	97.21	Silt
COR14_04_BV44	27/02/2014 - 16:15	45°26.437'	65°38.295'	96	Silt with many small pebbles and shells
COR14_04_BV45	27/02/2014 - 17:08	45°26.697'	65°46.163'	95	Silt
COR14_04_BV46	27/02/2014 - 18:17	45°35.062'	65°45.825'	98.5	Silt
COR14_04_BV47	27/02/2014 - 19:08	45°34.845'	65°37.985'	98	Silt
COR14_04_BV48	27/02/2014 - 20:30	45°34.600'	65°30.200'	95	Silt
COR14_04_BV49	27/02/2014 - 21:41	45°42.966'	65°29.959'	93.5	Silt
COR14_04_BV50	27/02/2014 - 22:34	45°43.208'	65°37.865'	94	Silt
COR14_04_BV51	28/02/2014 - 11:18	45°39.936'	63°47.527'	95	Sand and silt with shells
COR14_04_BV52	28/02/2014 - 20:38	45°36.536'	61°58.951'	108	Sand
COR14_04_BV53	01/03/2014 - 12:29	45°37.999'	59°43.910'	917	Sand with diatoms and *Lophelia Pertusa* coral (cold-water coral, fossil)
COR14_04_BV54	01/03/2014 16:10	45°34.753'	59°58.641'	647	Fine to medium sand with organisms
COR14_04_BV55	01/03/2014 - 20:00	45°33.821'	60°08.945'	141	Sand with many shells; ophiures (*Ophiuroidea*)

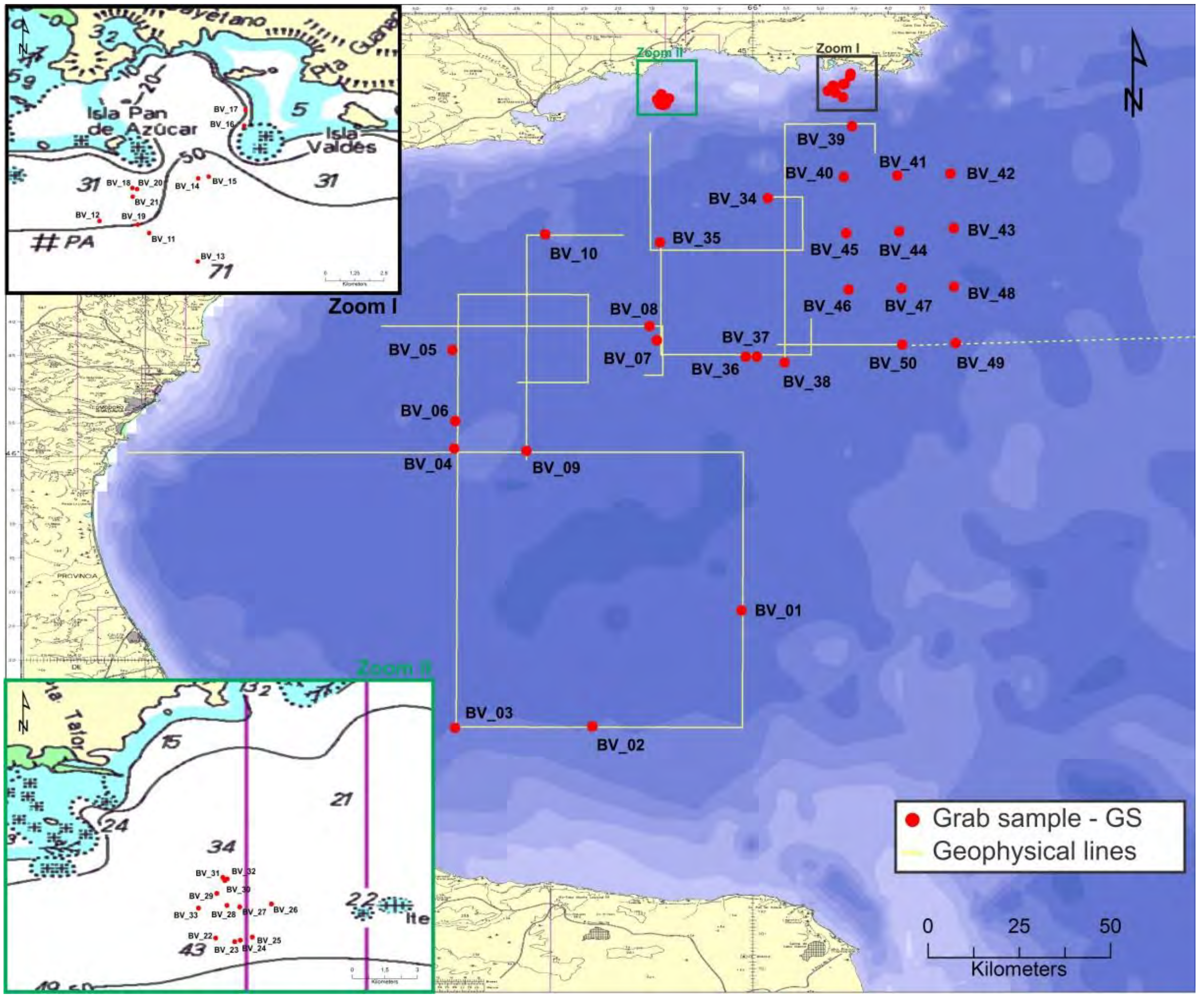

Figure 4. Van Veen grab sampling location in the Gulf of San Jorge.

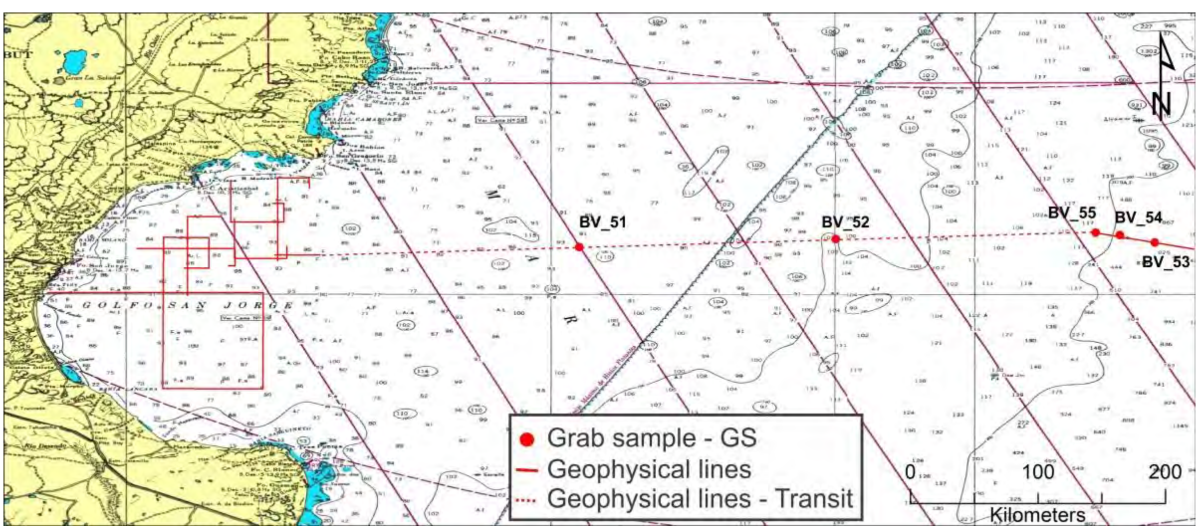

Figure 5. Van Veen grab sampling location on the way to the shelf edge and on the continental slope.

5.2.3 Gravity corer (Lehigh)

The gravity core has a maximum length of 3 m and penetrates the sediment under a 136-kg weight. A core catcher keeps the sediment in the corer when the latter is pulled upward. When the gravity core is used for the releasing of the piston corer, his name is trigger weight core. During the expedition, the gravity core was used for these two purposes. A total of 10 gravity cores were collected (Table 7, p. 26; Fig. 6). Sample location on seismic profiles and pictures are presented in Appendix IV (p. 102).

5.2.4 Piston corer (Benthos)

The piston corer is used with a weight of 2000 kg. When the companion trigger weight core touches the seafloor, it causes the rise of the trip arm and induces the piston corer free fall. A core catcher keeps the sediment in the corer when the latter is pulled upward. This coring instrument allows the collection of long cores up to a maximum of 9-m length due to the suction exerted by the piston in the tube. The piston corer was deployed 5 times during the expedition, and thus a total of 5 piston cores and 5 trigger weight cores could be sampled (Tables 8 and 9, p. 27; Fig. 7). Sample location on seismic profiles and pictures are presented in Appendix V (p. 112).

For each piston, gravity or trigger weight core, the first ~ 10 cm (base) were separated from the core. Those samples will be shipped to the Nordic Laboratory for Luminescence Dating (Roskilde, Denmark) for optically stimulated (OSL) dating analyses.

5.2.5 Sediment sample identification

Sediment samples were labelled as follow:

Example: COR1404-001PC-AB

COR→ Coriolis II
14 → Year 2014
04 → Leg # 04
001 → Station # 1
PC → Corer type (piston corer)
AB → Core section if applicable

Sediments from box corer (BC), piston corer (PC), trigger weight corer (TWC), and gravity corer (GC) follow station numbers.

* Note: the Van Veen grab sampler (BV) was used on seismic lines outside sampling stations and resulting samples are therefore labelled in order. For instance, on station # 1, core from the piston corer is labelled COR1404-001PC while sediments from the Van Veen grab sampler are labelled COR1404-BV06. For the subsamples, they were labelled according to the station number (box corer) or to the Van Veen grab station. OSL samples have the same name as the core.

5.3 Water and sediment sample storing

Cores were stored in the cold room located on the deck in the laboratory container. Other sediment samples were stored in the 4^{o}C refrigerator (cubes, plastic bags, and samples for organic matter analysis) and in the -80^{o}C freezer (samples for chlorophyll-a and isotopic analysis, and microbial community composition) in the wet laboratory. Seawater samples were stored at room temperature. All samples (sediment and water) and cores will be redirected and stored at ISMER-UQAR once the R/V Coriolis II will be back in Canada.

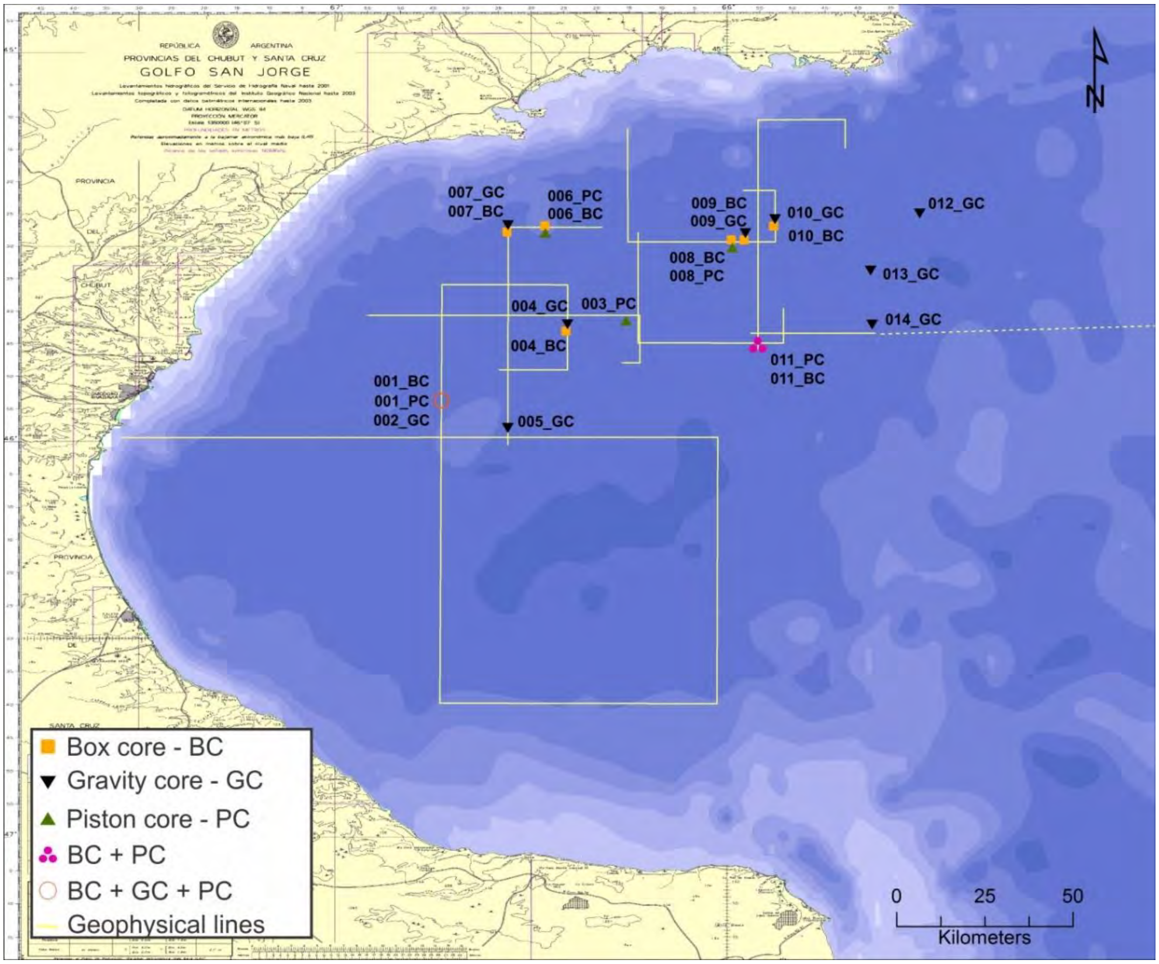

Figure 6. Sediment sampling location in the Gulf of San Jorge (box, piston, and trigger weight cores).

Table 6. Location, date hour, sampling depth of each box core, and length of the subsampled push cores.

Name	Date - Hour (UTC)	Lat. (S)	Long. (W)	Depth (m)	Push cores length/compaction (cm)			Comment(s)
					A	B	C	
COR1404_001BC	20/02/2014 - 12:04	45°54.427'	66° 44.100'	93	55/7	51/9	51/11	Silt
COR1404_004BC	21/02/2014 - 18:38	45°43.110'	66° 24.472'	90	60.5/0	60/0	60/0	Silt; thin black layer (1cm) at 45-cm depth
COR1404_006BC	22/02/2014 - 11:31	45°26.998'	66° 27.684'	91	61/0	60/0	61/0	Silt
COR1404_007BC	22/02/2014 - 18:23	45°27.935'	66° 33.482'	87	61/8	62/0	61/15	Silt
COR1404_008BC	25/02/2014 - 12:20	45°29.124'	65°59.155'	93.5	60/0	61/0	59/0	Silt with many worm burrows
COR1404_009BC	25/02/2014 - 18:51	45°29.167'	65°57.196'	90	60.5/0	60.5/0	61/0	Silt and clay
COR1404_010BC	25/02/2014 - 20:00	45°27.031'	65°52.662'	93	62/0	60/0	61/0	Silt and clay
COR1404_011BC	26/02/2014 - 16:15	45°44.986'	65°55.407'	99	61/0	60.5/0	60/0	Fine silt

Table 7. Location, date, hour, depth, and length of gravity cores. N/A = Not applicable.

Name	Date - Hour (UTC)	Lat. (S)	Long. (W)	Depth (m)	Length (m)	Section length (cm)			Comment(s)
						AB	BC	CD	
COR14_04_002GC	20/02/2014 - 21:02	45°54.500'	66°44.057'	100.6	1.8	90	90	N/A	OSL sampling 8 cm at the base
COR14_04_004GC	21/02/2014 - 20:10	45°43.127'	66°24.427'	90	1.33	133	N/A	N/A	Fine silt; OSL sampling 11.5 cm at the base; shells in core catcher
COR14_04_005GC	21/02/2014 - 19:40	45°58.969'	66°33.547'	94.5	2.31	112	112	17	Fine silt; OSL sampling 11.5 cm at the base
COR14_04_007GC	22/02/2014 - 21:40	45°27.926'	66°33.494'	87	2.32	116	116	N/A	Fine silt; OSL sampling 9.5 cm at the base
COR14_04_009GC	25/02/2014 - 18:03	45°29.169'	65°57.220'	90	1.48	148	N/A	N/A	Fine silt, OSL sampling 13 cm at the base
COR14_04_010GC-A	25/02/2014 - 21:35	45°27.028'	65°52.674'	88	0.63	63	N/A	N/A	Silt and sand + sand with clasts
COR14_04_010GC-B	27/02/2014 - 22:07	45°27.039'	65°52.661'	88	1.05	105	N/A	N/A	Core stopped to a pebbly clay layer containing a lot of shell fragments
COR14_04_012GC	27/02/2014 - 14:46	45°26.164'	65°30.545'	97	0.59	59	N/A	N/A	The first time the corer was empty; the second time → fine silt
COR14_04_013GC	27/02/2014 - 19:25	45°34.866'	65°38.058'	97	1.81	87	94	N/A	Fine silt; OSL sampling 9 cm at the base
COR14_04_014GC	27/02/2014 - 22:55	45°43.196'	65°37.840'	94	2.32	116	116	N/A	Fine silt; corer “overpenetration”; gas escaped

Table 8. Location, date, hour, depth, and length of piston cores. N/A = Not applicable.

Name	Date - Hour (UTC)	Lat. (S)	Long. (W)	Depth (m)	Length (m)	Section length (cm) AB	BC	CD	Comment(s)
COR14_04_001PC	20/02/2014 - 18:33	45°54.425'	66°44.040'	100.6	1.03	103	N/A	N/A	Compact sand in core catcher
COR14_04_003PC	21/02/2014 - 14:10	45°40.415'	66°15,295'	94	4.11	152	152	107	Fine silt; OSL sampling 9.5 cm at the base of AB section
COR14_04_006PC	22/02/2014 - 14:57	45°26.981'	66°27.688'	90.5	3.69	155	151	63	OSL sampling 9.5 cm at the base of AB section
COR14_04_008PC*	25/02/2014 - 16:16	45°29.190'	65°59.037'	95.3	2.71	136	135	N/A	Fine silt; OSL sampling 11.5 cm at the base of AB section; gas escaped
COR14_04_011PC*	26/02/2014 - 12:53	45°44.995'	65°55.420'	97	4.06	151	152	103	Fine silt; OSL sampling 10 cm at the base of AB section; gas escaped

* The piston was stocked in the liner

Table 9. Location, date, hour, depth, and length of trigger weight cores. N/A = Not applicable.

Name	Date - Hour (UTC)	Lat. (S)	Long. (W)	Depth (m)	Length (m)	Section length (cm) AB	BC	CD	Comment(s)
COR14_04_001TWC	20/02/2014 - 18:33	45°54.425'	66°44.040'	100.6	0.92	92	N/A	N/A	OSL sampling 7.5 cm at the base
COR14_04_003TWC	21/02/2014 - 14:10	45°40.415'	66°15,295'	94	1.54	27	127	N/A	OSL sampling 11.5 cm at the base; 60 cm corer “overpenetration “
COR14_04_006TWC	22/02/2014 - 14:57	45°26.981'	66°27.688'	90.5	2.25	112.5	112.5	N/A	Fine silt; OSL sampling 8.5 cm at the base; 60 cm corer “overpenetration “
COR14_04_008TWC	25/02/2014 - 16:16	45°29.190'	65°59.037'	95.3	2.26	113	113	N/A	Fine silt & clay; OSL sampling 9.5 cm at the base; 76 cm corer “overpenetration “; gas escaped
COR14_04_011TWC	26/02/2014 - 12:53	45°44.995'	65°55.420'	97	2.08	104	104	N/A	Fine silt; OSL sampling 11 cm at the base; gas escaped

5.5 SeaSPY magnetometer

Marine Magnetics' SeaSPY marine magnetometer measures the total magnetic field at a specific point. The measured magnetic intensity (nT) depends on the sediment and rock types that composed the seafloor. The SeaSPY measurement range is from 18 000 to 120 000 nT with an absolute accuracy of 0.1 nT. The magnetometer is towed behind the ship at a maximum distance. The data are acquired using the SeaLink software that records data in *xyzi* format and are not corrected for diurnal or bathymetric variations (post-processing). During the expedition, the marine magnetometer malfunctioned and on February 20th, we stopped using it. Therefore, we collected data intermittently from February 17th at 19:53 to February 20th at 5:00. Line characteristics and location are reported in Table 10 and Fig. 7.

5.6 Geophysical surveys

5.6.1 Edgetech X-star 2.1 subbottom profiler

The Edgetech X-star 2.1 is high-resolution hull-mounted subbottom profiling system that provides the surficial sediment stratigraphy. It transmits FM-type acoustic wave with a frequency between 0.5 and 12 kHz (frequency centered between 4.5 to 6 kHz). The beam opening angle varies according to the frequency between 50^{o} for 4.5 kHz and 25^{o} for 6 kHz. The acoustic impulse varies from 5 to 50 ms. The subbottom profiler is composed of 9 transducers that act as transmitters and receivers. The data are in *jsf* format and are displayed and recorded using the Discover X-star 2.1 software. During the expedition, we recorded data using the Hull_2_12_20FM pulse with a frequency of 1 Hz (1 impulse every second). For the two lines recorded on the shelf edge, we used the Hull_2_50_50wB "pulse" with a frequency between 0.33 and 1 Hz (1 impulse every 1 to 3 seconds) depending on the depth. Line characteristics and location are reported in Table 11 and Fig. 7.

Table 10. Date, hour and coordinates of the start and end of the marine magnetometer lines.

Name	Stop (CTD, …)	Start hour (UTC)	Start coordinates		End hour (UTC)	End coordinates		Date	Comments
			Lat. (S)	Long. (W)		Lat. (S)	Long.(W)		
Line_001		00:47:46	45°58,207	67°29,915	10:50:02	46°59,050	66°36,561	2014-02-18	-
	X	08:05:00	45°59,071	67°48,160	08:33:00	46°59,083	66°47,224	2014-02-18	-
Line_001_Bis		11:42:00	45°58,735	66°34,874	16:31:31	45°59,120	66°01,923	2014-02-18	Malfunctioned, back on board (bob)
Line_002		17:09:00	45°59,735	66°01,487	21:30:00	46°22,838	66°02,158	2014-02-18	Unusable data (bob)
Line_002_Bis		02:32:00	46°34,640	66°01,503	03:42:00	46°39,947	66°01,755	2014-02-18(19)	Restart
Line_003		03:45:41	46°39,947	66°01,755	07:04:00	46°39,879	66°22,987	2014-02-19	-
Line_003_Bis		08:21:00	46°39,895	66°26,327	10:49:34	46°39,910	66°42,842	2014-02-19	Restart after problem with GPS
Line_004		11:42:58	46°39,567	66°43,977	19:36:35	45°58,680	66°43,977	2014-02-19	-
Line_004_Bis		20:19:11	46°58,413	66°44,180	20:56:22	45°47,676	66°43,902	2014-02-19(20)	Unusable data (bob)
Line_005									Magnetometer didn't work
Line_006									Magnetometer didn't work
Line_006_Bis		08:08:05	45°44,748	66°24,439	09:02:41	45°48,797	66°24,460	2014-02-20	Restart mag. but unusable data
Line_007		09:04:50	45°48,817	66°24,672	09:27:00	45°48,753	66°28,061	2014-02-20	Last line (bob)

5.6.2 SQUID 2000 sparker

The Applied Acoustics SQUID 2000 sparker is a seismic instrument towed behind the ship with a frequency ranging from 0.3 to 3.8 kHz. It allows the visualization of marine sediment stratigraphy. The lower frequency allows a better penetration in coarse sediments although the resolution is lower than the Edgetech. The source is composed of electrodes that produce an electric arc which vaporises the surrounding water. A bubble is produced and then implodes, generating a sound wave that penetrates sediments. The signal is subsequently returned to the receiver which is composed of a series of hydrophones connected together in a polyurethane tube filled with oil. The pulse used during the recording of the first 10 seismic lines was 1000 J and 1 500 J (maximum power) for the following lines. In the Gulf of San Jorge and during the transits, we used a frequency of 1 Hz (1 shot every second) whereas on the continental slope area, the frequency was between 0.33 to 1 Hz (1 shot every 1 or 3 seconds) depending on depth. The raw data were recorded in *Coda* format (.cod) and then processed in SegY format (.seg). Lines characteristics and location are presented in Table 12 and Fig. 7.

5.6.3 Kongsberg Maritime EM 2040 & EM 302 multibeam echosounder

The Kongsberg Maritime EM 2040 and EM 302 multibeam echosounder measure relative water depths. A transducer (TX) emits an acoustic wave which is reflected by the seafloor and recorded by a receiver (RX). The time between the acoustic wave transmission and reception is transformed in depth using the speed of sound in water. The system processor then converts the sound signal from the various beams allowing the mapping of the seafloor over a large swath. The EM 2040 multibeam echosounder can be used with a frequency between 200 and 400 kHz owing to the depth and the wanted resolution. During the expedition, it was used at 300 kHz, except in the easternmost part of the marine national park, where 400 kHz was employed. The EM 302 uses a frequency of 30 kHz which allows mapping in deep waters. In order to accurately localise the sounding points, both EM 2040 and EM 302 multibeam echosounder were coupled to an inertial platform (Applanix POS/MV). The latter calculates six different movements of the ship (pitch, roll, heave, yaw, surge, and lurch) and is equipped with a DGPS. The data were integrated to Kongsberg SIS software in real time. During the expedition, the EM

2040 was used until February 25th, when we switched to the EM302 multibeam system due to a major electronic problem with EM2024 and upcoming survey in the deeper waters of the continent slope. The data were recorded in *.all* format and will be post-processed in Caris HIPS and SIPS software using notably CTD and tidal data. Line characteristics and location are reported in Table 11 and Fig. 7. Two specific areas were mapped in the marine national park. Associated data are presented in Table 13 and Fig. 8.

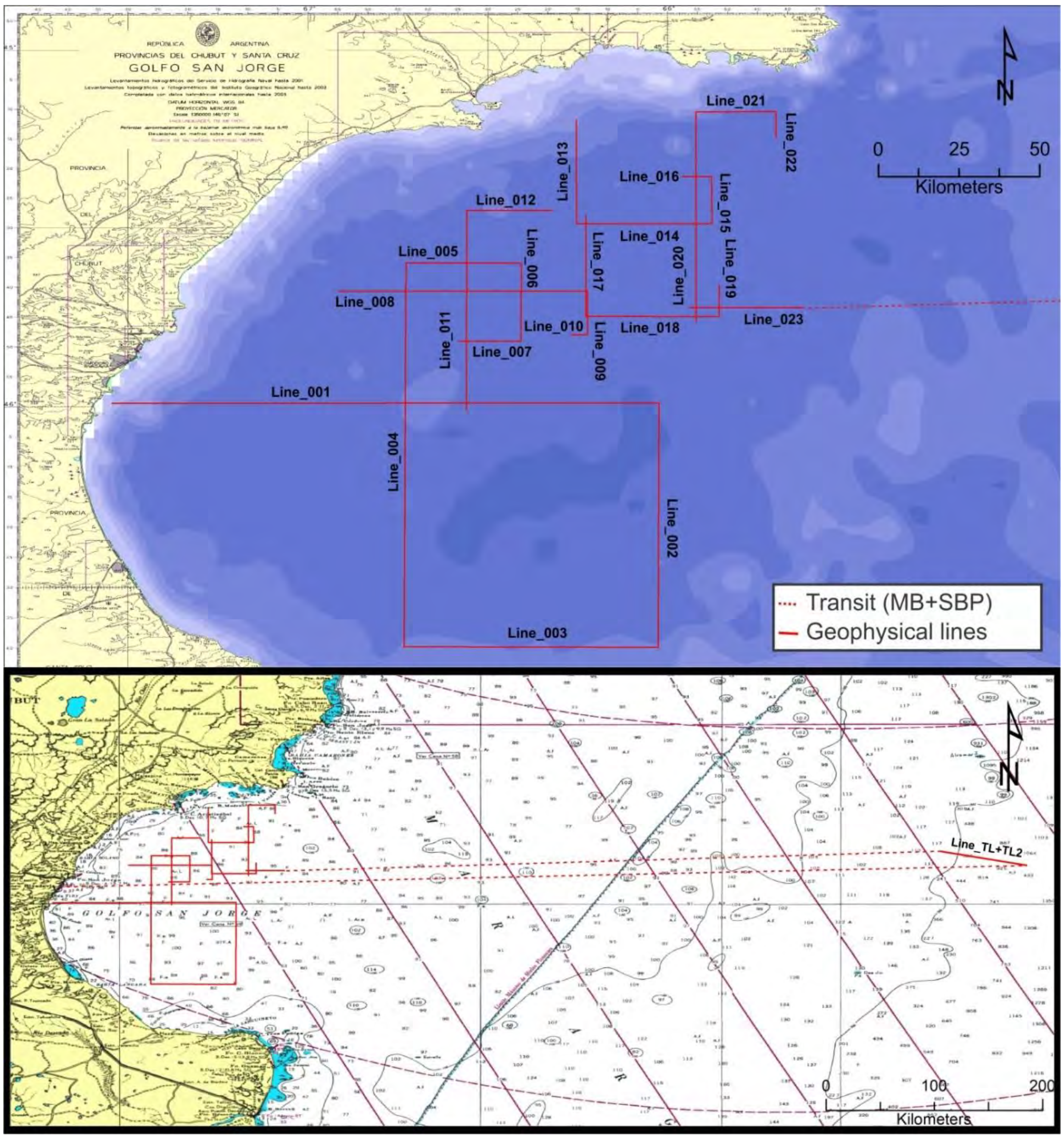

Figure 7. Location of the geophysical lines in the Gulf of San Jorge and the shelf edge.

Table 11. Date and hour and coordinates of start and end of multibeam echosounder (MB: EM 2040; MB3: EM 302) and Edgetech subbottom profiler (SBP) lines.

Name	Stop	Start hour (UTC)	Start coordinates Lat. (S)	Start coordinates Long. (W)	End hour (UTC)	End coordinates Lat. (S)	End coordinates Long. (W)	Instruments	Date	Comments
Line_001		00:50:00	45°58,207	67°29,422	10:50:02	46°59,050	66°36,561	SBP	2014-02-18	
		01:25:00	45°58,612	67°29,930				MB	2014-02-18	
	X	11:47:00	45°58,760	66°34,488	16:31:31	45°59,120	66°01,923	MB + SBP	2014-02-18	
Line_002		17:09:00	45°59,612	66°01,487	03:43:00	46°39,883	66°01,530	MB	2014-02-18(19)	
	X	21:54:55	46°22,343	66°01,501	23:34:00	46°22,840	66°02,158	MB	2014-02-18	
		23:59:32	46°23,798	66°01,651	03:43:00	46°39,883	66°01,530	SBP	2014-02-18(19)	SBP started later for checking
Line_003		03:44:00	46°39,883	66°01,530	10:50:32	46°66,516	66°72,425	MB + SBP	2014-02-19	
	X	07:04:00	46°39,886	66°23,079	08:11:00	46°39,909	66°25,169	MB + SBP	2014-02-19	
Line_004		11:40:42	46°65,385	66°73,209	01:56:07	45°36,886	66°43,654	MB + SBP	2014-02-19(20)	
	X	19:37:00	45°68,640	66°43,998	20:22:05	45°58,251	66°44,544	MB + SBP	2014-02-19	
Line_005		02:00:21	45°35,787	66°43,456	05:17:59	45°35,772	66°24,643	MB + SBP	2014-02-20	
Line_006		05:21:38	45°36,000	66°24,413	09:10:50	45°48,812	66°24,477	MB + SBP	2014-02-20	
	X	07:03:48	45°43,566	66°24,426	08:04:00	45°44,563	66°24,430	MB + SBP	2014-02-20	
Line_007		09:05:10	45°48,815	66°24,718	09:48;15	45°48,763	66°29,404	MB + SBP	2014-02-20	
Line_008		00:02:53	45°40,419	66°54,251	06:37:39	45°40,475	66°14,297	MB + SBP	2014-02-21	
		01:44:00	45°40,459	66°46,670	02:24:00	45°40,455	66°41,290	SBP	2014-02-21	No recording to try Knudsen SBP
Line_009		06:40:40	45°40,720	66°14,220	08:56:37	45°47,465	66°14,102	MB + SBP	2014-02-21	
	X	07:10:18	45°42,476	66°14,192	07:48:19	45°42,722	66°14,146	MB + SBP	2014-02-21	
		08:26:08	45°45,388	66°14,084	08:38:36	45°46,241	66°14,074	MB	2014-02-21	No recording to test SVP import
Line_010		09:02:30	45°47,607	66°14,690	10:10:00	45°47,649	66°21,134	MB + SBP	2014-02-21	
	X	09:06:05	45°47,664	66°19,024	09:12:00	45°47,700	66°15,702	SBP	2014-02-21	
Line_011		23:24:00	45°58,764	66°33,629	06:45:14	45°27,400	66°33,496	MB + SBP	2014-02-21(22)	
Line_012		06:50:12	45°27,250	66°33,679	10:12:00	45°27,005	66°19,015	MB + SBP	2014-02-22	
	X	07:18:00	45°27,010	66°30,822	08:13:26	45°26,979	66°30,427	MB + SBP	2014-02-22	
	X	08:58:09	45°26,997	66°26,140	09:15:50	45°26,996	66°24,062	MB + SBP	2014-02-22	
Line_013		23:56:43	45°12,400	66°15,237	03:47:00	45°29,115	66°15,236	MB + SBP	2014-02-24(25)	
Line_014		03:48:30	45°29,171	66°15,093	07:23:21	45°29,160	65°52,860	MB + SBP	2014-02-25	
Line_015		07:31:00	45°28,860	66°52,500	09:17:00	45°21,433	65°52,691	MB + SBP	2014-02-25	
Line_016		09:22:23	45°21,308	65°53,093	10:03:12	45°21,300	65°57,457	MB + SBP	2014-02-25	
Line_017		00:57:00	45°28,105	66°13,693	04:45:34	45°44,621	66°13,659	MB3 + SBP	2014-02-26	EM2040 → EM302
Line_018		04:53:42	45°44,939	66°12,961	06:59:00	45°46,026	66°59,972	MB3 + SBP	2014-02-26	
	X	07:51:48	45°44,960	65°58,923	09:07:37	45°45,001	65°51,766	MB3 + SBP	2014-02-26	
Line_019		09:14:27	45°44,708	65°51,708	10:33:00	45°39,398	65°51,418	MB3	2014-02-26	No recording for SBP
Line_020		22:26:00	45°45,280	65°55,310	05:37:00	45°11,326	65°56,192	MB3 + SBP	2014-02-26(27)	

Line_021		05:42:00	45°11,145	65°54,490	08:26:00	45°10,840	65°41,908	MB3 + SBP	2014-02-27	After CTD, in path of fish boat
	X	07:07:20	45°10,952	65°45,867	07:56:00	45°10,753	65°44,243	MB3 + SBP	2014-02-27	Vit: 2,2 kn; Lat: 45°10'75(~)
Line_022		08:29:00	45°10,963	65°41,903	09:49:20	45°12,229	65°42,269	MB3 + SBP	2014-02-27	
Line_023		01:00:00	45°43,133	65°55,857	04:06:45	45°43,110	65°36,525	MB3 + SBP	2014-02-28	
Line_TL		05:33:00	45°33,600	60°10,190	11:00:00	45°38,400	59°39,600	MB3 + SBP	2014-03-01	
Line_TL2		00:39:11	45°38,477	59°40,815	03:15:00	45°40,575	59°27,276	MB3 + SBP	2014-03-02	

Table 12. Date, hour and coordinates of the start and end of sparker lines.

Name	Stop (CTD, …)	Start hour (UTC)	Start coordinates		End hour (UTC)	End coordinates		Date	Comments
			Lat. (S)	Long. (W)		Lat. (S)	Long. (W)		
Line_001		00:47:46	45°58,207	67°29,915	10:50:02	46°59,050	66°36,561	2014-02-18	First line -Start at 1000 J - Trig: 1s
	X	08:05:00	45°59,071	67°48,160	08:33:00	46°59,083	66°47,224	2014-02-18	
Line_001_Bis		11:42:00	45°58,735	66°34,874	16:31:31	45°59,120	66°01,923	2014-02-18	
Line_002		17:09:00	45°59,735	66°01,487	21:30:00	46°22,838	66°02,158	2014-02-18	
Line_002_Bis		23:34:31	45°22,838	66°02,158	03:42:00	46°39,947	66°01,755	2014-02-18(19)	1000 J →1500 J →1000 J
Line_003		03:45:41	46°39,947	66°01,755	07:04:00	46°39,879	66°22,987	2014-02-19	
Line_003_Bis		08:11:00	46°39,909	66°25,169	10:49:34	46°39,910	66°42,842	2014-02-19	
Line_004		11:42:58	46°39,567	66°43,977	19:36:35	45°58,680	66°43,977	2014-02-19	
Line_004_Bis		20:19:11	46°58,413	66°44,180	01:55:46	45°35,912	66°43,888	2014-02-19(20)	No long. few sec. near 1:55
Line_005		01:58:39	45°35,800	66°43,683	05:17:39	45°35,768	66°24,677	2014-02-20	No long. few sec. near 2:18
Line_006		05:21:50	45°36,009	66°24,416	06:57:44	45°43,185	66°24,447	2014-02-20	No long. few min. near 6:00
Line_006_Bis		08:03:28	45°44,528	66°24,433	09:02:41	45°48,797	66°24,460	2014-02-20	
Line_007		09:04:50	45°48,817	66°24,672	09:27:00	45°48,753	66°28,061	2014-02-20	
Line_007_Bis		09:27:11	45°48,753	66°28,061	09:46:33	45°48,761	66°29,206	2014-02-20	2.5V; No long. few min. 66°40'454
Line_008		00:33:31	45°40,419	66°54,276	06:36:58	45°40,445	66°14,371	2014-02-21	
Line_009		06:40:30	45°40,687	66°14,219	07:00:04	45°42,108	66°14,173	2014-02-21	
Line_009_Bis		07:51:40	45°42,889	66°14,152	08:56:29	45°47,453	66°14,110	2014-02-21	
Line_010		09:27:00	45°47,683	66°14,690	10:02:43	45°47,715	66°20,815	2014-02-21	
Line_011		23:24:00	45°58,814	66°33,525	06:44:20	45°27,480	66°33,492	2014-02-21(22)	1000 J → 1500 J
Line_012		06:51:06	45°27,254	66°33,111	07:05:30	45°27,080	66°31,476	2014-02-22	
Line_012_Bis		08:14:00	45°26,994	66°30,377	09:22:56	45°26,996	66°23784	2014-02-22	
Line_012_Bis2		09:22:56	45°26,996	66°23784	10:11:28	45°27,004	66°19,076	2014-02-22	
Line_013		23:55:44	45°12,285	66°15,252	03:45:55	45°29,030	66°15,263	2014-02-24(25)	No long. for last minutes
Line_014		03:48:53	45°29,172	66°15,090	07:22:46	45°29,179	65°52,877	2014-02-25	
Line_015		07:30:16	45°28,945	65°52,488	09:17:21	45°21,431	65°52,686	2014-02-25	
Line_016		09:20:29	45°21,294	65°52,888	09:29:22	45°21,300	65°54,958	2014-02-25	
Line_016_Bis		09:29:22	45°21,300	65°54,958	10:03:00	45°21,298	65°57,439	2014-02-25	
Line_017		00:45:12	45°27,944	66°13,686	04:44:59	45°44,570	66°13,571	2014-02-26	

Line_018	04:53:55	45°44,941	66°12,969	06:56:51	45°45,010	66°00,194	2014-02-26	
Line_018_Bis	07:51:32	45°44,958	65°58,935	09:16:00	45°44,634	65°51,457	2014-02-26	
Line_019	09:23:57	45°44,110	65°51,421	10:31:38	45°39,474	65°51,417	2014-02-26	Recording problems
Line_020	22:25:01	45°45,360	65°55,312	05:37:14	45°11,386	65°55,227	2014-02-26(27)	
Line_021	05:41:39	45°11,198	65°54,699	07:00:59	45°10,964	65°46,375	2014-02-27	Low speed; No data after CTD
Line_022							2014-02-27	Sparker didn't work
Line_023	01:01:00	45°43,133	65°55,812	04:06:00	45°43,110	65°36,569	2014-02-28	
Line_TL	05:34:00	45°33,164	60°10,183	06:42:00	45°34,834	60°02,426	2014-03-01	05:56:32 Sound speed at 1550 m/s
Line_TL_Bis	06:44:00	45°34,861	60°02,275	10:30:00	45°38,546	59°40,507	2014-03-01	Sd speed 1500 m/s; Trig: 2s
Line_TL2	00:40:00	45°38,499	59°40,712	03:01:37	45°40,690	59°27,543	2014-03-02	Last line

Table 13. Date, hour and coordinates of the start and end of geophysical lines (multibeam echosounder and Edgetech subbottom profiler) performed in the marine national park.

Name	Start hour (UTC)	Start coordinates		End coordinates		Instruments	Date	Area
		Lat. (S)	Long. (W)	Lat. (S)	Long. (W)			
PA_1	23:29:52	45.0865	65.7934	45.0377	65.7929	MB+SBP	2014-02-22	Pan de Azúcar
PA_2	00:18:00	45.0382	65.7869	45.0984	65.7867	MB+SBP	2014-02-23	Pan de Azúcar
PA_3	01:01:00	45.0976	65.7817	45.0403	65.7819	MB+SBP	2014-02-23	Pan de Azúcar
PA_4	01:42:00	45.0405	65.7777	45.0986	65.7770	MB+SBP	2014-02-23	Pan de Azúcar
PA_5	02:24:00	45.0971	65.7730	45.0448	65.7725	MB+SBP	2014-02-23	Pan de Azúcar
PA_6	03:23:00	45.0479	65.7681	45.0989	65.7674	MB+SBP	2014-02-23	Pan de Azúcar
PA_7	04:04:00	45.0981	65.7631	45.0443	65.7634	MB+SBP	2014-02-23	Pan de Azúcar
PA_8	04:48:00	45.0450	65.7591	45.0982	65.7593	MB+SBP	2014-02-23	Pan de Azúcar
DIAG_PA	05:29:00	45.0982	65.7593	45.0554	65.7859	MB+SBP	2014-02-23	Pan de Azúcar
PA_2B	06:02:00	45.0554	65.7859	45.0642	65.7919	MB+SBP	2014-02-23	Pan de Azúcar
PA_1B	06:38:00	45.0642	65.7919	45.0751	65.7952	MB+SBP	2014-02-23	Pan de Azúcar
IV_1	06:50:00	45.0751	65.7952	45.1037	65.7946	MB+SBP	2014-02-23	Pan de Azúcar
IV_2	07:32:00	45.1014	65.7961	45.0758	65.7975	MB+SBP	2014-02-23	Pan de Azúcar
IV_3	07:53:00	45.0767	65.7986	45.1056	65.7984	MB+SBP	2014-02-23	Pan de Azúcar
IV_4	08:16:00	45.1050	65.7998	45.0754	65.8005	MB+SBP	2014-02-23	Pan de Azúcar
IV_5	08:39:00	45.0765	65.8023	45.1059	65.8021	MB+SBP	2014-02-23	Pan de Azúcar
IV_6	09:02:00	45.1050	65.8037	45.0753	65.8046	MB+SBP	2014-02-23	Pan de Azúcar
IV_7	09:25:00	45.0763	65.8063	45.1058	65.8056	MB+SBP	2014-02-23	Pan de Azúcar
IV_8	09:52:00	45.1026	65.8067	45.1042	65.8083	MB+SBP	2014-02-23	Pan de Azúcar
IV_P1	10:31:00	45.1041	65.8086	45.1035	65.8209	MB+SBP	2014-02-23	Pan de Azúcar
IV_P2	10:39:00	45.1035	65.8209	45.1025	65.8063	MB+SBP	2014-02-23	Pan de Azúcar

IV_P3	10:49:32	45.1019	65.8080	45.1019	65.8245	MB+SBP	2014-02-23	Pan de Azúcar
IV_P4	11:27:55	45.1011	65.8225	45.1008	65.8065	MB+SBP	2014-02-23	Pan de Azúcar
IV_P5	11:38:55	45.0999	65.8070	45.0998	65.8231	MB+SBP	2014-02-23	Pan de Azúcar
IV_P6	11:49:14	45.0990	65.8224	45.0989	65.8060	MB+SBP	2014-02-23	Pan de Azúcar
IV_P7	11:59:04	45.0979	65.8061	45.0979	65.8232	MB+SBP	2014-02-23	Pan de Azúcar
IV_P8	12:11:15	45.0970	65.8262	45.0969	65.8066	MB+SBP	2014-02-23	Pan de Azúcar
IV_P9	12:21:17	45.0959	65.8067	45.0960	65.8224	MB+SBP	2014-02-23	Pan de Azúcar
IV_P10	12:32:55	45.0951	65.8221	45.0947	65.8067	MB+SBP	2014-02-23	Pan de Azúcar
IV_P11	12:42:34	45.0937	65.8070	45.0939	65.8224	MB+SBP	2014-02-23	Pan de Azúcar
IV_P12	12:54:20	45.0930	65.8219	45.0925	65.8067	MB+SBP	2014-02-23	Pan de Azúcar
IV_P13	13:03:33	45.0916	65.8065	45.0917	65.8221	MB+SBP	2014-02-23	Pan de Azúcar
IV_P14	13:15:41	45.0909	65.8217	45.0906	65.8064	MB+SBP	2014-02-23	Pan de Azúcar
IV_P15	13:24:49	45.0896	65.8062	45.0894	65.8229	MB+SBP	2014-02-23	Pan de Azúcar
IV_P16	13:38:58	45.0887	65.8209	45.0883	65.8068	MB+SBP	2014-02-23	Pan de Azúcar
IV_P17	13:47:58	45.0873	65.8067	45.0873	65.8168	MB+SBP	2014-02-23	Pan de Azúcar
IV_BSt17	14:03:18	45.0934	65.8140			MB+SBP	2014-02-23	Pan de Azúcar
PA_BSt19	15:09:06	45.0923	65.7768	45.0777	65.7762	MB+SBP	2014-02-23	Pan de Azúcar
PA_BSt20	16:32:00	45.0760	65.7756	45.0760	65.7713	MB+SBP	2014-02-23	Pan de Azúcar
PA_BSt21	16:57:00	45.0767	65.7701	45.0575	65.7592	MB+SBP	2014-02-23	Pan de Azúcar
PA_BSt22	18:26:00	45.0540	65.7660	45.0513	65.7587	MB+SBP	2014-02-23	Pan de Azúcar
PA_BSt23	18:41:00	45.0531	65.7622	45.0810	65.8030	MB+SBP	2014-02-23	Pan de Azúcar
PA_BSt25	19:50:00	45.0826	65.8004	45.0860	65.8000	MB+SBP	2014-02-23	Pan de Azúcar
PA_BSt25	20:07:00	45.0864	65.7997	45.0807	65.8025	MB+SBP	2014-02-23	Pan de Azúcar
PA_BSt26	20:24:00	45.0815	65.8021	45.0844	65.8022	MB+SBP	2014-02-23	Pan de Azúcar
PA-RO	20:40:00	45.0847	65.8030	45.1156	66.2334	MB+SBP	2014-02-23	Pan de Azúcar
RO_1	23:21:00	45.1156	66.2334	45.1039	66.2240	MB+SBP	2014-02-23	Robredo
RO_02	23:38:00	45.1045	66.2258	45.1177	66.2365	MB+SBP	2014-02-23	Robredo
RO_03	00:01:00	45.1196	66.2392	45.1014	66.2239	MB+SBP	2014-02-24	Robredo
RO_04	00:23:00	45.1011	66.2248	45.1201	66.2409	MB+SBP	2014-02-24	Robredo
RO_05	00:49:00	45.1298	66.2426	45.0986	66.2234	MB+SBP	2014-02-24	Robredo
RO_06	01:16:00	45.0979	66.2244	45.1208	66.2441	MB+SBP	2014-02-24	Robredo
RO_07	01:44:00	45.1200	66.2443	45.0949	66.2220	MB+SBP	2014-02-24	Robredo
RO_08	02:24:00	45.1079	66.2255	45.1211	66.2376	MB+SBP	2014-02-24	Robredo
RO_09	02:44:00	45.1197	66.2338	45.1075	66.2238	MB+SBP	2014-02-24	Robredo
RO_10	02:57:00	45.1080	66.2228	45.1203	66.2318	MB+SBP	2014-02-24	Robredo
RO_11	03:19:00	45.1194	66.2299	45.1106	66.2330	MB+SBP	2014-02-24	Robredo
RO_12	03:29:00	45.1116	66.2227	45.1288	66.2340	MB+SBP	2014-02-24	Robredo
RO_13	03:58:00	45.1276	66.2315	45.1100	66.2205	MB+SBP	2014-02-24	Robredo
RO_14	04:18:00	45.1108	66.2194	45.1294	66.2306	MB+SBP	2014-02-24	Robredo
RO_15	04:46:00	45.1284	66.2280	45.1109	66.2175	MB+SBP	2014-02-24	Robredo

RO_16	05:06:00	45.1122	66.2169	45.1334	66.2273	MB+SBP	2014-02-24	Robredo
RO_17	05:38:00	45.1326	66.2555	45.1110	66.2143	MB+SBP	2014-02-24	Robredo
RO_18	06:04:00	45.1116	66.2128	45.1342	66.2241	MB+SBP	2014-02-24	Robredo
RO_19	06:37:00	45.1330	66.2221	45.1113	66.2118	MB+SBP	2014-02-24	Robredo
RO_20	07:02:00	45.1121	66.2109	45.1266	66.2213	MB+SBP	2014-02-24	Robredo
RO_21	07:25:00	45.1266	66.2213	45.1221	66.2093	MB+SBP	2014-02-24	Robredo
RO_22	07:41:00	45.1128	66.2089	45.1301	66.2225	MB+SBP	2014-02-24	Robredo
RO_23	08:02:00	45.1295	66.2214	45.1127	66.2071	MB+SBP	2014-02-24	Robredo
RO_24	08:21:00	45.1134	66.2067	45.1338	66.2227	MB+SBP	2014-02-24	Robredo
RO_25	08:48:00	45.1327	66.2112	45.1134	66.2047	MB+SBP	2014-02-24	Robredo
RO_26	09:15:00	45.1142	66.2047	45.1350	66.2211	MB+SBP	2014-02-24	Robredo
RO_27	09:46:00	45.1345	66.2190	45.1140	66.2020	MB+SBP	2014-02-24	Robredo
RO_28	10:12:00	45.1146	66.2025	45.1430	66.2262	MB+SBP	2014-02-24	Robredo
RO_BSt7	10:49:00	45.1430	66.2262	45.1265	66.2300	MB+SBP	2014-02-24	Robredo
RO_BSt8	11:44:53	45.1272	66.2288	45.1282	66.2212	MB+SBP	2014-02-24	Robredo
RO_BSt9	12:06:50	45.1288	66.2213	45.1270	66.2191	MB+SBP	2014-02-24	Robredo
RO_BSt10	12:32:00	45.1275	66.2189	45.1265	66.2141	MB+SBP	2014-02-24	Robredo
RO_BSt11	12:49:45	45.1265	66.2136	45.1122	66.2063	MB+SBP	2014-02-24	Robredo
RO_BSt12	13:20:57	45.1129	66.2063	45.1134	66.2188	MB+SBP	2014-02-24	Robredo
RO_BSt13	13:51:51	45.1140	66.2197	45.1133	66.2244	MB+SBP	2014-02-24	Robredo
RO_BSt14	14:07:45	45.1135	66.2241	45.1084	66.2282	MB+SBP	2014-02-24	Robredo
RO_BSt15	14:27:40	45.1084	66.2274	45.1034	66.2255	MB+SBP	2014-02-24	Robredo
RO_BSt16	14:58:40	45.1031	66.2248			MB+SBP	2014-02-24	Robredo
RO_BSt17	15:23:10	45.1034	66.2259	45.1019	66.2263	MB+SBP	2014-02-24	Robredo
RO_BSt18	15:37:00	45.1051	66.2286	45.1146	66.2364	MB+SBP	2014-02-24	Robredo
RO_29	16:23:06	45.1189	66.2450	45.1007	66.2291	MB+SBP	2014-02-24	Robredo
RO_30	16:42:00	45.1027	66.2305	45.1196	66.2466	MB+SBP	2014-02-24	Robredo
RO_31	16:59:54	45.1188	66.2476	45.1011	66.2292	MB+SBP	2014-02-24	Robredo
RO_32	17:17:09	45.1007	66.2301	45.1190	66.2491	MB+SBP	2014-02-24	Robredo
RO_33	17:38:14	45.1180	66.2494	45.0997	66.2299	MB+SBP	2014-02-24	Robredo
RO_34	17:58:19	45.0994	66.2308	45.1182	66.2511	MB+SBP	2014-02-24	Robredo
RO_35	18:20:07	45.1176	66.2516	45.0992	66.2316	MB+SBP	2014-02-24	Robredo
RO_36	18:40:33	45.0989	66.2325	45.1176	66.2528	MB+SBP	2014-02-24	Robredo
RO_37	19:02:53	45.1156	66.2549	45.1190	66.2548	MB+SBP	2014-02-24	Robredo
RO_38	19:31:54	45.1173	66.2545	45.0988	66.2332	MB+SBP	2014-02-24	Robredo
RO_39	20:05:55	45.0987	66.2347	45.1161	66.2540	MB+SBP	2014-02-24	Robredo
RO_40	20:26:33	45.1156	66.2548	45.0978	66.2360	MB+SBP	2014-02-24	Robredo
RO_41	20:50:48	45.0980	66.2380	45.1148	66.2555	MB+SBP	2014-02-24	Robredo
RO_42	21:09:41	45.1142	66.2563	45.0974	66.2386	MB+SBP	2014-02-24	Robredo
RO_43	21:32:00	45.0980	66.2407	45.1137	66.2571	MB+SBP	2014-02-24	Robredo

TO_44	21:51:03	45.1131	66.2581	45.0968	66.2406	MB+SBP	2014-02-24	Robredo
FINAL	22:53:13	45.1068	66.2403	45.1971	66.2547	MB+SBP	2014-02-24	Robredo

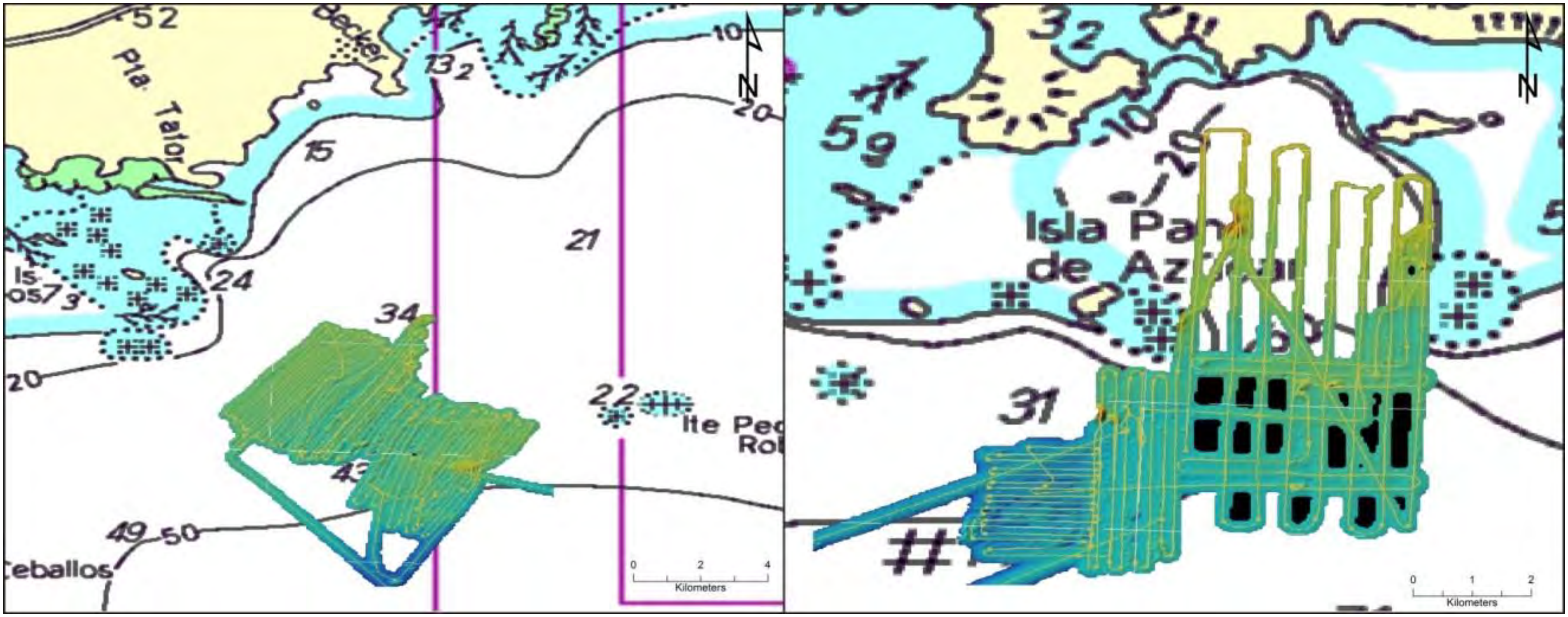

Figure 8. Multibeam echosounder lines conducted in the two areas of the national park.

6. Expedition log

Day 1: Monday, February 17th 2014

The R/V Coriolis II left the port of *Comodoro Rivadavia* at 19:00. Approximately 1h after departure, the rosette-CTD was deployed (Ros-01) and water samples were collected at 2, 9, 15 and 25 m depth at the starting coordinates of seismic line 001. Once the rosette-CTD was on board, the sparker, streamer, and marine magnetometer were deployed behind the ship and acquisition started at 21:47 in a moderately agitated sea during a sunny evening. In addition to these towed-instruments, the hull-mounted multibeam echosounder and subbottom profiler were used simultaneously during acquisition.

Day 2: Tuesday, February 18th 2014

Geophysical acquisition continued on seismic line 001 all night and morning with the sparker, marine magnetometer, multibeam, and subbottom profiler. During late morning, the subbottom profiler data were not of high quality. The transducers were checked and serviced and the subbottom profiler went back into operation. The rosette-CTD was performed two times (8:05 and 13:40; Ros-02 and 03) and water samples were taken at 2, 20, 40, 50 and 90 m, and 2, 40, 50 and 90 m, respectively. The sea was moderately agitated. At 13:31, seismic line 001 ended and line 002 started at 14:09. At 13:35, the marine magnetometer malfunctioned. It was brought back on deck, but it was impossible to repair it and an email has been sent to Marine Magnetics for technical support. Then, geophysical surveys were interrupted between 18:54-20:35 to perform a rosette-CTD (at 19:05) to get water column data (Ros-04). At 19:50, the first Van Veen (VV) grab sampler (BV01) was deployed but was opened too early on deck. As both top and bottom of the sampler were mixed, it was impossible to sub-sample surface sediment. The whole sediment was therefore used for the biodiversity sample. A second VV grab (also labelled BV01) was executed to the same location and was used to collect surface sediment adequately. Afterwards, geophysical acquisition continued at 20:35, except for the subbottom profiler which started at 20:59. Meanwhile, Marine Magnetics suggested that the marine magnetometer was probably not working well because it was too close to the ship. We therefore deployed it to its maximum possible length, giving an extra 15 m and it yielded better results.

Day 3: Wednesday, February 19th 2014

Seismic line 002 ended at 00:43 and line 003 started at 00:44. Geophysical instruments were stopped from 4:04 to 5:11. At 4:15, the rosette-CTD was deployed to profile the water column (Ros-05), and a second VV grab sampler was conducted to sample surface sediment around 4:40 (BV02). Line 003 ended at 7:50. At 08:08, another CTD cast was performed (Ros-06) and a third VV grab collected surface sediment (BV03). Seismic line 004 started at 8:46. Marine magnetometer malfunctioned once again and was brought back on the ship for an undetermined time. Geophysical line 004 was interrupted between 16:37 and 17:22 to perform the rosette-CTD (Ros-07) and the VV grab sampler (BV04). Seismic line 004 was continued and terminated at 22:56 and line 005 started immediately after (23:00). After 19:00, the sea was more agitated (waves ± 2 m high) caused by an eastern wind of more than 30 knots. Consequently, a lot of noise was observed on Edgetech data, the sediment/water interface was observable only during short intervals. The bad conditions generated noise on sparker data as well, and decreased the quality of multibeam echosounder data.

Day 4: Thursday, February 20th 2014

The bad sea conditions that started last night sustained until approximately 2:00. Therefore, data from geophysical acquisitions were not of high-quality during that time. Line 005 ended at 2:17 and then line 006 started (2:21) with normal conditions. The latter was stopped between 4:03 to 5:04 to perform the rosette-CTD (Ros-08) and a VV grab sampling (BV05). Sediment collected remained on the deck until approximately 8:00 when surface sediments were sub-sampled. The night crew also tried to deploy the marine magnetometer at 5:00 but it malfunctioned once again. It was then brought back to the ship at 6:48 for maintenance. Seismic line 006 ended at 6:10 and line 007 started immediately after. Line 007 stopped at 6:48 and continued as line 007 “transit to coring site” # 1. At 8:45, the box core was deployed. Once on the deck, the box was removed together with the structure of the sampler and sediments collapsed on deck. Around 9:04, a new box core has successfully collected sediment (001BC). From this box core, three push cores were sampled as well as surface sediment (same protocol as VV sampling) on one half of the box. From 11:00 to 15:30, the crew prepared the piston corer and deployed it at 15:33. The resulting core was 103-cm long (COR1401-001PC). Sediment in the core cutter was very compacted (semi-indured) which explains the low penetration of the corer. This hard horizon reflects the second reflector seen on most subbottom and sparker profile in the area. The ship then steamed to site # 2.

At 18:00, the gravity core was deployed. A 180-cm long core was collected (002GC). Around 19:30, surface sediments were sampled with the VV grab sampler at the same station (# 2). Samples are labelled BV06. At 19:35, the ship transited towards the starting point of line 008 that was initialized at 9:22 when all geophysical instruments were started (except the marine magnetometer). The data from the subbottom profiler were not of high quality. The water level around the transducers tank was checked but it was good. To validate if the problem originated from the transducers or from the subbottom profiler system, the Knudson subbottom profiler was tried from 22:44 to 23:24. The same problem was observed meaning that the problem comes from the transducers. After this check-up, line 008 continued as line 008bis and the Edgetech replaced the Knudson.

Day 5: Friday, February 21st 2014

Seismic line 009 started at 3:40 and terminated at 5:56. It was interrupted between 4:10 and 4:48 to perform the rosette-CTD (Ros-09) and the VV grab sampler (BV07). At 6:02, seismic line 010 started and continued until 7:10. The Edgetech subbottom profiler was interrupted from 6:06 to 6:12 to play back some lines to select a coring target. At 7:12, the ship started to transit towards the first coring site and the seismic line became "line 010 transit to coring # 3" and from 7:20, only the multibeam echosounder and subbottom profiler acquired data. From 8:00 to 10:00, the water tank where the transducers are located was emptied in order to check and clean them. Meanwhile, the crew prepared the piston corer. The latter was deployed around 11:00. A 400-cm and a 266-cm long core were collected with the piston corer (COR1404-003PC) and the trigger weight corer

(COR1404-003TWC) respectively. The sediment/water interface was sampled with the VV grab sampler (BV08). Around 14:30, the ship steamed to coring site # 4. At 15:38, the box corer collected surface sediment and three push cores were sampled in it (004BC). The gravity corer was also deployed at this site and resulted in a 121.5-cm long core (COR1404-004GC). Around 17:30, the ship transited to coring site # 5 where the gravity corer (COR1404-005GC) and a VV grab sampler (BV09) were performed. Seismic line 011 started at 20:24 nearby the coring site # 5. During the day, the subbottom transducers were cleaned. After that, data were of better quality, but still showed some short interruptions.

Day 6: Saturday, February 22nd 2014

Seismic line 011 ended at 3:45 and line 012 started at 3:50. The latter was interrupted between 4:18 and 5:13 to perform the rosette-CTD (Ros-10) and the VV grab sampler (BV10). Line 011 was also interrupted from 5:58 to 6:15 to play back seismic lines in order to choose potential coring sites. The ship transited to the coring site # 6 where the box core collected the sediment/water interface (006BC) at 8:31. Three push cores were sampled in it, as well as the usual VV protocol for surface sediment. At 11:18, the rosette-CTD (Ros-11) was performed. The piston corer was deployed at 11:55. A 216.5-cm long trigger weight core (COR1404-006TWC) and a 359.5-cm long piston core (COR1404-006PC) were collected. The latter stopped on a compacted clay layer. The core cutter was filled by the compacted clay which contained shell fragments. The ship then moved to coring site # 7, where a box core (COR1404-007BC) was sampled along with a 222.5-cm long gravity core (COR1404-007GC). Around 16:00, the ship transited towards the *Parque Nacional Interjurisdiccional Marino Costero Patagonia Austral* where two different areas are going to be mapped with the multibeam echosounder and the Edgetech subbottom profiler. At 19:50, the rosette-CTD (Ros-12) and the VV grab sampler (BV11) were performed at the starting point of the first area.

Day 7: Sunday, February 23rd 2014

During the night, the rosette-CTD was performed at 00:11 (Ros-13), and afterwards during the day at 8:18 (Ros-14), 11:12 (Ros-15), 13:15 (Ros-16) and 16:04 (Ros-17). The first area of the *Parque Nacional Interjurisdiccional Marino Costero Patagonia Austral* was mapped with the multibeam and subbottom profiler until approximately 17:00. The VV grab sampler (10 sites; BV12 to BV21) allowed the recovery of the sediment/water interface at : 11:04, 12:03, 13:13, 13:47, 15:19, 15:36, 16:05, 17:00, 17:18, and 17:38. The sites were selected to ground-truth the multibeam, backscatter and subbottom profiler data. The ship then steamed to the second area for mapping. The multibeam echosounder and the subbottom profiler acquired data during the transit and mapping of the second area started around 18:00. The sea was very agitated. As a result, the rosette-CTD was not used during the night.

Day 8: Monday, February 24th 2014

During the night, the multibeam echosounder and the subbottom profiler continued to map the second area in a very agitated sea. In the morning, the sea was calmer and the rosette-CTD was performed at 8:13 (Ros-18). At 8:32 and 8:45, two VV grab sampler were performed. Pebbles were found at both sites and only a cube filled with sediment was sub-sampled in the second one (BV22). BV23 was sampled at 9:01. Two other VV grab samples were then taken at 9:22 and 9:28. The former was filled with pebbles and organisms and the latter was empty (no BV24). BV25 was sampled at 9:45. At 10:10, a first deployment of the VV grab sampler was full of pebbles/cobbles and organisms. A second try was performed at 10:16 and was filled with sediment (BV26). Grab samples were then successfully recovered at 10:46 (BV27), 11:03 (BV28), and 11:22 (BV29). At 11:40, the rosette-CTD was performed (Ros-19), followed by two VV grab sampling attempts. The first grab sample contained no sediment, but many pebbles, while the second sample (BV30) was filled with shells and little sediment (just enough to sub-sample it). Between 12:14 and 12:18, two other VV were performed. The first was empty while the second one recovered just enough sediment to sub-sample a cube (BV31). BV32 and BV33 were then successfully sampled at 12:32 and 13:04 respectively. During the afternoon, the ship continued to map the second area of the national park with the multibeam echosounder and the subbottom profiler. The rosette-CTD was performed at 16:22, and 19:46 (Ros-20 and 21, respectively). A major problem occurred during the afternoon with the HIAB crane and it could no longer be used. The only instrument that absolutely needs the HIAB is the piston corer. In order to be able to still use the piston core, the crew moved its rail towards the A-frame in order to pull out the core with it instead of the HIAB. With this new setup, it is now impossible to use the three sections (9 m) of the piston corer, but two sections (6 m) can be used. In addition, the grab sampling will now be performed from the A-frame. Around 20:00, we stopped mapping the second area of the *Parque Nacional Interjurisdiccional Marino Costero Patagonia Austral* and the ship transited to the starting point of the seismic line 013 which started at 20:56 (including the sparker).

Day 9: Tuesday, February 25th 2014

During the night, a problem occurred with the hydraulic system of the ship and therefore both the VV grab sampler and the rosette-CTD were not used. Seismic line 013 was terminated at 00:47. Seismic line 014 was completed between 00:48 and 4:23, line 015 between 4:31 and 6:17, and line 016 from 6:22 to 7:03. The rosette-CTD and the VV grab sampler were performed at 7:22 (Ros-22) and 7:40 (BV34) respectively. At 7:51, the ship steamed to coring site # 8. The multibeam echosounder and the subbottom profiler continued acquiring data (without the sparker) and the seismic line is therefore labelled "016_transit_coring". The latter ended at 9:15. A box core was collected at 9:20 and three push cores were sampled in it (COR1404-008BC) in addition to the usual sediment/water interface sampling. The crew prepared the piston corer and deployed it around 13:15. We obtained a 226-cm long core with the trigger weight corer (COR1404-008TWC) and a 271-cm long core with the piston corer (COR1404-008PC). The piston corer stopped at a very compacted layer of fine sand. Then the ship moved to coring site # 9 to deploy the gravity corer and the box corer. The former collected a 147.5-cm long core (COR1404-009GC) and three push cores were sampled in the box core (COR1404-009BC). The ship transited to coring site # 10. Once again the box and gravity cores were deployed. Three push cores were sampled (COR1404-010BC) in the box core, whereas the recovered gravity core was 63 cm (COR1404-010GC-A). Due to the poor recovery, the gravity corer was deployed a second time and the resulting core was 105-cm long (COR1404-010GC-B). Both cores stopped at a clay layer containing a lot of small pebbles and shell fragments. The ship then steamed to seismic line 017. At 21:09, the rosette-CTD was performed (Ros-23), followed by the VV grab sampler (BV35) at the starting point of seismic line 017. A major problem occurred with the electronics of the multibeam echosounder (EM2040) and we were unable to fix the problem onboard. It will need later servicing and replacement of some electronic parts on shore. The EM302 multibeam system was used since that point.

Day 10: Wednesday, February 26th 2014

Seismic line 017 ended at 1:45 and line 018 started at 1:53 until 3:59. The rosette-CTD (Ros-24) and the VV grab sampler were then performed. At 4:51, seismic line 018bis started, was terminated at 6:07, and was followed by seismic line 019 which started 6:14 and ended at 7:33. The latter then changed to "019_transit_coring". During the transit, the crew prepared the piston corer. They deployed it at 9:53. The core in the trigger weight corer was 208 cm (COR1404-011TWC) and the core in the piston corer was 405 cm (COR1404-011PC). A problem occurred with the main winch (the one used for the piston corer) when the crew pulled out the corer on the deck. Around 13:00, the box core was deployed and the same problem occurred with the second winch. According to the engineers on board, the problem is related to the hydraulic system (both winches are on the same hydraulics) and both winches were further tested by the Chief engineer. VV grab sampler was deployed at 15:00 (BV37) and 17:46 (BV38), and the rosette-CTD at 17:36 (Ros-25). Seismic line 020 started at 19:26. After evaluation by the Chief engineer, the two main winches can now only be used 2 times per day, with a 4-hour delay between both deployments, and only for the gravity corer. **Neither box, nor piston corers can now be performed**. With that information, a decision was made by the Co-Chief scientists to pursue the expedition with geophysical lines during the night, grab sampling and two gravity cores during the day.

Day 11: Thursday, February 27th 2014

Seismic line 020 was terminated at 2:37. Seismic line 021 started at 2:42 and ended at 5:26. It was interrupted between 4:07 and 4:56 to perform the rosette-CTD (Ros-26) and the VV grab sampler (BV39). After that, a problem occurred with the sparker. The latter was brought back for verification and one series of tips was damaged. Seismic line 022 started at 5:29 and was terminated at 6:49 (multibeam and subbottom profiler only). The sparker was repaired. The VV grab sampler was performed at 8:11 (BV40), 9:16 (BV41), and 10:05 (BV42). The gravity corer was deployed at the coring site # 12 at 11:46. The resulting core was 59-cm long (COR1404-012GC). In the afternoon, the VV grab sampler was deployed at 12:21, 13:15, 14:08, 15:17, 16:08, 17:30, 18:41, and 19:34 (BV43 to BV50). At 16:25 (site of BV47), the gravity core was deployed and a 172-cm long core was collected (COR1404-013GC). In the core cutter/catcher, wood and shell fragments were found. Moreover, the gravity corer stopped at a very compacted layer of fine sediment. At 19:55, the gravity corer was deployed and a 221.5-cm long core was collected (COR1404-014GC). At 21:46, a rosette-CTD (Ros-27) was performed. Seismic line 023 started at 22:00 and ended at 1:06.

Day 12: Friday, February 28th 2014

From 1:19, the ship transited to the shelf break. The multibeam echosounder and the subbottom profiler continued to acquire data during the transit. The rosette-CTD was performed at 9:03 (Ros-28) and 17:38 (Ros-29) and the VV grab sampler at 9:18 (BV51) and 17:38 (BV52).

Day 13: Saturday, March 1st 2014

The ship steamed to shelf break until approximately 2:00. At 2:33, the seismic line labelled "TL" started. At 5:44, the rosette-CTD (Ros-30) was deployed; however, this presented problems with all sensors (Fig. 37). The rosette-CTD was comeback over the bridge and all sensors were re-calibrated. At 8:26, the rosette-CTD (Ros-31) was successfully performed and at 9:29, the VV grab sampler (BV53) collected a small amount of sand from the sediment/water interface. Both were performed at around 915 m depth. In addition, there were some benthic organisms and shells, and a piece of the cold-water coral (possibly of specie *Bathelia candida)*. The ship transited to a second site on the shelf break. Around 11:37, the rosette-CTD (Ros-32) was performed and water was sampled at 600, 300, 100, and 10 m depths. The VV grab sampler was performed three times. The first two times, the sampler did not hit the seafloor and came empty. The third time, the VV grab sampler (BV54) collected sand, shells, benthic organisms as well as two cold-water coral samples (possibly of specie *Caryophyllia antarctica*). The VV grab sampler was deployed at 17:00 and collected sand and a lot of shells (BV55). At 17:35, the last rosette-CTD (Ros-33) was performed. Finally, the gravity corer was deployed three times during the day but it came empty every time.

Day 14: Sunday, March 2nd 2014

At midnight, the ship started its long transit towards Comodoro Rivadavia. The multibeam echosounder and the subbottom profiler continued to acquire data during the transit.

Day 15: Monday, March 3rd 2014

The ship continued its transit towards Comodoro Rivadavia. As the day before, the multibeam echosounder and the subbottom profiler continued to acquire data during the transit.

The shipped arrived at the port on March 4th at 7:00.

7. Conclusion and preliminary results

Even though the expedition was challenging due to rough sea conditions, mechanical and/or hydraulic problems with the winches and crane, the expedition was still very successful with the acquisition of ~2000 km of geophysical lines, the collection of sediment samples at 62 stations and the profiling of the water column at 33 stations. A total of 55 grab samples, 8 box cores, 10 gravity, 5 piston cores and 17 seawater samples from 4 stations were recovered and will be analysed in details in the laboratory to achieve some of the MARGES objectives. In addition, two areas of the *Parque Interjurisdiccional Marino Costero Patagonia Austral* marine national park were successfully mapped at high-resolution, revealing submarine structures of interest for habitat mapping such as rock outcrops and sand waves, while several pockmarks in the Gulf of San Jorge and one large submarine landslide on the continental slope were also discovered during the cruise. In addition, at least two different species of cold water corals were identified and sampled, and will be used to reconstruct the sea water chemistry through time. Finally, the expedition was also a unique opportunity for students and postdoctoral fellow (5 from Argentina and 3 from Canada) to receive hands-on training in marine geology, and for some of them to collect the material and data necessary to pursue their respective degrees.

Appendix I – CTD profiles

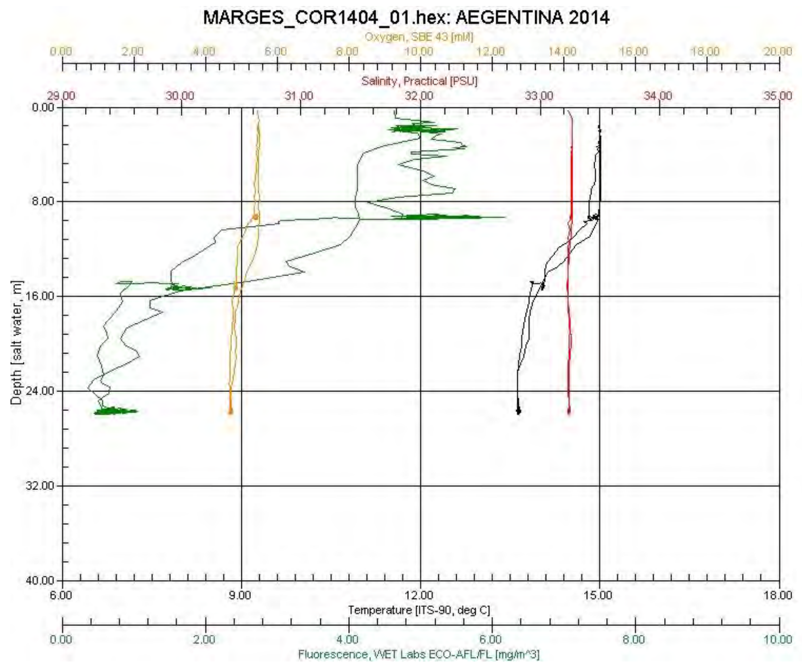

Figure 9. COR1404_01 CTD profile.

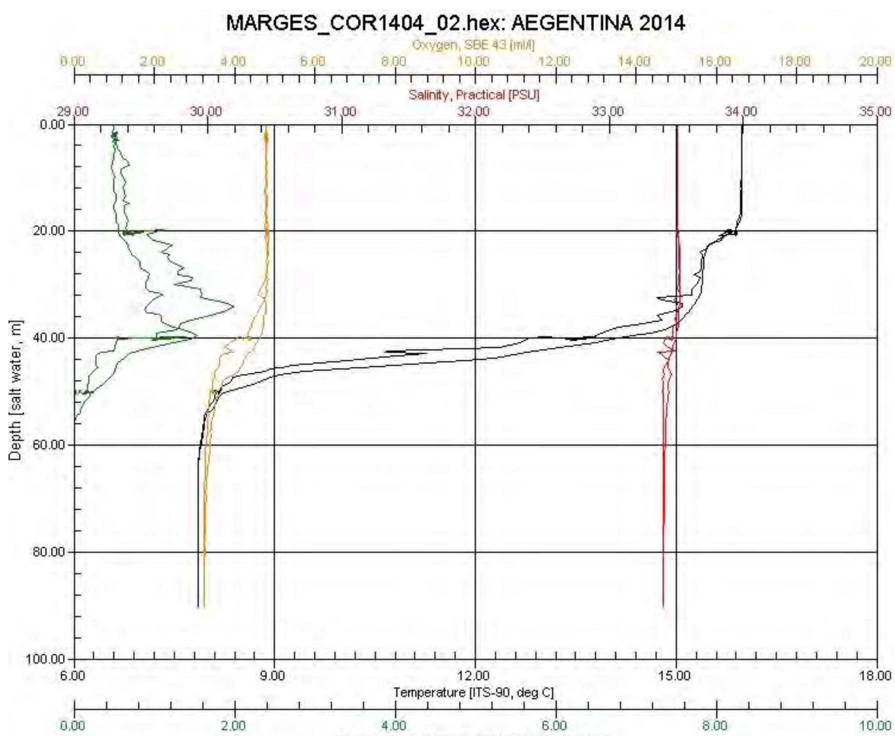

Figure 10. COR1404_02 CTD profile.

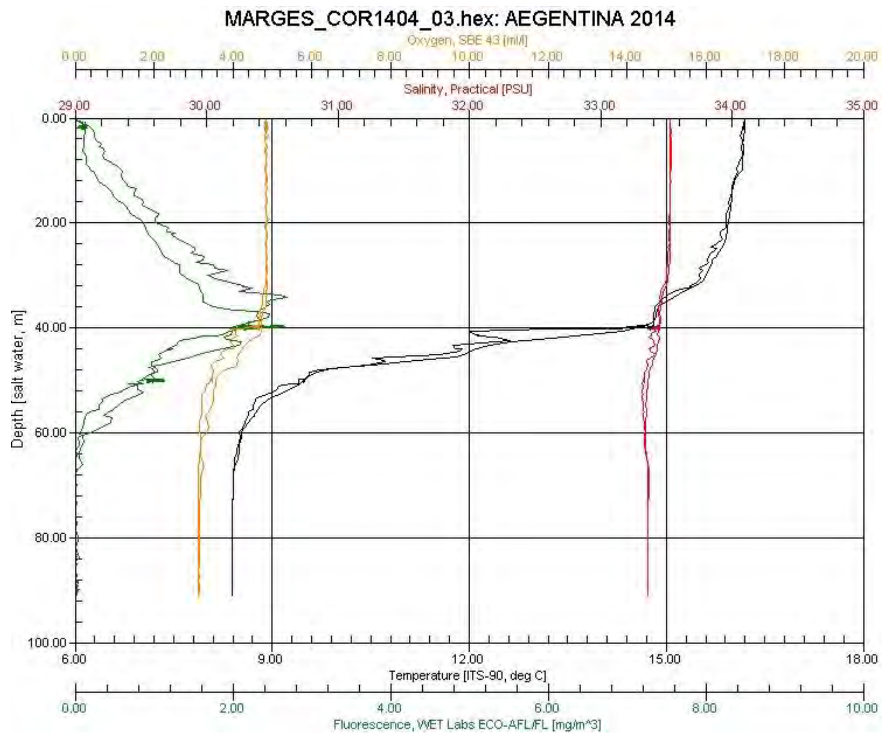

Figure 11. COR1404_03 CTD profile.

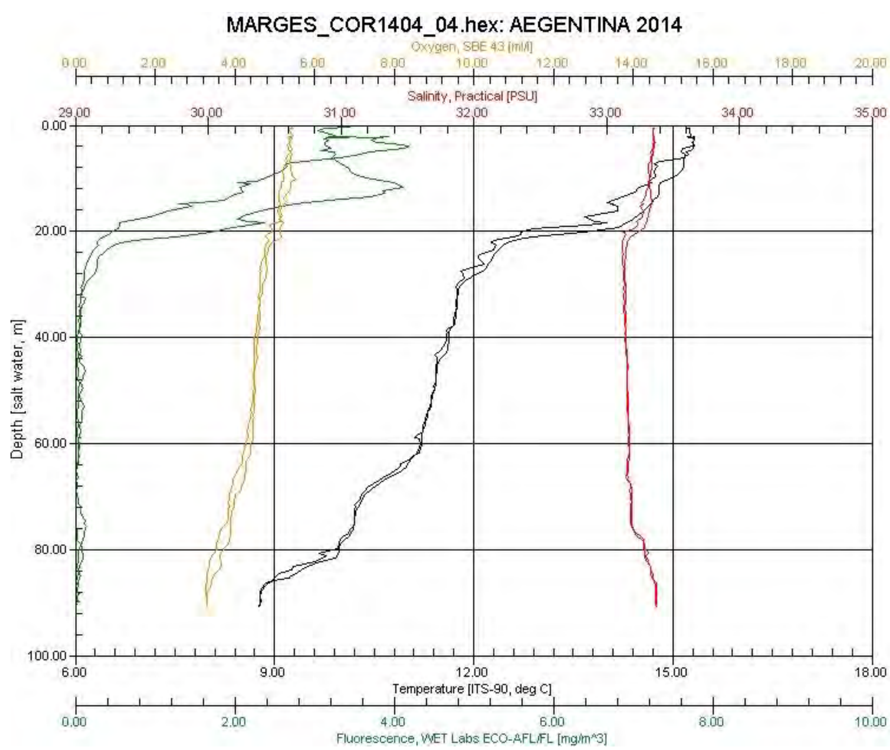

Figure 12. COR1404_04 CTD profile.

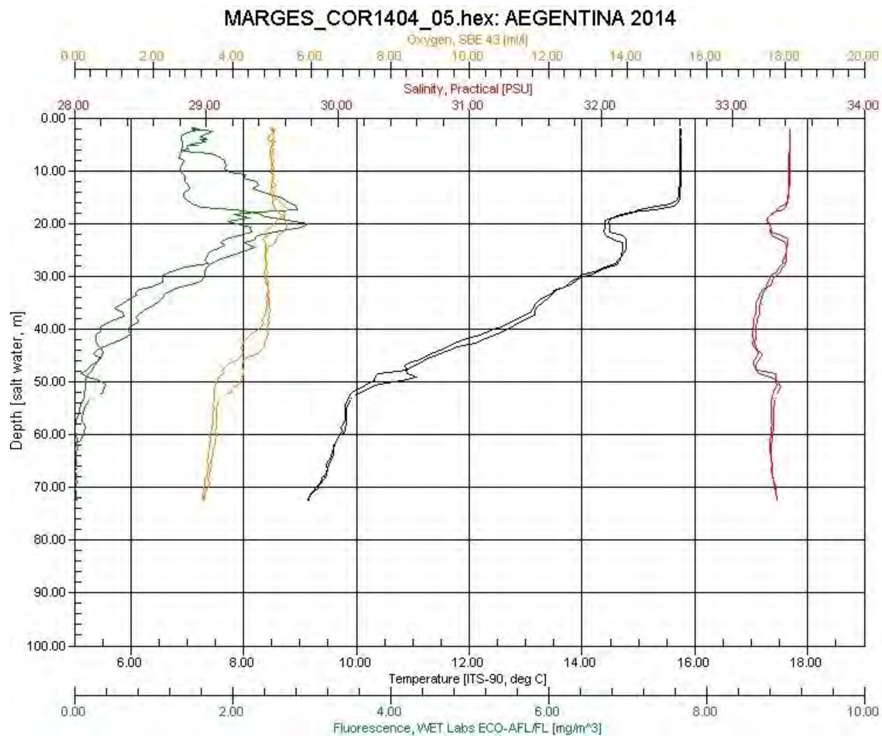

Figure 13. COR1404_05 CTD profile.

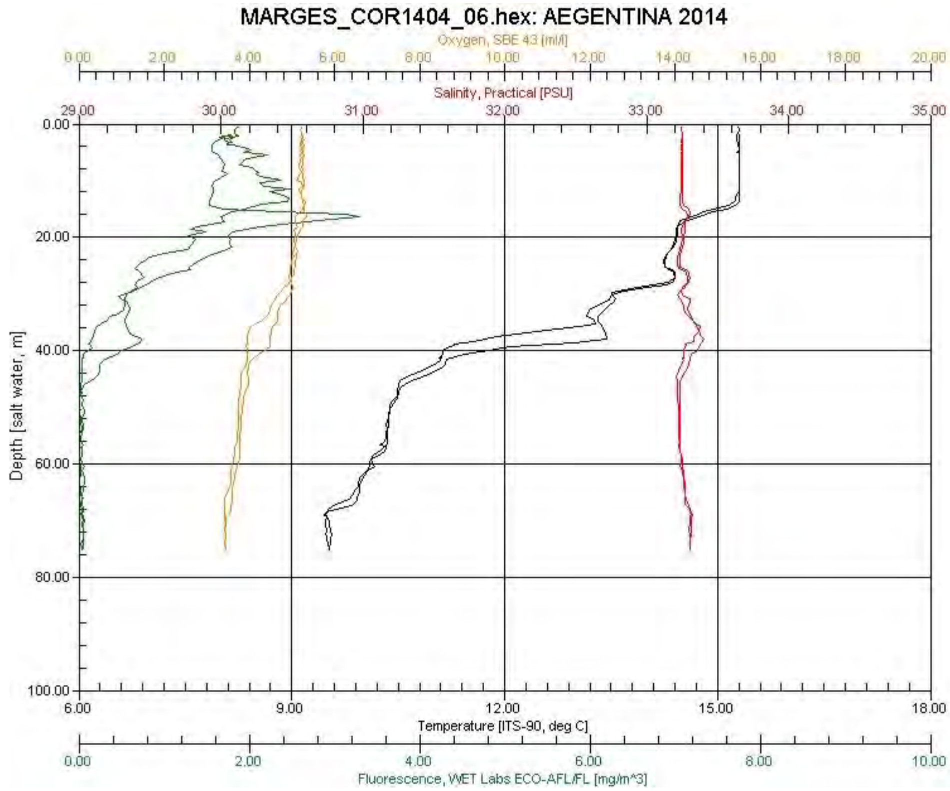

Figure 14. COR1404_06 CTD profile.

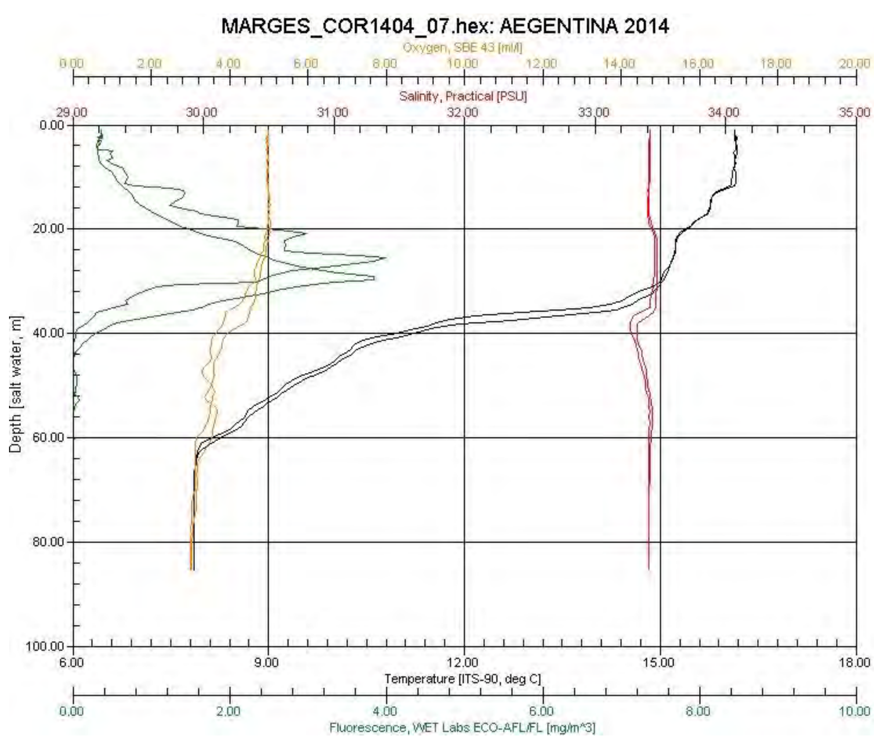

Figure 15. COR1404_07 CTD profile.

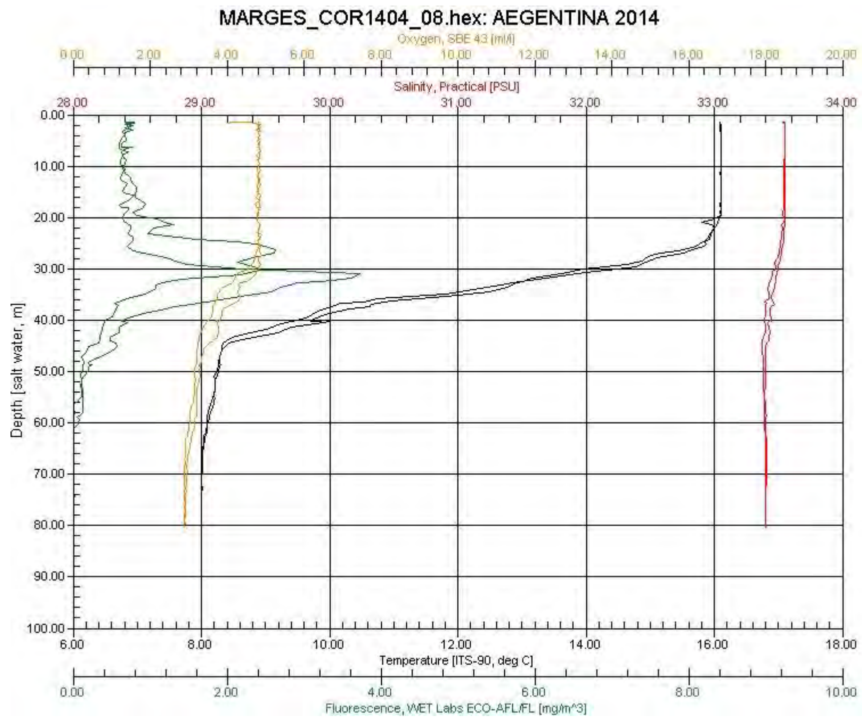

Figure 16. COR1404_08 CTD profile.

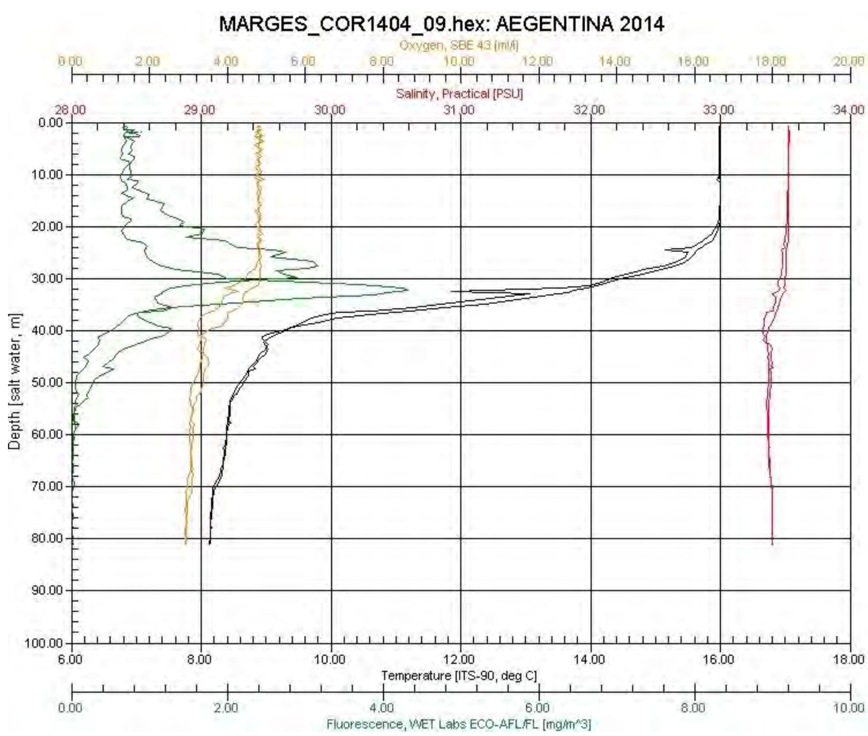

Figure 17. COR1404_09 CTD profile.

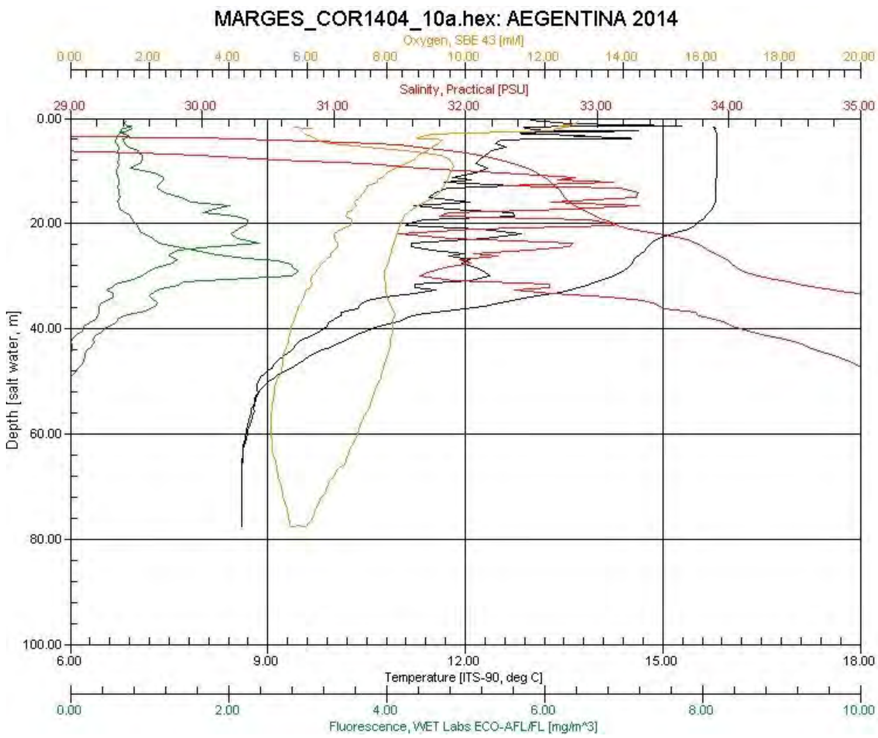

Figure 18. COR1404_10a CTD profile.

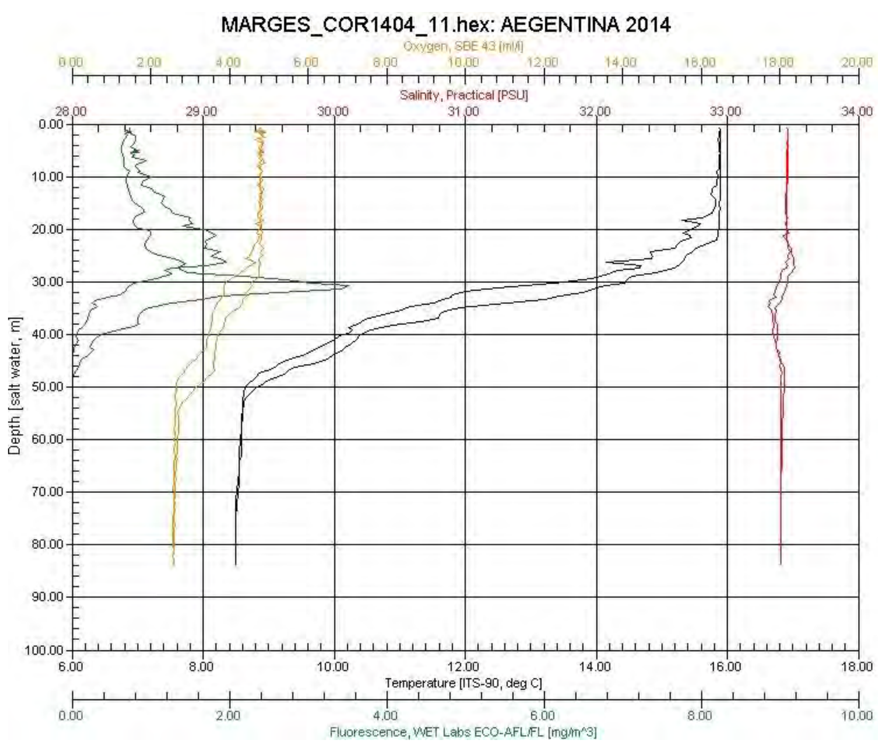

Figure 19. COR1404_11 CTD profile.

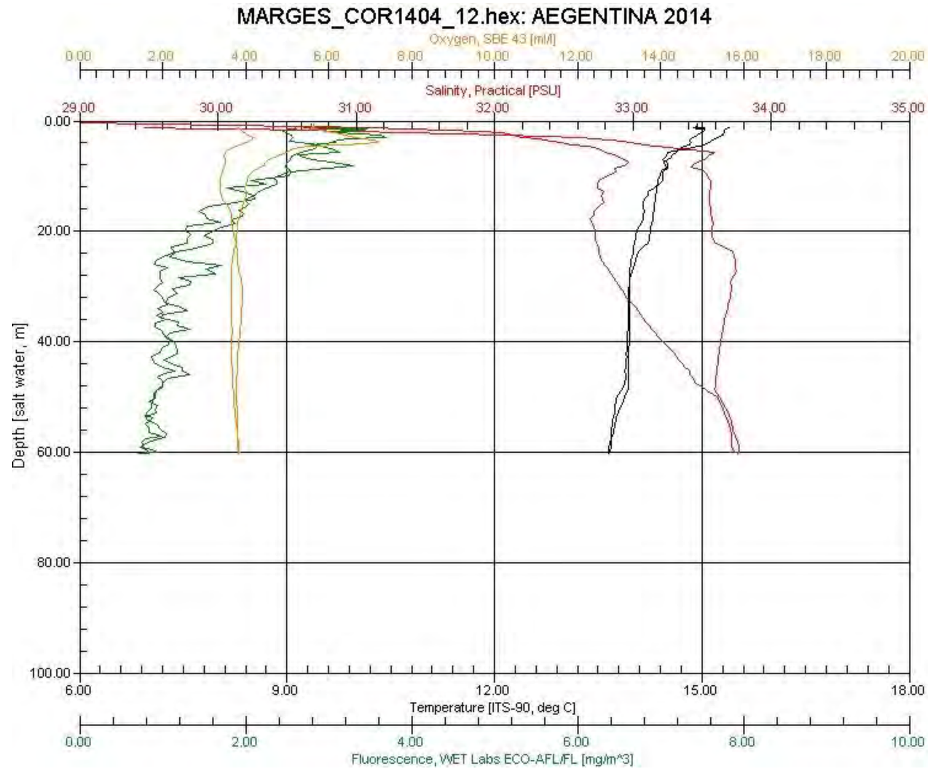

Figure 20. COR1404_12 CTD profile.

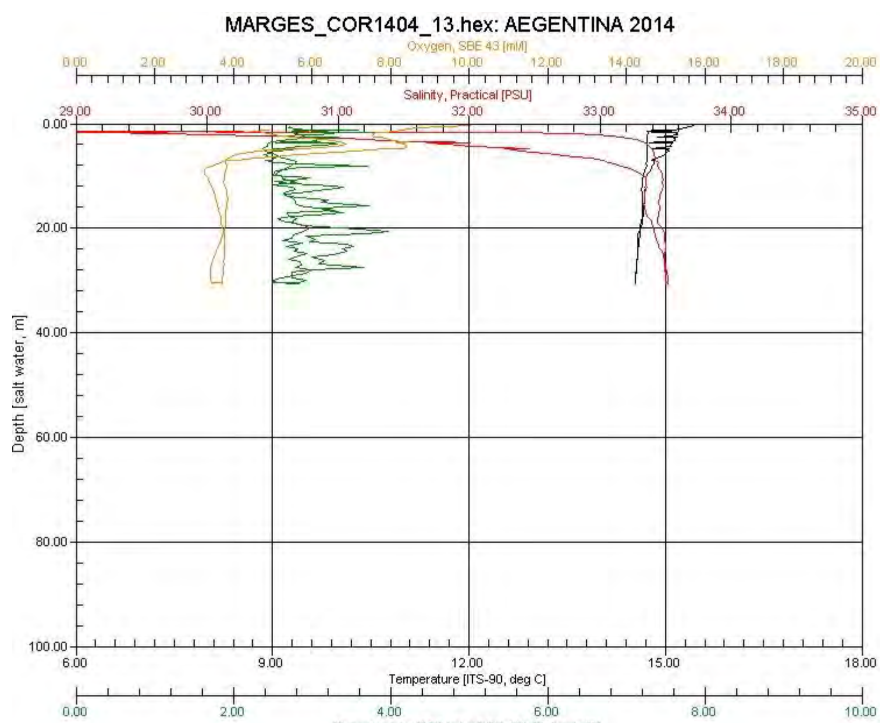

Figure 21. COR1404_13 CTD profile.

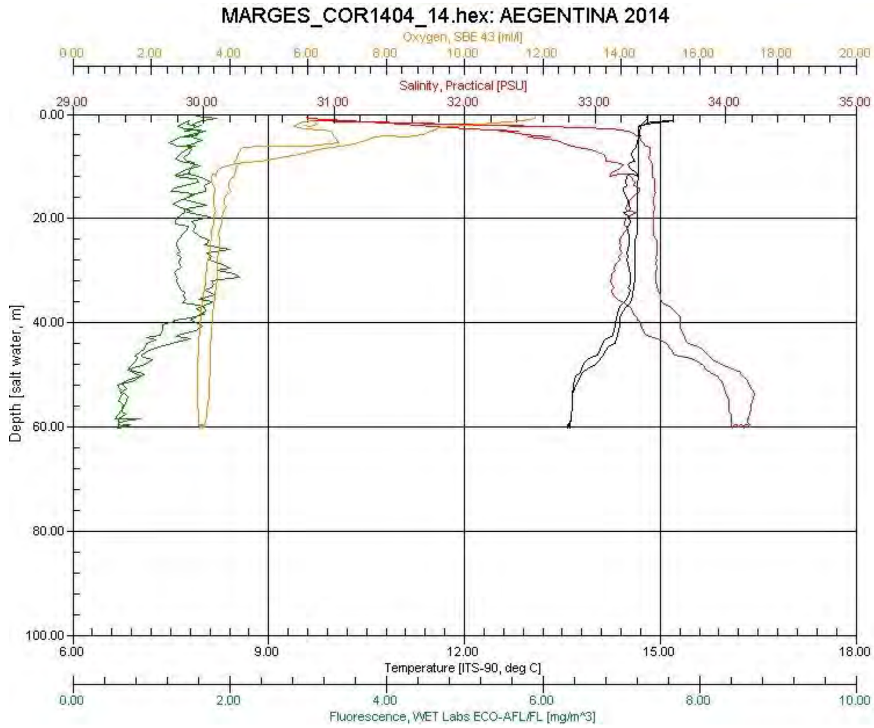

Figure 22. COR1404_14 CTD profile.

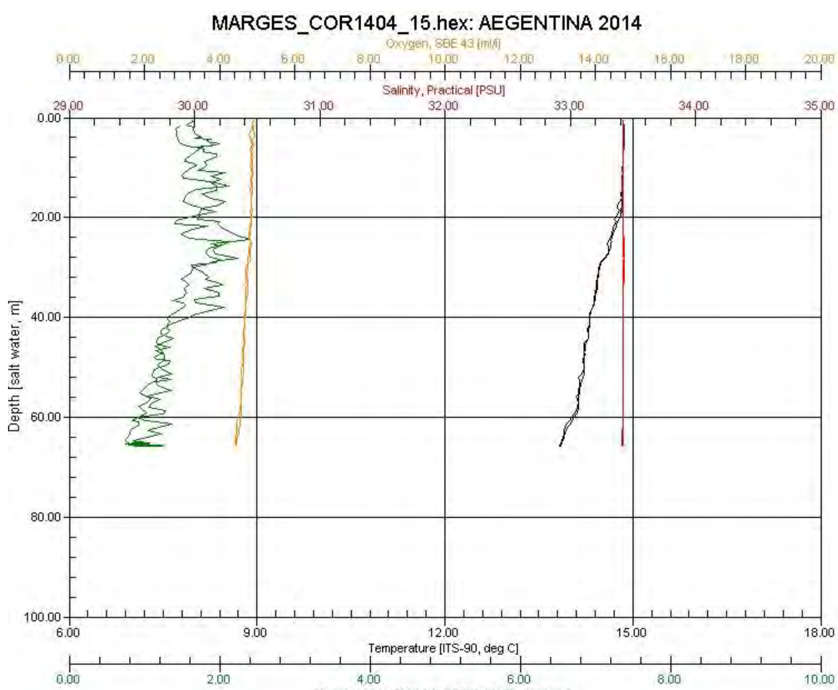

Figure 23. COR1404_15 CTD profile.

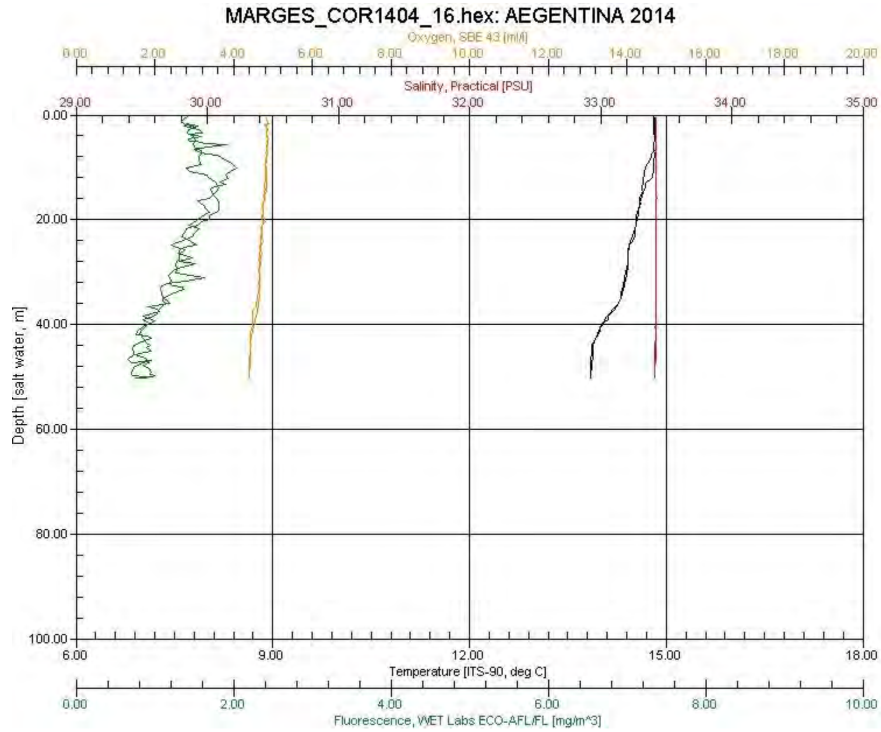

Figure 24. COR1404_16 CTD profile.

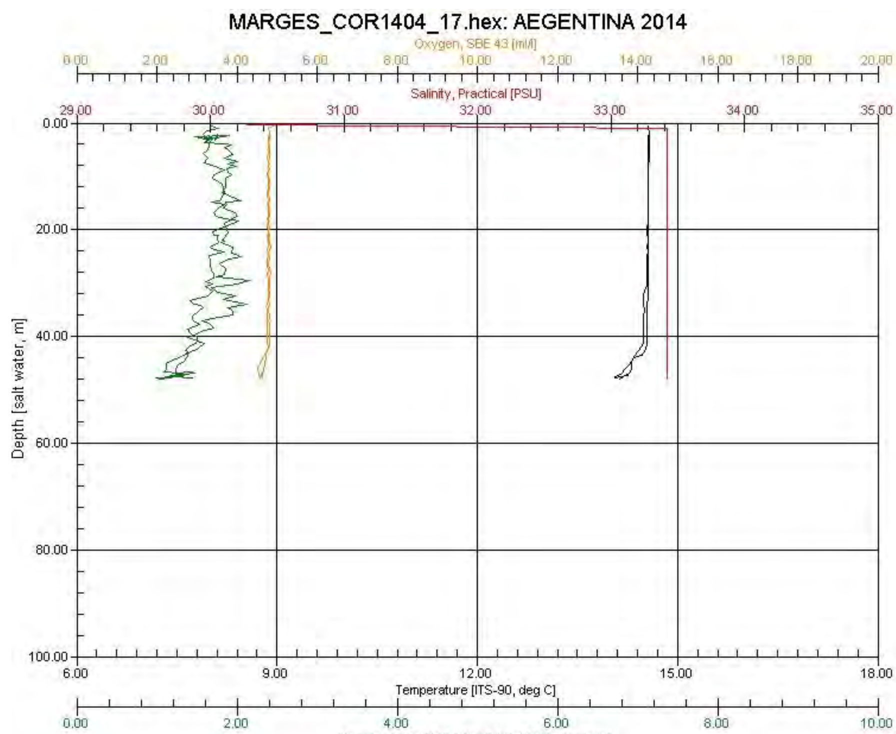

Figure 25. COR1404_17 CTD profile.

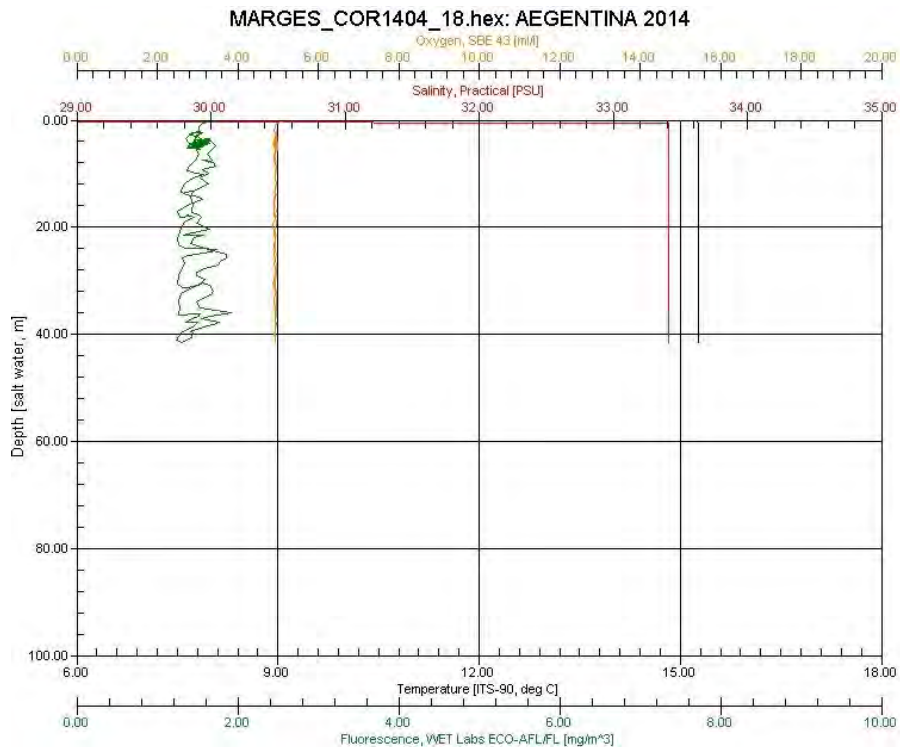

Figure 26. COR1404_18 CTD profile.

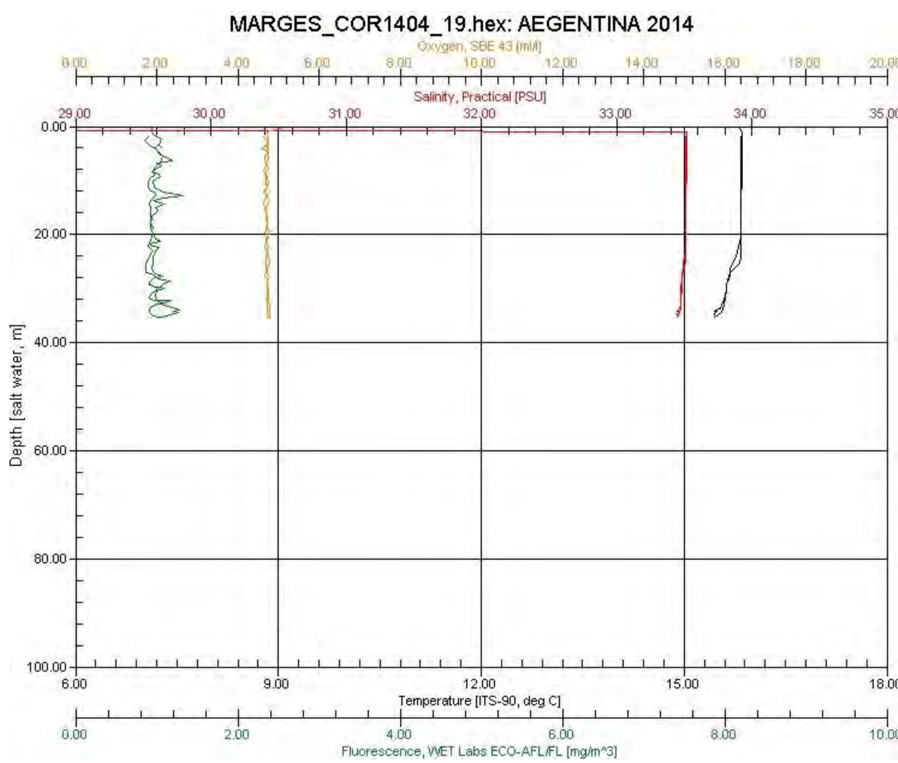

Figure 27. COR1404_19 CTD profile.

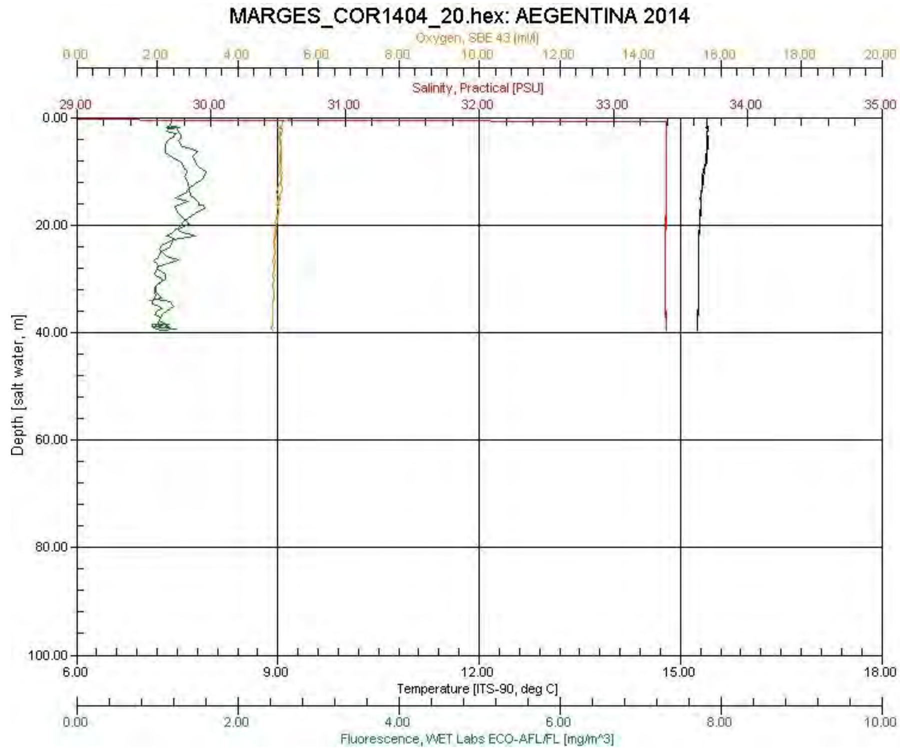

Figure 28. COR1404_20 CTD profile.

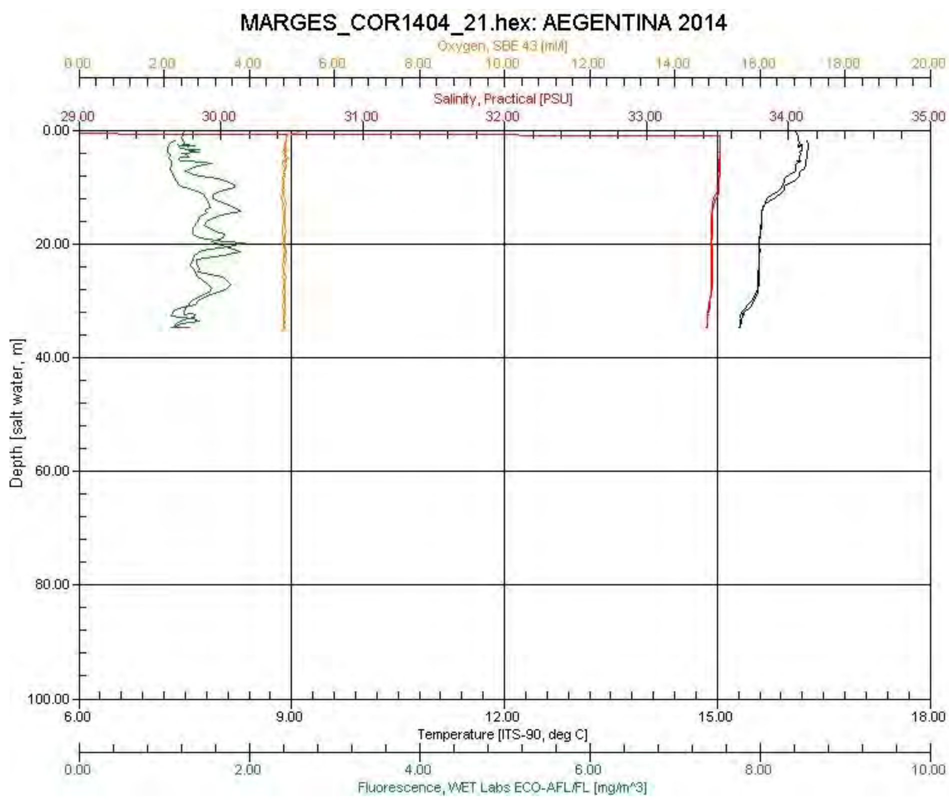

Figure 29. COR1404_21 CTD profile.

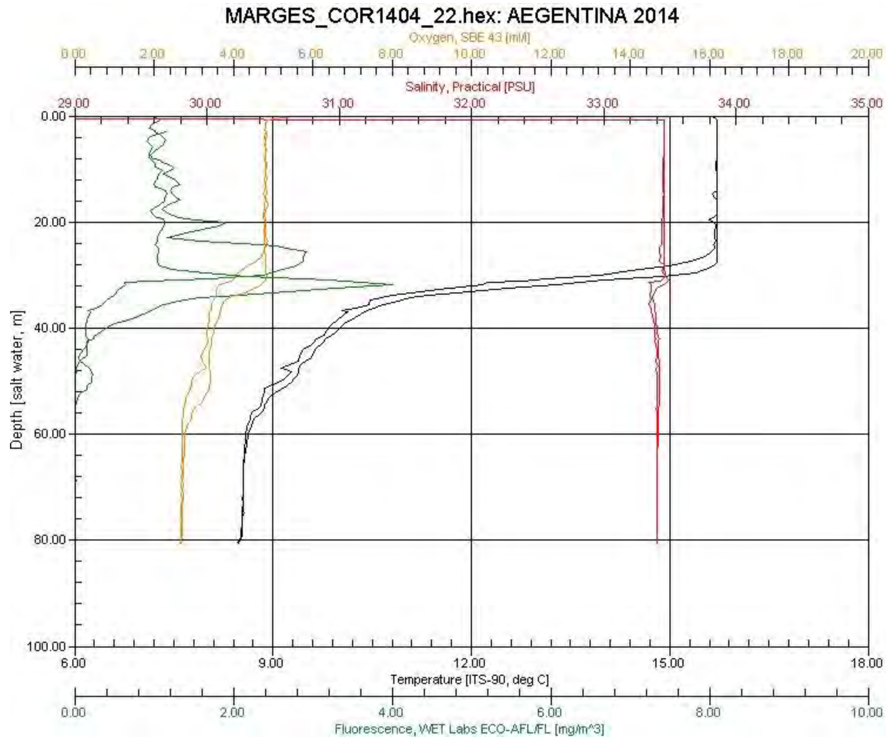

Figure 30. COR1404_22 CTD profile.

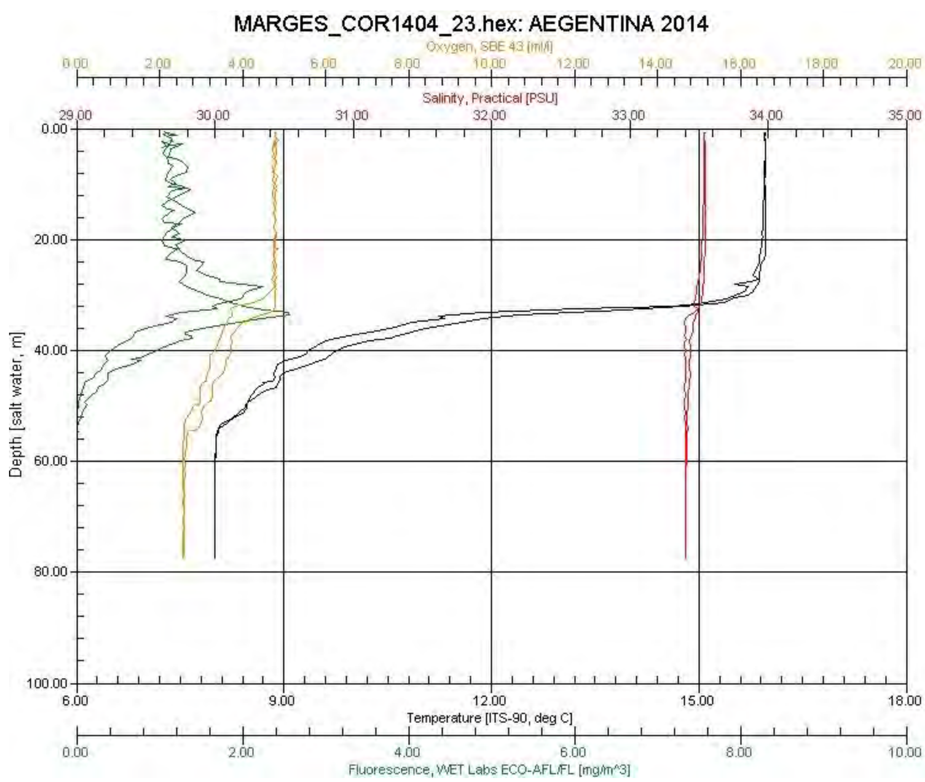

Figure 31. COR1404_23 CTD profile.

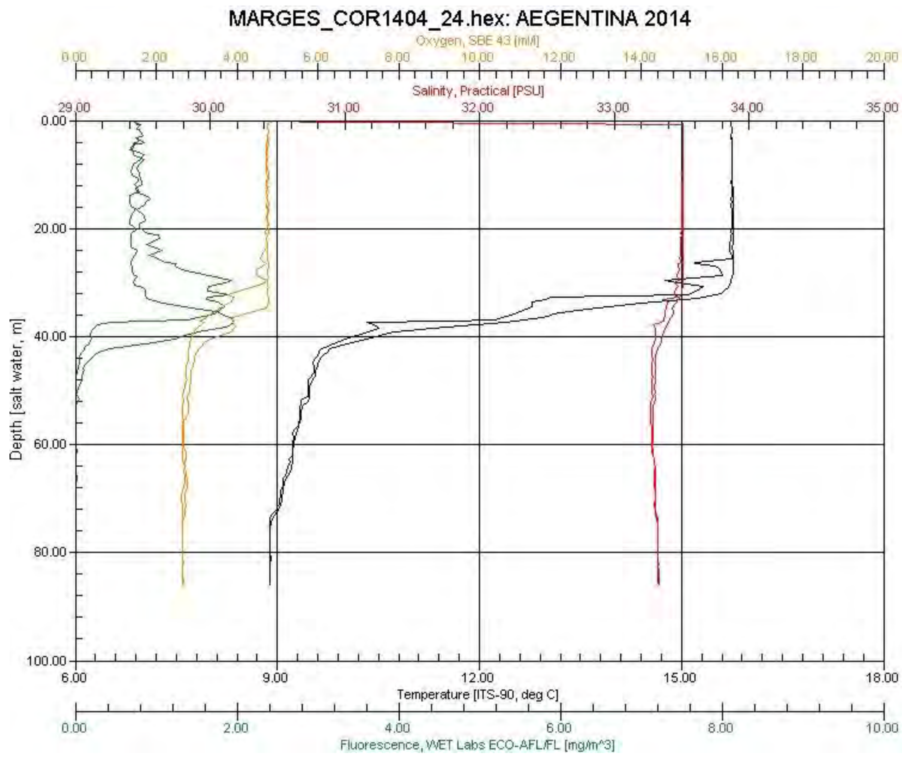

Figure 32. COR1404_24 CTD profile.

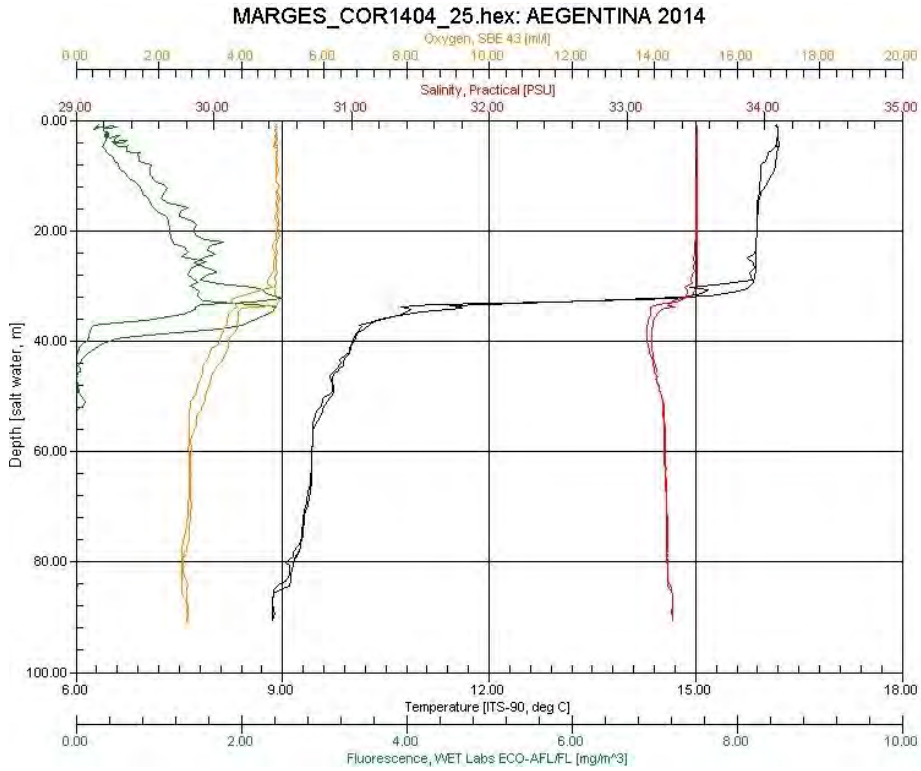

Figure 33. COR1404_25 CTD profile.

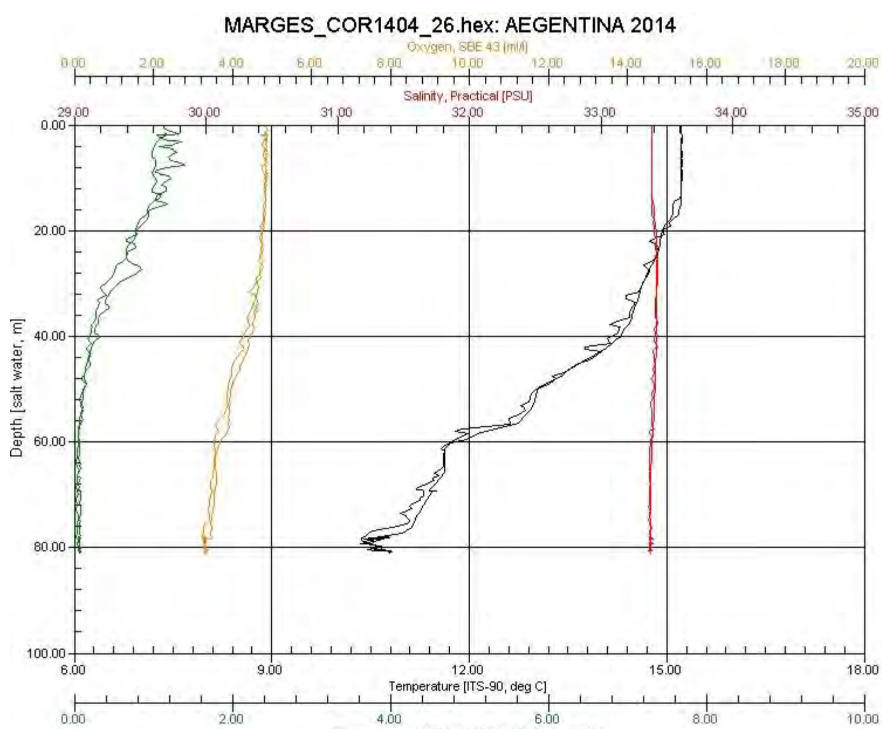

Figure 34. COR1404_26 CTD profile.

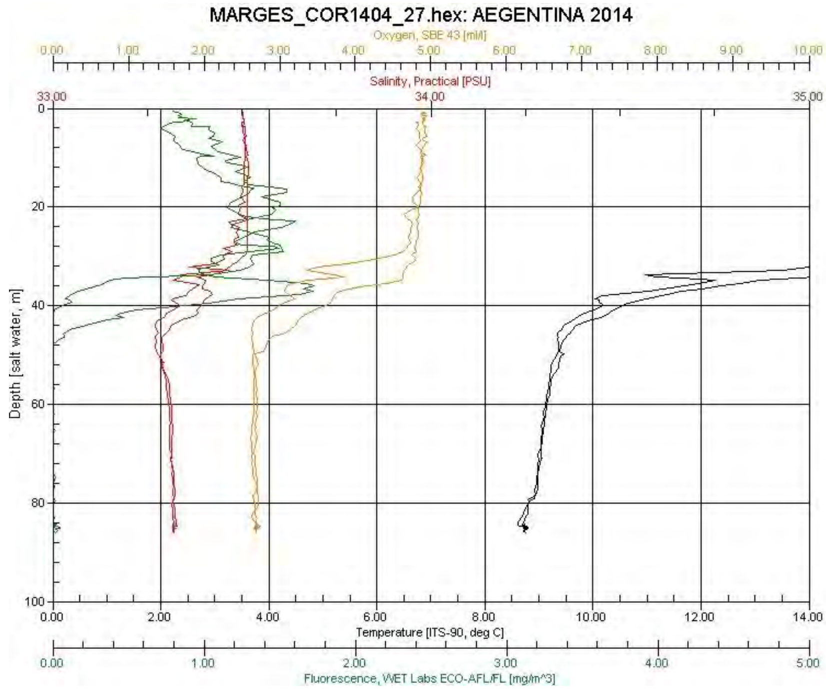

Figure 35. COR1404_27 CTD profile.

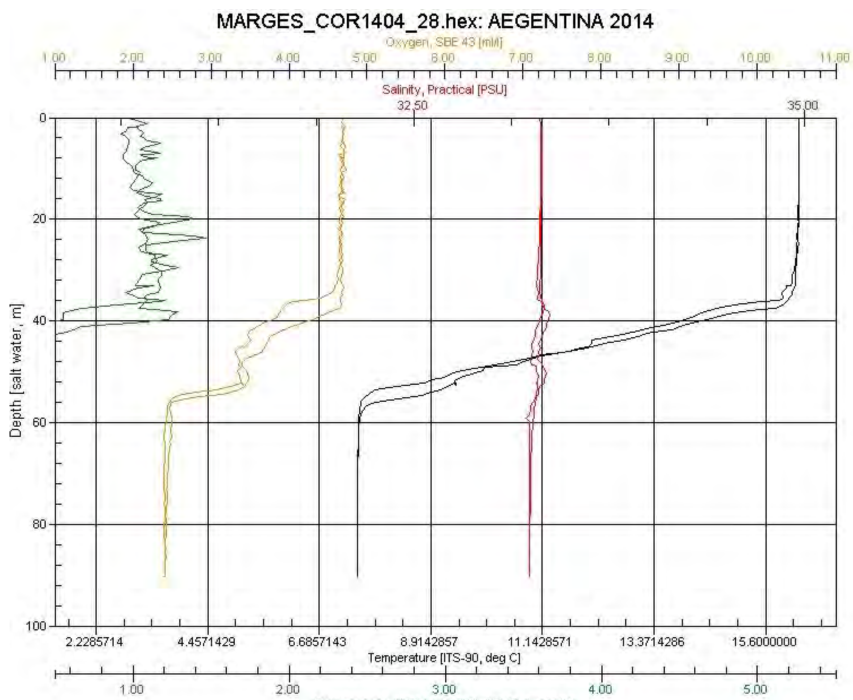

Figure 36. COR1404_28 CTD profile.

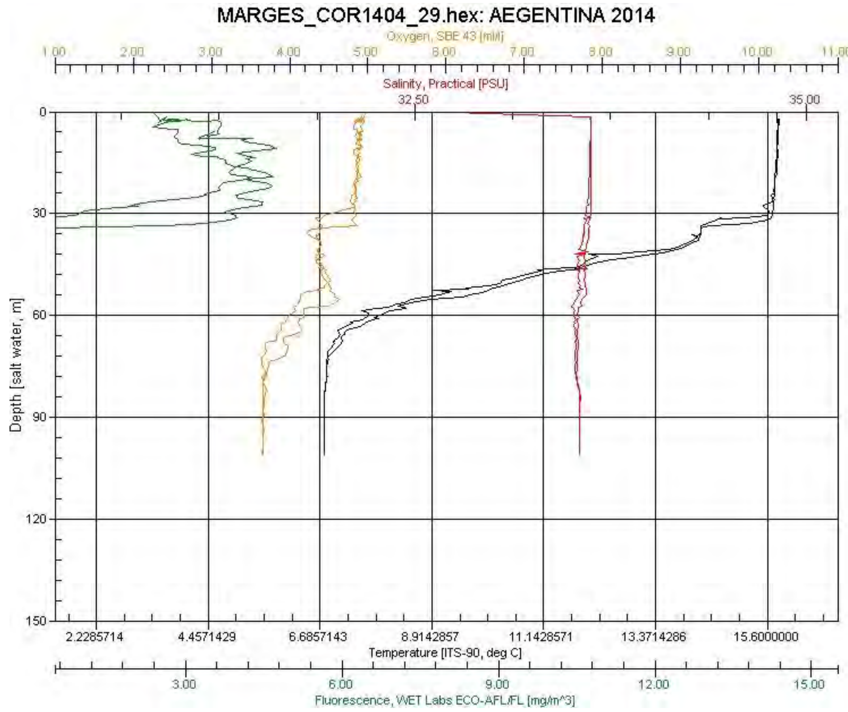

Figure 37. COR1404_29 CTD profile.

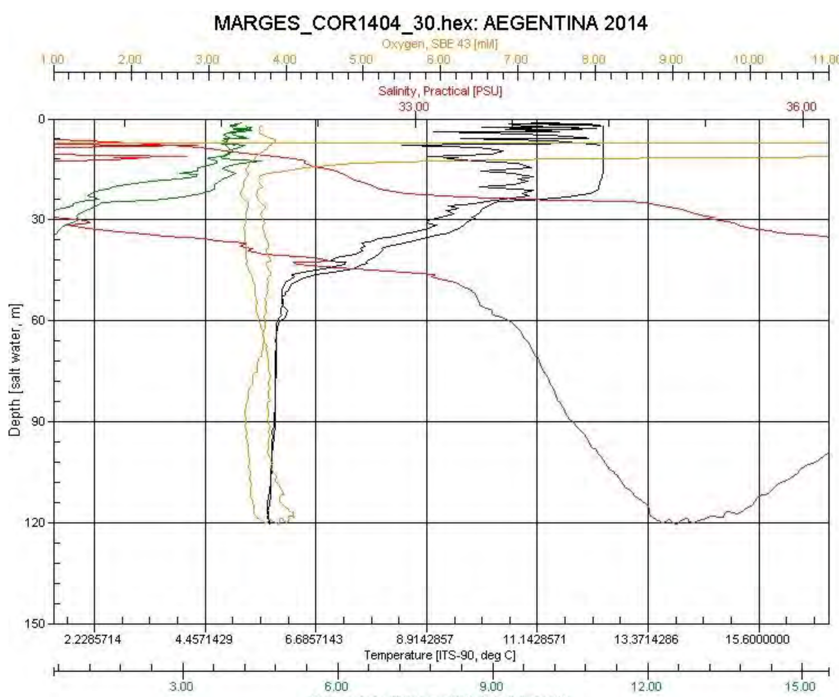

Figure 38. COR1404_30 CTD profile.

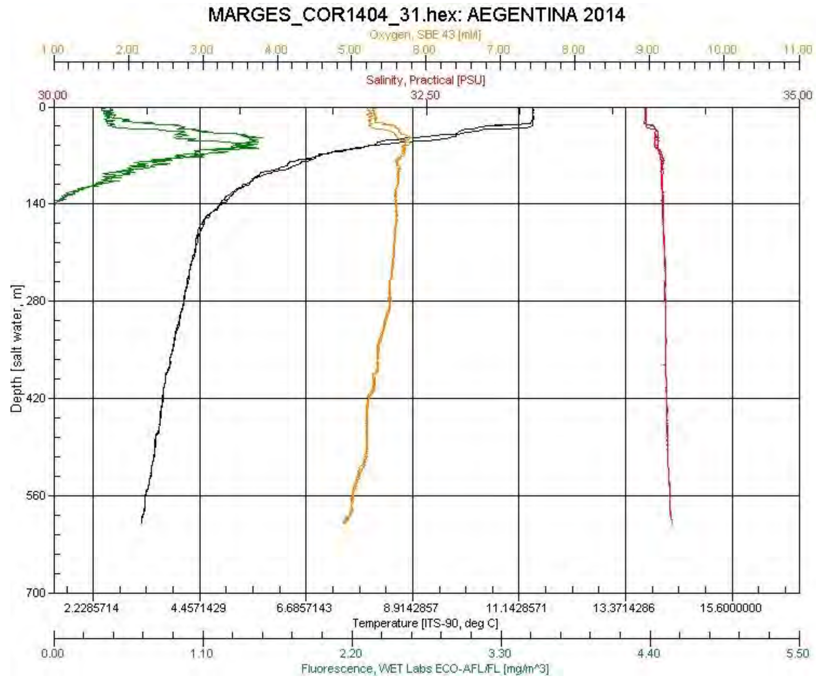

Figure 39. COR1404_31 CTD profile.

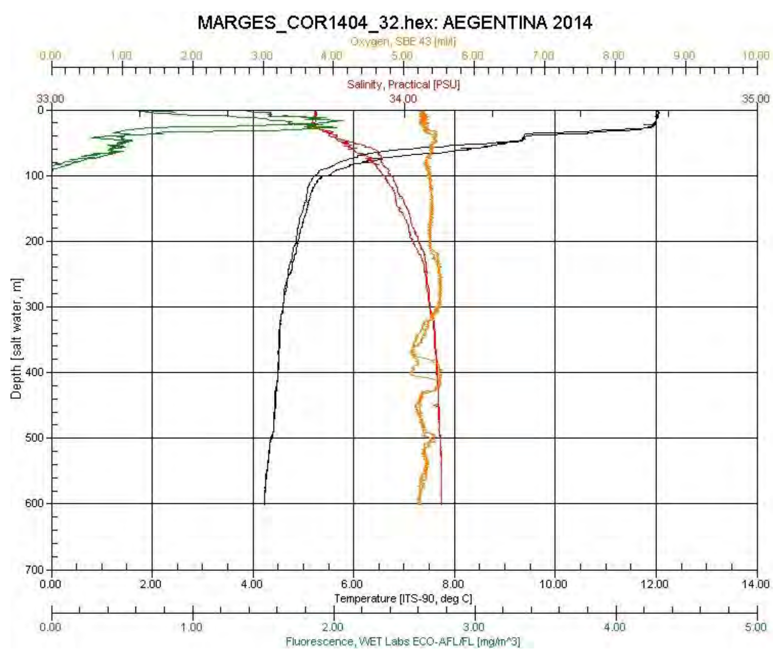

Figure 40. COR1404_32 CTD profile.

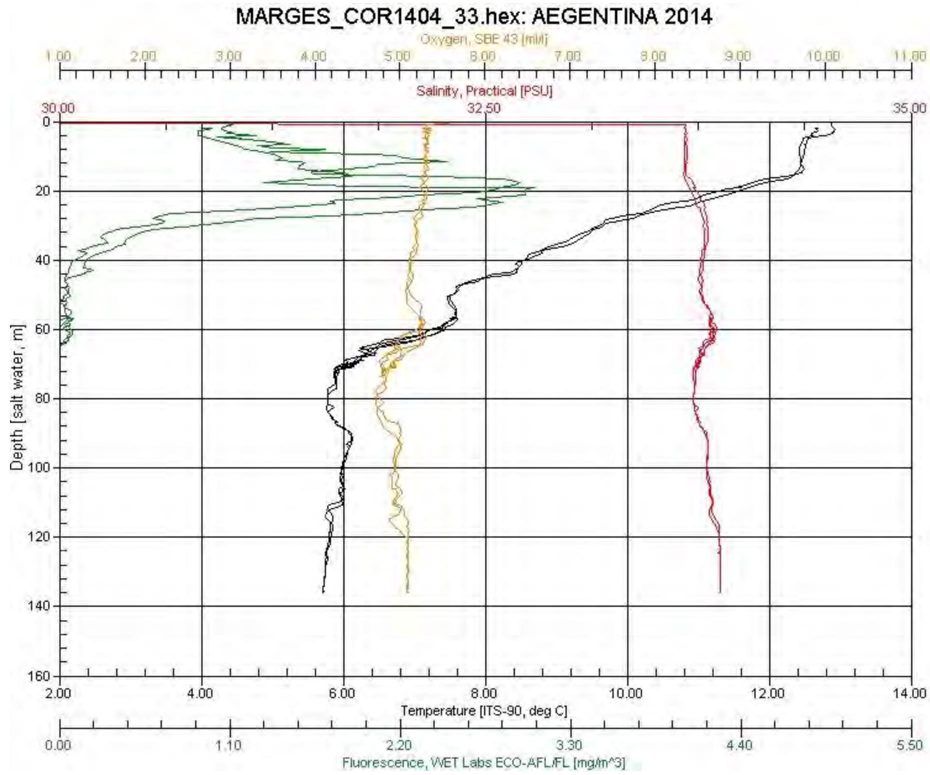

Figure 41. COR1404_33 CTD profile.

Appendix II – Van Veen grab samples

A. Sample pictures

Figure 42. COR1404_BV01 pictures. From right to left: sample from top, side, and sieved for benthic organisms.

Figure 43. COR1404_BV02 pictures. From right to left: sample from top and sieved for benthic organisms.

Figure 44. COR1404_BV03 pictures. From right to left: sample from top and sieved for benthic organisms.

Figure 45. COR1404_BV04 pictures. From right to left: sample from top, side, and sieved for benthic organisms.

Figure 46. COR1404_BV05 pictures. From right to left: sample from top, opened, and sieved for benthic organisms.

Figure 47. COR1404_BV06 pictures. From right to left: sample from top and sieved for benthic organisms.

Figure 48. COR1404_BV07 pictures. From right to left: sample from top, opened, and sieved for benthic organisms.

Figure 49. COR1404_BV08 pictures. From right to left: sample from top, opened, and sieved for benthic organisms.

Figure 50. COR1404_BV09 pictures. From right to left: sample from top, side, and sieved for benthic organisms.

Figure 51. COR1404_BV10 pictures. From right to left: sample from top, opened, and sieved for benthic organisms.

Figure 52. COR1404_BV11 pictures. From right to left: sample from top, opened, and sieved for benthic organisms.

Figure 53. COR1404_BV12 pictures. From right to left: sample from top, opened, and sieved for benthic organisms.

Figure 54. COR1404_BV13 pictures. From right to left: sample from top, opened, and sieved for benthic organisms.

Figure 55. COR1404_BV14 pictures. From right to left: sample from top, opened, and sieved for benthic organisms.

Figure 56. COR1404_BV15 pictures. From right to left: sample from top, opened, and sieved for benthic organisms.

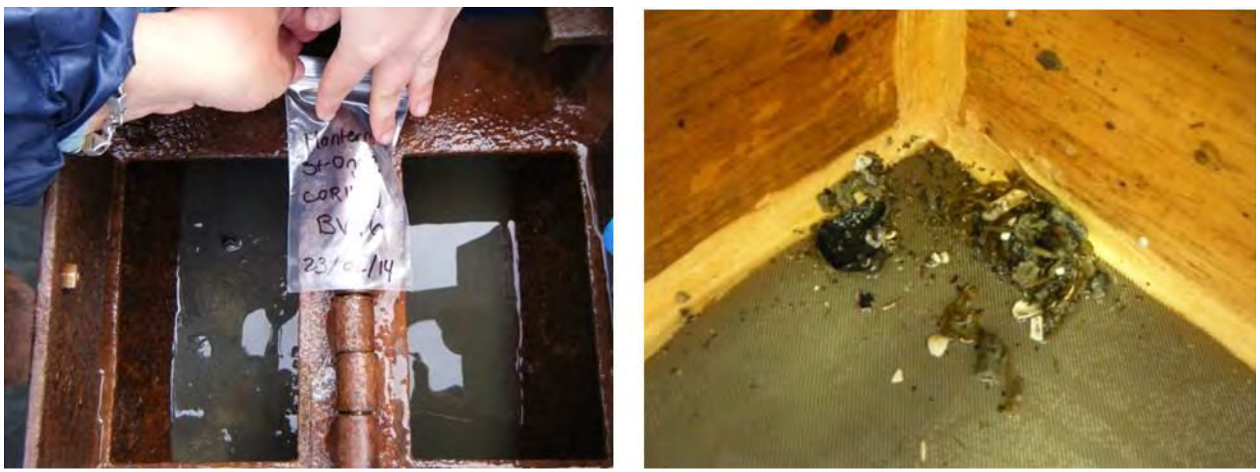

Figure 57. COR1404_BV16 pictures. From right to left: sample from top and sieved for benthic organisms.

Figure 58. COR1404_BV17 pictures. From right to left: sample from top, opened, and sieved for benthic organisms.

Figure 59. COR1404_BV18 pictures. From right to left: sample from top, opened, and sieved for benthic organisms.

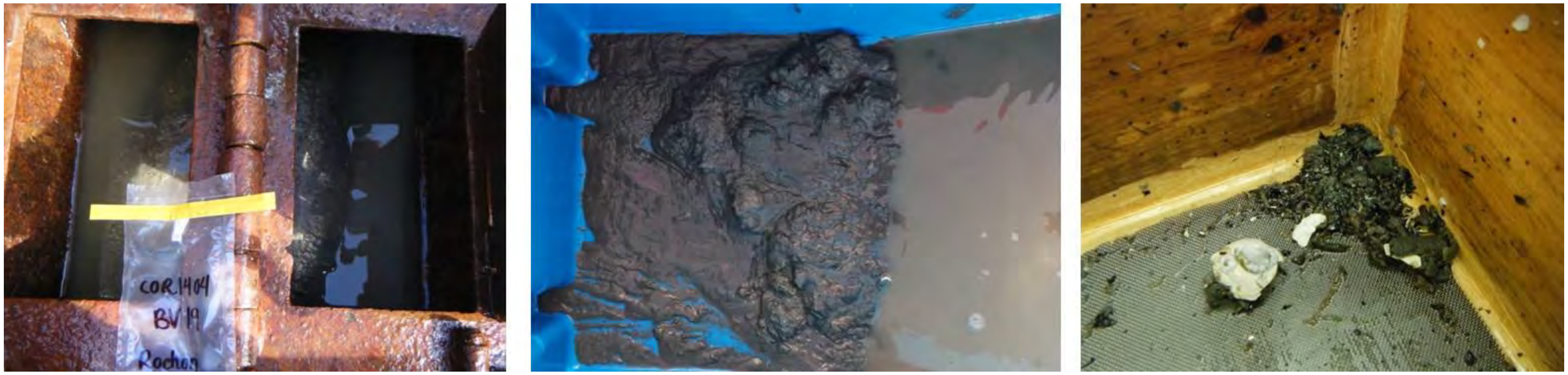

Figure 60. COR1404_BV19 pictures. From right to left: sample from top, opened, and sieved for benthic organisms.

Figure 61. COR1404_BV20 pictures. From right to left: sample from top, opened, and sieved for benthic organisms.

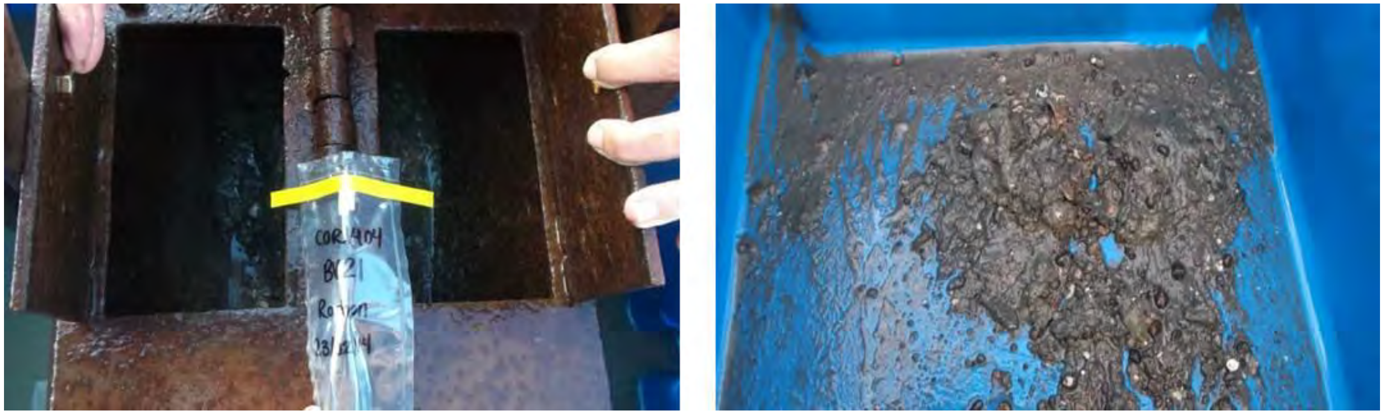

Figure 62. COR1404_BV21 pictures. From right to left: sample from top and opened.

Figure 63. COR1404_BV22 picture.

Figure 64. COR1404_BV23 pictures. From right to left: sample from top, opened, and sieved for benthic organisms.

Figure 65. COR1404_BV24 picture.

Figure 66. COR1404_BV25 pictures. From right to left: sample from top, opened, and sieved for benthic organisms.

Figure 67. COR1404_BV26 pictures. From right to left: opened and sieved sample for benthic organisms.

Figure 68. COR1404_BV27 pictures. From right to left: sample from top, opened, and sieved for benthic organisms.

Figure 69. COR1404_BV28 pictures. From right to left: sample from top, opened, and sieved for benthic organisms.

Figure 70. COR1404_BV29 pictures. From right to left: sample from top, opened, and sieved for benthic organisms.

Figure 71. COR1404_BV30 pictures. From right to left: sample from top, opened, and sieved for benthic organisms.

Figure 72. COR1404_BV31 pictures. From right to left: sample from top and sieved for benthic organisms.

Figure 73. COR1404_BV32 pictures. From right to left: sample from top, opened, and sieved for benthic organisms.

Figure 74. COR1404_BV33 pictures. From right to left: sample from top, opened, and sieved for benthic organisms.

Figure 75. COR1404_BV34 pictures. From right to left: sample from top, opened, and sieved for benthic organisms.

Figure 76. COR1404_BV35 pictures. From right to left: sample from top, opened, and sieved for benthic organisms.

Figure 77. COR1404_BV36 pictures. From right to left: sample from top, opened, and sieved for benthic organisms.

Figure 78. COR1404_BV37 pictures. From right to left: sample from top, opened, and sieved for benthic organisms.

Figure 79. COR1404_BV38 pictures. From right to left: sample from top, opened, and sieved for benthic organisms.

Figure 80. COR1404_BV39 pictures. From right to left: sample from top, opened, and sieved for benthic organisms.

Figure 81. COR1404_BV40 pictures. From right to left: sample from top, opened, and sieved for benthic organisms.

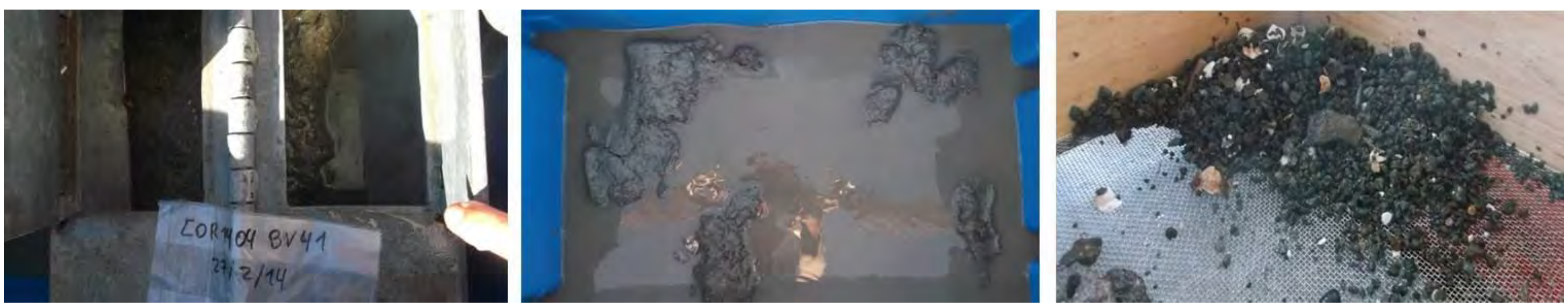

Figure 82. COR1404_BV41 pictures. From right to left: sample from top, opened, and sieved for benthic organisms.

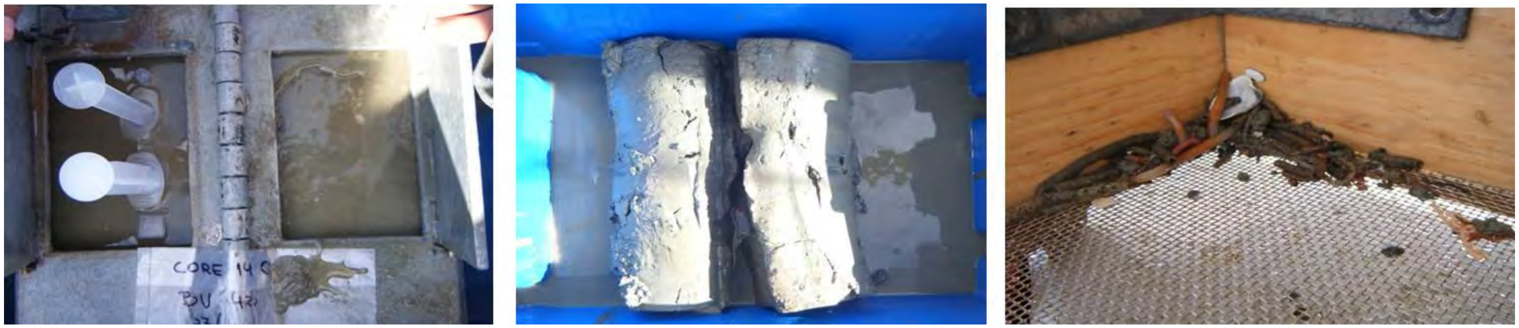

Figure 83. COR1404_BV42 pictures. From right to left: sample from top, opened, and sieved for benthic organisms.

Figure 84. COR1404_BV43 pictures. From right to left: sample from top, opened, and sieved for benthic organisms.

Figure 85. COR1404_BV44 pictures. From right to left: sample from top, opened, and sieved for benthic organisms.

Figure 86. COR1404_BV45 pictures. From right to left: sample from top, opened, and sieved for benthic organisms.

Figure 87. COR1404_BV46 pictures. From right to left: sample from top, opened, and sieved for benthic organisms.

Figure 88. COR1404_BV47 pictures. From right to left: sample from top, opened, and sieved for benthic organisms.

Figure 89. COR1404_BV48 pictures. From right to left: sample from top, opened, and sieved for benthic organisms.

Figure 90. COR1404_BV49 pictures. From right to left: sample from top, opened, and sieved for benthic organisms.

Figure 91. COR1404_BV50 pictures. From right to left: sample from top, opened, and sieved for benthic organisms.

Figure 92. COR1404_BV51 pictures. From right to left: sample from top, opened, and sieved for benthic organisms.

Figure 93. COR1404_BV52 pictures. From right to left: sample from top and sieved for benthic organisms.

Figure 94. COR1404_BV53 pictures. From right to left: sample from top, the subsample, and sieved for benthic organisms.

Figure 95. COR1404_BV54 pictures. From right to left: sample from top, opened (top) and cold-water coral (bottom), and sieved for benthic organisms.

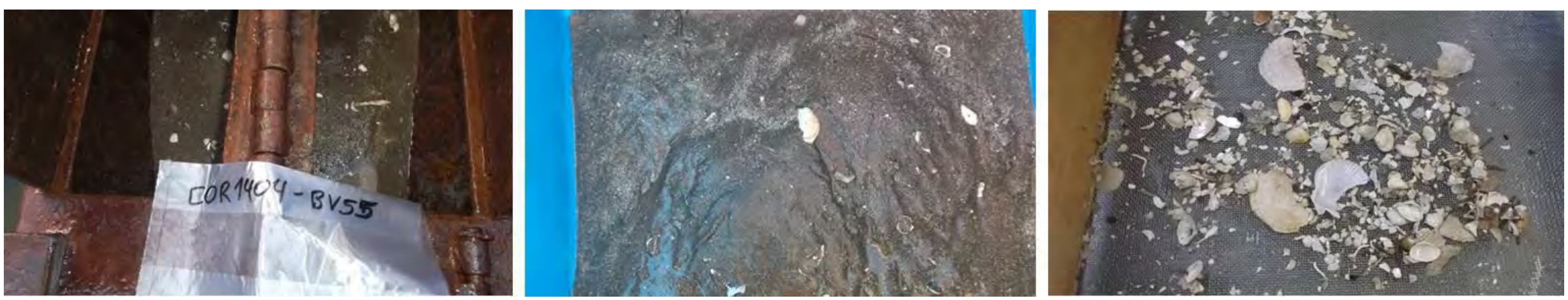

Figure 96. COR1404_BV55 pictures. From right to left: sample from top, opened, and sieved for benthic organisms.

Appendix III – Box cores

A. Sample location on seismic profiles

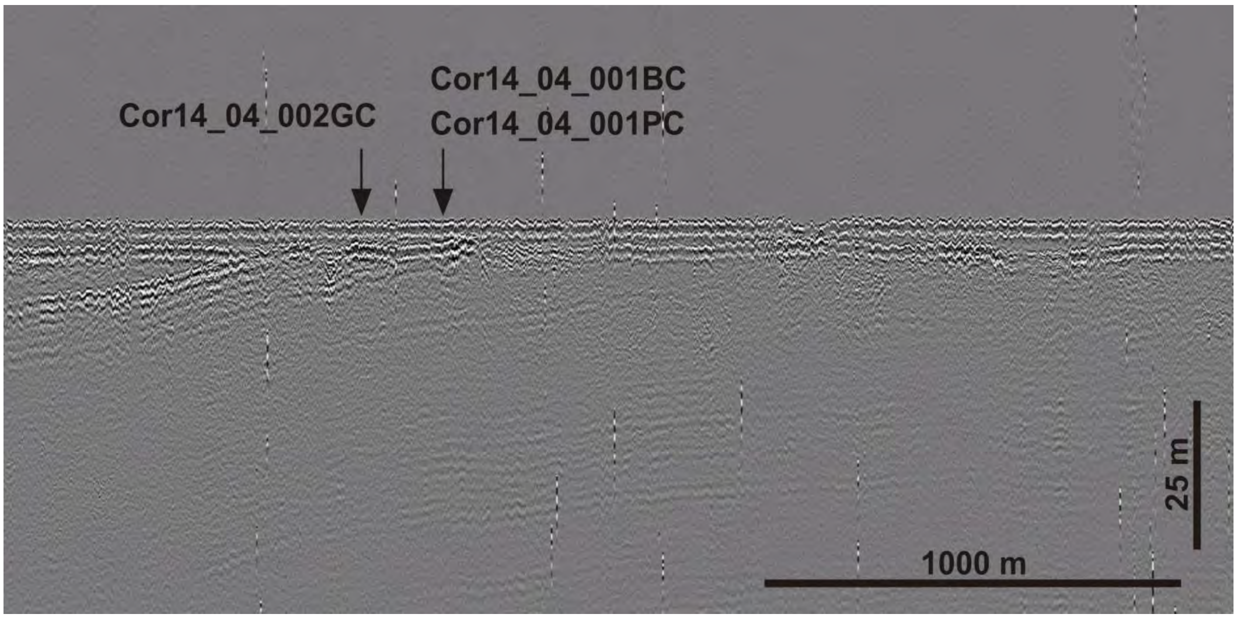

Figure 97. COR1404_001BC location on seismic profile.

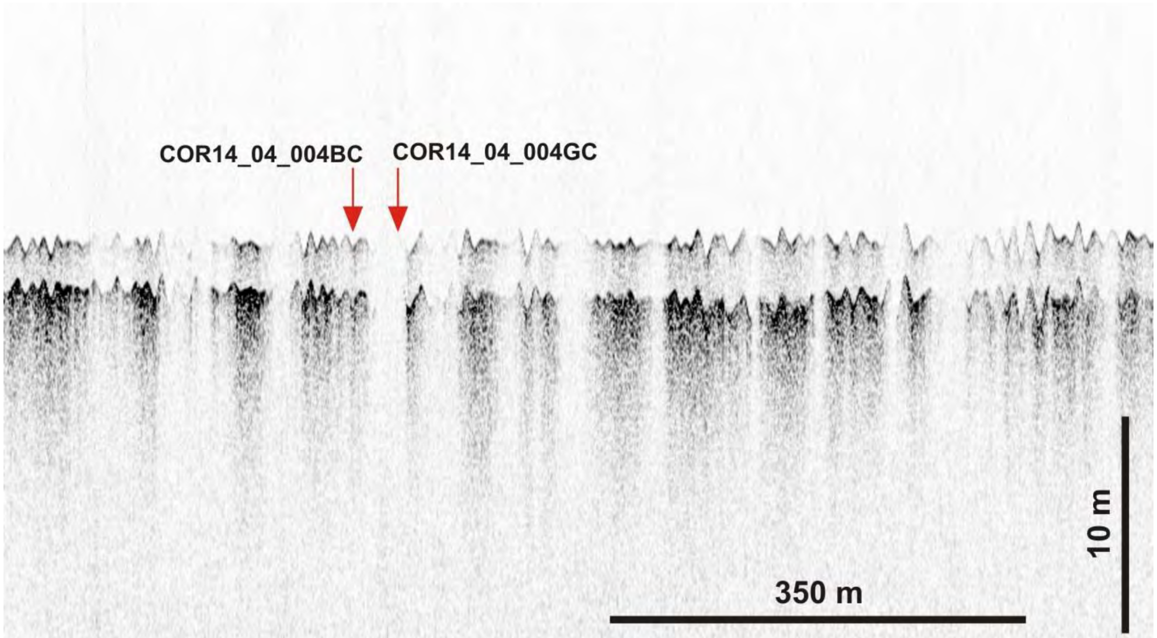

Figure 98. COR1404_004BC location on seismic profile.

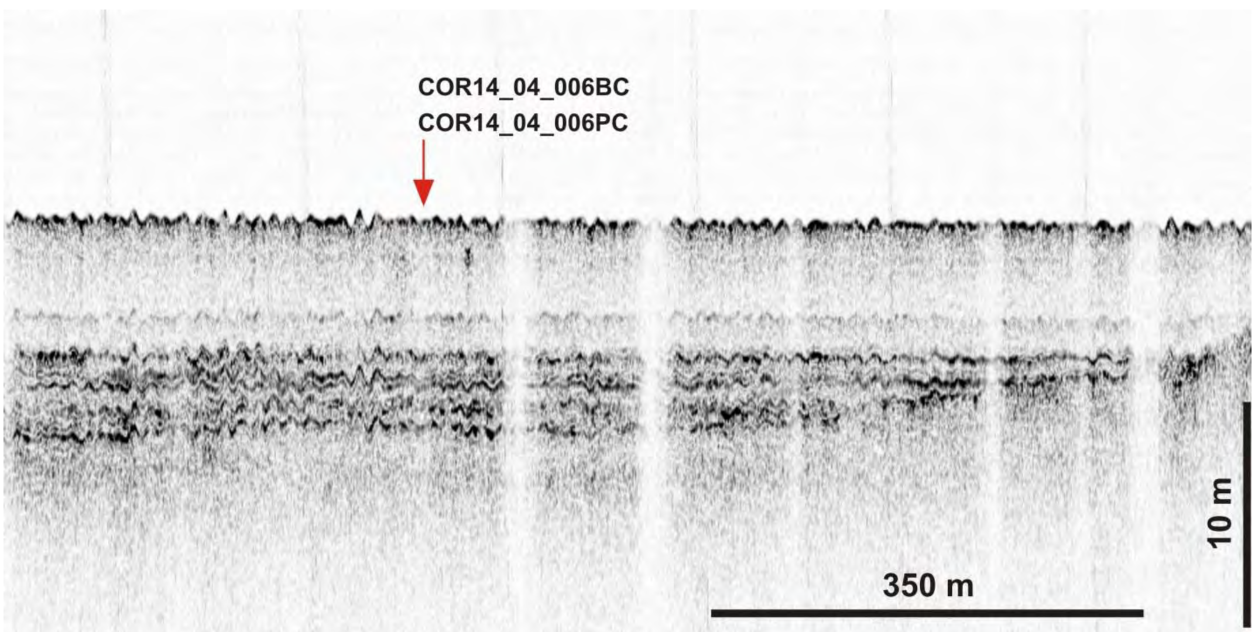

Figure 99. COR1404_006BC location on seismic profile.

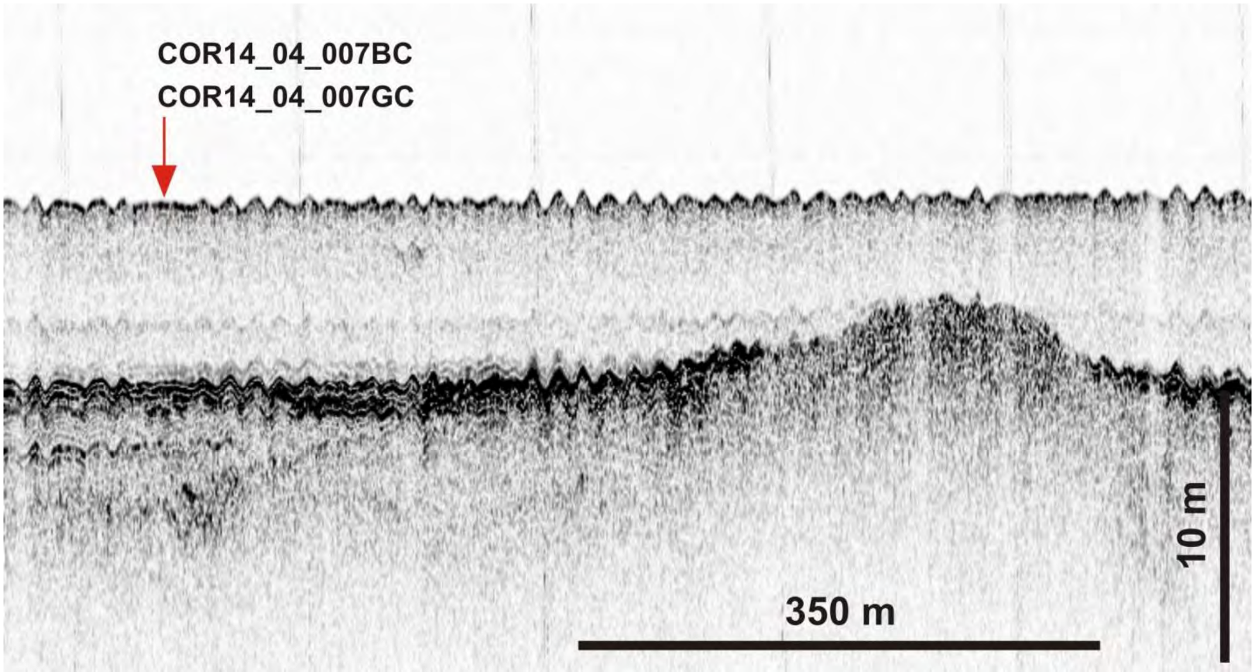

Figure 100. COR1404_007BC location on seismic profile.

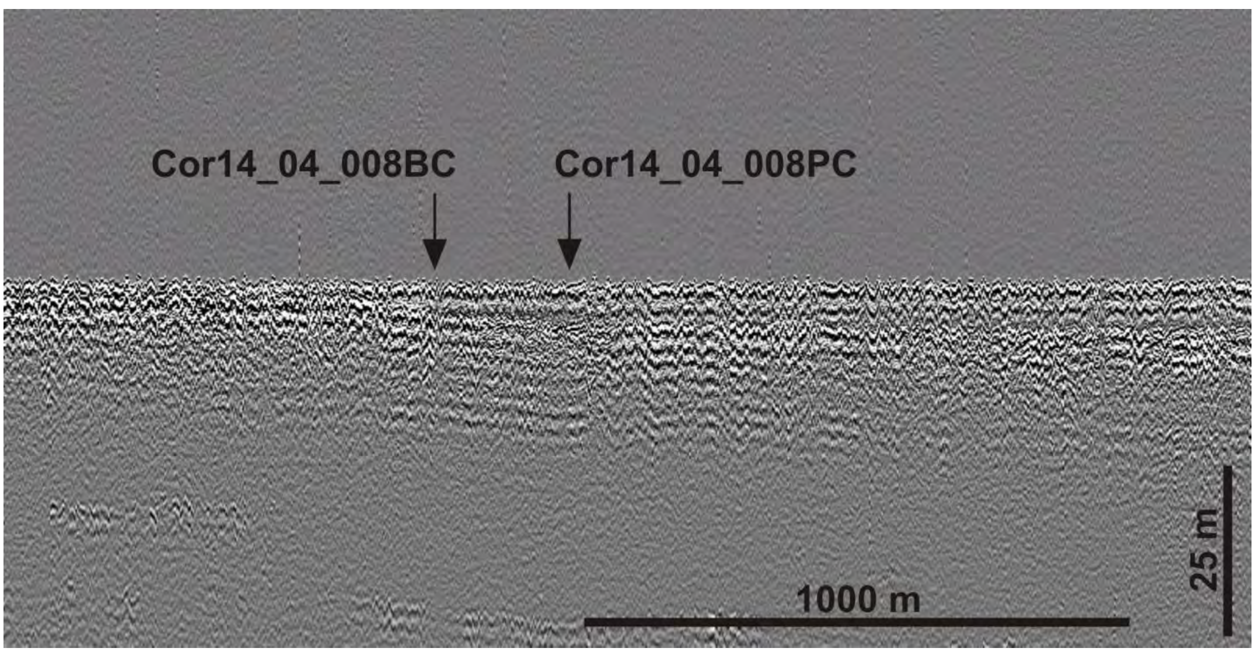

Figure 101. COR1404_008BC location on seismic profile.

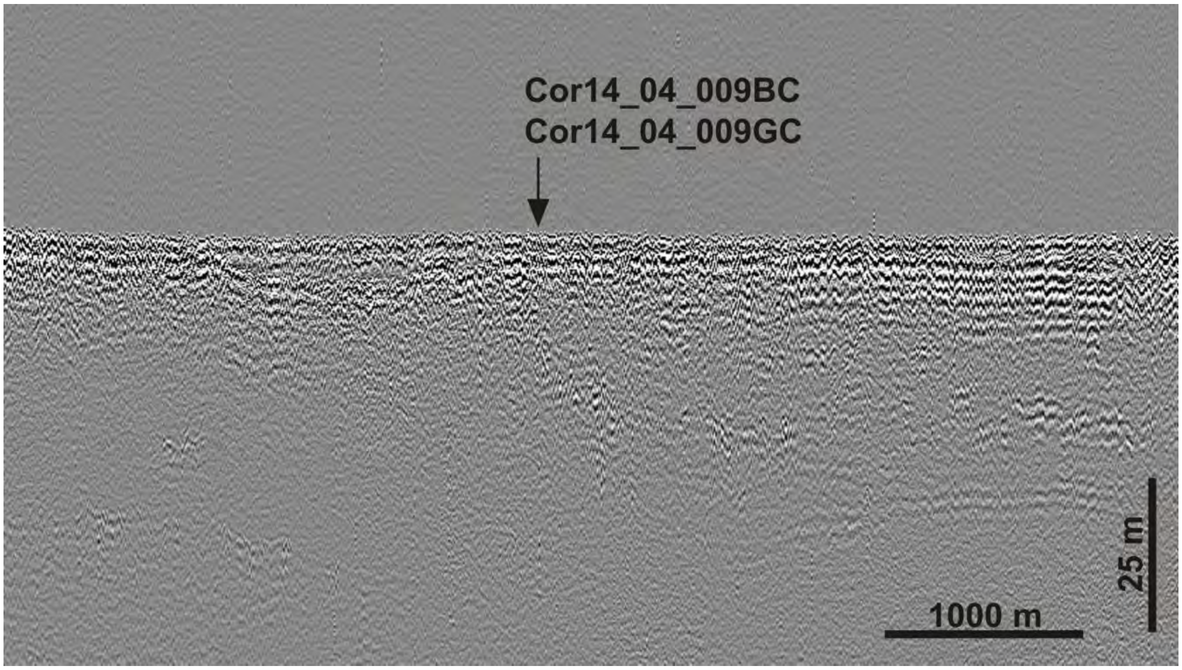

Figure 102. COR1404_009BC location on seismic profile.

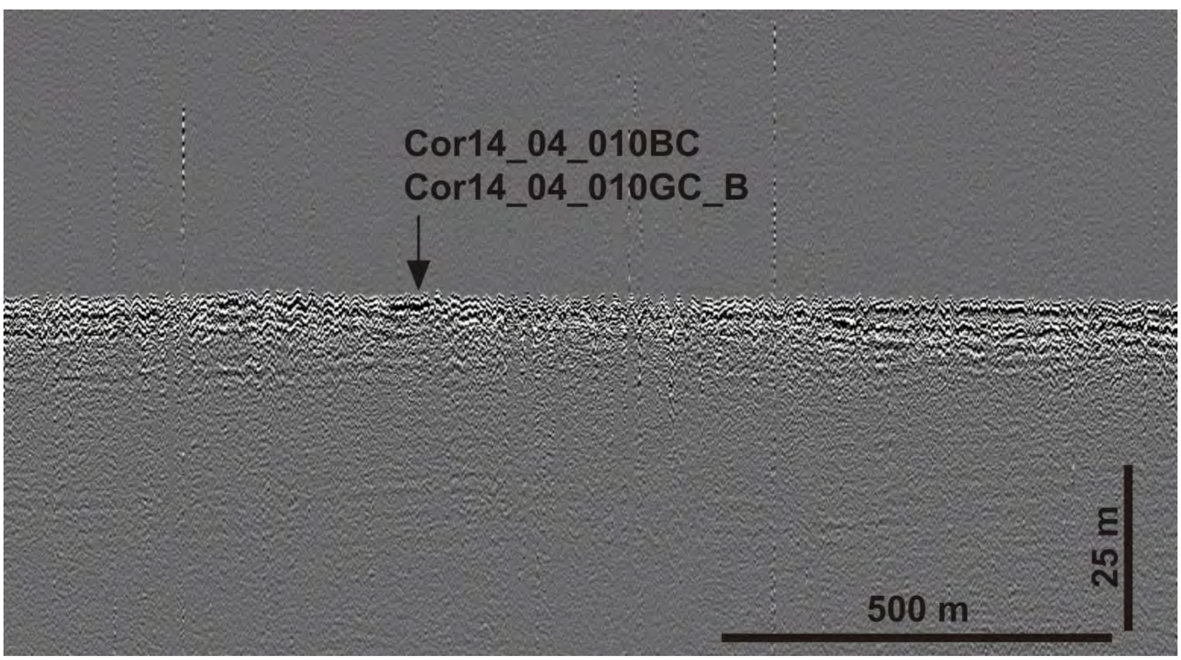

Figure 103. COR1404_010BC location on seismic profile.

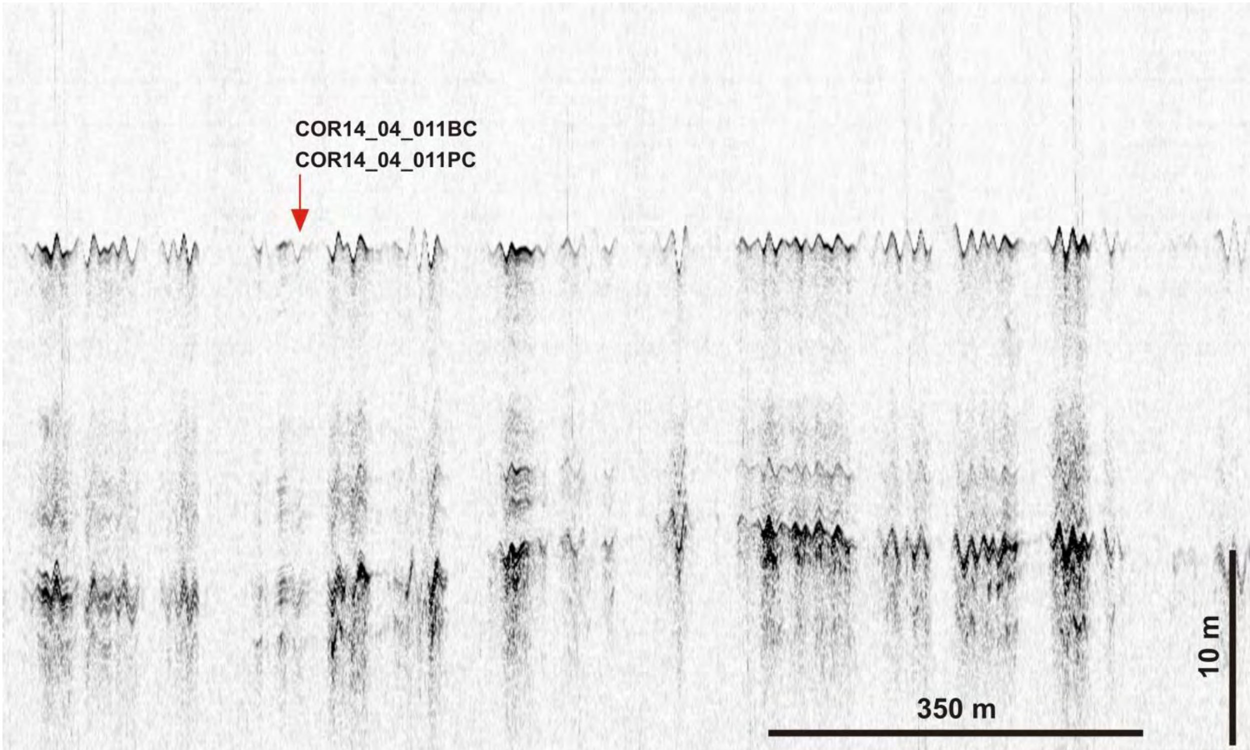

Figure 104. COR1404_011BC location on seismic profile.

B. Sample pictures

Figure 105. COR1404_001BC pictures. From right to left: sample from top, side and the push cores.

Figure 106. COR1404_004BC pictures. From right to left: sample from top and sieved for benthic organisms.

Figure 107. COR1404_006BC pictures. From right to left: sample from top and sieved for benthic organisms.

Figure 108. COR1404_007BC pictures. From right to left: sample from top, the push cores, and sieved sample for benthic organisms.

Figure 109. COR1404_008BC pictures. From right to left: sample from top, the push cores, and sieved sample for benthic organisms.

Figure 110. COR1404_009BC pictures. From right to left: sample from top, the push cores, and sieved sample for benthic organisms.

Figure 111. COR1404_010BC pictures. From right to left: sample from top, the push cores, and sieved sample for benthic organisms.

Figure 112. COR1404_011BC pictures. From right to left: sample from top, the push cores, and sieved sample for benthic organisms.

Appendix IV – Gravity cores

A. Sample location on seismic profiles

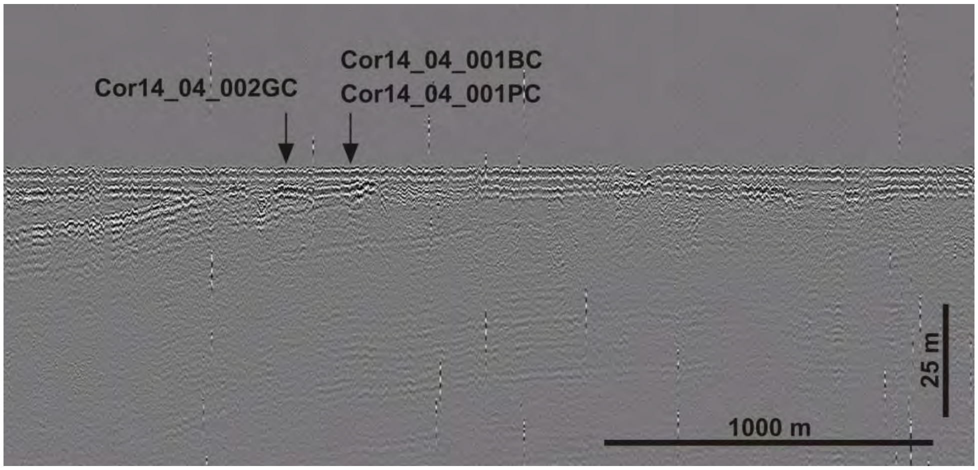

Figure 113. COR1404_002GC location on seismic profile.

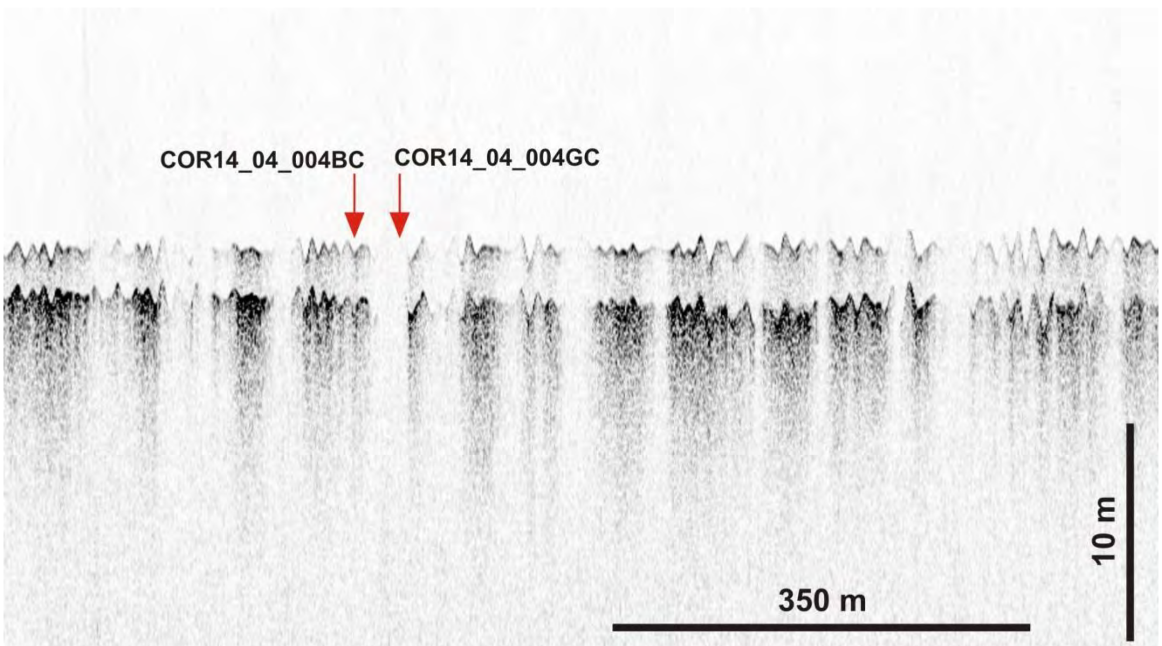

Figure 114. COR1404_004GC location on seismic profile.

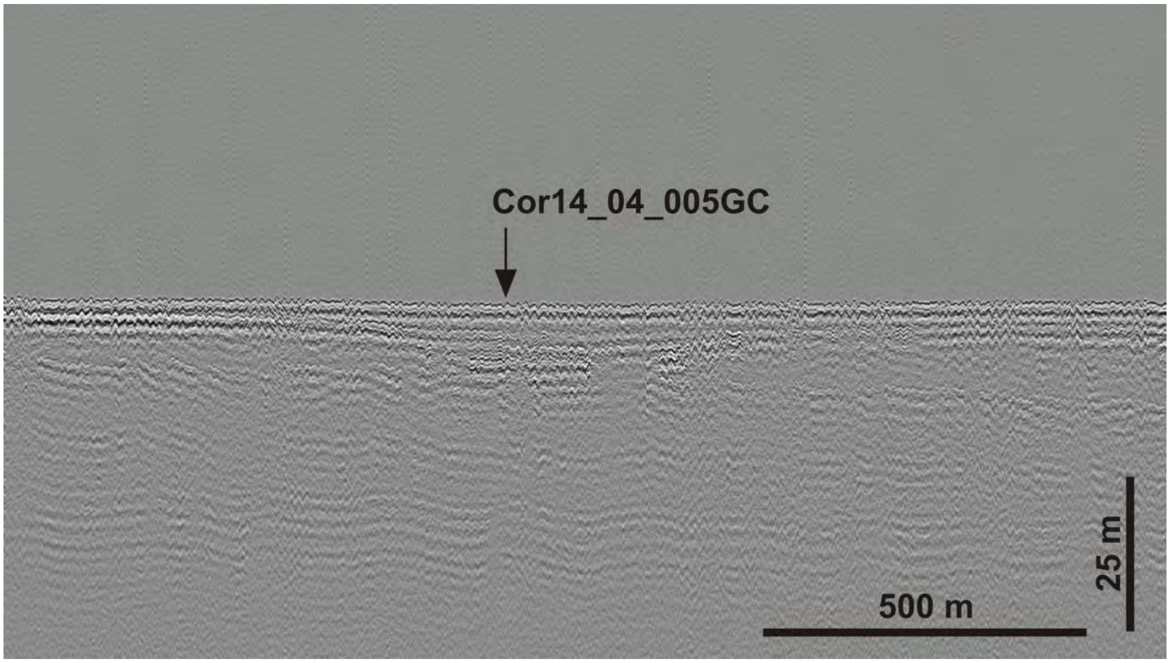

Figure 115. COR1404_005GC location on seismic profile.

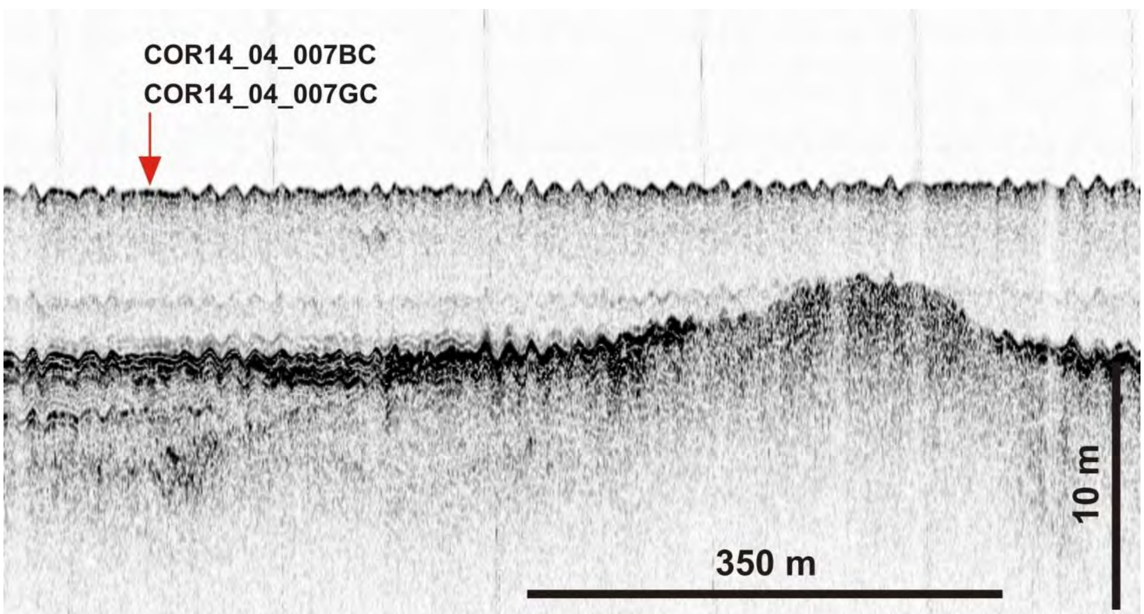

Figure 116.COR1404_007GC location on seismic profile.

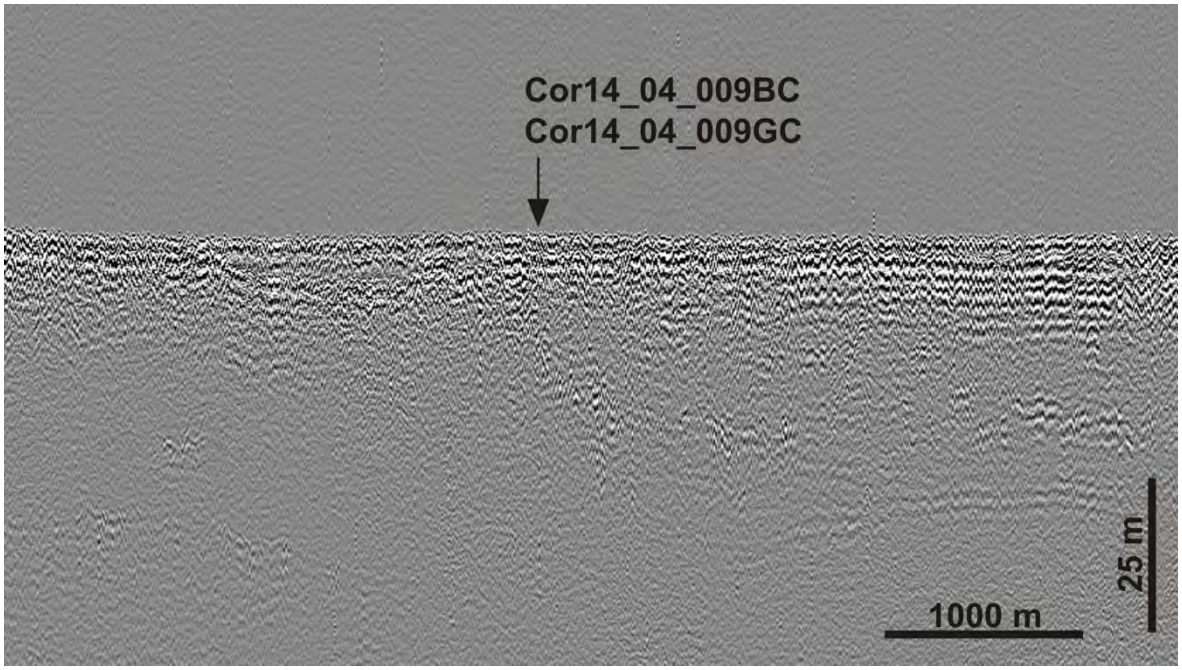

Figure 117. COR1404_009GC location on seismic profile.

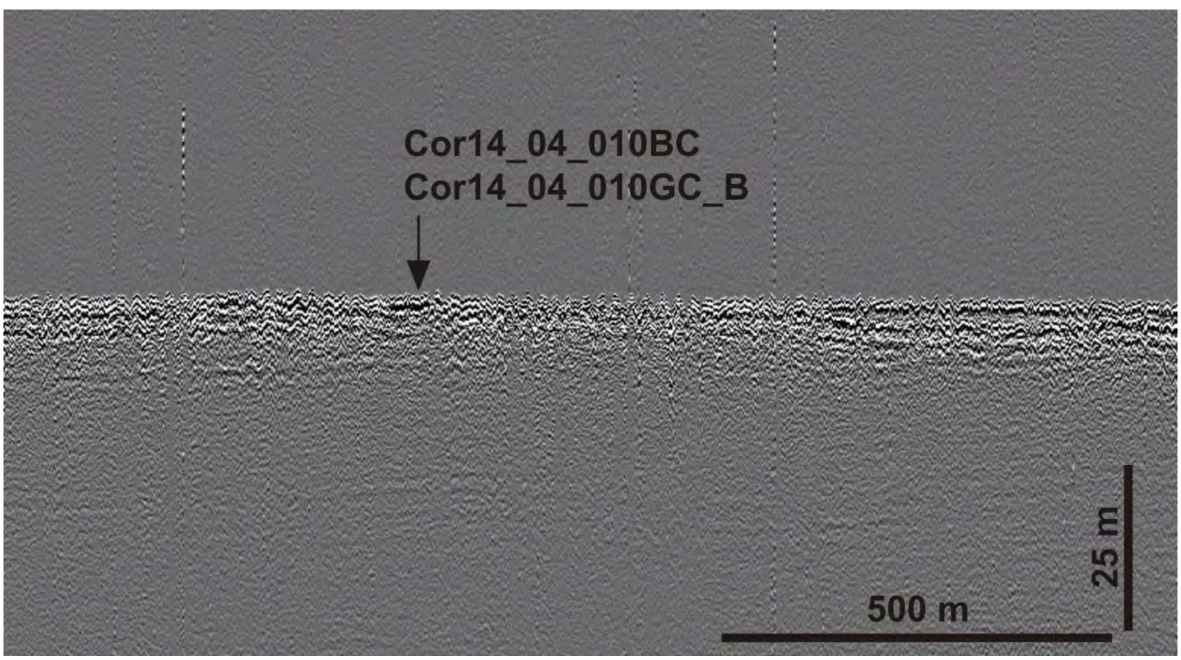

Figure 118. COR1404_010GC-B location on seismic profile.

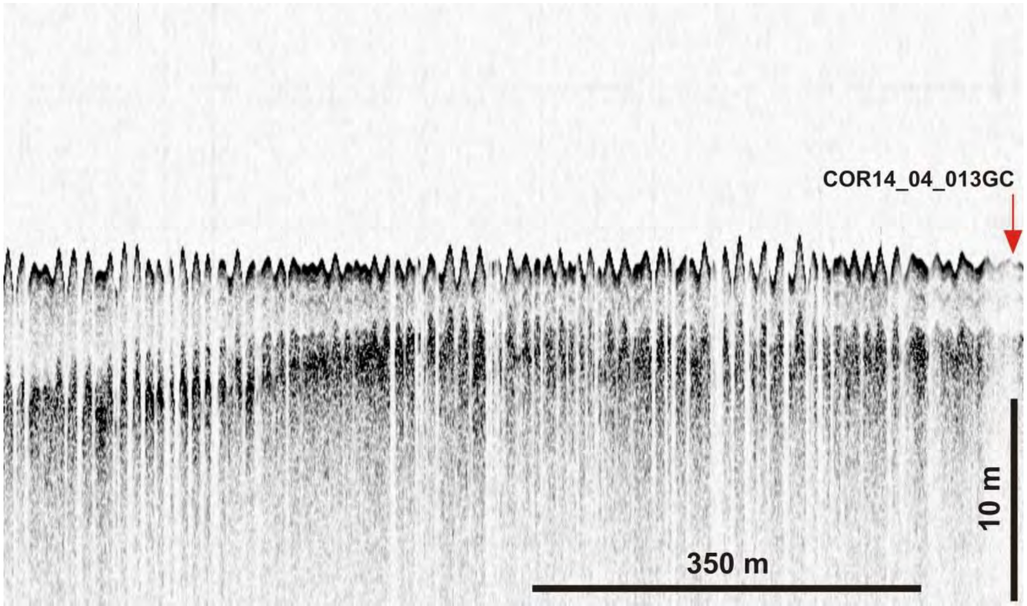

Figure 119. COR1404_013GC location on seismic profile.

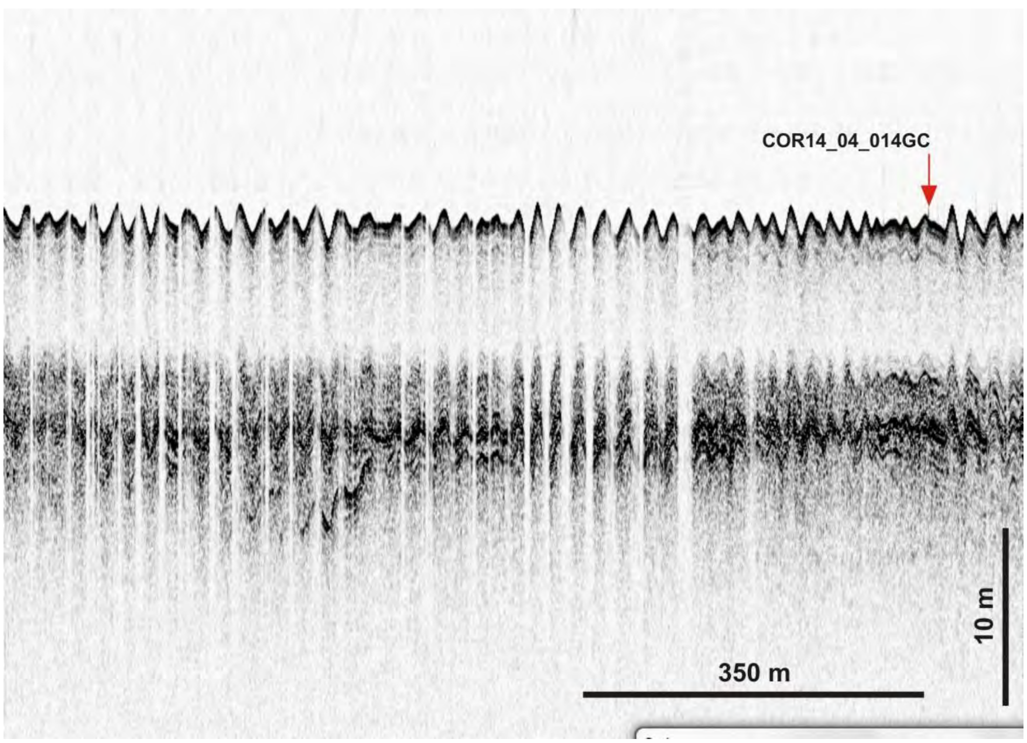

Figure 120. COR1404_014GC location on seismic profile.

B. Sample pictures

Figure 121. COR1404_002GC picture.

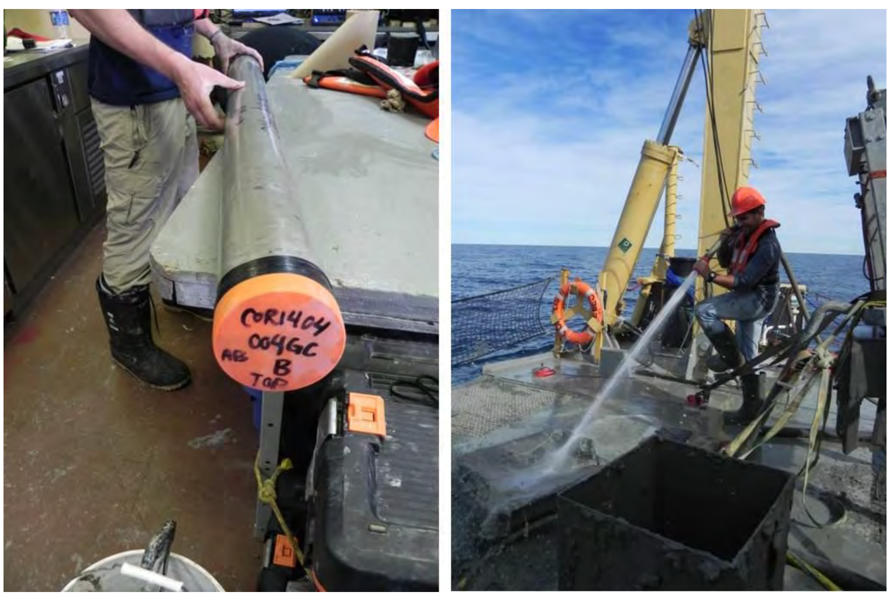

Figure 122. COR1404_004GC pictures.

Figure 123. COR1404_005GC pictures.

Figure 124. COR1404_007GC picture.

Figure 125. COR1404_009GC picture.

Figure 126. COR1404_010GC-A pictures.

Figure 127. COR1404_010GC-B pictures.

Figure 128. COR1404_012GC picture.

Figure 129. COR1404_013GC picture.

Figure 130. COR1404_014GC picture.

Appendix V – Piston and trigger weight cores

A. Sample location on seismic profiles

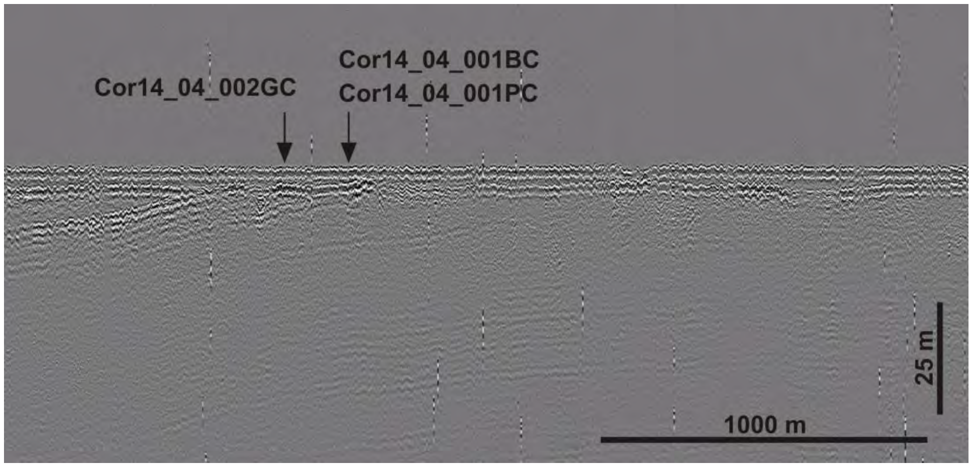

Figure 131. COR1404_001PC (and 001TWC) location on seismic profile.

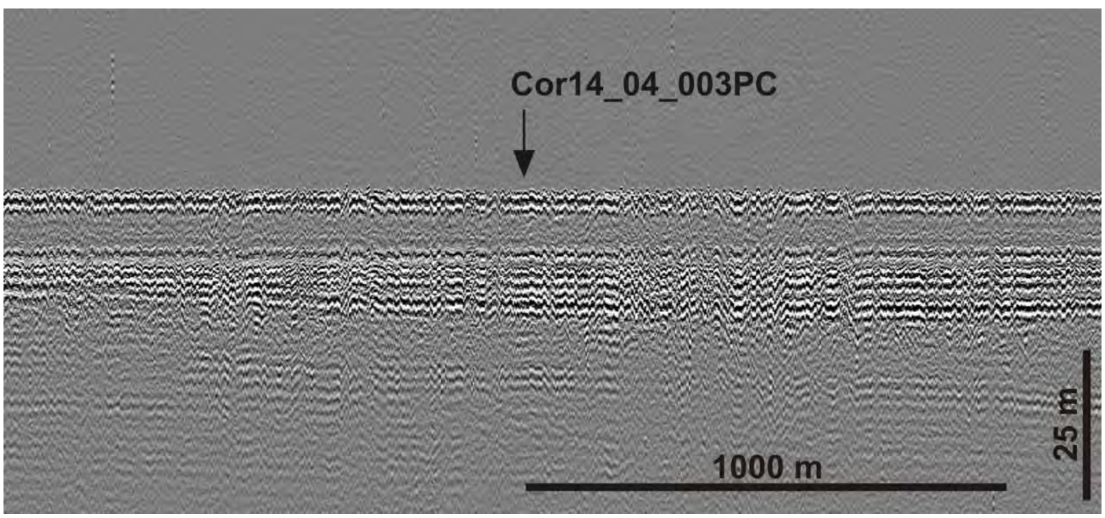

Figure 132. COR1404_003PC (and 003TWC) location on seismic profile.

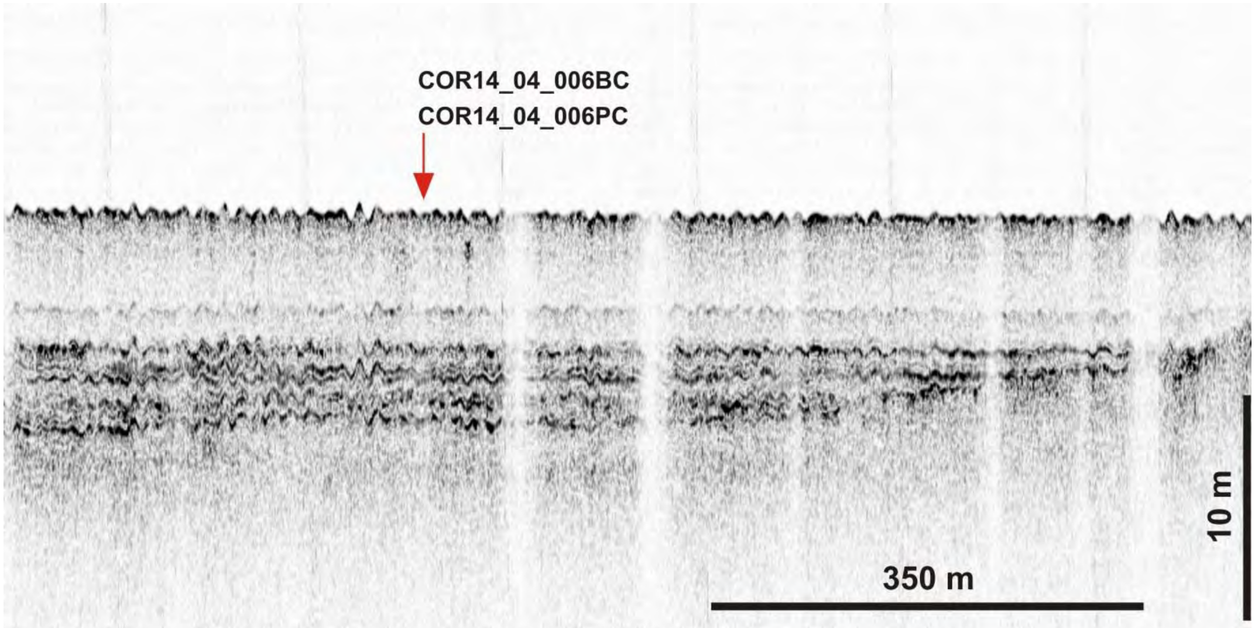

Figure 133. COR1404_006PC (and 006TWC) location on seismic profile.

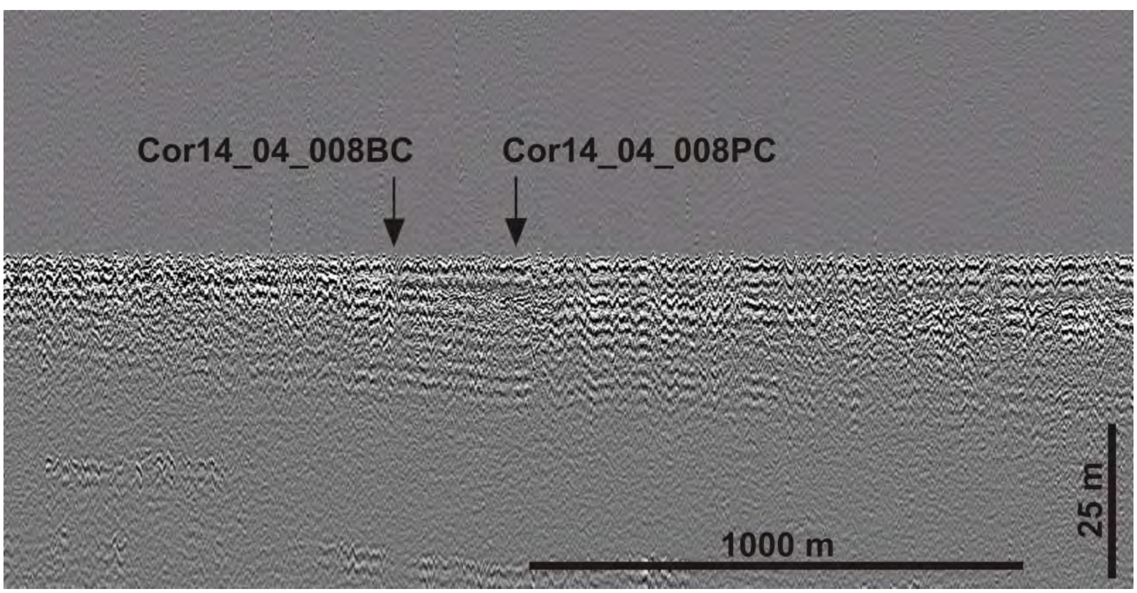

Figure 134. COR1404_008PC (and 008TWC) location on seismic profile.

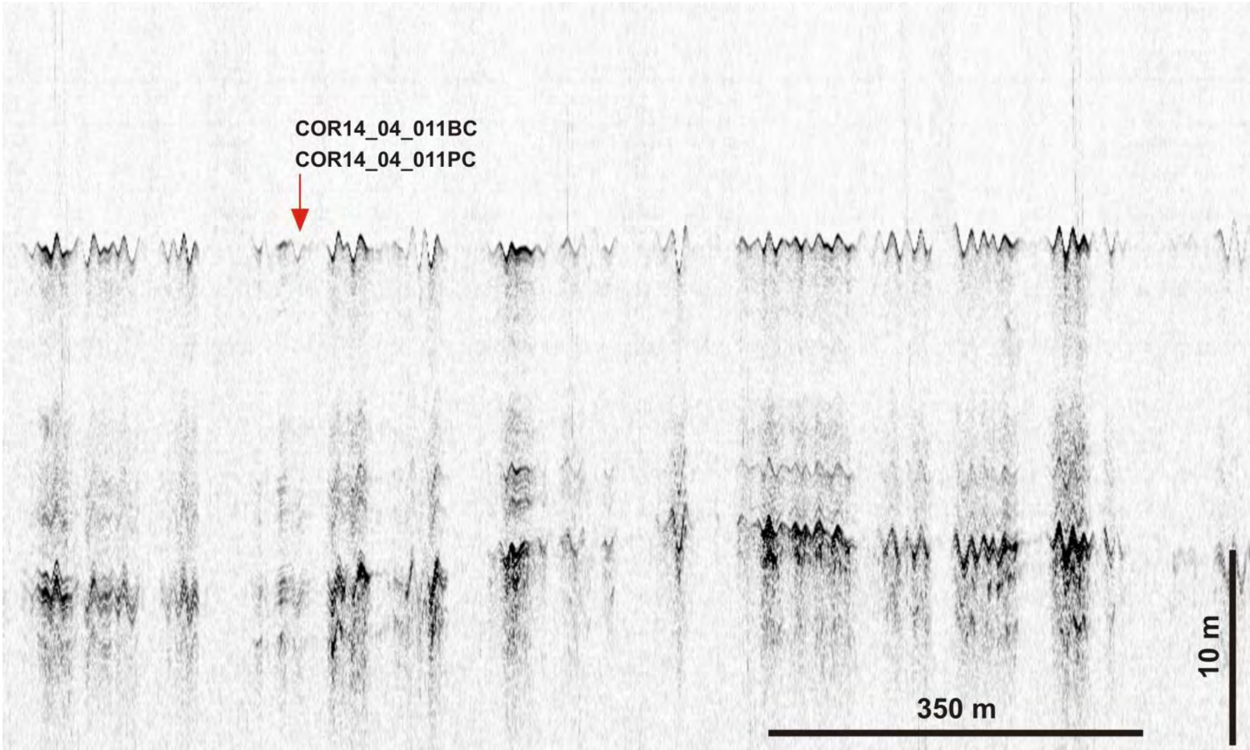

Figure 135. COR1404_011PC (and 011TWC) location on seismic profile.

B. Sample pictures

Figure 136. COR1404_001PC picture.

Figure 137. COR1404_003PC pictures.

Figure 138. COR1404_006PC picture.

Figure 139. COR1404_008PC picture.

Figure 140. COR1404_011PC pictures.

Figure 141. COR1404_001TWC picture.

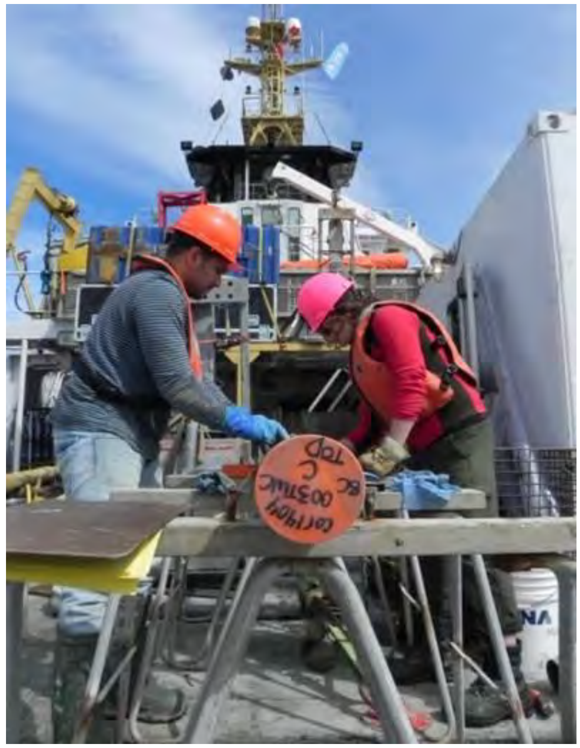

Figure 142. COR1404_003TWC picture.

Figure 143. COR1404_006TWC pictures.

Figure 144. COR1404_008TWC picture.

Figure 145. COR1404_011TWC picture.