Cruise Report

2012/2013 Ross Sea Expedition

(the second half of ANA03B Cruise)

Chief scientist : Jongkuk Hong

IBRV Araon, 9 February 2013 – 27 February 2013

(Jang Bogo Station – Ross Sea – McMurdo Station)

Contents

Chapter 1 Outline

An integrated expedition in the Ross Sea has been conducted in February, 2013. The Ross Sea expedition started from the construction site of Jang Bogo station, the new Korean Antarctic station. The survey area covers the western coast of the Ross Sea and the Eastern basin and the expedition ended at the McMurdo station. Scientific party comprised 37 scientific members including 4 Italians, one German and an American.

Many scientific programs such as K-PORT and K-POD of Korea and ROSSLOPE of Italy supported the cruise. During the cruise we conducted CTD casting, underway seawater measurement, fishing net, dredge, sediment sampling, seismic survey and OBS recovery to study marine biology, marine chemistry, physical oceanography, marine geology and marine geophysics.

During 17 working days, we casted 13 CTDs to measure salinity, temperature, density, pressure, conductivity, oxygen content, beam transmission and fluorescence. At every casting, we also samples of phytoplankton, chlorophyll, nutrient, protists and DOC at six different depths. Total 4 productivity experiments were conducted and zooplanktons are collected at 10 stations using Bongo net. Biological sampling was also conducted at 15 stations. We collected geological samples at 3 stations and acquired geophysical data including multichannel seismic data in the Central Basin of the Ross Sea.

During the survey weather condition was generally mild except cold temperature below than -10 degrees Celsius. Sea condition was relatively good during the whole period but we had to wait for one day because of bad weather.

Chapter 2 K-PORT project

2.1 Multichannel seismic survey

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As a collaborative work between Korea and Italy, a multi-channel seismic (MCS) survey was conducted for two days during ANA03B cruise. The survey area was located on the continental slope between Joides Basin and Central Basin in Ross Sea (Fig. 2.1). An airgun array consisted of 8 air guns with a total volume of 1,200 in^3 (19.7 liter) was used as a seismic source and it was towed at the depth of 6 m. Airguns have four different volumes of G.Gun II: Gun 1 & 2 were 250 in^3, Gun 3 & 4 were 200 in^3, Gun 5 & 6 were 90 in^3 and Gun 7 & 8 were 60 in^3. Airguns were shot every 50 meters and the pressure inside these were about 120 bar (1740 psi). We experienced many gun troubles caused by cold sea water temperature (below 0 degree Celsius), therefore we operated only two guns (Gun 3 & 4) which were in stable condition. A solid streamer of 120 channels was used as a receiver. The length of active section of the streamer is 1500-meter long. The depth of the streamer was controlled by 8 depth leveler (bird) and the towing depth was 8-meter deep. We recorded for 10 seconds after trigger at the sapling rate of 1 ms. For a quality control eSQC-Pro was used during the cruise. Seismic data (KSL12) were acquired on 3 profiles whose total length of more than 160 km(Fig. 2.2). The first profile of KSL12, KSL12-1, was started at UTC 10:31 22nd February 2013 and finished at 22:19, 22nd February 2013 in UTC. The shot number of KSL12-1 ranges from 249 to 2757 and the length of the line is 125.45 km. KSL12-2 was started at 22:20, 22nd February 2013 and finished at 00:37, 23rd February 2013. The shot number of KSL12-2 ranges from 2759 to 3202. KSL12-3 was started at 00:55, 23rd February 2013 and finished at 02:01, 23rd February 2013. The shot number of KSL12-3 ranges from 3243 to 3472. Fig. 2.3 is an example of shot gather of KSL12-1 showing relatively good data quality. Fig. 2.4 shows near-trace gather of KSL12-1 showing reflections and multiples.

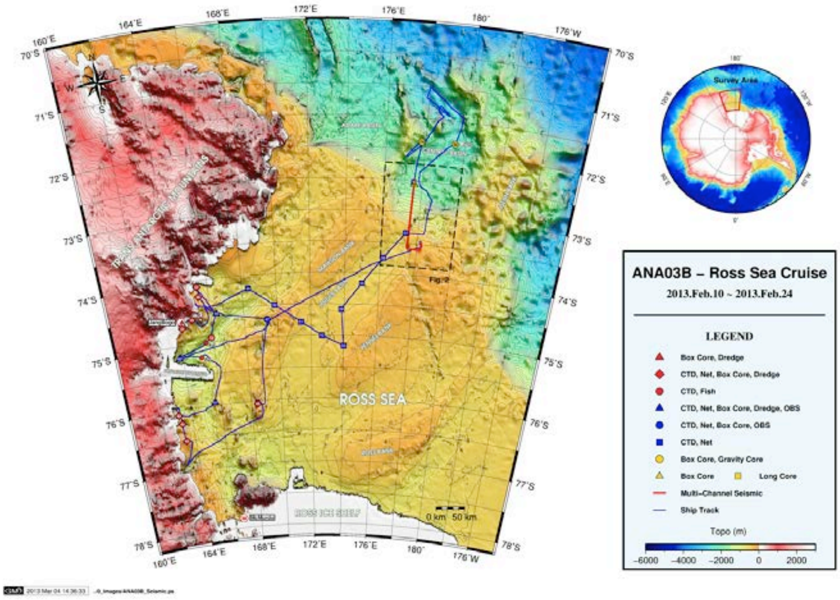

Figure 2.1 Survey map of ANA03B contains research stations and multi-channel seismic line and ship track.

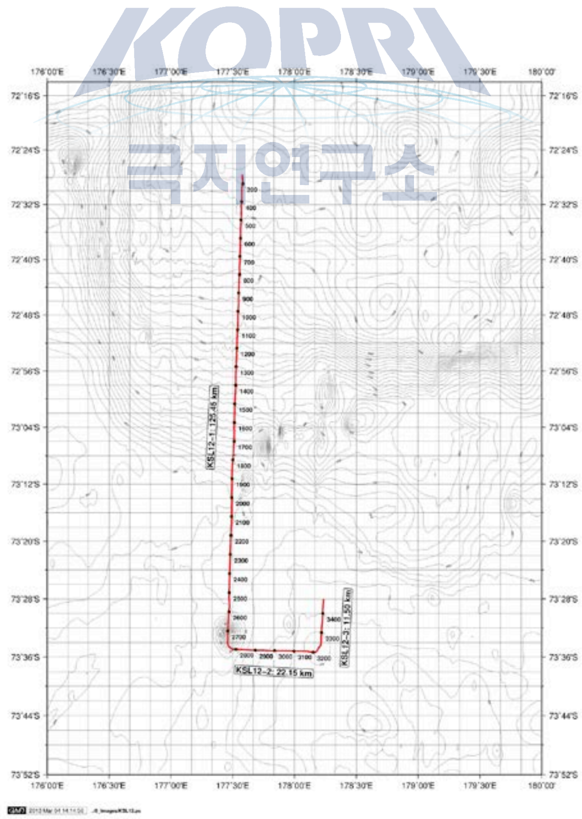

Figure 2.2 Trackchart of Korea Seismic Line 2012 (KSL12) of ANA03B. Solid red line is multi-channel seismic line and black dots mean shot number at intervals of 100.

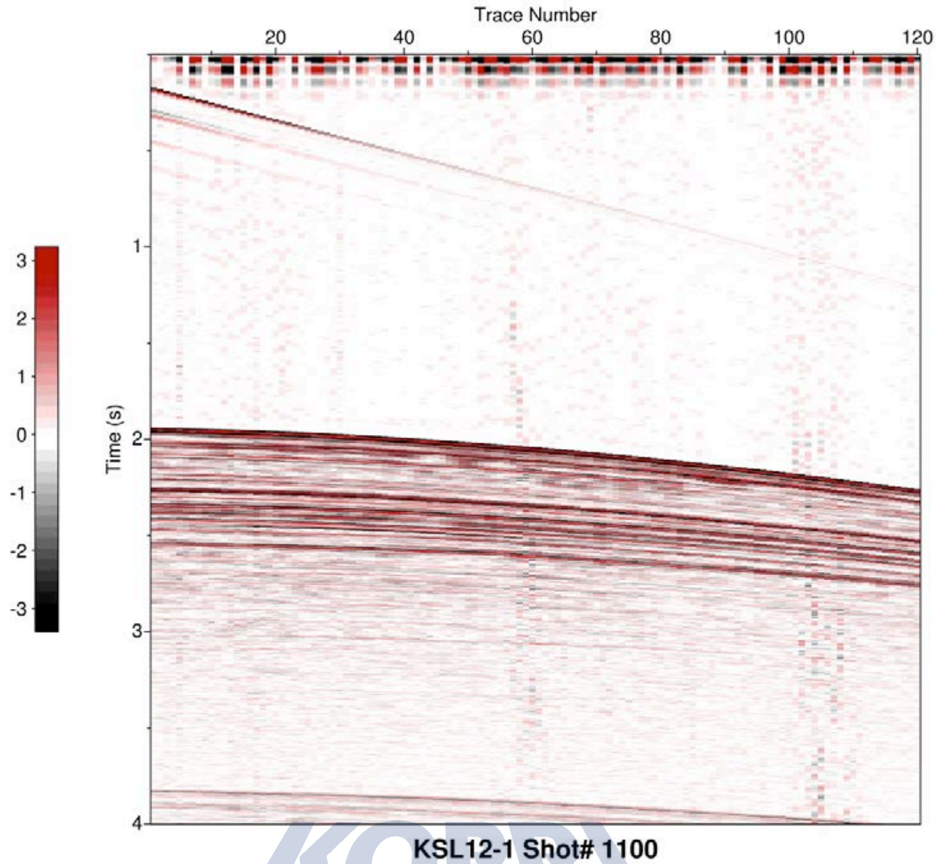

Figure 2.3 A shot gather of KSL12-1.

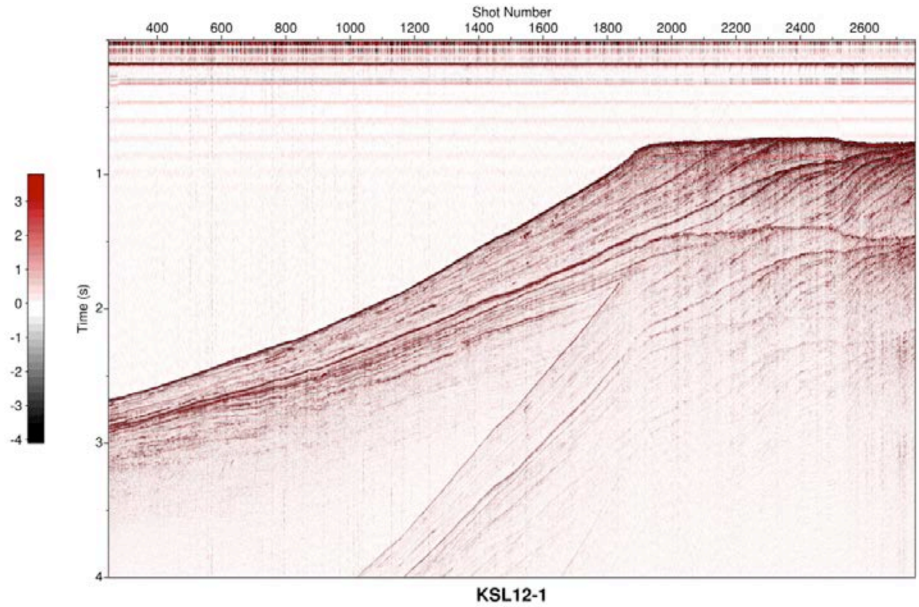

Figure 2.4 Near-trace gather of KSL12-1.

2.2 Mapping and geological sampling

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As a collaborative work between Korea and Italy, mapping and geological samplings were conducted during the cruise ANA03B. The Italian scientific program is ROSSLOPE, Past and present sedimentary dynamic in the ROSS Sea: a multidisciplinary approach to study the continental SLOPE. The goal of the collaboration between ROSSLOPE Project and KOPRI team in this cruise was to collect data in the East area of the Iselin Bank. This area is also very important because is the deep sea target site of IODP Proposal 751-Full "Direct chronologic and environmental-change constraints on the WAIS late Neogene grounding events at the Eastern Basin, Ross Sea, outer continental shelf" submitted in April 2010 by P. Bart, in collaboration with other proponents.

Because of the sea ice persistent in this area, the focus were moved to the Central Basin, another area of interest for the project.

From 18th to 23th of February the ROSSLOPE group activity was:

1) **Ice survey**: The ice survey, started at about at 6 pm (LT), were performed to know if the area selected had ice problem for the seismic acquisition. The survey was performed along the programmed seismic lines. Sub-bottom and MultiBeam data were acquired during the navigation. The track programmed was changed cause ice presence at about 72° S.
2) **Sediment sampling**. The sediment sampling started on 2013/02/19. Three the sampling stations (see location map-Fig.2.5).

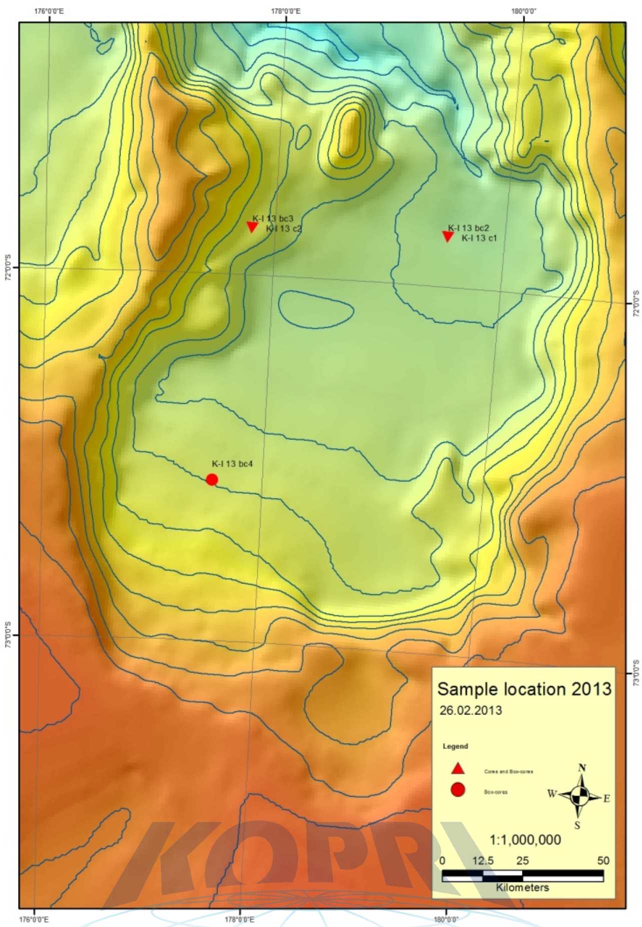

Figure 2.5 Location map of gravity and box cores.

- In the first station we have performed two box corer. The first (**K-I13 bc1**) failed cause stone and washing sediment. The second (**K-I13 bc2**) has collected 37 cm of gravelly mud sediment. The gravity core (**K-I13 c1**) was performed with a 9 meters tube long and collected 3.26 meters of sediment. After the sediment recovering operation, CTD was carried out.
- In the second station a 35 cm-length box core (**K-I13 bc3**) and a 2.32 m-long core **K-I13 c2**. The core catcher presented a very compacted and hard gray mud.
- The third station was selected to perform only a box core (**K-I13 bc4).** The ROSSLOPE project has already a gravity core in this station. The sampling operations were concluded at about 8.30 pm of February 21th.

The sampling sediment operation was interrupted from about 7 pm (19^{th} February) to about 2 pm (20^{th} February) to perform a Jumbo Corer test for another project in the North area of the Central Basin.

Box-core sediment was sub-sampled with 2 PVC liner: one for Kopri archive center, one for Italian team. Cores were split and described (see attached file). Radiographs, XRF core scanner, and a very detailed picture were carried out by I-TRAX core scanner (Fig. 2.6). Cores and box-cores were stored at +4°C. Archive halves will be stored in Kopri and the sampling half core will be sampled in Italy (at the Department of Mathematics and Geosciences laboratories of the University of Trieste-Italy) where will be sub-sampled. Sub-samples will be send to University of Busan – Korea (Prof. Boo-Keun Khim) to measure some organic matter parameters (TOC, CaCO3, Biogenic opal, C and N isotope) like previously established.

Table. 2.1 Coordinates of gravity and box cores

label	sampler	date	time (UTC)	date	time (LT)	depth	latitude (S)	longitude (E)	recover(cm)	sections	note
K-I 13 -bc1	box corer	18/02/2013	18.21	19/02/2013	9.21	2246	71° 51.9946	179° 20.3426	failed	1	stone trapped and washed sediment
K-I 13 -bc2	box corer	19/02/2013	00.05	19/02/2013	13.05	2246	71° 51.9951	179° 30.3409	37	1	sticky gravelly mud
K-I 13 - c1	coring	19/02/2013	03.30	19/02/2013	16.30	2246	71° 51.9942	179° 30.3387	326	4	coring tube 9 meters; penetration 6 meters; recovered 3.28 meters CTD has been performed in the same station

label	sampler	date	time (UTC)	date	time (LT)	depth	latitude (S)	longitude (E)	recover(cm)	sections	note
K-I 13 -bc3	box corer	20/02/2013	18.10	21/02/2013	7.15	1800	71° 52.4752	177° 48.0710	35	1	sandy silt very hydrated and soft
K-I 13 - c2	coring	20/02/2013	23.20	29/02/2013	12.20	1797	71° 52.4758	177° 48.0854	232	3	coring tube 6 meters; penetration 3 meters; recovred 2.27 meters The core catcher didn't close well; washed sediment on the top core Top compressed during storing operations.

label	sampler	date	time (UTC)	date	time (LT)	depth	latitude (S)	longitude (E)	recover(cm)	sections	note
K-I 13 -bc4	box corer	21/02/2013	6.23	21/02/2013	19.23	1772	72° 33.8214	177° 32.7408	44	1	sticky gravelly mud

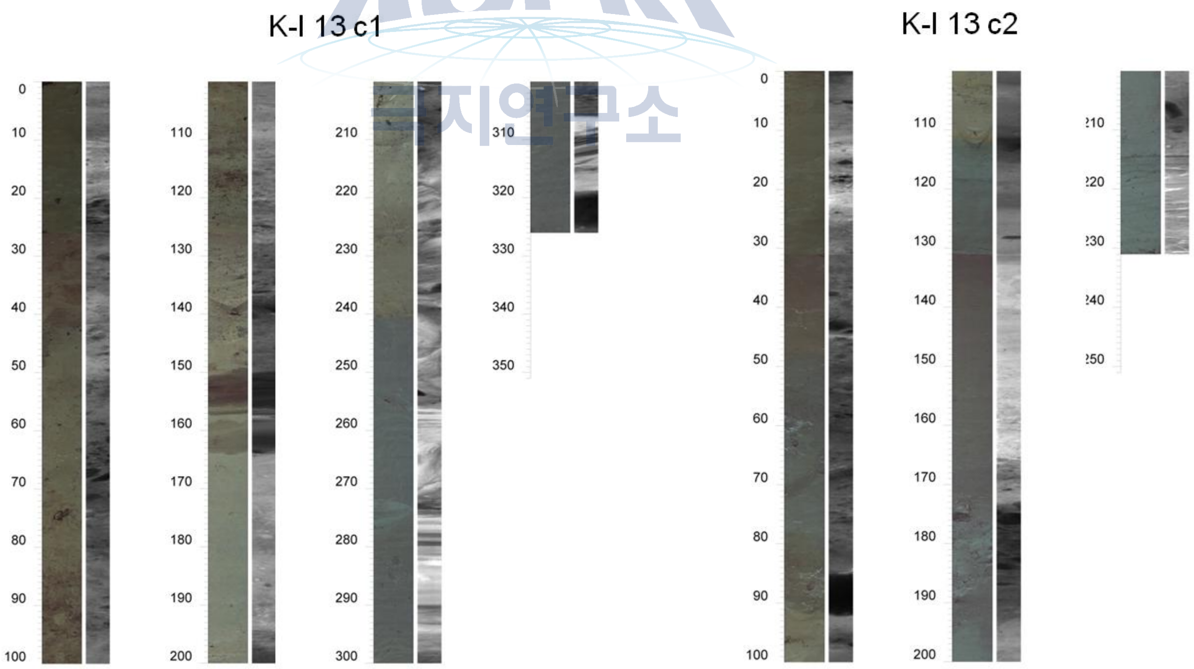

Figure 2.6 I-TRAX pictures and X-rays performed (by Mr. Heung Soo Moon – Kopri)

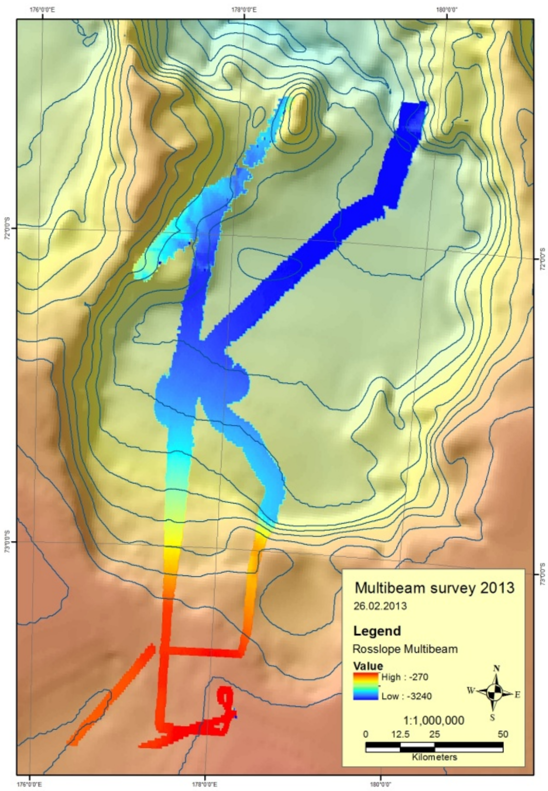

Figure 2.7 SBP survey.

Sub-bottom profiles and Multibeam surveys were performed during the navigation track in the selected Central Basin area (Figs. 2.7-8).

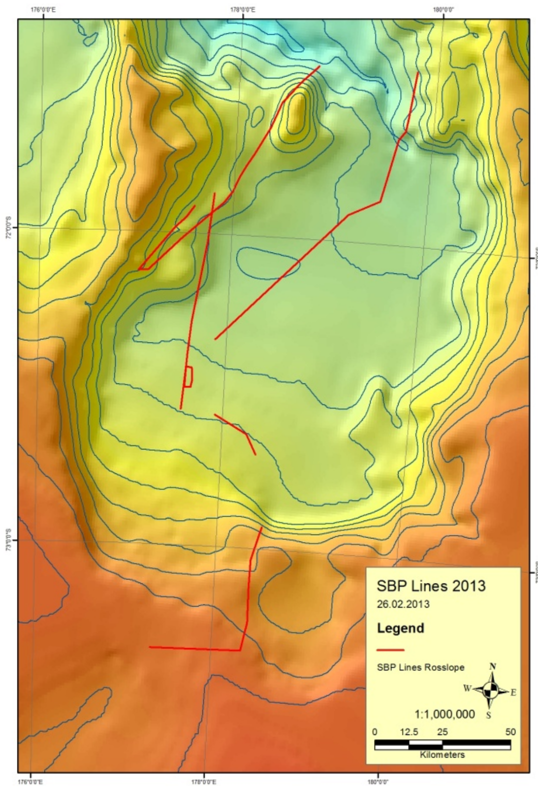

Figure 2.8 Multibeam survey.

Sub bottom profile (SBP)

In conjunction with multichannel seismic acquisition also sub bottom profile data were acquired. As for multichannel seismic acquisition a continuous QC were performed. Some data examples are shown in Figs. 2.9-10.

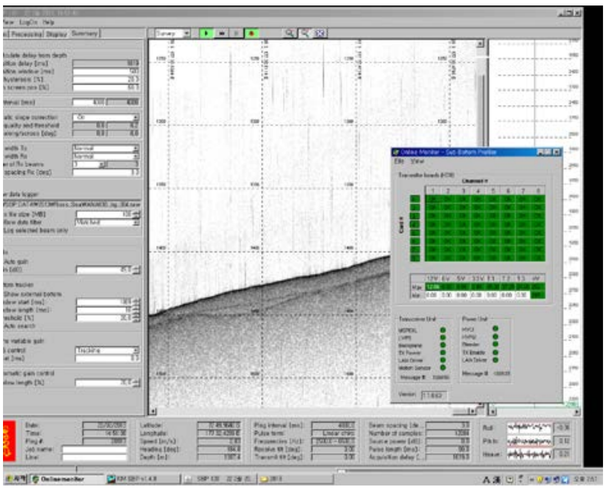

Figure 2.9 SBP QC.

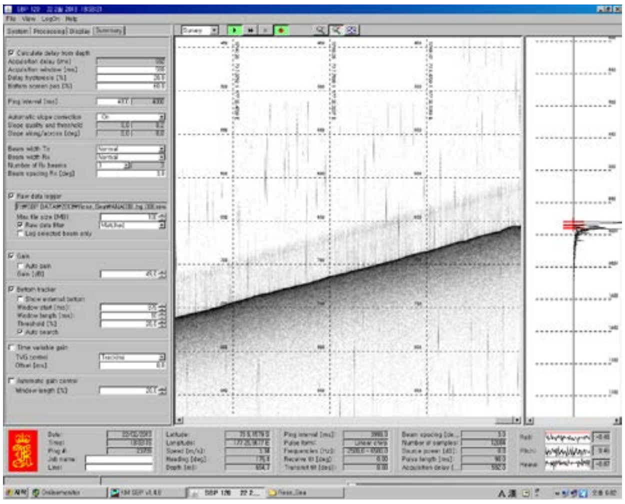

Figure 2.10 SBP QC.

Unfortunately after the end of the ROSSLOPE project acquisition, a significant part of the data files were overwrote and, consequently, definitively lost. The impossibility to reconstruct the sedimentary facies at different resolution scales represents a strong limitation respect to the original planning.

Multibeam data

Multibeam data were acquired along multichannel lines and in the nearby areas. In the Fig. 2.11 a snap shot acquired during the seismic survey is shown.

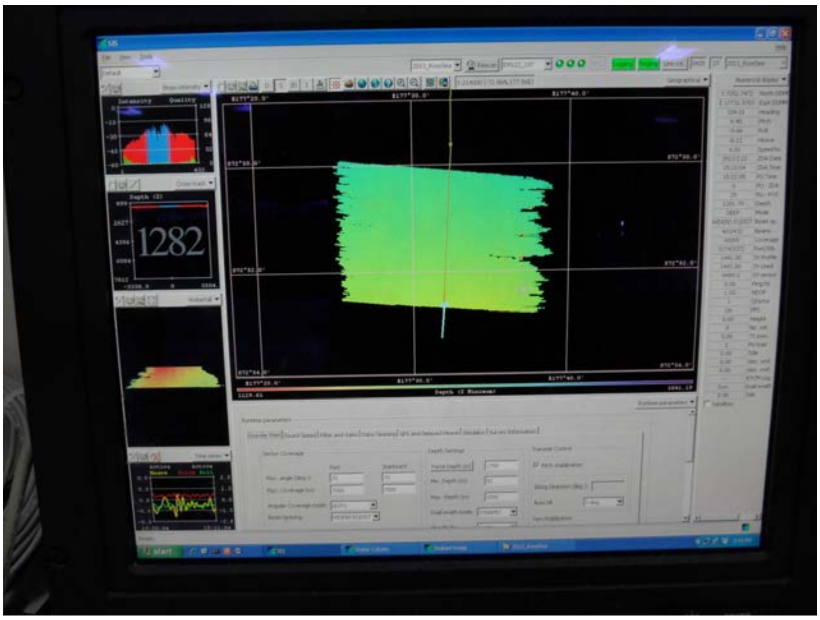

Figure 2.11 Multibeam data example.

2.3 Distribution of nutrients and phytoplankton community structure

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2.3.1 Introduction

The phytoplankton of the Ross Sea continental shelf is unusual relative to much of the rest of the Antarctic, in that it is extremely productivite and has a restricted number of functional groups that contribute to this productivity (Smith et al. 2010). Much of the photosynthesis occurs within a seasonal polynya located on the continental shelf, which generally becomes ice-free during late summer (Arrigo and van Dijken 2003; Barber and Massom 2007). Specifically, there are two major functional phytoplankton groups: diatoms and prymensiophytes, with the latter being dominated by *Phaeocystis Antarctica* (Arrigo et al. 1999; Smith and Asper 2001). It has been suggested that this relatively restricted phytoplankton assemblage in the Ross Sea results from a differential photosynthetic response of the two groups, with *P. Antarctica* being able to more effectively photosynthesize at lower irradiances than diatoms (Arrigo et al. 1999). The temporal pattern of phytoplankton assemblage composition is for the prymensiophytes *P. Antarctica* to bloom in November and reach very high standing stocks in December, after which the elevated biomass levels decrease rapidly. Diatoms appear in large part to be spatially segregated from *P. Antarctica* and attain dominance in February of the Ross Sea (Smith et al. 2010). At this time the region is usually characterized by high irradiance levels, 24-h photoperiods, shallow (<30 m, and ofter <15 m) mixed layers, growth-saturation nitrate, phosphate and silicic acid concentrarions (~ 15, 1 and 50 μM, respectively; Smith et al. 2000), but very low iron levels (<0.3 nM; Fitzwater et al. 2000).

Heterotrophic protists ingest a broad size spectrum of prey, from bacteria to microphytoplankton, and are themselves important prey items for mesozooplankton. Many researchers suggest that heterotrophic protists contribute to the trophic linkage between phytoplankton and mesozooplankton and are important in the pelagic food webs of many oceanic waters. The importance of heterotrophic protists in pelagic ecosystems has become increasingly evident in the past two decades, and trophic interaction between heterotrophic protists and phytoplankton has been reported in various marine.

The aim of the present study was to characterize the systematic composition of phytoplankton assemblages, their distribution, abundance, and size composition and associate them with varying abiotic factors during a limited period of time in summer 2013 in the Ross Sea. And we investigated protozoa abundance, biomass, and nutrient in 13 stations. Finally, The objective of this study to better understanding of the controls on distribution and variability of organic carbon in both the dissolved and particulate in the Ross Sea.

2.3.2 Materials and methods

Study area and Sampling

During Korea Icebreaker R/V ARAON cruise from 11 February to 23 2013, seawater sampling was carried out using a CTD/rosette sampler holding 24-10LNiskin bottles (OceanTest Equipment Inc., FL, USA). 13 sampling stations for analysis organic carbon were occupied between 73S and 75S, and 163E and 177W region (Fig. 2.12, Table 2.2)

Water column samples for analysis dissolved organic carbon (DOC) and particulate organic carbon (POC) were drained from the Niskin bottles into amber polyethylene bottle.

DOC samples were collected with precombusted (6 hrs. at 450C) GF/F filters using a nitrogen gas purging system under low (<1.0 atm) pressure (Fig. 2.13). After 20 ml of DOC samples were collected into a precombusted amber glass vial, 0.1ml MgSO4 was added to samples to remove inorganic carbon.

POC samples were collected with same procedure as DOC sample by filtration of known seawater volume. Both DOC and POC samples were stored frozen at -20C until analysis in the home laboratory.

The hydrographic characteristics of the sampling stations were measured using a CTD (Seabird 911+).

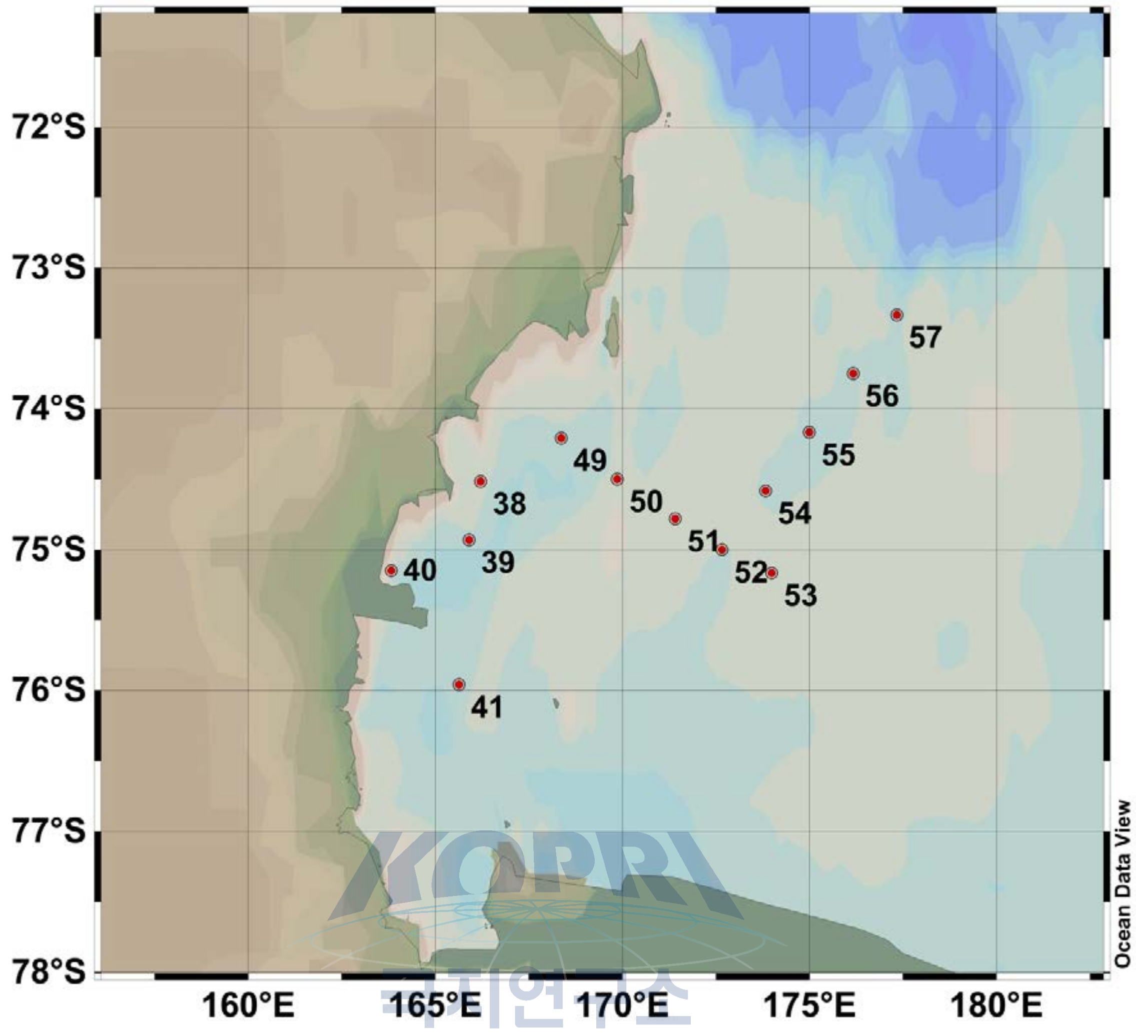

Figure 2.12 A map of study site surveyed during 2012.

Analysis

DOC samples will be analyzed with high-temperature oxidation (HTCO) method (Sugimura & Suzuki, 1988) using a Shimadzu TOC-V system. To maintain quality control of sample analysis, 3~4 point calibration curve of seawater DOC reference standards will be made.

POC samples will be determined with a CHN analyzer according to JGOFS protocol (JGOFS, 1996).

Composition of phytoplankton assemblages

A total of 13 stations were visited. Water samples were collected at 6 depths (Surface, 20m, 50m, 100m, 150m, and subsurface chlorophyll a maximum depth) with a rosette sampler equipped with 20 L Niskin-type bottles, an in situ fluorometer, and a high-precision Sea-Bird plus CTD probe. The subsurface chlorophyll maximum layer depths were estimated by CTD profiles.

To analysis phytoplankton community composition, water samples were obtained with a CTD/rosette unit in 20 L PVC Niskin bottles during the 'up' casts. Aliquots of 125 mL were preserved with glutaraldehyde (final concentration 1%). Sample volumes of 50 to 100 mL were filtered through Gelman GN-6 Metricel filters (0.45 µm pore size, 25 mm diameter). The chl a concentration was estimated by Fluorometer. Particulates were collected on 25 mm glass fiber filters (GF/F) and the filters were then left in the dark for 12 h in 90% acetone at 4°C for pigment extraction.

Abundance and community structure of heterotrohic protists

To determine the abundance of heterotrophic protists, a CTD-Niskin rosette sampler was used to take water samples from the following 6 depths. For ciliates and sarcodina, 500 ml water from the vertical profiles was preserved with 1% acid Lugol’s iodine solution these samples were then stored in darkness. For heterotrophic nanoflagellates and heterotrophic dinoflagellates smaller than 20 µm, 500 ml of water was preserved with glutaraldehyde (0.5% final concentration) and stored at 4° C.

Table 2.2 Sampling location and sampling depth at each station for organic carbon analysis.

Station	Lat.	Long.	Sampling depth(m)
ANA03B_#38	74˚30.90'S	166˚12.69'E	0, 20, 50, 75, 100, 150
ANA03B_#39	74˚55.95'S	165˚54.32'E	0, 20, 50, 70, 100, 150
ANA03B_#40	75˚08.98'S	163˚49.68'E	0, 20, 50, 70, 100, 150
ANA03B_#41	75˚57.51'S	165˚38.17'E	0, 20, 50, 100, 150

ANA03B_#49	74˚12.54'S	168˚21.99'E	0, 10, 30, 75, 100, 150
ANA03B_#50	74˚30.02'S	169˚51.72'E	0, 20, 40, 80, 100, 150
ANA03B_#51	74˚46.80'S	171˚24.79'E	0, 20, 50, 80, 100, 150
ANA03B_#52	75˚00.01'S	172˚39.94'E	0, 20, 55, 80, 100, 150
ANA03B_#53	75˚10.01'S	173˚59.60'E	0, 20, 50, 70, 100, 150
ANA03B_#54	74˚34.99'S	173˚49.98'E	0, 30, 50, 80, 100, 150
ANA03B_#55	74˚10.00'S	174˚59.94'E	0, 20, 50, 80, 100, 150
ANA03B_#56	73˚44.99'S	176˚10.01'E	0, 20, 50, 80, 100, 150
ANA03B_#57	73˚20.01'S	177˚19.96'E	0, 20, 50, 80, 100, 150

Figure 2.13 Nitrogen gas purging system for collecting DOC and POC.

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2.4 Assessment of mesozooplankton community and grazing impacts by major copepods on phytoplankton biomass

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2.4.1 Introduction

The bulk of mesozooplankton in marine pelagic ecosystems usually consists of copepods, and these small crustaceans often constitute as much as 80 % of the zooplankton biomass (Vargas et al. 2010), depending on locality and season (Mauchline 1998). Copepods are key components in the ‘classical’ food web, where they mainly function as herbivores, forming an important trophic link between phytoplankton as primary producers and higher trophic levels (Cushing 1989, Vargas et al. 2010). They also provide the dominant food source for fish larvae and planktivorous fish. Thus the main carbon flow from phytoplankton to fish is heavily mediated by copepods.

The Ross Sea is one of the most productive ecosystems in the Southern Ocean (Arrigo *et al*.,1996), yet data suggest that mesozooplankton and macrozooplankton biomass there, relative to the high phytoplankton biomass, is anomalously low compared to other Southern Ocean areas. The mesozooplankton community of some Antarctic areas has been the subject of extensive investigations carried out near South Gergia Island (Pakhomov et al., 1997) and in the Weddell Sea (Vuorinen et al., 1997; Burghart et al., 1999). Studies on taxonomy, distribution and biomass of copepods have been carried out in the Ross Sea and in its coastal zones, such as in Terra Nova Bay and neighbouring areas.

The main goal of our study were, 1) to understand the composition and community structure of mesozooplankton, 2) to evaluate the grazing impact of major copepods on the phytoplankton biomass in the study areas.

2.4.2 Material and methods

Zooplankton samples were collected with a Bongo net (330 and 500 μm mesh) at 10 selected stations (Fig. 2.14, Table 2.3). The net was towed vertically within the upper 200 m of water column and duration was about 10-20 minutes. Samples from the 330 μm mesh size were immediately fixed and preserved with buffered formaldehyde (pH 8, final concentration ca. 5 ~ 8%) for quantitative analyses. From the 500 μm mesh size samples, healthy individuals were transferred to 10 l polycarbonate carboys filled with natural seawater. The animals were transferred into 20 ml vials containing filtered seawater. These vials were frozen at -80°C defreezer for the gut content analyses.

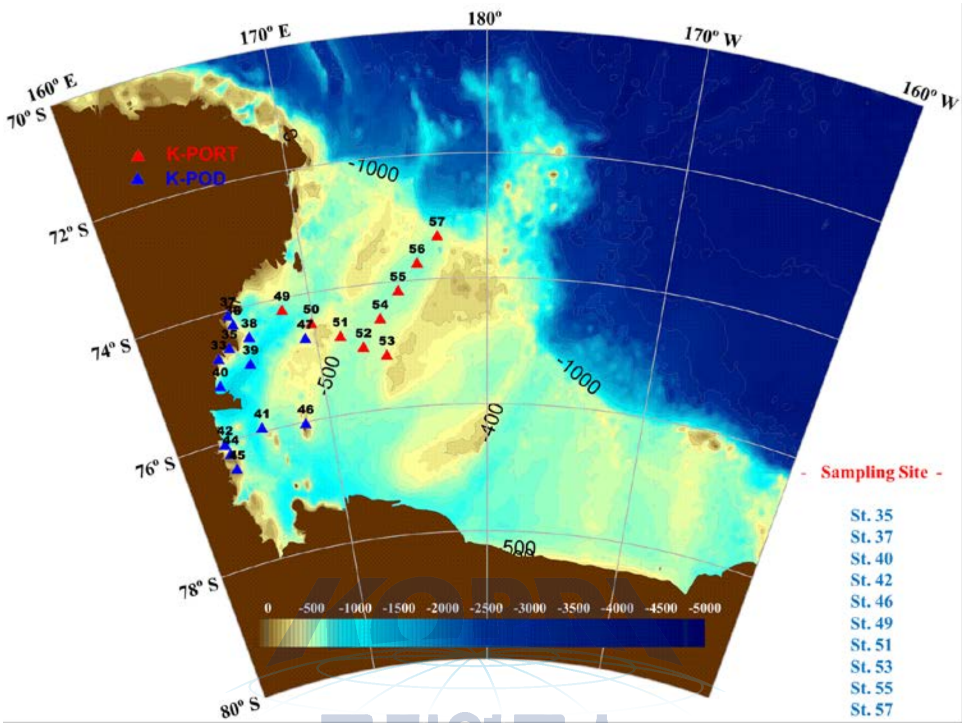

Figure 2.14 Sampling site of Bongo net in the Ross Sea.

Table 2.3 Latitude and longitude at sampling site and sampling depth of Bongo net from 10 February to 18 February 2013.

Date	Station	Latitude	Longitude	Sampling Depth (m)
2013-02-10	ANA03B-35	74.36.45 S	164.56.48 E	200
2013-02-11	ANA03B-37	74.06.18 S	165.19.77 E	200
2013-02-12	ANA03B-40	75.08.98 S	163.49.68 E	200
2013-02-13	ANA03B-42	76.03.35 S	163.04.72 E	200
2013-02-15	ANA03B-46	76.06.54 S	168.19.96 E	70
2013-02-16	ANA03B-49	74.12.54 S	168.21.98 E	200
2013-02-17	ANA03B-51	74.46.81 S	171.24.79 E	200
2013-02-17	ANA03B-53	75.10.01 S	173.60.00 E	200
2013-02-18	ANA03B-55	74.10.00 S	174.59.94 E	200
2013-02-18	ANA03B-57	73.20.00 S	177.19.95 E	200

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2.5 Carbon and nitrogen productions of phytoplankton

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2.5.1 Introduction

The Antarctic has low chlorophyll a despite high concentration of nutrients in ambient water (Minas et al., 1986), where is low primary production compared to other regions on an annual basis. On the other hand, it is crucial role in air - heat exchange, global deep seawater (such as Antarctic Bottom Water) formation, and efficient biological pump in world’s ocean (Siegenthaler and Sarmiento, 1993). The phytoplankton play major role in marine ecosystem, because it affects higher trophic levels at food web and may draw down a significant amount of atmospheric carbon dioxide (CO_2) into ocean by CO_2 utilization.

Our research region, the Ross Sea, where is known as one of the most productive polynya with Amundsen Sea and Ronne Ice Shelf, sum of these regions were accounting for over 75 % of total primary production in Antarctic (Arrigo et al. 2003). Hence, this data will contribute to help better understanding the change of Antarctic marine ecosystem and global carbon cycle by estimating phytoplankton production.

2.5.2 Methods and Materials

To estimate carbon and nitrogen uptake of phytoplankton at different locations, productivity experiments were executed by incubating phytoplankton in the incubators on the deck for 3-4 hours (Fig. 2.15) after stable isotopes (^{13}C, $^{15}NO_3$, and $^{15}NH_4$) as tracers were inoculated into each bottle. Total 4 productivity experiments (Fig. 2.16) were completed during this cruise. At every CTD station, the productivity waters were collected by CTD rosette water samplers at 3 different light depths (100, 30, and 1%). In addition, Along with the small (1 L) productivity bottle experiments, 4 large volume (8.8 L) productivity experiments for three depths (100, 30, and 1% light depths) were executed to study the physiological status and nutritional conditions of phytoplankton at the productivity stations (Fig. 2.16). These filtered (GF/F, ø = 47 m) samples will be chemically analyzed for the macromolecular level end products (such as lipids, proteins, polycarbonates and LMWM) of photosynthesis.

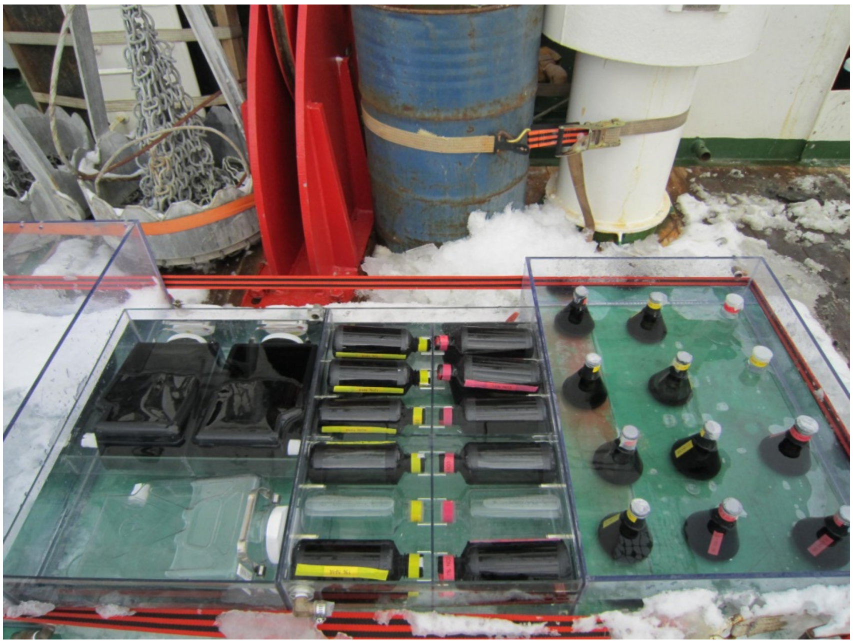

Figure 2.15 *In situ* incubation on deck for 3-4 hours.

After the incubation, all productivity sample waters were filtered on GF/F (ø = 25 mm or 47 mm) filters for laboratory isotope analysis at University of Alaska Fairbanks after this cruise.

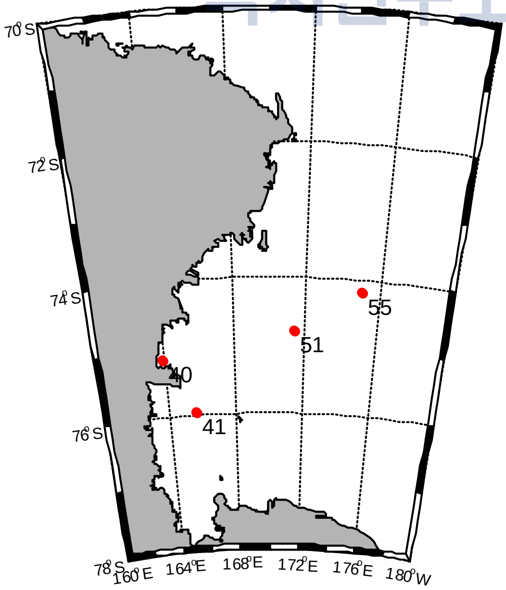

Figure 2.16 Stations for primary and macromolecular productivity during the Ross Sea cruise.

2.5.3 Preliminary Results

Light intensity during the cruise

Air surface light intensity measured during the cruise ranged from over 1600μmol m^{-2} s^{-1} for day time to about 0.8 μmol m^{-2} s^{-1} for night (Fig. 2.17).

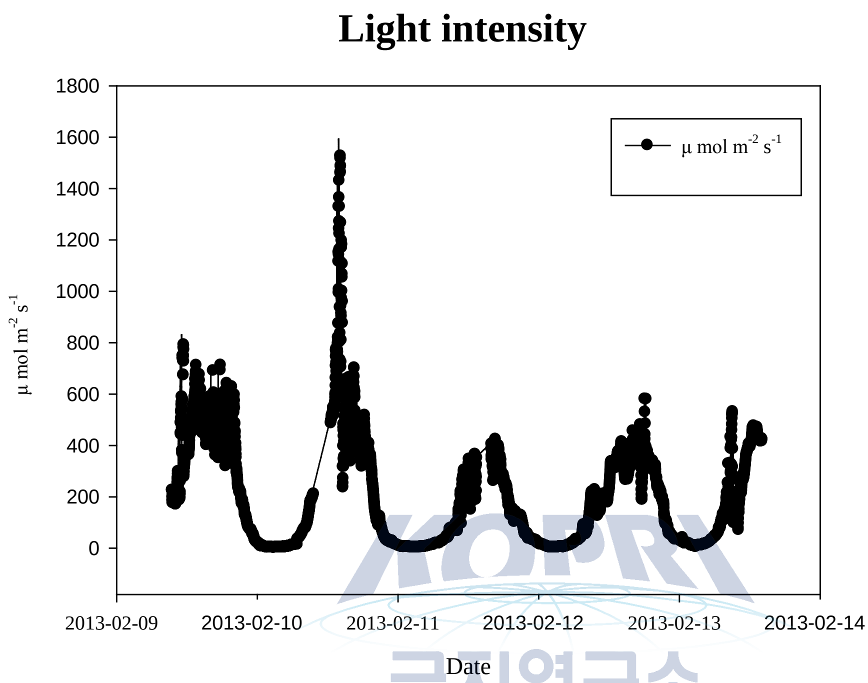

Figure 2.17 Air surface light intensity during the cruise in 2013.

There is a distinct pattern of light intensity for day and night cycle although night time is not dark at all most of time during the Antarctic summer. Therefore, the incubation time for phytoplankton productivity experiments should be executed during the day time when the light intensity high enough for their growth.

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Chapter 3 Biodiversity Study

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3.1 Introduction

The Ross Sea, southern extension of the Pacific Ocean, which, along with the vast ice shelf at its head, makes a deep indentation in the circular continental outline of Antarctica. (Michael Pidwirny, 2006). The Ross Sea is unique. It is the most extreme ocean in regard to the seasonality of light and its year-round existing ice cover. Arctic seas hold a multitude of unique life forms highly adapted in their life history, ecology and physiology to the extreme and seasonal conditions of this environment.

Figure 3.1 The Ross Sea, Antarctica.

Therefore, K-POD project has collected marine organisms from Ross Sea for understanding of biodiversity and their metabolites, related adaptation in extreme environment.

3.2 Materials and methods

1) Marine bacteria sampling used by CTD/Rosette at each station. Niskin bottles can be tripped at different depths for seawater sampling.
2) Metagenome sampling used by SV filters (0.25 um) from Sea water each station.
3) Zooplankton sampling used by Bongo-net at each station.
4) Sediment sampling used by Box-core sampler at 4 stations.
5) Marine biology dredge is used for benthos organisms within the smooth muddy floor of the Ross Sea

3.3 Expected result

3.3.1 Marine Bacteria

Bacteria are common inhabitants of sea water, and may contribute up to about 50% of the total biomass within this habitat. K-POD has collected marine bacterial samples from sea water, sea ice and Box-core. K-POD was isolated marine bacteria from marine samples in MA, R2A, SZB, YPG (marine fungi), ISP4 (marine actinomyces) and ASN II (marine microalgae) media. K-POD will try to study of biodiversity and metabolic flow for understanding extreme adaptation, and to develop their metabolites as industrial applications.

3.3.2 Metagenome study

Metagenomics is the study of metagenomes, genetic material recovered directly from environmental samples. Metagenomics has the potential to advance knowledge in a wide variety of fields. It can also be applied to solve practical challenges in medicine, bioengineering, agriculture and sustainability (Challenges and Functional Applications, National Research Council, 2007). K-POD has collected the Metagenome samples from sea water of Ross Sea. From samples, K-POD will try to study biodiversity, useful gene and industrial applications.

3.3.3 Zooplankton

The information of Arctic Ocean’s zooplankton and benthos are poor compared to most other northern regions. K-POD was collected some zooplankton by Bongo-net in Ross Sea, and we will try to study inner bacteria, useful gene and natural products.

3.3.4 Benthos

Very little research has been done on the benthic realms in Ross Sea. K-POD was collected some benthos by biological dredge in Chukchi sea, and we will try to study inner bacteria, useful gene and natural products.

3.3.5 Fish

For the cooperation with Italian teams (ALICE (Antarctic silverfish Life-cycle and sea-Ice, PNRA), K-POD has tried to collect silver fish from Ross Sea in 4 stations (near of Drygalski Glacier Tongue region) by Hambreg Plankton Net.

3.4 Summary and conclusions

K-POD project was collected various marine samples for studying of marine bacteria, metagenome, zooplankton and benthos from Ross Sea. We will try to study biological natural product and metabolite flow in this area.

Table 3.1 K-POD stations in the Ross Sea.

Station	Longitude [E]	Latitude [S]	Distance(km)	Depth(m)
1	164.249	74.661	0.0	-14.0
2	164.210	74.728	8.0	-139.0
3	164.860	74.615	23.0	-120.0
4	165.230	74.307	83.0	-135.0
5	165.330	74.060	28.0	-131.0
6	166.215	74.521	58.0	-691.0
7	163.848	75.175	100.0	-1010.0
8	165.688	75.953	142.0	-427.0
9	163.048	76.130	74.0	-106.0
10	163.029	76.320	21.0	-138.0
11	163.035	76.554	26.0	-132.0
12	162.707	76.880	37.0	-142.0
13	166.380	76.223	120.0	-129.0
14	168.332	76.109	54.0	-121.0
15	169.408	74.783	151.0	-500.0

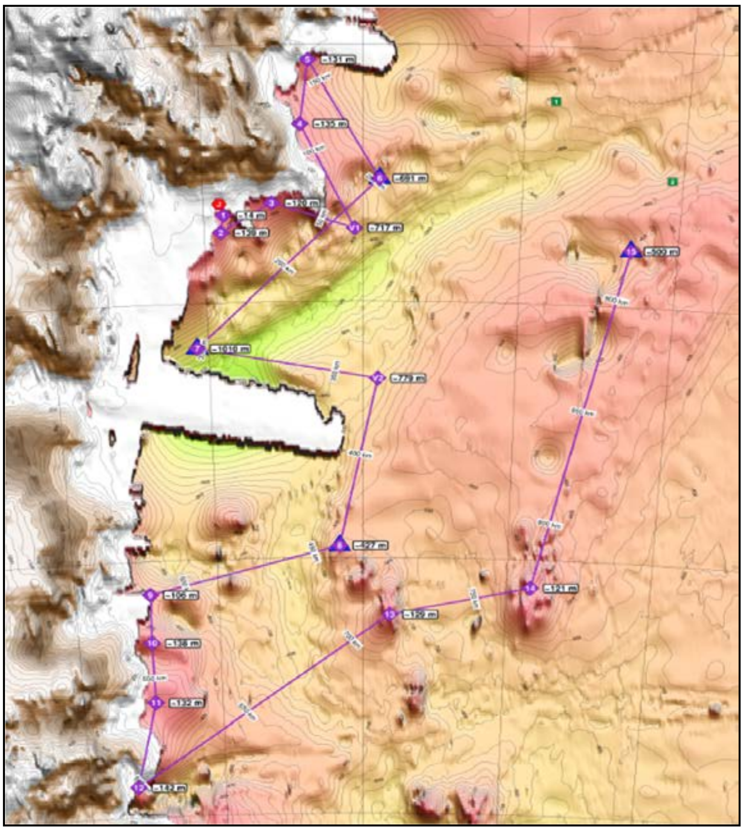

Figure 3.2 Location map of K-POD stations.

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Chapter 4 OBS Recovery

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During the Araon cuise 2011-2012 in the Ross-Sea, four Ocean Bottom Seismometer (OBS) had been installed to continuously record seismic activity and volcanic activity for more than a year. As far as we know, this is the first time an OBS has been deployed for such a long time in polar regions. Due to the high demands on quality and robustness, an instrument from K.U.M. GmbH (www.kum-kiel.de) was chosen. The OBS were equipped with a 3 channel broadband seismometer CMG-40T manufactured from Guralp Systems Ltd and a Hydrophone HTI LF 04 manufactured from High Technology Inc. Both sensors supply data in the frequency range from 100Hz down to 60 seconds. The data are aquired from a MCS seismic recorder manufactured from SEND GmbH. Data are collected with 50 samples per second, 24 bit each channel, at a signal-noise ratio of 130dB.

The instrument called LOBSTER (Longterm Ocean Bottom Seismometer for Tsunami and Earthquake Research) is equipped with a corrosion free frame of titanium, robust buoyancy from syntactic foam, an acoustic release KUMQuat with redundant power supply, an iron anchor and relocation aids such as a flag, a radio beacon and a flasher. Before deployment, the internal clock is syncronized with GPS. Once deployed, the LOBSTER sinks to the seafloor and autonomously gimbals the seismometer and starts data aquisition. If needed, additional autonomous gimbals can be performed. To recover, one sends a binary coded acoustic signal from the ship. The release KUMQuat decodes the signal, releases the anchor that remains on seafloor and due to its buoyancy it returns to the sea surface. After recovery, a second clock synchronisation is performed and the clock skew determined. A high clock accuracy is essential for the data quality. The picture shows a LOBSTER during deployment.

Figure 4.1 OBS Recovery.

Table 4.1 Coordinates of OBS locations.

OBS_01	74° 33,597' S	166° 21,443' E
OBS_02	74° 43,226' S	169° 22,300' E
OBS_03	75° 11,717' S	163° 46,053' E
OBS_04	75° 57,554' S	165° 38,226' E

On Monday, February 11th early morning we arrvied OBS_01 location. The sea was covered with ice more than 90% and the visibility was less than 150m. We did not try to recover the OBS. On the same day in the late evening we arrived OBS_03 position with simular condition. Again, we did not try a recovery. Next day we arrvied position of OBS_04 and successfully recovered the instrument. The clock accuracy was excellent showing just 2,5 seconds skew. A first look to the data showed that all channels worked and the Samoa-Event 6th Feb. 2013 could be clearly recorded. When we arrived at the position of OBS_02 on 15th, the ice conditions were promising while the visibility was less than 150m with strong winds and snow. Waterdepth was 350m only, so we decided to release the OBS. Recovery was difficult and the instrument got some damages, however the seismic recorder still worked and the clock again was very accurate with a deviation of just 2.2 seconds. On this instrument also the Samoa event was visible.

On the16th of February we arrived at the position of OBS_01 that unfortunately was covered with thick ice. The ice conditions seemed to be quite stable, so we decided to stop recording data to safe remaining battery capacity to power the clock. Using the acoustics of the KUMQuat release unit that is connected to the seismic recorder, we successfully switched the recorder to idle status.

On February 24th we recovered OBS_03 without any problems. Unfortunately, the recorder had internal hardware problems and stopped acquisition in August 2012. Clock synchronisation was lost due to empty batteries, so we assume that the damaged hardware consumed too much energy continuously.

Finally, two OBSs were recovered with good data, one with data of half a year where timing needs to be checked, and OBS_01 will remain on seafloor until next year.