

Cruise Observations in the Greenland Sea and Barents Sea, January 1999

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1999年1月に実施したグリーンランド海・バレンツ海における航海観測

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要旨: 国立極地研究所はロシアのクニボビッチ極域漁業海洋研究所との共同研究として北極域で海洋観測を実施した。調査海域はバレンツ海西部とグリーンランド海北東部である。この海域は炭素吸収域、また深層水形成域として知られている。地球規模炭素循環およびその季節変動の把握を主題とし、国立極地研究所北極圏環境研究センターの国際共同研究事業の一環として計画した。海上調査作業を速報するとともに、得られた結果の一部を紹介する。

Abstract: The National Institute of Polar Research (NIPR) carried out an observation cruise in the Arctic in cooperation with the Knipovich Polar Research Institute of Marine Fisheries and Oceanography (PINRO), Russia. The observation area was the western part of the Barents Sea and north-eastern part of the Greenland Sea. The area is considered to be a major carbon sink and also where bottom water is formed. The field work is reported here together with some preliminary results.

1. Introduction

The carbon circulation is one of the global material cycles, which describes the environment dynamically. The ocean surface is potentially considered as a sink, *i.e.* the carbon is taken from the atmosphere into the water. The carbon thus caught by the water will be, however, returned to the atmosphere sooner or later, unless it is brought down to a great depth in a short time. The northern Atlantic is one of the few areas where bottom water is formed. The water has downward motion during the formation of bottom water, and the carbon in the water is possibly transported downward as well (AOKI *et al.*, 1997).

NIPR and other institutions have carried out observations on this problem since 1993 in the Greenland Sea and Barents Sea. It appears that the area is indeed a carbon sink, although more observations are needed to draw a definite conclusion.

A particular point of interest is the seasonal change. Since carbon absorption is closely related to activity in the biosphere, and the latter shows a drastic change during the year especially at high latitude, the carbon exchange between the atmosphere and the

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sea is expected to change with the progress of the season.

Few winter data have been collected in this area, and none have been specifically oriented to the carbon circulation study. To fill the chronological gap in the data set, the Arctic Environment Research Center of NIPR planned a winter cruise observation.

2. Cruise

A Russian ice-reinforced vessel, the IVAN PETROV was chartered. IVAN PETROV was a research vessel of the Soviet Union State Committee of Hydrometeorology and Environmental Control (Gydrometflot), and belongs to the agent which succeeds the name and the task of the committee. The 49.9 m long ship displaces 929 ton. She is equipped with five winches, four laboratories and 35 berths. The cruising range is 35 days or 10000 km without supply. Twelve scientists, two from Russia and ten from Japan, boarded the vessel in Tromsø, Norway on 12 January and started the cruise on the same day. The member list is given in Table 1. The vessel headed north, passing the western coast of Spitsbergen, and reached the ice edge at 80° 57.5'N, 04° 12.0'E on 17 January, making observations on the way.

The area west of Spitsbergen and east of 0 degrees longitude was surveyed on the way back. The cruise was completed at Tromsø on 25 January. The stations are shown with dots in Fig. 1.

At each station a CTD (conductivity temperature depth profiler) cast was made down to 1500 m. The surface sea water was pumped up and fed into the equilibrator, and equilibrated air samples were obtained. A net was used to collect plankton samples. The water below the surface was sampled using Niskin bottles.

At a station a floating ice piece was fished and an ice sample was taken. Several XCTD (expendable CTD) casts were made en route, as were continuous meteorological observations.

Table 1. Scientists on board.

Name	Affiliation
Dr. Hajime ITO	National Institute of Polar Research (NIPR)
Dr. Yuji TANAKA	Tokyo University of Fisheries
Dr. Shinji MORIMOTO	National Institute of Polar Research (NIPR)
Mr. Kazushi ARANAMI	Hokkaido University
Ms. Michiyo YAMAMOTO	Hokkaido University
Mr. Kenji BABA	Hokkaido University
Mr. Hidemi SUETAKE	Hokkaido University
Mr. Daisuke KAWAI	Senshu University of Ishinomaki
Mr. Satoru YOSHIMURA	Tohoku University
Ms. Miyako NAYA	Tokyo University of Fisheries
Dr. Oleg TITOV	Knipovich Polar Research Institute on Marine Fisheries and Oceanography (PINRO)
Mr. Mihail ANTSIFEROV	Knipovich Polar Research Institute on Marine Fisheries and Oceanography (PINRO)

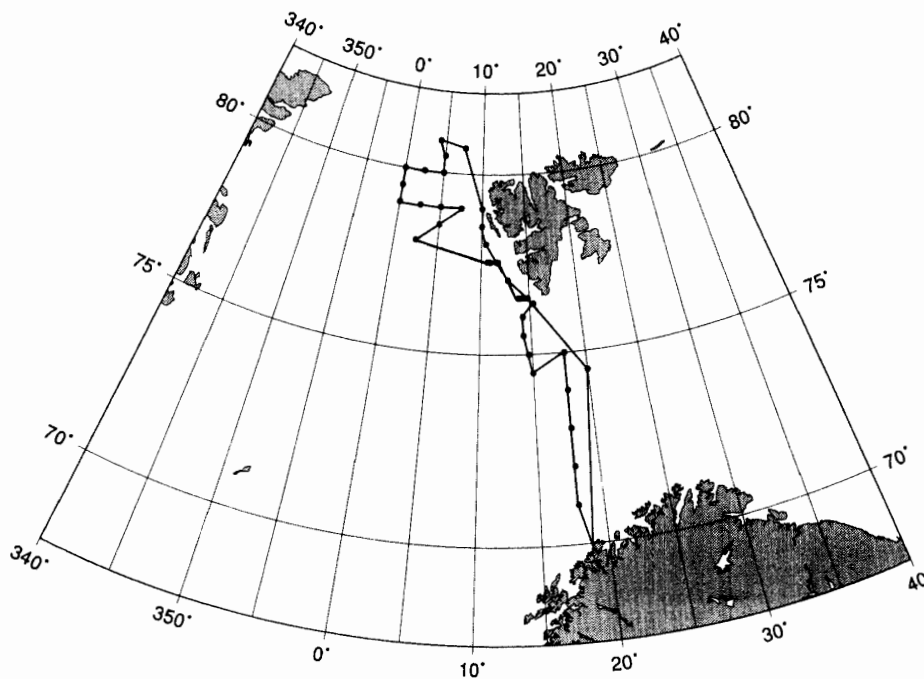


Fig. 1. The cruise route and stations.

3. Analysis

The CTD data were immediately processed. The temperature and salinity structures of the sea water at the station were used, to plan the depths and other details of the water sampling at that station. The CTD data together with XCTD data are to be further analyzed in Japan to clarify the bottom water formation mechanism.

The equilibrated air samples were brought back to Japan, where the analysis is being done. The partial pressure of carbon dioxide in the surface sea water in winter is to be measured in this area for the first time to serve as basic data in assessing the seasonal change of the carbon circulation.

Dissolved oxygen in the sea water was analyzed on board. Nutrient salts were also analyzed on board, to determine Si and P.

The water samples brought back to Japan will be analyzed for chlorophyll, total inorganic carbon, alkalinity, oxygen isotopes and salinity.

The ice samples brought back to Japan will be analyzed to determine the ice structure, and clarify the formation mechanism of Arctic sea ice.

The meteorological data will be sorted, analyzed and distributed, so that other disciplines have their observation environment in hand.

4. Preliminary Results

The analysis is still in progress. A couple of sample results are shown.

Figure 2 shows the salinity and temperature profiles of the water at the northernmost station, which was located at the ice edge. Good mixing is noticed in some layers.

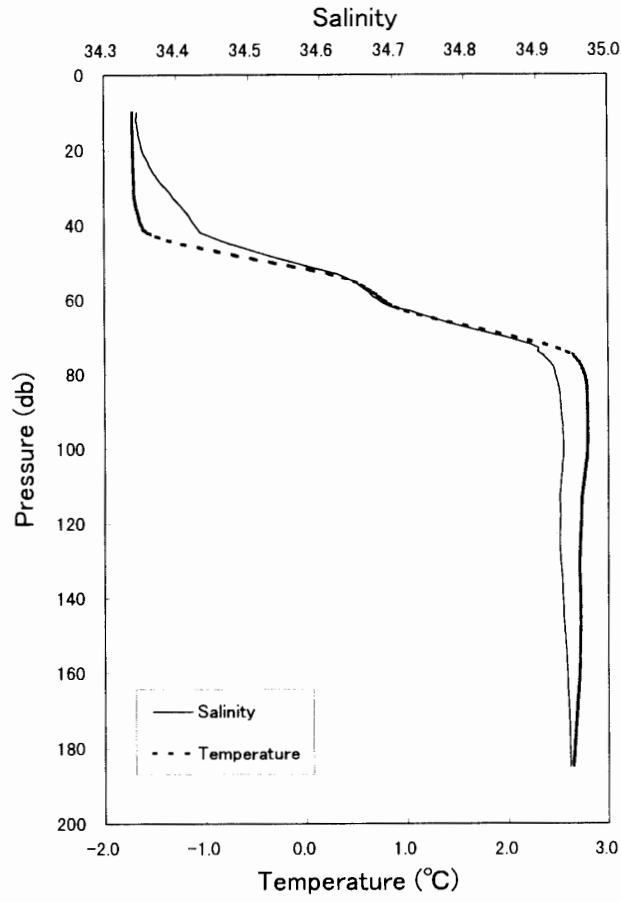


Fig. 2. Temperature and salinity profiles.

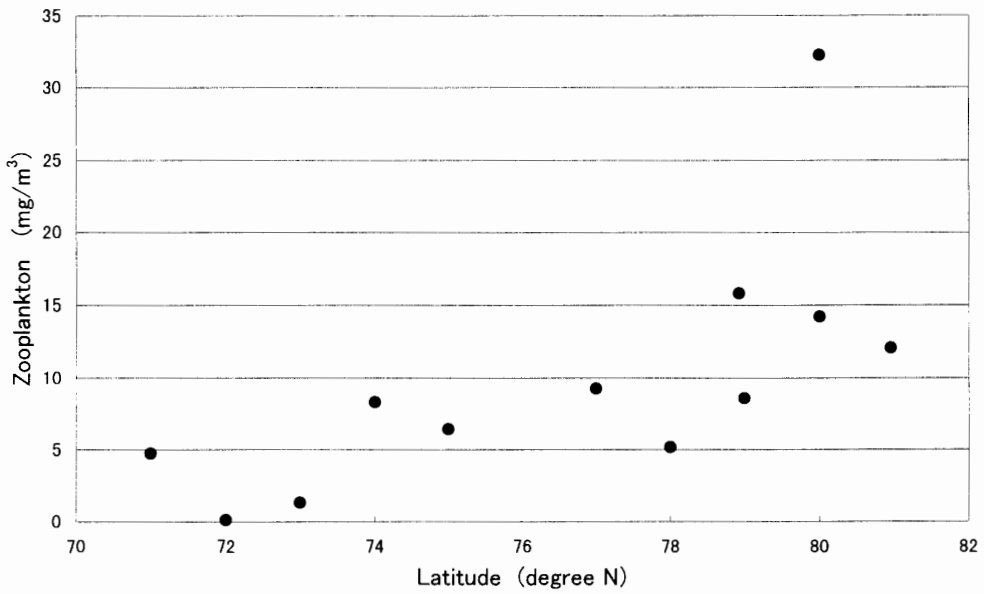


Fig. 3. Distribution of zooplankton.

Figure 3 shows the distribution of zooplankton. The peak at a rather northern position seems to be quite interesting.

The primarily processed data will be published in NIPR Arctic Data Report. The final results will be presented in journals and other opportunities.

Acknowledgments

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This was the first Arctic research cruise organized by NIPR. Many institutions and individuals contributed to the planning and execution of the cruise. Not all of the names are mentioned here but they are all sincerely acknowledged. The Russian partner, Dr. Yury BOCHKOV and his group in PINRO worked together with Japanese scientists from the planning stage, and carried out all the preparation on the Russian side. Captain Valeriy PUSTOSHNYI and his crew on the IVAN PETROV assisted the scientists beyond their duty during the work at sea.

Reference

AOKI, S., MORIMOTO, S., ITO, H., NAKAZAWA, T., YAMANOUCHI, T., ONO, N. and VINJE, T. (1997): Carbon dioxide variations in the Greenland Sea. Mem. Natl Inst. Polar Res., Spec. Issue, **51**, 299–306.

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