—報告—
Reports

Temperature Profiles of the Greenland Sea in the Summer of 1992: Report of the Oceanographic Observation on the R/V LANCE Cruise

Shuki USHIO[1], Meiji HONDA[2] and Hajime ITO[1]

1992年夏季，グリーンランド海の水温分布
—LANCE乗船観測報告—

牛尾収輝[1]・本田明治[2]・伊藤　一[1]

要旨: 1992年8月17日から30日までの間，グリーンランド海における国際共同観測に参加した．ノルウェーの観測船R/V LANCEに同国のほか，ドイツ，イギリス，米国，日本から計5カ国17名の研究者が乗船し，係留系の設置・回収，採水，CTD観測などを実施した．日本側は水温観測を担当し，流氷縁から東方の海域(77°～79°N, 3°W～15°E)2測線53点において水温の鉛直分布を測定した．流氷縁やスピッツベルゲン島近海では，氷塊の融解や陸水の流入に起因すると考えられる複雑な水温構造が形成されていた．

Abstract: Oceanographic observations in the Greenland Sea were conducted as a part of an international cooperative program. Seventeen scientists from five countries (Norway, Germany, England, U.S.A. and Japan) participated in the R/V LANCE cruise from August 17 to 30, 1992. Mooring work, CTD measurements, water sampling and others were carried out both in the ice-covered and open sea. Temperature profiles from XBT casts were obtained at 53 points. The thermal structure of the eastern Greenland Sea seems to be strongly influenced by ice melting near the ice edge and land-water influx from Spitsbergen.

1. Introduction

The Greenland Sea is located between Spitsbergen and Greenland and is covered with sea ice only in the northwest part in summer (PARKINSON *et al.*, 1987). Aiming to reveal the exchange process of water mass and atmosphere-ocean interaction, a number of international research programs have focused on the Greenland Sea. Many problems of polar oceanography, however, are not solved yet. As one of the National Institute of Polar Research's (NIPR's) International Cooperative Research Programs on the Arctic Environment, oceanographic observation of the Greenland Sea has been planned. The Norwegian initiated observations have been made for years using research vessels under the "International Arctic Ice Thickness Monitoring Project", the "International Greenland Sea Project", the "Norwegian ERS-1 ICECLIMA Project", and the "Norwegian Ocean Carbon

[1] 国立極地研究所. National Institute of Polar Research, 9–10, Kaga 1-chome, Itabashi-ku, Tokyo 173.
[2] 北海道大学低温科学研究所. Institute of Low Temperature Science, Hokkaido University, Kita-19, Nishi-8, Kita-ku, Sapporo, 060.

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Dioxide Uptake and Tracers Project". NIPR started to make arrangements with Norsk Polarinstitutt (NP) to send Japanese scientists to participate in the programs in 1991. In 1992 two Japanese scientists obtained an opportunity to participate in the R/V LANCE cruise. This study relates to that on fjord oceanography in Spitsbergen, which has been continued since 1991.

This report describes a summary of the cruise and the temperature profiles using expendable bathythermographs (XBTs).

2. Outline of *in-situ* Observations

Oceanographic observations were conducted on board R/V LANCE. Seventeen scientists from five countries (Norway, Germany, England, United States and Japan) participated in the cruise from August 17 to 30, 1992. The observed items are as follows: thermohaline measurement using CTD (conductivity-temperature-depth), water sampling for chemical analyses, deployment and recovery of moorings consisting of current meters, thermistor strings and upward-looking sonar, ground truth for remote sensing and deployment of surface drifters. The Japanese party was engaged in measurement of water temperature profiles using XBTs and air sampling for measurement of pCO_2 in the surface water. The main task for the cruise was to recover and deploy moorings.

Figure 1 shows the ship's track. She left Longyearbyen (78°10′N, 15°30′E), Spitsbergen on August 17, 1992 and headed toward 75°N, 4°W. Four surface drifters were deployed en route. Mooring work, CTD measurements, and sampling of water and air were done along 75°N. To the west of 12°W along the line, some of the moorings turned out to be impossible to recover and some of the operations were

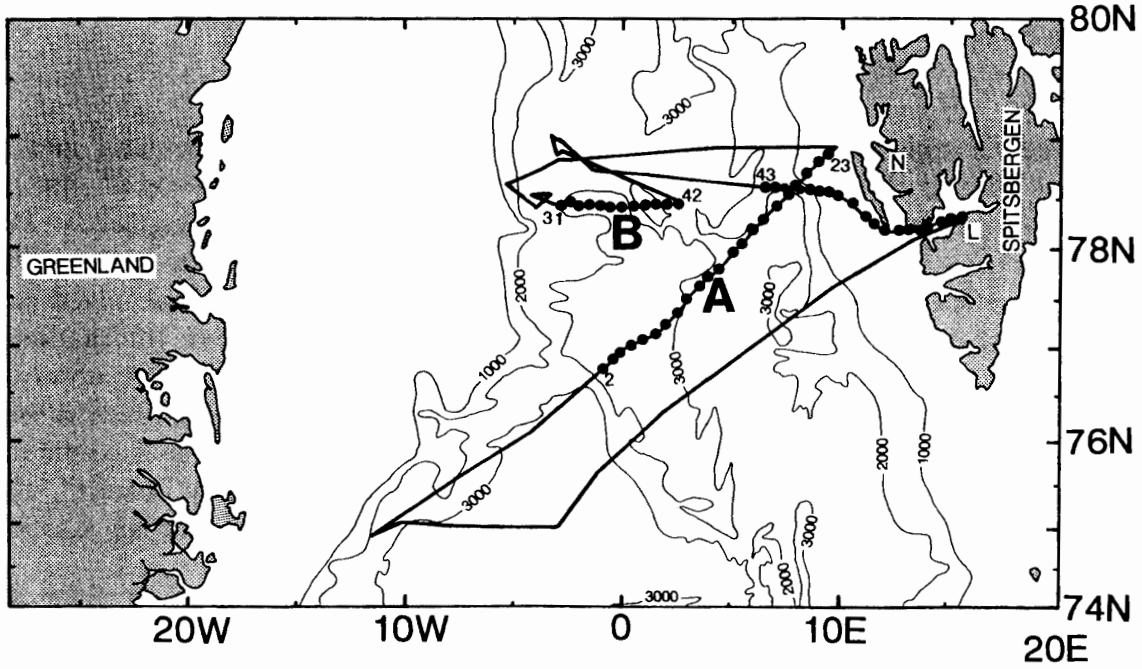

Fig. 1. Ship's track (thick line) and XBT-observation sites (solid circles) for the R/V LANCE cruise August 17–30, 1992. Isobathymetric lines are in meters. (L: Longyearbyen, N: Ny-Ålesund)

canceled due to the high sea-ice concentration. The ship started to sail northeast on August 22. On the way, two surface drifters were deployed and observation line A was set (Fig. 1). Along this line, temperature was measured using XBTs (Model MK-30, made by the Tsurumi Seiki Co., Japan) at 22 stations at intervals of 30 minutes of longitude. Almost all of the sensor probes were cast at the ship speed of 11 knots, and then temperature data down to 1000 m in depth were obtained at intervals of approximately 1 m depth. Temperature and depth accuracies of the XBT are ±0.1°C and ±5 m or ±2% of depth, respectively.

After reaching the water off Ny-Ålesund (78°50′N, 11°30′E), the ship sailed westward from August 23. Along the 79°N-line, mooring work, CTD measurements, sampling of water and air, and calibration work for remote sensing were carried out. The ship headed for Longyearbyen on August 29. XBT measurements were made

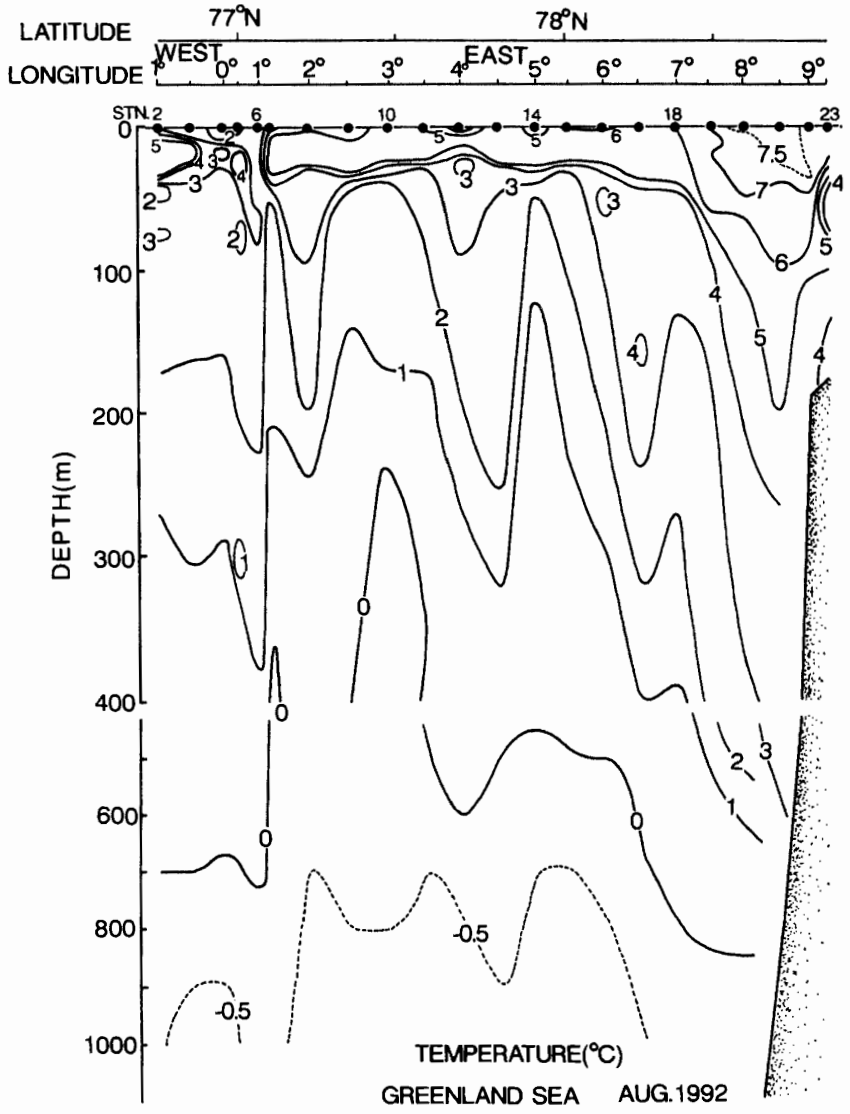

Fig. 2. Temperature section along line A. The closed circles indicate the positions of XBT observations.

along line B (Fig. 1) at 31 stations en route. The ship returned to Longyearbyen on August 30. These XBT data supplement the data obtained by CTD and are useful in understanding the thermal structure.

3. Results

Figure 2 shows a temperature section along line A. A thermocline is formed at 50 m depth. This must be due to surface warming in the summer. Near Spitsbergen, *i.e.* in the northeast part of the line, relatively high temperature is observed in the surface layer. This warm layer is considered to be influenced by the West Spitsbergen Current, which is believed to flow northward in the east part of the Greenland Sea. The relatively cold water mass, however, appears at 50–80 m depth in the easternmost area around Stn. 23. In the ice-edge region around 77°N, surface temperature is below 3°C and complicated thermal structure is formed. This suggests the intrusion of a different water mass and consequent mixing. The ice strip was found around Stn. 6 *in situ*. In the strip region, the air temperature as well as that of surface water falls below freezing point. It is considered that melting ice affected both

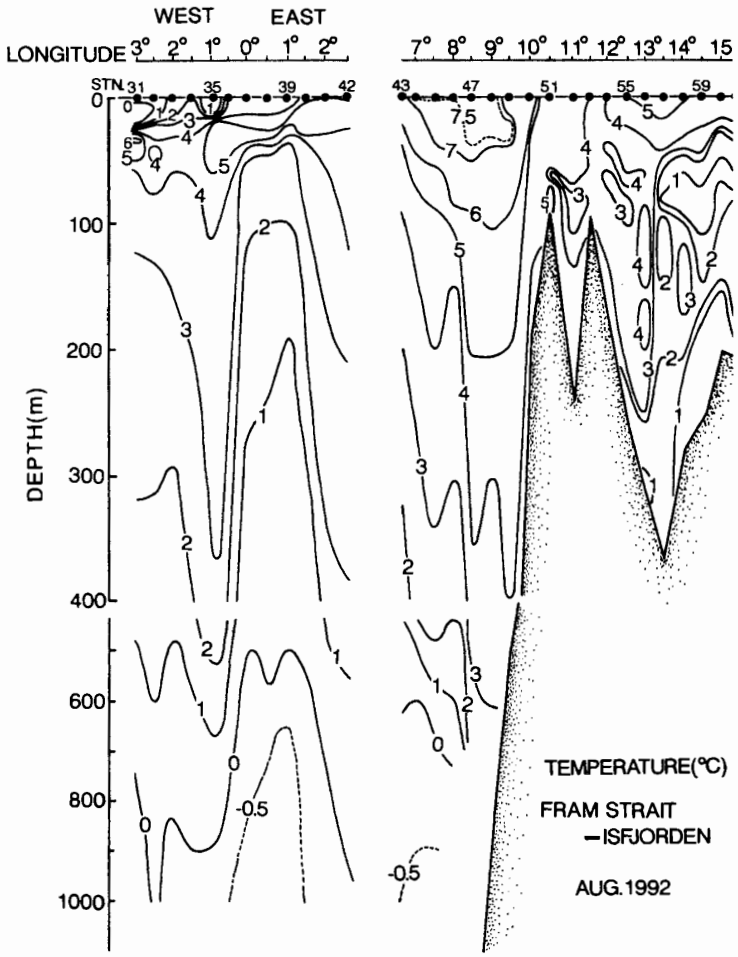

Fig. 3. Temperature section along line B. The closed circles indicate the positions of XBT observations.

air and sea conditions. From the isotherms, furthermore, cyclonic flow is expected to exist in the region. CARMACK (1986) called this the Greenland Gyre.

Figure 3 shows a temperature section along line B, 78°30'N (Fig. 1). The ice edge existed around 3°W on this line. The section between 3°W and 10°E looks similar to that of line A. A part of the Greenland Gyre was also detected. East of 13°E, complicated thermal structure appeared. This is the section within Isfjorden. This profile seems to be formed by the mixing of fresh water runoff with oceanic water.

4. Summary

Oceanographic observations were carried out in the Greenland Sea from August 17 to 30, 1992. The results from the XBT observations suggest that both ice floe melting near the ice edge and fresh water influx from Spitsbergen contribute to formation of the thermal structure. These *in-situ* observations are expected to be continued to reveal the environmental conditions and their variation in the Arctic region. It is also important to promote research on atmosphere-ice-ocean interactions in relation to the global climate.

The water temperature data from XBTs are deposited at the Arctic Environment Research Center of NIPR and are available to scientists.

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