

MR99–K05 Cruise Summary

1. Introduction

For the last few decades, we have come to realize the vulnerability of the Arctic and its residents to environmental and associated social changes. Climate model studies indicate that the Arctic environment may react particularly sensitive to global climate change. The recent observational studies reveal that the Arctic is in the midst of change extending from the top of atmosphere to below 1,000m in the ocean. Some changes appear to have begun as early in the 1970's, but many in the late 1980's or early 1990's. The lack of dense environmental data coverage in the Arctic due to inaccessibility or lack of long-term, continuous measurement stations, is a barrier to progress of modeling studies for global change prediction.

Because of its unique environmental conditions, better understanding of the Arctic region will contribute to basic research as well as a predictive capability for the impact of future change. Ice, snow, glaciers, and the permafrost, etc. in the Arctic are highly sensitive integrators and indicators of changes in environmental parameters such as the air temperature, the solar radiation and so on. Investigation of those can provide information about the fundamental processes, which regulate them, and the implications and effects of changes in the Arctic. This, in turn, requires efforts to conduct a long-term, systematic observations.

The purposes of this cruise, MR99–K05, were to study; 1) the physical/chemical oceanographic processes in the Canada Basin and at the marginal ice zone on the shelf of the Beaufort Sea; 2) the distributions of various kinds of volatile organic compounds (VOCs) in the atmosphere, sea ice and sea water in the Arctic Ocean; 3) the distributions and behaviors of trace gases and aerosols in the atmosphere in the Arctic Ocean and sub-arctic seas; 4) the radio-echo and dynamic structure of cloud system developed over the Arctic Ocean; 5) the paleo-climate history of the Arctic Ocean by sediment samples. In addition, the observations of physical and chemical properties from the central to eastern part of the subarctic gyre along the latitude of 47° N in the North Pacific was one of major objectives as well.

2. Summary

2.1 Ship

R/V Mirai
L x B x D 128.58m x 19.0m x 13.2m
Gross Tonnage 8,672 tons
Call Sign JNSR

2.2 Cruise Code

MR99–K05

2.3 Project Name

Arctic Ocean Observation Study

2.4 Undertaking Institute

Japan Marine Science and Technology Center (JAMSTEC)
2-15 Natsushima-cho, Yokosuka 237-0061, Japan

2.5 Chief Scientist

Leg-1 : Masao Fukasawa (Tokai University)
Leg-2 : Takatoshi Takizawa (JAMSTEC)

2.6 Periods and Ports of Call ([Fig.1](#))

Leg-1: From August 24, 1999 (Sekinehama) to September 10, 1999 (Dutch Harbor, USA)
Leg-2: From September 11, 1999 (Dutch Harbor, USA) to October 6, 1999 (Sekinehama)

2.7 Observation Summary

CTD (+ water sampling)	65 casts
CTD	9 casts
XCTD	47 casts
XBT	47 casts
ADCP Observation	Continuously
Oceanic Environment Monitoring	Continuously
Aerosol Sampling	Continuously
Surface Meteorology	Continuously
Sea Bottom Topography	Continuously
Geophysical Parameters	Continuously
Sediment Core Sampling	3 points
Doppler Radar Observation	Continuously
Radiosonde Launching	7 times
Sea Ice Sampling	1 point
Drifting Buoy Launching	4 buoys

2.8 Data Policy

All data obtained during this cruise will be under the control of the Data Management Office (DMO) of JAMSTEC.

2.9 Overview

(1) Leg.1: From August 23, 1999 (Sekinehama) to September 10, 1999 (Dutch Harbor, USA)

The first leg of MR99-K05 cruise was planned to complete WHP_P1 (World ocean circulation experiment Hydrographic Program; Pacific #1) line under a collaboration among other two cruises conducted by Japanese P1 revisit team and Institute of Ocean Science, Canada. WHP_P1 is a WOCE onetime hydrographic line along 47° N composed of 115 CTD+RMS stations. P1 observation was carried out in 1985 by United States. As it has been 15 years since P1 was observed, any possible climatological change may occur in the hydrographic structure. Thus, P1 revisit cruises mentioned above were

called for under a Japanese oceanographic research program, SAGE (Sub-Arctic Gyre Experiment). The high quality CTD+RMS casting and seawater analysis including chemical tracers and carbonate species are the main method of the WHP observation. Sixteen stations off Hokkaido and twenty-two stations between 166° W and 143.5° W were the duty for the first leg of MR99-K05 cruise.

We set sail on August 24th 1999 at Sekinehama, Japan. The first station of this leg was located at 42.81° N, 145.56° E where the CTD+RMS observation began at 8:31 JST on August 25th. At the fourth station, P1_#7, we placed, being not gently might be, whole CTD+RMS system and LADCP system with CTD cable of 4,000m long, on the sea bottom of 4,167m. As the back up CTD+RMS system did not work well, we made a port at Hachinohe on August 27th for a new ROSETTE system and restarted the cruise. It was assumed that the on board preparation for new CTD+RMS forced us to spend about 72 hours or more. We gave up our duty off Kushiro, Hokkaido for the most important objective of the cruise, i.e. to occupy stations between Japanese efforts and Canadian efforts. P1_#74 located 47° N, 165.96° W was set ahead.

On the course to P1_#74, 47 XBTS and 47XCTDs were dropped. We arrived at P1_#74 on September 3 1999 UTC. We occupied seventeen stations before we left the easternmost station of P1_92 located at 46.99° N, 145.80° W on September 8. Four SVP drifters (Surface Velocity Program drifter) were deployed in the midst of the Alaskan Gyre and the Alaskan stream at P1_#74 and at other three locations on the way to Dutch Harbor.

The first leg experienced a very rare and fatal accident. But 2/3 of planned stations were visited and 1/2 of planned water samplings were carried out. The nine(9) stations off Kushiro, Hokkaido were occupied during the second leg. We hope that our data will be useful for studies on climate changes in near future.

(2) Leg-2: From September 11, 1999 (Dutch Harbor, USA) to October 6, 1999 (Sekinehama)

We passed the Bering Strait on September 13, 1999 and stayed in the Chukchi and Beaufort Seas for 11 days. The ice edge was at about 75° N, 160° W and at about 73° N, 150° W. The most of research area was ice free except south of ice edge where we encountered very loose and patchy ice strips consisted from multi-year/first-year/brash ice with concentration less than 1/10. We have carried out the following observations along the shelfbreak from the Northwind Ridge to 150° W ([Fig.2](#)).

- CTD + water sampling ; 43 stations
- CTD; 9 station
- Sediment core sampling; 3 points
- Sea ice sampling; 1 point
- Atmospheric observations by the radiosonde and the Doppler radar
- Underway observations
aerosol sampling, surface meteorology, current profile, sea surface environment parameters, sea bottom topography and geophysical parameters

The weather was mostly cloudy and foggy, but sea conditions were generally favorable for the observation. The air temperature was below 0 ° C most of the days. Watching a polar bear and walrus was fun. We had a lucky night to observe northern light.

We passed the Bering Strait on September 23 seeing the Diomed Islands and Fairway Rock and steered our course southwestward for Kushiro, Hokkaido Japan. The passage was generally rough. In particular, after crossing the Aleutian Chain west of Attu Is., we

came up against dominant low pressure systems south off Kamchatka Peninsula in the North Pacific. We had a strong gale with the speed of more than 20m/s and very high sea condition with the wave height of 7 m. The latter half of the passage was calm and we carried out 9 CTD casts which were not made during Leg,1 and recovered a mooring off Kushiro, Hokkaido. We also conducted the underway observations and the atmospheric observations during the return voyage from the Arctic.

2.10 Acknowledgement

The remote location and harsh weather conditions made logistics and work in the Arctic Ocean and subarctic North Pacific difficult. The success of this cruise would not have been possible without the support and help of the crews of R/V Mirai and technical staffs of GODI and MWJ. We would like to express our heartfelt appreciation to all of them.

(MR99-K05 Leg-1 Chief Scientist Masao Fukasawa)

(Leg-2 Chief Scientist Toshi Takizawa)

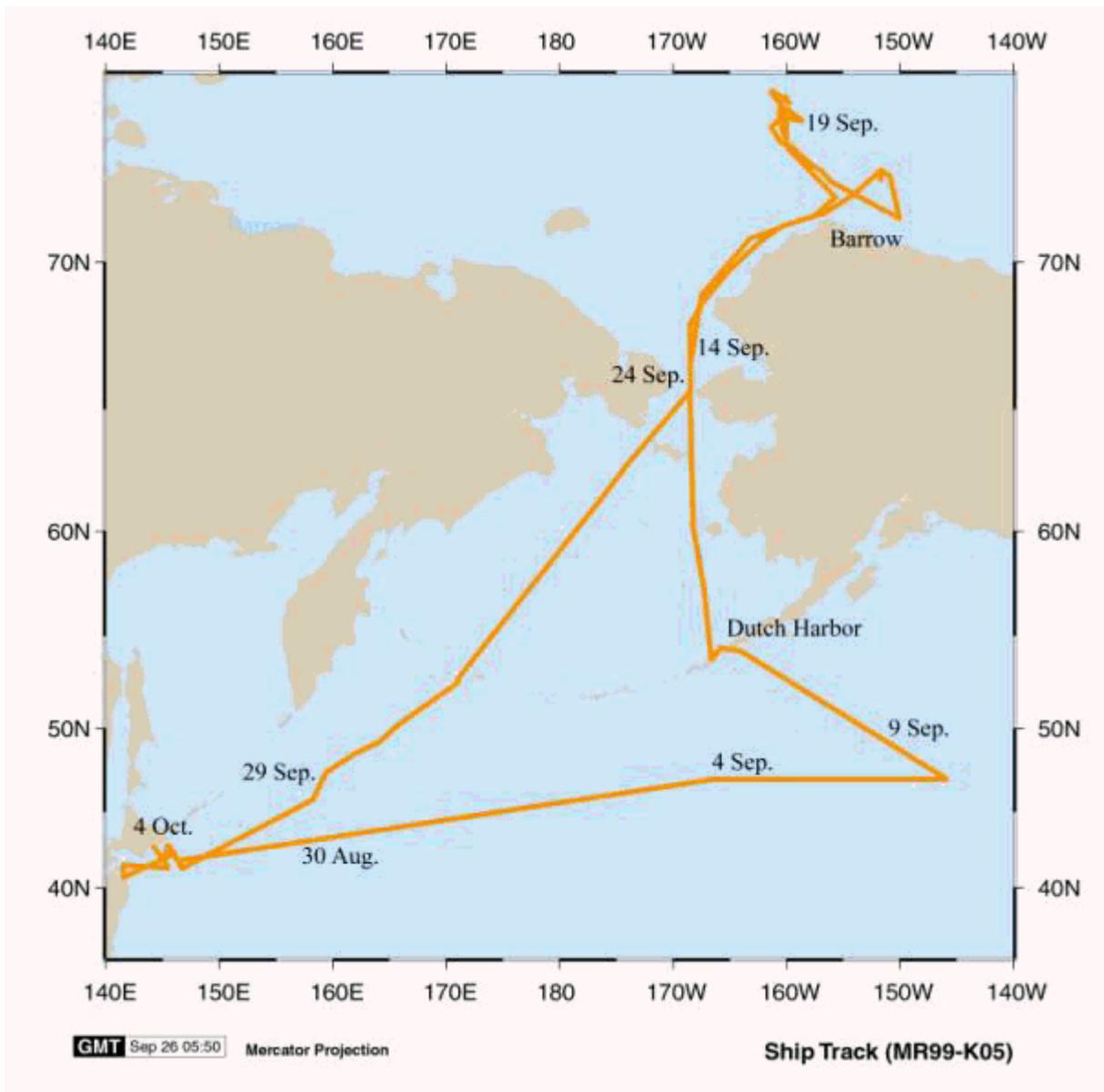


Figure 1. Cruise track of MR99-K05 (August 24 – October 6, 1999)

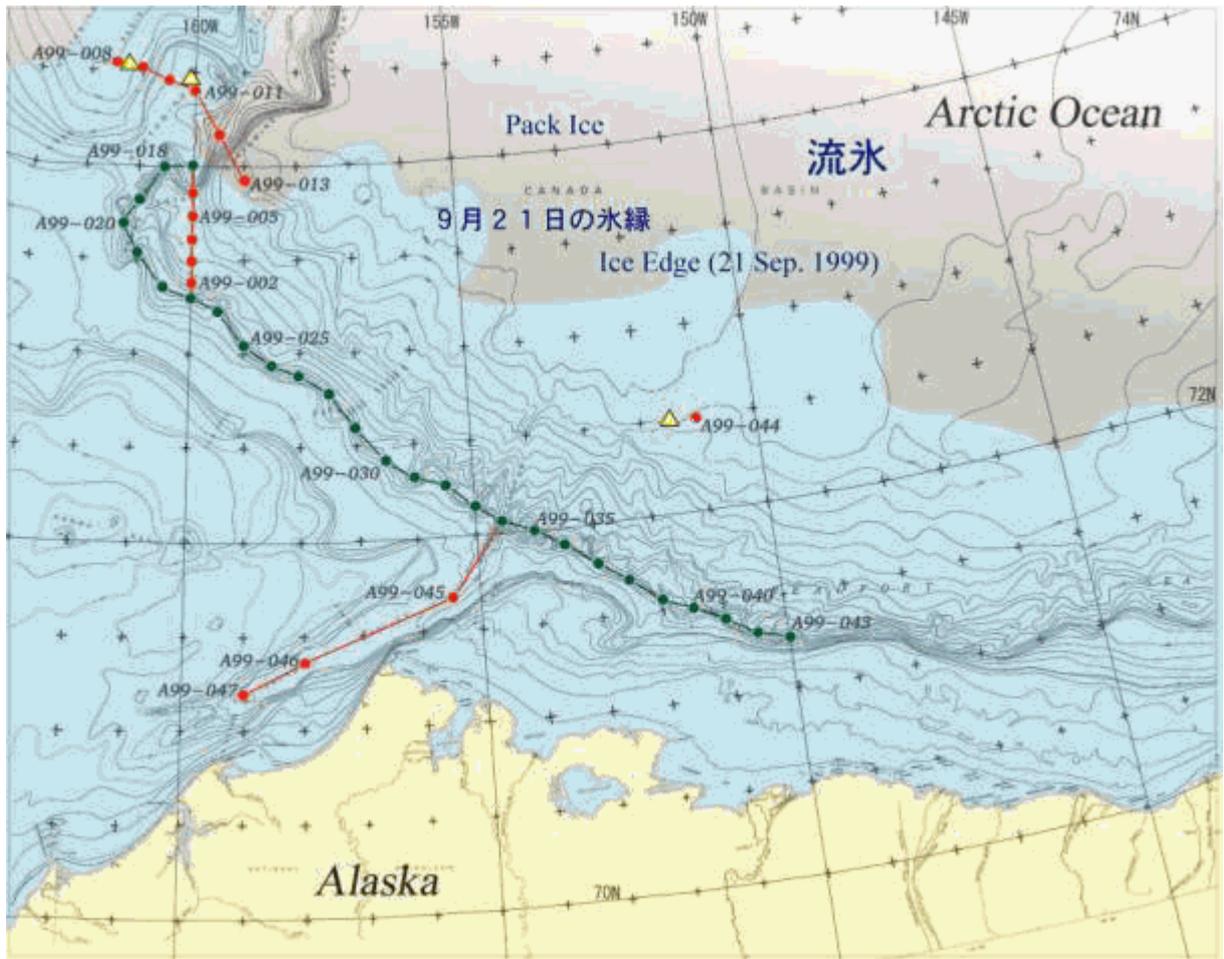


Figure 2. CTD stations (●●) and sediment core sampling stations (△) for Leg-2.