
MR00–K01 Cruise Summary



Objective of this cruise was the acquisition of biogeochemical data and the verification of biogeochemical material's cycle in the northwestern North Pacific in winter season when enough oceanographic data has not been obtained before. We planed to visit 21 stations located within 32.5_– 50_N and 142.5 – 165_E. R/V Mirai left her mother port, Sekinehama, on 6 Jan. 2000 and was back to Sekinehama on 7 Feb.. Institutions and universities which participated this cruise were as follows:

- Japan Marine Science and Technology center (JAMSTEC)
- National Institute of Environmental Science (NIES)
- National Institute for Resources and Environment (NIRE)
- Japan Meteorological Agency (JMA)
- Hokkaido University (HU)
- Nagoya University (NU)
- Tokyo Institution of Technology (TIT)
- Washington University (WU)
- (Technical support)
- Marine Works Japan Ltd. (MWJ)
- Global Ocean Development, Inc. (GODI)

Low pressure came to the Northwestern North pacific one after another. Averages of wind velocity and wave height during this cruise were 13 m/sec and 4 m, respectively. Sea surface was usually covered with white caps. However there were a few relatively calm days after stormy days, when wave height and wind velocity became lower enough to carry out observation. Thanks to the appropriate prediction by captain and devoted hard work by ship crews and marine technicians, we could visited stations north of 40oN including station 50N and carry out observation. After all, we could conduct observation at stations with approximately 80 % coverage rate (Fig.1).

Conducted observation and analysis were as follows (Institutions in the parentheses are in charge for each observation):

(1) Hydrocasting

At 16 stations, we conducted water sampling with RMS (Rosette Multi-bottle array water sampling system) with CTD (SBE 9 plus). These sea water were or will be used for the following analysis:

DO, nutrients (JAMSTEC, NIES) Carbonate chemistry: pH, TCO₂, TALK, 13C, 14C, Alkenone (JAMSTEC, NIES) Pigments (NIES, NU, HU,) Trace metal: Fe (JAMSTEC, NIES) Trace gas: DMS, CFCs, N₂, Ar , Ne, CH₄, CO (HU, TIT, WU) Radionuclides: 222Rn, 210Po, 234Th (JAMSTEC, NIRE, HU)

(2) Underway measurements (JAMSTEC, NIES)

Along the cruise track, pCO₂, TCO₂, nutrients, salinity, and temperature in the surface sea water were continuously measured by an automated system installed on R/V "MIRAI".

(3) Sea floor sediment coring (NIRE)

Sea floor sediment and sea water above the sea floor was collected at station 1 and 4 (KNOT) by a multiple core sampler. Radionuclides such as 14C and nutrients in the sediment and pore water will be measured at the laboratory.

(4) Drifting sediment trap experiment (JAMSTEC, NIRE, NIES, NU, HU)

In order to collect settling particulate matters in the shallow water, drifting sediment trap experiments were conducted at stations 4 (KNOT) , 6 (50N), and 8 (40N). Sediment trap mooring system with sets of "Knauer type trap" was drifted for few days. Thanks to the GPS buoy system, the drifting speed and direction of the mooring system could be monitored during the experiment. Some of collected sample was filtered and the others were stored in the refrigerator on board. These samples will be distributed to the trap working group and, in future, organic and inorganic carbon, opal, carbonate, carbon and nitrogen stable isotopes, radionuclides, and zoo-plankton in the sample will be measured.

(5) Time-series sediment trap experiment (JAMSTEC)

Time-series sediment trap experiment has been conducted since December, 1997 at three stations (St. KNOT: Japanese biogeochemical time-series station, St. 50N: western subarctic gyre, and St. 40N:

subarctic front). During MR00–K01 cruise, the sediment trap mooring systems at St. 40N which deployed in May 1999 was recovered and re-deployed successfully. On board, heights of total mass flux in collecting cups were measured as the first observation (Fig. 2). In May and June, during when total mass flux was expected to be high because of spring bloom, total mass flux did not increase. Total mass flux at 1000 m water depth increased from the middle of July to September (relatively high flux observed in the last interval should be artifact judging from low fluxes observed during other two intervals in winter). Total mass flux at 3000 m and at 5000 m also increased from July to September. The highest total mass flux was observed during September, which did not appear at 1000 m. In general, seasonal variability in total mass flux synchronized each other. These samples will be transported to laboratory being kept in refrigerator. At laboratory, chemical components such as carbon, nitrogen, carbonate, opal and trace elements will be measured. These analysis will reveal property of biological pump in the northwestern North Pacific.

(6) Atmospheric observation (TIT)

Air sample was collected on the flying bridge along the cruise track. No methane hydrocarbon will be measured at laboratory.

(7) Primary productivity and bio-optical measurement for ocean color remote sensing (NIES, NU, HU)

Using ^{13}C as a tracer, in situ and in vitro incubation experiments were carried out at station 4 (KNOT), 6 (50N), 8 (40N), and 15 (KNOT2). ^{13}C uptaked by phytoplankton will be measured by mass spectrometry, and primary productivity in winter season in this area will be presented.

In addition, the underwater spectral downward irradiance and upward radiance were measured by MER and FRRF in order to validate and develop bio-optical algorithm for new series ocean color sensors such as Sea WiFS and GLI.

(8) Plankton net (NIES)

The objective of this study is to reveal the species succession of phytoplankton, microzooplankton, and zooplankton in northwestern subarctic Pacific. These plankton were collected using three types nets: Palumbo–Chun–Petersen (PCP) type closing net (45cm mouth diameter, 0.06mm mesh), Twin-type (0.33mm mesh) and single type (0.2mm mesh) NORPAC nets (45cm mouth diameter, Motoda 1957). All net samples were immediately preserved in 5% buffered formalin–seawater solution.

(9) XBT / XCTD, P–ALACE float (JMA)

In order to investigate the structure and variation of sub-surface temperature and salinity in the subarctic circulation area focusing on the formation, advection, and diffusion of the North Pacific Intermediate Water (NPIW), XBT / XCTD were deployed along the cruise track. In addition, two P–ALACE floats were deployed around station 8 (40N). These floats descended by the abyssal water with the planned density (approximately 1500 m) and drifted. These will ascend to sea surface each 10 days and send these own positions and vertical profile of salinity and temperature. This study is a part of ARGO project.

(10) Geological survey (JAMSTEC)

In addition to the biogeochemical and physical oceanographic observations, geological survey such as magnetic field, gravity and sea floor topography observation were carried out.

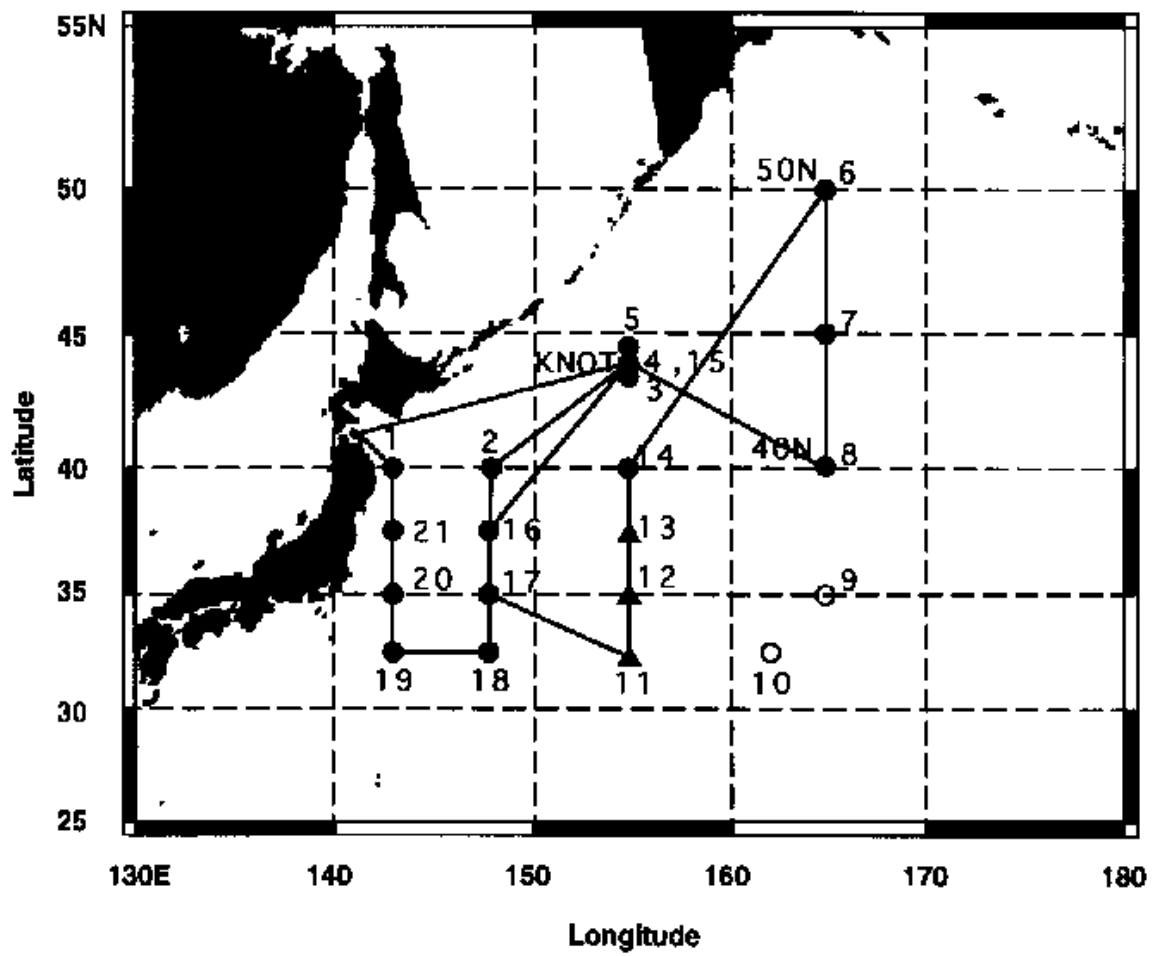


Fig. 1 Cruise track and stations

- ▲ XBT or XCTD
- no visit

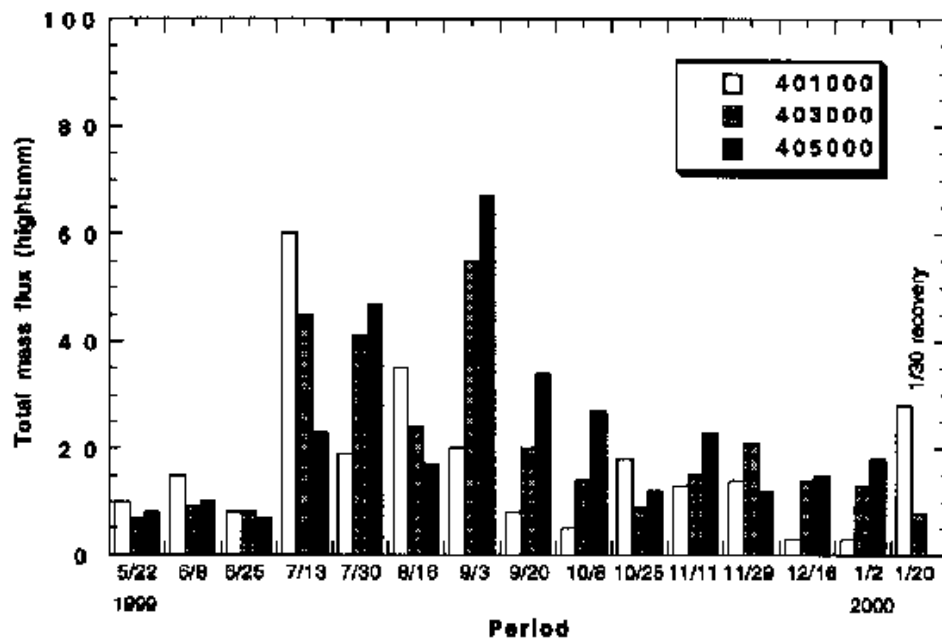


Fig. 2 Seasonal variability in total mass flux at 40N