

8.3 Distributions of atmospheric and sea water DMS

(1) Personnel

Ippeï Nagao (Graduate School of Environmental Studies, Nagoya University.)

(2) Objectives

It is widely accepted that DMS is one of the major precursors of non-sea salt sulfate aerosols in the marine air and can contribute to the atmospheric sulfur cycle. DMS is produced by the phyto-plankton in the surface seawater and released to the atmosphere. The emission rate of DMS to the atmosphere can be partly dependent on the seawater DMS distribution.

Western North Pacific Ocean is a research field of Aerosol Characterization Experiment (ACE-Asia), and DMS is one of key parameters to this experiment. Objectives of the measurement on this cruise (MR01-K02) is to obtain the spatial distributions of DMS in the surface seawater and atmosphere, and to estimate the emission rate to the atmosphere in this area.

(3) Measured parameters

Continuous measurement of the atmospheric DMS concentration was automatically carried out during this cruise almost at every 90 min. except for the seawater DMS analysis. The seawater DMS concentration (at 10 m depth) was also measured at each CTD observation point along 146 ° 25 E.

(4) Method

DMS was measured by Shimadzu GC-14B equipped with a flame photometric detector (GC/FPD) and 1/8" ODPN glass column.

Atmospheric DMS concentration

Air was introduced from the port side of the R/V Mirai with 5 m long Teflon-tube (ID is 12 mm). Sampling flow rate is set approximately at 85 ml L⁻¹ and atmospheric DMS was cryotrapped in a U-shaped glass tube filled with Tenax-GR in cooled ethanol (approximately -60 °C) after removing water vapor and oxidant. After 60 min. of sampling, DMS was desorbed by heating of the concentration tube at +140 °C within 3 min. and introduced to GC/FPD. During these steps, the air flow rate and temperature of the concentration tube were monitored and recorded by personal computer at every 10 seconds.

Seawater DMS

Surface sea water was sampled by Rossett water sampler at 10m depth at almost every 15 min in latitude from 30 ° 00' N to 36 ° 45' N. Surface seawater was introduced to 100-mL pyrex vials. The water samples were immediately transferred to a 30 mL glass syringe, and 20 mL of sea water was introduced to a degasification vessel. Samples were sparged with N₂ gas (60 mL min⁻¹) for 20 min. The extracted gas was then dried by using a Nafion drier and cryotrapped in a U-shaped glass tube in cooled ethanol (approximately -60 °C). This concentration tube was

subsequently heated (approximately 140 °C), releasing the extracted gas onto GC column. Two or three samples were analyzed to determine the seawater DMS concentrations at each point.

(5) Results

Fig. 1 shows the latitudinal distribution of the sea water DMS concentration along 146 ° 25 ' E, ranging between 0.4 and 2.0 nmol l⁻¹ except for the sample at 36 ° 45 ' N. Taking into consideration of the location of the Kuroshio current, the seawater DMS concentration in the open sea is less than 2.0 nmol l⁻¹. Although the sample number was one, sharp increase of DMS concentration at 36 ° 45 ' N was observed, suggesting that the seawater DMS concentration might be much higher in the coastal sea region than those in the open sea.

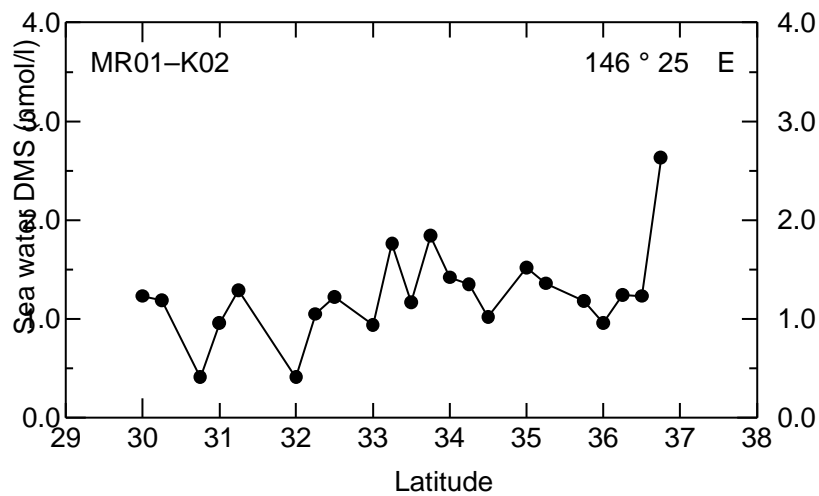


Fig. 1. Latitudinal distribution of DMS in the surface seawater along 146 ° 25 ' E.

In order to make sure that the air sampling system operates successfully, time series of flow rates and temperature of the concentration tube was shown in Fig. 2. Cryogenic sampling and purge steps were repeated successfully. Atmospheric DMS concentration was determined from the sampling volume of air and the area of chromatogram calibrated by the DMS standard gas.

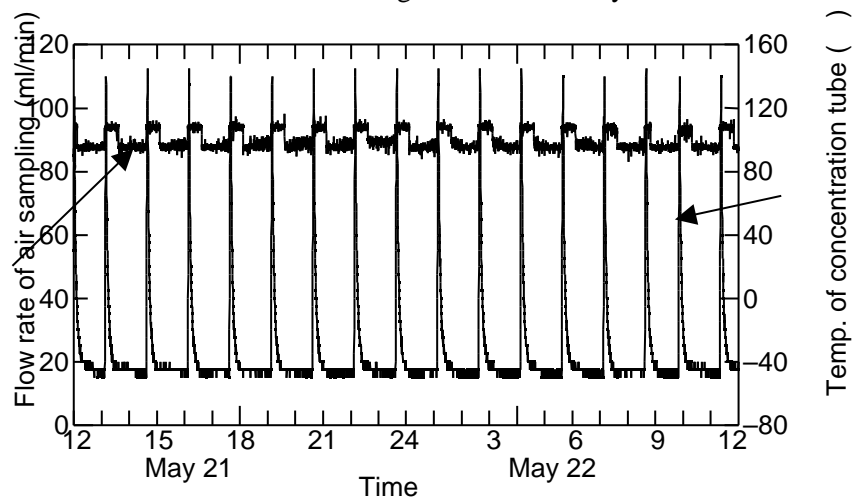


Fig. 2. Time series of sampling flow rate of air and temperature of the concentration tube.

Fig. 3 shows the atmospheric DMS concentration during this cruise. High concentration period (> 200 pptv) was observed May 24 when maritime air mass was transported by the low-pressure system. Very low concentration was observed between May 18 to 20 showing less than the detection of this system ($< \text{about } 8 \text{ pptv}$ of DMS in the 5.1 liter of air).

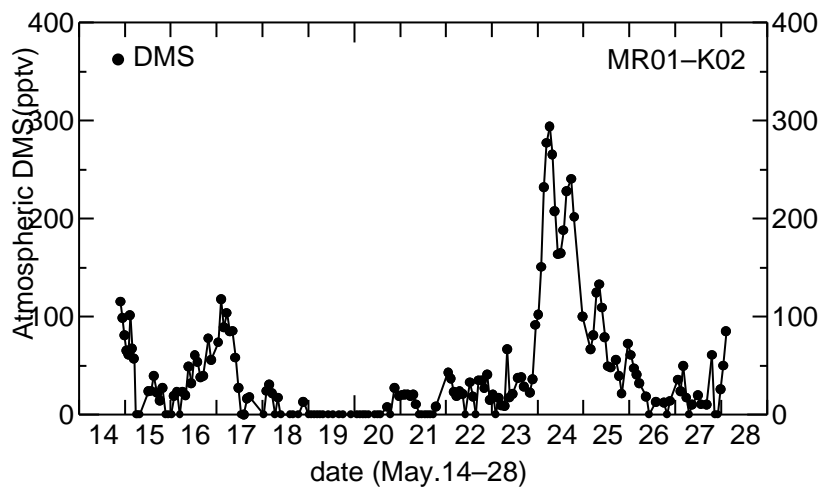


Fig. Time series of the atmospheric DMS concentration.

(6) Data archive

All of raw and processed data will be submitted to JAMSTEC Data Management Office and will be under its control.