Kagoshima Univ. Res. Center S. Pac., Occasional Papers, No. 21, 57 - 62, 1991
Survey Team 5, Report 1. The Progress Report of the 1990 Survey of the Research Project, "Man and the Environment in Papua New Guinea"

PARTICULATE ORGANIC CARBON AND CHLOROPHYLL FROM LAT. 20°S TO THE EQUATOR IN THE WESTERN PACIFIC OCEAN IN NOVEMBER 1990

Toshihiro ICHIKAWA and Hisashi SUZUKI

Introduction

A long oceanographic section was made in November, 1990 from 24°N to the equator at 138° to 145°E, on board the Keiten Maru of Kagoshima University. The oceanographic observations were initiated at 24°N east of Okinawa on November 7, and finished at the equator, north of Papua New Guinea on November 11. This area includes the North Equatorial Current, the Equatorial Counter Current, and the South Equatorial Current in the western Pacific Ocean. There have been many oceanographic studies in this area, but the data on particulate organic matter and chlorophyll is still limited. We described in this paper the distributions of particulate organic carbon and chlorophyll (phytoplankton standing crop) to 300 m in depth based on data obtained on this cruise.

Materials and Methods

Ten oceanographic sampling stations were selected for the study of particulate organic carbon and chlorophyll distribution (Fig. 1). The sea water samples were collected at nine different depths to 300 m in depth at each station with a 10 liter Niskin water sampler. The water samples were drained into polyethylene bottles. Every fourth liter of sea water was filtered through a Whatman GF/C filter on board for the carbon and chlorophyll analysis. The filter was then stored in a deep freezer and the analysis was done at the shore laboratory. The particulate organic carbon concentrations were determined by wet oxidation with dichromate and concentrated sulfuric acid, and the chlorophyll was measured by a spectrophotometric method. The analysis of carbon and chlorophyll followed the procedure of PARSONS *et al.* (1984). The water sampling was carried out with the cooperation of the scientists, students, and crew on board the R. V. Keiten Maru.

Results and Discussion

Fig. 2 shows the vertical profiles of chlorophyll concentrations observed at the ten sampling stationas. The characteristic chlorophyll maximum in the water column was found just above or in the thermocline (50-150 m) in all of the stations sampled. The concentration of the chlorophyll maximum layer was in the range of 0.1(St. 5) - 0.5(St. 2)μg/l. The surface layer (1m) of North Equatorial Current had an extremely low concentration of chlorophyll, less than 0.01μg/l(Sts. 2,3,4,5). Near the equator the surface concentration was greater than 0.1μg/l (Sts. 8,9). The total amount of chlorophyll in the water column was slightly lower

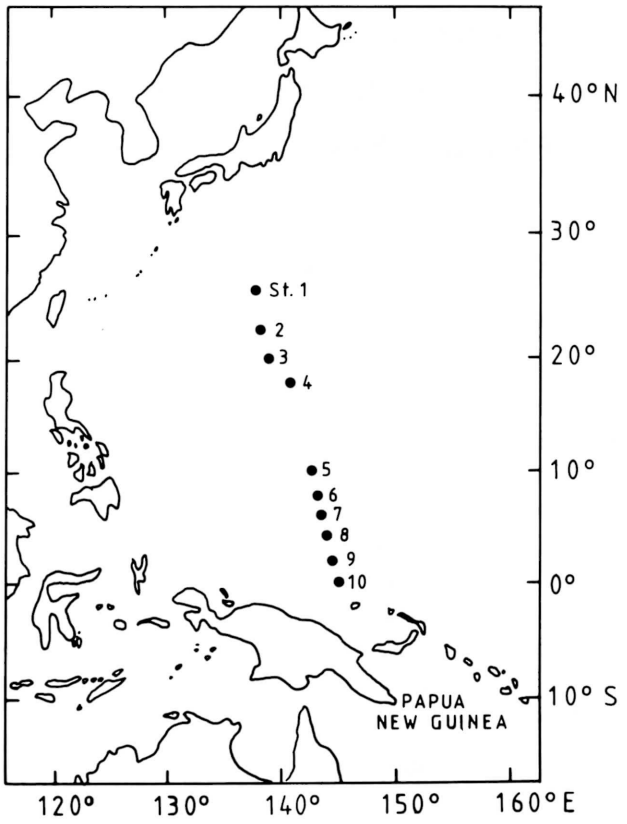

Fig. 1. Locations of sampling stations occupied during the cruise of the R. V. Keiten Maru, November 7-11, 1990.

in the North Equatorial Current than in the equatorial upwelling area. This is because upwelling at the equator brings nutrient rich water from a deeper layer into the euphotic layer, and the nutrient rich water spreads to both sides of the equator. Below the chlorophyll maximum layer chlorophyll concentrations decreased rapidly with depth and chlorophyll was only detected at a 200 m depth in one case (St. 8). The pattern of vertical distribution of chlorophyll in the present study was quite similar to those of the previous observations in the western Pacific Ocean. However, the general concentration in the present case showed relatively high values compared with the 175°E line reported by NISIZAWA *et al.* (1971) or the 142°E line (NAKAJIMA, 1975). This would be a result of regional variation of primaty productivity of phytoplankton in the euphotic layer.

Fig. 3 shows the vertical profiles of particulate organic carbon at all of the stations sampled. The carbon concentration ranged from 18 to 142μgC/l. The highest concentration was found at a depth of 30 m at the equator (St. 10) and the lowest concentration was observed at 1 m in depth at St. 1(24°N). One common feature was that the carbon maximum layer was always found at 30 to 150 m in depth at all of the stations. These subsurface carbon maximum layers did not coincide with chlorophyll maximum layer observed

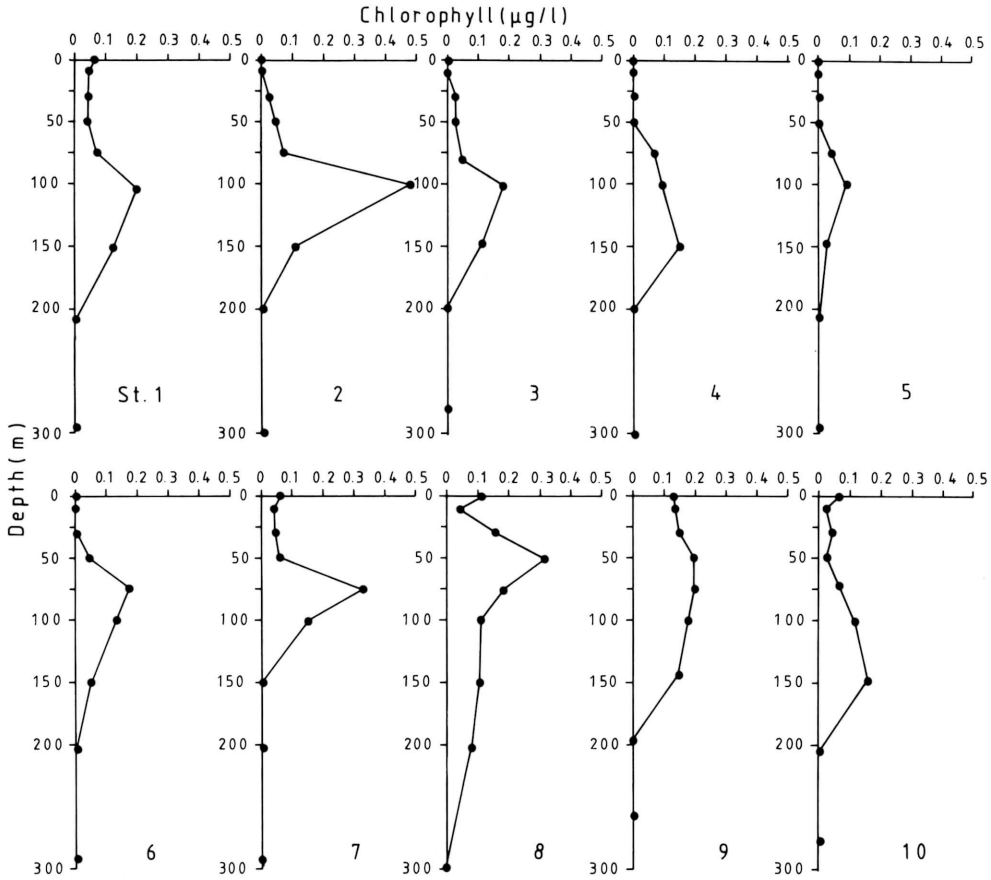

Fig. 2. Vertical profiles of chlorophyll at all the stations studied.

simultaneously except at St. 9 (Fig. 2). Below the carbon maximum layer, the concentration decreased rapidly but did not show a systematic decrease with depth. Carbon often increased again in the deeper layers and the significant minimum layers was found at 75 to 150 m (Sts. 1, 5, 6, 7, 9). The carbon concentration at 300 m depth was usually comparable to that of the surface layer. The general concentration of particulate organic carbon in the present area tended to be higher than in the 142°E line in the western Pacific Ocean (NAKAJIMA, 1975) and 155°W line in the eastern Pacific Ocean (ICHIKAWA and NISHIZAWA, 1975). The present observation showed relatively high values (18 - 142μgC/l) compared to the data along 142°E line in the tropical and subtropical western Pacific Ocean (20 - 70μgC/l). However the pattern of the vertical distribution of carbon was quite similar to that of the various areas of the Pacific Ocean (ICHIKAWA and NISHIZAWA, 1975; ICHIKAWA 1982).

Fig. 4 shows the relation between particulate organic carbon and chlorophyll for the present observations. It is clear that no distinct mutual correlation between carbon and chlorophyll concentrations is present. The same situation was already reported in the oligotrophic tropical and subtropical Pacific Ocean (NAKAJIMA, 1975), but in his study in the productive northern ocean, a fairly good linear relationship between carbon and chlorophyll

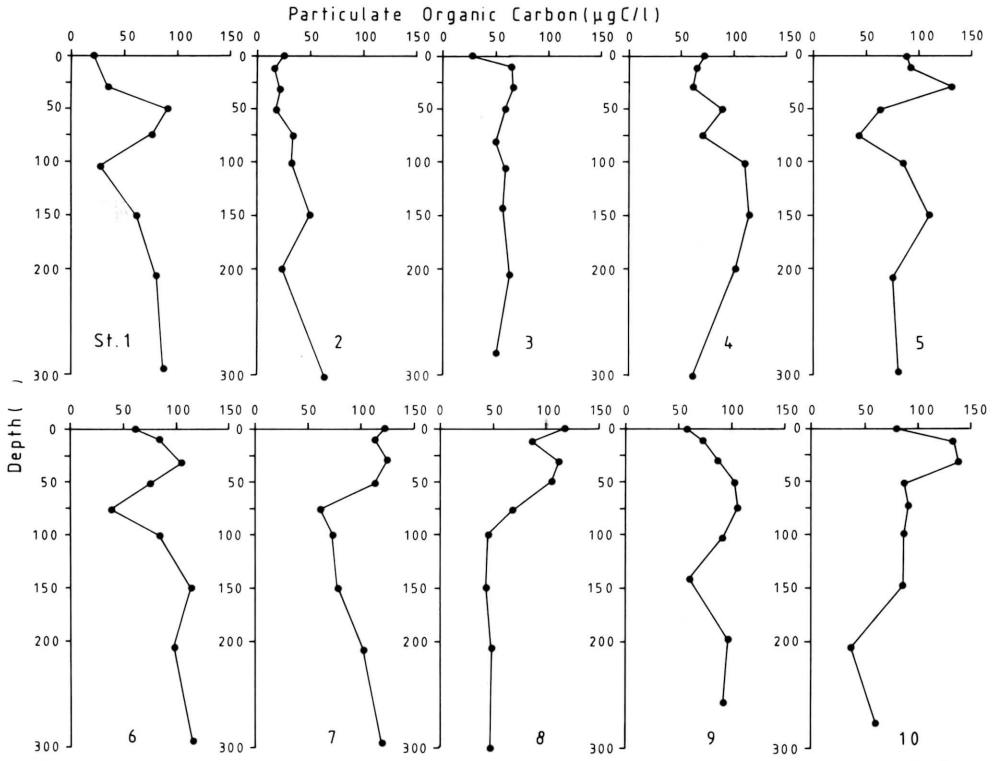

Fig. 3. Vertical profiles of particulate organic carbon at all the stations studied.

was observed. This does not mean that there is no relation between phytoplankton production and the distribution of particulate organic matter in the water column. As for the integrated values of particulate carbon and chlorophyll in the water column, the significant positive correlation was shown in the wide area of the Pacific Ocean (ICHIKAWA and NISHIZAWA, 1975). This suggests that regional variability in carbon standing stock is closely related to phytoplankton productivity in the euphotic layer. Probably, apparent poor correlation in vertical distribution pattern would be one of the characteristics in the oligotrophic tropical area. It is evident that most of the particulate organic carbon in the open ocean originates from phytoplankton in the euphotic layer, but the process of particle formation particularly in the tropical waters would be complicated and biological and physical processes may strongly affect the particle distribution. More work is needed to describe regional and vertical observations in particulate matter in the tropical and subtropical western Pacific waters.

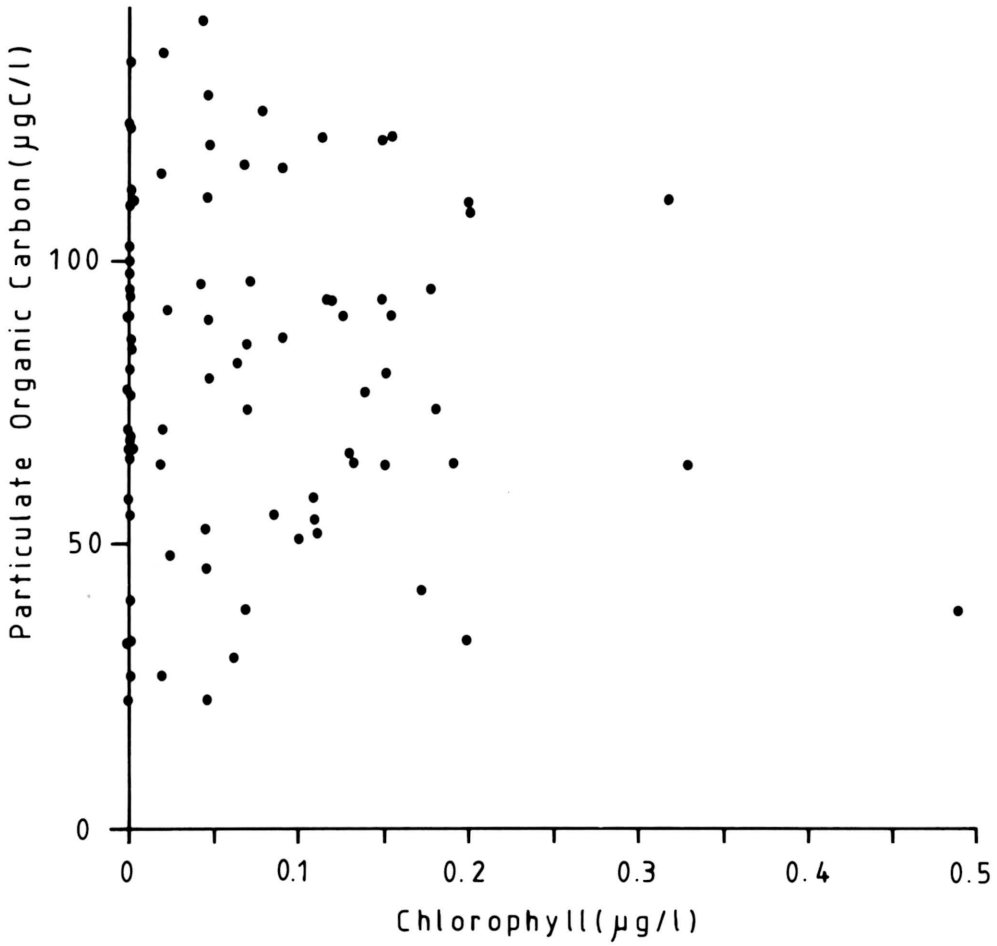

Fig. 4. Relationship between particulate organic carbon and chlorophyll in all of the samples observed.

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