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DISTRIBUTION OF NUTRIENTS AND DISSOLVED OXYGEN IN THE SUBTROPICAL WESTERN PACIFIC OCEAN IN 1994

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Introduction

Oceanographic observations were performed in October and November, 1994, from 34° to 11° N at 139° to 156° E, on board the training ship *Keiten-Maru* of Kagoshima University. The oceanographic observations were initiated at 34° N east of Japan on October 29, and finished at 11° N, north of Pohnpei Island on November 8. This area includes the Kuroshio and the North Equatorial Current in the western Pacific Ocean. We describe in this paper the distribution of nutrients and dissolved oxygen from sea surface down to 1000m depth based on data collected in this cruise.

Materials and Methods

Ten oceanographic sampling stations were selected for the study of nutrients and dissolved oxygen distribution (Fig. 1). The sea water samples were collected at twelve different depths from surface to 1000m in depth at each station with a series of 10-liter Niskin water samplers or 2-liter Niskin water bottles attached to the CTD system of *Keiten-Maru*. Dissolved oxygen was immediately fixed just after sampling on board, and oxygen was measured by the Winkler's method in the ship's laboratory. Every two hundred and fifty milliliters of sea water was drained into plastic bottles and was stored in a deep freezer until later analysis. Nitrate, nitrite, phosphate, and silicate concentrations were determined spectrophotometrically at the shore laboratory. The analysis of nutrients followed the procedure of PARSONS *et al.* (1984). The water sampling was carried out with the cooperation of scientists, students, and crew on board the *Keiten-Maru*.

Results and Discussion

Fig. 2 shows the vertical profiles of nutrients concentrations observed at the ten sampling stations. One of the remarkable features was that the nutrients contents were strikingly low in the euphotic layer in all of the stations, and below the euphotic layer, the nutrients concentrations increased with depth down to a 1000m sampling depth. A layer of maximum concentration of phosphate and nitrate was often observed between 500 and 700m depth.

The phosphate concentration ranged from an undetectable amount to 2.6 μg-atP/l. The highest concentration was found at 1000m depth in St. 4, and the lowest value was usually observed in surface mixed layer in all of the sampling stations. The phosphate maximum layer often occurred at 700m depth (Sts. 1, 7, 8, 9).

The nitrate concentrations varied from undetectable to 43 μg-atN/l (St. 1, 900m). The nitrate maximum was also observable at intermediate waters below the euphotic layer (Sts. 1, 3, 8, 9). The vertical distribution pattern of phosphate and nitrate were essentially

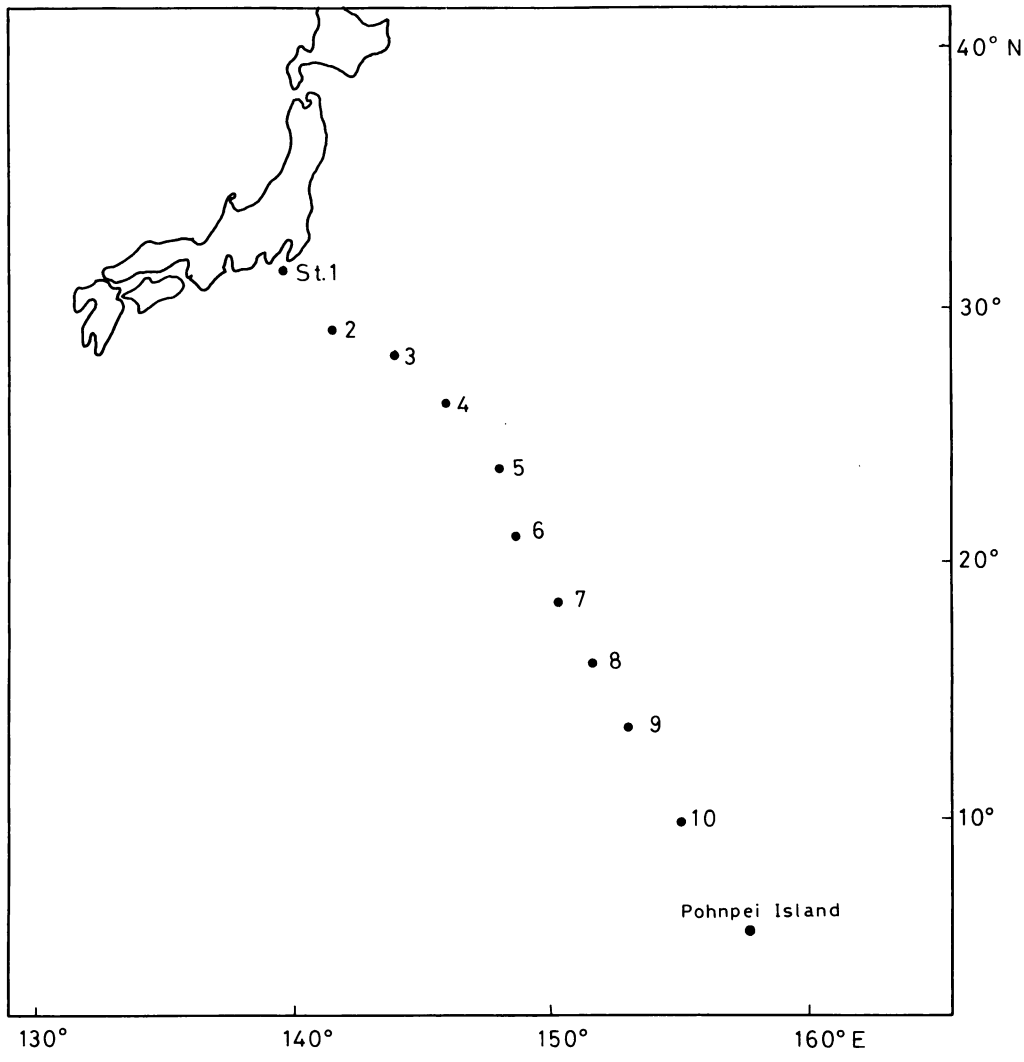

Fig. 1. Locations of sampling stations occupied during the research cruise of the *Keiten-Maru* in 1994

similar, because nitrogen and phosphorus are utilized and regenerated in a constant atomic ratio (REDFIELD *et al.*, 1963). Nitrite concentration was generally very low-level below 0.10 μg-atN/l in the whole of the water column in most of the stations, and the nitrite was often detected only in certain layers in the water column. Exceptionally, high nitrite contents (0.12 -0.4 μg-atN/l) were observed in the northern-most sampling station (St. 1) near Japan in both euphotic layer and sub-surface waters.

The silicate in the surface mixed layer was markedly depleted, as was the case with nitrate and phosphate. The silicate concentrations rapidly increased with depth, and the highest concentration was 230 μg-atSi/l at 900m depth in St. 1. The vertical distribution of silicate showed an essentially monotonic increase in concentration with depth, and no maximum silicate layer was observed. The general features of nutrients distribution in the present

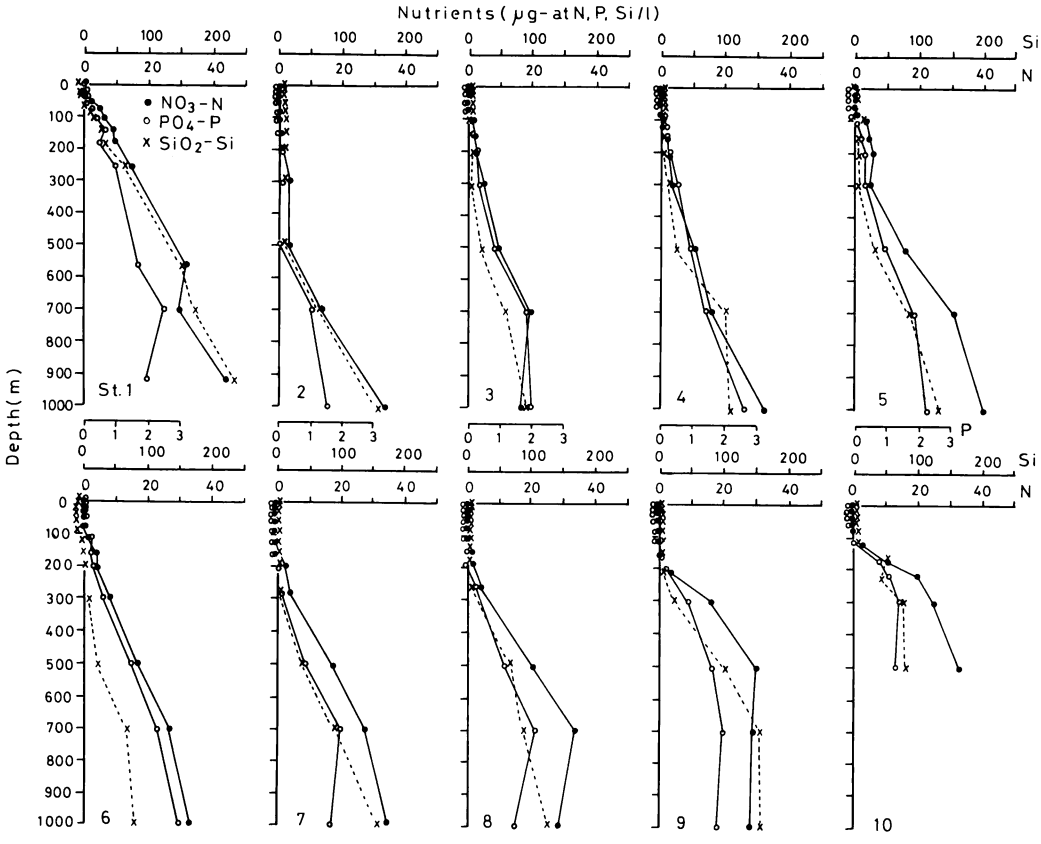

Fig. 2. Vertical profiles of phosphate, nitrate, and silicate at the ten sampling stations

results were comparable to those of the previous observations by many workers in the Pacific Ocean (ex. ICHIKAWA and KAMIYA, 1992).

Fig. 3 shows the vertical profile of dissolved oxygen. Oxygen content in the surface waters were high (4-4.5ml/l) and it consistently saturated due to the production of oxygen by photosynthesis of phytoplankton and air bubbles produced by wave. Oxygen concentration decreased with depth and dropped to less than 2ml/l at 1000m depth. It is well known that a characteristic oxygen minimum layer develops between 200 and 1000m depth in the Pacific Ocean. The depth of this minimum layer tends to be shallower toward the equator. The oxygen minimum layer in this study was observed in the southern stations at 300 to 700m depth (Sts. 8, 9, 10).

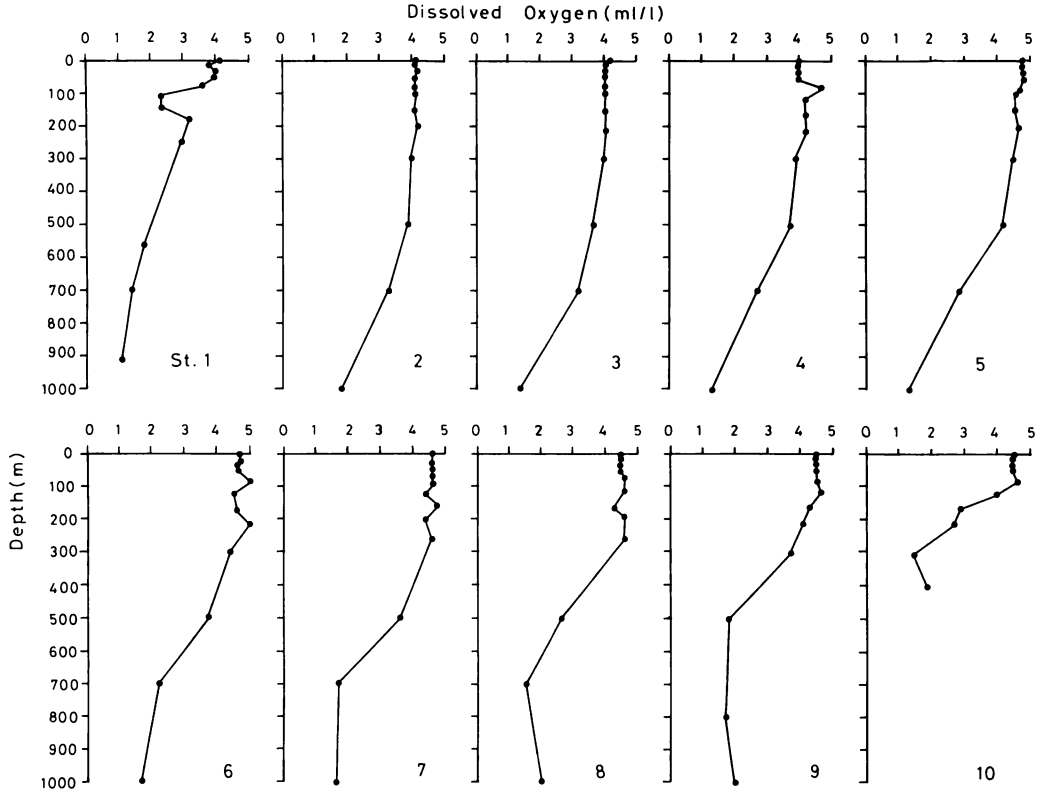

Fig. 3. Vertical profile of dissolved oxygen at the ten sampling stations

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