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Distribution of Vitamin B_{12} in Kagoshima Bay

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Abstract

Vitamin B_{12} contents in sea water of Kagoshima Bay were investigated in August and October, 1977. Mean values of 7.52 ng/*l* of vitamin B_{12} were found in summer samples and 6.53 ng/*l* in autumn samples, respectively. These amounts are almost comparable to those reported in this bay previously. Vitamin B_{12} showed little change vertically at each station especially below 50 m. Significant differences were not observed between the contents in samples from inner part of the bay and those from its outer part.

Introduction

Water soluble vitamins such as vitamin B_{12}, thiamine and biotin have been recognized as essential growth factors for most diatoms and dinoflagellates which dominantly concern with the primary production in the ocean. The potential significance of these vitamins in nature are already suggested by several investigators[1~4]. Laboratory cultures also indicated that these three vitamins were required by many phytoplankters alone or in combination. For example, 45 of 58 species in dinoflagellates and 25 of 54 in diatoms have been reported to require at least one of these vitamins[5].

Thus vitamin B_{12} can not exist independently of the recurrences of red tides in coastal waters, and it might trigger the rapid and abundant propagation of some limited phytoplankton species. There are several reports on the vitamin B_{12} contents in sea water along the coasts of Japan[6~10]. The distribution of vitamin B_{12} in Kagoshima Bay have also been reported in detail, and the diunal, vertical and horizontal changes were investigated previously. These investigations, however, were carried out about 20 years ago, and no surverys have been tried on vitamin B_{12} contents in this bay since this time. Red water by a dinoflagellate, tentatively assigned as *Hornellia* sp., appeared first time here in June, 1977. As can been seen in such peculiar occurrence, Kagoshima Bay is thought to have received some circumstantial changes during these years. Therefore the author tried again to assay the vitamin B_{12} contents in the water of Kagoshima Bay in order to comprehend present situation and to obtain fundamental

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knowledge for coming changes.

Method

The collection of sea water samples were carried out in August 4-5 and October 6-7, 1977, at 9 stations in Kagoshima Bay (Fig. 1) during the cruises by Nansei Maru, a research vessel of Kagoshima University. Samples were collected principally at 5 different depths, namely at surface, 50, 100, 150 and bottom at each station by Van Dorn water sampler. The collected samples were passed through Millipore filters (0.45 μ) as soon as possible and stored at $-20°C$ until the time of subsequent analysis. Preceding to analysis, samples were thawed and dialysed against water, two times each for 6 hrs, which were subjected to microbiological assays on vitamin B_{12} by *Lactobacillus leichmanii* ATCC 7830.

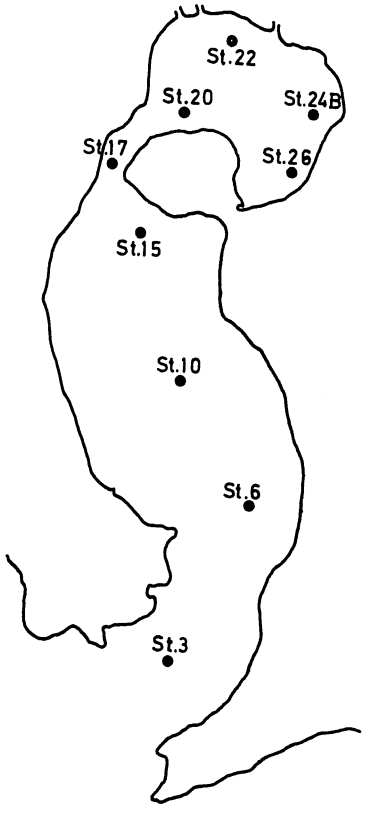

Fig. 1 Sampling stations

Results

The results obtained in August, 1977 are given in Fig. 2. There were found a wide range of vitamin B_{12} contents, from 0 (not detected) to 28.73 ng/*l* throughout the samples collected, but most of them fell between 5 and 10 ng/*l*. The mean value of all samples analysed was 7.52 ng/*l* which was higher than

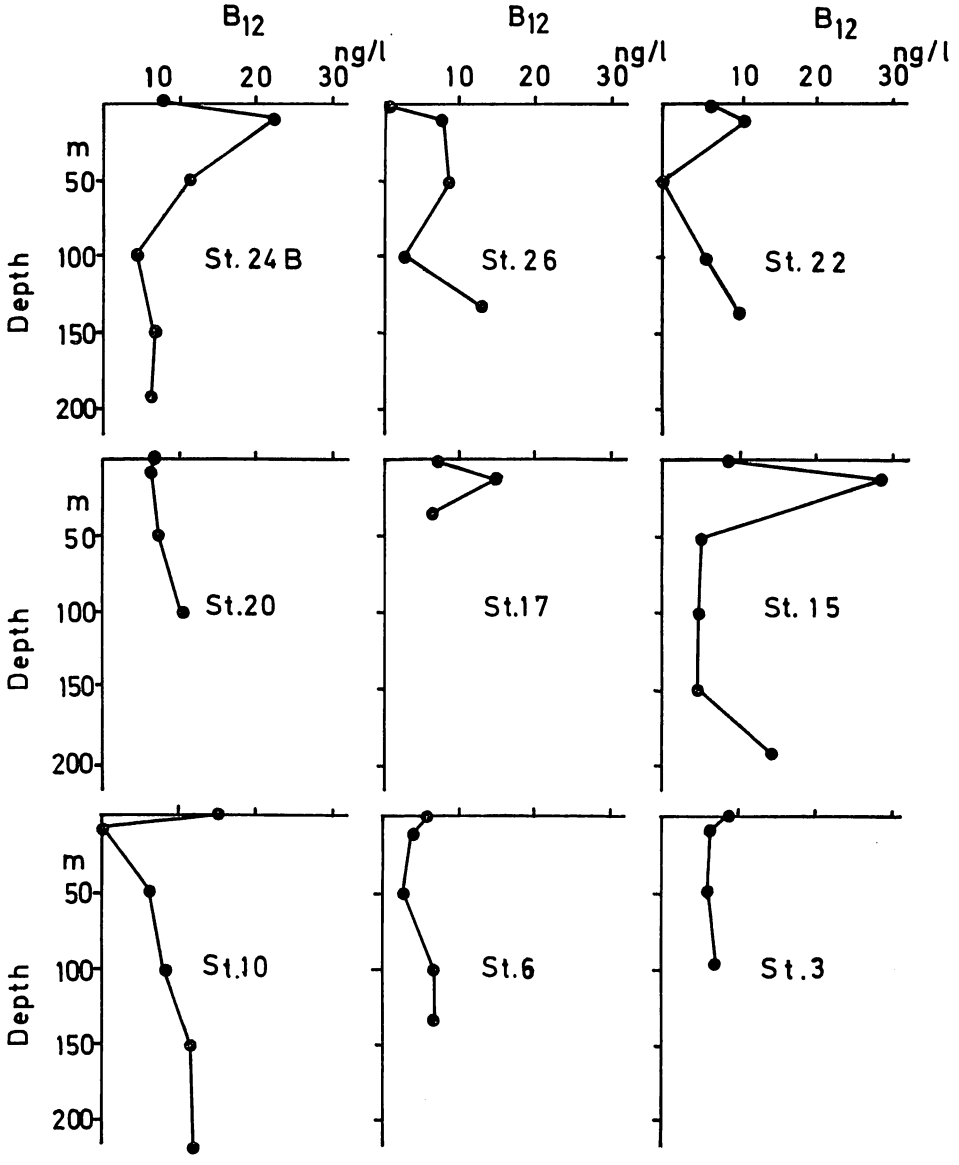

Fig. 2 Vitamin B_{12} distributions in Kagoshima Bay (August, 1977)

those of Seto Inland Sea[7~9] and practically the same with those reported in Kagoshima Bay before[11]. Abundant contents more than 20 ng/*l* were recognized in the samples from 10 m at St. 15 and 24 B, and the lowest undetectable amount, to the contrary, was also found in the same depth at St. 10. These two extremely different results at the same depth, where primary production by phytoplanktons were estimated to be active at the time of the year, were not

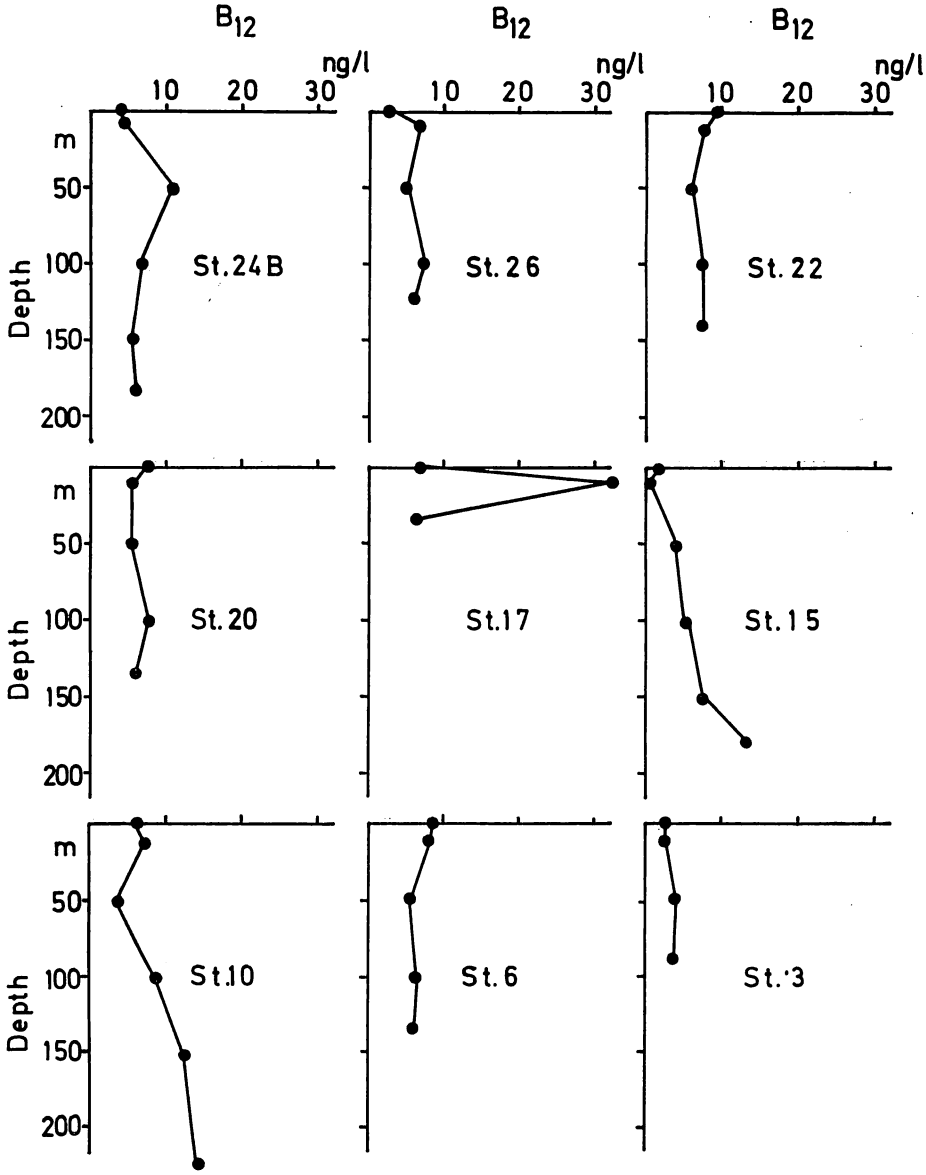

Fig. 3 Vitamin B_{12} distributions in Kagoshima Bay (October, 1977)

yet elucidated.

The results in October are also shown in Fig. 3. Averaged value of all samples is 6.53 ng/*l* which is almost equivalent to the one obtained in August. The largest quantity of vitamin B_{12}, 32.17 ng/*l*, was observed at 10 m of St. 17, and except this abnormal value the contents at other stations were nearly the same with little differences with depth. Significant differences were not recognized between the contents at each depth of inner part stations of the bay and those of the outer part.

Discussion

Many microorganisms have been adopted in the measurements of vitamin B_{12} in water. Each assay organism reacts with cyanocobalamin or its analogues in different way[12]. The values obtained in the present study may be regarded to show the contents of vitamin B_{12} (cyanocobalamin) itself, because the employed test organism (*L. leichmanii*) is specifically responsible to vitamin B_{12} and its limited analogues. Therefore vitamin B_{12} concentrations in oceanic and coastal waters reported until now can not be compared and discussed without taking any considerations. Droop, however, reported that the concentrations of vitamin B_{12} analogues are far lower than that of vitamin B_{12} itself in oceanic waters[13]. If this is also the case with the sea water of Kagoshima Bay, it can be said the vitamin B_{12} contents in this bay stayed almost constant during this 20 years.

As pointed out already, vitamin B_{12} contents in sea water fluctuate seasonally and change even during a day. Menzel and Spaeth, for example, showed that vitamin B_{12} concentrations in Sargasso Sea changed seasonally and auxotrophic diatoms appeared in significant number when vitamin B_{12} was found rich[14]. As far as two surverys carried out here concern, vitamin B_{12} in Kagoshima Bay distributed rather evenly, and it is not probable that this vitamin should be a limiting factor to the fluctuations and occurrences of red waters. However, more frequent and detailed investigations are needed before obtaining some conclusions.

According to Guillard[15], marine diatoms could be propagated to $0.13-0.48\times10^5$ cells by 1 $\mu\mu$g of vitamin B_{12}. Droop also reported the same dose of vitamin B_{12} could sustain 2.5×10^5 cells of *Skeletonema costatum* or 8×10^5 cells of *Monochrysis lutheri*[16]. When 1 $\mu\mu$g of vitamin B_{12} is postulated to have the abllity to grow 10^5 cells of phytoplankters, the mean contents of 6-7 ng/*l* in Kagoshima Bay correspond to the concentrations to grow them to population densities of nearly 10^7 cells/ml.

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