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PRELIMINARY MONITORING OF COASTAL SEAWATER IN YAP ISLANDS: OCTOBER, 1999

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Abstract

In the coastal reef of Yap Islands, water temperature, salinity, pH, Eh, conductivity, dissolved oxygen(DO), inorganic phosphate, organic phosphate, total phosphate, nitrate nitrogen, nitrite nitrogen, ammonium nitrogen, silicate and chemical oxygen demands(COD) were analyzed during October, 1999. The amount of DO in the seawater of the reef was very low; it contained only 22.0 - 53.4 % of saturated DO. While the effect of human activities was negligible in the coastal environment, COD was extremely high and showed 1.76 - 7.54 mg/L. This result may be explained by high concentration in the seawater of organic substances released from the mangrove forests of the islands and decomposed by bacteria or unidentified marine organisms inhabiting the coastal zone.

Key words: Yap, nitrogen, phosphate, DO, COD

Introduction

Yap State consists of 16 atolls and islands groups. Yap is the biggest island in the State and together with three small islands, *i.e.*, Map Is., Thilimad Is. and Rumung Is., is surrounded by marginal coral reefs which isolate all of the islands from the South Pacific.

Although Yap fishery communities appreciate the rich marine resources of the reef, little is known about chemical and physical oceanographic conditions, especially in the coastal sea of the island.

During the Yap Research Expedition conducted by Kagoshima University Research Center for the Pacific Islands in 1999, the authors had opportunity to analyze the surface water in the islands.

Materials and Methods

The study was carried out in Yap Islands from 21 to 26 October 1999. Thirty(30) samples were collected in the shallow surface water inside the reef as shown in Fig. 1.

Temperature, salinity, conductivity and dissolved oxygen (DO) were analyzed by YSI DO meter (Yellow Spring Instruments, Ohio, USA), and pH and Eh were measured by Yokogawa model PH/82 pH meter (Yokogawa Electric Co., Tokyo, Japan) in the field. Five hundred ml of seawater collected at the sampling sites were fixed with 0.5 ml of 18 N H_2SO_4 and placed in cold storage (-20℃). Using this seawater, inorganic phosphate(PO_4-P), total phosphate(T-P), nitrite nitrogen(NO_2-N), nitrate nitrogen(NO_3-N), ammonium nitrrogen(NH_3-N), silicate (Si) and chemical oxygen demand(COD) were analyzed by the procedure of PARSONS *et al.* (1984). Organic phosphate(Org.-P) and total nitrogen(T-N) were calculated as follows:

(Org.-P) = (T-P) - (PO_4-P)

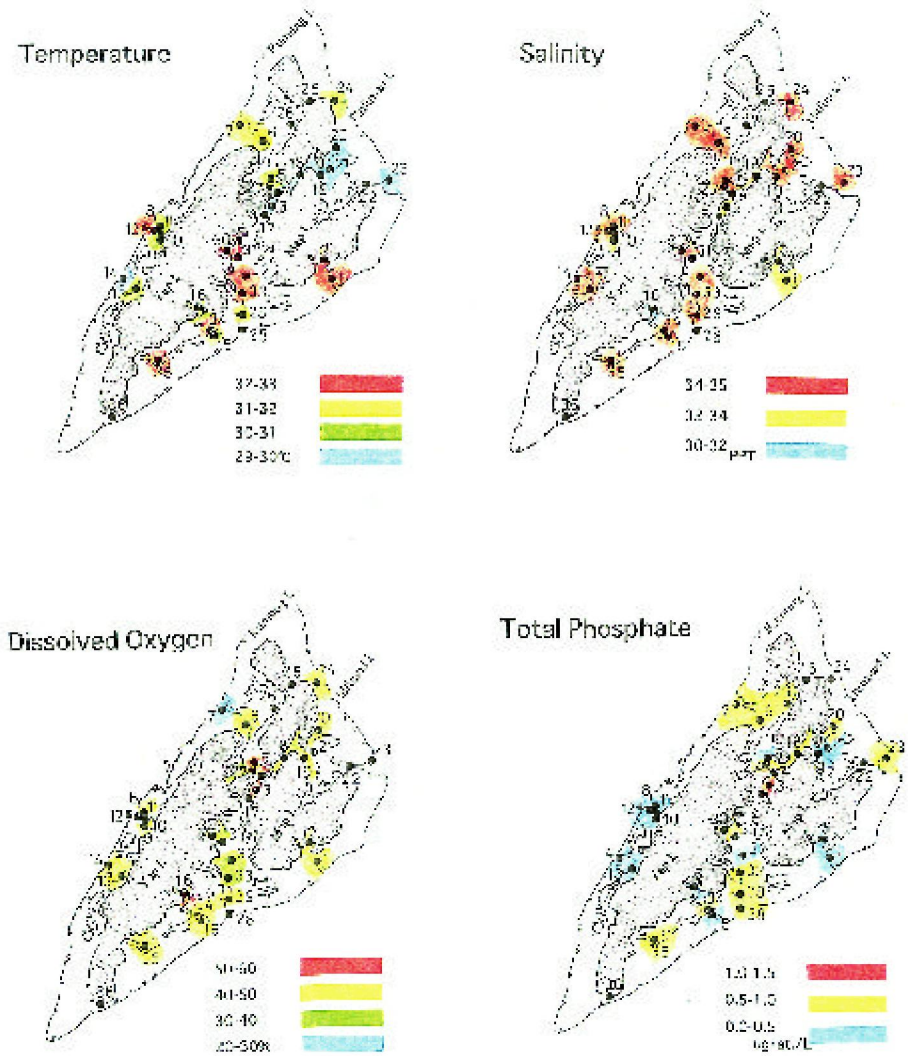

Fig. 1. Temperature, salinity, dissolved oxygen and total phosphate of the surface seawater in Yap on 21-26 Oct., 1999

$$(T\text{-}N) = (NO_2\text{-}N) + (NO_3\text{-}N) + (NH_3\text{-}N)$$

Results and Discussion

Table 1 shows the results of water analysis in the coastal water of Yap. Water temperature varied from 28.9 to 32.8℃; the difference in surface water temperature was reached 4℃. This big difference was due to the time of day when collecting the sample water. In a shallow coral reef such as Yap, surface temperature of the sea changes quite readily.

The salinity of the seawater was between 33 to 35 ppt in the coastal area. Yap Island is washed by high salinity seawater from the ocean. Exceptionally low salinity was observed in the inlet of the islands (St. 2, 9, 16; Fig. 1), however. Compared to the stable profile of the salinity

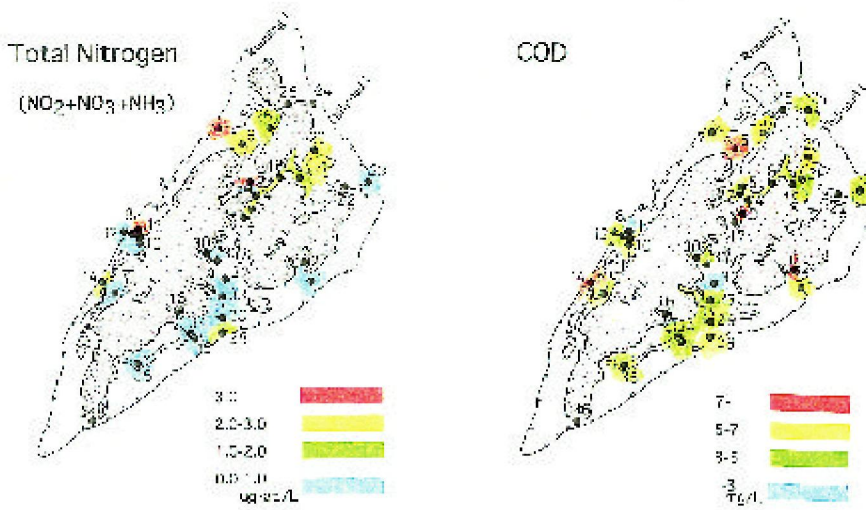

Fig. 2. Total nitrogen and COD of the surface seawater in Yap on 21-26 Oct., 1999

Table 1. Surface seawater of Yap on 21-26 Oct, 1999. Station refers to Fig.1.

St.	Temp (℃)	Salinity (ppt)	pH	Eh mV	Conduc. (uS)	DO (mg/L)	Do (%)	PO_4-P (μg.at/L)	Org.-P (μg.at/L)	T-P (μg.at/L)	NO_2-N (μg.at/L)	NO_3-N (μg.at/L)	NH_3-N (μg.at/L)	T-N (μg.at/L)	Si (μg.at/L)	COD (mg/L)
1	32.8	32.2	8.41	-92	49.7	2.94	46.0	0.21	0.13	0.34	0.00	0.50	0.00	0.50	82	5.30
2	32.2	33.7	8.23	-81	59.1	3.56	40.1	0.43	0.00	0.30	0.00	0.55	0.00	0.55	132	8.42
3	29.7	33.4	7.62	-47	55.9	1.37	22.0	0.91	0.10	1.01	0.00	0.83	0.26	1.09	132	7.54
4	29.8	34.0	7.98	-67	57.1	1.81	29.0	0.43	0.11	0.54	0.15	0.83	0.79	1.77	132	5.86
5	30.6	34.3	8.19	-79	58.1	1.75	28.1	0.43	0.00	0.26	0.04	1.22	3.05	4.31	132	6.82
6	31.3	34.2	8.28	-84	58.5	2.72	44.2	0.43	0.20	0.63	0.04	1.11	1.32	2.47	132	7.14
7	31.0	34.5	8.51	-97	58.5	3.30	53.4	0.35	0.16	0.51	0.11	0.78	2.74	3.63	132	6.50
9	30.4	33.4	7.66	-73	57.3	2.92	40.0	0.52	0.00	0.42	0.00	0.28	0.05	0.33	132	5.38
10	30.3	34.4	7.93	-88	57.8	3.19	50.8	0.30	0.04	0.34	0.00	0.61	0.00	0.61	79	5.22
11	30.1	34.4	7.97	-90	57.8	3.04	48.0	0.43	0.00	0.25	0.00	0.61	13.63	14.24	132	2.66
12	32.1	34.4	8.00	-93	59.1			0.30	0.12	0.42	0.00	0.28	0.00	0.28	97	3.06
13	30.4	34.0	7.97	-90	57.3	2.70	43.5	0.26	0.00	0.25	0.02	0.33	0.00	0.35	88	3.30
14	29.0	34.4	8.06	-95	57.2	2.86	45.3	0.43	0.00	0.38	0.02	0.61	0.63	1.26	76	7.22
15	30.0	34.5	8.04	-94	57.9	2.85	45.3	0.30	0.12	0.42	0.02	0.61	0.00	0.63	76	3.94
16	30.6	30.7	7.61	-69	52.6	1.85	29.3	0.43	0.04	0.47	0.02	0.33	0.00	0.35	83	1.70
18	29.0	34.4	7.67	-63	57.1	1.97	30.9	0.65	0.20	0.85	0.00	0.66	0.84	1.50	68	3.46
19	29.7	34.6	7.98	-86	57.7	2.98	43.0	0.43	0.04	0.47	0.11	1.06	0.00	1.17	132	4.26
20	28.9	34.7	8.00	-86	57.0	2.85	43.7	0.70	0.23	0.93	0.25	2.11	0.00	2.36	132	5.94
21	29.9	34.5	8.16	-95	57.8			0.83	0.00	0.25	0.02	0.66	1.79	2.47	91	3.62
23	29.9	34.8	8.19	-96	58.8			1.26	0.00	0.55	0.00	0.44	0.00	0.44	132	3.70
24	30.8	35.0	8.15	-96	58.7	3.07	49.2									
26								0.65	0.03	0.68	0.00	1.22	0.00	1.22	121	5.06
27	31.1	34.7	8.08	-90	59.4	1.90	31.4	0.52	0.03	0.55	0.06	0.55	1.05	1.66	132	3.30
28								0.52	0.00	0.51	0.00	0.55	0.89	1.44	132	5.22
29	31.2	34.6	8.07	-90	58.5	2.60	40.2	0.65	0.00	0.59	0.11	0.55	0.00	0.66	132	4.26
30	32.1	34.3	8.06	-90	59.1	2.29	37.3	0.39	0.20	0.59	0.00	0.22	0.00	0.22	132	4.02
32	32.6	34.4	8.09	-92	59.1	2.39	39.4	0.35	0.03	0.38	0.00	0.17	0.00	0.17	132	2.90
33	32.7	34.5	8.09	-92	59.7	2.41	39.5	0.52	0.11	0.63	0.00	0.17	0.00	0.17	132	5.22
34	32.9	34.5	8.09	-92	59.7	2.59	42.1	0.43	0.16	0.59	0.00	0.22	0.00	0.22	132	3.62
35	32.4	34.6	8.10	-92	59.6	2.95	48.2	0.57	0.00	0.51	0.00	0.78	0.00	0.78	132	3.54

Temp.: seawater temperature, Eh: oxidation-reduction potential, Conduc.: conductivity, DO: dissolved oxygen, Org.-P.: T-P: total-P, T-N: total-nitrogen, Si: silicate Si, COD: chemical oxygen demand.

concentrations around Yap island itself, pH changed markedly in the localities. The highest pH of 8.51 was observed at St.7 while the lowest was 7.61 at St 16. The reason for the difference in pH is not clear. In the low pH sites, high oxidation-reduction potential (Eh) was observed, as shown in St.3, but the relationship between pH and Eh is also obscure.

The amount of phosphate was low in the reef; it was less than 1μg P/L. Compared to low phosphate concentration, nitrogen reached 1 to 4μg N/L. In the nitrogen component, an extremely high concentration of ammonium N (13μg N/L) was detected from St. 11, where the effect of organic pollutants was expected.

Comparing these nutrients, an interesing phenomenon was observed in the distribution of DO and COD. As most sites, DO showed only 40 - 50 %. The highest DO was observed at St. 7, but it was only 53.4 %. Usually saturated (100 %) DO is expected in an unpollluted marine environment.

Generally, the amount of COD indicates organic matter released from human activities. One mg COD/L or less is the recommendation for natural environments such as marine parks; however, in almost all of the stations, 3 to 5 mg COD/L was analyzed in the seawater.

In the natural environment of Yap, no industrial organic pollutants were expected. Decomposed organic substances released from mangrove forests which are distributed around the island abundantly, may be the original source of the COD in the seawater. For microorganisms, such as bacteria or hetero/mixotrophic organisms, seawater which contains abundant organic carbon may be the natural culture medium. This would mean that the dissolved organic carbon in the seawater contributes to the primary productivity process in the coastal ecosystem in Yap.

References

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