WHP Ref. No.: PR23/PR24
Last updated: 31 July 1995

A. Cruise Narrative

A.1 Highlights

A.1.a WOCE designation PR23 PR24
A.1.b EXPOCODE 49XK9406/1
KAIYO-9406
A.1.c Chief Scientist Michio Aoyama, JAMSTEC, Japan
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A.1.d Ship R/V KAIYO
A.1.e Ports of call Malakal, Palau to Malakal, Palau
A.1.f Cruise dates 14 Jan. 1995 - 24 Jan. 1995

A.2 Cruise Summary Information

A.2.a Geographic boundaries

A.2.b Stations occupied
15 CTD/Rosette stations with 16 cast, 1 Rosette only cast and 2 trial casts were occupied.

We used 36 position Rossete water sampler with 36 Niskin bottles at the cast between PR23-01 and PR23-05 and at PR23-09. Except for these stations, the Niskin bottles were reduced to 24 because of the hard sea condition.

The sampling depths shallower than 1000m were 10, 20, 30, 50, 75, 100, 125, 200, 250, 300, 400, 500, 600, 700, 800, 900 and 1000m when we used 36 bottles. Below 1000m, we sampled sea water every 250m. In the case of 24 bottles, sampling depths were 50, 100, 200, 300, 400, 500, 600, 800 and 1000m above 1000m. Below 1000m, sampling depths used with 24 bottles were almost same as 36 bottles.

At PR23-15 on the Philippine trench, 2 casts/observations were carried out with 24 bottles in order to sample every 250m.

At PR23-09 and PR23-14, the CTD was not lowered below 5500m because of the danger of high wire tension causing deformity of the sheave we were afraid that the sheave was by high tension of the wire.

17 XBT casts were occupied.

AMS radiocarbon 92 (5 stations, all replicate samples)
H3/He3 13 (1 station)

Three hourly meteorological observations were carried out during the entire cruise.

Measurements of surface layer pCO2 and atmospheric pCO2 were made along the entire ship track.

The images scanned by Advanced Very High Resilution Radiometer (AVHRR)

mounted on the polar orbiting NOAA satellite were received 5 to 9 passes per day during the entire cruise.

A.2.c Floats and drifters deployed

A.2.d Moorings deploued or recovered

A.3 List of Principal Investigators

Table 1: List of Principal Investigators

Parameter / Instr.	Sampling Group	Principal Investigator(s)
CTD/rosette	JAMSTEC	Yuji Kashino/ Takeshi Kawano
ADCP	JAMSTEC	Yuji Kashino/ Michio Aoyama
XBT	JAMSTEC	Haruo Ishii
Salinity	JAMSTEC	Takeshi Kawano
O2, NO3, NO2, PO4, SiO2	JAMSTEC	Michio Aoyama
Radiocarbon, H3/He3*	JAMSTEC	Michio Aoyama
CO2	MRI	Hisayuki Y. Inoue
NOAA HRPT	JAMSTEC	Ichio Asanuma

* funds are still pending

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A.4 Scientific Programme and Methods

We started the WOCE cruise at (7 30 N,134 00 E) along 7 30 N. on 14 January 1995. Since the clearance for PR24 and PR1S, which pass through Indonesian water, could not be obtained from Indonesia, our observation and collection of samples were limited to the EEZ of Palau and Philippines. After the observations at PR23-5 were completed, strong winds and high sea conditions were forecast. Then we decided to change the order of the observation so waiting time (for better sea conditions) would be reduced. After we waited for two days at the Philippine coast near Station PR24-4, we started observation again from the opposite direction. We, however, stopped by the morning after PR24-1 due to slightly high wave and night time. At 20:46 (UTC) on 16 January 199 5, a big earthquake of magnitude 7.2 hit Kobe City and killed more than 5000 persons. The director of JAMSTEC ordered R/V Kaiyo to shorten her schedule and return to Japan to assist in the national rescue activity for this heavy disaster. The shedule of arrival in Palau was moved to the morning on 24 January 1995. To save on observation time, the cruise track was shifted from 7 30 N to7 00 N and station spacing wa modified. Observations were stopped at PR23-9 (7 00 N, 130 00 E), the same locations of PR1S-1 9 in the previous R/V Kaiyo cruise in Feb. - Mar. 1994.

The deep water temperature and salinity in the southern Philippine Basin along 7 N is almost the same as the observation results from the previous cruise for PR24, PR1S and 6N in Feb. - Mar. 1994 within the precision and accuracy of the observation/analyses.

The Mindanao Undercurrent toward the north was observed below 300m depth around 127 30 E along 7 N. The maximum northward velocity measured by ADCP was 20 cm/s. In this location, high salinity and high oxygen water was seen. This water seems to be some part of the South Pacific Tropical Water and Antarctic Intermediate Water advected by the New Guinea Coastal Undercurrent from the South Pacific.

The analysis of CTD corrected by the Autosal indicate that they meet WHP one-time survey standards for accuracy. The precision of CTD measurements are better or close to WHP one-time survey standards. Salinity measurement due to bottle samplings has shown ca. 0.001 PSS in accuracy and ca. 0.0005 PSS in precision. These meet WHP one-time survey standards for water samples. The precision of dissolved oxygen (DO.) measurement, 0.09%, meets WHP one-time survey standards for water samples. The precision of nitrate analysis and silicate analysis are close upon 0.2%, and that of phosphate also close upon 0.4% at the begining of the observation. These precisions meet WHP one-time survey standards for water samples, however, we have failed to keep these good precisions at some of the stations. The accuracy of nutrients measurements are better or close to WHP one-time survey standards.

CTD observations were done at 12 and 4 stations for PR23 and PR24, respectively. Just after departure from Palau, we conducted observations at 5 stations (from PR23-01 to PR23-05) of PR23 from 7 30 N, 134 00 E to 7 30 N, 132 00 E with an interval of 30 nm. Because of bad weather, we moved to the south of Mindanao and started the observation of PR24 from 6 16.7 N, 126 50 E to 6 50 N, 126 30 E (from PR24-04 to PR24-01). After the observation of PR24, we carried out the observation of PR23 along 7N from 126 45 E to 130 00 E (from PR23-17 to PR23-09). The interval

between stations near the Philippine trench (at the west of 127-30E) were less than 15 nm. At the east of 127 30 E, the station intervals were 30nm or 60nm. We returned to Palau after the last cast at PR23-09.

Preliminary Results
by M. Aoyama (23 March 1995)

The deep water character in the southern Philippine Basin along PR23 and PR24N was summarized together with the observation results from the previous cruise for PR24, PR1 S and 6N in Feb. -Mar. 19954(Table 2). Salinity and phosphate observed in Jan. 1995 are in good agreement with those in Feb.-Mar. 1994 within the precision of the observation/analyses. Silicate concentration in Jan. 1995 , however, shows 1.0 % lower than that in Feb.-Mar. 1994. Nitrate concentration in Jan. 1995 shows 1.4 % lower than that in Feb. -Mar. 1994. Dissolved oxygen in Jan. 1995 show 1.1-1.3 % higher than that in Feb.-Mar. 1994. When we assume that the deep water in the southern Philippine Basin has almost the same properties, these differences seen in dissolve oxygen, silicate and nitrate show the accuracy of our observation.

The Mindanao Undercurrent toward the north was observed below 300m depth around 127-30 E along 7 N. The maximum northward velocity measured by ADCP was 20 cm/s. In this location, high salinity and high oxygen water was seen. This water seems to be some part of the South Pacific Tropical Water and Antarctic Intermediate Water advected by the New Guinea Coastal Undercurrent from the South Pacific (Tsuchiya et al., 1989; Tsuchiya 1991; Fine et al.,1994). The analysis of CTD corrected by the Autosal indicate that they meet WHP one-time survey standards for accuracy. The precision of CTD measurements are better or close to WHP one-time survey standards. Salinity measurement due to bottle samplings has shown ca. 0.001 PSS in accuracy and ca. 0.0005 PSS in precision. These meet WHP one-time survey standards for water samples. The precision of dissolved oxygen (DO.) measurement, 0.09 %, meets WHP one-time survey standards for water samples. The precision of nitrate analysis and silicate analysis are close upon 0.2 %, and that of phosphate also close upon 0.4% at the begining of the observation. These precisions meet WHP one-time survey standards for water samples, however, we have failed to keep these good precisions at some of the stations. The accuracy of nutrients measurements are better or close to WHP one-time survey standards.

The accuracy and precision for CTD observation and water sample analysis for these two year WOCE cruise are tablated together with the WHP one-time survey standrads in Table 3.

Table 2 The average and the standard deviation of the properties below 3000 dbar in 1994 and 1995.

Range dbar	THETA degree	SALNTY PSS	OXYGEN umol/kg	SILICAT umol/kg	NITRAT umol/kg	PHSPHT umol/kg
Feb. -Mar. 1994						
7600 - 4998	1.2395	34.6794	150.6	139.7	36.08	2.46
	0.0029	0.0007	0.73	1.06	0.31	0.03
Jan. 1995						
7921 - 4995	1.2392	34.6790	152.68	138.28	35.57	2.45
	0.0023	0.0004	0.42	0.38	0.26	0.02

Feb.-Mar. 1994

6001 - 4998	1.2403	34.6793	150.6	139.7	36.11	2.47
	0.0024	0.0008	0.76	1.14	0.31	0.02
Jan. 1995						
6000 - 4995	1.2403	34.6791	152.53	138.26	35.65	2.45
	0.0016	0.0004	0.41	0.44	0.25	0.02
Feb.-Mar. 1994						
5003 - 3996	1.2447	34.6790	150.4	139.8	36.12	2.47
	0.0042	0.0009	0.88	1.22	0.33	0.03
Jan. 1995						
5009 - 3996	1.2469	34.6789	152.03	138.32	35.63	2.46
	0.0049	0.0005	0.45	0.46	0.20	0.01
Feb. -Mar. 1994						
4003 - 2998	1.3060	34.6748	146.8	140.5	36.29	2.48
	0.0482	0.0034	3.03	1.26	0.34	0.04
Jan. 1995						
4002 - 2997	1.3052	34.6745	148.02	138.84	36.03	2.48
	0.0552	0.0038	3.46	0.76	0.59	0.02

Table 3. The accuracy and precision for CTD observation and water sample analysis for these two year WOCE cruise together with the WHP one-time survey standrads.

CTD-TEMP deg C	-SALNTY PSS-78	-PRES dbar	SALNTY PSS-78	OXYGEN %	SILICAT %	NITRAT %	PHSPHT %
Estimated accuracy							
0.001	0.001	1	0.001	1.3	1.0	1.4	<1
WHP one-time survey standrads of accuracy							
0.002	0.002	3	0.002	< 0.5	ca. 1-3	ca. 1	ca. 1-2
Estimated precision							
<0.002	<0.002	0.4	0.0005	0.09	ca. 0.2	ca. 0.2	ca. 0.4
WHP one-time survey standrads of precision							
0.0005	<0.001	0.5	< 0.001	0.1	0.2	0.2	0.4

The accuracies of CTD-temperature and pressure were referenced to pre- and post cruise calibrations. The accuracies of CTD-salinity and water sample salinity were referenced to IAPSO standard seawater of batch # P124. The accuracies of dissolved oxygen and nutrients were estimated based on the diferences between the concentrations of deep water (deeper than 4000 dbar) in 1994 and those in 1995.

The precisions of CTD-temperature and CTD-salinity were evaluated based on the data between 3500 dbar and 3850 dbar of the trial casts. The precision of CTD pressure was evaluated using the repeat observations of the dead weight tester. The precision of the data of the water sample analyses were evaluated repeat analyses of the same water samples.

A.5 Major Problems and Goals not Achieved

A.6 Other Incidents of Note

A.7 List of Cruise Participants

Table 5-2: Cruise participants

Cruise participants with role and / or affiliation in parentheses.

Michio Aoyama	JAMSTEC	Chief Scientist/O2,Nutrients,C-14, H-3/He-3
Haruo Ishii	JAMSTEC	CTD/X-BT
Takeshi Kawano	JAMSTEC	Salinity,CTD/rosette hardware
Yuji Kashino	JAMSTEC	CTD Softwares/ADCP
Akira Sonoda	NME	O2
Hiroshi Yamamoto	NME	CTD
Koichi Takao	NME	Salinity
Atsuo Ito	NME	Salinity
Misumi Aoki	NME	O2
Mitsuru Hayashi	NME	CTD
Yasunori Nakashima	STM	CTD
Ranko Takeo	STM	O2
Takehiko Shiribiki	STM	O2
Keiko Komine	STM	Nutrients
Teruhisa Hattori	STM	CTD
Hidekazu Ota	KEEC	Nutrients
Kiyotaka Nakao	KEEC	Nutrients
Takashi Kitao	KEEC	CTD/CO2
Hirohiko Takata	NHE	Satellite rec. sys. op.
Angel Bravo	MGSB	Head of Philippine delegation
Allan Antonio A.Conda	MGSB	CTD
Conrad R. Miranda	MGSB	CTD

note: JAMSTEC Japan Marine Science and Technology Center, Japan
STM Sanyo Techno Marine, Inc., Japan
NME Nippon Marine Enterprises, Ltd., Japan
KEEC Kansai Environmental Engineering Center, Ltd., Japan
MRI Meteorological Research Institute, Japan
NHE Nippon Hakuyo Engineering, Ltd., Japan
MGSB Mines and Geo-Science Bureau, Department of Environment and Natural Resources, Philippines