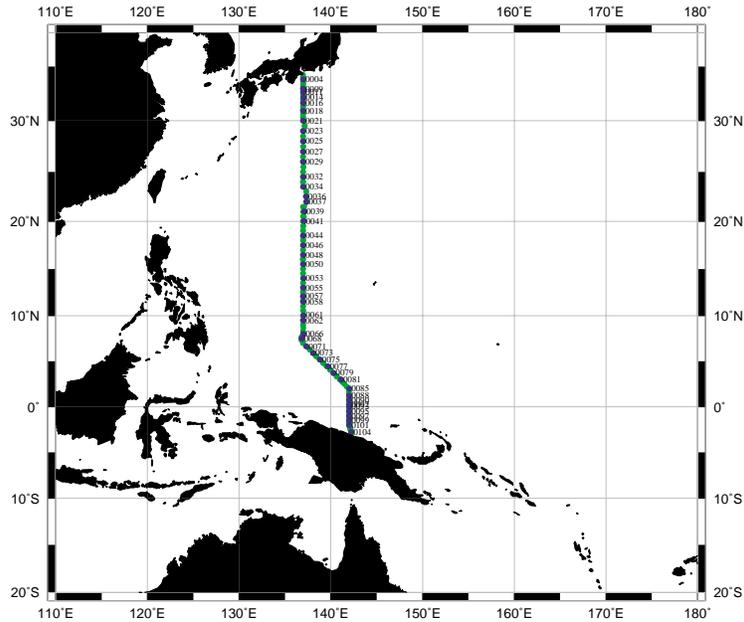


A. Cruise Narrative WOCE P09 (RY9407)



A.1. Highlights

WHP Cruise Summary Information

WOCE section designation	P09
Expedition designation (EXPCODE)	49RY9407_1-2
Chief Scientist(s) and their affiliation	Ikuo KANEKO *, Satoshi KAWAE**/JMA
Dates	1994.JUL.07 - 1994.AUG.25
Ship	R/V Ryofu Maru
Ports of call	Leg-1: Tokyo - Palau, Leg-2: Palau - Guam
Number of stations	105

Geographic boundaries of the stations	137° E	34° 15' N	142° E
		15° N	

Floats and drifters deployed	none
Moorings deployed or recovered	none

Contributing Authors	I. Kaneko, H. Kamiya, M. Tamaki, Y. Takatsuki, T. Miyao, M. Ishii
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*Chief Scientist **Co-Chief Scientist
 Oceanographical Division
 Marine Department
 Japan Meteorological Agency (JMA)
 1-3-4, Ohtemachi, Chiyoda-ku

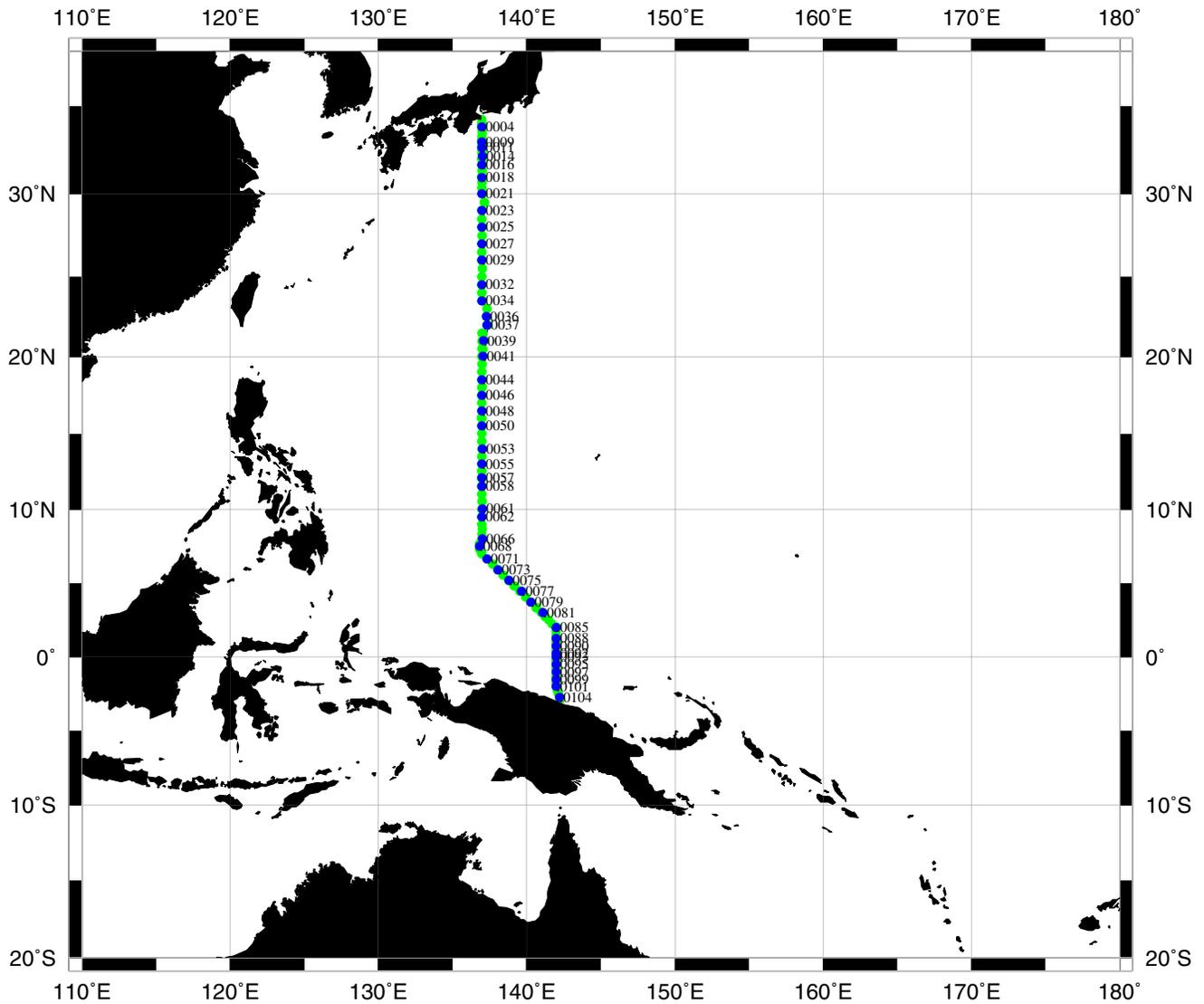
Tokyo 100, Japan
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WHP Cruise and Data Information

Instructions: Click on any item to locate primary reference (s) or use navigation tools above.

Cruise Summary Information	Hydrographic Measurements
Description of scientific program	CTD - general
	CTD - pressure
Geographic boundaries of the survey	CTD - temperature
Cruise track (figure)	CTD - conductivity/salinity
Description of stations	CTD - dissolved oxygen
Description of parameters sampled	
	Salinity
Floats and drifters deployed	Oxygen
Moorings deployed or recovered	Nutrients
	CFCs
Principal Investigators for all measurements	Helium
Cruise Participants	Tritium
	Radiocarbon
Problems and goals not achieved	CO2 system parameters
	References
	DQE Reports
	CTD
	S/O2/nutrients
	CFCs
	Data Status Notes

Station locations for p09



Produced from .sum file by WHPO-SIO

A.2 Cruise Summary Information

A.2.a Geographic Boundaries

The station locations along the P9 section are shown in [Figure 1.1](#) and tabulated in Table 1.1. Table 1.1 includes the dates, times and water depths. The section was occupied from north toward south except two parts of the section, between Sta. 37 and 40, and between Sta. 54 and 61. These parts of the section were occupied from south toward north. The details on the cruise track is given in Section 1.4.

Table 1.1: Station data of WHP-P9 (listed geographic sequentially)

Leg	Station		Date (JST: UTC+9h)	Time	Position (GPS)		W.depth (m)
					Latitude	Longitude	
1	1	8633	07 09 94	0149	34 15.02 N	137 00.04 E	145
1	2	8634	07 09 94	0329	34 06.56 N	136 59.86 E	1220
1	3	8635	07 09 94	0608	34 00.03 N	136 59.37 E	1010
1	4	8636	07 09 94	1006	33 50.02 N	136 58.66 E	1850
1	5	8637	07 09 94	1227	33 39.91 N	136 59.73 E	2010
1	6	8638	07 09 94	1525	33 29.79 N	137 00.98 E	2055
1	7	8639	07 09 94	1836	33 20.19 N	137 00.06 E	2620
1	8	8640	07 09 94	2207	33 10.28 N	137 00.35 E	2870
1	9	8641	07 10 94	0122	33 00.04 N	136 59.60 E	4295
1	10	8642	07 10 94	1124	32 49.10 N	136 59.71 E	3885
1	11	8643	07 10 94	1653	32 40.52 N	137 00.38 E	4180
1	12	8644	07 10 94	2202	32 30.68 N	137 00.18 E	4095
1	13	8645	07 11 94	0217	32 20.08 N	136 59.95 E	4050
1	14	8646	07 11 94	0720	32 10.67 N	137 00.58 E	4000
1	15	8647	07 11 94	1111	31 59.84 N	136 59.66 E	4230
1	16	8648	07 11 94	1821	31 40.39 N	136 59.45 E	4170
1	17	8649	07 11 94	2338	31 20.11 N	136 59.87 E	4165
1	18	8650	07 12 94	0523	31 00.49 N	136 59.73 E	4170
1	19	8651	07 12 94	1248	30 39.87 N	136 59.90 E	4235
1	20	8652	07 12 94	1803	30 20.47 N	137 00.12 E	4420
1	21	8653	07 12 94	2323	30 00.36 N	137 00.02 E	4490
1	22	8654	07 13 94	0807	29 30.15 N	137 09.66 E	4530
1	23	8655	07 13 94	1448	28 59.87 N	136 59.68 E	4550
1	24	8656	07 13 94	2102	28 30.12 N	136 59.84 E	4515
1	25	8657	07 14 94	0351	28 00.33 N	136 59.98 E	4160
1	26	8658	07 14 94	1226	27 29.80 N	137 00.34 E	4350
1	27	8659	07 14 94	1922	26 59.86 N	136 59.90 E	4700
1	28	8660	07 15 94	0433	26 30.09 N	136 59.67 E	5020
1	29	8661	07 15 94	1137	25 59.56 N	137 00.07 E	5545
1	30	8662	07 15 94	2118	25 29.75 N	137 00.56 E	4920

Leg	Station		Date	Time	Position (GPS)		W.depth (m)
			(JST: UTC+9h)		Latitude	Longitude	
1	31	8663	07 16 94	0413	25 00.41 N	137 00.14 E	5020
1	32	8664	07 16 94	1047	24 30.14 N	137 00.09 E	5310
1	33	8665	07 16 94	1812	23 59.81 N	136 59.87 E	3915
1	34	8666	07 17 94	0213	23 30.46 N	137 00.00 E	4220
1	35	8667	07 17 94	0942	23 00.27 N	137 19.61 E	4900
1	36	8668	07 17 94	1733	22 30.44 N	137 19.64 E	4580
1	37	8672	07 22 94	1352	22 00.12 N	137 20.23 E	4280
1	38	8671	07 22 94	0442	21 29.80 N	137 00.41 E	4370
1	39	8670	07 21 94	1806	20 59.63 N	137 00.11 E	4810
1	40	8669	07 21 94	0913	20 29.49 N	137 00.32 E	4465
1	42	8674	07 23 94	1657	19 30.27 N	136 59.85 E	4650
1	43	8675	07 23 94	2306	19 00.60 N	136 59.88 E	4690
1	44	8676	07 24 94	0542	18 30.63 N	137 00.05 E	4910
1	45	8677	07 24 94	1232	18 00.18 N	136 59.75 E	4920
1	46	8678	07 24 94	2117	17 29.88 N	136 59.78 E	4890
1	47	8679	07 25 94	0403	17 00.74 N	136 59.68 E	4775
1	48	8680	07 25 94	1042	16 30.21 N	137 00.05 E	5565
1	49	8681	07 25 94	1752	15 59.85 N	136 59.95 E	5200
1	50	8682	07 26 94	0239	15 30.27 N	136 59.96 E	5130
1	51	8683	07 26 94	0927	15 00.47 N	136 59.84 E	5290
1	52	8684	07 26 94	1643	14 30.58 N	136 59.64 E	4480
1	53	8685	07 26 94	2352	13 59.89 N	137 00.81 E	4810
2	54	8693	08 06 94	0836	13 29.30 N	136 59.75 E	5100
2	55	8692	08 06 94	0216	13 00.61 N	136 59.33 E	4815
2	56	8691	08 05 94	1752	12 30.13 N	137 00.06 E	4695
2	57	8690	08 05 94	0741	12 00.32 N	136 59.80 E	5150
2	58	8689	08 04 94	2318	11 30.20 N	136 59.78 E	4730
2	59	8688	08 04 94	0208	10 59.66 N	136 59.77 E	4895
2	60	8687	08 03 94	1921	10 30.55 N	136 59.89 E	5025
2	61	8686	08 03 94	1040	09 59.79 N	136 59.77 E	4860
2	62	8694	08 07 94	0934	09 29.99 N	136 59.85 E	4715
2	63	8695	08 07 94	1548	08 59.49 N	136 59.93 E	3160
2	64	8696	08 07 94	2026	08 40.29 N	137 00.95 E	2400
2	65	8697	08 07 94	2350	08 19.75 N	136 59.97 E	2270
2	66	8698	08 08 94	0306	08 00.52 N	137 02.00 E	2960
2	67	8699	08 08 94	0916	07 40.04 N	136 50.09 E	3175
2	68	8700	08 08 94	1304	07 30.56 N	136 50.09 E	2950
2	69	8701	08 08 94	1712	07 19.73 N	136 49.66 E	6560
2	70	8702	08 09 94	0224	07 00.12 N	136 59.89 E	4235
2	71	8703	08 09 94	0823	06 38.84 N	137 20.97 E	4110
2	72	8704	08 09 94	1428	06 17.09 N	137 43.42 E	4385
2	73	8705	08 09 94	2009	05 55.30 N	138 04.42 E	4210
2	74	8706	08 10 94	0352	05 33.29 N	138 26.19 E	4565

Leg	Station		Date	Time	Position (GPS)		W.depth (m)
					(JST: UTC+9h)		
2	75	8707	08 10 94	1008	05 11.16 N	138 49.05 E	4210
2	76	8708	08 10 94	1603	04 49.13 N	139 10.75 E	4400
2	77	8709	08 10 94	2144	04 27.48 N	139 32.89 E	4090
2	78	8710	08 11 94	0518	04 05.24 N	139 55.54 E	4250
2	79	8711	08 11 94	1113	03 43.08 N	140 17.05 E	4280
2	80	8712	08 11 94	1913	03 21.20 N	140 39.50 E	3775
2	81	8713	08 12 94	0023	03 00.76 N	140 59.67 E	3535
2	82	8714	08 12 94	0703	02 45.10 N	141 14.90 E	3030
2	83	8715	08 12 94	1131	02 30.08 N	141 29.64 E	2800
2	84	8716	08 12 94	1502	02 15.74 N	141 44.87 E	2615
2	85	8717	08 12 94	1838	02 00.52 N	141 59.74 E	2575
2	86	8718	08 13 94	0118	01 45.11 N	141 59.48 E	2750
2	87	8719	08 13 94	0524	01 30.64 N	142 00.18 E	2810
2	88	8720	08 13 94	0958	01 15.16 N	142 00.05 E	2940
2	89	8721	08 13 94	1442	01 00.48 N	142 00.10 E	3060
2	90	8722	08 13 94	2148	00 45.46 N	142 00.05 E	3140
2	91	8723	08 14 94	0224	00 30.14 N	141 59.96 E	3310
2	92	8724	08 14 94	0708	00 15.57 N	141 59.85 E	3420
2	93	8725	08 14 94	1230	00 00.07 S	141 59.83 E	3370
2	94	8726	08 15 94	0834	00 14.49 S	141 59.98 E	3285
2	95	8727	08 15 94	1333	00 30.03 S	142 00.01 E	3335
2	96	8728	08 15 94	1823	00 44.40 S	142 00.04 E	3140
2	97	8729	08 15 94	2323	00 59.63 S	142 00.03 E	3020
2	98	8730	08 16 94	0602	01 14.99 S	141 59.85 E	3195
2	99	8731	08 16 94	1053	01 30.21 S	141 59.93 E	3500
2	100	8732	08 16 94	1612	01 44.67 S	142 00.35 E	2855
2	101	8733	08 16 94	2045	01 59.46 S	142 00.05 E	3570
2	102	8734	08 17 94	0357	02 14.52 S	142 04.67 E	3910
2	103	8735	08 17 94	1027	02 29.22 S	142 09.86 E	4150
2	104	8736	08 17 94	1559	02 44.53 S	142 14.81 E	3040
2	105	8737	08 18 94	0718	02 52.16 S	142 16.92 E	1760
(Re-occupation)							
2	92	8738	08 19 94	0004	00 15.09 N	141 59.97 E	3395

A.2.b Total number of stations occupied

Sampling Accomplished

105 stations of CTD casts were completed. Station locations are shown in [Figure 1.1](#). Measured parameters and numbers of samples are as follows:

Numbers of sampling bottles and layers		
bottles:	triggered	3613
	successfully closed	3592
sampling layers:	triggered	3392
	successfully sampled	3226
Numbers of water samples analyzed:		
salinity	105 stations	3224 layers
oxygen	101 stations	3041 layers
nutrients	101 stations	3102 layers
CFCs	24 stations	351 layers
Total Carbonate	23 stations	618 layers
Numbers of water samples collected for shore-based analysis:		
helium-3 (3He)	25 stations	486 layers
tritium (3H)	25 stations	389 layers
AMS carbon-14 (14C)	23 stations	618 layers

A.2.c Floats and drifters deployed

None

A.2.d Moorings Deployed or Recovered

None

A.3 List of Principal Investigators for all Measurements (Table 1.2)

Table 1.2

Parameter	Sampling group	Principal Investigator
CTDO/Rosette	JMA/MD	Yasushi Takatsuki
Salinity	JMA/MD	Yasushi Takatsuki
Oxygen, Nutrients	JMA/MD	Hitomi Kamiya
CFC	JMA/MD	Ikuo Kaneko
	TU	Mamoru Tamaki
3H/3HE	JMA/MRI	Katsumi Hirose
	L-DEO	Peter Schlosser
14C	JMA/MRI	Katsumi Hirose
Total carbonate	JMA/MRI	Masao Ishii
ADCP	JMA/MD	Ikuo Kaneko
JMA/MD: Marine Department, Japan Meteorological Agency		
JMA/MRI: Meteorological Research Inst., JMA		
TU: Tokai University		
L-DEO: Lamont-Doherty Earth Observatory of Columbia University		

A.4 Scientific Programme and Methods

Figures 1.2a-1.2f show the locations where water samples were collected for analyses of dissolved oxygen, nutrients, CFCs, ^3H , ^3He , and ^{14}C . Figures 1.3a and 1.3b show preliminary vertical sections of potential temperature and salinity taken by the CTD.

ADCP Measurements

Continuous underway current measurements were made by ADCP (RD Instruments Inc., Model RD-VM0075TM) along the cruise track. The current was measured at 50 layers from the sea surface to 800m depth.

1.3 Lists of Principal Investigators and Cruise Participants

The measured parameters, sampling groups, principal investigators (PIs) and participants in the cruise are listed in Tables 1.2 and 1.3.

1.4 Preliminary Results

Cruise tracks

Leg-1 (from Tokyo to Palau, Sta. 1-53)

Leg-1 consisted of 53 stations (Sta. 1-53; Ry8633-8685). The P9 section was started at Sta. 1 (34 15 N, 137 00 E) on July 9, 1994. From the start of the section to Sta. 36 (Ry8668; 22 30N), the observations were carried out from north to south according to the plan. Owing to the approach of the typhoon (T9407), after Sta. 36 on July 17, R/V Ryofu Maru sailed down to 20 N to wait till the typhoon (T9407) went through the P9 section at about 25 N. The observations resumed at July 21 from Sta. 40 (Ry8669; 20 29 N) toward the northern stations to save shiptime because the sea condition recovered from south to north. A small rosette system (12 2.5-liter bottles) was used at Stas. 40, 39 and 38 (Ry8669-8671) owing to the unfavorable sea state due to high swell after the storm. After Sta. 37 (Ry8672) at 22 00 N, R/V Ryofu Maru sailed down to Sta. 41 (Ry8673) at 20 00 N and resumed the observation toward the southern stations. We cut short the first leg after Sta. 53 (Ry8685) at 14 00 N on July 26 to enter the port of Palau as scheduled. Sta. 53 is the last station of Leg-1.

Leg-2 (from Palau to Guam, Sta. 54-105)

Owing to the typhoon, we had to cut Leg-1 leaving eight stations unoccupied, and Sta. 54 at 13 30 N was the northernmost site in Leg-2. These made Leg-2 schedule tight. We, therefore, decided to introduce a new track of shortcut from 7 00 N, 137 00 E toward 3 00 N, 142 00 E. The new Leg-2 contained 52 stations (Sta. 54-105) from 13 30 N to the coast of Papua New Guinea.

When R/V Ryofu Maru left Palau on Aug. 2 and began to sail back to the northernmost station of Leg-2 at 13 30 N (Sta. 54), a weather forecast reported generation and approach of a typhoon (T9413). As stormy weather was predicted around the northern part of the Leg-2 section, we started Leg-2 from 10 00 N (Sta. 61; Ry8686) toward the

northern stations. The small rosette system (12 2.5-liter bottles) was used at Stas.58, 57 and 56 (Ry8689-8691) to carry out the observation safely in the rough sea.

R/V Ryofu Maru reached the northernmost station at 13 29 N (Sta. 54; Ry8693) on August 6 and turned back to south in aiming at the station at 9 30 N (Sta. 62; Ry8694). The observation progressed on schedule from Sta. 62 to the southernmost station (Sta. 105; Ry8737), where we arrived on Aug. 18. On the way to Guam, R/V Ryofu Maru return to the station at 0 15 N (Sta. 92) for reoccupation because mistrips of the rosette system had caused many data lacks at the station on the outward voyage. Sta. 92 at 0 15 N has, therefore, the two serial station numbers, Ry8724 and RY8738.

Some remarks on the hydrocast

Because R/V Ryofu Maru, which was constructed in 1966, is not equipped with facilities to hover herself at a fixed position, hydrocasts had to be carried out while R/V Ryofu Maru was kept drifting. The CTD/rosette system was flowed far from the ship in case of swift current or high wind. A water depth measured by sounding does not agree with one estimated from combination of CTD depth and its altimeter height from the bottom in such a case. At Sta. 36 (Ry8668), we had to deploy the CTD/rosette system under the condition that mean wind speed was over 17 m/s. The CTD/rosette system could not reach the bottom even payout of full length of the cable. The maximum CTD pressure was 4317 dbar while the water depth is 5075 m.

Sta. 69 (Ry8701) is above the western end of Yap Trench. Although the water depth was 6600 meters, we left off the cast at 6000 m depth, considering small power of our winch. Because mean water depths of the basins around Yap Trench never exceed 5500 m, the data lack in the deep trench will no seriously inconvenience for studies on the general circulations in this region.

Owing to the limited capacity of the winch and thin cable, we had to choose small sampling bottles for our the CTD/rosette system, regardless off their vulnerability to CFCs contamination. As a countermeasure against the contamination, we introduced Bullister style 2.5-liter sampling bottles, which were designed so that sampled water is hard to contaminate with CFCs contained in materials of the bottles. They were made at the factory of NOAA/PMEL.

The other countermeasure was a extra cast for CFCs sampling at stations for the tracers. At the stations, samples for oxygen and nutrients were completed in the first (shallow) and second (deep) cast. ^{14}C and ^3He samples below 1500 m depth were also drawn in the second cast. In the third extra cast, CFCs and $^3\text{H}/^3\text{He}$ samples above 1500 m depth were drawn. Salinity samples were also drawn from almost all bottles to determine true depths of bottle closings.

In addition to copper tubes sampling for $^3\text{H}/^3\text{He}$, 1 liter glass bottles filled with argon gas were used for ^3H sampling at layers above 1500 m depth.

A.5 Major Problems and Goals not Achieved

Problems

1) Mistrrip of the rosette system

We were troubled with mistrrips of the 24-bottles rosette system throughout the cruise.

The mistrrips occurred whenever the system was deployed below 1500 m depth. As the same number of double-trips always followed misfires, the number of closed bottles agreed with the one of trigger commands when the system was recovered on the deck. This agreement of the numbers delayed our discovery of the trouble.

Mistrrip was never reproduced at the trigger tests on the deck. Following the article of mistrrip appeared in the report of Moana Wave Cruise 893 (in WHPO90-1 manual), we intended to adjust the tensions of lanyards and bolts fixing the upper plate of the pylon, on monitoring occurrence of mistrrips. On the way of Leg-1, we took out the pylon from the rosette frame, cooled it in a bath filled with ice water for two hours and repeated triggers under the condition that lanyards pulled the balls with high tension. But, this trial was in vain because the mistrrip was not reproduced by the cooling. We speculated that this trouble was caused by high pressure and was a different phenomenon from the one occurred during Moana Wave Cruise 893.

We cleaned up the trigger pins, loosened the bolts of upper plate, and mounted digital RTMs and RPMs on as many bottles as possible. Once we specified a bottle (or trigger pin) which tended to cause a misfire, we set the rosette so as to use it at the shallowest layer or not to use it if possible. However, this countermeasure has caused irregular misfires at other pins. After some trials and errors, we found a way to use a misfire bottle at the deepest layer and to send trigger command twice or more there. When a misfire was forced firstly at the deepest, a double-fire stably occurred at bottles around the opposite side of the rosette frame, and the occurrence of mistrrips was kept under our control during several days. However, while we relaxed our attention, a misfire used to escape from the deepest layer to a shallower layer, and we had to change our sampling tactics. This vicious circle was continued until the last station.

Owing to the mistrrips, about 5% of total of the sampling layers were lost. As our rosette system was not an intelligent type, misfires and double fires caused sampling layer shifts. We determined true sampling layers carefully from the data of RTMs, RPMs, salinity and the other chemical properties when we assembled the water sample data file, 49RY9407.SEA.

2) CTD break down and replacement at Sta. 69 (Ry8701)

At the second cast of Sta. 69, the temperature sensor of our CTD (FSI Triton ICTDTM) broke down when the system descended below 3500 m depth. The CTD was replaced to the other Triton ICTD on the deck. However, a DO sensor prepared for the new CTD did not work on account of broken wires inside of plastics mold of the sensor unit. To repair the wires was impossible for us on the deck. The other DO sensor of the broken CTD did

not work on the new CTD because its inside circuit did not adapt to the new CTD. We, therefore, had to give up measuring DO profiles by CTD system since the deep cast of Sta. 69.

According to the comparison of water temperatures between the RTMs and CTD, a drift of the CTD temperature was recognized from Sta. 51 (Ry8683) and reached at the maximum of 0.02°C before the CTD breakdown. CTD temperature was carefully corrected based on the RTM temperatures, but had to be flagged as 'Bad measurement' in our CTD record files at several stations.

3) A trouble of DO titrator

We used a photometric automated titrator, Model ART-3TM manufactured by HIRAMA Riken Inc. During Leg-1, from Tokyo to Palau, the titrator often became unstable. The sensor circuit, bad focus of the lamp and large vibration of the table are speculated as the cause of bad titration. We could not repair the titrator until R/V Ryofu Maru reach Palau, where we replaced the bad optical unit with the one transported from Tokyo. In Leg-2, the titrator worked normally.

2. Measurement Techniques and Calibrations

2.1 Salinity measurements

(I. Kaneko)

Equipment and Technique

Salinity samples were collected in 150 ml amber glass bottles with rubber caps and stored in an air-conditioned laboratory for more than 24 hours before salinity measurements. The salinities were measured with a Guildline“ Autosal“ Model 8400B salinometer. The salinometer was standardized with IAPSO Standard Sea Water (SSW) every day when it was used for sample measurements.

During the cruise, we regularly took a batch of deep water below 1000 m depth, sealed in a polyethylene rectangular bag and used as a substandard water to monitor instrument drifts. We kept a batch of substandard sea water being isolated from air and stirred with a magnet stirrer so as to maintain its constancy of salinity during salinity sample measurements. A batch of substandard sea water was replaced by new one when the bag decreased in volume by half. This is because salinity of the substandard sea water tended to increase by about 0.0004 when its volume decreased largely.

We made efforts to keep the variation of laboratory temperature within 1°C between two standardizations before and after a series of salinity measurements, though the variation sometimes exceeded the limit and reached 2°C at the maximum. Drifts of the laboratory and bath temperatures were monitored with a HPTM2804A Quartz Thermometer, of which temperature resolution was set to 0.0001°C. 31 outputs of conductivity ratio from the Autosal were taken by a PC at each reading, and their median and standard deviation

were calculated and recorded with the laboratory and bath temperatures measured simultaneously.

Our results of inter-batch comparisons

After all the observations along the P9 section were over, the IAPSO SSW batch used during the present cruise, P123 (Dated 10/6/1993), was compared with some older batches of IAPSO SSW (P88, 100, 110, 114, 118, 121) available, so as to obtain the correction value of salinity data based on the batch P123. The results of the inter-batch comparison is shown in Table 2.1.1. As for the batch P88, white precipitate was recognized on the glass walls of three ampoules, all of which salinity values measured were about 0.015 lower than the labeled value. The other ampoule contained suspended particles, but the salinity difference between measured and labeled was not large compared with the other three ampoules.

Table 2.1.1 Differences of measured salinity (Smeas) and SSW label derived salinity (Slavel) referred to batch P123.

Batch	Preparation Date	K15	Slavel	Smeas-Slavel (sS: x103)	Mean sS (x103)
P88	1 Dec 1979	19.3760*	35.0037	-14.0, -16.7, -1.5, -16.7	-1.5**
P100	29 Nov 1984	1.00003	35.0012	1.0	1.0**
P110	20 Jul 1988	0.99999	34.9996	1.2	1.2**
P114	30 Jul 1990	0.99986	34.9945	1.8	1.8**
P118	12 Nov 1991	0.99994	34.9976	0.4, 0.4, 0.4, 0.4	0.4
P121	8 Sep 1992	0.99985	34.9941	-0.2, -0.4, -0.4, -0.2,	-0.3
P123	10 Jun 1993	0.99994	34.9976	0.0, 0.0, 0.2, 0.0, 0.0, 0.2	0.0
(Reference standard)					
* Chlorinity ** Single datum					

Anyway, the number of ampoules for P88, P100, P110, and P114 is not enough to connect our results with the former studies (e.g., Mantyla,1987; Takatsuki et al.,1991). We hope to connect our result of inter-batch comparison with other similar works of WOCE which may contain P118 and P121, so as to determine the correction value of our salinity measurements referred to P123.

Indexes of precision and accuracy

Table 2.1.2 shows the results of salinity measurements made during the cruise from 261 replicate samples collected in different glass bottles from a 2.5-liter Niskin bottle. The precision of salinity measurements is estimated at 0.0007 in Leg-1 and 0.0005 in Leg-2.

Table 2.1.2 Salinity measurements comparisons

Case	Standard deviation	Number of data
	PSS-78	
Leg 1		
Replicate	0.00071	199
Leg 2		
Replicate	0.00045	62

To provide the further estimate of data quality, scattering of property values at constant potential temperatures was inspected in the deep ocean, after the example given in WOCE Operations Manual (WHPO, 1991). **Figures 2.1.1** and **2.1.2** shows meridional distribution of salinity and oxygen concentration at constant potential temperatures of 1.2, 1.4, 1.6, 1.8 and 2.0°C. These plots indicate that meridional variation of the properties is almost linear at a constant potential temperature below 1.4°C, but not above 1.6°C. Considering characteristics of the bottom topography and property distributions in/around the Philippine Sea, we divided the whole P9 section into five regions. And, for each region, we calculated the standard deviations for the difference of property concentrations at the constant potential temperatures from a least squares linear-fit to them (**Table 2.1.3**). From this method, precision of salinity measurements is estimated at about 0.001.

The P9 section crosses with the P3 (1989) and the P4 (1989) sections. However, The station locations both of P3 and P4 sections around 137 E does not agree with the ones of P9. We, therefore, averaged the data around the crossings as a function of potential temperature, and compared them each other to obtain the systematic biases in our data. This comparison was done by using the data in the deep ocean below 2000 meters, where short-term variability in the deep water may be small. The results (**Table 2.1.4**) suggest that our salinity data are 0.0025 higher than that of P3, and 0.0008 higher than that of P4. We hope to know whether these biases are ascribed to inter-batch variation of the IAPSO SSW used in P3, P4 and P9 cruises.

A.6 Other Incidents of Note

A.7 List of Cruise Participants (Table 1.3)

Name	Affiliation	Role
Ikuo Kaneko	JMA/MD	Chief Scientist/ADCP
Satoshi Kawae	JMA/MD	Co-chief Scientist/Salinity
Yasushi Takatsuki	JMA/MD	CTDO/Rosette, Salinity
Takashi Yamada	JMA/MD	CTDO/Rosette
Satoshi Sugimoto	JMA/KMO	CTDO2/rosette
Tatsushi Shiga	JMA/NMO	Salinity
Hiroyuki Takano	JMA/HMO	Salinity
Hitomi Kamiya	JMA/MD	Oxygen, Nutrients
Toshiya Nakano	JMA/MD	Oxygen
Tomoaki Nakamura	JMA/MD	Oxygen
Takao Shimizu	JMA/MMO	Oxygen
Sukeyoshi Takatani	JMA/MD	Nutrients
Kazuhiko Hayashi	JMA/MD	Nutrients
Kazuhiro Nemoto	JMA/MD	CFCs
Shu Saitoh	JMA/MD	CFCs
Mamoru Tamaki	TU	CFCs
Masao Ishii	JMA/MRI	¹⁴ C, ³ H/ ³ He, Total carbonate
Takashi Miyao	JMA/MRI	¹⁴ C, ³ H/ ³ He
JMA/MD: Marine Department, Japan Meteorological Agency		
JMA/KMO: Kobe Marine Observatory, JMA		

2.2 Oxygen measurements (H. Kamiya and I. Kaneko)

Sampling Procedure

The dissolved oxygen samples were collected in 120 ml glass bottles, which were designed and manufactured being referred to WHPO 91-2 report (1991) on an inter-comparison of oxygen measurement methods and a paper by Green and Carritt (1966). Our bottle has a collar on its mouth as a flan flask has, and its round glass stopper contains a long nipple, which extends into the flask and displaces enough volume of sample water so that titration reagent do not overflow the flask. Both the bottles and stoppers had been washed and dried before they were used for seawater sampling on the deck. After a stopper was inserted into a bottle to seal seawater, temperature of a sample is measured with a thermistor probe being inserted into seawater remained in a collar.

Equipment and Technique

The reagents were prepared according to the recipes by Carpenter (1965) and Culberson (WHPO91-1 manual,1991) though normality of sodium thiosulfate for titration was selected about 0.03 in order that a titration for the highest oxygen concentration would finished within a volume of the burette. The titrator used in the P9 cruise, Model ART-3TM, was a photometric type (372 nm), which has been manufactured by Hirama Riken Inc. The volume of burette is 5 ml, and the resolution of titration is 0.0025 ml.

Reagent blanks (expressed as Vblk,dw in WHPO91-1 manual) were measured during the cruise, determined as 0.0050 ml both for Leg-1 and Leg-2, and subtracted from all of thiosulfate titers of the samples. The reagent blank (Vblk,dw) of 0.0050 ml obtained with our oxygen flask, of which nominal volume is 118 ml, corresponds to a oxygen concentration of 0.0068 ml/l. Seawater blanks (Vblk,sw) were measured only at Sta. 92 (Ry8724) in Leg-2 (Table 2.2.1). Considering the resolution of our titrator, 0.0025ml, this measurement did not detect vertical variability of Vblk,sw at Sta. 92 from surface to deep ocean. Vblk,sw of 0.0150 ml corresponds to a oxygen concentration of 0.0204 ml/l, which is three times larger than Vblk,dw. According to the suggestion in WHPO91-1 manual, the value of Vblk,sw was recorded, but not used for the calculations of oxygen concentrations.

Table 2.2.1 Measurements of seawater blanks

Date 14/08/94 Stn.92 (Ry8724)					
Lat. 00 16 N Lon. 142 00 E Water depth 3420m					
Depth (m)	Vblk,sw (ml)	Depth (m)	Vblk,sw (ml)	Depth (m)	Vblk,sw (ml)
0	0.0150	300	0.0175	1750	0.0725*
10	0.0125	400	0.0175	2000	0.0075
25	0.0100	500	0.0125	2250	0.0150
50	0.0100	600	0.0125	2500	0.0150
75	0.0150	700	0.0225*	2750	0.0150
100	0.0125	800	0.0125	3000	0.0175
125	0.0100	900	0.0175	3250	0.0150
150	0.0150	1250	0.0175	3385	0.0150
200	0.0150	1500	0.0175		

* bad measurement

Indexes of precision and accuracy

The results of comparisons between replicate/duplicate samples are shown in Table 2.2.2. Owing to frequent misfires and double-fires of the rosette system, we often failed to obtain duplicate samples at purposed layers. We, therefore, had to make the best use of the samples from double-fired bottles as duplicate samples. Duplicate samples were classified two cases. 'Duplicate-A' is the case that samples were drawn from two bottles which had closed normally at adjacent depths. 'Duplicate-B' is the case that samples were drawn from two bottles which were judged that they had closed at the same depths owing to double-fires.

Table 2.2.2 Oxygen analyses comparisons

Case	Standard deviation		Number of data
	mol/kg	(% of F.S.)	
Leg 1			
Replicate	1.591	(0.68)	244
Duplicate-A	1.604	(0.69)	18
Duplicate-B	1.711	(0.73)	88
Leg 2			
Replicate	0.595	(0.25)	252
Duplicate-A	1.133	(0.48)	70
Duplicate-B	0.576	(0.25)	85
F.S.: 234 mol/kg			

The precision during Leg-1 is not satisfactory. The sensor circuit, bad focus of the lamp and large vibration of the table are speculated as the cause of bad titration. The precision during the Leg-2 was improved since we replaced the titrator at Palau by new parts of optical unit. In Leg-2, mistrips frequently occurred at the time of duplicate sampling in the deep ocean and made the depths of available 'Duplicate-A' data weighted to be shallow. We, therefore, interpreted that the low-precision in 'Duplicate-A' is ascribed to large gradient or fluctuation of vertical oxygen distribution in shallow layers.

As is explained in the section of salinity measurements, scattering of oxygen concentrations at constant potential temperatures ([Figure 2.1.2](#)) is used for another estimate of precision. [Table 2.1.3](#) includes the standard deviations for the differences between the interpolated oxygen data and a least squares linear-fit to their values at each of the potential temperatures. The standard deviations at the deepest layer range from 0.4 to 0.9 mol/kg.

Table 2.1.3 Standard deviation of water sample data

Whole section (from 34 15 N to 02 52 S)							
Theta		Press.	Salinity	Oxygen	Silicate	Nitrate	Phosphate
°C	Points	dbar	PSS-78	mol/kg	mol/kg	mol/kg	mol/kg
1.2	50	101	0.0009	0.8518	0.8346	0.1771	0.0243
1.4	84	120	0.0012	0.8101	0.9432	0.2045	0.0259
1.6	92	63	0.0023	1.2691	1.1396	0.2152	0.0282
1.8	95	52	0.0042	1.4863	1.0212	0.2280	0.0254
2.0	95	53	0.0068	2.8115	1.0746	0.2520	0.0248

Shikoku Basin (from 34 15 N to 26 00 N)							
Theta		Press.	Salinity	Oxygen	Silicate	Nitrate	Phosphate
°C	Points	dbar	PSS-78	mol/kg	mol/kg	mol/kg	mol/kg
1.2	7	135	0.0015	0.8268	0.5752	0.0810	0.0059
1.4	19	84	0.0011	0.5234	0.6193	0.1488	0.0094
1.6	20	73	0.0016	1.0444	0.6171	0.1430	0.0135
1.8	21	68	0.0015	1.0064	0.6370	0.2386	0.0186
2.0	21	64	0.0014	1.6617	0.6697	0.1610	0.0146

Transient Area (from 26 00 N to 24 00 N)							
Theta		Press.	Salinity	Oxygen	Silicate	Nitrate	Phosphate
°C	Points	dbar	PSS-78	mol/kg	mol/kg	mol/kg	mol/kg
1.2	5	84	0.0014	0.3961	0.2042	0.0911	0.0042
1.4	5	37	0.0017	0.5051	0.4202	0.0874	0.0096
1.6	5	32	0.0005	1.6340	0.2598	0.0830	0.0086
1.8	5	34	0.0019	1.1954	0.6554	0.0591	0.0133
2.0	5	30	0.0036	2.1174	0.6255	0.0813	0.0123

West Mariana Basin (from 24 00 N to 08 20 N)							
Theta		Press.	Salinity	Oxygen	Silicate	Nitrate	Phosphate
°C	Points	dbar	PSS-78	mol/kg	mol/kg	mol/kg	mol/kg
1.2	30	94	0.0006	0.6649	0.6934	0.1368	0.0185
1.4	31	81	0.0010	1.0329	0.9236	0.1668	0.0155
1.6	31	57	0.0011	1.5957	1.0965	0.1441	0.0196
1.8	33	45	0.0014	1.3663	1.0321	0.1503	0.0194
2.0	33	51	0.0025	1.5907	0.7925	0.1521	0.0162

West Caroline Basin (from 08 20 N to 02 00 N)							
Theta		Press.	Salinity	Oxygen	Silicate	Nitrate	Phosphate
°C	Points	dbar	PSS-78	mol/kg	mol/kg	mol/kg	mol/kg
1.2	10	47	0.0008	0.5618	0.6337	0.1733	0.0236
1.4	15	35	0.0008	0.6066	0.6293	0.2133	0.0268
1.6	19	29	0.0008	0.5618	0.5614	0.2023	0.0282
1.8	20	27	0.0007	1.0387	0.9673	0.2439	0.0214
2.0	20	32	0.0008	1.4090	0.8063	0.2627	0.0198

Eauripik Ridge (from 02 00 N to 02 52 S)							
Theta		Press.	Salinity	Oxygen	Silicate	Nitrate	Phosphate
°C	Points	dbar	PSS-78	mol/kg	mol/kg	mol/kg	mol/kg
1.2	0	-	-	-	-	-	-
1.4	16	40	0.0007	0.4097	0.4273	0.1157	0.0197
1.6	20	34	0.0008	0.4800	0.4403	0.1459	0.0194
1.8	20	32	0.0010	0.4849	0.8089	0.1812	0.0234
2.0	20	33	0.0008	0.4649	0.4725	0.1392	0.0217

The P9 section crosses with P3 (1985) and P4 (1989) sections. We compared our results with the data of these sections. Its procedure is explained in the section on salinity measurements (Sec.2.1), and the results are included in Table 2.1.4. Our deep oxygen concentrations seems to well agree with the ones of P3 section, but to be 2 or 3% higher than those of P4 section.

Table 2.1.4 Comparison of water sample data between P9 and P3/P4

	Salinity	Oxygen	Silicate	Nitrate	Phosphate
Ratio (P9/P3)		1.0032	0.9843	0.9826	1.0245
Diff. (P9-P3)	0.0025				
P3 station :	P3 - 320 (24 15.40 N, 137 0.00 E)				
P9 stations:	P9 - 32 (24 30.14 N, 137 0.09 E)				
	P9 - 33 (23 59.81 N, 136 59.87 E)				
	Salinity	Oxygen	Silicate	Nitrate	Phosphate
Ratio (P9/P4)		1.0267	0.9860	1.0023	0.9958
Diff. (P9-P4)	0.0008				
P4 stations:	P3 - 26 (8 59.70 N, 136 40.10 E)				
	P3 - 27 (9 2.00 N, 136 38.50 E)				
	P3 - 28 (9 0.10 N, 137 14.90 E)				
P9 stations:	P9 - 62 (9 29.99 N, 136 59.85 E)				
	P9 - 63 (8 59.49 N, 136 59.93 E)				
	P9 - 64 (8 40.29 N, 137 0.95 E)				

2.3 Nutrient measurements (H. Kamiya and I. Kaneko)

Sampling Procedure

Nutrient samples were drawn into 10 ml polymethylpentene test tubes with screw caps. The tubes (bottles) were always handled with disposable polyethylene gloves. Each sample was collected in two bottles, one of which was immediately refrigerated as a spare in case of questionable measurement or malfunction of our analyzer. However in practice, we need not have used the spare samples throughout the P9 cruise. The Niskin bottles were filled with distilled water when we stopped observations for several days owing to bad weathers or a recess at Palau, and were washed with 0.1 molar NaOH before casts after the breaks.

Equipment and Technique

The nutrient analyses were performed using a Technicon AutoAnalyzer“-II (AA-II). We prepared the reagents and flow lines referred to the manual by L.I. Gordon et al. (13 July 1992; Draft), entitled 'An Suggested Protocol for Continuous Flow Automated Analysis of Seawater Nutrients in the WOCE Hydrographic Program and the Joint Global Ocean Fluxes Study'. However, as for phosphate and silicate analyses, we introduced the ascorbic acid method for convenience of reagent preservability. The manifolds and reagent prescriptions are shown in **Figures 2.3.1-2.3.4** for silicate, nitrate, nitrite and phosphate. Our system heated silicate and phosphate samples up to 37°C so as to keep coloration rate stable.

The analyses routinely were started within one hour after water sampling on deck. Samples were introduced to the manifolds through the cycle of 80 seconds sampling and 45 seconds washing with artificial seawater of salinity ca. 34.7. Nominal concentrations of A, B and working standards are listed in Table 2.3.1. Output from the AA-II was taken at each second by a microcomputer. For each sample, six output values were selected from ten highest values around a peak, by rejecting the two highest and lowest values, and they are averaged to yield a peak-hold value.

Table 2.3.1 Nominal concentrations of standards

	A-standard	B-standard	Working-standard
	(mol/l)	(mol/l)	(mol/l)
Silicate	99840*	1996.8	159.74
Nitrate	25000	500	40 + 1
Nitrite	12500	250	1
Phosphate	1875	37.5	3

* Three ampoules of Silica, 1000 ppm Standard“ by J.T. Baker Inc. were together diluted with 500ml water and preserved as A-standard.

Indexes of precision and accuracy

The results of comparison between duplicate/replicate samples are shown in **Table 2.3.2**. In the same manner as oxygen, duplicate samples were classified into two cases. 'Duplicate-A' is the case that samples were drawn from two bottles which had closed normally at adjacent depths. 'Duplicate-B' is the case that samples were drawn from two bottles judged that they had closed at the same depths owing to double-fires. The result of low-precision in 'Duplicate-A' during Leg-2 is similar to the one in oxygen. This supports our interpretation given in the section of oxygen measurements; i.e. owing to the mistrips, the data available for 'Duplicate-A' had been weighted to shallow layers, where gradients or fluctuations of vertical nutrient distributions are relatively large compared to the ones in the deep ocean.

Table 2.3.2 Nutrient analyses comparisons

(Unit: upper: mol/kg lower: % of full scale).

Case	Silicate	Nitrate	Nitrite	Phosphate	Num. Of data
Leg1					
Replicate	0.227 (0.16)	0.102 (0.24)	0.004 (0.42)	0.008 (0.27)	260
Duplicate-A	0.244 (0.17)	0.075 (0.18)	0.003 (0.28)	0.005 (0.17)	19
Duplicate-B	0.292 (0.20)	0.100 (0.24)	0.003 (0.29)	0.009 (0.30)	94
Leg2					
Replicate	0.370 (0.25)	0.137 (0.33)	0.005 (0.45)	0.011 (0.38)	295
Duplicate-A	0.559 (0.38)	0.165 (0.38)	0.005 (0.48)	0.017 (0.56)	66
Duplicate-B	0.413 (0.28)	0.098 (0.23)	0.005 (0.47)	0.013 (0.45)	89
Full Scale	146	42	1	3	(mol/kg)

As is explained in the section of salinity measurements, scattering of nutrient concentrations at the constant potential temperatures is used for another estimate of precision. **Table 2.1.3** includes the standard deviations for the difference between nutrient concentrations interpolated at the potential temperatures and a least squares linear-fit to their values.

Table 2.3.3 Nutrient laboratory temperatures for each station.

Leg	Station		Date	Time.	Temp	Leg	Station		Date	Time	Temp.
	P9	Ry					P9	Ry			
			ddmmyy	(UT)	(C)				ddmmyy	(UT)	(C)
1	1	8633	080794	1740	28.2	2	61	8686	030894	0633	27.5
1	2	8634	080794	2034	28.3	2	60	8687	030894	1200	28.0
1	3	8635	080794	2246	27.8	2	59	8688	030894	1823	27.0
1	5	8637	090794	0435	28.3	2	58	8689	030894	1935	26.7
1	7	8639	090794	1230	28.5	2	57	8690	050894	0541	26.9
1	9	8641	090794	2126	28.0	2	56	8691	050894	1330	27.5
1	10	8642	100794	0515	29.5	2	55	8692	050894	1825	27.4
1	11	8643	100794	1230	29.8	2	54	8693	060894	0250	29.3
1	13	8645	100794	2117	27.3	2	62	8694	070894	0200	28.0
1	15	8647	110794	0505	28.5	2	63	8695	070894	0740	29.0
1	16	8648	110794	1350	28.5	2	64	8696	070894	1400	28.5
1	17	8649	110794	1745	27.9	2	65	8697	070894	1656	27.5
1	18	8650	120794	0120	27.8	2	66	8698	070894	2100	28.6
1	19	8651	120794	0805	27.8	2	67	8699	080894	0256	28.9
1	20	8652	120794	1325	26.8	2	68	8700	080894	0505	29.3
1	21	8653	120794	1937	27.7	2	69	8701	080894	1300	28.5

Leg	Station		Date	Time.	Temp	Leg	Station		Date	Time	Temp.
	P9	Ry	ddmmyy	(UT)	(C)		P9	Ry	ddmmyy	(UT)	(C)
1	22	8654	130794	0400	29.0	2	70	8702	080894	1941	28.5
1	23	8655	130794	1005	29.0	2	71	8703	090894	0030	28.8
1	24	8656	130794	1640	28.5	2	72	8704	090894	0930	28.8
1	25	8657	130794	2156	27.8	2	73	8705	090894	1502	28.1
1	26	8658	140794	0821	29.1	2	74	8706	100894	0750	28.3
1	27	8659	140794	1700	29.2	2	75	8707	100894	0509	28.2
1	28	8660	150794	0040	28.5	2	76	8708	100894	0750	29.1
1	29	8661	150794	0710	28.5	2	77	8709	100894	1638	28.1
1	30	8662	150794	1800	28.2	2	78	8710	100894	2130	28.5
1	31	8663	150794	2248	28.4	2	79	8711	110894	0910	29.0
1	32	8664	160794	0745	28.9	2	80	8712	110894	1300	28.5
1	33	8665	160794	1320	29.8	2	81	8713	110894	1630	28.5
1	34	8666	160794	2146	27.7	2	82	8714	120894	0130	28.9
1	35	8667	170794	0600	29.0	2	83	8715	120894	0502	28.7
1	36	8668	170794	1430	28.8	2	84	8716	120894	0850	28.9
1	40	8669	210794	0412	28.2	2	85	8717	120894	1230	28.3
1	39	8670	210794	1700	28.8	2	86	8718	120894	1920	28.3
1	38	8671	220794	0100	27.8	2	87	8719	130894	0000	28.8
1	37	8672	220794	0940	26.6	2	88	8720	130894	0400	28.5
1	41	8673	230794	0410	29.9	2	89	8721	130894	0805	28.7
1	42	8674	230794	1300	29.4	2	90	8722	130894	1500	28.0
1	43	8675	230794	1846	28.9	2	91	8723	130894	1811	27.6
1	44	8676	240794	0130	28.5	2	92	8724	140894	0200	28.9
1	45	8677	240794	0803	27.8	2	93	8725	140894	0416	28.4
1	46	8678	240794	1705	28.8	2	94	8726	150894	0230	28.0
1	47	8679	240794	2300	29.2	2	95	8727	150894	0830	29.0
1	48	8680	250794	0710	29.3	2	96	8728	150894	1000	28.8
1	49	8681	250794	1400	28.8	2	97	8729	150894	2000	28.8
1	50	8682	250794	2223	27.6	2	98	8730	150894	2230	28.9
1	51	8683	260794	0600	28.0	2	99	8731	160894	0400	28.0
1	52	8684	260794	1230	29.3	2	100	8732	160894	0800	29.0
1	53	8685	260794	2050	27.3	2	101	8733	160894	1430	29.0
						2	102	8734	160894	000	8.9
						2	103	8735	170894	0230	9.2
						2	104	8736	170894	0800	9.5
						2	105	8737	180894	0045	8.3
						2	92	8738	180894	1827	8.0

The P9 section crosses with P3 (1985) and P4 (1989) sections. We compared our results with the data of these sections. Its procedure is explained in the section of salinity measurements (Sec.2.1), and the results are included in [Table 2.1.4](#). Our silicate and nitrate concentrations are ca. 2% lower than the P3 data, while our phosphate concentrations are 2% higher. As for the comparison with the P4 data, our nitrate and phosphate concentrations well agree with them, but the silicate concentrations are 1 or 2% lower, which level is close to the one obtained in the comparison with the P3 silicate data.

Laboratory temperatures at the measurements are indispensable for the concentration conversion from volumetric units to mass units. They are given in [Table 2.3.3](#).

2.4 CFC-11 and CFC-12 measurements (M. Tamaki and I. Kaneko)

Equipment and Technique

Concentrations of the dissolved chlorofluorocarbons (CFCs) F-11 and F-12 were measured by shipboard electron-capture (ECD) gas chromatography, according to the methods described by Bullister and Weiss (1988). Our extraction and analysis system was assembled by GL Science Corp. The ECD Gas chromatograph is Hitachi Corp., Model 263-30. The CFC measurements were carried out as a collaboration between the Japan Meteorological Agency and Tokai University. A total of 351 water samples were analyzed for CFCs. Replicate samples were taken at 200 m depth of nine stations.

Sampling Procedure and Data Processing

We used a 2.5Lx24 rosette system for water sampling. The rosette bottles were designed by Dr. J. Bullister so that sampled water is hard to be contaminated with CFCs contained in materials of the bottles, and were made at the factory of NOAA/PMEL.

On board sampling for the CFCs were usually carried out in the third cast. CFC samples were always drawn firstly by using 50 ml glass syringes. The samples were injected in the system and processed within 12 hours after sampling. Approximately 20 ml of samples was flushed, and 30 ml was transferred to the stripping chamber.

Calibration curves used for determining CFC concentrations are generated by multiple injections of known volumes of standard gas. However, at Stas. 9 (Ry8641) and 15 (Ry8647) in the beginning of the first leg, the volume of standard gas sample loop included in our system was so large that the amounts of F-11 and F-12 injected in one aliquot of standard exceed those contained in 30 ml surface seawater samples. As linear regressions to only two data, system blank and one aliquot of standard, had to be used for determining CFC concentrations at these stations, quality of the concentration data is not high, especially for the sample at deep layers. Before the third CFC station, Sta. 18 (Ry8650), we replaced the gas sample loop with a smaller one. For the stations south of Sta. 18 at 31°00'N, the curves were adequately obtained by least-square fittings of quadratic polynomials to five calibration data, from system blank to four aliquots of standard. The data at these two stations are, therefore, assigned a value of 3 for the quality bytes in our .SEA file, even in the case of good sampling and analysis.

Sample blanks

At the factory of NOAA/PMEL, the bottles were tested individually for CFC contamination. They generally had F-11 and F-12 blanks of about 0.005 pmol/liter/hour for water stored inside (J. Bullister, 1994; personal communication). The bottles were wrapped with blank paper, stored in a box of plain wood, and sent by air from Seattle to Tokyo.

Owing to many circumstances, we had no chance to measure the sample blank of F-11 and F-12 for each bottle in the beginning of the cruise. The sample blank for each bottle were finally measured at Sta. 79 (Ry8711; 3 43N, 140 17E) during the second leg, by sampling deep water at 1500m depth. No bottle seriously contaminated was found for F-11 and the mean and standard deviation of sample blanks were $0.015+0.003$ pmol/kg. However, as for F-12, very high concentrations, of which mean and standard deviation were $0.167+0.095$ pmol/kg, were obtained. The values of F-12 measurements sampled in the deepest layer had varied largely from station to station and often exceeded the level of 0.1 pmol/kg. A o-ring used in the connection of the glass stripping chamber was suspected of being a contamination source, but we could not replace it with other materials during the cruise.

As the other estimates of the blanks, the mean concentrations of CFCs measured south of 10 N in the layers deeper than 1250m were calculated. The mean and standard deviation of the F-11 measurements was $0.014+0.006$ pmol/kg, which is close to the result at Sta. 79. Those of F-12 measurements, $0.112+0.042$ pmol/kg, were considerably large. After all, we adopted these mean values as the sample blanks throughout the cruise. These blanks were subtracted from the measurement values of F-11 and F-12. Judging from the unacceptable large value and fluctuation of F-12 measurements in the deep ocean, all of the F-12 data are assigned a value of 3 or 4 for the quality byte in our 49RY9407.SEA file.

Precision

The reproducibility was estimated from replicate analyses of 200m-depth water at nine stations. It is about 1.3% for F-11 and 5.8% for F-12. Quality of the F-12 data is far from that of the WHP requirements.

Standard Gas

A standard gas used in our cruise was made by Nippon Sanso Inc. Concentrations of F-11 and F-12 contained in our standard gas were calibrated with the standard of University of Tokyo (UT) on Nov. 1 of 1994, about two month after the P9 cruise. F-11 and F-12 concentrations of our standard gas were $288.5+1.8$ pptv and $485.3+3.0$ pptv, respectively. We used these values to calculate the F-11 and F-12 concentrations of seawater sample obtained in the P9 cruise.

Both UT and SIO calibration scales were compared with the scale employed in the ALE/GAGE program. According to the result (Table 1.2.1 in the report ed. by J.A. Kaye et al., 1994), our data can be converted to the level of data referred to SIO scale by multiplying our data by 1.02 for F-11, 1.01 for F-12.

2.5 CTD/O Measurements (Y. TAKATSUKI)

Calibration and Standards

The CTDs used during Ry9407 cruise are Triton ICTDs“, which are manufactured by Falmouth Scientific Instruments Inc. (FSI). CTD #1316 was used at the hydrographic stations from Sta. 1 (Ry8633) to Sta. 69 (Ry8701), till its temperature circuit broke down at

the second cast of Sta. 69. We replaced CTD #1316 with CTD #1318 and used it until the last cast of the cruise at Sta. 92 (re-occupation; Ry8738). All of temperature, conductivity and pressure sensors are manufactured by FSI while the oxygen sensor by Beckman Inc.

As CTD #1318 was a new device delivered to JMA several days before the departure, we had no chance for pre-cruise calibration of its sensors. We had to regard CTD #1318 as being adequately adjusted by FSI. Fortunately, a Triton ICTD is the type that the sensor outputs are corrected by calibration tables written in a PROM of internal circuit. On the basis of the results of post-cruise calibrations and on-board check of the sensors by using the RTMs and RPMs, we determined reasonable processing methods of the data obtained by CTD #1318.

FSI claims a resolution of 0.0001°C and an accuracy of $+0.003^{\circ}\text{C}$ for the platinum temperature sensors. Post-cruise calibrations of CTD #1318 at FSI showed a trivial difference of CTD temperature from the standard, 0.00038°C at 0.5°C and 0.00111°C at 29°C (Figure 2.5.4). However, as for CTD #1316, the post-cruise temperature calibrations after the temporary repairs showed an extraordinary drift, of which values were no longer available for the data processing. The situation and correction method of this temperature drift are described in the section for CTD calibration constants.

The CTD pressure sensors, of which type is the one consists of titanium diaphragm and strain-gage, have a resolution of 0.1 dbar and an accuracy of $+0.03\%$ of full scale, according to the manual by FSI. Pre- and post- cruise calibrations for CTD #1316 and a post-cruise calibration for CTD #1318 were carried out in JMA by using a Budenberg“ Model 380D dead-weight tester with 'class-A' certificated weights. The pair of calibrations detected a minute drift about 0.2 dbar in average for CTD #1316 (Figures 2.5.1a and 2.5.1b). Condition of the pressure sensors during the cruise can be monitored to some extent through comparisons of CTD pressures with RPM pressures at the time the water bottle is tripped. Any drift exceeding a nominal precision of RPM was not detected for the two CTDs.

Pre- and post- cruise calibrations of the conductivity sensors were not carried out because we could not find the facility in Japan. The calibration constants used were calculated from a fit to the salinities measured from the water samples collected at each station. Statistical analysis of the difference between the CTD and water-sample salinities showed a standard deviation less than 0.0014 in the deep water (>2000 m; Table 2.5.1).

Table 2.5.1 Standard deviation of salinity difference between CTD and water sampling.

Station:Sta. 1 (Ry8633) - Sta. 69 (Ry8701), Cast-1

All data			Not flagged data	
Layer	S.Dev.	Num. of data	S.Dev.	Num. of data
all	0.0176	2272	0.0175	2257
>1000m	0.0038	1024	0.0017	1010
>2000m	0.0038	700	0.0014	691
>3000m	0.0047	450	0.0014	442
>4000m	0.0065	210	0.0013	206

Station:Sta. 69 (Ry8701), Cast-2 - Sta. 92 (Ry8738)

All data			Not flagged data	
Layer	S.Dev.	Num. of data	S.Dev.	Num. of data
all	0.0224	1243	0.0214	1238
>1000m	0.0105	526	0.0018	522
>2000m	0.0130	330	0.0013	326
>3000m	0.0174	152	0.0011	150
>4000m	0.0115	36	0.0009	35

The oxygen sensor mounted on CTD #1316 was also calibrated with shipboard oxygen measurements from the water samples collected at each station. Oxygen measurements by CTD have been discontinued at Sta. 69, where CTD #1316 was replaced by the other CTD, #1318. The oxygen sensor used on CTD #1316 did not work on CTD #1318 because its inside circuit did not adapt to the new CTD.

CTD Data Collection and Processing

The RS-232C signal from a FSI 1050 deck terminal was taken by a Compaq Deskpro“ PC to log and process data. The CTD data at down- and up- casts were fully logged in real time to the RAM disk, and were copied to MO disks after CTD recovery. Data were processed on the Compaq Deskpro with the software programmed by the members of Nagasaki Marine Observatory, according to the method by Millard (1993).

A time-constant difference between the temperature and conductivity sensors, which is necessary for salinity despiking, was determined so as to minimize fluctuations of salinity profile (Kawabe and Kawasaki, 1993).

CTD Calibration Constants

Pressure

The results of pre-/post- cruise calibrations for CTD #1316 and a post-cruise calibration for CTD #1318 are shown in [Figures 2.5.1](#) and [2.5.2](#), respectively. The comparison between the pre-cruise and post-cruise calibrations for CTD #1316 indicated that its pressure drift was about 0.2 dbar, of which effect on salinity error is negligible. Hence, so as to obtain the calibration constants for CTD #1316, the pre-cruise calibration data was used for a polynomial fit. For the data obtained by CTD #1318, a polynomial fit to the post-cruise calibration was applied because of the lack of pre-cruise calibration data. Any serious

pressure drift of CTD #1318 had not been detected with the bottle-mounted RPMs though their precision is lower than that of CTDs.

The calibration constants are tabulated in Table 2.5.2. Although the pressure differences between the increasing and decreasing curves owing to sensor hysteresis are not more than 1 dbar for both the CTDs, a technique known as exponential decay feathering (Millard, 1991) is introduced to adjust between the two curves.

Table 2.5.2 Pressure calibration constants

CTD #1316, Pre-cruise, 0-6000 dbar range		
	Increasing	Decreasing
	(Linear fit)	(Cubic fit)
Bias	0.101671	0.030432
Slope	0.999808	0.999893
Coef.1	0	-1.06871E-7
Coef.2	0	1.65002E-11

CTD #1318, Post-cruise, 0-6000 dbar range		
	Increasing	Decreasing
	(Cubic fit)	(Cubic fit)
Bias	0.118827	-0.360069
Slope	0.999365	0.999221
Coef.1	9.79631E-8	9.982900E-8
Coef.2	-1.60597E-11	-1.014070E-11

Temperature

The results of the pre-cruise calibration for CTD #1316 and the post-cruise calibration for CTD #1318 are shown in [Figures 2.5.3](#) and [2.5.4](#), respectively. The calibration constants are listed in Table 2.5.3.

Table 2.5.3 Temperature calibration constants

CTD #1316, Pre-cruise, 0-30°C range	
Quadratic fit	
Bias	-0.0108521
Slope	0.999385
Coef. 1	1.33467E-5

CTD #1318, Post-cruise, 0-30°C range	
Quadratic fit	
Bias	-0.000325853
Slope	1.00014
Coef. 1	-5.66299E-6

A temperature drift of CTD #1316 before its breakdown had been detected with seven RTMs mounted on the Niskin bottles. As an example, [Figure 2.5.5](#) shows a time-series of

temperature difference between CTD #1316 and RTM #T759. The drift began at Ry8686 (Sta. 61) and reached -0.02°C at Ry8700 (Sta. 68), one station before the breakdown. The mean of drift during this period is estimated at -0.008°C from the comparison between the CTD and seven RTMs. We, therefore, processed the CTD temperature as follows:

1. The constants obtained from the pre-cruise calibration for CTD #1316 is applied to correct the data of Leg-1, because any so large drift as to exceed 'WHP standards for CTD sensors' was not recognized through the monitoring with RTMs from Ry8633 to Ry8685 (Sta. 1-53).
2. The data at the stations from Ry8686 to the first cast of Ry8701 (Sta. 61-54 & Sta. 62-69) were processed in the same way as the data of Leg-1, and then, they were added by a constant value of +0.008°C.
3. Despite of the data correction above, a flag '3' (Questionable measurement) was assigned to the data at the stations from RY8696 to the first cast of Ry8701 (Sta. 64-69). This is because the drift at these station was so large that we could not corrected it adequately.
4. The constants obtain from the post-cruise calibration for CTD #1318 was applied to correct the data at the stations from the second cast of Ry8701 to Ry8738 (Sta. 69-105 & the reoccupation of Sta. 92).

The level of temperature differences between RTMs and CTDs is classified in three categories, CTD #1316 in Leg-1, CTD #1316 in Leg-2 and CTD #1318, and are compared in Table 2.5.4. The table indicates that the level of CTD temperature hardly changed before and after the replacement from CTD #1316 to CTD #1318 (see [Figure 2.5.5](#)).

Table 2.5.4 Difference between CTD and RTM temperatures obtained below 2000m depth

**Leg-1 Sta. 1- 53 (Ry8633-8685)
CTD #1316**

RTM#	T662	T710	T754	T755	T759	T760	T777
Mean (1)	-0.0029	-0.0021	-0.0038	-0.0032	-0.0045	-0.0036	0.0044
S.Dev.	0.0015	0.0022	0.0017	0.0023	0.0039	0.0015	0.0027
N.D.	38	31	38	23	39	41	31

**Leg-2a Sta. 61- 68 (Ry8686-8700)
CTD #1316**

RTM#	T662	T710	T754	T755	T759	T760	T777
Mean (2a)	0.0061	0.0035	0.0037	0.0033	0.0035	0.0039	0.0123
S.Dev.	0.0038	0.0016	0.0020	0.0005	0.0039	0.0014	0.0027
N.D.	16	13	15	7	16	10	13
Diff.							
(2a)-(1)	0.0090	0.0056	0.0075	0.0065	0.0079	0.0075	0.0079

**Leg-2b Sta. 69- 105, 92 (Ry8701-8738)
CTD #1318**

RTM#	T662	T710	T754	T755	T759	T760	T777
Mean (2b)	-0.0012	-0.0070	-0.0088	-0.0029	-0.0044	-0.0029	0.0051
S.Dev.	0.0020	0.0020	0.0029	0.0013	0.0026	0.0034	0.0019
N.D.	35	31	33	25	34	20	30
Diff.							
(2b)-(1)	0.0017	-0.0049	-0.0050	0.0003	0.0001	0.0007	0.0007

Conductivity

As mentioned above, we could not carry out pre- and post- cruise calibrations of the conductivity sensors. The bias was assumed in advance, and then, the slope was determined from a linear-fit to the salinities measured from the water samples collected at each station. The scaling factors finally adopted for the data processing are listed in Table 2.5.5.

Table 2.5.5 Conductivity scaling factors

Station		CTD No.	Bias	Slope
1 -4	(Ry8633-8636)	#1316	0.0150	0.999852
5 - 11	(Ry8637-8643)	#1316	0.0150	0.999690
12 - 21	(Ry8644-8653)	#1316	0.0150	0.999533
22 - 36	(Ry8654-8668)	#1316	0.0150	0.999520
40	(Ry8669)	#1316	0.0150	0.999422
39, 38	(Ry8670,8671)	#1316	0.0150	0.999497
37, 41	(Ry8672,8673)	#1316	0.0150	0.999596
42 - 53	(Ry8674-8685)	#1316	0.0150	0.999546
61 - 59	(Ry8686-8688)	#1316	0.0500	0.998507
58 - 56	(Ry8689-8691)	#1316	0.0500	0.998349
55, 54, 62	(Ry8692-8694)	#1316	0.0500	0.998440
63 - 65	(Ry8695-8697)	#1316	0.0500	0.998364
66 - 68	(Ry8698-8700)	#1316	0.0500	0.998343
69 Cast1	(Ry8701 Cast1)	#1316	0.0500	0.998508
69 Cast2	(Ry8701 Cast2			
-70	-8702)	#1318	-0.0100	1.000700
71 - 93	(Ry8703-8725)	#1318	-0.0100	1.000659
94 -105, 92	(Ry8726-8738)	#1318	-0.0100	1.000641

Oxygen

The scaling factors were determined according to the method developed by Millard (WHPO91-1 manual, 1991). The values of parameters used for each station groups are listed in Table 2.5.6.

Table 2.5.6 Oxygen scaling factors (for CTD #1316)

Station	Bias	Slope	Pcor	Tcor	Wt	Lag
1-6 (Ry8633-8638)	0.142	1.828	2.507E-4	-2.129E-2	0.911	5.712
7-21 (Ry8639-8653)	0.154	1.756	1.938E-4	-2.080E-2	0.841	2.597
22-36 (Ry8654-8668)	0.164	1.968	1.578E-4	-2.462E-2	0.893	1.051
40-37 (Ry8669-8672)	0.164	1.968	1.578E-4	-2.462E-2	0.893	1.051
41-53 (Ry8673-8685)	0.165	2.450	1.471E-4	-2.974E-2	0.943	0.734
61-59 (Ry8686-8688)	0.158	2.294	1.508E-4	-2.992E-2	0.932	0.724
58-54 (Ry8689-8693)	0.172	2.229	1.475E-4	-3.003E-2	0.676	0.715
62-69 (Ry8694-8701)	0.181	2.247	1.461E-4	-2.764E-2	0.931	1.057

2.6 Helium and Tritium Sampling (T. Miyao)

Samples for Helium Isotopes Measurement

Soft annealed, refrigeration-grade 5/8" copper tubing coils were used to collect crimped tube helium samples. The copper tubing was cut into 2' lengths and immediately placed plastic caps on both ends. Each tube was marked at the center and 2" from each end. Consequently, each 10" section between the center mark and the end mark was partially flattened. The sampling tubes were prepared by each arrival at sampling station.

Helium sampling always followed that for CFCs which started just after the rosette is on deck. To draw a sample, a pair of Tygon tube with pinch clamp was attached to the both ends of a sampling tube and one end was connected to the spigot on the Niskin bottle. Then the valve was opened to establish sample flow. The sampling tube was pounded during the flushing period to eliminate air bubbles. After purging air bubbles, the downstream clamp was closed first, and then the upstream one.

Immediately, the sample tube was crimped first at the end mark on one side, then at the center mark, finally at another end mark. Thus, two replicate crimped samples were taken. Each sample was re-rounded so that the inner pressure can be reduced. The crimped samples were carefully rinsed with fresh water. After towel drying, the samples were stored in foam-lined cardboard boxes.

A total of 521 pairs of samples were taken from seasurface to deep layer at 25 stations. It was found, however, that 9 sample tubes might contain some air bubbles. Thus, 512 pairs of complete samples might be successfully obtained during Ryofu-Maru WOCE P9 cruise.

Samples were sent to the laboratory of Dr. John Lupton, NOAA MRRD. They will then be shipped in flame-sealed glass ampoules to L-DEO for mass spectrometric measurement. The He-3/He-4 ratio with a precision of about +/-0.2 percent or better and the He-4 concentration with a precision of about +/-0.5 percent will be reported in two years or so.

Samples for Tritium Measurement

The 1 liter tape-sealed flint glass bottles, pre-baked for a few hours at about 180°C in an argon-atmosphere and put screw caps with polyethylene cones on, were used for tritium sampling.

Tritium sampling followed that for another elements but salinity. The sealed bottles were untaped and opened just before sample drawing. Sample was carefully led into the bottle with pre-soaked plastic tubing, not to . Each sample bottle was filled to within a cm or two of the top without rinse procedure. The sample bottle was immediately replaced with a cap, then tape-sealed, wrapped up with cushion sheet and stored in wooden box.

A total of 425 samples were taken from upper 1500m layer at 25 stations. However, sample volume was small for 4 bottles, and 2 bottles were overflowed.

Samples were sent to the laboratory of Dr. Peter Schlosser, Lamont-Doherty Earth Observatory of Columbia University. Then the samples for He-3 ingrowth from tritium decay will be flame-sealed after gas extraction. After a storage time of 6 to 9 months, the tritium concentration will be determined by mass spectrometric measurement of the tritogenic He-3. Precision of these measurements will be approximately +/-1 to +/-2 percent and the detection limit will be below 0.01TU. The results will be reported in two years or so.

2.7 Carbon-14 of the total dissolved inorganic carbon

(M. Ishii)

16 June 1995

Equipment and Technique

Carbon-14 isotopic ratio of the total dissolved inorganic carbon was analyzed using the AMS facility at the Institute of Geological and Nuclear Sciences Limited at Lower Hutt, New Zealand, which is based on a 6MV EN tandem Van de Graaff accelerator and uses a Chapman-type inverted sputter source with graphite targets produced by direct deposition (G. Wallace et al. 1987)

Sampling Procedure

Subsamples for carbon-14 of the total dissolved inorganic carbon analyses were collected after those for the concentration of the total dissolved inorganic carbon. Subsamples were drawn into 120 cm³ glass bottles carefully (i.e., no bubbles, low turbulence) after the bottles had been rinsed three times with approximately one forth of their volume and overflowed with at least half their volume. Then 0.2 cm³ of saturated HgCl₂ solution was added and rubber cap lubricated with Apiezon H grease was clamped with aluminum cap. These samples were stored at room temperature.

In the laboratory on land, CO₂ was extracted from the seawater samples using a vacuum line. A 300 cm³ flask in which 2 cm³ of conc. phosphoric acid and a magnetic stirring bar were put was attached to the vacuum line and evacuated. Then a seawater sample was sucked into the flask. The evolved CO₂ was purified by the cryogenic distillation using

electric cooler of -65 degree C and liquid nitrogen, and sealed in a 9 mm o.d. glass break-seal-tube.

Those CO₂ samples were sent to the Institute of the Geological and Nuclear Sciences Limited, where graphite targets for AMS were prepared using excess H₂ and an iron catalyst (D.C. Lowe et al., 1987).

Status

Delta-C¹⁴ analyses for 140 samples have been finished so far and their mean uncertainty is +/- 7.9 per mille.

2.8 Total dissolved inorganic carbon analyses (M. Ishii)

Equipment and Technique

Total dissolved inorganic carbon analyses were performed using a commercially available coulometer (UIC Inc., Model 5012) and hand-made automated CO₂ extraction unit. Sample bottles to be analyzed were placed in a temperature-controlled water bath (20.0 +/- 0.1 degree C) at least 30 minutes before analysis. Seawater subsamples were delivered to the carefully precalibrated pipette bulb with water jacket on the CO₂ extraction unit at 20.0 +/- 0.1 degree C by pressurizing the sample with nitrogen gas. The pipette was flushed with approximately 2 volumes of sample. Approximately 3 cm³ of 10% phosphoric acid was poured into the stripping chamber and was purged for 2 minutes with CO₂-free nitrogen gas treated with Ascarite before the coulometer reading was reset and the sample in the pipette was loaded into the stripping chamber. The carrier nitrogen gas containing the evolved CO₂ was dried with an electric desiccant unit, magnesium perchlorate and silica gel before entering the titration cell of the coulometer. The acidified sample was allowed to purge for 12 minutes.

The coulometer blank was determined once every 2 or 3 hours by allowing approximately 3 cm³ of pre-purged phosphoric acid to be purged with CO₂-free nitrogen gas for 12 minutes. It was 0.49 +/- 0.28 ugC/12 minutes (n=115).

Concentrations of the total dissolved inorganic carbon were calculated according to DOE (1994).

Sampling Procedure

Subsamples for total dissolved inorganic carbon analyses were collected immediately after those for dissolved oxygen as soon as the rosette arrived on deck. Subsamples were drawn into 300 cm³ borosilicate glass reagent bottles carefully (i.e., no bubbles, low turbulence) after the bottles had been rinsed three times with approximately one fourth of their volume and over flowed with at least half their volume. Samples were stored in boxes at room temperature and analyses were completed within 15 hours after the rosette reached the deck.

Calibrations and Standards

We used sodium carbonate solutions in order to calibrate the extraction/coulometric system. Anhydrous sodium carbonate (primary standard grade, 99.97%, Asahi glass Co.) dried at 600 degree C for 1 hour was carefully weighed in 3 cm³ vials in the laboratory on land and stored in 20 cm³ screw-capped vials with silica gel. The standard solutions were prepared in 1 dm³ volumetric flasks under CO₂-free nitrogen at 20.0 +/- 0.1degree C using deionized water prepared by a MILLI-Q.SP.TOC. (Millipore Co.) system. These standards were run immediately in order to avoid errors due to the absorption of atmospheric CO₂. Recovery (calibration factor) was calculated as 99.244%.

We assessed accuracy by analyzing Certified Reference Materials for total dissolved inorganic carbon provided by Dr. A. G. Dickson at Scripps Institution of Oceanography (batch #20;1983.40 +/- 1.59 (1s) mol/kg (n=13)) once every run. The mean of the results for the CRM analyses during this cruise was 1982.3 +/- 1.3 (1s) mol/kg (n=23). The means agreed at the 98% confidence level but disagreed at the 95% confidence level. Data presented are not corrected for the probable systematic error.

We monitored precision by analyzing duplicate samples taken from the same Niskin bottle and by taking duplicate samples from Niskin bottles tripped at the same depths. The mean of the absolute difference of duplicate analyses from the same Niskin bottle, shown in Table 2.8.1, was 1.2 mol/kg near surface and increased to 2.2 mol/kg in deep layers. The standard deviation estimated for the 10m - 75m layer and that for the 3250m - 4750m layer are significantly different at the 95% confidence level. The mean of the absolute difference of duplicate analyses from the different Niskin bottles was 2.0 mol/kg. All data for duplicate analyses from the same bottle and from different bottles are tabulated in Tables 2.8.2 and 2.8.3, respectively.

Table 2.8.1: Mean of the absolute value of the difference between duplicate analyses from the same Niskin bottle.

Layer	Mean of the absolute difference in mol/kg	Estimate of the standard deviation	Number of analyses
10m -75m	1.2	1.0	20
500m - 700m	1.5	1.2	6
1000m - 2250m	1.7	1.4	18
3250m - 4750m	2.2	1.8	11
Total	1.6	1.4	55

Table 2.8.2: All data for duplicate analyses from the same Niskin bottle.

STN	Cast	BTL	Depth m	TCARBN mol/kg	average mol/kg	difference mol/kg
RY-8642	1	23	75	1965.9	1964.8	2.0
				1963.8		
RY-8642	2	13	1249	2345.0	2346.1	2.2
				2347.2		
RY-8647	1	3	75	1969.0	1969.9	1.7
				1970.7		
RY-8647	2	21	1249	2342.3	2343.5	2.4
				2344.6		
RY-8653	1	8	25	1944.1	1944.1	0.2
				1944.0		
RY-8653	2	15	999	2317.4	2317.9	1.0
				2318.3		
RY-8653	2	4	3749	2323.6	2325.4	3.6
				2327.1		
RY-8658	2	15	1248	2346.6	2346.1	1.1
				2345.5		
RY-8663	1	16	50	1959.6	1959.6	0.0
				1959.6		
RY-8663	2	1	1249	2350.0	2350.4	0.8
				2350.9		
RY-8663	2	13	4000	2321.6	2320.9	1.5
				2320.1		
RY-8668	1	19	10	1908.5	1908.3	0.4
				1908.1		
RY-8668	2	23	1249	2339.5	2340.4	1.9
				2341.4		
RY-8673	1	16	50	1925.1	1924.6	0.9
				1924.2		
RY-8673	2	24	1501	2340.1	2340.8	1.4
				2341.5		
RY-8673	2	12	4001	2316.6	2317.5	1.7
				2318.3		
RY-8678	1	21	25	1892.8	1892.7	0.2
				1892.6		
RY-8678	2	2	1500	2338.0	2339.4	2.9
				2340.9		
RY-8678	2	14	4252	2318.9	2320.4	2.9
				2321.9		
RY-8683	1	22	25	1891.1	1891.6	1.1
				1892.2		
RY-8683	2	5	1500	2328.3	2327.8	0.9
				2327.3		
RY-8683	2	16	4502	2311.4	2311.0	0.8
				2310.6		

STN	Cast	BTL	Depth m	TCARBN mol/kg	average mol/kg	difference mol/kg
RY-8691	3	5	49	1883.5	1882.3	2.5
				1881.0		
RY-8691	2	2	1502	2329.6	2329.7	0.1
				2329.7		
RY-8691	1	2	4504	2311.2	2311.3	0.2
				2311.4		
RY-8686	1	21	9	1872.0	1872.7	1.2
				1873.3		
RY-8686	2	3	1250	2319.9	2318.6	2.5
				2317.4		
RY-8686	2	15	4003	2317.0	2316.4	1.2
				2315.8		
RY-8698	2	6	50	1890.4	1889.2	2.4
				1887.9		
RY-8698	1	3	500	2248.8	2249.5	1.4
				2250.2		
RY-8702	1	17	50	1904.9	1904.5	0.8
				1904.1		
RY-8702	2	22	2001	2336.0	2335.1	1.8
				2334.1		
RY-8702	2	14	3754	2319.8	2321.8	3.9
				2323.7		
RY-8707	1	18	26	1866.6	1866.0	1.2
				1865.5		
RY-8710	1	18	25	1887.4	1888.6	2.4
				1889.8		
RY-8710	2	21	2252	2336.7	2338.9	4.4
				2341.2		
RY-8710	2	14	3753	2325.2	2326.8	3.1
				2328.3		
RY-8717	1	10	25	1905.6	1905.4	0.4
				1905.2		
RY-8717	1	1	500	2239.4	2238.1	2.5
				2236.9		
RY-8717	1	15	2001	2334.6	2334.7	0.1
				2334.8		
RY-8721	1	17	51	1939.2	1939.4	0.4
				1939.7		
RY-8721	2	2	701	2248.5	2248.1	0.7
				2247.7		
RY-8725	1	17	50	1899.5	1898.6	2.0
				1897.6		
RY-8725	2	19	2001	2331.0	2330.5	1.0
				2330.0		
RY-8725	2	15	3002	2327.6	2329.1	3.0
				2330.6		

STN	Cast	BTL	Depth m	TCARBN mol/kg	average mol/kg	difference mol/kg
RY-8729	1	19	25	1892.8	1891.8	2.0
				1890.8		
RY-8729	2	3	700	2255.3	2255.6	0.7
				2256.0		
RY-8733	1	19	25	1889.6	1889.8	0.5
				1890.1		
RY-8733	2	4	700	2232.8	2233.9	2.2
				2235.0		
RY-8733	2	20	2001	2332.8	2333.5	1.4
				2334.2		
RY-8735	2	23	2251	2331.1	2332.6	3.0
				2334.1		
RY-8735	2	15	3753	2328.5	2330.0	2.9
				2331.5		
RY-8737	1	9	25	1911.8	1912.3	1.0
				1912.8		
RY-8737	1	21	699	2206.5	2207.4	1.7
				2208.3		
RY-8737	1	15	1251	2307.5	2308.4	1.7
				2309.3		

Table 2.8.3: All data for duplicate analyses from different Niskin bottles tripped at the same depth.

STN	Cast	BTL	Depth m	TCARBN mol/kg	average mol/kg	difference mol/kg
RY-8642	1	20	149	2003.0	2003.3	0.7
		19	149	2003.7		
RY-8642	2	22	298	2037.5	2036.0	3.0
		21	298	2034.5		
RY-8642	2	20	499	2166.7	2167.9	2.3
		19	499	2169.1		
RY-8642	2	12	1749	2342.3	2343.1	1.6
		11	1749	2343.9		
RY-8642	2	10	2249	2337.1	2335.9	2.3
		9	2249	2334.7		
RY-8647	2	21	1249	2343.5	2342.5	2.0
		20	1249	2341.5		
RY-8653	2	21	500	2070.7	2071.5	1.6
		20	500	2072.3		
RY-8653	2	7	3249	2325.0	2326.0	2.1
		6	3249	2327.0		
RY-8658	2	21	600	2107.3	2107.0	0.5
		20	600	2106.8		
RY-8658	2	12	2249	2336.5	2338.8	4.6
		11	2249	2341.1		
RY-8658	2	6	3749	2323.6	2323.6	0.1
		5	3749	2323.6		
RY-8658	2	3	4409	2321.0	2321.3	0.7
		2	4409	2321.7		
RY-8663	2	8	499	2131.5	2132.6	2.3
		7	499	2133.8		
RY-8663	2	22	1999	2342.7	2344.1	2.7
		21	1999	2345.4		
RY-8668	2	23	1249	2340.4	2340.8	0.7
		22	1249	2341.2		
RY-8678	1	13	399	2130.8	2131.9	2.3
		12	399	2133.0		
RY-8678	2	22	2501	2336.3	2338.9	5.3
		21	2501	2341.5		
RY-8683	1	13	500	2241.8	2242.3	0.9
		12	500	2242.8		
RY-8683	2	20	3753	2322.2	2323.0	1.7
		19	3753	2323.9		
RY-8686	1	16	124	2021.4	2019.8	3.3
		15	124	2018.1		
RY-8686	2	7	699	2259.6	2259.7	0.2
		6	699	2259.8		
RY-8702	2	7	499	2242.3	2243.2	1.9
		6	499	2244.2		

STN	Cast	BTL	Depth m	TCARBN mol/kg	average mol/kg	difference mol/kg
RY-8702	2	22	2001	2335.0	2336.1	2.2
		21	2001	2337.2		
RY-8710	2	7	502	2232.8	2232.3	1.0
		6	502	2231.8		
RY-8710	2	21	2252	2339.0	2337.8	2.3
		20	2252	2336.7		
RY-8717	1	20	1000	2300.4	2302.2	3.7
		19	1000	2304.1		
RY-8729	2	7	401	2199.2	2198.8	0.8
		6	401	2198.4		
RY-8733	2	7	500	2186.2	2186.7	1.0
		6	500	2187.2		
RY-8735	2	20	3003	2333.6	2333.3	0.6
		19	3003	2333.0		
RY-8735	2	16	3753	2332.5	2330.5	4.0
		15	3753	2328.5		
RY-8737	1	20	800	2228.0	2228.6	1.1
		19	800	2229.1		
RY-8737	1	17	1000	2270.6	2268.1	4.9
		16	1000	2265.7		
RY-8737	1	14	1500	2321.3	2322.0	1.4
		13	1501	2322.7		

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Figure Captions

- Figure 1.1 WHP-P09 station locations
- Figure 1.2a Location of oxygen samples collected on WHP-P09
- Figure 1.2b Location of nutrient samples collected on WHP-P09
- Figure 1.2c Location of CFCs samples collected on WHP-P09
- Figure 1.2d Location of tritium samples collected on WHP-P09
- Figure 1.2e Location of helium-3 samples collected on WHP-P09
- Figure 1.2f Location of carbon-14 samples collected on WHP-P09
- Figure 1.3a Potential temperature section by the CTD
- Figure 1.3b Salinity section by the CTD
- Figure 2.1.1 Meridional distribution of salinity
- Figure 2.1.2 Meridional distribution of oxygen concentration
- Figure 2.3.1 Reagents and flow diagram for the silicate determination
- Figure 2.3.2 Reagents and flow diagram for the nitrate determination
- Figure 2.3.3 Reagents and flow diagram for the nitrite determination
- Figure 2.3.4 Reagents and flow, diagram, for the phosphate determination
- Figure 2.5.1a Pressure sensor difference (CTD #1316, pre-cruise)
- Figure 2.5.1b Pressure sensor difference (CTD #1316, post-cruise)
- Figure 2.5.2 Pressure sensor difference (CTD #1318, post-cruise)
- Figure 2.5.3 Temperature sensor difference (CTD #1316, pre-cruise)
- Figure 2.5.4 Temperature sensor difference (CTD #1318, post-cruise)
- Figure 2.5.5 Drift of CTD temperature referred to RTM temperature

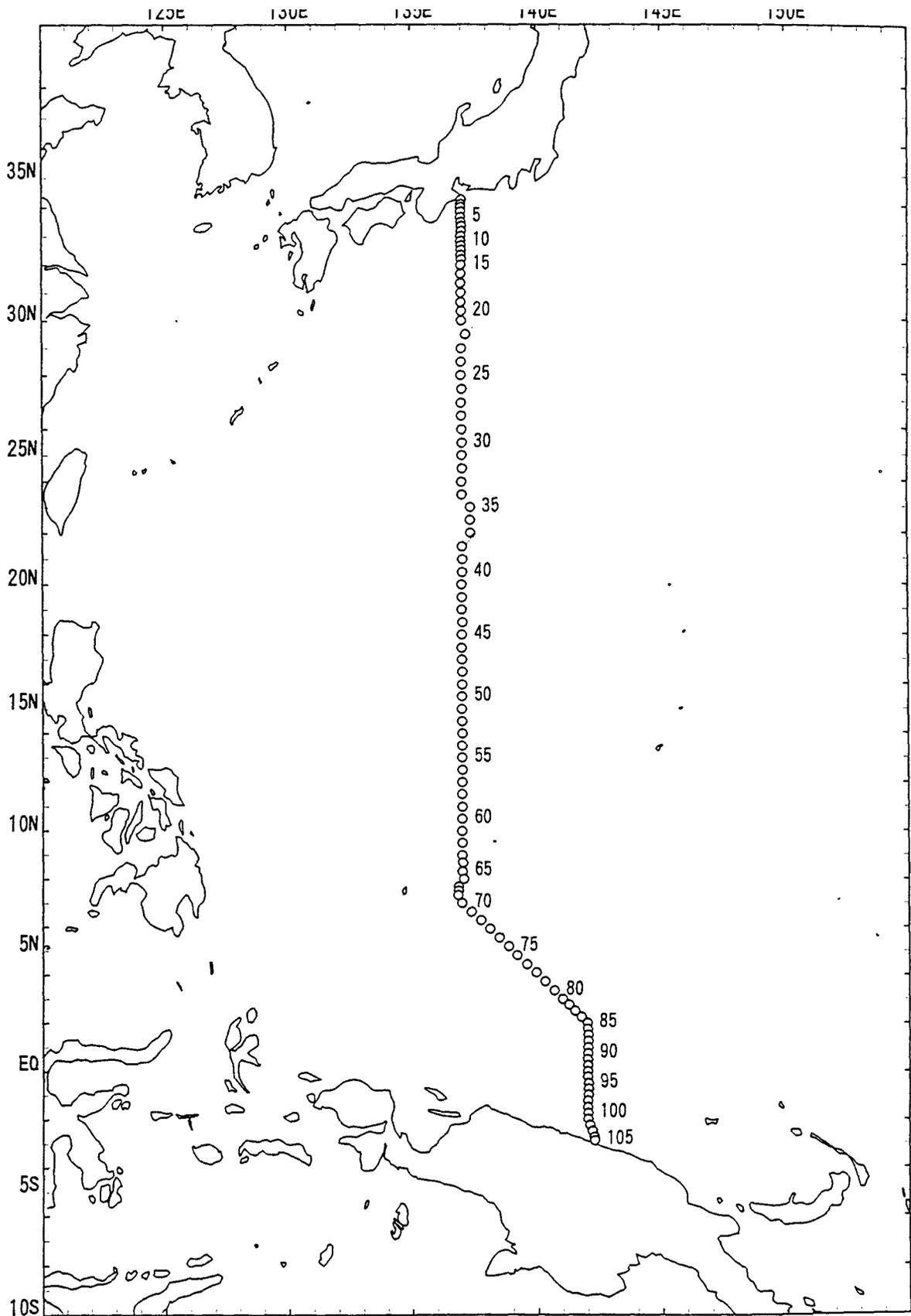


Figure 1.1

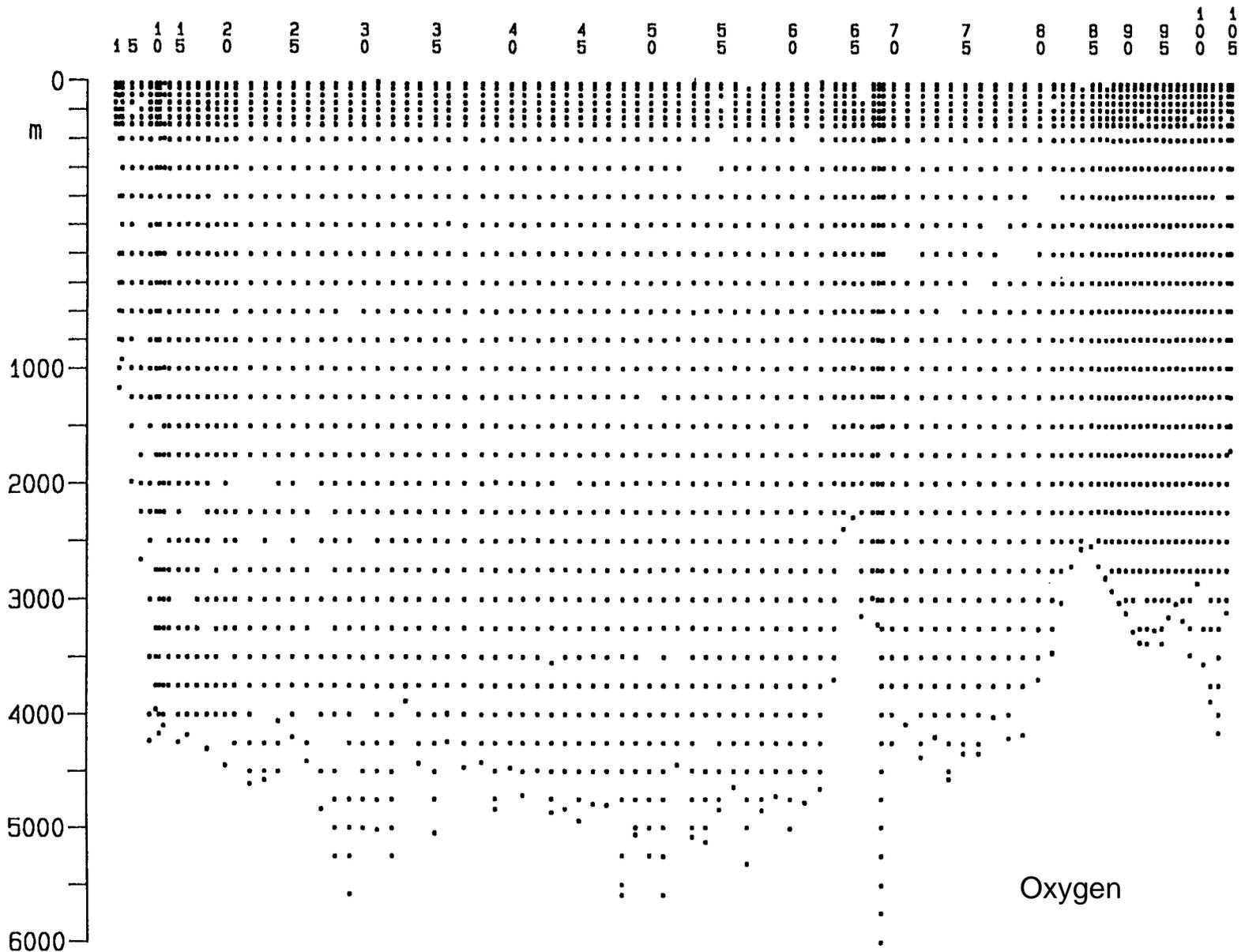


Figure 1.2a: Location of oxygen samples collected on WHP-P09

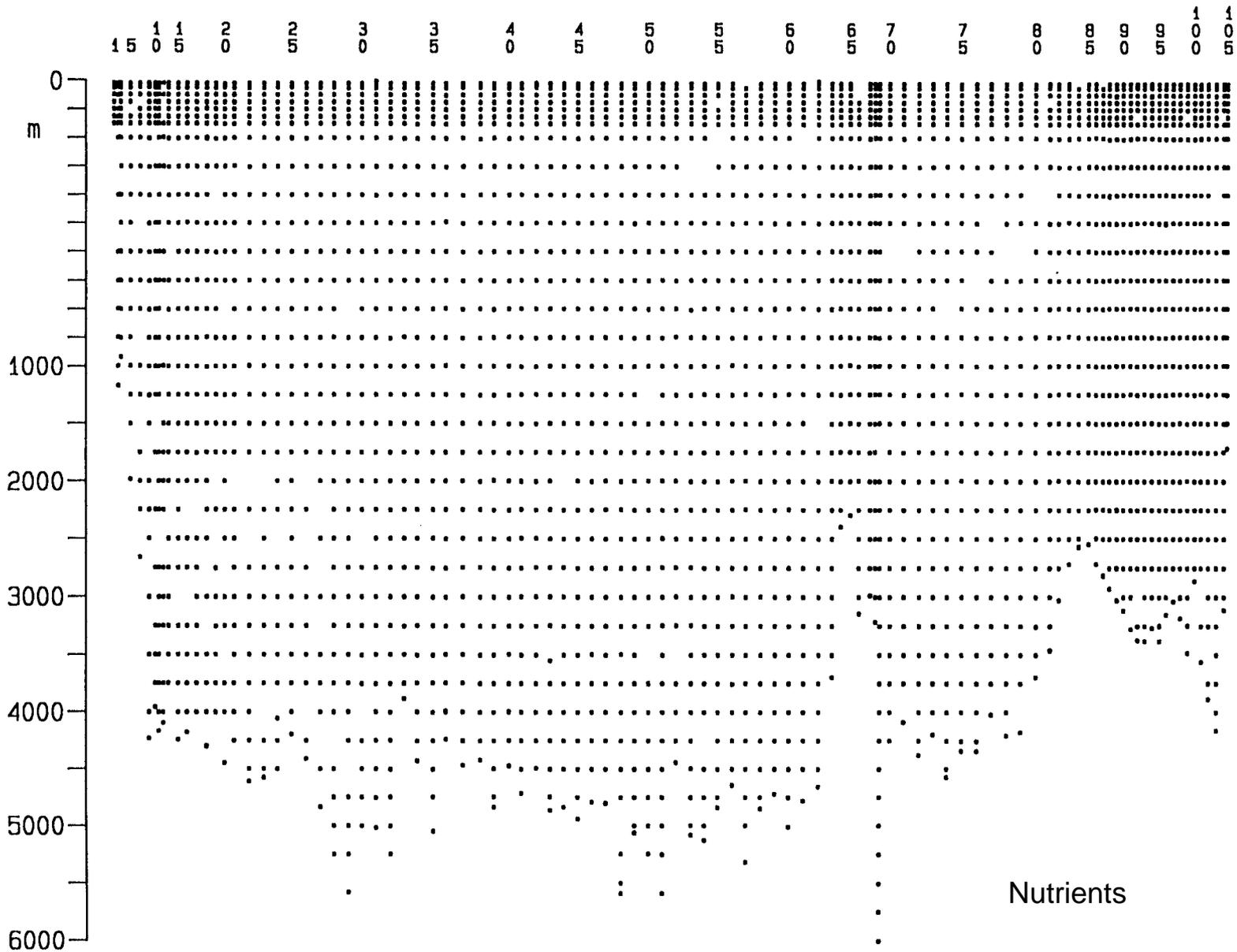


Figure 1.2b: Location of nutrient samples collected on WHP-P09

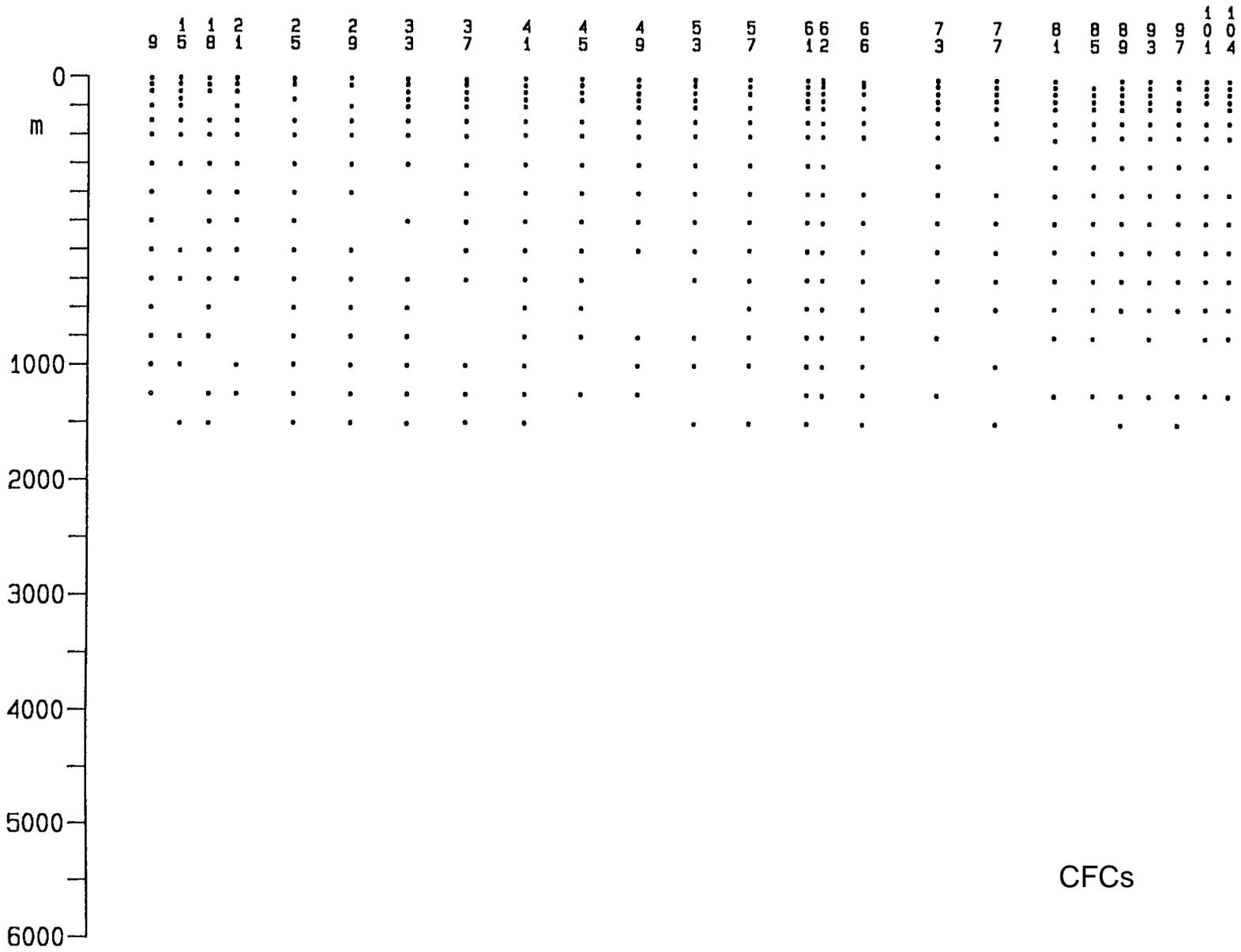


Figure 1.2c: Location of CFCs samples collected on WHP-P09

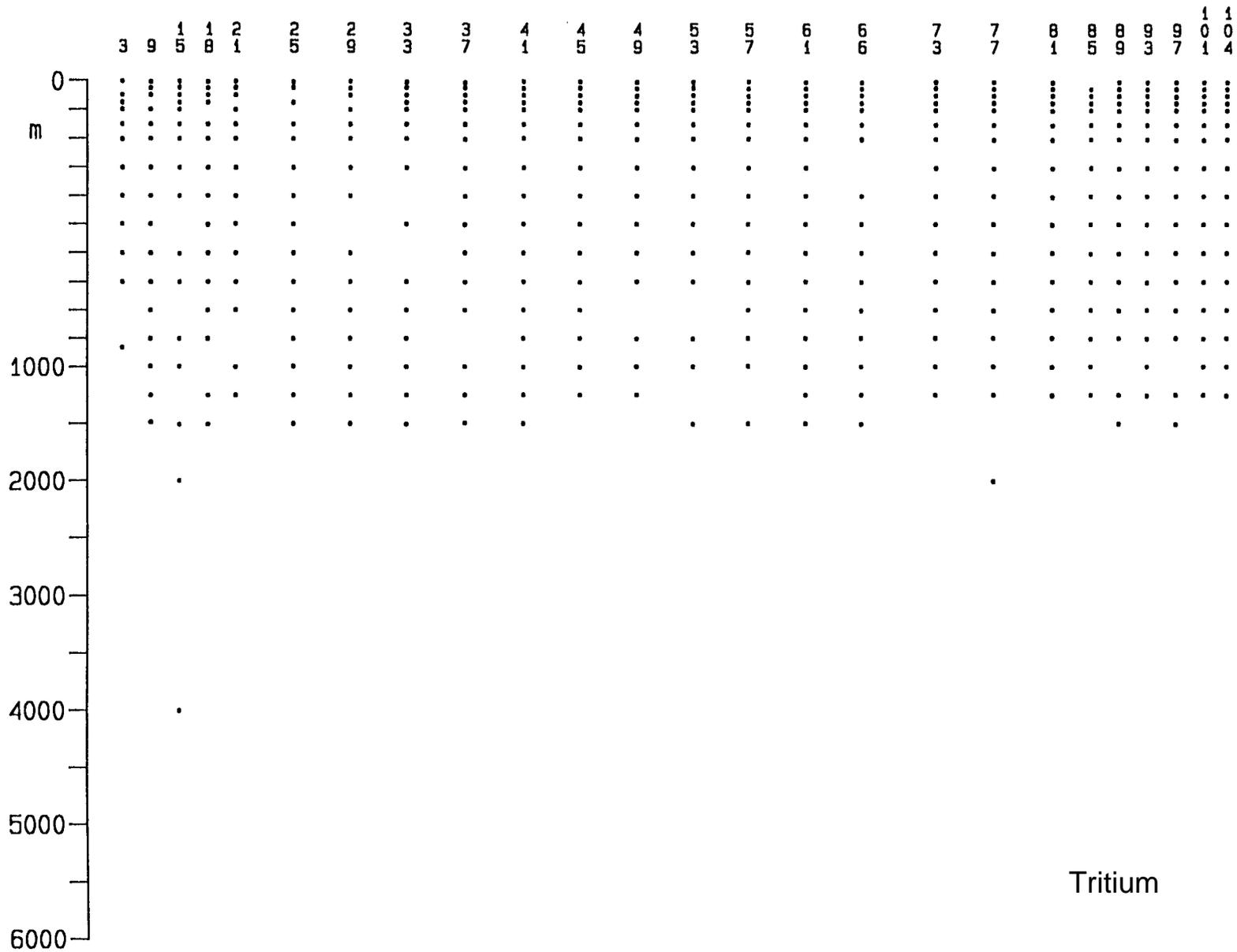
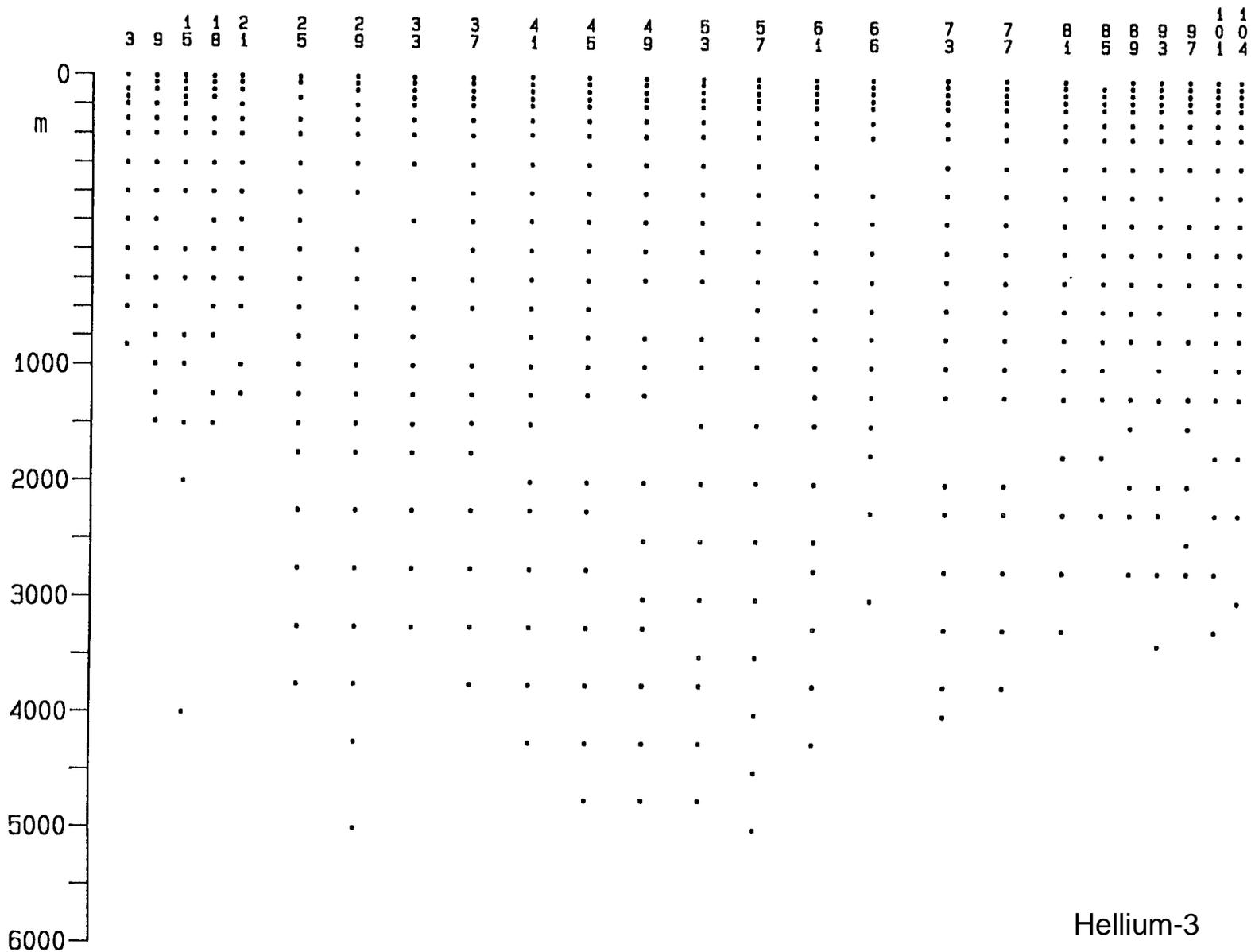


Figure 1.2d: Location of tritium samples collected on WHP-P09



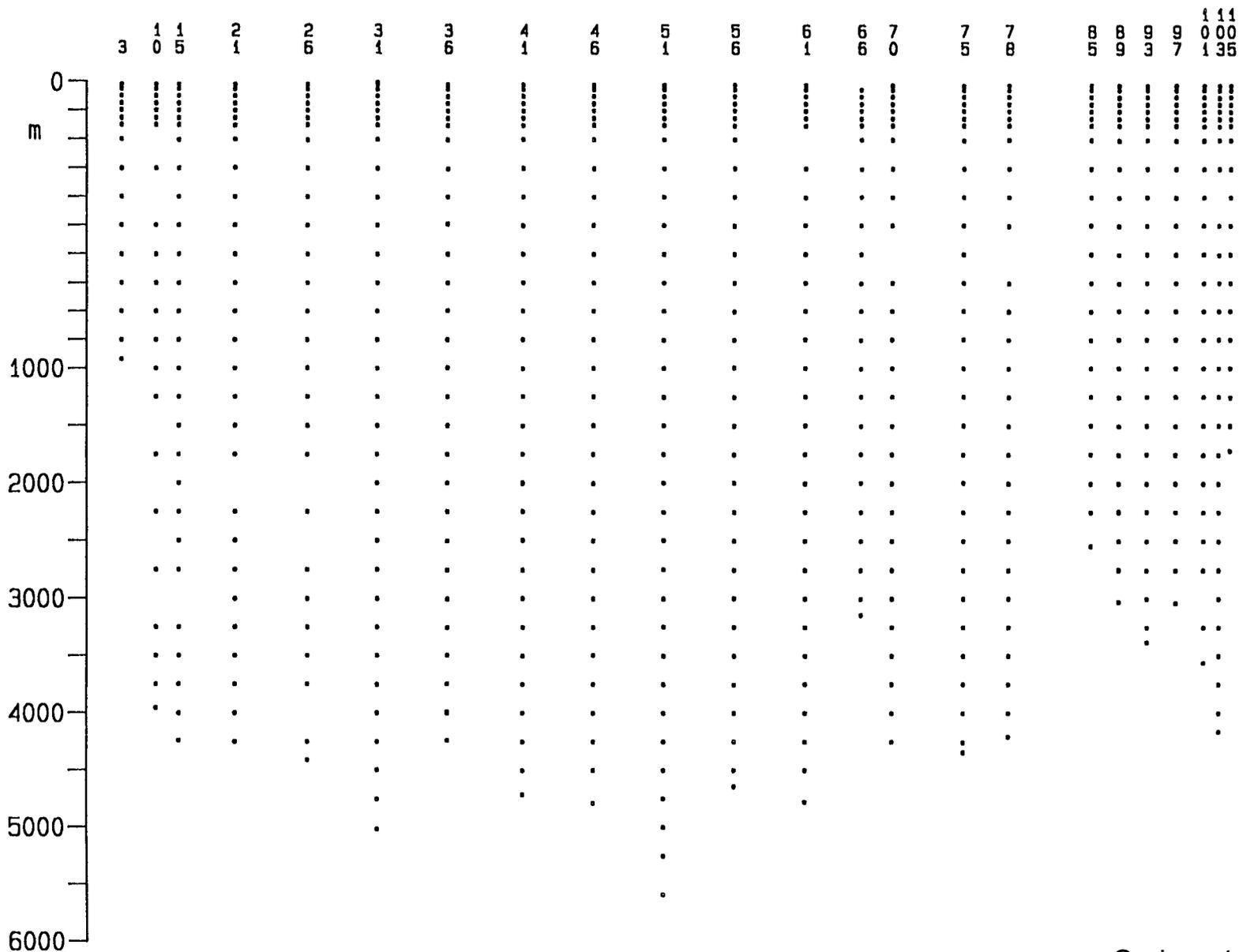


Figure 1.2f: Location of carbon-14 samples collected on WHP-P09

Carbon-14

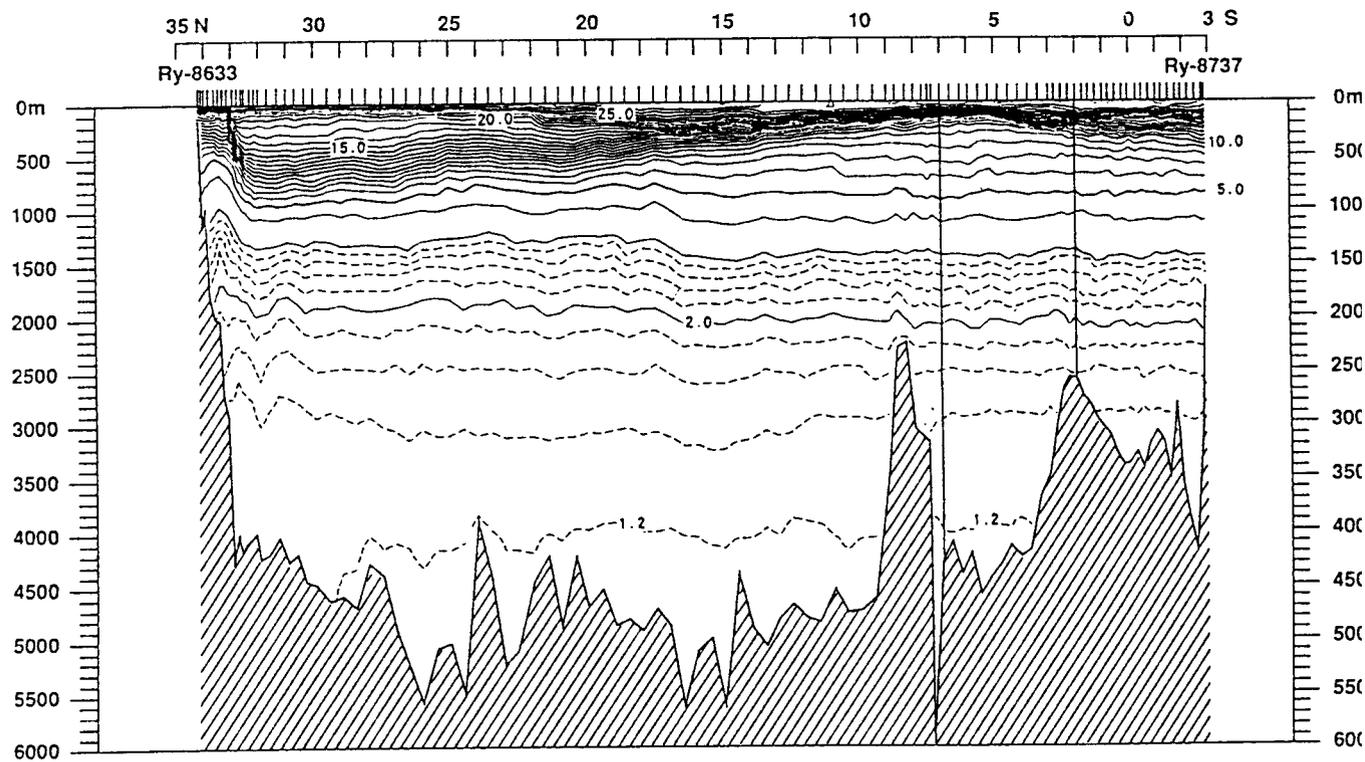
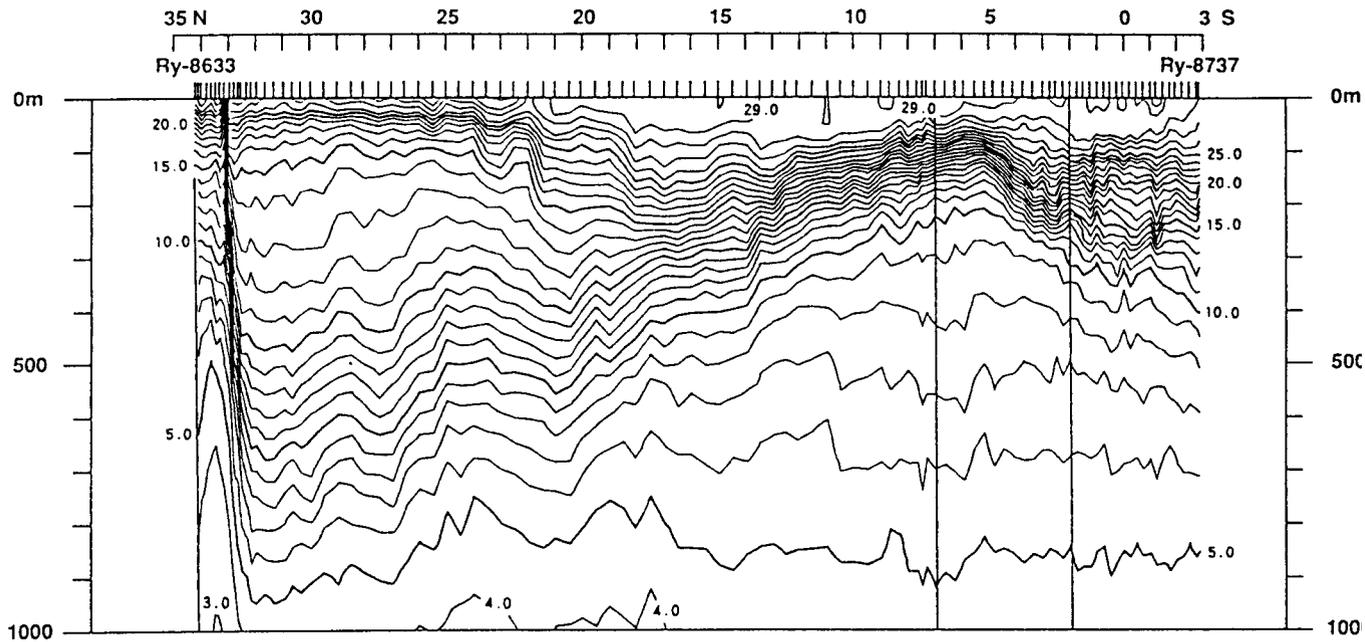


Figure 1.3a: Potential temperature section by the CTD

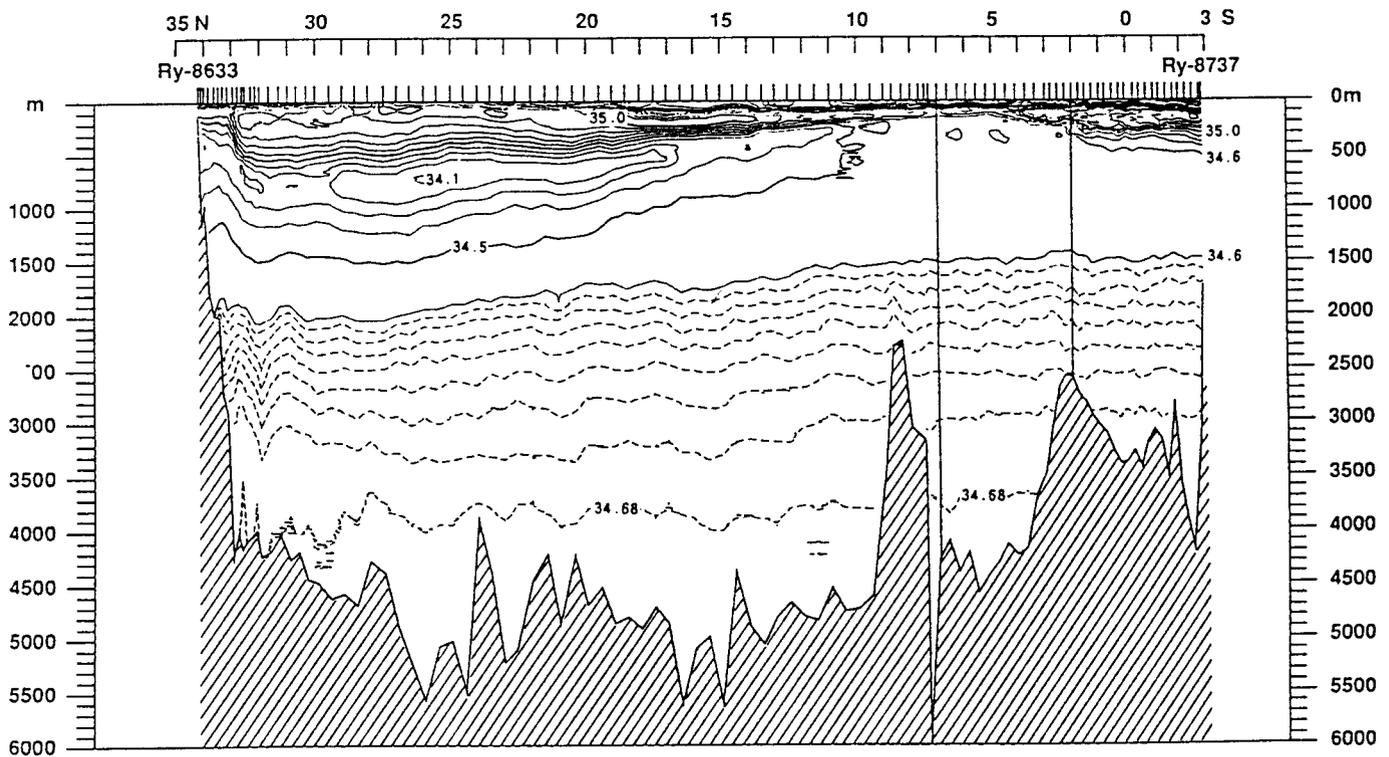
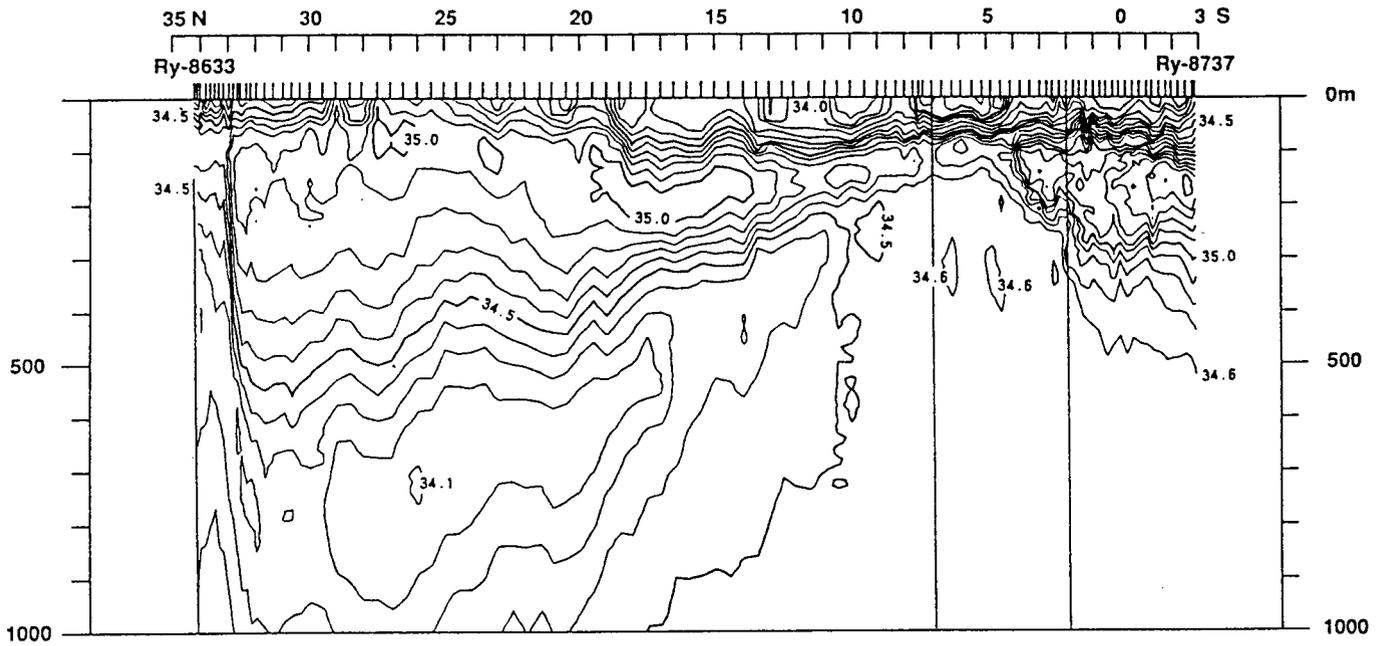


Figure 1.3b: Salinity section by the CTD

Meridional Distribution of Salinity

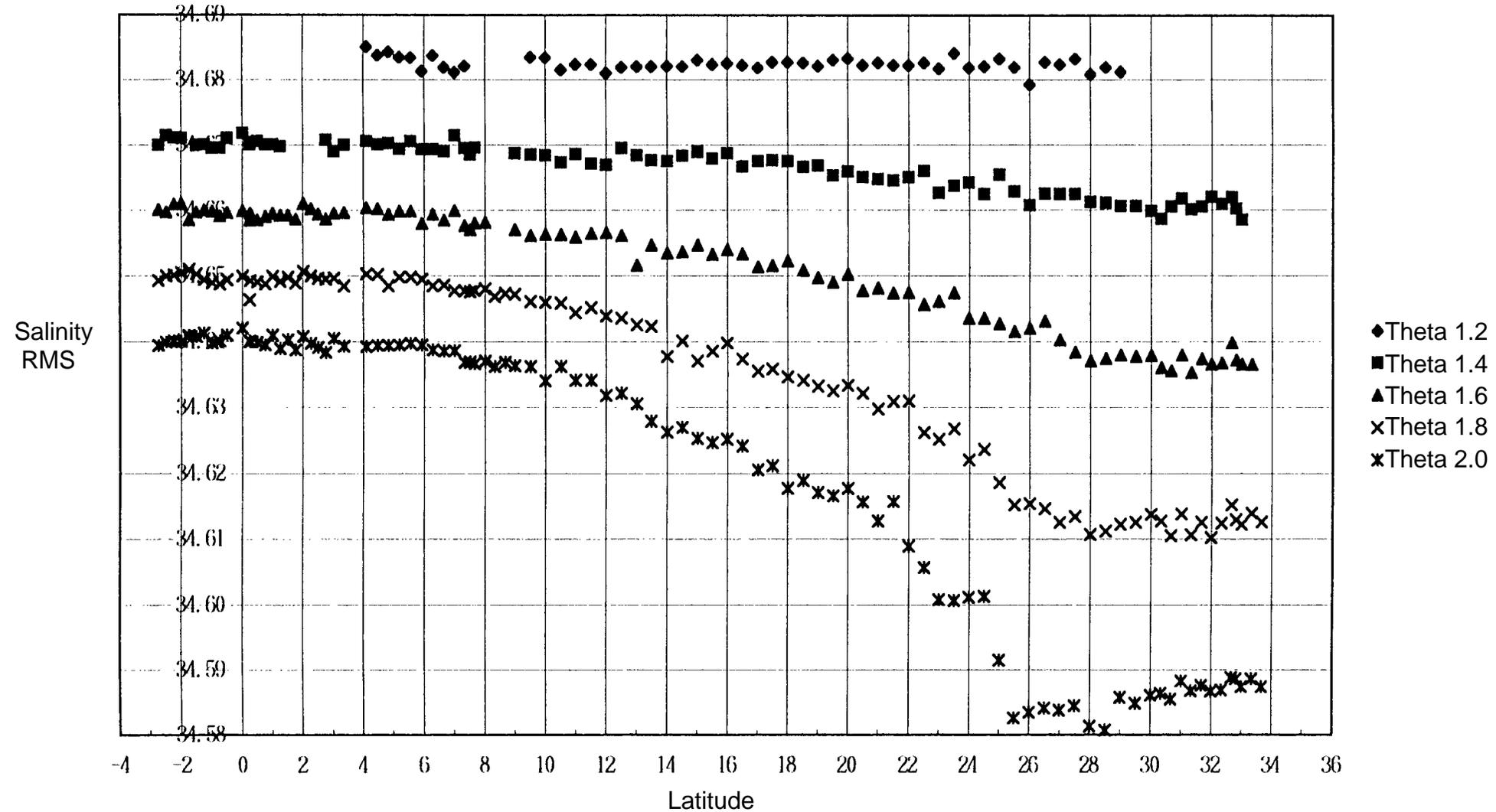


Figure 2.1.1: Meridional distribution of salinity

Meridional Distribution of Oxygen

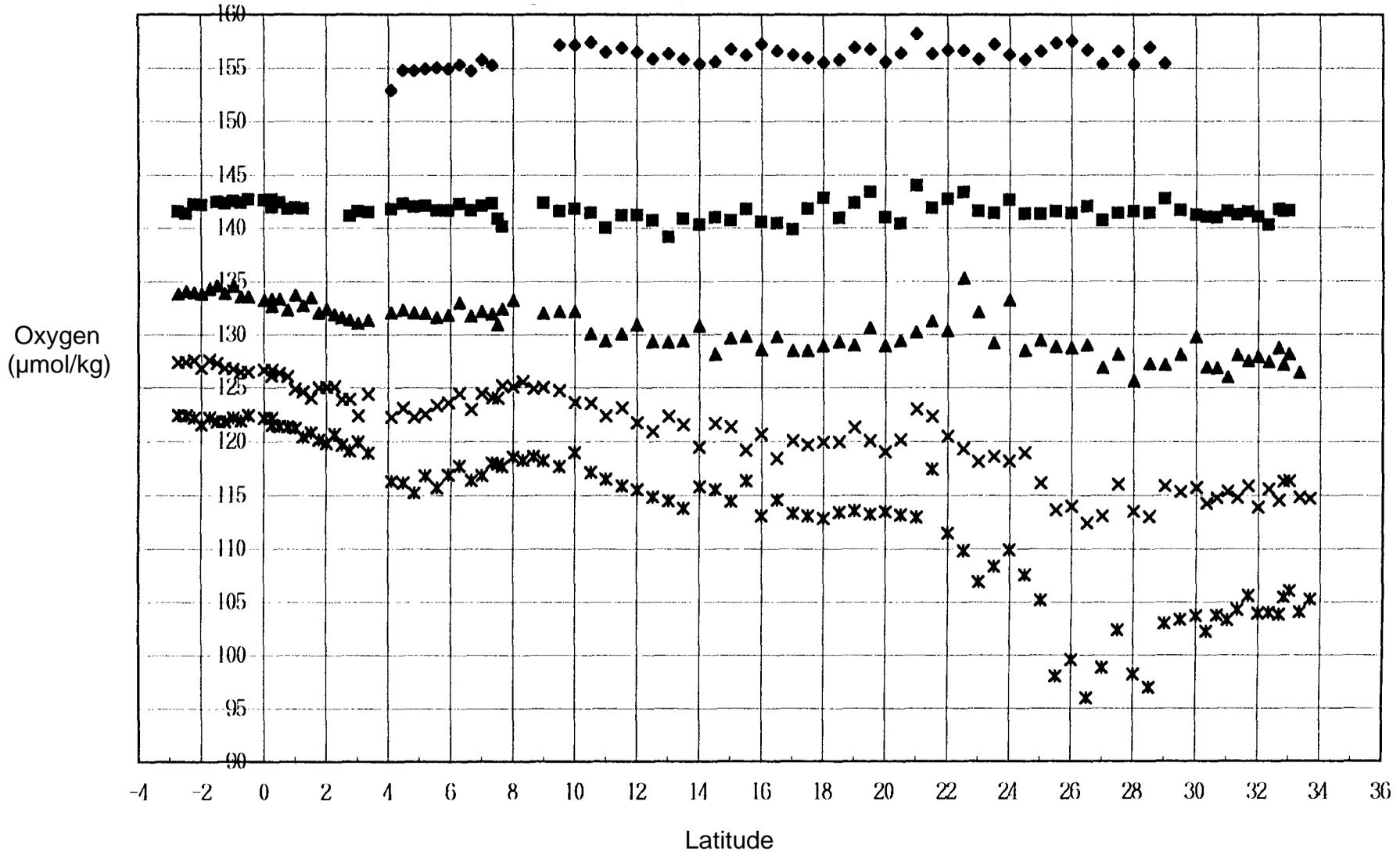


Figure 2.1.2: Meridional distribution of oxygen

Fig. 2.3.1 Reagents and flow diagram for the silicate determination

a. Molybdate reagent

Ammonium molybdate: $(\text{NH}_4)_6\text{Mo}_7\text{O}_{24}\cdot 4\text{H}_2\text{O}$	15	g
Sulfuric acid: H_2SO_4 (0.1N)	1000	ml
Sodium dodecyl sulfate: $\text{CH}_3(\text{CH}_2)_{11}\text{OSO}_3\text{Na}$ (15%)	20	ml

b. Oxalic acid reagent

Oxalic acid: $\text{C}_2\text{H}_2\text{O}_4$	50	g
Deionized, distilled water	1000	ml

c. Ascorbic acid reagent

Ascorbic acid: $\text{C}_6\text{H}_8\text{O}_6$	2.0	g
Acetone: CH_3COCH_3	5	ml
Deionized, distilled water	100	ml

d. Wash water

Artificial seawater

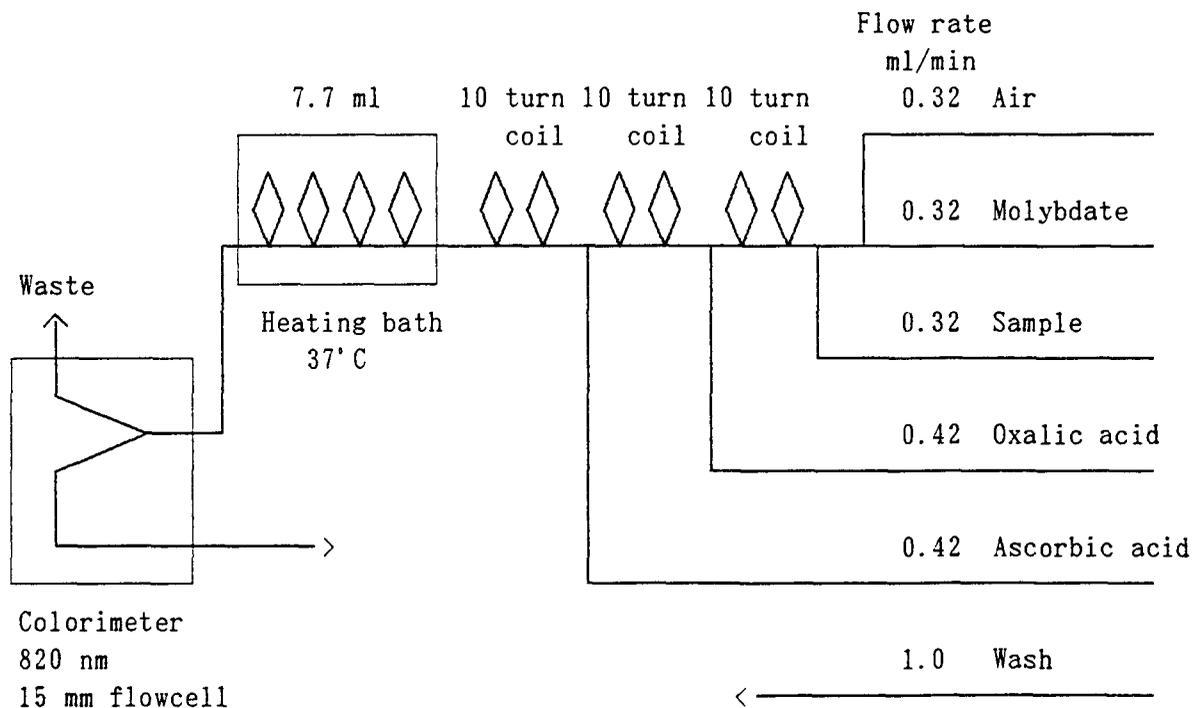


Fig. 2.3.2 Reagents and flow diagram for the nitrate determination

a. Ammonium chloride reagent

Ammonium chloride: NH_4Cl	35	g
Deionized, distilled water	1000	ml
Brij-35	0.5	ml

b. Sulfanilamide reagent

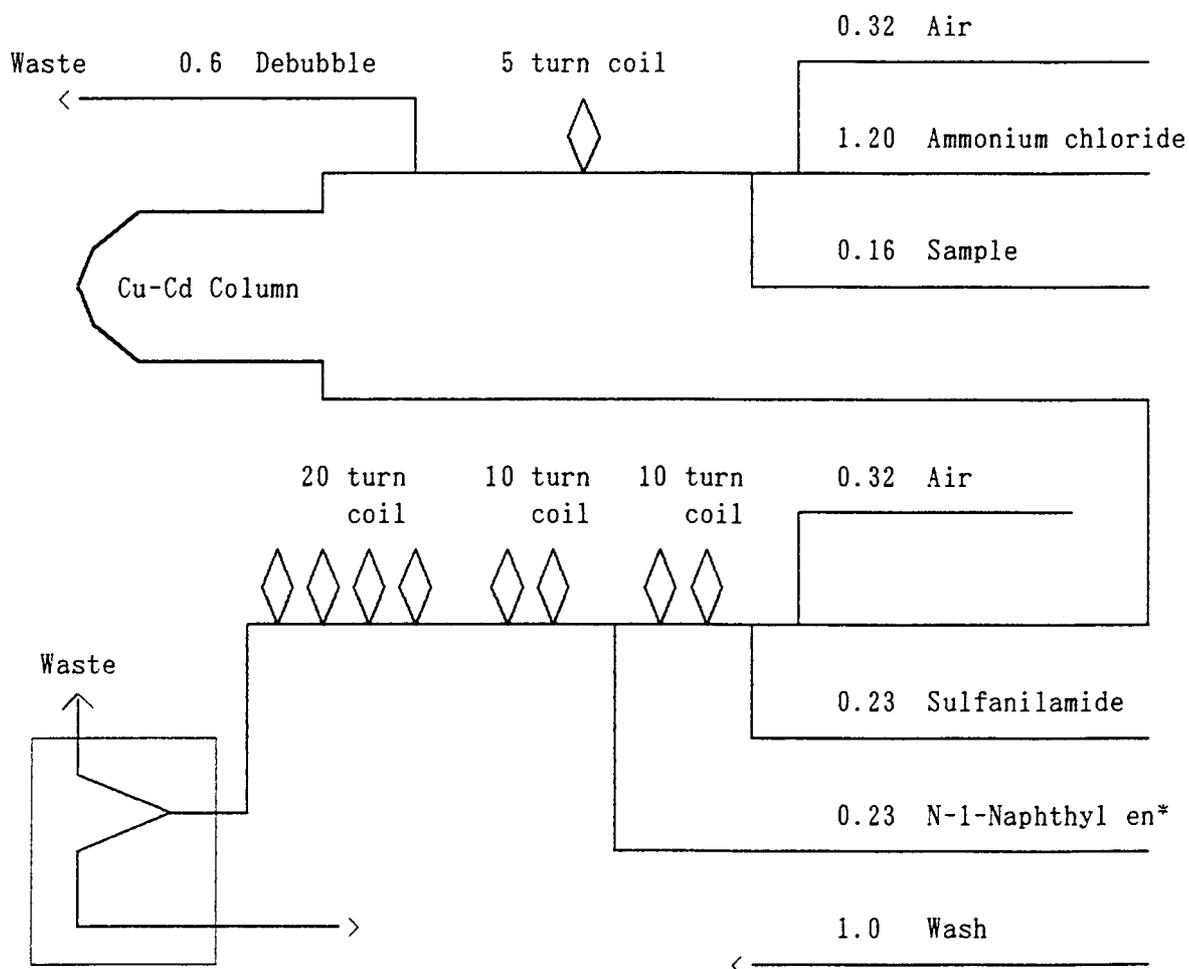
Sulfanilamide: $\text{C}_6\text{H}_4(\text{NH}_2)\text{SO}_2\text{NH}_2$	10	g
Hydrochloric acid: HCl	140	ml
Deionized, distilled water	1000	ml
Brij-35	2	ml

c. N-1-Naphtyl en reagent

N-1-Naphtylethylenediamine dihydrochloride: $\text{C}_{10}\text{H}_7\text{NH}_2(\text{CH}_2)_2\text{NH}_3\text{Cl}_2$	0.5	g
Deionized, distilled water	1000	ml

d. Wash water

Artificial seawater



Colorimeter
550 nm
50 mm flowcell

* en: ethylenediamine

Fig. 2.3.3 Reagents and flow diagram for the nitite determination

a. Sulfanilamide reagent

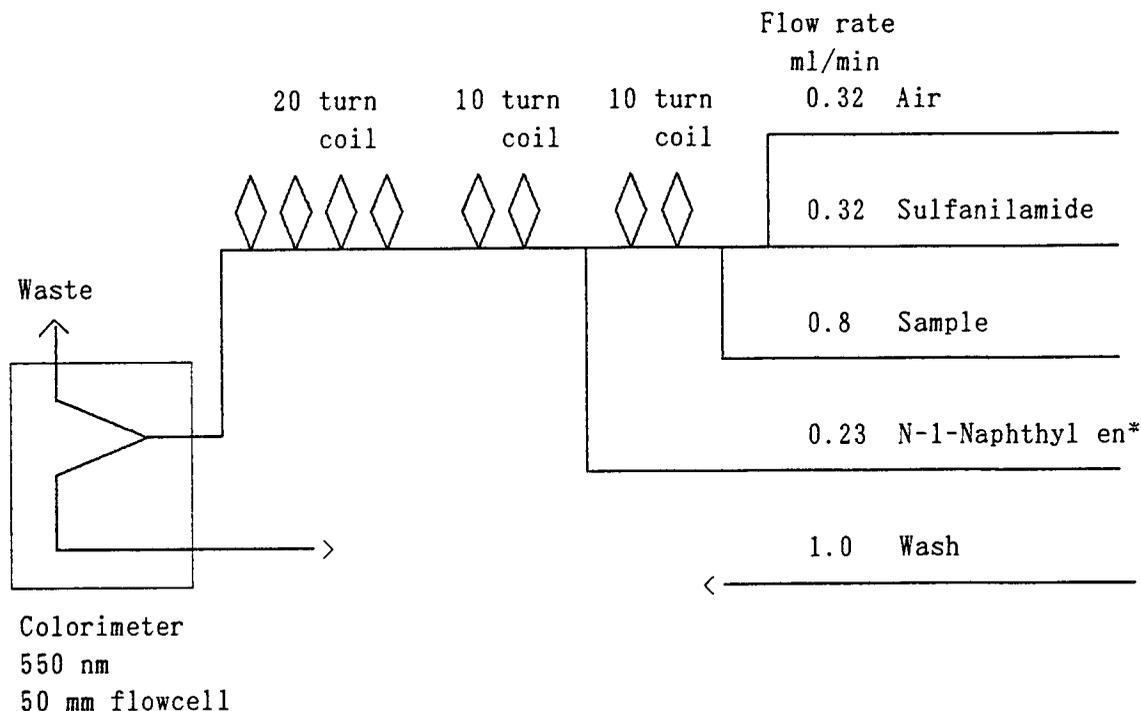
Sulfanilamide: $C_6H_4(NH_2)SO_2NH_2$	10	g
Hydrochloric acid: HCl	140	ml
Deionized, distilled water	1000	ml
Brij-35	2	ml

b. N-1-Naphtyl en reagent

N-1-Naphtylethylenediamine dihydrochloride: $C_{10}H_7NH_2(CH_2)_2NH_3Cl_2$	0.5	g
Deionized, distilled water	1000	ml

c. Wash water

Artificial seawater



* en: ethylenediamine

Fig. 2.3.4 Reagents and flow diagram for the phosphate determination

a. Molybdate reagent

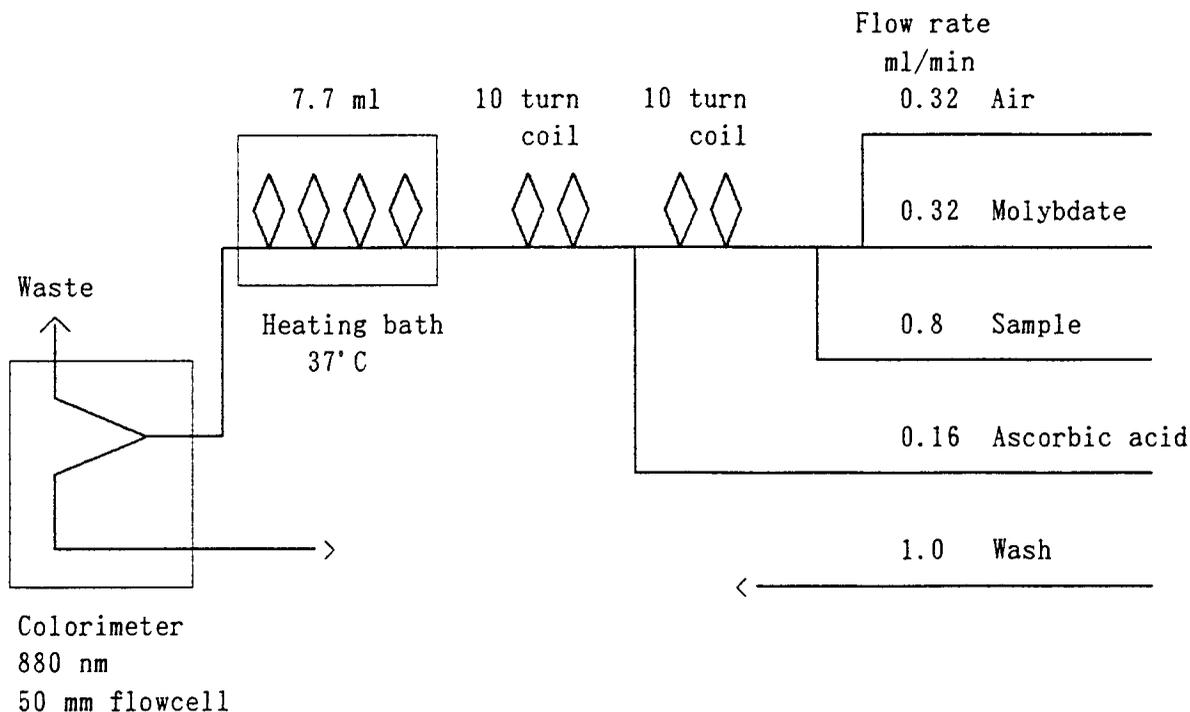
Sodium molybdate: $\text{Na}_2\text{MoO}_4 \cdot 2\text{H}_2\text{O}$	10	g
Potassium antimonyl tartrate: $\text{K}_2[\text{Sb}_2(\text{C}_4\text{H}_2\text{O}_6)_2] \cdot 3\text{H}_2\text{O}$	0.3	g
Sulfuric acid: H_2SO_4	60	ml
Deionized, distilled water	1000	ml
Sodium lauryl sulfate (15%)	20	ml

b. Ascorbic acid reagent

Ascorbic acid	2.0	g
Acetone: CH_3COCH_3	5	ml
Deionized, distilled water	100	ml

d. Wash water

Artificial seawater



Pressure Sensor Difference (CTD-DWT)

ICTD #1316 Pre Cruise Calibration

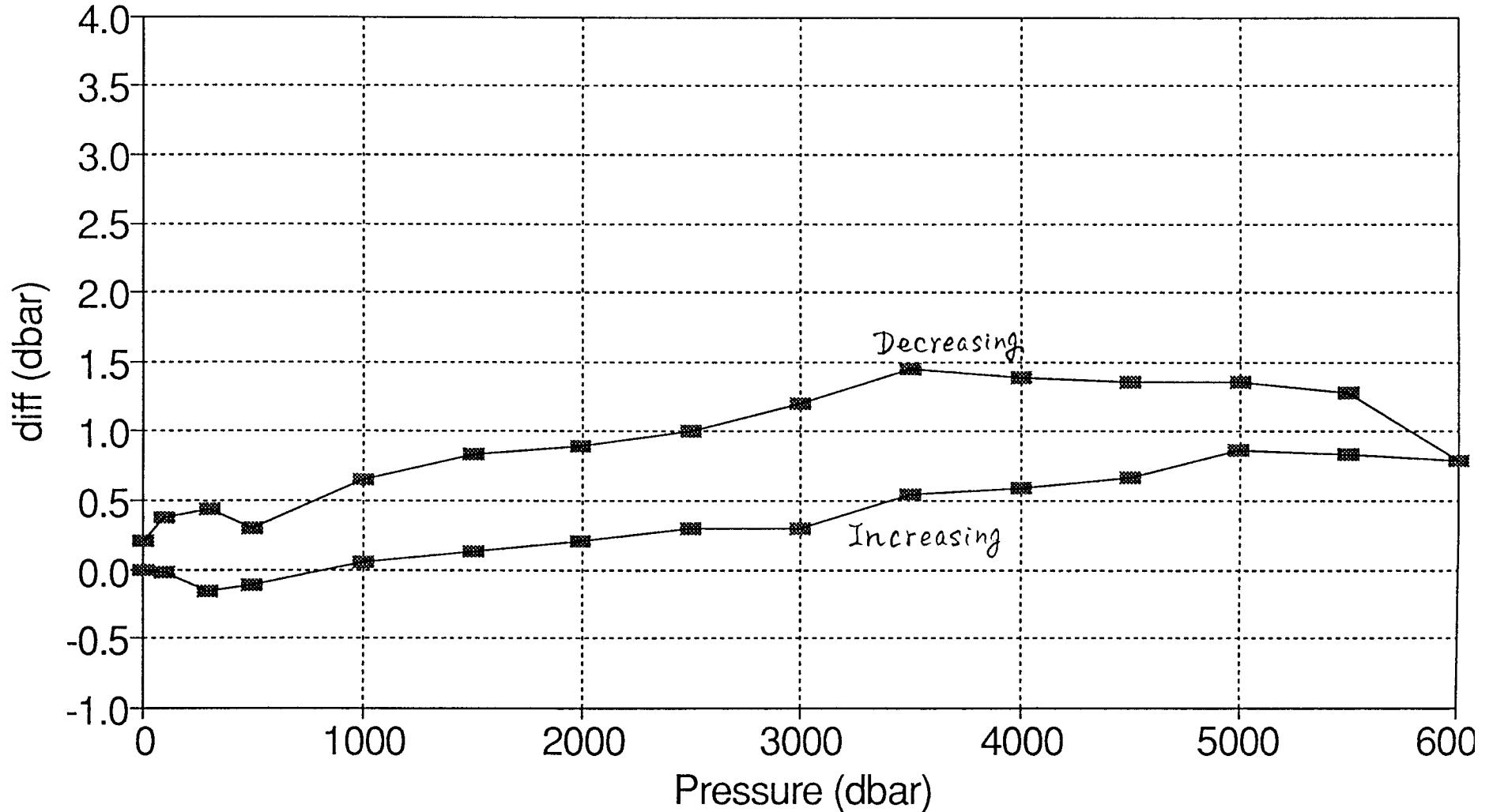


Figure 2.5.1a: Pressure sensor difference (CTD #1316, pre-cruise)

Pressure Sensor Difference (CTD-DWT)

ICTD #1316 Post Cruise Calibration

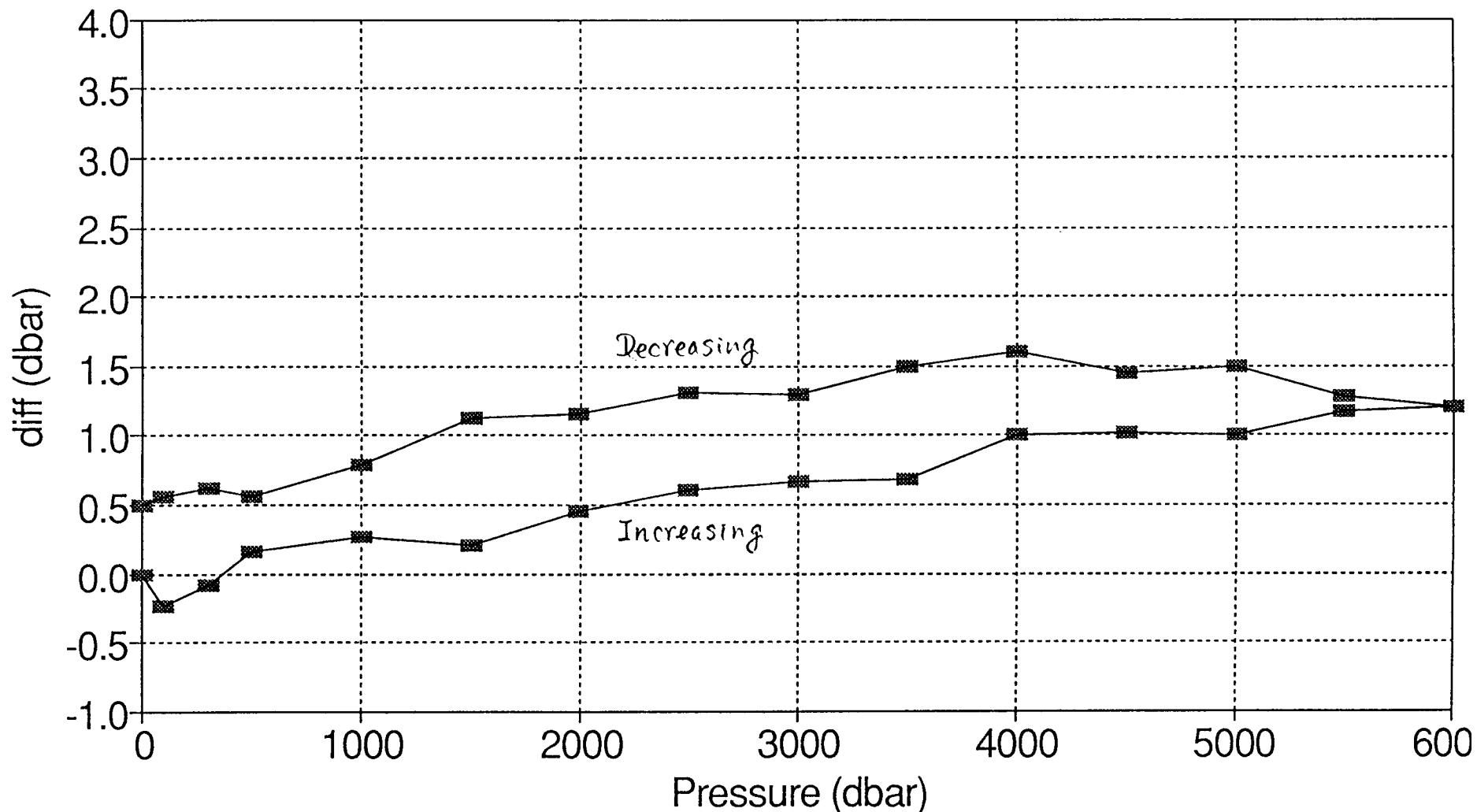


Figure 2.5.1b: Pressure sensor difference (CTD #1316, post-cruise)

Pressure Sensor Difference (CTD-DWT)

ICTD #1318 Post Cruise Calibration

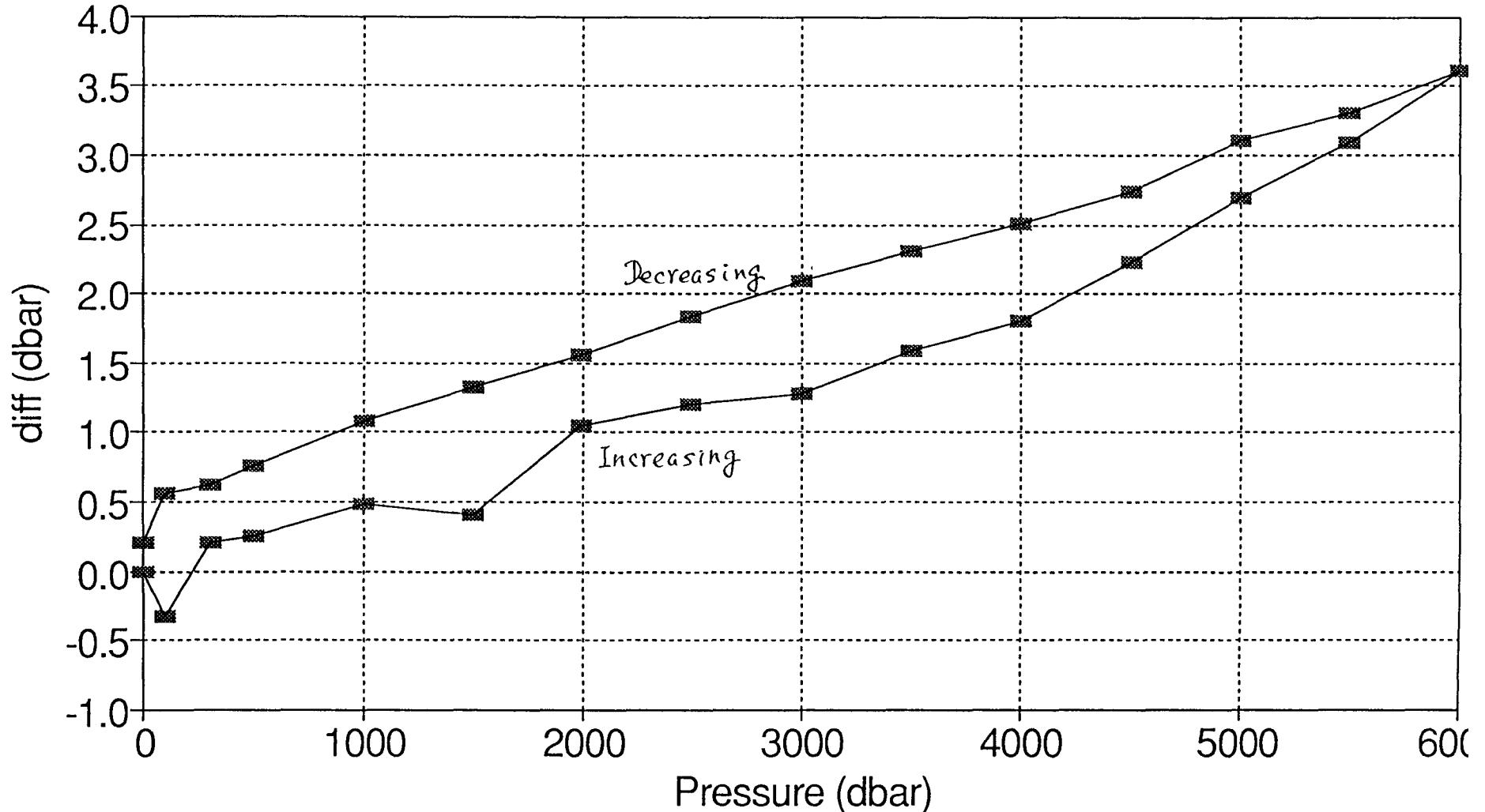


Figure 2.5.2: Pressure sensor difference (CTD #1318, post-cruise)

Temperature Sensor Difference(CTD-SPRT)

#1316 Primary T / Pre Cruise Calib.

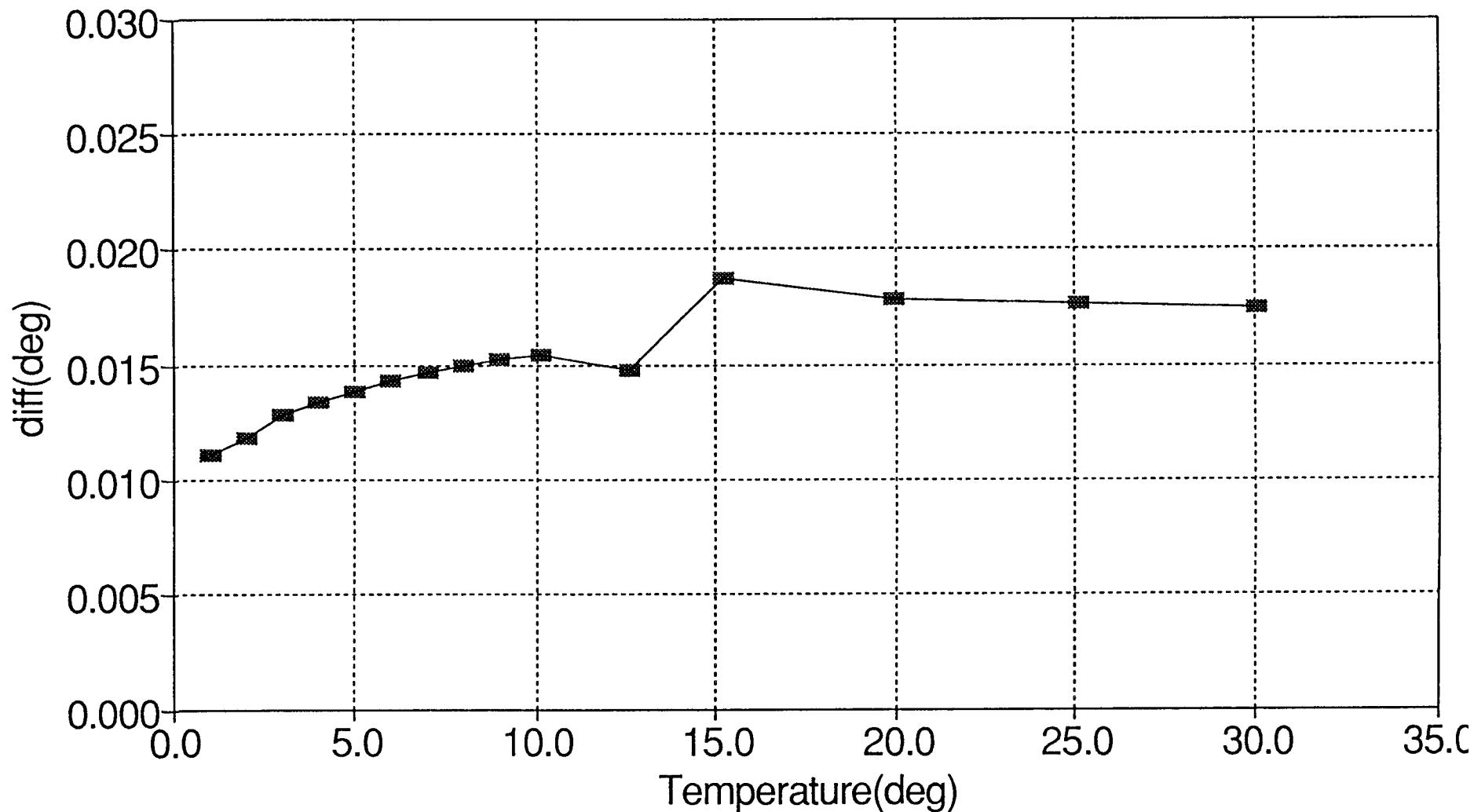


Figure 2.5.3: Temperature sensor difference (CTD #1316, pre-cruise)

Temperature Sensor Difference(CTD-SPRT #1318 Primary T / Post Cruise Calib.

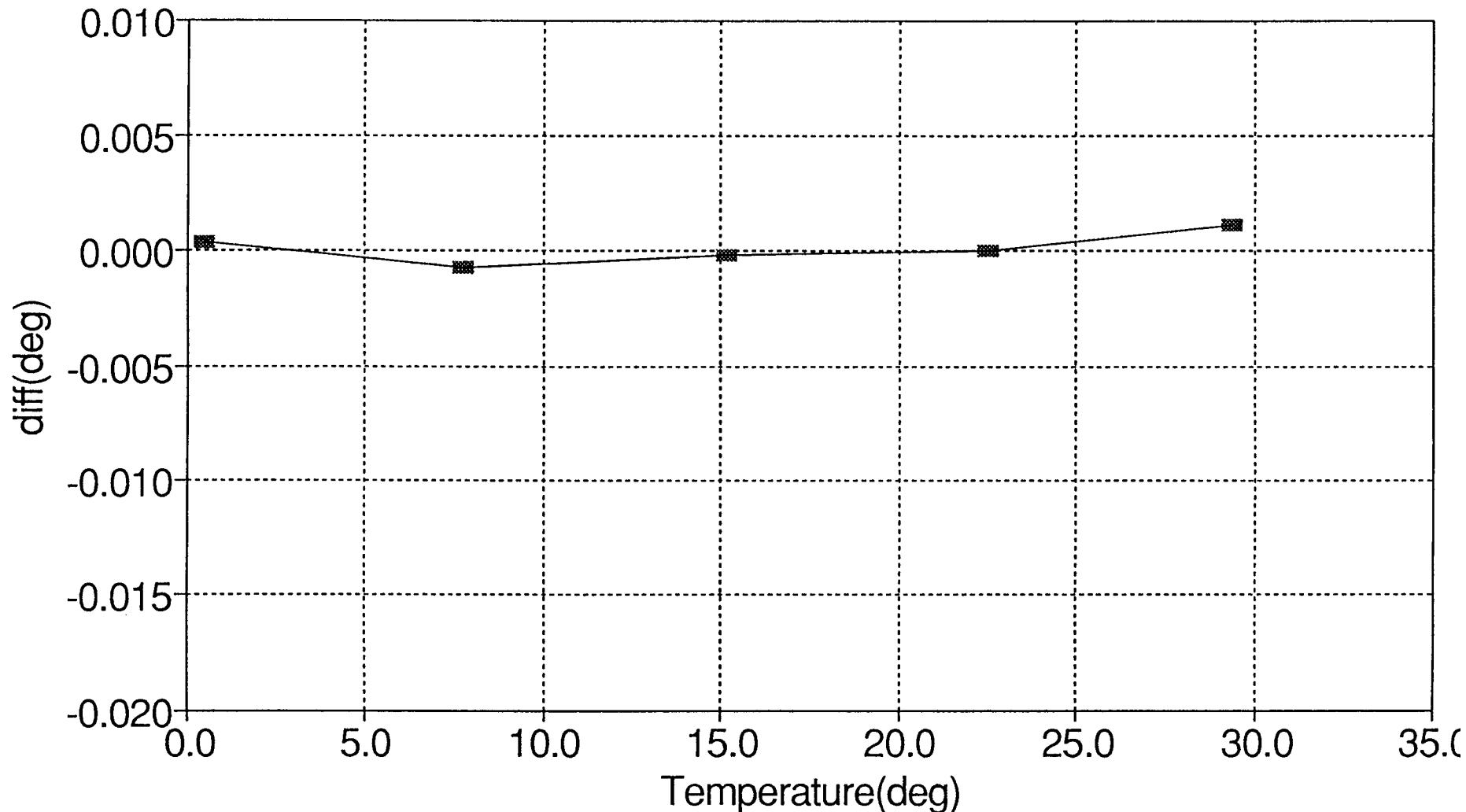


Figure 2.5.4: Temperature sensor difference (CTD #1318, post-cruise)

RTM-CTD

T759, below 2000m

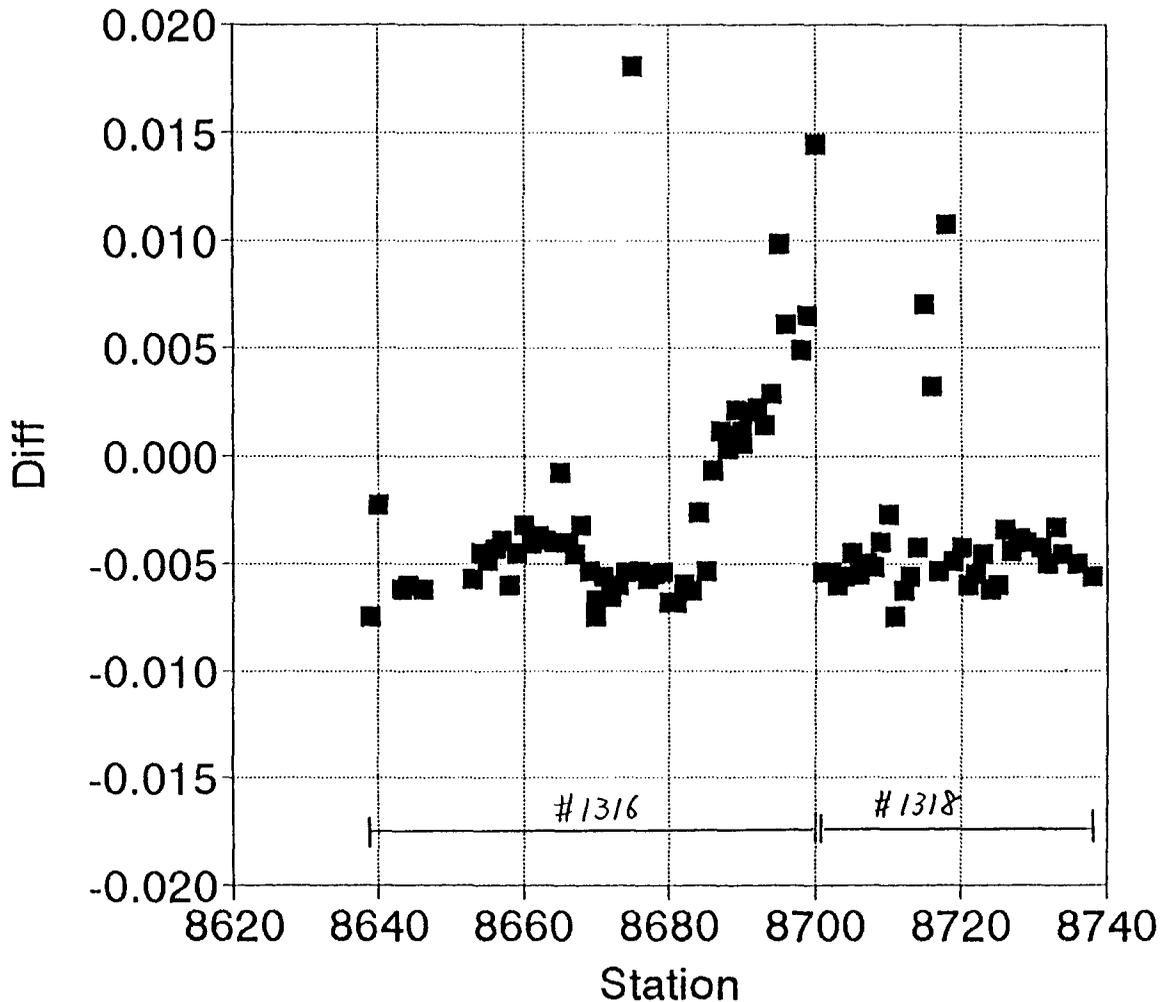


Figure 2.5.5: Drift of CTD temperature referred to RTM temperature

Comments on DQ Evaluation of WOCE P9 Hydrographic data (EXPOCODE: 49RY9407_1 & 49RY9407_2).

Michio AOYAMA

29 March 1996

The data quality of the hydrographic data of the WOCE P9 cruise (EXPOCODE: 49RY9407_1 & 49RY9407_2) are examined. The data files for this DQE work were P9.sum and P9.mka (this P9.mka file is created for DQE, then it has a new column of quality 2 word) provided by WHPO.

General;

The station spacing ranged from ca. 7 to ca. 38 nautical miles. Aside from suffering some lost data due to the trip malfunctions on the Rosette samplers throughout the cruise, the sampling layer spacing was kept ca. 250 dbar in the deeper layers during this P9 cruise. The ctd lowerings were made to within 20 meters to the sea bottom except several stations. The data originators have done a good job in evaluating the data and in solving trip problems. DQE, however, observed a few unreasonable values among the data flagged "good" by the data originators.

Aside from these small problems mentioned above, the Ryofu maru P9 cruise at 137E will improve our knowledge on the western North Pacific and update the deep water data set at this area.

DQE used the data flagged "2" by the data originators for this DQE work.

DQE examined 6 profiles and 7 property vs. property plots as listed below:
salinity, oxygen, silicate, nitrate, nitrite and phosphate profiles

5. theta vs. salinity plot
6. theta vs. oxygen plot
7. salinity vs. oxygen plot
8. nitrate vs. phosphate plot
9. salinity vs. silicate plot
10. theta vs. silicate plot
11. silicate vs. nitrate plot

1. Salinity;

The deep water salinity data bounced mostly toward fresher among the first 40 stations. This tendency observed among the stations between 54 and 60 again, but settled down as the cruise progressed.

Since the data originator had not flagged out these bounced values, DS, DS=CTD salinity - bottle salinity in dot sea file, vs. station # plot for the deeper layer (deeper than 2000 dbar) shows a larger variability of salinity difference among the stations up to 60 (**fig.1**)

2. Oxygen;

Bottle oxygen profile looks good. Salinity vs. oxygen and theta vs. oxygen plots also looks reasonable. DQE thinks that the flags of the bottle oxygen data are reliable.

3. Nutrients;

The profiles of nitrate, nitrite and phosphate look well. Nitrate vs. phosphate plot also looks pretty reasonable. Although DQE observes that silicate concentration seems to be slightly fluctuating station by station and higher as already stated in the cruise report (2.3 Nutrient measurements and [Table 2.1.4](#)), P9 silicate overlays pre-woce (P3 and P4) silicate data within the accuracy of 1-3%.

4. The following are some specific problems that should be looked at:

STNNBR XX/ CASTNO X/ SAMPNO XX at XXXX dbar:

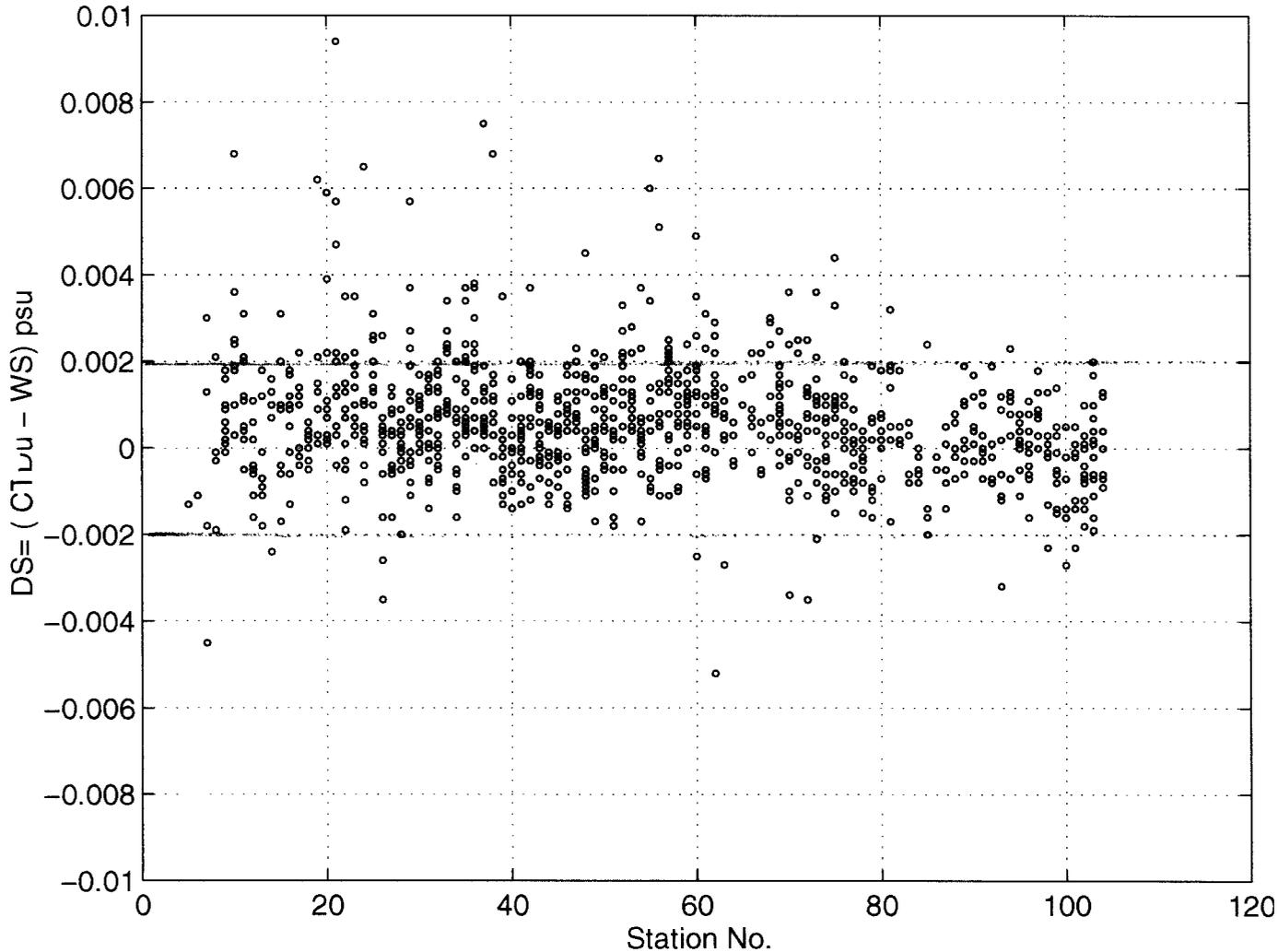
Stn	Press (dbar)	Note:
4/1/3	1515	Bottle salinity looks low. Suggest flag "3".
10/2/17	2276	Bottle salinity looks low. Suggest flag "3".
11/2/19	2022	Nitrate and phosphate concentrations look low and observed almost identical with the values at 2275 dbar.
13/2/11	3550	Bottle oxygen looks high. Suggest flag "3".
14/1/1	3806	Bottle salinity looks like high. Suggest flag "3".
14/1/4	3296	Bottle salinity looks like low. Suggest flag "3".
15/2/12	4063	Bottle oxygen looks high. Suggest flag "3".
15/3/34	1006	Bottle salinity looks low. Suggest flag "3".
17/2/10	4064	Bottle oxygen looks high. Suggest flag "3".
19/2/14	3298	Bottle salinity looks like low. Suggest flag "3".
20/2/12	4063	Bottle salinity looks low. Suggest flag "3".
20/2/13	3087	Bottle salinity looks like low. Suggest flag "3".
20/2/17	3040	Bottle salinity looks like low. Suggest flag "3".
21/2/14	3296	Bottle salinity looks like low. Suggest flag "3".
21/2/15	3296	Bottle salinity looks like low. Suggest flag "3".
21/2/16	3550	Bottle salinity looks like low. Suggest flag "3".
21/2/18	2529	Bottle salinity looks like low. Suggest flag "3".
24/2/15	3550	Bottle salinity and oxygen look low. Suggest flag "3".
24/2/16	3550	Bottle salinity looks like low. Suggest flag "3".
25/2/17	2783	Bottle oxygen looks high. Suggest flag "3".
26/2/12	4320	Bottle salinity looks like high. Suggest flag "3".
26/2/14	3807	Bottle salinity looks like high. Suggest flag "3".
28/ */	all depths	Silicate seems to be shifted toward lower considering the silicate concentrations at nearby stations. Suggest flag "3".
29/1/2	402	Bottle salinity looks very high. Suggest flag "4".
29/2/13	5683	Bottle salinity looks like low. Suggest flag "3".

Stn	Press (dbar)	Note:
29/2/16	5092	Bottle salinity looks like low. Suggest flag "3".
35/2/29	1512	Bottle salinity looks low. Suggest flag "3".
36/2/25	1513	Bottle salinity looks low. Suggest flag "3".
37/1/7	50	Bottle oxygen looks high. Suggest flag "3".
37/2/18	3039	Bottle salinity looks like low. Suggest flag "3".
38/11/8	2780	Bottle salinity looks like low. Suggest flag "3".
42/2/20	3038	Bottle salinity looks like low. Suggest flag "3".
43/2/13	4576	Bottle salinity, oxygen and nutrients should be at shallower layer. Suggest flag "4".
43/2/16	3806	Silicate concentration looks low. Suggest flag "3".
43/2/34	402	Bottle salinity looks like low. Suggest flag "3".
48/2/14	5697	Bottle salinity looks like very low. Suggest flag "4".
51/2/19	4320	Phosphate concentration looks high. Suggest flag "3".
54/*/* to 77/*/*	all depths	BTLNBRs for the stations 54 to 77 were blank or zero. Put correct BTLNBR
54/2/15	5091	Bottle salinity looks like low. Suggest flag "3".
55/2/20	3042	Bottle salinity looks like low. Suggest flag "3".
55/2/22	2531	Bottle salinity looks low. Suggest flag "3".
56/1/4	4063	Bottle salinity looks like low. Suggest flag "3".
60/2/17	4320	Phosphate concentration looks high. Suggest flag "3".
60/2/20	3808	Bottle salinity looks like low. Suggest flag "3".
61/2/16	3807	Bottle oxygen looks high. Suggest flag "3".
61/2/18	3295	Bottle oxygen looks high. Suggest flag "3".
61/2/20	2785	Phosphate concentration looks high. Suggest flag "3".
62/2/22	4319	Bottle salinity looks like high. Suggest flag "3".
62/2/34	1515	Bottle salinity looks low. Suggest flag "3".
69/2/29	3294	Phosphate concentration looks low . Suggest flag "3".
69/2/32	2530	Phosphate concentration looks low. Suggest flag "3".
69/2/37	1260	Bottle salinity looks low. Suggest flag "3".
69/2/39	907	Phosphate concentration looks low. Suggest flag "3".
70/2/12	3807	Bottle salinity looks like high. Suggest flag "3".
70/2/13	3552	Bottle salinity looks like high. Suggest flag "3".
71/2/12	4151	Bottle salinity looks low. Suggest flag "3".
73/2/13	4064	Bottle salinity looks low. Suggest flag "3".
75/2/20	2276	Bottle salinity looks like low. Suggest flag "3".
77/2/19	2022	Bottle salinity, oxygen and nutrients should be at shallower layer. Suggest flag "4".
79/2/10-33	1517-1518	Although the sampling depths are almost same for these layers, bottle oxygen varied from 155 mol/kg to 70 mol/kg. Put correct values with appropriate flags.
75/2/14	3552	Bottle salinity looks low. Suggest flag "3".
79/3/35	4061	Bottle salinity looks like low. Suggest flag "4".

Stn	Press (dbar)	Note:
89/3/30	1513	Bottle salinity looks low. And this salinity seems similar with the salinity at one layer shallower. Suggest flag "4".
90/2/19	1512	Bottle oxygen and nutrients should be at shallower layer. Suggest flag "4".
92/2/12	3296	Bottle salinity, oxygen and nutrients should be at shallower. Suggest flag "4".
92/4/14-17, 24-26, 28 and 31-37		Although the depth ranged from 152 dbar to 3433 dbar, phosphate concentrations are zero. Put correct values with appropriate flags.
92/4/22	2275	Bottle oxygen looks high. Suggest flag "3".
100/2/18	2276	Bottle salinity looks low. Suggest flag "3".
103/2/15	4225	Bottle oxygen looks very high. Suggest flag "4".
105/1/5	1008	Phosphate looks low. Suggest flag "3".
105/1/12	502	Phosphate looks low. Suggest flag "3".

Figure 1

/whp/a/home/maoyama/p9/ry8: DS up for pressures > 2000 dbar; std_s= 0.00806



Data Quality Evaluation of Hydrographic Data for P09

(George C. Anderson)

October 25, 1998 and updated several times since

Notes on the DQ Evaluation of Cruise P09,

a Japanese cruise along 137 E and 142 E from about 35 deg N to 3 deg South

EXPOCODE: 49RY9407_1 & 49RY9407_2

PI: Dr. Hiroki Kondo

DQE of the discrete data listing for:

- temperature,
- salinity (CTD and bottle data),
- oxygen (CTD and bottle data),
- silicate,
- nitrate,
- nitrite, and
- phosphate.

After completing the DQE work on this cruise, it was discovered that this cruise had already been DQE'd, a report written, corrections made, and an updated file submitted. The initial DQ evaluation had been done by Michio Aoyama and was dated 29 March 1996.

Unfortunately the file I examined was not the most recent, so many of the items I would have flagged had already been discovered and corrected.

The processing scheme consisted of preparing plots of the parameters to be investigated. All parameters were plotted versus pressure. As necessary, supplementary plots of Θ -salinity and salinity-silicate were prepared for individual stations or groups of stations. In addition, plots of phosphate (x-axis) versus nitrate (y-axis) were prepared for each station. From these data, plots of the N03/PO4 ratio, and y-intercept were prepared plotting these values versus station number (**copy attached**).

Positions from the sum file were plotted and appear to be correct. Cast times and dates were checked for consistency. No errors were found.

The work of Dr. Hiroki Kondo is to be commended in resolving bottle tripping problems. These are described in the Cruise Report.

Results:

Overall the data look quite good. There are some "bad" bottle salts; excluding the surface levels (1st and 2nd bottles) CTD-oxygens look very reasonable. There are some "bad" nutrient samples, mostly phosphate, and a few leaky bottles. The phosphate values on stations 104 and 105 are not of the quality of the rest of the cruise. On a few stations it appeared as though there were some key entry errors, double sampling from the same Niskin bottle, or data for two levels reversed.

At station 69 the CTD-02 sensor. failed and the back-up sensor was found to be faulty. As a result CTD-02 data were not available for the remainder of the cruise. This has been pointed out in the Cruise Report.

On four stations, numbers 55, 66, 68 and 70, some to all the silicates had been flagged uncertain. There does appear to be somewhat more scatter in the data than on other stations, but calling the data uncertain may be a bit harsh. I am recommending that the flags be changed back to "2".

The values of the N03/PO4 ratio change during the course of the cruise from about 14.2 at the beginning to about 14.8 at the end. At the same time, the value of the y-intercept changes from about 0 to ~ -1. These negative intercepts are quite reasonable and to be expected. The reason (s) for the change in the ratio over the duration of the cruise should be checked. There may have been a problem with one of the phosphate standards (See the attached report on the comparison of nitrate and phosphate data for Cruises P09 and P10).

Data from this cruise were compared with data from the following:

P09 Station No.	Cruise	Date	Station No.
11	Geosecs (Pacific)	(October of 1973)	224
32	TPS 24 [WOCE P03]	(May of 1985)	320
63	P04	(March of 1989)	28
81	WEPOC II	(February of 1986)	93

The data for TPS 24 and WEPOC 11 had oxygen concentrations listed in units of ml/l and nutrient values in units of Moles. These were converted to the WHPO units of moles/kg using approximate conversion factors. For oxygen, the values in ml/l were divided by 43.50; for nutrients, the M units were divided by a density value of 1.0236, based on an approximate lab temperature of 25 degrees Celsius and a salinity of 35 p.s.u.

Salinities from P09 compare very well with the data from P04, but are typically 0.002 to 0.004 p.s.u. higher than reported on the other cruises. This is consistent with the observations recorded in the Cruise Report (pages 7 & 8). Part of this offset may be the result of the batch of Wormley water used in standardizing the salinometer (Aoyama, WOCE Newsletter, No. 32, Sept. 1998).

Oxygen values are comparable to those reported on the other cruises.

The nutrients below 3000 meters show the following: excluding the data from Geosecs, P09 silicates are lower than those reported on the other cruises by 2 to 3 moles/kg [at a conc. of 141.0, 2.5 moles/kg is 1.8%]; nitrates are within -1 moles/kg of those reported on the other cruises [at a conc. of 36.5 moles/kg, this is ~ 2.7%]; excluding the data for WEPOCII where the phosphates are 0.05 moles/kg lower, phosphates are higher than those reported on the other cruises by approximately 0.05 moles/kg [at a conc. of 2.55

moles/kg, this is ~ 2.0%]. These observations are similar to those described in the Cruise Report (page 13). Except for nitrate, all observations have met the "data quality goals" specified in WOCE Report No. 67/91, Rev. 2, May 1994, page 20).

A philosophical question that has no bearing on the quality of the data for this cruise has to do with the use of quality flags when calibration data are not available for a cast. As an example when the CTD oxygen sensor was operational, there were casts made for water samples which did not include discrete samples for oxygen. One could make an argument that without these calibration data, one's confidence in the data is somewhat less than if discrete samples had been collected and analyzed. To this extent at best flag "3" should be used. However, since previous casts at this station and casts on adjacent stations had calibration data, quality flags should be assigned based on this information and normally would be "2". As stated above, this is a philosophical question whose answer goes beyond the scope of this DQE work.

George C. Anderson
DQE, WHPO

The following are some specific problems that should be checked:
Cruise P09 DQE data summary

Stn	Cast #	Btl #	Press. (decibars)	Notes
2	1	13	100.3	CTD salinity appears to be low; suggest flag it 3
	1	13		Bottle salinity appears to be okay; suggest change flag from 3 to 2
4	1	5	1009.7.	Bottle salinity is low; suggest flag it 3
	1	2	1515.2	Bottle data look okay; suggest change the bottle flag from 4 to 2
	1	3	1515.2	Bottle appears to have leaked; suggest flag 4 for bottle
11	1	6	50.1	CTD salinity is high; suspect a salinity spike or a key entry error
	2	1	4235.4	Phosphate value is low; suggest flag 3
13	2	7	3550.2	Bottle oxygen appears to be okay; suggest change flag to 2
	2	6	3805.6	Bottle oxygen low; suggest flag 3
15	2	9	4063.3	Bottle oxygen appears to be okay; suggest change flag to 2
	2	7	4306.8	Bottle oxygen low; suggest flag 3
16	2	10	2783.8	Bottle oxygen low; suggest flag 3
18	2	18	906.6	CTD oxygen looks okay; suggest change flag to 2
19	2	12	2274.9	Bottle oxygen high; suggest flag 3
23	1	7	49.9	CTD salinity spike; suggest flag 4
24	2	2	4577.1	Bottle oxygen low; suggest flag 3
27	2	11	2531.0	Phosphate value is low; suggest flag 3
30	2	7	3807.6	Oxygen and nutrient values low; suggest flag 3 for both parameters

Stn	Cast #	Btl #	Press. (decibars)	Notes
	2	4	4834.0	Bottle oxygen low; suggest flag 3
31	2	22	2021.2	Phosphate value is low; suggest flag 3
	2	10	4834.5	Bottle oxygen low; suggest flag 3
32	1	15	125.8	CTD salinity high; suggest flag 3
	2	4	1008.7	CTD salinity is high; suggest flag 3
	2	4		Bottle salinity looks okay; suggest change flag from 3 to 2
	2	15	4064.7	Phosphate value is low; suggest flag 3
33	1	16	24.9	CTD salinity spike; suggest flag 3
36	2	13	3547.8	Bottle salinity is low; suggest flag it 3
	2	14	3547.8	Bottle salinity is low; suggest flag it 3
	2	12	3805.5	Bottle salt looks okay; suggest change flag from 3 to 2
	2	9	4307.5	Bottle salinity is low; suggest flag it 3
39	2	1	2015.4	Bottle salinity is low; suggest flag it 3
41	2	3	907.9	CTD oxygen looks okay; suggest change flag from 3 to 2
	2	11	4320.0	CTD oxygen high; suggest flag 3
43	2	21	2020.9.	Nutrient values look okay; suggest change flags from 4 to 2
	2	14	3806.5	Silicate value is suspect but not bad; suggest change flag from 4 to 3
47	2	21	3040.1	Silicate value is low; suggest flag 3
50	1	18	100.5	CTD oxygen looks okay; suggest change flag to 2
	1	18	100.5	Bottle oxygen looks very low; suggest flag 4
	2	22	3040.1	Bottle salinity is low; suggest flag it 3
	2	16	4318.3	CTD oxygen value is high; suggest flag 3
52	2	12	4513.6	Bottle data appear to be okay; suggest change bottle flag from 3 to 2
55	2	10	503.8	Silicates from here to bottom flagged 3; data a bit noisy but okay; suggest change flags to 2
	2	20	3041.8	Bottle oxygen looks okay; suggest change flag from 3 to 2
61	2	17	3551.8	Bottle salinity is low; suggest flag it 3
60	2	13	5098.6	CTD salinity is low; suggest flag 3
57	2	3	1767.5	Bottle salinity is low; suggest flag it 3
56	2	8	604.6	CTD salinity is low; suggest flag 3
62	2	16	3805.0	Phosphate value high; suggest flag 3
63	2	19	2276.4	CTD salinity is low; suggest flag 3
66	2		all depths	Silicates flagged 3; data a bit ragged but okay; suggest change flags to 2
68	2	15	2529.6	Phosphate value is low; suggest flag 3
	2	7	150.2	Silicates at all depths between 150.2 and 3261.3 flagged 3;
	2	12	3261.3	data a bit noisy but okay; suggest change flags to 2
69	2	8	1260.6	CTD salinity is high; suggest flag 3
	2	8		Bottle salinity appears to be okay; suggest change bottle flag from 3 to 2
	2	12	6122.6	Bottle salinity is low; suggest flag it 3
70			all depths	Silicates flagged 3 but appear to be okay; suggest change flags to 2
72	2	17	3294.0	Bottle salinity is low; suggest flag it 3

Stn	Cast #	Btl #	Press. (decibars)	Notes
75	2	22	2275.6	Bottle oxygen is suspect; suggest flag 3
	2	22		Phosphate value is low; suggest flag 3
78	2	20	2275.9	Phosphate value is low; suggest flag 3
80	2	19	2022.5	Phosphate value is low; suggest flag 3
	2	13	3552.2	CTD salinity is high; suggest flag 3
93	2	15	3038.4	Bottle salinity is okay; suggest change flag from 3 to 2
	2	15		Bottle oxygen is suspect; flag it 3
	2	14	3295.9	Bottle oxygen low; suggest flag 3
101	2	6	503.9	CTD salinity is low; suggest flag 3
	2	19	2275.6	Phosphate value is low; suggest flag 3
103	1	16	301.7	Phosphate value is low; suggest flag 3
104	3	15	907.2	CTD salinity is high; suggest flag 3
92				The second occupation of this station. The phosphates at these depths appear to be low; suggest all be flagged 3. Many missing or suspect phosphates on this station
	3	16	127.0	
	3	15	151.6	
	3	13	302.2	
	3	14	302.2	
	3	11	404.5	
	3	12	404.5	

Review of the Nitrate and Phosphate Data from Selected Stations

WOCE Cruises P09 and P10

As part of the repeat DQE of WOCE Cruise P09, the nitrate and phosphate data from a station were plotted against each other. A least squares fit was used to determine the N03/PO4 ratio and intercept. Subsequently, plots were made of the slope and intercept values at each station versus the station number. There appeared to be a transition zone in the curves between stations 44 and 60. Between these stations the N03/PO4 ratio increased from ~ 14.3 to ~ 14.7 while the intercept changed from ~ -0.15 to ~ -1.0. Initially it was thought that this might have been the result of changes in the primary phosphate standards being used on the cruise.

To investigate this, data from WOCE Cruise P10, stations 29-31 and 70-72, were treated similarly as those from P09. The two groups of stations from P10 were at similar northern latitudes as those of P09 but were 12 degrees of longitude to the east at the northern stations and ~6 degrees of longitude to the east at the southern stations.

The N03/PO4 ratios from P09 & P10 are similar and increase towards the equator. At the northern stations the values are 14.27 and 14.44 respectively for P09 and P10. At the southern stations the values are 14.74 and 14.66 respectively. There is also an increase in the value of the intercepts in moving towards the equator. At the northern stations the values are -0.08 and -0.29 respectively for P09 and P10. At the southern stations the values are -0.74 and -1.30 respectively.

These data would suggest that the changes in the values of the N03/PO4 ratio and intercept seen on Cruise P09 are real. They are related to changes in the surface phosphate and nitrate values as one moves south rather than to problems with one of the standards used during the cruise.

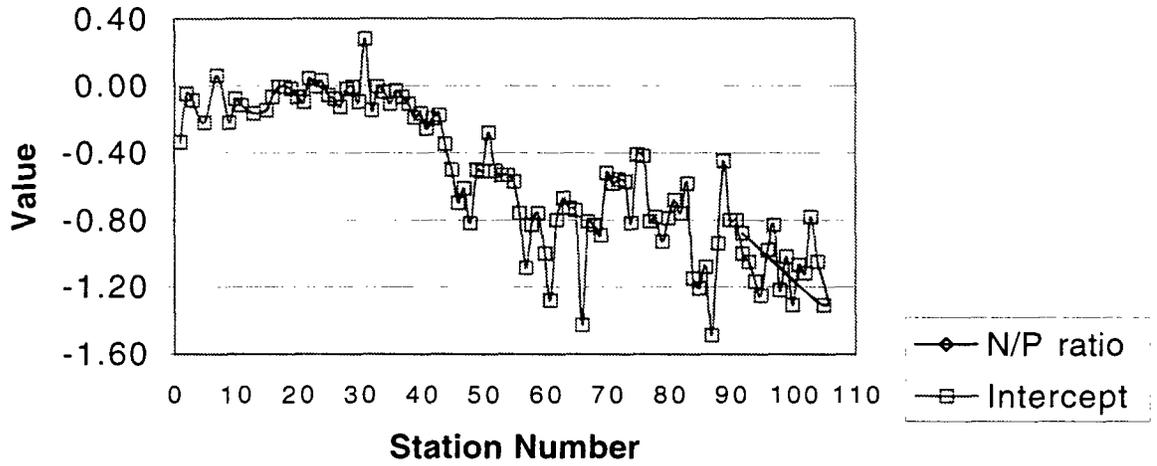
As a second approach in examining, this phenomenon, the N03/PO4 ratio was calculated for each bottle deeper than 3000 decibars at all stations from both cruises. The mean was determined for all values within each group of stations.

At the northern part of the pattern, the mean of the P09 station data is ~14.45, for P10, the mean is ~14.44, almost identical. At the southern part of the pattern, the mean of the P09 station data is ~ 14.6, for P 10, the mean is ~ 14.2, so P09 is ~ 0.4 units higher than P10. In going from the northern to the southern groups of stations, the P09 value increases by ~ 0. 15 units while the P10 value decreases by ~ 0.24 units.

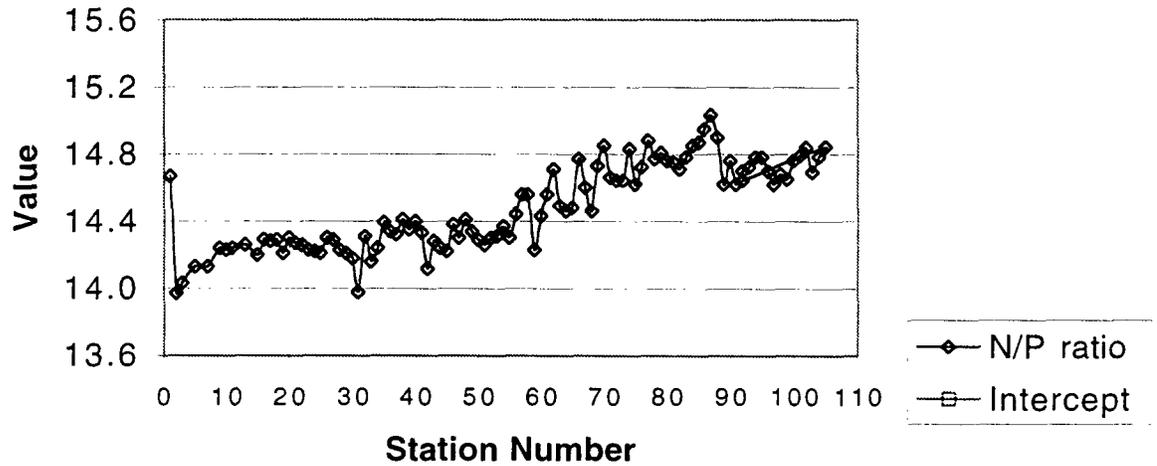
From these data, it would appear that there has been a shift in the deep data. Other sections need to be reviewed before resolving this

It should be noted that station depths on PIO were ~1000 decibars deeper than on P09. As a result a few more values were included in the averages at each PIO location.

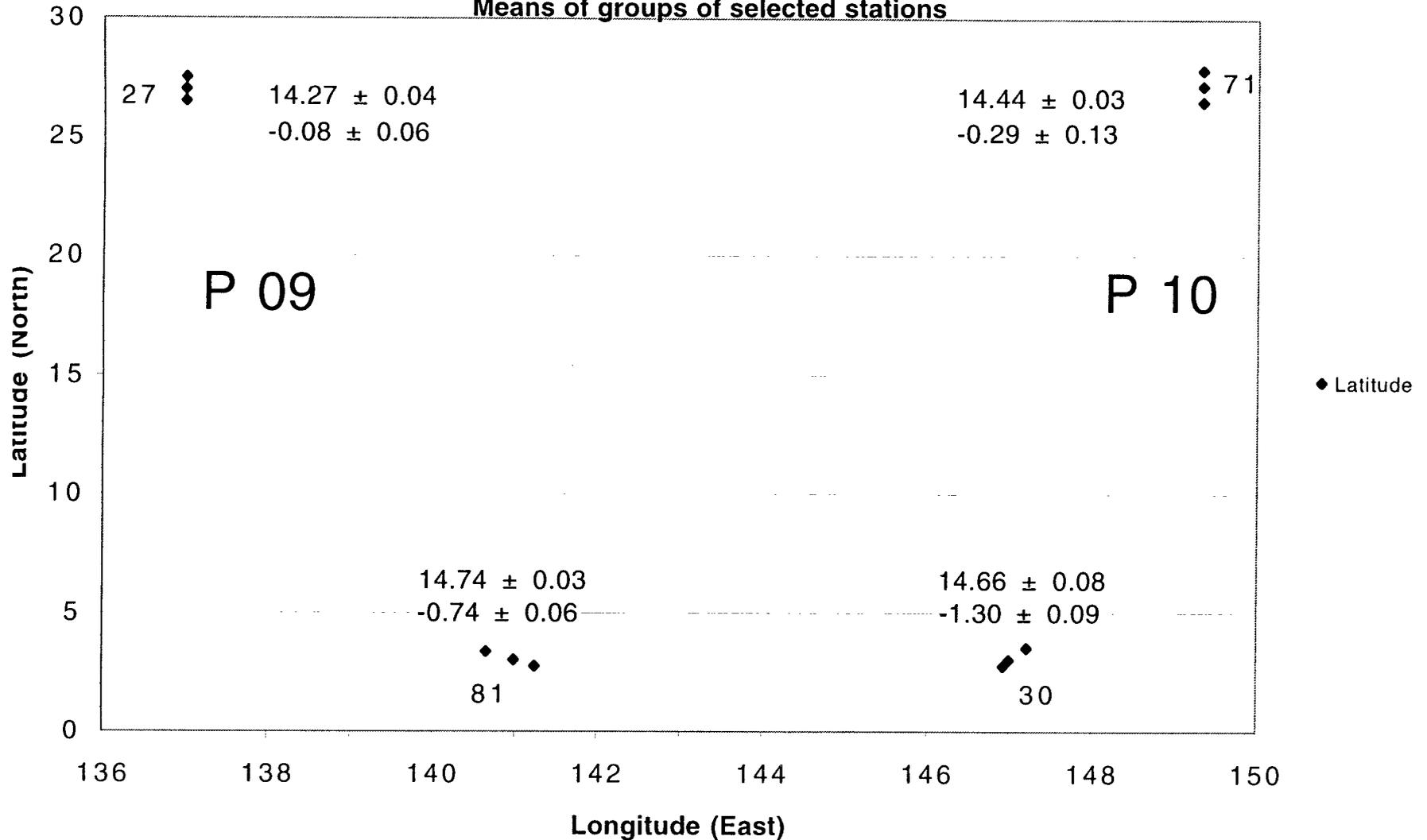
NO₃/PO₄ Intercept Values: WOCE Cruise P09



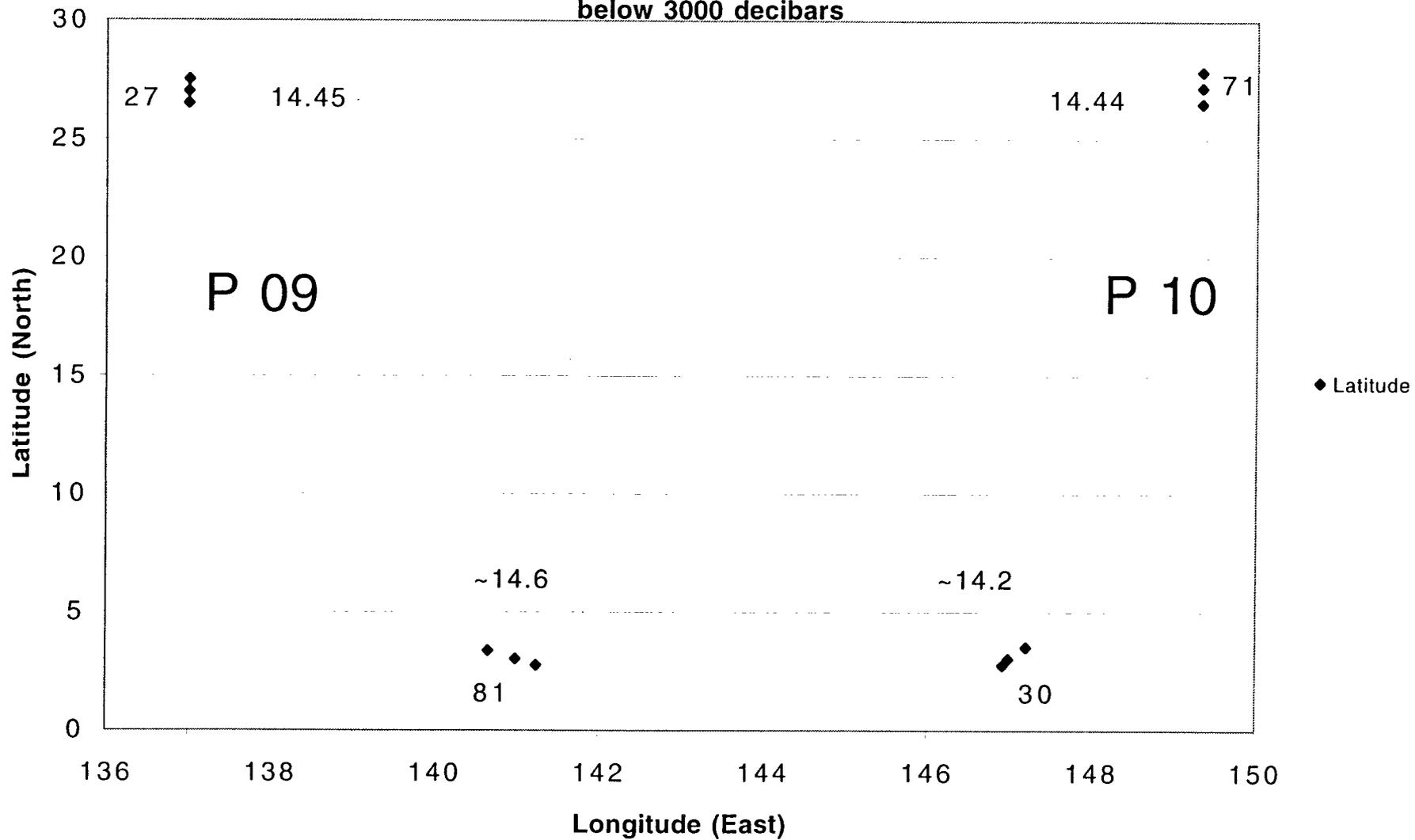
NO₃/PO₄ Ratio Values: WOCE Cruise P09



Stat Positions Cruise 09 &10
NO3/PO4 Ratios and Intercepts
Means of groups of selected stations



Stat Positions Cruise 09 &10
NO₃/PO₄ Ratios from discrete depths
below 3000 decibars



Comments on DQ Evaluation of WOCE P09 CTD data

(Michio AOYAMA)

29 March 1996

General:

The data quality of WOCE P09 CTD data (EXPOCODE: 49RY9407_1 & 49RY9407_2) and the CTD salinity and oxygen found in dot sea file are examined. The individual 2 dbar profiles were observed in temperature, salinity and oxygen by comparing the profiles obtained in the same basin. The 105 profiles of P09 CTD data were divided into five groups described in the cruise report as listed below;

Station number	Corresponding basin name
from 1 to 28	Shikoku Basin
from 29 to 33	
from 33 to 65	West Mariana Basin
from 65 to 85	West Caroline basin
from 85 to 105	Eauripik Ridge

The CTD salinity and oxygen calibrations are examined using the water sample data file p1 0.mka. DQE used the original water sample data flagged "2" only for the DOE work.

Details:

1. CTD profiles

CTD temperature, salinity and oxygen look good in general. CTD salinity profiles look a little bit noisy even in the deeper layers among the first 68 stations, while the quality of CTD salinity profiles becomes better among the stations from 69 to 105. DQE guesses that the first CTD unit used on the P09 cruise might have a problem from the beginning of the cruise. DOE also observed clear salinity spikes in a few CTD files obtained by both first CTD unit and second CTD unit. DOE also observed spikes and unreasonable values in the oxygen profile for a few stations.

Details for each problem are listed in Sec. 3.

2 Evaluation of CTD calibrations to water samples

2.1 Salinity calibration;

Standard deviation of D_s , D_s = CTD salinity in dot sea file - bottle salinity, is 0.0186 psu for all data and 0.00806 psu for deeper than 2000 dbar, respectively. These values are fairly large considering the required accuracy of CTD salinity and sample water salinity.

The histogram of D_s for all depths shows a non-symmetric distribution having a bias of negative D_s (fig.1). For the deep salinity fit, DQE also observed the non-symmetric

distribution having a bias of positive Ds (fig. 2). Ds vs. pressure plot shows the strong pressure dependency of Ds (fig. 3). This pressure dependency can explain the non-symmetric distributions and opposite sign of biases in the histograms of Ds for all depth and deep.

Since the deep water sample salinity data among the first 60 stations bounced toward fresher values and pressure dependency mentioned above, standard deviation of Ds might account for a larger value of 0.00806 psu than one would expect from good salinometer operation and CTD salinity calibration.

After flagged out the fresher values as suggested by DQE, standard deviation of Ds becomes 0.00115 psu for deeper than 2000 dbar. Although this smaller value of 0.00115 psu is well enough, the histogram of Ds for deeper than 2000 dbar still shows a non-symmetric distribution (fig. 4), DQE suggests that further/additional correction will improve the quality of CTD salinity.

2.2 Oxygen calibration;

Although the Dox, Dox = CTD oxygen in dot sea file - bottle oxygen, histogram for all depths (fig. 5) looks symmetric, Dox has a strong pressure dependency as shown in fig. 6. DQE also observed that this pressure dependency of Dox was unquestionable at the beginning of the cruise but settled down as the cruise progressed. Dox vs. pressure plots for the stations 1 to 10 (fig. 7), 21 to 30 (fig. 8), 41 to 50 (fig. 9) and 60 to 69 (fig. 10) show the gradual transition of the pressure dependency of CTD oxygen sensor. DQE strongly suggest further correction for CTD oxygen calibration considering the characteristics of the pressure dependency using several station groupings.

3. The following are some specific problems that should be looked at:

- stn. 11 Theta-salinity plot for stn. 11 does not overlay the theta-salinity plots for nearby stations. It may have originated from higher salinity and/or higher temperature. Check the conductivity scaling factor and/or temperature profile.
- stn. 37 from ca. 3230 dbar to 3427 dbar; oxygen shows extremely high. Suggest flag "4".
- stn. 53 from 3100 dbar to 3200 dbar: Oxygen spikes of 4 - 5 mol/kg were observed among these depths. Suggest flag "4".
- stn. 56 Many oxygen spikes were observed in the deep. Suggest flag "3" or "4".
- stn. 58 Many oxygen spikes were observed in the deep. Suggest flag "3" or "4".
- stn. 58 at 4140 dbar, 4213 dbar and 4315 dbar: Salinity spikes were observed at these depths. Suggest flag "4".
- stn. 62 within deepest 60 dbar: Noisy salinity profile. Suggest flag "T".
- stn. 69 at 2833 dbar: Salinity shift of 0.004 pss was observed clearly. Suggest check the whole profile.
- stn. 78 between 3700 dbar and 4200 dbar: Salinity profile looks noisy. Suggest flag "3".
- stn. 92 at 3379 dbar: Salinity spike/noise observed. Suggest flag "4".
- stn. 103 at 2333 dbar: Salinity spike/noise observed. Suggest flag "4".

Figure 1

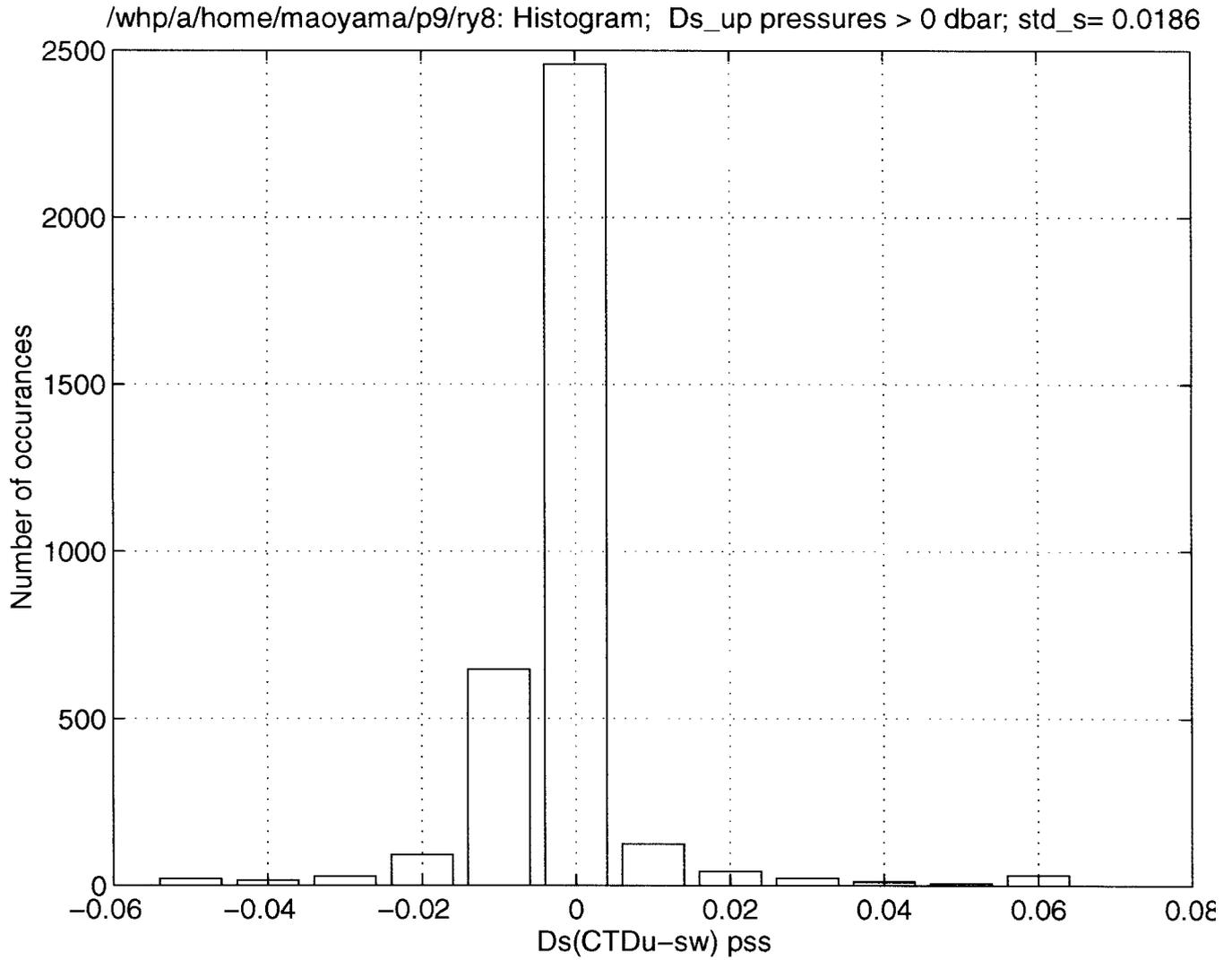


Figure 2

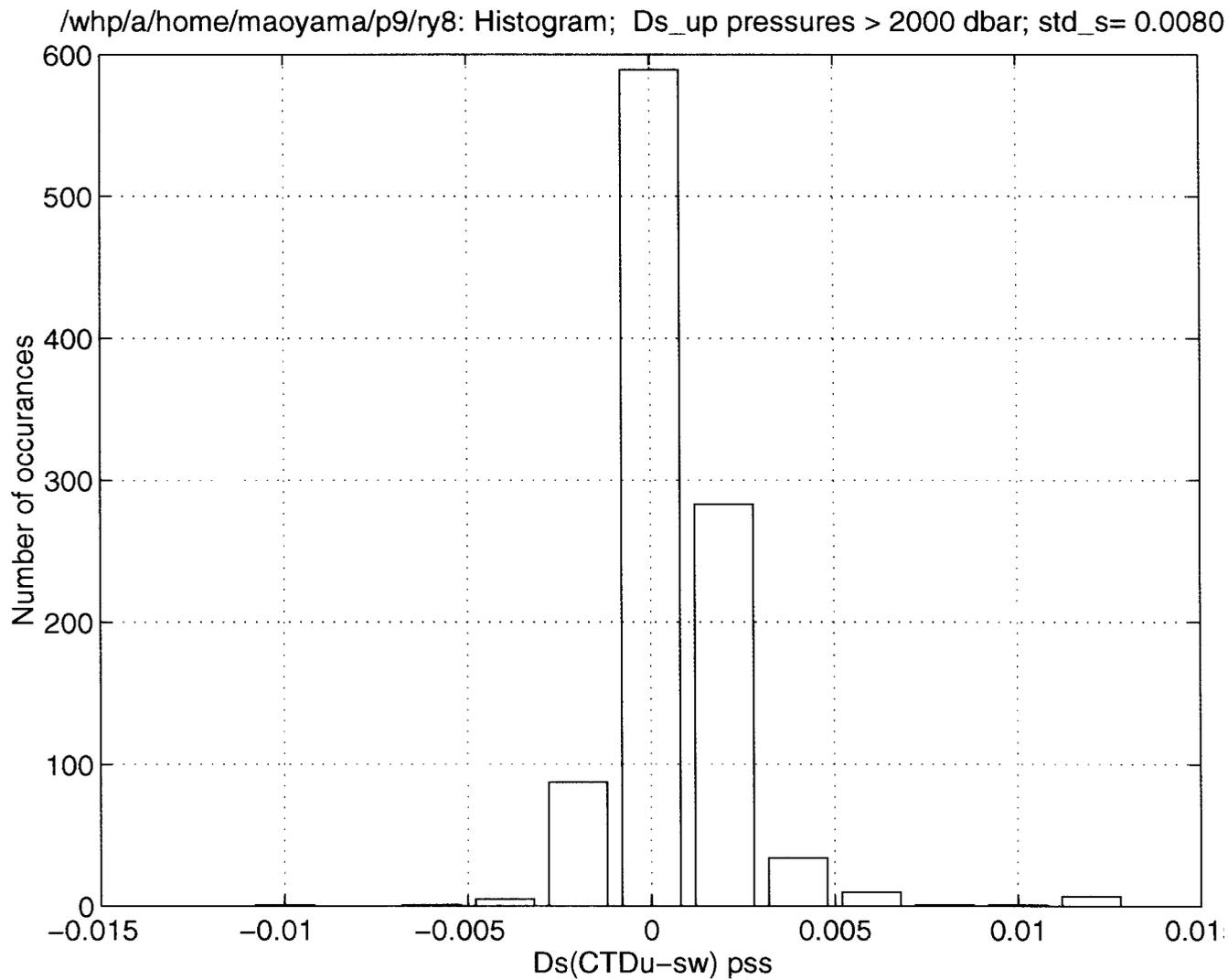


Figure 3

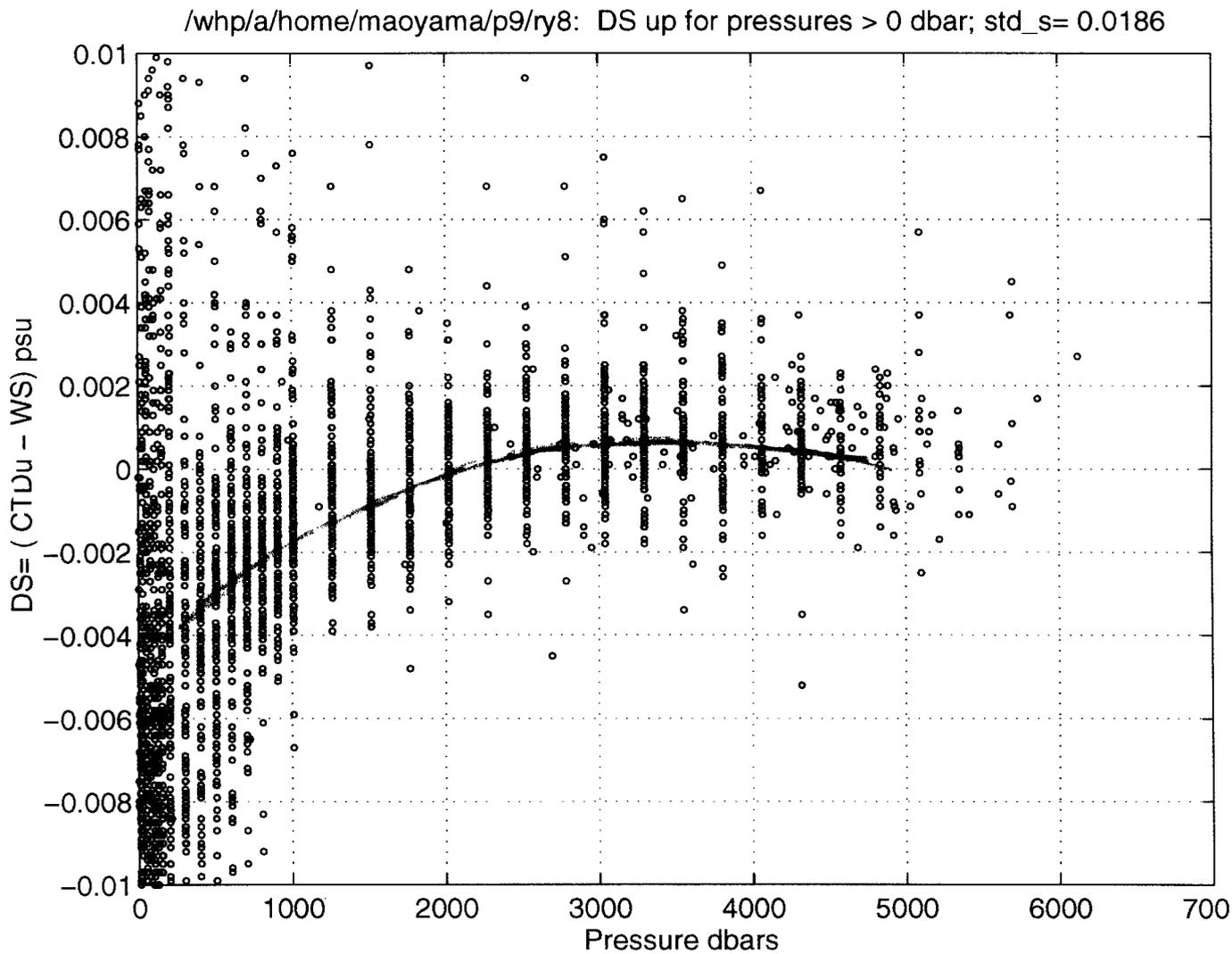
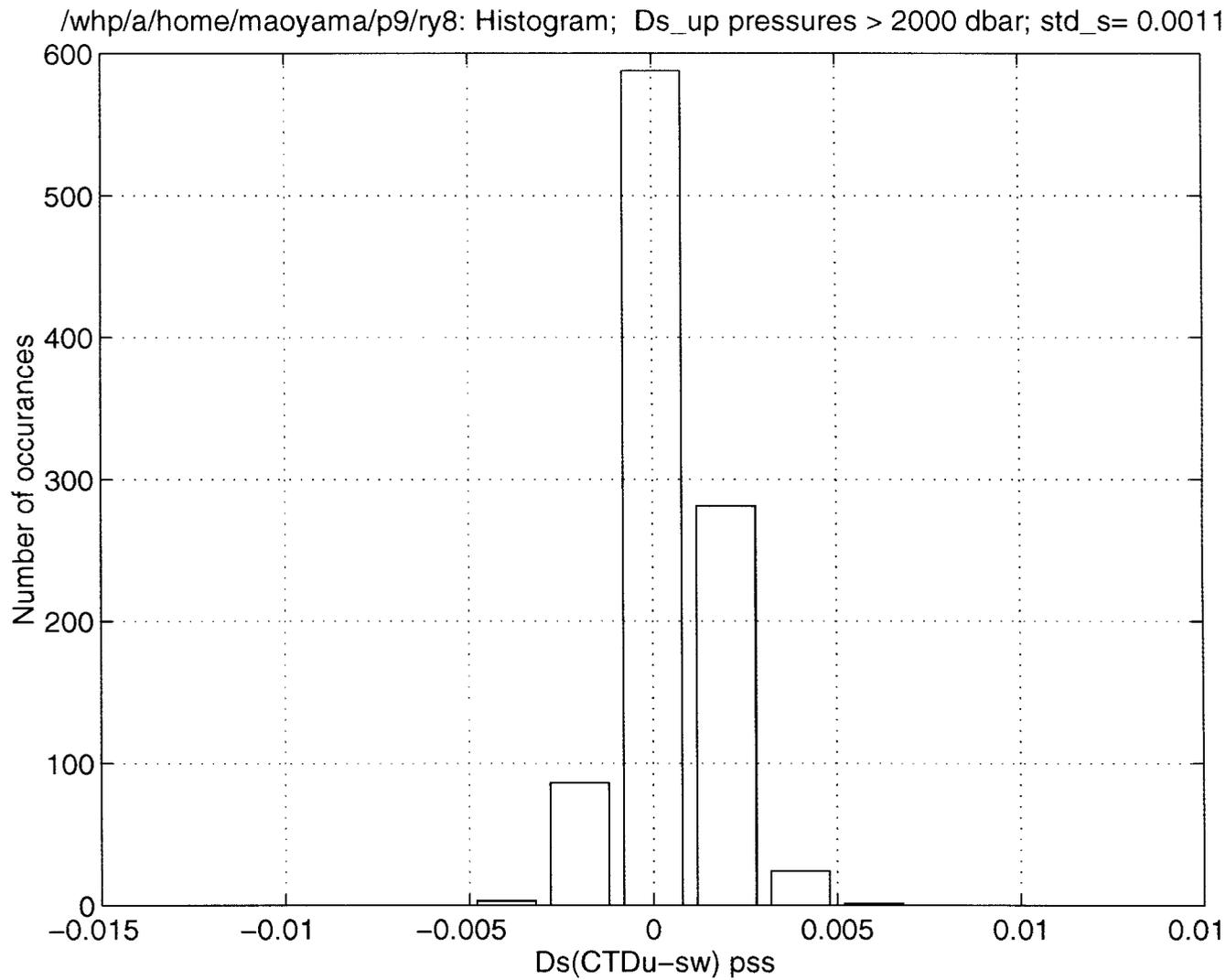


Figure 4



After DQE

Figure 5

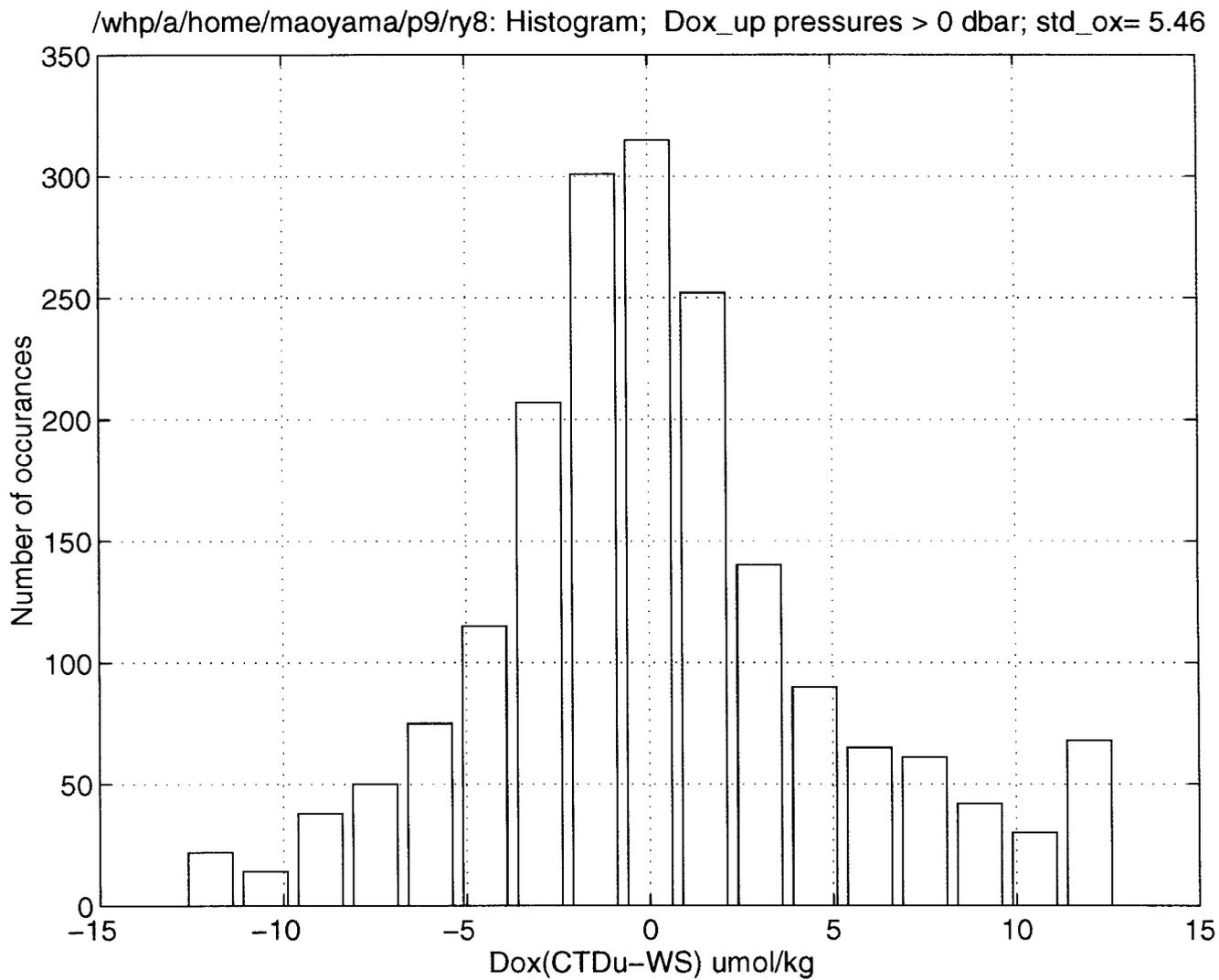


Figure 6

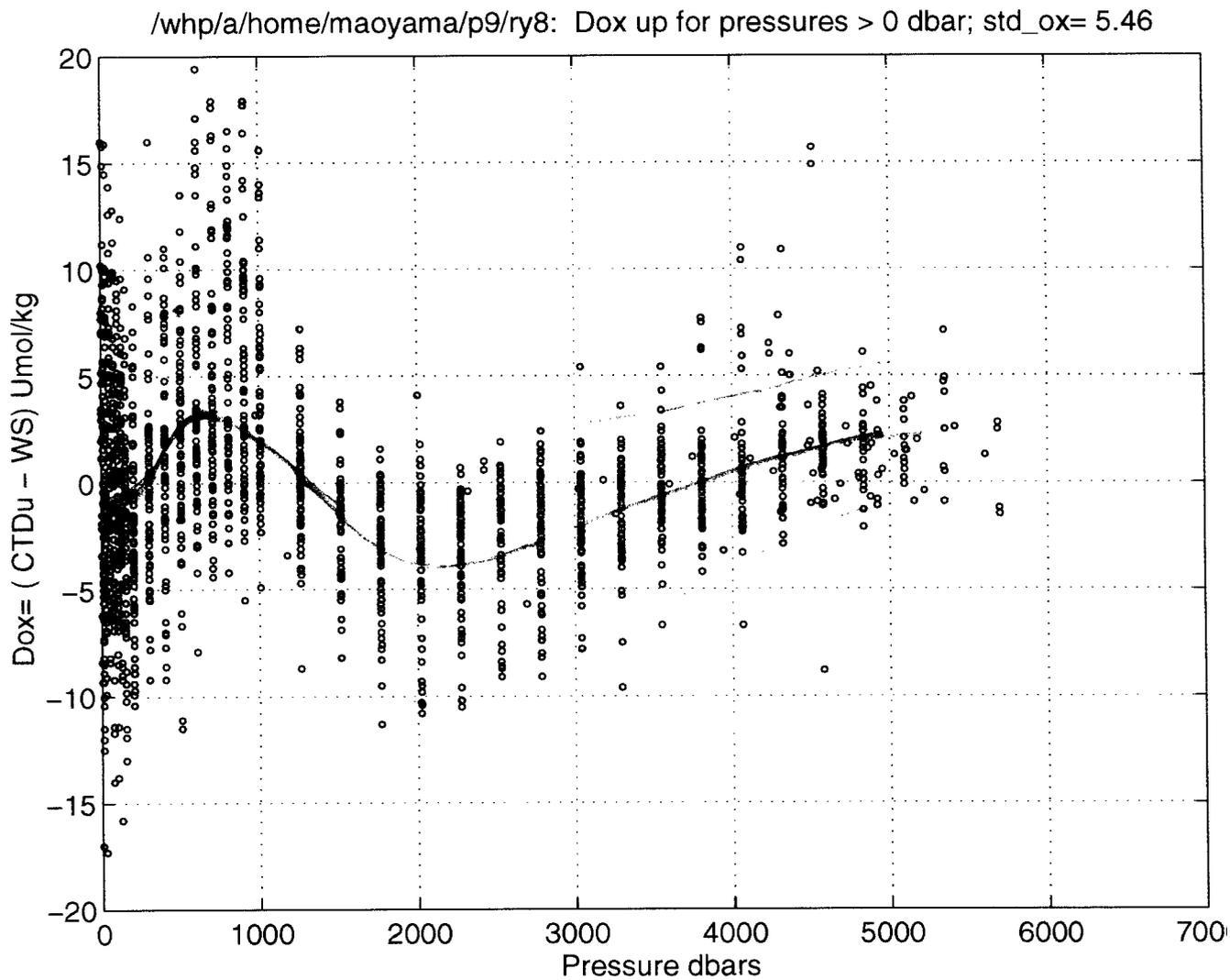


Figure 7

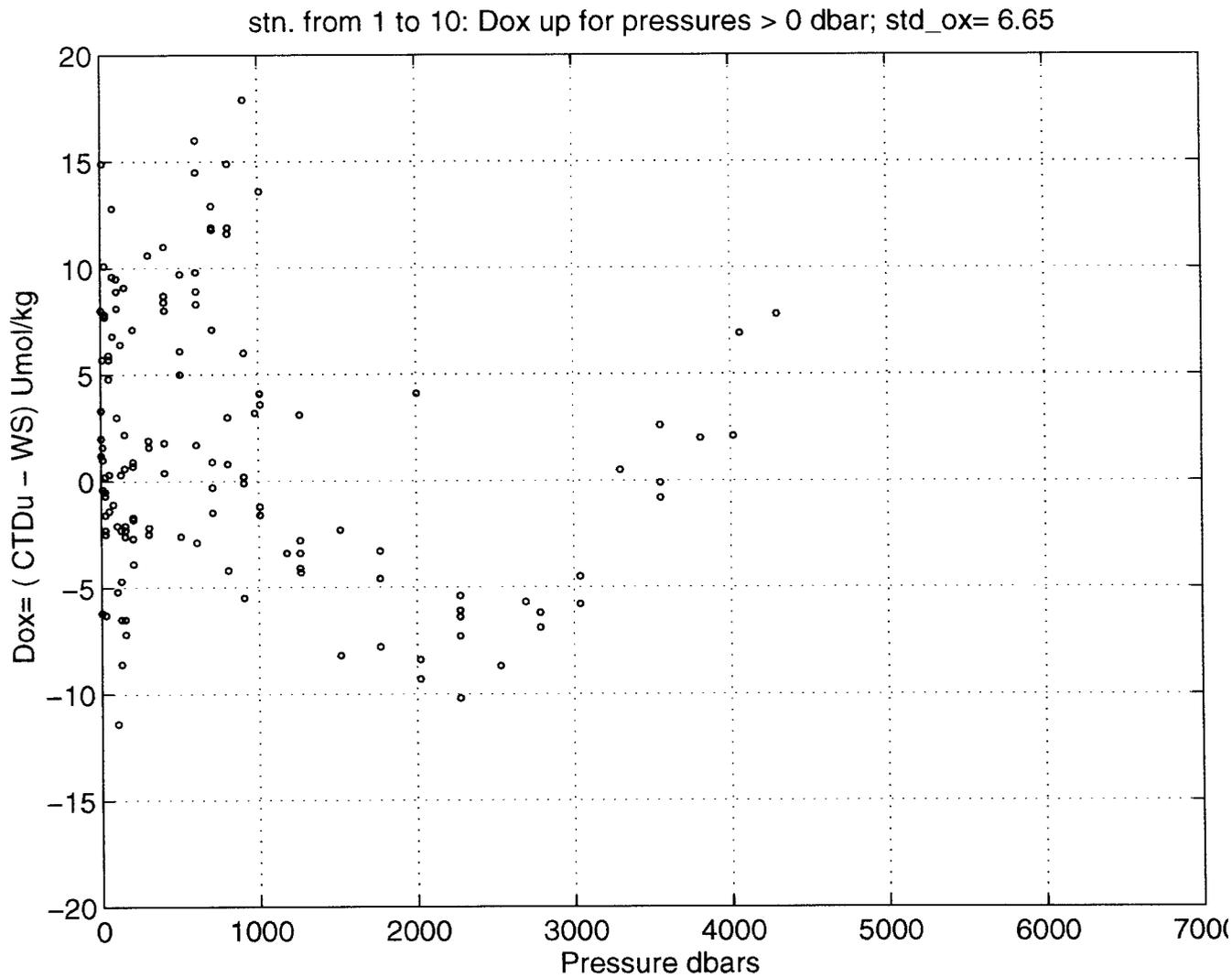


Figure 8

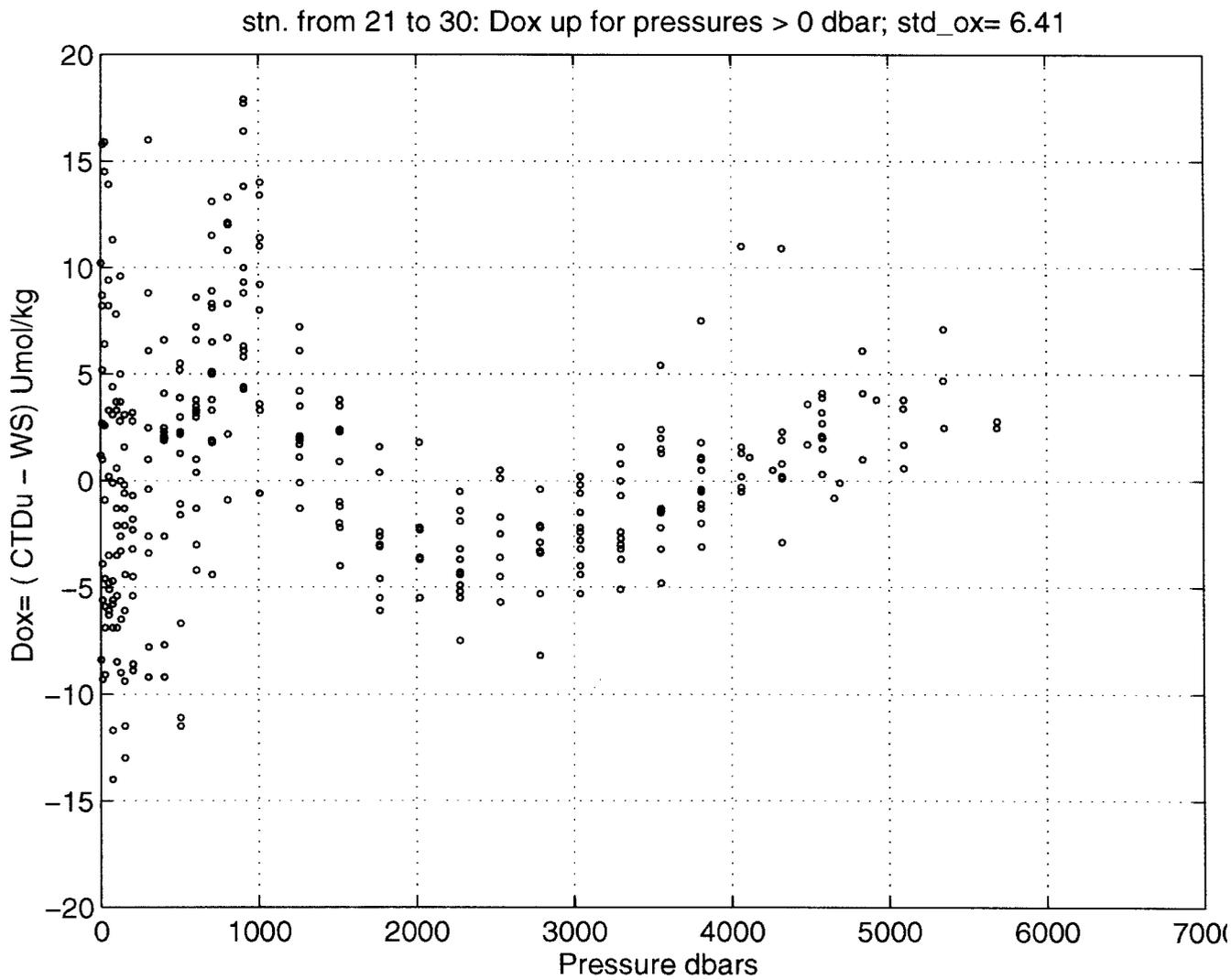


Figure 9

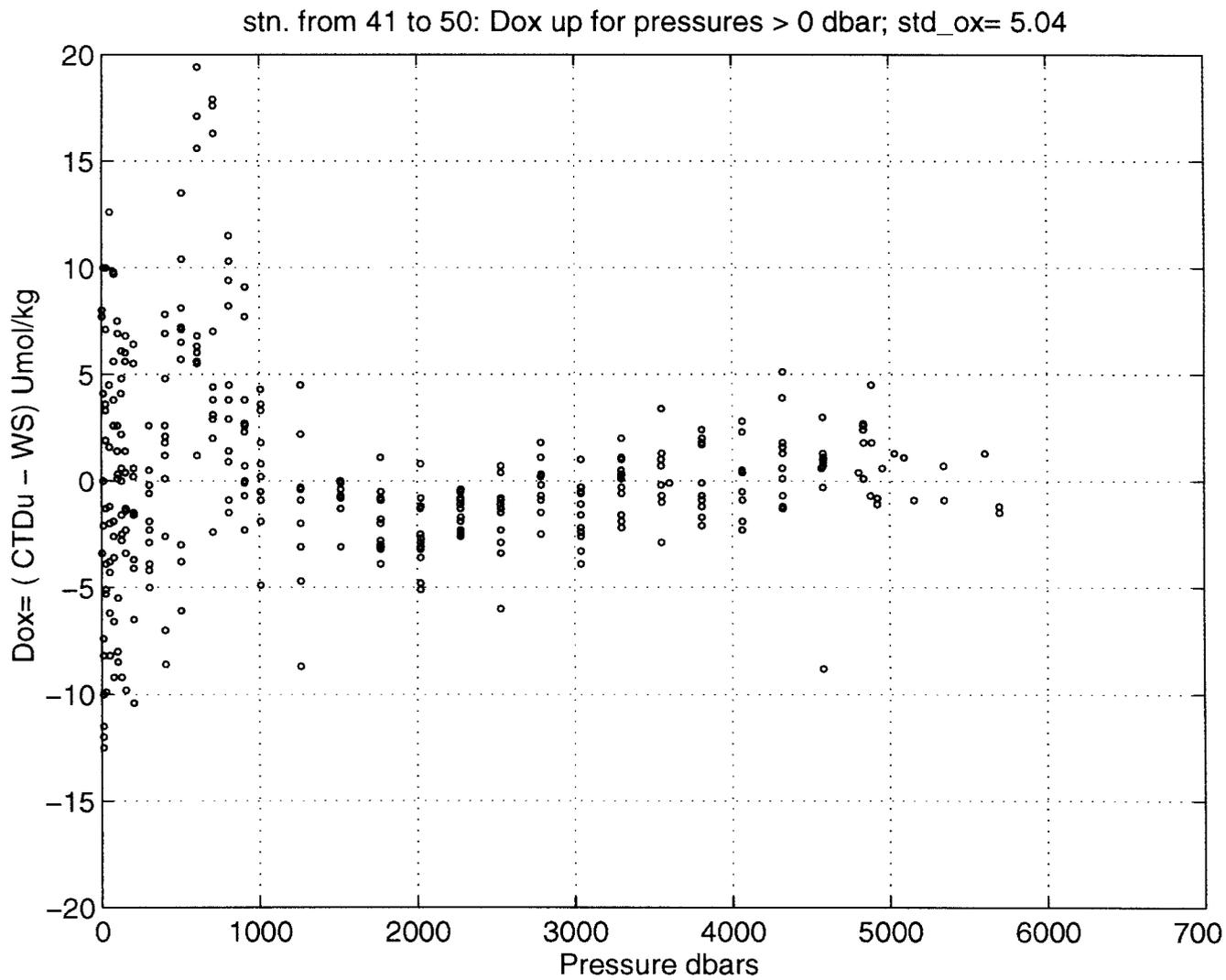
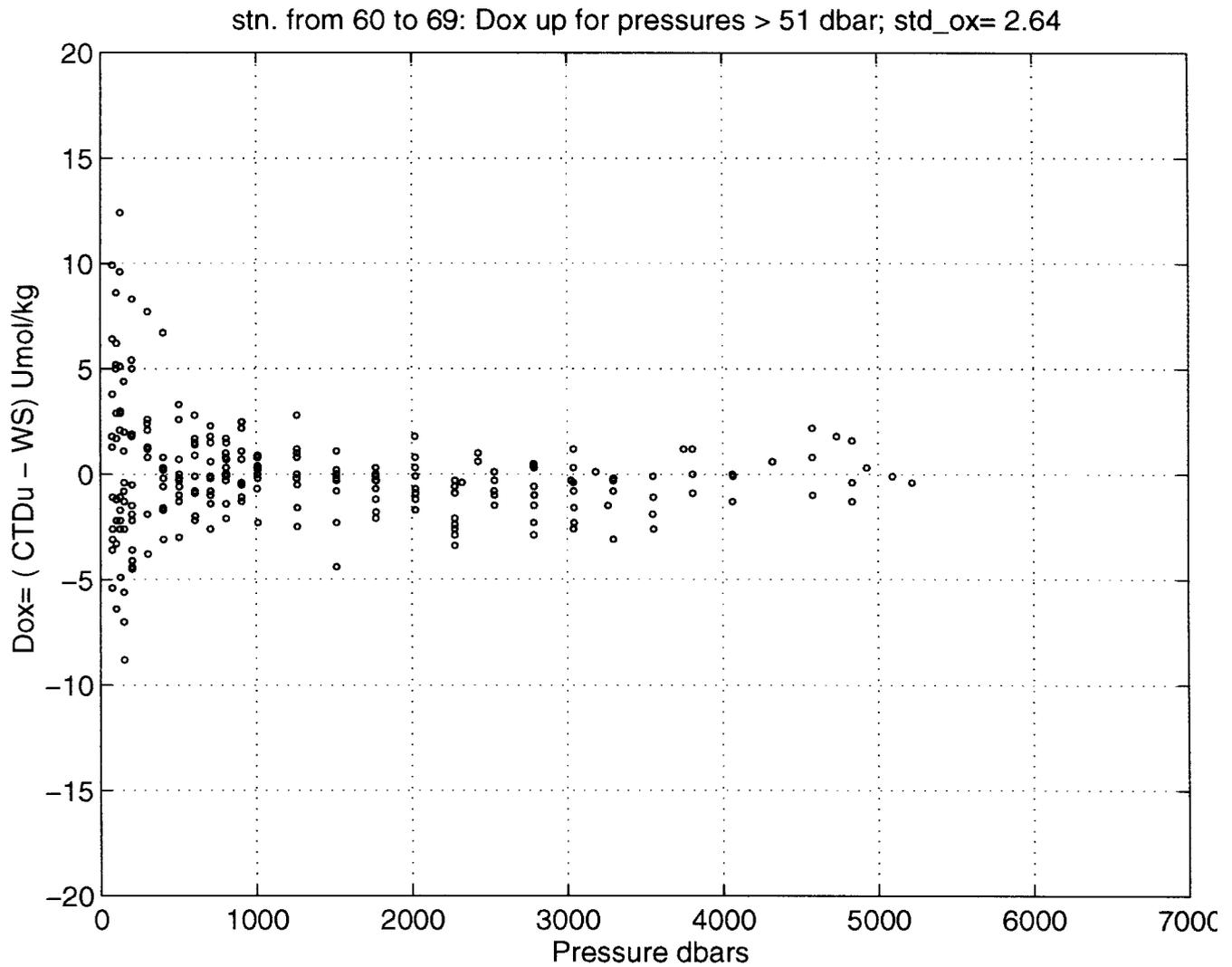


Figure 10



Final CFC Data Quality Evaluation (DQE) Comments on P09.
(David Wisegarver)
Dec 2000

Based on the data quality evaluation, this data set meets the relaxed WOCE standard (3% or 0.015 pmol/kg overall precision) for CFCs. Detailed comments on the DQE process have been sent to the PI and to the WHPO.

The CFC concentrations have been adjusted to the SIO98 calibration Scale (Prinn et al. 2000) so that all of the Pacific WOCE CFC data will be on a common calibration scale.

For further information, comments or questions, please, contact the CFC PI for this section (Dr. I. Kaneko, ikuo-kaneko@met.kishou.go.jp, or Y. Takatsui, yasushit@jamstec.go.jp, knemoto@mri-jma.go.jp) or David Wisegarver (wise@pmel.noaa.gov).

More information may be available at www.pmel.noaa.gov/cfc.

Prinn, R. G., R. F. Weiss, P. J. Fraser, P. G. Simmonds, D. M. Cunnold, F. N. Alyea, S. O'Doherty, P. Salameh, B. R. Miller, J. Huang, R. H. J. Wang, D. E. Hartley, C. Harth, L. P. Steele, G. Sturrock, P. M. Midgley, and A. McCulloch, A history of chemically and radiatively important gases in air deduced from ALE/GAGE/AGAGE J. Geophys. Res., 105, 17,751-17,792, 2000.

Data Processing History			
Date	Contact	Data Type	Data Status Summary
3/29/96	Aoyama	CTD/S/O	DQE Report rcvd @ WHPO
8/15/97	Uribe	DOC	Submitted
	<p>2000.12.11 KJU File contained here is a CRUISE SUMMARY and NOT sumfile. Documentation is online.</p> <p>2000.10.11 KJU Files were found in incoming directory under whp_reports. This directory was zipped, files were separated and placed under proper cruise. All of them are sum files.</p> <p>Received 1997 August 15th.</p>		
9/15/98	Talley	SUM/BTL	Website Updated
	SUM, S/O, NUTs, CFCs online		
10/30/98	Anderson	NUTs/S/O	DQE nearly complete
5/5/99	Anderson	NUTs/S/O	Letter from DQE to Chief Scientist:
	<p>Enclosed is a DQE report on the hydrographic data submitted to the WHPO for onetime line P9 (49RY9407/1 &2). As it turns out, this is the second review of the data for this cruise, and I think you deserve an explanation.</p> <p>I have recently been employed to do DQE work for the WHPO. Originally this work was coordinated through the WHPO office at the Woods Hole Oceanographic Institution located in Woods Hole, Massachusetts. About two years ago, the WHPO office was moved to the Scripps Institution of Oceanography. Unfortunately, during the transition, some records were misplaced including the original DQE evaluation of these data by M. Aoyama. It wasn't until after I completed my evaluation, the end of 1998, that his report and related records were discovered. This included a copy of correspondence sent to you by Terrence M. Joyce, Director, WHPO, dated 12 June, 1996, with M. Aoyama's DQE report.</p> <p>When the error was discovered, there was some discussion as to whether I should continue my efforts on this cruise. It was decided that since I had done as much work as I had, I should complete this task.</p> <p>Many of the items that I flagged had already been flagged by M. Aoyama, had been reviewed by your personnel, and differences in Q1 and Q2 flags had been resolved. These items will not be found in my listing. There are a few other items that I have flagged, only a few of which would affect the use of or interpretation of these data by other users.</p> <p>I found the nitrate/phosphate data plots of particular interest. As a result I went well beyond what might normally be done by a DQ Evaluator in examining the patterns in these plots. I have not resolved the question of the deep nitrate data discrepancies, but this is something that I will be looking at as I evaluate other cruises.</p>		
5/10/99	Anderson	NUTs/S/O	DQE Report rcvd @ WHPO
12/6/99	Huynh	CTD/BTL/SUM	Data Update
	New data files received		
4/14/00	Key	DELC14	Data are Public
	As of 3/2000 the 2 year clock expired on the last of the Pacific Ocean C14 data (P10). All Pacific Ocean WOCE C-14 data should be made public.		

4/19/00	Bartolacci	DELC14	Website Updated
	P09 Changed to indicate WHPO has data.		
6/7/00	Schlosser	HELIUM/DELHE3/NEON	Submitted
8/4/00	Saiki	CTD/BTL	Data are Public:
	<p>I am pleased to inform you that the PIs and participants of the one-time and repeat cruises conducted by the Japan Meteorological Agency's vessels agreed to change most of the data status to public. The only exception is the He/Tr of P09 and He/Tr, C-14 of P24.</p> <p>In this respect, a list of the cruises which we wish to change the status from non-public to public follows for confirmation.</p> <p>P09 Salinity, Oxygen, Nutrients, CFCs, C-14 and CTD</p>		
9/26/00	Schlosser	TRITUM	No Data Submitted; See Note:
	<p>Tritium data will be submitted later (after intercalibration). We hold tritium data for a subset of our He lines only. WHP lines with tritium: S04P, S04I (East), I08S, I09S, P09</p>		
9/29/00	Talley	He/Tr	Data Update; Schlosser responsible for all He/Tr
	<p>There will be one data set submitted from L-DEO. It covers the shallow water column for tritium and He and the deep water column for He only. - P. Schlosser</p>		
1/5/01	Kappa	DOC	Doc Update txt version created
1/8/01	Huynh	DOC	Website Updated; txt version online
2/16/01	Schlosser	HELIUM/DELHE3	Data NonPublic; final calibration not yet done
	<p>Thanks for your message. The reason that the he data are classified non-public is probably due to the fact that the final calibration has not yet been carried out. If there is a way to make them public with the note of caution that a small correction might be applied later, we should move the data into the public domain. we probably wanted to look at a 'funny' feature of elevated tritium concentrations that seem to fall along a certain isopycnal. We will transmit the tritium data within a short time (I would like to have another look at this feature and correlate it with some other properties).</p>		
2/26/01	Schlosser	HELIUM/DELHE3	Data are Public
	<p>Minor corrections may be needed post-intercal. Effort.</p> <p>Following up on bill Jenkins's message, I would like to ask you to make public all Ideo woce tritium/he data that have been submitted to you. Because the tritium/he community has not yet finished the final calibration of the data, I might have to apply minor corrections to these data once the intercal. effort has been completed. Our acce work was funded over a 5-year period that ended in 2000. Consequently, this data set is further behind in quality control before submission, but I expect that we will get these data ready soon.</p> <p>SR3 was never funded in a 'regular' fashion, but I used NOAA corc funds to keep the measurements of this sample set moving. I expect to finish the analyses this summer and submit them in fall.</p>		

3/29/01	Kaneko	CFCs/NUTs/C14/CO2	Update Needed; See Note:
	<p>Through DQE of P9-CFCs, we found considerable amount of errors in CFCs sampling layers at Stas.15, 33, 66, 73. These errors were occurred when CFC data were merged with the other property data.</p> <p>For the second cast at Sta. 66, three sampling bottles and layers of oxygen, nutrients, radio-carbon and total carbon were wrong. Oxygen value drawn from bottle 5 should be re-calculated because density used for the conversion from mol/l to mol/kg is changed.</p> <p>Mr. Takatsuki (yasushit@jamstec.go.jp) is now reconstructing new data set of water sampling. He will send it to WHPO/SIO via FTP, as soon as possible.</p>		
4/9/01	Takatsuki	CFCs/NUTs/C14/C O2	DQE Issues Resolved
	<p>The Bottle File has the following parameters: OXYGEN,SILCAT,NITRAT,NITRIT,PHSPHT,CFC-11,CFC-12,DELC14,TCARBN. The Bottle File contains: CastNumber StationNumber BottleNumber SampleNumber TAKATSUKI, YASUSHI would like the data PUBLIC. And would like the following done to the data: correct errors in CFCs (Stn.15,33,66,73) and Nutrients /Total Carbon /C-14 (Stn.66)</p>		
6/22/01	Muus	HELIUM	Submitted/not on web
	<p>Helium received June 7, 2000: /usr/export/html-public/data/onetime/pacific/p09/original/2000.06.07_P9_DOC_SEA/P9HeNe.SEA/P9HeNe.SEA and made public by P Schlosser Feb 26, 2001, are not yet on web bottle file. (19980914WHPOSIOSA)</p>		
6/22/01	Uribe	CTD/BTL	Website Updated; CSV File Added
	<p>CTD and Bottle files in exchange format have been put online.</p>		
9/14/01	Muus	CFCs	Data Merged into BTL file; merge notes follow:
	<p>Notes on P09 CFC merging Sept 14, 2001. D. Muus 1 New CFC-11 and CFC-12 from: /usr/export/html-public/data/onetime/pacific/p09/original/20010907_P09_CFC_UPDT_WISEGARVER/20010907.121249_WISEGARVER_P09/20010907.121249_WISEGARVER_P09_CFC_DQE.dat merged into SEA file received from web, Sept 7, 2001 (19980914WHPOSIOSA) 12. No SEA file QUALT2 words so added QUALT2 identical to QUALT1 prior to merging. 13. .SEA file name changed from p09hy.txt to p09_hy.txt. 14. .SUM file name p09su.txt and text left unchanged. 2 Exchange file checked using Java Ocean Atlas.</p>		
9/18/01	Muus	BTL/DOC	Website Updated
	<p>New CSV file w/ updated CFCs now online. Created directory in p09/orignal for new files and moved new file to p09 directory. New bottle and exchange files are now on line</p>		
9/18/01	Muus	CFCs	Website Updated
	<p>New btl file w/ updated CFCs now online</p>		
11/9/01	Kappa	DOC	Doc Update
	<p>added PDF version w/ figs, cfc/ctd/btl dqe reports in both versions</p>		