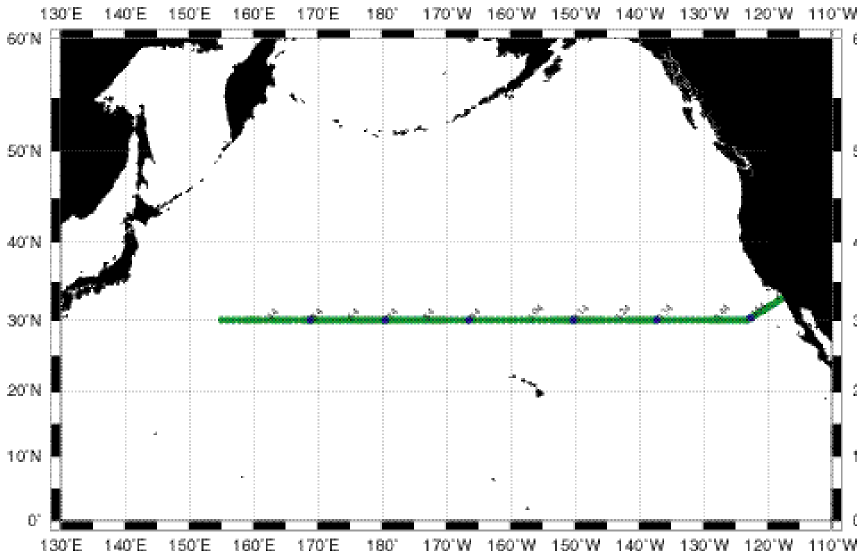
A. Cruise Narrative: P02E (along 30° N in the North Pacific)



A.1. Highlights

WHP Cruise Summary Information

WOCE section designation	**P02E**
Expedition designation (EXPOCODE)	**492SSY9310_1-2**
Chief Scientist(s) and their affiliation	**Tamotsu Bando /MSA***
Dates	1993.OCT.14 - 1993.NOV.27
Ship	S/V Shoyo
Ports of call	Leg 1: Tokyo, Japan to Honolulu, USA Leg 2: Honolulu, USA to San Diego, USA
Geographic boundaries of the stations	32° 58.2' N 155° 5.1' E 117° 33.1' W 29° 59.4' N
Number of stations	129
Floats and drifters deployed	unknown
Moorings deployed or recovered	unknown
Contributing Authors:	H. Yoritaka

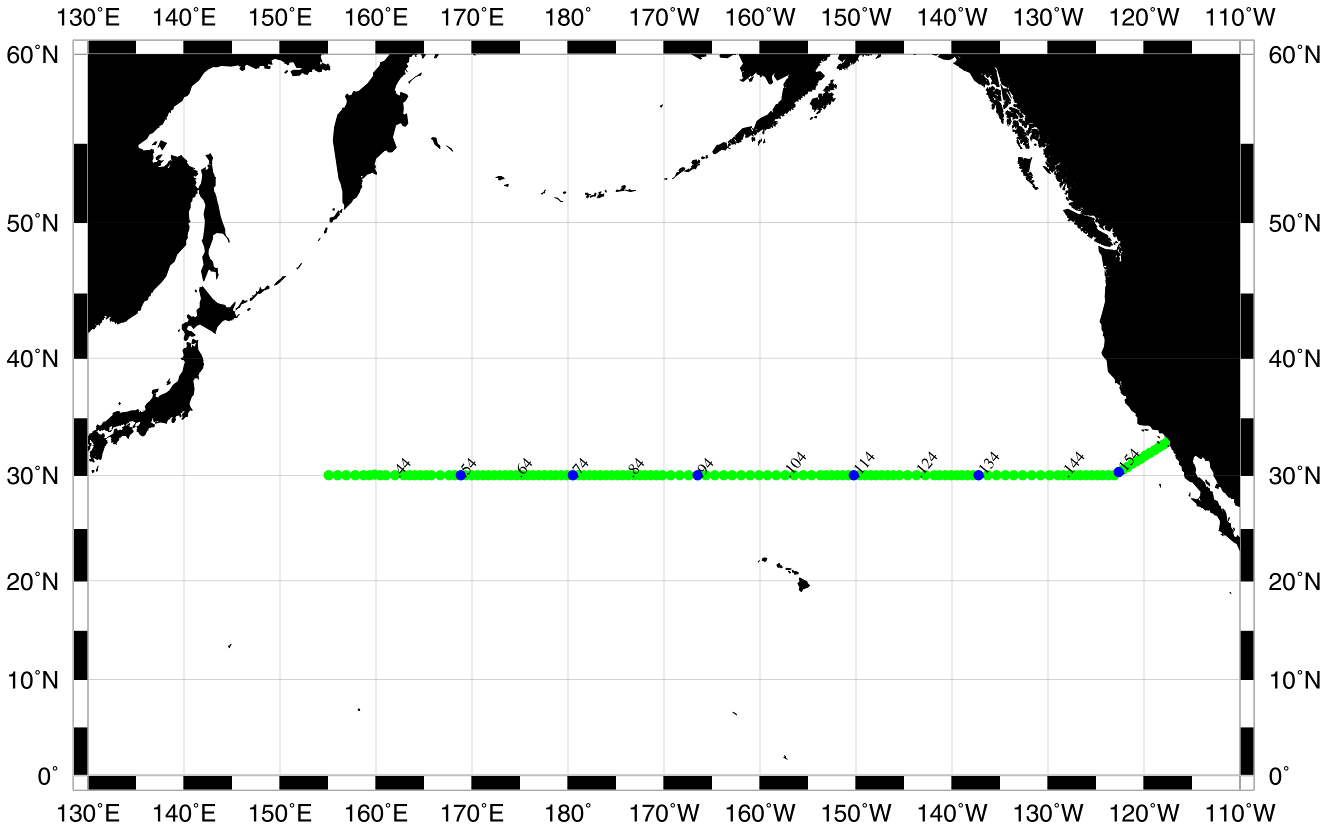
*__Chief Scientist__
Hydrograpic Department, Maritime Safety Agency
Tsukiji 5-3-1, Chuo-ku, Tokyo, 104, Japan
Contact Person:
Hiroyuki Yoritaka
Ocean Research Department, Japan Marine Science and Technology Center
Natsushima-cho 2-15, Yokosuka, 237, Japan
E-mail: yoritaka@jamstec.go.jp Phone: +81-468-66-3811 ext.357 Fax: 81-468-65-3202

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
	CTD - general
	CTD - pressure
Geographic boundaries of the survey	CTD - temperature
Cruise track (figure)	
Description of stations	
Description of parameters sampled	
	Salinity
Principal Investigators for all measurements	
Cruise Participants	
	Data Status Notes

Station locations for P02E (BANDO, 1993)



Produced from .sum file by WHPO-SIO

A.2 Cruise Summary

Cruise Track

The P2 line, along 30N in the North Pacific, consists of four cruises and includes 178 stations. P2E occupied the stations from 155-05E to eastern boundary of the Pacific.

Number of Stations

A total of 131 CTD/rosette stations were occupied using a GO 24 bottle rosette sampler with 23 1.2-liter Niskin bottles, and a NBIS Mk IIIB CTD equipped with Benthos altimeter.

Sampling

The water sample measurement were made for salinity, oxygen, phosphate, silicate and nitrate+nitrite. The sampling depths in db were 50, 100, 200, 300, 400, 500, 600, 700, 800, 900, 1000, 1250, 1500, 1750, 2000, 2250, 2500, 3000, 3500, 4000, 4500, 5000, 5500 and 6000.

A.3 List of Principal Investigators

List of parameters to be measured and the Principal Investigator(s) for each is as follows;

Parameter	Principal Investigator(s)	
CTDO/rosette	Masao Fukasawa	School of Marine Science, Tokai University
	Ichiro Yasuda	Tohoku Regional Fisheries Research Institute
	Hiroyuki Yoritaka	Hydrographic Department, MSA
Salinity	Hiroyuki Yoritaka	Hydrographic Department, MSA Oxygen
	Katsumi Yokouchi	Tohoku Regional Fisheries Research Institute
Nutrients	Chizuru Saito	National Institute for Environmental Studies

A.4 List of Cruise Participants

Cruise participants and their responsibilities are as follows;

Participant	Affiliation	Responsibilities
Tamotsu Bando	HD, MSA	Chief Scientist, CTD, S, O_2
Yoshiyuki Iwanaga	HD, MSA	PO_4, SiO_2
Hiroyuki Yoritaka	HD, MSA	CTD, S, O_2
Naoki Konishi	HD, MSA	PO_4, SiO_2
Masaharu Namiki	HD, MSA	CTD, PO_4, SiO_2, pCO_2
Masao Fukasawa	Tokai Univ.	CTD, S, O_2
Masahisa Oyaizu	Tokai Univ.	NO_3
Mamoru Tamaki	Tokai Univ.	NO_3
Ken-ichi Amaike	Tokai Univ.	NO_3
Hideki Kinoshita	Tohoku Univ.	O_2

C Hydrographic Measurement Techniques and Calibrations

C.1 Sample water salinity measurements

(H. Yoritaka)
November 1996

Salinity Sample Collection

The bottles in which the salinity samples are collected and stored are 125 ml brown glass bottles with rubber plugs. Each bottles were rinsed three times and filled with sample water. Salinity samples were stored for about 24 hours in the same laboratory as the salinity measurement was made.

Instruments and Method

The salinity analysis was carried out by a Guildline Autosal salinometer model 8400A. After three times rinse with sample water, double conductivity ratio were measured at fourth and fifth time. If difference between fourth time and fifth time was more than 0.00003 in double ratio, one more measurement was carried out at sixth time. The salinometer was operated in the air-conditioned ship's laboratory at a bath temperature of 24 deg. C. An ambient temperature varied from approximately 22 to 24 deg. C., and repeated rapid lowering and slow rising.

Standard Sea Water

Autosal model 8400A was standardized only before sequence of measurements for each leg, using IAPSO Standard Seawater batch P123. After the standardization, 8400A was monitored with SSW ampoules at every two stations. There was drift in monitoring of SSW, so correction was carried out for sample measurements as follows ;

Leg 1

Station 035-066: Corrected Double Ratio = Measured Double Ratio -0.00005
Station 067-096: Corrected Double Ratio = Measured Double Ratio +0.00008

Leg 2

Station 097-107: Corrected Double Ratio = Measured Double Ratio -0.00000
Station 108-145: Corrected Double Ratio = Measured Double Ratio +0.00012
Station 146-165: Corrected Double Ratio = Measured Double Ratio -0.00002

Duplicate and Replicate Samples Duplicate samples were drawn in the deeper layers in case of shallower water depth than 5000 m. Replicate samples were drawn from three or four Niskin bottles in every station. Standard deviation in the measurements of duplicate and replicate samples were as follows ;

Duplicate	All	0.0023 psu	126 pairs
	>=3000 db	0.0017 psu	81 pairs
Replicate		0.0014 psu	465 pairs.

C.2 CTD Measurements

(Hiroyuki Yoritaka)
November 1996

Equipment, calibrations and standards

1. Neil Brown Mk.IIIB CTD with FSI titanium pressure sensor, Beckman oxygen sensor and Benthos altimeter. Identification S/N 1194 and 1216.
2. General Oceanics 1.2 liter 24 bottle rosette sampler.
3. Eight sets of SIS digital reversing thermometers and digital reversing pressure meters.

The shipboard equipment included the following major units:

1. EG&G deck unit data terminal. Model 1401.
2. NEC PC-9801DA.
3. GO rosette firing module.

The data was backed up in DAT cassette data recorder.

Laboratory calibration of the Mk.IIIB CTD temperature and pressure sensors was carried out as follows;

	Pre-Cruise	Post-Cruise
#1194	WHOI (September 1993)	SEA Co. (January 1994)
#1216	SEA Co.(October 1993)	SEA Co. (January 1994)

According to the pre-calibration dataset (Table 3.1), temperature was corrected by following equation.

$$T_{corrected}=T_{raw}+a0+a1*T_{raw}+a2*T_{raw}^{2}+a3*T_{raw}^{3}+a4*T_{raw}^{4}$$

	#1194	#1216
a0:	+0.0011235	-0.00085089
a1:	-0.00049007	-0.00029946
a2:	+5.4001E-05	-2.5199E-05
a3:	-2.2491E-06	+1.6767E-06
a4:	+3.2474E-08	-2.9987E-08

Table 3.1. Pre-cruise temperature calibration in unit of degrees Celsius.

#1194		#1216	
Standard Temp.	Standard-CTD	Standard Temp.	Standard-CTD
0.9121	+0.0011	1.0092	-0.0012
7.4305	-0.0005	4.9896	-0.0027
15.0790	0.0000	10.1407	-0.0052
22.6401	-0.0001	15.2387	-0.0068
30.4018	-0.0008	20.0647	-0.0084
		25.0394	-0.0096

Table 3.2. Post-cruise temperature calibration.

#1194		#1216	
Standard Temp.	**Standard-CTD**	**Standard Temp.**	**Standard-CTD**
0.1341	+0.0057	0.9992	-0.0011
2.5326	+0.0051	1.9995	-0.0015
5.0047	+0.0043	2.9986	-0.0017
10.0860	+0.0037	3.9981	-0.0018
12.5178	+0.0037	4.9985	-0.0020
14.9969	+0.0040	5.9971	-0.0025
17.6101	+0.0042	6.9977	-0.0028
19.9477	+0.0043	7.9974	-0.0031
24.9453	+0.0048	8.9972	-0.0032
		9.9950	-0.0036
		10.9962	-0.0042
		11.9952	-0.0046
		12.9944	-0.0047
		13.9946	-0.0054
		15.1495	-0.0051
		20.0740	-0.0078
		25.0014	-0.0066
		29.8740	-0.0088

From the pre- and post-cruise temperature calibrations, temperature sensor errors during the cruise are estimated to be within 0.001C for 0-8C, within 0.002C for >8C on #1216. On #1194, there were 0.004C differences between pre- and post-cruise calibrations. Differences in temperature between CTD and digital reversing thermometer of the deepest layer over the cruise showed #01-1194 was 0.002C lower in temperature than #01-1216. It was consistent with pre-cruise calibration. Only one titanium pressure sensor (S/N 1333) was used over the cruise, while CTD was changed. According to the pre-calibration dataset (Table 3.3), pressure was also corrected by following equation.

$$P_{corrected}=P_{raw}+a0+a1*P_{raw}+a2*P_{raw}^{2}+a3*P_{raw}^{3}+a4*P_{raw}^{4}-Pdeck$$

a0: 0.039722
a1: -0.0017326
a2: 4.6731E-07
a3: -6.5441E-11
a4: 3.5102E-15

In the six times down/up calibration (up to 1000, 2000, 3000, 4000, 5000, 6000 db), there were differences between down-cast and up-cast within 0.5 db, so pressure at up-cast was corrected by equation same as down-cast.

Table 3.3. Pre-cruise pressure calibration in unit of decibar.

#1333 Standard Pres.	Standard-CTD
0.0	0.0
98.	-0.1
293.9	-0.4
489.9	-0.7
979.7	-1.3
1959.5	-2.0
2939.2	-2.4
3918.9	-2.7
4898.7	-2.9
5878.4	-3.1

Table 3.4. Post-cruise pressure calibration in unit of decibar.

#1333 Standard Pres.	Standard-CTD
0.0	0.0
98.0	0.1
293.9	-0.5
489.9	-0.9
979.7	-1.8
1959.4	-2.8
2939.1	-3.9
3918.8	-4.4
4898.5	-4.9
5878.1	-5.7

From the pre- and post-cruise temperature calibrations, pressure sensor errors during the cruise are estimated to be 2.6 dbar at 6000 dbar depth.

Equipment performance

CTD

Both oxygen sensors on #1194 and #1216 were out of condition. So we change CTD twice for maintenance of oxygen sensor, after station 041 and 74. But they did not recovered. At station 156, data from CTD #1194 included noise, so we change CTD for #1216. Summary of employment for CTD is as follows;

Station 035-041: #1194
Station 042-074: #1216
Station 075-156: #1194
Station 157-165: #1216

Another external sensors, pressure sensor and altimeter were in good condition.

C.3 CTD Data Processing

The data processing procedure was as follows;

(1) Noise removal
(2) P and T data correction by laboratory calibration
(3) Time lag filtration for T data for adjusting to C sensor response
(4) C data correction for sensor modification
(5) Time lag filtration for P and C data for adjusting to T sensor response
(6) Pressure averaging
(7) C data correction by water sampling data
(8) Pressure centering

(1) Noise removal Firstly, we perform first difference check in which if a data value jumps more than a certain critical value, the data was marked and interpolated. The critical values are 1.0 dbar in pressure, 0.02 degree in temperature and 0.02 mmho/cm in conductivity.

(2) P and T data correction by laboratory calibration Pressure and temperature correction by laboratory calibration were carried out as mentioned in section C.2.

(3) Time lag filtration for T data for adjusting to C sensor response From lowering speed of CTD, T data was filtered for adjusting to C sensor response as follows;

$$Tfiltered(t)=exp(-dt/tauc)*Tfiltered(t-dt)+(1-exp(-dt/tauc))*Traw(t)$$

where dt means CTD sampling interval (1/25 sec.), tauc means response time of C sensor. Response time of C sensor was read from Giles and McDougall (1986), the method was following Kawabe and Kawasaki (1993).

(4) C data correction for sensor modification According to SCOR Working Group (1988), C data was corrected for alumina sensor as follows;

$$C_{corrected}=C_{raw}*(1-6.5E^{-06}*(T-2.8)+1.5E^{-08}*(P-3000))$$

(5) Time lag filtration for P and C data for adjusting to T sensor response P and C data was filtered for adjusting to T sensor response as follows;

$$Pfiltered(t)=exp(-dt/tau)*Pfiltered(t-dt)+(1-exp(-dt/tau))*Praw(t)$$
$$Cfiltered(t)=exp(-dt/tau)*Cfiltered(t-dt)+(1-exp(-dt/tau))*Craw(t)$$

where dt means CTD sampling interval (1/25 sec.), tau means response time of T sensor. Response time of T sensor was estimated from maximum lagged correlation between T data series and C data series as follows;

#1194: 8/25 sec. (320 msec)
#1216: 5/25 sec. (200 msec)

(6) Pressure averaging P, T and C data were removed at upward moving at down-cast, and were averaged over (+/-)1 dbar range.

(7) C data correction by water sampling data Conductivity data was calibrated by comparison with sample salinity. We compared all CTD conductivity data averaged over 64 data (2.56 seconds) with those of water samples which was converted from salinity with temperature and pressure at the points bottles closed just after collection of 64 CTD data. We fitted a linear regression equation of

$$C_{sample} = a0+a1*C_{ctd}$$

with minimizing RMS. error. The water sample data whose values are most different from C_{ctd} are rejected. This rejection and fitting procedure is repeated until all data are within 0.003 mmho/cm. By using the CTD salinity determined with the cell factors determined by the above procedure, we again compared the CTD salinity and sample salinity. In this process, we detected bottle leak, miss-fire bottles and bottles taken at different depth. With the information of bottle rearrangements and rejection of questionable sample data, we again determined the cell factor as

Station 035-041(#1194):	a0=-0.020073	a1=1.0007220
Station 042-074(#1216):	a0=+0.010755	a1=0.9998601
Station 075-096(#1194):	a0=-0.022169	a1=1.0007604
Station 097-156(#1194):	a0=-0.016253	a1=1.0005141
Station 157-165(#1216):	a0=+0.004395	a1=1.0000042

With the cell factor determined by the above procedure, mean difference between CTD and water sample and standard deviations for depth ranges in the deep part are in the Table 3.5.

Table 3.5.

Depth Range (dbar)	Mean Salinity Difference $S_{ctd} - S_{sample}$ (psu)	Standard Deviation (psu)
50-200	+0.00055	0.00836
300-700	-0.00077	0.00471
800-1500	+0.00072	0.00340
1750-3000	+0.00090	0.00269
3500-6000	+0.00018	0.00206

(8) Pressure centering For uniform pressure series, P, T and S data were interpolated.

WHPO Data Processing Notes

Date	Contact	Data Type	Data Status Summary	
08/30/98	Talley	BTL	Data Update	
	quality flags added; formatting updated			
10/19/98	Thompson	DELC14	No Data Submitted	
	Masao Fukasawa/Tokai Univ. needs help processing C14 data			
04/13/99	Talley	SUM	Data Update	see note:
	Steve - I placed corrected versions of p02csu.txt and p02esu.txt in my ftp area at whpo. Please replace the online versions with these (and acknowledge). (What did I change - replaced P02C in the P02E file with P02E, replaced P02W in the P02C file with P02C). Lynne			
04/14/99	Talley	CTD	Data Update	see note:
	station 119 on p2e was corrupted. It was sent in a 1 dbar series, unlike all of the other stations. I decimated it to 2 dbar, changed the number of records in the header to match the 2 dbar series, and ftped it to the whpo site.			
04/15/99	Bartolacci	SUM	Data Update	see note:
	I've replaced all of the p02.sum files (p02w, p02e, p02c) and updated the table to reflect this. In the case of p02c and p02e the sum file changes (via Lynne) were correcting the occurrances of the old line number designation with the new line number designation, and (by me)replacing the slashes in the expocode to underscores. (See Lynne's emails below) IN the case of p02w the .sum file changes made (by Lynne) were converting decimal degrees into degrees and minutes in the lats and lons; the time was converted to GMT; station no. now has place holding zeros; cast type was changed from CTD to ROS; and height above bottom, wire out, and no. of bottles columns were also added. This conversion has shifted columns, however I ran sumchk on it with no errors. Slashes in the expocode were also replaced by underscores. I have also replaced the corrupted P2E119.WCT file with Lynne's updated version, and updated the table to reflect this. The table was also corrected to reflect the *bottle* data file being encrypted, NOT the .sum file (previously the table indicated the .sum file was Non-public and the bottle file was public).			
09/19/00	Michida	BTL	Data Update	
	With regard to the hydrographic data collected by Japanese groups, I found that the present status of availability of the data for P02E and P02W appeared as 'NP' in the listings of WHPO web site. I believe they should be ready to be made public. Have you had any contact to or from Mr Yoritaka, the present contact person for both lines? I will be pleased to ask him to confirm that the data are to be public, if necessary.			

10/02/00	Fukasawa	NUTs/CFCs	Data Update	

NUTs sent to WHOI, CFCs not collected
As for P2C and E, nutrients data were collected and Dr. Saito, who is the PI, reported me that data was submitted to WHOI. PI of CFCs is Dr. Watanabe although CFC data were note collected on neither P2C nor P2E.

02/21/01	Diggs	NUTs	Submitted silcat, no2 no3, phspht	

I received P02C/E nutrients as well from Saito, and just reformatted them and placed them in the original directories for each line. I'll have Stacy merge them in.

03/09/01	Yoritaka	CTD/BTL	Data are Public	

database updated as requested, see note:
I would like to consent to open Bottle_S/O2 and CTD data on P2E and P2W to the public as PI. Then, would you please change some information on the summarized table of WHP one time cruises on web as follows;

P02E;
CS: Bando/JODC -> Bando/(HD)MSA
Ship: SYOYO -> SHOYO

04/03/01	Bartolacci	BTL	Website Updated	

Files Unencrypted except NUTs; See note:
I have unencrypted the bottle file for both legs of this cruise, however the nutrients still reside in the original directory and are not yet merged into the bottle file.
Sarilee, Could you possibly merge these nutrients into the on-line bottle file? They're in the 'original' directory for P02E.

04/03/01	Saito	NUTs	Data are Public	

I heard from Yoritaka-san that P2E nutrient data have not yet public, then I would agree with these data will be public.

04/04/01	Michida	NUTs	Data are Public	

Today I heard that Dr. Saito, the PI for nutrient data of P2, sent an email to someone concerned in SIO (Lynne Talley?) to make the data public. I hope things go well in this regard.

07/17/01	Diggs	BTL/SUM	Website Updated	new P02e files on-line

SUM file reformatted
SUM, Bottle: (silcat, no2 no3, phspht) I have put all of the new P02e files on-line (with nutrients) at Lynne Talley's request. I have also attached Sarilee's reformatting note (kinda long). Sarilee also reformatted the SUM file and I have put it out on the website as well.

12/03/01	Diggs	CTD/BTL	Website Updated	CSV File Added, see note:

BOTTLE converted to exchange format and placed files online. CTD still non-public?

12/06/01 Diggs CTD/BTL/SUM Website Updated

Files reformatted and online, see note:

I have put all of the new P02e files on-line (with nutrients). I have attached Sarilee's reformatting note (kinda long). Sarilee also reformatted the SUM file and put it out n the website as well.

thanks,
-sd

Merged the nutrients into the .sea files for P02E.

The nutrient file had two sta. 35. When I compared the pressures of the second sta. 35 in the nutrient file with the pressures for sta. 36 in the .sea it was obvious that the station designation in the nutrient file should have been 36.

Ditto above only for sta. 105. Should have been 106 in the nutrient file.

There were numerous levels throughout the file that had 0 as the sample and/or bottle number. These levels had no data and were not in the .sea file and were not merged into the .sea file.

Stas. 36 and 37 had at 5501.1 and 5500.5 respectively a value of 972.51 for SILCAT and 9.73 for PHSPHT. The QUALT1 flag was 9 for each of them. These are impossible values for these parameters so I changed the values to -9.00.

Sta. 40 at 1000.0db had 99 for QUALT1 flags but a value of 113.91 for SILCAT and 9.73 for PHSPHT. Changed PHSPHT value to -9.00, SILCAT value is reasonable. Changed QUALT1 flags to 39.

List of stations where QUALT1 flags were not consistent with the data. I changed them so they agree with the data.

NOTE - most of the QUALT1 flags in the nutrient file were 3, so I used 3 when changing Q1 codes, except in one case where the data were obviously bad.

Leg 1

Sta.	Press.	Orig. Q1	New Q1	Sta.	Press.	Orig. Q1	New Q1
46	797.7	993	933	84	2500.8	999	939
53	1748.5	399	393	85	1999.5	999	939
54	698.1	399	393	85	2497.6	999	939
60	50.9	993	933	86	2501.2	999	939
66	999.2	399	393	89	2499.5	999	939
72	1000.1	399	393	90	1499.5	949	449
75	2250.8	999	939	91	2500.6	999	939
81	399.5	999	939	95	2250.3	999	939
81	5001.4	999	939	94	2248.5	999	939
82	3000.9	999	939	96	1999.5	999	939
83	2999.7	399	393	96	2249.8	399	393
				96	3999.2	999	939

Leg 2

Sta.	Press.	Orig. Q1	New Q1	Sta.	Press.	Orig. Q1	New Q1
99	799.0	999	939	130	1999.8	999	939
101	48.2	999	939	130	2248.2	999	939
102	4497.2	999	939	130	3997.8	999	939
103	2495.3	999	939	132	3998.9	999	939
105	5000.3	999	939	133	2247.8	999	939
106	100.8	399	393	133	2503.2	999	939

Leg 2 (continued)

Sta.	Press.	Orig. Q1	New Q1	Sta.	Press.	Orig. Q1	New Q1
106	900.5	999	939	133	4504.6	999	939
106	4500.0	999	939	134	3998.5	999	939
107	2000.8	999	939	135	3496.9	999	939
107	2498.2	999	939	135	3500.1	999	939
107	2999.8	999	939	136	3499.7	999	939
107	4000.0	999	939	138	4000.6	999	939
111	1498.2	999	939	139	4000.4	999	939
112	5000.7	999	939	140	4001.1	999	939
114	6001.3	999	939	141	4000.0	999	939
115	2501.8	999	939	142	2250.2	999	939
117	601.7	399	393	143	3999.6	999	939
117	998.2	399	393	144	3999.6	999	939
119	2001.3	999	939	145	499.1	999	939
119	4001.6	999	939	145	3999.4	999	939
120	2499.4	999	939	145	4003.2	999	939
122	2250.0	999	939	146	2449.9	999	939
123	4000.9	999	939	146	3499.4	999	939
126	2497.8	999	939	150	3001.2	999	939
126	3998.5	999	939	153	3498.0	999	939
127	4501.6	999	939	158	3498.9	999	939
128	48.6	999	939	159	3498.9	999	939
128	4001.8	999	939	162	203.4	399	393
129	3501.4	999	939	163	400.3	999	939
				163	704.9	999	939

13 April 2001 Sarilee Anderson

01/02/02	Diggs	CTD	Website Updated	CSV File Added, see note:

CTD files updated and slight refomatting was performed for conversion to Exchange format. P02e CTD zip archives now exclude stations from p02c. New ZIP archives of WOCE CTD and Exchange CTD formatted files are now on the website.

01/18/02	Kappa	DOC	Compiled PDF and Text Cruise Reports