

North Atlantic
OACES/CO2 Cruise
Legs I, IIA, IIB
July 4 through August 30, 1993

Leg I

Stations 1-31: (Fortaleza-Madeira) - The NOAA ship MALCOLM BALDRIGE departed Fortaleza, Brazil on July 4, 1993 and steamed to the beginning of the hydrographic section at 5°S, 25°W. Malfunctioning of the boilers and previous shutdown of the reverse osmosis unit left the ship without the capability to produce fresh water at 14°N, 29°W on July 17, 1993. The ship diverted to the Cape Verde Islands to obtain fresh water and subsequently went to Madeira for repair without performing anymore station work. A total of 31 sampling stations were occupied on the quasi north-south transect. At every station a CTD cast was performed to the bottom using 24-bottle sampling bottles mounted on a cage with Rosette and CTD. At some stations a double cast was performed yielding a total of 39 CTD casts.

Leg IIA

Stations 32-52: (Madeira-Madeira) - Operations on Leg IIA were directed to completing work not completed on Leg I due to problems with the ship's ability to make fresh water. MALCOLM BALDRIGE departed Funchal, Madeira on August 2, 1993 and proceeded 32°54.8'N, 18°9.09'W where a station was occupied to collect samples to test all over the side systems and laboratory equipment after a long inport in Madeira. The ship then proceeded to 34°N, 21°12.50'W and began occupying stations at 2 degree intervals along a line to 16°N, 29°00'W and then to 15°N, 29°00'W. The ship then reversed course along the same line occupying stations at 2 degree intervals to 33°N, 21°48.00'W. The net result was a line of stations at 1 degree intervals from 15°N to 33°N completing the stations planned for Leg I. The BALDRIGE then returned to Funchal, Madeira for fuel, water and provisions arriving on August 16, 1993. A total of 20 sampling stations were occupied along the quasi north-south transect described above, plus one test station.

LEG IIB

Stations 52-83: (Madeira-Iceland) - MALCOLM BALDRIGE departed Funchal, Madeira on August 17, 1993 and proceeded to an initial station at 35°N, 20°36.5'W. After completing that station the ship proceeded to a second station at 36°N, 20°W and proceeded to occupy stations at 1 degree intervals north along 20°W to 60°N (The station at 47°N was not occupied as CTD and rosette problems had resulted in loss of enough time to jeopardize contingencies at the north end of the section which was deemed more critical to program goals.) After 60°N the stations were occupied at the following approximate locations along 20°W: 60.5°N, 61°N, 62°N, 63°N, and at the 400 meter isobath at 63°14.37'N. A total of 31 stations were occupied along the transect described above for Leg IIB.

Explanation of nutrients:

During leg I there were two nutrient groups on board, the nutrient values from AOML have a prefix of GBN (George Berberian, AOML), while those from the University of Washington have the prefix KK (Kathy Kroglund, University of Washington). The KK_nutrients are more comprehensive and more precise; however, for legs 2A&2B the AOML nutrient group was the only one on board.

Comparison of deep water data with the Oceanus-202 cruise:

To discern large scale offsets in temperature, salinity, oxygen, and nutrients with historical data deep water observations, the data presented here were compared with data obtained on the Oceanus-202 cruise [Doney and Bullister, 1992; Tsuchiya and Talley, 1992]. The following conclusions were reached from comparing deep water values at 5 degree latitude ranges:

- * The O2 values of the N.ATL-93 cruise were systematically lower by 7.5 umol/kg for the entire cruise compared to the Oceanus-202 data.
- * T-S diagrams indicate that for leg 1, the N.ATL-93 data is up to 0.003 saltier or 0.04 degrees C colder. The offset is not systematic though.
- * T-S diagrams indicate that for leg 2-B, the N.ATL-93 data is up to 0.007 saltier or 0.05 degrees C colder. The offset is not systematic though.
- * Plots of T versus pressure suggest that leg 1 N.ATL-93 is up to 0.04 degrees colder. The offset is not systematic though.
- * Plots of NO3 versus depth show that:
NO3 (GBN): leg 1- up to 0.5 umol/kg lower
NO3(GBN): leg 2B- up to 1 umol/kg higher
NO3(KK): leg 1- up to 1 lower
SiO3 (KK): leg 1- up to 1.5 % lower

RECOMMENDATIONS:

1. The systematic offset in oxygen has been observed on other cruises run by NOAA/AOML and we recommend adding 7.5 umol/kg to all oxygen values. NOTE: This adjustment has NOT been made to the oxygen data in this report.
2. Since the offsets in T, S, NO3, and SiO3 were not systematic for the cruise, or even on a per leg basis we do not recommend wholesale adjustments to the data. The ranges in offsets can be used as a guide to the accuracy of the data.

Doney, S.C., and J.L. Bullister, A chlorofluorocarbon section in the eastern North Atlantic, Deep-Sea Res., 39, 1857-1883, 1992.
Tsuchiya, M., and L. Talley, An eastern Atlantic section from Iceland southward across the equator, Deep-Sea Research, 39, 1885-1917, 1992.

PLEASE NOTE: Bottom depths for each station/cast can be found in the file NATL93.BOT.

UNITS FOR THE NATL93 DATABASE

FIELD	UNIT
OPS_NO (Operations Number - concatenation of Year, Julian Day, and GMT Time)	integer
STATION	integer
SAMP_NO (Sample Number)	integer
DEC_LAT (Latitude)	decimal degrees
DEC_LONG (Longitude)	decimal degrees
PRESSURE	decibar
DEPTH	meters

TEMP (Temperature)	C
THETA (Potential Temperature)	C
BOT_SAL (Bottle Salinity)	
CTD_SAL (CTD Salinity)	
CTDSAL_QC (QC Flag for CTD Salinity)	character
SIGMA0 (Sigma Theta)	
OXY_WINK (Bottle Oxygen)	uM/kg
AOU (Apparent Oxygen Utilization)	uM/kg
GBN_PO4 (Phosphate)	uM/kg
PO4_QC (QC Flag for GBN_PO4)	character
GBN_NO3 (Nitrate)	uM/kg
NO3_QC (QC Flag for GBN_NO3)	character
GBN_NO2 (Nitrite)	uM/kg
NO2_QC (QC Flag for GBN_NO2)	character
GBN_SIO4 (Silicate)	uM/kg
SIO4_QC (QC Flag for GBN_SIO4)	character
KK_PO4 (K. Kroglund's Phosphate)	uM/kg
KK_NO3 (K. Kroglund's Nitrate)	uM/kg
KK_NO2 (K. Kroglund's Nitrite)	uM/kg
KK_SIO4 (K. Kroglund's Silicate)	uM/kg
NOAA_TCO2 (R. Wanninkhof's Total CO2)	uM/kg
N_TCO2_QC (QC Flag for Total CO2)	character
FM_TALK	uEq/Kg
FMTALK_QC (QC Flag for FM_TALK)	character
PCO2_20 (pCO2 at 20 C)	uatm
PCO2_QC (QC Flag for PCO2_20 and PCO2INSITU)	character
PH20CSPEC (spectrophotometric pH at 20 C)	
PCO2INSITU	uatm
F11 (Chloro Fluorocarbons)	pM/kg
F11_QC (QC Flag for F11)	character
F12 (Chloro Fluorocarbons)	pM/kg
F12_QC (QC Flag for F12)	character
CHLORO_A (Chlorophyll a)	ug/L
PHAEO (Phaeophytin)	ug/L
MONTH	integer
DAY	integer
YEAR	integer
CAST	integer
CTD_CAST	integer
LEG	character

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This file is a chronology of changes and/additions to the master database for Leg 1 of the OACES NATL93 cruise.

The data file accompanying this file has the basic structure of N93L1X.DBF, where the X represents the most recent change in an alphabetical format. This file you are now reading should always accompany the master datafile. Finally, a file with a .CSV file extension will be present which is a comma delimited ASCII file.

The most recent changes are described immediately following this sentence.

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October 30, 1997
(Dr. Peng/B. Huss)

The following is the file structure for version D of the NATL93 database being released today:

Structure for database: NATL93D.DBF
Number of data records: 2172

Date of last update: 10/03/97

Field	Field Name	Type	Width	Dec	Index
1	OPS_NO	Numeric	9		N
2	STATION	Numeric	6		N
3	SAMP_NO	Numeric	5		N
4	BOTTLE_QC	Character	1		N
5	DEC_LAT	Numeric	8	4	N
6	DEC_LONG	Numeric	9	4	N
7	PRESSURE	Numeric	9	1	N
8	DEPTH	Numeric	6		N
9	TEMP	Numeric	6	3	N
10	THETA	Numeric	6	3	N
11	BOT_SAL	Numeric	7	3	N
12	BOTSAL_QC	Character	1		N
13	CTD_SAL	Numeric	7	3	N
14	CTDSAL_QC	Character	1		N
15	SIGMA0	Numeric	9	3	N
16	OXY_WINK	Numeric	8	2	N
17	OXY_QC	Character	1		N
18	AOU	Numeric	9	3	N
19	GBN_PO4	Numeric	6	2	N
20	PO4_QC	Character	1		N
21	GBN_NO3	Numeric	6	2	N
22	NO3_QC	Character	1		N
23	GBN_NO2	Numeric	6	2	N
24	NO2_QC	Character	1		N
25	GBN_SIO4	Numeric	6	2	N
26	SIO4_QC	Character	1		N
27	KK_PO4	Numeric	6	2	N
28	KK_NO3	Numeric	6	2	N
29	KK_NO2	Numeric	6	2	N
30	KK_SIO4	Numeric	6	2	N
31	NOAA_TCO2	Numeric	8	2	N
32	N_TCO2_QC	Character	1		N
33	FM_TALK	Numeric	6	1	N
34	FMTALK_QC	Character	1		N
35	PCO2_20	Numeric	6	1	N
36	PCO2_QC	Character	1		N
37	PH20CSPEC	Numeric	7	3	N
38	PCO2INSITU	Numeric	6	1	N
39	F11	Numeric	8	3	N
40	F11_QC	Character	1		N
41	F12	Numeric	8	3	N
42	F12_QC	Character	1		N
43	CHLORO_A	Numeric	7	3	N
44	PHAEO	Numeric	7	3	N
45	MONTH	Numeric	2		N
46	DAY	Numeric	2		N
47	YEAR	Numeric	4		N
48	CAST	Numeric	4		N
49	CTD_CAST	Numeric	4		N
50	LEG	Character	6		N
** Total **			251		

October 4, 1997

(B. Huss)

Changed the GBN_PO4 QC flag for Sample Number 5814 from "2" to "4".

June 26, 1997

(B. Huss)

Recalculated depth from pressure using an algorithm from Doug Wilson.
Merged the new depth values into the database.

June 25, 1997

(B. Huss)

Remerged George Berberian's corrected nutrient data into the database. The first merge contained only Leg I data.

May 22, 1997

(Dr. Peng/B. Huss)

Release of version C of the NATL93 database.

March 31, 1997

(B. Huss)

Changed the date field to three integer fields - MONTH, DAY and YEAR.

March 20, 1997

(B. Huss)

Corrected the date for sample number 2412.

March 4, 1997

(B. Huss)

Changed all QC flags from "2" or "6" to "3" if the corresponding BOTTLE_QC flag equaled "3" or "7". Changed all QC flags to "4" if the corresponding BOTTLE_QC flag equaled "4". Changed all BOTSAL_QC and CTDSAL_QC flags from "A" to "3". Changed all PCO2_QC flags from "D" to "2".

February 3, 1997

(B. Huss)

Merged John Bullister's CFC update into the master database.

January 10, 1997

(B.Huss)

Merged the nutrient update (both the nutrient values and the nutrient flags) into the database.

December 3, 1996

(B.Huss)

Added the following QC flags: BOTTLE_QC, BOTSAL_QC (bottle salinity QC flag), and OXY_QC (oxygen QC flag) to the database. Updated CTDSAL_QC (CTD salinity QC flags).

October 15, 1996

(B.Huss)

For the CTD salinity QC flag: changed the flag from "8" to "A" and from "9" to "B" (WOCE non-numeric user defined QC flags). "A" = upcase value and "B" = nominal value.

October 7, 1996

(J.Hendee/B.Huss)

Release of version B of the NATL93 database.

October 4, 1996

(B.Huss)

George Berberian's nutrient data has not undergone final QC. Please note, the QC flags for CTD salinity contain non-WOCE values: "8" = upcast value and "9" = nominal value.

September 30, 1996

(B.Huss)

Changed the order of the fields and removed the fields FM_PH25C, FM_TCO2, and CC14 from the database. Renamed FM_PH20C to PH20CSPEC.

September 27, 1996

(B.Huss)

Oxygen and AOU was changed to -9.0 for sample numbers 13622 and 17213. AOU was changed to -9.0 for sample numbers 29001 to 29012, and 16823.

September 26, 1996

(B.Huss)

Replaced the nutrient QC flags that had a value of "0" to "A" (A means station not checked).

September 19, 1996

(B.Huss)

Removed the fields F113 and CH3CC1 from the master database. Changed the QC flags for FMTALK, NOAA_TCO2 and PCO2 data for the following samples: 1313, 1519, 1521, 2105, 2403, 2404, 2407, 2412, 2422, 2604, 4319, 4601, 4604, 4819, 6120, 6121, 6122, 6124, 7613, 7614, 7622, 8017, 8018, 9701, 11412, 11413, 11417, 14411, 23918, 26823, 27521, and 28822.

September 18, 1996

(B.Huss)

Added QC flags for F11 and F12 and merged Dr. Bullister's CFC update into the master database.

September 18, 1996

(B.Huss)

Added QC flags for FM_TALK (Frank Millero's TALK).

September 17, 1996

(B.Huss)

Corrected the latitudes for stations 66 and 75 to match the corresponding latitudes in the Chief Scientist's Report.

September 5, 1996

(B.Huss)

Merged CTD_CAST number into NATL93.DBF.

September 4, 1996

(B.Huss)

Converted K. Krogsland's nutrient data from umol/l to umol/kg using a constant temperature of 25 C bottle salinity (or ctd salinity if bottle salinity was missing) and pressure to calculate density.

August 31, 1996

(B.Huss)

Merged the CTD salinity qc flag (CTDSAL_QC) into NATL93.DBF. Changed all QC flags to "9" for all CTD_SAL equal to -9.0. Created a NATL93.QC file for NATL93 and updated the NATL93.UNI file. Removed LAT_DEG, LAT_MIN, LAT_HEM, LAT_QC, LONG_DEG, LONG_MIN, LONG_HEM, and LONG_QC from NATL93.DBF. The database now contains only DEC_LAT and DEC_LONG (decimal latitude and longitude). Corrected the longitude for Station 49, Cast 186. Merged Hua Chen's PCO2 update into NATL93.DBF. Corrected FM_TALK and FM_TCO2 (they were reversed).

August 29, 1996

(B.Huss)

Recalculated potential temperature and potential density (THETA and SIGMATHETA) using ctd salinity for all samples with no bottle salinity (bottle salinity = -9.0). The samples that were recalculated are: 1305, 1317, 1318, 1502, 1702, 1704, 1712, 2304, 2319, 3701, 3702, 5802, 5808, 5810, 6116, 6615, 8605, 9117, 9118, 9123, 9124, 9720, 10319, 13002, 16114 thru 16124, 18322, 18323, 18324, 20808, 21724, 22524, 23124.

August 28, 1996

(B.Huss)

Converted oxygen from ml/l to ml/kg using ctd salinity (bottle salinity was

equal to -9.0) to calculate density for the following samples: 9720, 1317, 1318, 26818, 28706, 28507, 20808, 3702, 3701, 1704, 2304, 1702, 1502, and 1712.

August 24, 1996

(B.Huss)

Added sample number 4924 (station 17, cast 49) to the NATL93 database. I need bottle and ctd salinity and George Berberian's nutrient values for that sample. As soon as I get bottle salinity, I can convert oxygen from ml/l to ml/kg (so right now OXY_WINK is -9.0). Replaced N_TCO2_QC flags that had values of "M" to "9" since the corresponding NOAA_TCO2 values were -9.0.

August 23, 1996

(B.Huss)

Changed the nomenclature for SIGMAT to SIGMATHETA. Removed CTD_PT and CTD_ST (sigma theta and potential temperature calculated with CTD salinity). Removed BOTTLE_PT and BOTTLE_ST (sigmatheta and potential temperature calculated with Bottle salinity). Recalculated SIGMATHETA and THETA using bottle salinity and merged this data into the master database.

August 21, 1996

(B.Huss)

Merged Hua's PCO2 update into NATL93.DBF.

August 20, 1996

(B.Huss)

Merged AOU (from Rik's database) into NATL93.DBF. Removed the field O2_SAT from NATL93.DBF.

July 15, 1996

(B.Huss) Converted oxygen from ml/l to umol/kg (requested by Rik) using a modification of Libby John's Sigmatheta program. Theta and sigma theta were calculated using bottle salinity. The oxygen was converted using the following formula from Dr. Peng:

$$\text{oxygen_kg} = \text{oxygen_l} * 44.6628 / (1.0 + \text{sigmatheta}/1000)$$

July 12, 1996

(B.Huss)

Converted G. Berberian's nutrient data from umol/l to umol/kg (requested by Rik) using the following formula from Dr. Peng:

$$y \text{ (umol/kg)} = x \text{ (umol/l)} / 1.0 + (\text{density}/1000)$$

Density was calculated using a constant temperature of 25 C, bottle salinity or ctd salinity (if bottle salinity was equal to -9.0 and ctd salinity was not, then ctd salinity was used in the conversion), and pressure. The new nutrient values were merged into the master database.

July 10, 1996

(B.Huss)

Changed the nutrient QC flags with a value of "M" for Missing to "9".

May 22, 1996

(B.Huss)

Checked the database NATL93.DBF to make sure the three legs (N93L1, N93L2A, and N93L2B) were merged (consolidated) into the one main database correctly.

May 21, 1996

(B.Huss)

Recalculated decimal longitude and latitude. Checked the latitudes and longitudes against the Chief Scientist's Report.

February 9, 1996

(B.Huss)
Corrected longitude for station 49.

January 26, 1996

(B.Huss)
Merged the three databases (one for each leg - LEG I, LEGIIA, and LEGIIB) into one master database called NATL93.DBF. Merged the three .DES files into one file.

January 12, 1996

(B.Huss)
Merged Frank Millero's TCO2, TALK and pH update (FM_TCO2, FM_TALK, FM_PH25C, and FM_PH20C) into the master database. Null values are -9.0. A copy of the merged update was mailed to Kitack for verification.

January 10, 1996

(B.Huss)
Changed all missing/invalid data to -9.0.

January 10, 1996

(B.Huss)
Recalculated Sigma Theta and Theta for both CTD and Bottle Salinity and merged this data into the database.

January 10, 1996

(B.Huss)
Corrected Latitude and Longitude for Station 38, Cast 139.

December 12, 1995

(B.Huss)
Merged the CTD data from Libby Johns (TEMP, CTD_SAL, BOT_SAL, OXY_WINK and PRESSURE) into the master database.

November 20, 1995

(B.Huss)
Changed the QC flags that were blank to "M" for Missing. Modified the .UNI file.

June 3, 1995

(B.Huss)
Merged Hua Chen's PCO2 update into the master database. Forwarded a copy of the merged data to Hua Chen for verification.

May 17, 1995

(B.Huss)
Merged F. Millero's total CO2, total alkalinity and pH data (FM_TCO2, FM_TALK, FM_PH25C and FM_PH20C) into the master database. This was a complete replacement of the existing data. Sent a copy of the merged data to Kitack Lee for verification.

May 17, 1995

(B.Huss)
Modified the record structure to include FM_PH25C and FM_PH20C (F. Millero's pH data) and changed RSMAS_TCO2 to FM_TCO2 and TALK to FM_TALK.

January 17, 1995

(B.Huss)
Calculated depth from pressure and merged these depth values into the master database.

December 27, 1994

(B.Huss)
Merged the updated NOAA_TCO2 data into the master database. This is a complete replacement of existing data.

