## A. Cruise Narrative

### A.1 Highlights

| | | |
|---|---|---|
| A.1.a | WOCE designation | AR7E |
| A.1.b | EXPOCODE | 06AZ129/1 |
| A.1.c | Chief Scientist | A. SY<br>Bundesamt Fuer Seeschiffahrt und Hydrographie<br>Postfach 30 12 20<br>Abtlg. M/M4<br>D-20305<br>Hamburg, Germany |
| A.1.d | Ship | R/V Valdivia |
| A.1.e | Ports of Call: | Reykjavik to Hamburg |
| A.1.f | Cruise dates: | September 12 to October 6, 1992 |

### A.2 Cruise Summary Information

A.2.a Geographic Boundaries: 60 N, 52.33 N, 42.67 W, 14 W

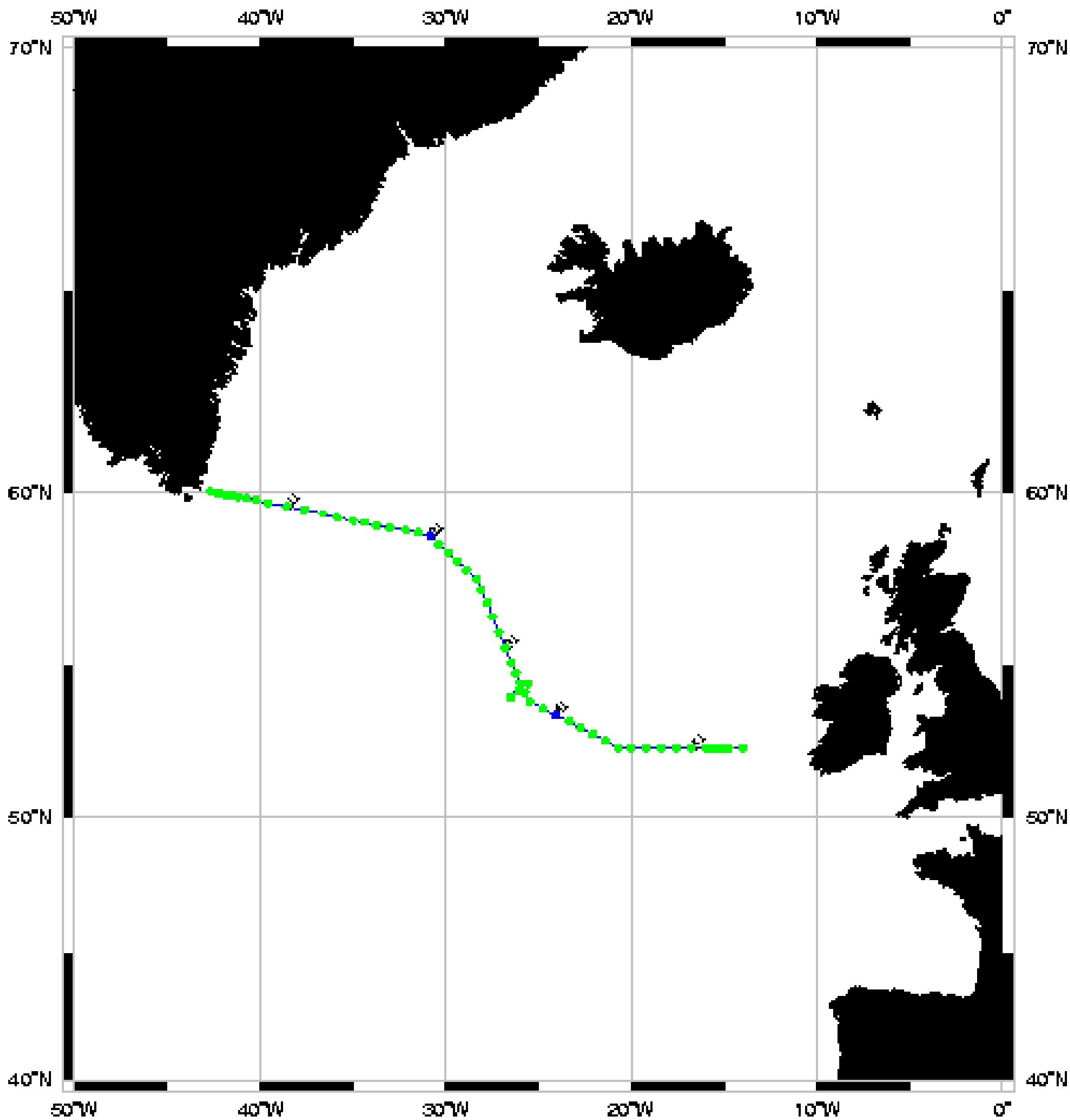
A.2.b Total number of stations: 58

A.2.c Floats and drifters deployed

A.2.d Moorings deployed or recovered

### A.3 List of Principal Investigators

Station locations for AR07EC SY




## A.4 Scientific Programme and Methods

Cruise # 129 by R.V. Valdivia (call sign: DESI) was a contribution to the World Ocean Circulation Experiment (WOCE) Hydrographic Programme. It started on September 12 in Reykjavik (Iceland) and finished in Hamburg (Germany) on October 6, 1992. The purpose of the cruise was to carry out a CTD survey from the east coast of Greenland at 60 N, 42

40 W to the southern tip of the Porcupine Bank off the west coast of Ireland at 52 20 N, 14 W (WOCE line AR7/East). The sampling was designed to meet WOCE requirements for repeat surveys. Valdivia cruise 129 was successful, and the data quality is expected to be good. The captain of the ship was Mr. Wolfgang Klaassen, the chief scientist was Dr. Alexander Sy.

Scientific Aims

The Atlantic Ocean is characterized through an intensive meridional circulation cell, carrying near surface water of tropical and subtropical origin northwards and deep water of arctic and subarctic origin southwards. The transformation and sinking of water masses at high latitudes are the important processes for the "overturning" of the ocean. The overturning rates and the intensity of the meridional transports of mass, heat, and salt are control parameters for the modelling of the ocean's role in climate.

Valdivia cruise 129 is part of the five-year observational programme WOCE- NORD (World Ocean Circulation Experiment - North Atlantic Overturning Rate Determination). Using repeated hydrographic sections between the southern tip of Greenland and Ireland in combination with current measurements from moored arrays the overturning rates of the North Atlantic will be quantified. The cruise is also part of the German WOCE programme, contributing to the global description of the world ocean. Valdivia cruise 129 covers section AR7/East within the WOCE hydrographic programme. The scientific measurements on this cruise included 58 surface-to-bottom CTD and small-volume stations. At the latter, a rosette water sampler was used with each CTD cast for on board analysis of salinity and oxygen. 12 electronic SIS DSRTs were used for in-situ temperature control, and 6 electronic SIS pressure meters for in-situ pressure control. The pre-cruise CTD calibration has been carried out at IfM Kiel, Germany; the post-cruise calibration is planned for late November 1992 at IfM Kiel. The station spacing was designed in accordance with bathymetry and was to vary between 10 nautical miles (nm) and 30 nm with a total length of the section of about 1200 nm. To avoid shallow topographic structures, and to resolve flows following bathymetry, the section was composed of five sections of different orientation instead of a straight line (see Fig 1.) In addition to the main work on section AR7/East XBT, XCTD, ADCP, and SST/SSS measurements have been carried out, however, XCTD and SST/SSS measurements for tests only.

| **Instruments** | |
|---|---|
| | |
| CIDO2/Rosette: | NBIS MK-III |
| Salinometer: | Guildline |
| Titration unit: | Metrohn-Titroprocessor |
| Further instrumentation: | ADCP, Thermosalinograph, XBT, XCTD |

Course of the Cruise

R.V. Valdivia left Reykjavik on September 12, 17:30 UTC heading for 60N, 42.5 W. On September 13, work began on taking sea surface, XBT, and ADCP measurements. Except ADCP, these measurements were taken as part of the IGOSS programme (Integrated Global Ocean Services System) to be transmitted in near- real time via METEOSAT to the BSH from where they were fed into the GTS network of WMO for worldwide distribution (BATHY and TRACKOB messages). All CTD profiles from the hydrographic section were distributed worldwide as TESAC messages. On September 15 the CTD station work began. An approaching storm system, however, interrupted work after measurements had been carried out at 11 CTD stations on September 17 and 18. The work on the main section could be completed on September 28 (see station list). No serious problems affected CTD measurements. Only one and the same CTD was used for all stations. Between September 29 and October 1st three CTD test stations in deep water (> 4000 m) at 51.4N, 15.8W and at 49.3 N, 14.4 W have been carried out for quality control purposes.

## A.5 Major Problems and Goals not Achieved

## A.6 Other Incidents of Note

## A.7 List of Cruise Participants

Table 2: List of Cruise Participants

| Name | Institutions* | Responsibility |
|---|---|---|
| | | |
| Dr. Alexander Sy | BSH | Chief Scientist (CTD, tests) |
| Uwe Paul | BSH | Scientist CTD |
| Manfred Bersch | IfMH | Scientist (ADCP, XBT) |
| Gerd Stelter | BSH | Technician (software) |
| Norbert Verch | IfMH | Technician (salinometer) |
| Heiko Mauritz | BSH | Technician |
| Ines Horn | BSH | Technician (oxygen) |
| Rita Kramer-Geilun | BSH | Technicican (oxygen) |
| Anna Gyldenfeld | IfMH | Student |
| Sofie Woelk | IfMH | Student |
| Johannes Karstensen | IfMH | Student |

| **Table 3: List of Institutions** | |
|---|---|
| | |
| Abreviation | Institutions |
| | |
| BSH | Bundesamt fur Seeschiffahrt und Hydrographie |
| | Bernhard-Nocht-Str. 78 |
| | D-2000 Hamburg 36 Germany |
| | Telex: 215 448 hydro d |
| | Fax: (40) 3190 5000 |
| | Telemail: BSH.HAMBURG |
| | |
| IfMH | Institute fuer Meereskunde der University Hamburg |
| | Troplowitzstr. 7 |
| | D-2000 Hamburg 54 Germany |
| | Telex: 212 586 ifmhh d |
| | Fax: (40) 4123 4644 |
| | Telemail: IFM.HAMBURG |

## B. Underway Measurements

### B.1 Navigation and bathymetry
### B.2 Acoustic Doppler Current Profiler (ADCP)
### B.3 Thermosalinograph and underway dissolved oxygen, fluorometer, etc
### B.4 XBT and XCTD
### B.5 Meteorological observations
### B.6 Atmospheric chemistry

## C. Hydrographic Measurements

### C.1 Oxygen Measurements

During VALDIVIA cruise no. 129 (Sept./Oct. 1992) dissolved oxygen was measured by Winkler titration as modified by Kalle (1939), and using an automated endpoint detection.

The Winkler/Kalle method was our traditional analytical method we were sure of and were skilled in handling. Several times the method has been intercalibrated with other institutes participating in the Baltic Monitoring Programme and in ICES research programmes.

In 1992 we improved and perfected our automatic endpoint determination. Further, stimulated by the intercomparison measurements with the Scripps Institution during METEOR cruise 18 we checked out method for possible iodine losses and started to adapt Carpenter's (1965) modification of the Winkler method.

The numerous experiments and tests could not be finished before Valdivia cruise 129, and it would not have been wise to change our procedure at this time.

After this cruise we introduced Carpenter's modification of the Winkler technique, as recommended for WOCE. The elimination of iodine loss by volatilization is the essential element of this modification. This is accomplished by optimizing the concentrations of the pickling reagents, and by performing the titration in the oxygen bottle (iodine flask).

To check the Winkler/Kalle technique for systematic errors relative to the Winkler/Carpenter technique, a series of experiments was performed in our laboratory.:

1) Opimizing the pickling reagent concentrations according to Carpenter resulted in oxygen values which are higher by

$$+ 0.074 \text{ ml/l } O_2$$

(average of 6 sets of comparison measurements, see appendix A)

2) Using iodine flasks to avoid iodine loss during sample transfer yielded

$$+ 0.027 \text{ ml/l } O_2$$

(average of 4 sets of comparison measurements, see appendix A)

Thus, all oxygen values measured during VALDIVIA cruise 129 have been corrected by adding

$$0.101 \text{ ml/l } O_2$$

The concentration range of the cruise results was nearly covered by the oxygen concentrations of the comparison measurements.

## D. Acknowledgments

## E. References


Carpenter, J.H. (1965): The Chesapeake Bay Institue technique for the Winkler dissolved oxygen method. Limnology Oceanography. 10, 141-143

Kalle, K. (1939): Einige Verbesserungen zur Bestimmung des gelosten Saurstoffs im Meerwasser. Ann. Hydrogr. u. Marit. Met. 67, 267-269.

Unesco, 1983. International Oceanographic tables. Unesco Technical Papers in Marine Science, No. 44.

Unesco, 1991. Processing of Oceanographic Station Data. Unesco memograph By JPOTS editorial panel.

## F. WHPO Summary

The DQE flagged several salinity and oxygen values, each of which the PI responded to. It was also noted that the ctdsal in the bottle file was uncalibrated. In May 1996 the Pi sent station groupings and corrections to be applied to the CTDSAL. The CTDSAL in the hyd file was re-calibrated at the whpo as follows:

TEMPORAL DRIFT CORRECTION
    Stations 1-7 and 24-61
        DSAL= -0.0067 + 0.00208786 * ISTA - 0.000195349 *
          ISTA**2 + 4.40793E-6 * ISTA**3 + OLDSAL
    Stations 8-23
        DSAL=OLDSAL

SALINITY CORRECTION
    Station 8-23
        SALNEW = 0.1085 - 0.003109 * DSAL + DSAL
    Stations 24-37
        SALNEW = .2407 - .00697 * DSAL + DSAL
    Stations 43-46
        SALNEW = -.367 + .010349 * DSAL + DSAL
    Stations 39,41,42,47,50,53
        SALNEW = .0932 - .002734 * DSAL + DSAL
    Stations 38,40,48-52,54-61
        SALNEW = .2015 - .005887 * DSAL + DSAL

Four figures were created by the WHPO for the benefit of the reader.

Figure 3 shows station number versus the difference between the individual oxygen water samples and their corresponding CTD value (OXYGEN-CTDOXY).
Figure 4 shows the oxygen difference versus pressure
Figure 5 shows station number versus the difference between the individual salinity water samples and their corresponding CTD value (SALNTY-CTDSAL).
Figure 6 shows the salinity difference versus pressure.

Several data files are associated with this report. The sum,hyd and csl files are preceeded with the expocode(ie 06AZ129_1.sum). The sum file contains a summary of the location, time, type of parameters sampled, and other pertient information regarding each hydrographic station. The hyd file contains the bottle data. The csl file is a listing of ctd and calculated values at standard levels. The ctd data for each station are in individual *.wct files. The *.wct files have been zipped into one file called 06AZ129_1wct.zip.

The following is a description of how the standard levels and calculated values were derived for the csl file:

Salinity, Temperature and Pressure: These three values were smoothed from the individual CTD files over the N uniformly increasing pressure levels using the following binomial filter-

$$t(j) = 0.25ti(j-1) + 0.5ti(j) + 0.25ti(j+1) \quad j=2....N-1$$

When a pressure level is represented in the *.csl file that is not contained within the ctd values, the value was linearly interpolated to the desired level after applying the binomial filtering.

Sigma-theta(SIG-TH:KG/M3), Sigma-2 (SIG-2: KG/M3), and Sigma-4(SIG-4: KG/M3): These values are calculated using the practical salinity scale (PSS-78) and the international equation of state for seawater (EOS-80) as described in the Unesco publication 44 at reference pressures of the surface for SIG-TH; 2000 dbars for Sigma-2; and 4000 dbars for Sigma-4.

Gradient Potential Temperature (GRD-PT: C/DB 10-3) is calculated as the least squares slope between two levels, where the standard level is the center of the interval. The interval being the smallest of the two differences between the standard level and the two closest values. The slope is first determined using CTD temperature and then the adiabatic lapse rate is subtracted to obtain the gradient potential temperature. Equations and Fortran routines are described in Unesco publication, Processing of Oceanographic Station Data, 1991.

Gradient Salinity (GRD-S: 1/DB 10-3) is calculated as the least squares slope between two levels, where the standard level is the center of the standard level and the two closes values. Equations and Fortran routines are described in Unesco publication, Processing of Oceanographic Station Data, 1991.

Potential Vorticity (POT-V: 1/ms 10-11) is calculated as the vertical component ignoring contributions due to relative vorticity, i.e. pv=fN2/g, where f is the coriolius parameter, N is the bouyancy frequency (data expressed as radius/sec), and g is the local acceleration of gravity.

Bouyancy Frequency (B-V: cph) is calculated using the adiabatic leveling method, Fofonoff (1985) and Millard, Owens and Fofonoff (1990). Equations and Fortran routines are described in Unesco publication 44.

Potential Energy (PE: J/M2: 10-5) and Dynamic Height (DYN-HT: M) are calculated by integrating from 0 to the level of interest. Equations and Fortran routines are described in Unesco publication, Processing of Oceanographic Station Data, 1991.

Neutral Density (GAMMA-N: KG/M3) is calculated with the program GAMMA-N (Jackett and McDougall) version 1.3 Nov. 94.

## Data Quality Evalutions

DQE of CTD data for the 129-th cruise of the r/v "Valdivia" WOCE section AR7E in the Northern Atlantic.

Eugene Morozov

Data quality of 2-db CTD temperature, salinity and oxygen profiles and reference rosette samples were examined. Vertical distributions theta-salinity and theta-oxygen curves were compared for individual stations using the data of up and down CTD casts and rosette probes. Data of several neighboring stations were compared.

The data were compared with the 91/1 cruise of the r/v "Tyro" (April, 1991), 90/3 cruise of the r/v "Tyro" (July, 1990) and cruise 18 of the r/v "Meteor" (September, 1991) carried out in the same region of the Northern Atlantic.

Questionable data in *.hy2 file were marked in QUALT2 word.

Quality bytes in .hyd file do not have bytes for BTLNBR. It was fixed at the WHP office. In future it should be done by originators.

Listing of results from the comparison of salinity and oxygen data. OnlY those stations are listed which have data remarks. The remarks for salinity and oxygen are given separately.

SALINITY

It is necessary to calibrate CTD salinities in upcast measurements. Usually the differences between upcast CTDSAL and SALNTYes are much greater than possible discrepancies for WOCE, and usually there is no definite offset for upcast CTDSAL (except stations 19 -23) Compared with SALNTY. Sometimes the discrepancies exceeed 0.01. I believe that none of upcast CTDSALes are calibrated.

Duplicate determinations of salinity made from rosette samples at the same level indicate that bottle measurements are a high quality data set that match WOCE requirements. Nevertheless there are several bottle measurements which I consider questionable or even bad. Usually they do not agree with the general vertical distribution of salinity or fall far from theta-S curve.

Station Pressure Remarks

14 397 dbSALNTY (34.869) is low compared with upcast CTDSAL (34.874) and downcast CTDSAL (34.889), flag 3.

602 dbSALNTY (34.870) is low compared with upcast CTDSAL (34.875) and downcast CTDSAL (34.890), flag 3.

1005 dbSALNTY (34.884) is hill compared with upcast CTDSAL. (34.880) and downcast CTDSAL (34.878), flag 3.

2021 dbSALNTY (34.864) is low compared with upcast CTDSAL (34.867) and downcast CTDSAL (34.872), flag 4.

16 There is a difference of about 0.01 for all levels of measurements between upcast CTDSAL and SALNTY (SALNTY is less). The agreement between SALNTY and downcast CTDSAL is better, nevertheless discrepancies at two levels are higherthan norm:

800 db SALNTY (34.876) is low compared with upcast CTDSAL (34.886) and downcast CTDSAL (34.890), flag 4.

900 db SANLTY (34.871) is low compared with upcast CTDSAL (34.878) and downcast CTDSAL (34.880), flag 4.

18 699 dbSALNTY (34.881) is low compared with upcast CTDSAL (34.886) and downcast CTDSAL (34.889), flag 3.

There is a front between stations 18 and 19 (different water masses) and many intrusions, so I flag only very large discrepancies.There is a difference of about 0.01 for all levels of measurements between upcast CTDSAL and SALNTY (SALNTY is less) for stations 19 through 23. It seems that there is an offset of about -0.01 for upcast CTDSAL for these four stations. The agreement between SALNTY and downcast CTDSAL is better.

19 501 dbSALNTY (34.984) is low compared with upcast CTDSAL (34.994) and downcast CTDSAL (35.015), flag 4.

601 dbSALNTY (35.014) is low compared with upeast CTDSAL (35.023) and downcast CTDSAL (35.034), flag 3.

There is a large vertical gradient of salinity at this level that is why I flag these measurements as Qble not Bad.

1407 db SALNTY (34.947) is low compared with upcast CTDSAL (34.955) and downcast CTDSAL (34.955), flag 4

OXYGEN

CTDOXY calibration in the upper 300 db, sometimes 800 db is bad for many stations. CTDOXY measurements at these stations do not at all match with bottle OXYGEN. Several bottle OXYGEN measurements do not agree with the general vertical distribution. Comparison with neighboring stations, with other cruises and with the form of the vertical distribution given by CTDOXY data make me think that these data are bad or questionable.

Station Pressure Remarks

| | | |
|---|---|---|
| 5 | CTDOXY calibration is high in the interval 1000-1500 db. | |
| 6 | CTDOXY calibration is high in the upper 300 db. | |
| 7 | 492 | OXYGEN (287.0) is low, flag 3; CTDOXY = 293.4 |
| 8 | 398 | OXYGEN (282.4) is low, flag 3; CTDOXY = 288.0 |
| 9 | 800 | OXYGEN (290.3) is low, flag 4; CTDOXY = 294.4<br>CTDOXY calibration is bad in the upper 400 db. |
| 10 | CTDOXY calibration is low in the interval 1800-2800 db. Thelowest bottle OXYGEN (2804 db) is Qble. There is a decrease of OXYGEN compared with (2731 db) bottle which is 110supported by CTDOXY There is such a similar near bottom OXYGEN decrease on station 9 (2527 and 2615 db) supported by CTDOXY. | |
| 12 | This station is the most difficult one to take a decision. Nevertheless I flag 6 bottles bad and 4 bottles Qble. The vertical distribution of OXYGEN below 1700 db does not match neither with the station 13 nor with downcast CTDOXY. CTDOXY for stations 12 and 13 are in a good agreement between themselves and with OXYGEN measurements for station 13. OXYGEN measurements below 1700 db do not match neither with the Meteor 18 data (1991) nor with the data from "Tyro" cruises in 1990 and 1991. These data fall out from the THETA-OXYGEN curve as well. | |

I flag the following bottles:

| | | |
|---|---|---|
| 1711db | OXYGEN (296.6) flag 4; | CTDOXY (291.5) |
| 1915db | OXYGEN (296.6) flag 4; | CTDOXY (284.5) |
| 2016db | OXYGEN (288.5) flag 4; | CTDOXY (281.1) |
| 2214db | OXYGEN (282.7) flag 4; | CTDOXY (273.9) |
| 2422db | OXYGEN (277.4) flag 4; | CTDOXY (272.1) |
| 2630db | OXYGEN (276.4) flag 4; | CTDOXY (273.0) |
| 2831db | OXYGEN (278.2) flag 3; | CTDOXY (275.8) |
| 2931db | OXYGEN (283.5) flag 3; | CTDOXY (277.6) |
| 3033db | OXYGEN (291.0) flag 3; | CTDOXY (288.5) |
| 3137db | OXYGEN (301.8) flag 3; | CTDOXY (296.8) |

| | | |
|---|---|---|
| 13 | 1303 | OXYGEN (294.0) is low, flag 3; CTDOXY= 297.8 |
| 14 | 397 | OXYGEN (296.5) is high, flag 4; CTDOXY= 282.2 |
| | 2021 | OXYGEN (291.8) IS HIGH, flag 3; CTDOXY= 287.3 |
| | CTDOXY calibration is low in the upper 800 db. | |

| | | |
|---|---|---|
| 15 | 1102 | OXYGEN (285.8) is low, flag 3; CTdOXY= 291.8 |

17 CTDOXY calibration is low in the interval below 2000 db.
CTDOXY calibration is high in the upper 600 db.

18 CTDOXY calibration is low in the interval below 2000 db.

20 CTDOXY calibration is high in the upper 200 db.

21 CTDOXY calibration is high in the upper 200 db.

23 CTDOXY calibration is high in the upper 400 db.

28 2525 OXYGEN (272.9) is high, flag 3; CTDOXY= 269.7
There is a maximum near this pressure on the CTDOXY curve, but it is no so pronounced.

29 497 OXYGEN (251.0) is high, flag 4; CTDOXY= 224.4

30 2787 OXYGEN (773.5) is high, flag 4; CTDOXY= 268.7

31 1400 OXYGEN (275.9) is low, flag 3; CTDOXY= 278.5

32 CTDOXY calibration is high in the interval 1000-2000 db.

33 2115 OXYGEN (271.9) is low, flag 4; CTDOXY = 276.5
CTDOXY calibration is high in the interval 1000-2000 db.

34 1506 OXYGEN (284.8) is high, flag 4; CTDOXY = 280.8
CTDOXY calibration is low below 2500 db.

37 CTDOXY calibration seems low in the interval 1000-1875 db compared only with neighboring stations. There are no bottle measurements to compare. The station is made over the submarine ridge 80 some changes in the oxygen distribution are possible. Data of the "Tyro" cruise gives even lower values of oxygen but not exactly in the same place over the bottom elevation.

42 2118 OXYGEN (283.4) is high, flag 4; CTDOXY = 275.1

43 3751 OXYGEN (240.3) is low, flag, 3; CTDOXY = 243.1

45 CTDOXY calibration is high below 2500 db. compared with bottle measurements but it matches well with "Tyro" and "Meteor 18" data. CTDOXY calibration is low in the upper 400 db.

46 CTDOXY calibration is low in the upper 800 db.

47 CTDOXY calibration is low in the upper 800 db.

48 CTDOXY ca]ibration is low in the upper 800 db and below 2500 db.

49 43O6 OXYGEN (239.9) is low, flag 3; CTDOXY= 242.1
CTDOXY Calibration is low in the upper 800 db.

50 CTDOXY calibration is low in the upper 500 db.

51 3832 OXYGEN (238.7) is low, flag 3; CTDOXY= 240.8
CTDOXY calibration is low in the upper 400 db.

52 CTDOXY calibration is low in the upper 600 db.

53 CTDOXY calibration is bad in the upper 800 db.

54 CTDOXY calibration is low in the upper 1200 db.

55 CTDOXY calibration is low in the upper 1000 db.

56 CTDOXY calibration is low in the upper 1000 db.

57 CTDOXY calibration is low for the entire station.

58 CTDOXY calibration is low for the entire station.

59 CTDOXY ca]ibration is low for the entire station.

## H. Response to DQE Report

Morozov's suspicion concerning V129 CTDSAL is correct. CTDSAL in the bottle file is the uncorrected CTD salinity, i.e. no laboratory or in-situ correction is applied to CTDSAL. 2 X-Y-diagrams attached (salinity residuals before and after correction) confirm Morozov's findings and will explain why a comparison of SALNTY with upsast CTDSAL as carried out by Morozov produced a wrong insight into the data quality (compare Morozov's remarks on salinity for V129 stat. # 16, 19-23). Thus his recommendations for QUALT2 SALNTY flags are not accepted except for stat. # 16 (800.2 db). By the way, there is an error in his remarks for stat. # 14 (1005 db): SALNTY (34.884) is a wrong number.

Concerning the CTDOXY calibration we did compare the uptrace CTDOXY with the bottle oxygen data, however, with bad results. That is not surprising because the oxygen sensor response depends on the flow of water, i.e. measurements differed considerably for a moving and for a stopped CTD. Thus CTDOXY is not shown in bottle files. 3 X-Y-diagrams of the final fit may help to answer your question as to how well the CTDOXY and OXYGEN data are reconciled. The problem of presumed poorly calibrated data in the upper ocean is the same as for "Meteor" 18 data ( see data report). Thus results from comparisons of CTDOXY with OXYGEN in the upper ocean should not lead to any down-flagging.

I attached a copy of Morozov's QUAL2 listing with my comments. V129 stat. # 12 is bad, indeed. CTD Cable problems appeared at this station (see remark in *.SUM file) which caused several mistrips. It cannot be excluded that several bottles were not reordered correctly. I assumed that at least bottles # 1-5 were not affected by mistrips. Perhaps I am wrong. Thus I suggest to downflag all flags to 3 (SALNTY included). The bottles should be flagged with 4. Or you can downflag QUAL1 according my suggestion and flag QUAL2 according your comments.

The following Table lists the levels where the QUALT1 flag was replaced by the QUALT2 flag, as per Sy's request.

| STN NBR | CAST NO | SAMP NO | CTDPRS | CTDSAL | CTDOXY | SALNTY | OXYGEN | QUALT1 | QUALT2 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | ******* | ******* | ******* | ******* | | |
| 12 | 1 | 11 | 1711.0 | | | | 296.6 | ~~~2 | ~~~4 |
| 12 | 1 | 10 | 1915.4 | | | | 296.6 | ~~~2 | ~~~4 |
| 12 | 1 | 9 | 2016.4 | | | | 288.5 | ~~~2 | ~~~4 |
| 12 | 1 | 8 | 2214.7 | | | | 282.7 | ~~~2 | ~~~4 |
| 12 | 1 | 7 | 2422.4 | | | | 277.4 | ~~~2 | ~~~4 |
| 12 | 1 | 5 | 2630.7 | | | | 276.4 | ~~~2 | ~~~4 |
| 12 | 1 | 4 | 2831.2 | | | | 278.2 | ~~~2 | ~~~3 |
| 12 | 1 | 3 | 2931.4 | | | | 283.5 | ~~~2 | ~~~3 |
| 12 | 1 | 2 | 3033.4 | | | | 291.0 | ~~~2 | ~~~3 |
| 12 | 1 | 1 | 3137.0 | | | | 301.8 | ~~~2 | ~~~3 |
| 13 | 2 | 16 | 1303.3 | | | | 294.0 | ~~~2 | ~~~3 |
| 14 | 1 | 10 | 2021.3 | | | | 291.8 | ~~~2 | ~~~3 |
| 15 | 1 | 11 | 1102.6 | | | | 285.8 | ~~~2 | ~~~3 |
| 16 | 1 | 16 | 800.2 | | | 34.8756 | | ~~3~ | ~~4~ |
| 28 | 1 | 4 | 2525.7 | | | | 272.9 | ~~~2 | ~~~3 |
| 30 | 1 | 17 | 2787.5 | | | | 273.5 | ~~~2 | ~~~4 |
| 31 | 1 | 11 | 1399.9 | | | | 275.9 | ~~~2 | ~~~3 |
| 33 | 1 | 9 | 2115.4 | | | | 271.9 | ~~~2 | ~~~3 |
| 34 | 1 | 11 | 1506.5 | | | | 284.8 | ~~~2 | ~~~4 |
| 42 | 1 | 12 | 2118.5 | | | | 283.4 | ~~~2 | ~~~4 |
| 43 | 1 | 4 | 3751.4 | | | | 240.3 | ~~~2 | ~~~3 |
| 51 | 1 | 1 | 3832.0 | | | | 238.7 | ~~~2 | ~~~3 |

## I. Appendicies

### Appendix A

1) Means of 10 oxygen measurements in each case, using reagent concentrations accorrding to

| **Winkler/Kalle** | **Winkler/Carpenter** | **Difference** |
|---|---|---|
| **ml/l** | **ml/l** | **ml/l** |
| | | |
| 5.817 +/- 0.0066 | 5.884 +/- 0.0050 | 0.067 +/- 0.0075 |
| 5.348 +/- 0.0076 | 5.440 +/- 0.0033 | 0.093 +/- 0.0075 |
| 5.628 +/- 0.0050 | 5.683 +/- 0.0025 | 0.055 +/- 0.0053 |
| 5.570 +/- 0.0043 | 5.683 +/- 0.0036 | 0.080 +/- 0.0051 |
| 6.013 +/- 0.0208 | 6.081 +/- 0.0125 | 0.068 +/- 0.0125 |
| 5.983 +/- 0.0043 | 6.062 +/- 0.0054 | 0.079 +/- 0.0062 |
| | | |
| Mean diff of the 6 sets of comparison | | 0.74 +/- 0.0138 |
| measurements +/- error of the mean | | |
| (95% confidence level) | | |

2) Means of 10 oxygen measurements in each case (reagent concentrations according to Carpenter), using

| **Normal O2 flasks** | **Iodine flasks** | **Difference** |
|---|---|---|
| **ml/l** | **ml/l** | **ml/l** |
| | | |
| 5.551 +/- 0.0029 | 5.566 +/- 0.0036 | 0.015 +/- 0.0044 |
| 5.448 +/- 0.0050 | 5.475 +/- 0.0064 | 0.027 +/- 0.0076 |
| 5.101 +/- 0.0064 | 5.135 +/- 0.0064 | 0.035 +/- 0.0084 |
| 5.017 +/- 0.0036 | 5.047 +/- 0.0036 | 0.030 +/- 0.0048 |
| | | |
| mean diff of the 4 sets of comparison | | 0.027 +/- 0.0135 |
| measurements +/- error of the mean | | |
| (95% confidence level) | | |
| | | |
| 1) + 2) mean difference of the oxygen values caused by iodine loss | | 0.101 +/- 0.0193 |

## Cruise Plan

Line AR7E 57°N - Ireland to Greenland

Logistical requirements:
Length (nm): 1110
Small Volume Stations: 38
Repeats/Yr: 4x;1/ No. of Yrs: 5
Program constraints: Once each season; and late winter or early spring annually. Full depth sampling and full suite of small vol. tracers required. Salinity vital. Dense station spacing and to bottom over ridges and slopes.

Operator: GERMANY
Chief scientist: Sy/BSH
Ship: VALDIVIA Cruise/leg: 06AZ129/1
Cruise date: Sept. 12-Oct. 6 1992
Cruise plan received:
Cruise report received: Dec. 92
ADCP: Bersch/IfMH
CTD: Paul/BSH
CTD pressure: Unknown
CTD salinity: Unknown
CTD temperature: Unknown
CTD uncalibrated pressure: Unknown
Oxygen: Unknown
Potential temperature: Unknown
Reverse pressure: Unknown
Reverse temperature: Unknown
Salinity: Unknown
XBT: Bersch/IfMH
XCTD: Unknown
Notes: Relocated at CP3-4.