Preliminary data Report
March 28, 1995

CRUISE REPORT

A. Cruise Narrative

A.1 Highlights

A.1.a WOCE designation: AR16

A.1.b Expedition Designation: 06HF991/1, 06HF991/2, 06HF991/3,

A.1.c Chief Scientists:

Leg 1: Hans-Christian John, BAH
Leg 2: Hans Georg Andres, BAH
Leg 3: Hans-Christian John, BAH
Address for Both Chief Scientists
Taxonomische Arbeitsgruppe der Biologischen Anstalt Helgoland
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Hamburg, Germany
Phone: 040/41232287 or 41235642
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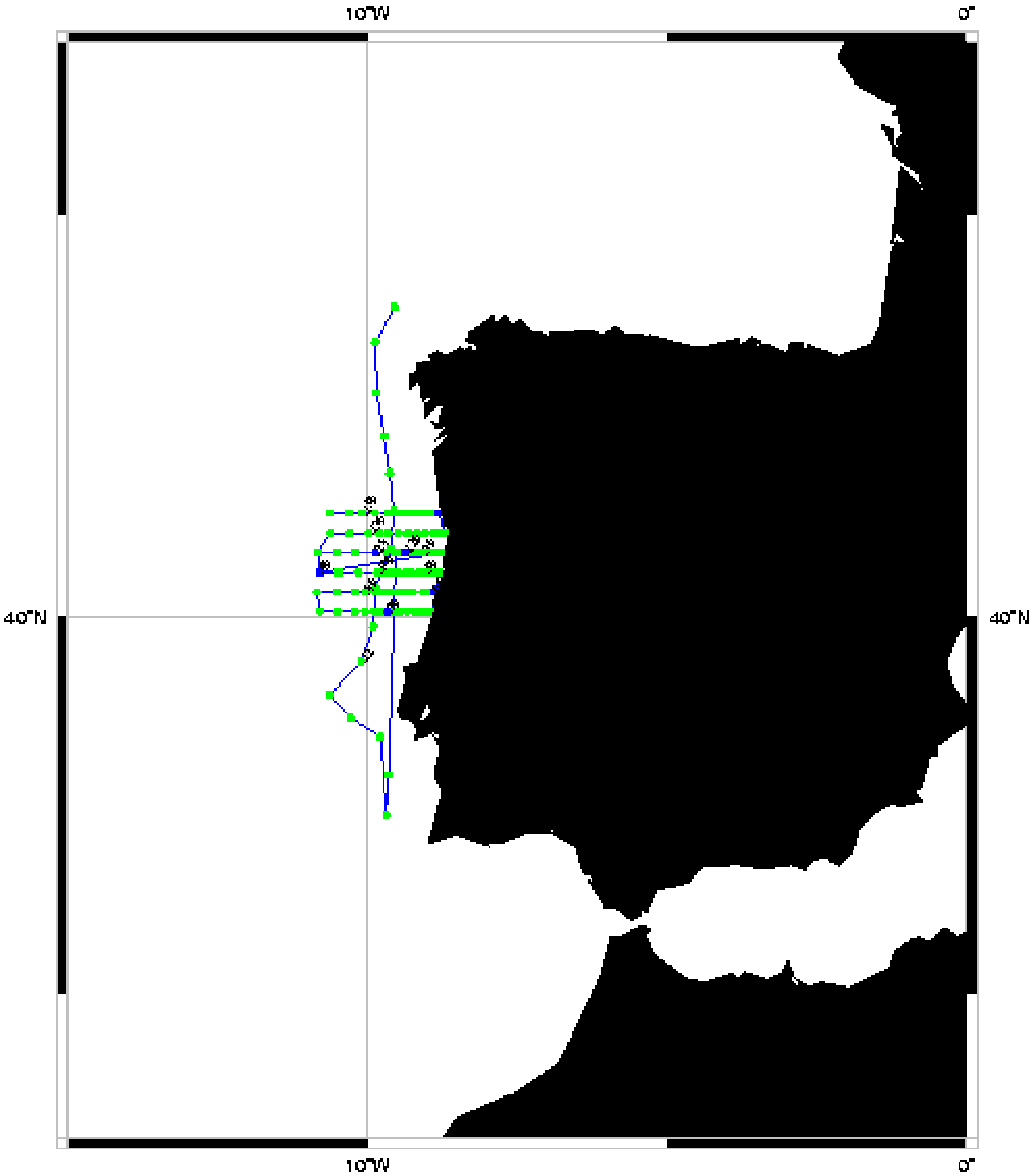
A.1.d Ship: R/V Heincke

A.1.e Ports of Call:
Leg 1: Cuxhaven, Germany to Leixoes, Portugal
Leg 2: Leixoes to Lisboa, Portugal
Leg 3: Lisboa to Leixoes

A.1.f Cruise Dates:
Leg 1: March 9 to March 20, 1991
Leg 2: March 22 to March 28, 1991
Leg 3: April 1 to April 11, 1991
Leg 4: April 13 to April 20, 1991

A.2 Cruise Summary

Station locations for AR16 : JOHN



A.2.a Geographical boundaries

	43 53.00 N	
10 50.00 W		08 45.00 W
	38 27.00 N	

A.2.b Total number of stations occupied

During the cruise a total of 132 CTD/rosette stations were occupied using a CTDO equipped with a 12 position rosette with 2.7 liter teflon water sampling bottles.

A.2.c Floats and drifters deployed

A.2.d Moorings deployed or recovered

A.3 List of Principal Investigators

Principal Investigator: CTDO Eberhard Hagen IfMW

A.4 Scientific Programme and Methods

The following report deals only with the CTD-measurements and the water sampling for sensor calibration, because this was the part of our institute during the cruise. Biological measurements and moorings had been done by the colleges of BAH and BSH (Bundesamt fuer Seeschiffahrt und Hydrographie, Hamburg).

Measurements
CTDO and sound speed; salinity and oxygen of water samples; temperature and pressure by reverse deep sea thermometers.

Rationale and history
The cruise started in Cuxhaven, Germany on 09. March 1991 and ended at the island of Helgoland, Germany on 20. April 1991. Foreign ports of call were Leixoes (twice) and Lisboa, where the ship received visits from Portuguese scientists and students.

This cruise was the third in sequence within a cooperation existing since 1987 between "Biologische Anstalt Helgoland" and the University of Lisboa on the seasonal dynamics in the Portuguese upwelling area. The cruises are designed to investigate eastern boundary currents in the temperate Northeast Atlantic and the seasonal dynamics of plankton and hydrography off the western Iberian Peninsula.

Eastern boundary current systems with coastal upwelling are important fishing areas worldwide. They have in common at least seasonally (off Portugalduring summer) a coast-parallel wind stress, forcing offshore Ekman transport at the surface. The resulting mass-deficit close to the coast is partly compensated by an intermediate compensating current onshore. Fish larvae are transported both by the Ekman drift and the compensating current. Drift is probably one of the mechanisms affecting larval survival. The compensating current feeds cold and nutrient-rich water into the euphotic layer and thus enhances primary production, used by successive steps in the food web up to exploited fish populations. Upwelling areas have generally a somewhat impoverished specific diversity and show equatorward shifts of faunistic boundaries.

In a larger context this study shall at the time of the "World Ocean Circulation Experiment (WOCE)" contribute to the study of the Eastern Boundary Currents off the Iberian Peninsula and (later) off Morocco. Questions are:

1. Which variability and interactions in time and space exist within the system?
2. Does the poleward undercurrent described south of 26∞N also exist off Morocco?
3. Is there a direct connection between the African undercurrent and the undercurrent observed off the Iberian Peninsula?
4. How far are distributions and drift of zooplankton and fish larvae influenced by this current system?

Narrative

The following research activities were carried out:

A) At hourly intervals meteorological data were automatically registered. Intercalibration of automatic sensors was done daily.
B) 133 vertical CTD-profiles were made to 1500 m depth (or the bottom, respectively) at all stations. The parameters pressure (P), Conductivity (C), Temperature (T), dissolved oxygen (02) and sound velocity (SV) were measured directly and salinity (S) was automatically derived. In-situ calibration was done at each station for P, T, 02 and S. Repeated measurements were made at survey lines C (three times) and D (twice).
C) 28 horizontal neuston net tows and 32 vertical plankton hauls by a multiple opening-closing net (1000 m depth or bottom) were made.
D) 107 oblique tows by the multiple opening-closing net (200 m or bottom) were made. Survey lines C and D were covered twice.
E) 52 biological box corers were taken along the survey lines C and D from the coastal stations to maximum bottom depths of 1450 m.
F) Raw-data evaluation was done for several parameters from the CTD along all transects and for surface temperature and salinity at the "synoptic" stations.
G) Macroscopical analysis of biological sampling was done for bathymetry and substrate-dependence of ampeliscid amphipods from the box corers and the distribution in space and time of clupeoid fish larvae from plankton tows.
H) Long-term current meter moorings (to be recovered in February, 1992) were laid at bottom depths of about 2000 m. Recording depths (6 instruments each) are from the bottom to 200 m.
I) Short-term current meter moorings were laid at the positions K1 and K2. Mooring KI was recovered at the end of the cruise (3 instruments, bottom to 40m), mooring K2 was lost. The biological material was for analysis in the laboratory and subsequent joint publication split between the Portuguese and German participants. The more detailed German cruise report and all accompanying environmental data available so far are also in hands of the Portuguese counterparts. There is mutual agreement to continue this project and the common desire to expand it including smaller scale future studies.

A.5 List of Cruise Participants

Table 1: List of Cruise participants

Name	Responsibility	Affiliation
H.-G. Andres		BAH
R. Bahlo	CTD Hardware	IfMW
H. Giese		BSH
E. Goncalves		UL
W. Hub	Salts	IfMW
H. -Ch. John		BAH
M. Kloppmann		BAH
J.C. Marques		UC
E. Mittelstaedt		BSH
H. Petersen		BAH
P. Re		UL
G. Schilling	CTD Software	IfMW
F. Zapp	Oxygens	IfMW

* See table 2 for list of Institutions

Table 2: List of Institutions

Abbreviation	Institution
BAH	Biologische Anstalt Helgoland
	Martin-Luther-King-Platz 3
	Hamburg, Germany 20146
BSH	Bundesamt fuer Seeschiffahrt und Hydrographie
	Postfach 30 12 20
	Hamburg, Germany D-20305
IfMW	Institut fuer Meereskunde Warnemunde
	Seestr. 15
	D-18119 Rostock-Warnemande
	Germany
UC	University of Coimbra
UL	University of Lisboa

C. Hydrographic Measurements

C.1 CTDO

The CTDO and the sensors are manufactured at the institu fuer Meereskunde Warnemuende, Germany. The CTDO is an OM-87 = Oceanological Measuring System, consisting of an expandable dividing CTDO-probe, interfaced through a special designed slave-computer, a meteorological subsystem interfaced by a second slave-computer and a master-PC. The IfMW meteorological subsystem interfaced by a second slave-computer anda master-PC. The IfMW began to develop oceanographic measuring systems in the 1960's. The first computer controlled CTD-system, OM-75 (Moeckel, 1980) was taken into service in 1976. The new generation: OM-87 has been used since 1988.

The CTD is equipped with frequency-analogous sensors at standard ports, developed and manufactured by IfMW; the oxygen sensor together with FSI "Kurt Schwabe", Meinsberg, Germany.

C.1.a Sensor Configuration List

The various sensors used on the different CTDs are listed in Table 3 by station and CTD number.

Table 3: CTD sensor configuration

CTD/Stat. No.	Parameter	Sensor	Resolution	Precision
CTD No. 2	Pressure	P251	0.1 dbar	2dbar
CTD No. 3/Sta. 161	Pressure	P252	0.1 dbar	2dbar
CTD No. 2/Sta. 161	Temp	T103	0.0015 K	0.01 K
CTD No. 2/Sta. 161	Conductivity	C853	0.0008MS/cm	
CTD No. 2/Sta. 161	Oxygen	0022	0.01 ml/l	0.1 ml/l
CTD No. 2/Sta. 137	Sound Speed	V116	0.025m/s	0.3 m/s
CTD No. 2/Sta. 139-141	Sound Speed	V116	0.025m/s	0.3m/s
CTD No. 2/Sta. 147-161	Sound Speed	V143	0.025m/s	0.3m/s

All sensors were calibrated before the cruise at the calibration laboratory of IfMW. The oxygen sensor was recalibrated during the cruise at the first station with water samples. The calibration constants of all sensors were checked up by the in situ comparisons of p, T, C, O2.

B.1.b CTDO

The down cast data were recorded on hard disk.

Sampling rate:
1 record in 1.2s = 0.83 HZ integration time of sensors: 1s lowering speed of CTD: 1.0

m/s time constants: pressure and temperature sensors = 0.1 s conductivity sensor = 0.1 s at 1 m/s lowering speed.

The calibration constants of pressure, temperature, conductivity, soundspeed sensors and the recalibration constants of the oxygen sensor were used over the whole cruise. The check measurements of CTDO and water sample data (in situ comparisons) were used for calculating the post-cruise corrections.

B.1.c Post-Cruise CTD Data Processing

The raw data are digitized frequencies, which had been converted to physical units of pressure, temperature, conductivity, oxygen and soundspeed. A validation routine was applied to the CTDO down cast data (LASS et al., 1983), to eliminate:

1. data values, which are not physically realizable.
2. Random errors by recursive low-pass filtering (Acheson, 1975).
3. Systematic errors caused by the effect of ship's rolling and pitching on the lowering rate of CTD. Records acquired while CTD is moving down too slowly have been discarded to enforce a strict monotonic sequence in pressure. The so called eddy-algorithm in connected view with the values of sensor integration time and lowering rate reduce the effect of different time lags of the sensors to minor importance.

The calculation of salinity from conductivity and conversion of dissolved oxygen of volumetric to weight concentration were done last after correcting the data as described below. Dissolved oxygen was converted according to the WOCE Operations Manual (1991).

The data haven't been averaged finally in 2 dbar increments because of the low sampling rate of the CTD and a great amount of discarded records in the course of data processing, up to 50% on average.

C.1.d CTD Post-Cruise Corrections

In order to get the CTDO to match the water sample and, respectively, the thermometer data that following fits defined in Table ??? were applied to the CTDO data.

C.1.e CTD Errors and Noise

During the cruise two sensor failures were located. After station no.2 the pressure sensor had to be replaced and after station no. 146 the sound speed sensor. The sound data of station 138, 145 and 146 were disturbed and have been discarded.

C.2 Water sampling for In Situ Comparisons

After finishing the down cast (CTDO-recording), the CTD was lifted and stopped within well mixed layers. After 10 minutes waiting to let the deep-sea thermometers adapt to the surrounding temperature two water bottles were tripped while a short time CTDO recording. The deep sea thermometers (2 protected and 2 unprotected) were reversed simultaneously with the first bottle tripping.

When the first bottle of each sampling depth tripped correctly the water samples (2 dissolved oxygen and 2 salinity) were drawn from these bottles, otherwise from the second ones.

Table 4: CTD calibration Coefficients

CTD No./Sta. No.	**Sensor**	**Fitting Parameter**	**Fitting Polynomials**
pressure: offset-fit PRES,		fitted=A0+PRES	
		A0	
2	P251	0.0 (no fit)	
3-161	P252	5.0	
temperature: linear fit TEMP,		fitted=A0+A1*TEMP	
		A0	A1
2-61	T103	0.02905	0.991986
72-161	T103	0.01525	0.993555
conductivity:linear fit COND,		fitted=A0+A1*COND	
		A0	A1
2-61	C853	0.33395	0.991045
72-161	C853	0.26103	0.992632
Oxygen:linear fit ml/l OXYG,		fitted=A0+A1*OXYG	
		A0	A1
2-61	O025	0.948	0.2236
72-161	O025	1.366	0.2136
Oxygen: Temp Correction (ml/l) OXYG,		corr.=OXYG,fitt.+A0+A1*TEMP	
		A0	A1
2-61	O025	1.0	-0.1
72-161	O025	1.1	-0.1
sound speed: no fit			
2-144	V116		
147-161	V143		

C.3 Salinity

The water sample salinities were measured with a Guildline Autosal Model 8400A salinometer, manufactured by Guildline Instruments Ltd., Smiths Falls, Canada. The salinometer was standardized weekly with IAPSO Standard Seawater (SSW) Batch P 111. Differences in standardization readings were less than 3.

The salinometer manufacturer claims a precision of 0.002 and an accuracy of better than 0.003; better than 0.001 when the laboratory temperature is constant (=/- K) and about 1-2 K below the bath temperature of the salinometer.

Water samples were let to come to the ambient temperature before measuring. The laboratory was temperature controlled (+/-1...2 K), 1...2 K below the bath temperature.

C.3.a

The laboratory temperature was 20 C constant (+/-1...2 K)

The temperature of salinity samples was determined before measuring conductivity. Oxygen samples had equilibrated to room temperature when measured.

C.3.b Standards Used

IAPSO Standard Seawater, P111, Feb 7, 1989.

C.4 Oxygen

The dissolved oxygen samples were analyzed by the Winkler Titration Method modified by Carritt and Carpenter (1966).

C.5 Temperature

The following reverse thermometers were used:

Manufactured by: VEB Thermometerwerk Geraberg, Germany		
	scale	graduated in
pressure protected	-2...+30°C	0.1K
unprotected	-2...+30°C	0.1K

Manufactured by: Gohla-Precision, Kiel, Germany		
	scale	graduated in
pressure protected	-1. .+35°C	0.1K

C.6 Differences and Standard Deviation of Water Samples

The differences between the salinity and oxygen measurements of the duplicate water samples and the standard deviation of the differences are shown in Table 3:

Table 5: Sample variance

Parameter	Average difference	Maximum difference	Standard deviation
salinity	0.0014	0.021	0.0022
oxygen	0.011	0.03	0.0083

D. Acknowledgments

E. References

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

Unesco, 1991. Processing of Oceanographic Station Data, 1991. By JPOT Seditorial panel.

Wlost, K.-P., 1993. The OM-87-System: a brief description. Institut of Baltic Reasearch Warnemnde, Germany. unpublished paper.

WOCE Operations Manual, Vol. 3, Sec.3.1, Part 3.1.2, 1991. WHP Office Report WHPO 90-1, WOCE Report No. 67/91, Woods Hole, Mass., USA.

WOCE Operations Manual, Vol. 3, Sec 3.1, Part 3.1.3: WHP Operations and Methods; C.H. Culberson: Dissolved Oxygen, WHP Office Report WHPO 91-1, WOCE Report No. 68/91, 1991, Woods Hole, Mass., USA.

F. WHPO Summary

Several data files are associated with this report. They are the ebc1.sum, ebc1.hyd, ebc1.csl and *.wct files. The ebc1.sum file contains a summary of the location, time, type of parameters sampled, and other pertient information regarding each hydrographic station. The ebc1.hyd file contains the bottle data. The *.wct files are the ctd data for each station. The *.wct files are zipped into one file called ebc1.wct.zip. The ebc1.csl file is a listing of ctd and calculated values at standard levels.

20000831 HLB

Bottle: (theta, salnty, oxygen, revprs, revtmp)

Found a newer bottle file with QUALT2 flags in the WHOI dump directory. Added this to the website.

**NOTE: A preliminary *.csl files were not created due to CTD data beingprovided in non-uniform levels.