Southampton Oceanography Centre
James Rennell Division
Cruise Report No. NNN

RRS *James Clark Ross*
JR16
13 NOV 1996 - 7 DEC 1996

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ABSTRACT

CRUISE NARRATIVE

Highlights

Cruise Summary

Principle Investigators

Scientific Programme and Methods

Preliminary Results

Problems Encountered on Cruise

Cruise Diary

Thursday 28 Nov, DOY 333

Data processing and navigation logging. VMADCP set to bottom tracking. Depart Rothera at 2030 UTC on passage to Vernadski. Overflight by Twin Otter reveals ice free passage immediately south of Adelaide Island which speeds passage northwards

Friday 29 Nov, DOY 334

Navigation logging. Fast passage to Vernadski arriving 1830 UTC. Heavy ice conditions still prevail so no attempt made to get to base. Depart immediately, destination Signey Island. Passage through Mare Channel dramatic and highlight is broaching Killer Whales.

Saturday 30 Nov, DOY 335

No bottom track ADCP data due to speed of passage, typically above 16 knots. Navigation logging. On passage to Signey.

Sunday 1 Dec, DOY 336

Arrive Signey at 1430 UTC. No ADCP bottom track on shelf around Signey due to high speeds. Scientists help work cargo to base from 1500 to 2200 UTC. Depart Signey 0000 UTC.

Monday 2 Dec, DOY 337

En route around Signey to POL mooring 11 at position 60° 03.1' S, 47° 10.0' W. Bottom pressure recorder laid in approximately 2600 m depth. Depart mooring position at 1000 UTC for passage to north west to POL 8 just south of Burdwood Bank. This passage is used to make a T5 XBT (1800 m nominal depth) section. Probes are launched at intervals of 90 minutes throughout the passage. Navigation, underway logging and water track VMADCP data logging. At start of section during daylight hours XBT's launched at 16 knots limiting depth penetration to 1000 m. Later due to deteriorating weather ship slows to 8 knots for XBT launches allowing full penetration to 1800 m. Non-toxic supply to Oceanlogger stops after heavy rolling. Measurements abandoned and underway salinity sampling stopped.

Tuesday 3 Dec, DOY 338

Arrive at POL 8 position 54° 56.6' S, 58° 23.1' W at 2200. XBT section ends at this point in approximately 1000 m depth. POL mooring tracked to sea bed. Head north for the Falklands

Wednesday 4 Dec, DOY 339

Arrive Mare Harbour for bunkers at 1400 UTC. Depart 1800 for Stanley, tied up at FIPASS at 2200 UTC. Science party departs for walk to the Lady Elizabeth.

Thursday 5 Dec, DOY 340

All logging terminated at a 0006 UTC having logged some navigation whilst tied up FIPASS. Processing, packing and tidying up continues from yesterday.

List of Cruise Participants

Table 1: Ships Personnel

Burgan, Michael J.S.	Master
Reading, Antony M.T.	Ch. Off
Gatti, Antonio	2nd Off.
Alletson, Simon J.	3rd Off.
Gloistein, Michael E.	R/O
Anderson, Duncan E.	Ch/Eng.
Smith, Colin	2nd Eng.
Inch, Malcom	3rd Eng.
Tyrer, Gerard A.	3rd Eng.
Rowe, Antony K.	Elec.
Wright, Simon	Deck Eng.
Reynolds, Paul M.	Eng. Cadet
Gibson, James S.	Cat. Off.
Stewart, George M.	CPO Bosun
Chalk, Charles A.	PO B'n Mate
Peck, David J.	SG1
Williams, David O.	SG1
Rees, David	SG1
Owen, Howard P.	SG1
Clark, Paul	SG1
Macaskill, Angus L.	M'Man
Bretland, David	M'Man
Hunt, David A.	Ch. Cook
Carney, John	2nd Cook
Ceballos, Gabriel E.	Stwd.
Pratley, Clifford R.	2nd Stwd.
Jones, Mark H.	Assist. Stwd.
Moore, Thomas J.	Stwd.

Table 2: Scientific Staff

King, Brian A.	SOC
Cunningham, Stuart A.	SOC
Griffiths, Michael J.	SOC

Brandon, Mark A.	BAS
Lamden, Bruce J.	BAS
Vassie, Iain	POL
Spence, Robert	POL
Hargreves, Geoff	POL
Ashley, Johnathen	POL
Byrne, Mark	TD

Special thanks to Mark Byrne of Tillbury-Douglas, on passage to Rothera, generously helped with the scientific program.

MEASUREMENT TECHNIQUES AND CALIBTRATIONS

Sample Salinity Measurements

CTD measurements

Deployment

Deployment of the CTD underwater package was from the midships gantry and A-frame. There were no problems deploying the CTD package: close control of the package was maintained with the gib arm whilst the package was suspended above the surface. Hand lines were also used.

The CTD cable is a single condUTCor, torque balanced cable from Rochester Cables, hauled on the 10T traction winch.

Deck Engineer's Report

The cruise has been affected to no great degree by problems with the ship's fixed scientific installations. I have been very satisfied with the equipment under my charge during the cruise. The systems used were the ten tonne traction winch and midships gantry for the deployment of a CTD package. There follows a brief explanation of any faults that did occur;

Station No. 4

The cable required reterminating after it slipped off the side of the roller at the top of the midships gantry during deployment. This resulted in it becoming trapped between the previous sheave and it's cheek plate which damaged the wire. It is assumed that the wire moved due to the ships motion when it was slack between stations.

Station No.16

A kink in the cable occurred during deployment, which it was impossible for the deck crew to control, resulting in the cable having to be reterminated. This occurred just after the ship was informed that the ADCP data indicated that the package was rotating in the same direction on veer and haul, hence winding up the cable. This appears to have started after an alteration to the water bottle configuration was made to the rosette. After this a stabilising fin was fitted to the package which prevented further rotation, however an estimated 60 - 80 rotations had still been imposed on the cable.

Station No.19

A kink in the wire caused it to jam on the sheave at the top of the spurling pipe from the winch room when the package was being lifted off the deck. The cable appeared to have a lot of "life" in it and as a retermination would be required about 50 metres was cut to remove some other suspect areas. At this point it was decided to deploy the cable after reterminating and blanking to 3000 metres with a weight and swivel in an attempt to unwind the cable. This appears to have had some effect as subsequent deployments showed very little twisting of the cable at the outboard end. Occasionally the package was disconnected and the cable allowed to relax which removed a further half or one turn from it.

Station No.27

Just before the package reached the surface on haul a hydraulic hose failed, however this did not prevent the package being recovered. The hose fed an auxiliary function on the gantry so it was possible to blank the hose off until the section had been completed.

It is the hope of the Deck Engineer that the services provided have met the scientific party's expectations and should any suggestions be forthcoming that they will be passed back directly for future consideration.

S.A. Wright, Deck Engineer

Underwater Instrumentation

The following underwater instrumentation and equipment were fitted to the large Aluminium CTD frame with the additional stainless skirt and mounts for the LADCP.

CTD EG&G NB MkIIIc 25 Hz	DEEP03	Stns. 1 to 6
CTD EG&G NB MkIIIc 25 Hz	DEEP04	Stns 7 to 30
Rosette Multisampler	SOC 2	
Simrad Altimeter		
IOSDL 10 kHz pinger		
Seatech Transmissometer	Sn 35	
Chelsea Instruments Transmissometer	Sn XXX	
SIS Pressure Sensors	P6394H & P6393	
SIS Temperature Sensors	T995 & T989	

Niskins: A mixture of FSI 10 litre and GO 1.7 litre bottles with no more than 12 mounted on the rosette.

CTD Frame Fin (0.255 m X 1.067 m. Area = 0.24 m^2)

RD Instruments 150 kHz ADCP

The mixture of bottles was necessitated by the failure of many of the FSI bottles and it is likely that the mixture of bottles unbalanced the package underwater causing the observed spinning. From the heading measurements of the LADCP about 60 turns were put in the CTD wire on the first 15 stations. This started to cause problems when slack wire came under tension on deployment leading to wire failures. In an attempt to remove the twists the cable was veered out to with a weight and swivel to 3000 m before station 16. This certainly helped a little, however it was, for the next few stations necessary to remove the termination from the package to release the twists between package and gantry. Eventually this proved unnecessary as the twisting was removed. On station 16 a fin was fitted to the underwater package in an attempt to prevent rotation of the package. LADCP heading measurements showed that this was almost completely successful.

Shipboard Equipment

The following were installed in the Underway Instruments Control suite for the operation and data capture from, the underwater package.

In duplicate:
EG&G demodulator 1401
EG&G non data interrupt rosette firing module
Kepco power supply ATE150-0.7M
IBM PS/2 PC with 150Mbyte tape drive. Raw data were acquired with General Oceanics Data Acquisition (DA) software version 5.2 revision 2.

CTD Data Collection and Processing

CTD data were passed from the CTD deck unit to the level A. This despikes the raw data, computes the rate of change of temperature over one second and assembles one second averages of the raw data. These data are then passed to level B logging and to level C archiving [Pollard et al., 1987].

One irritating problem for data transfer from the RVS level c to pstar was the bit map reversal of logged data from the multiplexed channels of the CTD as detailed in the table below

Table NNN: Multiplexed CTD to RVS channels

CTD bit map	CTD A/D channels	Variable order for CTD A/D channels	RVS bit map	RVS ANCIL
001	1	press_t	100	4
010	2	oxyc	010	2
011	3	oxyt	110	6
100	4	fluor	001	1
101	5	trans	101	5
110	6	alt	011	3
111	7	chelsea tran	111	7
000	8	CTD zener voltage	000	0

so that the variable appearing on multiplexed channel one appears on RVS ANCIL channel four etc.

Raw binary CTD data were also logged by the deck unit pc's. This is the first log of the raw, demodulated 25 Hz data and the .RAW files produce by the GO DA software were archived to tape. Raw data were able to be recovered using the DOS BACKUP command to copy raw files to floppy and then using sneakernet to transfer them to a UNIX workstation. There a C program, mk3c.c, was able to reassemble the raw binary file and output an ascii file. Subsequently a FORTRAN program levela.F imitated the level A, to produce a one second averaged file. This route was used once during the cruise due to a level A crash.

On a previous WOCE cruise [Heywood and King 1996] using the same level A on board the RRS *James Clark Ross* serious and unresolved problems with the level A were experienced. In that case frequent crashes of the CTD level A, and subsequent data loss, were reported. We had one such incident. A new logged parameter is the number of frames making up the one second average output by the level A. We found that the level A unacceptably decimated the data to around the 40 to 50 % level. The level A software emulation did no such thing. Whilst it cannot be guaranteed that the emulation software and the level A were identical the suspicion is that the level A cannot cope with a 25 Hz data rate and is as a consequence loosing good data. This is unacceptable and in future it is to be recommended that the level A is removed from the data path.

Summary

CTD data are logged to a PC running General Oceanics control software and the RVS ABC system. The GO control software was version ??????, and raw data backup was accomplished by dumping the data to a tape streamer. The CTD level A, mainly through historical reasons, averages the data at this point to 1 second averages and passes the data through a simple editing procedure. During this editing procedure pressure jumps of greater than 100 raw units (this is equivalent to 10 db for the pressure transducer) are removed along with spikes in individual channels through a median sorting routine. The rate of change of temperature change is also calculated. The one second data are then passed to the ship's UNIX system and archived. Calibration routines are then applied and will be decried below. The S.O.C Deep03 was used for stations 1 to 7 but erratic performance then led to the change to Deep04. This unit was used for the rest of the section.

In this report we first give details of the calibration route before describing the calibration procedure in detail. The route for the calibration process is detailed in figure 1. In all CTD stations the downcast data are reported as the final prodUTC with the exception of station 16. At this station some of the upcast was copied out and sorted to reverse the pressure signal to replace a data gap caused by a combined Level A and PC crash.

The level A problems

The serious problems encountered on WOCE section A23 in May 1995 have been greatly improved by the replacement of the CTD Level A in January 1996. However, the level A is still unsatisfactory and it crashed on five occasions listed in table A as well as the numerous and still unexplained "serial overuns". Unlike on A23 all of the level A crashes were recoverable by reseting the unit. A more serious problem with the current level A application is the amount of apparently good data it rejects. #INCLUDE <* ANGRY COMMENTS ABOUT NFRAMES HERE *>.

Bottle problems

Twelve FSI GO 10 litre bottles were deployed on a 24 bottle pylon for the collection of samples for calibration of the CTD. Once mounted the bottles were lashed into place. Several problems were experienced with these bottles during the first 10 stations. Problems on the first two casts were caused by faulty constrUTCion of the CTD frame in that the top bottle mounting plate was not parallel to the bottom plate. This meant that the mounting was least secure at bottles six and seven where the plates were furthest apart. The complete loss of bottles before this problem was identified and cured were prevented by the previously mentioned lashings. More significant problems were caused by bottles fracturing at their mounting point. We believe this is due to poor bottle constrUTCion. During the first ten stations four of the 10 litre bottles were lost and replaced by BAS 1.7 litre General Oceanic bottles. All the bottle problems encountered are detailed in Table B.

Bottle Pylon missfires

It was hoped to be able to control the pylon firing through the CTD control software, however new software had been installed on both of the CTD deck unit PC's that offered choices that none of the team had seen before when a bottle was fired from the keyboard. We therefore chose to fire all bottles manually from the CTD deck unit, the bottle firing signal being logged to a level A data stream. During the section the pylon signalled missfires on 9 casts although with only twelve bottles on the pylon any problems caused were easily spotted and cured. Table C summarises the pylon missfires.

The calibration of the CTD

As two units were used during the section after each calibration equation we report both sets of coefficients. For the salinity calibration we report three sets of coefficients. This is described in greater detail below. Deep 03 was calibrated by S. Keene (Ocean Scientific Limited) on 9 July 1996 and Deep 04 was calibrated by S. Keene in July 1996.

Temperature calibration

The temperature calibration applied to the data was through the following equation

$$T = a + b\,Traw + c\,Traw^2$$

and the results are in degrees C in the ITS-90 scale.

For deep03 the coefficients are

a = -2.1232 b = 0.99115 c = 4.2e-6.

For Deep04 the coefficients are

a = 0.013079 b = 0.999316 c = 0.0

The large difference between the two sensors takes into account the fact that deep03 has been adjusted to give it a better response at low temperatures.

To allow for the missmatch in response times between the temperature sensor and condUTCivity sensor, the temperature was lagged. This lag was achieved by adding a fraction FRAC of the rate of change of the temperature that is output from the level A (dT) to the temperature. The temperature is then

$$Tnew = T + FRAC * dT$$

From experiment the condUTCivity spiking was minimised for deep03 with a FRAC of 0.25, and for with a FRAC of 0.3.

Pressure temperature was derived from the following equation

$$Tpress = a + b\,Tpraw + c\,Tpraw^2$$

For deep03 the coefficients used were

a = 65.31984 b = -2.3346 c = 1.776e-4

and for

a = 86.5386 b = -2.2711 c = 3.648e-4

The fast response temperature probe of the CTD although not used as yet was calibrated following the equation

$$Tfast = a + b\,Tfraw + c\,Tfraw^2 + d\,Tfraw^3$$

for deep03 the coefficients were

a = 3.23738 b = 1.0568 c = -6.2633e-3 d = 1.34e-4

and for

a = -0.45889 b = 1.03814 c = -5.661e-3 d = 1.202e-4 pressure calibration

A pressure calibration was applied to the CTD pressure data through the following equation

$P = a + b\ Praw + c\ Praw^2$

For deep03 the coefficients are

$a = -38.9 \quad b = 1.07449 \qquad c = 4.8e\text{-}8$

for the coefficients are

$a = -37.5 \quad b = 1.07328 \qquad c = 6.9e\text{-}8$

We are still discussing the applicability of a static pressure correction to the data. For both deep03 and a correction was applied in the form

$P = P + Pstat$

and

$Pstat = (0.075 - 0.0 * Praw) * (Tpress - 10.0)$

Given the temperature range encountered during this cruise this correction factor is small.

extraction of upcast data

The upcast data was selected by merging the firing file as logged on the level A with the ten second averaged data file. The full process being detailed at the end of the report and figure 1.

salinity calibration

For this cruise we calibrated the condUTCivity and then derived salinity. A full data processing route is detailed at the end of this report. In brief, first we applied a calibration of the form

cond = 0 + 1 * cond_raw

Then from the salinity samples we calculated bottle condUTCivity using in-situ temperature and pressure. We then calculated the difference of bottle and CTD condUTCivity to derive a value we call deltaC. We then plot bottle condUTCivity (*x variable*) against deltaC (*y variable*). This gives a straight line graph where from

$y = m x + c$

We get

deltaC = m (bottle condUTCivity) + c

After rejecting suspect bottles we use the pstar programme plreg2 to derive m and c for deltaC.

Now, as

deltaC = bottle condUTCivity - CTD condUTCivity

the calibration coefficients for the CTD condUTCivity are derived through substitution and the CTD condUTCivities are now

cond = a + b * cond_raw
where a = c / (1 - m)
and b = 1 / (1-m)

The processing route is then repeated and the new graph of deltaC against bottle condUTCivity gives the condUTCivity residuals, the residuals should now be random with a mean of zero.

For deep03 and stations 1 to 7 the values of a and b were

a = -0.044672 b = 0.94518

This calibration procedure does have a feature in that as we moved south along the section and moved into waters where the entire water column was of lower condUTCivity than the station used for the initial calibration the validity of the original m and c are called into question because of extrapolation. To overcome this for we used stations as calibration points.

stations 7 to 15 were calibrated with values based on station 11 and were

a = -0.10062	b = 0.9705

station 16 to 30 were calibrated with values based on station 26 and were

a = 0.00263	b = 0.9671

After applying these calibration coefficients to the relevant stations there is still a residual drift within the condUTCivity signal and time. For each station this drift is

deltaC = residual drift

and from substitution we remove the residual drift from the signal. The condUTCivity calibration details are summarised along with the residual drift in table D.

The quality of the condUTCivity calibration procedure
After applying the calibration coefficients and adjusting for the residual offset the salinity of the bottle was differenced with the derived CTD salinity. After rejecting 9 samples detailed in table D the mean of the remaining 305 samples was 0.0000 with a standard deviation of 0.0017 psu. In figure 2 we show the residual salinity offset against station number and in figure 3 the residual salinity offset against pressure. The greater variability of the residual for the stations using Deep03 show that the unit was behaving badly.

Transmissometer calibration

The transmissometer data was treated in a different way to that of past cruises as the CTD had both a Sea Technology 1 m path length unit and a Chelsea Instruments 0.25 m path length instrument. To enable the units to be compared more easily the FOTRAN programme ctdcal.F was modified to output data from the Sea Tech instrument in the same form as that from the Chelsea instrument. That is with raw transmissometer data from both instruments being output as volts.

The calibration equation to the Sea Tech instrument is of the form

$$Trvolt = a + b\ rawTrvolt + c\ rawTrvolt^{2}$$

for deep03

a = -5.0273 b = 1.5344e-4 c = -3.7038e-13

for although the instrument is the same the A to D convertor boards are different and so the coefficients change to

a = -5.656 b = 1.7267e-4 c = -2.2442e-12

For the Chelsea Instruments transmissometer the equation is of the form

$$Chvolt = a + b * rawChvolt + c\ raw\ Chvolt^{2}$$

for deep03

a = -5.027 b = 1.534e-4 c = -3.704e-13

for

a = -6.6776 b = 1.8762e-4 c = 2.24385e-12

The Sea Technology transmissometer SN35 has a history of erratic performance. During JR16 the unit showed the same behaviour before the problem was partially cured by changing the unit leads on station 16. The Chelsea instruments unit caused no specific problems although it is less sensitive to than the Sea Tech unit as due to the shorter path length. Both instruments had frequent drop outs and the data will require editing to produce usable data.

Simrad Altimeter

The altimeter on the CTD frame did not perform as well as hoped and it had some problems. In previous cruises I noted that the altimeter had held a value of 205 m until coming into range. Then as the package was lowered towards the sea floor the altimeter counted down the height off bottom. On this cruise on some casts when the package was descending, the altimeter value flickered between 1.5 m and 205 m. Problems with the altimeter are summarised in table C.

The altimeter lead was changed at one point but it is not mentioned in the CTD deck log.

The calibration equation for the altimeter is

$$Alt = a + b\ rawAlt + c\ rawAlt^{2}$$

for deep03 the coefficients are

a = -249.7 b = 7.62e-3 c = -1.04e-10

for the coefficients are

a = -234.5 b = 7.16 c = -9.48e-5

IOSDL 10 Khz Pinger
The 10 Khz pinger worked well throughout the cruise with only one exception. During station 26 the return echo from the pinger was very diffuse. This was most likely due to the slope of the sea floor rising rapidly coupled to the orientation of the package. As stated in the altimeter section the top shackle was replaced after this station as it was very twisted.

The CTD processing route for JR16

Step 1: ctd0

Purpose: To read in the CTD data from the RVS stream.
The programmes are

datapup - read in the data from an RVS stream into a pstar file.
pcopya - reset the raw data flag in the pstar file.
pheadr - set the header of the pstar file.

The output of the exec is in the form ctdCCC$num.raw

The purpose of the exec is as in all execs with the 0 extension in that it simply transfers the data from the RVS system to a pstar data format.

Step 2: ctd1

Purpose: To calibrate the ctd data.
The programmes are

ctdcal - to apply a nominal calibration to the ctd data (on JR16 this program was modified to deal with the Chelsea transmissometer data and was called "ctd").
pcopya - select out the relevant variables. Ouput file is extension .du.
pavrge - average the .du file on 10 seconds. Output file is extension .10s.

The output files are ctdCCC$num.du
and ctdCCC$num.10s

Step 3: fir0

Purpose: To read in the bottle firing data.
The programmes are

datapup - read in the data from an RVS stream into a pstar file
pcopya - reset the raw data flag in the pstar file
pheadr - set the header of the pstar file

The output of the exec is in the form firCCC$num.tim

Step 4: fir1

Purpose: To merge the bottle firing file with the 10s ctd file.
The programmes are

pmerge - merge .tim file with the .10s file

The output of the exec is in the form firCCC$num

Step5: recexec1

Purpose: To create a text file to match with the samples

mlist - create an ascii file
ed - edit out unwanted information from the ascii file

The output of the exec is in the form matCCC$num

Step 6: Matching of sample files

The matching of sample files is slightly tricky. On the face of it one would expect the constrUTCion of a mechanism to close water bottles when required would be rather trivial. The rosette functions by having a stepper motor which rotates through 360 degrees releasing 24 bottles (one bottle every 15 degrees). This does not seem a particularly high accuracy requirement and again, it should be easy to constrUTC a rosette. However, the General Oceanic (GO) rosettes have proved time and time again that this apparently not a reasonable requirement. If the motor is not exactly lined up with its start point, as it rotates through 15 degrees to trip one bottle, the trigger can trip two bottles to close instead of one. The implication is that with all 24 bottles on the rosette is not uncommon to get two samples taken at a one sample level, and no sample at a level. It is usually quite obvious when this has happened because the salinity values in the sample file are identical when in fact one thought they were sampled from water hundreds of metres apart.

For a JR16 (R96) we had twelve 10 litre water bottles in alternate positions on a 24 point GO rosette pylon. In the sampling strategy we therefore triggered the rosette twice at each sampling point and ended up with two data cycles in the bottle firing file for each rosette sample.

This meant that in the firCCC$num.tim and consequently the firCCC$num file we have 24 data cycles but only a maximum of twelve samples to match. It should be completely trivial to just delete every other data cycle in these files to a perfect match. Again, in practice, this was not the case. Problems, when encountered, were usually between the first bottle to be closed (bottle 1) and the last (bottle 12) and meant that a surface sample could be matched with a deep water position in the firing file. The problem was most probably caused by the trigger point in the sampling rosette being at the wrong place at the start of a CTD cast. The problem is easily spotted as the sample values and reversing pressure and thermometers on bottle 1 will reveal the problem. On one occasion on JR16 the reversing sensors were not set to sample data on the CTD cast and on one occasion the lanyard to trigger the sensors apparently snagged. On three consecutive occasions there were “long” missfires on rosette potions 9 and 10. With a “long” missfire it is usual to assume that samples have been taken but on two of these casts bottles had not closed and we ended up with double samples at the next sampling point.

The sample data path
First assemble the relevant information on the macintosh.
The file must be saved as a text file.

Step 7: sal.exec

Purpose: To read in the sample file from the mac to the unix system.
The programmes are

getexel.exec - reads data file from the mac

This really needs changing but the output files must be renamed.
The file samp.nnn must be renamed to samp.nnn.txt
The file samp.bot must be renamed to samp.nnn

Step 8: ed_fir_in

Purpose: To read in the corrected “mat” firing file and merge it with the sample data.
The programmes are

pascin - read in the corrected matCCC$num file
pcopya - copy in five extra variables
pheadr - set the header of the new file
ppaste - paste in the sample data from samp.nnn

The output file is in the form sampCCC$num

Step 9: sr1_ctd_cal
Purpose: Work out the differences in condUTCivity between the ctd and sample file.
The programmes are

peos83 - derive a condUTCivity from in-situ T and P from the sample
parith - calculate the delta condUTCivity
mlist - get a scatter plot of condUTCivity against delta condUTCivity
The output file is in the form sampCCC$num.cond

Step 10: Determine the ctd offset
We use phisto to calculate the final ctd condUTCivity offset from our data.

Step 11: ctd_final_cal
Purpose: To add the station by station final offset.
The programmes are

pcalib - add the offset to the .du extension file
pcalib - add the offset to the .10s extensioned file
peos83 - derive the salinity from corrected condUTCivity in the .du file
peos83 - derive the salinity from corrected condUTCivity in the .10s file
pmerg2 - merge the .tim file withcorrected .10s file
mlist - create an ascii file from the new firing file
ed - edit out unwanted information from the ascii file

The output of the exec is in the form matCCC$num.final
NB the last three programmes include fir1 and recexec1 that were on the first iteration

Step 12: Edit the corrected "mat" file
Here we edit the new mat file in exactly the same way as we did in step 6.

Step 13: final_fir_in

Purpose: To read in the corrected CTD data and merge it with the sample data.
The programmes are

pascin - read in the corrected matCCC$num.final file
pcopya - copy in five extra variables
pheadr - set the header information
ppaste - paste in the sample data from samp.nnn
parith - calculate the salinity offsets now

The output files are in the form sampCCC$num.final
and sampCCC$num.offsets

Step14: ctd2

Purpose: To get the final result from the ctd data
The programmes are

pcopya - copy out the downcast from the .du file
pmdian - remove the large spikes from P, T, cond, salin and potemp
pintrp - interpolate the missing data removed by pmdian
psort - sort the file on pressure. output file extension .1hz
pavrge - average the .1hz file to 2db levels. ouput file extension .2db
pintrp - remove missing data from the .2db file

The output files of the exec are in the form ctdCCC$num.1hz
and ctdCCC$num.2db

Extra Execs

Step 15: add_stat_num

Purpose: To add the station number as a variable.
the programmes are

pcopya - copy in an extra variable to the .final file
pheadr - change the extra variable name to station number in .final
pcalib - make the variable equal to station number in .final
pcopya - copy in an extra variable to the .offset file
pheadr - change the extra variable name to station number in .offset
pcalib - make the variable equal to station number in the .offset file

Step 16: add_position

Purpose: To add the latitude and longitude as variables.
The programmes are

pcopya - copy in an two variables to the .final file
pheadr - change the two variables names to latitude and longitude
pcalib - make the two equal to lat and lon in .final
pcopya - copy in an two variables to the .offset file
pheadr - change the two variables names to latitude and longitude
pcalib - make the two equal to lat and lon in the .offset file

TABLES

Table A: Level A crashes on JR16

JDAY	Station
320	4
320	5
321	11
322	12
323	16
325	29

Table B: Bottle problems encountered during JR16

Station	Problem	No of bottles on CTD frame
1	7 out of rack - not sampled replaced	12
2	6 and 7 out of rack. Top plate of rosette not level	12
3	Bottle 10 broken	10
4		9
5	Bottle 9 broken	9
6	Bottle 4 broken	9
7		9
8		9
9		9
10	Installed 4 BAS 1.7l bottles. Seal changed on bottle 10.	12
	For All further casts there were 12 bottles	
18	seal replaced on bottle 11	

Table C: The pylon missfires during JR16

Station	**Position**	**Type of Missfire**
4	1	Long
5	12	Long
16	3	Long
17	5	Long
19	9	Long
	10	Long
21	9	Long
	10	Long
22	9	Long
	10	Long
	24	Short
23	9	Long
	10	Long
25	7	Long

Table D: The condUTCivity calibration details for the CTD stations

station	residual offset	CTD	condUTCivity calibration	rejected samples
1	0.1417	Deep03	station 4	
2	0.0119	Deep03	station 4	202
3	-0.0171	Deep03	station 4	316
4	0.0002	Deep03	station 4	
5	0.0195	Deep03	station 4	517
6	0.0046	Deep03	station 4	
7	0.0072		station 11	
8	0.0042		station 11	
9	0.0019		station 11	
10	0.0007		station 11	
11	-0.0001		station 11	
12	-0.0002		station 11	1217
13	0.0011		station 11	
14	-0.0006		station 11	1419
15	-0.0031		station 11	
16	0.003			station 26
17	0.0018		station 26	
18	0.0016		station 26	1821
19	0.0007		station 26	
20	0.0003		station 26	
21	0.0003		station 26	2121
22	0.0005		station 26	
23	0.0008		station 26	
24	0.0002		station 26	2423
25	-0.0002		station 26	2501
26	0		station 26	
27	-0.0008		station 26	
28	-0.0007		station 26	
29	0.0011		station 26	
30	-0.0005		station 26	

Table E: Problems encountered with the Altimeter mounted on the CTD package.

Station	Problem.
3	altimeter dropped out towards bottom but sea floor falling off a lot.
4	no altimeter information
5	no altimeter information
10	altimeter dropping out but OK at crucial moments.
26	altimeter disagreed with 10 Khz pinger, possibly caused by rising bottom or the orientation of the frame (the top shackle was replaced after this cast).

Expendable Bathymetric Thermography

Thirty-three stations were taken using Sippican T-5 XBTs - see Table. Data were logged on a PC, running the Sippican 'mk9' Data Acquisition System software (version 5.2). Post station, the data were exported to ASCII files containing depth and temperature, using the Sippican Post Trace Analysis Application software. Using the ever trusty sneaker net, data were transferred to UNIX and converted to PSTAR. Although the XBTs were stored on deck before use, the first few records for each cast were bad, as the probe rapidly changed temperature. This transient response, plus further spikes throughout the trace, and noise as the wire breaks, were graphically edited, and this is all that was done to the data.

Vessel Mounted Acoustic Doppler Current Profiler (VMADCP) Measurements

An RD Instruments 150 kHz, hull mounted ADCP is fitted to the RRS *James Clark Ross* with the transducer orientation at 45 degrees to the fore-aft direction. Firmware version 17.07 and data acquisition software (DAS) version 2.48 were used. The ADCP was operated in bottom track mode with one bottom track ping to four water track pings where water depth was less than 500 m. For water depths greater than 500 m water track mode was used. Both bottom and water track modes recorded two minute averaged data in 64 x 8 m bins. 'Blank beyond transmit' was four m and the depth of the transducers is five m putting the centre of the first bin depth at 13 m.

Speed Correction Factor

The ADCP is fitted behind a Low Density PolyEthylene window and is back filled with an unspecified oil. This problem was recognised by [King and Alderson, 1994] and requires a correction to speed data. The DAS software assumes that the temperature measured at the transducer is in water and determines a speed of sound calculated assuming, in this cruise, a salinity of 35 and using the equation of state for sea water. A correction factor, as a function of temperature is then used to correct for sound speed in seawater (at S = 35) to sound speed in oil, viz

$$F = 1 - 0.004785 \times T + 0.0000355 \times T^2$$

applied to the raw velocities.

Clock Correction

The internal clock for the ADCP drifts at about one second per hour. To correct this to the ships master clock, this difference was recorded manually every four hours, see [Pollard 1996 XXX]. This correction was then applied to the ADCP time base.

Heading and Velocity Amplitude Correction

ADCP data were corrected for heading by merging with Ashtech GPS3DF minus gyro differences giving velocities relative to the forward direction of the Ashtech. This process is again described in [Pollard, 1996 XXX]. A final correction is required to correct the misalignment between the direction defined by the Ashtech GPS3DF antenna and the direction of the ADCP transducers. This is the heading misalingnment. A procedure adopted by [King and Alderson, 1994] was followed and is noted below.

1. Two minute ensembles were merged with GLONAS position fixes, and ships east and north velocity from the GLONAS fixes calculated. Absolute ADCP bottom tracking velocities were also calculated.
2. The data were then averaged into 30 minute periods. A 30 minute ensemble was accepted if: i. at least 13 two minute ensembles had bottom tracking data; ii. the two minute averages of speed had a range of no more than 20 cm/s; iii. the two minute averages of direction over the ground had a range of no more than 20 degrees.
3. Velocity amplitude (speedGPS/speedADCP) and direction (dirnGPS - dirnADCP) corrections were calculated. The resulting direction difference is added to all ADCP directions to produce ship over ground or ship over water velocities. A new exec botcal.exec was written to determine the calibration from selected data cycles.

Table XXX is a summary of estimates of heading and velocity amplitude made using the above method on a recent cruise [Heywood and King 1996]. Table XXX is a summary of estimates made on this cruise.

Table XXX

Mean amplitude correction	SD	mean heading correction	SD	Note
0.9985	0.008	-2.381	0.275	
1.0095	0.005	-2.386	0.212	
0.9995	0.003	-2.392	0.174	

0.9542	0.003	-2.055	0.257	
1.0176		-2.2		WT

Table XXX

Mean amplitude correction	SD	mean heading correction	SD	Note
1.0319		-1.7146		

XXX Clearly some big time problem here XXX

Lowered ADCP (LADCP) Measurements

Navigation

GPS Trimble 4000

Position fixes from the receiver were logged once per second throughout the cruise. Although previously the primary navigation stream this year great success with the Ashtech GLONAS receiver meant that the Trimble 4000 data were considered as secondary to the GLONAS GPS data set. For 86400 s of data whilst moored at FIPASS, Stanley the RMS position errors for Trimble fixes were about 20 m in latitude and longitude.

Differential GPS will not be necessary because of the quality and reliability of the GLONAS.

Ashtech GPS3DF

Ashtech GPS3DF GPPAT messages containing time, position and attitude messages were logged, via a level A, once per second and merged on time with gyro data to provide a correction for gyro headings. A full description of the system and installation may be found in [King and Alderson 1993].

In Grimsby in summer 1996 new antenna were fitted to the wheelhouse top. The antenna geometry was surveyed using the Ashtech software using data collected in Grimsby in September 1996. The best solution for the relative positions may be found in the table of receiver parameters below. As before the port-aft antenna is designated as number 1; port-fwd is 2; stbd-fwd is 3; and stbd-aft is 4. The XYZ vectors have been adjusted so that the heading is defined bye the direction normal to the 1-4 baseline, i.e. that baseline has Y = 0.

Data coverage was excellent except for a very unfortunate period near the start of the cruise whilst attempting to gather bottom track ADCP data for calibration. This meant that only 35 minutes of usable ashtech data were available and consequently no heading corrections available for ADCP calibrations. Coverage was 98 % of 200 s intervals containing data.

Table XXX: Ashtech GPS3DF receiver parameters (menu 4 and submenus).

POS	54:17.0S,35:40.0W,+0.0m
Alt known	N
Ranger	0
Unhealthy Sv	N
Rec. Intv	20
Min no. Sv	4
Elev mask	10
Pdob mask	40

Port A	
nmea	off
real time	off
VTS	off
baud	9600
Port B	
(level A logging)	
nmea	on
real time	off
VTS	off
baud	4800
OPTIONS	PAT ON 1 s rate

Attitude Control Menu

max mrms	8			
search ratio	0.5			
1 s update	Y			
3 Sv search	N			
	TAU	T0	Q	R
Hdg	999	000	1.0e-2	1.0E-2
Pitch	020	000	4.0e-2	1.0E-2
Roll	020	000	4.0e-2	1.0E-2
Kalman filter reset	N			

Attitude Setup Menu

Vector	X(R)	Y(F)	Z(U)
1-2	2.955	4.751	0.0
1-3	11.499	4.754	0.0
1-4	13.227	0.0	0.0
offset	0 (H)	0 (P)	0 (R)
Max cycle	0.2 cyc	Smoothing	N
Max mag	0.08	Max angle	10

Ashtech GLONAS

ASHTECH GG24

The Ashtech GG24 receiver accepts data from both GPS and GLONASS satellites. Not only do the Russian GLONASS satellites give much improved position information (the data are not dithered, as for the GPS with selective availability), the extended constellation (forty-eight vehicles instead of twenty-four) gives supposed better data coverage. A GG24 receiver was fitted installed on the RRS *James Clark Ross* at the start of the cruise; the first time such a receiver has been installed on a British research vessel.

The antenna was mounted on the Wheelhouse Top (starboard side), and connected to the receiver (innocuous, black box) installed on the Bridge (starboard side, behind the ????). A cable was routed under Bridge floor to a 25 way D-type connector (Radio Room partition, DDBO/AX), therby giving a connection to the Electrical Locker.

All data output from the GG24 is ASCII NMEA messages, although which flavour of NMEA message is produced, is controlled by the user. Prior to the cruise, it was decided that the 'POS' message was the most appropriate, (see format below).

NMEA 'POS' message format

n,qq,hhmmss.ss,ddmm.mmmmm,s,dddmm.mmmmm,s,saaaaa.aa,seeeee,ttt.t,ggg.g,svvv,pp.p,hh.h,vv.v,tt.t,vvv

Item	Significance
n	Raw/differential position flag (0 for raw)
qq	Number of satellites used in position fix
hhmmss.ss	UTC time
ddmm.mmmmm	Latitude (degrees & minutes)
s	Latitude sector (N or S)
ddmm.mmmmm	Longitude (degrees & minutes)
s	Longitude sector (E or W)
saaaaa.aa	Altitude (metres)
seeeee	reserved/unused
ttt.t	True course over ground (degrees)
ggg.g	Speed over ground (knots)
svvv	Vertical velocity (decimetres per second)
pp.p	Position dilution of precision
hh.h	Horizontal dilution of precision
vv.v	Vertical dilution of precision
tt.t	Time dilution of precision
vvv	Firmware version

Example message

```
$PASHR,POS,0,14,193638.00,5141.50762,S,05749.36107,W,+00037.50,,000.0,000.0,+000,01.3,00.
8,01.0,00.7,GA00*13
```

Before the cruise, the level A application to read the NMEA 'POS' messages was written by RVS at SOC before the cruise, and EPROMs created. These were installed in a Mk2 Level A on the ship, but it was not possible to log data. This was thought to be due either to cable problems (much confusion over pin numbers) or a change in the specified NMEA format (an unused four character variable was not present, giving a shorter record length). Instead, the data were logged to a PC in the UIC, using the ship's trunking to get the data to the lab - see wiring diagram.

On the PC, the 'Terminal' program was used to receive the NMEA messages, (9600 baud, 8 bits, 1 stop, XON/XOFF, no parity), with the data logged as text files. These text files were downloaded to the UNIX system (using FTP), nominally every day. From UNIX, the ASCII data were parsed into PSTAR, and edited and processed using PEXEC.

Processing

A FORTRAN program (pglon.F) was written to parse the data from NMEA to PSTAR format. The data were then edited, with position data set to absent where

- the number of satellites was 3 or less (nsv < 4),
- the position dilution of precision was greater than 10 (pdop > 10),
- the horizontal dilution of precision was greater than 10 (hdop > 4),
- the vertical dilution of precision was greater than 10 (vdop > 4),
- the time dilution of precision was greater than 10 (tdop > 4).

Data were then graphically edited (plxyed) to remove jumps in position or time. The edited data for the Drake Passage and Bransfield Strait section were appended to one master file and converted to RVS format so that the program 'bestnav' could be run. bestnav was set such that data gaps larger than 300 seconds were filled with data from the GPS 4000 Trimble (RVS data stream gps_trim). Remaining data gaps were filled by dead-reckoning with data from the Chernikeeff log (data stream relmov). The final bestnav file was read to PSTAR using the same C-shell scripts as for the GPS Trimble.

Data quality is much improved over the GPS 4000 Trimble - see plots.

On several occasions, no position data were received, and blank NMEA messages were sent. This was despite the fact that GPS satellites were clearly visible (GPS_4000 was receiving data, for example). The problem was usually resolved by re-initialising the receiver (i.e. switching off and on, and setting up port A again). Only once did this method fail to kick the receiver into action, and on that occasion, the receiver was left and on returning with a cup of tea, POS messages had miraculously appeared again. If left unattended, these periods of no position data extended to many hours (e.g. all of day 337).

The table shows the data coverage (all data, including bad) for the section across the Drake Passage, and Bransfield Strait. After this, the nature of the ship operations meant the PC wasn't checked as often as necessary. The receiver hung on several occasions, unnoticed, causing data to be lost, in one case for over a day. Such gaps in the data caused problems with the parsing program, which became confused about what day it was and introduced time jumps.

Day	Number of records
317	9490
318	81554
319	83086
320	82953
321	82587
322	85301
323	72394
324	70199
325	76230
326	75355
327	81765
328	79903

INSTRUCTIONS FOR LOGGING AND PROCESSING GG24 DATA

Setting up the receiver

The receiver has two ports (A and B); during JR16, data were sent on port A, leaving port B free to interrogate the receiver, using the ship's portable PC. The PC has been installed with the Ashtech Evaluate software, which sets up and monitors the receiver. (Once correctly set-up, it is not necessary for the PC to remain connected).

1) Connect port B to serial port on PC, and run Ashtech Evaluate.
2) Connect to receiver using COM1, (9600 baud, 8 bits, 1 stop, no parity). Make sure the 'Turn off ALL NMEA messages on detach' box is not ticked.
3) Go to the GPS option, and select the Terminal. This displays the messages on port B, and allows commands to be sent to the receiver. Click on 'type', to manually send commands to the receiver.
4) To start POS messages on port A, type
   ```
   $PASHS,NME,POS,A,ON
   ```
   then press Send. By default, SAT messages may be sent to port A. To switch these off, type
   ```
   $PASHS,NME,SAT,A,OFF
   ```
   then press Send.

PC logging

Before running windows, login as user 'gd24', password 'glonass'. This allows you to use FTP at a later time, without having to quit the Windows environment.

1) Run the TERMINAL program (under ACCESSORIES folder).
2) Go to the SETTINGS option, and select COMMUNICATIONS. Set to 9600 baud, 8 bits 1 stop no parity XON/XOFF. Data should appear on the screen straight away.
3) To start logging, go to the TRANSFERS option, and select RECEIVE TEXT FILE. Enter a file name and press RETURN.
4) When changing to a new file, go to the TRANSFERS option and select STOP. Then start logging to a new file. Once logging to a new file, you can use FTP (under the ASHTECH EVALUATE folder) to copy the file to UNIX.

FTP

1) Connect to jrue, as user pstar (password 1pexec).
2) Copy files to directory /users/mlsd/pstar/data/glonass.

Initial UNIX processing

As user 'pstar', and under directory /users/mlsd/pstar/data/glonass, run the following C-shell scripts and programs.

1) ggexec0 - parses ASCII data to binary PSTAR (program pglon)
2) ggexec1 - edits data, on condition of nsv, pdop, hdop, tdop and vdop.
3) plxyed - time jumps, position jumps

4) papend - append daily files to one file.

BESTNAV

Creating bestnav navigation file

By default the RVS software looks at the data areas under /rvs/[pro|raw]_data. For this exercise, an alternative 'bestnav' navigation file is created under the PSTAR data areas. This prevents confusion (and possible disaster) by keeping clear of the 'real' bestnav data. As well as the new GG24 data, the bestnav program needs an alternative position file (GPS 4000 here), and the Chernikeeff Log data file (relmov), for dead-reckoning.

1) Set the environment to look at the PSTAR data areas by typing
   ```
   source $HOME/data/glonass/rvs.source
   ```
2) Create an RVS file called glonass under ~pstar/pro_data
   ```
   datapup ./appended_file glonass -
   ```
3) Ensure all data points are labelled as status GOOD.
   ```
   edstatus -n GOOD glonass -
   ```
4) Create a streamstates entry
   ```
   setstr glonass
   ```
5) Test this has worked by using
   ```
   lookc
   dfinfo glonass
   listit -s ????????? -e ????????? glonass lat lon
   ```
6) Copy across gps_trim and relmov data from the RVS directories, and create streamstate entries for these, as above.
7) If bestnav and bestdrf files already exist under the PSTAR pro_data directory, delete (or rename) these, and remove the streamstates entry.
   ```
   garstr bestnav
   garstr bestdrf
   ```
8) Generate empty bestnav and bestdrf files. Copy bestnav.frm and bestdrf.frm files from /nerc/packages/rvs/control/frm to ~pstar/control/frm, then...
   ```
   credat bestnav (crtl-Z to setup file)
   credat bestdrf (crtl-Z to setup file)
   setstr bestnav
   setstr bestdrf
   ```
9) Copy bestnav.menu from /nerc/packages/rvs/control/menu to ~pstar/control/menu.
10) Ready to go. Run bestnav, checking details (primary file should be glonass), then ctrl-Z to finish. bestnav program runs on background until end of file (or a problem).

Gyrocompass and Electomagnetic Log

Heading was determined from a Sperry Mk 37 model D gyrocompass. Voltages from a synchro pickup are passed to the level A and ADCP are digitised separately to 0.1° intervals. Laboratory repeaters for the gyro measure relative changes and are initialised with a correct heading. Of the two gyros available gyro 1 was used throughout.

Gyro performance relative to Ashtech GPS3DF measurements showed the gyro to be latitude dependant. The offset (a-ghdg) was about -1.5° near 53°S and drifted to -3.5° by 64°S. The relationship between offset and heading was less clear as the data were contaminated by latitude dependence. The gyros did not show any unexpected behaviours and were corrected using ashtech GPS3DF measurements.

Processing VMADCP, Navigation and Gyrocompass measurements

A complete reworking of navigation, 3-D GPS and ADCP processing was carried out by Raymond Pollard on Discovery Cruise 223 to the North Atlantic, August - November 1996. We were fortunate to be able to follow the path now laid down in that report [XXX There will be a report to reference XXX]. Few changes were necessary and a few differences have arisen with data from the RRS *James Clark Ross.* They are listed briefly below, though are discussed more fully elsewhere if important.

1. BESTNAV GLONAS, Trimble 4000, dead reckoning no smoothing, 30 s fixes
2. Primary real time navigation from GLONAS: better or as good as differentially processed GPS Trimble.
3. Ashtech GPS3DF, editing of pitch, roll data now includes routine for estimating the mean of these parameters. Operating round a zero mean was a poor assumption for the RRS *James Clark Ross.*
4. VMADCP, an exec was written to extract suitably chosen records from the bottom file to determine the amplitude and heading misallignment factors. An exec was written to extract good data cycles from the final calibrated file, produce a file of good data and to determine on station and underway average profiles.

Underway Measurements

Oceanlogger

The oceanlogger system is a BAS designed and built (P. Woodroffe, I.S.G.) PC based logging system. It emulates the function of several RVS level A systems and it has an input from the ships master clock coupled to real time display of data. This allows the logging of meteorological and sea surface data to the RVS ABC system with a ships time stamp on the data. The instruments with an analogue output are connected to self contained digitising Rhopoint modules located close to the relevant instrument. The modules are then interrogated by the controlling PC using the RS485 standard. A full list of the sensors used is given in table one.

During cruise JR16 the sampling period was set to 5 seconds and the oceanlogger was run from leaving Mare Harbour on day 318 to the end of WOCE special section SR1 and into the Bransfield Strait on day 327. At this point the intake pump of the thermosalinograph was switched off to prevent fouling by ice. The intake pumps were switched back on day 337 for the XBT section during the second crossing of the Drake Passage and again run until Mare harbour on day 339. The wind speed and direction are not logged by the oceanlogger and it was decided to merge this data into the initial pstar file rather than leave the stream as a stand alone data set.

The processing route of the data involved six distinct steps that are described in full below. The first step was a shell script named oclexec0. It read the oceanlogger data from the RVS system, read in the anemometer data and then merged the two data sets together on time. The output data file had the extension .raw and was archived. Step two was the shell script oclexecl. The script copied out the meterological section of the data (that is last five data streams in table one) the data being archived as a meteorological file, archived with a .raw extension and no further work on this data set was undertaken. The sea surface data was also copied (the first three sensors in table 1) to a separate file, a raw salinity derived and navigation added. During WOCE leg A23 it was noticed that the condUTCivity from the SBE - 21 lagged the temperature of the housing (temp_h) causing spiking in the derived salinity signal. The A23 scientists overcame this by applying a lag through a filter to temp_h. On JR16 we tried filters of varying length and value before settling on a 48 one way filter with n successive coefficients given by $w\ (1-w)^{n-1}$ and a w found by experiment to reduce the salinity spiking best with a value of 0.03. The shape of the 96 (48 points being equal to zero) filter is in figure 1 and it had an effect over the last four minutes of data. This filter was applied in the third step of the processing route in oclexec2 where the data were appended together, filtered and a new salinity derived, navigation data was also added to a 1 minute average of this file.

There now remained the calibration of the oceanlogger. Salinity samples were taken at a nominal time spacing of 4 hours throughout the section, the samples being analysed in the same manner as the CTD samples. The sample salinities were calculated on an Apple Macintosh and transferred to the unix system in step four of the processing route using a script called ocl_samples. In the fifth step, oclexec3, the time in this sample file was converted to the RVS format of seconds since the beginning of the year. Finally in step six, oclexec4, we derive a calibration drift against time for the salinity. For the 24 samples collected during the first crossing of the Drake Passage five were rejected as being clearly bad, the mean of the residuals between the samples and the calibrated oceanlogger file were 0.000 with a standard deviation of 0.003.

Table 1: The instruments connected to the oceanlogger.

Instrument	**Type**	**Location**	**Field Name**
sea temperature	4 wire PRT	Transducer space	sstemp
flow meter	Liter Meter	prep lab	flow
Thermosalinograph	Sea Bird SBE 21	prep lab	temp_h and cond
Air temperature	vector T351	foremast	atemp
PAR sensor	Didcot DRP1	foremast	par
TIR sensor	Kipp & Zonen CM5	foremast	tir
Barometer	VaisalaPA11	UIC	Press
Ships anemometer	???????????	formast	wnd_speed, wind_dir

The Oceanlogger data processing route for JR16

Step 1: oclexec0

Purpose: To read in the oceanlogger data from the RVS stream. The programmes are

datapup - read in the data from the RVS oceanlogger stream into a pstar file.

pcopya - reset the raw data flag in the oceanlogger pstar file.

datapup - read in the data from the RVS anemometer stream into a pstar file.

pcopya - reset the raw data flag in the anemometer pstar file.

pmerge - merge the two files together on time.

pheadr - set the header of the pstar file.

The output of the exec is in the form oclCCC$num.raw

Step 2: oclexec1

Purpose: To copy out the relevant file sections, and in one case merge in the navigation.

The programmes are

pcopya - copy out the segment of the oceanlogger that is sea surface data.

pheadr - set the variable names in the sea surface data file.

pedita - take out the large spikes in the flow sensor.

pcopya - copy out the segment of the oceanlogger that is meteorological data.

pcalib - set the dummy pressure variable created in the first pcopya to zero.

pmdian - take out spikes of greater than 0.05 mmho/cm in the sea surface data.

peos83 - derive a raw salinity for the sea surface data.

pavrge - average the sea surface data to 2 minutes.

pmerge - merge the bestnav navigation to the 2 minute averaged sea surface data.

There are three output files. These are metCCC$num.raw
oclCCC$num
and oclCCC$num.2min

Step 3: oclexec2

Purpose: To append all of the one day files together and derive a better salinity.

The programmes are

pheadr - change the dataname on the first file to a dummy dataname.

papend - add all of the relevant oceanlogger files.

pfiltr - apply a 48 point filter to the temperature at the housing (see text for details).

pheadr - set the variable name of rawsalin to press.

pcalib - set the dummy pressure to zero.

peos83 - derive a salinity from the filtered temperature and the dummy pressure.

pheadr - set the dataname of the file to something sensible.

pavrge - average the appended file into 1 minute bins.

pmerge - merge navigation to the averaged file from the bestnav file.

There are two output files. These are oclCCC
and oclCCC.nav

Step 4: ocl_samples

Purpose: To read in the sample data from the macintosh.

The programmes are

getexcel.exec - read sample data from the mac.

The output file is oclbt$num.bot

Step 5: oclexec3

Purpose: To reformat time in the oceanlogger file.

The programmes are

pcopya - copy in an extra jday variable.

pheadr - change the name of the extra jday to time (seconds).

pcalib - take one from the time variable.

pcalib - multiply time by 86400, hrs by 3600 and mins by 60.

parith - add time and hours.

parith - add time and minutes.

parith - add time and seconds.

The output file is oclbt$num.samples

Step 6: oclexec4

Purpose: To apply a calibration to file oclCCC.nav

The programmes are

pmerge - merge oclbt$num.samples to oclCCC.nav.

parith - determine residuals (botsal - oceanlogger salinity).

phisto - get statistics of the residuals.

plreg2 - fit the residuals to salinity correction = a + b * time.

pcopya - copy an extra time variable to oclCCC.nav.

pheadr - change the name of the extra time variable to fit.

pcalib - make fit = a + b * time.

parith - add fir and salinity in the oclCCC.nav file.

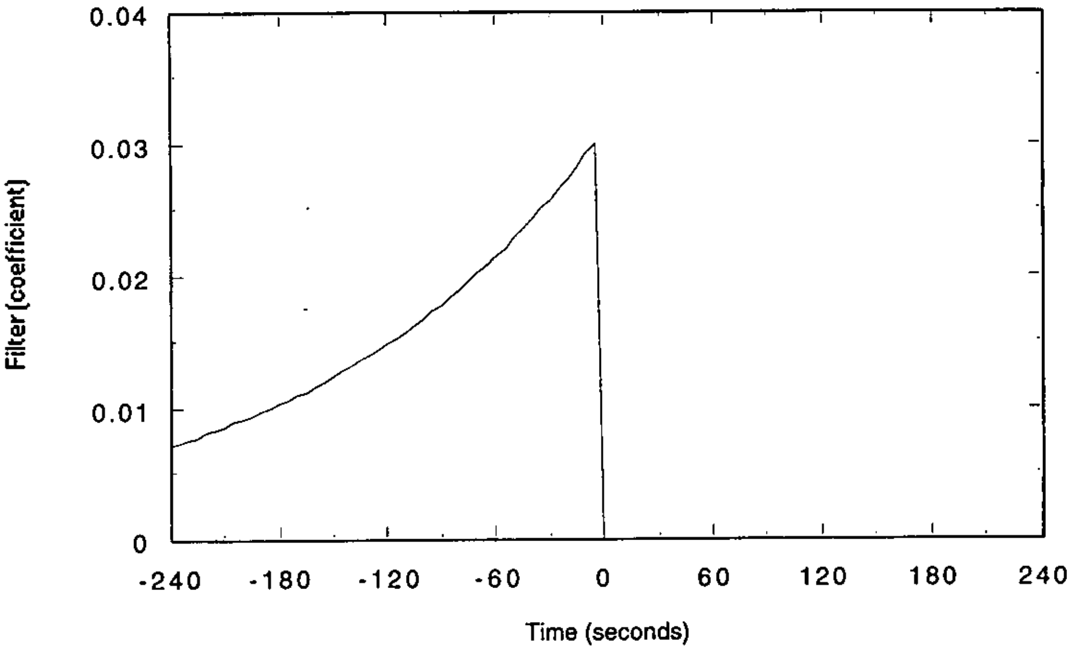
pmerge - merge oclbt$num.samples to the corrected oclCCC.nav.

parith - determine new residuals (botsal - corrected oceanlogger salinity).

phisto - get statistics of the residuals.

The output files are	oclCCC.nav.cal
and	oclbt$num.res

Figure 1: Filter applied to temp_h of the oceanlogger.



Echosounding

SIMRAD EA-5000 ECHO SOUNDER

Data were logged via the Level B to the Level C, and stored in two separate data streams - sim500 (the raw, uncorrected depths), and prodep (containing depths corrected using the Carter Correction Tables). Both datasets were read and converted to PSTAR. Spikes in the corrected data were graphically edited. On completion of this task, data were extracted at the times when the CTD was at the bottom of each cast. Then, it was noticed the corrected water depths didn't match the values on the CTD logsheets (taken from the level B display and corrected by hand). The raw data used in creation of the prodep file had first been multiplied by a PES Correction Factor (1.01972), before correction using the Carter tables. This correction factor comes about since the SIMRAD collects data assuming a speed of sound of 1470 cm/s, whereas the Carter Tables are based on a speed of sound of 1500 cm/s. At the start of the cruise, it was thought that the EA-5000 had been set to transmit data converted to use a speed of sound of 1500 cm/s. So, prodep was reconstructed using a PES Correction Factor of 1.0000, the data reprocessed, and again the depths extracted for the bottom of CTD casts. This time, it was noticed that the water depths were often shallower than the water depths computed from the maximum CTD depth and altimeter height off. Reprocessing all data (again) with a PES Correction Factor of 1. 01992 (1500/1470.6 cm/s) lead to water depths too great (100m too deep in some cases) and still some stations with water depths shallower than the CTD plus altimeter figure. O me miserum.

Shipboard Computing

1 - Introduction

Computing facilities available onboard the RRS James Clark Ross include IBM compatible PC's networked via Novell NetWare to central file servers; Sun Unix workstations running SUNOS 4 and Solaris 2; and the RVS ABC Data Acquisition and Logging System. The main workhorse for data analysis during the cruise was a Sun UltraSparc I Creator running Solaris 2.5.1 with 20GB of disk space. PCs were used almost exclusively as an interface to the BAS Messaging System which provides an E-mail connection to the outside world, plus a small amount of word processing at the end of the cruise. One of the general purpose PCs was dedicated to logging GPS/GLONASS data. SOC provided their own Apple Macs which were used for word processing, spreadsheet, and frontending the Unix systems. Two Tektronix Xterminals were also available as frontends to the Unix systems. A4 monochrome and colour, and A0 colour HPGL/Postscript printers were available. Data analysis was mainly undertaking using PSTAR.

2 - Data Logging and the ABC System

The majority of data streams were logged without difficulty. However problems were encountered in the following areas.

a) The CTD Level A did not capture all data output by the CTD (see the CTD report for more details). Also encountered were occasional forward clock jumps during hardware resets. This can result in backward time jumps in data files after the clock is corrected unless the data file is corrected or a new file started before logging recommences.

b) The Trimble GPS receiver “locked up” on two occasions and output duplicate time and position data until reset. The Level A application did not detect this “lock up” and flagged the duplicate data as GOOD (status 50).This data was reflagged REJECT using edstatus.

c) It was not possible at the beginning of the cruise to establish data logging for the new Ashtech GPS+GLONASS receiver via the ABC system. This appeared initially to be due to cabling difficulties. Latterly a problem with the Level A application has been suggested. The application was developed prior to data being available and it was likely that minor modifications to the application would be required. It is now believed that the cabling difficulties have been resolved. RVS have provided advice on amending the application and work is underway at the time of writing.

d) At some point during the cruise a problem occurred with the system clock on the PC running the ADCP data acquisition software. This resulted in the date logged at the end of the cruise being two days behind. Time appears to have been logged correctly. This is under investigation at the time of writing.

e) There were occasional ship master clock jumps. At one point all Level As needed resetting due to this.

f) The Ashtech GPS receiver outputs a value of "666 degrees" when satellite coverage is poor. This results in an alarm message being sent from the Level A continuously until satellite coverage improves.

3 - Summary of Data Recorded

Stream	Raw/ Pro	Records	Size (MB)	Comment
adcp	r	863936	86.4	
adcp_raw	r	1133056	38.5	logged during homeward journey
anemom	r	2100998	33.6	
bestdrf	p	69041	1.9	
bestnav	p	69215	3.6	
bottlem2	r	705	0.01	
ctd12old	r	6912	0.66	test data prior to sailing
ctdbad_t	r	26616	2.5	data up to 4 day forward clock jump on day 320
ctdstn6	r	8376	0.8	CTD station 6 on day 320
ctd_12c	r	210924	19.8	data from day 321
dop_log	r	2073602	33.2	
em_log	r	922477	9.2	
gps_ash	r	2001582	116.1	
gps/glonass	n/a	1416728	97.3	logged to PC

gps_trim	r	2068012	144.8	
gyro	r	2075773	20.8	
oceanlog	r	350037	53.0	
prodep	p	202851	4.5	
rawdep	p	202871	2.0	generated from sim500 for prodep calculation
relmov	p	69223	2.4	
sim500	r	302115	8.5	
tsshrp	r	655401	22.3	

Stream	**Variables**
adcp	bindepth roll pitch heading temp velps velfa velew velns velvert velerr ampl good bottoew bottomns depth
adcp_raw	rawampl rawgood beamno bindepth rawdopp
anemom	wind_dir wind_spd
bestdrf	vn ve kvn kve
bestnav	lat lon vn ve cmg smg dist_run heading
bottlem2	code
ctd12old	press temp cond fast_t uu press_t oxyc oxyt fluor trans alt chvolt ctdvolt deltat nframes
ctdbad_t	- as ctd12old -
ctdstn6	- as ctd12old -
ctd_12c	- as ctd12old -
dop_log	speedfa speedps
em_log	speedfa
gps_ash	sec lat lon hdg pitch roll nrms brms attf
gps/glonass	
gps_trim	lat lon pdop hvel hdg svc s1 s2 s3 s4 s5
gyro	heading
oceanlog	atemp mstemp sstemp hum par tir fluor flow psy1 psy2 soap press cond temp_h
prodep	uncdepth cordepth cartarea
rawdep	uncdepth
relmov	vn ve pfa pps pguro
sim500	uncdepth rpow angfa angps

tsshrp	hacc vacc heave roll pitch

BJ Lamden (BAS)

ACKNOWLEDGEMENTS

REFERENCES

CTD STATION LIST

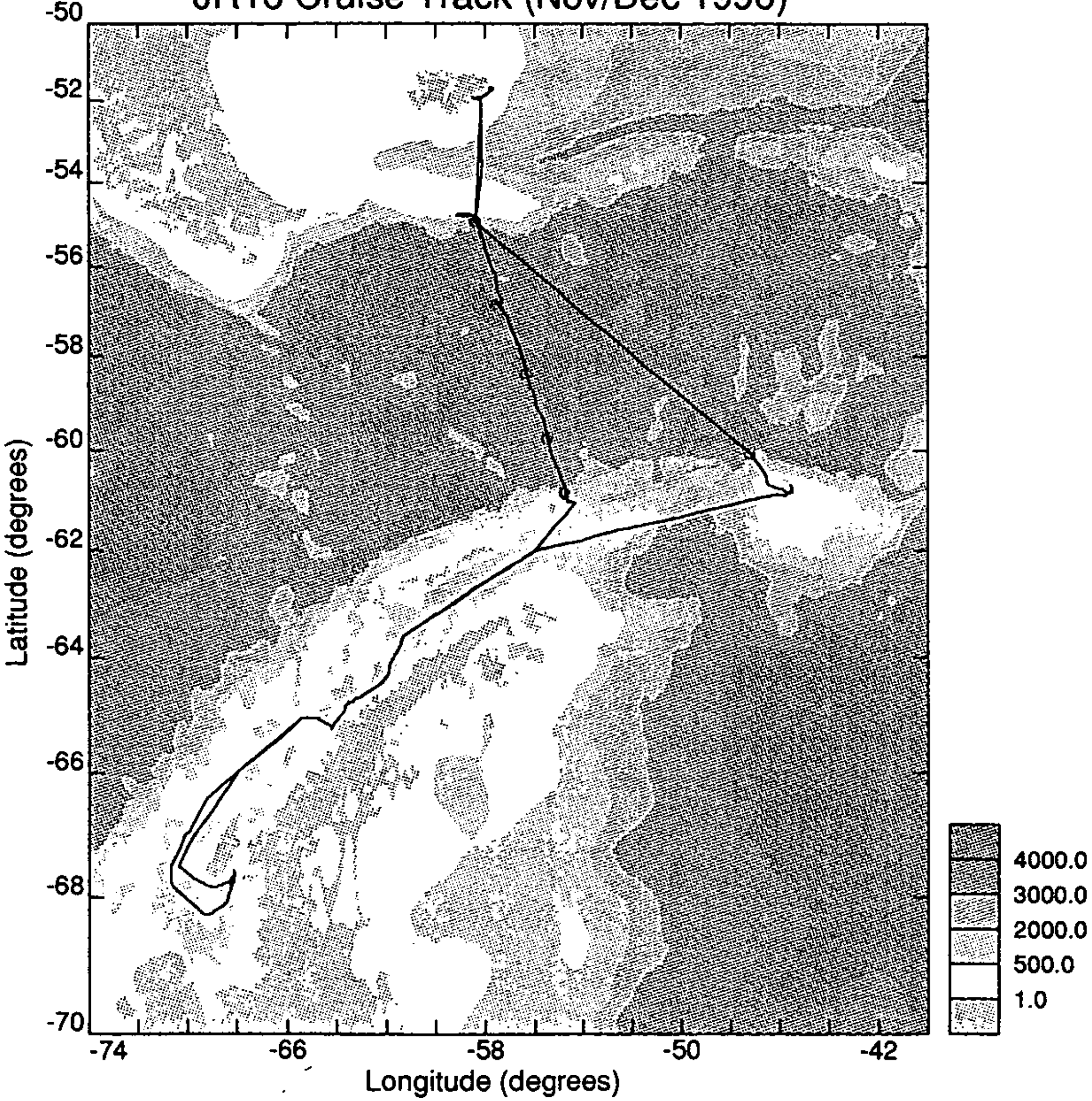
		Time, GMT			Position, degrees		Depth, m		
Stn	Day	Start	Bottom	End	Latitude (S)	Longitude (W)	Cor.Wtr	CTD max	Alt.
1	319	0943	1031	1129	53 30.22	58 07.88	2348.98		141.0
2	320	1042	1056	1114	54 47.46	58 27.11	397.54	386.98	16.1
3	320	1256	1317	1345	54 55.85	58 21.19	876.15	849.26	30.0
4	320	1444	1514	1602	54 57.94	58 20.85	1583.11	1586.12	0.0
5	320	1720	1759	1847	55 04.07	58 16.28	1981.63	1985.02	0.0
6	320	2213	2307	0019	55 06.80	58 13.26	2460.65	2479.21	13.2
7	321	0449	0544	0657	55 10.25	58 13.11	2961.56	2970.31	6.1
8	321	0757	0913	1035	55 12.63	58 12.60	3746.12	3785.69	16.7
9	321	1246	1403	1531	55 31.31	58 02.03	4240.32	4225.14	14.2
10	321	1730	1852	2036	55 49.15	57 52.51	4621.93	4613.26	11.7
11	321	2240	2349	0119	56 06.97	57 38.96	3662.18	3686.08	12.8
12	322	0416	0525	0649	56 27.93	57 31.45	3597.62	3588.56	10.0
13	322	0849	0940	1046	56 47.49	57 18.09	2566.63	2559.13	17.6
14	322	1512	1630	1756	57 05.41	57 07.44	4387.45	4381.87	13.2
15	322	2000	2111	2233	57 26.29	56 55.13	3966.22	3958.14	14.1
16	323	0238	0342	0507	57 43.39	56 39.71	3428.34	3430.30	9.0
17	323	0724	0836	1009	58 03.48	56 31.46	3993.29	3985.16	16.9
18	323	1448	1603	1731	58 22.38	56 21.31	3811.73	3804.13	15.0
19	323	2305	0014	0148	58 41.54	56 09.26	3786.98	3776.78	10.7
20	324	0405	0513	0639	59 00.13	55 59.11	3784.49	3776.68	10.1
21	324	0844	0949	1115	59 18.84	55 41.41	3729.93	3716.24	15.0
22	324	1326	1430	1551	59 38.93	55 31.12	3676.05	3663.56	13.6
23	324	2144	2247	0013	60 00.64	55 19.44	3498.30	3482.28	20.0
24	325	0238	0339	0459	60 20.47	55 03.94	3440.47	3421.76	14.6
25	325	0735	0831	0943	60 40.41	54 47.86	3100.30	3090.02	8.6
26	325	1327	1413	1510	60 48.12	54 42.72	2259.41	2395.78	68.0
27	325	1553	1624	1715	60 50.14	54 43.48	1580.13	1685.59	39.0
28	325	1916	1938	2008	60 51.09	54 43.20	1064.25	1122.86	21.8
29	325	2113	2124	2148	60 59.04	54 37.42	583.07	574.48	10.5
30	325	2231	2241	2254	61 02.11	54 36.97	504.05	499.42	12.6

XBT STATION LIST

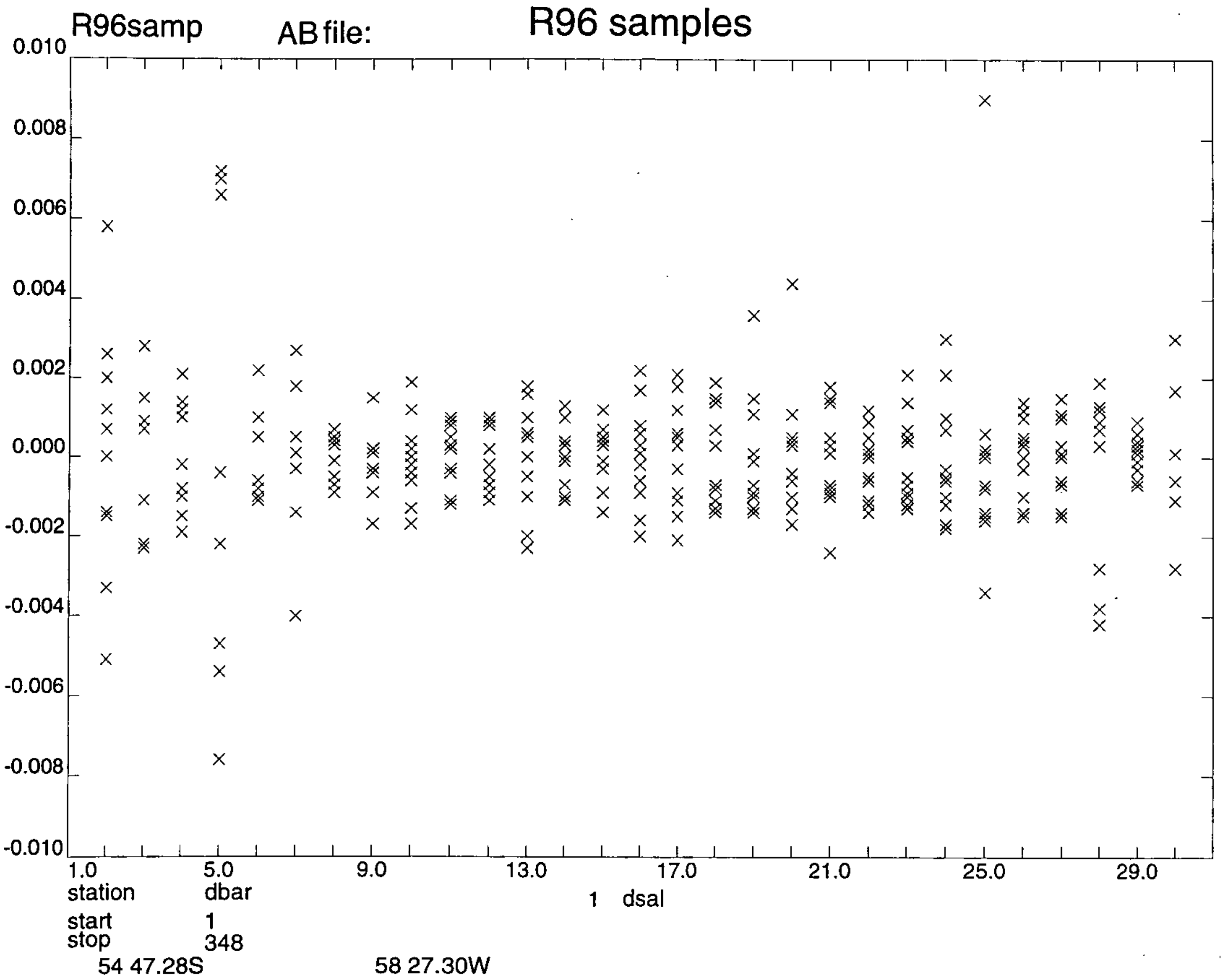
	Time		Position	
No.	Day	HHMM	Latitude (S)	Longitude (W)
1	320	0040	54 46.14	58 38.72
2	324	1225	59 29.71	55 35.56
3	324	2026	59 50.05	55 24.96
4	324	2033	59 50.96	55 24.34
5	325	0126	60 9.99	55 12.15
6	325	0644	60 34.75	54 52.90
8	337	1024	60 1.36	47 12.88
9	337	1203	59 46.57	47 48.75
10	337	1329	59 33.57	48 19.86
11	337	1458	59 19.99	48 50.56
12	337	1630	59 6.42	49 22.62
13	337	1805	58 51.91	49 55.05
14	337	1930	58 39.12	50 24.02
15	337	2100	58 26.52	50 53.18
16	337	2228	58 14.51	51 22.55
17	337	2353	58 2.22	51 48.61
18	338	0123	57 48.57	52 16.14
20	338	0258	57 34.84	52 45.78
21	338	0426	57 24.75	53 9.10
22	338	0604	57 13.89	53 34.77
23	338	0734	57 2.51	53 59.19
24	338	0854	56 52.12	54 21.62
25	338	1028	56 39.55	54 47.14
26	338	1200	56 26.23	55 13.98
27	338	1329	56 15.34	55 40.13
28	338	1500	56 3.07	56 7.31
29	338	1628	55 50.10	56 31.62
30	338	1802	55 37.76	56 58.43
31	338	1932	55 24.71	57 26.23
32	338	2100	55 11.94	57 53.97
33	338	2230	54 57.82	58 21.26

FIGURE CAPTIONS

FIGURES



JR16 Cruise Track (Nov/Dec 1996)


R96samp
AB file:
R96 samples
0.010
0.008
0.006
0.004
0.002
0.000
-0.002
-0.004
-0.006
-0.008
-0.010
1.0
5.0
9.0
13.0
17.0
21.0
25.0
29.0
station
dbar
1 dsal
start
1
stop
348
54 47.28S
58 27.30W

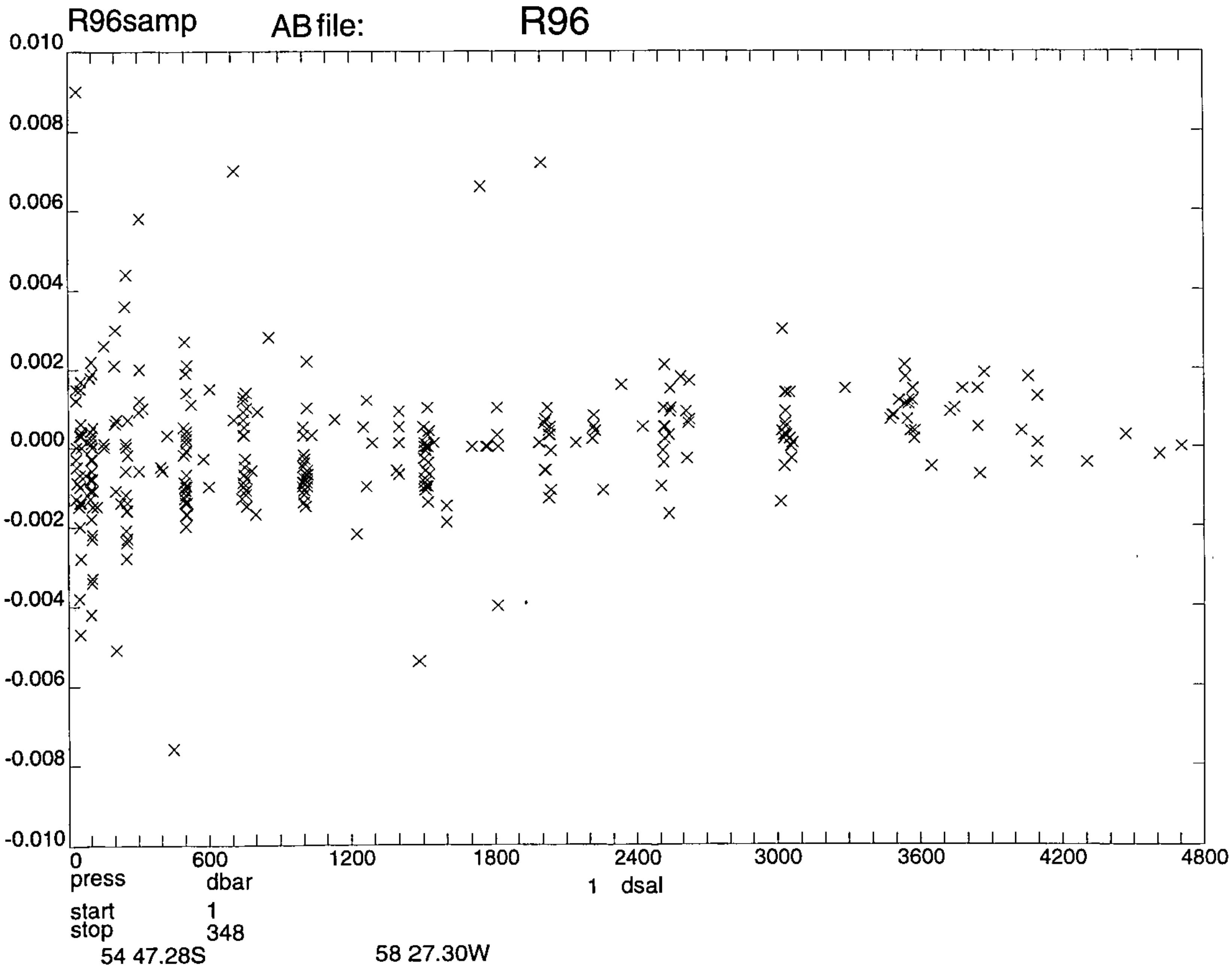

R96samp
AB file:
R96
0.010
0.008
0.006
0.004
0.002
0.000
-0.002
-0.004
-0.006
-0.008
-0.010
0
600
1200
1800
2400
3000
3600
4200
4800
press
dbar
1 dsal
start
1
stop
348
54 47.28S
58 27.30W

Figure 1: The CTD processing path