RRS *Discovery* cruise 351
10 – 28 May 2010
CTD sensor calibration

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12/11/10	Open issue	Issue 01	S Painter
23/12/10	Updated Table 1	Issue 02	S Painter
23/12/10	Added appendix of final data file version codes	Issue 03	S Painter

Introduction

At the end of RRS *Discovery* cruise 351 a number of analytical and technical problems prevented the complete calibration of the CTD data (conductivity and oxygen sensors). This document summarises the work done after the cruise to complete the calibration process. Much relevant information concerning instrumentation and basic data processing can be found in the cruise report (Read 2010 – NOC cruise report No. 50).

During the cruise a total of 101 CTD casts were made, with the majority (89) being conducted with the stainless steel (StS) framed CTD. The remainder (12) were conducted using the trace metal clean titanium (TiT) framed CTD system. An attempt to calibrate the conductivity sensor on both CTD's was made during the cruise, yet whilst this was completed for the TiT CTD the last few casts of the StS CTD were not calibrated due to the replacement of the primary conductivity cell and a lack of time. Furthermore, the oxygen sensors on both the StS and TiT CTD's were not calibrated due to questionable oxygen concentration data obtained from independent Winkler titration analyses. A further complication was noticed with the oxygen sensor fitted to the TiT CTD in that it displayed clear evidence of a pressure hysteresis effect, which required correction.

Titanium CTD data
12 casts were made during the cruise and all conductivities were calibrated before the cruise finished as detailed in the cruise report. The calibration equations derived from comparison of the CTD conductivity data to discrete bottle salinity samples were

Primary conductivity = measured primary conductivity * 1.00017129 [1]
Secondary conductivity = measured secondary conductivity * 1.00003340 [2]

Once applied, salinity, potential temperature and density were all recalculated.

Stainless steel CTD data
89 StS casts were made during the cruise and a partial calibration was applied. CTD's 001 to 093 (as numbered in the cruise report) were calibrated as follows,

Primary conductivity = measured primary conductivity * 1.00013479 [3]
Secondary conductivity = measured secondary conductivity * 1.00028104 [4]

During CTD casts 094 to 095 (yo-yo CTD) an offset in conductivity of ~0.03 mS/cm was noticed during the downcasts and the conductivity data were not calibrated until further examination of this offset could be made. During the post cruise assessment the offset was confirmed and 0.03 mS/cm was added to the primary conductivity data for casts 094 and 095. Thereafter conductivity for casts 094 and 095 was calibrated using the equations above before salinity, potential temperature and density were all recalculated.

After cast 095 the primary conductivity cell was replaced. Consequently CTD's 096 to 101 required a separate calibration that is not detailed in the cruise report. Conductivity residuals for CTD's 096 – 101 are shown in **Figure 1** for the primary and secondary conductivity cells. Following the methodology described in the cruise report the calibration coefficients A and B were calculated as A = 1.00006769 & B = 1.00038149.

The final calibrated conductivity data for CTD's 096 – 101 was obtained via the equations

Primary conductivity = measured primary conductivity * 1.00006769 [5]
Secondary conductivity = measured secondary conductivity * 1.00038149 [6]

Once applied salinity, potential temperature and density were all recalculated for CTD's 096-101.

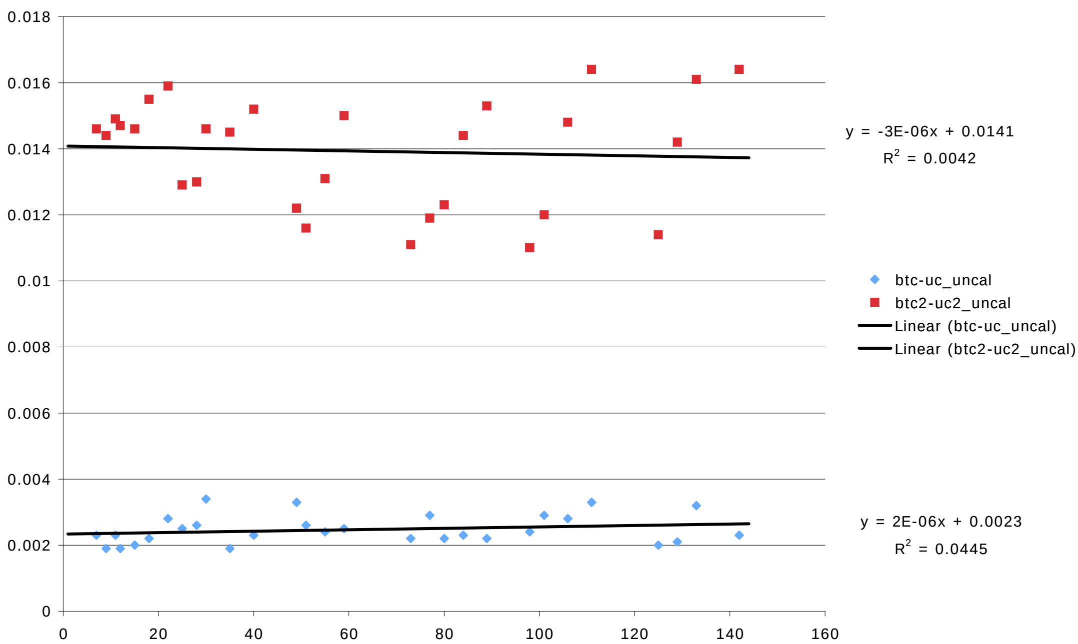

Figure 1. Bottle-CTD conductivity residuals for the StS CTD for casts 096 – 101.

Oxygen

Neither of the SBE43 dissolved oxygen sensors were calibrated during the cruise due to concerns over the accuracy of the Winkler titration oxygen data. During the cruise it was noted that there were large changes in the residual offsets between the titration concentration data and the SBE43 oxygen measurements for both CTD packages. Preliminary investigation led to the suspicion that the reagents used in the Winkler titrations were at fault as it was noted that when changing the reagents large jumps in the oxygen residuals could be seen. Whilst investigating this during the post cruise processing a number of other potential sources of error such as general typos and errors in the calculation spreadsheets were also identified and corrected (**Figure 2**; Stainless steel CTD only). Following thorough investigation of the Winkler titration data it is now believed that the root cause of the errors in the oxygen titration data shown in **Figure 2** are due to errors in the standardization of the thiosulphate reagent used in the titrations. Two estimates of the standardization were obtained during the cruise by two different individuals. Shown in **Figures 3** and **4** are the results of extrapolating these separate standardization values to all oxygen samples collected during the cruise. The results shown in **Figure 3** are less variable relative to the initial dataset (**Figure 2**) but it is clear that there is a drift in the data initially and a jump in the data around sample 600. In contrast, **Figure 4** shows a smaller drift in the early part of the data record and no jump in the residual offset values suggesting that this is a more robust correction.

Consultation with Mark Stinchcombe led to the adoption of the dataset based upon the standardization values collected by the individual who was considered to have better analytical skills as the final oxygen dataset (**Figure 4**).

Stainless steel CTD

From the data shown in **Figure 4** the mean oxygen residual for the uncalibrated stainless steel SBE43 sensor was calculated to be 5.34±1.39 μmol L^{-1}.

Calibration of this sensor was accomplished on the basis of a linear regression fitted to the data (**Figure 5**). The equation of the regression was y = 1.00489x + 3.64632. Due to required changes in units (from μmol L^{-1} to mL L^{-1}; achieved using the O_2 molar gas volume of 44.61497 L^{-1} per mol O_2 gas) the final form of the calibration equation was

$$\text{Calibrated oxygen} = 1.00489 * \text{measured oxygen} + 0.081729 \qquad [7]$$

Following application of the calibration the residuals were recalculated (**Figure 6**). The mean oxygen residual for the calibrated dataset was reduced to 0.34±1.39 μmol L^{-1}.

As a final check of the data the oxygen residuals were plotted against depth (**Figure 7**) to check for pressure effects. There are no obvious hysteresis problems, but due to errors inherent in the underlying oxygen data it is possible that such pressure related problems may be masked by more fundamental errors in the actual measurements.

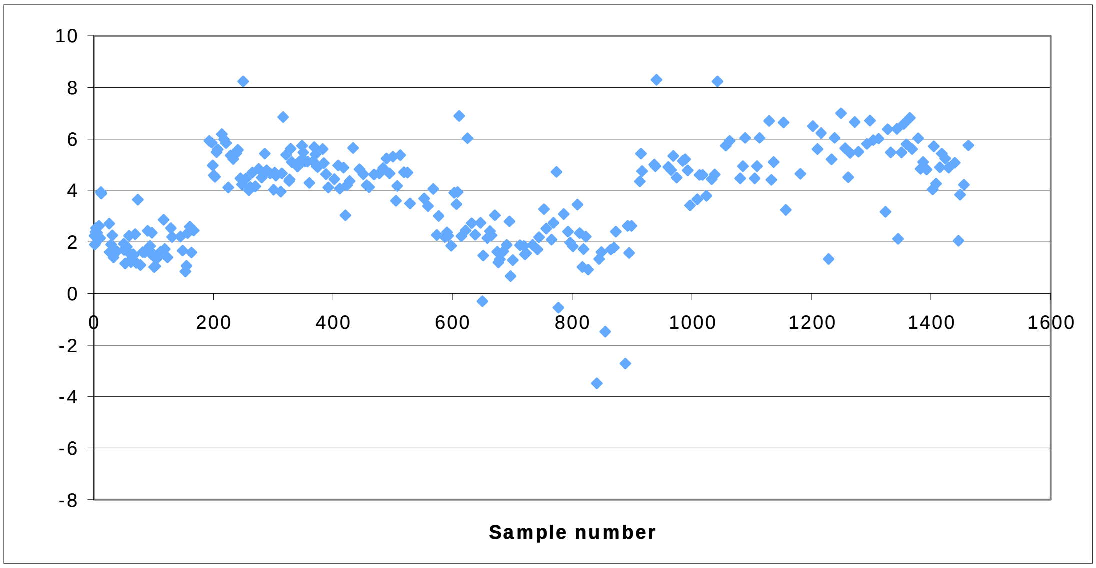

Figure 2. First attempt at correcting the oxygen data for typos and general calcultation errors did not remove the ambiguous signal seen in the oxygen residual data. This figure shows the residuals for the stainless steel CTD only.

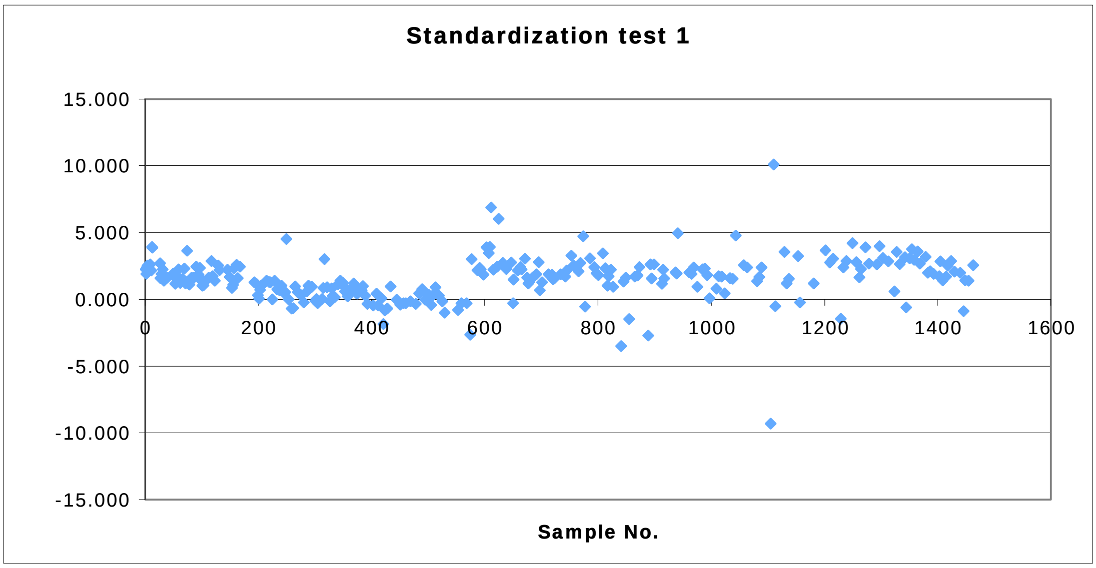

Figure 3. In this test one of the two standardization values obtained for the thiosulphate reagent was used for all samples. Note the initial drift in the residual offsets and the jump around sample 600 indicative of poor standardization.

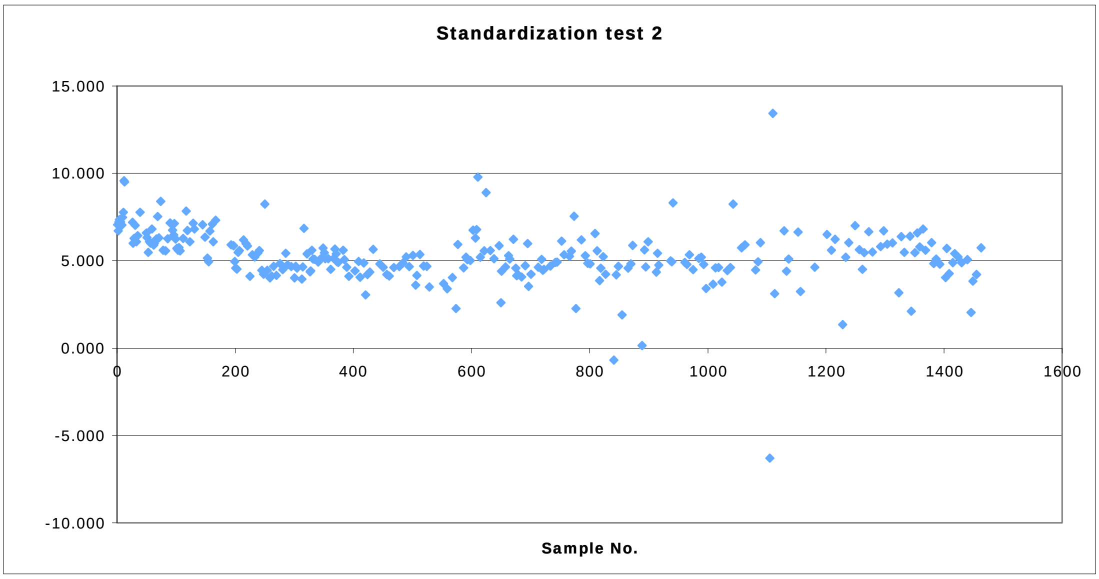

Figure 4. In this test the second of the two standardization values obtained for the thiosulphate reagent was used for all samples. Note that the initial drift is still present but that there is no longer a jump in the data. Note also that in this approach the mean residual offset is stable at approximately 5 µmol L^{-1}.

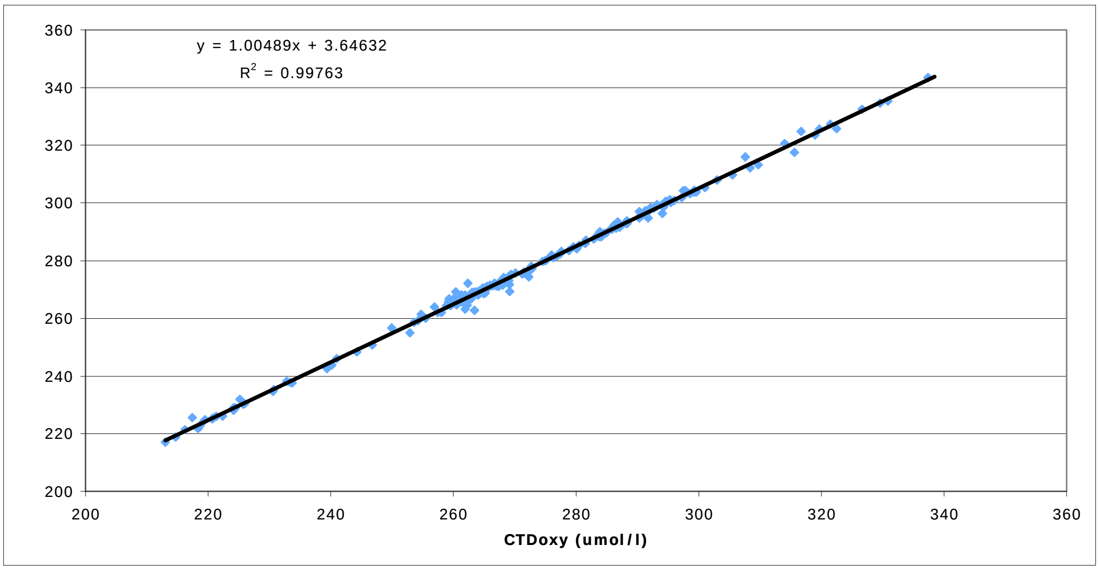

Figure 5. Linear regression between SBE43 measured oxygen concentrations (CTDoxy) and

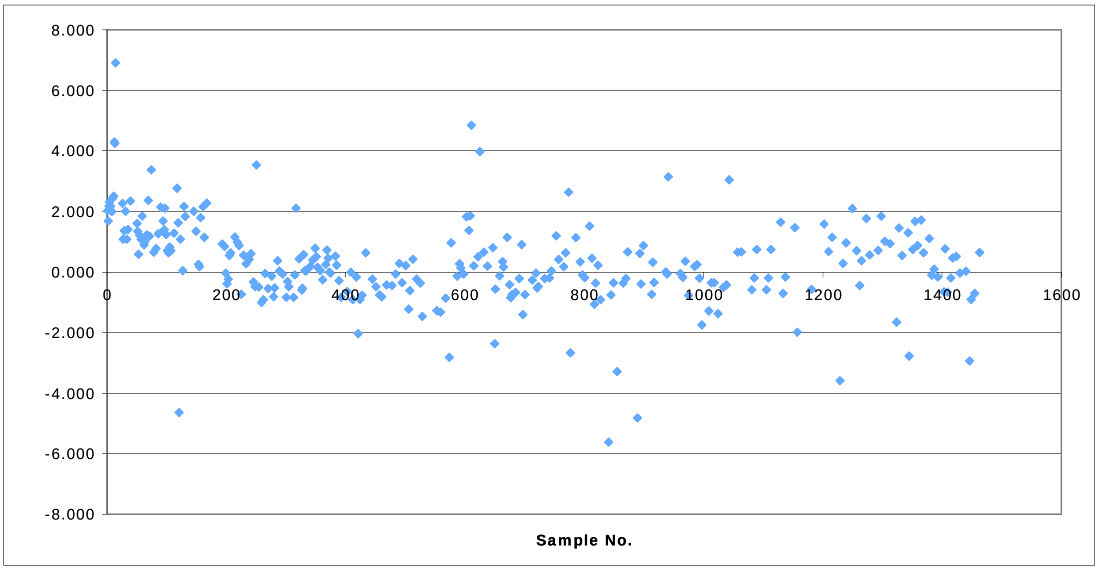

Figure 6. Oxygen residuals following application of the calibration equation (eq. 7 above).

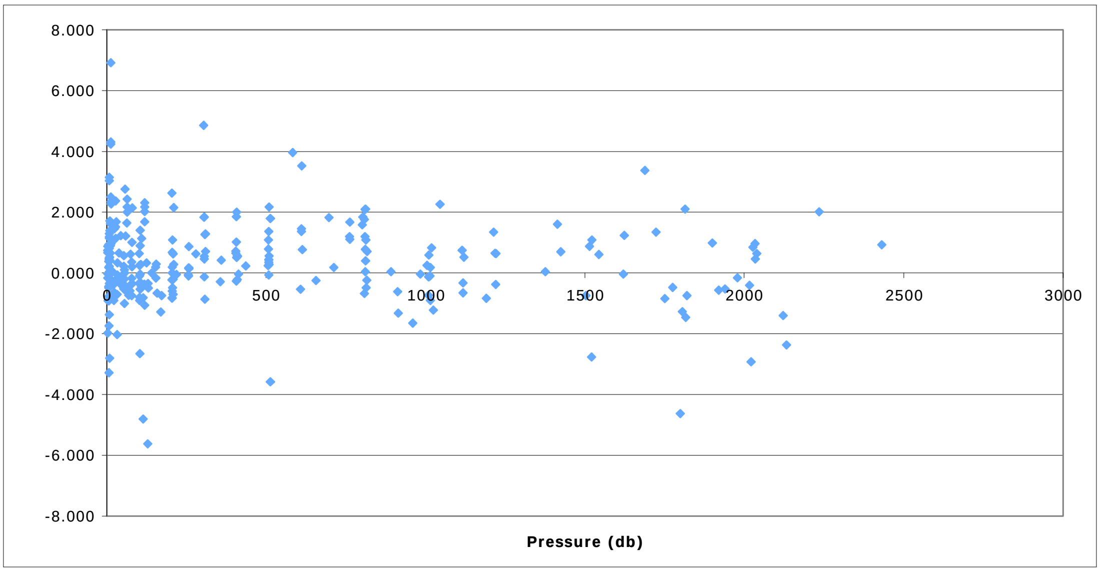

Figure 7. Check of the calibrated oxygen data against pressure for pressure hysteresis problems.

Titanium CTD

Initial assessment of the oxygen residuals for the SBE43 instrument attached to the titanium frame revealed some very peculiar trends in the data (**Figure 8**). Further investigation revealed this to be a pressure hysteresis problem (**Figure 9**) and indicated a more sophisticated calibration procedure was required than was used for the oxygen sensor on the stainless frame (described above).

Similar hysteresis problems have been seen before and various pstar execs have been written to help solve such issues. The basic procedure involves obtaining new calibration coefficients for the oxygen sensor from a least squares minimization of the titration data against the instrument measurements. This produces a series of coefficients (voltage offset, RHO, ALPHA, BETA) that are similar to those provided by Seabird on the instrument calibration sheets (see cruise report). The calibration coefficients from the calibration sheets are entered into the Seabird software and used during data acquisition and initial processing, thus any inaccuracies or improvements to these can have large improvements on data quality.

The exec *oxyca3* was used to obtain calibration coefficients from the Winkler titration data and instrument oxygen measurements. The results were

Offset = -0.49614 RHO = 0.4151 Alpha = 0.00051 Beta = -0.0001387 [8]

Having obtained these calibration coefficients the script *oxygn3* was used to apply them to the CTD oxygen profile data (2db and ctu files). These results of this are shown in **Figures 10** and **11**, which are comparable figures to **Figures 8** & **9.** The mean oxygen residual following calibration was -0.01±0.6 μmol L^{-1}.

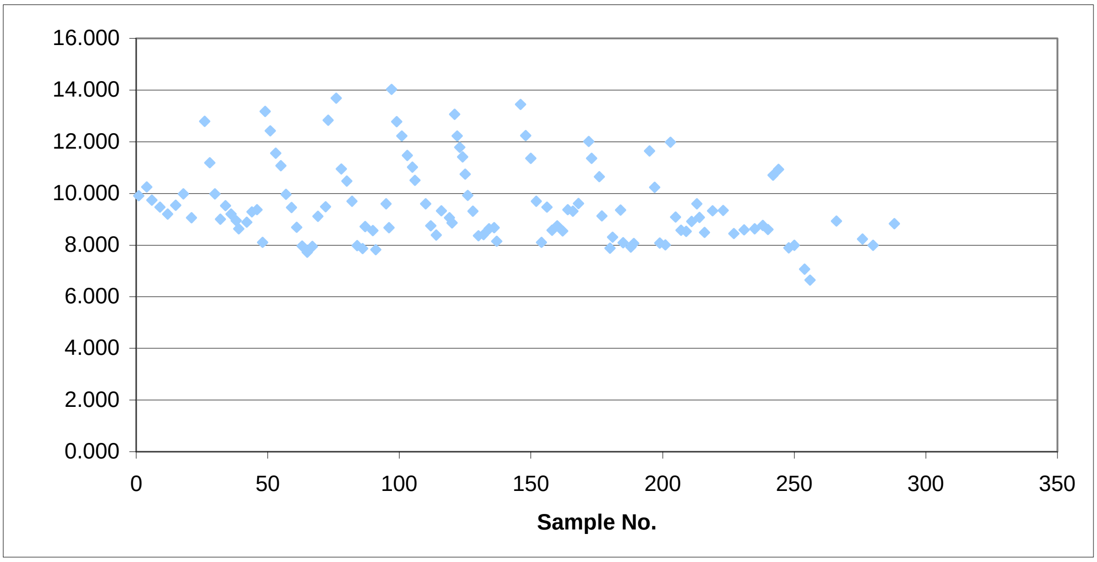

Figure 8. Initial oxygen residual plot for the SBE43 instrument attached to the titanium framed CTD. Note the large range in residual values associated with individual profiles suggesting a pressure hysteresis problem.

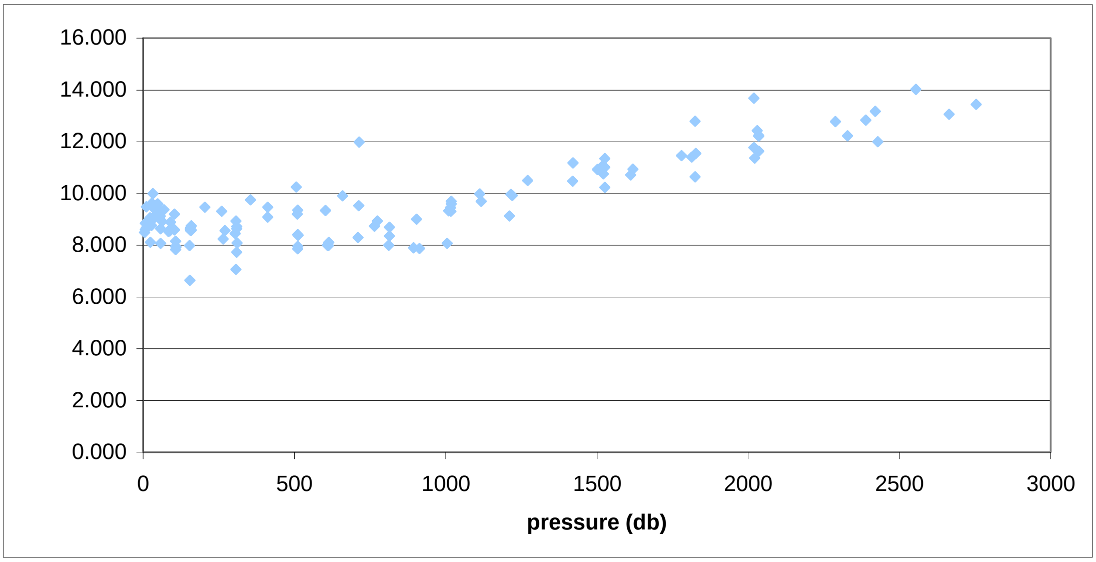

Figure 9. Titanium oxygen residual against pressure demonstrates the presence of a pressure related hysteresis problem.

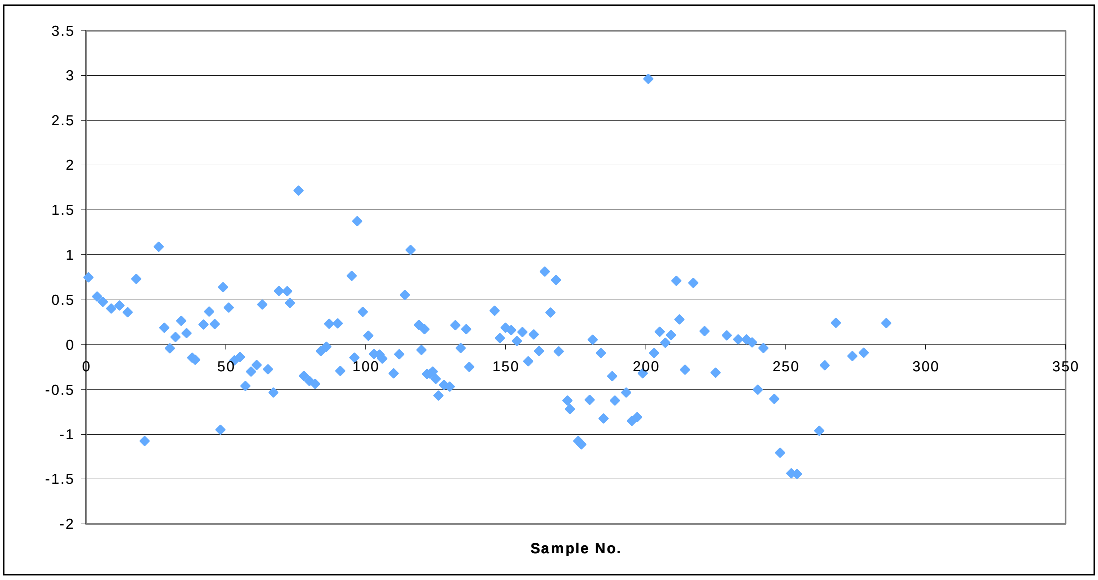

Figure 10. Calibrated oxygen residual plot for the SBE43 instrument attached to the titanium framed CTD.

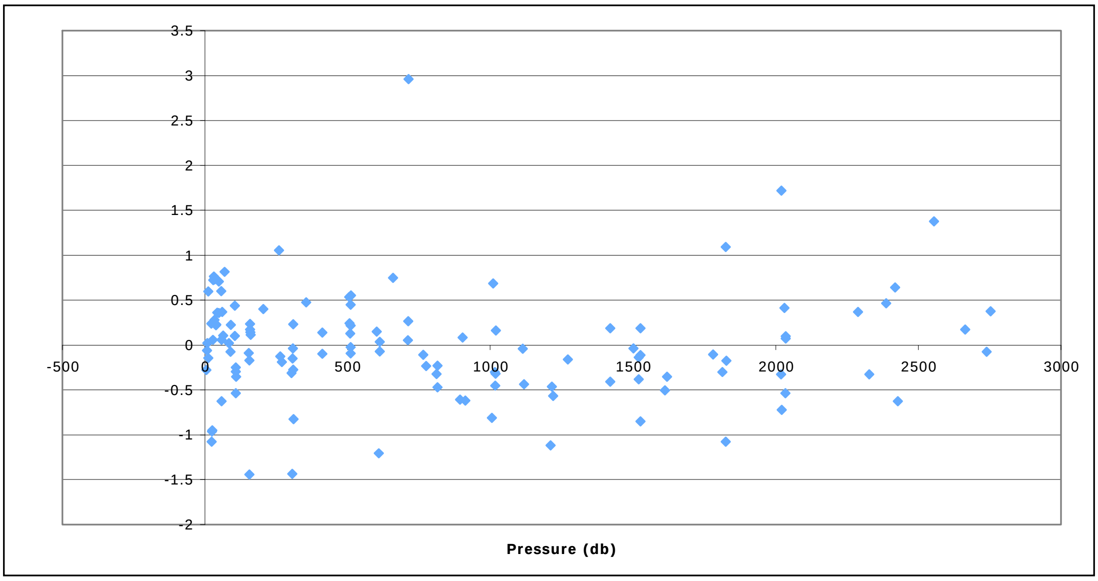

Figure 11. Calibrated oxygen residuals against pressure. The pressure hysteresis problem has been corrected.

Summary

Despite, instrumentation and analytical problems during the cruise the CTD data from D351 was eventually calibrated with only minor difficulty. **Table 1** summarises the various data files produced. For future reference, the .2db and .ctu files in the respective subdirectories contain the final fully calibrated data., whilst the sam.cal files contain calibrated CTD data (salinity and oxygen) to which I have added nutrient, bottle oxygen, and salinity sample data.

File Type	Details
ctd351002.24hz	Raw CTD data (**uncalibrated**)
ctd351002.10s	Raw CTD data averaged to 10 second time base (**uncalibrated**)
ctd351002.1hz	Raw CTD data averaged to 1Hz (1 second) (**uncalibrated**)
ctd351002.ctu.bak	Backup of **uncalibrated** CTD profile data as originally produced by pstar exec *ctds2 or ctdt2*
ctd351002.ctu.o2.bak	Backup of CTD data following conductivity calibration (copy of output of pstar exec *ctdcondcals* or *ctdcondcalt*). Oxygen data remains **uncalibrated**
ctd351002.ctu	**Final calibrated** up and down cast information StS conductivity calibrated with equations 3,4 or 5,6. StS oxygen calibrated with equation 7. TiT conductivity calibrated with equations 1,2. TiT oxygen calibrated with pstar exec *oxygn3*.
ctd351002.2db.bak	Backup of **uncalibrated** CTD profile data as originally produced by pstar exec *ctds2 or ctdt2*
ctd351002.2db.o2.bak	Backup of CTD data following conductivity calibration (copy of output of pstar exec *ctdcondcals* or *ctdcondcalt*). Oxygen data remains **uncalibrated**
ctd351002.2db	**Final calibrated** up and down cast information StS conductivity calibrated with equations 3,4 or 5,6. StS oxygen calibrated with equation 7. TiT conductivity calibrated with equations 1,2. TiT oxygen calibrated with pstar exec *oxygn3* and coefficients in equation 8.
fir351002	Parameter values at moment of Niskin bottle closure obtained from SBE .bl files.
sam351002	Niskin sampling information from fir351002 (**uncalibrated**) pasted into a master template file.
sam351002.ed	<u>Applicable only to TiT casts</u>. This file is similar to sam351002 except it has had the parameter oxyV (SBE43 oxygen voltage output) pasted on to it from the fir351002 file. This was done to aid the calibration of oxygen using exec *oxyca3.*
sam351002.cal	**Calibrated** sam file. Conductivity has been calibrated and salinity etc recalculated. Oxygen is also calibrated either via the application of equation 7 (StS sam files) run as part of the exec *calibratesamfiles* (only works on a subset of the data for CTD's 001-095), *calibratesamfiles2 (works on all of the data for CTD's 001-095), calibratesamfiles3 (works on all of the data from CTD's 096-101) or* via the pstar exec *oxygn3* (TiT sam files) run as part of the exec *calibratesamfilet* and using coefficients in equation 8.

Table 1. Summary table of the file types and nomenclature produced during the processing of D351 CTD data. Note that for demonstration purposes only, all file numbers are identical.

Appendix A: Summary list of final data file version codes

Stainless Steel CTD files

Calibrated 2db files

file: ctd351001.2db	dataname: CT351001	version: DP
file: ctd351003.2db	dataname: CT351003	version: CX
file: ctd351004.2db	dataname: CT351004	version: CX
file: ctd351005.2db	dataname: CT351005	version: CG
file: ctd351006.2db	dataname: CT351006	version: CB
file: ctd351008.2db	dataname: CT351008	version: CB
file: ctd351009.2db	dataname: CT351009	version: JT
file: ctd351010.2db	dataname: CT351010	version: CD
file: ctd351018.2db	dataname: CT351018	version: BN
file: ctd351019.2db	dataname: CT351019	version: BN
file: ctd351020.2db	dataname: CT351020	version: BN
file: ctd351021.2db	dataname: CT351021	version: BN
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file: ctd351027.2db	dataname: CT351027	version: BZ
file: ctd351028.2db	dataname: CT351028	version: BN
file: ctd351029.2db	dataname: CT351029	version: BN
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file: ctd351066.2db	dataname: CT351066	version: BX

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file: ctd351101.2db	dataname: CT351101	version: BT

Calibrated ctu files

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file: ctd351079.ctu	dataname: CT351079	version: BN
file: ctd351080.ctu	dataname: CT351080	version: BN
file: ctd351081.ctu	dataname: CT351081	version: BX
file: ctd351082.ctu	dataname: CT351082	version: BN
file: ctd351083.ctu	dataname: CT351083	version: BN
file: ctd351084.ctu	dataname: CT351084	version: BN
file: ctd351085.ctu	dataname: CT351085	version: BN
file: ctd351086.ctu	dataname: CT351086	version: BN
file: ctd351087.ctu	dataname: CT351087	version: BX
file: ctd351088.ctu	dataname: CT351088	version: BN
file: ctd351089.ctu	dataname: CT351089	version: BN
file: ctd351090.ctu	dataname: CT351090	version: BN
file: ctd351091.ctu	dataname: CT351091	version: BN
file: ctd351092.ctu	dataname: CT351092	version: BN
file: ctd351093.ctu	dataname: CT351093	version: BN

file: ctd351094.ctu	dataname: CT351094	version: BP
file: ctd351095.ctu	dataname: CT351095	version: BZ
file: ctd351096.ctu	dataname: CT351096	version: BX
file: ctd351097.ctu	dataname: CT351097	version: BX
file: ctd351098.ctu	dataname: CT351098	version: BX
file: ctd351099.ctu	dataname: CT351099	version: DB
file: ctd351100.ctu	dataname: CT351100	version: CP
file: ctd351101.ctu	dataname: CT351101	version: CD

sam files (uncalibrated)

file: sam351001	dataname: sm351001	version: DO
file: sam351003	dataname: sm351003	version: CU
file: sam351004	dataname: sm351004	version: CJ
file: sam351005	dataname: sm351005	version: BZ
file: sam351006	dataname: sm351006	version: CJ
file: sam351008	dataname: sm351008	version: BZ
file: sam351009	dataname: sm351009	version: BY
file: sam351010	dataname: sm351010	version: BX
file: sam351018	dataname: sm351018	version: BM
file: sam351019	dataname: sm351019	version: BM
file: sam351020	dataname: sm351020	version: BM
file: sam351021	dataname: sm351021	version: BM
file: sam351022	dataname: sm351022	version: BM
file: sam351024	dataname: sm351024	version: BM
file: sam351025	dataname: sm351025	version: BM
file: sam351026	dataname: sm351026	version: BM
file: sam351027	dataname: sm351027	version: BM
file: sam351028	dataname: sm351028	version: BM
file: sam351029	dataname: sm351029	version: BM
file: sam351030	dataname: sm351030	version: BM
file: sam351031	dataname: sm351031	version: BM
file: sam351032	dataname: sm351032	version: BM
file: sam351034	dataname: sm351034	version: BM
file: sam351035	dataname: sm351035	version: BM
file: sam351036	dataname: sm351036	version: BM
file: sam351037	dataname: sm351037	version: BM
file: sam351038	dataname: sm351038	version: BM
file: sam351040	dataname: sm351040	version: BM
file: sam351041	dataname: sm351041	version: BM
file: sam351042	dataname: sm351042	version: BM
file: sam351043	dataname: sm351043	version: BM
file: sam351044	dataname: sm351044	version: BM
file: sam351045	dataname: sm351045	version: BM
file: sam351046	dataname: sm351046	version: BM
file: sam351047	dataname: sm351047	version: BM
file: sam351048	dataname: sm351048	version: BM
file: sam351049	dataname: sm351049	version: BM
file: sam351050	dataname: sm351050	version: BM
file: sam351051	dataname: sm351051	version: BK
file: sam351052	dataname: sm351052	version: BM
file: sam351053	dataname: sm351053	version: BM
file: sam351054	dataname: sm351054	version: BM
file: sam351055	dataname: sm351055	version: BM
file: sam351056	dataname: sm351056	version: BM
file: sam351057	dataname: sm351057	version: BM
file: sam351058	dataname: sm351058	version: BM
file: sam351059	dataname: sm351059	version: BB
file: sam351060	dataname: sm351060	version: BB
file: sam351061	dataname: sm351061	version: BB

file: sam351062 dataname: sm351062 version: BB
file: sam351063 dataname: sm351063 version: BB
pinq: can't open sam351064
pinq: can't open sam351065
pinq: can't open sam351066
pinq: can't open sam351067
pinq: can't open sam351068
pinq: can't open sam351069
pinq: can't open sam351070
pinq: can't open sam351071
file: sam351072 dataname: sm351072 version: BB
pinq: can't open sam351073
pinq: can't open sam351074
pinq: can't open sam351075
pinq: can't open sam351076
pinq: can't open sam351077
pinq: can't open sam351078
pinq: can't open sam351079
pinq: can't open sam351080
file: sam351081 dataname: sm351081 version: BB
pinq: can't open sam351082
pinq: can't open sam351083
pinq: can't open sam351084
pinq: can't open sam351085
pinq: can't open sam351086
file: sam351087 dataname: sm351087 version: BA
pinq: can't open sam351088
pinq: can't open sam351089
pinq: can't open sam351090
pinq: can't open sam351091
pinq: can't open sam351092
pinq: can't open sam351093
pinq: can't open sam351094
file: sam351095 dataname: sm351095 version: BB
file: sam351096 dataname: sm351096 version: BC
file: sam351097 dataname: sm351097 version: BB
file: sam351098 dataname: sm351098 version: BB
file: sam351099 dataname: sm351099 version: BM
file: sam351100 dataname: sm351100 version: BA
file: sam351101 dataname: sm351101 version: BA

sam files (calibrated)

file: sam351001.cal dataname: sm351001 version: FF
file: sam351003.cal dataname: sm351003 version: DW
file: sam351004.cal dataname: sm351004 version: DL
file: sam351005.cal dataname: sm351005 version: DB
file: sam351006.cal dataname: sm351006 version: DL
file: sam351008.cal dataname: sm351008 version: DB
file: sam351009.cal dataname: sm351009 version: DA
file: sam351010.cal dataname: sm351010 version: CZ
file: sam351018.cal dataname: sm351018 version: CO
file: sam351019.cal dataname: sm351019 version: CO
file: sam351020.cal dataname: sm351020 version: CO
file: sam351021.cal dataname: sm351021 version: CO
file: sam351022.cal dataname: sm351022 version: CO
file: sam351024.cal dataname: sm351024 version: CO
file: sam351025.cal dataname: sm351025 version: CO
file: sam351026.cal dataname: sm351026 version: CO
file: sam351027.cal dataname: sm351027 version: CO

file: sam351028.cal dataname: sm351028 version: CO
file: sam351029.cal dataname: sm351029 version: CO
file: sam351030.cal dataname: sm351030 version: CO
file: sam351031.cal dataname: sm351031 version: CO
file: sam351032.cal dataname: sm351032 version: CO
file: sam351034.cal dataname: sm351034 version: CO
file: sam351035.cal dataname: sm351035 version: CO
file: sam351036.cal dataname: sm351036 version: CO
file: sam351037.cal dataname: sm351037 version: CO
file: sam351038.cal dataname: sm351038 version: CO
file: sam351040.cal dataname: sm351040 version: CO
file: sam351041.cal dataname: sm351041 version: CO
file: sam351042.cal dataname: sm351042 version: CO
file: sam351043.cal dataname: sm351043 version: CO
file: sam351044.cal dataname: sm351044 version: CO
file: sam351045.cal dataname: sm351045 version: CO
file: sam351046.cal dataname: sm351046 version: CO
file: sam351047.cal dataname: sm351047 version: CO
file: sam351048.cal dataname: sm351048 version: CO
file: sam351049.cal dataname: sm351049 version: CO
file: sam351050.cal dataname: sm351050 version: CO
file: sam351051.cal dataname: sm351051 version: CM
file: sam351052.cal dataname: sm351052 version: CO
file: sam351053.cal dataname: sm351053 version: CO
file: sam351054.cal dataname: sm351054 version: CO
file: sam351055.cal dataname: sm351055 version: CO
file: sam351056.cal dataname: sm351056 version: CO
file: sam351057.cal dataname: sm351057 version: CO
file: sam351058.cal dataname: sm351058 version: CO
file: sam351059.cal dataname: sm351059 version: CD
file: sam351060.cal dataname: sm351060 version: CD
file: sam351061.cal dataname: sm351061 version: CD
file: sam351062.cal dataname: sm351062 version: CD
file: sam351063.cal dataname: sm351063 version: CD
pinq: can't open sam351064.cal
pinq: can't open sam351065.cal
pinq: can't open sam351066.cal
pinq: can't open sam351067.cal
pinq: can't open sam351068.cal
pinq: can't open sam351069.cal
pinq: can't open sam351070.cal
pinq: can't open sam351071.cal
file: sam351072.cal dataname: sm351072 version: CD
pinq: can't open sam351073.cal
pinq: can't open sam351074.cal
pinq: can't open sam351075.cal
pinq: can't open sam351076.cal
pinq: can't open sam351077.cal
pinq: can't open sam351078.cal
pinq: can't open sam351079.cal
pinq: can't open sam351080.cal
file: sam351081.cal dataname: sm351081 version: CD
pinq: can't open sam351082.cal
pinq: can't open sam351083.cal
pinq: can't open sam351084.cal
pinq: can't open sam351085.cal
pinq: can't open sam351086.cal
file: sam351087.cal dataname: sm351087 version: CC
pinq: can't open sam351088.cal

pinq: can't open sam351089.cal
pinq: can't open sam351090.cal
pinq: can't open sam351091.cal
pinq: can't open sam351092.cal
pinq: can't open sam351093.cal
pinq: can't open sam351094.cal
file: sam351095.cal dataname: sm351095 version: CD
file: sam351096.cal dataname: sm351096 version: CE
file: sam351097.cal dataname: sm351097 version: CD
file: sam351098.cal dataname: sm351098 version: CD
file: sam351099.cal dataname: sm351099 version: CO
file: sam351100.cal dataname: sm351100 version: CC
file: sam351101.cal dataname: sm351101 version: CC

Titanium CTD data files

Calibrated 2db files

file: ctd351002.2db dataname: CT351002 version: EE
file: ctd351007.2db dataname: CT351007 version: BX
file: ctd351011.2db dataname: CT351011 version: BJ
file: ctd351012.2db dataname: CT351012 version: BJ
file: ctd351013.2db dataname: CT351013 version: BJ
file: ctd351014.2db dataname: CT351014 version: BJ
file: ctd351015.2db dataname: CT351015 version: BJ
file: ctd351016.2db dataname: CT351016 version: BP
file: ctd351017.2db dataname: CT351017 version: BJ
file: ctd351023.2db dataname: CT351023 version: BJ
file: ctd351033.2db dataname: CT351033 version: BJ
file: ctd351039.2db dataname: CT351039 version: BJ

Calibrated ctu files

file: ctd351002.ctu dataname: CT351002 version: EB
file: ctd351007.ctu dataname: CT351007 version: BU
file: ctd351011.ctu dataname: CT351011 version: BG
file: ctd351012.ctu dataname: CT351012 version: BG
file: ctd351013.ctu dataname: CT351013 version: BG
file: ctd351014.ctu dataname: CT351014 version: BG
file: ctd351015.ctu dataname: CT351015 version: BG
file: ctd351016.ctu dataname: CT351016 version: BM
file: ctd351017.ctu dataname: CT351017 version: BG
file: ctd351023.ctu dataname: CT351023 version: BG
file: ctd351033.ctu dataname: CT351033 version: BG
file: ctd351039.ctu dataname: CT351039 version: BG

sam files (uncalibrated)

file: sam351002 dataname: sm351002 version: BO
file: sam351007 dataname: sm351007 version: BL
file: sam351011 dataname: sm351011 version: BA
file: sam351012 dataname: sm351012 version: BA
file: sam351013 dataname: sm351013 version: BA
file: sam351014 dataname: sm351014 version: BA
file: sam351015 dataname: sm351015 version: BA
file: sam351016 dataname: sm351016 version: CA
file: sam351017 dataname: sm351017 version: BA
file: sam351023 dataname: sm351023 version: BA
file: sam351033 dataname: sm351033 version: BA
file: sam351039 dataname: sm351039 version: BA

sam files (calibrated)

file: sam351002.cal	dataname: sm351002	version: CC
file: sam351007.cal	dataname: sm351007	version: BS
file: sam351011.cal	dataname: sm351011	version: BH
file: sam351012.cal	dataname: sm351012	version: BH
file: sam351013.cal	dataname: sm351013	version: BH
file: sam351014.cal	dataname: sm351014	version: BH
file: sam351015.cal	dataname: sm351015	version: BH
file: sam351016.cal	dataname: sm351016	version: CO
file: sam351017.cal	dataname: sm351017	version: BH
file: sam351023.cal	dataname: sm351023	version: BH
file: sam351033.cal	dataname: sm351033	version: BH
file: sam351039.cal	dataname: sm351039	version: BJ