## REVISION NOTICE TABLE

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| DATE | DESCRIPTION OF REVISION |
| 18 March 2025 | Updated channel names & formats in TOB files. G.G. |

## PROCESSING NOTES

Cruise: 2022-022

Agency: OSD

Location: WCVI

Project: La Perouse

Chief Scientist: Nelson J.

Platform: John P. Tully

Cruise Dates: 25 August 2022 – 4 September 2022

Processed by: Germaine Gatien

Date of Processing: 18 October 2022 – 13 December 2022

Number of original HEX files: 96 Number of processed CTD files: 95

Number of rosette casts: 59 Number of processed CHE files: 57

Number of original TSG csv files: 1 Number of processed TOB files: 102

# INSTRUMENT SUMMARY

CTD #0443 was mounted in a rosette and attached were 2 Wetlabs CSTAR transmissometer (1185DR & #1883DG), a SBE 43 DO sensor on the primary pump (#3791), SeaPoint Fluorometer on the secondary pump (#3641), a Biospherical QSP-400 PAR sensor (#70613) and an altimeter (#76341).

A thermosalinograph (SeaBird 45 S/N 0620) was mounted with a Wetlabs WETStar fluorometer (#1656) and flow meter; sampling interval was 5s.

Seasave version 7.26.7.121 was used for acquisition.

The data logging computer WP #102.

The deck unit was a Seabird model 11+ #425.

An IOS rosette with 24 10L bottles was used.

# SUMMARY OF QUALITY AND CONCERNS

The Daily Science Log Book and rosette log sheets were in good order with comments about problems encountered and a detailed list of equipment.

The standard deployment procedure for this cruise as follows:

The rosette was brought to the surface. Pumps were turned ON. The rosette was brought down to 10m and kept there for 30 seconds. Once back at the surface, the data started to be archived, with the rosette at the surface for 30 seconds longer. Then the cast would start.

For all rosette casts:

Niskin bottles closed from 0 to 400 dbar (both included) had a wait time of 60 seconds.

 All Niskin bottles deeper than 400 dbar had a wait time of 30 seconds.

There were 2 WetLabs CStar transmissometers in use during this cruise:

 Channel Transmissometer refers to sensor #1185DR (650nm - red)

 Channel Transmissometer:Green refers to sensor #1883DG (530nm - green)

For comparison with other Institute of Ocean Sciences cruises, note that the transmissometer wavelength is 650nm unless otherwise stated.

Something odd occurred between casts #128 and #133.

* The comparison of dissolved oxygen sensor with titrated samples changed abruptly between casts #128 and #133 and hysteresis was noted that was not seen in the earlier casts. A significant change had to be made to factor E in the DO configuration parameters to produce reasonable values below the OMZ.
* Cast #129 had unusually noisy data.
* During cast #132 many bottles were said to have tripped accidentally at about 800db on the upcast. In the top 60m of the downcast the secondary salinity values reached values >36psu, unheard of in this region even at great depths and the fluorescence was very high down to 60db at which point it dropped precipitously to normal values.
* Extracted CHL values were very high at cast #133 which could be related to whatever happened during #132.
* Tests were run using a variety of settings for hysteresis parameter E in the configuration file. A setting was found that worked much better for casts #133 to the end of the cruise; this had no significant effect on the fit against bottles. Principally this improved SBE DO results below the Oxygen Minimum Zone. It is unusual to have to fine-tune the hysteresis factors except immediately after service, and rarely is as large an adjustment needed as was the case for these casts.
* During 2 other cruises in this region (May La Perouse and August Line P) variable results were seen in comparisons with bottles which appeared to be due to variations in natural conditions with intrusive features affecting results, but that did not seem to be a factor for this cruise.
* Values in the oxygen minimum zone where errors are likely to be low confirm a change though it is not known precisely when it occurred. A fit of differences versus sensor DO suggested that cast #133 was closer to the late group.

The later casts were reconverted with different hysteresis parameters. Separate recalibration schemes were found for the 2 groups of casts.

The SBE DO sensor has a fairly long response time so data accuracy is not as high when it is in motion as it is during stops for bottles. This will be especially true when vertical DO gradients are large. To get an estimate of the accuracy of the SBE DO data during downcasts (after recalibration) a rough comparison was made between downcast SBE DO and upcast titrated samples. Some of the difference will be due to incomplete flushing of Niskin bottles and imperfect matches in levels from the two data sets as well as errors in sample analysis/collection, so the following statement likely underestimates SBE DO accuracy.

Downcast (CTD files) Oxygen:Dissolved:SBE data for this cruise are considered, very

roughly, to be:

 ±0.60 mL/L from 0-100db except in areas of very large DO gradients

 ±0.20 mL/L from 100db-500db

 ±0.04 mL/L below 500db

The Thermosalinograph worked well with good detail in temperature, salinity and fluorescence traces and few spikes in salinity. Some data were padded for a few minutes due to interruption of the flow in the loop. The differences between lab and intake temperatures were often larger than expected, but large near-surface vertical gradients and temporal variability likely account for this. TSG intake temperatures compared reasonably well with CTD values from around 4m, but there was a lot of noise in the comparison. Salinity was recalibrated by adding 0.036psu based on comparisons with CTD salinity and loop samples. TSG fluorescence values were about 70% of those from the CTD fluorometer and about

60% of loop CHL samples but there were few loop samples available.

# PROCESSING SUMMARY

##### Seasave

This step was completed at sea; the raw data files have extension HEX.

There was a summary of sampling protocols and problems in the log; this is very helpful.

The standard deployment procedure for this cruise as follows:

The rosette was brought to the surface. Pumps were turned ON. The rosette was brought down to 10m and kept there for 30 seconds. Once back at the surface, the data started to be archived, with the rosette at the surface for 30 seconds longer. Then the cast would start.

For all rosette casts:

Niskin bottles closed from 0 to 400 dbar (both included) had a wait time of 60 seconds.

 All Niskin bottles deeper than 400 dbar had a wait time of 30 seconds.

##### Preliminary Steps

The Log Book and rosette log sheets were obtained.

* Nutrients, extracted chlorophyll, dissolved oxygen, salinity and NH4 data were obtained in QF spreadsheet format from the analysts.
* The cruise summary sheet was completed.
* The history of use of the pressure sensor and conductivity and dissolved oxygen sensors was obtained. 2022-008 was the only cruise that had used them since they were last serviced at the factory.

The configuration files were checked; there were no changes during the cruise and all entries were correct.

##### BOTTLE FILE PREPARATION

The ROS files were created using file 2022-022-ctd.xmlcon.

The ROS files were converted to IOS format.

The IOS files were put through CLEAN to create BOT files.

Temperature and salinity were plotted for all BOT files to check for significant outliers.

Casts #33 and 75 had some noise in salinity. CTDEDIT was used to remove a few Salinitiy:T1:C1 points from #33 and clean Salinity:T0:C0 in #75; the output files were copied to \*.BOT.

Cast #132 looked bad, but there was a problem that was mentioned in the log and a second cast was run to replace it; no bottle file is to be prepared for that cast so it was removed from the cast list.

Cast #108 had no sampling so was removed from the cast list.

A preliminary header check was run; no problems were found.

The BOT files were bin-averaged on bottle number.

The output was used to create file ADDSAMP.csv. First, the file was sorted on event number and Bottle Position order. Then sample numbers were added based on the rosette logs.

The ADDSAMP file was then reordered on event # & sample #.

The ADDSAMP file was used to add sample numbers to the BOT files – output \*.SAM.

Run MERGE on SAM files to get the water depths right.

The SAM files were bin-averaged on bottle # and called SAMAVG.

The SAMAVG file for event #1 was reduced to just 1 record as only Niskin 1 was sampled.

The addsamp.csv file was converted to CST files, which will form the framework for the bottle files.

Next, each of the analysis spreadsheets were examined to see what comments the analysts wanted included in the header file. These were used to create file 2022-022-bot-hdr.txt which will be updated as needed during processing.

Loops samples were moved from the salinity, chlorophyll and nutrient CSV files to a combined loop data file for later use.

DISSOLVED OXGYEN

Dissolved oxygen data were provided in spreadsheet QF2022-022\_OXY\*.xlsx which includes flags, comments and a precision study. Draw temperatures are available. The spreadsheet page with the final data was simplified and saved as 2022-022oxy.csv. That file was converted into individual \*.OXY files.

EXTRACTED CHLOROPHYLL

Extracted chlorophyll and phaeo-pigment data were obtained in file QF2022-022\_CHL QF\*.xlsx. The file included comments and flags and a precision study. A simplified version of the spreadsheet was prepared and saved as 2022-022chl.csv. The csv file was then converted to individual CHL files.

SALINITY

Salinity analysis was obtained in file QF2022-022\_SAL.xlsx which included a precision study. The analyses were carried out in a temperature-controlled lab 6 to 18 days after collection. The files were simplified and saved as 2022-022sal.csv. That file was then converted to individual SAL files.

NUTRIENTS

The nutrient data were obtained in spreadsheet QF2022-022\_NUTS\*.xlsx. This includes a precision study. The file was simplified, saved as 2022-022nuts.csv. The file was converted to individual NUT files.

AMMONIUM

NH4 data were obtained in spreadsheet QF2022-022 QF NH4\*.xlsx. This includes a precision study. The file was simplified and saved as 2022-022NH4.csv. This file was converted to NH4 files.

The SAL, CHL, OXY, NUT and NH4 files were merged with CST files in 5 steps.

After the 5th step the files were put through CLEAN to reduce the headers to File and Comment sections only.

These files are ordered on sample number, but the SAMAVG files are ordered on bottle number, so one or the other set needs to be reordered in order to merge them. The MRGCLN1 files were reordered on Bottle\_Number and saved as \*. MRGCLN1s.

The MRGCLN1s files were then merged with SAMAVG files using merge channel Bottle\_Number.

The output of the MRG files were exported to a spreadsheet and compared to the rosette log sheets to look for omissions. A few discrepancies were found:

* Event 44 – Bottle #3 was a misfire with no sample # assigned, so this line was removed from the SAMAVG file and the MRG repeated.
* Event 178 – No NH4 data in raw file but 4 samples listed in rosette log. Add flag 9.
* Flags were missing for replicates for NH4. The spreadsheet was updated.

The merge process was repeated after corrections.

##### Compare

Salinity

Compare was run with pressure as reference channel. A fit was done excluding cases where the standard deviation in the CTD salinity during the 10s window was >0.0008psu plus one outlier flagged 4 by the analyst and 2 outliers that appear to be cases of Niskin contents being corrupted by shed wakes. Of those, one came from a bottle fired at the bottom of a cast so the sample has lower salinity as shed wakes came from above and the other was in shallow water where a shed wake brought higher salinity from below. The primary salinity was lower than bottles by an average of ~0.0015psu (std dev 0.0016psu) and the secondary salinity was low by an average of ~0.0004psu (std dev 0.0015psu). The differences between the 2 fits correspond well with the differences between downcast salinity channels reported in section 9.

There are more rejected differences in the fit of primary salinity to bottles because there were more cases with the standard deviation in the sensor data over the 10s being >0.0008psu. However, there is not a large difference in the average standard deviation over all bottles, with the primary higher by ~2.5%.

Outliers were examined:

Sample #118, Event 44 – Significant outlier in compare, flagged 4 previously; analyst replaced value with pad value and flag changed to 5.

Sample 137, Event 53 – Already flagged 4 – High by ~0.003psu so a little out of line. Flag left unchanged.

Sample 581, Event 231 – Significant outlier in compare but analysis likely fine – bottle closed at bottom so shed wake from above likely. Flagged 3.

There is little variation with time, especially in the secondary fit.

Analysis was done very quickly so we do not expect significant evaporation and longer waits before firing bottles should minimize errors due to incomplete flushing.

For full details for the COMPARE run see file 2022-022-sal-comp1.xls.

Dissolved Oxygen

COMPARE was run with pressure as the reference channel.

The fit is noisy but this likely reflects heavy sampling in a variety of environments and both above and below the OMZ where the effect of incomplete flushing of Niskin bottles is to produce errors of opposite sign. There are more cases of outliers being above the x-axis than usual. This looks odd compared to what is usually seen.

A few notes of interest:

* The cases of SBE DO being higher than the samples are found both above and below the oxygen minimum, so this is not just an issue of hysteresis.
* There are a few casts where the descent rate was very steady so that flushing would likely have been poor. But the local gradient was very low so any error would be small.
* The cases with SBE looking significantly low all came from the bottom of shallow casts – this makes sense as local gradients would be high and incomplete flushing would lead to sample values having higher DO than ambient DO.
* There is evidence of time dependence in the plots against file pair number. These are always hard to judge since sampling and conditions vary so much, so a study was done by only including the deep casts (44, 53, 95, 128, 133, 150, 156). The results from the first 4 of these casts look closer to the results of the previous cruise, but the slope and offset using the last 3 are significantly different from the early casts and from 2022-008 results.
* Excluding the deep samples from the late casts has little effect on the fit, though the fit is too noisy to judge this very well.
* Cruise 2022-008 also had some odd changes in the DO comparison, with 3 casts that were somewhat out of line with others. The casts run before and after those 3 looked similar. There was no indication of significant hysteresis except from the last of the 3 odd casts. The fit had a small slope with the opposite sign to what is expected, but the offsets were similar. That could be partly explained by poor flushing but the descent rate would suggest flushing was not a major issue. Local gradients in the top 400m were similar for casts #38, 57 and 67, but only cast #38 had the unusual fit. The only difference noted was that the SBE DO minimum was lower for the affected casts, though #38 was only slightly lower than #57. There was no cast before the affected casts deep enough to study whether going through very low DO water might be a factor.
* Cruise 2022-015 in May visited the same area as this cruise, but used a different DO sensor. Similar variations in fits between early and late casts looked like it was due to real changes as cold, fresh intrusions moved into the area. Repeat casts at LG06 showed a few sharp intrusive features in a T-S plot and DO profile, while the later cast showed a well-developed intrusion spread between 200 and 450m with many small reversals in DO. Both the contents of the Niskin bottles and the ambient conditions seen by the DO sensor would be varying; together with slow response of the DO sensor the result is too complex to assess.

The fit for casts up to #128 when outliers were removed based on residuals is:

 CTD DO Corrected = CTD DO \* 1.0164 + 0.0063 R2 = 0.83

All samples from cast #33 were flagged 4, but removing them had negligible effect on the fit.

For cruise 2022-008 the fit found when the suspicious casts were excluded plus outliers based on residuals was:

 CTD DO Corrected = CTD DO \* 1.0156 + 0.0036 R2 = 0.75 (1)

These fits are close.

For the latter part of this cruise (casts 133 to the end) the fit is:

 CTD DO Corrected = CTD DO \* 1.0215 + 0.0393 R2 = 0.78 (2)

This is very different from the 2022-008 cruise and the early part of this cruise. The change occurred between casts #128 and #133, a small window.

During cast #132 fluorescence had very high values in the top 60m of the downcast where it suddenly shifted to normal values; the upcast looks ok. The secondary salinity was also very high (>36.5psu) down to 60m at which point it fell into line with the primary salinity. Transmissivity and oxygen look normal but a small change in DO would not show up in these plots. So the channels on the secondary pump were affected badly, likely due to biological contamination. But on the upcast Niskin bottles #4 to 24 were all fired on the fly between 880 and 810db and bottle #1 was fired again. This cast will not be archived, but does demonstrate that something went seriously wrong. What that was and whether it could have affected the hysteresis settings of the oxygen sensor are unknown.

The difference between the 2 fits (-0.0151\*DO +0.0330) varies from 0.033mL/L for DO=0 to +0.003 for DO=7. So it is significant at the low end of the range, but near-zero at the upper end.

The hysteresis check was done by highlighting in a different colour points from below 1000db but there are not enough deep data to give a convincing answer, especially given that they are split between the two fits found. The only samples that suggest hysteresis in the early part of the cruise come from the bottom of casts which could mean the samples represent conditions above the firing level with lower DO. For casts #150 & 153 there is some suggestion of hysteresis; unfortunately, but there are no other deep casts with DO samples after that.

Tests to adjust the hysteresis parameters were run on one deep cast to see if adjusting factor E in the configuration file produces a better fit overall. Cast #150 was converted with parameter E set to 0.034, 0.032, 0.030 and 0.026 and the files were processed to the bin-averaged stage. Values were recorded for the SBE DO value at levels 300, 400, 500, 750, 1000, 1250, 1500 and 2000db and differences from bottles recorded. Plots were made of the differences versus SBE DO for each E value including 0.036. The mark of a good setting is when the differences are similar for similar SBE DO values above and below the DO minimum. There is little change at low values but when DO is ~1.2, a setting of E=0.032 looks like it has not quite gone far enough but E=0.030 has gone a little too far. So E=0.031 is likely the best choice. When DO is ~0.6 the best choice looks like E=0.031. Right at the minimum E=0.026 looks best but there differences are slight. Using E=0.031 is likely a good idea for the late casts. It is not expected to have the E factor changed between servicing of the sensor, and it is particularly odd that it should change mid-way through a cruise, but it does seem to have happened.

If we rerun these files with a different E value it will not have a significant effect on the fit, since the offset would be only slightly lower and the hysteresis correction is ~0 near the surface. The correction has no significant effect on the fits that will determine recalibration of DO, and insignificant fits on DO values above the OMZ but it will change values at 2000db by up to 3%. So the files for casts #133 onwards were reconverted.

The only casts between CTD casts#128 and #133 were #129 which was shallow and #132 for which there were no bottle samples. The log notes that many bottles were fired accidentally during cast #132 so #133 was run to replace it. It is conceivable that whatever happened during #132 affected the DO sensor.

Steps were repeated for casts #133-#207 and COMPARE was rerun. As expected the change to the fit was slight:

 CTD DO Corrected = CTD DO \* 1.0201 - 0.0285 R2 = 0.79

The hysteresis check looks better. The file was saved as 2022-022-dox-comp1b.xls.

Unusual conditions may account for the odd comparisons in 2022-008 and 2022-015, but for this cruise there is evidence of an instrumental factor and little evidence of significant changes in conditions between the two groups. A few more tests were run.

Data were plotted from the Oxygen Minimum Zone (~750 and ~1000db). At this level the differences are close to 0. There is a clear increase in the differences between casts #128 and #150 with no associated increase in either the CTD or titrated DO values. Cast #133 looks like it could fit in either group given the scatter. This appears to confirm a real change in the sensor calibration as this is a depth at which gradients are low so variability during stops for bottles and errors due to incomplete flushing are small. The scatter in the earlier casts likely shows the range of errors from incomplete flushing, and analysis precision was Sp=0.004mL/L. The fit of differences versus CTD DO was done for cast #133 to see if it looked more like the first group or the second. There is considerable scatter in the fit, but no matter how outliers were identified and eliminated, the fits look closest to the later group, with slopes about 1.02 and offsets about -0.02 to -0.03.

For full details for the COMPARE run see file 2022-022-dox-comp1.xls and 2022-022-dox-comp1b.xls.

Fluorescence

COMPARE was run with extracted chlorophyll and CTD Fluorescence using pressure as the reference variable. The usual patterns were seen. CTD Fluorescence is about 120% of CHL overall, but is much higher than CHL when CHL is <2ug/L and only about 50 to 70% of CHL when CHL is >5ug/L with a few exceptions.

However, there are a few outliers from those patterns so they were investigated:

* For some near-shore casts, mostly early in the cruise the fluorescence was higher relative to chlorophyll than expected. They appear to be from casts with highly variable gradients so are likely due to in-exact matches in level. Similarly, some with higher ratios show the same variability.
* Cast #133 stood out as odd.

|  |  |  |  |
| --- | --- | --- | --- |
| Pressure | downcast Fl | upcast | CHL |
| 5.0 | 7.2 | 6.38 | 9.15 |
| 10.0 | 10.3 | 6.70 | n/a |
| 20.1 | 1.4 | 2.30 | 13.29 |
| 30.8 | 0.5 | 0.46 | 0.48 |
| 50.5 | 0.4 | 0.19 | 0.09 |

CHL was very high at 20m. We expect fluorescence to be lower than CHL for high CHL values, but it was anomalously low at 20db, but in reasonable agreement at 5m. It is odd to have the maximum CHL come from lower in the water column than the fluorescence peak. This cast was a repeat of cast #132 due to bad data in the top 60m of the downcast. Something obviously got into the plumbing and produced bad chlorophyll, fluorescence and salinity data and may possibly have affected the dissolved oxygen sensor. It is possible that whatever happened on the previous cast that led to extremely high fluorescence values for #133 was biological material getting into the Niskin bottle. However, this cast was near Brookes Peninsula where odd things happen.

For full details for the COMPARE run see file 2022-022-fl-chl-comp1.xls.

##### Conversion of Full Files from Raw Data

File 2022-022-ctd.xmlcon was used to convert files #1-132 and 2022-022-ctd2.xmlcon for files #133-231. The Tau function and the hysteresis function were selected since there was deep sampling. Depth was included in the conversion.

A few casts were examined and all expected channels are present, and there are no obvious problems in any channels except for a few isolated spikes in conductivity.

##### WILDEDIT

Program WILDEDIT was run to remove spikes from the pressure, depth, conductivity & temperature only in the full cast files (\*.CNV).

Parameters used were: Pass 1 Std Dev = 2 Pass 2 Std Dev = 5 Points per block = 50

The parameter “Keep data within this distance of the mean” was set to 0 so all spikes would be removed.

Conductivity spikes noted in the previous step were removed.

##### ALIGN DO

A few casts were examined; both temperature channels were noisy during upcasts so the tests were not easy to interpret, but using +2.5s improved the alignment and overall looks like a good choice. That value is the one most often chosen for the SBE911s.

ALIGNCTD was run on all casts using +2.5s.

##### CELLTM

CELLTM was run using default values (α = 0.0245, β=9.5) for both the primary and secondary conductivity.

##### DERIVE and Channel Comparisons

Program DERIVE was run on all casts to calculate primary and secondary salinity and dissolved oxygen concentration.

The alignment of dissolved oxygen looks good.

DERIVE was run a second time on 4 of the deeper casts to find the differences between the pairs of temperature, conductivity and salinity channels.

All differences were small, but there is slight increase in conductivity differences and decrease in temperature differences from the observations of 2022-008. The result is slightly larger salinity differences though they are still small at ~0.001 with a slight increase with time.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Cast # | Press | T1-T0  | C1-C0 | S1-S0 | Descent Rate |
| 2022-008-0027 | 1000 | 0 | 0 | -0.0001 | High, Mod |
|  | 2000 | -0.0004 | 0.00002 | 0.0004 | “ |
| 2022-008-0048 | 1000 | -0.0001 | -0.00002 | -0.0003 | High,VNoisy |
|  | 2000 | -0.0004 | -0.00002 | 0.0001 | “ |
| 2022-008-0067 | 1000 | -0.0002 | -0.00004 | -0.0003 | High, XNoisy |
|  | 2000 | -0.0006 | -0.00002 | 0.0002 | “ |
|  | 3000 | -0.0006 | -0.00003 | 0.0003 | “ |
|  | 4000 | -0.0007 | -0.00003 | 0.0004 | “ |
| 2022-008-0093 | 1000 | -0.0007 | -0.00007 | -0.0003 | High, VNoisy |
|  | 2000 | -0.0007 | -0.00005 | 0 | “ |
|  | 3000 | -0.0007 | -0.00006 | 0 | “ |
|  | 4000 | -0.0007 | -0.00005 | 0.0001 | “ |
| 2022-022-0044 | 500 | -0.0001 | -0.00011 | -0.0012 | High, VNoisy |
|  | 1000 | -0.0005 | -0.00011 | -0.0009 | “ |
| 2022-022-0053 | 500 | -0.0004 | -0.00014 | -0.0012 | High, Noisy |
|  | 1000 | -0.0004 | -0.00012 | -0.0010 | “ |
|  | 1400 | -0.0004 | -0.00011 | -0.0009 | “ |
| 2022-022-0104 | 500 | +0.0001 | -0.00013 | -0.0016 | High, Mod |
|  | 1000 | -0.0001 | -0.00013 | -0.0014 | “ |
|  | 1400 | -0.0002 | -0.00013 | -0.0013 | “ |
|  | 1900 | -0.0004 | -0.00012 | -0.0011 | “ |
| 2022-022-0150 | 500 | -0.0003 | -0.00018 | -0.0016 | High XNoisy |
|  | 1000 | -0.0001 | -0.00012 | -0.0015 | “ |
|  | 1400 | -0.0003 | -0.00014 | -0.0013 | “ |
|  | 1900 | -0.0005 | -0.00013 | -0.0012 | “ |

##### Conversion to IOS Header Format

The IOSSHELL routine was used to convert Sea-Bird 911+ CNV files to IOS Headers.

CLEAN was run to add event numbers and to replace pad values in the pressure channel with interpolated values based on record number.

##### Checking Headers –

* The cross-reference check and header check were run. A few errors were found and corrected:
* 1, 10 & 50 – station name format corrected
* 152 & 170- station name corrected

The same changes were made to the affected SAM & SAMAVG files (events 1 and 10).

* Surface check was run and the average surface value was 2.3db. This is the measure after the 10m soak which is reasonable for the Tully.
* Header Check was run. Fluorescence did not go of scale and there are no negative values. Salinity does occasionally go very low. The bottle file header check shows silicate will need recalibration.
* The lowest pressure recorded during the cruise was -0.8db but was associated with spikes in temperature and conductivity.
* At the end of cast #170 logging was left on accidentally. Pressure was ~+0.1db through that period.
* During cast #55 acquisition was on well after the pumps went off. Transmissivity values were 0 when pressure was between +0.15 and -0.1db.
* Cruise tracks were plotted and added to the end of this report.

The surface pressure appears to be accurate within ±0.2db, so pressure recalibration will not be needed.

The altimeter and water depth readings from the headers of the CLN files were exported to a spreadsheet. A check value was calculated by subtracting water depth from maximum depth sampled plus altimetry header. The value was reduced by 1 to allow for the fact that altimetry is averaged over the bottom 2m so are likely too high by an average of 1m Where that number was > 5m checks were made to see if the log entry differed from the header entry and whether the altimetry signal at the bottom provided a good header value. There were 10 casts that needed investigation. No problems were found in the altimetry headers though they should be considered ±2m. Water depths are sometimes recorded before the cast starts and the ship may move during the cast, so there can be significant differences if the topography is fairly steep. So checks are made against other casts at the same site where possible. In 4 cases the water depth recorded was lower than the maximum depth sampled. For casts #54 and #91 the differences are within 10m so no change was made. Casts for which adjustments were made were:

* Cast 28 had a header depth entry that did not match the log. The log entry produced an acceptable value.
* Cast 42 had a clear typo in the header entry. It was changed to match the log entry.
* Casts 46, 156 and 161 had other activities at the same site. Using log depths for those activities produced good results for 2 and better results for #161.
* Casts 53 and 129 were changed to calculated values (Max Depth Sampled + Altimetry -1m). The differences were 18 and 38m. Checks of the site for event #129 in previous years turned up water depths from 790 to 900m so it is quite possible there was a large change during that cast. However, since the depth at which the CTD reached bottom is probably of most interest to users, the depths for the 2 casts were changed to calculated values.

The same changes were made to SAM and SAMAVG files for 4 of the casts.

##### Shift

Fluorescence

SHIFT was run on the SeaPoint fluorescence channel in all casts using the usual advance of +24 records. Plots show that the fluorescence offset is reasonably close to the temperature offset after this step.

Dissolved Oxygen

The Dissolved Oxygen voltage channel was aligned earlier. A few casts were checked to see if the alignment looked ok, and it did. No further alignment is needed for the DO concentration channel.

Conductivity

Tests were run on a selection of casts to find the alignment shift best for the 2 conductivity sensors as judged by noise in T-S space. The best choice was -0.6 records for the primary and -0.75 records for the secondary channels, although none looked great as there is a lot of small-scale variability.

SHIFT was run twice on all SBE911 casts using -0.6 records for the primary and -0.75 for the secondary. Salinity was recalculated for both channels.

##### DELETE

The following DELETE parameters were used:

Surface Record Removal: Last Press Min

Maximum Surface Pressure (relative): 10.00

Surface Pressure Tolerance: 1.0 Pressure filtered over 15 points

Swells deleted. Warning message if pressure difference of 2.00

Drop rates < 0.30m/s (calculated over 11 points) will be deleted.

Drop rate applies in the range: 10db to 10db less than the maximum pressure

Sample interval = 0.042 seconds. (taken from header)

COMMENTS ON WARNINGS: There were no warnings.

##### Other Comparisons

Experience with these sensors since last factory service –

The pressure, temperature, conductivity and dissolved oxygen sensors were used for only 1 cruise between the last factory service and this cruise. During 2022-008 the salinity channels were both close to bottles. Pressure was adjusted in the configuration file before conversion and no further change was required. Dissolved oxygen was recalibrated by multiplying values by 1.0163; 3 casts were somewhat out of line in the comparison, possibly due to unusually variable vertical gradients due to intrusions. There was insufficient information to apply a time-variable recalibration.

Historic ranges – Profile plots were made with 3-standard deviation climatology ranges of T and S superimposed. Temperature was slightly high in the top 20m of station LD09. Temperature was high and salinity low in the top 10m for most casts in the Strait of Georgia and salinity was a little low even deeper at a few sites in the Strait. None of these excursions suggest a problem with calibration as low salinity near the surface has been noted on other cruises even well offshore.

Post-Cruise Calibration – None available.

Repeat Casts –The only repeat casts were too far apart in time for test of repeatability or were due to problems during the first of the casts.

##### DETAILED EDITING

There is little difference between the channel pairs though there is slightly less noise in the secondary. The primary data were slightly noisier in the COMPARE run. The secondary channels were chosen for the previous use of this CTD and were selected for editing and eventual archival for this cruise.

All DEL files were copied to \*.EDT.

The data were edited using files prepared as part of an AI test of a predictive model that indicates where records may need deletion.

CTDEDIT was used to remove records that appear to be corrupted by shed wakes. Salinity was cleaned to remove spikes that appear to be due to small misalignment or instrumental noise. All files required some editing. Notes about editing applied were added to the files.

After editing, T-S plots were examined for all casts; 3 were opened again in CTDEDIT and further editing was applied to file #24. The other 2 have unstable features that may be real.

##### Corrections to Pressure, Salinity and Dissolved Oxygen Concentration

Pressure and salinity do not need recalibration.

There was salinity <25psu in CTD salinity in the bottle files (MRG) so silicate does need correction in the bottle files.

File 2022-022-recal1.ccf was prepared to apply the following correction to the SBE dissolved oxygen channel:

Casts 1-132:

 CTD DO Corrected = CTD DO \* 1.0164 - 0.0063

Casts 133-231:

CTD DO Corrected = CTD DO \* 1.0202 - 0.0282

This correction was first applied to the SAM and MRGCLN2 files.

COMPARE was rerun for dissolved oxygen and shows that the correction was applied properly. The casts from late in the cruise do not stand out as different from the early section. When outliers are excluded based on residuals, the CTD salinity is higher than bottles by 0.0004mL/L but the standard deviation is 0.027mL/L.

CALIBRATE was then run on the EDT files using the same recalibration file.

CALIBRATE was run on the MRGCOR1 files to correct silicate when salinity < 25psu, with output \*.MRGCOR2.

##### Final Calibration of DO

The initial recalibration of dissolved oxygen corrects for sensor calibration drift. Alignctd corrects for transit time errors. Those 2 steps may partly correct for response time errors, but to see if a further correction is needed, a comparison is made of downcast CTD data to bottle data from the same pressure. Small differences are expected due to ship drift, temporal changes, incomplete flushing of Niskin bottles and delayed response and noise in CTD data.

Downcast files were bin-averaged to 0.5m bins for the casts with DO bottle samples. Those files were then thinned and compared to the bottle values in the MRG files. COMPARE was run to study the differences between the downcast CTD DO data and the titrated samples from upcast bottles.

The CTD DO was lower than the titrated samples by an average of 0.05mL/L but when outliers were removed based on residuals it was low by ~0.002mL/L (standard deviation 0.041mL/L). When the data were divided into the early and late casts, it is clear that there are many more outliers in the early group.

When outliers are removed, the CTD DO was higher than bottles by an average of 0.005mL/L (std dev 0.039) for the early group and low by 0.004mL/L (std dev 0.071) for the later group. Given the noise level this is good agreement. We expect the values to be slightly too high, based on incomplete flushing of bottles and slow response in the DO sensor, but finding an average within ±0.005mL is a good result. There is too much noise in the comparison to suggest further refinement of the recalibration.

A plot of differences versus pressure was then done, excluding outliers as determined in a fit against bottle DO. Based on this an estimate is made of errors in DO in different pressure ranges. This is likely too severe a method given time differences and inexact matches in depths.

Downcast (CTD files) Oxygen:Dissolved:SBE data for this cruise are considered, very roughly, to be:

 ±0.60 mL/L from 0-100db except in areas of very large DO gradients

 ±0.20 mL/L from 100db-500db

 ±0.04 mL/L below 500db

For more detail see file 2022-022-dox-comp3.xls.

##### Fluorescence Processing

There were no off-scale fluorescence values.

A median filter, size 11, was applied to the fluorescence channel in the COR1 files. Plots of a few casts showed that the filter was effective. (Output:\*.FIL)

##### BIN AVERAGE of CTD files

The following Bin Average values were applied to the FIL files (output AVG):

Bin channel = pressure Averaging interval = 1.000 Minimum bin value = .000

Average value will be used. Interpolated values are NOT used for empty bins.

On-screen T-S plots were examined.

Profile plots were examined. No problems were noted.

##### Final CTD File Steps (REMOVE and HEADEDIT)

For all casts REMOVE was run to remove the following channels:

Scan\_Number, Temperature:Primary, Conductivity:Primary, Oxygen:Voltage:SBE, Descent\_Rate, Status:Pump, Altimeter, Salinity:T0:C0, Prediction Flag and Flag.

A second SBE DO channel (with umol/kg units) was added.

REORDER was run to get the two DO channels together.

HEADER EDIT was used to fix formats and channel names and to add comments about processing.

The Standards Check routine was run and no problems were found.

PAR was removed from casts #50 and #53 since it was not mounted for those casts.

The Header Check was run; no problems were found.

Profile and T-S plots were examined. A few small unstable features were found on the CS line and in the Strait of Georgia, but those are likely real. No other problems were found.

The sensor history was updated.

##### Dissolved Oxygen Study

As a final check of dissolved oxygen data, % saturation was calculated and plotted. Values at 2 to 3m ranged between ~40% to 145%. As usual the Haro Strait and Juan de Fuca Strait values were very low. Casts with well-mixed surface waters were generally in the 103%-110% range. Values seemed high at some deep offshore casts, but the near-surface gradients were high, transmissivity was relatively low and fluorescence fairly high. Given such conditions, the values are reasonable and do not suggest a DO calibration problem.

##### Final Bottle Files

SORT was run to arrange casts in pressure order.

For all casts REMOVE was run to remove the following channels:

Scan\_Number, Temperature:Secondary, Conductivity:Secondary, Oxygen:Voltage:SBE, Descent\_Rate, Status:Pump, Altimeter, Salinity:T1:C1 and Flag.

A second SBE DO channel with mass units was added for both the CTD DO and titrated DO and REORDER was run to get the pairs of DO channels together.

EDIT HEADERS was run to fix formats and channel names and to add comments about analyses and CTD processing.

Data were exported from the CHE files to file 2022-022-bottles-final.xlsx. A few random checks were made by comparing with the rosette log sheets and no problems were found.

PAR was removed from cast #53 since it was not mounted for that cast.

Standards check and a header check were run. No problems were found.

The track plot looks ok.

Plots of each file were examined and no problems were found.

A cross-reference listing and header check were produced for the CHE files.

##### Thermosalinograph Data

An IOS TSG45 was used for this cruise and data were saved in 1 file, CR6Series\_Data.dat, which also contained data from the previous cruise.

Formatting problems include having the Date and Time columns combined and NAN entries.

The NAN entries were replaced with pad values.

All data were removed until August 26th when flow started again for this cruise.

The spreadsheets were adjusted as follows:

* 2 lines of headers were added – channel names and units.
* Some initial records were removed as there was no flow.
* A column with pressure was added with all values set to 4.5 (to enable derivation of salinity).
* A temperature difference column was added (Lab-Intake).
* The fluorescence channel is in volts. It was moved to column M. Then a concentration value was calculated in column F using scale 14.6 as determined in the most recent factory recalibration of the fluorometer. The clean water offset value was 0.081. For previous uses of this equipment it was sometimes found necessary to adjust the offset to obtain reasonable values. A quick comparison was made between the fluorescence values in the TSG file and CTD values around 4.5m from a few casts in variable environments. The CTD values were reasonably close to those of the CTD given different deployment methods and suggests that the TSG fluorescence parameters are appropriate, though recalibration is possible later in processing. The offset was also found appropriate for the previous cruise.
* Time and date were separated by copying the combined entry to separate columns and re-formatting.
* The file break column was filled with date info so that a new file would be created at the beginning of each day. After conversion the format was 2022-022-20220826. (Cruise # plus date for the file.)

The files were then converted to IOS Header format with header info added. There are 10 IOS files, each covering all or part of 1 day.

CLEAN was run to reset the number of records, min and max values, set the start and end times, and latitude and longitude limits.

ADD TIME CHANNEL was used to add Julian dates – i.e. Decimal Year. A record number was also added to enable averaging (for use in comparison to CTD files). Time zero was set to 31 December 2021 0:00:00. (Note that this step leads to problems plotting until REORDER is run.)

DERIVED QUANTITIES was run twice, first to derive salinity using the lab temperature and again to derive sigma-T.

REORDER was run to move the Julian date to after the Time/Date channels and to put salinity and fluorescence after the lab temperature. Also the record # was moved to the end.

a.) Plots

A track plot was produced and added to the end of this report.

Time-series plots were produced. Salinity has few spikes. A few problems were noted:

* The intake flow rate is noisier than usual.
* The fluorometer flow rate was very steady other than a few very brief spikes unlikely to affect data.
* Temperature differences are very noisy but there is a lot of variability in temperature so this is expected.
* Salinity dropped to near-zero for a few minutes on Aug. 30 about 11:40 and flow stopped - will need editing.
* There was a drop in temperature and rise in salinity on August 31st around 16:00. The data look ok and examination of CTD data show a large temperature difference in successive CTD casts. real. So this is likely ok.
* A similar change around 14:00 on Sept. 1st is likely ok – the temperature during the drop agrees with a CTD, though the temperature after it went up again couldn’t be checked.

All \*.reo files were copied to \*.edt.

b.) Checking Time Channel

The CTD files were thinned to reduce the files to a single point from the downcast at or within 0.5db of 4.5db. These were exported to a spreadsheet which was saved as 2022-022-tsg-ctd-loop-rosette-comp.xlsx. All CTD casts overlapped with TSG records. There are 90 points of comparison.

For comparison with CTD data, the TSG files were averaged over 6 records (30s) on record number to reduce the noise and file size. Standard deviations were included. Then required records (times, positions, temperatures with standard dev, salinity with standard dev, fluorescence with standard dev, flow rate) were exported to a spreadsheet and that file was thinned to the closest times of CTDs and added to file 2022-022-tsg-ctd-loop-rosette-comp.xlsx.. The same file was thinned to the closest times to loop files and added to the TSG-Loop comparison. There were 7 loop samples that overlapped with TSG records.

A comparison was made of positions for the CTD and TSG data to check for good matches. The differences in positions are expected to be small despite the averaging because the ship was stopped at these times. The median differences were 0.0000º for both latitude and longitude. There were no differences> 0.0012º. So the matches are good.

c.) Comparisons

Comparison of T, S and Fluorescence from TSG and CTD data

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Lat Diff** | **Long Diff** | **TsgTint-CtdT** | **TsgTlab-CtdT** | **TSG SAL-CTD SAL** | **TSG FL /CTD FL** |
| **min** | -0.0012 | -0.0012 | -2.8537 | -1.1728 | -1.5746 | 0.22 |
| **max** | 0.0007 | 0.0018 | 0.9483 | 1.3235 | 0.1201 | 1.23 |
| **average** | -0.0001 | 0.0000 | -0.0554 | 0.3828 | -0.0672 | 0.67 |
| **median** | 0.0000 | 0.0000 | 0.0218 | 0.3585 | -0.0368 | 0.68 |
| **std dev** | 0.0004 | 0.0005 | 0.4153 | 0.2752 | 0.1911 | 0.17 |

The initial comparison between TSG and CTD data using all casts confirmed the problem noted in the time-series plots; the TSG intake temperature had some very large differences from lab temperatures. The average difference and standard deviation are larger than usual. Natural scatter due to near-surface variability and slight differences in time and depth of the TSG and CTD measurement likely account for most outliers.

The plots below show the differences between TSG and CTD temperature and salinity. There are outliers in salinity in Juan de Fuca and the Strait of Georgia, but the west coast casts show little scatter. There are more outliers in temperature differences. CTD profiles were examined and the gradients in this area do look fairly high for temperature, less so for salinity.



While some of the outliers are associated with large standard deviations in TSG intake temperature over the 30s used in the average, some of them occur at very low standard deviation. When the data used are restricted to cases where (TSG Intake Temp - CTD Temp)<0.2°, the results are:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | TSG Tint Temp-CTD Temp | TSG Tlab-CTD Temp | TSG SAL-CTD SAL | TSG FL /CTD FL |
| min | -0.1307 | -0.0359 | -1.5746 | 0.22 |
| max | 0.1923 | 1.3153 | 0.1201 | 1.23 |
| average | 0.0161 | 0.3525 | -0.0635 | 0.67 |
| median | 0.0123 | 0.3089 | -0.0358 | 0.68 |
| std dev | 0.0589 | 0.2497 | 0.1990 | 0.17 |

There is a lot of scatter in in the differences between the lab temperature and CTD temperature and some of those outliers are in the area where the most problems in intake temperature are seen. However, the median differences look reasonable with or without the outliers identified from the intake temperature.

* TSG intake temperature is high by a median of 0.012C° when outliers are removed. This is higher than usually found but not unreasonable.
* TSG lab temperature is higher than the intake temperature by a median of 0.34C° using the full set of casts, or 0.30C° using the reduced set. Heating in the loop by that amount is reasonable for this time of year. A plot of heating versus CTD temperature shows the usual pattern of heating by about 0.31C° when intake temperature is ~12°C and by about 0.11C° when the intake temperature is ~20°C. There were many outliers but the most extreme were from the Strait of Georgia where the near-surface temperature gradients were extremely high. A very slight difference in the level of the CTD measurement and the intake for the CTD would easily account for those outliers.
* Salinity is low by about 0.0368psu or 0.358psu using the full or reduced data sets, and the standard deviation is slightly higher with the reduced set. The difference is a little higher than found during 2022-008 which might suggest calibration drift, but more likely it is due to higher vertical salinity gradients. The low values are likely due primarily to bubbles in the loop water.
* TSG fluorescence is about 68% of the CTD fluorescence overall with either data set, but is somewhat higher at the lower end of the fluorescence scale.

Comparisons of Loop samples and TSG data

* There were 7 loop Salinity and Chlorophyll samples taken while underway. The loops were compared with TSG data. TSG fluorescence is usually higher than loop samples when CHL is low, but in this case there were only 2 very low CHL values and one had been flagged by the analyst. For the 2 high CHL samples (>7ug/L) the TSG was about 60% of CHL, a typical value seen in comparisons of this type of fluorometer.
* The TSG salinity was lower than the loop samples by a median of 0.0353psu but higher by an average of +0.0363 due to 2 major outliers, one of which had a very high standard deviation in TSG salinity. When those were excluded the TSG salinity was low by an average of 0.0370psu and a median of 0.0365psu. These differences are higher than during the previous cruise but surface gradients are likely higher and/or there may have been more bubbles in the loop.

No comparison was possible between loops and rosette samples as all loops were taken underway.

d.) Calibration History

The TSG was serviced and recalibrated shortly before cruise 2022-022; only the 2nd dissolved oxygen sensor and fluorometer has any history available.

* During 2021-001 the TSG fluorescence values were about 32% of fluorescence from the CTD and 74% of the loop CHL samples and loop chlorophyll was about 75% of that from the rosette.
* During 2021-006 the TSG fluorescence values were about 50% higher than those from the CTD and higher than loop CHL samples by 50 to 300%. For the cases where the CHL was in the range 0.49 to 5.0ug/L, the TSG fluorescence was higher than loop samples by 8%, but the loop chlorophyll values were lower than rosette samples.
* During 2021-005 TSG fluorescence values were close to those from the CTD and higher than rosette CHL samples for low CHL and about 50% of CHL when CHL>4ug/L.
* During 2021-069 TSG fluorescence values were reasonably close to those from the CTD fluorometer and about 50% of rosette CHL samples when CHL>4ug/L.
* During 2021-008 the TSG fluorescence values were about 1.4 times those from the CTD and higher than loop CHL samples by a median of 3.5, For the cases where the CHL was <0.5ug/L, the TSG fluorescence was higher than loop samples by a median factor of 3.5 but for the few values between 1 and 2ug/L the TSG fluorescence is close to the CHL values.
* During 2022-008 the TSG fluorescence was higher than Extracted CHL by up to a factor of 2.5 for the samples with CHL < 0.4ug/L. It dropped sharply as CHL increased. It was close to CHL for CHL=0.7ug/L and about 20% of CHL for CHL=11.6ug/L. The TSG salinity was lower than the loop samples by a median of 0.021psu (std dev 0.024psu).

e.) Conclusions re TSG

1. The TSG clock worked well and position information is reliable.

2. Both flow rates were in a good range, though the loop flow varied a little more than usual.

3. The TSG salinity was lower than loops by an median of 0.0365psu excluding 2 outliers. It was lower than CTD salinity by 0.368psu or 0.358psu depending on whether the full or reduced data set was used. This is a larger difference than in the previous cruise, but the agreement between the comparisons with CTD and loops is good. There may be some calibration drift but it is also possible that there were more bubbles present in loop water.

4. There was no evidence of the severe problems noted during 2022-008 with the intake thermistor reading much too high for a few hours. The differences between the TSG temperature and that from the CTD look very noisy at times. There is some overlap between where that comparison looks bad and where the lab temperature also looks a little out of line. This does not appear to be due to the intake thermistor malfunctioning as it did during a previous cruise. It may just be due to local temporal and vertical variability leading to noisy comparisons. Temperature gradients were notably high near the surface so that slight mismatches in level and time could be significant. While the data are pretty noisy and there were problems with the sensor on the previous cruise, the intake temperature is likely ok.

5. TSG fluorescence was lower than loop CHL for all but 1 sample. Fluorescence is lower than usual for low CHL. For the 2 samples with CHL>7ug/L fluorescence is 50-60% of CHL values which is typical of this type of fluorometer. It was also lower than CTD fluorescence. During the previous cruise it was higher than the CTD fluorometer but that difference may be due to there being much higher CHL in the LaPerouse area.

6. The TSG lab temperature read higher than the TSG intake temperature by a median of 0.3585C° degrees with a standard deviation of 0.3352C° using all the data. If only the data from casts with intake temperature data that look reliable are included, the median difference is 0.3089C° but the standard deviation is still high at 0.2497C°. This may be partly due to the fact that the heating in the loop is proportional to intake temperature and that varied greatly through this cruise.

f.) Editing

Editing was applied to the following file:

20220830 – Removed points from the Temperature:Lab, fluorescence and salinity channels between ~11:43 and ~11:46 pm on August 30th. Flow stopped during that period.

g.) Calibrate & Remove

REMOVE was run to remove channels Pressure, Temperature:Difference and record #.

Calibrate was run to add 0.036psu to channels Salinity.

h) Preparing Final Files

HEADER EDIT was used to change the DATA DESCRIPTION to THERMOSALINOGRAPH and add the depth of sampling to the header and to change channel names to standard names and formats and to add comments.

The TSG sensor history was updated.

As a final check plots were made of the cruise track and time-series and all looks fine.

A cross-reference list was prepared:



P**articulars - Notes from Daily Science Log and Rosette Logs**

PAR off: 50, 53

Casts with bottle fired out of order: 44, 193

Loops: 49, 99, 120, 143, 148, 203, 206

Casts with bottles fired but not sampled: 108, 132

No split casts.

Deployment schemes:

The rosette was brought to the surface. Pumps were turned ON. The rosette was brought down to 10m and kept there for 30 seconds. Once back at the surface, the data started to be archived, with the rosette at the surface for 30 seconds longer. Then the cast would start.

For ALL rosette casts:

Niskin bottles closed from 0 to 400 dbar (both included) had a wait time of 60 seconds.

 All Niskin bottles deeper than 400 dbar had a wait time of 30 seconds.

TSG notes

Loop samples taken.

CTD notes

1. All bottles fired as a test – only Niskin 1 sampled.

6. High current.

10. Cleaning product used on LARS brake, potential contaminant LB01 and LB02.

12. Large difference between 2 salinity channels at times during cast (ex 25-50db) and high variability at surface. Water appears brown-green at surface.

13. Conductivity difference looks good.

44. Bottle 20 replaces bottle 3

45. Delay in recording END lat/long/time.

55. Spigot stiff Niskin 7; leak top valve not seated Niskin 19.

61. Spigot stiff Niskin 7

90. Stopped just north of Stn due to fishing vessels close to LD08.

95. No sal or nuts for sample 293 – ran out of water.

108. Bottle fired accidentally – no sampling – no bottle file needed.

111. Rosette came out of water before going down.

119. Went back down 10m after 30m stop instead of up.

132. All bottles fired accidentally – repeated cast as #133

144. Stop at 60db down to straighten wire.

170. Logging left on.

204. RBR off for this cast only.

After 213. Loop pump shut down due to plumbing leak.

223. Added sample 9572.

**2022-022**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CTD#** | **Make** | **Model** | **Serial#** | **Used with Rosette?** | **CTD Calibration Sheet Competed?** |
| **1** | **SEABIRD** | **911+** | **0443** | **Yes** | **Yes** |
| **Calibration Information - 0443** |
| **Sensor** | **Pre-Cruise** | **Post Cruise** |
| **Name** | **S/N** | **Date** | **Location** | **Date** | **Location** |
| **Temperature** | **4700** | **5Jan2022** | **Factory** |  |  |
| **Conductivity** | **3531** | **8 Feb2022** | **Factory** |  |  |
| **Secondary Temp.** | **4888** | **14Jan2022** | **Factory** |  |  |
| **Secondary Cond.** | **4513** | **8 Feb2022** | **Factory** |  |  |
| **Transmissometer** | **1185DR** | **28Apr2021** | **Factory** |  |  |
| **Transmissometer** | **1883DG** | **28Apr2021** | **Factory** |  |  |
| **SBE 43 DO sensor** | **3791** | **18Mar2022** | **Factory** |  |  |
| **PAR sensor** | **70613** | **24Feb2021** | **Factory** |  |  |
| **SeaPoint Fluor.** | **3641** |  |  |  |  |
| **Pressure Sensor** | **0443** | **23Mar2022** | **Factory** |  |  |
| **Valeport Altimeter** | **76341** | **10Feb2021** | **Factory** |  |  |

**CRUISE SUMMARY – CTD**

# TSG Make/Model/Serial#: SEABIRD/45/0620

|  |
| --- |
| **Calibration Information** |
| **Sensor** | **Pre-Cruise** | **Post Cruise** |
| **Name** | **S/N** | **Date** | **Location** | **Date** | **Location** |
| **Temperature** | **0620** | **12Jan22** | **Factory** |  |  |
| **Conductivity** | **0620** | **12Jan22** | **Factory** |  |  |
| **Wetlabs WETStar Fluor.**For depths deeper than, and including, 125 dbar, we would wait 30 seconds before closing a bottle. For depths shallower than, and including, 100 dbar, we would wait 60 seconds before closing a bottle.  | **1656** | **12Mar2021** | **Factory** |  |  |

 

