## REVISION NOTICE TABLE

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| DATE | DESCRIPTION OF REVISION |
| **15 Nov. 2024** | Sorted to BOT files in pressure order. G.G. |
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## PROCESSING NOTES

Cruise: 2024-043

Agency: IOS, Ocean Sciences Division, Sidney BC

Chief Scientist: Young K. Platform: Richardson Point

Location: Strait of Georgia Project: Strait of Georgia Plankton

Date: 25 March 2024 –29 March 2024

Processed by: Germaine Gatien

Date of Processing: 5 November 2024 – 12 November 2024

Number of original xml files: 14

Number of CTD files: 12 Number of BOT files: 7

##### INSTRUMENT SUMMARY

A SeaBird Model SBE-25 CTD (s/n 1255) was used with temperature sensor #6448, conductivity sensor #6147, Wetlabs ECO Fluorometer #8046, dissolved oxygen sensor #4378, PAR/Logarithmic Satlantic sensor #2274 and pressure sensor #1255. A 1.7 L Niskin bottle was attached approximately 1m above the CTD for deep sampling at 5 sites. The sampling rate was 16Hz.

# SUMMARY OF QUALITY AND CONCERNS

There was a digital Daily Science Log with positions and notes about sampling and a digital sampling log. Header information was entered in the raw files in a format that enabled easy conversion into IOS Header format.

CTD casts were run at 12 sites. There were 2 sites which also had a separate CTD cast to enable Chito sampling. The Chito casts were not prepared for the archive due to frequent stops during downcasts, but calibration samples taken during those casts are included in the bottle files for those sites. There was a regular CTD cast at each of the Chito sites.

While all activities were given separate event numbers in the log, the files prepared for the archive will contain only 1 BOT file per site with the event number matching the associated regular CTD cast.

There was a soak at 10m followed by a return to the surface before the full cast was run. Stops at the surface mostly lasted 30s or more as recommended, though a few were a little shorter.

There were 5 salinity calibration samples taken during this cruise, of which only 2 were from below 5m. Four samples differed from the CTD salinity by 0.005psu or less. The only outlier was from a cast with a a very high vertical salinity gradient at 5m. Salinity is likely good to +/-0.005psu.

Extracted chlorophyll samples were gathered at 6 sites, mainly at the surface using a bucket; 1 sample

came from a Niskin bottle at 5m. The CTD fluorescence data looked somewhat lower than usual compared to CHL, but the surface fluorescence data are not very reliable having spikes as the sensor equilibrates.

# PROCESSING SUMMARY

##### 1. Seasave

This step was completed at sea.

##### 2. Preliminary Steps

A digital daily log was obtained as well as a sampling log.

The cruise summary sheet was completed.

For most casts the CTD was taken down to 10m for a soak which lasted for at least 2 minutes. The CTD was then brought back to the surface and then the full cast was run.

There was no 10m soak for the Chito casts (19 and 24); these casts had stops during the downcast to enable addition of Niskin bottles at a variety of depths. There was also a regular CTD cast at each of those sites. The Chito casts are not suitable for archiving given stops during downcasts, but samples gathered at 5m and the bottom were included in the bottle files for the sites.

The waits at the surface after 10m soaks were mostly 30s or longer, but a few were shorter. The 30s is recommended so that waters can settle that may be disturbed by raising the CTD to the surface.

There was an error in the Sampling Log sheet for the chito cast at station 42. The event number should be 19, not 15.

##### 3. Conversion of Raw Data

The configuration file used at sea was correct. It was saved as 2024-043-ctd.xmlcon and used to convert all HEX files.

Plots were made of a few casts and all expected channels have data that looks reasonable.

The only large spikes seen were at the tops of casts. There was a small spike in cast #4 conductivity.

There was some confusion in naming CTD files from events 15 and 19. The log indicates that chito sampling was done during event #15 but the CTD file for event #19 clearly was a chito cast and #15 was not. It is assumed that the naming of the CTD casts is wrong and the sampling logs are correct.

Fluorescence dark value is ~0.035ug/L with no values <0. This is the same value found in 2023.

There are some steps in the pressure profiles with very slight reversals on the order of 0.01db.

The PAR values look reasonable.

Salinity and Descent rate derivations were left until step 8.

##### 4. WILDEDIT

WILDEDIT was run and greatly reduced the largest conductivity spikes. It reduced the cast #4 conductivity spike significantly.

##### 5. FILTER

Program FILTER was run to apply a low-pass filter with a time constant of 1s to pressure and depth.

This removed reversals.

Next the temperature and conductivity were examined and the usual approach of applying a cosine filter, size 16, in routine WFILTER did a good job of removing small reversals.

##### 6. ALIGNCTD

In the past it has generally been found best to run ALIGNCTD to advance the DO channel by 2.5s. Comparisons of DO and temperature traces before and after this step were hard to interpret due to much fine-scale variability, but overall the setting of 2.5s appears to have worked well. In particular, it brought some downcast features into better alignment with temperature features. This can be checked again after the 10db soak data are removed.

ALIGNCTD was run on all casts using an advance of 2.5s.

##### 7. CELLTM

CELLTM was run on all casts using the SeaBird recommended parameters, (α, 1/β) = (0.04, 8).

This correction worked as expected, lowering salinity where temperature is decreasing (cell warms water raising conductivity but temperature sensor reading is correct, so salinity is overestimated). Conversely, it raises salinity where temperature is increasing (conductivity too low).

##### 8. DERIVE

Program DERIVE was run to calculate salinity and dissolved oxygen concentration (tau correction included) and descent rate.

At this point the 2 CHITO files were renamed with a leading 9 in the event number to make them easier to keep separate in IOS SHELL routines.

##### 9. Conversion to IOS Headers

The IOSSHELL routine was used to convert the CNV files to IOS Headers.

Times in the files match the log times.

Plots were examined to see if there are any cases of fluorescence <0; the only cases found were at the very beginning of casts before the soak period.

CLEAN was run to replace pad values in the pressure channel with interpolated values..

##### 10. Checking Headers

Cross-reference listing was run and times were checked against the log. All were within 1 minute of the log start times.

Header Check was run and there are many negative values since the soak data have not been removed.

Track plots looked good and were added to the end of this report.

Surface Check was run on the IOS files to find the average pressure when data acquisition began; the average was +0.25db with a range of +0.19 to +0.31db. Files were reversed and Surface Check was run again and the average was +0.27 with a range of 0.20-0.31db. Examination of plots from the upcast indicate fluorescence dropping to 0 at between 0.3db and 0.4db. These results are in rough agreement with those from 2023-023.

##### 11. CLIP

The next step is to remove the data collected during soaks at 10m. Plots were examined to see how many records should be removed from each cast. File clip.csv was prepared with 2 columns containing event # and # of records to removed. CLIP was run and output plots examined; adjustments were made to the clip file until all plots looked appropriate.

##### 12. SHIFT

Conductivity

Tests were run to see what shift to conductivity made the best improvement to stability in T-S space. A shift of +2.0 records was applied to all casts.

Fluorescence

The fluorometer was not pumped, so a shift in alignment is expected to be small or unnecessary. Profile plots of temperature and fluorescence were examined and the alignment appears to be good though the range of fluorescence was mostly small, so judging this is difficult. Shift was not run on fluorescence.

Dissolved Oxygen

This channel was aligned earlier, but checks were made by examining plots of temperature and dissolved oxygen. No further adjustment was made.

##### 13. DELETE

DELETE was run on all casts using the following parameters:

Surface Record Removal: Last Press Min. Surface Swell Pressure Tolerance: 1.0

Swells deleted. Warning message if pressure difference of 2.00

Drop rates < 0.3m/s (calculated over 9 points) was deleted from 10db to 10db above the maximum pressure.

Pressure was not filtered since it was filtered earlier.

COMMENTS ON WARNINGS: There were no warnings.

##### 14. DETAILED EDITING

All DEL files were copied to \*.EDT so there will be a complete set of files even if some need no editing.

CTDEDIT was used to edit 10 files, mostly removal of a few records near the top and/or bottom. A few casts required some editing of salinity.

No editing was applied to files from events #15 and 29.

Heavy editing was needed for event #22 which was run in bad weather with very noisy descent rate in the top 25db including some complete reversals of the CTD during the downcast.

Other files were edited lightly.

Notes of editing details were made in the headers.

T-S plots were examined after this step. Some small unstable features remain in areas where instability is expected.

##### 15. Initial Bottle Data Steps

There was no rosette available for this cruise.

There was salinity, chlorophyll and nutrient sampling at 7 sites.

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 2024-043-bot-hdr.txt which will be updated as needed during processing.

BOT files were prepared with the sample data plus CTD gathered at the same sites.

There was a regular CTD cast at each site.

There was a second cast at 2 sites (Stations 42 and GEO1) for chito sampling ( Events #19 and #24).

For casts #19 and 24 multiple rosette bottles were attached and all fired when the CTD was at the bottom.

Most of the bottles at those 2 casts were for chito sampling only, so are not included in the bottle files.

Surface samples were gathered from a bucket during the soak period of the regular CTD casts.

Samples at 5m and 1m above bottom of the casts were gathered during chito casts.

File 2024-043-bottles\_plus\_CTD\_6linehdr csv was created and a 6-line header was added based on such files from previous cruises from this program. Analysis data from the QF worksheets were added. Space was included for the addition of CTD data.

The next step was to select CTD data from as close to the depth of sampling as possible during the cast when they were gathered – regular or chito.

Details of sampling at the sites with 2 CTD casts: At 2 of the sites there were separate CTD and Chito casts. Bottle files will be given the event # associated with the regular CTD casts.

* For station 42 - Bottle file will have event #15:
* The surface bucket samples, #11, were taken during the soak period for the regular CTD cast, #15; it was recorded in the log as event #16.
* The 5m samples and bottom sample, #10 and #5, were taken during a chito cast, event #19 when the CTD was stopped.
* For station GEO1 – Bottle file will have event #22:
* The surface bucket samples (#20) were taken during the soak period for the regular CTD cast, #22.
* The 5m samples (#19) and deep samples (#13) were taken during Chito cast #24.

The CLIP files were bin-averaged in 0.5db bins.

THIN was run on the binned files using a list of pressures needed: several levels 0.5-1.5db and 4.5-5.5db and, for the Chito casts only, the maximum pressure sampled for each deep cast – 1db. A range of depths around the estimated depth were included and checked to see if values looked reasonable. CTD Data are generally not reliable right at the surface, so slightly deeper data were selected than were likely collected by backet. The data selected were added to file 2024-043-bottles\_plus\_CTD-6linehdr.csv.

There was a 1 minute wait before closing the bottles for event #19 but the CTD gradually moved deeper by a few metres during that time. The stop at the bottom lasted only a few seconds for event #24, so the Niskins may contain water from higher in the water column..

The spreadsheet was then converted to separate files in IOS Header format.

Workbook 2024-043-bottle-CTD-comp.xlsx was prepared (using data from the 6-line header file) to do a comparison of CTD and bottle data for salinity and fluorescence.

##### 16. Compare

Salinity Comparison

There were 5 bottle samples, 1 from 1m, 2 from 5m and 2 near the bottom.

The only salinity sample taken right at the surface was during event #22 at station GEO1. The CTD salinity read lower than the bottle sample by 0.0023psu; the bucket sample came from shallower water, so some (or perhaps all) of the difference is likely due to local vertical salinity gradient.

The 2 samples from 5m both show the CTD to be reading lower than bottles, for station 42 by 0.5619psu and for station GEO1 by 0.0018psu. The first case is in a high salinity gradient. The second is also questionable because there was a short wait after the stop before firing and the CTD salinity was noisy.

The most reliable of those samples was from 1m above the bottom during cast #24. There was a long wait while the CTD was at the bottom, but it did sink gradually through the stop. The vertical gradient was fairly low so we might expect the CTD to read slightly higher than the bottle sample, but it actually reads lower by about 0.005psu.

The other deep bottle was fired after a very short wait but the local gradient was low. So once again we might expect the CTD to look high and in this cast it did read high by about 0.004psu.

Given the rough nature of the comparison it is encouraging that the CTD reads is within 0.005psu of the bottles in 4 out of 5 cases..

Fluorescence

The only extracted chlorophyll sampling was at the surface or 5m.

Fluorescence values were an average of 38% of CHL values. That is lower than usually seen especially at the low end of the CHL range. However, most samples come from higher in the water column that are available in the CTD files. Since this fluorometer is not pumped values close to the surface were checked and a few values looked a little higher at 1db than after a 10m soak and at the end of the casts, but the differences were not terribly large.

The fluorometer is new and has only been used for one other cruise in 2023. During that cruise the fluorometer had higher FL/CHL ratios but the range of CHL was much lower.

See 2024-043-bottle-CTD\_comp.xlsx for more detail.

##### 17. Other calibration checks

Sensor History – All sensors were used during 2023-023 in July 2023. The pressure sensor had surface values from 0 to +0.4db. Salinity was high by a median of 0.003psu based on 5 bottles from roughly 300db. There was no dissolved oxygen sampling. The fluorometer may have read low, but with only surface sampling this was not clear.

Historic Ranges – All temperature and salinity within the historic ranges.

Post-cruise calibrations – None were available.

##### 18 CALIBRATE

No calibration was applied. Surface pressure is within expectations. The salinity bottle comparison is very limited, but suggests there is no significant error in calibration.

##### 19. Fluorescence Filter

The fluorescence data did not require filtering.

**20. Bin Average, Remove, Derive DO in mass units, Reorder**

The files were bin averaged using 1db bins.

REMOVE was run to remove Scan\_Number, Oxygen:Voltage, Descent Rate and Flag channels.

Dissolved Oxygen was derived in mass units and that was used to calculate DO saturation. Oxygen:Dissolved:SBE values cannot be confirmed as there was no calibration sampling

for dissolved oxygen.

Surface saturation values were between 85% and 155% with all values that were below 100% coming from areas likely to have strong vertical mixing. The highest values came from stations 41 and 42 and fairly high values were found for stations 38 and 46.

REORDER was used to get the 2 dissolved oxygen channels together.

##### 21. HEADER EDIT and final checks of CTD files.

Header Edit was used to fix headers, fix formats and to add comments about processing.

A cross-reference listing was produced.

A header check and standards check were run on the CTD files and no errors were found.

Details of sensor history were forwarded to J. Bedard as follows:

*CTD 1255*

*Pressure high by about 0.25db.*

*Conductivity 6147 (Temp 6448) – few samples but salinity appears to be good to 0.005psu.*

*Oxygen Dissolved: No dissolved oxygen sampling.*

*Fluorometer: ECO 8046 – only surface CHL sampling. CTD FL/CHL little lower than usual but samples from bucket near surface and CTD FL data from a little deeper.*

Plots of CTD casts were examined and no problems were found.

##### 2. Final BOT file preparation

Workbook 2024-043-bottles\_plus\_CTD\_6linehdr. csv was converted to IOS Header files. (\*.ios)

Change units was run on the thinned files to get dissolved oxygen in mass units.

REORDER was run to get the 2 DO channels together.

The time and date are present as channels as these cannot be converted directly into header entries.

CLEAN was run to add START and END time to the headers. The END TIME is identical so the START time so it will be removed later.

CLEAN was also used to enter 0 flags where the flag channels are empty.

There are salinity values <25, so silicate values require correction.

CALIBRATE was run using file 2024-043-recal-SIL.ccf.

No other recalibration was applied as salinity and pressure look reasonably accurate.

Change Units was run to add mass units to channel Oxygen:Dissolved:SBE.

There was no DO calibration sampling so a second run of Change Units was not needed.

REORDER was run to get the 2 DO channels are together.

REMOVE was run to remove Date and Time channels.

Header Edit was run to add comments and to remove END TIME since it is the same as START TIME and TIME ZERO.

The final files have extensions BOT.

The standards check was run and no errors were found.

A cross-reference list and header check were run on the BOT files and no problems were found.

Plots were made of all BOT casts. With just 1 or 2 levels these were not very useful.

Finally all data from BOT files were extracted to a spreadsheet and compared to the event log; no problems were found.

PARTICULARS – notes from log

1 & 2. No data obtained. “No blue light at end”. Event 4 at same site.

4. Replaced batteries. Bottle on wire and surface sample taken during CTD soak.

9. Longer soak for CTD (~3min); surface sample during CTD soak.

12. Bottle fired during soak; soak >2 min.

20. High wire-angle during cast (30-40deg)

22. Bad weather. Cast run end of data; surface bottle only.

24. 4 1L bottles filled for FLC study.

28. Bottle fired during CTD soak.

**CRUISE SUMMARY**

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| Cruise ID#: 2024-043 |
| Dates: Start: 25 March 2024 End: 29 March 2024 |
| Location: Strait of Georgia Plankton |
| Chief Scientist: Young K. |
| **CTD#** | **Make** | **Model** | **Serial#** | **Used with Rosette?** | **CTD Calibration Sheet Competed?** |
| 1 | SEABIRD | 25+ | 1255 | No | Yes |

**CTD CALIBRATION INFORMATION**

**Make/Model/Serial#: SEABIRD/SBE25/0456 Cruise ID#: 2024-043**

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| **Calibration Information** |
| **Sensor** | **Pre-Cruise** | **Post Cruise** |
| **Name** | **S/N** | **Date** | **Location** | **Date** | **Location** |
| **Temperature** | **6448** | **4Feb2023** | **Factory** |  |  |
| **Conductivity** | **6147** | **18Jan2023** | **Factory** |  |  |
| **ECO Fluorometer** | **8046** | **21Apr2023** | **Factory** |  |  |
| **SBE43 Oxygen** | **4378** | **28Mar2023** | **Factory** |  |  |
| **PAR/Satlantic** | **2274** | **25Jan2023** | **Factory** |  |  |
| **Pressure****D:\Te****lewo****rk\2022-0** **28\Process****ing\ios\** | **1255** | **13Feb2023** | **Factory** |  |  |

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