## REVISION NOTICE TABLE

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| DATE | DESCRIPTION OF REVISION |
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## PROCESSING NOTES

Cruise: 2024-031

Agency: IOS, Ocean Sciences Division, Sidney BC

Chief Scientist: Young K. Platform: Neocaligus

Location: Strait of Georgia Project: Strait of Georgia Plankton

Date: 16 July 2024 – 20 July 2024

Processed by: Germaine Gatien

Date of Processing: 21 November 2024 – 26 November 2024

Number of original xml files: 31 (including 3 chito casts)

Number of CTD files: 28 Number of BOT files: 15

##### 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.

Regular CTD casts were run at 28 sites. At 15 sites surface samples were collected in a bucket while the

CTD was soaking at 10m. At 3 of the sites there was a special cast for chito sampling during which a CTD was mounted on the wire. The Chito casts had frequent stops during downcasts in order to mount bottles, so they were not suitable for archiving.

Searchable bottle files were created by combining CTD data with chemistry (salinity, extracted chlorophyll and nutrients). Data from the regular casts were extracted to accompany the surface samples. Data from the Chito casts were extracted to accompany the 5m samples and samples taken 1m above the deepest level of the CTD cast. While all activities were given separate event numbers in the log, the bottle 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 full casts were run. The stops at the surface after the 10m soak were mostly very short. It is recommended that the CTD be kept at the surface for at least 30s before running the full cast, to enable disturbance from the upcast to dissipate.

There were 6 salinity calibration samples taken during this cruise, of which only 3 were from below 5m. CTD salinity compared well with the deep samples. Based on these samples and results of previous uses of this CTD, salinity is considered good to +/-0.005psu.

Extracted chlorophyll samples were mainly gathered at the surface using a bucket; 3 samples

came from a Niskin bottle at 5m. The near-surface CTD fluorescence data looked somewhat lower than usual compared to CHL, but the surface fluorescence data are not very reliable. The comparison did show the usual pattern of the ratio of fluorescence to extracted chlorophyll dropping as CHL values increased.

# PROCESSING SUMMARY

##### 1. Seasave

This step was completed at sea.

##### 2. Preliminary Steps

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

The cruise summary sheet was completed.

The CTD was taken down to 10m for a soak which lasted for at least 1 minute. The CTD was then brought back to the surface and after about a short wait, the full cast was run. A longer wait before the full cast is recommended, about 30s.

The chito casts (events 3, 14 and 40) had stops during the downcast to enable mounting of Niskin bottles at a variety of depths; a CTD was also deployed on those casts. There was also a regular CTD cast at each of those sites (events 2, 13 and 39).

Surface bucket samples were gathered during the 10m-soaks of 15 regular CTD casts.

##### 3. Conversion of Raw Data

The configuration file used at sea was correct. It was saved as 2024-031-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.

There were a few small spikes in conductivity.

Fluorescence dark value is the same as for cruise 2024-043, 2024-029 and 2024-030 at ~0.035ug/L, but noise in the signal occasionally went very slightly negative. Negative values should disappear in bin-averaging.

Salinity and Descent rate derivations were left until step 8.

##### 4. WILDEDIT

WILDEDIT was run and removed the conductivity spikes noted before the run.

##### 5. FILTER

The pressure looks very smooth, so FILTER was not run.

Next the temperature and conductivity were examined and the usual approach of applying a cosine filter, size 16, in routine

##### 6. ALIGNCTD

ALIGNCTD was run on all casts using an advance of 2.5s, based on previous results with this type of DO sensor.

##### 7. CELLTM

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

##### 8. DERIVE

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

Checks were made that each step worked properly:

* The temperature and conductivity were smoothed by the WFILTER step. This produced much smoother salinity traces after DERIVE.
* The descent rate is noisy with a lot of fine-scale variability. This makes the profiles of dissolved oxygen data very noisy, and so alignment is hard to judge. For casts with steadier descent rate the alignment is definitely improved and downcast features are in good agreement, so ALIGNCTD appears to have worked well.
* CELLTM 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). This brings downcast and upcast traces closer together, so T-S downcast and upcast plots are in better agreement after this step.

At this point the 3 CHITO files were renamed with a leading 9 in the event number to make them easier to treat them separately in IOS SHELL routines.

##### 9. Conversion to IOS Headers

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

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

##### 10. Checking Headers

Cross-reference listing was run.

Times in the files are within a minute of those in the log. The last time this CTD was used the times were a earlier than the log by a little more. This confirms that the clock is well, and the difference noted during 2024-030 was likely just a matter of the particular timing of making entries in the log.

Surface Check was run on the IOS files; the average was +0.33db with a range of +0.27 to +0.38db. Files were reversed and Surface Check was run again and the average was +0.34 with a range of 0.30-0.38db.

These results are very close to those during 2024-030 and just slightly higher than those from 2024-029.

No recalibration will be applied.

Track plots were added to the end of this report, one with event #s and one with station names.

##### 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

For 2024-029 a shift of +2.0 records for conductivity was found to produce the best results in improving stability in T-S space, while for 2024-030 +1.8s was found to work better, though results varied from feature to feature. A few tests were run using a variety of settings, and +2s was found to work a little better, though no choice worked best for all features examined. There appears to be a lot of variability in alignment, which may be due to small-scale temperature variability or possibly some variability in flow to the conductivity sensor. Some jitter in descent rate is seen at most casts, though it did not seem to affect the pressure.

A shift of +2 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.

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 filtered over 7 records. (Tests were done and, as expected, filtering had no noticeable effect since pressure was very smooth.)

COMMENTS ON WARNINGS: There were no warnings.

##### 14. DETAILED EDITING

All DEL files except those for the 3 Chito casts were copied to \*.EDT so there will be a complete set of files even if some need no editing.

The DEL files were zipped and submitted to the CTD-QC File processor. DELPRED files were returned.

CTDEDIT was used to edit 24 DELPRED files, which mostly involved the removal of records near the top and/or bottom and some editing of salinity.

No editing was applied to files from events #13, 16, 43, 45.

Notes of editing details were made in the headers.

There were many slightly unstable features in the presence of temperature gradients like those seen during 2024-029 and 2024-030, but not during 2024-043. Tests were done during 2024-029 to see this might be due to a poor choice in the conductivity alignment correction, but no improvement was noticed when the shift setting was varied. Further tests were run to see if the CELLTM step had created these features, but dropping that step made no difference. Skipping the Windows Filter step made reversals much larger and more frequent. The issue may be due to local gradients or possibly the winch is a factor since 2024-043 was run on a different vessel. It is not bad enough to cause shed wake corruption, but it is possible that it could have some effect on alignment if it affects pump performance. For many of the casts bin-averaging would have the same effect as cleaning salinity, so editing was generally not applied or kept light.

The data from the top 10m at some sites near the Gulf Islands had large unstable features that do not disappear when metre-averaged. Many of these look like they are due to vertical mixing, so no editing was applied. For some others only deletion of records over several metres would remove the instability; these were left unedited as it is not clear that they are not real.

T-S plots were examined after this step. Some unstable features remain in areas where instability is expected. Other small unstable features are expected to disappear after metre-averaging. The largest unstable feature was from Satellite Channel.

##### 15. Initial Bottle Data Steps

There was no rosette available for this cruise.

There was salinity, chlorophyll and nutrient sampling.

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 2024-031-bot-hdr.txt which will be updated as needed during processing.

For the chito casts (events 3, 14 and 40) multiple rosette bottles were attached and all fired when the bottom was reached. Most of the bottles during those casts were for chito sampling only, so are not included in the bottle files. A CTD was used during the chito casts. There were regular CTD casts at each site, run before the Chito casts (#2, 13 and 39). Surface samples were taken while the CTD was soaking at 10m during the regular casts. The samples from 5m and near bottom were taken during the chito casts.

File 2024-031-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 left for the addition of appropriate CTD data. Data were sorted on sample # order.

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 (bucket) or chito (Niskin).

The edited CTD files associated with sampling were averaged over 0.5db and thinned to the levels of bottle samples including the 3 different deep water depths; data were selected over a ±0.5db range in case some levels were not present in the files. Those data were exported to a spreadsheet and lines removed for which there was no sampling. A second run was made for the chito casts.

The CTD data were sorted on event # and pressure and added to the 6-line header file. Care was taken to ensure the sample numbers matched.

The spreadsheet was sorted on pressure for each event.

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

##### 16. Compare

Workbook 2024-031-CTD-bottle-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.

Salinity Comparison

There were 6 bottle samples, 1 from near the surface, 2 from 5m and 3 from near the bottom.

The surface CTD salinity was higher than the bottle sample by 0.0040psu which is remarkably close given high surface variability.

The 2 samples from 5m produced quite different results with the CTD reading lower than the bottles by 0.0638psu and 0.03532psu. Since those samples came from CHITO casts, there is a time difference between bottle closing and CTD data collected, as well as large vertical gradients.

The 3 deep samples that came from a CTD on the chito cast show the CTD salinity to be lower than bottles by 0.0003, 0.0034 and 0.0015psu for an average of 0.0017psu.

These results are in line with previous cruises using this equipment and offer further evidence that the sensor calibrations are good.

Fluorescence

The only extracted chlorophyll sampling was at the surface (8 samples) or 5m (3 samples).

The CTD Fluorescence is an average of 43% of extracted CHL with highest values when CHL is low.

That is lower than usually seen from this type of sensor, especially at the low end of the CHL range. However, many of the samples come from higher in the water column than the CTD data with which they were compared. The results are similar to other 2024 cruises using this CTD.

When 2 outliers are excluded the ratio FL/CHL is 49%. One of the outliers had extremely noisy CTD fluorescence at the sampling level including very large values and negative values. A pad value was entered in the CTD fluorescence value for that bottle.

The pattern of FL/CHL decreasing as CHL rises is normal.

CTD fluorescence values were an average of 25% of CHL values, much lower than found during 2024-030 when it was 42%, but when 1 outlier was excluded it was 46%.

The evidence is too weak to suggest a problem with the sensor.

See 2024-031-bottle-CTD\_comp.xlsx for more detail on both salinity and fluorescence comparisons.

##### 17. Other calibration checks

Sensor History –

* 2023-023 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.
* 2023-043 March 2024 Pressure was high by about 0.25db. Salinity appeared good to ~0.005psu. Fluorescence looked low but all samples from surface with CTD values from deeper. There was no DO sampling.
* 2023-029 April 2024. Pressure high by about 0.25db. Salinity appeared good to ~0.005psu. Fluorescence mostly low but one sample from 5db looked normal compared to extracted CHL. No DO sampling.
* 2023-029 May/June 2024. Pressure high by about 0325db. Salinity appeared good to ~0.005psu. Fluorescence low compared to extracted CHL. No DO sampling.

Historic Ranges – Casts 37 (bottom), 43 (>110db) and 45 (all depths) had high salinity values; these casts in the southern Strait of Georgia. All other casts had salinity within the climatology. Temperatures were mostly within the climatology, but were very close to or above the maximum around 150m during casts 2, 4 and 6 and in the top 10 to 50 at sites in the Gulf Islands region.

The cast at station 56 fell well within the Southern SoG climatology whereas on other recent cruises it seemed to fit in the Gulf Islands climatology better. The data from the top 50m of the cast at station 59 looked like the surface waters would better fit the southern SoG.

All these excursions are likely due to real variability in this very active region rather than calibration problems.

Post-cruise calibrations – None were available.

##### 18 CALIBRATE

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

The following information was sent to J. Bedard for sensor history:

*CTD 1255*

*Pressure high by about 0.34db.*

*Conductivity 6147 (Temp 6448) –only 3 deep samples; low by <0.002psu.*

*Oxygen Dissolved: No dissolved oxygen sampling.*

*Fluorometer: ECO 8046 –fluorescence lower than usual compared to bucket CHL samples, but most CTD FL data are from a little deeper.*

##### 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, Flag and Prediction\_Flag channels.

Oxygen:Dissolved:SBE values cannot be confirmed as there was no calibration sampling

for dissolved oxygen.

Dissolved Oxygen was derived in mass units and that was used to calculate DO saturation.

Surface saturation values were between 55% and 145% with the highest values coming from the north part of the Strait of Georgia and the lowest from stations 56, SC04 and CBE2.

It is likely that oxygen values are slightly low with typical errors for these sensors being from 1% to 3%.

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.

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

##### 2. Final BOT file preparation

Workbook 2024-031-bottles\_plus\_CTD\_6linehdr. csv was converted to IOS Header files. (\*.ios)

The time and date are present as channels as these could not 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 no salinity values <25, so silicate values do not require correction.

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 header check was run on the BOT files.

Plots were made of all BOT casts. With just 1 to 3 levels these were not very useful.

Finally all data from BOT files were extracted to a spreadsheet and compared to the 6line header file and sampling logs; no problems were found.

PARTICULARS – notes from log

17. Aborted CTD cast sample taken for Station 22

18. Station 22 CTD cast started about 20 minutes after event #17 sample

35. CTD came out of water after soak; aborted and restarted.

Chito casts - 3, 14, 40. Associated CTD casts - 2,13,39

**CRUISE SUMMARY**

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| --- | --- | --- | --- | --- | --- |
| Cruise ID#: 2024-031 | | | | | |
| Dates: Start: 16 July 2024 End: 20 July 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#: 2024-031**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **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** |  |  |

