## REVISION NOTICE TABLE

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| DATE | DESCRIPTION OF REVISION |
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## PROCESSING NOTES

Cruise: 2024-029

Agency: IOS, Ocean Sciences Division, Sidney BC

Chief Scientist: Young K. Platform: Neocaligus

Location: Strait of Georgia Project: Strait of Georgia Plankton

Date: 30 April 2024 –4 May 2024

Processed by: Germaine Gatien

Date of Processing: 12 November 2024 – 15 November 2024

Number of original xml files: 31 (including 1 empty file & 3 Chito casts)

Number of CTD files: 27 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. No data were recorded during event #48.

CTD casts were run at 27 sites. There were 3 sites which also had a separate CTD cast to enable Chito sampling. The Chito downcasts were not prepared for the archive due to frequent stops, 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 full regular casts were run. Stops at the surface mostly lasted about 10s. Waits of 30s are recommended.

There were 6 salinity calibration samples taken during this cruise, of which 3 were from below 5m. CTD salinity compared well with the deep samples. Salinity is likely good to +/-0.005psu.

Extracted chlorophyll samples were gathered mainly 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 having spikes as the sensor equilibrates. The comparison at 5m looks typical of these sensors which suggests the sensor worked well.

# 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 about 2 minutes. The CTD was then brought back to the surface and after about a 10s wait, the full cast was run. A longer wait before the full cast is recommended, about 30s.

There was no 10m soak for the Chito casts (3, 16 and 41); these casts had stops during the downcast to enable mounting 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 and CTD data were extracted from the chito downcast as well. Surface bucket samples were gathered during the 10m-soaks of some regular CTD casts.

##### 3. Conversion of Raw Data

The configuration file used at sea was correct. It was saved as 2024-029-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, ~0.035ug/L but noise in the signal occasionally went very slightly negative. Negative values will disappear in bin-averaging.

Pressure looks smooth.

The PAR values look reasonable.

Salinity and Descent rate derivations were left until step 8.

##### 4. WILDEDIT

WILDEDIT was run and greatly 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 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.

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).

##### 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.

The dissolved oxygen alignment with temperature is hard to assess as the upcast is noisy. 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).

T-S downcast and upcast plots are also 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.

Times in the files match the log times.

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 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 +0.24db with a range of +0.09 to +0.31db. Files were reversed and Surface Check was run again and the average was +0.25 with a range of 0.10-0.31db. Examination of plots from the upcast indicate fluorescence dropping to 0 at between 0.3db and 0.4db. These results are in agreement with those from 2023-023 and 2023-043.

##### 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

When last used a shift of +2.0 records for conductivity was found to produce the best results in improving stability in T-S space. A few tests were run using other settings, and +2.0s was found to work well for these data as well.

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. 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.

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 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 #23, 33 and 37.

Notes of editing details were made in the headers.

There were more unstable features in the presence of temperature gradients than seen during 2024-043 when this CTD was last used. Salinity shifts low and then high as temperatures drop. To see if this might be due to a poor choice in the conductivity alignment correction, tests were done on one cast and no improvement was noticed when the shift setting was varied. A test was also done 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. Some of the shallow reversals may have been due to short waits at the surface after the 10m soak or variable descent rates as the drop got “up to speed”. However, it is likely that most are due to variable temperature gradients. The overall temperature and salinity gradients were an order of magnitude higher than during 2024-043. Variations in descent rate may have some effect but do not appear to be the primary cause.

Unstable features are expected at many of the nearshore casts due to active mixing.

Fortunately, most of the unstable features are small and mostly 2-sided; so will be resolved by metre-averaging.

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.

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 2024-029-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 3 sites (Stations GEO1, 12 and 42) for chito sampling ( Events #3, #16. #41).

For the chito files multiple rosette bottles were attached and all fired when the CTD was at the bottom.

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

Only the 5m and bottom bottles are used for the BOT files.

Surface samples were gathered from a bucket during the soak period of the regular CTD casts (1, 14 and 39) and are also included in the BOT files.

File 2024-029-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 (bucket) or chito (Niskin).

A text file with target pressures was created, including a range around the targets as there may be no data right at the target. The data in the text file were sorted on increasing pressure. This file includes deep values for all chito files.

THIN was run on all files using the text file to indicate levels to be included. The data from the thinned files were extracted to a CSV file and data were selected with the best match to the bottle depths for each cast. Those data were copied to the 6-line header spreadsheet.

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

Workbook 2024-029-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.

##### 16. Compare

Salinity Comparison

Salinity sample # 30 was flagged 1 this was changed to 2 since there is one sample available, only 1 of the replicates was lost.

There were 6 bottle samples, 3 from near the surface and 3 from near the bottom.

Looking at the 3 deep samples the CTD salinity was found to be lower than samples by 0.000, 0.001 and 0.0033psu. If the Niskin bottles did not flush completely they may contain water from slightly shallower, in which case we expect the CTD salinity to read higher than the bottles, so the error may be higher than it seems. If the bottles contain water from 5m above the closing level, then the CTD salinity is reading low by 0.0012, 0.0037 and 0.0056psu. While there are few data, the correspondence is good and falls in line with the previous use of this equipment when the CTD salinity was considered to be ±0.005psu.

The samples at 5m come from chito casts, so the shallow CTD data are collected earlier than the bottle is fired. Given high gradients at 5m, this makes a significant difference. There was also no 10m soak for the CTD sensors, so salinity may not have equilibrated. The one bucket salinity sample was compared with CTD data from 2m deeper and there was a lot of variability in the CTD salinity. So the surface and 5m samples are not reliable for calibration checks. They show the CTD salinity to be reading low.

Given the rough nature of the comparison it is encouraging that the CTD reads is within 0.005psu of the bottles at depth.

Fluorescence

The only extracted chlorophyll sampling was at the surface (11 samples) or 5m (3 samples).

Fluorescence values were an average of 42% of CHL values. That is lower than usually seen especially at the low end of the CHL range. However, the samples come from higher in the water column than the CTD data with which they were compared. The 5m samples could be better matched to CTD data, though there is a time difference since the CTD data were collected during the downcasts, while the bottles were fired when the CTD was at the bottom of casts. Nonetheless, the 5m samples show a relationship much closer to what we normally see when rosette sampling is done. The ratio of fluorescence to CHL is highest for lower CHL and gradually drops as CHL rises which is the pattern normally seen with this type of sensor. Having fluorescence reading about 60% of CHL when CHL is high is in the range expected..



See 2024-029-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.

Historic Ranges – Most temperature and salinity within the historic ranges. Cast #21 was very shallow and close to shore; both temperature and salinity fell outside the climatology which is likely due to the location not being represented in the climatology. Cast #45 had salinity above the maximum below 100m; the salinity data do fall easily within the range for the Gulf Islands, but not for southern Strait of Georgia. This is a problem with the area definition, not the data, and has been noted repeatedly in this area.

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.

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

*CTD 1255*

*Pressure high by about 0.25db.*

*Conductivity 6147 (Temp 6448) – 3 deep samples -appears to be good to 0.005psu.*

*Oxygen Dissolved: No dissolved oxygen sampling.*

*Fluorometer: ECO 8046 –fluorescence lower than usual compared to bucket CHL samples, but CTD FL data are from a little deeper; 3 samples from 5m fit normal pattern for this type of sensor.*

##### 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 60% and 180% with all values that below 100% coming from the Gulf Island area where strong vertical mixing is likely. The highest values came from stations 9, 12 and BS-11 in the northern part of the Strait of Georgia.

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) – 3 deep samples -appears to be good to 0.005psu.*

*Oxygen Dissolved: No dissolved oxygen sampling.*

*Fluorometer: ECO 8046 –fluorescence lower than usual compared to bucket CHL samples, but  CTD FL data are from a little deeper; 3 samples from 5m fit normal pattern for this type of sensor.*

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

##### 2. Final BOT file preparation

Workbook 2024-029-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 salinity values <25, so silicate values require correction.

CALIBRATE was run using file 2024-029-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.

SORT was run to get the records in increasing pressure order.

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 to 3 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. Surface bottle closed during CTD soak.

3. Chito cast Station GEO1. Surface bottle closed during CTD soak. (same site as event 1)

The 150 bottle failed to release messenger – redeployed the 350 and 250m bottles to appropriate depth.

6. Surface bottle closed during CTD soak.

14. Surface bottle closed during CTD soak.

16. Chito cast Station 12 (same site as event 14)

33. Program crashed BE is during CTD soak.

39. Surface bottle closed during CTD soak.

41. Chito cast Station 42 (same site as event 36)

48. No data in in file.

50. Accidentally brought CTD out of water; sent back down to resoak.

52. GPS crash - Manual GPS used.

**CRUISE SUMMARY**

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| Cruise ID#: 2024-029 |
| Dates: Start: 30 April 2024 End: 4 May 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#: 2024-029**

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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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