## REVISION NOTICE TABLE

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| DATE | DESCRIPTION OF REVISION |
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## PROCESSING NOTES

Cruise: 2024-030

Agency: IOS, Ocean Sciences Division, Sidney BC

Chief Scientist: Young K. Platform: Neocaligus

Location: Strait of Georgia Project: Strait of Georgia Plankton

Date: 28 May 2024 – 1 June 2024

Processed by: Germaine Gatien

Date of Processing: 15 November 2024 – 21 November 2024

Number of original xml files: 30 (including 2 from Chito casts)

Number of CTD files: 28 Number of BOT files: 16 (including 1 with no CTD data)

##### 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 16 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. For 2 of those chito casts, a CTD was mounted on the wire, but during chito cast #3 there was no CTD mounted. 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. The exception was for Chito cast #3 for which the 5m and deep CTD data came from the regular cast (event #1), so the match is not as reliable given the 1 hour time difference between the 2 casts.

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. One of the deep samples was collected an hour after the CTD cast. CTD salinity compared well with the 2 deep samples with good time matches. 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 a sampling log.

The cruise summary sheet was completed.

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 short wait, the full cast was run. A longer wait before the full cast is recommended, about 30s.

The chito casts (events 3, 16 and 41) had stops during the downcast to enable mounting of Niskin bottles at a variety of depths. There was a CTD mounted during casts #16 and 41, but not #3. There was also a regular CTD cast at each of those sites (events 1, 14 and 39).

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 2024-030-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 and 2024-029, ~0.035ug/L, but noise in the signal occasionally went very slightly negative. Negative values will 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.
* The dissolved oxygen upcasts are quite noisy so hard to assess, but 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 a few minutes earlier than those in the log. This is likely a case of the CTD being started before the log entry was made, but the CTD clock may have drifted a little.

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; the average was +0.35db with a range of +0.23 to +0.42db. Files were reversed and Surface Check was run again and the average was +0.36 with a range of 0.24-0.42db. Examination of plots from the upcast indicate fluorescence dropping to 0 at about 0.35. This suggests a little drift since 2024-043 and 2024-029. A check was made of a test conversion of 1 cast from each of cruises 2024-031 and 2024-70 when the same CTD was used in July and August. The surface appears to be at +0.36db in July and +0.30db in August, so any drift is slight. No recalibration will be applied.

##### 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 +1.8s 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.

A shift of +1.8 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 26 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 #46 and 47.

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 but similar features were seen in the 2024-029 data. 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.

For 2024-030 tests were also done varying the SHIFT settings and it was found that the best choice varied from one feature to another. The temperature range was smaller during 2024-043 and generally increased with depth. For -029 and -030 the range was larger and temperature decreased with depth in the top 100db and mostly increased below that, but with many local variations. So the difference in results may be related to temperature gradients. The overall temperature and salinity gradients were an order of magnitude higher than during 2024-043.

It could also be that the winch is a factor as the descent rate is noisier for -029 and -030 than for the earlier cruise, -043 which 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 kept light.

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.

##### 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 2024-030-bot-hdr.txt which will be updated as needed during processing.

For the chito casts (events 3, 16 and 41) 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 mounted on the Chito casts #16 and 41 but not on #3. There were regular CTD casts at each site, run before the Chito casts (#1, 14 and 39).

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 2 chito casts with a CTD cast attached. They had a 10m soak, so data were taken from after the return to the surface.

As usual, there were complications in pulling together bottle files.

* Some sample numbers are not in event-number order, so great care was required in manipulating files.
* The aim is to prepare BOT files with the sample data plus CTD gathered at the same sites.
* The surface samples were gathered with a bucket during the 10m soak period of the regular CTD cast. So CTD data from the regular CTD cast are used for those samples.
* For Event #14 the surface data was noisy so CTDEDIT removed much of the near-surface CTD records. An estimate was made using the shallowest data available from a pre-editing file.
* For the 5db and Max Press-1 db samples, CTD data were taken from the Chito CTD casts, except for Event #1 for which there was no CTD on the chito cast. For that case data were taken from Event #1, so don’t match well in time. When a comparison is done, it must be remembered that the 5db and deep samples from event #1 do not match in time with the CTD data.
* No CTD data were collected during event #45 at station 56. The cast was repeated as event #46. Surface nutrient and CHL samples were collected during event #45 and nutrients during event #46. There was a 15-hour break between these two events. As well as a time-difference there is also significant variation between the nutrient values, confirming that the CTD data from #46 should not be listed with the samples from event #45.

File 2024-030-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. Data were sorted on sample # order.

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 then converted to separate files in IOS Header format.

Workbook 2024-030-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

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

The surface CTD salinity was lower than the bottle sample by 0.1764psu which is not surprising given high surface variability and the bottle likely coming from deeper than the bucket sample.

The 2 samples from 5m produced quite different results with the CTD reading lower than the bottle by 0.0168psu for event 1 and higher by 0.1757psu for event 39. Since the event 1 sample was collected on a CHITO cast and there was no CTD data for that one, it is less reliable than the event 39 comparison.

The 2 deep samples that came from a CTD on the chito cast show the CTD salinity to be low by 0.0007 and 0.0013psu. If the Niskins did not flush completely, we expect the CTD salinity to be higher than the samples, so the salinity may be lower by more than this comparison suggests. However, the local vertical salinity gradients were not high, so salinity is likely good to ±0.005psu. The sample from cast #3 with no CTD show the salinity to be higher by 0.0243psu. Both different times and internal waves will lead to less reliable data for that comparison.

While there are only 2 deep samples from the same time, the 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).

Fluorescence values were an average of 42% of CHL values, the same as noted during cruise 2024-029.

That is lower than usually seen from these sensors, 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.

One of the 5m samples looks more in line with expected results for these sensors. During the previous use all the 5m samples seemed more in line with expectations. The pattern of FL/CHL decreasing as CHL rises is normal.

See 2024-030-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 goo to ~0.005psu. Fluorescence from 5db look normal compared to extracted CHL. No DO sampling.

Historic Ranges – Casts #5-28 had temperatures above the maximum at various depths (all above 100m). These are all from the northern part of the Strait of Georgia. South of 49.4N all temperature data fell within the climatology. Two casts east of Texada Island and very close to shore had low salinity in the top 10m. Cast #46 had salinity above the maximum below 30m; 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 for this site, station 56. None of the excursions suggest calibration problems.

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. High temperatures are frequently seen in recent years, so do not suggest a calibration problem.

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

*CTD 1255*

*Pressure high by about 0.35db.*

*Conductivity 6147 (Temp 6448) –only 2 usable 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 70% and 110% with all values below 80% coming from near the Gulf Islands where strong vertical mixing is likely. The highest values came from stations 12 and CBE2.

It is likely that 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 2024-030-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 2024-030-recal-SIL.ccf. (Note that cast #45 had no salinity data, so this step did not run. The CLN file for that cast was copied to \*.CORSIL to ensure a full set.)

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.

Separate notes were added to the headers of 2 events:

* Event #1- to explain that the CTD data came from a cast run about an hour before the cast when the samples were collected.
* Event #45 to explain that no CTD data were recorded, so the cast was rerun the next day. Both events #44 and #46 include samples, but only 46 has CTD data as well.

The standards check was run and no errors were found.

A header check was run on the BOT files.

The speed check turned up a problem in the match of CTD to bottle data for the last 3 events. This was fixed and the steps in section 22 were repeated.

The cross-reference list and header check were run 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 6line header file and sampling logs; no problems were found.

PARTICULARS – notes from log

3. Chito cast (same site as event #1) No CTD attached.

9. NMEA dropped out

16. Chito cast (same site as event 14)

41. Chito cast. Messenger on 150m bottle hung up, sent back down to refire. (Same site at event 39)

45. No data – CTD not turned on. Rerun as event 46.

**CRUISE SUMMARY**

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| --- |
| Cruise ID#: 2024-030 |
| Dates: Start: 28 May 2024 End: 1 June 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#: 2024-030**

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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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