Regional Operations Centre
Canadian Coast Guard – Pacific

PACIFIC REGION CCG VESSEL - POST CRUISE REPORT

Line P Program – Fisheries and Oceans Canada

NAME OF SHIP/PLATFORM: John P Tully

DATE: **FROM:** 08 August 2023 **TO:** 24 August 2023

SCIENCE CRUISE NUMBER: 2023-088 **SHIP'S PATROL NUMBER:** 23-06

CHIEF SCIENTIST[S]: Marie Robert

SCIENTIFIC PERSONNEL:

Female	Male
Isabelle Baconnais (U Lausanne)	Michael Arychuk (IOS)
Danielle Caleb (IOS)	Jan Finke (UBC)
Moira Galbraith (IOS)	Morgan Griffith (UBC)
Marie Robert (IOS)	TJ Guercio (Bigelow)
Laura Sofen (Bigelow)	Jody Klymak (UVic)
Lynn Wharram (UVic)	Stephen Romaine (IOS)
	Ian Tompkins (MUN)

AREAS OF OPERATION: Saanich Inlet, Haro Strait, Juan de Fuca Strait, Line P, Station Papa.

INTRODUCTION/PROGRAMS BACKGROUND:

Line P is a long standing monitoring program which surveys a 1400 km long section 3 times annually. Data have been collected along this line since 1956 and show evidence of the impact of climate variability on ocean productivity. It is the only Canadian long time-series that allows scientists to monitor climate changes so far offshore in the Pacific Ocean. It is also the best opportunity for other programs (e.g. Universities) to do research in the Pacific since the Line P data give them background as well as current water properties.

CRUISE OBJECTIVE/OBJECTIVES: Repeat hydrography, zooplankton, and trace metal sampling along Line P; repeat chromium, ONAr, and organic carbon surveys along Line P; deploy a glider and a Arvor float for IOS; MVP survey for UVic/IOS; hopefully recover the Waverider mooring near Station P and the Marine Mammal Group (PBS) mooring near Oshawa Seamount.

CRUISE DESCRIPTION: This cruise was a typical "while you're out there" type of cruise. As well as the regular DFO Line P work, and the additional "university" work, we were asked a little "at the last minute" to recover two moorings, and to deploy a glider and a float. The cruise started with a few gremlins on board (see the Problems: science gear section) but eventually we were on our way and things worked rather smoothly. The weather was excellent during the whole cruise which was our main asset. Many members of the crew were new to the ship and/or to the Line P program but everyone proved to be a quick learner. The two recurring issues that cost us the most time were the problems with the winches and the limited size of the grey water tanks. We did manage the extra requests of deploying the Arvor float and the glider, and the recovery of the Waverider mooring; unfortunately the Oshawa Seamount was too far off route and we ran out of time.

DAYS ALLOCATED: 16

DAYS OF OPERATION: 16

DAYS LOST DUE TO WEATHER: none.

SAMPLING:

- The cruise was very successful. All stations got sampled in order, every planned cast was performed. Five CTD casts (P5, P7, P9, P11, and P35) stopped at 1005 dbar instead of 2005 to save a bit of time.
- Some extra work was also added: we deployed a glider at P4, a float at P8, and recovered the Waverider mooring.
- The samples collected include:

  1) Underway: **IOS:** Thermosalinograph (Temperature, Conductivity, Fluorescence), acoustic sounder, ADCP, met data (temp, winds, pressure, humidity) **– UVic (Klymak):** MVP (Moving Vessel Profiler).

  2) "E-data" from CTD: **IOS:** Pressure, Temperature, Conductivity, Dissolved Oxygen, Transmissivity x2, Irradiance, Fluorescence.

  3) From the Rosette: **IOS:** Dissolved oxygen, salinity, nutrients, chlorophyll, pigments (HPLC), DMS, DMSP, dissolved inorganic carbon (DIC), alkalinity, phytoplankton, biotoxins, domoic acid, bulk water **– MUN (Tompkins):** total organic carbon (TOC), dissolved organic carbon (DOC), coloured dissolved organic matter (CDOM) **– UVic (Wharram):** ONAr (Oxygen/Nitrogen/Argon ratio) **– UBC (Finke):** Metatranscriptome – **University of Lausanne (Baconnais):** Chromium.

  4) Zooplankton nets: Vertical net hauls using a Bongo, 236 µm mesh size, were done to either 10 m off the bottom, 250 m, or 1200 m.

  5) Trace metal Go-flos: **IOS (Caleb):** trace metals filtered, trace metals unfiltered, ligands, nutrients, salinity **– Bigelow Lab (Sofen and Guercio):** particulate and dissolved iron, nutrients, chlorophyll a, POC, community composition, Fv/Fm.

RADIOISOTOPE USE:

No radioisotopes were used during the cruise.

PROBLEMS [SCIENTIFIC GEAR AND OPERATIONS]:

CTD/Rosette: we had some initial frustrations at the test station in Saanich Inlet with the CTD failing to talk to the deck unit, but these were worked out and no further communications issues were experienced. Although we could not completely isolate the issue, the USB 4 com port was swapped out with another brand after the first station.

One Niskin failed during the cruise with a crack on the bottom and had to be replaced.

Several of the Niskin spigots were quite stiff and needed to be filed down to allow easier opening.

Stephen Romaine

We lost three marine particle samples to recurrent technical issues with one of the LVPs (one per station). Additionally, several faulty parts of the LVPs had to be replaced during turnovers (e.g. flowmeters, trigger caps).

Isabelle Baconnais and Morgan Griffith

The trace metal container door is very rusty, such that rust-colored dust was picked up from the floor despite frequent cleaning. Also the trace metal container air temperature was high (>25 degC, often close to 30 degC). This caused water to warm during our incubation setup, which could stress phytoplankton communities. This should be noted for future users of the container so that they can prepare alternative measures if this will impact their work.

Laura Sofen

It would still be preferable if the TSG were not running on the same computer as the ADCP. This is a repeat request from May. Both the ADCP and TSG are vital instruments and we should not be doing real time data acquisition for both on the same computer.

The compressed timing and changes of the cruise were an issue. There was also a lot of time spent on station, and on tank breaks. Some streamlining and hustle on station (both science and ship) would leave more flexibility in the schedule.

Jody Klymak

SUCCESSES [SCIENTIFIC]:

We used Mark Belton's e-logging system for the first time on a Line P cruise. Even though a few functions were not quite setup for our needs it is a good way to log the time and location of our sampling.

The TSG data logger running on the ADCP computer stopped recording four days before the end of the cruise. The display did not indicate in any way that the data file was not updating anymore. Fortunately the data are recorded in two different locations and Lindsay Mazzei was able to extract the TSG data for the entire cruise.

Trace metals sampling was a complete success, not a single sample was missed thanks to the cooperation of everyone in the lab and the deck crew. Bigelow labs, University of Lausanne and IOS efficiently shared the trace metals container space for sampling and sample processing at multiple stations.

Danielle Caleb

PROBLEMS [SHIP'S EQUIPMENT/OPERATIONS/PLATFORM SUITABILITY]:

The loading at the beginning of the cruise took a long time. Even though we knew that we couldn't leave until the next morning (waiting for 2nd cook), it would have been good to have more gear on board the first day (both containers). Part of the issue is the lack of forward crane. Many crew members as well as some scientists ended up spending lots of time moving all the groceries from the stern of the Tully to the galley. Hopefully the forward crane will be operational again soon.

The trace metal winch is back to having spooling issues. For cruise after cruise that winch hasn't been spooling properly. During the last May Line P cruise it was working great, but now it's back to not spooling automatically. The spooling switch is extremely finicky and intermittent. These issues are impacting the number of crew members required to do a cast, the engineers' time trying to solve the issue, and ship time being wasted.

Once again we spent quite a bit of time having to go off-station to empty the grey water tanks. Hopefully something can be done about this during the coming VLE.

The multinet (MPS) conducting cable didn't get set up through the block before we left the dock. Since it is required to send someone up in the bosun's chair to rig it up which cannot be done offshore, we had to cancel the deep MPS cast planned at Station P.

When deciding speeds for the MVP survey, the allowable speed range should probably be stated as a bracket around an average. We agreed on an average of 8.8 kts, but that ended up as a minimum speed. Perhaps next time we should agree on something like 8.5-9 and get an average of 8.75.

Jody Klymak

SUCCESSES [SHIP]:

It sure was fantastic to have Chad sailing with us. He solved many issues, big and small, that often can only be dealt with while we're offshore. This improved not only this cruise but will also help future cruises. It sure would be great to always have an IT tech on board with us, if possible.

The recovery of the UW/APL Waverider mooring went extremely well. Thank you to the Captain, officers, bosun and deck crew for taking the time to have the required meetings prior to the operation and for such a smooth recovery.

Both the ONC and the Starlink internet systems worked very well during the whole cruise.

Having both engines on at the offshore end of Line P allowed us to have a Station P schedule that made sampling easier and more appropriate for everyone. It also allowed us the time and weather window to recover the Waverider mooring, as well as more time to collect good MVP data on the return leg.

It was a pleasure having Chad on board to work on various projects, including science network. We identified a few future science/CCG projects to improve overall connectivity and data availability.

Stephen Romaine

DELAYS [OTHER THAN WEATHER]:

About 22 hours for the 2nd cook to get on board.
About two hours to get a crew member off the ship near Tofino.
Many hours for tank breaks and a few hours because of winches issues.

SAFETY CONCERNS:

None.

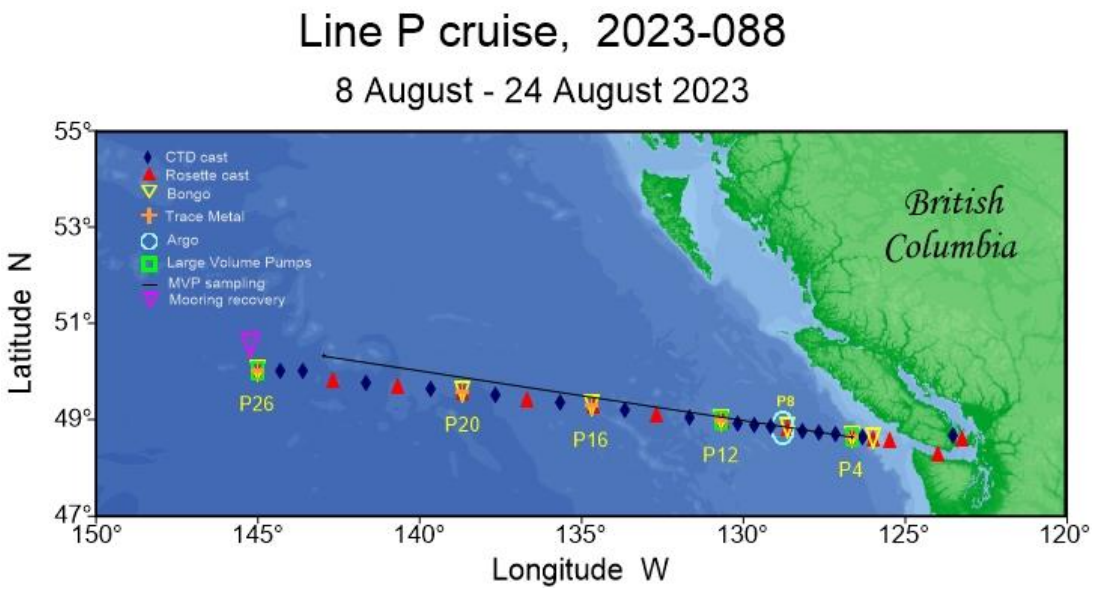
HAZARDOUS OCCURRENCES:

None in the science group.

EVENT LOG:

Tuesday 8 August:	Load the IOS gear in the cube van in the morning. Start loading the ship after lunch. The TM container gets loaded.
Wednesday 9 August:	DMS container and winch get loaded. Arrival of 2nd cook in the morning. Science meeting at 0900, safety meeting at 1000. Leave the jetty around 1300. Over three hours of troubleshooting before we can do the test cast in Saanich Inlet. Test cast, station Haro59.
Thursday 10 August:	JF2, P1 to P3, start P4. Fire and boat drill between P2 and P3.
Friday 11 August:	Complete P4, P5, P6.
Saturday 12 August:	P7 to P11, start P12. Deploy a float 5 miles west of P8.
Sunday 13 August:	Complete P12.
Monday 14 August:	P13 to P15, start P16.
Tuesday 15 August:	Complete P16, P17, P18.
Wednesday 16 August:	P19, P20, P21.
Thursday 17 August:	P22 to P24.
Friday 18 August:	P25, P35, start P26.
Saturday 19 August:	Complete P26, recover the Waverider mooring, start heading east along Line P with the MVP.
Sunday 20 August:	MVP sampling.
Monday 21 August:	MVP sampling.
Tuesday 22 August:	End of MVP sampling at ~P4, continue on towards Pat Bay.
Wednesday 23 August:	Arrive at IOS, start offloading.
Thursday 24 August:	Complete offloading, ship cleared by noon.

CRUISE TRACK:



SUMMARY/FINAL COMMENTS:

- Many thanks to everyone at IOS who packed and prepared all the gear and helped loading, as well as Chloe, Scott and Julian for the forklifting.
- Special thanks to Kim Houston for her help with getting four security clearances approved on time.
- Thanks to Lucius for the help with setting up the "CTD comms" before we left, and BIG thank you to Scott for standing by in the 753 in Pat Bay while we were figuring out what was wrong with the CTD comms.
- As usual, many many thanks to *everyone* on board for all your help: the whole galley crew for all the special meals and smiles and special attention; the deck crew with your constant help; the engineers with answers to all our questions; and the officers for keeping station hours on end.
- Special thanks to Captain Hamilton for agreeing to use two engines so we would have time to do more work at Station P and recover the Waverider mooring, as well as adapting to our many changes of plans.
- And last but not least, many many thanks to Chad for ALL the help and time he spent helping us with so many issues.
- Hopefully we'll see you all this coming January!

Marie Robert

- We would like to thank Marie Robert (IOS) for her fantastic sense of organisation that allowed everyone (including us) to sample stress–free around our long LVP casts. We would also like to thank the John P. Tully's Captain and stellar crew, who helped us tremendously in setting the heavy pumps on the lines and retrieving them without issues, and even sometimes troubleshooting them when needed, especially the IT/Electrical technician Chad Paget whose technical expertise was critical when diagnosing electrical problems with the pumps. We also extend our gratitude to Mark Horn (McLane Company Inc.), Steven Pike (Woods Hole Oceanographic Institution, USA), Maureen Soon (University of British Columbia, Canada), Phoebe Lam (University of California – Santa Cruz, USA) and Laura Sofen (Bigelow Laboratory for Ocean Sciences, USA) for their expertise and online support in investigating the recurring issues with one of our LVPs.

Isabelle Baconnais and Morgan Griffith

- I would like to thank the involved staff of the Institute of Ocean Sciences and the captain and crew of the John P. Tully for their outstanding support during this cruise.

Jan Finke

- Thank you to the exquisite team of scientists onboard the Line-P vessel; you always offered help and looked out not to contaminate my samples. Thank you to the Crew of the *Tully*, who always persevered through any problems we had with equipment allowing things to run smoothly. Special thanks to Gage and Taylor for their incredible hospitality and for dealing with my sleep-deprived state. Also, special thanks to Marie, Moira, and Steve, who always ensured we had a great working environment in which data/sample collection was done efficiently and on time while in a positive, joyful manner. And finally, special thanks to the Chefs, the food was terrific.

Ian Tompkins

- Marie Robert was prompt and very informative during email exchanges for pre-cruise coordination and planning. During the cruise, she managed an excellent schedule to balance all of the science needs and allow people to mostly maintain regular shifts. Kyle Simpson was also helpful during pre-cruise planning. Notably, the TM team accommodated our request to pressurize GO-Flo bottles for particle sampling although it is not part of their routine operations. This significantly improved our sampling methods. For trace metal (TM) casts, Danielle Caleb trained us appropriately and coordinated space and sampling needs effectively. Ship operations generally went smoothly and we were able to complete our experiments with small adjustments to plans. In particular, the crew operating the TM winch were excellent and responsive.

Laura Sofen and TJ Guercio

- Thank you to the officers and crew for a great voyage, and to the IOS crew for their expert assistance and advice, particularly Steve Romaine for fixing our electrical termination so quickly. Thanks to the rest of the science party for keeping us company while doing the MVP watches. As always thanks to Marie Robert for all her organization and communication efforts.

Jody Klymak

PROJECTS AND RESULTS:

Water masses – Marie Robert, DFO/IOS.

The most striking feature of the water masses during this cruise is how the surface waters have warmed up during the summer. In May (figure 1, left panel) the temperature anomaly was extending down to roughly 100 m but was mainly offshore, west of P18 – P20, whereas this August the anomaly was confined to the surface but was present all along Line P (figure 1, right panel), reaching values of almost 5°C. Another interesting feature is the positive salinity anomaly that can be observed at a depth of 120 m or so on the continental shelf (figure 2, right panel). That positive salinity anomaly has not changed much since last May (figure 2, left panel). Unfortunately we did not have a winter cruise this year so we don't know when this anomaly appeared. We can only say that it was not present in August 2022.

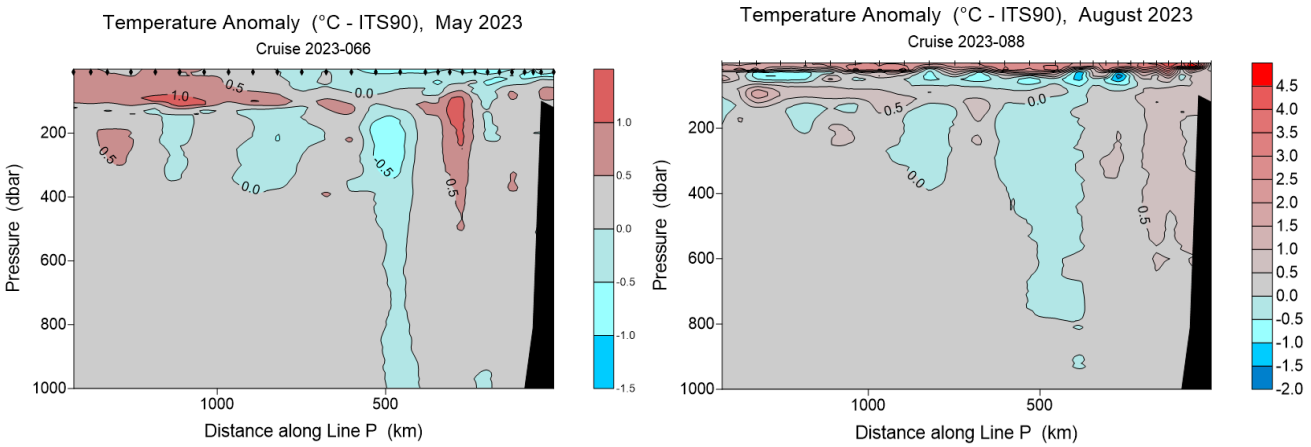


Figure 1: temperature anomalies along Line P with respect to the 1956 – 1991 averages for May 2023 (left panel) and August 2023 (right panel).

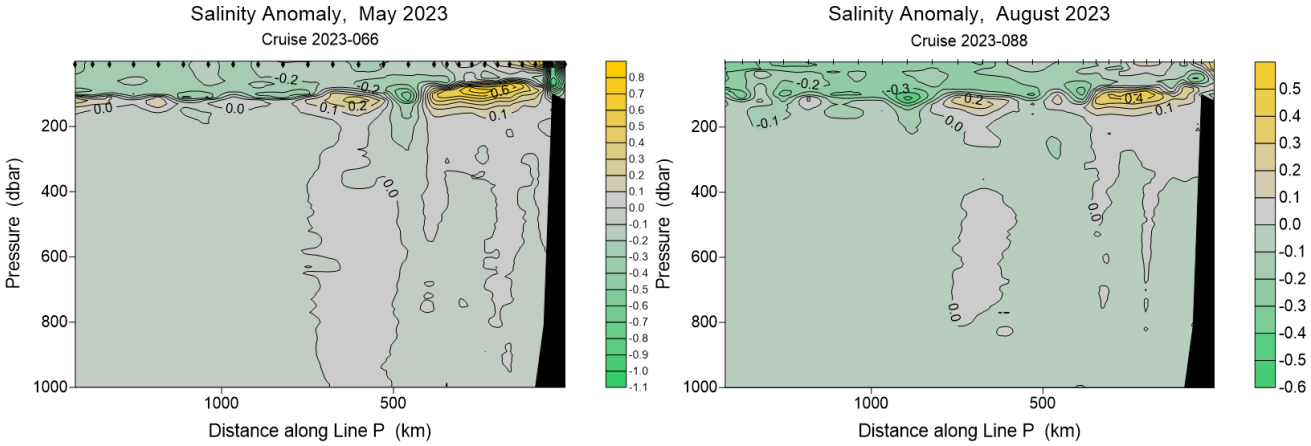


Figure 2: salinity anomalies along Line P with respect to the 1956 – 1991 averages for May 2023 (left panel) and August 2023 (right panel).

Cruise Report: Line-P 2023-088 – Lynn Wharram, Ocean Gases Lab, University of Victoria

ONAr dissolved gas samples for the Ocean Gases Lab (Hamme, UVic) were successfully collected at stations P4 through P26 from 5m depth Niskin bottles. Thanks to Laura Sofen (Bigelow) and Jody Klymak (UVic) for assistance.

Trace Metal Cruise Report: Line-P 2023-088 – Danielle Caleb, DFO/IOS

Trace metals sampling was a complete success, not a single sample was missed thanks to the cooperation of everyone in the lab and the deck crew. Bigelow labs, University of Lausanne and IOS efficiently shared the trace metals container space for sampling and sample processing at multiple stations.

Cruise report Line P 2023-088 – Laura Sofen and TJ Guercio, Bigelow Lab.

Project: Volcanic Blooms

PIs: Ben Twining, Cath Mitchell, Karen Stamieszkin (Bigelow Lab); Bess Hoffman (Colby College)

Measurements and experiments:

We conducted two incubation experiments to study the effect of volcanic ash inputs on surface phytoplankton communities. Ash inputs are expected to release nutrients that can fuel phytoplankton blooms. We tested different ash sources. These experiments continued work begun on the August 2022 Line P cruise.

Incubations were set up at stations P16 and P26. For each incubation, samples for particulate and dissolved iron (PFe and DFe, respectively) were collected from GO-Flo bottles deployed to 35, 50, 75, 100, and 150 m during the routine trace metal (TM) casts. In addition, we deployed 10-12 GO-Flos in a dedicated "bulk water" trace metal cast to collect water from 25 m. This water was homogenized in a barrel in the TM container and redistributed into 4 L cubitainers which were amended with ash and placed in the seawater-cooled incubator on the helideck.

At incubation setup and after 3-5 days incubation, incubations were sampled for nutrients to be performed by IOS, chlorophyll a (>5um and >0.2um) by acetone extraction and fluorometry, POC, community composition by imaging flow cytobot, and Fv/Fm by fast repetition rate fluorometry.

Comments:

Marie Robert was prompt and very informative during email exchanges for pre-cruise coordination and planning. During the cruise, she managed an excellent schedule to balance all of the science needs and allow people to mostly maintain regular shifts. Kyle Simpson was also helpful during pre-cruise planning. Notably, the TM team accommodated our request to pressurize GO-Flo bottles for particle sampling although it is not part of their routine operations. This significantly improved our sampling methods. For trace metal (TM) casts, Danielle Caleb trained us appropriately and coordinated space and sampling needs effectively. Ship operations generally went smoothly and we were able to complete our experiments with small adjustments to plans. In particular, the crew operating the TM winch were excellent and responsive.

The following could be noted or improved upon for future work:

1. Upon initial setup of the incubator, the bosun pointed me to a freshwater source rather than seawater. The engineering department helped me find an appropriate seawater source.
2. The trace metal container door is very rusty, such that rust-colored dust was picked up from the floor despite frequent cleaning.
3. The trace metal container air temperature was high (>25 degC, often close to 30 degC). This caused water to warm during our incubation setup, which could stress phytoplankton communities. This should be noted for future users of the container so that they can prepare alternative measures if this will impact their work.
4. During our first bulk water cast, the TM winch stopped working due to a broken level-wind switch when we had one bottle in the water at <25m. The engineers quickly identified and repaired the problem, but this resulted in a delay of 1 hour. Fortunately, the deployed GO-Flo bottle was most likely deep enough to avoid contamination from the ship during this delay.
5. The 10 L GO-Flo bottles actually contain slightly less than 10 L, so we had less water than anticipated on our first incubation (P16). This was easily corrected at P26 with the additional GO-Flos available on board. This is worth noting for future cruises where the TM water budget is tight.

2023–088 Line P report – Isabelle Baconnais (University of Lausanne, Switzerland), Morgan Griffith (University of British Columbia, Canada)

The marine cycle of chromium (Cr) has been investigated via measurements of its concentration ($[Cr]_T$ = Cr(VI) + Cr(III)), and more recently, stable isotopic ratios ($\delta^{53}Cr$) in seawater. Depth profiles of dissolved $[Cr]_T$ and $\delta^{53}Cr$ reveal a nutrient–like behavior linked to the propensity of Cr(III), the product of the soluble Cr(VI), to adsorb onto particles and get released into deeper waters during particle remineralisation. This last statement is inferred mostly from the variations of $\delta^{53}Cr$ in the dissolved fraction of seawater since no successful measurements of $[Cr]_T$ and $\delta^{53}Cr$ in marine particles are available. However, dissolved Cr can unexpectedly be found in Oxygen Minimum Zones (O_2 < 60 µmol.Kg^{-1}) and Oxygen Depleted Zones (O_2 < 5 µmol.Kg^{-1}), where oxygen levels should favor the reduction of Cr(VI) and the co–precipitation of its product. Aside from the potential for low–molecular weight ligands to bind Cr(III) and keep it in the dissolved fraction of seawater, understanding the properties of marine particles that would favor Cr adsorption and its potentially varying

isotopic fractionation seems detrimental to further understanding Cr's cycle in seawater. This step may allow the development of Cr as a new proxy for further determining the marine carbon pump.

Samples of marine particles and seawater were collected during the 2023–088 Line P expedition (08th August to 25th August 2023) aboard the John P. Tully at stations P4, P12 and P26. Marine particles were collected onto acid–leached 0.80µm PES filters (142 mm; Supor®) using three Large Volume Pumps (LVP; McLane Company Inc.) borrowed from Roger François (University of British Columbia, Canada). The three pumps were run for up to 3h over three casts per station, allowing the retrieval of up to nine samples per station. The filters were kept in acid–clean petri dishes and allowed to dry in the clean hood of the trace–metal clean container (IOS). In order to understand the relation between the dissolved and particulate fractions of Cr, we also sampled for seawater which was collected into acid–clean 0.5L bottles from the 10L Niskins. The samples were then filtered using a 0.8/0.2 µm Acropak 500 capsule w/ Supor® membrane (Pall Corp.) and acidified with 2 ml/L of double–distilled concentrated HCl. Filtration and acidification were conducted in the trace–metal clean container (IOS).

Our sampling trip was very successful, with a total of 24 marine particle samples and 50 seawater samples. We lost three marine particle samples to recurrent technical issues with one of the LVPs (one per station). Additionally, several faulty parts of the LVPs had to be replaced during turnovers (e.g. flowmeters, trigger caps).

Acknowledgments: We would like to thank Marie Robert (IOS) for her fantastic sense of organisation that allowed everyone (including us) to sample stress–free around our long LVP casts. We would also like to thank the John P. Tully's Captain and stellar crew, who helped us tremendously in setting the heavy pumps on the lines and retrieving them without issues, and even sometimes troubleshooting them when needed, especially the IT/Electrical technician Chad Paget whose technical expertise was critical when diagnosing electrical problems with the pumps. We also extend our gratitude to Mark Horn (McLane Company Inc.), Steven Pike (Woods Hole Oceanographic Institution, USA), Maureen Soon (University of British Columbia, Canada), Phoebe Lam (University of California – Santa Cruz, USA) and Laura Sofen (Bigelow Laboratory for Ocean Sciences, USA) for their expertise and online support in investigating the recurring issues with one of our LVPs.

Cruise Report Line-P 2023-088 – Jan F. Finke, Research Associate University of British Columbia & The Hakai Institute

20th of August 2023

This report is covering the Line-P cruise 2023-088 aboard the CCGS John P. Tully from the 08.08.2023 to 24.08.2023, cruise participant was Jan F. Finke. Purpose of the cruise was to investigate viral activity, i.e. active viral replication in microorganisms across locations, depths and under varying environmental conditions. Viral infection of hosts is thought to be driven by encounter rates and thus affected by mixing of the water column. Furthermore, viral replication efficiency can be affected by nutrient and other resource limitations. This study aims to better understand these processes and produce a clearer image of how warming and stratification patterns will change viral infections with the associated impacts on the marine microbial loop.

To assess viral activity samples of four to five litres of water were filtered through 0.22 um Sterivex filtration cartridges, recovering the cellular fraction. Samples were stored at -80C for subsequent metatranscriptome sequencing of mRNA. In contrast to traditional approaches in environmental virology where free viral particles are study this approach recovers information about in situ viral replication for viruses from all viral realms indiscriminately and simultaneously. The samples collected on the present cruise will be analyzed in context of samples from the previous Line-P cruise in May 2023 (cruise number 2023-066) and coastal time series as part of UBC's and Hakai's Marine Virus Program. A total of 24 samples were collected, samples from the surface layer at five meters were collected for JF2, P2, P4, P8, P12, P14, P16, P18, P20, P22, P24, P26. For stations P8 to P26 additional samples from the OMZ at 1000 meters were taken, at station P26 further samples were taken at ten and 2000 meters to be compared to historic data.

Supporting the metatranscriptome samples additional samples for ribosome analysis were collected. For the ribosome sampling 50ml of water were filtered through 0.2um GTBP filters, filters and filtrate aliquots were stored at -80C for subsequent amplicon sequencing of 16S and 18S ribosomal RNA. The ratio of free to cellular bound ribosomes per organism can provide an estimate of cellular mortality rates. The mortality rates can be related to the viral activity to further understand the fraction of cellular mortality caused by viral infection.

I would like to thank the involved staff of the Institute of Ocean Sciences and the captain and crew of the John P. Tully for their outstanding support during this cruise.

Cruise Report: Line-P 2023-088 – Ian Tompkins, Graduate Student at Memorial University of Newfoundland (MUN) working in Dr. Heather Reader's Lab

Samples of organic carbon from the last few years have revealed intense carbon export to the deep ocean along Line P, but this carbon export is variable in time and space. Samples collected for Total Organic Carbon (TOC) and Dissolved Organic Carbon (DOC) will be used to quantify this export flux and determine if the high total organic carbon seen on past cruises is primarily in the particulate or dissolved fraction; this information can be used to quantify the export flux and to assess the region. Paired measurements of chromophoric dissolved organic matter (CDOM) will be used to assess the quality and nature of the exported carbon.

Seven hundred fifty samples were taken from almost every other station along Line-P, starting with Station P2 and ending with Station P26. Using the Rosette, samples were taken from various depths, ranging from 5m depth to 10m from the bottom. Measures were made to avoid carbon contamination at all experiment stages, with the most predominant being the constant use and changing of nitrile gloves and the continuous lookout for volatile organic compounds, like ethanol or diesel fumes. Samples were collected in amber vials cleaned using 10% hydrochloric acid solution by volume, followed by being ashed at 450ºC for 5 hours to remove residual carbon. TOC was collected by waterfalling water samples direct from Niskin, making sure to avoid contact between the vial and Niskin. CDOM and DOC were collected by connecting via acid-washed silicon tubing a Whatman Polycap 75 TC (Pore Size 0.8/0.2 µm). The capsule was rinsed using at least three volumes worth of seawater before waterfalling the sample into vials. TOC and DOC samples were then acidified using 100µl of 4N HCl, followed promptly with all samples being placed in the cold room.

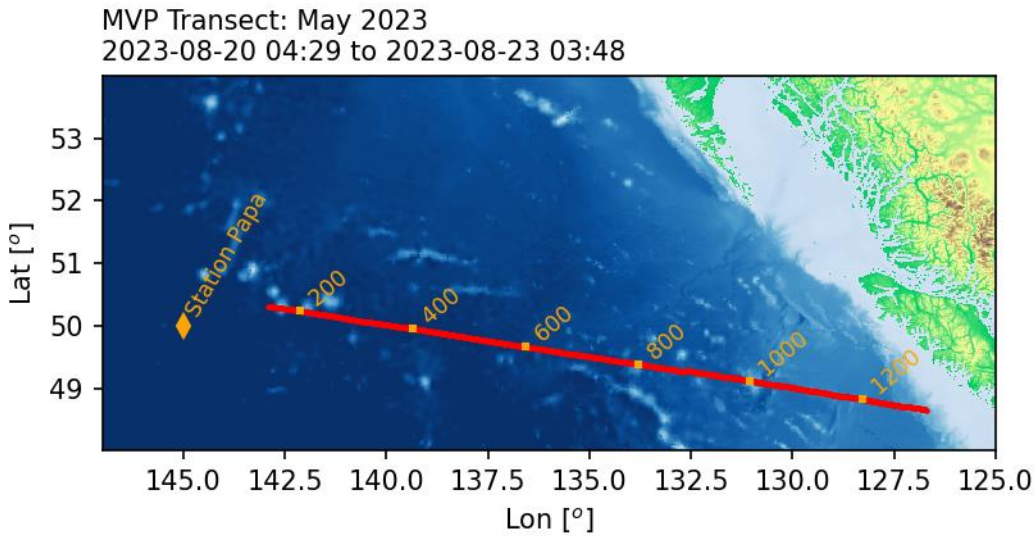
Acknowledgements:
Thank you to the exquisite team of scientists onboard the Line-P vessel; you always offered help and looked out not to contaminate my samples. Thank you to the Crew of the *Tully*, who always persevered through any problems we had with equipment allowing things to run smoothly. Special thanks to Gage and Taylor for their incredible hospitality and for dealing with my sleep-deprived state. Also, special thanks to Marie, Moira, and Steve, who always ensured we had a great working environment in which data/sample collection was done efficiently and on time while in a positive, joyful manner. And finally, special thanks to the Chefs, the food was terrific.

Cruise Report - LP23b – Jody M. Klymak and Lynn Wharram; University of Victoria

Setup and deck operations

These were great as usual. MVP setup was smooth, and crew very helpful.

Data



Cruise plan was changed due to time and weather. Instead of heading to Cape Scott we came back to St of Juan de Fuca. This was suboptimal from a comparative data point of view as the previous cruises were along "Line R" to Cape Scott. We

were also somewhat short on time, so ran for a 160 km at full speed before deploying the MVP. The ship was averaging 9kts, which is faster than the optimal 8kts, though the total MVP line was longer than to Cape Scott.

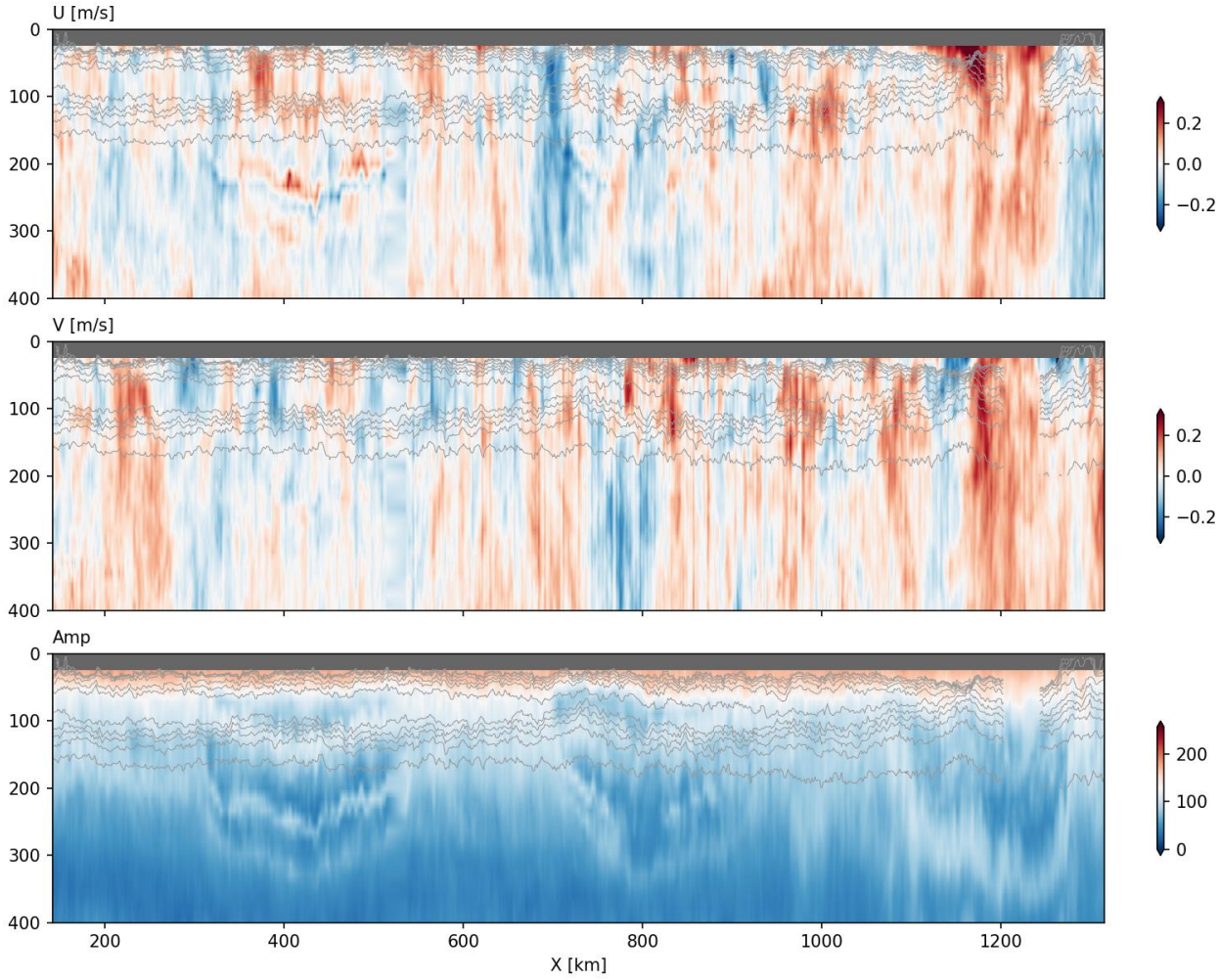
ADCP

ADCP data was logged using VM-DAS and monitored using WinADCP. Data comes in UDP ports supplying feeds NMEA1 and NMEA2 to VM-DAS.

Data is corrected for ship motion using the GPS to compute the ship's speed over land. Heading comes from the navigational gyro. So far as I can tell, there is no pitch or roll sensors on the Tully.

ADCP data was good quality except for an hour where the ADCP software stopped recording.

The only issue with the ADCP is that there is definite banding in the velocity in the along-ship direction due to backscatter inhomogeneity in the water. This error is ship-speed dependent, and is another reason for these surveys to be carried out at modest speed.



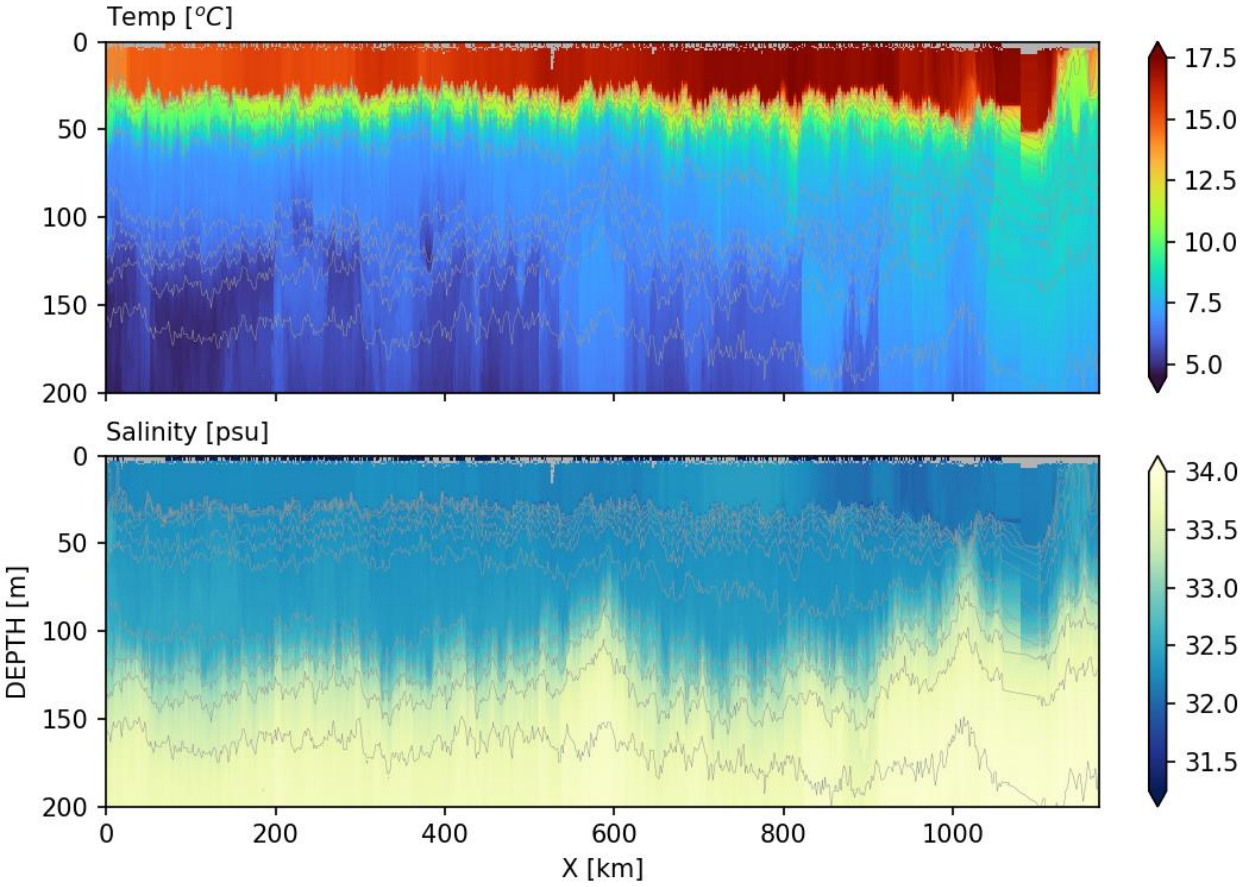
MVP

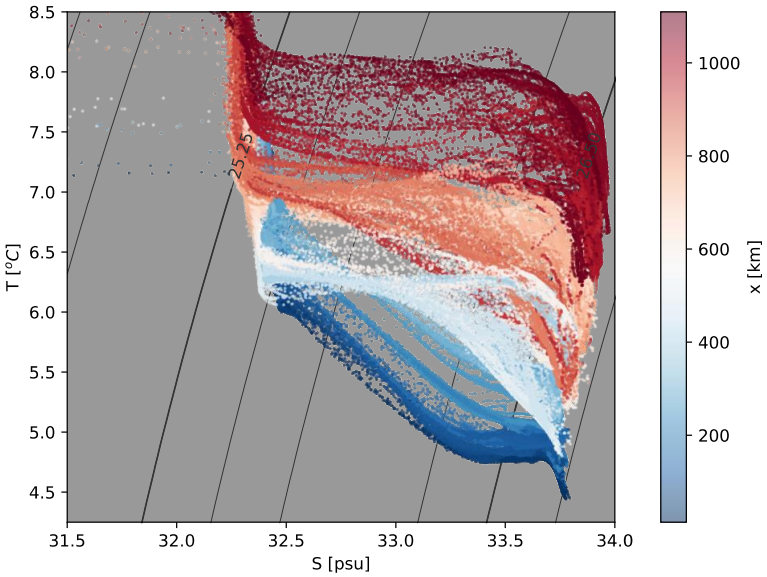
MVP operations were generally smooth, except for a failed cable near the end of the trip. We pulled the fish out of the water while it was reterminated by Steve Romaine (IOS).

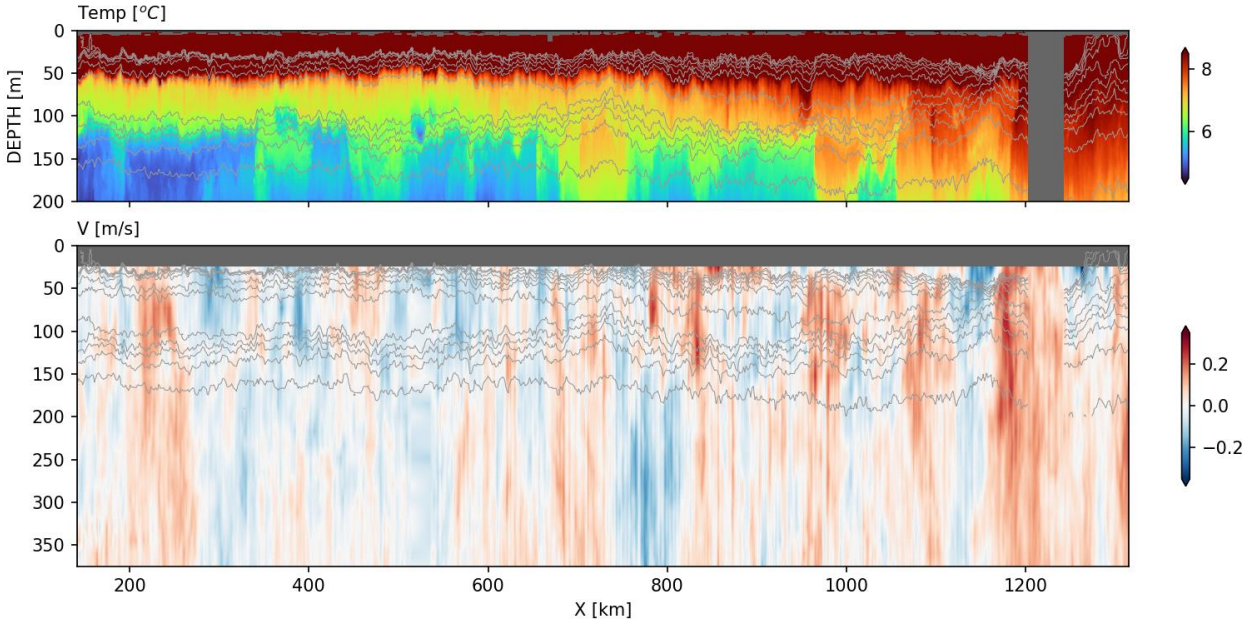
We made 661 MVP casts to 200 m, with a median cast spacing of 1.7 km along a line that was 1350 km long.

Data shows a seasonal temperature stratified mixed layer with relatively homogenous salinity. There are a couple of large coherent features at X=600 km and X=1000 km, where the isopycnals come up 50 m. These appear in the Line P section as "salinity anomalies". Considering the velocities, it's hard to say if these are eddies or not; the one at X=1000 km maybe has a cyclonic circulation, but the one more offshore at X=600 km has anti-cyclonic, so not clear.

As with previous transits these sections have a rich layering and interleaving of ocean temperatures from the offshore to the onshore. The overall goal is to understand what drives this lateral mixing, and to separate lateral processes from internal wave processes.







Issues and recommendations

- It would still be preferable if the TSG were not running on the same computer as the ADCP. This is a repeat request from May. Both the ADCP and TSG are vital instruments and we should not be doing real time data acquisition for both on the same computer.
- The compressed timing and changes of the cruise were an issue. There was also a lot of time spent on station, and on tank breaks. Some streamlining and hustle on station (both science and ship) would leave more flexibility in the schedule.
- When deciding speeds for the MVP survey, the allowable speed range should probably be stated as a bracket around an average. We agreed on an average of 8.8 kts, but that ended up as a minimum speed. Perhaps next time we should agree on something like 8.5-9 and get an average of 8.75.

Thank-yous

Thank you to the officers and crew for a great voyage, and to the IOS crew for their expert assistance and advice, particularly Steve Romaine for fixing our electrical termination so quickly. Thanks to the rest of the science party for keeping us company while doing the MVP watches. As always thanks to Marie Robert for all her organization and communication efforts.