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:** 7 February 2020 **TO:** 25 February 2020

SCIENCE CRUISE NUMBER: 2020-001 **SHIP'S PATROL NUMBER:** 19-12

CHIEF SCIENTIST[S]: Marie Robert

SCIENTIFIC PERSONNEL:

Female	Male
Danielle Caleb (IOS)	Mike Arychuk (IOS)
Sophie Johannessen (IOS)	Mark Belton (IOS)
Sile Kafrissen (UVic)	Michael Livingston (UVic)
Racquelle Mangahas (UBC)	Hugh Maclean (IOS)
Jyotsnamani Mohanta (U Sask)	
Marie Robert (IOS)	
Xuan Zheng (MUN)	

AREAS OF OPERATION: Saanich Inlet, Juan de Fuca and Haro Straits, North East Pacific, Line P, Station P, Dixon Entrance, Hecate Strait, Chatham Sound.

INTRODUCTION/PROGRAM BACKGROUND: Line P is a long standing 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 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 section (physics, chemistry, zooplankton); deploy one drifter for IOS (cement-ball Sponge-Bob); repeat Trace Metal sampling; repeat TOC/DOC/CDOM/PIC/POC sampling; sample an eddy near Station P; sample for winter nutrient and carbon budget in Chatham Sound.

CRUISE DESCRIPTION: This cruise (2020-001) was a typical February cruise, with strong winds and high sea-states causing cancellation of stations or creating delays during transit time. Despite the weather it was a very successful cruise. Only one Line P station was cancelled, and all stations on the "top priority" and "Priority 2" lists for the Chatham Sound work were done, as well as some of the "lower priority" list of stations. It was good to do the Chatham Sound work for a second year in row and would be good to have "back-up extra work" for the future February cruises, should the weather days not be all used up on Line P. Finally we also had time to deploy a mooring on Swiftsure Bank and recover a Viking buoy from Powell River for DFO.

DAYS ALLOCATED: 18 **DAYS OF OPERATION:** 17

DAYS LOST DUE TO WEATHER: ~8.5 hours total between P16 and P20; cancel P18.
~8 hours getting to and in Dixon Entrance, 4 stations cancelled.
~8 hours in Chatham Sound.

SAMPLING:

- The Line P survey was 98% successful. Most casts were completed. Only P18 was cancelled.
- One "cement-ball Sponge-Bob" drifter was deployed for IOS (see Science reports).
- We managed to sample 31 of the 48 stations planned for Dixon Entrance and Chatham Sound. Two of the six bongos were done. All cancellations were due to bad weather.
- The samples collected include:

  1) Underway: **IOS**: Thermosalinograph (Temperature, Conductivity, Fluorescence), acoustic sounder, pCO_2, ADCP – **MBARI (Johannessen for MBARI):** Nitrate, pH, temperature, salinity.

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

  3) From the Rosette: **DFO-IOS:** dissolved oxygen, salinity, nutrients, DMS, DMSP, chlorophyll, pigments (HPLC), dissolved inorganic carbon (DIC), alkalinity, phytoplankton, PIC, POC, DOC, CDOM, **– UBC (Mangahas for Hallam):** high-resolution bacterial DNA sequencing, number of cells per millilitre, single cell DNA analysis, virus analysis, viral counts – **MUN (Zheng):** DOC, CDOM, EDOC – **UVic (Livingston, Kafrissen)**: C/N/Si uptake rates (productivity), biogenic silica, size-fractionated chlorophyll, phytoplankton, bacteria, nutrients, dissolved silica, transparent exopolymer particles, POC, PON, particulate phosphate, total fatty acids, phyto IDs – **U Sask (Mohanta):** Chromium.

  4) Zooplankton nets: **DFO-IOS (Maclean, Belton):** Zooplankton using vertical net hauls (Bongo to 250 m and 1200 m).

  5) From the Trace Metal Rosette: **DFO-IOS (Caleb):** filtered and unfiltered iron, nutrients, salinilty – **UBC (Mangahas):** dissolved (<0.2 μm) and total dissolvable (unfiltered) trace elements, chlorophyll, RNA, cell count and particulate organic matter

RADIOISOTOPE USE:

^{32}Si radioisotopes were used during this cruise. Due to problems with the boat davit, and the necessity to bring a different rescue boat, the Rad-van could not be used. The radioisotopes used were of very low activity and quantity hence the work was carried out in the main lab. The lab was decommissioned at the end of the cruise.
It will be important to have the Rad-Van on board for the May and the August Line P cruises as both are "full-house" and the main lab will be too busy to have any radioactive materials isolated from all the people.

PROBLEMS [SCIENTIFIC GEAR AND OPERATIONS]:

The conductive cable jumped sheave between P20 and P21 while attempting to re-tape the termination. The sea-cable had to be cut to remove a kink and reterminated.
Sea-save stopped working twice. The first time only the software had to be restarted. The second time the whole computer got rebooted.
The DMS system encountered some serious problem and stopped working at some point. See "Projects and Results" section.
We ran out of -20°C freezer space very early in the cruise. We will have to buy another, bigger chest freezer and put in down in the hold for every cruise from now on.

SUCCESSES [SCIENTIFIC]:

We used a new label printing system developed by Mark Belton. This new system is fantastic. It is very easy to use and prints very clear and clean labels that should not fade away as the previous ones did.
We also used one of the new CTD data acquisition computers. Besides the software Sea-save stopping twice we had no other major issue. A few "tools" were missing at first (like "The Good Egg" timer) but that was very

easy to fix. And we finally had a back-up computer as well. Unfortunately we didn't have the opportunity to try swapping computers in the middle of a cast but hopefully next cruise we can try that. Now that we have those "mini-computers" working it would be good to re-design the "Closet" into a better setup.
The PCO2 system worked well this cruise without any major problems. There were a couple of instances where Windows would try and do an auto-update, despite it being disabled, and this would result in the certain functions of the PCO2 program to freeze. A re-start was required in those cases.
We had more IOS people than usual on this cruise. We normally do Line P cruises with 4 IOS people, but this time we were six IOS employees and all were very busy. It's not that we were "short of students" per se, but some of the students were so busy having to do work for others (on land) that they could not really help with their watches. Supervisors should think twice about what they ask their students or technicians to do as, at some point, the work load can become a safety issue at sea, especially when sleep is hard to get in rougher weather or people are still trying to get their sea legs.

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

The conductive cable jumped sheave between P20 and P21. It was partly because one of the washers holding the keeper above the sheave was too small and the keeper didn't stop the wire.
The conductive cable jumped sheave a second time in Chatham Sound. Fortunately the rosette got recovered even though the sea cable was jammed between the sheave and the side of the block.
Also in Chatham Sound the CTD which lost power for about one hour.
There is a new system sending the GPS string throughout the ship. The baud rate is much higher than it used to be, which caused some software to crash a few times. Also the ip address to get the GPS data was changed yet again; fortunately Shane Fraser (CCG IT tech) was sailing with us and found out that address for us.

Even though the laptop used by the Chief Scientist has received lots of "black magic" in past years from Gerald Rohatensky and his colleagues, and after Shane and Chad spent a few hours trying to reconnect that laptop – or the new one – to the Chief Scientist's shipboard email account via Outlook, we came to the conclusion that the set-up had been changed yet again and the Chief Scientist email account can now be accessed only by using Webmail. This is very inconvenient for a few reasons: first there is no easy way to save the emails sent and received using Webmail. Second if Outlook doesn't work it makes it complicated to access the email messages saved in the office on an external hard drive and that are needed during the cruise. Finally it made it awkward to send big files to the bosun since the access to the "Public" directory on the ship server is no longer accessible. If this new set-up is to be permanent then a computer should be provided in the Chief Scientist's cabin with access to Outlook (TullyCS account) and the Public drive.

SUCCESSES [SHIP]:

The ship seems to have gained some speed after the "tweaking" of her engines during the refit of November 2019.

The ADCP seemed to be working really well. The data haven't been looked at yet but what was on the monitor was very promising. The software had to be restarted only once.

DELAYS [OTHER THAN WEATHER]:

An hour or two on major stations for "Tank breaks".
~1.5 hour between P20 and P21 for retermination of the CTD wire and fixing the LARS wire keeper.
~3 hours between CH6 and CH5 for two reterminations of the CTD wire.
~1 hour for problems with CTD winch hydraulics between CH5 and CH4.
~3.5 hours for fuelling in Port Hardy.

SAFETY CONCERNS:

The "weather doors" preventing the flooding of the main lab when green water is on the aft-deck are very tricky to walk over while wearing rain pants and rubber boots. That weather door is quite high and we get tripped by the little "lip" on top of that addition. This door is a disaster in waiting. A new system needs to be designed there (simply new doors?) to keep the green waters off the deck before someone ends up forehead on deck. Another option is that if the weather door continues to be used there needs to be some sort of "step" built that makes it easier to get over the height on both sides.

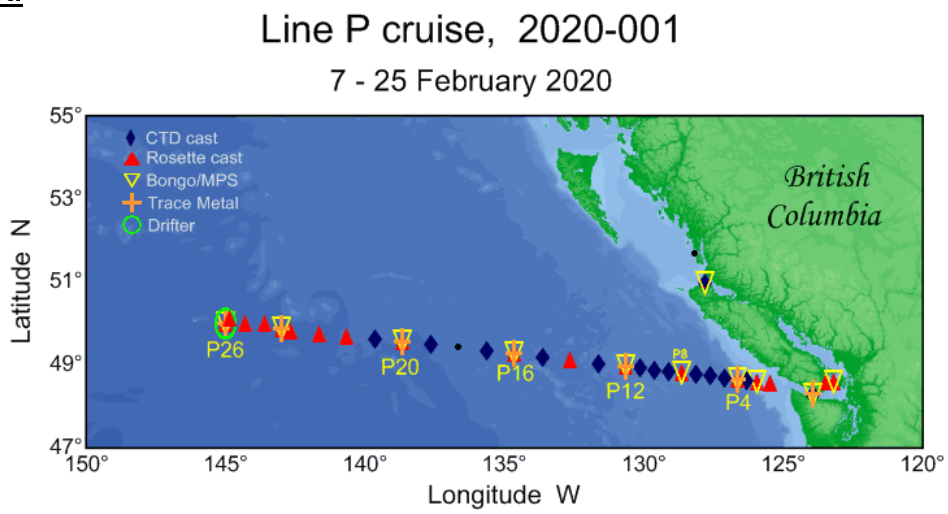
HAZARDOUS OCCURRENCES:

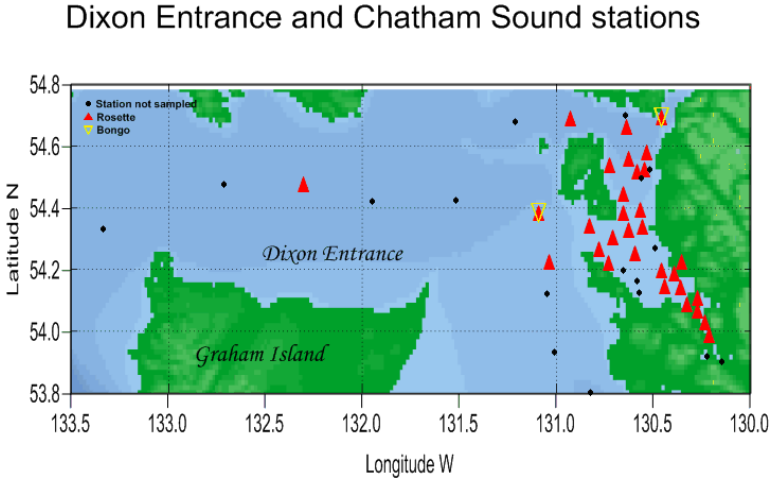
One person caught their finger in one of the outside doors. No major harm was done.
No other hazardous occurrences in the science team.

EVENT LOG:

Friday 7 February:	Load science gear after lunch, containers, some winches.
Saturday 8 February:	Load last of the gear. Safety meeting at 1000. Science meeting at 1030. Leave Pat Bay at 1230. Fire and boat drill at 1300. Saanich Inlet cast. Station 59.
Sunday 9 February:	Station JF2. Deploy Svein Vagle's mooring on Swiftsure Bank. Stations P1 to P4.
Monday 10 February:	Stations P4 to P8.
Tuesday 11 February:	Stations P9 to P13.
Wed 12 February:	Stations P14 to P16
Thursday 13 February:	Stations P17 and P19. Weather day, cancel P18.
Friday 14 February:	Stations P20 and P21.
Saturday 15 February:	Stations P22 to P24 and Eddy.
Sunday 16 February:	Stations P25, P35, P26, PA-013. Deploy "cement-ball sponge-bob" drifter at Papa.
Monday 17 February:	Transit to Dixon Entrance.
Tuesday 18 February:	End of transit to Dixon Entrance. Bad weather.
Wed 19 February:	Cancel stations Dix5 and Dix4, do Dix3, cancel Dix2 and Dix1. Do stations CH1, CH2, CH3, CH6.
Thursday 20 February:	Stations CH5, CH4, CH8, CHAT3, CH10 to CH17 (no CH11), HECS8, HECS7, CHAT2, CH20.
Friday 21 February:	CH19, CH23, CH25 to CH27, CH29, CH31, PRHR74, CHAT1, MP55, OGCH50, Skeena River sampling.
Saturday 22 February:	CPE1, fuelling in Port Hardy in the afternoon.
Sunday 23 February:	Pick up IOS Viking buoy in Powell River.
Monday 24 February:	Return to IOS, offload.

CRUISE TRACK:





SUMMARY/FINAL COMMENTS:

- Many thanks to everyone at IOS and on board who have helped make this cruise a success, as much in the lab getting things ready as on board getting the ship ready and helping with watches. Also a special "thank you" to Germaine who looked at our first few casts and made sure that all was fine with our equipment even though we left on a weekend, and to Marty for sending the hand warmers.
- Thank you to Ocean Networks Canada for the use of their satellite system.
- Thank you to Captain Corfield for help with weather forecast, and for everyone on the bridge keeping us on station without excessive use of the bow thrusters!
- Thanks to bosun Johnny and his whole crew. And a special thank you to the "deck guys" who worked with the Go-flo team in the chains. That was much appreciated. Thanks also for picking up the Viking buoy even though that wasn't part of the original plan!
- Thanks to the engineering department for putting up with all our requests for tank retention (and for fixing everything!)
- Thanks to Shane and Chad for trying to get my new laptop going at the beginning of the cruise, and to finally manage to at least get the old one somewhat hooked up. Thanks to Shane for your help with so many little things during the cruise, and to Chad for setting up the weather station at the beginning of the cruise.
- A major thanks to the whole galley crew for feeding us so well and looking after us in such a wonderful way! You guys did great especially with the circumstances and the weather! Thanks Meghan for all the special meals, and good luck with everything Connor!
- Thanks to the cadets (and everyone else) who entered the weather data in the spreadsheet.
- Finally, farewell to Chief Engineer Roger and to sea-going technician Hugh. We had easy cruises together, we had tougher ones, but all of them were good. We'll miss you guys … wishing you happy retirements!

Marie Robert

- I would like to thank all the people of this cruise. The captain and crew made us sail successfully. The chief scientist and my watch leader insured my sample collection going smoothly. And the cooks provided us with tasty foods. I would like to thank Dr. Sophia for helping me collect samples when I am not able to.

Xuan Zheng

- Thank you to the Coast Guard crew for providing a welcoming and warming accommodation, as well as the deckhands who helped with the deployment of Go-Flos. I would also like to thank IOS for giving me the opportunity to conduct research along Line P again!

Racquelle Mangahas

- I would like to thank Max, James, Spencer and Tom for all their help launching the Go Flos and the captain and crew of the CCGS J.P. Tully for all their support in these challenging conditions.

Danielle Caleb

- Thank you, Marie, for including the Chatham Sound stations in this cruise! I would like to thank all the members of the science party for help with sampling, and the officers and crew of the Tully for their professional and friendly support. I would particularly like to thank the galley crew and stewards for making and serving wonderful vegetarian and nut-free meals throughout the cruise, even under very difficult weather conditions.

Sophie Johannessen

- Our sincere thanks to the captain and crew of the John P. Tully, our chief scientist Marie Robert, our watch leaders, and all personnel aboard who helped make this a successful cruise.

Sile Kafrissen and Michael Livingston

- I thank the Captain of the Tully for the opportunity to do science on a ship. It was an incredible experience. And Marie Robert! (Where do I start!) I cannot thank you enough for this (probably once a lifetime) opportunity, for accommodating things last minute so that I could filter in time and still be able to collect all the samples, sampling for me and also helping me when I got sick. Thank You Very Much!!! I would also like to thank Dr Sophia Johannessen for accommodating me last minute for river water sampling. I am really glad I could do that. I also want to thank crew members Tom and John for taking us into the adventurous river water sampling ride in the freezing cold and especially John for, literally, sampling for me. And last but not the least, I would like to thank the entire crew for making it the most comfortable sampling experience I have ever had.

Jyotsnamani Mohanta

PROJECTS AND RESULTS:

Water masses – Marie Robert, DFO/IOS.

The February and June 2019 data featured some important temperature anomalies along Line P (fig 1) with respect to the 1956-1991 averages. By August the waters were still very warm compared to the old averages (fig 2 left panel). This February (fig 2 right panel) the temperature anomaly field was mainly dominated by an eddy that we sampled between P24 and P25 (fig 3). All temperature anomaly graphs are done with the same scale for easier comparison.

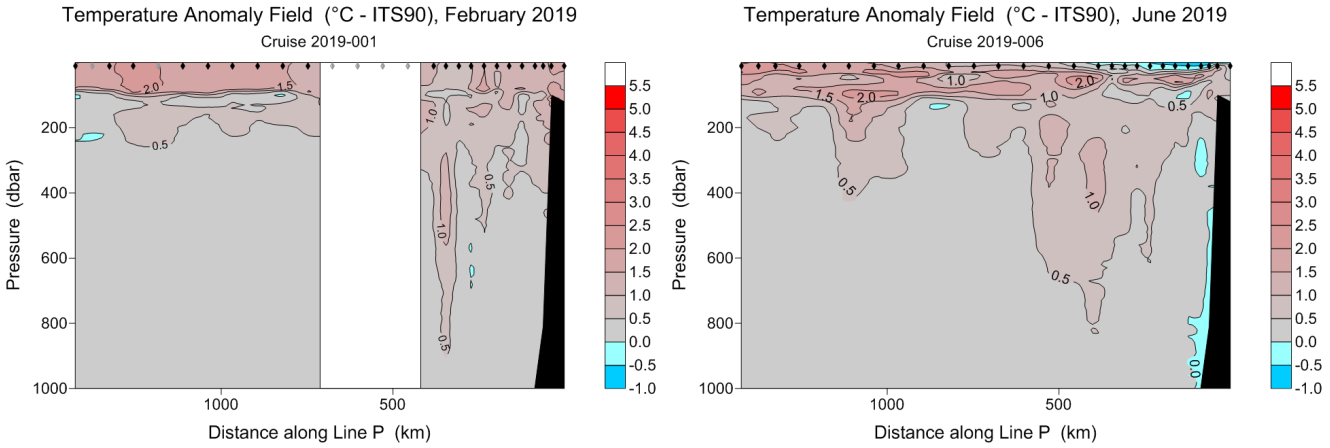


Figure 1: Temperature anomaly field with respect to the 1956 – 1991 averages for February 2019 (left panel) and June 2019 (right panel).

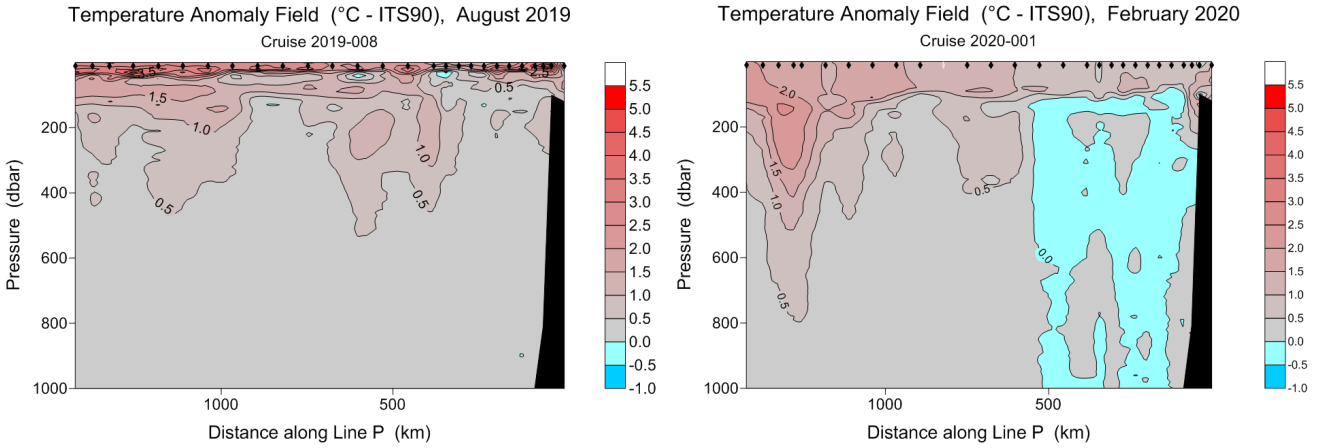


Figure 2: Temperature anomaly field with respect to the 1956 – 1991 averages for August 2019 (left panel) and February 2020 (right panel).

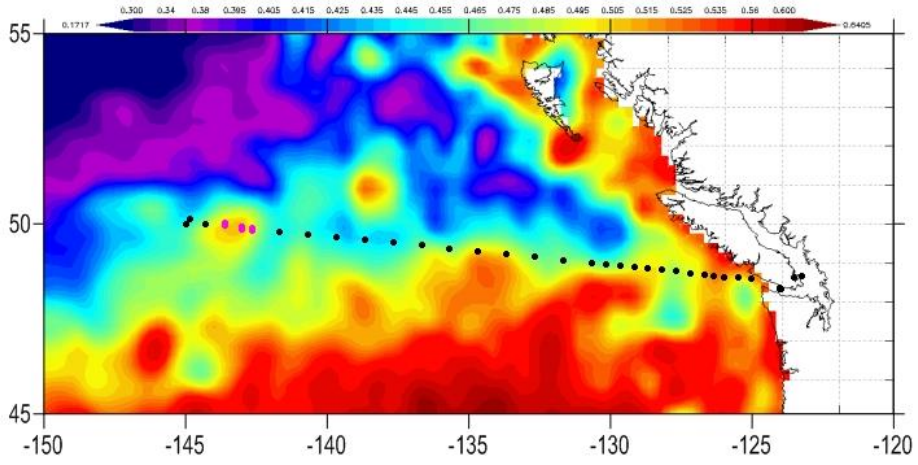


Figure 3: Sea-level height anomaly in metres on 14 February 2020 with the Line P stations indicated by a black dot and P24, Eddy and P25 indicated by a magenta dot.

DMS system – Michael Arychuk, DFO/IOS.

The dimethysulfide system did not perform well on this cruise. Despite being tested out before the cruise, upon reaching Station P2, the system started to behave erratically. Reproducibility and an unacceptable calibration curve resulted in the data for P2 being flagged and P4 being cancelled for DMS. In an attempt to isolate which component (purge and trap, gas chromatograph or detector) could be causing the problem several parts of the purge and trap were replaced. A calibration was subsequently run and shown to give a very good curve and reproducibility. Another calibration was run before the P12 samples and despite there being some reproducibility issues at the beginning an acceptable calibration was eventually obtained and the samples were able to be run. However, the next day all the problems returned. Reproducibility and sensitivity issues plagued the system and the focus turned towards the gas chromatograph and/or detector. The photomultiplier tube in the detector was replaced but it did not have any impact. The detector was taken apart and cleaned but there was nothing obvious that could be the cause of the problems. The technical notes for the gas chromatograph refer to "sensitivity" issues possibly being caused by a faulty "signal board" in the gas chromatograph and to "replace the board." Unfortunately, this gas chromatograph is over 25 years old and parts such as signal boards are no longer made. In any respect, in an attempt to access the board for inspection, and while putting the detector back together, the one of the wires for the ceramic heater disintegrated upon touch due to decades of heating and cooling. As with the signal board, the manufacturer no longer makes heaters for this model of GC and for all intents and purpose the system at that point became inoperable. No DMS samples were collected for P16, P20 or P26.

The situation with the DMS system is not surprising considering the age of the instrument. Inevitably there is a point where one has to consider replacing components on the system because the manufacturer no longer has the resources to make parts or offer service. The DMS system is comprised of components ranging from 15 to 30 years of age and for this reason a plan was implemented a couple of years ago to replace the detector and gas chromatograph with current technology. In December 2019 a new gas chromatograph and detector were delivered and a new dimethyl system is currently being designed. This system should be operational within a year. In the meantime, DMS will be analyzed by the GC currently being used for the DMSP system.

February 2020 Line P – Xuan Zheng, Heather Reader's lab (Memorial University of Newfoundland)

Background

Dissolved organic matter plays an irreplaceable role in the sea-surface photochemical reactions, global carbon storage and biological activities in the ocean. My project is characterization of dissolved organic matter in marine environments.

Sampling

I collected samples for dissolved organic carbon (DOC), chromophoric dissolved organic matter (CDOM) in full-depth profiles at stations P2, 4, 8, 10, 12, 14, 16, 20, 22, 24 and 26. Exchangeable dissolved organic carbon (EDOC) samples are collected at the 12 shallowest depths at stations P4, 16, 26. All the samples were collected using an Opticap 0.22-micron cartridge filter, and were filtered directly from the Niskin bottle.

Details

Our lab uses an advanced TOC analyzer and UV-Vis spectrophotometer to measure the concentration of DOC and the absorption coefficient of CDOM. For DOC and CDOM samples, our aims are to repeat what other scientists did on Line-P in the last year and to discover something new this year. Thus, we can get the distribution of DOC at different depths along Line-P. We can also gain more information after the measurement of the absorption of CDOM. We will do fluorescent dissolved organic matter (FDOM) sample analyses this year. For the improvement of DOC analysis methods, we collected EDOC samples to determine what is often neglected while we measure DOC in the seawater samples. SPME and ESI-MS may be used for this experiment.

Acknowledgements

I would like to thank all the people of this cruise. The captain and crew made us sail successfully. The chief scientist and my watch leader insured my sample collection going smoothly. And the cooks provided us with tasty foods. I would like to thank Dr. Sophia for helping me collect samples when I am not able to.

LINE P Cruise Report (2020-001) – Racquelle Sabrina Mangahas, UBC, Maldonado Lab

Dust mixed with anthropogenic pollutants originating from the desert regions and highly urbanized as well as industrialized cities in Asia can be transported into the Pacific Ocean by strong northwesterly winds, with some undergoing long range transport to North America. They enter the troposphere (0-10/15km layer of the atmosphere), with the chemical composition being made up of, for example, ammonium, nitrate, carbonaceous material and, which my research is primarily focused on- trace metals. Aerosols can be removed from the atmosphere through dry or wet deposition, and enter the surface waters of the Pacific Ocean, thus possibly affecting phytoplankton productivity.

For this cruise, I collected dry deposition of aerosol trace metals on Whatman41 filters using the TE-5170V-BL Total Suspended Particulate Volumetric Flow Controller High Volume Air Sampler connected to Instromet Weather Systems Ltd Wind Speed and Direction Switch, in order to avoid the ship's stack exhaust, on Monkey's Island. To collect wet deposition, I also placed trace metal clean bottles on the handrail beside the Air Sampler. Along with Danielle Caleb (IOS), I obtained dissolved trace metal and chemical speciation samples at the five major stations at the depth of 10m and 35m through the usage of 10L Go-Flos on the Kevlar line via messenger release.

In the future, on the May and August/September cruises, I will continue doing the above, as the trace metal composition of these Asian-derived aerosols is found to vary seasonally. I hope to eventually collect size-fractionated chlorophyll, RNA and DNA samples to investigate the potential effects these trace metal aerosols may have on phytoplankton physiological responses and community dynamics.

Aside from my own research, I also sampled for dissolved silver at JF2 and P4, a continuation of the MetroVan project (Maldonado Lab, UBC) investigating its leakage from wastewater treatment plants in coastal BC. Additionally, I collected some microbial cell counts, SAGs, DNA and RNA samples at SI03 for the Hallam Lab (UBC).

Thank you to the Coast Guard crew for providing a welcoming and warming accommodation, as well as the deckhands who helped with the deployment of Go-Flos. I would also like to thank IOS for giving me the opportunity to conduct research along Line P again!

LINE P Cruise 2020-001 – Danielle Caleb, DFO/IOS

Go Flos

Filtered (0.2 micro) seawater samples were collected for trace metal analysis and chemical speciation, and unfiltered sea water was collected for trace metal, salinity and nutrient analysis. All Go-Flos were deployed on a Kevlar line using a messenger release system, once the Go-Flos were recovered they were transferred to a trace metal clean container to sample the water from the Go-Flos.
At JF2 station, five Go-Flos from UBC were deployed at depths of 80m, 100m, 120m, 140m and 160m. The Go Flo at 100m did not trigger and was lowered back to 100m to be redeployed. Dissolved silver samples were collected from filtered seawater at all depths.
At P4, two casts of Go-Flos were deployed. The first cast was a shallow cast with six Go-Flos from IOS at 10m, 35m, 50m, 100m, 150m and 250m. The second cast was five Go-Flos from IOS deployed at 300m, 350m, 400m, 600m and 800m. Trace metal samples were collected from all depths, speciation samples were collected from 10m, 35m and 50m, and dissolved silver samples were collected at 250m, 300m, 350m and 400m. Go-Flos from 800m and 400m were leaking from their spigots.

All Go-Flos from IOS were soaked from 10m - 150m at P8 for an hour to help rinse them of the high metal concentrations from P4, and only IOS Go-Flos were used at all other stations.

A shallow cast of Go-Flos deployed at 10m, 35m, 50m, 100m and 150m, and a deep cast of Go-Flos deployed at 250m, 350m, 400m, 600m and 800m was performed at stations P12, P16, P20, EDDY, and P26. All Go-Flos were triggered without issues, however a couple of Go-Flos were leaking once in the trace metal container and samples were not able to be collected at 400m from P20 and 800m from P26. Trace metal samples were collected from all depths, speciation samples were collected from 10m, 35m and 50m.

An additional cast was performed at P26 at depths of 10m, 25m and 35m to collect filtered seawater for UBC and UVIC.

I would like to thank Max, James, Spencer and Tom for all their help launching the Go Flos and the captain and crew of the CCGS J.P. Tully for all their support in these challenging conditions.

Station P carbon export and Chatham Sound nutrient budget - Sophia Johannessen, DFO/IOS

Station P carbon export (collaboration with Andrea Fassbender, Monteray Bay Aquarium Research Institute, USA)

Background and goal

The ocean helps to reduce the effects of global climate change by absorbing heat and carbon dioxide at the surface. The ocean's uptake of carbon dioxide is limited by the rate at which carbon can be exported from the surface layer. Phytoplankton transform the carbon dioxide into particulate inorganic carbon and dissolved and particulate organic carbon. Some of the particulate carbon sinks into deeper water, trapping the carbon away from the surface and from the atmosphere. Some of the dissolved organic carbon returns to carbon dioxide, but some of it persists in the ocean for thousands of years.

The goals of this project are: 1) to determine the proportions of dissolved and particulate organic carbon produced in surface waters near Station P; 2) to determine the rate of export of particulate organic and inorganic carbon; and 3) to predict these proportions and the rate of export from satellite ocean colour data.

Sampling

We collected samples of total and dissolved organic carbon and coloured dissolved organic matter in full depth profiles at stations P24, 25, 26 and 35, as well as particulate organic and inorganic carbon in full depth profiles at stations P24, 26 and 35.

Comments

We collected all the samples that we came for, except for the profiles of PIC and POC at station P25. We skipped the PIC/POC at P25, because there were not enough people, time or collection bottles to filter all those samples before the next (more important) cast at station P35.

We ran out of freezer space on this cruise. I recommend that collaborators on multi-program cruises give an estimate of their requirements for refrigerator and freezer space to the Chief Scientist well ahead of the cruise.

Chatham Sound nutrient budget

Background and goal

Nutrients from wastewater or other land-based discharges can cause problems for marine life, including fish. Environmental impact assessments of new coastal developments often include an assessment of the release of nutrients, but these assessments do not usually include the natural cycle of nitrogen. In some places, like the St. Lawrence, runoff from farming and other discharges has resulted in low oxygen in the deep water. In other places, like the Strait of Georgia, all the human sources together make up less than 1% of the total nitrogen budget; in the Strait of Georgia, the ocean supplies nearly all the nitrogen, and local sources are not significant.

We do not know the relative importance of the ocean and local sources of nitrogen in Chatham Sound. With increased industrial development proposed for Prince Rupert, we need to find out. The goal of this project is to determine the natural sources, burial and exchange of nutrients in Chatham Sound to provide context for future development.

Sampling

We collected nutrient samples (nitrate + nitrite, phosphate, silicate) at 31 stations in Chatham Sound and its approaches, as well as at four samples in the Skeena River. We also collected other types of samples and data that will help to interpret the nutrient data: temperature, salinity, dissolved oxygen, suspended particles, dissolved and total organic carbon, dissolved inorganic carbon, and oxygen stable isotopes.

Comments

We had to skip some stations due to stormy weather, but we were able to complete all the high-priority stations. Overall, the sampling was very successful.

Thank you, Marie, for including the Chatham Sound stations in this cruise! I would like to thank all the members of the science party for help with sampling, and the officers and crew of the Tully for their professional and friendly support. I would particularly like to thank the galley crew and stewards for making and serving wonderful vegetarian and nut-free meals throughout the cruise, even under very difficult weather conditions.

Cruise Report: Line-P 2020-001, February 9th-24th 2020 - Sile Kafrissen and Michael Livingston
Varela Lab, University of Victoria

Phytoplankton form the base of the marine food web and are extremely important in large-scale Earth processes such as oxygen production and carbon sequestration. The physiological processes of phytoplankton link the ocean, atmosphere, biosphere and lithosphere together in a global biogeochemical cycle. Understanding the functional characteristics and physiology of natural phytoplankton assemblages can help us understand how phytoplankton influence ocean chemistry and support higher trophic levels in the ocean. Of particular interest are a group of large, nutrient rich phytoplankton called Diatoms which build shells, called frustules, out of silica. In order to understand the particular role that diatoms play in the ocean, we can investigate the marine silicon cycle to see how concentrations of dissolved and particulate silica in the ocean fluctuate during the growth and decay of blooms.

Experiments designed to measure maximum silicon and nitrate uptake rates, as well as ambient productivity rates were conducted at 5 major stations along Line P. Additionally, biomass samples were taken at two stations in the Dixon Entrance/Hecate Strait area; DIX3 and HECS8. Net primary production was measured via carbon uptake, new production via nitrate uptake, and silica productivity via ^{32}Si uptake. Incubations were also enriched to various levels of nitrate and silicic acid concentrations above the ambient values (1, 2, 3, 4, 8, 12, and 20 µM additions) in order to determine maximum uptake rates of the natural phytoplankton assemblages. Incubations were performed at P4, P12, P16, P20, and P26. Samples were taken at 2 depths, 5 m and below the mixed layer. Water was collected into 300mL-2L polycarbonate bottles and spiked with an isotopic tracer. Added spikes were: 1) Radioactive ^{32}Si as $Si(OH)_4$ and stable $Si(OH)_4$ for enrichment, 2) combined $NaH^{13}CO_3$ and $Na^{15}NO_3$ as well as $Na^{14}NO_3$ for enrichment. Samples were placed in an incubator on the helideck with tubes screened to reduce light levels especially in the long (red) wavelengths. Surface seawater was pumped through the incubator to keep temperatures similar to SST. After at least 24 hours, the samples were removed from the tubes. Samples were filtered onto 0.75 µm combusted GFF filters or 0.65 µm PC filters. Samples for incubation blanks were collected from a Niskin in the mixed layer and spiked just prior to filtering.

At each depth the following samples were collected: triplicate dissolved silica (dSi), nutrients, fatty acid, particulate phosphate and phyto ID samples, triplicate samples for bacteria and transparent exopolymer particles (TEP), triplicate samples for total and size fractionated chlorophyll-a and particulate biogenic silica (bSi) analysis. For Chl-a, half of the 1 L sample was filtered directly onto a 0.75 µm GFF and half was filtered onto a 20 µm PC filter before being filtered into 5µm PC filter and finally onto a 0.75 µm GFF. Additionally, particulate silica was also size fractionated at both depths by filtering first onto a 5µm PC filter and then onto a 0.65 µm PC filter. Triplicate 1 L samples were also collected at each depth for total particulate organic carbon (POC) and nitrogen (PON).

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Our sincere thanks to the captain and crew of the John P. Tully, our chief scientist Marie Robert, our watch leaders, and all personnel aboard who helped make this a successful cruise.

Cement-ball Sponge-Bob drifter – Tom Juhasz.

This is the 7th attempt and the current pointy-end of a long development saga. Prototypes 1 and 2 were 50-50 success, prototypes 3 and 4 were total disaster, prototypes 5 and 6 are still awaiting deployment, and P7-1 is yours to do with as Roy (Hourston) and Charles (Hannah) see fit. The sponge buoys, (SCTs), are still working fine, but while they are apparently good as science tools in the hands of people who care about the outcome, like you, Roy, and others at IOS, ultimately they are not robust enough for the work-a-day, commercial and engineering operations. Thus the new design based on the use of CFC (floating cement) for the hull, which replaces the sponge, wood, and most of the metal, and allows for simplification of the design. Further, in this design, beside robustness, I can provide variable/improved drag ration, variable drogue size and depth, quadruple operation life, symmetrical surface component to reduce drift biases from wind and wave, and still retain the other desirable features of the SCT. I could still use boxer shorts for a drogue to adhere to the square pants theme. I would like to acknowledge the role and thank everyone at IOS and on the *John P Tully* who have been involved in the saga of “Sponge-Bob the drifter”.

LINE P Cruise 2020-001 – Jyotsnamani Mohanta, University of Saskatchewan

Background: The study of chemical speciation of trace elements in environmental samples is important because the effect of elements, especially the trace heavy metals, on ecological and biological systems are generally influenced by their individual chemical forms. Some elements exist in more than one oxidation state. Cr exists in 5 oxidation states but Cr(III) and Cr(VI) are the dominant species out of which Cr(III) is insoluble while Cr(VI) is present in aqueous state. Now speciation of elements like Cr is a very challenging task especially due to changes in the species and oxidation state of Cr during sample handling and analysis.
I would be analysing the seawater collected from the Line P for $\delta^{53}Cr$ (total Cr) in seawater and $\delta^{53}Cr$ in dissolved species, Cr(III) and Cr(VI) along with their individual concentrations.

Work onboard: I collected samples at Stations 59, P2, P4, P8 and CH27 from the rosette and from the Skeena river while on board the Tully. I filtered the seawater onboard while the analysis for both Total Cr and Cr speciation would take place in the Saskatchewan Isotope Laboratory. I also got to learn how to collect for salinity, DIC, chlorophyll, nutrient etc. samples during my shift. I collected river water along a salinity gradient from 1.8 to 23.7. This salinity range also constitutes estuarine type mixing. We already have an idea on total Cr concentrations in river water and seawater but the new data generated from this study would give us an idea on "which Cr species contribute the most to the Total Cr" in 3 different environments i.e., river, estuary and seawater. This would also help us understand the behavior of Cr species during its journey from river through estuary and finally into the sea and would provide us with more information to interpret the Cr cycle in seawater.

Acknowledgement: I thank the Captain of the Tully for the opportunity to do science on a ship. It was an incredible experience. And Marie Robert! (Where do I start!) I cannot thank you enough for this (probably once a lifetime) opportunity, for accommodating things last minute so that I could filter in time and still be able to collect all the samples, sampling for me and also helping me when I got sick. Thank You Very Much!!! I would also like to thank Dr Sophia Johannessen for accommodating me last minute for river water sampling. I am really glad I could do that. I also want to thank crew members Tom and John for taking us into the adventurous river water sampling ride in the freezing cold and especially John for, literally, sampling for me. And last but not the least, I would like to thank the entire crew for making it the most comfortable sampling experience I have ever had.