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:** 13 August 2019 **TO:** 29 August 2019

SCIENCE CRUISE NUMBER: 2019-008 **SHIP'S PATROL NUMBER:** 19-06

CHIEF SCIENTIST[S]: Marie Robert

SCIENTIFIC PERSONNEL:

Female	Male
Moira Galbraith (IOS)	Mike Arychuk (IOS)
Sile Kafrissen (UVic)	Michael Livingston (UVic)
Chelsi Lopez (U Miami)	Hugh Maclean (IOS)
Racquelle Mangahas (UBC)	Richard Nelson (BIO)
Marie Robert (IOS)	Chris Payne (UBC)
Jade Shiller (UBC)	
Robyn Taves (UVic)	

Unfortunately Jyotsnamani Mohanta from University of Saskatchewan did not get her security clearance on time therefore she could not participate in the cruise.

AREAS OF OPERATION: Saanich Inlet, Juan de Fuca and Haro Straits, North East Pacific, Line P, Station P.

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 eight drifters for IOS (seven Argo floats and one Sponge-Bob); repeat Cesium sampling; repeat Trace Metal sampling; repeat TOC/DOC/CDOM/PIC/POC sampling.

CRUISE DESCRIPTION: This cruise (2019-008) was quite interesting "weather-wise". Usually in August the seas are calm, there is not much wind and there is a lot of fog. This cruise turned out to be quite windy, with roughly a day of delay because of storms, and the fog horn wasn't heard a single time. Otherwise it was a pretty typical cruise with a bit of gear issues but nothing major.

DAYS ALLOCATED: 16 **DAYS OF OPERATION:** 15

DAYS LOST DUE TO WEATHER: ~1 hour between P4 and P6; ~9 hours between P24 and P25; ~12 hours between P25 and P26.

SAMPLING:

- The Line P survey was 100% successful. All casts at all stations were completed.
- Seven "Arvor 1" Argo floats and one "cement Sponge-Bob" drifter were deployed for IOS.
- The samples collected include:

1) Underway: **IOS**: Thermosalinograph (Temperature, Conductivity, Fluorescence), acoustic sounder, pCO_2 – **MBARI (Lopez 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 **– DFO-BIO (Nelson):** Cesium, ^{129}Iodine – **UBC (Shiller):** high-resolution bacterial DNA sequencing, number of cells per millilitre, single cell DNA analysis, virus analysis, viral counts – **U. MIAMI (Lopez):** DOC, TOC, CDOM, PIC, POC, Gels – **UVic (Livingston, Kafrissen)**: C/N/Si uptake rates (productivity), biogenic silica, size-fractionated chlorophyll, phytoplankton, bacteria, nutrients, dissolved silica, transparent exopolymer particles, POC, PON, fatty acids, particulate phosphate.

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

5) From the Trace Metal Rosette: **UVic, UBC (Taves, Mangahas, Payne):** dissolved (<0.2 μm) and total dissolvable (unfiltered) trace elements, nutrients, salinity, chlorophyll, RNA, cell count and particulate organic matter

RADIOISOTOPE USE:

^{32}Si radioisotopes were used during this cruise. The work was carried out in the Rad-Van. The fume hood of the Rad-Van got certified before we left the dock. Since the lab is being used for the same work by the same people on the following cruise (La Perouse 2019-023) the lab was not decommissioned at the end of this cruise.

PROBLEMS [SCIENTIFIC GEAR AND OPERATIONS]:

This was the first time that the new label printer was used on a Line P cruise. We had many hiccups during the first couple of days with the system, with random labels being printed, or the communication being lost between the laptop and the printer. Finally we managed to use the new label printer but some work will have to be done to make it more bullet-proof. It was very fortunate that we had some of the old labels onboard.

The ship position being recorded in the TSG data file is wrong. We'll have to use the time stamp from other files after the cruise to get the correct position into the TSG files.

There were some kinks in the CTD conducting cable at the very beginning of the cruise.

Logistics for the Trace Metal winch and related gear was poorly planned and not well communicated. The CCG Winch shop was asked at the last minute to pick up the winch. They have done so in the past as a favour but it should not be assumed and should have been arranged well in advance. They also noted a few problems with the TM winch and proceeded to fix/repair it in the interest of the program. Here are the details from Greg Middleton, head of the winch shop:

> Work performed on the Trace Metal winch:
> -Removed level wind rollers and pivoting mechanism which actuates the level wind motor thru contact switches.
> -cleaned all components, lubricated and re assembled.
> -Bolts on the pivoting mechanism were miss-aligned and not contacting the switches properly and or sticking, holding down one of the switches making the level wind move on its own.

-These bolts were removed and washers welded to the head of the bolt to make a better contact surface to activate the switches.
-Once assembled the function of these switches was tested along with the end stop switches, all operated as they should.
-The hydraulic tank was filled as it was pretty well empty.
-All other components of the winch were inspected, greased and lubricated. There were no obvious signs of hydraulic leaks causing the low level in the Tank.
-Roughly 3 hours for 2 techs.

It should not be part of the CCG winch shop tasks to service, nor to provide the supplies needed to fix, a winch belonging to universities.

DFO/IOS provided some Go-flo bottles and messengers for the Trace metal work. This request in itself can be fine as part of collaborative work, but again it came at the very last minute (for two of the bottles). Outside users have to remember that IOS staff has their own work to perform and it may not be convenient for them to put everything aside because the ship is about to sail.

When we arrived at P26, we discovered that one bongo sock had come loose and flipped over the side of the vessel. Upon impact with the vessel's stern, the thumb of the carabineer broke off, effectively making the remaining part a hook, which then ripped into the net, tearing several holes in the lower portion. We then switched to the backup set of bongos and used them for the rest of the cruise.

SUCCESSES [SCIENTIFIC]:

The Niskin bottles are working better than they ever have, with no leaking and no very stiff spigots.

Once the new label software was setup to work, the printed labels seemed of better quality than the old ones.

The pCO2 system worked well on this cruise with no problems. The data were consistent with previous cruises.

The inaugural cruise for the new Rad-van went really well with no issues.

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

At the end of the last P21 rosette cast the forward latching mechanism of the LARS head had a hydraulic leak. Hydraulic oil spilled over the rosette, although fortunately mostly over the Niskins that were already closed. Nevertheless, the rosette still had to be properly cleaned and the latching mechanism had to be fixed.

Just as the rosette was at the surface at P23 it was noticed that the wire had jumped off the sheave. While the rosette was recovered the latching mechanism failed again, and again the rosette was covered with oil, this time with all the Niskins opened. During recovery we also noticed that all the tape covering the termination had been stripped off, and the conductive cable had many kinks in it. We had to reterminate, removing ~110 m of wire. The LARS latching mechanism got fixed again.

The LARS head kept dripping oil very slowly for a few more days until the pressure in the LARS head cylinders got adjusted.

SUCCESSES [SHIP]:

The loading for this cruise happened really smoothly.

The Rad-Van fume hood was certified without any problem.

DELAYS [OTHER THAN WEATHER]:

An hour or so on major stations for "Tank breaks".
~4.5 hours at P23 for retermination of the CTD wire and fixing the LARS hydraulic leak.

SAFETY CONCERNS:

None.

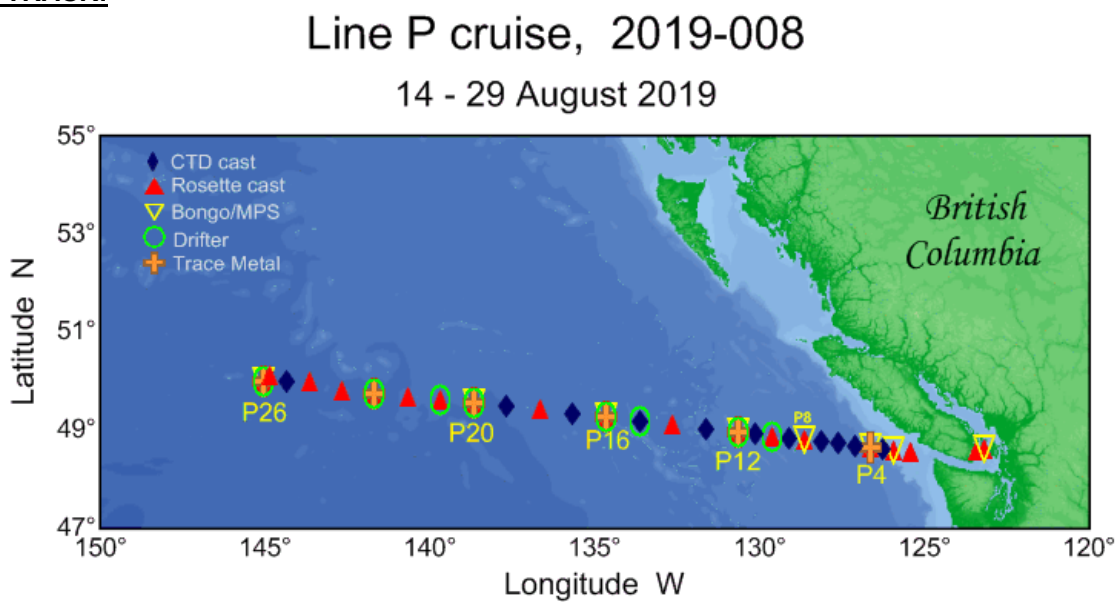
HAZARDOUS OCCURRENCES:

One person scraped the skin off their shin slipping off the side of the rosette while trying to clean the oil. No major harm was done.

EVENT LOG:

Tuesday 13 August:	Load science gear after lunch, containers, some winches.
Wednesday 14 August:	Load last winches. Rad-Van fume hood testing. Safety meeting at 0900. Leave Pat Bay at 1230. Fire and boat drill at 1300. Saanich Inlet cast. Science meeting at 1600. Station 59.
Thursday 15 August:	Stations P1 to P4.
Friday 16 August:	Stations P4 to P10. Deploy Argo float at P10.
Saturday 17 August:	Stations P11 to P13. Deploy Argo float at P12.
Sunday 18 August:	Stations P14 to P16. Deploy Argo float at P15.
Monday 19 August:	Stations P16 to P19. Deploy Argo float at P16.
Tuesday 20 August:	Stations P20 and P21. Deploy Argo float at P20 and P21.
Wednesday 21 August:	Stations P22 to P24. Deploy Argo float at P23.
Thursday 22 August:	Station P25. Weather day, waiting ~9 hours before P25, ~12 hours after P25.
Friday 23 August:	Station P26: five rosette casts (Deep, DMS, Chem, 2x Cesium), 250m bongo, 400m TMR.
Saturday 24 August:	Station P26: Two rosette casts (UBC, Productivity), two TMR casts (4000m and 30), 2500m MPS, Deploy Sponge-Bob drifter. Stations PA-013 and P35. Start sailing east.
Sunday 25 August:	Sailing east.
Monday 26 August:	Sailing east.
Tuesday 27 August:	Sailing east. Revisit Station P4.
Wednesday 28 August:	Arrive at IOS and offload. Fuelling in the afternoon.

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 cast and made sure that all was fine with our equipment.
- Very special "thank you" to Greg Middleton for moving the Trace Metal gear to IOS so it could be loaded, and mainly for the repairs on the Trace Metal winch so it could be used at sea without impacting the program.
- Welcome to Captain Barker on a Line P cruise! Everything went really well, and thank you for your help with weather forecasting.
- Thanks to bosun Johnny and his whole crew. As usual you guys were always there to help with all we did. Special thanks for the help with all those Argo deployments.

- Thanks to the engineering department for putting up with all our requests for tank retention.
- A big thank you to the officers for hours and hours of station keeping and adapting to sometimes last minute plans, as well as for sending the Grib files every day.
- Thanks to Andrew for your help with those little things that can be really annoying, and for keeping the ONC system in good order.
- Finally, a major thanks to the galley crew for feeding us so well and looking after us in such a wonderful way! The food was amazing and the smiles wonderful.

Marie Robert

- We'd like to give a special thank you to the crew of the *CCGS John P. Tully* for their amazing work handling the trace metal rosette and winch, especially during rough seas. Thanks to the Captain and the rest of the crew for a successful trip and thank you to Marie for re-accommodating the TMR casts during poor sea conditions.

Robyn Taves, Chris Payne, Racquelle Mangahas

- I very much appreciate the inclusion of SI03 in the sampling plan and IOS's willingness to collect and process oxygen and nutrient samples at this station. This is vital to maintaining the time series that the Hallam and Tortell labs began more than 10 years ago, so thank you very much to everyone who helped sample and those who analyzed the samples in Saanich Inlet.
- I'd like to thank the captain and crew of the *Tully* for their excellent work and their interest in and support of our scientific program. Thanks to the galley crew for keeping us extremely well fed. Thanks to the IOS team and my fellow scientists for their help and their humour on deck and in the lab. And finally, a great big thank-you to Marie for her amazing organization in the face of ever-changing conditions.

Jade Shiller

- Thanks to the officers and crew of the CCGS John P. Tully for the work to make this a successful cruise. Special thanks to Marie Robert for all of the wire time and all those who helped carry the 24 ℓ carbouys.

Rick Nelson

- I also wanted to say a huge thank you for allowing me to conduct my research alongside IOS. It was a great experience considering this was my first research cruise ever and I really appreciate being given the opportunity to do so!

Racquelle Mangahas

- Many thanks to the Captain and crew for making the Tully such an excellent scientific sampling platform.

Moira Galbraith

- 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

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. This August the waters are still very warm compared to the old averages (fig 2 left panel), and they also seem rather fresh offshore, down to about 150 m (fig 2 right panel). All three temperature anomaly graphs are done with the same scale for easier comparison.

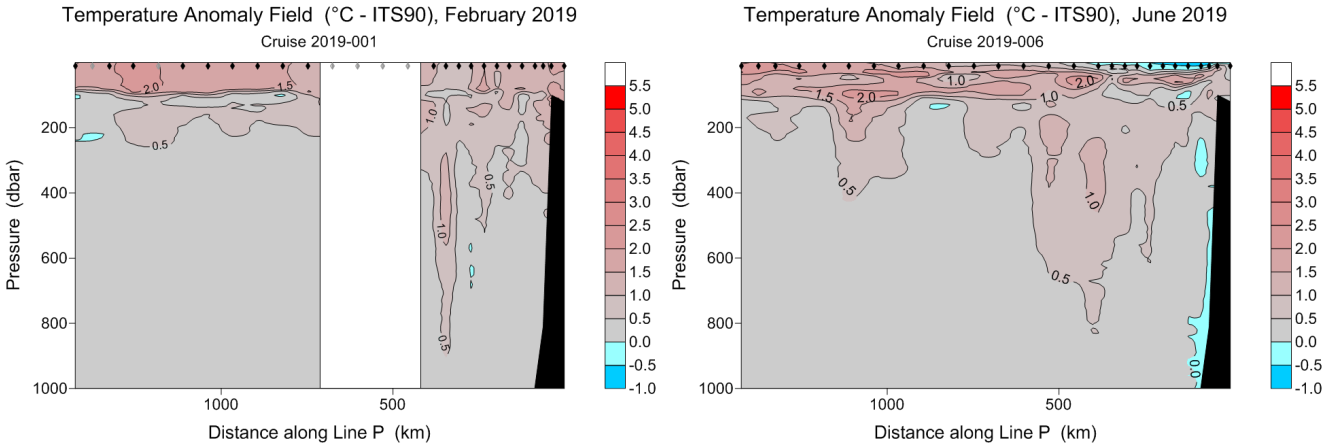


Figure 1: Temperature anomaly field with respect to the 1956 – 1991 averages for February 2019 (left panel) and June 2019 (right panel) showing warmer waters at the offshore end of Line P, with a slight surface cooling near the coast in June.

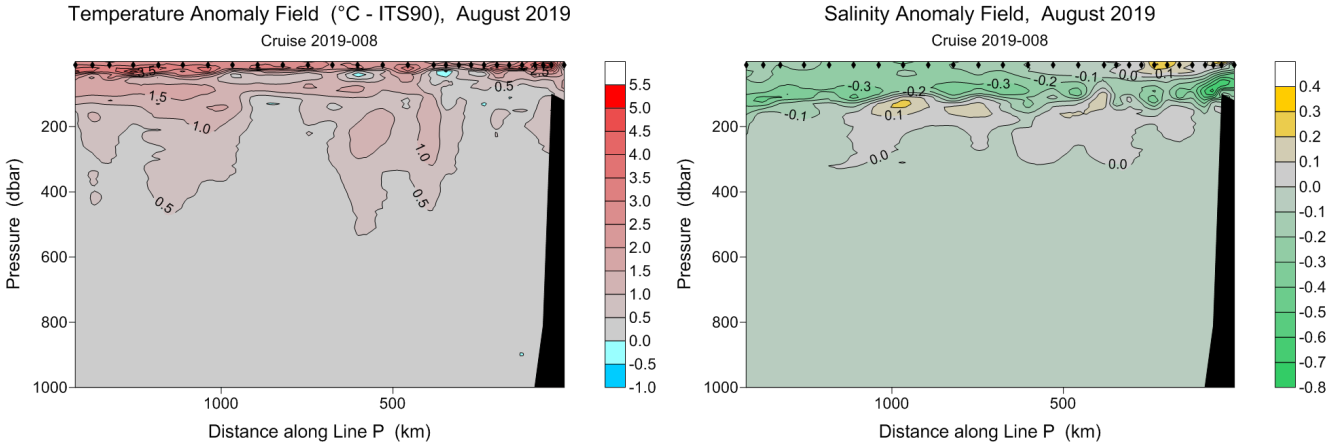


Figure 2: Temperature anomaly field (left panel) and Salinity anomaly field (right panel) with respect to the 1956 – 1991 averages for August 2019.

Trace Metal Sampling- Robyn Taves (UVic), Chris Payne (UBC), Racquelle Mangahas (UBC)

PI
Dr. Jay T. Cullen
School of Earth and Ocean Sciences
University of Victoria, Victoria, BC
jcullen@uvic.ca

Dr. Maite Maldonado
Earth, Ocean & Atmosphere Sciences
University of B.C., Vancouver, BC
mmaldonado@eos.ubc.ca

Dr. Andrew Ross
Institute of Ocean Sciences
Sidney, BC
Andrew.Ross@dfo-mpo.gc.ca

Samples Collected
Filtered (0.2 micro PALL Supor Opticap) and unfiltered seawater was collected for trace metal analysis (UVic), and for speciation and incubation analysis (UBC). Unfiltered seawater samples were collected for nutrient and salinity analysis.

Background
Trace metal samples continue to be collected at the major Line P time series stations in support of ongoing investigations of trace-metal biota interactions and metal biogeochemistry. The sampling supports an ongoing GEOTRACES process cruise project between UBC-UVic and IOS.

Methods
Seawater sampling was performed using a trace metal rosette (TMR) system that consists of a 12-position powder coated rosette frame equipped with 12 ℓ, Teflon coated GO-Flo (General Oceanics, Miami, USA) bottles and a SeaBird 911 CTD/SBE 43 Oxygen sensor instrument package. Seawater was filtered in a new HEPA filtered 10ft container modified for this purpose after bottles were removed from the rosette and placed on racks inside the container. Seawater for trace metal analysis was acidified with 12 N HCl to a final pH of ~1.7. Archived samples will be returned to the laboratory for subsequent analysis for dissolved trace metals using offline pre-concentration followed by inductively coupled plasma mass spectrometry (ICP-MS). Samples for dissolved organic ligand analysis will be returned to the lab where ligands will be concentrated from seawater and determined by ESI-ICP-MS.

At P4 12 depths (to 1200 m) were sampled while at P12, P16 and P20 normally 24 depths were sampled to a maximum depth of ~2000 m. At P26 24 depths were sampled to a maximum depth of 4000m.

Cruise Notes
Eight 12ℓ GO-Flo bottles (UVic) were accompanied by four 10ℓ GO-Flo bottles borrowed from Kyle Simpson and Andrew Ross (IOS) to make up the 12 positions on the TMR.

During the P12 shallow cast two of the GO-Flo bottles did not close upon ascent at depths 10 and 40m. In order to get better resolution of the mixed layer, the 130m depth of the P12 deep cast was substituted for 10m depth. Due to sample bottle shortage, P26 unfiltered 1800 and 3000m were not sampled.

We'd like to give a special thank you to the crew of the *CCGS John P. Tully* for their amazing work handling the trace metal rosette and winch, especially during rough seas. Thanks to the Captain and the rest of the crew for a successful trip and thank you to Marie for re-accommodating the TMR casts during poor sea conditions.

Hallam lab, UBC (Jade Shiller) – August 2019 Line P

Objectives:
Continue a decades-long time series studying the microbial diversity and geochemical properties of Saanich Inlet.

Describe the taxonomic and metabolic diversity of the microbial communities in the cycling of major nutrients along Line P, focusing on the communities in the oxygen minimum zone.

Sampling summary:
In Saanich Inlet (SI03),

1) At 17 depths, the following samples were collected: oxygens, gases, sulphides, 2 ℓ high-resolution (HR) bacterial DNA sequencing, single amplified genomes (SAGs), cell counts, and filtered nutrients.
2) At 6 of those depths (10, 100, 120, 135, 150, 200), an additional 2 ℓ seawater was collected for bacterial protein sequencing.

At 5 stations (P4, P12, P16, P20, and P26),

1) 2 ℓ seawater samples (at 16 depths) for high-resolution (HR) bacterial DNA sequencing were filtered.
2) 30 ml seawater samples were taken per depth to count microbial population density using flow cytometry and single cell DNA analysis. Samples were aliquoted and preserved using glutaraldehyde and glycerol+trisEDTA, respectively.

Additionally, at 3 major stations (P4, P12, and P26), the following were sampled at four depths: 10, 500, 1000, and 2000 (bottom+10 at P4) across the oxygen minimum zone:

1) Large volumes (20 ℓ; LV) at each depth were filtered to create genomic libraries of the bacterial communities. From each sample, the first 2 ℓ were preserved for RNA sequencing. The remaining 18 ℓ were preserved for DNA.
2) 30 ml seawater samples were collected per depth to count microbial population density using flow cytometry and single cell DNA analysis. Samples were aliquoted and preserved using glutaraldehyde and glycerol+trisEDTA, respectively.

Comments:

My sampling objectives for this cruise were fulfilled at all stations. The work area distribution was convenient for my sampling needs.

I very much appreciate the inclusion of SI03 in the sampling plan and IOS's willingness to collect and process oxygen and nutrient samples at this station. This is vital to maintaining the time series that the Hallam and Tortell labs began more than 10 years ago, so thank you very much to everyone who helped sample and those who analyzed the samples in Saanich Inlet.

I'd like to thank the captain and crew of the *Tully* for their excellent work and their interest in and support of our scientific program. Thanks to the galley crew for keeping us extremely well fed. Thanks to the IOS team and my fellow scientists for their help and their humour on deck and in the lab. And finally, a great big thank-you to Marie for her amazing organization in the face of ever-changing conditions.

Mission 2019-008 CCGS J P Tully August 14 to 28 2019:
Cs-137 and I -129 Sampling – Rick Nelson, DFO/BIO.

An earthquake triggered tsunami on March 11, 2011 caused extensive damage to the nuclear generating station at Fukushima Japan resulting in the discharge of large amounts of Cs-137 and other radionuclides directly to the Western North Pacific ocean during the months following the accident. The radioactive plume was transported northeastward under the influence of the Kuroshio current and was expected to approach the Canadian coastline several years after the accident. A Canadian monitoring program was established to detect the arrival of Fukashima radioactivity in the water columns of the eastern North Pacific and the Arctic oceans.

Water samples were collected at stations occupied on the "Line P" missions on the CCGS J P Tully in June of 2011, 2012 and 2013. The program was expanded in 2014 to include both the Feb and Aug Line P missions. In 2018 a single mission was sampled in June. In 2019 a single sampling mission was sampled in August 2019.

Sampling 2019-008:

Five depth profiles were collected at stations P4, P16, and P26. Depths 500, 400, 300, 200, 150, 100, 50 and 5 meters. Analysis from previous has shown no signal at 500 meters. Stations P10 and P21 were sampled to 400 meters and no sample was collected at 500 meters.
Sixty liter samples were collected at all depths.
In addition 60 liter surface samples were collected from the underway loop system after the ship was on station at P1, P6, P8, P12, P14, P18, P19, P23, P24, P25. A total of 48 samples were collected.

In addition 500 milliliter samples were collected for ^{129}Iodine analysis from the rosette at Station P4, P10, P16, P21 and P26. A total of 38 samples were collected.
The samples for Cs were extracted onto KCFC (potassim cobalt ferrocyanide) ion exchange resin at flow rates of approximately 300 ml's per minute, then sealed for return to the Bedford Institute of Oceanography.

The resin samples were then dried, placed in appropriate counting geometries and the Cs-137 and Cs-134 radionuclides were determined by Gamma ray Spectroscopy using HPGE (high purity Germanium) detectors.

Thanks to the officers and crew of the CCGS John P. Tully for the work to make this a successful cruise. Special thanks to Marie Robert for all of the wire time and all those who helped carry the 24 ℓ carbouys.

Line P cruise report – Racquelle Mangahas, UBC.

I am interested in the effects of highly soluble and transportable aerosols originating from heavily polluted parts of Asia on phytoplankton physiology and the water column. Atmospheric deposition in the open ocean, especially within HNLC areas, can have a significant influence on the bioavailability of trace metals, which are micronutrients essential for phytoplankton growth. They can alter the overall ratio of essential:toxic trace metals found in the water.

During this cruise, I performed a 6-day long incubation that manipulated the concentration of copper (Cu), a trace metal that at too high concentrations can induce toxicity, available to phytoplankton in cubitainers filled with P23 water collected at a depth of 10 metres. I either added copper chloride (+Cu, 10nM), no manipulation (control) or added a ligand called Cyclam, which binds to Cu and therefore decreases its concentration (-Cu, 30nM). I measured parameters such as chlorophyll, nutrients, RNA, cell count and particulate organic matter. This allowed me to determine whether they were experiencing Cu toxicity or limitation at P23.

I also used the TE-5170V-BL Total Suspended Particulate Volumetric Flow Controller High Volume Air Sampler attached to an anemometer and switch to collect aerosols, in particular trace metals in the atmosphere, along the Line P transect. The anemometer and switch were used to ensure the conditions of wind speed (>0.5m/s) and direction (NW, N and NE) were met, to avoid contamination of stack exhaust from the ship. I used the air sampler to investigate the spatial variance of trace metal aerosols from coastal to open-ocean stations. Additionally, I gathered chemical speciation samples and aided in collecting dissolved metal samples from the depths of 10 and 20/25 metres at the five major stations (P4, P12, P16, P20, P26). This will help me understand the composition of trace metals in seawater that are bioavailable to phytoplankton, and infer whether there is a noticeable trend in relation to my aerosol samples. For example, if the phytoplankton are experiencing Cu toxicity in a HNLC area such as P23, there must be an input of this trace metal from a source such as the atmosphere. Therefore, my research this cruise can show me the possible effects anthropogenic pollutants can have on the water column, which inevitably can hinder phytoplankton growth as well as community composition, and ultimately primary production. In the future, I hope to investigate the seasonal composition of aerosols, as they can combine with mineral dusts from deserts during the spring time, thereby displaying their temporal variance.

I also wanted to say a huge thank you for allowing me to conduct my research alongside IOS. It was a great experience considering this was my first research cruise ever and I really appreciate being given the opportunity to do so!

Line P Cruise 2019-008 – Moira Galbraith, DFO/IOS.

Net Operations

I was able to get 1 deployment of the multiple plankton sampler (MPS), at P26; from a depth of 2500m, stratified by depth for a total of 5 samples per cast. There were no hitches with the winch or the deck unit electronics; deck deployment and recovery was very smooth. Planned cast at P4 was dropped due to poor sea state. There were some difficulties with the heave compensator; starboard side has a leak which the crew is hoping to fix in the time available till next cruise.

8 Bongo nets samples, using 236 micron mesh were collected from a depth of 250m (or 10m off bottom whichever is shallower) at 59, P2, P4, P8, P12, P16, P20 and P26. 4 deep casts, from 1200m, were collected from P4, P12, P16 and P20. Additional bongo was done at P4 on the return trip. A portion of each of deep sample was set aside in ethanol for DNA work back in the lab. I was able to collect several large medusae from P4 deep tow for UBC student Florian Lueskow.

When we arrived at P26, we discovered that one bongo sock had come loose and flipped over the side of the vessel. Upon impact with the vessel's stern, the thumb of the carabineer broke off, effectively making the remaining part a hook, which then ripped into the net, tearing several holes in the lower portion. We then switched to the backup set of bongos and used them for the rest of the cruise.

Many thanks to the Captain and crew for making the Tully such an excellent scientific sampling platform.

Oxygen Kit

After the mooring cruise, we were lucky to have Kenny Scozzafava come on board to check over and restock the oxygen kit. There were no hitches or major problems with the kit over the whole trip. When lab temperatures got high the crew found a fan to keep the kit temperature below 26 C. Minor things of note: more attention to the dispensing of chemicals when fixing the samples and more rigorous check of the rosette to assure that all vents and spigots are closed.

Rosette

The hydraulic fluid leak was cleaned up by rinsing the rosette in hot soapy water, rinsing with fresh water, washing with hot soapy water, rinsing with hot water and then fresh water. First leak was over closed bottles, second leak was over open bottles. Upon deployment, the rosette was taken to 50m with pump off and brought to surface, twice. On the third, pump turned on at depth, then up to surface and the cast began from there. The carousel was taken out each time and placed in hot soapy water while we worked to clean the rosette. A cylinder was replaced and absorbent material wrapped around key parts to ensure no oil incidentally getting on the rosette.

The CTD program stopped working, luckily, we were able to reboot and start it up again. The remaining portion of the profiles was saved into a separate file.

Line P 2019-008, August 14-28, 2019 – 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 traits and the physiology of natural phytoplankton assemblages can help us understand how phytoplankton influence ocean chemistry and support higher trophic level organisms 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. Net primary production was measured via carbon uptake, new production via nitrate uptake, and silica uptake via ^{32}Si incubations. 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 communities. These different types of 24-hr incubations were performed at P4, P12, P16, P20, and P26. Depths were chosen to correspond to the Chl-max and 5 m below the surface. 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: duplicate 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).

Acknowledgements

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.

August 2019 Line P – Chelsi Lopez (University of Miami)

Samples for dissolved and total organic carbon (DOC/TOC) for the Hansell lab (UMiami) were collected at all major stations, as well as samples for marine gels and microbial analysis for Orellana lab at UWashington. Chromophoric dissolved organic matter (CDOM), particulate inorganic carbon (PIC) and particulate organic carbon (POC) samples were collected at stations P23, P24, P25, and P26. More DOC/TOC samples were collected for Sophie Johannessen at IOS.
The SUMO underway system was running throughout the cruise to measure nitrate, temperature, and pH levels along the way. Five loop samples were collected to calibrate the sensor back at the lab.

Methods:
TOC/DOC (Hansell): Samples were collected from niskin bottles in 40 ml glass vials. TOC was collected as whole water, and DOC was filtered inline with a 0.7 micron GF/F filter. Samples were acidified with 4M HCl and stored at room temperature.
TOC/DOC (Johannessen): Samples were also collected into 40 ml glass vials, TOC as whole water and DOC filtered through the 0.2 micron Opticap filter. The vials were frozen in the -20 freezer.
CDOM: Samples were filtered from the rosette using the opticap filter and placed in 100 ml amber glass bottles and placed in the walk-in refrigerator.
PIC/POC: One liter bottles were collected from the rosette and filtered onto 0.7 micron GF/F filters. PIC samples were rinsed with filtered seawater, and POC filtered with a mixture of HCl and seawater.
Gels and microbial samples: Whole water was collected from the rosette and placed in 100 ml polycarbonate containers. Subsamples of water (4 ml) was placed in a cryovial and inoculated with 25 ul of glyceraldehyde. Gel samples were fixed with 100 ul of 5% sodium azide.
SUMO: The underway system was turned on at P2 on the way out. Periodically, the sensor was cleaned with methanol and HCl. Loop samples were collected into 500 ml glass bottles and fixed with mercuric chloride.