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:** 18 August 2015 **TO:** 3 September 2015

SCIENCE CRUISE NUMBER: 2015-10 **SHIP'S PATROL NUMBER:** 15-06

CHIEF SCIENTIST[S]: Marie Robert

SCIENTIFIC PERSONNEL:

Female	Male
Moira Galbraith (IOS)	Mark Belton (IOS)
Marie Robert (IOS)	Michael Bentley (Volunteer)
Jade Shiller (UBC)	Glenn Cooper (IOS)
Lianna Teeter (UVic)	Niko Finke (UBC)
Manman Wang (UVic)	Aram Goodwin (UBC)
	Hugh Maclean (IOS)
	Rick Nelson (BIO)
	Stephen Page (IOS)
	Kyle Simpson (IOS)

AREAS OF OPERATION: 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 has been collected along this line since 1956 and shows 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, trace metal), sample for Cesium, various sampling for universities.

CRUISE DESCRIPTION: This cruise (2015-10) was a success despite some bad weather at the beginning of the cruise as well as after Station Papa (see details in Sampling section). The demands on wire time were slightly less than usual since many regular participants were in the Arctic this summer. This turned out to be a good thing considering the rough weather we encountered. Trace Metal rosette operations would have been tricky in these sea states.

DAYS ALLOCATED: 16 **DAYS OF OPERATION:** 14

DAYS LOST DUE TO WEATHER: About 2 hours between P26 and P23, and 9 hours between P23 and P22. Five stations were cancelled, two of which could be partially done on the way back. Two casts had to stop at 1000 m and one stopped at 150 m instead of 2000 m needed in all cases because of weather windows closing on us.

SAMPLING:

- The Line P survey was mostly successful. Three planned stations had to be cancelled, and three casts were sampled to a shallower depth than needed. On the other hand, eight (planned) stations were added at the beginning of the cruise in order to investigate the effects of an important algal bloom that was present along the coast in May/June of this year.
- The samples collected include:

  1) Underway: **IOS**: Thermosalinograph (Temperature, Salinity, Fluorescence), acoustic sounder, ADCP, pCO_2, irradiance off the heli-deck.

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

  3) From the Rosette: **DFO-IOS:** dissolved oxygen, salinity, nutrients, DMS, DMSP, chlorophyll, pigments (HPLC), dissolved inorganic carbon (DIC), alkalinity, pH, micro-plastics, water for AML – **DFO-BIO (Nelson):** Cesium, ^{129}Iodine – **UBC (Schiller):** number of cells per millilitre, virus counts, bacterial genomic (DNA, RNA) and sequencing – **UBC (Finke):** Sulfide oxidation rates, dark carbon fixation, CH4 and methane production rates, methane oxidation, gases – **UBC (Goodwin):** Neodymium – **UVic (Teeter):** ONAr (Oxygen, Nitrogen, Argon), dissolved oxygen, triple oxygen, ammonium, nutrients, chlorophyll, ^{17}O, salinity.

  4) **DFO-IOS (Galbraith):** Zooplankton using vertical net hauls (Bongos to 250 m and 1300 m) and Multinet to 3000 m.

  5) From the Trace Metal pump: **IOS (Simpson):** Dissolved and total dissolvable iron.

RADIOISOTOPE USE:

C^{14} and H^3 radioisotopes were used during this cruise. The Rad-van was decommissioned properly at the end of the cruise and all paperwork was handed to the appropriate people.

PROBLEMS [SCIENTIFIC GEAR AND OPERATIONS]:

The CTD cable jumped sheave right at the beginning of the cruise, before even the test cast in Saanich Inlet. It had to be reterminated.

The rosette touched bottom twice. The second time, enough wire was paid out so that it wrapped around the bottom spigot of a Niskin bottle and tore it out. The cable was to be reterminated on the return leg since this wrapping around the spigot created a small kink in the wire but the kink slowly stretched itself out and no retermination was necessary.

Niskin 1 is still always leaking, despite a new o-ring around the top valve.

The Acoustic sounder hard drive was full, causing the recording to stop for a few hours. Fortunately we noticed that RECORD was off. There are lots of data from old cruises that need to be deleted. It also stopped working at some point, we are not sure for how long. Exiting and restarting the software seems to have fixed the problem.

The ADCP stopped working for 3 days after a change in set-up. We finally got it going again, with help from Doug Yelland in the office and Kyle Simpson on board. This is yet another example of the necessity of having internet signal while at sea. If we had tried to solve this problem using ship's email, it would have taken days on account of all the back-and-forth messages that were required.

The TSG NMEA got disconnected and we lost the signal for four days. Although the position data wasn't being recorded, at least we were still getting temperature, salinity and fluorescence values. When rebooting the TSG computer to try getting the NMEA data back – before realising that it was simply disconnected – some settings got changed and the TSG stopped communicating altogether. We then noticed that the ground cable had gotten disconnected. That was part of the problem. After reconnecting the ground cable to a pipe going to the manifold, we had to reset all the settings. It turns out that the instructions written in the TSG logbook are wrong. Seaterm had to be used to reconnect to the TSG. Thanks to Kyle Simpson and Hugh Maclean for spending hours figuring this out.

Four DIC (empty) glass bottles were broken during loading.

We were told a few hours before returning to IOS that a TV crew would be on deck to film the Tully and equipment offloading. This kind of event **must** be discussed with the people on board the ship, at the very least with the Captain and Chief Scientist, before it's at the "too late" stage.

SUCCESSES [SCIENTIFIC]:

The loading and offloading of the science gear went very smoothly, with everyone participating and helping. Loading over two days help reduce the feeling of "chaos" normally encountered on loading days.

The Milli-Q water was clean during the whole cruise with no signs of contamination.

The Closet (CTD lab) has much more space now with the computer rack gone. There are still some issues, e.g. the laptop sitting on the desk not leaving enough room for logbook and sampling logs, but at least the transformation is started. The "renovations" can hopefully be completed during the following La Perouse cruise.

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

On arrival we noted the slide block on the inboard flank of the Lars flagging sheave was deeply grooved. When unloaded the sheave moved stiffly particularly when moving inboard. The upper and lower swivel bearing carriers were loosened and realigned which significantly improving the freedom of movement. The slide blocks were reversed to monitor wear and it worked acceptably for the remainder of program. It warrants removal and inspection to determine if the bushings are worn or the swivel (trunnion)pins are bent but would have to be derigged from the rosette to do so. Also the bushing dimensions need to be determined to manufacture spares.

The cable of the repeater feed going from the monitor in the CTD closet to the LARS cab got torn apart at some point. Thanks to the engineer for a quick repair.

The EA600 sounder is still an old XP machine and the software that runs the sounder keeps "not responding" every time one click is done with the mouse. That computer is also still only held by two ropes and looks very unstable. This equipment is essential for science operation and it would be a major setback if it stopped working.

SUCCESSES [SHIP]:

Thanks to the engineers for adapting the "emptying of the tanks" and the burning of garbage around our work on long stations.

DELAYS [OTHER THAN WEATHER]:

We had to drop one student off in Ucluelet because of sickness.

SAFETY CONCERNS:

None.

HAZARDOUS OCCURRENCES:

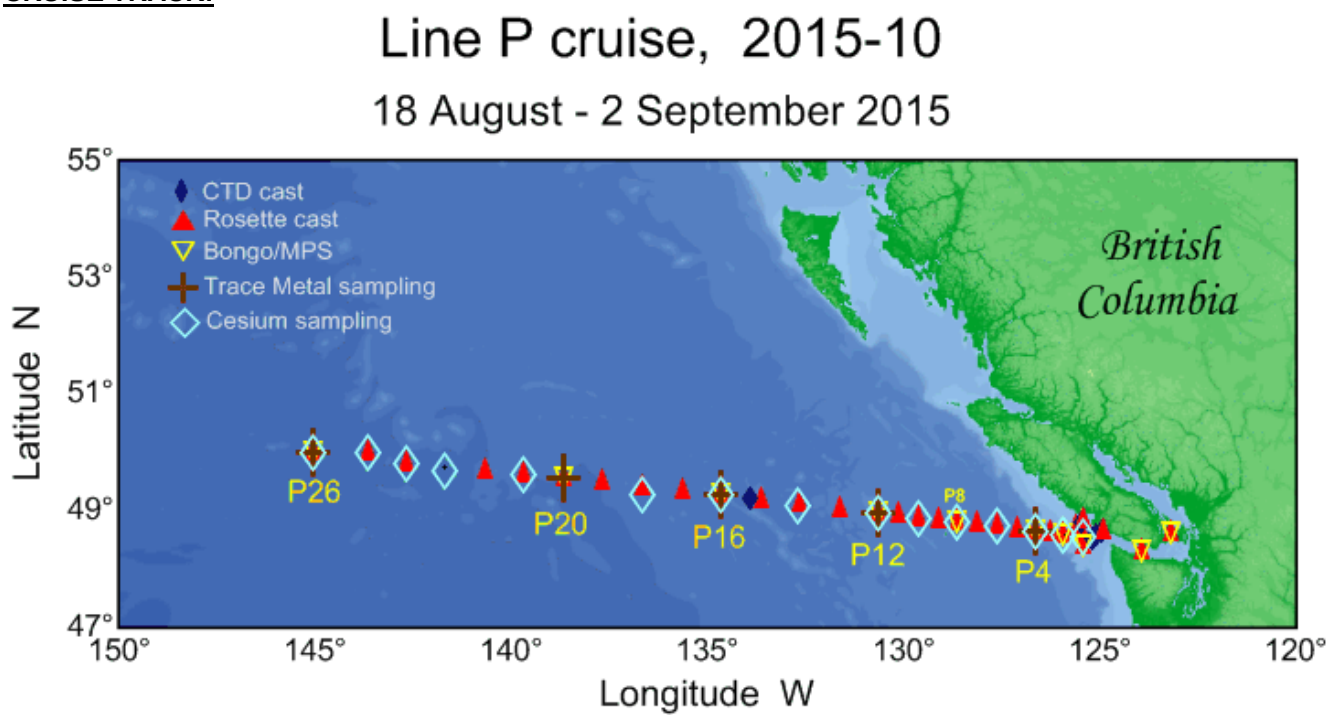
There was a small spill of roughly 0.25 ℓ of 600 g/ℓ Manganous Chloride solution and 10 ml of Alkaline Iodide solution (320 g/ℓ sodium hydroxide + 600 g/ℓ sodium iodide) in the main lab. The spill was quickly contained

and absorbed with Ampho-Mag. The deck area all around the spill and the counters were then cleaned many times with water, and water was also sent down the drains to clear away all potential residual chemicals.

EVENT LOG:

Tuesday 18 August:	Start loading the ship at IOS around 1400. Load mainly winches and containers, and university gear (UBC and UVic).
Wednesday 19 August:	Load the IOS gear starting around 0800. Rad-Van fume hood testing at 0900. Safety meeting at 1100. Fire and boat drill at 1300. Leave IOS around 1400. Problems with CTD wire. Proceed to stations Haro59 and JF2. Science meeting at 1600.
Thursday 20 August:	Stations LB01 to LB08 and LC04 to LC01. Stop in Ucluelet to drop off sick student. Then start Line P, stations P1 and P2.
Friday 21 August:	Stations P3 to P5.
Saturday 22 August:	Stations P6 to P11.
Sunday 23 August:	Stations P12 and P13.
Monday 24 August:	Stations P14 to P16.
Tuesday 25 August:	Complete station P16, then stations P17 and P18.
Wednesday 26 August:	Stations P19 and P20. Skip station P21.
Thursday 27 August:	Skip station P22 and P23. Do stations P24 and P25. Skip station P35 and start work at station Papa.
Friday 28 August:	Complete work at Station P by 1500. Last cast only done to 1000 m instead of 2000 m because of weather getting worse. Cancel cast at PA-009 mooring and the second chance to do station P35 and head to P23.
Saturday 29 August:	Cancel P23. Make our way to P22. Wait on station for 2.5 hours. P22 cast to 1000 m. Then P21; only one cast to 150 m.
Sunday 30 August:	Sailing east. Emergency exercise in the afternoon.
Monday 31August:	Station P13.
Tuesday 1 September:	Station P4.
Wednesday 2 Sept:	Dock at IOS and offload.

CRUISE TRACK:



SUMMARY/FINAL COMMENTS:

- Many thanks to everyone at IOS who, once again, helped with loading and cruise preparation: Kenny, Nina, Kelly, Tamara … your help is always greatly appreciated!

- Thanks to Captain Corfield for all the help trying to figure out the weather forecasts what kept changing daily. Your help was a key factor in decision making.

- Thanks to Glenn Cooper for his expertise in biological sampling, and all who helped dealing with the samples at all stages of the process.

- And thanks to everyone on board for such a successful and enjoyable cruise! It was great sailing with you again after such a long time. Special thank you to Kara for the barbecues, not only were they delicious but everything was already taken care of, thanks!!

Marie Robert and the science team

- Special thanks to the Tully deck crew and bosun, very professional under trying conditions.

Moira Galbraith

- I'd like to thank the captain and crew of the *Tully* for their assistance, excellent work, and wonderful meals throughout the cruise. Thanks to the IOS team and the scientists onboard for their help and their humour on deck and in the lab. And finally, a great big thank-you to Marie for a very well organized trip.

Jade Shiller

- Thanks to the crew and officers 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 carboys.

Rick Nelson

- Thank you to the Captain, officers and crew of the JP Tully for making the cruise productive, and to Kara and the rest of her galley staff for the amazing food. I also want to thank IOS personnel for their help sampling, filtering and analyzing samples. Many thanks to the science crew. Thank you especially to Marie Robert for her support and accommodating my sampling requests, Hugh Maclean and Niko Finke for help sampling, Steve Page for his help with the PAR casts, and Glenn Cooper for his help with the incubators. I want to thank Sarah Thornton for allowing me to borrow equipment.

Lianna Teeter

- I thank Marie for all the help accommodating all our various needs to perform our work. I thank Kyle for the help getting the gas bottles and the radvan onto the ship, and lending of the note book, Hugh, Steven, Glenn, and Jade for the help sampling. I also thank the entire crew of the John P. Tully for the support making this work possible and the galley staff for delicious food.

Niko Finke

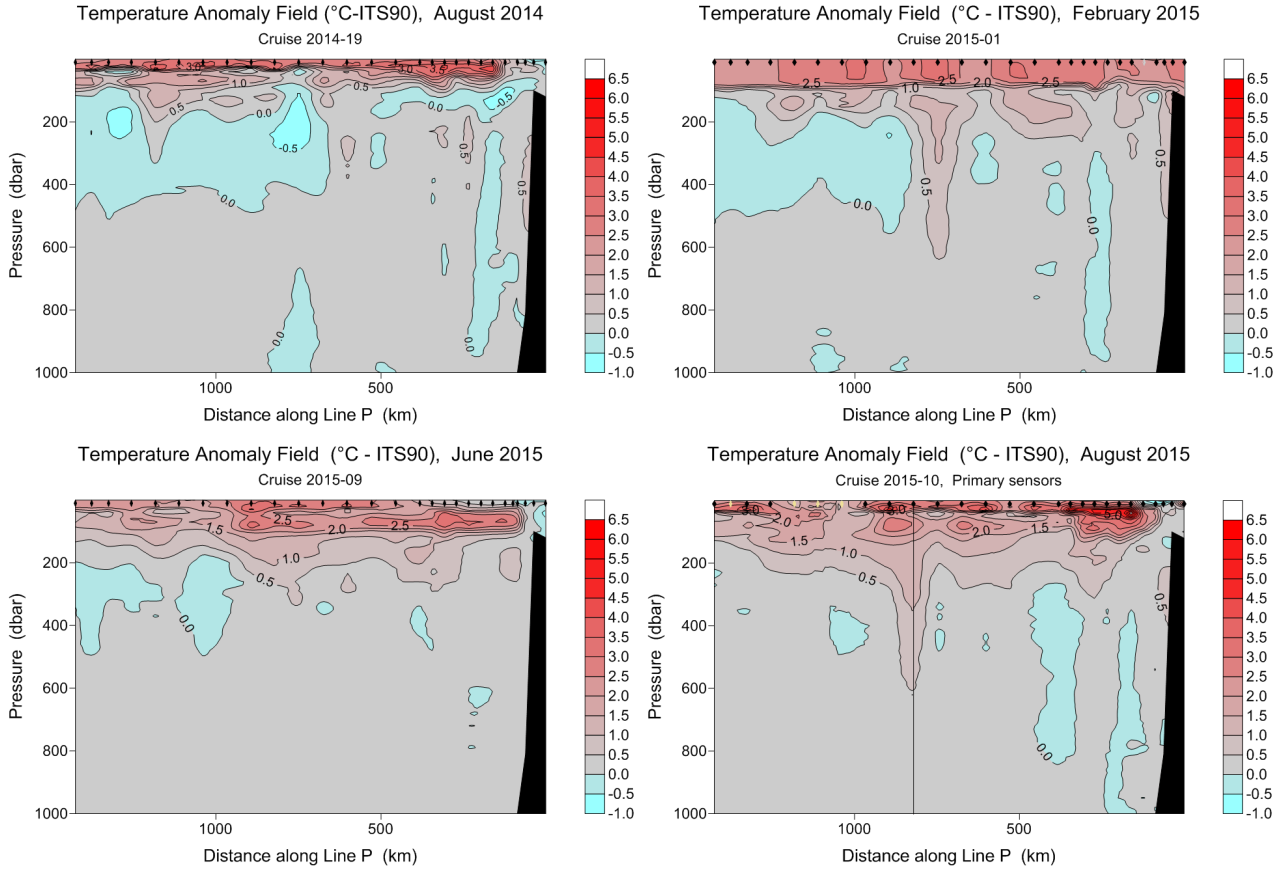
- Thanks so much for your kind and sweet take care and feel sorry for getting so many trouble. I feel better now. Have a nice trip, good luck with everything.

Manman Wang

PROJECTS AND RESULTS:

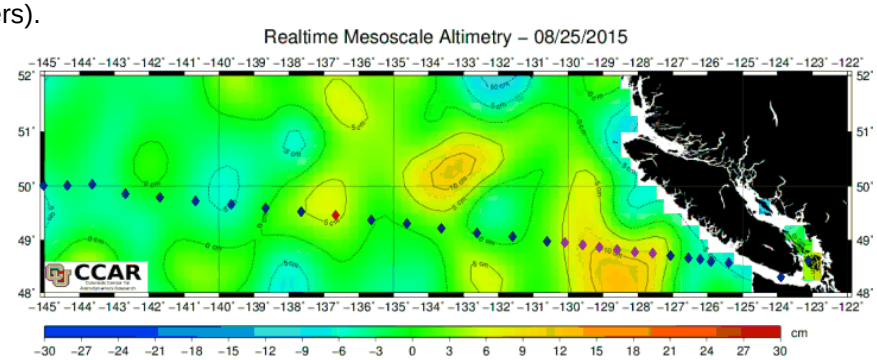
Water masses – Marie Robert, DFO/IOS.

Once again, the main question everyone had when we left on this cruise was: is the Blob still there? The "Blob" is the very large mass of warmer-than-usual water situated in the top 100 metres or so of the ocean, covering most of the Gulf of Alaska, which appeared around October 2013. The following figures show the temperature anomalies along Line P for August 2014, February 2015, June 2015, and August 2015 with respect to the 1956-1991 averages, all displayed on the same scale of -1.0°C to 6.5°C (non-processed data). When looking at these graphs, it seems that the answer is still "Yes, the Blob is still present". The range of anomalies for August 2014, February 2015, June 2015 and August 2015 were, respectively (°C): -0.85 to 4.39; -0.52 to 3.32; -0.72 to 3.56; and -1.28 to 6.91. Again on this cruise the largest anomaly is found just below the surface at around 40 m and is situated just past the shelf break.



Temperature anomaly field with respect to the 1956 – 1991 averages for every Line P cruise since August 2014.

The "eddy-like" signature present at station P18 in the August 2015 profile of temperature anomaly (indicated by the vertical line at 821 km) could be linked to the slight increase in sea-surface height as seen in the figure below, where station P18 is represented by a red marker. The sea-surface height anomaly of up to 10 cm closer to the coast could potentially be due to thermal expansion of the water present between stations P6 to P11 (purple markers).



DMS/DMSP – Mark Belton, DFO/IOS (filling in for Mike Arychuk)

Summary:

The DMS container was loaded onto CCGS JP Tully Aug 18 2015. Ship power was successfully established approximately 3 hours following loading. The GC flame was successfully lit following recommended parameters on Aug 18 at 1630. The following morning the flame had gone out. Flame was relit at the recommended parameters and feathered air down to ~ 58-59 psi. The flame remained lit without incident for the duration of cruise with the exception of changing out a N2 tank (dropped below 400 psi) on AUG 22 and relighting.

Standard and performance evaluation material (PEM) were prepared at 0700 Aug 19 prior to departure. Two small vials of both undiluted standard and PEM were brought and stored in the fridge. It was observed that these small vials produced a fairly strong odour. The vials were put in plastic tubes to reduce odour, however, the odour seemed to persist throughout the duration of cruise and was quite noticeable when opening the fridge.

Running one or two blanks prior to standards for any given station would initially yield some peaks either at the expected DMS retention time or before or after. The system appeared to run clean blanks following this. In one instance there was higher than expected results for 0.5 and 1.0nM standards, however this appeared to come back to expected levels after going through a few runs. Suspect DMS odour from fridge could contribute to initial background.

Standards run across all six DMS stations yielded consistent results. It should be noted that the lowest standard (0.5nM) appeared as an outlier with linear regression and should perhaps be omitted for data analysis. Standard evaluation against the PEM yielded an average percent difference of less than 2.25.

Dry ice production via CO2 tanks was a potential issue as it was determined that one tank unused was almost empty not producing any dry ice and another only produced two batches before becoming exhausted. A regulator indicated that only the last bottle producing dry ice had a pressure of ~ 850 psi (the pressure CO2 will liquefy). In the event that the last bottle of CO2 became exhausted several batches of ~ 500mL of isopropanol were stored in the -80C freezer. It did not turn out necessary to have to use this method.

DMSP sample blanks were prepared using the Tully water system as I failed to fill glass jugs at IOS prior to departure.

A general impression of the DMS GC system is that it is fairly robust and easy to use with some practice. There should perhaps be some thought to data backup as the PC used to run the instrument is very old and does not support a USB connection. An alternative to dry ice production via tanks could be to bring pellets and store, or if tanks are used they should be clearly tagged and dated as to their status. At one point in was observed that the electrical transformer in the DMS container was running extremely hot to the touch. Following suggestion from the chief engineer I turned off all unnecessary electrical (air conditioning etc.).

Cs-137 and I -129 Sampling – Rick Nelson, DFO/BIO

An earthquake triggered tsumani 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 radioactivity 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, 2013 and in February and August of 2014 and this year 2015.

Sampling 2015-10:

Profiles were collected at stations P-4, P-16, and P-26 with samples collected at 500, 400, 300, 200, 150, 100, 50 and 5 meters. At P10 depths at : 300, 200, 150 50 and 5 meters. At station P-21 samples were collected at 150, 100, 50, and 5 meters. A second cast for 200 and 300 meter samples was cancelled due to weather conditions. 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 P-1, P-2 P-6, P-8, P-12, P-14, P-18, P-19, P-23, P-24, and P-25. A total of 45 samples were collected.

In addition 500 millilitre samples were collected for I-129 analyses from the rosette at Station P-4, P-16 and P-26. A total of 24 samples were collected.
The samples for Cs were extracted onto KCFC (potassium cobalt ferrocyanide) ion exchange resin at flow rates of approximately 300 ml's per minute, rinsed with 100 mls of milli Q water and then sealed for return to the Bedford Institute of Oceanography.

The resin samples were then oven 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 crew and officers 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 carboys.

Zooplankton work – Moira Galbraith, DFO/IOS

Eleven 250 m and four 1300 m bongo plus two 3000 m multi-net tows were completed this trip. Several MPS (multi plankton sampler) casts had to be scraped due to poor weather conditions for deployment. Stations Haro-59, JF2 and LB08 were done in support of the LaPerouse/Strait of Georgia zooplankton monitoring programs. It will be interesting to visit these stations again two weeks later to compare community structure changes. Though the deep net casts had many interesting bathypelagic shrimps and jellies, there were no or very few Neocalanus copepods noted in the samples till P20 and P26. The highlight for the trip was the capture of a Leptocephali larva, *Thalassenchelys coheni* (deep water eel) from the P8 deep bongo tow. Special thanks to the Tully deck crew and bosun, very professional under trying conditions.

Line P – August 2015 – Jade Shiller, UBC

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

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

1) 2 L seawater samples (at 16 depths) for high-resolution bacterial DNA sequencing were filtered.
2) 50 mL seawater samples were taken per depth to count the number of cells per milliliter using flow cytometry and single cell DNA analysis. Samples were aliquoted and preserved using glutaraldehyde and glycerol+TE, 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) at each depth were filtered to create genomic libraries of the bacterial communities.
2) After adding of iron chloride to the filtered water, the samples were filtered again for later virus analysis.
3) For viral counts, samples were taken and preserved using glutaraldehyde and betaine.
4) 50 mL seawater samples were taken per depth to count the number of cells per milliliter using flow cytometry and single cell DNA analysis. Samples were aliquoted and preserved using glutaraldehyde and glycerol+TE, respectively.

Comments:

All my lab objectives for this cruise were successfully fulfilled. The work area distribution was very convenient for my sampling needs and I will try to use the same setup on future cruises. Weather prevented the collection of one sample (large volume sample from 2000m at P26), but all other samples were successfully collected and processed.

I'd like to thank the captain and crew of the *Tully* for their assistance, excellent work, and wonderful meals throughout the cruise. Thanks to the IOS team and the scientists onboard for their help and their humour on deck and in the lab. And finally, a great big thank-you to Marie for a very well organized trip.

Carbonate Studies – Glenn Cooper and Kyle Simpson, DFO/IOS

The standard four components of the carbonate system were measured and sampled on the 2015-10 Line-P program to Station Papa. Both pH and pCO_2 were measured onboard the Tully. Samples for Dissolved Inorganic Carbon (DIC) and Total Alkalinity (TA) were collected preserved and returned to Institute of Ocean Sciences (IOS) for analysis.

1) pCO_2

The pCO_2 system was set up on the bench across from the loop system. After several days of operation, the data file was sent to Sophie Johannessen to ensure the system was collecting reasonable data. Overall she was okay with data although the gas flow rates were rather variable. Also inlet temperature probe was giving erroneous values. With assistance from the Chief engineer it was determined that the probe was working properly but the correction constants which convert the voltage into temperature values were incorrect. Being unfamiliar with the software which corrects for this and that the inlet temperature could be collected from the TSG system it was decided best not to alter the system for fear of causing more harm than good. Before the next cruise on the Tully, the inlet temperature gauge constants need to be determined and calibrated so as to provide meaningful values.

The system performed relatively well but starting Aug. 25 problems with the LiCor started occurring. On several occasions the LiCor's C2 display gave a full deflection value (65535), and was not a result of stack gas. Thus all values for the standards, equilibrator, and atmosphere were recorded at 65535. All components of the pCO_2 system were checked but nothing obvious to explain the error. Our initial thought was that the problem was a result of moisture in the LiCor system. The external scrubber seemed dry but since a spare was onboard and it is easy to swap out the scrubber, it was replaced. A full power shut down of the LiCor reset the unit. This corrected the issue and would work properly and provide reasonable values. However the problem returned again on Aug. 28. Again a full shut down of the LiCor corrected the problem. Correspondence with Mike Arychuk, who is very familiar with the system, indicated that the system had done this previously and only a full shut down would remedy the issue. It was something internal to the LiCor unit and would need to be returned to the manufacture for servicing.

The system was run using the seawater loop system and was online shortly after leaving Pat Bay and was run until shut down on September 2nd , on return to Pat Bay.

2) DIC/alkalinity sampling

DIC/alkalinity samples were collected in 500ml bottles and preserved with 100ul of $HgCl_2$ at all major stations on line P including (P1, P2, P4, P12, P16, P20, P25, P26). Stoppers were greased with Apeizon grease and taped closed with electrical tape. One duplicate was collected at each station between 1000 and 3000m as well as a duplicate bottle tripped at one of the deeper depths (full set of duplicates at station Papa).

A calibration cast was conducted at P25 on the way to OSP (5 bottles for DIC/TA were tripped at 2000m and each sampled in triplicate). A subset of samples were collected on the same Niskins and treated with copper chloride instead of mercuric chloride. A similar set of copper chloride treated samples were collected from Niskins closed (surface/Chl max) at P4 on the return to Pat Bay.

Triplicate samples were collected at 2000m at P25 and chlorophyll max at P4 into screw top bottles, and preserved with 100 ul of saturated $HgCl_2$ solution. These screw top bottles are similar to bottles used in a previous expedition and will be used to compare with the traditional 500ml glass bottles with greased glass stoppers.

3) pH

Seawater pH was determined using the spectrophotometric method developed by Clayton and Byrne (Deep Sea Research, 1993). Seawater was collected directly from the rosette Niskins into 10cm path length glass cuvettes. Meta-cresol purple (mCP) was used as the indicator dye and was validated prior to the cruise at IOS. The following stations were sampled: P01, P02, P04, P12, P16, P20, and P26. A set of triplicate samples were taken at P01 and P02 stations, whereas all other casts had two sets of triplicates which will be used to determine precision. A calibration cast was performed at P25. This consisted of collecting triplicates from 5 Niskins which were all closed at the same depth (2000m).

At P04 (Event#28), stoppers of 4 samples came loose in the cell block holder, resulting in the complete loss of sample. These 4 depths were re-collected on a later P04 station cast (Event#31), including 2 other samples collected at event #28 for internal comparison.

The pH system was set up in temperature controlled lab to maintain a stable room temperature throughout the analysis. Temperature of the seawater in the cells was measured after each analysis using a Teflon immersion probe.

For a trial run we deployed a Satlantic SeaFET pH sensor set up in flow through mode and flowed surface seawater from the seawater loop to the SeaFET. pH data were logged onboard the SeaFET and on a laptop. The same laptop also logged NMEA data. We will also collect the TSG data in order to post process the pH data for salinity, and to validate the SeaFETs onboard temperature sensor. At several of the major stations, replicate loop samples were collected and pH analyzed spectrophotometrically as described above.

Trace metal sampling – Kyle Simpson, DFO/IOS

Overview: At all major stations (P4, P12, P16, P20 and P26), samples for the determination of dissolved (filtered <0.2 µm) and total dissolvable (unfiltered) trace elements were collected. At All major stations, 12 discrete depths station were sampled, to a maximum depth of 800m. Target depths were 10m, 25m, 40m, 50m, 75m, 100m, 150m, 200m, 300m, 400m, 600m, and 800m. Depths were confirmed using an RBR Solo-D. Confirmed depths were typically within 5% of target depths.

Sample Collection: Seawater was collected using a TM clean pumping system and Niskin-X bottles. The majority of sampling was accomplished using the Teflon lined Nisken-X bottles which were deployed from the chains on a Kevlar line. On return to the surface the GO-Flo bottles were removed from the line and sampled in the wet lab next to a MAC10 type HEPA flow bench. Surface sampling at P4 was conducted to a maximum of 35 m depth using an air driven, double diaphragm all Teflon pump (IOS) that moved seawater through Teflon lined tubing deployed from the ships starboard chains. Seawater flowed through the tubing to a Class 100 HEPA flow bench in the Wetlab where filtered and unfiltered samples were collected. Kinks in the tubing from previous deployments made sampling both difficult and potentially unreliable. The tubing was repaired by splicing with HDPE tubing (inside) and silicon tubing (outside) and held together with vinyl electrical tape. Given the potentially unreliable splice and loss of ~3m of tubing we decided not to use the pumping system at the remaining stations until a new length of tubing can be acquired. Instead surface samples were obtained using the Niskin-X bottles. One Niskin was damaged at P16 and wasn't repairable with the parts we had on board. As such an extra cast was made at the remaining stations. P4 deep waters were sampled on the way back so as to not contaminate the Niskins with high metal concentration found in coastal waters. Samples for dissolved trace metals from Niskin-X bottles were filtered through a 0.2 µm filters and Millipore Opticap durapore cartridge filter (0.22 µm). All samples were acidified on the day of collection with 1ml of 6N Seastar Baseline HCl per 250ml of seawater.

Due to inclement weather conditions the Zodiac was not deployed and no “true” surface water was collected

Tully MilliQ Water System – Glenn Cooper, DFO/IOS.

The Millipore DirectQ 5 water system was placed in the main science lab near the aft sink. To extend the life of the DirectQ5 system and filters, 1 micron and carbon prefilters were installed. Prior to departing, the 30ℓ reverse osmosis (RO) water reservoir was cleaned with 19ml of 5.25% chlorine bleach. The reservoir was rinsed 3 times with SuperQ water and Mark Belton tested the MilliQ water from the unit to ensure no sulfur compound containing containments were present. The system performed flawlessly for the entire cruise and was able to keep up with the significant demand for MilliQ and RO water.

2015-10 Cruise Report – Lianna Teeter, University of Victoria

Biological productivity is an important process controlling the export of carbon to the deep ocean. There are multiple methods to estimate production and I focused on two techniques: dissolved gas ratios and incubations. Dissolved gas ratios included measurements of oxygen, nitrogen and argon (ONAr) ratios and triple oxygen isotope ratios. Incubations included 18O and dual 13C/15N additions.

ONAr: Samples were collected in duplicate at two depths within the mixed layer at P4, P12, P16, P20 and P26. ONAr samples collected on this cruise will be analyzed at the University of Victoria to obtain precise measurements of O2/Ar.

Dissolved oxygen: Duplicate samples were collected at 10 m, 100%, 50%, 30%, 15% and 1% light levels at P4, P12, P16, P20 and P26. Dissolved oxygen samples were analyzed on board using the Winkler titration method with a visual endpoint.

Triple oxygen isotope: Duplicate samples were collected within and below the mixed layer at P4, P12, P16, P20 and P26. The below the mixed layer depth was chosen based on the oxygen profile. Samples will be analyzed for the 16, 17 and 18 oxygen isotopes.

Dual tracer incubations, NH4, nutrients, chlorophyll: Samples were collected at 5 light depths (100, 55, 30, 10 and 1%) at P4, P12, P16, P20 and P26. Two sets of incubations were done using $NaH^{13}CO_3$ and either $^{15}NO_3$ or $^{15}NH_4$. $^{15}NO_3$ samples were done in duplicate at 100%, 15% and 1% light levels and singles samples at all other depths. $^{15}NH_4$ samples were collected in duplicate at 100% light level and all other depths had single replicates. A blank was collected at 100% light level for each ^{15}N nutrient. All incubations were incubated for 24 hours under a constant flow of seawater and then filtered. Duplicate NH_4 samples and single nutrient and chlorophyll samples were collected at the 5 light depths as well.

Salinity: Samples were collected below the mixed layer, within the oxygen maximum and at 50%, 30%, 15% and 1% light levels at P4, P12, P16 and P26.

18O incubations: Triplicate samples were collected at 5 light depths (100, 55, 30, 10 and 1%) at P4, P12, P16, P20 and P26. Samples were spiked with 18O labeled water and incubated for 24 hours under a constant flow of seawater. After 24 hours, the samples were collected into flasks and will be analyzed at the University of Victoria.

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Dissolved neodymium concentrations and isotopic composition from the Strait of Georgia to Station Papa - Aram Goodwin from Roger Francois group at UBC

Neodymium (Nd) concentrations and isotopic composition are used to study the continental weathering processes and past ocean circulation. We speculate that the Pacific water circulating in the Strait of Georgia alters its neodymium isotopic composition as a result of post depositional dissolution of suspended sediment from the Fraser River. This isotopic alteration could be used to produce an estimate for the "local continental weathering rate" and improve our understanding of the oceanic neodymium cycle. Sampling along Line P will allow us to examine whether the isotopic alteration is indeed expressed as contrasting isotopic signatures between the water circulating inside the strait and the water outside, in the Pacific.
We hope to see that the lower inflowing layer from the Strait of Georgia to the Pacific has a different Nd isotopic composition from the upper outflowing water layer.
In this cruise, we collected 10 ℓ samples from the Niskins on the rosette at stations as given in the table below. Each sample was filtered through a 0.45 micron in-line filter cartridge and acidified to pH 2 with HCl, a ~ 1 ℓ aliquot was taken for concentration determination whereas the rest ~ 9 ℓ were amended with $FeCl_3$. The pH was then raised back to 8 using ammonium hydroxide to initiate precipitation of the metals from the seawater. The seawater supernatant was then decanted and discarded of. The pellet containing the metals was retained and will be separated on columns later in the lab to purify Nd for isotopic analysis.

Table describing sampling. On the right hand side smaller tables are within given per each station where Depths refer to the depths samples in (dbar), Niskin to the bottle number, REE refer to 1 ℓ bottle # used for the aliquot and Density in units of kg per Liter.

Station	Day of Aug 2015	Event	Starting latitude	Starting longitude	Bottom depth [m]					
Haro 59	20	2	40.62	-123.25	231	**Depths**	**5**	**222**		
						Niskin	5	1		
						[REE]	230	234		
JF2	20	4	48.32	-124.01	186	**Depths**	**5**	**100**	**173**	
						Niskin	5	2	1	
						[REE]	222	219	220	
LB08	20	11	48.42	-125.48	135	**Depths**	**5**	**126**		
						Niskin	2	1		
						[REE]	224	215		
LC04	20	13	48.72	-125.68	165	**Depths**	**5**	**157**		
						Niskin	2	1		
						[REE]	216	218		
P1	20	16	48.58	-125.49	112	**Depths**	**3**	**8**	**50**	**102**
						Niskin	6	7	5	4
						[REE]	213	214	209	217
P3	21	22	48.63	-126.33	821	**Depths**	**30**	**50**	**150**	**811**
						Niskin	6	3	2	1
						[REE]	208	212	207	211
P6	22	34	48.74	-127.67	2541	**Depths**	**5**	**125**	**215**	**805**
						Niskin	7	6	5	4
						[REE]	204	206	205	211
						Density		25.69	56.52	27.22
P13	31	111	49.04	-131.67	3060	**Depths**	**5**	**110**	**200**	**780**
						Niskin	4	3	2	1
						[REE]	193	200	192	194
						Density		25.69	26.52	27.22
P18	26	73	49.43	-136.67	3832	**Depths**	**5**	**120**	**201**	**805**
						Niskin	4	3	2	1
						[REE]	201	202	195	203
						Density		25.69	26.59	27.22
P20	26	82	49.57	-138.66	3963	**Depths**	**5**	**87**	**153**	**740**
						Niskin	21	20	19	18
						[REE]	199	198	196	197
						Density		25.69	26.52	27.22

Line-P report Crowe lab – Niko Finke, UBC

Sampling on the rosette

N-species (NO_3^-, NO_2^-, NH_4^+) concentrations
Dark carbon fixation
Sulfide oxidation rates
CH_4 and N_2O concentrations
Methane oxidation
CH_4 production rates

Description of the Crowe lab sampling

N-cycle

We will generate profiles for the N-species (NO_3^-, NO_2^-, and NH_4^+) at P2, P4, P12, P20 and P26. NO_3^- and NO_2^- will be measured by chemoluminescence and NH_4^+ (filtered samples) will be measured by fluorometry.

Dark carbon fixation

I sampled the entire depth profile from station P4 and 100, 200, 600, 1000, and 1500 from station P12 for dark carbon fixation incubations. The samples were spiked with ^{14}C-bicarbonate and after 2 days samples for total tracer, organic carbon, and fixed carbon were taken. At station P4 at the depth of 600, 1000, and 1500m sulfide and methionine were added to test for the potential to use reduced sulfur compounds for dark carbon fixation. The samples will be analyzed on the liquid scintillation counter at UBC.

Sulfide oxidation

I sampled 30mL glass syringes (gas-tight) at the OMZ depths of 600, 1000, and 1500m for P 4 and 12, and 600, 800, and 1000m for P26 to test for potential sulfide oxidation. Sulfide oxidation rates were tested over a period of 24 hours with addition of sulfide, and sulfide and nitrate.

Gasses

I sampled for CH_4 and N_2O profile measurements at stations P3, P4, P8, P12, P16, P20, and P26. I sampled from the deep cast taking samples from most of the depth throughout the water column. Additionally, I took high resolution samples from the surface water from stations P4, P12, and P26. The samples will be analyzed by the Tortell lab at UBC.

Methane oxidation

At stations P4, P12, P20 and P26 I took samples of the whole profile to measure methane production in the water column. 3H-methane was added to the samples. After 2 days the reaction was stopped, total 3H-concentration measured. The remaining methane tracer in the sample was purged of and the 3H-water, produced by methane oxidation will be determined at UBC by liquid scintillation counting.

Aerobic methane production

At stations P4 and P26 I took water from the surface and the chlorophyll/fluorescence maximum depth to perform methane production incubations in the oxic water column. I incubated water from these depths in deck incubators and measured methane concentration time series in the gas headspace. Methane was measured on a GC equipped with an FID detector. Triplicate samples of various treatments (including control, DCMU, FeOOH addition, methylphosphonate addition, DMSP addition, dark, dark anoxic, Hg-killed) were measured.

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