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:** 8 June 2014 **TO:** 24 June 2014

SCIENCE CRUISE NUMBER: 2014-18 **SHIP'S PATROL NUMBER:** 14-06

CHIEF SCIENTIST[S]: Marie Robert

SCIENTIFIC PERSONNEL:

Female	Male
Victoria Lam (UBC)	Michael Arychuk (IOS)
Marie Robert (IOS)	Mark Belton (IOS)
Nina Schuback (UBC)	Glenn Cooper (IOS)
Maureen Soon (UBC)	Michael Craig (NOAA)
Mariela Tuquero (UW)	Mirkko Flecken (UBC)
	Steve Kunze (NOAA)
	Andreas Mueller (UBC)
	Chris Payne (UBC)
	Doug Yelland (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). Recover NOAA mooring PA-007 and deploy mooring PA-008 at Station Papa. Deploy 13 weather data drifting buoys: 3 for Environment Canada and 10 for NOAA. Deploy one Argo float for IOS.

CRUISE DESCRIPTION: This cruise (2014-18) was a success all around. All stations were visited but one, and all casts were performed. Unfortunately we did not collect any trace metal samples since the person in charge of these samples had an injury prior to the cruise and could not sail. Also the Argo float that was to be deployed along Line P got left at IOS by mistake. The biggest challenge of the cruise was to plan the mooring work at Station P around the mooring work performed by the *RV Melville*, working in the same area as the *CCGS John P Tully* during the same four days we were near Station P. It turned out that operations were done without any conflict and even the weather cooperated on mooring day.

DAYS ALLOCATED: 17 **DAYS OF OPERATION:** 16

DAYS LOST DUE TO WEATHER: only a few hours, one station cancelled.

SAMPLING:

- The Line P survey was almost 100% successful. All planned stations but one were visited and all planned profiles got done.
- Three weather data drifting buoys were deployed for Environment Canada, and ten were deployed for NOAA. We also deployed two experimental drifters for Tom Juhasz from IOS.
- The Multiple Plankton Sampler (MPS or Multinet) was used at 2 stations; a 2000m cast at P16 and a 3000m cast at P26.
- No trace metal samples were collected on this cruise.
- 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, Transmissivity, Irradiance, Fluorescence (only one sensor).
  3) From the Rosette: **DFO-IOS:** dissolved oxygen, salinity, nutrients, DMS, DMSP, chlorophyll, HPLC, dissolved inorganic carbon (DIC), alkalinity, pH – **UBC (Mueller):** number of cells per millilitre, virus counts, bacterial genomic (DNA, RNA) and sequencing – **UBC (Schuback, Flecken):** HPLC, Chl *a*, FCM, POC, ^{14}C primary productivity, FRRF, absorption, nutrients, salinity – **UBC (Soon, Payne, Lam):** Dissolved silicon, biogenic silicon, nutrients, dissolved Neodymium – **UW (Tuquero):** ONAr, dissolved oxygen.
  4) Biology: **DFO-IOS (Yelland):** Zooplankton using vertical net hauls (Bongos) to 250 m and 1200 m or 1300m; 2000 m MPS at P16; 3000 m MPS at P26.

RADIOISOTOPE USE:

The following radioisotope was used in the Rad-Van: ^{14}C-bicarbonate. Wipe tests were done in all appropriate areas of the ship every seven days and upon completion of the studies. The lab was inspected and decommissioned at the end of the cruise.

We are very grateful for being able to conduct our ^{14}C assimilation experiments in the Rad Van during this as well as during previous cruises. The Rad Van provides a more than adequate environment for these experiments. Unfortunately during this cruise there were issues with the freshwater supply to the Rad Van, which resulted in the van being flooded at several occasions and no fresh water being available for most of the cruise. This did not influence the experiments or safety of experiments conducted during this cruise, however, the plumbing in the Rad Van should be fixed before further cruises. Also, the door of the Rad Van has been getting very hard to close properly and opens itself easily which could be easily fixed with a simple additional lock.

Nina Schuback

PROBLEMS [SCIENTIFIC GEAR AND OPERATIONS]:

The thermosalinograph (TSG) seems to be an ongoing nightmare. Although things are slowly improving, there seems to be a lot of resistance to fix simple things like using a better computer to collect the data. May we suggest connecting the TSG directly to the science server in order to avoid issues like the laptop rebooting on its own every 24 hours, or even just to be able to access the keyboard when we need to start a new file? Also having the TSG data going straight into the science server would make the data available on the network. At present, the laptop is often not connected and always loses its IP address between cruises, requiring resetting and creating new setup files to collect the data into SCS.

A lab book is now available to write TSG notes/modifications/suggestions. TSG starting instructions need to be written at the beginning of this lab book, including the proper baud rates and other useful information. The two sheets of instructions glued to the side of the panel by the TSG are obsolete, and no other instructions are available to troubleshoot – or even start – the thermosalinograph at this point.

The plumbing part of the TSG is slowly getting better but many issues are still problematic. First, the front arm of the plumbing does not allow enough flow to reach the TSG. We could only get a reading of about 0.5 ℓ/min when 1.0 ℓ/min is the recommended rate. The back arm of the plumbing was working much better. Secondly, the 90° T-junction between the debubbler and the TSG dividing the flow between fluorometer and TSG does not allow enough water to go through the fluorometer. Indeed, when the outflow tubing of the fluorometer is elevated no more water flows out, suggesting that the water flows towards the fluorometer under gravity influence alone. Thirdly, the new system takes so much space that the pCO_2 set-up had to be modified at the last minute, and now the pCO_2 tubes and parts are under lots of strain for being in a different position without proper modification to the whole unit. Hopefully this fall the whole corner of the lab surrounding the sink will be redesigned in order to contain the new pCO_2 unit and a new permanent MIMS unit as well as the TSG set-up. The TSG set-up will have to be contained in a smaller foot-print, or even better: be at least partly mounted under the sink. Finally, the present location of the debubbler and most of the valves makes it impossible for most people to access safely.

There was a problem at the beginning of the cruise whereby people were throwing their wet gear and coats over the gas cylinders in the Science Lab. As attractive as these cylinders may look as coat hangers they actually do serve another purpose of supplying calibration gas to the pCO_2 system. To that end they have lines coming off them and those lines are prone to leaks at the fittings where they attach to the regulator. When coats are thrown over them the weight of the gear stresses the fittings and leaks can occur. A few days into the cruise this exact situation occurred and a leak at the fitting caused an entire tank of calibration gas to empty. The implications of this were the cost of the gas ($1200) and the loss of data quality as the pCO_2 system no longer had a clearly defined calibration range. In the future it would be appreciated if coats, pants and any other wet gear be hung up in an appropriate area other than on the gas cylinders.

Michael Arychuk

Another ongoing issue is the end of the termination of the CTD wire that has to be re-taped every few casts. This issue was already documented in the August 2013 Papa cruise. Modifications were made to a few parts of the LARS head during the last two years or so. We don't know if these modifications are the cause of the helicoil fraying, but it seems logical that one simple solution would be to find a shorter termination than what is being used now. If the end of the helicoil were contained inside the bullet then they could not possibly hit anything and keep fraying. Or there may by some types of terminations that do not require helicoil. It would be worth investigating.

SUCCESSES [SCIENTIFIC]:

Thanks to Doug Yelland for allowing the loading of most of the Line P gear, including three containers, prior to the La Perouse cruise, and to Mike Arychuk and Kyle Simpson for spending a week at IOS without their container. Same goes to the UBC groups who loaded their Line P gear at the beginning of La Perouse. It made for a shorter turn-around time between cruises.

Thanks also to all scientists for submitting their section of the cruise report before the end of the cruise!

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

We experienced a very short black-out. Most instruments and computers were ok but some of them had to be rebooted and lost some data. No major damage was done.

The ship's email system was having some issues. Messages were coming in but not going out. This is especially an issue when trying to plan for offloading on a Monday and not being in internet range until the weekend.

When we tried to store science equipment and totes on the hydrographic chart room's new shelving we discovered that they were already loaded with many boxes and totes, apparently ship's equipment and supplies. This space has always been allocated for science and the shelving was installed to store science gear but now seems to be no longer available.

SUCCESSES [SHIP]:

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

This crew is amazing. They have been working together for a long time and it shows. Operations go smoothly, the mood is awesome, everyone is laughing, yet the work is done seriously and safely. This means that there is some value to having the same people working together on the ship for a while instead of constantly having to train new people. The mooring work was a perfect example of the team work that can be accomplished when the crew has been working together for some time.

DELAYS [OTHER THAN WEATHER]:

A few hours at the beginning of the cruise to certify the LARS crane.
A few hours before departure because of problems with CTD wire.
A few minutes to fix the co-ax satellite phone cable in the dome at P24 outbound.
About one day because of a net caught in the propeller reducing the speed of the ship significantly.

SAFETY CONCERNS:

None.

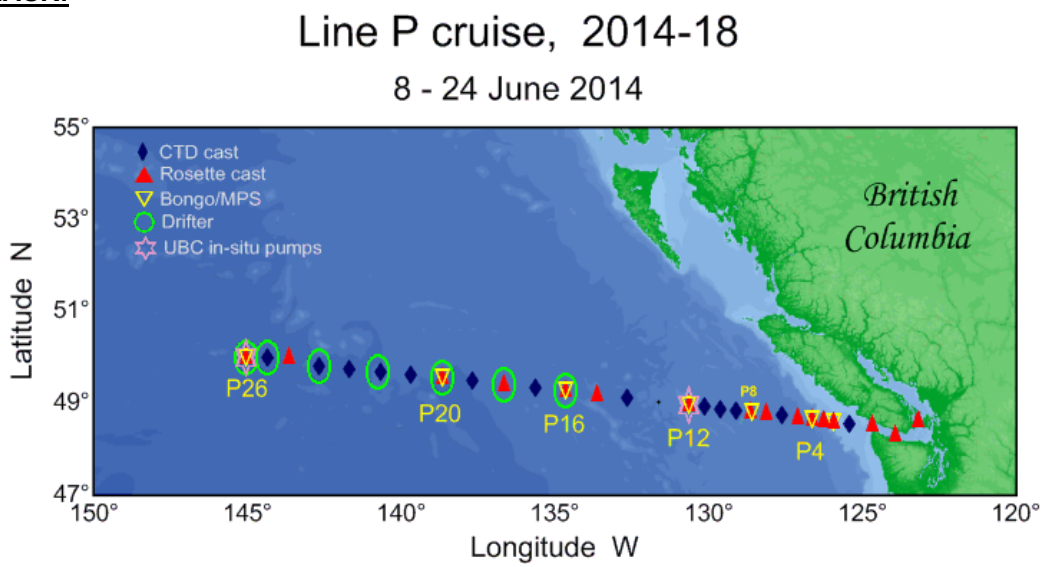
HAZARDOUS OCCURRENCES:

One scientific crew got injured prior to sailing.

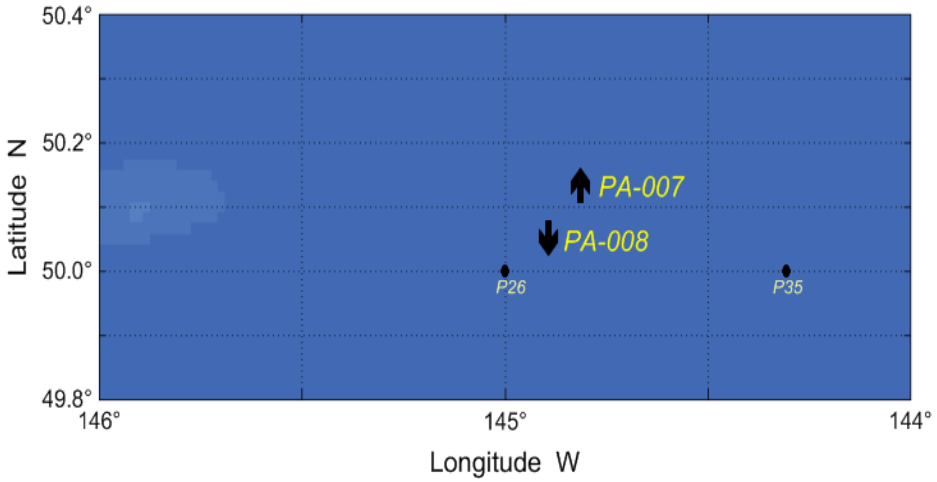
EVENT LOG:

Sunday 8 June:	Start loading the ship at IOS around 0930. Safety meeting at 1330. Science meeting at 1800. Depart at 1900. Station Haro59.
Monday 9 June:	Fire and boat drill at 1300. Stations JF2 to P4.
Tuesday 10 June:	Stations P4 to P8.
Wednesday 11 June:	Stations P8 to P12.
Thursday 12 June:	Station P12.
Friday 13 June:	Stations P14 to P16. Deploy one NOAA drifter.
Saturday 14 June:	Stations P17 to P20. Deploy one NOAA drifter.
Sunday 15 June:	Stations P20 to P22. Deploy three NOAA and one EC drifters.
Monday 16 June:	Stations P23 to P35. Deploy three NOAA and one EC drifters.
Tuesday 17 June:	Deep and DMS casts, UBC (Maureen) cast, 2 UBC *in-situ* pump casts, 250m bongo, 22-hr loop water experiment.
Wednesday 18 June:	UBC (Andreas) cast, deploy mooring PA-008, recover mooring PA-007. Two ONAr casts.
Thursday 19 June:	Deep plastics cast, 3000m Multinet, deploy two NOAA and one EC drifters, deploy two "sponge drifters" for Tom Juhasz. Leave Papa around lunch time.
Saturday 21 June:	Test the UBC *in-situ* pumps.
Monday 23 June:	Arrive at IOS and offload.

CRUISE TRACK:



MOORING WORK:



SUMMARY/FINAL COMMENTS:

- Many thanks to everyone at IOS who have helped make this cruise a success: Kenny, Tamara, Moira, Nina, Marty, Scott, Hugh … your help is always greatly appreciated!
- Thanks to the engineering group for constantly adjusting the "tank and incinerator" schedule around our sampling schedule. Thanks also for trying to improve the rosette latching mechanism. Special thank you to Chief Horton for taking the time to explain exactly how this mechanism works.
- Thanks to Captain McCullagh for his advice with 'weather forecasting', and to Zib, Rob and Tony for downloading the 'grib files' to help with planning. Those files were most helpful.
- Thanks to John and his amazing 'deck crew' for all the help with our work and for being constantly cheerful. You guys are awesome!
- Finally: Meghan, you and your galley crew were just FANTASTIC! You took on a big challenge but you definitely have what it takes to fill-in these shoes! Congratulations, but mainly: THANK YOU! ☺

Marie Robert and the science team.

- I would like to send a big thank you to the deck crew for all their help, expertise and professionalism in making my first stint as a watch leader go smoothly. Thank you to Victoria Lam, Andreas Mueller, Steve Kunze and Nina Schuback for stepping up and providing great assistance during my watch. A great thank you to the galley for the excellent inspired cuisine and making meal times always something to look forward to. Thank you to Marie Robert and Doug Yelland for both their instruction and more importantly patience.

  Mark Belton

- Project PI Meghan Cronin sends her sincere appreciation to the captain and crew of the Tully as well as to Marie Robert and the rest of the science team aboard. Thanks also to IOS for the continued partnership and cooperation that makes this ocean reference station mooring at Station P possible.

  Steve Kunze, Mike Craig

- We would like to thank all those (there are many) who assisted in collecting and poisoning the DIC/Alk samples. Your assistance was greatly appreciated.

  Glenn Cooper

- We would like to thank Marie Robert for all her help during preparation for this cruise and especially for making it possible to have our casts at very specific times of the day. Very special thanks also goes to Mike Arychuk, Nina Nemcek and Kyle Simpson for providing help with receiving and using radio-isotopes during this cruise. Further, we would like to thank Glenn Cooper for receiving our liquid nitrogen at IOS and Andreas Mueller for having extras of all the little things we forgot to bring! We would like to thank the crew of the Tully and all other scientists on board for a great cruise!

  Nina Schuback and Mirkko Flecken

- We would like to thank the Officers and the entire Crew of this trip. Everyone has been so helpful and accommodating. We would also like to thank the IOS gang for allowing us to become part of “their family” during this trip. Thank you ALL.

  Maureen Soon, Chris Payne, Victoria Lam

- We would like to thank the crew of CCGS John P Tully for all their hard work. We also thank the scientists from IOS and the rest of the science team (UBC, NOAA) for all their help and moral support. Line P has been a great experience in collaboration and cooperation between the different ocean sciences.

  Mariela Tuquero

- I really appreciated the time on board with the crew, officers and scientist to explain their work to me. The cruise gave me the opportunity to learn more about of the work of the scientist and the environment of the Pacific Ocean.

  All our lab objectives for this cruise were successfully fulfilled. The work area distribution was very convenient for our sampling needs and we will try to use the same setup once again in future cruises.

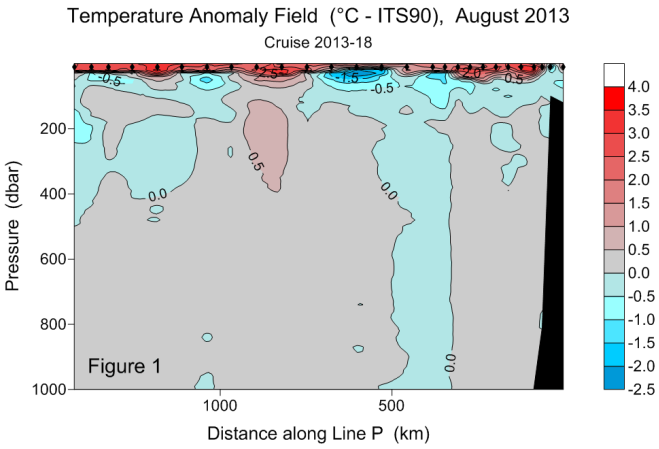
  I wish to thank the Tully crew for their assistance and excellent work throughout the cruise. Thanks to Marie Robert and the scientists onboard for their help on deck and in the lab.

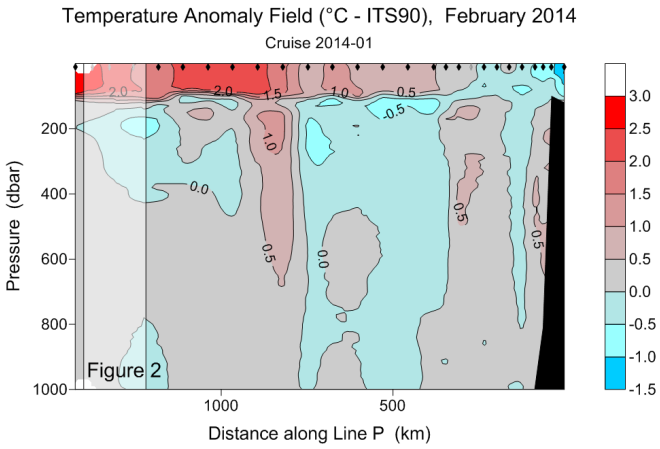
  Andreas Mueller

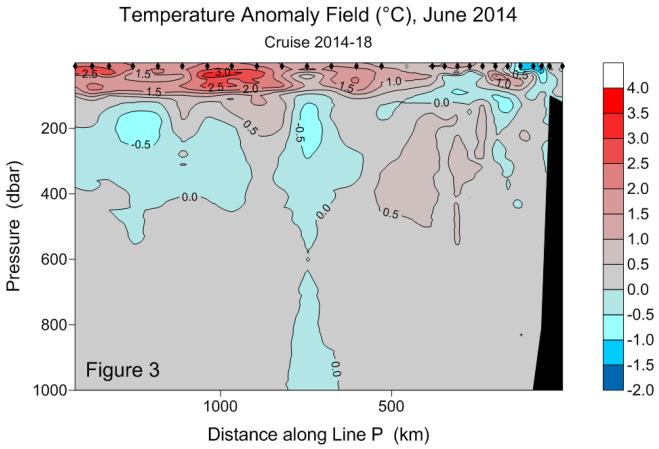
PROJECTS AND RESULTS:

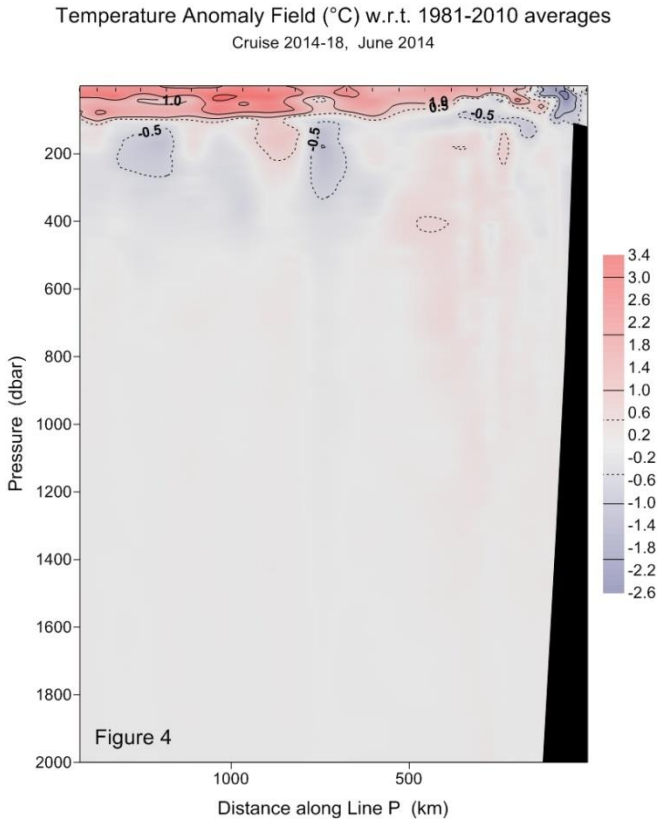
Water masses – Marie Robert, DFO/IOS.

In August 2013 the surface waters along Line P were much warmer than the long-term (1956-1991) averages, but the anomaly was concentrated in the first top metres of the ocean (Fig. 1). By February 2014 the anomaly was present towards the offshore portion of the line only, but it was present down to about 100 m (Fig. 2). It seems that the same anomaly is still present and even goes a little deeper (Fig. 3). These surface waters are not only warmer than the 1956-1991 averages, they are also warmer when compared to the last three decades, as shown in figure 4.









Figures 1 to 3: temperature anomalies with respect to the 1956 – 1991 averages for August 2013 (1), February 2014 (2), and June 2014 (3).
Figure 4: temperature anomalies with respect to the 1981-2010 averages for June 2014.

Mooring work – National Oceanic and Atmospheric Administration
Pacific Marine Environmental Laboratory
Steve Kunze, Mike Craig

The replacement NOAA mooring (PA-008) was deployed from the stern on June 18th, 2014 at a position of 50 03.23 N, 144 46.49W. As the ship departed Station P the newly deployed mooring was reporting data from all sensors, which include standard meteorological measurements, as well as subsurface temperature, salinity and currents to 300m. The previous mooring (PA-007) was successfully recovered later the same day. The mooring came aboard without incident, and all instruments, both surface and subsurface were recovered. The High-resolution data will be made freely available to researchers around the world. Project PI Meghan Cronin sends her sincere appreciation to the captain and crew of the Tully as well as to Marie Robert and the rest of the science team aboard. Thanks also to IOS for the continued partnership and cooperation that makes this ocean reference station mooring at Station P possible.

Carbonate Studies - Glenn Cooper, Marie Robert, and Mike Arychuk, DFO/IOS.

Four parameters of the carbonate system were measured on the 2014-18 mission. Both sea water pH and underway continuous automated pCO_2 were measured onboard the Tully. Samples for Total Inorganic Carbon (TIC) and Total Alkalinity (TA) were collected, preserved and returned to the Institute of Ocean Science (IOS) for further analysis.

1) Seawater pH analysis:

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: Haro59, JF02, P01, P02, P04, P12, P16, P20, and P26. A set of triplicate samples were taken at P02 station, whereas all other casts had two sets of triplicates which will be used to determine precision. Inter and intra niskin calibration was performed at P25, whereby 5 niskins were closed at 2000m and triplicates were analyzed from each niskin.

An article by Lui *et al* (Environ. Sci & Tech. 45.11, 2011) found that m-cresol purple indicator dye from various manufactures contained small amounts of impurities. Some of the impurities were able to absorb at the same wavelengths used to determine a sample's pH. Depending upon the type and the amount of impurity present in the dye could impact the accuracy of the pH measurement. Lui was able to purify mCP and fully characterized its physical and chemical properties. We obtained a small amount of Lui's purified dye in the hopes to compare it with the indicator dye (Anachemica Lot# 780322) presently being used on Line P missions. This study was initiated on the June 2013 Line P cruise but our goal was to gather more data to fully characterize our indicator dye. Samples were collected from various depths at P06 and P24. Six samples were drawn from each niskin and divided. Half of the samples were analyzed with the purified mCP and the other half with our mCP dye. Further samples were to be taken but initial analysis of obtained data showed inconsistencies with the purified dye and so the experiment was halted until it could be further assessed.

2) Total Inorganic Carbon and Alkalinity Sampling:

Total inorganic carbon and alkalinity (TIC/Alk) samples were collected at the following stations: Haro59, JF02, P01, P02, P04, P12, P16, P20, and P26. One set of replicates was taken at each station. An entire extra set of samples was taken at P26 for archiving. Inter and intra niskin calibration samples were taken at P25. All samples were collected into 500ml glass bottles and overfilled with one and a half volumes. Samples were poisoned with 100 µl of saturated mercuric chloride. Bottles were then sealed with greased glass ground stoppers which were kept in place with electrical tape. Samples were stored at 4°C until off loaded. We would like to thank all those (there are many) who assisted in collecting and poisoning the samples. Your assistance was greatly appreciated.

Cruise Report, Line-P, June 2014 – Nina Schuback and Mirkko Flecken, UBC

Samples collected during this cruise will extend our dataset characterizing phytoplankton primary productivity along Line-P and give insight into how these rates are optimized under contrasting external environmental conditions.
Data was collected from rosette casts (three depth) at five stations along the transect as well as during a 24 hour time-course experiment at P26 (8 time-points, loop water).
For each of these 23 sampling points we performed duplicate ^{14}C-assimilation experiments (10 light level light response curves, 3- 4 hour incubation time) and triplicate rapid light curves (RLCs). RLCs acquired on a fast repetition rate fluorometer (FRRF) provide an estimation of electron transport in photosystem II (ETR_{PSII}) as a function of light. Therefore, we simultaneously measured two different "currencies" of primary productivity (Carbon assimilation and ETR_{PSII}), both as a function of light. The observed coupling or decoupling of the two rates will be interpreted as a photo-physiological response of the phytoplankton community, fine-tuning primary productivity under given environmental conditions (e.g. light availability, Fe limitation, time of the day).
As supplementary data for each sampling point we used the FRRF to measure additional photo-physiological parameters (Fv/Fm, functional absorption cross-section (σPSII), PQ pool size, PSII turnover time), and collected samples for determination of [chl-a], pigment composition by HPLC, POC, flow cytometry, absorption coefficients and absorption spectra.
This dataset will provide insight into the photo-physiology of field phytoplankton assemblages and how photosynthesis and primary productivity is affected by the environment. Further, it allows to derive a conversion factor needed to convert rates of ETR_{PSII}, which can be acquired in high spatial and temporal resolution, to ecologically relevant rates of carbon assimilation.
Further, we used a novel multi excitation wavelengths FRRF instrument to acquire spectrally resolved measurements of phytoplankton biomass, photo-physiology and primary productivity along the whole transect and as 10 depth profiles at 5 stations. Different taxa of phytoplankton contain different light harvesting pigments with characteristic spectral properties. In this novel approach we attempt to distinguish the relative contribution of different "spectral groups" to bulk estimates of biomass, photo-physiology and primary productivity.
The MIMS was set up to collect data on O_2/Ar, a measure of net community productivity, along the transect.

Rad Van
We are very grateful for being able to conduct our ^{14}C assimilation experiments in the Rad Van during this as well as during previous cruises. The Rad Van provides a more than adequate environment for these experiments. Unfortunately during this cruise there were issues with the freshwater supply to the Rad Van, which resulted in the van being flooded at several occasions and no fresh water being available for most of the cruise. This did not influence the experiments or safety of experiments conducted during this cruise, however, the plumbing in the Rad Van should be fixed before further cruises. Also, the door of the Rad Van has been getting very hard to close properly and opens itself easily which could be easily fixed with a simple additional lock.

Acknowledgements
We would like to thank Marie Robert for all her help during preparation for this cruise and especially for making it possible to have our casts at very specific times of the day. Very special thanks also goes to Mike Arychuk, Nina Nemcek and Kyle Simpson for providing help with receiving and using radio-isotopes during this cruise. Further, we would like to thank Glenn Cooper for receiving our liquid nitrogen at IOS and Andreas Mueller for having extras of all the little things we forgot to bring! We would like to thank the crew of the Tully and all other scientists on board for a great cruise!

Biogenic and Dissolved silica sampling – Maureen Soon, Chris Payne and Victoria Lam; University of BC

We collected seawater samples in Line-P in order to measure the isotopic compositions of biogenic and dissolved silica. The goal of our study is to document the isotopic signature of the dissolution of lithogenics deposited onto the continental margins. This dissolution could be an important source of elements to oceans but it's not yet quantified. The line-P sampling is the land to open-ocean part of our study (the entire study includes the Fraser river and Georgia Strait samplings). Our working strategy was thus mostly focus on sampling onto the continental margin up to P5. Further stations (P7, P12 and P18) allow us to define the open ocean end-member.

Rosette samples:

We sampled seawater from rosette at station Haro 59, JF2, P1, P3, P5, P7, P12 and P18. For these sites, between 3 and 10 depths were sampled and 10L to 40L was collected for each depth. The 10L Niskin content was transferred into 20L cubitainer and directly processed at the lab to collect dissolved silica, nutrients and biogenic silica.
Dissolved silica and nutrients: a 50ml aliquot from each sample was subsampled using a syringe and filtered through a 0.45µm acetate filter (25mm diameter filter, swinex cartridge), then acidified with 100 microliter of 50% HCl. 10ml of seawater were also subsampled, filtered and frozen for nutrient analysis at UBC.
Biogenic silica: Between 20L and 40L of seawater were filtered through a 47mm Supor filter using a 12 filtration manifold unit.

Location	Depths	# Biogenic Si	# Dissolved Si	# Nutrients
Haro Strait 59	5, 100, 220	3	3	3
JF2	5, 25, 80, 100, 125, 175	6	6	6
P1	5, 15, 40, 70,90, 102	6	6	6
P3	5, 25, 50, 150, 300, 450, 600, 750, 810	9	9	9
P5	10,100,300,600,1000,1400,1800,2095	8	8	8
P7	10,100,300,600,1000,1400,1800, 2500	8	8	8
P12	5,20,40,60,80,100,300,500,750, 1000	10	10	10
P18	5, 20, 40, 60, 100, 300, 500,700,900	9	9	9
Total		**59**	**59**	**59**

Underway samplings:

Biogenic and dissolved silica from surface water were collected using the underway-sampling unit in the lab sink along the Line-P transect. A 142 cm diameter SUPOR filter was placed into an inline filtration unit equipped with a flow meter connected to the sink sampling line. Filter was changed between every station back and forth and dissolved silica and nutrients (already filtered fraction) were sampled directly into 50ml and 15 ml test tubes and processed as described above. A total of 34 filters for biogenic silica and 35 samples each for dissolved silica and nutrients were collected between the Line P stations from the underway system.

Large volume pump sampling at P12 for Silica:

One of our goals for this study is to document the biological uptake of silica in surface water and its sinking to deep water. We used our Large Volume Pumps (LVP) to collect as much particles as possible at deep water for this purpose. Two casts of 6 pumps each were deployed to cover the depth ranges of 2150 to 3000m in one cast and 1150 to 1900m in another cast. An average of 5 hours was used for each cast which includes the 2 hour pumping.

Pump #	Depth, m (cast 1/cast 2)	Volume, L (cast 1/cast 2)
1	2150/1150	710/767
2	2300/1300	492/77
3	2450/1450	647/256
4	2600/1600	668/637
5	2750/1750	517/474
6	3000/1900	81/281

All pumps worked for both casts except pumps 2 and 7 stopped after filtering about 70L in cast 2. Pump 2 had a “Sudden Pressure Release” and pump 7 had a “Min Flow Reached” error messages. The pump head problem was probably causing the Min Flow Reached problem for pump 7. The error for pump 2 is unknown at this point.

Dissolved neodymium concentrations and isotopic composition from the Strait of Georgia to Line P
Maureen Soon, Chris Payne and Victoria Lam, University of BC

Neodymium 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.

In this cruise, we collected 2 seawater samples from JF2. 20L of seawater samples was collected at the surface 5m and 20L was collected at 175m. We hope to see that the lower inflowing layer from the Pacific to Strait of Georgia has a different Nd isotopic composition from the upper outflowing water layer. These 2 samples are to replace the 2 samples from the February Line P cruise that were lost due to a puncture on the sample containers. These 2 samples were filtered through a 0.45 micron in-line filter and acidified to pH 2 with 6N HCl. Further sample processing will be done at UBC.

Large Volume Pumping (LVP) at P26 for Neodymium

Pump #	Depth, m (cast 1/cast 2)	Volume, L (cast 1/cast 2)
1	202/15	692/267
2	200/20	1.8/3.0
3	22/30	101/46.4
4	18/didn't use	225/0
5	14/200	5.7/11.4
6	10/205	0.7/3.8

Only 4 pumps worked from the 2 casts. Primping the pumps was not an issue because we are confident that these pumps were primped well. Contacted Phoebe Lam from Woods Hole Oceanographic Institutions and she suggested that cleaning the pins and connections on the cable between the power and motor would help a lot. Cleaned the pins and connections as suggested and applied the Dow Corning Compound 4 electrical grease on all connections. The pump head for pumps 2,3,5 and 7 were also taken apart and cleaned.

Large Volume Pump test cast between P14 and P15

The purpose of this test cast is to check if greasing all the pins and connectors properly and cleaning the pump heads help to improve the success rate of having the pumps stayed pumping for the duration of the time programmed. All six pumps were deployed 20 meters apart starting from 10 meters down to 110 meters. They were programmed to pump for 15 minutes. The result was not very promising. Only one out of the six pumps pumped for the full 15 minutes. 2 pumps pumped partially but stopped pumping before reaching the full 15 minutes. The ones that didn't work all had the "Sudden Flow Obstruction" error message. We now have to back to do more troubleshooting on this LVPs.

We would like to thank the Officers and the entire Crew of this trip. Everyone has been so helpful and accommodating. We would also like to thank the IOS gang for allowing us to become part of "their family" during this trip. Thank you ALL.

Cruise Report – Mariela Tuquero (University of Washington)

On this cruise, we successfully deployed a CTD package on the PAPA mooring and recovered the same from the previous mooring. The CTD package includes an Aanderaa optode and Seabird 43 for oxygen measurement, a Gas Tension Device for measuring total gas pressure, a Wetlabs ECOFLNTUS for fluorescence and backscatter, and a Seabird 16plus for temperature and salinity. We also took discrete water samples of oxygen and ONAr (Oxygen, Nitrogen, and Argon) at the sites of both the deployed and recovered moorings in order to calibrate these sensors. Oxygen and ONAr samples were also collected at the major

stations along Line P for Roberta Hamme at University of Victoria to provide data for mixed layer export models that both UVic and UW are collaborating on.

The transport of carbon from the atmosphere into the ocean plays a significant role in controlling carbon dioxide content in the atmosphere. This flux is driven by biological production as well as physical absorption. We can measure the amount of biologically produced carbon exported to the deep ocean by making precise oxygen measurements and using the Redfield ratio. These oxygen measurements along with measurements of the biologically inert gases nitrogen and argon, allow distinction between physical processes that affect gas saturation from biological production and consumption of oxygen. The discrete measurements taken on this cruise, coupled with the high resolution data collected from the mooring allows us to estimate carbon export and work towards constraining the carbonate system at station P.

We would like to thank the crew of CCGS John P Tully for all their hard work. We also thank the scientists from IOS and the rest of the science team (UBC, NOAA) for all their help and moral support. Line P has been a great experience in collaboration and cooperation between the different ocean sciences.

Andreas Mueller UBC Line P – June 2014

Objectives:
Describe the taxonomic and metabolic diversity of the bacterial community in the cycling of major nutrients and gasses along the Line P, focusing on the communities in the Oxygen Minimum Zone.

Sampling summery:
At 5 Stations (P4, P12, P16, P20 and P26)

1) 1 ml seawater samples were taken per depth to count the numbers of cell per milliliter using Flow Assisted Cytometry
2) 2 L seawater samples (at 16 depth) for high resolution bacterial DNA and sequencing were filtered
3) For single cell DNA analysis, samples were taken and preserved using *glyTE*

Additionally, at 3 major stations (P4, P12 and P26) the following were sampled at four depths across the oxygen minimum zone

1) 20 L per depth (10m, 500m 1000m and 2000m) 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 through 0.8µm for later virus analysis
3) Samples were taken and preserved using *glutaraldehyde* to use for Flow Cytometry analysis
4) For virus counting, samples were taken and preserved using *glutaraldehyde* and *betain*
5) 1 ml seawater samples were taken and preserved with *glutaraldehyde* per depth to count the numbers of cell per milliliter using Flow Assisted Cytometry
6) For single cell DNA analysis, samples were taken and preserved using *glyTE*
7) For P26 seawater samples were taken, preserved using *formaldehyde* and were filtered for FISH analysis

Comments:
I really appreciated the time on board with the crew, officers and scientist to explain their work to me. The cruise gave me the opportunity to learn more about of the work of the scientist and the environment of the Pacific Ocean.

All our lab objectives for this cruise were successfully fulfilled. The work area distribution was very convenient for our sampling needs and we will try to use the same setup once again in future cruises.

I wish to thank the Tully crew for their assistance and excellent work throughout the cruise. Thanks to Marie Robert and the scientists onboard for their help on deck and in the lab.