Regional Operations Centre
Canadian Coast Guard – Pacific

PACIFIC REGION CCG VESSEL - POST CRUISE REPORT

Line P Program – Fisheries and Oceans Canada

NAME OF SHIP/PLATFORM: John P Tully

DATE: **FROM:** 7 June 2013 **TO:** 25 June 2013

SCIENCE CRUISE NUMBER: 2013-17 **SHIP'S PATROL NUMBER:** 13-03

CHIEF SCIENTIST[S]: Marie Robert

SCIENTIFIC PERSONNEL:

Female	Male
Natalie Cohen (UNC)	Seth Bushinsky (UW)
Jennifer Keene (NOAA)	Glenn Cooper (IOS)
Nina Nemcek (IOS)	Michael Craig (NOAA)
Marie Robert (IOS)	Hugh Maclean (IOS)
Nina Schuback (UBC)	Adrian Marchetti (UNC)
Amelia Weiss (U. Berkeley)	Andreas Mueller (UBC)
	Rick Nelson (BIO)
	Todd Wood (U. Berkeley)
	Oliver Wurl (N Baltic Res. Centre)
	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 OBJECTIVES: Repeat hydrography section. Deploy three MetOcean floats for IOS, two Iridium float for University of Washington (UW), three weather data drifting buoys for Environment Canada, and two Carbon Explorer drifters for the University of California – Berkeley, to be recovered on the way back. Recover NOAA mooring PA-006 and deploy mooring PA-007 at Station P. Collect samples in order to detect the Cesium signal from the Fukushima tsunami. Get better profiles of HPLC along Line P.

CRUISE DESCRIPTION: This cruise (2013-17) was very successful despite problems with the main CTD Hawboldt winch. All stations were visited, all casts performed, and the mooring work was completed with only one very small mishap. One major difference from regular Line P cruises is that no DMS/DMSP samples were collected. Also, the UBC MIMS (Membrane Inlet Mass Spectrometer) was not on board.
We deployed three MetOcean drifters for DFO/IOS, two Iridium drifters for University of Washington, three weather buoys for Environment Canada, and two Carbon Explorer drifters at station P16 that were recovered on the way back.
The regular sampling done during this cruise was completed using a CTD, a Rosette, a Bongo, and the Multiple Plankton Sampler (MPS). Trace Metal sampling was done at Station P using a clean Teflon pump, and sea surface sampling was performed from the ship's small boat (733).

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

DAYS LOST DUE TO WEATHER: only a few hours.

SAMPLING:

- The Line P survey was 100% successful. All planned stations were visited and all planned profiles got done.
- Three MetOcean floats were deployed for DFO/IOS, one at P8, one at P12, and the last one at P16. They seem to be functioning properly. Two Iridium floats were deployed, at P20 and P26, for the University of Washington, and both are reporting as they should. Two Carbon Explorers drifters were deployed by University of California – Berkeley at P16 on the way west and were recovered on the way back. Three weather data drifting buoys were deployed for Environment Canada.
- The Multiple Plankton Sampler (MPS or Multinet) was used at 4 stations.
- No DMS/DMSP samples were collected on this cruise. Since the DMS container was not on the aft-deck there was more space on the aft-deck for all the mooring gear and operations.
- We collected some Trace Metal samples at Station P26 to detect the effects – if any – of the Pavlof Volcano erupting in the Aleutian Islands, AK.
- The samples collected include:
  1) Underway: **IOS**: Thermosalinograph (temperature, salinity, fluorescence), acoustic sounder, ADCP, irradiance off the heli-deck (near the incubators) – **UBC (Schuback):** FRRF.
  2) "E-data" from CTD: Pressure, Temperature, Conductivity, Dissolved Oxygen, Transmissivity, Irradiance, Fluorescence, and a Transmissometer and Turbidity sensors for University of California – Berkeley.
  3) From the Rosette: **DFO-IOS:** dissolved oxygen, salinity, nutrients, chlorophyll, HPLC, DIC, Alk, pH – **DFO-BIO (Nelson):** Cesium – **UBC (Mueller):** dissolved nitrogen (N_2), oxygen (O_2), carbon dioxide (CO_2), argon (Ar), nitrous oxide (N_2O), number of cells per millilitre, bacterial genomic (DNA, RNA), Methane – **UBC (Schuback):** Chl a concentrations, HPLA, Absorption spectra, FCM, ^{14}C, FRRF **UW/UVic (Bushinsky):** Oxygen, O^{17}, ONAr (Oxygen, Nitrogen, Argon), DIC, DOC, Noble gases, salinity – **UofC – Berkeley (Wood, Weiss):** Particulate Inorganic Carbon (PIC) – **UNC (Marchetti, Cohen):** Vitamin concentrations, size fractionated Chl *a*, phytoplankton preservations, flowcytometry, DNA, RNA.
  4) From the pump: **For IOS and UVic (Marchetti):** Iron (filtered and non-filtered), **UNC (Marchetti, Cohen):** metal free water.
  5) **DFO-IOS (Yelland)):** Zooplankton using vertical net hauls (Bongos and MPS).
  6) From the small boat (733): **Baltic Sea Research Centre (Wurl):** Gels, ATP, DNA, RNA, bacterial counts, picoplankton counts, POC, DOC.

RADIOISOTOPE USE:

The following radioisotopes were 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 decommissioned at the end of the cruise.

PROBLEMS [SCIENTIFIC GEAR AND OPERATIONS]:

The thermosalinograph was just problem after problem during this cruise, yet again. The filter kept plugging up, the salinity was really noisy, and the flow to the fluorometer was very variable and mainly is not recorded anywhere. Also the computer seems to be locked to remote data access, which should not be the case while at sea.

Many computers, recently "upgraded" to Windows 7, were creating problems to their owners. The main problem was when trying to access the ship's LAN. Thanks to Doug Yelland for spending hours helping many people on board with their computers.

We had a few misfires with the rosette all during the cruise.

We need a bigger freezer in the main lab somewhere, or else a secondary freezer somewhere on the ship, maybe in the hydrographic chart room. Many samples were lost because they could not get stored properly in the freezer and fell out when the door was opened. The cold bottles shattered when hitting the deck.

Not all necessary gain cables were on board for the fluorometer. This is especially unfortunate as there was someone on board to specifically sample HPLC.

SUCCESSES [SCIENTIFIC]:

As usual it was good doing the Line P cruise back-to-back with the La Perouse cruise; less equipment had to be loaded at the beginning of the cruise. Thanks to Doug Yelland for loading the Rad-Van on his cruise even though it was not needed in order to save time at the beginning of Line P.

It was very fortunate that the Line P Program bought a spare CTD cable a few years ago, after all the problems during the La Perouse cruise of the cable breaking so easily (see report for cruise 2013-38). It is imperative that a new spare cable be put in the OSD priority list of purchases so that we can have it in three years or so when this one will need to be replaced.

The ADCP was working pretty well during this cruise, except for a few lock-ups once in a while.

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

There were major problems with the main CTD winch on the boat deck (Hawboldt 17026). The winch would pay in ok but would not pay out properly. It caused some heating in the LARS cab that could have developed into real fires, and it also created some delays at the beginning of a few casts.

SUCCESSES [SHIP]:

As mentioned above, the main CTD winch was not working properly. Thanks to the engineering team – Ryan, Paul and Tom – for all the hours they spent trying to figure out the problem, babysitting the winch over many casts, and finally fixing it for good so that we did not have to work off the aft-deck. You guys are amazing.

The mooring work went really well. During the recovery of PA-006 the rubber band around the buoy got stuck on a cleat and had to be cut, but besides that it was pretty much a full success (see NOAA report in the Appendix).

Thanks to Captain Gronmyr for using both engines from about P20 to P16 on the return leg in order to increase our chances of recovering the non-communicating University of Berkeley CE drifter. By getting in the area early enough we were able to locate and recover it as it resurfaced. The deck crew also did an amazing job in locating the drifter in the middle of the night.

DELAYS [OTHER THAN WEATHER]:

A few hours because of the winch.

SAFETY CONCERNS:

Smoke in the LARS cab because of the winch problems.

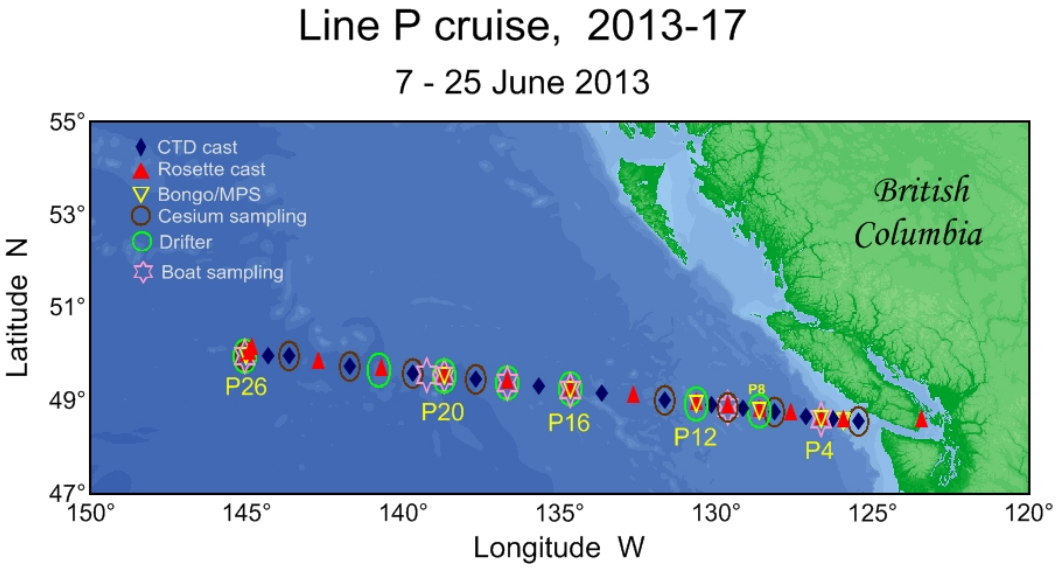
HAZARDOUS OCCURRENCES:

None involving scientific personnel.

EVENT LOG:

Friday 7 June:	Start loading the ship at IOS mid-morning. Safety meeting at 1600. Science meeting at 1830. Leave at 1900. Do the Saanich Inlet cast, leave for P1 when completed.
Saturday 8 June:	Stations P1 to P4.
Sunday 9 June:	Stations P4 to P8.
Monday 10 June:	Stations P8 to P12.
Tuesday 11 June:	Stations P12 to P14.
Wednesday 12 June:	Stations P15 to P16. Deploy the Berkeley CE drifters.
Thursday 13 June:	Stations P17 to P20.
Friday 14 June:	Stations P20 to P22.
Saturday 15 June:	Stations P23 to P35.
Sunday 16 June:	Arrive at Papa shortly after midnight. Pumping in the chains for UNC, then Cesium 1, 3 ONAr, and Deep Rosette casts. Boat sampling for Oliver.
Monday 17 June:	Cesium 2 and HPLC 1 Rosette cast in the morning, then deploy NOAA mooring PA-007. Two calibrations casts at PA-007, then HPLC 2 cast at Papa.
Tuesday 18 June:	UBC and UNC cast during the night, then calibration cast near PA-006. Recover NOAA mooring PA-006 during the day. MPS and bongo at Papa in the evening.
Wednesday 19 June:	Cesium 3+O^{17} and Light+UNC+O^{17} casts in the morning. Boat sampling for Oliver. Deploy UW Iridium float and EC weather drifter, then start heading east.
Thursday 20 June:	Boat sampling for Oliver between P21 and P20.
Friday 21 June:	Recover CE drifters near P16. Rosette cast at P16.
Saturday 22 June:	Rosette cast at P4.
Sunday 23 June:	Arrive at IOS.
Monday 24 June:	Offload at IOS before noon. Fuel in the afternoon.

CRUISE TRACK:



SUMMARY/FINAL COMMENTS:

- Many thanks to everyone at IOS who have helped make this cruise a success: Janet, Kenny, Marty, Mike, Moira, Wendy, … your help is always greatly appreciated!
- Thanks to Doug Yelland for spending hours helping many people on board with their computers.
- Special thanks to Ryan and his engineering team for not giving up on the Hawboldt winch despite all the headaches, frustrations, and babysitting it required! You guys definitely saved the cruise.
- Thanks to Captain Gronmyr for using both engines on the way back from Papa so that we could recover both University of Berkeley's Carbon Explorer drifters at P16. Thanks also for all the weather reports.
- Big, heartfelt "thank you" to the entire deck crew for all their help, as well as the boat rides in the middle of the night in order to recover the CE drifters!
- Finally, thanks to the entire galley crew for looking after us so wonderfully!
- Hopefully see you all in August 2014 for another successful Papa trip!

Marie Robert and the science team.

- We are extremely grateful to many of the members of IOS for their assistance in helping us prepare for this cruise and collecting samples while at sea. Mike Arychuk provided onshore support with receiving shipment of our field equipment and obtaining liquid N_2 and dry ice for sample preservation. Kyle Simpson, Keith Johnson and Glenn Cooper assisted with the setup of the IOS trace metal clean sampling system. Hugh Maclean and Doug Yelland assisted with sample collection. Darren Tuele provided and set up the incubators that were essential for our Station P grow-out experiment. Lastly we are extremely thankful to Marie Robert (chief-scientist) for allowing us to participate on this cruise and putting up with our incredibly high water demands. All fellow scientists and the officers and crew of the *CCGS J.P. Tully* were very helpful in assisting in sample collection and were essential to accomplishing our research goals. This being my 7th Line P trip, in my opinion, what makes Line P such an amazing oceanographic time series is not just the interesting attributes of the region but also the incredible sense of collaboration among all the scientists that participate on these cruises. We appreciate all their efforts.

Adrian Marchetti, Natalie Cohen

- I would like to thank everybody who helped me before and during the cruise, collecting samples and especially facilitating the use of the Rad Van and the use of radioisotopes during this cruise.

Nina Schuback

- Project PI Meghan Cronin sends her sincere thanks to the captain and crew of the TULLY, and to IOS, for the continued partnership, hard work, and cooperation that make this ocean reference station mooring at Station P possible.

Jennifer Keene, Mike Craig

- 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

- We would like to thank Marie Robert for accommodating our water requests. Thanks to the captain and crew for all their hard work and for feeding us well. Special thanks to Adrian Marchetti and Mike Craig who helped fill dozens of HPLC bottles.

Nina Nemcek, Angelica Peña.

- 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

- We would like to thank the Captain and crew for a successful recovery of these instruments under very difficult conditions.

Todd Wood, Amelia Weiss

- I acknowledge that without the cooperation of the crew of the J.P. Tully this work would not have been possible. I thank them especially for the small boat operations to collect samples.

Oliver Wurl

- I would like to thank the crew of the John P. Tully, Marie Robert and the scientists from IOS who make this cruise run as smoothly as possible, and the rest of the science crew for all of their help on this cruise. Finally, Michael Craig and Jennifer Keene were, as always, very helpful and supportive throughout the trials and tribulations of deploying instrumentation on a mooring. And thanks to Doug Yelland, who does fantastic work.

Seth Bushinsky

PROJECTS AND RESULTS:

Water masses – Marie Robert, DFO/IOS.

It looks like there's a cold and salty water mass near the coast, as can be seen in these anomalies of temperature and salinity, with respect to the 1956 – 1991 averages (Figure 1). Note that the data shown here are not processed yet.

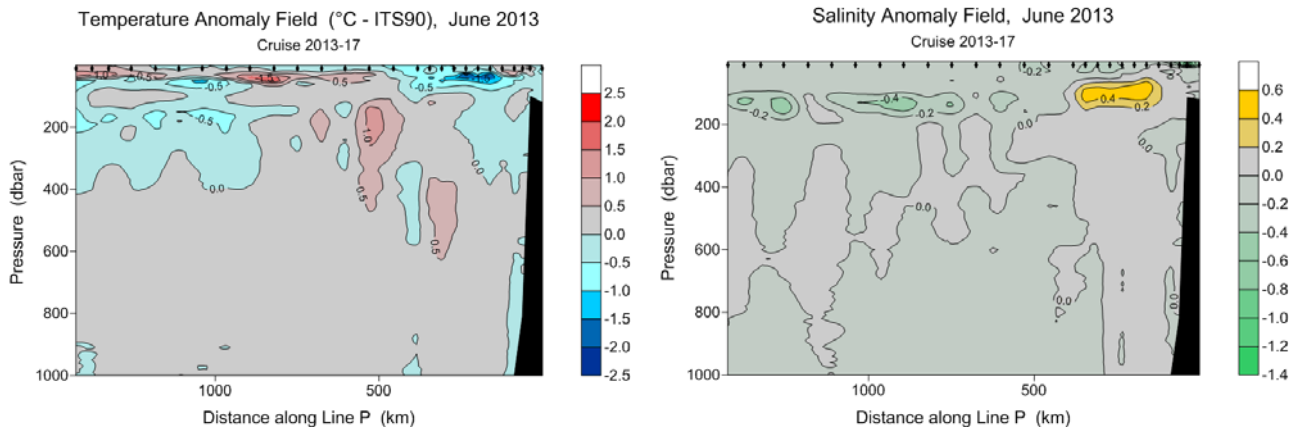


Figure 1: Temperature and Salinity anomalies along Line P in June 2013 with respect to the 1956 – 1991 averages.

The other thing worth mentioning is the vast amount of salps that were present all along Line P. The thermosalinograph and bongo/MPS were constantly being clogged by the salps, and while sailing the number of salps visible at the surface was quite astonishing.

Finally, looking at very preliminary results, it seems that there might be some deep mixing at Station P, broadening the Oxygen Minimum Zone but also increasing the amount of dissolved oxygen contained at these depths, as shown on the figure 2. A lot more time looking at data is needed to comment more on this graph.

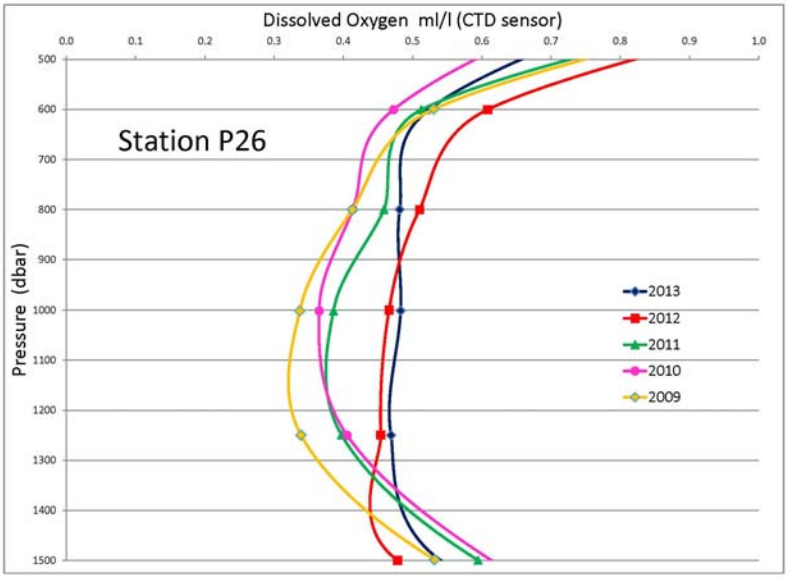


Figure 2: Dissolved Oxygen (CTD sensor) in ml/l at Station P during the early summer cruises of 2009 to 2013.

June 2013-17 Line P Cruise Report – Dr. Adrian Marchetti, Assistant Professor, University of North Carolina at Chapel Hill; and Natalie Cohen, Graduate Student, University of North Carolina at Chapel Hill.

Area of research interests: Phytoplankton physiology, biogeochemistry and molecular ecology

Our primary objectives during this cruise were to a) examine phytoplankton distributions and physiology and molecular ecology in relation to vitamin concentrations along the Line P coastal to open ocean transect and b) assess whether phytoplankton communities at Station Papa (P26) are co-regulated by iron (Fe) and vitamins. We focused our efforts on two vitamins, vitamin B_{12} and biotin (also known as vitamin B_7) which have recently been identified to be in very low concentrations in seawater, potentially limiting to phytoplankton biomass and important in regulating phytoplankton species composition. Our sampling efforts were divided into two main components: a) the Line P transect and b) and an Fe/vitamin amendment experiment at P26. At each of the major stations along Line P we collected water samples at two depths; surface (5m) and the deep chlorophyll maximum (DCM, depth varied throughout transect). At each depth we collected samples for a) size-fractionated chlorophyll *a* (>5 µm and GF/F), b) flow cytometry, c) phytoplankton counts (Lugol's preservative), d) DNA, e) RNA and f) dissolved vitamin concentrations. Back at the lab, we will use the DNA obtained from each sample to examine the presence/absence of specific diatoms we are interested in using as molecular bioindicators. With the RNA, we will then query the expression of functional genes in involved in Fe homeostasis, biotin synthesis as well as other biotin requiring protein-encoding gene and vitamin B_{12} requiring protein encoding genes to evaluate the potential for Fe and/or vitamin limitation in the diatom communities.

At P26 we performed a very ambitious microcosm Fe/vitamin amendment grow-out experiment. The aim of this experiment was to assess changes in the phytoplankton biomass, diversity, physiology and gene expression after the addition of Fe, biotin and vitamin B_{12}. We used the trace metal clean pump to obtain water from a depth of 15 m (33 % I_o) (Figure 3). Over the course of 4 hours we filled 18 x 1L cubitainers (for a 48 hour time point) and 18 x 10L cubitainers (for a 96 hour time point). There were 6 treatments: a) an unamended control b) Fe only (4 nM), c) biotin only (200 pM), d) vitamin B_{12} only (200 pM), e) Fe and biotin and f) Fe and vitamin B_{12}. Three replicates of each treatment were incubated in large incubators on the Tully helideck (Figure 4). At 48 hours following incubation, the 1L cubitainers were harvested for a) size-fractionated chlorophyll *a*, b) flow cytometry, c) nutrients, d) Fv/Fm, e) phytoplankton counts and f) DNA. At 96 hours following incubation, the 10L cubitainers were harvested for all these same measurements as well as POC/PON and RNA. For this experiment, Nina Shuback from UBC performed variable fluorescence measurements (including Fv/Fm) and photosynthesis light curves using both an FRRF and C_{14}.

Figure 3: Natalie Cohen filling a cubitainer for our Fe/vitamin amendment grow-out experiment at Station Papa using the IOS trace metal clean sampling pump system.

In addition to our own sampling efforts, we collected samples for Dr. Christina De LaRocha (Université de Bretagne Occidentale) for Si Isotope analysis and Dr. Jay Cullen for Fe analysis. For Si Isotopes, 500 mL of pre-filtered seawater from the deep sampling depths were collected at stations P8, P12, P16, P20 and P26. For Fe analysis, filtered and unfiltered samples were collected at 40m, 30m, 20m, 10m and 5m from P26 using the IOS trace metal clean sampling pump. We also served on watch duty. Natalie was on watch from 00:00 – 06:00 and I was on watch from 18:00: 0:00. During this time we assisted with all Line P duties including sampling from the rosette, bongos, filtering of chlorophyll samples and nutrient sampling on the deep casts…and there were lots and lots of nutrient samples to be collected. According to the Chief Scientist, I can now consider myself as a professional nutrient sampler!

Figure 4: Incubations for the Fe/vitamin amendment grow-out experiment at Station Papa.

We are extremely grateful to many of the members of IOS for their assistance in helping us prepare for this cruise and collecting samples while at sea. Mike Arychuk provided onshore support with receiving shipment of our field equipment and obtaining liquid N_2 and dry ice for sample preservation. Kyle Simpson, Keith Johnson and Glenn Cooper assisted with the setup of the IOS trace metal clean sampling system. Hugh Maclean and Doug Yelland assisted with sample collection. Darren Tuele provided and set up the incubators that were essential for our Station P grow-out experiment. Lastly we are extremely thankful to Marie Robert (chief-scientist) for allowing us to participate on this cruise and putting up with our incredibly high water demands. All fellow scientists and the officers and crew of the *CCGS J.P. Tully* were very helpful in assisting in sample collection and were essential to accomplishing our research goals. This being my 7th Line P trip, in my opinion, what makes Line P such an amazing oceanographic time series is not just the interesting attributes of the region but also the incredible sense of collaboration among all the scientists that participate on these cruises. We appreciate all their efforts.

Carbonate Studies: Marie Robert and Glenn Cooper, DFO/IOS.

Four parameters of the carbonate system were measured on the 2013-17 mission. Both sea water pH and underway continuous automated pCO_2 were measured onboard the Tully. Samples for Dissolved Inorganic Carbon (DIC) and Total Alkalinity (TA) were collected, preserved and returned to IOS for 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 into 10cm path length glass cuvette. Meta-cresol purple (mCP) was used as the indicator dye and was validated prior to the cruise at the Institute of Oceans Science. The following stations were sampled: P01, P02, P04, P12, P16, P20, and P26. One triplicate was taken at P02 station, whereas all other casts had two triplicates taken to determine precision for the overall cruise. Inter and intra Niskin calibration was performed at P25, whereby 5 Niskins were closed at 2000m and triplicates were analyzed from each Niskin. Precision for the entire cruise is estimated to be ± 0.0005 pH units.

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 which can 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, significantly affected the pH measurement accuracy. Lui was able to purify mCP and fully characterized its physical and chemical properties. We obtained a small amount of Lui's purified dye and compared it with our indicator dye (Anachemica Lot# 780322) used on this and previous Line P cruises. Samples were collected from various depths and stations (P04, P06, P10, P18 and P21), representing the entire pH range typically seen on the Line P cruise. 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. By comparing the results from the purified mCP to the Anachemica mCP, the goal is to generate an offset so as to further increase the accuracy of our system.

2) Dissolved Inorganic Carbon and Alkalinity Sampling:

Dissolved inorganic carbon and alkalinity (DIC/Alk) samples were collected by Marie Robert at 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. DIC/Alk was also taken at the calibration cast (P25). Sea water was 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 sealed with greased glass ground stoppers and kept in place with electrical tape. Samples were stored at 4^{o}C until off loaded. We would like to thank Michael Craig, Richard Nelson, and Todd Wood for assisting in sampling, poisoning, and sealing the samples.

3) pCO_2:

The pCO_2 underway system started logging data upon our exit of Saanich inlet and left on until our return to the Strait of Juan de Fuca from Ocean Station Papa. Overall the system worked well except for a couple minor issues during the entire cruise.

First the system was plagued by constant plugging of the pCO_2 system pre-filter. This resulted in stopping the data acquisition program several times during the cruise in order to clean the pre-filter. The underway TSG unit onboard, which uses the same underway seawater loop system, was also plagued with pre-filter clogging. It became so frequent that the engineers checked the inlet filters for the underway loop system to see if they had been damaged. This resulted in the underway system being shut down so they could remove and inspect the filters which were found to be clean and intact. The only explanation for all the clogging is the pre-filters are getting to the point where even regular cleaning can not completely remove all the clogged material. They either need to be replaced or soaked in something caustic to remove trapped hardened material.

On June 11, 2013 at 17:00 (PDT), the pCO_2 computer was found in the Windows log on screen state. Not sure how this occurred but it seems that the computer underwent a restart. It took some time to log back into the computer as the setup manual did not have the user id and password. Eventually they were found in the pCO_2 log book. Programs and systems had to be all restarted as per the setup manual. From that point on the system continued running without any issues.

Cruise report - Nina Schuback, UBC.

Discrete samples were taken from the rosette at three depth (3m, chlorophyll max, mid mixed layer) at all five major stations (P4, P12, P16, P20, P26).

From each of these points samples were collected for flow cytometry (triplicate), HPLC (duplicate), [chl-a] (duplicate), absorption coefficients and absorption spectra (duplicate). Further, water from each depth at each station was used to perform ^{14}C-assimilation experiments (10 light level light response curves, 2-3 hour incubation time) and to acquire data on the FRRF (10 light level rapid light curves, ETR_{PSII}, Fv/Fm, functional absorption cross sections, PQ pool size).

Data from ^{14}C-assimilation and FRRF and experiments were further collected for the Iron/Vitamin addition experiments conducted by Adrian Marchetti and Natalie Cohen.

Together with Andreas Mueller samples were collected at all major stations for analysis of trace gasses.

The FiRe as well as the FRRF were connected to the underway sampling system to log underway data of Fv/Fm and functional absorption cross section and water was collected at P20, P26 and P4 to isolate cyanobacteria using a sorting flow cytometer at UBC.

I would like to thank everybody who helped me before and during the cruise, collecting samples and especially facilitating the use of the Rad Van and the use of radioisotopes during this cruise.

Mooring operations - Jennifer Keene and Mike Craig, NOAA

The replacement NOAA mooring was safely deployed on June 17, 2013 at a position of 50º 7.69'N, 144º 49.21'W. The newly deployed PA007 mooring is reporting data from all sensors, which include all standard meteorological measurements, as well as subsurface temperature, salinity and currents to 300m. The previous mooring was successfully recovered the following day, on June 18. High-resolution data from the recovered PA006 mooring will be made freely available to researchers around the world. Project PI Meghan Cronin sends her sincere thanks to the captain and crew of the TULLY, and to IOS, for the continued partnership, hard work, and cooperation that make this ocean reference station mooring at Station P possible.

Mission 2013-17 CCGS J P Tully June 6 to 25, 2013; 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 Fukushima 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 this year 2013.

Sampling 2013-17:

Three 9 depth profiles were collected at station P-4, P-16 and P-26 at depths 600, 500, 400, 300, 200, 150, 100, 50 and 5 meter depths. For stations 4 and 16 40 liter samples were collected for each depth and for station P-26 60 liter samples were collected.
In addition 60 liter surface samples were collected from the underway loop system after the ship was on station at P-1, P-7, P-10, P-13, P-19, P-20, P-21, P-23, P-24, P-25 and at P-26 as a comparison to the 5 meter samples collected from the rosette. A total of 38 samples were collected.
In addition 1 liter samples were collected from the underway loop system for I-129 analysis at stations P-19, P-21, P-23, P-25 and a full depth profile from the rosette at Station P-26. A total of 14 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 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.

Phytoplankton Community Composition by HPLC Along Line P - Nina Nemcek & Angelica Pena, DFI/IOS.

Sampling of phytoplankton for HPLC determination of pigment concentrations and community composition has been carried out along Line P since 1999 (regularly since 2006). The sampling program in place since 2010 has involved collecting samples at 3 depths in the euphotic zone at the major stations (P2, P4, P8, P12, P16, P20, P26), and at 5 m and the subsurface chl maximum at all other CTD stations (P1-P35). The goal for this cruise was to increase our vertical sampling resolution to understand how the pigment composition changes through the euphotic zone. Ten depths were sampled between 5-60 m at every even numbered station (P2-P26, both rosette and CTD), with the standard 2 depths sampled at all odd numbered station. Our hope is that the increased vertical resolution will shed light on how well our current 3 depth sampling scheme captures the vertical variability in community structure along Line P.

We would like to thank Marie Robert for accommodating our water requests. Thanks to the captain and crew for all their hard work and for feeding us well. Special thanks to Adrian Marchetti and Mike Craig who helped fill dozens of HPLC bottles.

Line P – June 2013 - Andreas Mueller, UBC.

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) Gasses samples were taken for later dissolved nitrogen (N_2), oxygen (O_2), carbon dioxide (CO_2), Argon (Ar) and nitrous oxide (N_2O) measurement using Chromatography Mass Spectrometry
2) 10 ml seawater samples were taken per depth to count the numbers of cell per milliliter using Flow Assisted Cytometry
3) 10 ml seawater samples were taken for hydrogen sulfide (H_2S) quantification
4) 1 L seawater samples (at 16 depth) for high resolution bacterial DNA and sequencing were filtered
5) 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) Large volumes (20 L) per 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) Samples were taken and preserved using *DMSO* to use for Flow Cytometry analysis
4) For virus counting, samples were taken and preserved using *glutaraldehyde*
5) Gasses samples were taken for later dissolved nitrogen (N_2), oxygen (O_2), carbon dioxide (CO_2), Argon (Ar) and nitrous oxide (N_2O) measurement using Chromatography Mass Spectrometry
6) 10 ml seawater samples were taken per depth to count the numbers of cell per milliliter using Flow Assisted Cytometry
7) 10 ml seawater samples were taken for hydrogen sulfide (H_2S) quantification
8) For single cell DNA analysis, samples were taken and preserved using *glyTE*
9) 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.

Gas samples were taken, in triplicate at all depths at stations P4, P12, P16, P20 and P26. Additionally, gas samples were also taken in duplicate at the 4 UBC depths at P4, P12 and P26.

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.

Particulate Inorganic Carbon Sensor and Carbon Flux Explorer Deployment - Todd Wood, Lawrence Berkeley National Lab, Berkeley, CA; and Amelia Weiss, University of California Berkeley.

Objective: The goal of this project was to measure the Particulate Inorganic Carbon (PIC) content of the North Pacific Ocean along Line P. These observations will be used to calibrate a PIC sensor designed by James Bishop (University of California, Berkeley), which currently is in the final stages of development. The PIC sensor measures calcium carbonate (*CaCO3*), which is mainly formed by coccolithophores. These phytoplankton use *CaCO3* to make protective casings. Thus, *CaCO3* forms in areas of high productivity.

Much of this particulate carbon is ultimately lithified on the ocean floor, making it an important carbon sink. The sensor uses a polarized laser and a cross polarized receiver. When calcium carbonate enters the beam path, it changes the plane of polarization, and the signal increases. The sensor was mounted on the Rosette, along with a transmissometer. Profiles were taken all along P. At major stations, 1 liter water samples were collected. These samples were filtered using a small volume direct filtration system, and the Supor membrane disc filters were saved for later analysis.

Carbon Flux Explorer Deployment

The Carbon Flux Explorer (CFE) is an autonomous profiling instrument which captures high frequency images of sinking particles while drifting at depth. The instrument periodically surfaces to transmit data on the imaged particles in order to classify particle types and concentrations. A major goal on this cruise was to perform an extended open ocean test of new polarized imaging hardware designed to enhance the detection of PIC. Two CFEs were deployed at P16 and profiled 3 times per day from 150 m, 350 m and 600 m. The CFEs were recovered on our return to P16 after a successful 10 day test mission. Below is a backlight image collected by CFE002 during the P16 deployment. We would like to thank the Captain and crew for a successful recovery of these instruments under very difficult conditions.

CRUISE REPORT FOR LINEP 2013 - Oliver Wurl, Leibniz Institute for Baltic Sea Research, Seestrasse 15, 18119 Rostock, Germany.

Biofilm-like properties of the ocean´s surface

The sea-surface microlayer, the interfacial layer between the ocean and the atmosphere (typically 40-100 µm in thickness), plays an important role in air-sea gas exchange, particle aggregation, generating organic-rich aerosols and biogeochemical cycling. Sieburth (1983) hypothesized that the microlayer is a hydrated gel-like layer formed by a complex structure of carbohydrates, proteins, and lipids. His hypothesis has been recently confirmed by finding that transparent exopolymer particles (TEP), abundant gel-like particles in the ocean, are enriched in the microlayer (Wurl et al. 2009; Wurl et al., 2011). Based on those findings, the emerging consensus is that the microlayer is an aggregate-enriched biofilm environment that is ecologically distinct from those present in the subsurface water immediately below, as described by Cunliffe et al. (2011).

Sampling along Line P in June 2013 contributes significantly to a number of field studies around the world (e.g. South China Sea, California Current and Baltic Sea) to investigate biofilm-like properties of the sea-surface microlayer at various sea state and primary production rates. Line P samples will reveal new insights in the chemistry and microbiology of the microlayers with the possibility to directly compare oceanic and coastal microlayers. During LineP 2013 a total of 13 pairs of microlayer and subsurface water have been collected at various sea states (3 to 20 knots wind) from a small boat. Slick samples, intensive accumulation of surfactants in the microlayer appearing as smooth patches compared to adjacent rippled water surfaces through wave-damping effect, could be collected at station P26 and between P20 and P21. Open ocean slicks occur with a much less frequency than in coastal waters providing very important data on their chemical and microbiological properties. All samples have been processed, filtered and stored for the further analysis of TEP, dissolved (DOC) and particulate organic carbon (POC), chromophoric dissolved organic matter (CDOM), adenosinetriphosphate (ATP), DNA/RNA for molecular analysis and counts of bacteria and picoplankton. From the onboard staining procedure for the analysis of TEP, it can be already qualitatively concluded that the slicks samples are greatly enriched in gelatinous material, a basic foundation of biofilms. Analysis of ATP as biomass indicator, counts on cells, and bacterial composition (DNA/RNA fingerprints) are used to assess increased microbiological activities and unique communities in the microlayer, especially during slick conditions, to further conclude biofilm-like properties. To complement the data, further slick samples are planned to be collected in Saanich Inlet upon return to the Institute of Ocean Sciences, allowing the first time to compare coastal and open ocean slicks for the first time. Six additional pairs of samples were collected and frozen for further lab-based experiments on how microlayers affect the composition of marine aerosols (with Lisa Miller and Svein Vagle, both IOS).

I acknowledge that without the cooperation of the crew of the J.P. Tully this work would not have been possible. I thank them especially for the small boat operations to collect samples.

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Mooring and ONAr report - Seth Bushinsky (University of Washington)

On this cruise we deployed a SeaBird CTD package and a SAMI pH sensor on the PAPA mooring and recovered the same from the old mooring. The CTD packages measure temperature, salinity, oxygen through both a Seabird 43 and Aandaeraa optode, total gas pressure from a Gas Tension Device, and fluorescence and backscatter using a Wetlabs ECOFLNTUS. To both calibrate these sensors and provide data for mixed layer export models we took discrete water samples of oxygen, ONAr (Oxygen, Nitrogen, and Argon), neon, alkalinity, dissolved inorganic and organic carbon, and salinity. Additionally, ^{17}O was measured to estimate biological production at Papa. Along the rest of Line P we took ONAr, noble gas, oxygen, and dissolved organic carbon measurements.

The transport of carbon from the atmosphere into the ocean plays a major role in controlling the carbon dioxide content of the atmosphere. This flux is driven both by physical absorption and biological production. The amount of biologically produced carbon that is exported to the deep ocean can be measured by making precise oxygen measurements. These oxygen measurements, coupled 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 PAPA.

I would like to thank the crew of the John P. Tully, Marie Robert and the scientists from IOS who make this cruise run as smoothly as possible, and the rest of the science crew for all of their help on this cruise. Finally, Michael Craig and Jennifer Keene were, as always, very helpful and supportive throughout the trials and tribulations of deploying instrumentation on a mooring. And thanks to Doug Yelland, who does fantastic work.

"Extra report":

CFEs deployed and recovered – Jim Bishop, University of California – Berkeley.

Following an 8 day deployment, Carbon Flux Explorers, CFE002 and CFE003 were recovered today {21 June 2013} from the subarctic North Pacific ocean by Todd Wood with the expert help of captain and crew and science party aboard the Canadian Coast Guard Vessel J.P. Tully. Todd was aided by UC Berkeley, Earth and Planetary Science marine science program graduate, Amelia Weiss.
Recoveries took place in hours of darkness and first light at 49N 135W in the open subarctic North Pacific. While CFE003 operated perfectly and relayed its GPS positions during its mission and at the planned end of mission, CFE002 failed to report any positions during its mission and refused to acknowledge satellite commands to abort its mission. We only had two 20-30 minute windows for recovery of this float. It was recovered on its first surfacing. I've posted a few tweets as the saga developed on @OC_Explorer.

This was the first truly open ocean test of the new CFEs. They are expected to be deployed for a year long mission in Feb 2014 at station PAPA (50N 145W). Carbon Flux Explorers are autonomous ocean profiling robots designed to follow hourly variations of carbon sedimentation in the ocean, a barely observed process, but a critical process governing the sequestration of carbon in the ocean. The Carbon Flux Explorer program is supported by the National Science Foundation. Engineering of the CFE was a joint effort by UC Berkeley, Lawrence Berkeley National Laboratory and the Instrument Development Group at Scripps Institution of Oceanography.