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:** 14 August 2012 **TO:** 30 August 2012

SCIENCE CRUISE NUMBER: 2012-13 **SHIP'S PATROL NUMBER:** 12-06

CHIEF SCIENTIST[S]: Marie Robert

SCIENTIFIC PERSONNEL:

Female	Male
Amy Cain (UBC)	Michael Arychuk (IOS)
Annie Cox (UBC)	Glenn Cooper (IOS)
Desirée Dillman (UVic)	Jay Cullen (UVic)
Jennifer Forscutt (UVic)	Dave Janssen (UVic)
Moira Galbraith (IOS)	Ernesto Martinez (U. Berkeley)
Nina Nemcek (IOS)	Scott Rose (IOS)
Marie Robert (IOS)	
Christina Schallenberg (UVic)	
Nina Schuback (UBC)	

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.

This cruise (2012-13) was a success from beginning to end, despite a few patches of rough weather. All stations were visited and all casts performed, including a few extra stations on the return leg. The Trace Metal Rosette and Winch worked as expected, as did the Hydro Winch. We deployed a float for the Applied Physics Lab of University of Washington (UW) and two weather data drifting buoys for Environment Canada.

CRUISE OBJECTIVE/OBJECTIVES: Repeat hydrography section. Perform intense Trace Metal sampling. Deploy an Iridium float for University of Washington (UW) and two weather data drifting buoys for Environment Canada.

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

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, although one station had to be done on the way back.
- One Iridium float was deployed at P26 for the University of Washington/Applied Physics Lab and it seems to be functioning properly. Two weather data drifting buoys were deployed for Environment Canada.
- The set-up for the Trace Metal Rosette (TMR) worked really well. Two TMR casts were performed at each major station, as well as some pumping with the Teflon pump. Extra sampling was done at Station P with the Go-flos as well as a third TMR cast. The TMR was used again at P16 on the return trip.
- Extra water was collected for different HPLC experiments.
- Extra sensors (two C-Star transmissometers) were added to our CTD for the University of Berkeley, CA.
- The samples collected include:
  1) Underway: **IOS**: Thermosalinograph (Temperature, Salinity, Fluorescence), acoustic sounder.
  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 (Cox, Schuback):** 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, DMSO, DMSOp – **UVic (Forscutt):** Oxygen, O^{17}, ONAr (Oxygen, Nitrogen, Argon), DIC, Dissolved Organic Carbon (DOC), Noble gases – **U. Berkeley (E. Martinez):** Particulate Inorganic Carbon (PIC), Silicate – **UGA (for Miller):** Deep Organic Refractory Carbon (DORC) – **UW (for Orellana):** DOC.
  4) From the pump/Trace Metal Rosette/Go-Flos: **UVic–UBC (Cullen, Schallenberg, Janssen, Dillman, Cain):** Iron (Dissolved and Total dissolved), Fe (II), zinc, superoxide, aluminium, manganese, lead isotope, cadmium isotope, copper speciation, copper ligands.
  5) **DFO-IOS (Galbraith):** Zooplankton using vertical net hauls (Bongos) to 250 m and 1200 m.

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 decommissioned at the end of the cruise.

PROBLEMS [SCIENTIFIC GEAR AND OPERATIONS]:

On the evening of our departure from Pat Bay the Science Server crashed. It seems that the main hard drive is the problem. Without the science server we had no SCS data (weather data). The science server is also used as a repeater for navigation data (when we get on station), as a back-up place for CTD files, as a common directory for files that need to be shared during the cruise, and as the main computer to store useful software, drivers, to access the printer, etc.

We had problems right at the beginning of the cruise with some computers protected by passwords that are required for onshore access to the DFO network. All sea-going computers should A. Have administrative privileges on them, and B. Be free of all IT DFO-network specific software. It seems that every cruise we have some computer with a similar problem.

We lost two channels on the CTD at some point between P12 and P16. After that we had to use either the altimeter or the PAR sensor, as we could not have both at the same time. Additionally cables had to be manually changed every time we needed one sensor or the other. After Station Papa all sensors got moved to the spare CTD.

The filters for the Chlorophyll fluorometer fume hoods needed to be changed and we had no spares on board. The alarm kept going off, the air flow was really low and the acetone fumes were pretty bad in the instrument lab.

There were some problems with the oxygen kit at the beginning of the cruise due to the high temperatures in the lab during the day; several times reaching 34C. After talking with crew we were able to bring the temp down to an uncomfortable 26C by manipulating ship vents and clearing all air conditioning exhausts in the lab. The high temperature caused samples to outgas while mixing on the stirrer which led to program problems in reaching an endpoint. Solution was to stop running oxygen samples, have them sit in a cool spot and wait until temperatures in the lab were more reasonable. Ran P12 to P26, in sequence, after the last rosette cast with no problems with kit, chemicals or program. Computer program and kit work better when being run continuously rather than stop/start with down time in between.

Moira Galbraith

SUCCESSES [SCIENTIFIC]:

Every group emailed me their water requests and sampling plan before we sailed, which made the science meeting must smoother and helped solving some issues before we even set foot on the ship. Thanks to everyone for this.

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

The AVOS data were not distributed to the lab properly at the beginning of the cruise. Thanks to Doug Yelland for staying on board even during the Saanich Inlet cast in order to fix this.

The hydraulics to the main CTD winch got turned off while the rosette was being recovered at Station P21. While trying to get the hydraulics back on, the main UPS got turned off in the main lab, which resulted in a black-out and shut down all our instruments and computers. While trying to re-set everything the UPS got shut down a second time.

Other computers were affected by random power checks on the main deck a few days later.

The controls in the LARS cab leaked their hydraulic oil. Fortunately no oil got on the rosette.

Yet again there were some problems with Mike Arychuk's email account, and yet again the only person who knows how to fix these problems, Gerald Rohatensky, was not available to send instructions. It would be very valuable to have the instructions for various problems kept in a file on the bridge since the same problems keep coming up with various email accounts.

There was the usual problem with the bongo winch: as the line is paying out it jumps the metre block on the swells causing the wire to drop to the deck and snap up again. Working with the ship's crew, we added on more weight and had the winch operator vary the downward speed in concert with the ship swells to minimize the jumps until such time there was enough wire out to cancel the jumping.

Nearing P4 there was grease coming through the loop system in the main lab. Ship's engineers were able to track down the source and adjust the pump below deck. No further grease spots were encountered.

Moira Galbraith

SUCCESSES [SHIP]:

Even though a few deck crew were new to our program, there was no time lost to teach them how to use the LARS or how to do a bongo or a TMR cast. The training of the new crew members was seamless.

The bridge was emailing the UGrib weather files every morning along with the regular weather charts. It is a very efficient way of distributing the weather forecasts without everyone having to download these big files from the internet every day.

The hydro winch worked flawlessly! ☺

Most of the internet sites were unblocked which made our "virus protection updates" and other necessities possible. One student from University of Berkeley in California also managed to receive the assignments he was to work on during the cruise.

DELAYS [OTHER THAN WEATHER]:

~ 1 hour during lab black-out and winch hydraulic stop.
~ 2.5 hours during SAR call.

SAFETY CONCERNS:

None.

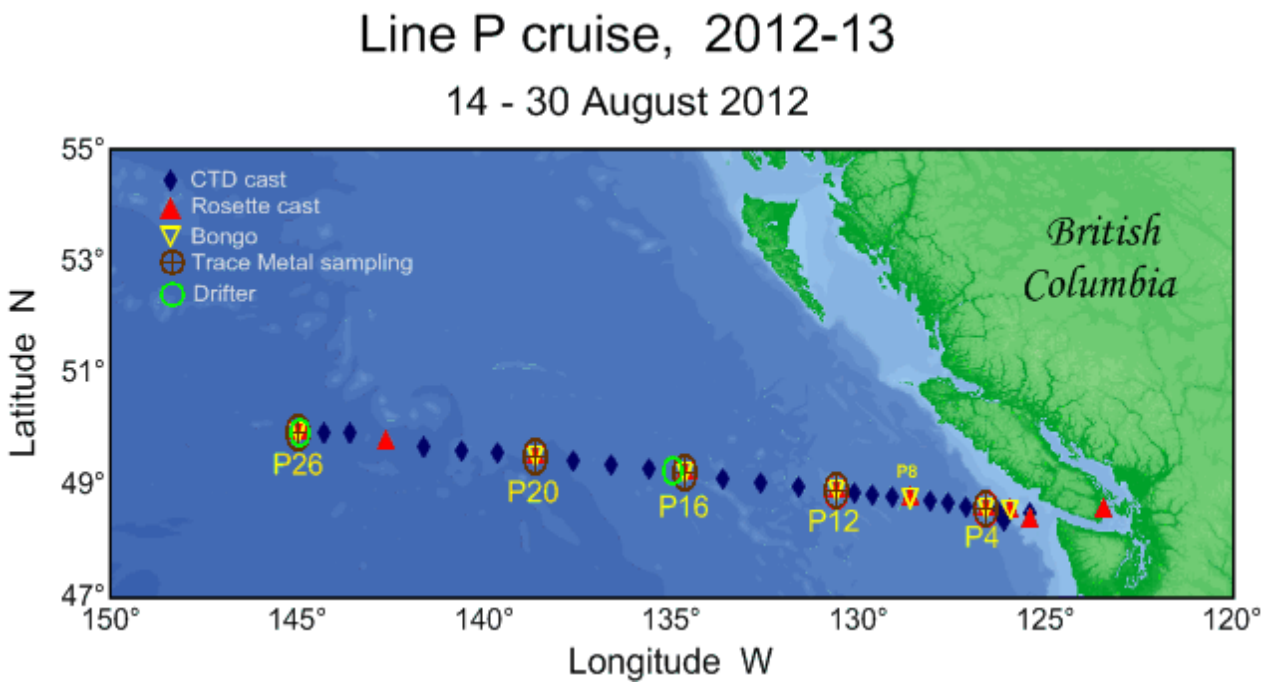
HAZARDOUS OCCURRENCES:

None involving scientific personnel.

EVENT LOG:

Tuesday 14 August:	Start loading the ship at IOS around 1530.
Wednesday 15 August:	Safety meeting. Leave the jetty around 1300. Fire and boat drill. Saanich Inlet cast. Leave for P1 around 1600. Science meeting at 1800.
Thursday 16 August:	Stations P1 to P4.
Friday 17 August:	Stations P4 to P8.
Saturday 18 August:	Stations P9 to P12.
Sunday 19 August:	Stations P12 to P14.
Monday 20 August:	Stations P15 to P16.
Tuesday 21 August:	Stations P17 to P20. Deploy EC weather drifter.
Wednesday 22 August:	Stations P20 to P21.
Thursday 23 August:	Stations P22 to P25.
Friday 24 August:	Arrive at Papa early morning. Do deep cast 5 miles from Papa. Do Light, TMR-1, DMS casts, then calibration casts at PA-006. Back to Papa for Go-flos, bongos, ONAr3.
Saturday 25 August:	UBC, ONAr, TMR-2 and DORCs casts, then TM pumping. Deploy float for APL/UW. TMR-3, deploy EC weather drifter. Station P35.
Sunday 26 August:	Loop sampling.
Monday 27 August:	TMR at P16.
Tuesday 28 August:	SAR call. Station P4, rosette and TM pumping.
Wednesday 29 August:	Station VPS and LB08. Arrive at IOS after dinner.
Thursday 30 August:	Offload at IOS.

CRUISE TRACK:



SUMMARY/FINAL COMMENTS:

- Many thanks to everyone at IOS who have helped make this cruise a success: Janet, Wendy, Kenny, Kyle, Bill for the graphs … your help is always greatly appreciated!
- Thanks to the engineering group for constantly adjusting the "tank schedule" around our sampling schedule.
- Thank you to the entire deck crew for their constant help with our equipment, for carrying the TMR bottles, and mainly for such experienced handling of the TMR!
- Many thanks also to the smokers who followed the "Green means go, otherwise it's no" TMR code. It worked well!
- Big thanks to the galley crew for looking after us so well and feeding us too much! As usual, the BBQ was absolutely fantastic, thanks!!! ☺
- Finally, thanks to Paddy Murphy for being so patient with the security clearance issues!

Marie Robert and the science team.

- We would like to thank Marie Robert for all the sampling (of DIC/Alk), and Dave Janssen, Jay Cullen, Nina Schuback and Michael Arychuk for poisoning and sealing samples.
- I would like to thank Annie Cox and Dave Janssen for their assistance with sample filtration.

Glenn Cooper

- All sampling and analysis was conducted successfully and my time aboard the Tully has been a wonderful learning experience as it was my first research cruise.

Jennifer Forscutt

- I would like to thank Marie Robert and the watch leaders Moira and Scott for facilitating my “light casts” and making it possible to have them all at the right time of the day. Furthermore, I would like to thank IOS for the acquisition of PAR data during this cruise. Special thanks also to Mike Arychuk for all the help with the radioisotope paperwork, and the co-ordination of liquid nitrogen and compressed gases.

- And of course thank you to all the awesome crew of the Tully and all other scientists on this cruise! I am looking forward to see many of you again next year.

Nina Schuback

- All of the Hallam 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 in future cruises. We wish to thank the Tully crew for their excellent assistance and work throughout the cruise. We also wish to thank Marie Robert and the scientists onboard for their help on deck and in the lab.

Annie Cox

PROJECTS AND RESULTS:

Water masses – Marie Robert, DFO/IOS.

The weather during this Line P cruise was very nice. We had very sunny and warm weather at the beginning of the cruise. The skies then turned grey and overcast but the winds did not pick up until just before getting to Station P. This gave for very stratified surface waters as can be seen in Figure 1 (Sigma-t Field). Although there seems to be an eddy around P8 in the density profile, no eddies are apparent in the altimetry graph centered on 21 August (see Figure 2. Note: P8 is at 48°49N, 128°40), which suggests that the signal seen in sigma-t could be from a "cuddy" (subsurface lens of warm and salty water formed in the California Undercurrent).

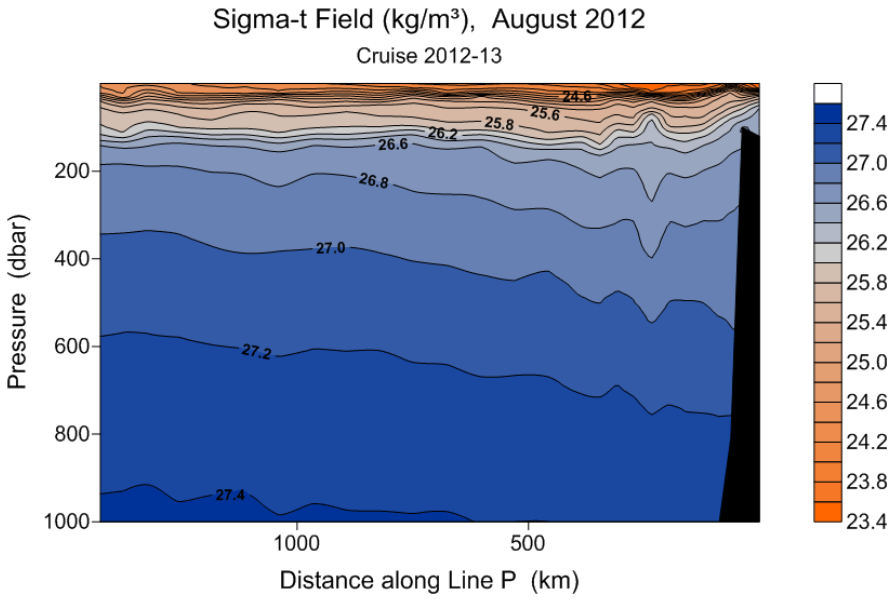


Figure 1: Sigma-t along Line P in August 2012. Note how tight the density levels are near the surface

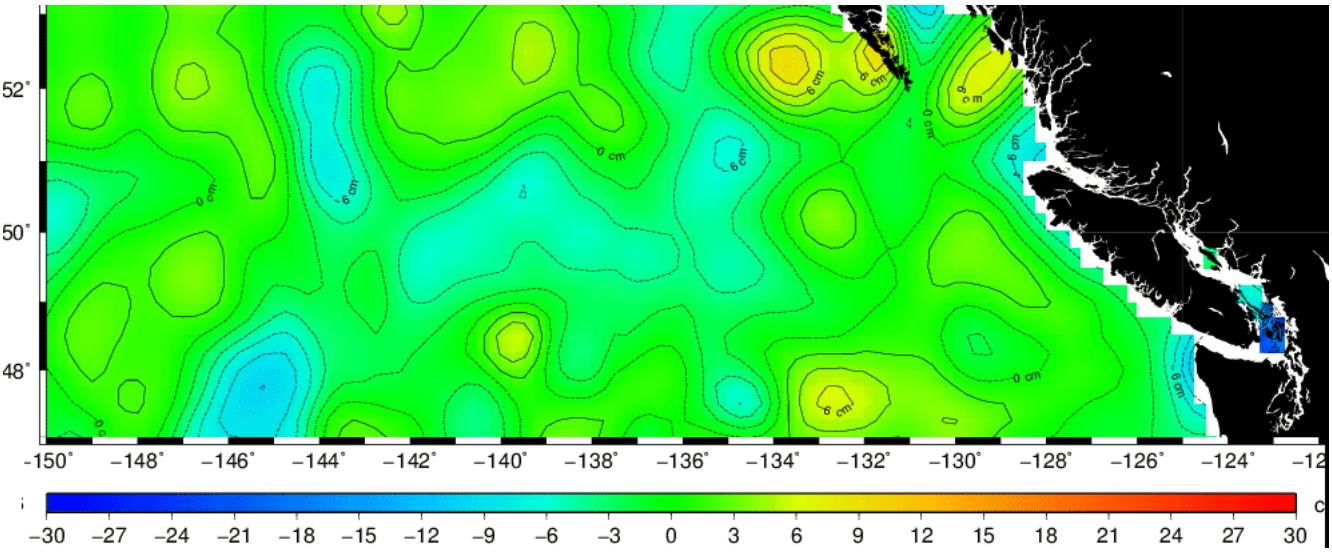


Figure 2: altimetry plot on 21 August 2012.

Trace metal sampling - Carried out by UVic (Cullen Lab) with aid from UBC, IOS and ship's crew

Participants: *Glenn Cooper (IOS), Jay Cullen (UVic), Dave Janssen (UVic), Christina Schallenberg (UVic), Desiree Dillman (UVic), Amy Cain (UBC) and E.J. Martinez (UC Berkley)*

Overview: At all major stations (P4, P12, P16, P20 and P26), samples for the determination of 1) dissolved (<0.2 μm) and total dissolvable (unfiltered) trace elements and, 2) the reactive oxygen species superoxide were collected for return to the laboratories at UVic, UBC and Max Planck Institute MPI in Mainz, Germany or for analysis at sea. At these major stations 15 to 27 discrete depths per station were sampled, to a maximum depth of 4000 m at Ocean Station PAPA (P26).

Sample Collection: Seawater was collected using four distinct systems. The majority of sampling was accomplished using the UVic/UBC Trace Metal Rosette (TMR) system. The TMR system consists of a 12 position powder coated rosette frame equipped with 12 L, Teflon coated GO-Flo bottles and a SeaBird CTD/SBE 43 Oxygen sensor instrument package. The rosette is deployed via the ships aft A-frame and heave compensator on a conducting vectran cable using a purpose built winch and trace metal clean block. On return to the surface the GO-Flo bottles are removed from the rosette and sampled in a 10ft container on the aft deck fitted with a Class 100 clean flow bench. Some surface sampling at P4, P20 and P26 was conducted to a maximum of 35 m depth using an air driven, double diaphragm 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. At P26 GO-Flo bottles were mounted on the IOS Kevlar line and deployed through a stainless steel block mounted at the ships starboard chains. A total of 4 x 12L Go-Flo bottles were deployed to 2500, 3000, 3500 and 4000 m depth and tripped with Teflon messengers. These bottles were returned to the 10ft container on the aft deck for subsequent sampling. Samples for dissolved trace metals from GO-Flo bottles were filtered through PALL AcroPak 0.2 μm filters and pumped samples were filtered with a Millipore Opticap cartridge filter (0.22 μm). Some samples were acidified at sea, with the majority awaiting acidification in the laboratory on shore. At P20 and P26, additional surface samples free of contamination from the ship were taken from the Zodiac 733 at a distance of about 1 nm from CCGS Tully for analysis in the laboratory.
The majority of samples will be returned to laboratories at UVic, UBC and Max Planck Institute MPI in Mainz, Germany for analysis for trace metal concentrations including but not limited to iron, copper, zinc, cadmium, lead, manganese and aluminum. Certain of the analyses for trace metals and reactive oxygen species were conducted on the ship and are described briefly below.

Trace metal and reactive oxygen species analysis on board

Zinc, Dave Janssen (UVic)

Filtered samples for dissolved zinc were collected at the five major stations as described above and analyzed using the fluorescence based flow-injection method described by Nowicki et al. (1994). Depths were selected to provide higher resolution in the broad oxygen minimum zone centred around 1000 m. Samples analyzed at sea were acidified using hydrochloric acid to pH = 1.7 at least 5 hours prior to analysis. The remaining samples will be acidified in the lab at UVic and analyzed using the same fluorescence based method.

Iron(II), Christina Schallenberg and Jay Cullen (UVic)

At all major stations, filtered samples were drawn from GO-Flo bottles as soon as they were secured in the container or from the pump in the wetlab. Samples were filtered as described above and were brought to the flow bench in the trace metal sampling container within a minute of filtration to be analyzed for Fe(II). Likewise, pumped samples were analyzed within 1 minute of filtration. Iron(II) was detected with the luminol method combining the experimental set-up of Hansard et al. (2009) with the chemistry as described by Croot and Laan (2002). Samples were not acidified prior to analysis and were pumped directly into the flow cell without an injection valve. Care was taken to maintain a stable light field in the flow bench during measurements as the luminol reagent was found to be extremely sensitive to changes in light intensity.

Superoxide, Christina Schallenberg (UVic)

Filtered samples from the Teflon pump were analyzed for superoxide at up to three distinct depths. Because superoxide is a fast-decaying radical species, it is impossible to measure steady-state concentrations after filtration. Instead, the decay of superoxide was followed using the chemiluminescence reagent MCLA. The set-

up follows that of Heller and Croot (2010), where MCLA and the seawater sample are drawn simultaneously into a flow cell mounted in front of a photomultipliertube (PMT). The resulting chemiluminescence is proportional to superoxide and is recorded by the PMT. By following the decay of the superoxide in the sample, one can re-extrapolate to the superoxide concentration at the time of filtration. It was found that superoxide decayed to undetectable levels on time scales of 3-10 minutes. The delay from filtration to measurement was usually on the order of 20-30 seconds and was recorded carefully for each sample.
The method was calibrated with superoxide standard that was freshly made each time by dissolving a small amount of KO_2 in 0.001 M NaOH containing 7.5 µM DTPA. The decay of superoxide in this solution (10s of µM) was followed by measuring absorbance at 240 nm - where the absorbance of superoxide peaks - over 7 minutes. A sub-sample from this superoxide standard was taken towards the end of decay to make a stable intermediate standard solution in 0.01 M NaOH, from which additions were made to seawater in order to calibrate the superoxide concentrations measured in the ocean. When superoxide is added to seawater in this manner, it decays, so it is once again the superoxide decay that is followed with the MCLA method and re-extrapolated back to the time that the addition was made.

References:
J.L. Nowicki et al. (1994). Analytica Chimica Acta 66: 2732-2738.
P.L. Croot, P. Laan (2002). Analytica Chimica Acta 466: 261-273.
S.P. Hansard et al. (2009). Deep-Sea Res. I 56: 1117-1129.
M.I. Heller and P.L. Croot (2010). Environ. Sci. Technol. 44(1): 191-196.

Seawater pH analysis – Glenn Cooper, DFO/IOS.

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 or quartz cuvettes. Meta-cresol purple was used as the indicator dye and was validated prior to the cruise at the Institute of Oceans Science. All samples were collected and analyzed aboard by Glenn Cooper. The following major stations were sampled: P02, P04, P08, P12, P16, P20, and P26. At each major station two sets of triplicates were taken to determine precision for the overall cruise. Inter and intra Niskin calibration was performed at P25 station whereby 5 Niskins were closed at 2000m and 3 samples from each Niskin were analyzed. Precision for the entire cruise is estimated to be ± 0.0003 pH units.

On the February Line P cruise (2012-01), a greater number of dye perturbation analyses were performed than usual. Typically, dye perturbation is linear across the entire depth range; however, the perturbation had opposite effects on the sea water depending if the sample were from the upper mixed layer (~100m) or from the deep thermo and nutrocline lower layer. To determine if this phenomenon continues to exist during the 2012-13 cruise, an exhaustive dye perturbation analysis was undertaken.

The pH system was set up in the temperature control lab aboard the *John P. Tully*. Room temperatures were monitored and it was found best to set the air conditioning to turn on at 22°C, due to the systems slow response time. Having the temperature controlled room meant that sample temperatures didn't fluctuate significantly, aiding the analysis.

Dissolved Inorganic Carbon and Alkalinity Sampling – Glenn Cooper, DFO/IOS.

Dissolved inorganic carbon and alkalinity (DIC/Alk) samples were collected at P02, P04, P12, P16, P20, and P26. One set of replicates was taken at each station and an extra set of samples were taken for archiving at P26. DIC/Alk was also taken at the calibration cast (P25). Sea water was collected in 500ml glassed bottles and overfilled with one and a half volumes of sample water. 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, then placed into a 4°C cooler until off loaded. We would like to thank Marie Robert for all the sampling, and Dave Janssen, Jay Cullen, Nina Schuback and Michael Arychuk for poisoning and sealing samples.

Dissolved Organic Refractory Carbon Sampling – Glenn Cooper, DFO/IOS.

Dissolved organic refractory carbon (DORC) samples were collected by Glenn Cooper on behalf of Dr. Bill Miller and Dr. Patricia Medeiros at the University of Georgia. All samples were filtered through a 0.2 um polycap cartridge filter and each of the three depths had its own designated filter. Before sample collection, one litre of sample water was flushed through each filter, then the corresponding sample volume was collected (see table below). Collected samples were immediately stored in a dark 4°C cooler until off loaded. After filtration, filters were rinsed with 1 litre of MilliQ water and stored at 4°C until needed.

Station	Depths	Volumes
P2	Surface Bottom (~100m)	**2 L+ 1 L polycarb** **2 L + 1 L polycarb**
P4	**Surface** 300 m **Bottom (~1300m)**	1 L 2 L 1 L
P8	Surface 300 m Bottom (or 2000m)	1 L 1 L 1 L
P12	Surface 300 m 3000 m	1 L 1 L 1 L
P16	**Surface** 300 m **3000 m**	**2 L + 1 L polycarb** 2 L + 1 L polycarb **2 L + 1 L polycarb**
P20	Surface 300 m 3000 m	1 L 1 L 1 L
P26(PAPA)	**Surface** **300 m** **3000 m**	**2 L + 1 L polycarb** **2 L + 1 L polycarb** **2 L + 1 L polycarb**

For the first 4 stations (P2, P4, P8 and P12), samples were collected after all other samples had been drawn from the Niskins. This meant that the Niskin head pressure was very low and resulting in long filtration times. For the remaining stations, Niskins were solely dedicated to DORC collection, resulting in quicker filtration times because of the increased Niskin head pressure. No spare filters were sent out on this cruise. In future it would be advisable to send spare filters in the event if one were to break, leak, be lost overboard, or becomes too clogged to properly filter. I would like to thank Annie Cox and Dave Janssen for their assistance with sample filtration.

Bongos – Moira Galbraith, DFO/IOS.

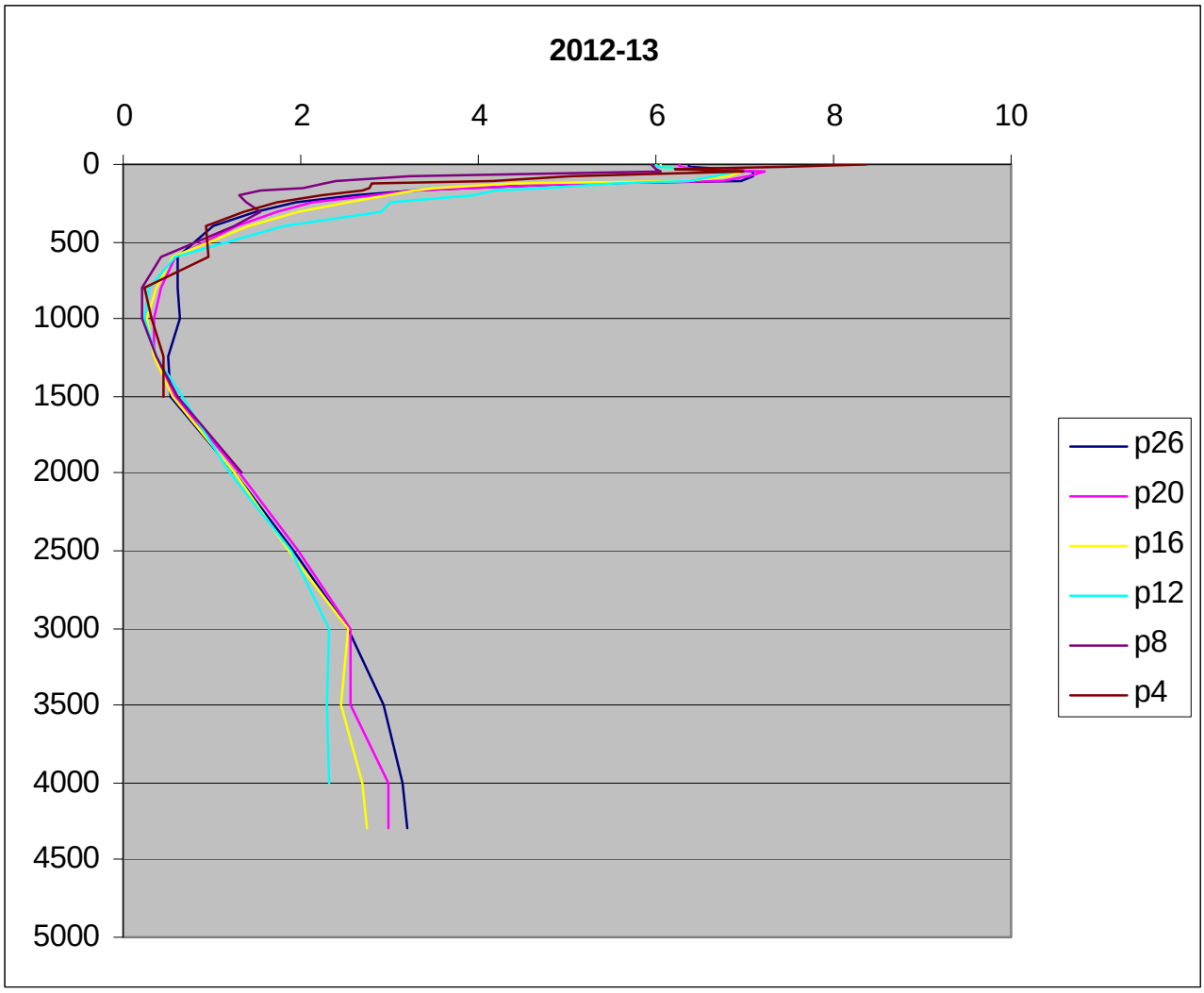
Overall the bongos went fairly well, 13 samples collected, 2 from each major station at depths of 250m and 1200m except for P2 with one sample. The samples on the shelf, shelf edge and shelf break showed very little Neocalanus copepods at surface but there were a good number at depth. P20 had a large number of Neocalanus in the shallow tow and a moderate amount in the deep tow. It would appear that the downward migration of Neocalanus had already begun for near shore and was just beginning for the oceanic stations.

There was the usual problem with the bongo winch: as the line is paying out it jumps the metre block on the swells causing the wire to drop to the deck and snap up again. Working with the ship's crew, we added on more weight and had the winch operator vary the downward speed in concert with the ship swells to minimize the jumps until such time there was enough wire out to cancel the jumping.

Oxygen Analysis – Moira Galbraith, DFO/IOS.

There were some problems with the oxygen kit at the beginning of the cruise due to the high temperatures in the lab during the day; several times reaching 34C. After talking with crew we were able to bring the temp down to an uncomfortable 26C by manipulating ship vents and clearing all air conditioning exhausts in the lab. The high temperature caused samples to outgas while mixing on the stirrer which led to program problems in reaching an endpoint. Solution was to stop running oxygen samples, have them sit in a cool spot and wait until temperatures in the lab were more reasonable. Ran P12 to P26, in sequence, after the last rosette cast with no problems with kit, chemicals or program. Computer program and kit work better when being run continuously rather than stop/start with down time in between.

Duplicates were usually within 0.005 of each other; Scott (draw) and Nina (shaker) win with several duplicates being dead on or within 0.001. P4 oxygen samples were poorly sealed allowing the chemicals to leak out a bit; people must remember to twist the stoppers in place.



Microplastics – Moira Galbraith, DFO/IOS.

Microplastics: Plastic debris, less than 1mm, is accumulating in the environment, particularity marine habitat. Ingestion by zooplankton suggests that the microplastics may be stored in tissues providing a pathway of accumulation of organic contaminants in the marine food web. Studies have started around the world looking at marine sediment along shoreline and beaches. This is a pilot study of microplastics in the water column from the ocean environment: Line P out to Station Papa, and shelf - nearshore waters: LaPerouse survey.

75 samples were collected through the ship's salt water system via the loop set up. Water was washed over a series of stacked sieves: 0.063mm, 0.125mm and 0.250mm; for approximately 1 to 4 hours, collected in scintillating vials kept cold in the fridge for analysis back at IOS (not that there is a contaminant lab in DFO).

Problems encountered: there is a need to be constantly fiddling, in the nearshore waters, with the filters on the TSG system to keep the flow rate up to optimum. Once away from land, this is not a concern. Nearing P4 there was grease coming through the system and lodging on the filter. Ship's engineers were able to track down the source and adjust the pump below deck. No further grease spots were encountered.

Phytoplankton Community Composition Along Line P – Nina Nemcek & Angelica Pena, DFO/IOS.

HPLC sampling for phytoplankton community composition has been carried out along Line P since 1999 (regularly since 2006). The current IOS monitoring program collects samples at 3 depths in the euphotic zone at the major stations (P2, P4, P8, P12, P16, P20, P26), and at 5m and the subsurface chl maximum at all other CTD stations (P1-P35). In addition to the collection of the regular monitoring samples which was completed successfully during this cruise, our goal was to obtain several sets of replicates at various locations along Line P to be able to compare the different methods used over the years. As our sampling program has grown and evolved, so too have some of our filtration, extraction and analysis techniques. It became clear that it was necessary to compare these methods in the same oceanographic regime where the samples are being collected to assess any affect these changes may have on the time-series data. The samples collected for the experiments will be analyzed back at IOS along with the regular monitoring samples and can be broadly assigned to 4 categories listed below:

1. Filtration Rig Comparison: P4, P12, P26 – triplicate samples were collected with each of 3 different filtration rigs using various seawater volumes and 2 different sizes of filter.
2. Filtration Volume differences: P1-P4 –comparison of filtration until colour is seen on the filter vs. to a set fixed volume.
3. Extraction volume and method comparisons: P6, P12, P16, P20, P26 – comparison of both 2 different extraction volumes using 2 different sizes of filter and new and old extraction methods.
4. Filtration Storage Time Experiment: P15 & P22 at midnight, P11 & PAA-06 at noon – 8 replicate samples were collected at each of these stations with duplicates being filtered at 4 different time points (0-14 hrs) following storage in the dark at 4C. The aim of this experiment is to determine how long samples can be stored prior to filtration before losses are seen.

ONAr and noble gas sampling – Jennifer Forscutt, UVic.

Objective: to collect oxygen, noble gas and ONAr samples at the major stations for Roberta Hamme at the University of Victoria and additionally collecting DIC/Alk, DOC, Salinity and O17 samples at Station Papa for Seth Bushinsky from the University of Washington in order to calibrate the mooring already in place.

Oxygen and ONAr samples were taken at a single depth (5m) at stations P4, P12, P16 and P20. The Entire water column was sampled for oxygen, ONAr and noble gasses at station P26 (2 to bot-10m) while Oxygen, DIC/Alk and DOC were sampled to a depth of 250m at the mooring (Table1.).

Table 1. Stations samples were drawn and the type of samples taken (denoted by an “x”).

Station	P4	P12	P16	P20	P26	Mooring
Type of sample						
Oxygen	x	x	x	x	x	x
ONAr	x	x	x	x	x	x
Noble					x	
DIC/Alk						x
DOC						x
O17					x	x
Salinity					x	x

Oxygen samples were analyzed on board using the Winkler titration method by Jennifer Forscutt. All other samples were preserved and will be analyzed at a later date.

All sampling and analysis was conducted successfully and my time aboard the Tully has been a wonderful learning experience as it was my first research cruise.

Processes of Primary Productivity – Nina Schuback, UBC

My research addresses the fundamental processes of primary productivity which underlie the marine foodweb and drive biological carbon cycling in the oceans. I am applying a variety of methods which each measure various aspects of primary production over different time and space scales, each having particular strengths and weaknesses. I am aiming to utilize the same techniques to determine changes in primary production in response to key environmental variables such as light intensity and iron availability. Because each method estimates primary production by measuring a different aspect of photosynthesis, a direct comparison of the results will make it possible to infer at which exact point of the photosynthetic process different environmental variables act.

During this cruise I collected samples from six light levels at six stations along the transect. For each light level at each station samples were incubated with 14C, in a short time / small bottle approach. The samples will be analyzed back at UBC to derive rates of carbon fixation.

Furthermore, light and dark adapted water samples were analyzed on a Fluorescence Induction and Relaxation (FIRe) system to gain information on photophysiology and to estimate electron transport rates through photosystem II. In an additional and complementing approach of estimating electron transport rates, water was filtered to determine the phytoplankton absorption coefficient.

Triplicate samples were taken from each depth at each station to determine chlorophyll concentration and cell number (by flowcytometry) in order to normalize the two different primary production rates to different aspects of biomass.

Membrane inlet mass spectrometry (MIMS) was run underway to determine the mixed layer biological oxygen saturation, another approach of estimating primary productivity, through measurements of O_2/Ar ratios.

The same instrument was used to measure DMS concentration along the transect.

On the way back from OSP to Vancouver Island the FIRe system was run in underway sampling mode to acquire photophysiological data which can be used to derive the influence of iron availability on the photosynthetic potential of in situ phytoplankton communities.

I would like to thank Marie Robert and the watch leaders Moira and Scott for facilitating my “light casts” and making it possible to have them all at the right time of the day. Furthermore, I would like to thank IOS for the acquisition of PAR data during this cruise. Special thanks also to Mike Arychuk for all the help with the radioisotope paperwork, and the co-ordination of liquid nitrogen and compressed gases.

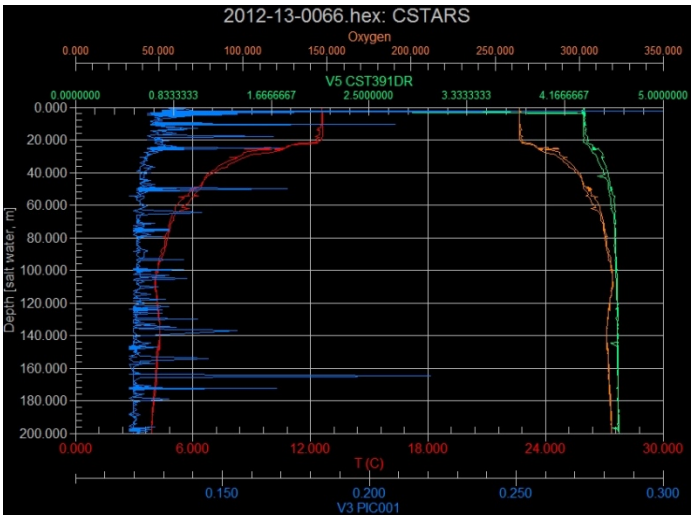
And of course thank you to all the awesome crew of the Tully and all other scientists on this cruise! I am looking forward to see many of you again next year.

PIC SENSING – Ernesto Martinez

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 ($CaCO_3$), which is mainly formed by coccolithophores. These phytoplankton use $CaCO_3$ to make protective casings. Thus, $CaCO_3$ 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, with results consistent with measurements taken by remote sensing. 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.

Below is an example of a PIC profile. This profile is from station PAPA. The blue line indicates the PIC sensor readings. The spikes are most likely caused by large organisms, but the trend shows high levels of PIC, especially near the surface, as is expected.



Currently, the greatest challenge is repeating the signal as the rosette returns to the surface. A small drift in the upper layer indicates a thermal lag. The sensor reaches very low temperatures at the near the ocean floor, as it warms in the mixed layer, it causes the measurements to drift. Further work is needed to properly correct for the hysteresis that this causes.

Annie Cox UBC Line P – August 2012

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

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

1) Gas samples were taken for later dissolved nitrogen (N_2), oxygen (O_2), carbon dioxide (CO_2), argon (Ar), nitrous oxide (N_2O) measurement using Gas Chromatography Mass Spectrometry.
2) 15 mL seawater samples were taken per depth to count the number of bacteria cells per millilitre using Flow Assisted Cytometry.
3) 15 mL seawater samples were taken for hydrogen sulfide (H_2S) quantification, an indicator of microbial anaerobic respiration.
4) 1L seawater samples (at 16 depths) for high resolution bacterial DNA sequencing were filtered.
5) Samples were taken and preserved with *gly*TE (glycine/TE buffer) to perform a single cell Whole Genome Analysis.

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. Another 2 L was filtered for RNA transcriptome analysis.
2) Gas samples were taken for later dissolved nitrogen (N_2), oxygen (O_2), carbon dioxide (CO_2), argon (Ar), nitrous oxide (N_2O) measurement using Gas Chromatography Mass Spectrometry.
3) Samples were taken and preserved with *gly*TE to perform a single cell Whole Genome Analysis at P4 and P12. At P26 samples were preserved using *gly*TE for single cell DNA analysis. This enables genomic sequencing at a later date if promising results are found in those regions of the transect.
4) Seawater samples (15 mL) were taken for hydrogen sulfide (H_2S) quantification an indicator of anaerobic respiration.
5) Seawater samples (15 mL) were taken per depth to count the number of cells per millilitre uing Flow Assisted Cytometry.

Comments:

All of the Hallam 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 in future cruises. We wish to thank the Tully crew for their excellent assistance and work throughout the cruise. We also wish to thank Marie Robert and the scientists onboard for their help on deck and in the lab.