Regional Operations Centre
Canadian Coast Guard – Pacific

PACIFIC REGION CCG VESSEL - POST CRUISE REPORT

NAME OF SHIP/PLATFORM: John P Tully

DATE: **FROM:** 28 May 2008 **TO:** 17 June 2008

SCIENCE CRUISE NUMBER: 2008-26 **SHIP'S PATROL NUMBER:** 08-03

CHIEF SCIENTIST[S]: Marie Robert

SCIENTIFIC PERSONNEL:

Female	Male
Kristina Brown (UBC)	Patrick A'Hearn (NOAA)
Janet Barwell-Clarke (IOS)	Doug Anderson (IOS)
Colleen Durkin (UW)	Michael Arychuk (IOS)
Rhonda Marohl (UW)	Tory Fitchett (OSU)
Marie Robert (IOS)	Tim Giesbrecht (UVic)
Nes Sutherland (IOS)	Keith Johnson (IOS)
Marnie Jo Zirbel (OSU)	Adrian Marchetti (UW)
Jody Wright (UBC)	Chris Payne (UBC)
	David Semeniuk (UBC)
	Chuck Stump (UW)
	Doug Yelland (IOS)

AREAS OF OPERATION: North East Pacific, Rivers Inlet, Hakai Passage, Queen Charlotte Sound.

INTRODUCTION/PROGRAM BACKGROUND: Line P is a long standing program which surveys a 1400 km long section 3 times annually. Data have been collected along this line since 1956 and show evidence of the impact of climate variability on ocean productivity. It is the only Canadian long-time-series that allows scientists to monitor climate changes in the Pacific Ocean. It is also the best opportunity for other programs (e.g. Universities) to do research in the Pacific since the Line P data give them background as well as current water properties. In addition, it is the best occasion for other projects (e.g. Universities) to access offshore waters.

This cruise (2008-26) went really well despite the fact that we were 3 days late leaving IOS because of problems with the new crane on the Tully aft-deck. Because of this we had less time to do the mooring work at Station Papa than planned, therefore the work pace was a little crazy. Also we had to cancel all the stations on the return leg except for the Hakai Passage/Koeye River stations and the Rivers Inlet stations. As a bonus though we had time to complete two of the stations missed on the previous cruise also due to the aforementioned crane problems.

CRUISE OBJECTIVE/OBJECTIVES: Repeat hydrography sections, recover/deploy moorings, deploy Glider, deploy Argo float, and test the NPRB sounder.

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DAYS ALLOCATED: 20 **DAYS OF OPERATION:** 15

DAYS LOST DUE TO WEATHER: ~ 16 hours, no station cancelled.

RESULTS:

- The Line P survey was totally successful; all stations were sampled.

- Line R and Line SS got cancelled because of lack of time.

- The first IOS Iridium float was deployed and reported successfully. The UW Sea-Glider was also deployed and reported successfully.

- Both subsurface and surface moorings were recovered and deployed again at Papa.

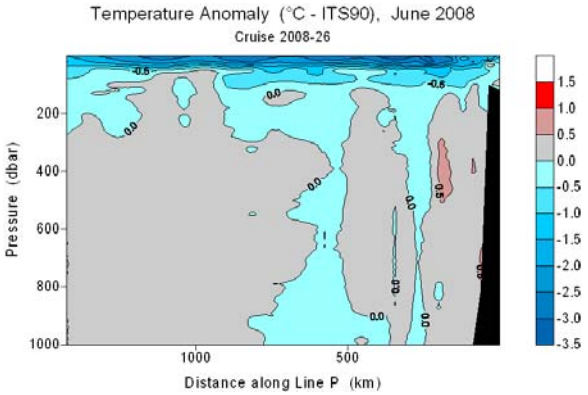
- The mooring at Bowie Seamount could not be recovered because of lack of time.

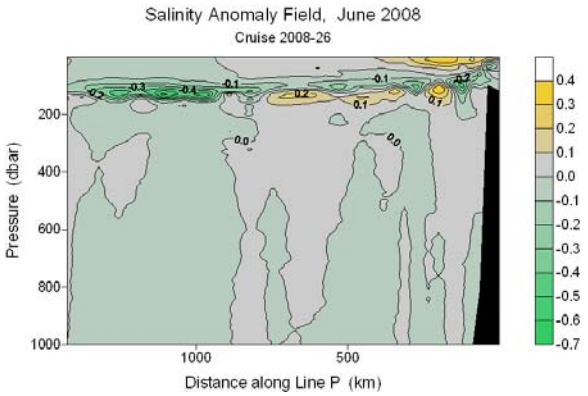
- The samples collected include:

- Underway: T, S, fluorescence, pCO_2, acoustic sounder, pigment analysis (HPLC and fluorescence derived chlorophyll), pad absorption (to quantify functional absorbance and within-cell packaging effects) particulate carbon/nitrogen, discrete flow cytometry samples, ^{14}C productivity experiments, and continuous measurements of beam attenuation (Wetlabs ac-s), variable fluorescence (Chelsea fast repetition rate fluorometer- FRrF), and photosynthetically active radiation (Biospherical), water vapour, N_2, O_2, Ar, CO_2, DMS.
- Discrete (casts): T, S, fluorescence, oxygen, transmissivity, irradiance.
- Water: oxygen, salinity, nutrients, chlorophyll, HPLC, DIC, Alk, DMS, $DMSP_d$, $DMSP_t$, pH, ONAR (Oxygen, Nitrogen, ARgon), Bacterial genomic, CO_2, CH_4, N_2O, ^{14}C productivity, particulate carbon/nitrogen PCPN, Pad absorption, discrete flow cytometry samples.
- Go-flos and pumping: Fe, Cu, Cd, Cr, bulk water.
- Zooplankton using vertical net hauls and the multinet.
- Phytoplankton using a phyto net.

M. Robert: water masses.

The main characteristic of the water mass along Line P during this cruise was the cooler temperatures. The temperature anomaly was negative along the whole Line down to about 100 m, with values between -1.5°C and -3.5°C at the surface along the entire line. The salinity anomaly pattern showed slightly saltier waters at the surface from the coast to about P12, as well as between 100 and 200 m from about P5 to P18, and fresher waters at these same depths for the western end of the line.





W. K. Johnson, Nes Sutherland & Tim Giesbrecht
: Iron/Trace metal Sampling JP Tully 2008-26, May2 8th – June 16th

Line P trace metal sampling was carried out with IOS's normal clean sampling methods using the Asti all Teflon pump for 5 to 40m samples and 12L X-Niskins for 75m to 800m. The HEPA hood was set up on deck by the "Chains" to sample 5-40m samples for both unfiltered and filtered (0.2u Opti cartridge). Zodiac (733 FRC) hand sampling was undertaken where conditions permitted for surface samples which were filtered in the temporary clean "bubble" using pre-cleaned Durapore o.2u membrane filters. Sampling was focused on the major Line-P stations to 400m with only P26 down to 800m. Labile and dissolved iron analysis were completed onboard in the clean tent/bubble. Profiles were collected for IOS (filtered and unfiltered Fe), U. Vic. (Tim Giesbrecht and Jay Cullen) for filtered Cu and for UBC (Maite Maldonato and Dave Semeniuk) for filtered and unfiltered Cr. Bulk Trace metal clean seawater was also collected by UW (Adrian Marchetti) and UBC for incubation experiments. Half of the IOS samples were acidified with 1 ml of 1:1 conc. Baseline HCl per 125ml seawater for "total" analysis at a later date. U. Vic. samples were similarly acidified. Salinities were collected from all sample depths greater than 50m to confirm depth of sample, although the mixed layer was below 100m.

Sampling Summary for Fe, Cd and Cu profiles

Depth	P04	P12	P16	P20	P26
0m	X	X	X	X	XX
5m					XX
10m	X	X	X	X	XX
25m	X	X	X	X	XX
40m	X	X	X	X	XX
75m	X	X	X	X	XX
100m	X	X	X	X	XX
150m	X	X	X	X	XX
200m		X	X	X	XX
300m		X	X	X	XX
400m		X	X	X	XX
600m					XX
800M					X X

Notes:

1) There was a problem with the Kevlar occasionally jumping out of the shive. This seemed to be caused by a combination of misalignment of the Kevlar on the winch with the shive and possibly not enough weight (100 pounds) on the Kevlar.
2) The counter started to malfunction on P16 and was not working on P20 until the engineering department replaced the coupling measuring the rotations of the shive.

W. K. Johnson, and Mike Arychuk: Carbonate Studies JP Tully 2008-26, May 28th – June 16th

Three aspects of carbonate sampling and analysis were undertaken for the June 2008 expedition to OSP. The normal underway continuous automated pCO2 and the discrete sampling for DIC and total alkalinity were again complimented by discrete pH analysis which we plan to do routinely on future cruises.

1) pCO2

pCO2 was run using the seawater loop system for the entire expedition up until June 15th. The system was set up by Marty and Mike using Mike's SOP. A new daily check system was put in place to ensure the system was operating properly on a continuous basis. Four standards including the zero gas were run this trip for the first time and the collection timing was modified to test flushing of Licor. Three repeat equilibrator and air samples were collected with flushing time of 5 minutes.

At one point the NMEA connection to the computer loosened and no position data etc was collected for some hours before it was reconnected. This happened at OSP on June 9th.

2) DIC/alkalinity sampling

DIC/alkalinity samples were collected in 500ml bottles at all major stations on line P. One duplicate was collected at each station between 1000 and 3000m. A calibration cast was conducted with 5 bottles tripped at 2005m and each sampled in triplicate. Station P26 was sampled in duplicate so that C13 could be measured as well. Sampling was normally done by Marie assisted by Janet and or Mike.

3) pH

pH was conducted at major line P stations using the new Agilent (HP) spectrophotometer and the m-cresol purple technique of Clayton and Burne. Cells (100mm cylindrical glass) were filled directly from Niskins. They were stabilized at 25^{o} C using a Neslab constant temperature bath (only adjustable to 0.1 ^{o}) and the IOS aluminium block. Profiles were collected from all major line P stations as well as two shallow mooring casts: one prior to retrieval and one post deployment for calibration /check of pH on mooring. A calibration cast was also conducted with 5 bottles tripped at 2000m and each sampled in triplicate. Two storage studies were also undertaken to determine effects of pH versus time in Aluminium block and time in cold room.

Jody Wright and Kristina Brown: Cruise report, UBC, Line P, June 2008

Objective:

Establish underway surface and depth distributions of the climate active gases nitrous oxide (N_2O), methane (CH_4), carbon dioxide (CO_2) and dimethylsulfide (DMS), measure underway surface O_2/Ar gas distributions to infer Net Community Production, and describe the taxonomic and metabolic diversity of the bacterial communities involved in the cycling of these gases along Line P.

Sampling plan:

Measure dissolved nitrogen (N_2), oxygen (O_2), CO_2, argon (Ar) and DMS continuously at the surface using a membrane inlet mass spectrometer (MIMS).

At 11 surface stations along Line P, filter large volumes (20 L) of seawater at the surface to create DNA and RNA genomic libraries of the bacterial communities and identify bacterial genes involved in sulfur and DMS cycling.

At the 5 major stations, 1) measure the bacterial abundance and the concentration of greenhouse gases (CO_2, CH_4 and N_2O) along a 12 depth-vertical profile, 2) filter 1 L samples at 12 depths for high resolution bacterial DNA and RNA extraction and sequencing; and 3) filter large volumes (60 L) of seawater at 4 depths across the oxygen minimum zone (OMZ) to create genomic libraries of the bacterial communities.

At Station Papa, viral proteins were precipitated from 0.2µm filtrate and will be examined to see if this may be a useful and interesting protocol to add to our regular Line P agenda.

Comments:

The sampling and filtering for all the bacterial genomics work went smoothly and without a hitch. This is the first time we have taken such large volumes at depth (60L) and we hope this will provide enough DNA for our purposes.–Salinity samples were taken from all our of large volume samples this time which will be invaluable in the event that any rosette misfirings are discovered.

The operation of the MIMS system went smoothly for most of the trip despite some early hiccups with hardware and a few water issues. The location of the water bath for gas standards was changed to below the MIMS bench, instead of beside the sink, and the water bath was plumbed into the sink drain. This set up was found to work very well to keep the bath circulating at low flow and maintained the bath temperature at ±0.5degC of surface temperature values (read from the thermosalinograph). Issues with plumbing the MIMS water intake to the loop system were also resolved. In the past tubing used to draw water from the loop system had been placed in an overflowing container in the sink, however some problems with the tubing being knocked out of the sink had been noted in the past. This was fixed by fitting a nalgene bottle to an extra faucet connector and puncturing the lid to allow water to overflow. The inflow tubing connected to the MIMS was then fit into the lid of the nalgene to stop it from falling out. To reduce bubbles in the sample, a perforated PVC tube was

placed on the faucet to allow bubbles to escape as water filled the nalgene bottle. This set up was found to work quite well, with no loop intake problems over the course of the trip.

Prior to the trip, the MIMS system had a new ion source installed and a change to the thickness of the cuvette membrane. It is likely that these alterations reduced our ability to establish a low detection limit for DMS. During the first few days of the trip calibrating the instrument with DMS standards was found to be quite difficult because the software would freeze up at low & mid level DMS concentrations. It was decided that this issue was due to an oversaturation at the SEM detector and the emission current of the ion source was reduced from 500uA to 350uA in an attempt to resolve this problem. While this allowed a full DMS standard curve to be measured, it also caused the sensitivity of the instrument to DMS to be compromised. This lower emission current combined with a thicker membrane on the cuvette resulted in a detection limit on the order of 3nM, instead of the expected 2nM seen in the past.

We wish to thank the Tully crew for their assistance and excellent work throughout the cruise. Special thanks to the AMAZING chefs Sam and Liz for their delightful culinary creations☺ Thanks to Marie Robert and the scientists onboard for their help on deck and in the lab.

Tory Fitchett & Marnie Jo Zirbel: Carbon Cycles in the North Pacific—Cruise Report from Oregon State University for Tully Cruise 2008-26

Non-IOS Scientists/Engineers involved in this project on this cruise:

Tory Fitchett, Oregon State University
Marnie Jo Zirbel, Oregon State University

The North Pacific Carbon Cycle Science Program is a U.S. - Canadian collaboration involving scientists at the University of Washington and NOAA's Pacific Marine Environmental Laboratory (PMEL) in Seattle, WA., Oregon State University in Corvallis, OR., and the Institute of Ocean Sciences (IOS) in Sidney, B.C. The goals of the project are to understand the processes controlling the flux of carbon between the atmosphere and ocean in the North Pacific. Under the direction of P.I. Ricardo Letelier, the main objective of OSU's component is to quantify the spatiotemporal variability of the phytoplankton community in order to understand the biological contribution to the functioning of the eastern subarctic Pacific as a carbon sink.

MOORING INSTRUMENTS: One of the major components of our study involved the deployment of three instruments on the PMEL UW surface mooring. These instruments included two fluorometers (Wetlabs FLNTUSBs, down-looking at 4 and 26 m) and a 7 wavelength downwelling radiometer (Satlantic OCR507, up-looking at 8 m) to characterize the biological response and light availability through time. All instruments were programmed to sample for 3-5 seconds every hour, in an effort to spread their resolution to last into the spring 09 bloom. These instruments, in concert with those deployed by UW and PMEL, will characterize the temporal variability of the carbon sink near Station Papa.

DISCRETE MEASUREMENTS: In order to characterize the spatiotemporal variability in phytoplankton structure, abundance, physiology, and productivity, discrete measurements of pigments (HPLC and extracted chlorophyll), particulate carbon and nitrogen, functional absorbance, and flow cytometry were collected at the following stations from water collected at 5m: P4, P7, P11, P12, P14, P16, P20, P22, P26 (Papa), PMEL surface mooring site and the coastal station M6. Underway samples as above were also taken at 13 points between stations with water from two depths: 5 m and the chlorophyll max, which ranged from 18 to 55m.

PRODUCTIVITY: Productivity experiments with $CaC^{14}O_3$ were conducted with 5m water at P7, P12, P16, P22, P26 (Papa), near the PMEL surface mooring site and at two underway locations. Photosynthetically active radiation (PAR) for these experiments ranged from 55-1260 µE m^{-2} s^{-1} (1 Einstein = 1 mol photons). Pulse amplitude modulated fluorometry (PAM) measurements for F_v/F_m (photosynthetic yield of photosystem II) and productivity vs. irradiance (P vs. E) curves were usually taken in tandem with productivity experiments using the Armbrust PhytoPAM. Size-fractionated productivity experiments were conducted at Papa and two points East underway with whole seawater and <10µm seawater filtrate using the UBC peristaltic pumps.

CONTINUOUS MEASUREMENTS: Our AC-S meter and Fast Repetition Rate Fluorometer (FRRF) were installed in parallel with the Armbrust flow-through flow cytometer in the ship's loop system, downstream from our de-bubbler. The AC-S meter (S/N040, Wetlabs- Philomath Oregon USA) obtained a continuous record of absorption and attenuation in the surface layer (Figure 1). The FRRF fast-track *a* (Chelsea UK) meaasured real-time variable fluorescence in surface waters. Variable fluorescence is a quantification of photosynthetic efficiency and has been compared to C^{14} productivity in other North Pacific systems- i.e. Station Aloha (Corno et al. 2005; *J Phycol*.). The FRRF had some I/O issues toward the end of the cruise on the return from Papa, interrupting the continuity of data.
Finally, continuous measurements of PAR were collected using a Biospherical PAR sensor that was installed on a gimbled mast on the heli deck to minimize shading from the ship (Figure 2). Mid-day PAR usually exceeded 1000 µE m^{-2} s^{-1} for the majority of the cruise (Figure 3).

Once these data have been processed, we hope to have a near-continuous derivation of the surface biomass, physiological state, and potentially, primary production that we can compare to satellite algorithms currently in progress.

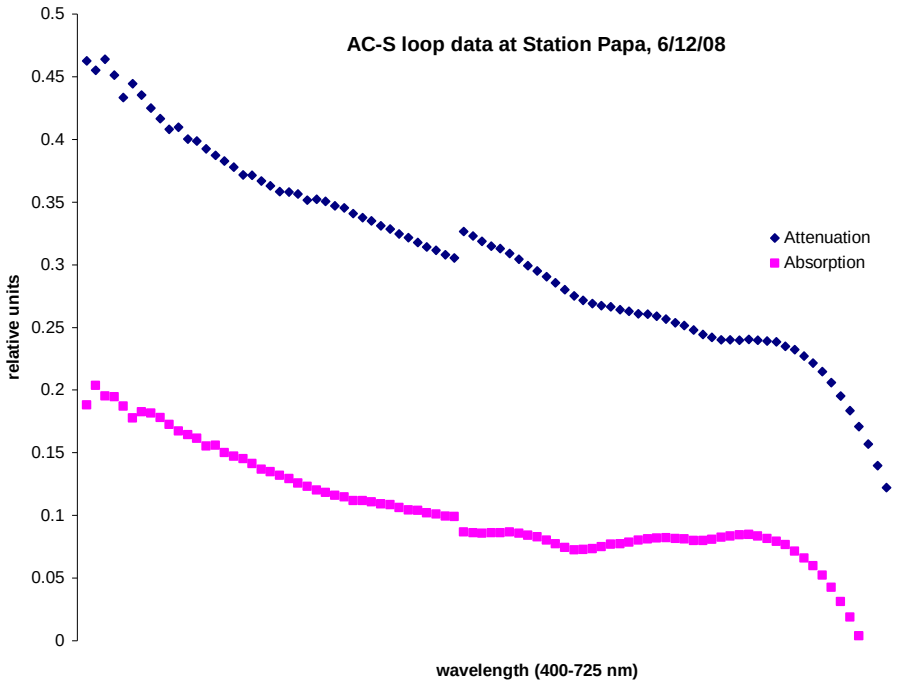


Figure 1. Absorption and attenuation data from loop water on Tully, 12 June 2008 at Station Papa.

Figure 2. Biospherical Instruments PAR sensor on gimbled mast above Tully heli deck.

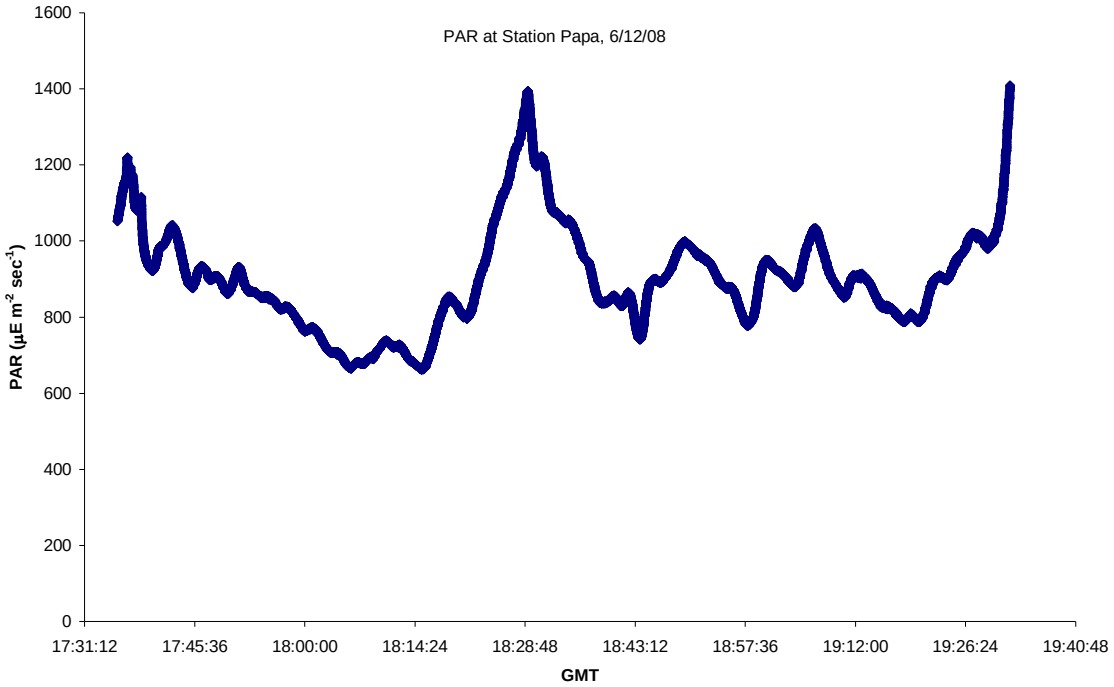


Figure 3. PAR at Station Papa during 2008-26 cruise, roughly 08:30-14:30 local on 12 June 2008.

Special thanks goes to the IOS science team involved in this effort: Chief Scientist Marie Robert for her skill in organizing and carrying out these cruises, to Dougs Anderson and Yelland for their excellent watch-keeping, and to Janet Barwell-Clarke, Melanie Quenneville and Michael Arychuk for logistical, equipment and lab space support.

June 2008-26 Line P Cruise Report
E.V. Armbrust Group Members:

Dr. Adrian Marchetti (Post-doctoral Fellow, University of Washington)
Colleen Durkin (Graduate Student, University of Washington)
Rhonda Marohl (Research Technician, University of Washington)

Our primary objectives during this cruise were to assess phytoplankton distributions, diatom productivity and molecular ecology along the Line P transect and during an iron enrichment microcosm grow-out experiment at Station Papa. Along Line P we collected samples for phytoplankton properties. We sampled two depths at each of the major stations (P2, P4, P12, P16, P20 and P26) which included the subsurface chl *a* maximum (variable depths) and the surface (5m). We collected samples for phytoplankton biomass (size-fractionated chl *a*, biogenic silica and particulate carbon/nitrogen), enumeration (flowcytometry and diatom preservations), physiology (maximum photochemical yield of PSII), and gene diversity and expression (DNA and RNA). We performed incubation experiments to stain for chitin in diatom cells and the deposition of new silica in the frustules. We also tested out the performance of a prototype flow-through flowcytometer (FTF) which was hooked up to the ship loop seawater system.

At Station Papa we performed a very ambitious microcosm iron grow-out experiment. The aims of these experiments are to assess changes in the phytoplankton diversity, nutrient consumption and transcript abundance of specific genes and pathways in relation to iron status and productivity. We initially filtered 100s of litres of water from 10m depth for RNA extraction. This RNA will be used for a meta-transciptome sequencing analyses performed on a 4-5-4 sequencer. We also filled 24 x 10L cubitainers and added 4 nM of iron to 21 of them, leaving 3 for controls. At 96 hours, 3 iron-enriched and the 3 controls were harvested for all the phytoplankton properties as outlined for the Line P transect. The remaining cubitainers (210 L) were filtered for the meta-transcriptome sequencing project. We also collected 2 x 50L carboys of trace metal clean water and spiked one carboy with 4 nM of Fe while the other carboy was kept at ambient iron conditions to serve as a control. These carboys were placed in sea-water flow through incubators on the ship's helicopter deck. Using a very long length of tubing, water from these carboys was continuously pumped to the FTF and alternatively measured every 30 minutes. This will allow for a continuous recording of the iron-induced phytoplankton bloom progression. The bloom was followed for 5 days, at which time all the NO_3 was used up. For the Station Papa grow-out, we collaborated with the Maldonado Group (David Semeniuk) who performed iron and carbon uptake measurements at P26 and 96 hours after iron enrichment.

We are extremely grateful to Janet Barwell-Clarke from IOS for macronutrient analysis, Nes Sutherland and Keith Johnson from IOS, for iron analysis from the cubitainers and for allowing us to use there trace metal clean pump and flowhood to collect all of our seawater. We are also very thankful to Marie Robert from IOS (chief-scientist) for allowing us to participate on this cruise and putting up with us having to dominate the fluorometer room for our fluorescence measurements. All fellow scientists and the officers and crew of the CCGS J.P. Tully were extremely helpful in assisting in sample collection and were essential to accomplishing our research goals. We appreciate all their efforts.

Adrian Marchetti

RADIOISOTOPE USE:

Some work was done with radioisotopes (^{14}C) by the OSU personnel, and with ^{14}C, ^{55}Fe, ^{3}H, and ^{64}Cu by the UBC personnel. The lab was cleaned and decommissioned as soon as their work was completed. Copies of the decommission lab report and other related paperwork were handed to the first officer on board the Tully as well as to the IOS RSO.

PROBLEMS [SCIENTIFIC GEAR AND OPERATIONS]:

During the cruise prior to Doug Yelland's (La Perouse cruise, 2008-05) it was noticed the -80 freezer was not operational. That is, would not go down to the -80 operating temperature. When the ship arrived back at IOS, Fosters (the Fisher service representative) came to look at it and determined the problem was with the low stage compressor not functioning. Further investigation determined that a 3/8" copper line was not secured properly to the frame of the freezer. Over time, the vibration from the high stage compressor combined with the vibrations from the ship caused the line to reverberate to such a degree it eventually fractured, drained all the fluid and caused the low stage compressor to fail. The Foster service

representative also felt that the high stage compressor was somewhat noisier than he would expect and felt it should be replaced as well. Before the Line-P cruise left the dock, Fosters was contacted and confirmed that they had approval from Fisher to replace the compressor. The part was ordered but had not arrived in time to be installed before the ship sailed on May 31. During the Line-P cruise the compressor unfortunately did fail and once again the freezer was non-functional and had to be turned off. Foster's is scheduled to install the new compressor on June 16 which should hopefully resolve the -80 freezer issues once and for all.

Michael Arychuk

SUCCESSES [SCIENTIFIC]:

We managed to do all the Line P Stations, the mooring work, and the coastal work despite a late departure (see below). The rosette was working much better this time with no major problems. The new instrument lab was also better temperature regulated than during the February cruise.

We managed to find room for all the equipment and empty boxes even though the ship was unusually crowded. Thanks to the crew for building the tables in the data room by the ship's office during the first week of their cycle so that we could work in that part of the ship as well.

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

We left 3 days later than planned because the new aft-deck crane still wasn't working properly, 2 months after installation. We finally got the ok to go and to use the crane, but because it was not fully trusted it wasn't used to deploy the surface mooring anchors at Papa. An alternative method had to be used which resulted in a break of equipment (eye bolt) leading to an incident that could have been very disastrous. Very fortunately no one was seriously hurt.

Because of that 3 day delay at the beginning of the cruise we had less time to do the mooring work. A change in weather made us decide to deploy the surface mooring right after recovering. It was a long day for everyone involved with that work and not a very safe practice.

Even though a new GPS unit had been installed for science use in the main lab, only one output was functional, as well as only one of the two distribution boxes, and only one of the two data feeds from the bridge (for weather and other ship's data). A tech had these problems fixed before departure however. Still, the DD20 boxes aren't suitable for RS232 data distribution since they also output RS422, a potential risk to computers connecting using standard 9-pin cables. Several adaptors were installed but a more permanent solution should be sought.

The IOLan data distribution box on the forward bulkhead of the main lab (starboard side) was non-functional and possibly needs replacement. This unit is essential for data archiving from several sources. One complete set of data was not archived on the science server due to this failure.

Doug Yelland

The ADCP quit working during the previous cruise. No cause has been determined yet. Hopefully this can be addressed soon.

SUCCESSES [SHIP]:

Thanks to the whole crew for all their help and experience with the mooring work. This was very complex work, especially in these circumstances (new crane not fully operational) and they did a great job.

DELAYS [OTHER THAN WEATHER]:

3 days for new crane.

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SAFETY CONCERNS:

The main lab was unusually crowded with 19 scientists on board from 8 different groups. 2 groups were using radioactive substances. Although the quantities used were below the maximum allowed limits, the 2 groups had to be in different parts of the lab because they could not both work near the fume hood. As a consequence they had to walk all through the lab with their radioactive samples, and people had to walk and work near their area. We are hoping that the modifications needed to the ship in order to use the radiation lab (new portable container) will be addressed soon.

HAZARDOUS OCCURRENCES:

The eye-bolt that let go during the mooring deployment. See PROBLEMS [SHIP'S EQUIPMENT/OPERATIONS/PLATFORM SUITABILITY] section.

EVENT LOG:

DATE	OPERATIONS
Wednesday 28 May:	**Start loading the ship at IOS.**
Saturday 31 May:	**Load mooring gear and leave Pat Bat. Saanich Inlet cast.**
Sunday 1 Jun:	**Start Line P.**
Thursday 5 Jun:	**Lose one day because of weather.**
Sunday 8 Jun:	**Arrive at Station P.**
Monday 9 Jun:	**Recover and deploy subsurface NOAA ADCP mooring.**
Tuesday 10 Jun:	**Recover and deploy surface NOAA mooring.**
Wednesday 11 Jun:	**Leave Station P.**
Saturday 14 Jun:	**Sample Koeye River/Hakai Passage and Rivers Inlet.**
Sunday 15 Jun:	**Sample 4 CS stations for La Perouse project.**
Monday 16 Jun:	**Arrive at IOS and offload.**

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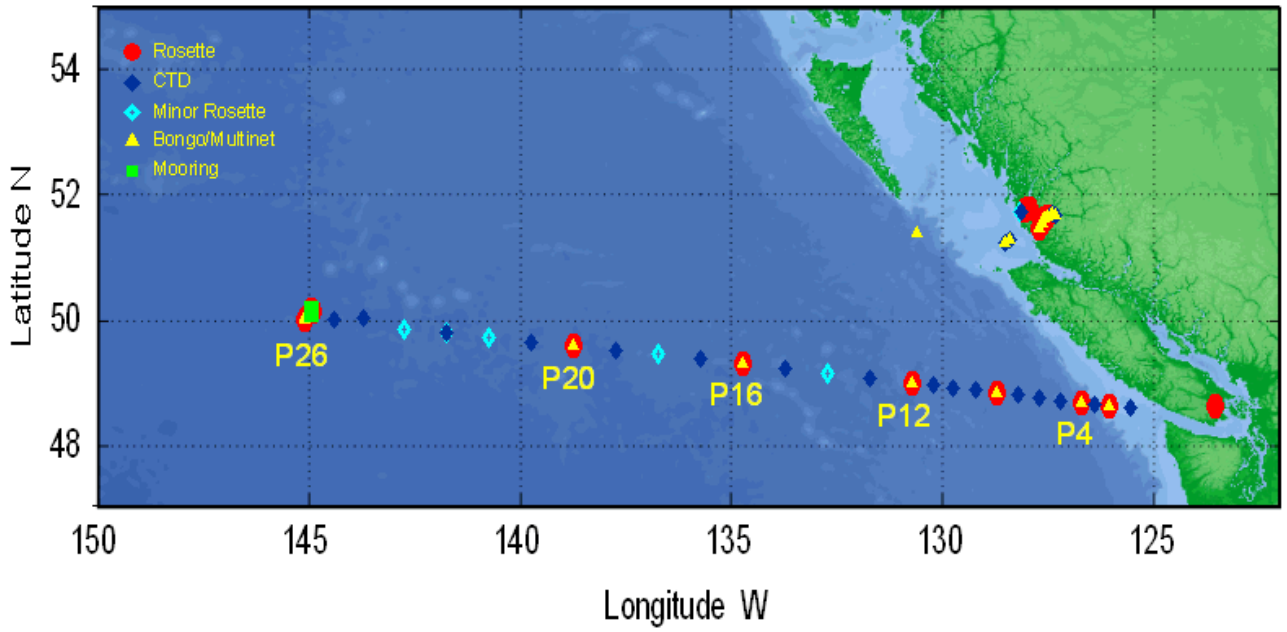
CRUISE TRACK:



SUMMARY/FINAL COMMENTS:

- Many thanks to the whole crew of the Tully for all their help in making this cruise such a success, despite having so many of us on board with so much gear!
- Very huge ‘thanks’ to the cooks, and the whole galley crew, for keeping all of us so well fed.
- Captain Schwarz, it was a pleasure sailing with you!