



**CRUISE DESCRIPTION:** This cruise (2014-19) was heavily compromised by time. We barely had enough time to do all the work required, and that did not include any weather days. There are two reasons for this lack of time. Normally the Line P and La Perouse programs share a Coast Guard cycle on the Tully, so we have 28 days to perform both programs. This time, the last day of the cycle was given to Natural Resources Canada (NRCan) so that they could start loading their gear before their allotted ship time. In addition, the Strait of Georgia (SoG) program, normally done over five days on the Vector, was imposed to the Line P and La Perouse programs because the Vector was up in Douglas Channel area for the whole summer. The consequences of having the SoG work at the end of Line P are twofold: not only did we have to give up two full days of operations, we also had to return to the coast going north via Cape Scott, in order to start the SoG stations at the northern end. Normally, we would sail back along Line P coming back from Papa and any work missed on our way west would be done on our way east. This time, each station and cast were a “one chance deal”. Because of this some people were overworked due to all the major stations happening every day with no off-day in between and no chance of doing the work on the return leg.

**DAYS ALLOCATED:** 16

**DAYS OF OPERATION:** 16

**DAYS LOST DUE TO WEATHER:** none, but some gear was damaged due to weather.

**SAMPLING:**

- The Line P survey was 100% successful. All planned stations were visited and all planned profiles got done.
- Three weather data drifting buoys were deployed for Environment Canada, one Argo float was deployed for DFO/IOS, and two Gliders were deployed for WHOI.
- The Multiple Plankton Sampler (MPS or Multinet) was used at 4 stations; a 1315 m cast at P4, 2000 m casts at P12 and P20, and a 3000m cast at P26.
- Trace Metal samples were collected for IOS and UVic using the Trace Metal Rosette (TMR) at P4, P12, P16, P20 and P26. The TM pump was also used at P26 to collect surface samples for IOS, UVic and UBC. Finally surface samples were collected from the small boat at P20.
- The samples collected include:
  - 1) Underway: IOS: Thermosalinograph (Temperature, Salinity, Fluorescence), acoustic sounder, ADCP, pCO<sub>2</sub>, irradiance off the heli-deck – **UBC (Asher, Jarnikova):** O<sub>2</sub>, Ar, CO<sub>2</sub>, DMS, DMSO, DMSP
  - 2) “E-data” from CTD: Pressure, Temperature, Conductivity, Dissolved Oxygen, Transmissivity, Irradiance, Fluorescence (one sensor).
  - 3) From the Rosette: DFO-IOS: dissolved oxygen, salinity, nutrients, DMS, DMSP, chlorophyll, HPLC, dissolved inorganic carbon (DIC), alkalinity, pH, micro-plastics – **DFO-BIO (Nelson):** Cesium, <sup>129</sup>Iodine – **UBC (Mueller):** number of cells per millilitre, virus counts, bacterial genomic (DNA, RNA) and sequencing– **UVic (Timmerman):** ONAr (Oxygen, Nitrogen, Argon), dissolved oxygen, ammonium, nutrients, chlorophyll, <sup>17</sup>O.
  - 4) **DFO-IOS (Galbraith):** Zooplankton using vertical net hauls (Bongos) or Multinet Plankton Sampler.
  - 5) From the Trace Metal Rosette and pumps: DFO-IOS (Ross, Simpson): Dissolved and total dissolvable iron, ligands, filtered water for UBC – **UVic (Janssen, Purdon):** Suspended particulates, cadmium stable isotope

**RADIOISOTOPE USE:**

No radioisotopes were used during this cruise.

## **PROBLEMS [SCIENTIFIC GEAR AND OPERATIONS]:**

Immediately after leaving the dock in Pat Bay a test cast was done in Saanich Inlet. The main CTD we were going to use – CTD 0506 – was setting off an alarm every time the CTD went deeper than approximately 50 dbar. We tried to fix this problem by removing various sensors, and then redoing the electrical splice, but the alarm was still resounding at pressures higher than 50 dbar. Finally we had to use the spare CTD – CTD 0443 – for the remainder of the cruise. Unfortunately, that CTD was showing important differences between conductivity sensors, so hopefully our salinity samples will be analyzed as soon as we'll be back to IOS in order to determine which set of sensors is the best one. CTD 0506 finally got fixed while at Station P.

The main CTD data acquisition computer crashed three times during casts.

The thermosalinograph (TSG) was still not hooked to the internet and was therefore not being recorded with the SCS data on the ship's server.

One of the Multinet Plankton Sampler (MPS)'s five nets got ripped in two during the 3000m cast at Station P26.

The Trace Metal Rosette (TMR) hit the stern of the ship and the A-frame during the recovery at Station P26. 4 Niskins were broken beyond repair, and the frame of the rosette was quite damaged.

These two events (MPS net ripped and TMR being damaged) are related to working in very marginal weather conditions because of no weather window during this cruise.

The GPS distribution box in the main lab got turned off one evening, probably by accident. This resulted in the loss of underway data for a few hours.

One major experiment that we were supposed to do during this cruise required the use of a drifting drogue that we were to follow for roughly 36 hours in order to perform all our sampling in the same water mass. Unfortunately as soon as the drogue was deployed it started to sink and never made it back to surface. Not only did we lose the equipment – VHF antennas, strobe light, etc – but the whole experiment had to be cancelled.

A full day after leaving the Station P area we learnt that one of the two Gliders deployed started leaking after doing six dives to 1000 m. It then went to the surface in "recovery mode" and had to stop its mission. Unfortunately we could not afford the time to turn around and go retrieve it.

Milli-Q (Direct Q-5) pure water system:

The Milli-Q system was set up in its usual place in the lab with brand new filter packs for this cruise (both Proguard and Ionex). After completing initial set up it produced error messages i.e. error 11 and associated error messages (see Millipore trouble shooting guide for more info) indicating a problem with the reverse osmosis membrane. We did not have the appropriate tools/chemicals on board to attempt to remedy this issue. Regardless the Milli-Q did continue to produce satisfactory water for the duration of the cruise. It should be noted however that the system wasn't performing to the standard expected as it was not removing sulfur compounds to levels acceptable to the DMS analyses performed on board. After reaching roughly P12 or P16 we suspect that the ships water (now all made on board rather than shore water) was of better quality as the milli-Q system output got better.

Finally at some point at station Papa the bolt holding the point of use mechanical arm striped, or else the plastic broke, as the arm no longer holds in position.

Kyle Simpson

## **SUCSESSES [SCIENTIFIC]:**

The new TSG "pond filter" finally seems to be the answer to good data and constant flow. The salinity data did shift for a short time but this was easily fixed with a cleaning of the TSG cells.

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

We experienced a very short black-out at the very beginning of the cruise. Most instruments and computers were ok but some of them had to be rebooted.

The High Temperature Light on the LARS winch came on for approximately 15 minutes during a CTD cast, during which time the cast had to be interrupted.

Hawboldt winch 17027 conducting cable has a broken strand near the 750m mark. It seems to be ok to use it for the MPS but it would probably be unsafe to use it as a spare for the Rosette package.

## **SUCSESSES [SHIP]:**

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

A very special thank you to everyone on board, but mainly and especially to Bruce and his deck crew, for all their effort to depart on the evening of the first day of the cruise. Normally for the August Line P cruise we plan to depart on day two around lunch time, but because of the shorter cruise, as discussed earlier, we attempted to depart on the day of crew change. The deck crew worked hard and it was a very long day for them. Even though we did end up leaving on day two, the 0600 departure was just short of a miracle considering all that had to be done to leave in a safe manner. Hopefully we won't have to attempt this ever again!

Even though the A-frame was rather crowded with bongos and *in-situ* pumps being deployed on the starboard out block, and the MPS and the TMR being deployed on different blocks, but both in the inside of the A-frame, all deployment and recovery were done successfully (with the exception of the recoveries done in too rough weather, see “Science problems” section).

During the February and June cruises we had many problems with the top of the CTD termination catching in the LARS head. All parts of the LARS head have been replaced by new ones, and the latching of the rosette seemed to be much smoother on the termination.

## **DELAYS [OTHER THAN WEATHER]:**

None.

## **SAFETY CONCERNS:**

None.

## **HAZARDOUS OCCURRENCES:**

None involving scientific personnel.

## **EVENT LOG:**

Tuesday 19 August: Start loading the ship at IOS around 1530. Safety meeting at 1600. Keep loading and setting up after dinner.

Wednesday 20 August: Leave IOS at 0600. Do two test casts in Saanich Inlet, then Haro59. Fire and boat drill at 1300. Stations JF2 and P1.

Thursday 21 August: Stations P2 to P4.

Friday 22 August: Stations P4 to P8. Deploy one IOS Argo float at P7.

Saturday 23 August: Stations P9 to P12.

Sunday 24 August: Stations P13 to P16.

Monday 25 August: Stations P16 to P18.

Tuesday 26 August: Stations P19 to P21. Deploy one EC drifter at P20.

Wednesday 27 August: Stations P22 to P35. Deploy one EC drifter at P24.

Thursday 28 August: Papa Day 1: TM pumping; TMR cast; *In-situ* pumps; Bongo to 250 m and MPS to 3000 m; Cesium, Deep, DMS, Light rosette casts; deploy drogue.

Friday 29 August: Papa Day 2: Plastics, UBC, <sup>17</sup>O, ONAr rosette casts; *in-situ* pumps; deploy Gliders; fix spare CTD.

Saturday 30 August: Leave Station Papa at 0100. Sail towards northern end of Vancouver Island.

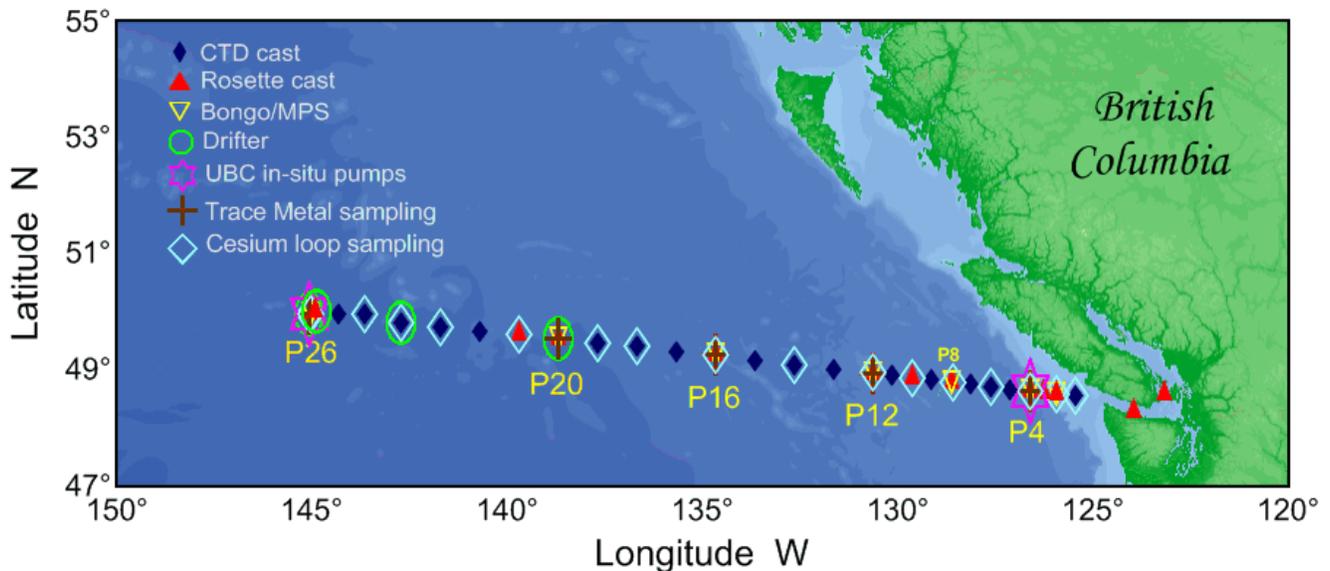
Tuesday 2 September: Take the 0500 tide at Seymour Narrows. Start the Strait of Georgia program at 0630.

Thursday 4 Sept: Arrive at IOS and offload.

**CRUISE TRACK (not including Strait of Georgia Program stations):**

# Line P cruise, 2014-19

19 August - 4 September 2014



**SUMMARY/FINAL COMMENTS:**

- Many thanks to everyone at IOS who have helped make this cruise a success: Kenny, Tamara, Nina, Marty ... your help is always greatly appreciated! Thanks for the extra hand (and backs!) while loading...
- Thanks also to all the scientists on board for giving me their cruise report before the end of the cruise. That's *really* appreciated!
- Thanks to the engineering group for constantly adjusting the "tank and incinerator" schedule around our sampling schedule.
- Thanks to Captain Gronmyr for his advice with 'weather forecasting'.
- Thanks to the officers for adapting to all our last minute plan changes, as well as for downloading the "Grib files".
- Thanks to Bruce and the whole deck crew for all the help with our work. Special thanks to Jim and Gord for getting the drogue ready before deployment.
- Finally: thanks to Alex and the galley crew for a fantastic barbecue and for always keeping us well fed!  
Marie Robert and the science team.
- I would like to personally thank Andrew Ross for sampling DIC on this cruise. It was much appreciated!  
Marie Robert
- Many thanks to the crew of the Tully for dealing with all the idiosyncronicities of net sampling off the aft deck in such a professional manner, very much appreciated.  
Moirra Galbraith

- Thank you to the Captain, officers and crew of the JP Tully for making the cruise productive. I also want to thank IOS personnel for their help sampling, filtering and analyzing samples. Thank you especially to Marie Robert for her support and accommodating my sampling requests. Many thanks to the rest of the science crew especially everyone who helped me move incubation bottles to and from the helideck. I want to thank Sarah Thornton for allowing me to borrow equipment to measure dissolved NH<sub>4</sub> concentrations.

Amanda Timmerman

- I really want to thank the scientists and the crew of the J.P. Tully for their help and the wonderful time on board. I appreciated the chance to learn more about the different projects and the work of the scientists. I wish to thank the Tully crew for their assistance and excellent work throughout the cruise. Special thanks to Marie Robert who organized the cruise and who was always helpful with questions and problems.

Andreas Mueller

- The trace metal group thanks Captain Victor Gronmyr and chief scientist Marie Robert as well as Bosun Bruce Wilson, the deck crew, and the other scientists for their assistance during deployment and recovery of the TMR and the McLane pumps.

Dave Janssen and Kathryn Purdon

- I would like to thank all of the J. P. Tully crew and officers for the fine job they did in launching the two gliders. The Bosun and his team did a fantastic job launching the gliders while the bridge maintained a perfect position for us to observe the instruments while staying safely away from them. I would also like to thank the galley staff along with Vince and Sheila for the fantastic meals that were put out for us each and every day.

Brian Guest

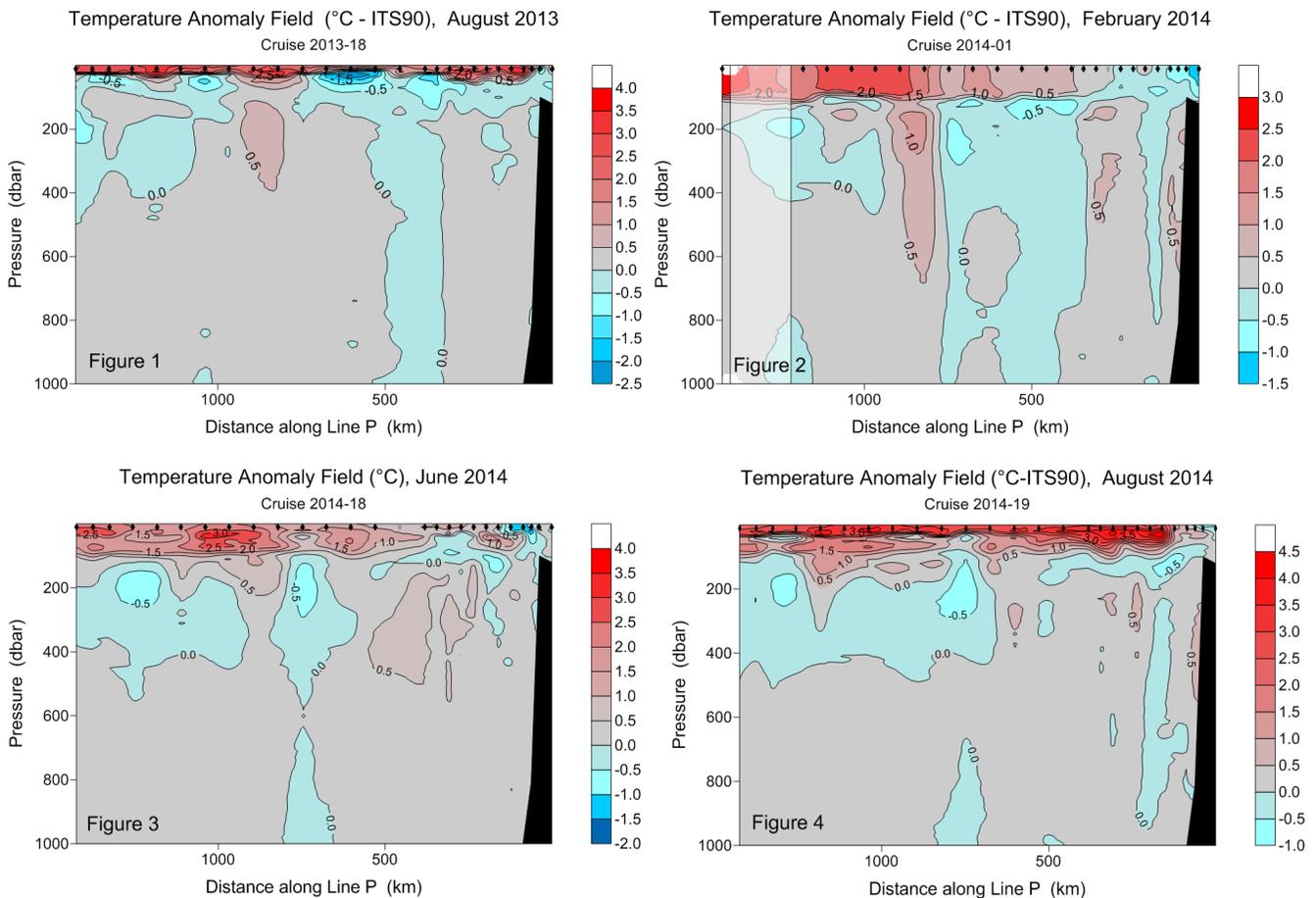
- Thanks to the crew and officers of the CCGS John P. Tully for the work to make this a successful cruise. Special thanks to Marie Robert for all of the wire time and all those who helped carry the 24 l carboys.

Rick Nelson

## PROJECTS AND RESULTS:

### Water masses – Marie Robert, DFO/IOS.

In August 2013 the surface waters along Line P were much warmer than the long-term (1956-1991) averages, but the anomaly was concentrated in the first few metres of the ocean (Fig. 1). By February 2014 the anomaly was present towards the offshore portion of the line only, but it was present down to about 100 m (Fig. 2). The conditions were similar in June of this year (Fig. 3). Now not only is the anomaly still present, it extends further inshore (Fig. 4). All these anomalies were calculated with respect to 1956-1991 averages. Another aspect of the cruise worth mentioning is the “almost absence” of marine life. Although this statement is only a “feeling” – no record were taken – and although we did see a few black-footed albatross - and even one or two Laysan albatross – and some pods of Dall porpoises, it ‘seemed’ that the oceans and skies were more devoid of marine life than they normally are. This said, a female hatchery Coho was caught just before station P13, as well as 6 tuna.



Figures 1 to 4: Temperature anomaly field with respect to the 1956 – 1991 averages for August 2013 (1), February 2014 (2), June 2014 (3), and August 2014 (4).

### Zooplankton report – Moira Galbraith, DFO/IOS.

Bongo: seven vertical net haul from 250m to surface at stations P2, P4, P8, P12, P20 and P26; two vertical nets from 1200m to surface at P8 and P16.

Multiple Net Sampler (MPS): three vertical nets hauls; P4 from 1300m, P12 from 2000m and P26 from 3000m.

No pteropods were found in samples on the shelf or offshore; were able to collect some *Limacina* and *Clio* for NOAA lab from P20 and P26 for comparison to pH levels taken at those stations.

The bongo tows went without a hitch. There was some heave slack in the wire on the downward casts but between the more aft position of the winch and the fine control of the winch operator, the wire never came near the deck or presented a head hazard. The heavier gauge of the wire and more robust swivel on the bongo frame has prevented the twisting load seen on previous cruises.

The MPS had several failures: battery problems at P20 prevented the deck unit from firing the nets; end result was no samples for this station. Tests on the batteries showed that one was bad and obviously failed under load. In the future, test batteries after two tows and replace as necessary. The second problem was one of marginal seas at P26; even though the seas were not that rough it was enough to cause some significant heaving off the aft deck. Speculate that upon retrieval, a swell made some slack in the wire causing the cod end and sampler to come near one another. Net number 5 (last net) got wrapped on the frame and ripped off when the line went taut again. Ideally the MPS should go through the heave compensator; not possible on this cruise due to conflict with the Trace Metal Rosette (TMR). Ideally there would be some weather days worked into the cruise which would have allowed us to put off the cast until the seas were calmer but not possible due to lack of ship time.

The conducting wire on the winch for the MPS had a broken wire loop in the outer coat at 786m (777m count on the winch) which was noticed on the up cast of the first tow at P4. On the down cast at P12, the winch was stopped and the wire was repaired by removing the single strand back to where it was good and securely tape down either end. This was looked at in subsequent tows and appears to be holding well but should be checked out by the winch shop. The MPS is much lighter than a CTD rosette and not sure how the wire would perform under a heavier load.

Many thanks to the crew of the Tully for dealing with all the idiosyncronicities of net sampling off the aft deck in such a professional manner, very much appreciated.

#### **2014-19 Cruise Report** – Amanda Timmerman, University of Victoria.

Biological productivity is an important process controlling the export of carbon to the deep ocean. There are multiple methods to estimate production and I focused on two: dissolved gases ratios (Oxygen, Nitrogen and Argon (ONAr)) and dual, stable isotope tracer  $^{15}\text{N}/^{13}\text{C}$  incubations.

ONAr, dissolved oxygen: Samples were collected in duplicate at 2.5 and 10 m at P4, P12, P16, P20 and P26. ONAr samples collected on this cruise will be analyzed at the University of Victoria to obtain precise measurements of  $\text{O}_2/\text{Ar}$ . Dissolved oxygen samples were analyzed on board using the Winkler titration method with a visual endpoint.

Incubations,  $\text{NH}_4$ , nutrients, chlorophyll: Samples were collected at 5 light depths (100, 55, 30, 10 and 1%) at P4, P12, P16, P20 and P26. Two sets of incubations were done using either  $^{15}\text{NO}_3$  or  $^{15}\text{NH}_4$ . All samples were also spiked with  $\text{H}^{13}\text{CO}_3$ .  $^{15}\text{NO}_3$  samples were done in duplicate for all depths.  $^{15}\text{NH}_4$  samples were collected in duplicate at 100% light level and all other depths had single samples. Blanks were collected at 100% light level and filtered immediately. All other samples were incubated for 24 hours under a constant flow of seawater and then filtered.  $\text{NH}_4$ , nutrients and chlorophyll were collected from the same depths.

UW 17O, dissolved oxygen: Samples were collected in duplicate at 200, 150, 100, 50, 20 and 5 m at P26 on behalf of Paul Quay at the University of Washington.

UW ONAr, dissolved oxygen: ONAr samples were collected in duplicate at 2, 5 and 10 m at the mooring on behalf of Steve Emerson at the University of Washington. Results will be used to calibrate instruments on the mooring. Dissolved oxygen samples were analyzed on board using the Winkler titration method with a visual endpoint.

Acknowledgements: Thank you to the Captain, officers and crew of the JP Tully for making the cruise productive. I also want to thank IOS personnel for their help sampling, filtering and analyzing samples. Thank you especially to Marie Robert for her support and accommodating my sampling requests. Many thanks to the rest of the science crew especially everyone who helped me move incubation bottles to and from the helideck. I want to thank Sarah Thornton for allowing me to borrow equipment to measure dissolved  $\text{NH}_4$  concentrations.

## Line-P 2014 Cruise Report – Elizabeth Asher, Tereza Jarnikova – UBC

During the August 2014 Line P cruise, we aimed to improve the spatial resolution of three ecologically relevant and climate-active reduced sulfur compounds and to take part in a ~36 hour lagrangian experiment studying diel cycling of dimethylsulfide (DMS) at station Papa (145W 50N). Our goal was to follow the temporal evolution of DMS and the related compounds, dimethyl sulfoniopropionate (DMSP) and dimethyl sulfoxide (DMSO) in surface seawater (~5m) while Mike Arychuk from the Institute of Ocean Sciences measured DMS and DMSP in four-hour intervals from Niskin bottle samples taken at the base of the mixed layer and at 10m below the mixed layer. Unfortunately, due to a technical malfunction, the IOS drogue buoy required for the diel cycling experiment sank shortly after being deployed.

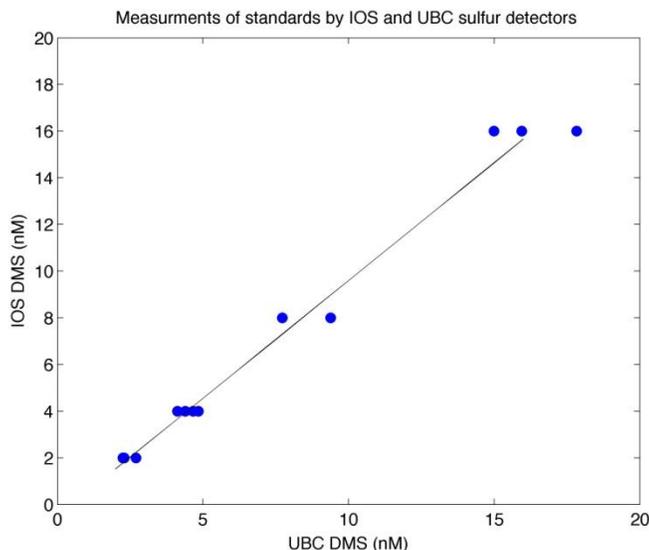
As a result, our focus shifted toward acquiring high spatially resolved transect data for dissolved major gasses and reduced sulfur compounds. We also routinely performed inter-calibrations between the IOS flame photometric detector (FPD) on board and our instruments from the University of British Columbia (UBC) to inform collaborations similar to this one in the future. Our lab is well equipped to measure dissolved gasses and reduced sulfur compounds underway from the ship's intake using two instruments: a membrane inlet mass spectrometer (MIMS) and a purge and trap reduced sulfur analyzer (PTRSA).

The MIMS measures O<sub>2</sub>, Ar, CO<sub>2</sub>, and DMS partial pressures (Torr) every ~30 seconds by passing surface seawater through a cuvette in which dissolved gases equilibrate across a membrane into a quadrupole mass spectrometer. O<sub>2</sub>/Ar ratios can be used to infer the biological production of oxygen in surface waters. Liquid air (with constant O<sub>2</sub>/Ar ratio), CO<sub>2</sub> and DMS standards are introduced to determine the concentrations of these gasses in seawater. O<sub>2</sub>/Ar and CO<sub>2</sub> remained near equilibrium in the open ocean and ranged between under saturated and supersaturated in coastal waters. We recorded highest DMS measurements in the calm open ocean waters between Station Papa and the north tip of Vancouver Island.

This cruise represents the maiden voyage for the PTRSA and the acquisition of the largest DMSO dataset in the NE Pacific to date. The PTRSA has considerable advantages over other reduced sulfur analysis systems due to its ability to sequentially analyze three biochemically linked compounds (DMS, DMSO, DMSP) at a relatively high temporal resolution (1.6 hours per analysis). The instrument also has the potential to measure samples off-line, which enables a user defined sampling resolution - on this trip, we were also able to collect duplicate samples from interesting points for analysis in the laboratory at a later date. The PTRSA also has a more sensitive detection limit of ~0.2 nM, compared to the MIMS detection limit of ~ 1 nM for DMS.

Inter calibrations between the IOS detector and UBC's PTRSA took place at P12, P20 and P26 on August 25<sup>th</sup>, August 26<sup>th</sup>, and August 29<sup>th</sup>, yielding 1-1 agreement ( $r^2 = 0.99$ ; Fig. 1). In addition to the calibration of instruments between IOS and UBC, we also compared DMS and DMSP measurements from our underway sampling loop and a simultaneous Niskin cast with bottles fired at depths of 5m, 15m and 25m. This cruise therefore also represents the first in-depth comparison of sulfur analysis methods between IOS and UBC.

Figure 1.



## Line P – August 2014 – Andreas Mueller, UBC.

### **Objectives:**

The project is focused on the taxonomic and metabolic diversity of the bacterial community in the cycling of major nutrient and gasses in the Oxygen Minimum Zone along Line P.

### **Sampling summary:**

Discrete samples were taken from the rosette at up to 17 depths at all five major stations (P4, P12, P16, P20 and P26).

From each of these points 2 L seawater samples for high resolution bacterial DNA and sequencing were taken and filtered using 0.22µm Sterivex filter units. Furthermore, 1 mL seawater samples per depth were taken and preserved in *glutaraldehyde* for later enumeration of cells per milliliter using Flow Assisted Cytometer. Additional samples for single cell DNA analysis were taken and preserved in *GlyTE*.

At 3 major stations (P4, P12 and P26) additional 20 L seawater samples at four depths (10m, 500m 1000m and 2000m) across the Oxygen Minimum Zone were taken for Meta-genomic analysis and to create genomic libraries of the bacterial community. For RNA analysis, 2 L water were filtered and preserved in *RNA later*.

The 0.22µm filtrate (20 L) were treated with 2 mL iron chloride ( $\text{FeCl}_3 \cdot 6\text{H}_2\text{O}$ ) to precipitate the viruses and after an incubation of 1 hour filtered using a 0.8µm 142 mm polycarbonate membrane filter. For virus counting, samples were taken and preserved using *glutaraldehyde* and *betain*.

Also at P26, seawater samples were taken, preserved with *formaldehyde* and filtered for later FISH analysis.

### **Comments:**

I really want to thank the scientists and the crew of the J.P. Tully for their help and the wonderful time on board. I appreciated the chance to learn more about the different projects and the work of the scientists.

I wish to thank the Tully crew for their assistance and excellent work throughout the cruise. Special thanks to Marie Robert who organized the cruise and who was always helpful with questions and problems.

## Carbonate Studies – Andrew Ross, Kyle Simpson, DFO/IOS.

Four components of the carbonate system were measured/sampled on the 2014-19 expedition along Line-P to Station Papa. Both pH and underway pCO<sub>2</sub> are measured onboard the Tully. Samples for DIC and TA were collected preserved and returned to shore for analysis.

### 1) pCO<sub>2</sub>

The pCO<sub>2</sub> system is in need of an overhaul, again this system gave many problems during start-up. Specifically the computer power supply this time (I suggest that any new system be run of a sturdy laptop such as a “toughbook”). We found a spare computer of the same vintage and swapped out the power supply. The system was run using the seawater loop system shortly after leaving Pat Bay and through the inside passage of Vancouver Island (return via Port Hardy. The unit performed well with the exception of the intake temperature probe that no longer works (this data will have to be taken from the TSG).

### 2) DIC/alkalinity sampling

DIC/alkalinity samples were collected in 500 ml bottles and preserved with 100 µl of HgCl<sub>2</sub> at all major stations on line P including Haro59, JF2, P1, P2, P4, P12, P16, P20, P26; on the return trip Via Port Hardy we also sampled at Stations 12 and 42 (Cruise 2014-60). Stoppers were greased with Apeizon grease and tapped closed with electrical tape. One duplicate was collected at each station between 1000 and 3000m as well as a duplicate bottle tripped at one of the deeper depths (full set of duplicates at station Papa.

A calibration cast was conducted at P24 on the way to OSP (5 bottles for DIC/TA were tripped at 2005m and each sampled in triplicate). Most DIC sampling was carried out by Andrew Ross, poisoning and taping was carried out by a variety of personnel.

### 3) pH

Seawater pH was analyzed at major line P stations using the Agilent (HP) spectrophotometer and the m-cresol purple technique of Clayton and Byrne. Cells (100mm cylindrical glass) were filled directly from Niskins. They were stabilized at 25° C using a constant temperature bath and an aluminium block. A temperature controlled cell holder was also used to maintain sample temperature at 25C during analysis.

Profiles consistent with DIC/TA depths were collected from all major line P stations as well as a calibration cast at P24.

As usual, the pH system was set up in temperature controlled lab. The lab temperature remained relatively stable throughout the trip. The temperature of the seawater in the cells was measured after each analysis to confirm the temperature. Sample collection and analysis was carried out by Kyle Simpson.

**Trace metal sampling** - Carried out by IOS and UVic (Cullen Lab)

***Participants:*** Dave Janssen and Kathryn Purdon (UVic), Kyle Simpson and Andrew Ross (IOS)

***Overview:*** At all major stations (P4, P12, P16, P20 and P26), samples were collected for the determination of dissolved (<0.2 µm) and total dissolvable (unfiltered) trace elements. At all major stations 12 discrete depths per station were sampled, to a maximum depth of 1500 m. Suspended particulate samples (>0.8 µm) for trace metal composition, cadmium stable isotope composition and X-ray fluorescence (XRF) analysis were collected at P4 (10 depths) and at P26 (13 depths), and ligands (1 depth).

***Sample Collection:*** Seawater was collected using 3 distinct systems. The majority of sampling was accomplished using the UVic 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 was 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.

Surface sampling at P26 was conducted to a maximum of 40 m depth using an air driven, double bellows Teflon pump (IOS) that moved seawater through Teflon lined tubing deployed from the ships starboard chains in addition to the surface samples collected from the TMR. Seawater flowed through the tubing to a Class 100 HEPA flow bench in the Wetlab where filtered and unfiltered samples were collected. At P20, additional surface samples free of contamination from the ship were taken from the Zodiac 733 at a distance of about 1.5 nm from CCGS Tully.

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). Samples were not acidified at sea and are awaiting acidification in the laboratory on shore.

Particulate samples were collected using 5 McLane large volume in-situ pumps fitted with two filter heads per pump. The pumps were deployed using the 5/16" steel cable on the aft deck. A ~2 m stretch of wire extending from just below the base of the pump to >1 m above the top of the pump was covered in duct tape to minimize contamination from the metal wire. The dual head pumps were equipped with 0.8 µm Supor filters for trace metal analysis and cadmium stable isotope composition and 1.2 µm Polycarbonate filters for XRF.

At P26 problems were encountered during recovery of the TMR. Sea conditions, which were worse during this deployment than the preceding stations, and worsened during the deployment resulting in difficult conditions for recovery. This caused the rosette to swing violently when it was brought out of the water. Two trace metal clean boathooks were lost and another was broken during attempts to recover the rosette before plans were amended to focus on recovery of the rosette without strong concern for trace metal clean procedures. A line was fixed on the frame with a happy hooker which helped to limit swinging away from the ship and side to side but could not prevent the rosette from swinging toward the ship. During recovery the rosette smashed into the side of the ship repeatedly, breaking 4 of the GO-Flo bottles, shearing off one vertical support from the rosette frame, and bending another support.

In previous years a weighted bucket was attached approximately 5 m below the bottom of the rosette to help minimize swinging as the rosette was brought out of the water. The bucket was lost in 2012 during a deployment and not replaced in 2013. In deployments in 2013 and leading up to P26 in 2014 conditions were such that the bucket was not needed, and it was believed that deployment and recovery worked better without the bucket. With the stronger winds and larger swell at P26 (~2.5 m) in 2014 the rosette needed some sort of hanging weight. In future cruises a bucket or another hanging weight should be required for deployment in any rougher conditions and it would probably be wise to include a hanging weight for all deployments. The trace metal group

will work on a new hanging weight system and will consult with the deck crew as needed to come up with a good option.

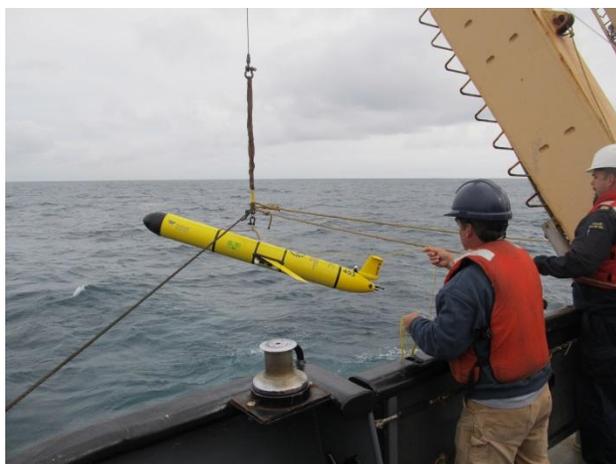
The trace metal group thanks Captain Victor Gronmyr and chief scientist Marie Robert as well as Bosun Bruce Wilson, the deck crew, and the other scientists for their assistance during deployment and recovery of the TMR and the McLane pumps.

**OOI Glider Deployment Station Papa, August 29 2014** – Brian J. Guest, Woods Hole Oceanographic Institution

As part of the Ocean Observatory Initiative (O.O.I.), two Slocum gliders from the Woods Hole Oceanographic Institution (WHOI) were deployed near the Station Papa site during a Line P cruise aboard the CCGS John P. Tully.

Initially the deployment was scheduled for Thursday August 28<sup>th</sup> but winds around 30 knots and seas up to 4 meters persuaded me to call off the deployment. I was confident that we could deploy both gliders in that sea state but if there was a need to recover one for any reason I doubted that it would be safe to attempt. The deployment was rescheduled for Friday August 29<sup>th</sup> in anticipation of better conditions. The ship had lost internet connection a number of days earlier so all communication with WHOI prior to deployment was conducted via a portable Iridium telephone.

At 1800 local time the call was made to WHOI to inform them that both instruments had been prepared for deployment and WHOI conducted a number of prelaunch test via satellite uplink. Both gliders passed their initial test. Using a winch equipped with 3/16” wire rope running through a block on the starboard side of the A frame, the first glider was lifted over the rail and lower to the water. Once in the water a quick release was triggered setting the instrument free from the vessel. The ship then slowly moved to the north to be clear of the glider which would perform its initial test dive in a westerly direction. Once the glider completed its test dive, word was received from WHOI that it was working properly and we could proceed with the second instrument deployment, which was conducted in the same manner. WHOI confirmed that both gliders were performing properly and we were clear to leave the area. At 2000 local we were underway to the next science station.



Date	Time Z	Instrument S/N	Lat	Lon
08/30/2014	0111	453	50 – 02.00 N	144 – 50.04 W
08/30/2014	0216	362	50 – 02.29 N	144 – 49.43 W

On the evening of the 30<sup>th</sup> an email was received stating that glider #453 had reported there was a leak in the tail second after completing its 6<sup>th</sup> dive to 1000 meters. A request was made for us to return to the site and recover the instrument. At this point we were 20 hours away from the deployment location and a rescue would have set us back 44 hours in total. No buffer time, such as weather days, had been built into the schedule and any attempt to return to the site to recover the glider would significantly affect the ability to conduct scheduled science stations and possibly delay the departure of the next science cruise so it was relayed to WHOI that we could not possibly attempt to recover the glider. Unfortunately, we were most likely the closest vessel to the glider for the next few months.

I would like to thank all of the J. P. Tully crew and officers for the fine job they did in launching the two gliders. The Bosun and his team did a fantastic job launching the gliders while the bridge maintained a perfect position for us to observe the instruments while staying safely away from them. I would also like to thank the galley staff along with Vince and Sheila for the fantastic meals that were put out for us each and every day.

**Mission 2014-19 CCGS JP Tully August 18 to Sept 4, 2014: Cs-137 and I-129 Sampling** - Rick Nelson, DFO/BIO.

An earthquake triggered tsunami 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, 2013 and for the first time during February in 2014. This was the first August sampling on Line P as part of the ongoing monitoring program.

**Sampling 2014-19:**

Three 8-depth profiles were planned at stations P-4, P-16 and P-26 at depths 500, 400, 300, 200, 150, 100, 50 and 5 meter depths. At station P-10 four depths were sampled 200, 150, 50 and 5 and at P-21 5 depths were sampled at 200, 150, 100, 50 and 5 meters. Sixty liter samples were collected at all depths with the surface samples being collected using the underway loop system.

Sixty liter surface samples were collected from the underway loop system after the ship was on station at P-1, P-2, P-6, P-8, P-12, P-14, P-18, P-19, P-23, P-24 and P-25 during the outward leg and samples were collected on the return steam north of Line P at 4 stations.

A total of 50 Cs-137 samples were collected.

In addition 1 liter samples were collected for I-129 at station P-4, P-16 and P-26. Full 8-depth profiles were collected all 3 stations for a total of 24 samples.

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.

**Problems:**

This was the first August cruise and problems were encountered at near shore stations with the amount of particulate matter in the water column. The result was only 30 liter samples were collected at P-1 and P-2. In future there may be a need to pre filter the nearshore samples with a 53 micron prefilter before passing the sample through the KCFC columns.