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:** 10 February 2014 **TO:** 24 February 2014

SCIENCE CRUISE NUMBER: 2014-01 **SHIP'S PATROL NUMBER:** 13-11

CHIEF SCIENTIST[S]: Marie Robert

SCIENTIFIC PERSONNEL:

Female	Male
Ashley Davidson (UVic)	Michael Arychuk (IOS)
Rachel Emswiler (UW)	Glenn Cooper (IOS)
Marie Robert (IOS)	Nicolas Estrade (UBC)
Maureen Soon (UBC)	Roger François (UBC)
	Aram Goodwin (UBC)
	Sam Kheirandish (UBC)
	Hugh Maclean (IOS)
	Richard Nelson (BIO)
	William Ostrom (WHOI)
	Greg Siddall (BIO)
	Kyle Simpson (IOS)
	Doug Yelland (IOS)

AREAS OF OPERATION: North East Pacific, Line P, Station P.

INTRODUCTION/PROGRAM BACKGROUND: Line P is a long standing program which surveys a 1400 km long section 3 times annually. Data 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.

Despite the fact that the weather in the NE Pacific had been calm for most of the 2013-2014 winter, this cruise (2014-01) saw a change in weather patterns. We went through storm after storm, and many stations had to be cancelled on our way west, and only a few casts were performed at the long stations. Fortunately the weather was much better on the return leg and we could catch up on most of the work.
We deployed 4 Argo drifters for DFO/IOS, deployed a glider for OOI/WHOI and recovered another one of their gliders, and deployed three weather data drifting buoys for Environment Canada.

CRUISE OBJECTIVE/OBJECTIVES: Repeat hydrography section (physics, chemistry, biology, iron). Sample cesium at the surface and in depth (maximum 300 m) at five stations along Line P. Sample for micro-plastics at the surface and in depth at two stations along Line P. Deploy Argo drifters for DFO/IOS, a glider for OOI/WHOI, recover a glider for OOI/WHOI, repair a malfunction of the SeaCycler on the OOI mooring near Station P; and deploy three weather data drifting buoys for Environment Canada.

DAYS ALLOCATED: 14 **DAYS OF OPERATION:** 14

DAYS LOST DUE TO WEATHER: ~2.5 days.

SAMPLING:

- This cruise was very compromised by the weather. 4 stations were missed, and out of 71 planned casts, only 50 were done. 7 of our "2000 m casts" only went to 1000 m. Fortunately the weather was excellent on the way back so 9 of the skipped stations were visited then.
- Three weather data drifting buoys were deployed for Environment Canada; two at P26 and one at P20.
- Four Argo floats were deployed for DFO/IOS at P10, P13, P15 and P26. They all seem to be functioning properly. We managed to film two of the deployments for a news item about the Argo program for the Découverte TV show at Ici Radio-Canada.
- One glider was deployed for OOI/WHOI at P22, and one glider recovered at P20.
- Unfortunately the efforts spent on trying to communicate with the SeaCycler on the OOI mooring were not successful.
- The samples collected include:
  1) Underway: **IOS**: Thermosalinograph (Temperature, Salinity, Fluorescence), acoustic sounder, pCO_2.
  2) "E-data" from CTD: Pressure, Temperature, Conductivity, Dissolved Oxygen, Transmissivity, Irradiance, Fluorescence (two sensors).
  3) From the Rosette: **DFO-IOS:** dissolved oxygen, salinity, nutrients, DMS, DMSP, chlorophyll, HPLC, Dissolved Inorganic Carbon (DIC), Alkalinity, pH, microplastics – **UBC (Kheirandish):** 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) – **UBC (François, Estrade, Goodwin, Soon):** Dissolved silicon, biogenic silicon, nutrients, dissolved neodymium, Rare Earth Elements, density anomaly (for Pawlowicz), – **UW (Emswiler):** Gels, Protein.
  4) From the pump/Trace Metal Go-Flos: **DFO-IOS (Simpson, Davidson):** Fe (III) filtered and un-filtered, salinity, nutrients.
  5) **DFO-IOS (Yelland):** Zooplankton using vertical net hauls (Bongos) to 250 m.

RADIOISOTOPE USE:

No radioisotope were used during this cruise.

PROBLEMS [SCIENTIFIC GEAR AND OPERATIONS]:

Bongo report
Due to almost constant high winds and large seas, only two bongo tows were completed during the outbound leg of this Line P cruise. A third one was completed on the inbound leg. On the first attempted cast, a moment of inattention to the wire led to a severe forward angle and subsequently the weights, one cod end, and half of one net were lost through the ship's propeller while trying to recover the wire angle. Two later tows in marginal conditions did result in success but there were often large wire angles during the deployment.

Doug Yelland

Many "cool" nutrients samples – samples that should have been stored in the cold room – ended up in the freezer. More care has to be given to how samples are handled (better training to new people).

The underway pCO_2 analyzer was setup in main lab next to the seawater loop and was running from shortly after leaving the Jetty at IOS. Once again the system didn't perform well, but several more problems arose during trouble shooting.

1. The standard gas 250ppm CO2 appears to have been mislabelled as the system reads it a 0ppm CO2 – this will need to be confirmed in the lab.
2. Upon removing the above noted standard the system performed better, but the standard curve and standard deviation were unacceptable
3. The temperature probe in the seachest (inlet of the loop system) seems to have failed as it is reading significantly higher than the temperature at the equilibrator.
4. We were unable to connect to the AVOS system to retrieve GPS data at the beginning of the cruise.

Kyle Simpson

The thermosalinograph was still not working properly. The remote temperature was reading -9.999°C during the whole cruise, and the salinity data quality was very poor, maybe because of all the air in the filters, going into the main part of the TSG.

It would be helpful if a larger monitor (or computer) could be used for the Thermosalinograph, and a static IP set. It's difficult to keep track of whether it's working properly with the tiny screen set very high up. If anyone is ever going to take the TSG (and data) seriously, a serious attempt must be made to incorporate it into the lab on a more permanent basis. My suggestion is to mount a computer in the rack (or simply run it on the server). Also, automatic connection and data logging to SCS would be easier with a static IP (and permanent computer).

Doug Yelland

SUCCESSES [SCIENTIFIC]:

We managed to do an amazing amount of work despite the storms and the ship motion.

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

Onboard network and Science computer systems report.

Recent changes to the network on the Tully necessitated considerable effort to reconnect various computers and systems. A new IP network system was implemented so all the Science computers that use static IP addresses were converted. In addition, the SCS system, which logs various ship board data sources, had to be reconfigured. The AVOS weather system had been shut down due to VHF radio interference and when restarted was not properly connected for data distribution. With help from Gerald Rohatensky this was eventually sorted out and meteorological data was recorded for much of the return leg of the cruise. The science server functioned well, although a USB hub failed, causing printing issues to the laser printer (will be replaced).
There is some issue with email; onboard accounts don't always log on properly if they become disconnected (using Microsoft Outlook). An unexpected fix is to sign on to the shipboard Webmail system in a browser (https://jpt01/exchange); when signed into this, Outlook will automatically become connected to the Exchange account. Then the Webmail window can be closed.

The sounders worked well considering the amount of air under the hull during much of the outbound trip. New keyboards are required (with built-in track pads) as the mice kept getting lost in the back of the rack (Velcro and various other remedies have proven ineffective), and the keyboards are simply too wide to be on a rack shelf. Also, the EK60 computer that was replaced last year is still 'temporarily' installed; the components need to be transferred to the proper rack-mount case.
As mentioned, many thanks to Gerald Rohatensky for his help sorting out the technicalities of reconfiguring the computers and devices used by Science.

Doug Yelland

There was a problem with one of the engines in the night after P20 on the way back. Fortunately we had gained lots of time by using both engines between P26 and P20. The engine was repaired a few days later.

SUCCESSES [SHIP]:

We had to recover a glider at Station P20. We got on station after sunset, with still just enough light left to look for the glider. We managed to locate it, but then it somehow escaped the search light circle. With lots of patience and determination we managed to find it again, and recover it at night, with the wind picking up. Hats-off to the whole crew on watch that night, this was an awesome accomplishment!

We picked-up most of the missed stations on our way back from Papa because of running on 2 engines after Papa to P20, as well as after P12 for a while.

Thanks to the Captain and ship crew for letting us load before noon on Monday. That allowed us to leave that same evening.

DELAYS [OTHER THAN WEATHER]:

None.

SAFETY CONCERNS:

None.

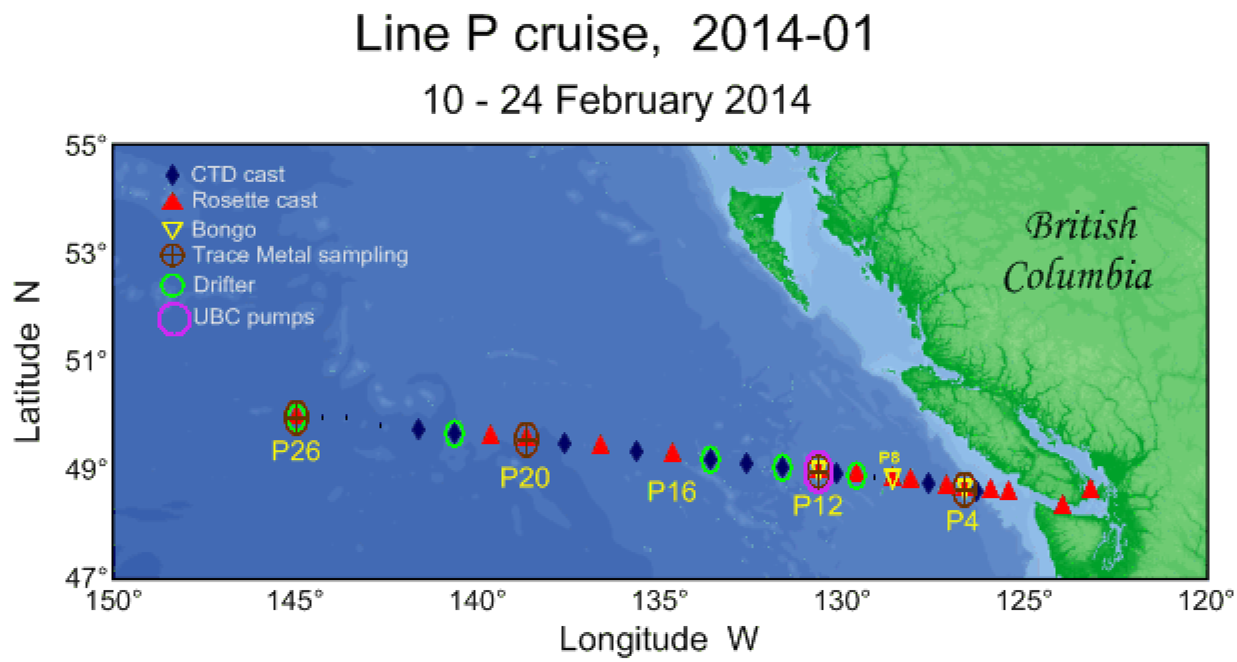
HAZARDOUS OCCURRENCES:

None involving science personnel.

EVENT LOG:

Monday 10 February:	Start loading the ship at IOS. Safety meeting at 1600. Leave the jetty around 2000. Haro59 station around 2245.
Tuesday 11 February:	JF2 rosettes. P1 to P4.
Wednesday 12 February:	Stations P4 to P8.
Thursday 13 February:	Stations P10 and one cast at P12 (P9, P11, most P12 skipped b/o weather).
Friday 14 February:	Stations P14 to P16 (only 2 casts at P16 b/o weather).
Saturday 15 February:	Weather day, no work, just trying to go west.
Sunday 16 February:	Weather day most day, finally get to P20 around 2130. (only 3 casts)
Monday 17 February:	Stations P20 and P21. Sail to Papa.
Tuesday 18 February:	Weather day, sailing to Papa.
Wednesday 19 February:	Arrive at Papa just after midnight. Work on SeaCycler. More weather delay in the morning. Work at Papa all day, leave Papa around 2100.
Thursday 20 February:	Stations P23, P22 – Deploy glider. Recover other glider at P20, deploy EC drifter.
Friday 21 February:	Stations P19, P18, P17.
Saturday 22 February:	Stations P13, P12, P11.
Sunday 23 February:	Station P5.
Monday 24 February:	Arrive at IOS and offload.

CRUISE TRACK:



SUMMARY/FINAL COMMENTS:

- Many thanks to everyone at IOS who have helped make this cruise a success: Tamara, Mark, Kelly, Kenny, Moira, Nina, Scott … your help is always greatly appreciated!
- Special thanks to Jill Rose for working her magic and clearing some people at the very last minute!
- Thanks to Doug Yelland for all his help with figuring out the new Network on board and setting up the computers so that we could do our work properly.
- Thanks to the Captain and ship crew for letting us load before noon on Monday. That allowed us to leave that same evening.
- Thanks to the engineering group for constantly adjusting the “tank and burn schedule” around our sampling schedule.
- Thanks to Captain McCullagh for using two engines as we left Papa so that we could do most of the skipped work on our way back east.
- Thank you to the deck crew for helping us stabilizing the rosette in rough weather, and properly securing lots of our gear for us.
- Thanks to the officers for adapting to our constant changes in plans, and going along with “Plan F”! Thank you also for downloading UGrib every day, as well as all the other weather charts.
- But the gold medal REALLY goes to the galley crew. Cooking and cleaning and serving in this weather could probably be considered an Olympic event! Not only did you guys keep working through hell and high water – literally – but the food was really awesome. Wonderful job, thanks!
- See you all back in June? ☺

Marie Robert and the science team.

- Many thanks to Gerald Rohatensky for his help sorting out the technicalities of reconfiguring the computers and devices used by Science.

Doug Yelland

- We would like to thank Rachel Emswiler, Rick Nelson, Greg Siddall and Will Ostrom for assisting in poisoning, and sealing the DIC samples.

Glenn Cooper

- It is with much gratitude for the expertise and assistance from CCGS Tully's Captain McCullagh and crew in successfully completing the glider deployment and recovery. We thank Chief Scientist Marie Robert and very helpful science party in completing these tasks.

William Ostrom

- 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

- I'd like to thank our Chief Scientist; Marie Robert (IOS) for letting me participate on the cruise and for the opportunity to be on station for a SeaCycler surfacing. It's unfortunate that stormy weather prevented us from learning more, but I'm still very grateful for the time we received.
- A strong thank you also goes out to the captain and crew of the CCGS John P. Tully for their expert seamanship getting us safely through challenging weather, for being extremely helpful on deck and for the provision of delicious food. It was also a pleasure to meet and work with the entire science crew.
- My best to you all, Greg

Greg Siddall

- We really appreciated the time on board with the crew, officers and scientist to explain their work to us. The cruise gave us the opportunity to learn more about of the work of the scientist and the environment of the Pacific Ocean.
- All our lab objectives for this cruise were successfully fulfilled. The work area distribution was very convenient for our sampling needs and we will try to use the same setup once again in future cruises.
- We wish to thank the Tully crew for their assistance and excellent work throughout the cruise. Thanks to Marie Robert and the scientists onboard for their help on deck and in the lab. And a special thanks to Marie for printing us extra labels after we discovered we are missing our own labels. It really helped us do better sampling and labeling.

Sam Kheirandish

PROJECTS AND RESULTS:

Water masses – Marie Robert, DFO/IOS.

The most striking feature in the eastern North Pacific ocean during the winter was a large positive temperature anomaly centered on the Gulf of Alaska. This anomaly was seen in the Argo data, was reported by the temperature sensors mounted on the NOAA mooring (PA-007) situated about 10 miles northeast of Station P, and is also clearly visible in the sea-surface temperature data acquired by satellite, as seen in Figure 1.

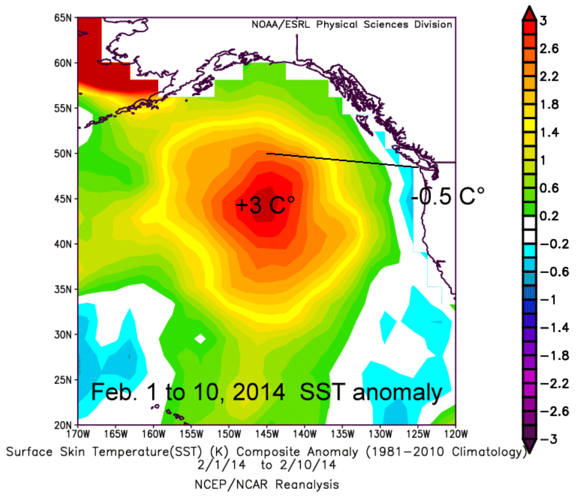


Figure 1: Sea-surface temperature anomaly in the Gulf of Alaska between 1 and 10 February 2014. Data provided by NOAA. The black line indicates the position of Line P.

This same anomaly can be seen in our CTD data (Figure 2) as we go from the shore (negative anomaly) to station Papa (large positive anomaly). Please note that the data presented here are unprocessed.

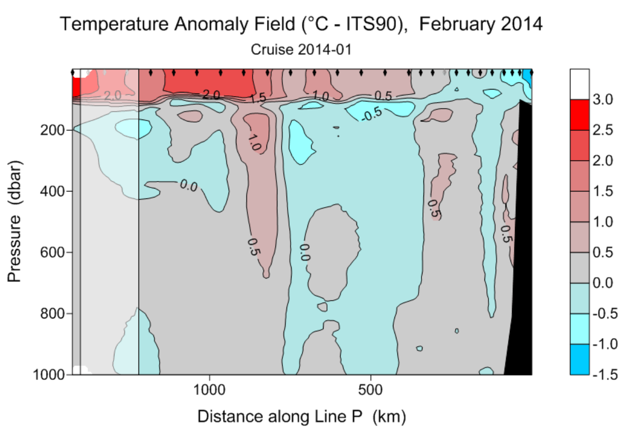
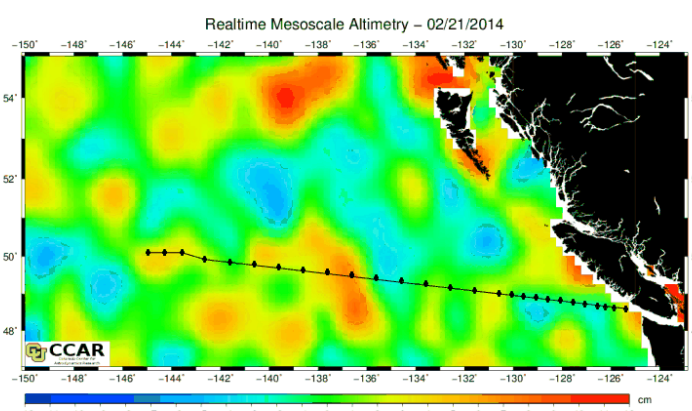
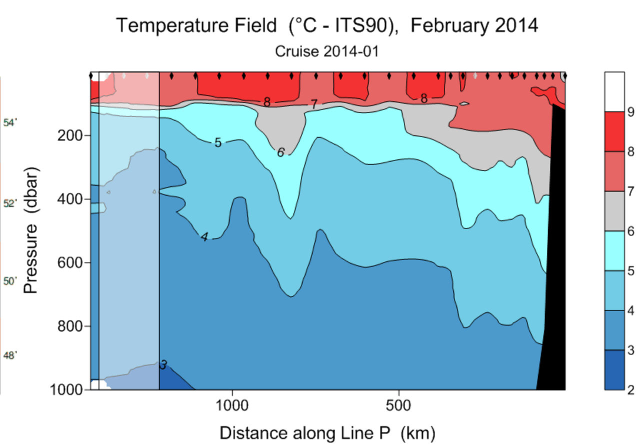


Figure 2: Temperature Anomaly Field (with respect to 1956-1991 averages) along Line P during the 2014-01 cruise, from 10 to 24 February 2014. A large temperature anomaly gradient is clearly visible going from the coast (negative anomaly) to Station P (+2.5°C anomaly).

Finally it is interesting to see that the eddy visible in the altimetry image of 21 February can also be detected in the temperature field around P18:





Slocum Glider Deployment and Recovery Operations - Will Ostrom, Woods Hole Oceanographic Institution

Slocum G2 glider “sn 361” was deployed and glider “sn 365” was recovered on Feburary 20, 2014. These assets are part of the Ocean Observatories Initiative (OOI) program at Station PAPA. Glider sn 361 shown in figure 1. was removed from its shpping crate and positioned on the CCGS Tully’s aft deck so that the drifter had unobstructed sky by which a FreeWave and Iridium signal connection could be made.

Figure 1 Slocum glider sn361 pre-deployment

A FreeWave antenna was secured to an aft 03 level railing with its cabling routed into the ship’s main lab. The FreeWave connection was used to start the glider in preperation for an Iridium satellite link to allow a shore pilot to interrogate the instrument with a pre-depoloyment check out. This check out took approximately 1 hour to accomplish. Once the shore glider pilot confirmed that the glider was ready for deployment, the instrument was shifted to the deployment area shown in figure 2.

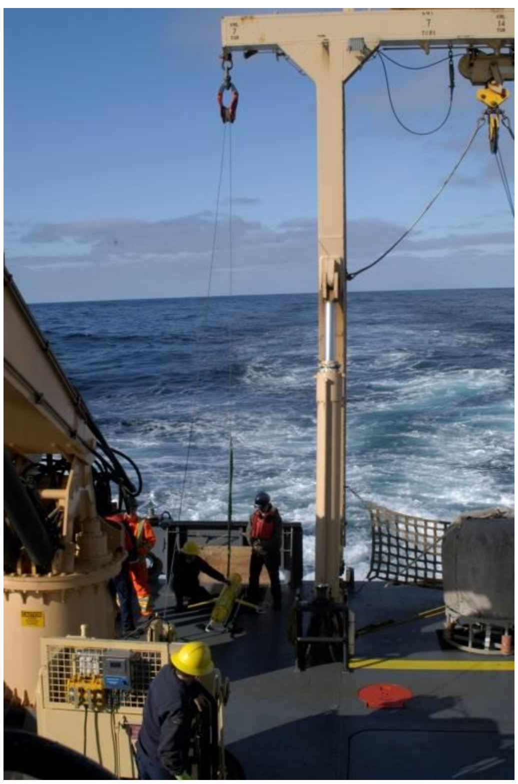


Figure 2 glider pre-deployment

The ship's A-frame and hydrographic winch were used to deploy the drifter, with a Ronstan # RF6210 snap shackle (series 200) with a 6 foot "Lift All" sling were secured on the drifter lifting bail shown in figure 3. The free end of the sling was shackled to the winch wire which was reeved through an A-frame fairlead block.

Figure 3 Ronstan RF 6210 series 200 snap shackles

The deployment personnel were a glider handler, deck supervisor, and winch and A-frame operators. The ship was positioned into the weather hove to. The glider was lifted up over the ship's transom and lowered so that the glider was in contact with the sea. The snap hook release line was pulled freeing the drifter. The ship then steamed ahead slowly clear of the glider. Figures 4 show this progression. Glider 361 was deployed at position 49 42.23N 140 41.57W at 12:07 PST

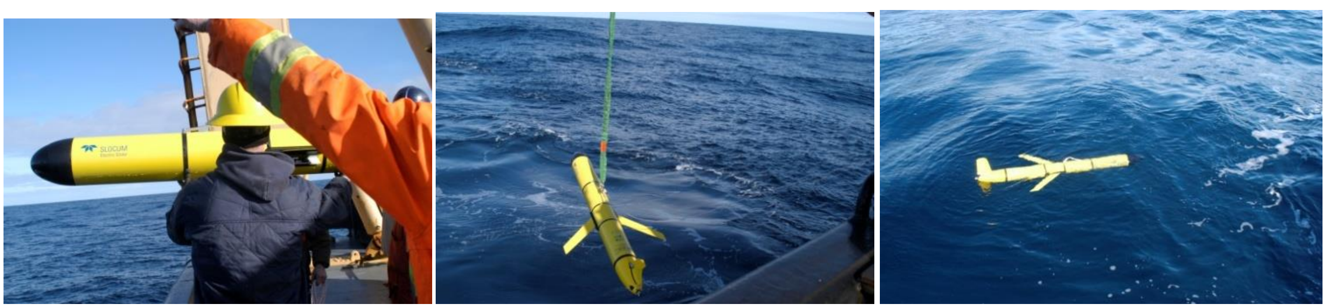


Figure 4 deployment progression

The glider pilot then programmed the glider to complete a test-dive to 100m. The CCGS Tully re-positioned 1 kt. mile away to Line P; Station 22, where a CTD cast was done. Approximately 1 hour following, the glider pilot confirmed that the glider was functioning properly and it was ok to transit to the next station.

Slocum Glider "sn 365" was recovered just following twilight on February 20th. The shore side glider pilot had programmed the glider to be floating on the sea surface and report its position in 5 minute intervals through the Iridium link. Updated positions were relayed to the ship via satellite phone. The plan for recovering the glider was to use the ship's rescue boat with ship's officer, two glider handlers and a boat operator. The glider was spotted using the ship's search light. The boat was deployed and the drifter recovered. Drifter "sn 365" was recovered at 19:40 PST at position 49 36.846N 138 47.884W.

It is with much gratitude for the expertise and assistance from CCGG Tully's Captain McCullagh and crew in successfully completing the glider deployment and recovery. We thank Chief Scientist Marie Robert and very helpful science party in completing these tasks.

<u>Carbonate Studies</u> - Glenn Cooper, Marie Robert, Mike Arychuk, and Kyle Simpson, DFO/IOS.

Four parameters of the carbonate system were measured on the 2014-01 mission. Both sea water pH and underway continuous automated pCO_2 were measured onboard the Tully. Samples for Total Inorganic Carbon (TIC) and Total Alkalinity (TA) were collected, preserved and returned to the Institute of Ocean Science (IOS) for further analysis.

1) Seawater pH analysis:

Seawater pH was determined using the spectrophotometric method developed by Clayton and Byrne (Deep Sea Research, 1993). Seawater was collected directly from the rosette niskins into 10cm path length glass cuvettes. Meta-cresol purple (mCP) was used as the indicator dye and was validated prior to the cruise at IOS. The following stations were sampled: Haro59, JF02, P01, P02, P04, P12, P16, P20, and P26. A set of triplicate samples were taken at P02 station, whereas all other casts had two sets of triplicates which will be used to determine precision. A calibration cast was not performed due to significant time lost due to extreme weather conditions.

2) Total Inorganic Carbon and Alkalinity Sampling:

Total inorganic carbon and alkalinity (TIC/Alk) samples were collected at Haro59, JF02, P01, P02, P04, P12, P16, P20, and P26. One set of replicates was taken at each station. An entire extra set of samples was taken at P26 for archiving. Also an extra set of samples was taken at P12 but collected into 250ml glass bottles. All other samples were collected into 500ml glass bottles and overfilled with one and a half volumes. Samples were poisoned with 100 µl of saturated mercuric chloride. Bottles were sealed with greased glass ground stoppers and kept in place with electrical tape. Samples were stored at 4^oC until off loaded. We would like to thank Rachel Emswiler, Rick Nelson, Greg Siddall and Will Ostrom for assisting in poisoning, and sealing the samples.

<u>Cs-137 and I -129 Sampling</u> – 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.

Sampling 2014-01:

Three 6 depth profiles were planned at stations P-4, P-16 and P-26 at depths 300, 200, 150, 100, 50 and 5 meter depths. Sixty liter samples were collected at all depths with the surface samples being collected using the underway loop system. Due to weather condition the profile at P-16 was cancelled and sample depths at only 5 and 300 meters were collected. In addition 4 depth profiles were collected at stations P-10 and P-21.

Sixty liter surface samples were collected from the underway loop system after the ship was on station at P-1, P-2, P-4, P-8, P-12 and P-20 during the outward leg and samples were collected at stations P-25, P-24, P-23, P-19, P-18, P-14, and P-6 during the inward leg.

A total of 33 Cs-137 samples were collected.

In addition 500 ml samples were collected for I -129 at station P-26 and P-16. A full 6 depth profile was collected at P-26 and the same was planned at P-16 but due to weather problems only samples at 300 and 5 meters were collected

The samples for Cs were extracted onto KCFC (potassium cobalt ferrocyanide) ion exchange resin at flow rates of approximately 300 ml's per minute, rinsed with 100 mls of milli q water and then sealed for return to the Bedford Institute of Oceanography.

The resin samples were then dried, placed in appropriate counting geometries and the Cs-137 and Cs-134 radionuclides were determined by Gamma ray Spectroscopy using HPGE (high purity Germanium) detectors.

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

Trace metal Sampling – Kyle Simpson, DFO/IOS; and Ashley Davidson, UVIc.

The HEPA hood and TraceMetal Clean sampling pump were set up in the wetlab and all sampling equipment (pump and X-Niskins) were deployed from the Chains - The clean hood/pump setup was used for all surface samples (Stations P4, P12, P20, P26 (10-40m), P16 was not sampled because of weather conditions. Both unfiltered and filtered (0.2u Opti cartridge). All samples were collected into TM cleaned 250ml LDPE bottles and acidified to pH~ 1.7 by adding 1ml of 6N Seastar HCl. – No bulk TM seawater was collected during this cruise. Because of the rough weather and high seas, the pump sampling depths were changed from traditional to 10m, 25m, 35m. We did not have a long enough sampling tube to comfortably lower it to 40m.

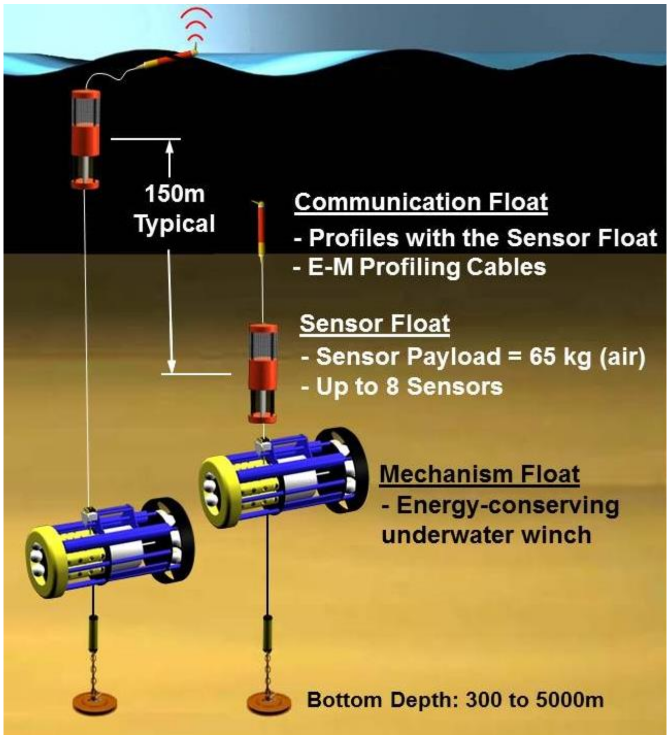
Due to inclement weather, samples deeper than 40m were only collected at Station Papa. Depths sampled were 800m, 400m, 300m, 200m, 150m, 100m, 75m, and 50m. All sampling was completed in the wet lab and sample processing and analysis was completed in the IOS trace metal container.

The Zodiac was not deployed for trace metal surface water sampling as weather conditions were not favourable for sampling. As such no true surface samples were collected.

Some attempts at on board analysis of dissolved Iron were made, but not successfully (trouble shooting revealed that likely the problem was a degraded hydrogen peroxide reagent, but this will need to be confirmed at shore). Thus all analyses will be completed on shore at a later date. No samples were lost do to analytical or sampling errors.

SeaCycler "Feb 2014 Line-P" Cruise Report – Greg Siddall, DFO, currently on secondment.
Greg.Siddall@rolls-royce.com

Introduction:
The SeaCycler Prototype was deployed 8.6 nautical miles from Station PAPA (Gulf of Alaska) on July 25, 2013 as part of the Global Scale Nodes program of the National Science Foundation's Ocean Observatories Initiative (OOI).
SeaCycler is a new profiling mooring that cycles a sizable sensor suite between the surface and a "parking depth" of 150m, once per day for a full year. When oceanographic sensors (on the SensorFloat) reach the surface, a small antenna is floated to communicate either locally (using UHF), or with satellites (using the Iridium protocol).
The Iridium system enables the mooring to deliver newly collected data to shore in near-real time and receive new commands for adjusting sampling parameters remotely.



The UHF system (known as "FreeWave"), provides local communication (up to a 2.5km line of sight) enabling a nearby operator to take complete control of the mooring as if they were hard-wired to it.
A third communication option is the use of acoustics. Acoustic communication requires a transducer to be positioned within 500 metres of the mooring in a quiet underwater environment. This method offers fewer diagnostic options, but does provide (1) a "status update" to check system health, (2) the ability to force an immediate profile where FreeWave could take over, and (3) a "reboot" feature to fix various software issues.
A second acoustic modem (not shown in the figure) is located near the sea floor on a separate Lower Mooring Controller that uploads lower-mooring data to SeaCycler using inductive modem technology.
The Problem:
After completing 14 profiles under near-perfect health, the SeaCycler prototype suddenly went silent half way through Profile 15 during its Iridium telemetry session. Many failure theories were formulated, but no conclusions could be made without visiting the site.

The goal of this investigation is to visit the mooring site to communicate with SeaCycler in hopes of either “fixing” the mooring (by re-starting Iridium communication), or at least learning what went wrong as understanding the problem is vital to making future corrections and improvements.

The Plan:

SeaCycler is currently programmed to surface every 20 hours and therefore its surfacing times are predictable. If a ship is on station when the mooring surfaces, the FreeWave system is designed to intercept the Iridium session before it’s started. This is the best scenario possible providing the most options and the best chance of fixing the problem. If the site visit could be timed to occur in daylight, it may also be possible to visualize the antenna float on the surface to confirm that it’s still profiling and most likely collecting data.

If FreeWave communication is not possible, acoustics will be used to interrogate the mooring directly. Acoustic communication can be attempted at any time, but is far less desirable than FreeWave because of its slower transfer rate and reduced reliable due to the need for a quiet acoustic environment.

If both acoustic and FreeWave communication are not possible, the ships sounder will be used to range on the mooring to determine the depths of various components.

The Investigation:

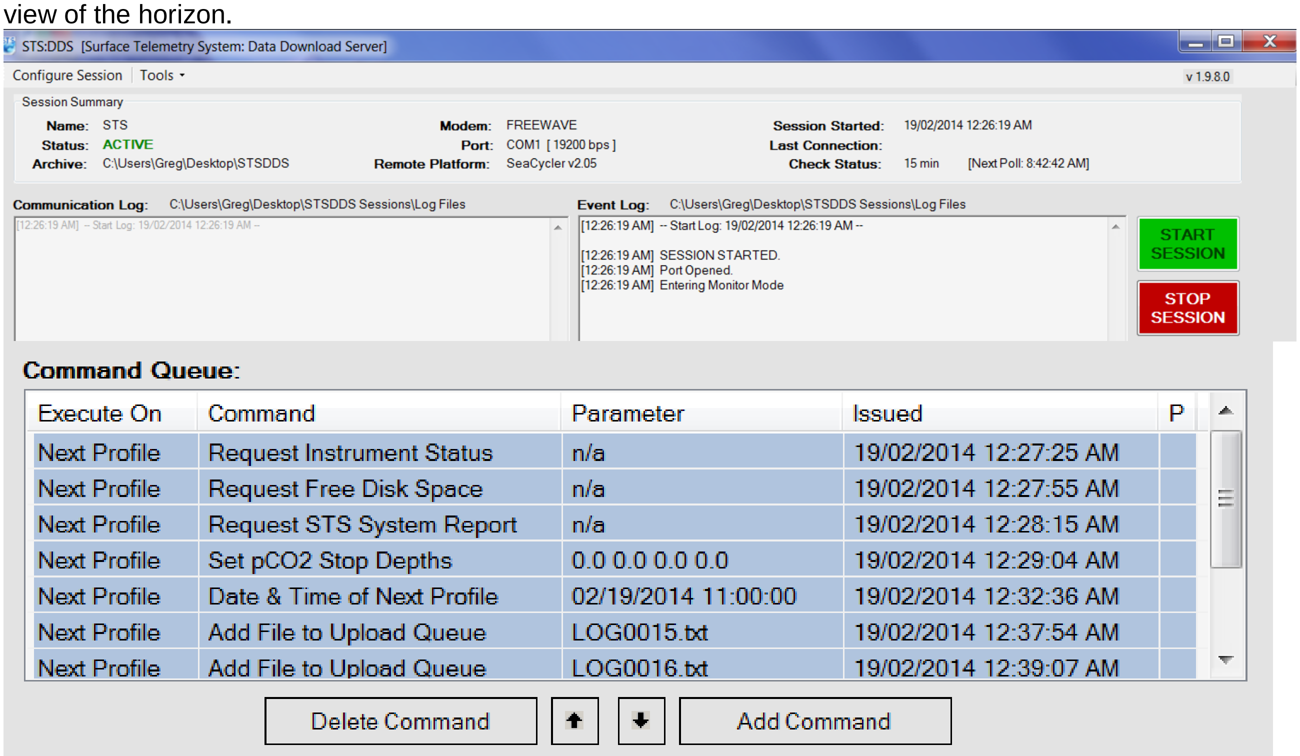
The winter 2014 Line-P cruise experienced some rough weather and missed several sampling stations on route to Station PAPA (P26). This forced the SeaCycler investigation to be conducted in bad weather with a shortened window of opportunity.

The ship reached the SeaCycler mooring site at 00:37 PST on Feb 19, 2014.

Profile #260 was expected to surface at either 01:14, or 01:58 PST depending on the connection status of the Lower Mooring Controller.

Wind speed was a steady 35 kts; gusting to 60 kts and wave heights were measured nearby at 3.8m.

FreeWave was set up and listening with commands queued as per below. The antenna and cable were from WHOI (tested with gliders 9 days previous) and located 3 decks (~6.5m) off the water pointing aft with a clear view of the horizon.



No FreeWave signal was detected during the experiment.

At 02:14, FreeWave was left queued up, while acoustic communication was attempted.

The Benthos 9400-UDB was used because its transducer cable was longer than the portable unit. The transducer was secured about 1 metre above a weight on the hydro wire and lowered as deep as possible; perhaps 3m below the keel.

Acoustic communication was attempted at three different locations (0.8, 0.5 and 0 kms from the mooring), but no response was received from either SeaCycler, or the Lower Mooring Controller.

Acoustic power levels and data bit rates were varied without success.

A quiet ship was requested. All sonar was turned off, but the propeller could not be de-clutched (stopped from spinning) due to steering control concerns in high winds. Zero propeller pitch was tried instead, but did not help.
Ship sonar was turned back on at 02:52 in an attempt to visualize the mooring components. No targets were identified even after positioning the ship directly over the mooring site. There was no time remaining for any kind of search.
At 03:00 PST the ship was instructed to leave the area heading for Station P26.
The acoustic “Hang Up” command (ATH) was not issued, since neither modem ever responded.
The transducer took a hit against the ship and bent its guard ring, but its performance does not appear to be affected and the guard was repaired the following day.
Greg Siddall requested another attempt on the following night (Feb 20) to catch Profile 261 (scheduled to surface between 21:14 and 21:58 PST) under much improved weather conditions.
The Chief Scientist said she could not afford the time.
On the following night, between 17:00 and 22:15 PST, the same FreeWave setup was used again as we left the P26 area. No connection was made, but this was not surprising since we were 12.3 kms from the mooring and FreeWave is not expected to work beyond 2.5 kms.

What did we learn?
Weather conditions during the investigation prevent us from drawing any firm conclusions, as we’re left with the question of whether our lack of communication was the result of a mooring problem, or simply due to stormy weather.
If the mooring was producing a FreeWave signal, we were in a good position to receive it. Based on this, it is likely that SeaCycler is either not profiling, or has lost all radio communication capability, but this is not conclusive since we’ve never tested FreeWave in large waves.
Excessive noise from storm waves and propeller spinning is likely the reason for the lack of acoustic mooring response, since the Lower Mooring Controller was recently interrogated (on Jan 21, 2014) by gliders.

Acknowledgements:
I’d like to thank our Chief Scientist; Marie Robert (IOS) for letting me participate on the cruise and for the opportunity to be on station for a SeaCycler surfacing. It’s unfortunate that stormy weather prevented us from learning more, but I’m still very grateful for the time we received.
A strong thank you also goes out to the captain and crew of the CCGS John P. Tully for their expert seamanship getting us safely through challenging weather, for being extremely helpful on deck and for the provision of delicious food. It was also a pleasure to meet and work with the entire science crew.
My best to you all, Greg

Biogenic and dissolved silica sampling – Nicolas Estrade, Roger François, Maureen Soon

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

Rosette samples:

We sampled seawater from rosette at station Haro 59, JF2, P1, P3, P5, P7, P12 and P18. For these sites, between 3 and 9 depths were samples and 2 to 4 Niskins were used to recover one sample. The 10L Niskin content was transferred into 20L cubitainer and directly processed at the lab to collect dissolved silica, nutrients and biogenic silica.
Dissolved silica and nutrients: a 50ml aliquot of the cubitainer was subsampled using a syringe and filtered through a 0.45µm acetate filter (25mm diameter filter, swinex cartridge), then acidified at 0.1% HCl. 10ml of seawater were also subsampled and filtered as well for nutrient analysis in UBC and directly frozen.
Biogenic silica: Between 20L and 40L of seawater were processed through a 47mm filtered using a 12 manifold filtration unit.

Location	Depths	# Biogenic Si	# Dissolved Si	# Nutrients
Haro Strait 59	5, 100, 220	3	3	3
JF2	5, 25, 80, 100, 125, 175	6	6	6
P1	5, 15, 40, 70,100, 125	6	6	6
P3	5, 25, 50, 150, 300, 450, 600, 750, 806	9	9	9
P5	200, 600, 1000, 1400, 1800, 2100	6	6	6
P7	5, 25, 75, 250, 750, 1500, 2100, 2530	8	8	8
P12	5, 20, 40, 60, 80, 100, 300, 600, 1000	9	9	9
P18	5, 20, 40, 60, 100, 300, 600, 900	8	8	8
Total		**55**	**55**	**55**

Underway samplings:

We took the opportunity to use the underway-sampling unit in the lab sink to collect biogenic and dissolved silica fraction from surface water all along the Line-P. A 12.5 cm diameter suppor filter was placed into a specific filtration unit equipped with a flow meter connected to the sink sampling line. Filters were periodically removed (around every 2 stations back and forth) and dissolved silica and nutrients (already filtered fraction) were sampled directly into 50ml and 10 ml bottles and processed as described above. A total of 20 samplings between Line-P stations was carried out. As a sampling consist in filters (biogenic silica) and seawater (dissolved silica and nutrients) samples, 60 samples from underway sampling were taken up.

Large volume pump sampling at P12 (Feb 22th):

One of our goals for this study is to document the biological uptake of silica in surface water and its sinking to deep water. We thus performed a set of samplings with our large volume pumps in order to recover biogenic silica from 1750 to 3000m at P12. 6 pumps were used simultaneously and set up on the winch. A total of 5.5 hours were used to perform these samplings including 2 hours pumping.

Pump #	Depth (m)	Volume (L)
1	2900	512.8
2	2650	1.7
3	2400	531.0
4	2150	11.6
5	1900	413.0
6	1650	2.4

Only there pumps out of six have been successful during this sampling. Issues came from the insufficient level of battery as pumps have been prepared for the initial cast Feb 13th that has not been perform at the last minute due to inclement weather conditions.

<u>Dissolved neodymium concentrations and isotopic composition from the Strait of Georgia to line Papa</u> – Aram Goodwin, Maureen Soon, Roger François.

We have collected 10-20 L seawater samples along the Papa line to determine the concentration and isotopic composition of the element neodymium, which is dissolved in seawater.

Neodymium is of interest in oceanography as its pathways into and out of the ocean have implications for the studies of continental weathering processes and past ocean circulation, respectively.

We speculate that the Pacific water circulating in the Strait of Georgia alters its neodymium isotopic composition as a result of post depositional dissolution of suspended sediment from the Fraser River. This isotopic alteration could be used to produce an estimate for the "local continental weathering rate" and improve our understanding of the oceanic neodymium cycle.

In this cruise we examine whether the above isotopic alteration is indeed expressed as contrasting isotopic signatures between the water circulating inside the strait and the water outside, in the Pacific.

For this end we collected the following samples:

Station name	Depth [m]	Sample's cruise name
Haro 59	0	24
	100*	21
	222	18
JF2	0	39 40
	110	35 36
	175*	27 28
P1	0	63 64
	60	61 62
	125	59 60
P3	0**	114
	150	113
	300	112
	806	103
P7	0	256
	25	255
	120	254
	302	253
	1200	252

In the lab we concentrate and extract neodymium from the water by iron oxide co-precipitation. We then purify it further on separation columns and analyze its concentrations and isotopic composition with mass spectrometers.

UBC Line P – Sam Kheirandish

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

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

1) Duplicate gasses samples were taken for later dissolved nitrogen (N_2), oxygen (O_2), carbon dioxide (CO_2), Argon (Ar) and nitrous oxide (N_2O) measurement using Chromatography Mass Spectrometry
2) 50 ml seawater samples were taken per depth to count the numbers of cell per milliliter using Flow Assisted Cytometry and single cell DNA analysis. Samples were aliquated and preserved using glutaraldehyde and Glycerol +TE respectively.
3) 2 L seawater samples (at 16 depth) for high resolution bacterial DNA and sequencing were filtered

Additionally, at 3 major stations (P4, P12 and P26) the following were sampled at four depths:10, 500, 1000, 2000/or bot-10 (whichever comes first) across the oxygen minimum zone.

1) Large volumes (20 L) per depth were filtered to create genomic libraries of the bacterial communities
2) After adding of iron chloride to the filtered water, the samples were filtered again for later virus analysis
3) For virus counting, samples were taken and preserved using *glutaraldehyde.*
4) Duplicate gasses samples were taken for later dissolved nitrogen (N_2), oxygen (O_2), carbon dioxide (CO_2), Argon (Ar) and nitrous oxide (N_2O) measurement using Chromatography Mass Spectrometry

5) 50 ml seawater samples were taken per depth to count the numbers of cell per milliliter using Flow Assisted Cytometry and single cell DNA analysis. Samples were aliquated and preserved using glutaraldehyde and Glycerol +TE respectively.
6) Additionally, water was taken for salinity and nutrient analysis

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

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

We wish to thank the Tully crew for their assistance and excellent work throughout the cruise. Thanks to Marie Robert and the scientists onboard for their help on deck and in the lab. And a special thanks to Marie for printing us extra labels after we discovered we are missing our own labels. It really helped us do better sampling and labeling.