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:** 5 June 2018 **TO:** 19 June 2018

SCIENCE CRUISE NUMBER: 2018-26 **SHIP'S PATROL NUMBER:** 18-06

CHIEF SCIENTIST[S]: Marie Robert

SCIENTIFIC PERSONNEL:

Female	Male
Moira Galbraith (IOS)	Michael Arychuk (IOS)
Lian Kwong (UBC)	Hugh Maclean (IOS)
Chelsi Lopez (U Miami)	Lindsay Mazzei (IOS)
Marie Robert (IOS)	Richard Nelson (BIO)
Jade Shiller (UBC)	
Theresa Venello (UVic)	

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.

CRUISE OBJECTIVE/OBJECTIVES: Repeat hydrography section (physics, chemistry, zooplankton), repeat Cesium sampling, deploy 4 Argo floats for IOS, test 5 "RBR-CTDs" for RBR Ltd.

CRUISE DESCRIPTION: This cruise (2018-26) was a "shake down" cruise, the first cruise after the Tully came out of VLE, and it went amazingly well! Following the 2006 VLE we were expecting more delays and more problems. Lots of people must have worked really hard for the ship to be ready on time; but she sure was! Of course the just about perfect weather helped us to accomplish all our work. We stopped at all the stations, in order, at a good pace, and returned on Monday 18th as planned. All in all, this was really a perfect cruise! Many, many people have to be thanked: both crews, the White and the Red; the land based IT team and the 'sailing' IT techs; ONC for their internet; and of course all the usual helpers of a Line P cruise. Great work everyone!

DAYS ALLOCATED: 14 **DAYS OF OPERATION:** 13

DAYS LOST DUE TO WEATHER:

None.

SAMPLING:

- The Line P survey was 100% successful. All stations were visited and all standard casts were performed.
- Four Argo floats (2 NOVA and 2 ARVOR) were deployed for IOS at P9, P14, P18, and P26.
- The samples collected include:

  1) Underway: **IOS**: Thermosalinograph (Temperature, Conductivity, Fluorescence), acoustic sounder, some ADCP, pCO_2 – **UBC (Venello for Izett):** PIGGY (O_2, total gas tension ~N_2).

  2) "E-data" from CTD: Pressure, Temperature, Conductivity, Dissolved Oxygen, Transmissivity, Irradiance, Fluorescence.

  3) From the Rosette: **DFO-IOS:** dissolved oxygen, salinity, nutrients, DMS, DMSP, chlorophyll, pigments (HPLC), dissolved inorganic carbon (DIC), alkalinity, pH, demoic acid, phytoplankton **– DFO-BIO (Nelson):** Cesium, ^{129}Iodine **– UBC (Shiller):** high-resolution bacterial DNA sequencing, number of cells per millilitre, single cell DNA analysis, virus analysis, viral counts – **UBC (Shiller, Kwong, Venello for Izett):** methane and nitrous oxide (N_2O) – **UVic (Venello):** secondary productivity, zooplankton **– UBC (Kwong):** 'bugs' – **U Miami (Lopez):** DOC, TOC, GELS (for M. Orellana, UW).

  4) **DFO-IOS, UVic and UBC (Galbraith, Venello, Kwong):** Zooplankton using vertical net hauls (Bongo to 250 m and 1200 m, single fine-mesh net to 250 m, one MPS to 2000 m and one MPS to 3000 m, and surface tows).

RADIOISOTOPE USE:

No radioisotopes were used on this cruise.

PROBLEMS [SCIENTIFIC GEAR AND OPERATIONS]:

Some Niskins were not set-up properly at the beginning of cruise. Niskin 11 was impossible to open and had to be modified. Many spigots are still really hard to open/close, and some top and bottom caps are still not fitting properly, causing the Niskins to leak a lot.
The longitude didn't always appear in the NMEA window of Seasave.
Seasave froze up once in the middle of a cast. We had to stop the cast and start a new one.
The water bath for the pH system was shutting down on its own, we could not use it at all.
Unfortunately we didn't have the old TSG on board; it would have been nice to have the old (SBE-21) and the new (SBE-45) TSG side by side to compare the data while there was space on the grating. Let's hope that this can be done on another cruise.
Despite all Lindsay's efforts, the ADCP is still not working properly. There seems to be a problem with the software itself.

SUCCESSES [SCIENTIFIC]:

The ONC network worked great all the way to Station P. There seems to be a dead angle which corresponds to the ship's course when we're sailing back east though. But for most of the cruise it was wonderful to have.
There is finally a cooling fan underneath the main CTD laptop.
The RBR testing went well, despite a few problems with a couple of downloads. The RBR support team was very helpful and we managed to fix the problems and keep going with the testing. Thanks to Hugh and Moira for dealing with the RBRs between each cast.

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

The little motor lowering and lifting the gate by the rosette landing is on its last leg. It definitely needs to be fixed or replaced before the next cruise on which the rosette will be used.

There is a **very** loud noise on the aft-deck at a certain engine RPM.
Moira Galbraith: It would be nice to have a bolt supplied for the bullet end of the conducting wire winch. Also the rate of line payout was not working, for the same winch, metres per second had to be calculated and monitored constantly.
On the last day of the cruise the ship's crane had some hydraulic issues. Fortunately we could use the land crane for offloading, with only a slight delay in operations. Thanks to Mike Burdon for offloading our gear!

SUCCESSES [SHIP]:

The ship's internet was working much better with the new dish although there is still a dead angle.
Despite all the changes made to the network and the systems on board, it's good that the chief scientist's email account still exists.
The science weather station now seems to be working.
Having Peter and Alex on board was fantastic and they helped solve many issues with our computers and equipment.
Moira Galbraith: Station keeping was superb, all wire angles were low or non-existent which was important for the deep sampling. Winches were in good working order and winch operators very knowledgeable.

DELAYS [OTHER THAN WEATHER]:

None.

SAFETY CONCERNS:

None.

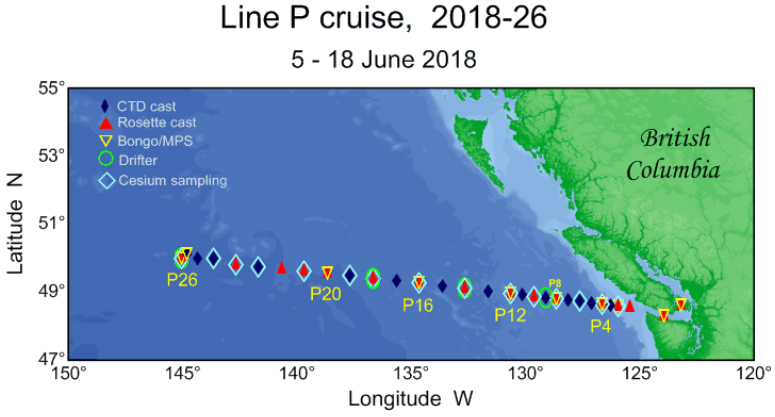
HAZARDOUS OCCURRENCES:

None.

EVENT LOG:

Monday 4 June:	Start loading and setting up a few things.
Tuesday 5 June:	Load the rest of the science gear and the winches/container. Safety meeting at 1600.
Wednesday 6 June:	Departure at ~0830. Science meeting at 1000. Fire drill at 1300. Stations Haro59 & JF2.
Thursday 7 June:	Stations P1 to P5.
Friday 8 June:	Stations P6 to P11. Deploy Argo (NOVA) float at P9.
Saturday 9 June:	Stations P12 to P14. Deploy Argo (NOVA) float at P14.
Sunday 10 June:	Stations P15 to P17.
Monday 11 June:	Stations P18 to P20. Deploy Argo (ARVOR) float at P18.
Tuesday 12 June:	Stations P21 and P24.
Wednesday 13 June:	Stations P25 to PA-011. Deploy Argo (ARVOR) float at P26.
Thursday 14 June:	Heading east.
Friday 15 June:	Heading east. Surface bongo tows, afternoon and evening. "Show and Tell" day.
Saturday 16 June:	Heading east.
Sunday 17 June:	Revisit Station P4.
Monday 18 June:	Back to IOS, offload.

CRUISE TRACK:



SUMMARY/FINAL COMMENTS:

- Many thanks to everyone at IOS who have helped make this cruise a success, as much in the lab getting things ready as on board getting the ship ready.

- Big thank you to Peter and Alex for all their help with our side of the network and our instruments, as well as fixing so many little things here and there that made a world of difference.

- Thanks to Oceans Network Canada for the use of their satellite dish, and especially to Jarrett Little for his "tutorial" at the beginning of the cruise.

- Many thanks to all the informatics techs, Andy and his team, who worked so hard prior to sailing so that the ship would be ready on time for our cruise. Very special thanks to Gerald, Brian, and Ranjit who spent quite a bit of time setting up my laptop so that I could do my work more smoothly. Thanks for "the gravy"! ☺

- Thanks to Captain Corfield for the extra speed to compensate for some small gremlins still present with the engines at lower speed.

- And most importantly, thanks to everyone who worked so hard between the end of dry dock and the beginning of this cruise to get the ship in tiptop shape and mainly got her ready to sail on time.
  Marie Robert

- Many thanks to the captain and crew of the JP Tully.
  Moira Galbraith

- Many thanks to the crew and the Chief Engineer for re-plumbing the atmospheric line above the deckhead panels which went missing during the refit. Thanks to Marie for sending off the data files and to Paul Covert for reviewing them.
  Mike Arychuk

- We'd like to thank the Captain and crew of the *John P. Tully* for all their assistance and hard work throughout the cruise. Thanks to Marie Robert and the IOS science crew for having us on board to do this work and accommodating our sampling needs.
  Theresa Venello and Lian Kwong

- I'd like to thank the captain and crew of the *Tully* for their excellent work and their interest in and support of our scientific program. Thanks to the IOS team and my fellow scientists for their help and their humour on deck and in the lab. And finally, a great big thank-you to Marie for organizing everything flawlessly even before we knew whether we'd get to be back on the *Tully* for this trip.
  Jade Shiller

- Thanks to the officers and crew 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

- Thank you to all of the Tully crew members!
  Chelsi Lopez

PROJECTS AND RESULTS:

Water masses – Marie Robert, DFO/IOS.

The weather during this cruise has been excellent. All the stations were done in order and without any delay. The main feature along Line P during this cruise is an eddy that we sailed through at Station P20. (See figure 1). The eddy signature can be seen in the temperature and temperature anomaly fields (See figure 2). Moira Galbraith also reported that the content of the bongo nets was much different at Station P20 where she saw more "coastal" species.

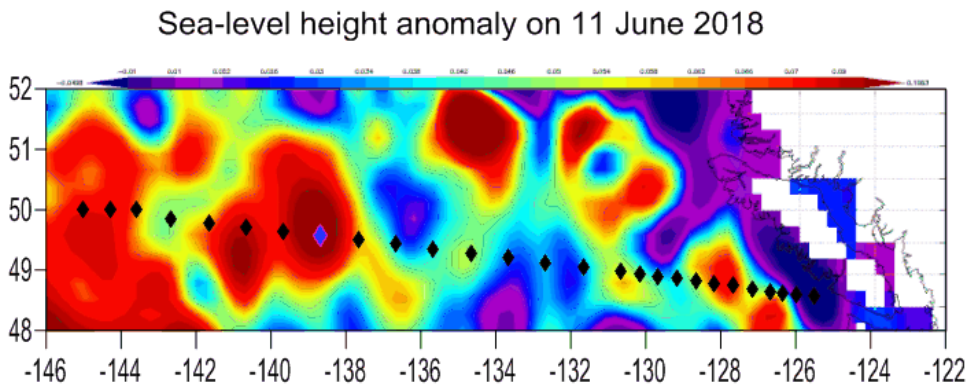


Figure 1: Sea-level height anomaly from the AVISO site, centered on 11 June, showing the eddy at Station P20.

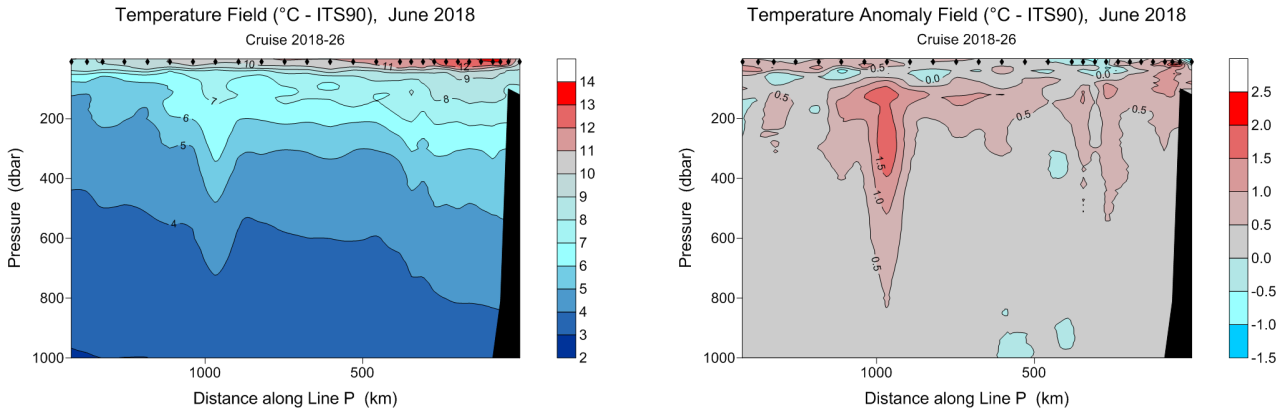


Figure 2: Temperature field (left panel) and temperature anomaly field with respect to the 1956 – 1991 averages for June 2018 (right panel) showing the eddy "signature" at P20.

Net Operations – Moira Galbraith, DFO/IOS.

10 shallow bongos to 250 m or 10 off the bottom; 4 deep bongos to 1200 m;
1 MPS to 2000 m and 1 MPS to 3000 m; 7 ring nets to 250 m; 4 Neuston tows 0 to 5 m.

The Tully continues to be an excellent sampling platform for all aft deck net operations. All the net work was at the major stations along Line P plus Haro59 and Juan de Fuca. Station keeping was superb, all wire angles were low or non-existent which was important for the deep sampling.
Winches were in good working order and winch operators very knowledgeable. It would be nice to have a bolt supplied for the bullet end of the conducting wire winch. Also the rate of line payout was not working, for the same winch, metres per second had to be calculated and monitored constantly.
The only real problem was the weird noise, apparently generated from the propeller, at certain pitches or speeds. It was necessary to wear ear plugs when working on the aft deck.
Many thanks to the captain and crew of the JP Tully.

pCO2 – Mike Arychuk, DFO/IOS.

The system worked very well this cruise with the exception of one flowmeter. This secondary flowmeter is calibrated for a different equilibrator which was not used on this cruise. As a result, it was non-operational but the primary flowmeter was functional and so there was no issue with metering the flow of water. As usual after a refit there are missing components and the biggest this time was the approximately $400 in copper tubing that disappeared from the pass throughs in the deckhead of the lab. Initially thought by the Chief Engineer to be in the fume hood the tubing was never found and was an unexpected cost addition to the pCO_2 analysis this year. Many thanks to the crew and the Chief Engineer for re-plumbing the atmospheric line above the deckhead panels which also went missing during the refit. Finally, every two or three days a data file was sent back to IOS for confirmation that the data were acceptable. This additional step seemed to work well and instilled some additional confidence on the system. Thanks to Marie for sending off the files and to Paul Covert for reviewing them.

Zooplankton Productivity and Net Community Production – Theresa Venello-UVIC (Dower Lab), Lian Kwong- UBC (Pakohomov Lab), Robert Izett- UBC (Tortell Lab)

Objectives: Quantifying crustacean zooplankton productivity along Line P using the chitobiase-method. Linking zooplankton community composition to crustacean zooplankton productivity. Estimating net community production using shipboard autonomous instruments (PIGI and Kermit).

Sampling:
500 ml of seawater was taken from 6 depths (5, 10, 20, 50, 150, 250 m) at all 7 major stations that have a bongo net cast (P2, P4, P8, P12, P16, P20, P26). All samples were collected on the way out to OSP.

Water was taken from the rosette, filtered through 54 µm mesh and into 500 ml Nalgene bottles. Water samples were then 'spiked' with a homogenate made from ground krill and/or copepods (depending on what was in the bongo sample); filtered every three hours over a 12 hr period to create a decay of the moulting enzyme chitobiase. Samples were assayed and read using a fluorometer while on board.

Zooplankton samples were also collected from the rosette at P2, P4 and P26 by filtering whole Niskin bottles at three depths (5, 50, 100) through a 40 µm mesh sieve. The ring net (60 µm) was also used at P2, P4, P8, P12, P16, P20 and P26 to collect an additional zooplankton taxonomy sample. Net tows were collected on the way out to OSP. This work was conducted for Evgeny Pakhomov and Lian Kwong at UBC.

PIGI and Kermit were run off the seawater loop system continuously (with minor bugs) from Haro Strait onwards. Gas samples were collected at JF2 and all Line P stations from the 5m Niskin to help calibrate PIGI's autonomous sampling data. This work was conducted for Robert Izett and Phil Tortell at UBC.

Comments:
All of our sampling goals for this cruise were met.

We'd like to thank the Captain and crew of the *John P. Tully* for all their assistance and hard work throughout the cruise. Thanks to Marie Robert and the IOS science crew for having us on board to do this work and accommodating our sampling needs.

Hallam lab, UBC (Jade Shiller) – June 2018 Line P

Objectives:
Describe the taxonomic and metabolic diversity of the bacterial and viral communities in the cycling of major nutrients along Line P, focusing on the communities in the oxygen minimum zone.

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

1) 2 ℓ seawater samples (at 16 depths) for high-resolution (HR) bacterial DNA sequencing were filtered.
2) 50 ml seawater samples were taken per depth to count microbial population density using flow cytometry and single cell DNA analysis. Samples were aliquoted and preserved using glutaraldehyde and glycerol+trisEDTA, respectively.

Additionally, at 3 major stations (P4, P12, and P26), the following were sampled at four depths: 10, 500, 1000, and 2000 (bottom+10 at P4) across the oxygen minimum zone:

1) Large volumes (20 ℓ; LV) at each depth were filtered to create genomic libraries of the bacterial communities.
2) After adding iron chloride to the filtered water, the samples were filtered again for later virus analysis.
3) For viral counts, samples were taken and preserved using glutaraldehyde and betaine. Filtered seawater was also collected without preservatives in order to isolate and culture viruses in the lab.
4) 50 ml seawater samples were collected per depth to count microbial population density using flow cytometry and single cell DNA analysis. Samples were aliquoted and preserved using glutaraldehyde and glycerol+trisEDTA, respectively.

Comments:

All of my sampling objectives for this cruise were successfully fulfilled. The work area distribution was convenient for my sampling needs.

I'd like to thank the captain and crew of the *Tully* for their excellent work and their interest in and support of our scientific program. Thanks to the IOS team and my fellow scientists for their help and their humour on deck and in the lab. And finally, a great big thank-you to Marie for organizing everything flawlessly even before we knew whether we'd get to be back on the *Tully* for this trip.

Cs-137 and I -129 Sampling – Richard 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 radioactive 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 Fukashima radioactivity in the water columns of the eastern North Pacific and the Arctic oceans.

Water samples were collected at stations occupied on the "Line P" missions on the CCGS J P Tully in June of 2011, 2012 and 2013. The program was expanded in 2014 to include both the Feb and Aug Line p missions. In 2018 a single mission was sampled in June.

Sampling 2018-26:

Five depth profiles were collected at stations P4, P10, P16, P21 and P26. Depths 500, 400, 300, 200, 150, 100, 50 and 5 meters. As the signal from Fukushima moves towards the coast and begins to slowly sink all 5 stations were sampled to 500 meters
Sixty liter samples were collected at all depths.
In addition 60 liter surface samples were collected from the underway loop system after the ship was on station at P2 P6, P8, P12, P14, P18, P19, P23, P24, P25. In addition a duplicate sample was collected at P26. A total of 50 samples were collected.

In addition 500 milliliter samples were collected for I-129 analysis from the rosette at Station P4,P10, P16, P21 and P26. A total of 40 samples were collected.
The samples for Cs were extracted onto KCFC (potassium cobalt ferrocyanide) ion exchange resin at flow rates of approximately 300 ml's per minute, 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 officers and crew 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.

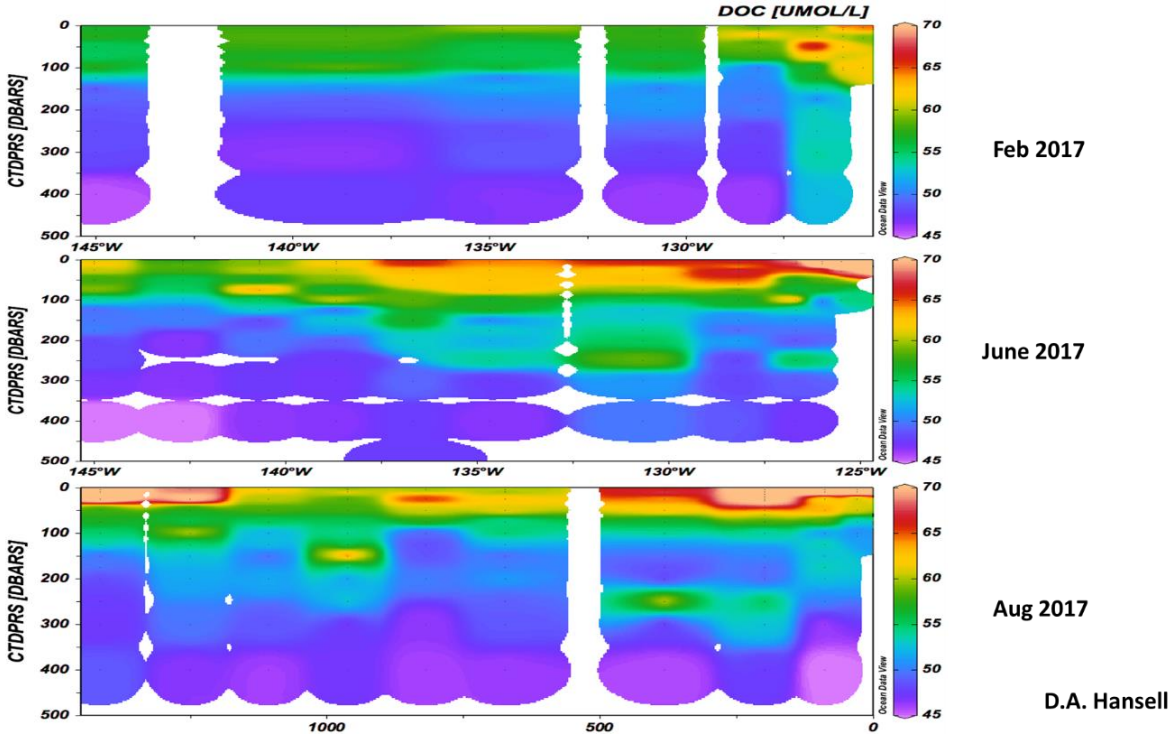
DOC/TOC/Gels cruise report – Chelsi Lopez (Hansell Lab)

Objectives: Collect samples for dissolved and total organic carbon (DOC/TOC) and marine gels (for analysis at University of Washington). All samples were collected as planned.

Projected Outcomes: The samples will be analyzed in the Hansell lab at the University of Miami for TOC/DOC concentrations and the resulting data will be visualized and compared to previously collected data to interpret the seasonal changes in carbon production and export to depth. We also aim to understand the changes in productivity over annual time frames to understand how the system may be affected by climate change.

Methods: DOC samples are collected by filtration directly from the Niskin bottles through 0.7 µm filters and acidifying them. Whole seawater is collected for TOC samples, allowing us to have a measure of particulate organic carbon (POC) using the difference between TOC and DOC. Carbon concentrations are measured in the lab using combustion instruments and ultimately loaded onto Ocean Data View, which provides a visual of the carbon in the system. From this, we can gain a better understanding of the production of carbon by ocean life and how it moves through the system, whether it be transferred up the food chain or sequestered at depth.

Data collected from previous Line P cruises are shown below:



Thank you to all of the Tully crew members!