Report of the Fourth Annual Line P Workshop, Institute of Ocean Sciences, Fisheries and Oceans Canada, Sidney, BC, March 15 and 16, 2011

Chaired by **Marie Robert**, Line P program manager, Institute of Ocean Sciences, Fisheries and Oceans Canada (IOS/DFO).

Introduction

Fifty-four ocean scientists and technicians met in March 2011 to share recent observations along Line P, as well as to present their current research interests and proposed future sampling plans. "Line P" is a 1400-km-long set of ocean stations off Canada's West Coast, monitored for over 50 years by weatherships and research vessels. It began with sampling from weatherships during their transits to and from Ocean Station Papa (OSP) at 50N, 145W, from the 1950s until 1981. Fisheries and Oceans Canada has financed ship time and core scientific program since 1981. With more international and academic partners joining the program, leading to more diverse studies, it became useful to meet annually to compare insights and plan future programs. At the 1st workshop in February 2008 scientists met to discuss future experiments and techniques. The 2nd workshop in March 2009 focused more on scientific results, as well as on promoting collaborations and optimizing ship time and space. For the 3rd workshop in March 2010, optimizing ship time and space became critical since all cruises are fully booked with more people on waiting lists. The main concept coming out of this 4th workshop was **collaboration** among all groups, not only for ship time and space, but for the sharing of scientific data, resources and ideas.

Marie Robert (IOS/DFO): *Overview of the Line P Program.*

Marie described the basics of the Line P Program; what sampling is done at what station, what is the distance/timing between stations, how long each cruise lasts, etc. She also described the paperwork needed and schedule for the next year:

- Requests for security clearances have to be started at least two months prior to the cruise.
- Paperwork for radioisotope use has to be started in April for the June and August cruise and in November for the February cruise. The new IOS radioisotope safety officer, **Michael Arychuk,** was introduced.
- All scientists joining the cruise need to bring along their passport.
- Proof of handling of dangerous goods training will now have to be provided, either the WHMIS (Workplace Hazardous Materials Information System) training for Canadian participants or equivalent training for people from outside Canada. (e.g. HAZMAT – Hazardous Materials – for US scientists).
- DFO needs to be acknowledged whenever cruise data are being used for publications, presentations or posters. Please reference this Internet site in the acknowledgement: http://www.pac.dfo-mpo.gc.ca/science/oceans/data-donnees/line-p/index-eng.htm.

- The participation line-up for the three coming Line P cruises was presented. There are several scientists now on the waiting list because the *CCGS John P Tully* has a limited number of berths for scientists and two Coast Guard cadets are booked on the next few cruises.

Finally, **Marie** gave an update of the data available on the Line P Website. Five recent cruises have been added to the already available library with more data coming soon.

Uwe Send (UCSD – Scripps Institution of Oceanography): *OOI effort.*

Uwe presented the Ocean Observatory Initiative (OOI) program, with the emphasis on the portion of the program deployed around the Station Papa site. Their plan is to have three moorings at OSP: a hybrid profiler mooring for active vertical profiling of the water column up to the surface, and two flanking sub-surface moorings with set-depth instrumentation. They will also have gliders going around the mooring array that will fill in the dual purpose of measuring temperature, salinity and other properties of the water column as well as transmitting data from the subsurface moored sensors to the land-based laboratory. All data will be publicly available online. The deployments will start in summer 2013 and the moorings will be serviced once per year after that by American ships. The OOI is looking for collaborators to fully use the data from the sensors that are already planned, as well as input from other users to improve their sampling plans.

Meghan Cronin (NOAA/PMEL): *Ocean Station Papa Mooring: Cooperative and Collaborative Research.*

Meghan gave a presentation about the surface mooring at Ocean Station Papa. The mooring, deployed for the first time in June 2007, was funded through at 3-year National Science Foundation (NSF) grant to **S. Emerson** at the University of Washington (UW) with a subcontract to **M. Cronin** (NOAA/PMEL). It is now funded solely from NOAA to **Meghan** as an OceanSITES time series reference. Although its primary purpose is to monitor the carbon cycle and ocean acidification, there are discussions that this mooring may become the surface mooring that OOI are planning to have at OSP (see **Uwe**'s talk above). With all the moorings already at OSP and those planned for the near future, careful consideration will have to be given to the position of all these deployments with respect to each other and to OSP. **Marie Robert** claimed 50N, 145W as the OSP position for water sampling from ships. Moorings will occupy nearby sites. **Meghan** described the sensors presently on the surface mooring and showed some scientific results derived from the data. She then talked briefly about the Wave Impacts project at OSP of which the Waverider mooring (~8 km WSW of OSP) is a constituent. Only the surface mooring needs servicing during this coming June 2011 cruise, the Waverider will be serviced only in June 2012.

Jim Bishop (UC Berkeley): *The Carbon Explorer Program.*

The processes of the ocean's biological carbon pump are poorly observed in space and time. To address this gap, Berkeley proposes to deploy optical sensors as part of the IOS CTD/Rosette package to characterize the spatial and cruise to cruise variation of Particulate Organic Carbon (POC), Particulate Inorganic Carbon (PIC) and particle refractive index/size distribution along line P. Carbon Explorer and Carbon Flux Explorer floats deployed at OSP will gain diurnal

records of POC and PIC concentration and sedimentation in the upper kilometre. Their work will initiate in February 2012 for the CTD sensors and in June 2012 for the floats, which will hopefully be recovered during the August 2012 Line P cruise.

Roberta Hamme (University of Victoria): *Dissolved gas sampling to constrain productivity and global denitrification.*

The first part of **Roberta**'s talk regarded the link between dissolved gases and productivity, more specifically the estimation of productivity by Oxygen (O_2) mass balance and how the Oxygen/Argon ratio (O_2/Ar) measurements remove the effect of some processes in that estimation. She presented some mixed layer measurements of biological O_2 (O_2/Ar) from 2007 to 2009, explained how the vertical mixing flux overwhelms mass balance in February, and revealed how Line P is the first comparison of O_2/Ar-NCP (Net Community Production) and nitrate uptake. Finally she described the future work she would like to see happening on Line P, depending on a new student in her laboratory. This work is mainly oriented towards further comparisons of productivity methods using diverse experiments. The second part of **Roberta**'s talk concerned the oceanic nitrogen cycle and the way she views this phenomenon. She presented the science behind her ideas and discussed the logistics of this new line of study, mainly the requests for berths on Line P cruises, what work they would do and the collaborations they are willing to make with IOS/DFO people.

Jim Christian (IOS/DFO): *Recalibration/quality control of the historic (1985-2001) chemistry data.*

Jim started his talk by introducing the PACIFICA data synthesis project, which is the PICES-sponsored construction of a uniformly calibrated basin-scale data set for carbon parameters, nutrients, oxygen, and salinity. It builds on earlier work of GLODAP (Global Ocean Data Analysis Project) and CARINA (CARbon IN the Atlantic ocean) using WOCE (World Ocean Circulation Experiment) data flags, and includes American and Japanese long-line (CLIVAR – Climate Variability and Predictability) cruises and Canadian/American/Japanese time series stations (Line P, HOT – Hawaii Ocean Time-series, A-line, 137E). He then explained the crossover analysis that is done between different profiles in order to quality control the data. He gave a short history of the Line P data quality control and archiving processes as well as some comparison between Line P and HOT data. His conclusions are that the reflagging and archiving of the Line P data are getting along well. The variance is comparable to HOT for Dissolved Inorganic Carbon (DIC), nitrate and silicate, slightly higher for oxygen and phosphate, and significantly higher for total alkalinity through 2001. The DIC data are of consistently high quality since the introduction of coulometry in 1985, and the problems with alkalinity have been solved. The standard deviation of nutrient concentrations is within 2% of the threshold. Finally, the oxygen crossover analysis requires consistent offset of data down a profile for correction purposes.

Keith Johnson (IOS/DFO): *IOS Iron time series along Line P & in the Alaska Gyre, 1997 to 2010.*

Keith first presented all the different sampling methods for Iron studies that have been used over the years, including the X-Niskin, the Teflon pump, and the towed fish to name but a few. He then explained how the analysis is performed and the method that is followed. Different methods of treating and preserving the samples (filtered/unfiltered, buffered or acidified, size fractionated, etc) were introduced and the corresponding results were shown. **Keith** then talked about the history of iron studies along Line P, the various collaborators on these various projects, and where the funding came from. Finally, comparisons of IOS with Geotraces Iron analysis results were shown. **Keith** concluded his talk by explaining how all IOS iron data are in the process of being archived and how hopefully iron concentration can become a standard measurement along Line P with the help of new collaborators and some funding to refurbish the old instrumentation.

Wendy Richardson (IOS/DFO): *Nutrient storage study: quality comparison of storage methods and storage time.*

Wendy presented results of a "nutrients storage experiment", a quality comparison of storage methods and storage time results started during the February 2010 Line P cruise, trying to answer the following questions: do we need to analyse the nutrients fresh at sea, or can we keep the samples cool and bring them back to land for analysis in the lab, or freeze them at sea for later analysis on land? And if frozen, how long can the samples stay frozen for? The pros for analysing the samples at sea are the following: nutrients have been analysed at sea since 1987, so it's a better continuity in the dataset. There is a possibility that some people need "real-time" nutrient values (although they still have to wait 24 hours or so for the results). Frozen values are not considered WOCE standards. Silicate values below 400 dbar lose quality when the samples are frozen. The pros for bringing the samples back to the IOS lab are the following: It would free up a berth and two bench spaces in the ship's main lab. Working conditions can be rough at sea, both for the analyst and the analyser. The temperature variations in the ship's lab are not good for data quality. Having the instrument in the IOS lab allows the analysis of more samples during the year.

The experiment consisted of taking 20 samples from each of 6 depths (10, 250, 400, 600, 1000, and 4000 dbar) at station P20: 4 samples analysed fresh at sea, 4 samples kept cool on the ship and analysed back in the lab, and 12 samples frozen, to be analysed in 3 weeks, 4 months, and 12 months following the sampling date. These samples were taken in February 2010.

Wendy presented the following conclusions: frozen samples results compare well to fresh samples from surface to 350 dbar for all nutrients, but at 400 dbar and below silicate does not come back into solution completely upon thawing. On the other hand, the silicate samples analysed cool after three weeks are in good agreement with fresh results, including the deep samples from below 400 dbar. The use of new test tubes gives the best precision between duplicates. Frozen samples may be analysed after four months in storage but phosphate results are irretrievable after one year of frozen storage. She cautioned that over the last 10 years the precision of duplicates has been much better with fresh samples than with frozen. Samples should be analyzed fresh on Line P once a year to continue DFO's high quality long term data set. Finally the importance of drawing the samples carefully was reiterated.

Seth Bushinsky (UW): *A method for In-Situ Calibration of Aanderaa Oxygen Sensors on Surface Moorings.*

Seth's presentation was in two parts. The first section of his talk gave a partial overview of **Steve Emerson**'s lab group work. He described how they do nitrogen (N_2) and O_2 measurements at Station Papa to evaluate Carbon export calculation; how the changes in carbon dioxide (CO_2) and pH help defining the carbonate system; and he presented calculated and modeled changes in carbon trioxide (CO_3). The second section of **Seth**'s talk reported of the Oxygen Optode Calibration Project. The goals of this project are to develop an in-situ calibration system for a mooring deployed Aanderaa optode, and to use the atmospheric O_2 as a standard. S**eth** first discussed the physical operation of the calibration system. He then presented some validation for the method obtained in their laboratory. Finally he showed how the field data match their laboratory results.

Nadja Steiner (IOS/DFO): *The DMS puzzle at OSP – Putting together the pieces of a decade.*

Nadja started by presenting the regular sampling program along Line P; at what depths dimethyl sulfide (DMS) is collected and what other variables are collected along with it (nutrients, dimethylsulfoniopropionate (DMSP), High Performance Liquid Chromatography (HPLC), and chlorophyll-*a*). She showed how the frequency of DMS sampling has varied from 1996 to 2010. She then displayed a schematics of the science behind her model. The next section revealed the DMS data over these 15 years: spatial variability at the surface along Line P in June and in August, profiles at OSP in June and in August, and section view of pressure versus time for the February data. The final part of **Nadja**'s talk compared the actual data with her model output. She looked at links between the data and various signals such as the Pacific Decadal Oscillation (PDO) or El Niño-Southern Oscillation (ENSO); presented some sensitivity study results to different Silicate-Nitrate (S-N) ratio or iron limitation; looked at the physical conditioning of the model (wind speed, mixed layer depth, etc), and finally presented some preliminary results from the diel cycle study performed at OSP in August 2010.

Elizabeth Asher (UBC): *Strengthening the DMS time-series program along Line P: The addition of multi-tracer process studies.*

Elizabeth started her presentation by showing past DMS observations along Line P and pointing out the important spatial variability of the data. Her goal is now to describe and understand that spatial variability. She introduced different methods of determining the spatial scales of the variability and showed how the mixed layer depth influences the seasonal and spatial DMS distributions. After discussing how biological cycling dominates this issue, she presented some results of experiments recently performed in Antarctica to test the methods mentioned above. Finally **Elizabeth** explained how she wants to now experiment with this work on Line P, by: measuring the biological DMS/O/P cycling at major stations, by measuring the DMS consumption (bacteria/flux/photo-ox), by comparing the net turnover to temporal observations, and finally by studying the collaboration between iron, light limitation, and DMS cycling.

Maurice Levasseur (U Laval): *Past and future aeolian Fe and pH manipulation experiments along Line P.*

Maurice's project, as well as his doctorate student **Josiane Mélançon**, studies the two main sources of iron (Fe) deposition in the Pacific Ocean attributed to airborne dust – Asian deserts and volcanoes – and their effects on DMS and pH at OSP. **Maurice** first described the work performed at sea along Line P in June 2009 – mainly experiments with various dusts; in June 2010 – experiments with dust and volcano ashes; and in August 2010 – experiments with dust and various values of pH. He explained in detail what treatments were applied to the samples during each cruise, the types of dusts and ashes used, presented some results and drew some conclusions which lead them to the work they will perform along Line P in June 2011. Their objective for this coming year is to measure the response of the Northeast Pacific Subarctic planktonic community to an addition of volcanic ashes similar to those emitted by the Kasatochi volcano in 2008. Again the various treatments were described as well as all the variables that will be measured. Finally **Maurice** discussed the effect of acidification on iron bioavailability, on cell physiology and carbon uptake, on cell physiology and calcification, and on community.

Angelica Peña (IOS/DFO): *Phytoplankton distribution along Line-P from HPLC pigment analysis.*

Angelica first explained how phytoplankton composition is important by playing a key role on ocean biogeochemical cycles. To help explain this she presented a schematics of plankton ecosystem/biogeochemical models. She then introduced the objectives of her research – to monitor changes in phytoplankton community composition along Line P and to improve understanding of factors determining the abundance and distribution of main phytoplankton groups in this region; and the approach used in order to obtain these objectives – an analysis of phytoplankton pigment composition. The instrumentation and analysis method were then presented. **Angelica** displayed the sampling frequency of HPLC along Line P and showed some results. She concluded her talk by discussing her plans for the coming cruises, which are: to continue monitoring of phytoplankton composition along all Line P stations using HPLC pigments analysis; to carry out the analysis of pigment data to determine seasonal and interannual variability in phytoplankton composition along Line P; to validate the results of pigment analysis with microscopic analysis; and to compare phytoplankton composition to environmental variables to better understand the factors controlling phytoplankton composition in the NE subarctic Pacific.

Maria Kavanaugh (OSU): *Seascape studies of microbial structure and function.*

The motivation behind **Maria**'s studies is that the subtropical gyres are projected to increase in size with increasing Sea-Surface Temperature (SST), so what will the resultant effect be on the poleward ecosystems? The main challenges of this study are that the present data are patchy and ephemeral; the ship time is expensive; and there is a need to optimize and conciliate the in-situ and satellite measurements. **Maria** then gave us a definition of seascapes – an extent where reciprocal interaction between spatial (temporal) pattern and ecology occurs (Turner, 2005) – and asked the main questions: can we classify the seasonal and interannual progression of seascapes in the North Pacific coherently and quantitatively? Are there different chemical and ecological states? And what is the likelihood of boundaries (ecotones) existing; are there some edge effects? After describing a brief and simplified methodology used to obtain monthly

climatologies of Chlorophyll, SST and PAR, basin scale maps of these climatologies were shown and used to classify various gyre scales. Differences exist between the seascapes and there is interannual variability of ecotone location. **Maria**'s final results are the PRSOM (Probabilistic Regularized Self-Organizing Map) classifier creates provinces that are reasonable and statistically distinct; and the seascapes can be used to describe chemistry, microbial communities, and the edge effects may results in functional changes.

Frank Whitney (IOS/DFO – Emeritus): *Subarctic Pacific Nutrient Trends.*

Using time series measurements from the mid 1980s to 2009, **Frank** finds that winter nutrient levels are neither increasing nor decreasing significantly across the subarctic Pacific. Yet evidence from the Oyashio region and Station P show the upper ocean is becoming more stratified. The few locations across this region where time series profile data is available (Oyashio, California coast, Line P) show that nutrients have been accumulating over the past two decades, which has increased the reservoir available during winter mixing. Both N and P are accumulating at near-Redfield ratios in regions far from coastal influences, whereas waters influenced by contact with coastal sediments show a denitrification signature and some evidence of gas hydrate mobilization (oxygen loss without nutrient increases). A subtropical signature of declining silicate, observed from HOT data, is detectable in deeper waters near the southern California coast.

David Semeniuk and Ania Posacka (UBC): *On observing nothing interesting at all: the interaction between Fe and Cu physiological requirements in Fe-limited phytoplankton.*

The first half of the presentation was given by **David**, who started by showing a global map of underutilized surface nitrate and iron limitation. By zooming on this map, he showed how Line P traverses a strong gradient of surface nitrate from the coastal waters to OSP. After discussing how phytoplankton adapts to iron limitation, **David** introduced the laboratory and field hypotheses that he wants to verify. These hypotheses asked: do iron-limited phytoplankton require more copper (Cu) to grow? And do oceanic species have higher Cu requirements than coastal species? Answers to both questions in the laboratory are yes. As for field conditions, the answer to the first question became "some" (iron-limited phytoplankton require more Cu to grow), whereas the answer to the second is still unknown. Another question for field conditions is: are High Nutrients Low Chlorophyll (HNLC) phytoplankton co-limited by Fe and Cu? **David** described the methods they used at sea in August 2010 to try to answer this question, and the answer they obtained was: it depends on when and where. In August 2011 he plans to try to answer the link between Cu limitation and toxicity in coastal and oceanic water. **Ania** then gave the second part of the talk called *Copper speciation: the role of strong organic ligands*. She first explained the speciation of copper. She then described the copper toxicity and the production of ligands. She showed the Cu-L complex uptake by phytoplankton from Line P – how organically bound Cu is taken by iron-limited phytoplankton, and how the oxidation state affects Cu uptake. Finally she presented her goals for the Line P cruises: seeing how the speciation of copper alters along the Line P transect from Fe-replete to Fe-limited areas; study the different types of ligands present and observe whether they differ depending upon the iron concentration conditions; what are their concentrations; and finally what is the concentration of labile copper.

Jason McAlister, Amy Cain, Nari Sim (UBC): *Pb, Al, Mn, Ga/Al: The Orians lab on Line P.*

Jason presented the work of **Jeffrey Charters**, who could not attend the Workshop. **Jeffrey** studies lead data from 1980 compared to 2010, and from the Pacific versus the Atlantic. The second speaker was **Amy** who works with Aluminum (Al) and its atmospheric sources. **Nari** then discussed her work with Manganese (Mn), from the sediments sources to the Oxygen Minimum Zone (OMZ). **Jason** finally came back to talk about his own work in the **Orians** lab studying the ratio of Gallium and Aluminum (Ga/Al) and the Carbon flux.

Jennifer Brum (U. Arizona): *From FISH to viral metagenomes: Line P research in the Tucson Marine Phage Lab.*

The Tucson Marine Phage Lab (Principal Investigator: Dr. **Matthew Sullivan**) is conducting three major research projects in the Line P program. The bacterial clade Marine Group A is being studied by Dr. **Elke Allers** and has been found to be more abundant within than outside of the oxygen minimum zone at P26 based on Fluorescence In Situ Hybridization (FISH). Dr. **Allers** is currently developing a novel method using FISH and flow cytometry to generate a population genome of this uncultivated bacterial clade to investigate their gene content and to understand the reasons for their increased dominance within OMZs in the world's oceans. **Bonnie Hurwitz** is currently analyzing 1.8 million sequences from 19 viral metagenomes generated from multiple depths and seasons in the Line P transect. Preliminary analysis using functional protein groups and hierarchical clustering shows that viral genes at P26 are driven primarily by seasonality rather than depth. However, these analyses are based on recruitment to protein clusters generated through the Global Ocean Sampling expedition and annotation using the Gene Ontology database, both of which are extremely underrepresented with respect to viruses. Therefore, she will be developing new functional protein clusters using the Line P viral metagenomes and generating ecological profiles for each novel cluster to understand the ecological conditions under which they are present. Dr. **Jennifer Brum** will then use a new method, targeted viral metagenomics, to investigate novel virus groups or viruses containing novel or interesting genes detected in the viral metagenomes. Intact viruses will be fractionated based on their differing physical and chemical properties, thus reducing diversity, and the resulting fractions will be screened using pcr (polymerase chain reaction) primers designed to detect the novel viral groups or genes. Metagenomes generated from the fractions containing the target viral genes will then be used to reassemble viral genomes that have the target genes, thus enabling the examination of the genes within the context of their genomes. These novel methods developed in the Tucson Marine Phage Lab will not only generate new information about bacteria and viruses in Line P, but will also transform the field of aquatic microbial ecology, resulting in new approaches to studying the genomes and ecology of aquatic microorganisms.

Jody Wright (UBC): *Variability in dark CO_2 fixation pathways along Line P.*

Jody presented some very recent results of metagenomic analysis that were performed on their Line P samples. She first described the autotrophic CO_2 fixation in the deep ocean as well as its pathways, showing how likely it is that autotrophy in the meso- and bathypelagic water column have been underestimated in carbon models. New ecological, biochemical, and genomic studies carried out over the last decade have not only elucidated new pathways but also shown that autotrophic carbon fixation via pathways other than the Calvin-Benson-Bassham cycle can be significant. This has ramifications for our understanding of the carbon cycle and energy flow in

the ocean. Four of these new pathways were observed in genomics sequences collected from the water column along Line P. Not only did they observe these pathways, but these are among the most abundant pathways present in their samples – more abundant than any other basic metabolism which indicates an important role for autotrophy in the northeast subarctic Pacific. Before presenting some results, **Jody** reviewed the Line P sampling plan that was followed in June 2009 when her samples were collected. She then reviewed the four pathways found in her samples and asked the questions: what physical, chemical, biological variables determine which pathways dominate deep ocean CO_2 fixation? And how will increases in oceanic CO_2 affect rates of dark CO_2 fixation? After presenting a few additional observations, **Jody** addressed the questions that will direct future research: which respiration pathways are being used to generate energy for dark CO_2 fixation? Are there seasonal patterns in presence of CO_2 fixation pathways? Finally, how do observations of genetic potential correlate with expression and protein data?

Bill Crawford (IOS/DFO): *Global indices, Gulf temperature and salinity.*

In the first part of his talk, **Bill** presented maps of average sea surface temperature anomalies (SSTA) in February and March from 2008 to 2011 in the North Pacific, to show how the conditions oscillated between La Niña to El Niño, then back to La Niña patterns. He then displayed the average sea-surface pressure (SSP) in January-February for the years 1968-1996, as introduction to a series of graphs showing air pressure anomaly and the corresponding ocean surface temperature anomaly for January/February 2009, January/February 2010, May, July/August, September, October, November, December 2010, January 2011 and February 2011. This series of graphs revealed all the changes in conditions that occur in the North Pacific between one fixed 'regime' and the next. In the second part of his talk, **Bill** presented the anomalies of various indexes (Oceanic Niño index, Southern Oscillation Index, etc). The third part of the talk was built on plots of temperature and salinity anomalies in the northeast Pacific, both in summer and in winter 2010, and both near the surface and at a depth of 150 metres. The conclusion of this series of graphs was that the northeast Pacific was warm and fresh last winter, especially along the west coast of Vancouver Island (WCVI), whereas the waters were cool and salty during the summer 2010, again along the WCVI. **Bill** then continued his presentation by showing **Marie Robert**'s graphs of temperature, temperature anomaly, salinity anomaly, and dissolved oxygen field along Line P, comparing the conditions in February 2010, June 2010, August 2010, and February 2011. The last part of the talk showed some composite satellite images of chlorophyll *a* concentration for April, May, June, and July, superimposed on images of altimetry, to show how well the chlorophyll *a* concentrations follow the sea-level height contours, and the persistent patterns of variability of phytoplankton in surface waters of the Gulf of Alaska.

Gillian Stewart (CUNY): *Plankton community structure, POC export, and short-lived natural radionuclides.*

Gillian (City University New York) had not planned to give a talk this year, but due to the large audience to the Workshop she presented her project again. Here is a resume of what she presented last year and re-introduced this year:

Gillian presented this new project, which is in collaboration with **Bradley Moran** (U. Rhode Island) and **Michael Lomas** (Bermuda Institute of Ocean Sciences). The two big questions they ask are: How variable is the partitioning of particulate organic carbon (POC), ^{210}Po (polonium), and ^{234}Th (thorium) (and their ratios) between suspended and sedimenting particles and the

dissolved pool, and their subsequent export fluxes, in response to seasonal variability in the euphotic zone plankton community? And how do remineralization and decomposition rates of POC, ^{210}Po, and ^{234}Th vary with the packaging and export of materials produced by the planktonic community in the surface ocean under low and high flux conditions? The motivation behind these questions is to understand the variable efficiency of the biological pump and the ocean's capacity to sequester CO_2. It is important to work in an HNLC region where long time series are available. They want to open the black box of "biology" in geochemist's view of the ocean, and want to compare polonium versus thorium as a tracer of POC. The three hypotheses to check are:

- seasonal shifts in plankton community structure result in variations in carbon (C) export (quality and quantity),
- size fractionated samples and taxonomy will allow for determination of the role of large and small plankton cells in POC export,
- Polonium to lead ratio (Po/Pb) will track this differently than Thorium to Uranium ratio (Th/U) because Po behaves more like organic matter.

Gillian then described the logistics of the work they want to do on the Line P cruises.

General discussion

The first topic of the discussion was: *should we keep the Line P Workshop as an annual event or should the Workshop be held every two years.*

The comments were unanimous: the Workshop should occur every year. The arguments in favour of a yearly Workshop were:

- There are always new participants to the Line P program and new projects to coordinate every year.
- Even long flights are worthwhile in order to coordinate complicated cruises.
- Three cruises per year require a lot of planning. Some programs have a planning meeting before each of their cruise.
- Graduate students need yearly meetings; otherwise Master's students will probably miss out (most M.Sc. programs are less than two years).
- The workshops have really helped to build cohesion among the groups and have facilitated collaborations and the exchange of ideas.
- There are always things that come up for discussion regarding cruise planning.
- We could use technology (conference calls, Webimar, etc) at some point for the science day, but face-to-face is still better for planning purposes.
- The Line P Workshop simply needs to be coordinated with the Ocean Sciences meeting in order to reduce travel stress for people going to both (enough time between meetings).
- The Line P group should take ownership of OOI at Ocean Station Papa for it to be successful; the meeting then has to happen yearly.

On Wednesday 16 March, Day 2 of the Workshop, group discussions took place regarding cruise planning.

First the berths reservations were discussed. Some people reserve berths in advance but their plans change and they don't need them when the time comes. Or else people were not planning to be part of a cruise, but because of the other participants it became interesting for them to be on the ship for collaborative research, so they added their names to the waiting list. So it is good to discuss the line-up for berths for each cruise as a group.

Once it is a little clearer who will participate in each cruise – June, August or February – we have to discuss deck space and laboratory space allocations. Other discussions also have to take place, for example the sharing of common instruments, etc. Finally, collaborative sampling (a group taking samples for another group who cannot be on board the ship) are discussed.

This year there is a proposal to take a new container on the *CCGS John P Tully* on the Line P cruises. This container would be dedicated to Trace Metal work. This would guarantee that the Trace Metal work is done in very clean conditions without contamination from other samples or instruments in the main laboratory, and it would also help with space allocation in the main lab. Since there are already two containers regularly brought on the Line P cruises, it was important to discuss exactly where this third container can be situated. Captain Andy Quaye nicely agreed to take a few people to the *CCGS John P Tully*, which was docked at the IOS facility in Patricia Bay, to try to figure out the best emplacement for the Trace Metal container.

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