C-MORE / SCOPE
HOE - Legacy II: Chief Scientist Report

Hawaii Ocean Experiment – Legacy II (HOE-Legacy II)

Chief Scientist: Tara M. Clemente

Cruise ID: KOK1507
Departed Honolulu, HI: July 24th, 2015 @ 0800(HST)
Arrived Honolulu, HI: August 3, 2015 @ 1830 (HST)
Vessel: R/V *Ka'imikai-O-Kanaloa*, University of Hawaii
Master of the Vessel: Donn Jack, University of Hawaii
Chief Scientist: Tara Clemente, University of Hawaii
OTG Marine Technicians: Jeff Koch and Patrick A'Hearn

1. SCIENTIFIC OBJECTIVES

The objective of this cruise was to conduct Lagrangian field operations in close proximity to the Hawaii Ocean Time-series (HOT) station (Station ALOHA), which is defined as a circle with a 6 nautical mile radius centered at 22° 45'N, 158°W. The Surface Velocity Program (SVP) drifters (15 m) were deployed by the *R/V Kilo Moana* upon arriving on station (~ 21° 23'N, 158° 20'W) and monitored by both ships for the duration of the cruise. The *Ka'imikai-O-Kanaloa* conducted various array deployments, incubation experiments and water-column sampling, using the CTD-rosette within ~2 nautical miles from the *R/V Kilo Moana* and the drifters when possible. The SVP drifter locations were transmitted every 30 mins. The positions were recorded at PacificGyre.com (username C-MORE, login microstar) and were also transmitted via email to sdrifter@soest.hawaii.edu. In detail our activities included:

1. CTD operations:
    - 26-Vertical profiles of temperature, conductivity and dissolved oxygen were made with an instrument package consisting of a Sea-Bird CTD attached to a 24-place rosette with 10 liter Bullister sampling bottles. Water samples for various biogeochemical measurements were collected on each cast. The CTD channels were set up with the following sensors: dual temperature (2), dual conductivity (2), oxygen SBE43 (2) and optode (1), fluorometers (2), transmissometer (1). All CTD casts were conducted within ~2nm of the *R/V Kilo Moana* and drifters when possible.
    - 10 – Trace Metal CTD Vertical profiles between 0-400 m were conducted for trace metal analysis using a rosette package with autonomous Auto Fire Module. This mini-CTD rosette consists of a SeaBird CTD attached to a 12-place rosette with 8 liter Niskin sampling bottles. We deployed the CTD rosette using a trace metal clean winch, Delrin block and 1/4" Amsteel line using trace metal clean procedures from the stern of the vessel using the A-Frame. (*John & Repeta Labs*)

2. Deployment and recovery of free floating sediment net trap arrays *(Van Mooy Lab*):
    - 5- Sediment net traps were deployed, 2 at 150 m and 3 at 200 m depth for approximately one-day intervals.
    - 7- Sediment net traps were deployed at 150 m depth for approximately six hour intervals.
3. Deployment and recovery of two free floating Particle Interceptor Traps (PIT) Sediment Trap arrays:
    - 1- Six day deployment with 12 PIT traps at 8 depths (500, 400, 350, 300, 250, 200, 150 & 100m). *(Karl and Caron Lab)*
    - 1- Three day deployment with 12 PIT traps at 4 depths (750, 500, 300 and 150 m). *(Church and Caron Lab)*
4. Deployment and recovery of Mesopelagic 14C and 3H array:
    - 3- 24 hour mesopelagic chemotrophic production incubation array deployments at 6 depths (750, 500, 300, 250, 175, 150m). (*Church Lab*)
5. Deployment and recovery of Incubation array:
    - 1 – 24 hr incubation array to investigate differences in growth and grazing rates as a function of light and temperature in the water column, where conducted at 4 different depths in the photic zone (100,75,45,25m). *(Zehr Lab)*
6. Diaphragm pump (*Repeta Lab*):
    - 7- Diaphragm pump operations were conducted using a small compressed air driven pump (P100 Wilden Advanced plastic 1/2" pump).
7. Plankton Net Tows *(Caron Lab)*:
    - 6 - Net tows were conducted on selected days to a depth of 100m using three separate nets with different mesh sizes (10um, 200um and 1mm). The nets were deployed from the stern, each for 20 minute periods at noon and 10pm local time using the A-frame and tow winch when necessary.
8. Various onboard incubator experiments were also conducted (See individual Lab group summaries for more details on incubation experiments).

2. SCIENCE PERSONNEL

Participant	Title	Citizenship	Affiliation
Greyson Adams (M)	Research Scientist	USA	University of Hawaii
Randie Bundy (F)	Postdoctoral Scholar	USA	WHOI
Jim Burkitt (M)	Research Scientist	USA	University of Hawaii
Brady Cunningham (M)	Graduate Student	USA	USC
Alexa Nelson (F)	Research Scientist	USA	University of Hawaii
Natalie Dornan (F)	Research Scientist	USA	University of Hawaii
Tara Clemente (F)	Chief Scientist	USA	University of Hawaii
James Collins (M)	Graduate Student	USA	WHOI
Ken Doggett (M)	Research Scientist	USA	University of Hawaii
Hanna Farnelid (F)	Postdoctoral Scholar	Sweden	UCSC
Chris Follett (M)	Postdoctoral Scholar	USA	MIT

Gabe Foreman (M)	Marine Engineer	USA	University of Hawaii
Alyssa Gellene (F)	Research Scientist	USA	USC
Britt Henke (F)	Graduate Student	USA	UCSC
Justin Ossolinski (M)	Research Scientist	USA	WHOI
Emily Townsend (F)	Undergraduate Student	USA	USC
Kendra Turk (F)	Research Scientist	USA	UCSC
Patrick A'Hearn (M)	Marine Technician	USA	OTG
Jeff Koch (M)	Marine Technician	USA	OTG

(19 science party: 10 males, 9 females)

3. GENERAL SUMMARY

Operations were conducted with minor modifications to the cruise schedule. Two days of ship time was lost due to vessel complications (starboard prop) and anticipated weather. Core biogeochemical measurements, CTD operations and a variety of back deck activities were conducted by the following SCOPE participants: Greyson Adams, Jim Burkitt, Tara Clemente, and Gabe Foreman. Below is a summary of each lab groups cruise related activities:

Caron Lab, USC
Cruise Participants- Alyssa Gellene

The Caron lab ran a series of 24 hr incubation experiments using fluorescently labeled bacteria (FLBs) to determine daily community grazing on heterotrophic bacteria. These experiments were run in conjunction with diel incubations (sampled every 2hrs for 24 hrs), which use a size-fractionated approach (WSW, <10 µm, <2 µm) to look at cycles of growth and grazing in the picoplankton. In addition, net tows using 1mm, 200 µm, and 10 µm nets were collected during the day and at night to characterize the upper water column from the surface to ~100m. Sediment trap samples were also collected at 150m and 500m from both 3 and 6 day deployments for microscopy analysis.

Church Lab, University of Hawaii
Cruise Participants- Natalie Dornan and Alex Nelson

The Church lab had two major foci for the summer cruise: 1) examine depth-variability in the composition and size of sinking particulate material, and 2) evaluate rates and stoichiometry of sinking particulate matter decomposition. Both objectives relied on sediment traps to collect sinking particulate matter. For the first objective, particle interceptor traps were deployed at 4 depths (150, 300, 500, and 750 m), passively collecting sinking particulate matter over a 4 day period. Two of these traps from each depth were prepared with acrylamide gels in the bases of the traps; these gel bases preserved the sinking particle morphology and allowed for subsequent microscopic quantification of particle size structure. The second major focus of our research examined the elemental stoichiometry of particle remineralization and rates of microbial organic matter decomposition of sinking particles. For these experiments, particles were collected from the base of the euphotic zone (150 to 200 m depth) using a net trap (in

collaboration with Ben Van Mooy's group). Collected particles were quantitatively split and aliquots of the particle splits were added to two types of incubation experiments. The first set of incubations were conducted in gas tight bags to examine the stoichiometry of particle remineralization; for these experiments, seawater was sub-sampled from the bags at daily intervals over a 72 hour period for subsequent measurements of carbon and nitrogen transformations. In total, four of these gas-tight bag experiments were performed during the cruise. In addition, particles were added to short-term (24 hour) *in situ* incubation experiments aimed at assessing the influence of particles on rates of microbial heterotrophic and chemoautotrophic production. In total, 3 *in situ* arrays were deployed to measure rates of ^{3}H-leucine incorporation and ^{14}C-bicarbonate assimilation. These experiments with measurements conducted at 6 depths in the lower euphotic zone and upper mesopelagic waters (150 m, 175 m, 200 m, 300 m, 500 m, 750 m).

Mick Follows Lab, MIT
Cruise Participants- Chris Follett

The Follows lab was interested in the mechanisms which drive the stability of large nitrogen fixing plankton like Diatom-diazotroph associations (DDAs). During the cruise material between 20 and 200 microns was filtered from the ships flow-through seawater system for elemental analysis of C, N, and P. This material was primarily DDAs as confirmed by microscopy. We are looking to see if there is a diurnal fluctuation in the stoichiometry of these organisms consistent with nutrient sharing between the large diatoms and their nitrogen fixing symbionts. A large fluctuation in this ratio suggests a mechanism for both partners to benefit from the relationship.

Seth John Lab, MIT
Cruise Participants- Brady Cunningham and Emily Townsend

The John lab collected trace-metal clean samples using specialized trace-metal clean Niskin bottles and CTD rosette. The majority of this water is being processed for oceanic metal concentrations and isotope fractionation. We also attempted to use the "pie-filtration" technique created by John Casey to determine extended elemental stoichiometry of available Prochlorococcus species. Finally, in collaboration with the Lindell lab, we attempted a virus settling experiment to determine settling rates of viruses and phytoplankton.

Karl Lab, University of Hawaii
Cruise Participants- Ken Doggett

The Karl lab had two major foci for the summer cruise onboard the KOK: 1) Examine depth-variability in the calorimetric composition and sinking particulate material, and 2) explore the uptake of ^{3}H-leucine and ^{14}C-HCO_3 by *prochlorococcus* and heterotrophic bacteria. For the first objective, particle interceptor traps were deployed at 8 depths (100, 150, 200, 250, 300, 350, 400 and 500 m), passively collecting sinking particulate matter over a 6 day period. PIT traps for each depth were then combined and filtered back ashore. Under the second

objective, several different experiments were performed throughout the cruise to explore the uptake of 3H-leucine and ^{14}C-HCO_3 by *prochlorococcus* and heterotrophic bacteria. The experiments were performed and measured on whole seawater with aliquots preserved for later cell sorting of the individual populations. Two ^{14}C-HCO_3 time courses were performed to look at daytime activity and nighttime activity. One 24-hour time course was done using ^{3}H-leucine. Finally, a series of uptake experiments were performed to examine limiting vs. saturating concentrations of ^{3}H-leucine.

Repeta Lab, WHOI
Cruise Participants- Randie Bundy

The Repeta Lab looked at microbial cycling of organic metal-binding ligands. Previous cruises at station ALOHA have allowed us to identify a suite of well-defined metal-binding organic compounds (iron, copper, cobalt and nickel). The cycling of these organic ligands was assessed using four different research activities in order to determine the conditions under which microbes produce organic metal-binding ligands. Two large-volume (~1200 L) ligand samples were taken from surface waters (15m) in order to identify metal-binding ligands present in the mixed layer via solid phase extraction (SPE), and will be individually isolated by high performance liquid chromatography inductively coupled plasma mass spectrometry (HPLC-ICPMS). In addition to large volume samples, an eight-depth profile was collected using the trace metal rosette. 20 L of seawater from each depth was loaded onto a 6mL SPE column, which will be subsequently analyzed via HPLC-ICPMS. Several other samples were also collected at these depths, including samples for the electrochemical determination of organic metal-binding ligands, total dissolved metals, proteomics, and flow cytometry. In order to help interpret the profile data, two different types of incubation experiments were also conducted. The first set of experiments were done in the light (2 experiments) and focused on the effect of iron and nitrate addition on microbial growth and metal-binding ligand production. These incubations were conducted in on-deck flow-through incubators over a 24-hour period, and included measurements for organic ligands (SPE), nutrients, flow cytometry, and proteomics at the beginning and end of each experiment. The second set of incubation experiments (3 experiments) were completed in the dark in order to investigate the effect of particle remineralization processes on ligand sources in the subsurface water column. These experiments utilized net trap material collected over a 24-hour period from 150m by the van Mooy group. The material was re-suspended in trace metal clean seawater and incubated in the dark for up to 5 days. Samples were taken for organic ligands (SPE) and flow cytometry at four time-points (t=0, 1, 3, and 5 days) from control, particle, and particle + nutrient treatments.

Van Mooy Lab, WHOI
Cruise Participants- Jamie Collins and Justin Ossolinski

The Van Mooy Lab group had three main objectives: 1) Collect sinking particles near the bottom of the euphotic zone (150m-200m) with quasi- Lagrangian “net trap” particle collectors. The particles would then be aliquotted and distributed to several other research groups (Church,

Karl, Zehr, Caron, Lindell, Ingalls, John) to serve as a major component of a variety of experiments and analyses. Our group will use particle samples to provide key insights on export in the context of the diel water column sampling on the *Kilo Moana*. 2) Perform a series of photo-oxidation incubation experiments in on-deck incubators using surface water (15m) in Tedlar bags. Collect dissolved and particulate phase sample material, then transport to WHOI for extraction and analysis, and 3) Measure community respiration rates in various samples using a bench-top incubator and prototype automated dissolved oxygen measuring instrument (AutoBOD). At-sea activities included: 1) The deployment and recovery of 12 net traps (7 diel, 6-hour traps; 5 24-hour traps) over the course of the cruise. Collected particles were successfully aliquotted and distributed, and each lab group was able to accomplish their goals with these samples. While we encountered some challenges with ship operations due to unfamiliarity with the configuration of our equipment, we achieved our overall objectives for these valuable and unique samples. The starboard engine casualty shortened our cruise, preventing us from testing our newly-designed trace-metal free net trap; scientifically, this was our only major disappointment. 2) The photo-oxidation experiments proved challenging but yielded high-quality samples that are currently awaiting analysis in Woods Hole. The SCOPE cruise model will provide an excellent platform for launching more photo-oxidation experiments on future cruises, and 3) Using the AutoBOD, we collected extensive respiration rate data at high temporal resolution for the Church group. The instrument proved immensely capable during its inaugural cruise.

Zehr Lab, UCSC
Cruise Participants- Hanna Farnelid, Britt Henke and Kendra Turk

The Zehr Lab conducted two large incubation experiments to investigate growth and grazing rates in diazotrophs. To investigate differences in growth and grazing rates as a function of light and temperature in the water column, we deployed an in-situ drifting array, where we conducted a classical grazing experiment at 4 different depths in the photic zone. To investigate the effect of nutrient ratios (nitrogen:phosphorus) on diazotroph growth rates and transcriptional changes, and to determine whether these correlate with shifts in the microbial community composition, a large deck-board incubation was also conducted. We also ran several small incubations to investigate mixotrophy in eukaryote/diazotroph associations, and to enrich diazotrophs for cultivation efforts. Individual particles (~50-1000 um, 220 in total) from 7 net-traps deployed at 150 m during a 48 h diel were visualized using microscopy and handpicked for downstream molecular analyses. Using flow cytometry sorting, populations of photosynthetic picoeukaryotes for molecular work and microscopy were collected from 75, 100, and 125 m. Populations and single sorts of both the picoeukaryote population containing the UCYN-A association and *Chrocosphaera* were collected also collected for single cell genomic work.

4. R/V KILO MOANA OFFICERS AND CREW, TECHNICAL SUPPORT

The officers and crew of the *R/V Ka'imikai-O-Kanaloa* were helpful and accommodating throughout the cruise. The crew showed enthusiasm, concern and dedication to our scientific mission.

Technical support during this cruise was good. OTG personnel were available at any time to assist in our work and helped keep operations timely.

Overall the cruise was a huge success thanks to the hard work and dedication of the scientists, ship's crew and OTG staff. The comments below are just a few observations and suggestions for improvements:

Loading Day:
The KOK appeared un-prepared on loading day. Repairs were still in process, scientific equipment was still being installed and tested, the Rock Lab was torn apart and the Aurora crane was not operational. This delayed the loading of large items until late in the day when the shore crane became available. The remaining large items had to be craned on board the following morning before departure. The CTD rosette was not configured with appropriate sensors requested. Perhaps for larger expeditions, such as this, a longer loading window needs to be scheduled.

CTD Operations:
The OTG CTD had to be thoroughly cleaned and tested before the first cast. In appearance the OTG CTD carousel was not properly maintained as bottles, firing mechanism and frame were all covered in salt crust before first use. We had several sensor malfunctions during the cruise. The Sea Point Fluorometer did not work properly (noisy data) and in the end was unusable. With no backup sensor on board, we were left with one working fluorometer. The transmissometer did not work on the first 3 casts, but after swapping out the Y cables for factory manufactured cable and switching channels with the Optode it began working. The Optode was installed but not properly programmed to send out analog data. OTG Patrick A'Hearn and Scientist Jim Burkitt were instrumental in troubleshooting and fixing the Optode and other CTD problems. Also, the primary conductivity sensor needed to be replaced halfway through the cruise. The KOK only had one back up conductivity sensor, temperature and oxygen sensor. I would recommend that OTG keep several back up CTD sensors onboard to avoid future issues.

Back Deck Operations:
Thanks to the help of OTG and the KOK crew all back deck operations were all completed safely. However during several array deployments and recoveries, lines were under high tension and scientific gear was being dragged through the water. This is less than ideal and compromised a few of the net trap samples. Communication between the bridge, OTG and back deck operations could have been improved. Information regarding wire angel and tension should be reported frequently, so as to allow appropriate maneuvering when necessary. The North

American Crane and DSE Winch (Small blue/white winch used for Trace Metal CTD) appeared to have trouble maintaining power and maneuvering with the loads.

On Deck Incubators:
The on deck incubators set up could be improved. The new pump and system plumbed through the Straza tower was great for maintaining high flow rates to the incubators, however the incubator outflows were too small. We tried playing with flow rate, but were unable to lower it enough by closing valves without causing the pump to potentially overheat. Also the spill pallets proved ineffective and when the ship rolled, water would spill onto the deck. Water on the deck then poured down onto the back deck in full waterfall style. Also drain hoses should be longer, so as to reach further down the hull and prevent spraying the back deck on the port side. It was not ideal for A-frame operators or for folks working on the port side as there was a continual spray from the drains. Scientist will work on improving incubator set up and operations for future cruises to prevent these problems from occurring in the future.

Science Labs:
The Rock Lab was torn apart upon arrival with no monitors available for CTD operations. It took several days to get additional monitors in place allowing us to have video display and Nobel Tech for position display. We had some trouble with the DI system, but were able to obtain spare parts from the KM. Perhaps having a supply of back up DI systems parts is advisable for the future as this would have been a show stopper for science operations. The fridge and freezers in the wet lab suddenly stopped working causing several science groups to lose samples, luckily it was detected early and many thanks to the ships engineers who fixed the DI system and fridge/freezers immediately.

5. DAILY REPORT OF ACTIVITIES (all times are local time (HST) unless otherwise stated)

July 23rd, 2015 – Loading Day
0800 – Equipment and science supplies were loaded on this day.

July 24th, 2015
1217- Depart Snug Harbor
1224- OTG intern accidentally left on board- launched small boat in Honolulu harbor to run him back to shore.
1247-Small boat back on board, underway in Honolulu Harbor
1300- Passing Honolulu Harbor sea buoy
1316- Fire drill
1325-Abandon ship drill
1345- Safety Briefing
1345- Underway to Station Kahe
1622- Weight cast at Station Kahe
1730- S1C1-test cast at Station Kahe
1825- Underway for 24.2N, 156.8W

Test cast showed sensor errors with Optode, Transmissometer and Seapoint Fluorometer. Ship's crew being trained on CTD winch operation.

July 25th, 2015

1600- Kilo Moana appears on ships radar and AIS
1817- Communicate with Sam Wilson on Kilo Moana
1830- Arrive on Station ~ 0.5 miles NE of the Kilo Moana
1850- Net Trap # 1 in the water (24 14.8N, 156 47.7W)
1900- Net Trap #1 released (24 14.9N, 156 47.9W)
1943- Start Sediment Trap #1 deployment – weight in the water (24 16.0N, 156 47.8W)
2117- Sediment Trap #1 released (24 17.1N, 156 48.3W)
2200- S2C1 CTD-500m (24 17.2N, 156 47.3W)

We spent a majority of the day setting up labs, prepping arrays (Net Trap, Sed Trap), preparing sediment solution for the 8-cross sediment trap and troubleshooting the CTD sensor errors. Decided to remove the Seapoint Fluorometer which was not working and just go with one fluorometer on the package (Wetlabs Fluorometer). This also freed up a sensor channel which allowed us to reconfigure the Optode sensor without using the Y cable connector which was causing Optode errors. The Optode and Transmissometer are now working correctly. The Net Trap and Sediment Traps were both deployed successfully. Both are tracking with the drifters in a NNW direction. The Sediment trap has gone 4.6nm in 18hrs. All looks well.

July 26th, 2015

0412- S3C1 CTD-1000m- (24 16.0N, 156 48.9W)-Transmissometer appears to be faulty, trouble shooting.
0548- S4C1- 200m (24 16.3N, 156 49.4W)
0830- S5C1- 1000m (24 19.7N, 156 50.2W)- Core Cast; Transmissometer appears to be working after swapping cable.
1043- Mesopelagic PP array # 1 deployment- weight in the water (24 20.1N, 156 50.6W)
1128- Mesopelagic PP array # 1 released (24 20.5N, 156 50.7W)
1154 – Diaphragm Pump # 1 (24 20.6N, 156 51.0W)
1320-Trace Metal Cast #1a (24 20.6N, 156 52.2W)- Bottles did not trip, did not reach target depth of 200m- redeployed
1400- Trace Metal Cast #1b (24 20.5N, 156 52.7W)-Bottles Tripped reached max depth of 400m.
1700-S6C1- 500m (24 23.9N, 156 48.9W)
1900- Net Trap # 1 recovered (24 24.4N, 156 47.6W)
1940- Net Trap # 2 Deployed (24 25.3N, 156 48.1W)

Had a little trouble with the transmissometer this morning, but it appears to be working again. The Mesopelagic PP array was deployed. The first Trace Metal CTD cast did not reach target depth of 200m, therefore the bottles did not trip. Re-deployed the Trace metal CTD successfully maximum depth reached 400m. The MilliQ system on board is down. Contacted the KM and they have a spare membrane filter needed to fix our system. We deployed the small boat after

the trace metal cast to pick up the membrane filter from the KM and were able to fix the MilliQ system. Net Trap #1 was recovered and Net Trap #2 deployed.

July 27th, 2015

0201- S7C1 CTD-500m (24 27.8N, 156 47.2W)
0505- S8C1 CTD-500m (24 29.5N, 156 45.0W)
0600-Incubation Array deployment- weight in the water
0655-Inbubation Array released (24 30.2N, 156 44.4W)
0800- S9C1 CTD-500m (24 30.5N, 156 45.2W)
0848- Diaphragm Pump # 2 (24 20.6N, 156 51.7W)
1136- Mesopelagic PP array # 1 recovery- (24 26.7N, 156 47.1W)
1300- Trace Metal Cast #2 (24 29.8N, 156 42.0W)
1706- S10C1 CTD-1000m (24 31.1N, 156 40.2W)
1900-Net Trap # 2 Recovery – Net Trap line stuck on prop, spent some time troubleshooting how to unhook line from prop, used a GoPro with dive light to look under the hull. Pulled line forward and were finally able to release and maneuver line from the prop. All science gear on board @ 2112 (24 33.4N, 156 41.2W).
2300- Mesopelagic PP array # 2 deployment-(24 34.1N, 156 40.2W)
2335-Start of the Diel Net Trap Experiment- Net Trap # D1, deployed (24 35.6N, 156 40.0W)

We had an exciting evening recovering Net Trap #2, sea conditions were really calm, but the current was fairly strong. The currents dragged the buoy and line under the starboard stern and the line got caught on the prop. Light was dwindling so we used a GoPro with a dive light attached to assess the situation. After several failed attempts to unhitch the line from the prop, we decided to use a tag line to pull the line forward towards the air castle. This allowed us to free the line and buoy from the prop. However the line was still tending under the vessel. After some careful ship maneuvering the line moved out from under the vessel and we were able to recover the Net Trap successfully. The whole operation took ~ 2hrs, but everything was recovered in good condition. The Mesopelagic PP array was then deployed a little later than scheduled and the start of the Diel Net Traps began, with the deployment of Net Trap # D1 at 2330.

July 28th, 2015

0600- Net Trap # D1, recovered (24 36.5N, 156 37.7W)
0630- Net Trap # D2, deployed (24 36.7N, 156 37.3W)
0832 - S11C1 CTD-500m (24 35.8N, 156 35.5W)-No Water Collected, just CTD trace.
0928- Diaphragm Pump # 3 (24 35.7N, 156 34.6W)
1100- Net Trap # D2, recovered (24 37.9N, 156 35.5W)
1206- Net Trap # D3, deployed (24 38.7N, 156 35.3W)
1252-Net tows, 3 different sizes (10um, 200um, 1mm)- vertical down to 100m (24 38.0N, 156 35.7W)
1413- Trace Metal Cast #3 (24 38.2N, 156 35.2W)
1700- Net Trap # D3, recovered (24 39.2N, 156 33.0W)
1733- Net Trap # D4, deployed (24 38.9N, 156 32.6W)

1749- S12C1 CTD-1000m (24 38.9N, 156 32.3W)
1945- Mesopelagic PP array # 2 recovery-(24 35.8N, 156 36.9W)
2117- Net tows, 3 different sizes (10um, 200um, 1mm - vertical down to 100m (24 36.8N, 156 36.4W)
2300- Net Trap # D4, pinged and released. Could not locate the buoy, light may not have been working, but we were close enough to communicate with the pinger and close the net, ending that time point. Was not able to recover Net Trap #D4 until daylight. Did not deploy Net Trap #D5 due to deck complications (24 39.2N, 156 32.2W)

The first day of Net Trap diels went fairly well, except for the evening trap. We had trouble locating the buoy for recovery (could not get a visual), the moon was extremely bright and the light was not visible. However, we were able to communicate with the pinger and release the trap ending the time point and sample collection. It was decided that Net Trap # D4 would be recovered at first light when visible. Net Trap #D5 as not deployed immediately after due to deck complications, but was deployed the following morning at 0600 upon recovery of Net Trap # D4. Therefore the 2300-0600 diel net trap time point was not sampled.

July 29th, 2015
0255- S13C1 CTD-500m (24 37.1N, 156 27.8W)
0605- Net Trap # D4, recovered (24 39.1N, 156 28.6W)
0637- Net Trap # D5, deployed (24 39.1N, 156 28.5W)
0801- S14C1 CTD-500m (24 36.7N, 156 26.6W)
0854- Diaphragm Pump # 4 (24 37.0N, 156 26.4W)
1100- Net Trap # D5, recovered (24 40.0N, 156 26.9W)
1124- Net Trap # D6, deployed (24 40.1N, 156 26.6W)
1400- Trace Metal Cast #4 (24 41.0N, 156 26.7W)
1600- Net Trap # D6, recovered (24 40.3N, 156 24.5W)
1638- Net Trap # D7, deployed (24 40.3N, 156 24.2W)-being towed in the water during deployment, due to ship maneuvering, may have compromised sample.
1720- S15C1 CTD-500m (24 40.0N, 156 24.4W)
2300- Net Trap # D7, recovered (24 40.3N, 156 22.6W)-net being towed through water again, due to trying to position the ship. Bridge informed that this could damage the gear and compromise sample.

The second day of Net Trap diels went okay, we had some trouble with maneuvering the ship to keep the line tending astern with no headway. Net Trap #D7 was being towed in the water both during the deployment and recovery which may have compromised the sample or damaged the gear. The gear returned aboard safely, but the sample is questionable. The bridge was notified that towing these nets is not favorable and that clearer communication between OTG and the bridge would potentially help prevent this from occurring during future deployments. All other operations are going smoothly.

July 30th, 2015
0600- Net Trap #3, deployed (24 36.4N, 156 23.1W)

0804- S16C1 CTD-1000m (24 37.0N, 156 23.9W) - Core Cast
0923- Diaphragm Pump # 5 (24 37.5N, 156 23.9W)
1217- Net tows, 3 different sizes (10um, 200um, 1mm) - vertical down to 100m (24 35.0N, 156 21.5W)
1308- Trace Metal Cast #5 (24 35.0N, 156 21.6W)
1601- Trace Metal Cast #6 (24 34.2N, 156 20.5W)
1655- S17C1 CTD-1000m (24 34.3.0N, 156 20.7W)
2208- Net tows, 3 different sizes (10um, 200um, 1mm) - vertical down to 100m (24 34.3N, 156 22.0W)

Operations today were a little more relaxed after finishing the Net Trap diel. We have started to trend slightly south again and continue drifting towards the east. The arrays have all followed the drifter pattern. The first sediment trap PIT array is currently 16nm to the west (~2hr steam) and is scheduled to be picked up on 7/31 at 2100. The second sediment Trap array will be deployed a few hours later. All science is going well. Folks on board continue to work well together and spirits are high.

July 31st, 2015
0200- S18C1 CTD-25m (24 32.5N, 156 17.4W)
0330- S19C1 CTD-1000m (24 34.5N, 156 17.7W)
0505- S20C1 CTD- 500m (24 34.8N, 156 18.5W)
0610- Net Trap #3, recovered (24 33.6N, 156 19.9W)
0630- Net Trap #4, deployed (24 33.9N, 156 19.8W)
0802- S21C1 CTD-500m (24 33.9N, 156 19.8W)
0854- Diaphragm Pump # 6 (24 34.6N, 156 20.7W)
1003- Mesopelagic PP array # 3 deployed- (24 34.9N, 156 20.5W)
1300- Trace Metal Cast #7 (24 32.3N, 156 20.6W)
1445- Surface Hand Net Tow (24 31.9N, 156 20.5W)
1605- Trace Metal Cast #8 (24 31.1N, 156 21.4W)
1700- S22C1 CTD-500m (24 30.5N, 156 20.9W)
1909- Start Sediment Trap #1 Recovery
2036- Sediment Trap # 1 weight on board (24 32.3N, 156 31.9W)

Operations are going well. We successfully deployed Mesopelagic Array # 3 and recovered sediment trap # 1 with 8 crosses and 96 PIT traps. The supernatant was removed and the traps are being stored in the dark, to be processed ashore. The Net Trap diel experiment is finished and we have returned to deploying the Net Traps for 24hrs incubations. We successfully revovered Net Trap # 3 and deployed Net Trap #4. Everyone's incubation and science experiments are going well.

August 1st, 2015
0305- Start Sediment Trap #2 deployment – weight in the water
0419- Sediment Trap #2 released (24 32.4N, 156 21.1W); PITS @ 750,500,300,150m
0500- S23C1 CTD-500m (24 29.2N, 156 20.4W)

0719- Net Trap #4, Recovered (24 29.0N, 156 18.5W)
0745- Net Trap #5, deployed (24 26.7N, 156 20.0W)
0829- S24C1 CTD-500m (24 26.7N, 156 20.0W)
0915- Diaphragm Pump # 7 (24 27.4N, 156 20.4W)
1040- Mesopelagic PP array # 3 recovered- (24 31.6N, 156 19.7W)
1205- Net tows, 3 different sizes (10um, 200um, 1mm) - vertical down to 100m (24 31.95N, 156 19.48W)
1305- Trace Metal Cast #9 (24 31.0N, 156 19.6W)
1604- Trace Metal Cast #10 (24 29.8N, 156 21.2W)
1700- S25C1 CTD-500m (24 29.6N, 156 20.0W)
2207- Net tows, 3 different sizes (10um, 200um, 1mm) - vertical down to 100m (24 28.3N, 156 21.7W)

All operations are going great! We successfully deployed Sediment Trap #2 with PITs at 750, 500, 300 and 150m. We recovered Net Trap #4 and deployed Net Trap #5 and recovered the Mesopelagic Array # 3. CTD and Trace Metal CTD operations continue to run smoothly and several net tows were conducted.

August 2nd, 2015
0500- S26C1 CTD-1000m (24 20.3N, 156 22.8W)
0645- Net Trap #5, Recovered (24 19.0N, 156 22.8W)
0745- Starboard Engine No Response- ALL SCIENCE OPERATIONS SUSPENDED
0915- Talked with Sam on the KM about recovering Sediment Trap # 2 on the morning of August 4th, to keep experiment going.
0920- Called Dave Karl- left voice mail message
1000- Bound for Honolulu on one (PORT) engine.

Unfortunately the starboard engine failed just after recovering Net Trap # 5. The Chief Engineer spent several hours trouble shooting, but was unable to fix the starboard engine. With one engine and hurricane Guillermo heading towards us we were required by the US Coast Guard to suspend all science operations and begin steaming for Port. Arrangements were made with the KM to recover Sediment Trap # 2 on the morning of August 4th to allow for the experiment to come to completion. We are scheduled to arrive in port on August 3rd at 1830. All are doing well on board.

August 3rd, 2015
1800 - Arrive at Honolulu Harbor sea buoy
1830 - Tied up at Snug Harbor

August 4rd, 2015
0800 - Departed vessel, full off-load