HOT-298: Chief Scientist Report

Chief Scientist: Andrew King

R/V Ka'imikai-O-Kanaloa

11-15 December, 2017

Cruise ID: **KOK 17-18**
Departed: 11 December at 0900 (HST)
Returned: 15 December at 0820
Vessel: **R/V Ka'imikai-O-Kanaloa**
Master of the Vessel: Captain Ross Barnes
OTG Marine Technicians: Jeff Koch, Julianna Diehl

1. SCIENTIFIC OBJECTIVES

The objective of the cruise was to maintain a collection of hydrographic and biogeochemical data at the Hawaii Ocean Time-series (HOT) stations. Three stations were to be occupied during the cruise, in the following order:

1) Station 1, referred to as Station Kahe, is located at 21° 20.6'N, 158° 16.4'W and will be occupied on December 11th for about 2 hours.
2) Station 2, referred to as Station ALOHA, is defined as a circle with a 6 nautical mile radius centered at 22° 45'N, 158°W. This is the main HOT station and will be occupied December 11th – 13th
3) Station 52, the site of WHOTS-14 Mooring (anchor position 22 40.01'N 157 57.09'W) will be occupied on for about one hour on December 14th.

Upon arrival to Station Kahe a 300 lb. weight-test cast to 500 m, and one CTD cast to 1000 m were to be conducted on the afternoon of December 11th. The single CTD cast was to be conducted to collect a continuous profile of various physical and chemical parameters. Water samples were to be collected at discrete depths for biogeochemical measurements. After these operations were satisfactorily completed, the ship was to proceed to Station ALOHA.

Upon arrival to Station ALOHA, the free-drifting sediment trap array was to be deployed, followed by the deployment of the Wirewalker. These two arrays were to stay in the water for about 52 hours. This was to be followed by a 1000 m CTD cast for preparation of the Primary Productivity Array. This cast was to be followed by the deployment of the free-drifting Primary Productivity Array to incubate *in situ* for 12 hours. A full-depth (~4740 m) CTD cast was to be conducted after the deployment of the Primary Production Array centered over Station ALOHA, followed by 1000 m CTD casts at strict 3 hour intervals for at least 36 hours for continuous and discrete data collection, ending with another full-depth CTD cast at 2300 on December 13th.

Another free-drifting array (Gas Array) was to be deployed for 24 hours for incubation experiments on December 13th. The Gas Array was to be recovered on December 14th.

A plankton net was to be towed between 1200-1300, and 2200-2300 for 30 minute intervals on December 12th and 13th at Station ALOHA. An additional net tow was to be run for Dr. Erica Goetze between 2130-2200 on December 12th.

An optical package including a package consisting of a SeaBird Seacat with temperature, conductivity, fluorometer, and pressure sensors, and a LISST particle size and distribution analyzer was to be used to profile the upper 200 m at Station ALOHA in the early morning on December 14th.

A trace metal free sample was to be collected by the ATE sampler on December139th at Station ALOHA.

After the 36 hour burst period of CTD work and the optical cast at Station ALOHA were accomplished, the ship was to transit to recover the floating Gas Array, the Wirewalker, and the Sediment Trap Array on the morning of December 14th.

After recovering the arrays, the ship was to transit to Station 52 to conduct a one-hour 200 m CTD yo-yo cast. The ship was to remain 0.25 nmi, downwind and downcurrent from Station 52, after completion of the CTD yo-yo to gather one hour of shipboard ADCP for comparison to WHOTS-14 ADCP data.

Once operations at Station ALOHA were complete, the ship was to transit to the location of the deep sediment trap anchor at 22°51.971' N, 157°53.167' W. Recovery of the sediment trap was expected to take approximately 3 hours, with return to the surface expected to take an hour.

After deep sediment trap recovery operations were complete, the ship was to transit back to Honolulu Harbor, Pier 35.

The following instruments were to collect data throughout the cruise: shipboard ADCP, thermosalinograph, underway fluorometer, transmissometer, the meteorological package.

2. SCIENCE PERSONNEL

Participant	Title	Affiliation/HOT Group
Karin Bjorkman	Scientist	UH
Dan Sadler	Research Associate	UH
Brenner Wai	Research Associate	UH
Blake Watkins	Marine Engineer	UH
Tim Burrell	Research Associate	UH/SCOPE
Tara Clemente	Research Associate	UH/SCOPE
Eric Shimabukuro	Research Associate	UH/SCOPE
Fernando Santiago-Mandujano	Research Associate	UH
Andrew King – Chief Scientist	Research Associate	UH
Gerarda Terlouw	Post Graduate Trainee	UH
Carolina Funkey	Research Associate	UH
Ryan Tabata	Research Associate	UH
Svetlana Natarov	Research Assistant	UH
Jefrey Snyder	Marine Technician	UH
Morgan Linney	Graduate Student	UH
Erica Goetze	Professor	UH
Kara Nichols	Volunteer	High School
Kaylee Scidmore-Rossing	Volunteer	HPU
Julianna Diehl	Marine Technician	OTG
Jeff Koch	Marine Technician	OTG

3. GENERAL SUMMARY

Changing weather conditions at Station ALOHA presented complications with the safe recovery of scientific equipment, namely arrays. A contingency schedule at Station ALOHA was finalized to adapt to the higher seas and winds, shown below.

Pre-cruise weather predictions estimated high winds (+25 kt) and high swell (+10 ft) by the morning Thursday, December 14th. These conditions made the recovery of the gas array, sediment trap, Wirewalker, and deep sediment trap potentially unsafe for both crew and equipment. To accommodate an early recovery of this gear that maximized water time, the following changes were made from the pre-deployment operational cruise plan:

- S2C8, GAS cast, Wednesday, December 13th 0200, was cancelled
- Deployment of the gas array, Wednesday, December 13th 0400, was cancelled
- Deep sediment trap recovery, Thursday, December 14th 1600, was cancelled
- S2C10, PSi cast, rescheduled to S2C8 on Wednesday, December 13th 0200
- Recovery of sediment trap and Wirewalker were rescheduled from 0700 to 0900 on Wednesday, December 13th

Some of the CTD casts showed secondary fluorescence maxima between 180 and 600 dbar during down and upcasts. Brown, stringy organic matter was found on the rosette after S2C8, PSi.

One 1000 m CTD cast was completed at Station Kahe. Two near bottom CTD casts and twelve 1000 m CTD casts were conducted at Station ALOHA. The GAS cast, typically S2C8, was cancelled due to weather. One 200 m yo-yo CTD cast was completed near the WHOTS mooring (Station 52) with five cycles completed.

The ship's squirt boom and winch and 0.322" wire were used for CTD deployments off starboard the R/V KOK. Maximum CTD lowering speed was 60 m/min, although sea states would not permit faster than 45 m/min on most downcasts. The CTD rosette back-twisted the CTD 0.322" wire after S2C5 due to ship motion towing the rosette. After allowing the CTD cable to regain proper torsion by air-spinning the CTD rosette, the CTD was redeployed. A kink in the CTD cable, due to shock loads on the CTD line, required re-termination of the CTD cable after S2C8. The cable was re-terminated after cutting 25m.

The shipboard depth sounder was non-functioning during HOT-298; the Knudson and HOT pingers were used as a hot-backup for bottom-depth knowledge. This is a two fault tolerant configuration; simultaneous failures of the shipboard Knudson and HOT altimeter would require aborting bottom depth measurements.

A persistent modulo error issue with the CTD deck unit presented itself on HOT-298; 3 errors in total were tracked. One error occurred at the beginning of the S2C8 cast (PSi), just prior to entering the water. Two errors occurred on the PO-3 deep cast, once at 4700 dbar upcast, and once at 450 dbar upcast. In all three instances, both CTD pumps remained running.

GPS signal to the CTD deck unit intermittently dropped out during HOT-298; this was an artifact of the baud rate of the POS-MV GPS source passed though the R/V KOK's virtual machine. A direct connection to the Furuno device and a deck unit baud rate of 9600 Hz is expected to fix this issue.

The Sediment Traps, Wirewalker, Primary Production were all deployed and recovered successfully, with minor damage to the Wirewalker's strobe LED beacon due to back-spooling on the SeaMac winch. Approximately 10 ft of Nylon cord back-spooled before tension broke the line free, dropping the WireWalker buoy and damaging the strobe on the starboard railing.

Five net tows for the core HOT zooplankton collection were completed successfully; three during the day, and two during the night; one of the two night net tows was conducted for Dr. Erica Goetze. Two other scheduled net tows were cancelled due to weather. The net tows suffered two rips, one during the first day (minor) and one during the second night (lost at sea).

The optical package was deployed as scheduled.

The ATE was deployed as scheduled and a sample was taken.

The thermosalinograph, fluorometer, and transmissometer were collecting data during the cruise. No flow cytometry was conducted on KOK 17-17.

The broad band/narrow band Ocean Surveyor ADCP and the Workhorse ADCP were working correctly during the cruise.

The ship's meteorological suite ran without interruption during the cruise.

The ship's Knudson depth sounder malfunctioned at the start of the cruise and was unable to provide an estimation of bottom depth during HOT-298.

Winds were southwesterly 8-15 kt the first day of the cruise with 4-10 ft swell, 1-2 ft sea. Winds turned to N and eventually northeasterly by midday December 12th and increased to 20-25 kts with occasional gusts to 30 kts. Seas increased to 15-20 ft by December 13th, seas increasing to 6-8 ft as well.

Ship: R/V *Ka'Imikai-O-Kanaloa* HOT 298: Weather Contingency Schedule
Date: December 11-15, 2017

TIME	Mon 12/11	Tue. 12/12	Wed. 12/13	Thur. 12/14	Fri. 12/15
0000		Deploy WireWalker			
0100		Deploy Sed Traps			
0200		S2C1 PP	S2C8 PSi		
0300				Optics	
0400		Deploy PP Array			
0500			S2C9 Open	Transit St. 52	
0600		S2C2 PO-1		ATE	
0700	All Sci. Aboard		Transit sed trap		
0800	Depart Pier 35		Recover sed trap Transit WireWalker	S52C1 WHOTS	Arrive Pier 35
0900	Arrive Kahe (10:00)		Recover WireWalker		
1000	Weight cast		ATE		
1100	S1C1 Kahe	S2C3 PO-2 (Begin 36 hr)	S2C10 Open	ADCP Inter-comp	
1200	Transit ALOHA	Net Tow Net Tow	Net Tow	Transit Kaena	
1300					
1400		S2C4 PC/PN	S2C11 ATP		
1500					
1600		S2C5 PPO4			
1700		Recover PP array	S2C12 Open		
1800				Arrive Kaena Transit Pier 35	
1900					
2000		S2C6 BEACH	S2C13 PUR		
2100		Goetze Tow			
2200		Net Tow Net Tow	Net Tow		
2300	Arrive ALOHA (0000)	S2C7 HPLC	S2C14 PO-3 (end 36 hours)		

December 12th: Sunrise 0700, Sunset 1751

4. R/V Ka'imikai-O-Kanaloa OFFICERS AND CREW, TECHNICAL SUPPORT

The R/V Ka'imikai-O-Kanaloa continues to maintain very good ship support for our work. Captain Barnes and the ship's crew showed flexibility, enthusiasm, concern, and dedication to our scientific mission.

Technical support during this cruise was very good. OTG personnel were available to assist in our work during the cruise.

5. DAILY REPORT OF ACTIVITIES (HST)

December 11, 2107

0800 - Depart from Pier 35
0840 - Fire, ship drills
0850 - All science briefing w/ Chief Mate
0905 - OTG and Chief Scientist briefing
1100 - Arrive at Kahe
1107 - Start of weight cast (300 lbs) to 500m.
1134 - End of weight cast
1148 - Minor hiccup w/ GPS feed to CTD deck unit, fixed
1227 - Start S1C1
1333 - End of S1C1
1340 - Transit to Station ALOHA
1447 - OTG reports issue w/ SeaBeam for bottom depth reads, not presently working
2316 - Arrive at ALOHA

December 12th, 2017

0011 - Deployed WireWalker. 22 44.03' N. 158 2.347' W. Minor damage to WireWalker strobe LED beacon due to back-spooling on the SeaMac winch
0106 - Deployed Sediment Trap. 22 43.506'N, 158 2.765'W.
0214 - Start of s2c1, PP cast
0321 - End of s2c1. Uncharacteristic fluorometer trace between ~650m and 300m.
0430 - Deploy PP array. 22 44.75'N, 158 1.35'W.
0515 - Transit to center
0555 - Start of s2c2, PO-1 cast.
1000 - End of s2c2
1134 - Start of s2c3, PO-2 cast.
1301 - End s2c3.
1310 - Start of net tow. 22 43.86'N, 158 1.52'W.
1400 - Start s2c4
1445 - Second uncharacterisitic fluorometer trace, at 900m. Shows a local maxima for fluorescence at this depth.

Schedule of Activities (HST)

December 12th, 2017

1533 - End of S2C4.
1545 - Transit to near PP array location for post-cast recovery.

1625 - Intermittent drop out of GPS signal during CTD casts.
1635 - Start of Station 2 Cast 5.
1716 - Secondary local maxima for fluorometer trace @ 600 dbar on downcast.
1745 - End of S2C5.
1745 - Transit to PP array, transiting outside of ALOHA circle.
1815 - Recovering PP array. 22 38.511'N, 158 0.488'W.
1840 - Recovered PP array.
1900 - Transit to pump tanks.
2000 - Potential issue w/ the 0.322" CTD cable, multiple "unwound"
spots found due to rosette spinning while being towed by the vessel. CTD allowed to spin prior to cast to fix issue.
2015 - Start of S2C6.
2118 - End of S2C6.
2130 - Start of Dr. Goetze's net tow.
2202 - End of net tow.
2215 - Start of net tow.
2244 - End of net tow; net ripped and was lost at sea.
2300 - Start of net tow, using other net.
2327 - End of net tow.
2342 - Start of S2C7, HPLC.

December 13th, 2017

0000 - Bump in fluorometer signal @ 500 dbar, downcast.
0020 - Bump in fluorometer signal @ 540 dbar, upcast. Stopped for a sample.
0049 - End of S2C7.
0202 - Start of S2C8, PSi. 1 modulo error @ start of the cast, prior to rosette hitting the water.
0215 - Strings of brown organic material found on bottles and lanyards after S2C7.
0245 - More fluorometer traces, no indication from the transmissometer signal. Recommend swapping fluorometer to diagnose potential sensor issue.
0308 - End of S2C8.
0310 - Kink found in hydro wire ~4m above rosette. Reterminated wire, 25m cut.
0545 - Start of S2C9.
0700 - End of S2C9, transit to arrays.
0800 - Start of sediment trap recovery. 22 32.75'N, 158 01.93'W.
0845 - ST recovered. Transit to wirewalker.
0957 - Start WW recovery, 22 31.1637'N, 158 0.8459'W.
1013 - WW recovered.
1130 - Start of S2C10, 1 modulo error as CTD hit the water.
1243 - End of S2C10. Intermittent GPS issues persisting.
1310 - Start of net tow, 22 40.28'N, 158 2.79'W.
1335 - End of net tow
1340 - Start of net tow.
1410 - End of net tow.
1422 - Start of S2C11
1531 - End of S2C11
1700 - Start of S2c12.
1801 - End of S2C12.
2001 - Start of S2C13, PUR. Fluoresence secondary max at 775 dbar
during downcast, not seen during upcast. One bottle fired at 775 dbar.
2050 - Sea life! Large squid followed the rosette upcast, was keenly interested in the CTD wire. Photo documented by R. Tabata.

2103 - End of S2C13.
2304 - Start of S2C14, PO-3. Intermittent GPS signal failure during the cast.

December 14th, 2017

0050 - 7m off the bottom, 22 44.71'N, 158 0.22'W. Seabeam not functioning, unable to get an accurate fix of ocean floor depth. Estimated depth: 4740m.
0100 - 1 deck unit modulo error at 4700 dbar. CTD pumps remained on during the error.
0226 - 2nd modulo error at 450 dbar. Error occurred just after resuming the upcast after sampling 500 dbar. Pumps remained on during the error.
0304 - End of S2C14.
0345 - Start of optics. 22 46.06'N, 158 0.90'W.
0545 - End of optics. 3 yo-yo's completed.
0550 - Transit to WHOTS buoy.
0620 - Stop tranit to deploy ATE. 22 44.68'N, 157 59.91'W.
0651 - Recovered ATE.
0805 - Start of S52C1
0810 - Cycle #1
0826 - Cycle #2
0839 - Cycle #3
0855 - Cycle #4
0911 - Cycle #5
0930 - End of S52C1
1100 - Gathering ADCP data for comparison to WHOTS-14.
1200 - End of ADCP intercomp.
1205 - Transit to Station Kaena.

December 15th, 2017

0415 – Arrive Statipon 52, Kaena
0430 – Cancel Kaena cast based on weather assessment; winds > 25 kts, swell > 10 ft, seas > 6 ft
0435 – Transit to sea buoy, 1500 ETA.
1845 – Arrived @Pier 35, UH Marine Center.

6. HOT program sub-components:

Investigator	Project	Institution
Dave Karl	Core Biogeochemistry	UH
John Dore	Biogeochemistry QA/QC	MSU
Roger Lukas	Hydrography	UH
Mike Landry	Zooplankton dynamics	SIO
Ricardo Letelier	Optical measurements	OSU

Ancillary programs:

Angelique White	SCOPE: Diazotroph Microscopy, Underway C-STAR	OSU
Matt Church	Diversity and activities of nitrogen-fixing microorganisms	UM/FLBS
Andrew Dickson	CO_2 dynamics and intercalibration	SIO
Paul Quay	$DI^{13}C$	UW
Dan Repeta	SCOPE: DOM collection	WHOI
Erica Goetze	eDNA collection: Metazoan diversity in the abyssal Pacific	UH
Morgan Linney Sam Wilson	Reduced gases in the upper ocean	UH
Sara Ferrón-Smith Gerianne Turlouw	Determination of gross primary production from the euphotic zone in situ, using the drifting primary production array	UH
Dave Caron	SCOPE: DNA collection	USC
Ed DeLong	SCOPE: DNA and Viral DNA collection	UH
Morgan Linney David Karl	Characterizing free DNA at Station ALOHA	UH
Patrick Martin Karin Bjorkman	Phenol oxidase activity in seawater	UH
Morgan Linney Christopher Schvarcz	Cultivation of phytoplankton from coastal and offshore Hawaii	UH