Hawaii Ocean Time-series
HOT-304 Cruise Plan

Cruise ID: **KOK-1807**
Vessel: R/V *Ka'Imikai-O-Kanaloa*, University of Hawaii
Master of the Vessel: Captain Ross Barnes
Chief Scientist: Dan Sadler, University of Hawaii
OTG Marine Technicians: Jeff Koch and Steve Tottori

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Dan Sadler Cell Number: (808)393-6298

Loading: July 20, 2018 @0900
Departure: July 23, 2018 @0700 (Science personnel on board by 0630).
Arrival: July 27, 2018 @ 0800
Debrief: July 27, 2018 @ 1000 in the KOK Conference Room

1.0 SCIENTIFIC OBJECTIVES

The objective of the cruise is to maintain a collection of hydrographic and biogeochemical data at the Hawaii Ocean Time-series (HOT) stations. Four stations will 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 July 23rd 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 July 24-26th.
3) Station 52, the site of WHOTS-14 Mooring (anchor position 22° 40.0154'N, 157° 57.0915' W) will be occupied on for about one hour on July 26th.
4) Station 6, referred to as Station Kaena, is located off Kaena Point at 21° 50.8'N, 158° 21.8'W and will be occupied on July 26th for about 2 hours.

1.1 SCIENTIFIC OPERATIONS

Station	Activities
Kahe (Sta. 1)	Weight Cast, Hyperpro cast, CTD cast (1000 m)
ALOHA (Sta. 2)	Sediment traps, gas array, net tows, CTD operations, primary productivity measurements, optics casts, misc. experiments.
WHOTS mooring station (Sta.52)	One CTD cast (yo-yo to 200 m), surface instrument inter-comparisons.
Kaena (sta. 6)	One CTD cast (near bottom)
Underway/continuous	ADCP, thermosalinograph, fluorometry, meteorology

2.0. SCIENCE PERSONNEL

Participant	Title	Affiliation	Citizenship
Karin Björkman	Scientist	UH	Sweden
Kendra Brooks	Research Associate	UH	USA
Macarena Burgos	Scientist	UCádiz	Spain
Robert Cacace	Student –Volunteer	Stockton University	USA
Carolina Funkey	Research Associate	UH	USA
Svetlana Naratov	Graduate Student	UH	USA
Dan Sadler– Chief Scientist	Research Associate	UH	USA
Fernando Santiago-Mandujano	Research Associate	UH	USA
Eric Shimabukuro	Research Associate	UH	USA
Michelle Smith	Biology Lecturer –Volunteer	WCC	USA
Jefrey Snyder	Marine Technician	UH	USA
Ryan Tabata	Research Associate	UH	USA
Kellie Teague	Graduate Student –Volunteer	HPU	USA
Ksenia Trifonova	Research Assistant	UH	Germany
Blake Watkins	Marine Engineer	UH	USA
Fernanda Henderikx Freitas	Scientist	UH	Brazil
Jeff Koch	Marine Technician	OTG	USA
Steve Tottori	Marine Technician	OTG	USA

3.0. SUMMARY SCHEDULE

18 July	Pre-cruise planning meeting 1130 hrs, Moore Conference Center, CMH
20 July	Ship loading at 0900 hrs.
23 July	Depart from Pier 35 at 0700 hrs. **Science personnel on-board by 0630.**
23 July	Station 1 Kahe Pt. operations.
24-26 July	Station ALOHA operations. Station 52 CTD yo-yo cast, Station Kaena
27 July	Arrive back to Pier 35. Full offload.
27 July	Post-cruise meeting at 1000 hrs. KOK Conference Room.

4.0. OPERATIONAL PLANS

4.1. Station Kahe (21°20.6'N, 158°16.4'W)

A 500 lb. 1000 m weight-test cast, a Hyperpro cast (Sect. 4.2.9), and one CTD cast to 1000 m (Sect. 4.2.5) will be conducted at this location on July 23rd. The CTD winch and starboard squirt boom will be required for these operations. After the operations are satisfactorily completed, the ship shall proceed to Station ALOHA.

4.2. Station ALOHA (22°45'N, 158°W with 6 nm radius)

4.2.1. On arrival at Station ALOHA, one 200-m CTD cast will be conducted. After this operation is completed the Wirewalker will be deployed (Sect. 4.2.1). Once the Wirewalker is deployed, the Sediment Traps will be deployed (Sect. 4.2.2.) followed by the Primary Production Array (4.2.3). These operations will be followed by a near-bottom CTD cast and the start of the 36-hour water column observations at Station ALOHA.

Note: Array tracking is facilitated through the SOEST Cruise and Drifter Tracks tool found at http://hahana.soest.hawaii.edu/nowcast/loctable.html

4.2.1 Wirewalker deployment

Upon arrival to Station ALOHA A Wirewalker (Del Mar Oceanographic) will be deployed at Station ALOHA to take hydrographic and optical observations in the upper 400 m of the water column. The instrument is about 1.5 m long and 0.6 m wide and about 30 Kg, with a 40 Kg bottom weight, and attached to a surface buoy with strobe light and Pacific Gyre positioning system (ID: DMO-GLBCN-0003 or DMO-GLBCN-0004), Xeos 51020, Iridium (platform #: 704320), and one Rockblock Beacon.

The Wirewalker will be deployed and recovered close to the sediment traps deployment and recovery, so that the two should drift in the same direction to reduce the transit time to recover them. The instrument will stay in the water for about 2 days. Deployment and recovery will be conducted from the back deck through the A-frame and using the SeaMac winch, each operation will take 30 to 60 min. Blake Watkins will be in charge of this operation with 2 or 3 members of the science party. Two ABs will be required to operate the A-frame and winch respectively.

After deployment of the Wirewalker, the ship shall prepare to deploy the Sediment Trap Array.

4.2.2. Sediment trap array deployment

The floating sediment traps will be deployed at a location within Station ALOHA, to be determined by local current conditions. The array will be deployed from the starboard stern rail using the small crane and the Sea-Mac winch. After deployment we request that the bridge verify that the radio transmitters are functioning and directionally correct.

The array will drift for about 56 hours before recovery. The array is equipped with 1 ARGOS satellite transmitter (platform #: 60484), 1 Novatech Iridium beacon (platform #: 200), strobe lights, a radio transmitter (channel 74: 156.725 MHz). Daily positions of the array shall be transmitted by email directly to the ship (argosfix@kok.soest.hawaii.edu , password: argosfix), therefore the ship will **not** need to keep within site of the array until the time of the recovery. Assistance from the bridge is requested in plotting the drift track of the array. We request the use of the ship's radio direction finder for locating the array before recovery.

After deployment of the sediment trap array, the ship shall prepare to deploy the primary production array.

4.2.3 Primary production experiment

Samples for the primary productivity experiment will be collected from the rosette. Before dawn (Sunrise 0600 hrs on July 24th), a free drifting incubation array will be deployed from the starboard stern rail using the small crane and the Sea-Mac winch. The array is equipped with two ARGOS satellite transmitters (platform # 84857), Novatech Iridium beacon (platform #: 100), strobe lights and a radio transmitter (channel 73: 156.675 MHz). Positions of the array will be emailed to argosfix@kok.soest.hawaii.edu , password: argosfix. The **ship shall keep within site of the array** while performing CTD operations for the last 6 hours of the approximately 12-hour time the array will be in the water unless the array drifts outside of the ALOHA circle. If the array drifts out of the circle, the ship should return inside the circle to conduct CTD casts, and the monitoring of the array will be coordinated with the watch leader. The array will be recovered at 1930, just after sunset (1917 hrs). All radioactive waste generated by the experiment shall be returned to the University of Hawaii. Only qualified personnel shall handle radioactive material.

After deployment of the primary production array, the ship shall transit to the center of the station circle to conduct a near bottom CTD cast (approximately 4740 m).

4.2.4. Water column measurements

Vertical profiles of temperature, conductivity and dissolved oxygen will be made with an instrument package consisting of a Sea-Bird CTD attached to a 24-place rosette with 12 liter Bullister sampling bottles. We will need the ship's CTD winch and crane for these operations. Water samples for biogeochemical measurements will be collected on each cast. The cast after the deployment of the Primary Productivity Array shall be made to the near bottom (approximately 4740 m). Following this cast, a series of 1000-m casts shall be made continuously every 3 hours for a 36-hour period, ending with a second near-bottom cast. It is highly desired that this burst sampling be done without interruption and we request the ship to maintain position within the study area for that period of time, and repositioning to the center of the Station before each cast whenever possible.

Whenever pumping of the ship's tanks is needed, it must be conducted outside the circle that defines station ALOHA (Sect. 1.0). To avoid disruptions in the schedule, this operation should be coordinated with the chief scientist or the watch leaders **(Jefrey Snyder and Eric Shimabukuro).**

4.2.6. Gas Array deployment

A free drifting incubation array will be deployed the third day of the cruise at Station ALOHA. Samples for the gas array will be collected from Station 2 CTD cast 8. The gas array will be deployed from the starboard stern rail using the small crane and the Sea-Mac winch. The array is equipped with two ARGOS satellite transmitters (platform # 84857), Novatech Iridium beacon (platform #: 100), strobe lights and a radio transmitter (channel 73: 156.675 MHz). Positions of the array will be emailed to argosfix@kok.soest.hawaii.edu , password: argosfix. The ship will **not** need to keep within sight of the array until the time of the recovery, approximately 25 hours after its deployment. Assistance from the bridge is requested in plotting the drift track of the array.

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4.2.7. Zooplankton net tows

A plankton net will be deployed from the stern and shall be towed for half-hour periods. Half-hour periods are scheduled around noon and midnight on the second, third, and fourth days (see schedule) for a total of six slots. The A-frame and small capstan will be needed for this operation. B. Watkins will be in charge of these operations.

4.2.8. Optics

An optical package including a Wet Labs AC9 that measures water column spectral absorption and attenuation at nine wavelengths, a Chelsea Fast Repetition Rate Fluorometer (FRRf), a SeaBird Seacat with temperature, conductivity, fluorometer, and pressure sensors, and a LISST particle size and distribution analyzer will be deployed two times during the cruise.

Each deployment will consist of two up and two down profiles to a target depth of 200 m at a constant speed of 10 m/min during both the downcast and upcast. An instrument soaking period at just below the surface will be required between the two profiles. The A-frame and capstan will be needed for this operation.

4.2.9. Hyperpro

The Hyperpro is a profiling unit with one up-looking and one down-looking hyperspectral radiometer, a WET Labs ECO-BB2F triplet (measuring Chlorophyll-a fluorescence and backscattering in the blue and red wavelengths), temperature and conductivity sensors. This instrument also incorporates a ship mounted surface radiometer. Around 1400 on the first, second and fourth days, the Hyperpro will be deployed from the stern through a small block hung from the A-frame. The instrument is lowered and retrieved by hand. Each deployment will consist of two profiles and one yo-yo (5 x 20m) before the instrument is retrieved.

4.2.10. Optical Profiling Float

On the morning of November 26th, an optical profiling float (bio-argo style) will be deployed after the primary productivity array deployment, to compare float based productivity to that measured by the array. The float will be hand-deployed from the back deck.

4.3. Gas Array, Sediment Trap Array and Wirewalker recovery

In the morning of July 26th, after the optics cast has been completed, the ship shall transit for the recovery of the Gas Array. The small crane and the Sea-Mac winch will be needed to retrieve the sediment trap array. After the Gas Array is recovered, the ship shall transit to recover the floating sediment trap array. On completion of sediment trap array recovery, the ship shall transit to recover the Wirewalker. Once the wirewalker recovery is complete, the ship shall transit to Station 52 and conduct one 200 m CTD yo-yo cast.

4.4 Station 52 - WHOTS-14 Mooring

The anchor position of the WHOTS-14 mooring is 22° 40.0154' N, 157° 57.0915' W. The watch circle of the buoy is about 2 nautical miles. Generally, the buoy stays on the edge of the watch circle. The buoy can be detected via radar in good weather conditions but is harder to detect with larger sea states.

4.4.1 CTD yo-yo cast (subsurface instrument intercomparison)

One 200-m CTD yo-yo cast with at least 5 full cycles will be conducted near the WHOTS mooring on July 26th for subsurface instrument intercomparison. This cast should be conducted downwind, down current, and about 200 m from the mooring.

4.4.2 Surface instrument intercomparison

While on station, the ship's meteorological system shall be in operation for surface instrument intercomparisons with the WHOTS mooring. Once the yo-yo cast is completed, ADCP intercomparisons will be run between the shipboard ADCP system and the moored instuments on the WHOTS-14 mooring line. These comparisons should also be conducted downwind, down current, and about 200 m from the mooring.

4.5.1 Acoustic Doppler Current Profiler

The ship's acoustic Doppler current profiler (ADCP) will be in operation during the duration of the cruise. The OTG technicians will be in charge of the ADCP system.

4.6.1 Thermosalinograph and Fluorometer

The ship's thermosalinograph and fluorometer sampling the uncontaminated seawater supply system will be in operation during the duration of the cruise while the ship is outside Pier 35. Salinity samples to calibrate the thermosalinograph will be taken from the intake hose at 4-hour intervals throughout the duration of the cruise by the science personnel. The OTG technicians will be in charge of the thermosalinograph and fluorometer operations.

4.7.1 Microtops Sun Photometer

Each day, around noon local time, the Microtops Sun Photometer will be used to measure the aerosol optical depth of the atmosphere. The instrument is hand held and remains on board during operation. Measurements can be made concurrently with other operations as it is not deployed over the side of the ship.

5.0. EQUIPMENT

5.1. The HOT science party shall be bringing the following

1. Seabird CTD system, all sensors, deck boxes and computer CTD acquisition systems
2. Rosette and 24 12L Bullister sampling bottles, and all associated spare parts
3. Three 20 ft. laboratory vans (#23, and SCOPE) with assorted equipment for radioisotope and general use. One 10 ft. blue storage van (PO) for equipment and spare storage.
4. Distilled, deionized water and all required chemicals and isotopes
5. Large vacuum waste containers
6. Liquid nitrogen dewar
7. Drifting sediment trap array with strobe lights, satellite and radio transmitters, floats, weights, line, sediment traps and crosses.
8. Drifting primary production array with strobe lights, satellite and radio transmitters, floats, weights, line primary production bottles and spreader bars.
9. Drifting gas array with strobe lights, satellite and radio transmitters, floats, weights, line, 4 L bottles and short mounting bars.
10. Hyperpro and other optical measuring instruments.
11. Oxygen titration system
12. Plankton nets and towing lines
13. Desktop and laptop personal computers
14. Assorted tools
15. All required sampling bottles
16. Pertinent MSDS
17. Chest Freezer (22 cubic inch)
18. Wirewalker

5.2. We will need the use of the following ship's equipment:

1. A-frame
2. A-frame block assembly
3. CTD winch
4. Electric power
   -440/480 VAC, 3 phase 60Hz, 60amp for winches
   -208 VAC single phase at 60 amps for lab vans
5. Space on the main deck in the hanger for one laboratory van **(#23)**
6. Space on upper deck for two vans **(SCOPE and Blue PO Van)**
7. Space on deck for ~5 deck baskets of array gear
8. Small capstan (~ 10 m/min)
9. SeaMac Winch
10. Radio direction finder
11. Hand-held VHF transceivers
12. Shackles, sheaves, hooks and lines
13. Precision depth recorder
14. Shipboard Acoustic Doppler Current Profiler
15. Thermosalinograph, pCO_2 system, and Fluorometer
16. Meteorological suite
17. Grappling hooks and line
18. Navlink2 PC or equivalent
19. Running fresh water and seawater, hoses
20. Uncontaminated seawater supply
21. -80°C Freezer
22. 4°C Refrigerator and -20°C Freezer
23. Distilled, deionized water system

24. Electronic mail system
25. GPS system
26. Underway/on-station data acquisition system for meteorological instruments, ADCP, thermosalinograph, fluorometer, and access to real-time data through the network.
27. OTG's 24-place rosette, and 24 12-l water sampling bottles (to be used as spare)
28. ~1000 lb weight
29. Remote CTD dbar pressure display in the winch operator area.
30. Monitor in CTD Lab displaying ship coordinates, bottom depth and GMT.
31. OTG's transmissometer

Ship:R/V *Ka'Imikai-O-Kanaloa* **HOT 304 CTD CASTS** **Date: July 23-27, 2018**

Cast		Samples	#Bottles
Kahe Pt.			
s1c1	1000 m	O_2, Temp, DIC/Alk, Nuts, Chl a, LLN, LLP, DOC, FCM, Salts	24
Station ALOHA			
s2c1	200 m	Primary Production, SF-S(pb 3@ 5, 25, 45, 75, 100, 125), Salts SF-SO2(1@15)	23
s2c2	4740 m (PO-1)	O_2, Temp, DOC, DIC/Alk, Nuts, Salts	24
s2c3	1000 m (PO-2)	O_2, Temp, DOC, DIC/Alk, Nuts, Salts	24
s2c4	1000 m	PC/PN, DNA(1@5,25,45,75), Salts	18
s2c5	1000 m	PPO4, SF-S(1@5, 25), SF-SO2(1@15),Salts	17
s2c6	1000 m (BEACH)	O_2, Temp, DIC/Alk, Nuts, LLN, LLP, DOC, Keeling, Quay, Salts, SF-S(1@5,pb@25)	24
s2c7	1000 m	PUR, SF-S(1@5, 25), DNA(1@,100,125,150,175), Salts	16
s2c8	1000 m	Gas Array(3@5,25,45,75,100,125), SF-S(1@5, 25), Salts	22
s2c9	1000 m	DNA(1@200,225,250,275), SF-S(1@5, 25), MC(1@5, 25, 45, 75, 100, 125, 150, 175), SF-SO2(1@15),Salts	17
s2c10	1000 m	PSi, SF-S(1@5, 25), Salts	12
s2c11	1000 m	SF-S(1@5, 25), Salts	4
s2c12	1000 m	ATP, DNA(2@300,400,500,770), SF-S(1@5, 25), Salts	21
s2c13	1000 m	SW(1@5,25,45,75,100,125,150,175, 200, 300, 400, 800), SF-S(1@5, 25), SF-SO2(1@15)Salts	17
s2c14	1000 m	HPLC, Chl a, Salts	14
s2c15	4740 m (PO-3)	Oxygen, DNA(1@1000,2000,3000,4000), Salts	12
WHOTS Mooring			
s52c1	200 m yo-yo	DIC/TA(1@5)	1
Kaena			
s6c1	2400 m	Chl a, Salts	13

MC=Matt Church, **SW**=Sam Wilson, **SF-S**=Sara Ferrón-Smith

Ship: R/V *Ka'Imikai-O-Kanaloa* HOT 304 Date: July 23-27, 2018

TIME	Mon. 7/23	Tues. 7/24	Wed. 7/25	Thurs. 7/26	Fri 7/27
0000					
0100		Arrive ALOHA (0200)			
0200		S2C1 PP	S2C8 GAS		
0300		Deploy WireWalker		Optics	
0400		Deploy Sed Traps	Deploy Gas Array		
0500		Deploy PP Array	S2C9 OPEN	Transit gas array	
0600		S2C2 PO-1		Recover gas array	
0700	Depart Pier 35			Transit Sed traps	
0800			S2C10 PSi	Recover Sed traps	Arrive Pier 35
0900	Arrive Kahe (10:00)			Transit WireWalker	
1000	Weight cast		ATE	Recover WireWalker	
1100	Hyperpro Microtops	S2C3 PO-2 (Begin 36 hr)	S2C11 Open Microtops	Transit St. 52	
1200	S1C1 Kahe	Microtops Net Tow	Net Tow Net Tow	Microtops	
1300	Transit ALOHA	Hyperpro		Hyperpro	
1400		S2C4 PC/PN	S2C12 ATP	S52C1 WHOTS ADCP Inter-comp	
1500				Transit St. Kaena Deploy Optics Float	
1600					
1700		S2C5 PPO4	S2C13 OPEN		
1800					
1900		Recover PP array			
2000		S2C6 BEACH	S2C14 HPLC	S6C1 Kaena	
2100					
2200		Net Tow Net Tow	Net Tow	Transit Pier 35	
2300		S2C7 PUR	S2C15 PO-3 (end 36 hours)		

July 24th: Sunrise 0600, Sunset 1917

6.0 HOT-304 Watch Schedule

0300-1500
Jefrey Snyder – Watch Leader – *Tag*
Ksenia Trifonova – *Console*
Kellie Teague – *Alt. Tag*
Dan Sadler – Chief Scientist– *Alt. Tag*
Carolina Funkey – *Water Boss*
Eric Shimabukuro– *Tag*

1500-0300
Karin Björkman –*Water Boss*
Fernando Santiago-Mandujano – *Console*-Watch Leader
Svetlana Naratov – *Alt. Tag*
Robert Cacace – *Alt. Tag*
Kendra Brooks – *Tag*
Ryan Tabata – *Tag*

0900-2100
Michelle Smith

At Large
Blake Watkins
Macarena Burgos
Fernanda Henderikx Freitas

OTG
Jeff Koch
Steve Tottori