FK180310 30-day Post Cruise Report

1. **Ship name**: Falkor
2. **Cruise Dates - Day Departed**: 3/10/2018
3. **Cruise Dates - Day Returned**: 4/10/2018
4. **Cruise Number**: FK180310
5. **Departure Port**: Honolulu, HI, USA
6. **Arrival Port**: Honolulu, HI, USA
7. **Mid-Cruise Port Call (if any)**: None
8. **Mid-Cruise Port Call (if any)**: None
9. **Participating Organizations, Institutions, Foundations, Government Agencies, etc.**: MBARI, Oregon State University, Technion, U Montana, UC Santa Cruz University of Hawaii, University Southern California, WHOI
10. **Funding Sources**: Simons Foundation through the Simons Collaboration on Ocean Processes and Ecology #329108
11. **Describe all of the geographical area(s) where the science occurred**: within 200 nautical miles north of the Hawaiian Islands
12. **Name of Chief Scientist**: Sam Wilson
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13. **Cruise Objectives**: (1) Determine the hydrographic structure of mesoscale eddies, their variability over timescales of weeks to months, and the associated biophysical interactions. (2) Quantify how phytoplankton and microbial community composition, diversity, productivity, and biogeochemical cycling vary between eddies of different types, and along eddy fronts. (3) Determine how mesoscale eddies influence model predictions of ocean productivity, and carbon and energy export to the ocean's interior.

14. **Cruise Summary**:

(1) Open ocean deployment of multiple Long Range Autonomous Underwater Vehicles (LRAUVs), Seagliders, and free-drifting instrumentation; (2) Upper-water column hydrographic surveying using the CTD-rosette, underway CTD, and ADCP (3) High-resolution metagenomic, biogeochemical, and oceanographic analyses of seawater samples and sensor data collected on the LRAUVs; and (4) Metabolic measurements of phytoplankton community to determine rates of productivity, respiration, grazing, and export. The primary objective of Leg 1 of FK180310 was to focus on the engineering testing of new MBARI designed, Long Range Autonomous Underwater vehicles (LRAUV). These vehicles were designed to sample the microbial metabolic activity occurring over hours and days within the broader context of our long term objectives of understanding the microbial temporal and spatial dynamics in a cyclonic eddy. Since using the LRAUVs on a large research vessel and in the open ocean was new, the implementation required two stages of testing. The first stage was to work with the vehicle in relatively calmer waters about 12 nautical miles off the west side of Oahu (Waianae Coast) , testing the newly designed launch and recovery system, the Environmental Sample Processor (ESP), as well as checking the various communication paths between the Waveglider, LRAUVs, and the R/V Falkor. Only the initial deployment of an LRAUV from the vessel during was unsuccessful as the LRAUV collided with the R/V Falkor. All other deployments and recoveries were successful. The ESP was determined to have 90% success in its initial short term testing of a few cartridges, and with the modifications to the LRAUV /ESP control software, the operational and sampling success was substantially increased for the entire 30 day cruise. The second stage of Leg 1 was to fully test these systems within the cyclonic eddy itself using one LRAUV /ESP at depth, for an extended period of time and a second LRAUV profiling to provide the larger spatial context. Leg 2 of the expedition focused on achieving the scientific objectives of the cruise, in particular in understanding the effects of mesoscale features on microbial distributions, activities and biogeochemical processes. Experiments and measurements aimed at elucidating linkages between the diel periodicity of microbial activities and biogeochemical processes were another component of cruise scientific focus. To achieve our research objectives, we deployed a wide range of scientific equipment including LRAUVs, Waveglider, Wirewalker, Seagliders, incubation arrays (productivity, N2 fixation, sediment traps), bio-optical profiles, and trace metal clean seawater sampling. CTD casts were conducted at sunrise, midday, and sunset, and at other times of the day as needed. The flexibility of the Falkor's schedule provided invaluable opportunities for the science party to make improvements and test all aspects of the science mission instrumentation, i.e. the Waveglider to ship communications, AUV software debugging, and ESP data sampling improvements. The Falkor's ability to adapt its use of the ship's work boat in high sea-states also contributed significantly to the success of the overall project. One noteworthy aspect of using the R/V Falkor, was the enhanced use of high-speed ship to shore network channels. This cruise was particularly dependent on

controlling the many Lagrangian drifting instruments, using the shore based web sites. Communication between the bridge and the scientists was greatly facilitated by real-time tracking of the equipment in the water. This was a tool developed by Lance Fujieki at the University of Hawaii and is very useful when keeping tracking of multiple objects in the water. The website is http://hahana.soest.hawaii.edu/hot/trackmap/TrackMap.html. The bridge would keep the website updated and it was the point of reference when transiting to recover items or when to plan the next few days of activity. Our recommendations are minor. As can occur, a period of shipyard work with one set of technicians, with a different set of technicians for the expedition, created a bit of a slow start for having the ship's systems all fully functional for the oncoming science party. Once the ship's new underway data paths and underway data security issues were worked out, everything worked fine and the extended network connectivity to the lower labs had been addressed.

15. **Did you collect Measurements or Samples, including biological specimens?** No
16. **Did you deploy and/or recover any Moorings, Bottom Mounted Gear, or Drifting Systems?** No
17. **Equipment Used**: Shipboard observations
    - CTD & rosette operations (Falkor) Vertical profiles of temperature, conductivity and depth were made with an instrument package consisting of a Sea-Bird CTD attached to a 24-place rosette with 12 liter Niskin sampling bottles. Water samples for biogeochemical measurements will be collected on each cast. Additional CTD channels will be used for the following sensors: secondary temperature, secondary salinity, oxygen SBE43 sensor, Seapoint fluorometer, Wetlab fluorometer, c-star transmissometer, and scalar PAR sensor.
    - Underway CTD: An underway CTD (Oceansciences) was deployed from the stern of the ship during the cruise. The instrument used a free-fall, internal-logging probe tethered to the ship by a high strength line that is loaded on a special tail spool before every cast. As the probe fell through the water, the line on 8"" the tail spool was paid out at the same time as line was paid out from the winch on the ship, similar to the operation of an XBT or XCTD, but with the probe being recovered after each cast. The uCTD winch is used to recover the probe. The web link to the instrument is http://www.teledynemarine.com/underwayctd?BrandID=13. It is a different model to the Teledyne rapidCAST.
    - HyperPro: Daily deployments of Satlantic radiometer to characterize irradiance and radiance. 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.

Shipboard instrumentation sampling from uncontaminated seawater supply

- Flow cytometer 'SeaFlow': This instrument provides continuous measurements of cell abundance and cell size distributions will be used to generate hourly estimates of Prochlorococcus and other picophytoplankton growth and loss rates.
- Transmissometer: This instrument is configured to auto-sample whole water for 50 mins and 0.2 μm filtered seawater for 10 mins at hourly intervals from the ship's underway system.

In situ autonomous vehicles

- Long Range Autonomous Underwater Vehicles: LRAUVs are 2.5 m in length, weigh 120 kg, and can support an 8 W sensor payload when travelling at 1 m/sec. The vehicles are based off the MBARI Tethys AUV design
- Waveglider: A Waveglider (Liquid Robotics) sat at the surface, equipped with sensors to conduct its own independent operations, and also act as a communication relay or 'mule' between one of the deployed LRAUVs and the R/V Falkor.
- Seaglider: Two Seagliders were deployed during the cruise to survey the region of interest.

Free drifting floats, nets, and arrays

- SVP Drifters: We deployed two Surface Velocity Program (SVP) drifters that comprised of a spherical surface float (equipped with a solar LED) and a "holey-sock" drogue. One drifter was centered at 15 m below the surface and the other at 120 m below the surface. The drifter transmitted its position using iridium and drift along with the surface.

18. **Station Plots**:

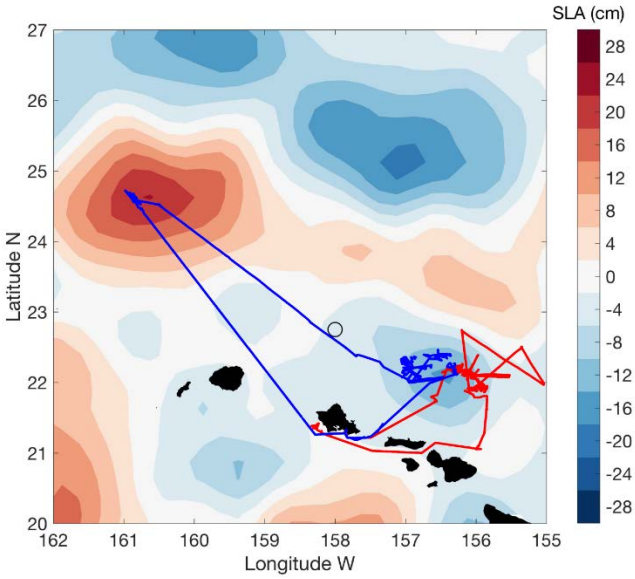

Figure 1: Map of the FK180310 Cruise Track overlain with Sea Level Height Anomaly (SLA). The red and blue lines depict the different legs of the cruise.

FK180310 – Leg One
EVENT LOG (ALL TIMES: HST)

TYPE CODE: ST=Sediment Trap, Array SW = N2 fixation (Sam W, Rosie G) and N (Tristy), CTD =CTD, SVP drifter, HYP=Hyperpro, OPT=Optics, TM Niskin =Trace metal Niskin (Nick H), Niskin = Starboard 5 L Niskin (Ana C), WW = WireWalker

Event #	Date (HST)	Time Start	Time End	Latitude	Longitude	Type	Cast #	Cast Depth	Comments
1	3/10/18	1704	1720	21°21.000	158°19.800	AUV#1	Ahi		Launch & Recover Ahi
2	3/10/18	1842	1841	21°21.000	158°19.800	AUV#2	Opah		Deploy
3	3/10/18	1852	1853	21°21.000	158°19.800	AUV#3	Aku		Deploy
4	3/11/18	0846	0848	21°21.000	158°19.800	WG	Mola		Deploy
5	3/11/18	1513	1638	21°21.153	158°17.498	CTD	#1	1000	
6	3/11/18	1815	1822	21°21.981	158°20.182	WG	Mola		Recover
7	3/12/18	0850	0909	21°19.927	158°18.009	LARS			Testing launch/recovery system
8	3/12/18	1035	1053	21°20.700	158°20.400	AUV	Aku		Recover
9	3/12/18	1358	1357	21°20.580	158°19.920	AUV	Opah		Recover
10	3/13/18	0600	0715	21°01.942	156°02.156	U'wayCTD			Testing
11	3/13/18	0714	1926	21°01.431	156°20.335	U'wayCTD			Transect Profiles
12	3/13/18	2010	2011	21°50.155	156°08.606	SVP drifter	#1		Shallow drifter deploy
13	3/13/18	2032	2103	22°49.824	156°08.004	CTD	#2	400	
14	3/13-3/14	2143	0512	21°01.431	156°20.335	U'wayCTD			Transect Profiles
15	3/14/18	0537	0633	22°43.199	156°14.411	CTD	#3	400	
16	3/14/18	0647	0655	22°43.068	156°16.447	AUV	Opah		Deploy
17	3/14/18	1835	1843	21°57.172	155°06.096	AUV	Aku		Deploy
18	3/14/18	1925	1936	21°56.970	155°05.649	SG148	148		Deploy
19	3/14/18	1945	2025	21°56.787	155°05.457	CTD	#4	400	
20	3/15/18	0118	0123	22°28.822	155°23.988	SG626	626		Deploy

FK180310 – Leg One
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Event #	Date (HST)	Time Start	Time End	Latitude	Longitude	Type	Cast #	Cast Depth	Comments
21	3/15/18	0145	0226	21°51.561	156°01.653	CTD	#5	400	
22	3/15/18	1103	1115	21°52.199	156°52.199	WW	#3		Deploy
23	3/15/18	1136	1136	21°52.59	156°02.750	SVP Drifter	#2		Deep drifter deploy
24	3/15/18	1247	1356	21°51.489	156°02.216	Float	#1		Apex float launch
25	3/15/18	1306	1350	21°51.346	156°01.779	CTD	#6	400	
26	3/15/18	1930	1932	21°52.884	156°05.306	WG	Mola		Deploy
27	3/16/18	0620	1653	21°51.596	156°02.228	CTD	#7	400	
28	3/16/18	0620	1653	21°51.596	156°02.228	CTD	#8	400	
29	3/16/18	1326	1359	21°53.363	156°00.372	HYPERP	#1		
30	3/16/18	1503	1541	21°54.739	155°59.665	CTD	#9	400	
31	3/16/18	1822	1850	21°54.739	155°59.665	CTD	#10	400	
32	3/16/18	0603	0635	21°54.739	155°59.665	CTD	#11	400	
33	3/17/18	1159	1244	21°54.739	155°59.665	CTD	#12	400	
34	3/17/18	1314	1349	21°56.172	156°00.608	HYPERP	#2		
35	3/17/18	1503	1541	21°54.739	155°59.665	CTD	#13	400	
36	3/18/18	1503	1541	21°54.739	155°59.665	CTD	#14	400	Recovered
37	3/18/18	1503	1541	21°54.739	155°59.665	SED TRAP	#1		
38	3/18/18	1503	1541	21°54.739	155°59.665	CTD	#15	400	
39	3/18/18	1303	1339	22°22.123	156°45.857	HYPERP	#3		
40	3/18/18	1458	1618	22°21.633	156°45.278	CTD	#16	400	

FK180310 – Leg One
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Event #	Date (HST)	Time Start	Time End	Latitude	Longitude	Type	Cast #	Cast Depth	Comments
41	3/19/18	0604	0638	22°05.319	156°09.908	CTD	#17	400	
42	3/19/18	1200	1254	22°04.477	156°10.605	CTD	#18	400	
43	3/19/18	1307	1357	22°04.536	156°10.653	HYPERP	#4		
44	3/19/18	1503	1630	22°03.749	156°09.762	CTD	#19	1000	
45	3/19/18	1820	1905	22°07.092	156°05.124	FLOAT	#1		Recovery
46	3/19/18	1905	1940	22°04.222	156°09.982	CTD	#20	400	
47	3/20/18	0607	0640	22°05.811	156°12.194	CTD	#21	400	
48	3/20/18	1200	1243	22°04.556	156°13.961	CTD	#22	400	
49	3/20/18	1312	1348	22°03.860	156°13.560	HYPERP	#5		
50	3/20/18	1759	1849	22°04.970	156°12.103	CTD	#23	400	
51	3/21/18	2346	0105	22°04.079	156°34.568	SED TRAP	#2		Deploy
52	3/21/18	0601	0646	22°06.969	156°12.810	CTD	#24	400	
53	3/21/18	1157	1244	22°10.468	156°15.830	CTD	#25	400	
54	3/21/18	1302	1338	22°11.751	156°16.001	HYPERP	#6		
55	3/21/18	1510	1601	22°11.032	156°17.069	CTD	#26	400	
56	3/21/18	1800	1843	22°09.729	156°18.949	CTD	#27	400	
57	3/22/18	1252	1340	22°42.931	156°36.719	OPAH			Recovery
58	3/22/18	1422	1440	22°43.073	156°36.137	AKU			Recovery
Leg One returns to Honolulu Port. The event Log for Leg Two follows consecutively on from LegOne									

FK180310_Leg Two
EVENT LOG (ALL TIMES: HST)

TYPE CODE: ST=Sediment Trap, Array SW = N2 fixation (Sam W, Rosie G) and N (Tristy), CTD =CTD, SVP drifter, HYP=Hyperpro, OPT=Optics, TM Niskin =Trace metal Niskin (Nick H), Niskin = Starboard 5 L Niskin (Ana C), WW = WireWalker

Event #	Date (HST)	Time Start	Time End	Latitude	Longitude	Type	Cast #	Cast Depth	Comments
59	3/27/18	1834	1853	22°05.192	156°21.336	AUV Opah			Deploy
60	3/27/18	1854	1901	22°05.142	156°21.288	AUV Ahi			Deploy
61	3/27/18	1926	2026	22°05.494	156°20.182	CTD	#28	400	
62	3/27/18	2052	2110	22°05.434	156°19.929	TM Niskin	#1		
63	3/27/18	2130	2230	22°05.452	156°19.339	OPTICS	#1		
64	3/28/18	0259	0346	22°06.341	156°21.336	CTD	#29	400	
65	3/28/18	0548	0603	22°08.487	156°20.215	ARRAY	#KB1		Deploy
66	3/28/18	0614	0659	22°08.315	156°19.975	CTD	#30	400	
67	3/28/18	0808	0908	22°05.676	156°18.451	WW	#1		
68	3/28/18	1202	1242	22°09.413	156°20.815	CTD	#31	400	
69	3/28/18	1302	1343	22°09.431	156°20.335	HYPERP	#7		
70	3/28/18	1502	1550	22°10.871	156°21.534	WW	#2		
71	3/28/18	1802	1843	22°12.560	156°21.128	CTD	#32	400	
72	3/28/18	1900	1912	22°12.451	156°21.078	ARRAY	#KB1		Recover
73	3/28/18	1912	1930	22°12.376	156°20.983	ARRAY	#KB2		Deploy
74	3/28/18	2209	2350	22°12.587	156°23.613	OPTICS	#2		
75	3/29/18	0022	0301	22°12.654	156°23.166	CTD	#33	400	
76	3/29/18	0418	0440	22°12.452	156°23.631	ARRAY	#KB2		Recover
77	3/29/18	0543	0611	22°12.422	156°23.110	ARRAY	#SW1		Deploy
78	3/29/18	0621	0705	22°12.445	156°22.855	CTD	#34	400	

EVENT LOG (ALL TIMES: HST)

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Event #	Date (HST)	Time Start	Time End	Latitude	Longitude	Type	Cast #	Cast Depth	Comments
79	3/29/18	1018	1038	22°20.252	156°30.534	TM Niskin	#2		
80	3/29/18	1027	1044	22°20.252	156°30.567	TM Niskin	#3		
81	3/29/18	1158	1237	22°20.990	156°31.557	CTD	#35	400	
82	3/29/18	1247	1337	22°20.986	156°31.343	HYPERP	#8		
83	3/29/18	1459	1542	22°21.189	156°32.357	CTD	#36	400	
84	3/29/18	1802	1842	22°21.974	156°34.242	CTD	#37	400	
85	3/29/18	1907	1942	22°21.818	156°35.244	TM Niskin	#4		
86	3/29/18	1913	1952	22°21.795	156°35.350	TM Niskin	#5		
87	3/29/18	2026	2028	22°20.984	156°36.625	Niskin	#1		
88	3/29/18	2102	2128	22°20.819	156°36.337	CTD	#38	100	
89	3/29/18	2259	0012	22°18.144	156°32.582	OPTICS	#3		
90	3/30/18	0050	0055	22°18.278	156°32.478	CTD	#39	400	
91	3/30/18	0216	0304	22°18.796	156°40.931	CTD	#40	400	
92	3/30/18	0340	0341	22°18.762	156°40.833	ARRAY NH	#1		Deploy
93	3/30/18	0423	0445	22°19.363	156°35.697	ARRAY PP	#1		Deploy
94	3/30/18	0524	0622	22°21.156	156°32.386	ARRAY SW	#SW1		Recovered
95	3/30/18	0631	0717	22°21.273	156°32.861	CTD	#41	400	
96	3/30/18	1200	1241	22°22.702	156°32.965	CTD	#42	400	
97	3/30/18	1303	1339	22°22.123	156°45.857	HYPERP	#9		
98	3/30/18	1458	1618	22°21.633	156°45.278	CTD	#43	1000	

EVENT LOG (ALL TIMES: HST)

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Event #	Date (HST)	Time Start	Time End	Latitude	Longitude	Type	Cast #	Cast Depth	Comments
99	3/30/18	1700	1755	22°21.612	156°45.250	TM Niskin	#6		
100	3/30/18	1856	1913	22°20.361	156°41.264	ARRAY PP	#1		Recovered
101	3/31/18	0941	0942	22°20.731	156°54.890	Niskin	#1		
102	3/31/18	1152	1240	22°20.415	156°54.374	CTD	#44	400	
103	3/31/18	1459	1531	22°20.145	156°54.133	CTD	#45	400	
104	3/31/18	1758	1843	22°19.324	156°45.245	CTD	#46	400	
105	3/31/18	2003	2006	22°19.933	156°45.110	Niskin	#2		
106	3/31/18	2103	2130	22°19.422	156°45.077	CTD	#47	400	
107	3/31/18	2158	2328	22°18.617	156°45.756	OPTICS	#4		
108	4/01/18	0002	0050	22°18.209	156°45.002	CTD	#48	400	
109	4/01/18	0203	0250	22°17.640	156°45.157	CTD	#49	400	
110	4/01/18	0439	0453	22°17.307	156°45.094	CTD	#50	400	
111	4/01/18	0538	0621	22°16.767	156°45.235	ARRAY KB	KB#3		
112	4/01/18	0638	0727	22°15.497	156°45.395	ARRAY SW	SW#2		
113	4/01/18	1010	1050	22°17.981	156°45.922	TM Niskin	#7		
114	4/01/18	1158	1241	22°17.719	156°45.600	HYPERP	#10		
115	4/01/18	1304	1334	22°17.594	156°45.520	CTD	#51	400	
116	4/01/18	1459	1536	22°16.790	157°01.335	CTD	#52	400	
117	4/01/18	1600	1641	22°16.993	157°01.432	TM Niskin	#8		
118	4/01/18	1824	1911	22°15.950	157°00.586	Small boat			Visit the LRAUV

FK180310_Leg Two
EVENT LOG (ALL TIMES: HST)

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Event #	Date (HST)	Time Start	Time End	Latitude	Longitude	Type	Cast #	Cast Depth	Comments
119	4/01/18	2011	2019	22°14.399	157°00.261	ARRAY KB	KB#3		Recover
120	4/01/18	2023	2024	22°14.366	157°00.306	Niskin	#3		
121	4/01/18	2036	2050	22°14.118	157°00.411	ARRAY KB	KB#4		Deploy
122	4/01/18	2139	2216	22°16.965	157°01.655	CTD	#53	400	
123	4/01/18	2225	2352	22°17.371	157°01.066	OPTICS	#5		
124	4/02/18	0002	0031	22°15.615	157°03.793	CTD	#54	400	
125	4/02/18	0206	0304	22°15.520	157°03.892	CTD	#55	400	
126	4/02/18	0436	0450	22°12.682	157°00.650	ARRAY KB	KB#4		Recover
127	4/02/18	0528	0604	22°12.767	156°59.180	ARRAY SW	SW#2		Recover
128	4/02/18	0630	0649	22°12.203	156°58.552	PP ARRAY	PP#2		Deploy
129	4/02/18	0655	0745	22°15.800	157°05.311	CTD	#56	400	
130	4/02/18	1000	1027	22°18.189	157°05.345	CTD	#57	155	
131	4/02/18	1156	1232	22°15.354	157°05.800	CTD	#58	400	
132	4/02/18	1304	1339	22°14.269	157°01.531	HYPERP	#11		
133	4/02/18	1517	1536	22°07.879	156°56.279	CTD	#59	400	
134	4/02/18	1606	1627	22°03.630	156°49.371	TM Niskin	#9		
135	4/02/18	1712	1714	22°03.377	156°49.986	Niskin	#4		
136	4/02/18	1808	1844	22°03.356	156°50.861	CTD	#60	400	
137	4/02/18	1857	1815	22°09.924	156°51.668	PP ARRAY	PP#2		Recover
138	4/02/18	2032	2049	22°03.523	156°49.471	ARRAY NH	PP#1		Recover

EVENT LOG (ALL TIMES: HST)

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Event #	Date (HST)	Time Start	Time End	Latitude	Longitude	Type	Cast #	Cast Depth	Comments
139	4/02/18	2049	2101	22°03.460	156°49.527	ARRAY NH	NH#2		Deploy
140	4/02/18	2203	2332	22°02.808	156°51.728	OPTICS	#6		
141	4/02/18	0159	0241	22°10.131	157°02.039	CTD	#61	400	
142	4/03/18	0509	0524	22°11.239	157°03.375	ARRAY KB	KB#5		Deploy
143	4/03/18	0531	0625	22°11.373	157°03.987	CTD	#62	400	
144	4/03/18	0918	0933	22°11.540	156°44.836	LRAUV	Aku		Recover
145	4/03/18	1010	1031	22°11.544	156°46.496	LRAUV	Opah		Recover
146	4/03/18	1105	1113	22°12.547	156°46.339	WaveGlider			Recover
147	4/03/18	1212	1247	22°11.855	156°40.547	CTD	#63	400	
148	4/03/18	1304	1333	22°11.507	156°40.604	HYPERP	#12		
149	4/03/18	1418	1453	22°13.462	156°40.838	Sed Trap	Center		Recover
150	4/03/18	1719	1736	22°08.093	157°04.388	TM Niskin	#10		
151	4/03/18	1744	1745	22°08.000	157°04.424	Niskin	#5		
152	4/03/18	1748	1749	22°07.987	157°04.451	CTD	#64	400	
153	4/03/18	1853	1912	22°07.098	157°04.643	ARRAY KB	KB#5		Recover
154	4/03/18	1917	1942	22°07.098	157°04.643	ARRAY KB	KB#6		Deploy
155	4/04/18	2208	2348	22°07.417	157°03.884	OPTICS	#7		
156	4/04/18	0155	0249	22°05.855	157°02.065	CTD	#65	400	
157	4/0\4/18	0428	0441	22°05.355	157°03.104	ARRAY KB	KB#6		Recover
158	4/0\4/18	0507	0537	22°04.915	157°03.288	ARRAY SW	SW#3		Deploy
159	4/0\4/18	0602	1030	22°05.045	157°02.045	CTD	#66	1000	
160	4/0\4/18	0808	0907	22°09.775	156°58.161	PUMP			DIAPHRAGM PUMP

EVENT LOG (ALL TIMES: HST)

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Event #	Date (HST)	Time Start	Time End	Latitude	Longitude	Type	Cast #	Cast Depth	Comments
161	4/04/18	0902	0907	22°09.775	156°58.161	Niskin	#6		
162	4/04/18	1120	1140	22°07.497	156°56.262	WW	WW#2		Recover
163	4/04/18	1200	1246	22°07.474	156°56.268	CTD	#67	400	
164	4/04/18	1258	1327	22°05.842	156°56.931	HYPERP	#13		
165	4/04/18	1412	1441	22°03.680	156°58.465	CTD	#68	200	
166	4/04/18	1510	1618	22°01.249	157°00.767	CTD	#69	1000	
167	4/04/18	1701	1718	21°59.012	156°59.325	Drifter	Deep		Recover
168	4/04/18	2043	2103	22°03.210	156°30.752	ARRAY NH	#2		Recover
169	4/04/18	2202	2341	22°02.517	156°34.619	OPTICS	#8		
170	4/05/18	0400	0418	21°50.940	156°56.262	CTD	#70	400	
171	4/05/18	0524	0550	21°58.916	156°55.353	ARRAY SW	SW#3		Recover
172	4/05/18	1132	1218	22°21.732	157°43.609	SED TRAP	#2		Recover
173	4/05/18	1226	1309	22°21.320	157°43.694	CTD	#71	400	
174	4/05/18	1801	1851	22°50.016	158°22.610	CTD	#72	400	
175	4/06/18	0520	0525	23°45.318	159°31.221	LRAUV	OPAH		Deploy
176	4/06/18	0556	0643	23°47.061	159°33.693	CTD	#73	400	
177	4/06/18	1334	1404	24°29.992	160°29.922	HYPERP	#14		
178	4/06/18	1500	1546	24°30.912	160°30.699	CTD	#74	400	
179	4/06/18	1610	1638	24°30.915	160°30.964	TM Niskin	#11		
180	4/06/18	1801	1847	24°30.629	160°33.102	CTD	#75	400	
181	4/06/18	2155	2304	24°35.992	160°50.179	OPTICS	#9		
182	4/07/18	0203	0255	24°37.006	160°51.708	CTD	#76	400	

EVENT LOG (ALL TIMES: HST)

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Event #	Date (HST)	Time Start	Time End	Latitude	Longitude	Type	Cast #	Cast Depth	Comments
183	4/07/18	0505	0527	24°34.394	160°51.627	ARRAY SW	#4		Deploy
184	4/07/18	0556	0645	24°35.248	160°52.597	CTD	#77	400	
185	4/07/18	0715	0737	24°35.320	160°52.887	TM Niskin	#12		
186	4/07/18	1008	1011	24°35.009	160°51.847	TM Niskin	#13		
187	4/07/18	1158	1242	24°35.395	160°52.370	CTD	#78	400	
188	4/07/18	1302	1333	24°35.598	160°52.147	HYPERP	#15		
189	4/07/18	1502	15229	24°36.614	160°52.747	TM Niskin	#14		
190	4/07/18	1602	1652	24°34.488	160°52.374	CTD	#79	400	
191	4/07/18	1813	1856	24°35.281	160°53.254	CTD	#80	400	
192	4/07/18	1908	1929	24°35.379	160°53.000	TM Niskin	#15		
193	4/07/18	2201	2349	24°35.329	160°50.128	OPTICS	#10		
194	4/08/18	0200	0252	24°32.388	160°46.453	CTD	#81	400	
195	4/08/18	0422	0445	24°31.086	160°46.121	ARRAY SW	#4		Recover
196	4/08/18	0520	0540	24°31.303	160°46.103	ARRAY PP	#3		Deploy
197	4/08/18	0603	0651	24°32.040	160°46.693	CTD	#82	400	
198	4/08/18	0757	0836	24°32.038	160°47.396	CTD	#83	400	
199	4/08/18	1036	1101	24°31.519	160°48.835	OPAH			Recover
200	4/08/18	1158	1245	24°33.817	160°50.832	CTD	#84	400	
201	4/08/18	1300	1330	24°34.035	160°50.988	HYPERP	#16		
202	4/08/18	1500	1608	24°28.369	160°47.898	CTD	#85	1000	
203	4/08/18	1800	1843	24°26.560	160°45.749	CTD	#86	400	
204	4/08/18	1910	1931	24°27.719	160°45.789	ARRAY PP	#3		Recover

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Event #	Date (HST)	Time Start	Time End	Latitude	Longitude	Type	Cast #	Cast Depth	Comments
205	4/08/18	2203	2357	24°27.560	160°45.340	OPTICS	#11		