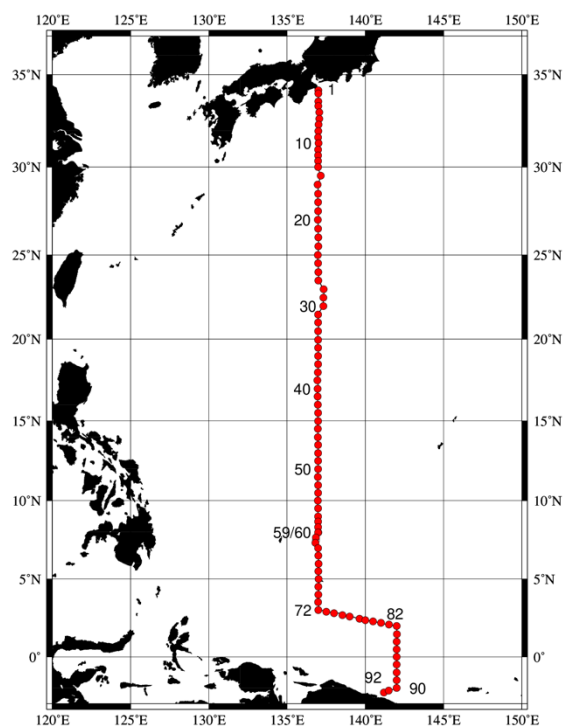


CRUISE REPORT: P09

(Updated JUN 2018)



Highlights

Cruise Summary Information

Section Designation	P09 (aka: RF16-06)	
Expedition designation (ExpoCodes)	49UP20160703	
Chief Scientists	Naoki NAGAI / JMA	
Dates	2016 JUL 03 - 2016 AUG 24	
Ship	<i>R/V</i> RYOFU MARU	
Ports of call	Leg 1: Tokyo–Palau Leg 2: Palau–Tokyo	
Geographic Boundaries	34°10.98' N	
	136°48.36' E	142°2.91' E
Stations	2°17.46' S	
	92	
Floats and drifters deployed	1 float, 1 drifter	
Moorings deployed or recovered	0	

Contact Information:

Naoki NAGAI

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Links to Select Topics

Shaded sections are not relevant to this cruise or were not available when this report was compiled.

Cruise Summary Information	Hydrographic Measurements
Description of Scientific Program	CTD Data:
Geographic Boundaries	Acquisition
Cruise Track (Figure):	Processing
Description of Stations	Calibration
Description of Parameters Sampled	Temperature Pressure
Bottle Depth Distributions (Figure)	Salinities Oxygens
Floats and Drifters Deployed	Bottle Data
Moorings Deployed or Recovered	Salinity
	Oxygen
Principal Investigators	Nutrients
Cruise Participants	Carbon System Parameters
	CFCs
Problems and Goals Not Achieved	Helium / Tritium
Other Incidents of Note	Radiocarbon
Underway Data Information	References
Navigation Bathymetry	
Acoustic Doppler Current Profiler (ADCP)	
Thermosalinograph	
XBT and/or XCTD	
Meteorological Observations	Acknowledgments
Atmospheric Chemistry Data	
Data Processing Notes	

A. Cruise narrative

1. Highlights

Cruise designation: RF16-06 (WHP-P09 revisit)

a. EXPOCODE: 49UP20160703

b. Chief scientist: Naoki NAGAI (n-nagai@met.kishou.go.jp)

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c. Ship name: R/V Ryofu Maru

d. Ports of call: Leg 1: Tokyo–Palau

Leg 2: Palau–Tokyo

e. Cruise dates: Leg 1: 3 July 2016–27 July 2016

Leg 2: 31 July 2016–24 August 2016

f. Floats and drifters deployed: 1 float

1 drifter

2. Cruise Summary Information

RF16-06 cruise was carried out during the period from July 3 to August 24, 2016. The cruise started from the south of Honshu, Japan, and sailed towards south along approximately 137°E meridian. This line (WHP-P9) was observed by JMA in 1994 as WOCE (World Ocean Circulation Experiment) Hydrographic Programme and in 2010 as CLIVAR (Climate Variability and Predictability Project) / GO-SHIP (Global Ocean Ship-based Hydrographic Investigations Program).

A total of 92 stations was occupied using a Sea-Bird Electronics (SBE) 36 position carousel equipped with 10-liter Niskin water sample bottles, a CTD system (SBE911plus) equipped with SBE35 deep ocean standards thermometer, JFE Advantech oxygen sensor (RINKO III), Teledyne Benthos altimeter (PSA-916D), and Teledyne RD Instruments L-ADCP (300kHz). To examine consistency of data, we carried out the observation twice at 8°N, 137°E (Stn.59 and 60). Cruise track and station location are shown in [Figure 1](#).

At each station, full-depth CTDO₂ (temperature, conductivity (salinity) and dissolved oxygen) profile were taken, and at almost all stations except for Stn. 62, up to 36 water samples were taken and analyzed. Water samples were obtained from 10 dbar to approximately 10 m above the bottom. In addition, surface water was sampled by a stainless steel bucket at each station. Sampling layer is designed as so-called staggered mesh as shown in Table 1 (*Swift*, 2010). The bottle depth diagram is shown in [Figure 2](#).

Water samples were analyzed for salinity, dissolved oxygen, nutrients, dissolved inorganic carbon (DIC), total alkalinity (TA), pH, CFC-11, CFC-12, CFC-113 and phytopigment (chlorophyll-a and phaeopigments). Underway measurements of partial pressure of carbon dioxide (*p*CO₂), temperature, salinity, chlorophyll-a, subsurface current, bathymetry and meteorological parameters were conducted along the cruise track.

R/V Ryofu Maru departed Tokyo (Japan) on July 3, 2016. The hydrographic cast of CTDO₂ was started at the first station (Stn.1 (34°10'N, 137°E; RF5802)) on July 4. Leg 1 consisted of 59 stations from Stn.1 to Stn.59 (8°N, 137°E; RF5860). Stn.59 was finished on July 23. She called for Palau (Republic of Palau) on July 27 (Leg 1). She left Palau on July 31, 2016. The hydrographic cast of CTDO₂ was restarted at the station (Stn.60 (8°N, 137°E; RF5861)) on August 1. Leg 2 consisted of 33 stations from Stn.60 (8°N, 137°E; RF5861) to Stn.92 (2°20'S, 141°30'E; RF5893). Stn.92 was finished on August 11. She arrived at Tokyo (Japan) on August 24, 2016 (Leg 2). Location data of stations is shown in [Table 2](#).

One Argo float and one drifting ocean data buoy were deployed along the cruise track. The

information of deployed the float and the buoy are listed in [Table 3](#).

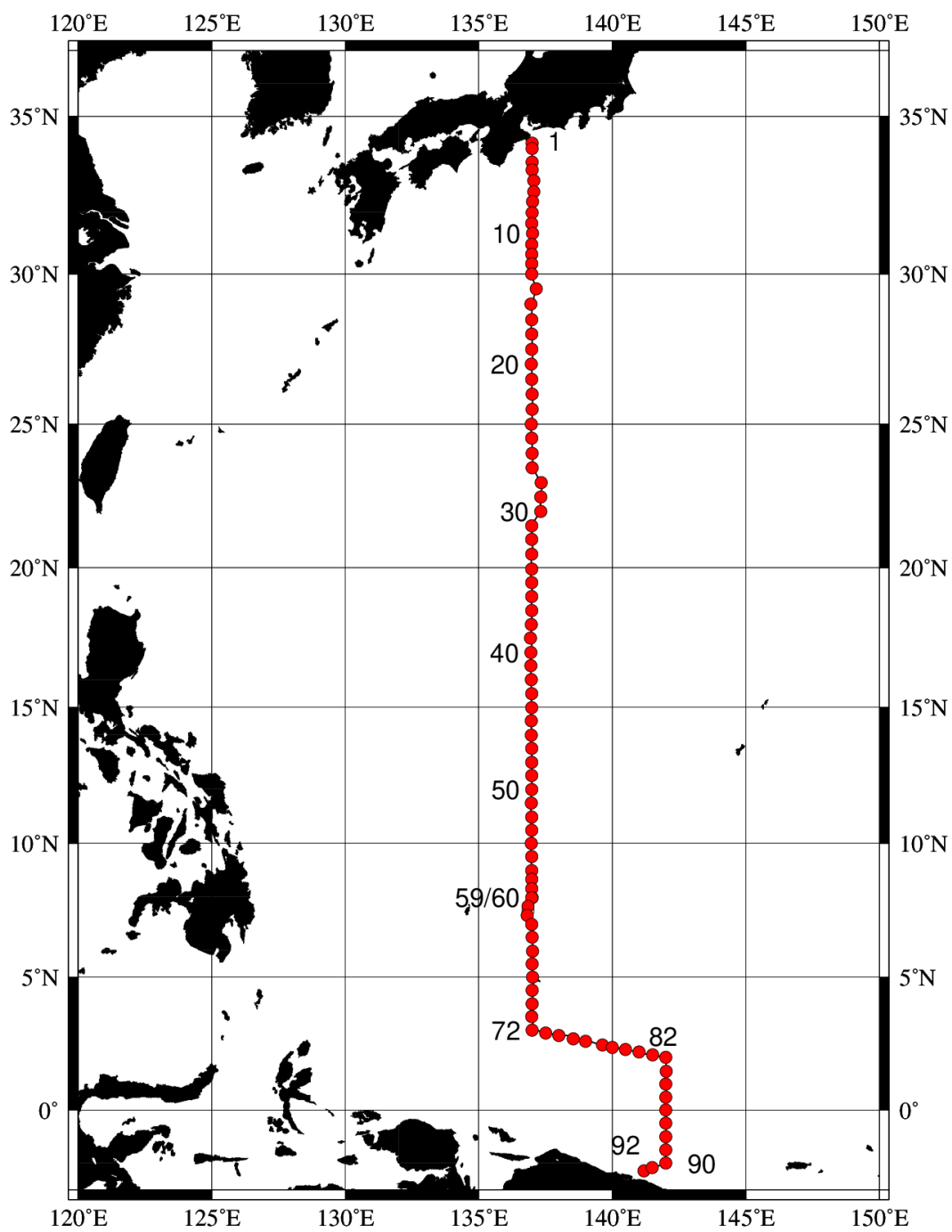


Figure 1. Cruise track of RF16-06.

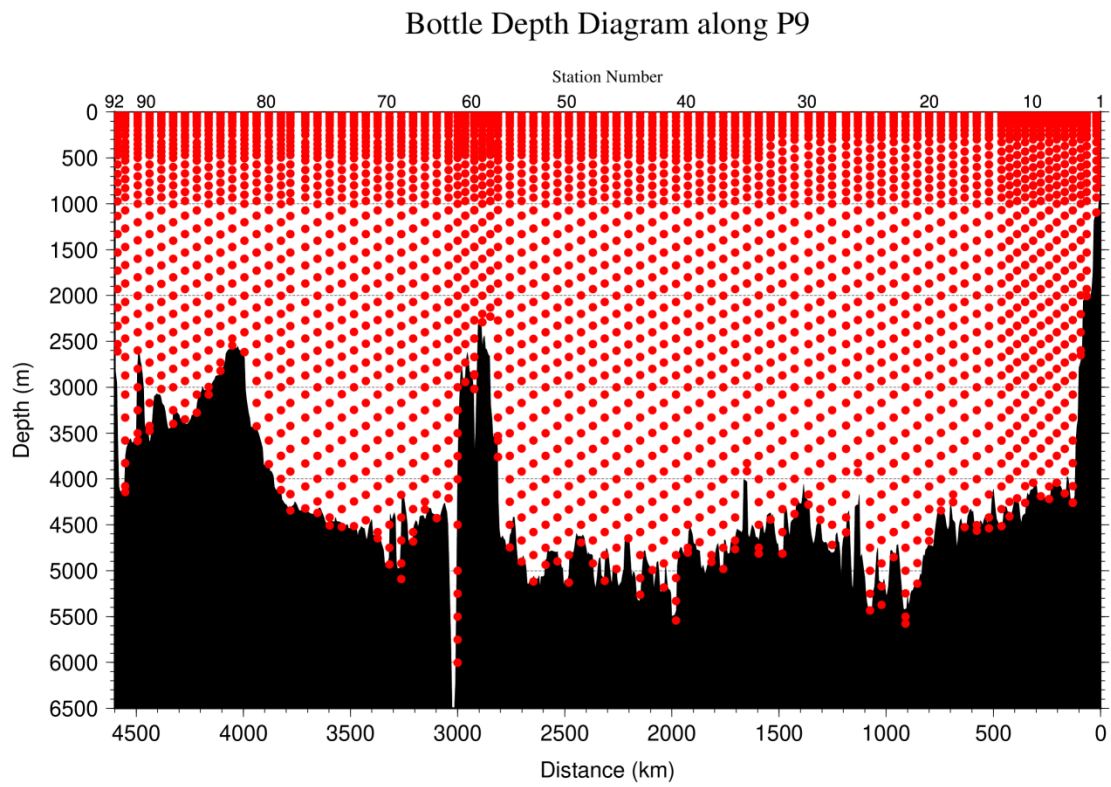


Figure 2. The bottle depth diagram for WHP-P9 revisit.

Table 1. The scheme of sampling layer in meters.

<i>Bottle count</i>	North of 20°N (Stn.1–Stn.33)			South of 20°N (Stn.34–Stn.92)		
	<i>scheme1</i>	<i>scheme2</i>	<i>scheme3</i>	<i>scheme4</i>	<i>scheme5</i>	<i>scheme6</i>
<i>1</i>	10	10	10	10	10	10
<i>2</i>	25	25	25	25	25	25
<i>3</i>	50	50	50	50	50	50
<i>4</i>	75	75	75	75	75	75
<i>5</i>	100	100	100	100	100	100
<i>6</i>	125	125	125	125	125	125
<i>7</i>	150	150	150	150	150	150
<i>8</i>	200	200	200	200	200	200
<i>9</i>	250	250	250	250	250	250
<i>10</i>	300	330	280	300	330	280
<i>11</i>	400	430	370	350	380	320
<i>12</i>	500	530	470	400	430	370
<i>13</i>	600	630	570	450	480	420
<i>14</i>	700	730	670	500	530	470
<i>15</i>	800	830	770	600	630	570
<i>16</i>	900	930	870	700	730	670
<i>17</i>	1000	1070	970	800	830	770
<i>18</i>	1200	1270	1130	900	930	870
<i>19</i>	1400	1470	1330	1000	1070	970
<i>20</i>	1600	1670	1530	1200	1270	1130
<i>21</i>	1800	1870	1730	1400	1470	1330
<i>22</i>	2000	2070	1930	1600	1670	1530
<i>23</i>	2200	2270	2130	1800	1870	1730
<i>24</i>	2400	2470	2330	2000	2070	1930
<i>25</i>	2600	2670	2530	2200	2270	2130
<i>26</i>	2800	2870	2730	2400	2470	2330
<i>27</i>	3000	3080	2930	2600	2670	2530
<i>28</i>	3250	3330	3170	2800	2870	2730
<i>29</i>	3500	3580	3420	3000	3080	2930
<i>30</i>	3750	3830	3670	3250	3330	3170
<i>31</i>	4000	4080	3920	3500	3580	3420
<i>32</i>	4250	4330	4170	3750	3830	3670
<i>33</i>	4500	4580	4420	4000	4080	3920
<i>34</i>	4750	4830	4670	4250	4330	4170
<i>35</i>	5000	5080	4920	4500	4580	4420

Table 1. Continue.

<i>Bottle count</i>	North of 20°N (Stn.1–Stn.33)			South of 20°N (Stn.34–Stn.92)		
	<i>scheme1</i>	<i>scheme2</i>	<i>scheme3</i>	<i>scheme4</i>	<i>scheme5</i>	<i>scheme6</i>
<i>36</i>	5250	5330	5170	4750	4830	4670
<i>37</i>	5500	5580	5420	5000	5080	4920
<i>38</i>	5750	5830	5670	5250	5330	5170
<i>39</i>	6000	6000	6000	5500	5580	5420
<i>40</i>				5750	5830	5670
<i>41</i>				6000	6000	6000

Table 2. Station data of RF16-06 cruise. The ‘RF’ column indicates the JMA station identification number.

<i>Leg</i>	<i>Station</i>		<i>Position</i>		<i>Leg</i>	<i>Station</i>		<i>Position</i>	
	<i>Stn.</i>	<i>RF</i>	<i>Latitude</i>	<i>Longitude</i>		<i>Stn.</i>	<i>RF</i>	<i>Latitude</i>	<i>Longitude</i>
1	1	5802	34-10.49 N	137-00.02 E	1	33	5834	20-29.25 N	136-59.38 E
1	2	5803	34-00.26 N	137-00.04 E	1	34	5835	19-58.33 N	136-59.74 E
1	3	5804	33-35.10 N	137-00.32 E	1	35	5836	19-29.61 N	136-59.86 E
1	4	5805	33-20.36 N	137-00.73 E	1	36	5837	18-59.87 N	136-59.31 E
1	5	5806	33-00.42 N	137-03.29 E	1	37	5838	18-29.90 N	136-59.51 E
1	6	5807	32-39.77 N	137-03.32 E	1	38	5839	17-59.19 N	136-58.61 E
1	7	5808	32-20.44 N	137-01.63 E	1	39	5840	17-30.27 N	136-56.65 E
1	8	5809	31-59.45 N	137-00.82 E	1	40	5841	16-59.80 N	136-57.92 E
1	9	5810	31-38.69 N	136-59.83 E	1	41	5842	16-30.21 N	136-57.90 E
1	10	5811	31-19.13 N	137-01.13 E	1	42	5843	16-00.19 N	136-58.60 E
1	11	5812	30-58.80 N	136-59.55 E	1	43	5844	15-30.09 N	136-59.00 E
1	12	5813	30-39.47 N	136-59.83 E	1	44	5845	14-59.50 N	136-59.35 E
1	13	5814	30-20.04 N	136-59.20 E	1	45	5846	14-30.08 N	136-58.88 E
1	14	5815	30-00.70 N	136-59.29 E	1	46	5847	13-59.79 N	136-58.40 E
1	15	5816	29-31.59 N	137-09.03 E	1	47	5848	13-30.33 N	136-59.25 E
1	16	5817	29-01.52 N	136-57.97 E	1	48	5849	12-59.99 N	136-59.33 E
1	17	5818	28-30.27 N	136-59.73 E	1	49	5850	12-30.39 N	136-59.39 E
1	18	5819	28-02.64 N	136-59.38 E	1	50	5851	11-59.12 N	136-59.61 E
1	19	5820	27-31.32 N	136-59.83 E	1	51	5852	11-29.12 N	136-58.77 E
1	20	5821	27-02.23 N	136-58.87 E	1	52	5853	10-58.76 N	136-59.38 E
1	21	5822	26-31.86 N	136-59.52 E	1	53	5854	10-29.23 N	136-59.52 E
1	22	5823	26-01.18 N	137-00.69 E	1	54	5855	10-00.11 N	136-58.67 E
1	23	5824	25-30.16 N	137-00.72 E	1	55	5856	9-30.04 N	136-59.13 E
1	24	5825	25-00.33 N	136-58.55 E	1	56	5857	8-59.69 N	136-59.36 E
1	25	5826	24-31.44 N	136-59.38 E	1	57	5858	8-40.01 N	136-59.64 E
1	26	5827	24-00.38 N	137-00.96 E	1	58	5859	8-19.94 N	136-59.87 E
1	27	5828	23-30.16 N	137-00.34 E	1	59	5860	7-59.75 N	137-00.12 E
1	28	5829	22-59.78 N	137-20.39 E	2	60	5861	7-59.61 N	136-59.17 E
1	29	5830	22-29.37 N	137-19.64 E	2	61	5862	7-39.02 N	136-50.51 E
1	30	5831	21-59.88 N	137-19.31 E	2	62	5863	7-29.24 N	136-50.68 E
1	31	5832	21-29.68 N	136-59.35 E	2	63	5864	7-19.40 N	136-49.06 E
1	32	5833	21-00.15 N	136-59.86 E	2	64	5865	6-59.16 N	136-59.90 E

Table 2. Continue.

<i>Leg</i>	<i>Station</i>		<i>Position</i>		<i>Leg</i>	<i>Station</i>		<i>Position</i>	
	<i>Stn.</i>	<i>RF</i>	<i>Latitude</i>	<i>Longitude</i>		<i>Stn.</i>	<i>RF</i>	<i>Latitude</i>	<i>Longitude</i>
2	65	5866	6-30.87 N	137-00.96 E	2	79	5880	2-17.67 N	140-29.90 E
2	66	5867	5-59.23 N	137-01.41 E	2	80	5881	2-11.07 N	141-00.26 E
2	67	5868	5-30.57 N	137-00.53 E	2	81	5882	2-05.23 N	141-30.55 E
2	68	5869	5-00.59 N	137-01.33 E	2	82	5883	1-59.08 N	142-00.39 E
2	69	5870	4-31.23 N	137-00.61 E	2	83	5884	1-28.93 N	142-01.54 E
2	70	5871	4-00.90 N	137-00.43 E	2	84	5885	0-59.28 N	142-00.82 E
2	71	5872	3-31.28 N	136-59.95 E	2	85	5886	0-29.32 N	142-00.70 E
2	72	5873	3-01.39 N	137-00.83 E	2	86	5887	0-00.07 S	142-00.61 E
2	73	5874	2-54.33 N	137-30.63 E	2	87	5888	0-29.90 S	142-00.87 E
2	74	5875	2-49.26 N	138-00.52 E	2	88	5889	1-00.75 S	142-00.28 E
2	75	5876	2-41.51 N	138-32.00 E	2	89	5890	1-30.46 S	142-00.26 E
2	76	5877	2-36.54 N	139-00.45 E	2	90	5891	2-00.37 S	142-00.02 E
2	77	5878	2-27.30 N	139-38.67 E	2	91	5893	2-10.54 S	141-29.74 E
2	78	5879	2-22.85 N	140-00.81 E	2	92	5892	2-17.23 S	141-11.36 E

Table 3. Information of deployed float and buoy.

<i>Float</i> <i>WMO number</i>	<i>Date and Time</i> <i>of Deployment (UTC)</i>	<i>Position of deployment</i>		<i>PI</i>	
		<i>Latitude</i>	<i>Longitude</i>		
2902982	2016 Aug. 15 23:20	21-57.62 N	139-02.82 E	JMA	ARVOR

<i>Buoy</i> <i>WMO number</i>	<i>Date and Time</i> <i>of Deployment (UTC)</i>	<i>Position of deployment</i>		<i>PI</i>	
		<i>Latitude</i>	<i>Longitude</i>		
21704	2016 July 07 19:11	30-00.98 N	136-59.99 E	JMA	YTSS-2100

ARVOR: nke Instrumentation, France

YTSS-2100: JVC KENWOOD Co., Japan

3. List of Principal Investigators for all Measurements

The principal investigator (PI) and the person in charge responsible for major parameters measured on the cruise are listed in Table 4.

Table 4. List of principal investigator and the person in charge on the ship for RF16-06.

Item	Principal Investigator (PI)	Person in charge on the ship
<u>Hydrography</u>		
CTDO ₂ / LADCP	Toshiya NAKANO	Yoshikazu HIGASHI
Salinity	Toshiya NAKANO	Keizo SHUTTA
Dissolve oxygen	Toshiya NAKANO	Kazuhiro SAITO
Nutrients	Toshiya NAKANO	Takahiro KITAGAWA
Phytopigment	Toshiya NAKANO	Hiroyuki TAKANO
DIC	Toshiya NAKANO	Shinji MASUDA
Total Alkalinity	Toshiya NAKANO	Shinji MASUDA
pH	Toshiya NAKANO	Shinji MASUDA
CFCs	Toshiya NAKANO	Kazukaka ENYO
<u>Underway</u>		
Meteorology	Toshiya NAKANO	Naoki NAGAI
Thermo-Salinograph	Toshiya NAKANO	Shinji MASUDA
pCO ₂	Toshiya NAKANO	Shinji MASUDA
Chlorophyll-a	Toshiya NAKANO	Hiroyuki TAKANO
ADCP	Toshiya NAKANO	Yoshikazu HIGASHI
Bathymetry	Toshiya NAKANO	Yoshikazu HIGASHI
<u>Floats</u>		
Argo float	Kazuhiro NEMOTO	Keizo SHUTTA

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Reference

Swift, J. H. (2010): Reference-quality water sample data: Notes on acquisition, record keeping, and evaluation. *IOCCP Report No.14, ICPO Pub. 134, 2010 ver.1*

CCHDO Data Processing Notes

Data History

- **File Online Carolina Berys**

[p09su.txt \(download\)](#) #63b78

Date: 2018-06-08

Current Status: unprocessed

- **File Online Carolina Berys**

[p09_hy1.csv \(download\)](#) #f416f

Date: 2018-06-08

Current Status: unprocessed

- **File Online Carolina Berys**

[A_cruise_narrative_2016_P09_20180502.doc \(download\)](#) #a1704

Date: 2018-06-08

Current Status: unprocessed

- **File Online Carolina Berys**

[ct1.zip \(download\)](#) #f88c7

Date: 2018-06-08

Current Status: unprocessed

- **File Submission Toshiya NAKANO**

[p09su.txt \(download\)](#) #63b78

Date: 2018-05-12

Current Status: unprocessed

Notes

Ship Name: Ryofu Maru (Japan Meteorological Agency)
Section: P09 (RF16-06)
Cruise date:
RF16-06 : 3 July 2016-24 August 2016

- **File Submission Toshiya NAKANO**

[p09_hy1.csv \(download\)](#) #f416f

Date: 2018-05-12

Current Status: unprocessed

Notes

Ship Name: Ryofu Maru (Japan Meteorological Agency)
Section: P09 (RF16-06)
Cruise date:
RF16-06 : 3 July 2016-24 August 2016

- **File Submission Toshiya NAKANO**

[ct1.zip \(download\)](#) #f88c7

Date: 2018-05-12

Current Status: unprocessed

Notes

Ship Name: Ryofu Maru (Japan Meteorological Agency)
Section: P09 (RF16-06)
Cruise date:
RF16-06 : 3 July 2016-24 August 2016

- **File Submission Toshiya NAKANO**

[A_cruise_narrative_2016_P09_20180502.doc \(download\)](#) #a1704

Date: 2018-05-12

Current Status: unprocessed

Notes

Ship Name: Ryofu Maru (Japan Meteorological Agency)
Section: P09 (RF16-06)
Cruise date:
RF16-06 : 3 July 2016-24 August 2016