



R/V Yokosuka Cruise Report

YK16-02

Vicinity of the Japan Trench

Strategic Innovation Promotion Program

Enhancement of Societal Resiliency against Natural

Disasters (Seafloor Geodetic Observation)

May 1st, 2016 – May 24th, 2016

Japan Agency for Marine-Earth Science and Technology

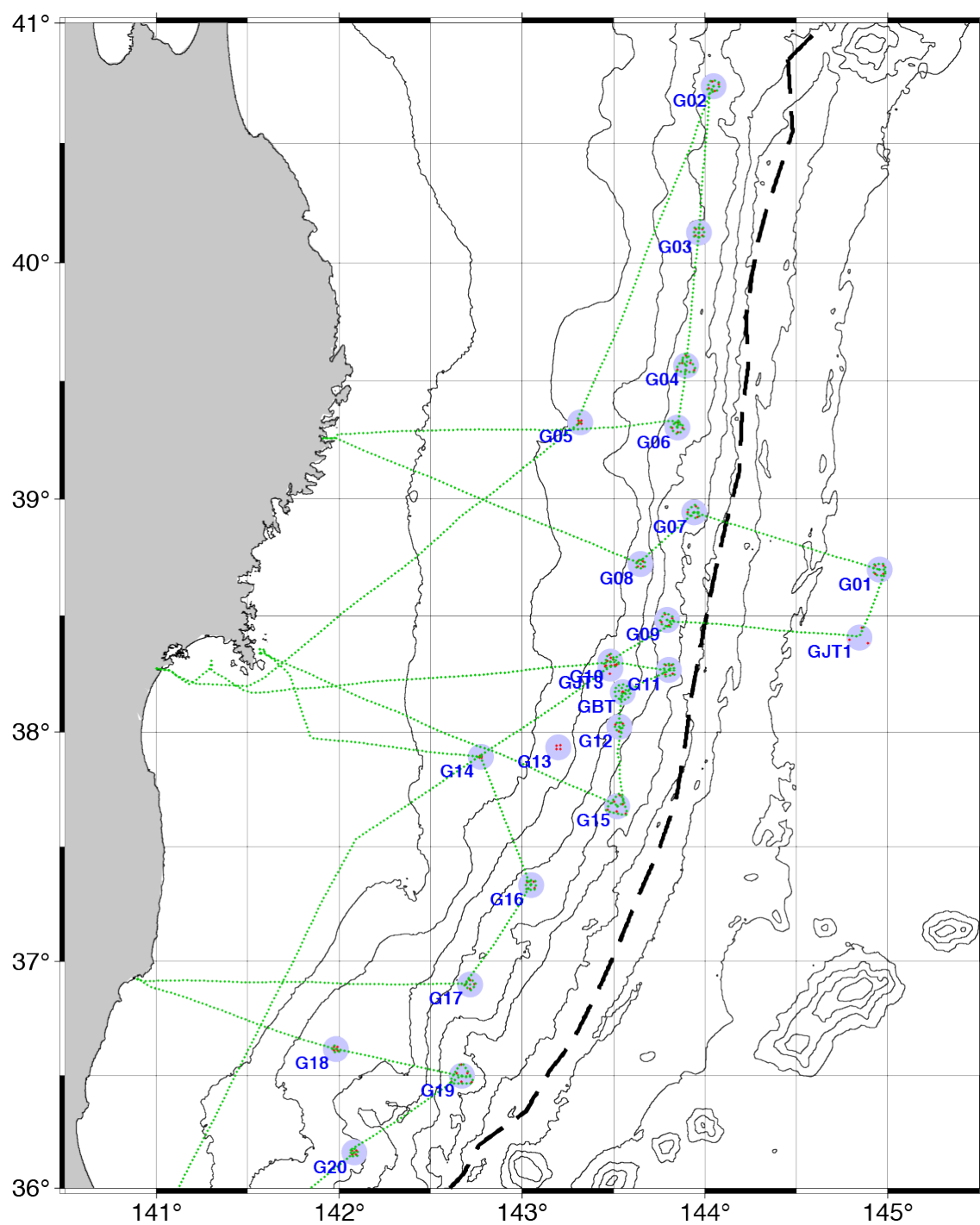
(JAMSTEC)

●Contents

1. Cruise information
2. List of participants
 - 2.1 Onboard scientists
 - 2.2 Crew members
3. Observation
 - 3.1 General purpose of GPS/acoustic survey
 - 3.2 Methods
 - 3.3 Data recording
 - 3.4 List of observation equipment
 - 3.5 Cruise log
 - 3.6 Research results of GPS/A survey (in UTC)
 - 3.7 Autonomous Surface Vehicle (ASV) deployment
 - 3.8 Research information
 - List of number of shot and duration of sum of point and moving GPS/A surveys
 - List of XBT measurements
 - List of XCTD measurements
 - List of CTD casts
4. Notice on using

1. Cruise Information

- Cruise ID: YK16-02
- Name of vessel: R/V Yokosuka
- Title of the cruise: Strategic Innovation Promotion Program, Enhancement of Societal Resiliency against Natural Disasters (Seafloor Geodetic Observation)
- Title of proposal: Finding optimal site for installation of the seafloor geodetic observation system (Shuichi Kodaira)
- Cruise period: May 1st to 24th, 2016
- Ports of departure / call / arrival: JAMSTEC / Sendai / JAMSTEC
- Research area: Vicinity of the Japan trench
- Research Map



Cruise track and survey sites throughout the cruise (Leg1/Leg2)

2. List of participants

- Chief scientist [Affiliation]: Takeshi Iinuma [JAMSTEC] (Leg 1) & Kentaro Imai [JAMSTEC] (Leg 2)
- Representative of the science party [Affiliation]: Shuichi Kodaira [JAMSTEC]

2.1. Onboard scientists

- Science party (List) [Affiliation, assignment etc.]

Leg 1.

Takeshi IINUMA	JAMSTEC	(Chief Scientist)
Motoyuki KIDO	Tohoku Univ.	(Vise Chief Scientist)
Makiko SATO	Tohoku Univ.	
Ryusuke YAMAMOTO	Tohoku Univ.	

Leg 2.

Kentaro IMAI	JAMSTEC	(Chief Scientist)
Yoshibumi KAWADA	Tohoku Univ.	(Vise Chief Scientist)
Fumiaki TOMITA	Tohoku Univ.	
Misae IMANO	Tohoku Univ.	

Marine Technician (Leg 1 & 2)

Shinsuke TOYODA	Marine Work Japan
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2.2. Crew members

Captain	Eiko UKEKURA
Chief Officer	Yasuhiko SAMMORI
2nd Officer	Tetsuo SHIRAYAMA
Jr. 2nd Officer	Takeshi EGASHIRA
3rd Officer	Yuki FURUKAWA
Jr. 3rd Officer	Akihiro NUNOME
Chief Engineer	Koji FUNAE
1st Engineer	Wataru KUROSE
2nd Engineer	Kenichi SHIRAKATA
3rd Engineer	Yoshihiro OTSUGA
Chief Electronic Op.	Hiroyasu SAITAKE
2nd Electronic Op.	Yuka MORIWAKI
3rd Electronic Op.	Toshihiko YUASA
Jr. 3rd Electronic Op.	Ryuji ONIKUBO
Boatswain	Kazuo ABE
Quarter Master	Tsuyoshi CHIMOTO
Quarter Master	Kaname HIROSAKI
Quarter Master	Takuya MIYASHITA
Quarter Master	Hiroataka SHIGETA
Quarter Master	Kosei KAWAMURA

Sailor	Kyohei MURAI
No.1 Oiler	Yukihiro YAMAGUCHI
Oiler	Katsuyuki MIYAZAKI
Oiler	Shinya SUGI
Assistant Oiler	Aoi TAKAMIYA
Assistant Oiler	Seiya WATANABE
Chief Steward	Kiyotak KOSUJI
Steward	Hideo FUKUMURA
Steward	Masao HOSOYA
Steward	Hiroyuki OHBA
Steward	Haruka KINOSHITA

3. Observation

3.1 General purpose of GPS/acoustic survey

For the subject entitled as “Enhancement of Societal Resiliency against Natural Disasters” in Strategic Innovation Promotion Program promoted by JST and Cabinet Office, Government of Japan, we have dedicated to intensive seafloor geodetic surveys to elucidate regional postseismic deformation pattern along the Japan trench after the 2011 Tohoku Earthquake and also to evaluate the most effective site where on-demand seafloor geodetic system should be installed at. We mainly employ so-called GPS/acoustic (GPS/A) technique to measure seafloor movement. GPS/A is a combination of two measurements: one is kinematic GPS measurement of surface platform and the other is acoustic ranging between the surface platform and seafloor transponders. A single observation site consists of three or more seafloor transponders forming an array and we have constructed more than 20 sites along the Japan trench ranging from Ibaraki-oki to Aomori-oki after the Tohoku earthquake. In this cruise, R/V Yokosuka plays a role of a GPS/A surface platform using hull-mount acoustic transducer and GPS antenna, permanently installed last year. This cruise is the first opportunity to use these facilities. In the cruise, totally lasted for 24 days, we tried to conduct GPS/A survey at as much sites as possible.

3.2 Methods

In the cruise, GPS/A surveys were repeated at each site with a similar manner. In the first, moving survey is carried out at 5 knot along the circumference of the array of seafloor transponders. It takes one to three hours depending on the array size, which is nearly proportional to their depth. In the second, point survey is made at the center of the array for basically 12 hours. At some sites, moving survey is omitted or carried out after point survey. During a point survey, CTD and/or XBT/XCTD casts were made at least once. At two reference sites, G14 and G18, turning surveys for 10 minutes were carried out for calibrating the transducer position. Acoustic ranging pings were continued every 60 sec during the survey. GPS data,

include baselines to temporal antenna for attitude determination, were recorded throughout the cruise. Primary attitude is obtained from OCTANS, a hull-mount fiber optical gyro in the STCM data, provided by radio room. When sea condition is calm enough, ASV is deployed for concurrent acoustic ranging with ship's using slightly different position.

3.3 Data recording

Acoustic surface unit	100kHz 16bit 10sec for a single ping
Trimble NetR9	2Hz (GPS, GLONASS, QZSS)
JAVAD	2Hz (GPS, GLONASS) with auxiliary antenna baselines
Septentrio PolaRx 2@	2 Hz (GPS) with auxiliary antenna baselines
Motion sensor	50Hz tri-axial linear acceleration, rate of turn, magnetic field
OCTANS	8Hz attitude (head, roll, pitch)
XBT	20Hz, 291sec (~1832m)
XCTD	25Hz, 537sec (~1950m)
CTD	24Hz (converted into every 1m depth)

3.4 List of observation equipment

Hull-mount transducer:	bottom	ITC-3148 filled with fresh water.
Hull-mount gyro		OCTANS (Fiber Optic)
Permanent GPS antenna	top of the bridge	Trimble Zephyr Geodetic with redome
Permanent GPS receiver	control room	Trimble NetR9 with rubidium clock
Temporal GPS antennas	funnel deck	Trimble Zephyr Geodetic with redome
GPS receiver 1	control room	Septentrio PolaRx 2@
GPS receiver 2	control room	JAVAD
Motion sensor	control room	xsens
Acoustic surface unit	control room	Kaiyo-denshi
Autonomous buoy	garage	ASV C-Stat2
ASV controller	2nd bridge	ASV

3.5 Cruise log (in JST)

05/01	10:00	JAMSTEC	Departure
	22:00	G20	Arrival, started point survey
	23:23	G20	XBT
05/02	07:31	G20	CTD started (2742m)
	08:23	G20	CTD bottom
	09:17	G20	CTD finished

	09:30	G20	Started moving survey
	11:03	G20	Shift to G19
	13:10	G19	Arrival
	13:40	G19	Started point survey
	14:30	G19	CTD started (5725m)
	16:00	G19	CTD bottom
	17:25	G19	CTD finished
	22:58	G19	XBT
05/03	02:00	G19	Started moving survey
	05:37	G19	Shift to G18
	08:00	G18	Arrival, started point survey (+calibration)
	11:18	G18	XCTD
	15:00	G18	Evacuation to Onahama
	19:00	Onahama	Anchoring
05/04	--:--	Onahama	Wait
05/05	07:00	Onahama	Unanchor, shift to G17
	13:00	G17	Arrival, started point survey
	14:00	G17	CTD started (4232m)
	16:30	G17	CTD finished
	21:00	G17	XBT, started moving survey
	23:00	G17	Shift to G16
05/06	01:30	G16	Arrival, started moving survey
	03:40	G16	Started point survey
	08:00	G16	CTD started (4406m)
	10:13	G16	CTD finished
	14:48	G16	XBT, shift to G14
	17:05	G14	Arrival
	17:35	G14	Started moving survey
	18:42	G14	Started point survey
	18:43	G14	CTD started (1312m)
	19:32	G14	CTD finished
	19:36	G14	Calibration (10 min.)
05/07	03:06	G14	XBT, evacuation to Sendai-bay
05/07	--:--	Kinkazan	Wait
	22:45	Kinkazan	Shift to G15 (110nm)
05/08	05:30	G15	Arrival, started point survey

05/09	08:20	G15	XCTD (twice)
	14:00	G15	CTD started (5263m)
	17:00	G15	CTD finished
	18:30	G15	Started moving survey
	22:30	G15	Shift to G12 (21nm)
	00:00	G12	Arrival, started moving survey
	03:00	G12	Started point survey
	06:00	G12	Deployed ASV
	11:30	G12	XCTD
	14:30	G12	Recovered ASV on deck
	15:00	G12	Shift to GBT (9nm)
	16:00	GBT	Arrival, started point survey
	16:30	GBT	CTD started (3448m)
	18:30	GBT	CTD finished
	19:00	GBT	Started moving survey (1nm radius)
05/10	20:00	GBT	Started moving survey (2nm radius)
	22:00	GBT	Shift to G11 (20nm)
	00:00	G11	Arrival, started moving survey
	03:30	G11	Started point survey
	06:00	G11	Deployed ASV
	07:53	G11	Recovered ASV on deck (communication failure)
	08:16	G11	CTD started (5548m)
	10:54	G11	CTD finished
	14:47	G11	XBT
	15:00	G11	Shift to GJT3 (15nm)
	16:10	GJT3	Trial to check transponders' response
	16:30	GJT3	Doubled to Sendai bay
05/11	09:00	Sendai Port	Arrival
05/12	08:00	Sendai Port	Transition briefing from Leg.1 to Leg.2
	09:00	Sendai Port	Departure to G05
05/13	17:30	G05	Arrival
	17:55	G05	CTD started (2084 m)
	18:17	G05	Started point survey
	19:13	G05	CTD finished
	06:04	G05	XBT
	06:10	G05	Started moving survey

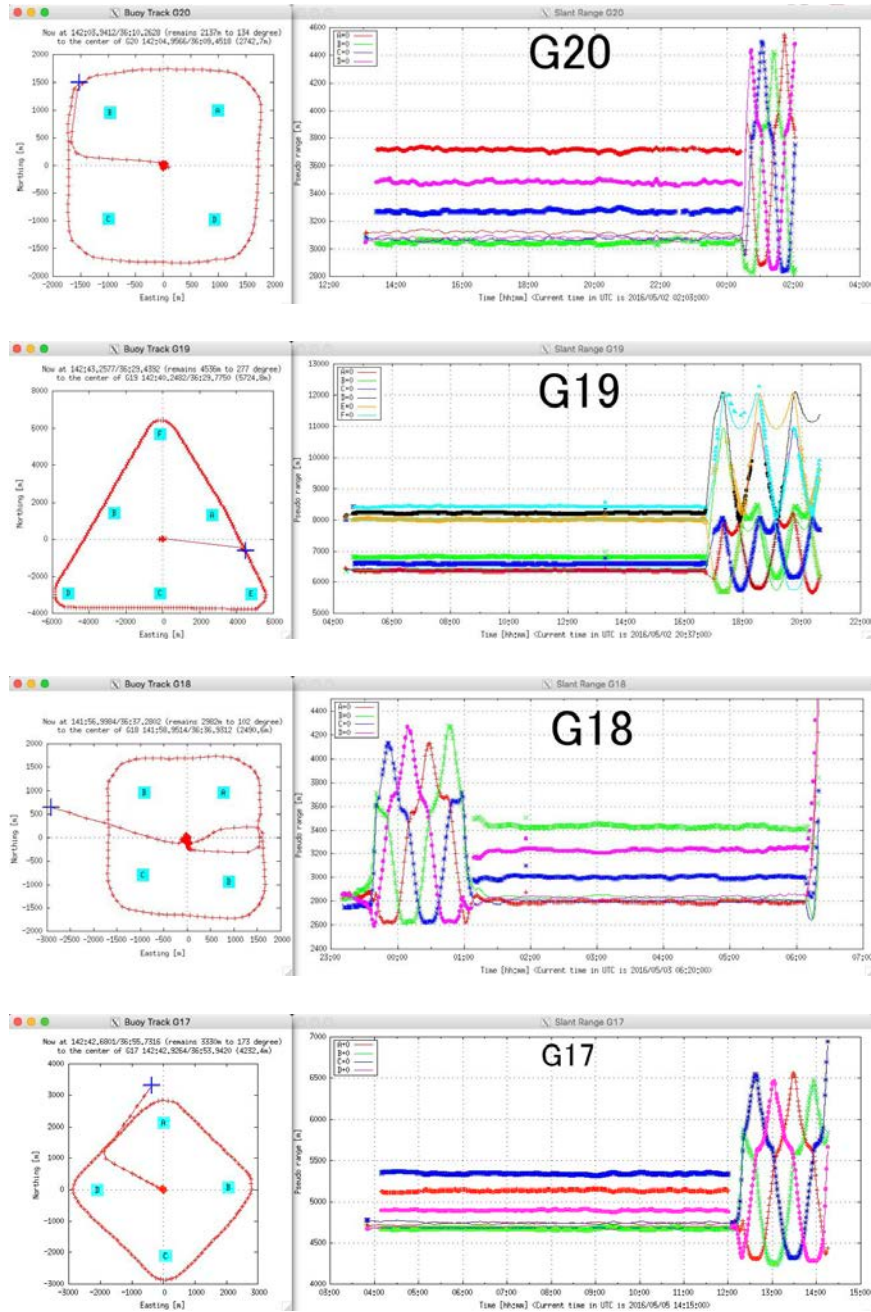
	07:30	G05	Shift to G02 (91nm)
	12:47	G02	Arrival
	13:13	G02	CTD started (4672 m)
	13:26	G02	Started point survey
	15:30	G02	CTD finished
05/14	00:02	G02	XBT
	01:00	G02	Started moving survey
	03:19	G02	Shift to G03 (38nm)
05/14	05:24	G03	Arrival
	05:52	G03	Started moving survey
	07:53	G03	Started point survey
	08:11	G03	CTD started (4218 m), clean ASV
	09:58	G03	Finished ASV clearance
	10:24	G03	CTD finished
	20:00	G03	XBT
	20:30	G03	Shift to G04 (34nm)
	22:35	G04	Arrival
	23:04	G04	Started moving survey
05/15	03:18	G04	Started point survey
	07:58	G04	CTD started (4586 m)
	10:07	G04	CTD finished
	15:00	G04	XBT
	15:30	G04	Shift to G06 (16nm)
	16:51	G06	Arrival, started moving survey
	19:11	G06	Started point survey
	19:32	G06	CTD started (4770 m)
	21:43	G06	CTD finished
05/16	04:01	G06	XBT
	08:00	G06	Evacuation to Kamaishi
	14:40		Kamaishi Arrival, anchor
05/17	07:00	Kamaishi	Unanchor, departure to G18
	12:40	G08	Arrival
	13:03	G08	CTD started (3473 m)
	13:15	G08	Started point survey
	14:43	G08	CTD finished
	23:45	G08	XBT

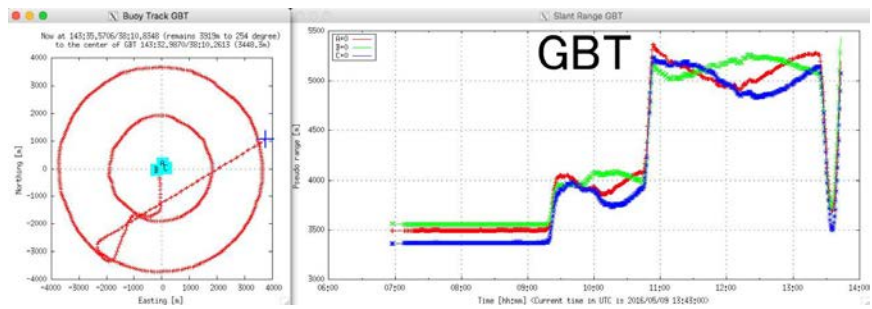
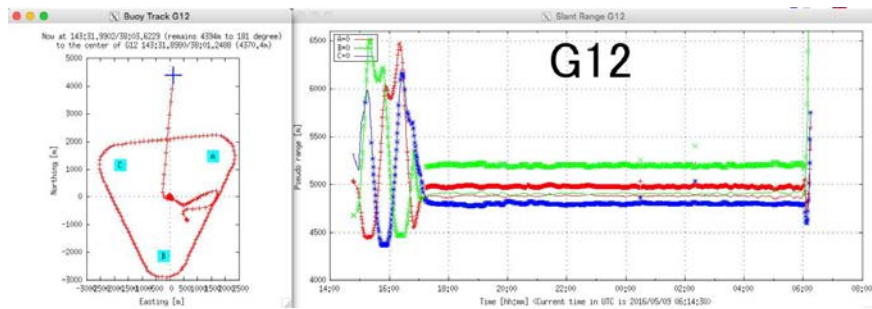
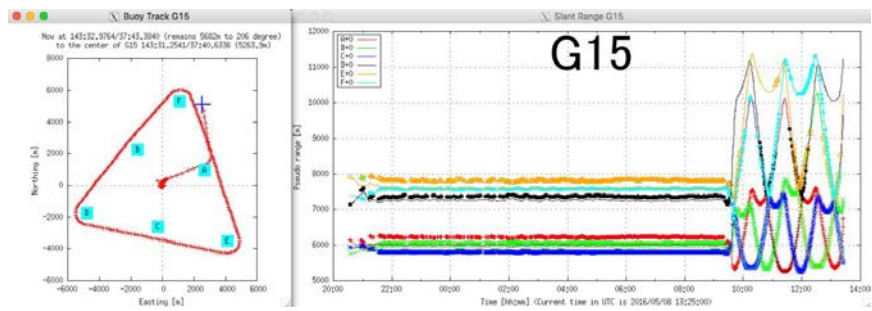
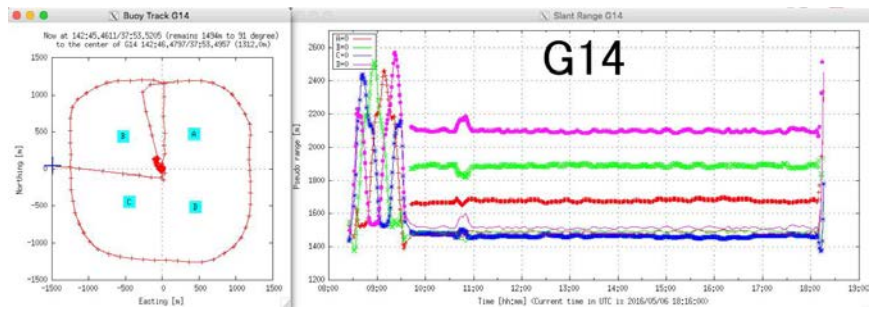
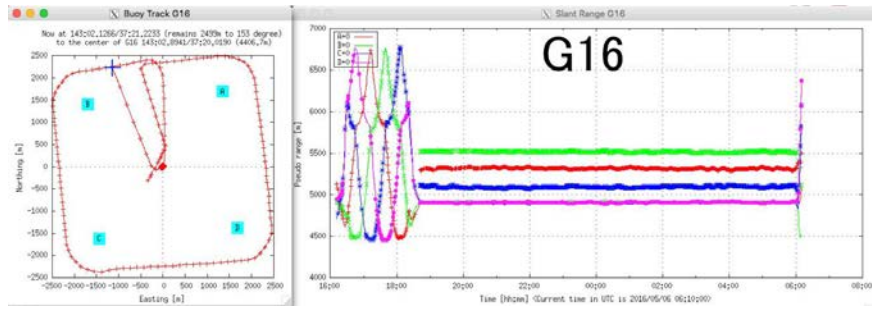
05/18	01:30	G08	Started moving survey
	03:42	G08	Shift to G07 (19nm)
	05:10	G07	Arrival
	05:34	G07	Started moving survey
	08:13	G07	Started point survey
	08:52	G07	XBT
	13:37	G07	CTD started (5550 m)
	16:11	G07	CTD finished
	20:30	G07	Shift to G01 (54nm)
	23:05	G01	Arrival
	23:30	G01	Started point survey
05/19	00:03	G01	XBT
	08:07	G01	CTD started (5490 m)
	10:43	G01	CTD finished
	12:01	G01	Started moving survey
	14:44	G01	Shift to GJT1 (19nm)
	15:59	GJT1	Arrival, trial to check transponder response
	19:33	GJT1	Shift to G09 (51nm)
	22:45	G09	Arrival
	23:14	G09	Started point survey
	23:57	G09	XBT
05/20	08:07	G09	CTD started (5646 m)
	10:47	G09	CTD finished
	13:00	G09	Started moving survey
	15:33	G09	Shift to G10 (19nm)
	17:11	G10	Started point survey
	17:36	G10	CTD started (3270 m)
	19:12	G10	CTD finished
05/21	03:58	G10	XBT
	05:29	G10	Started moving survey
	08:17	G10	Shift to GJT3
	08:35	GJT3	Arrival, trial to check transponder response
	11:54	GJT3	Finalize all the survey, doubled to Yokosuka
05/22	--:--	Tokyo bay	Wait, clear stuffs
05/23	09:00	Yokosuka	Arrival

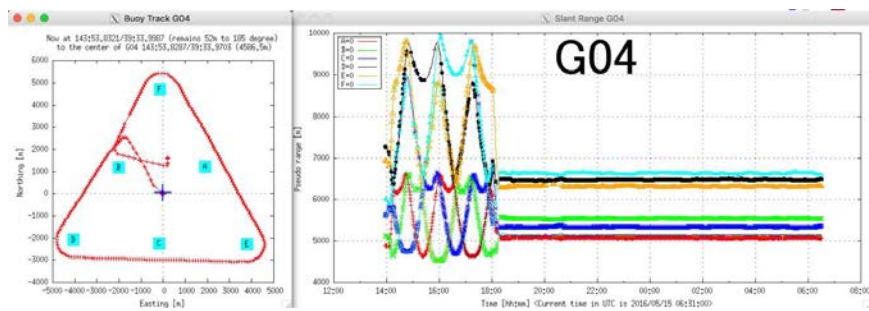
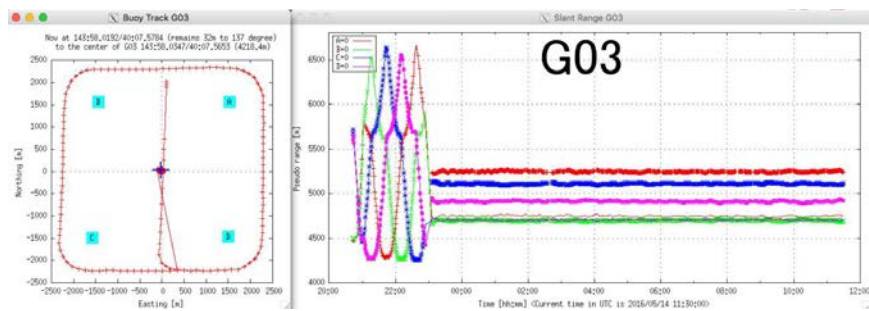
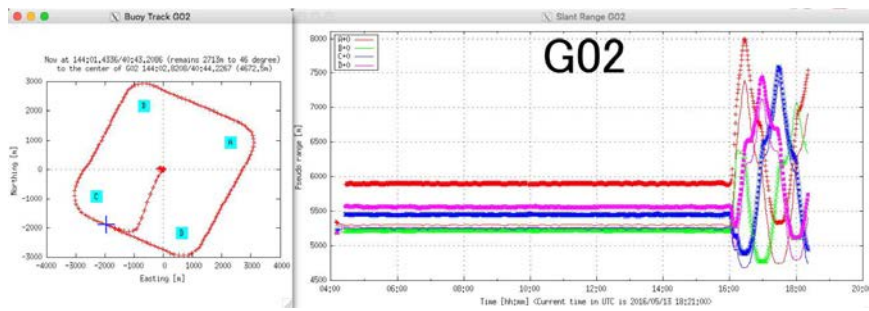
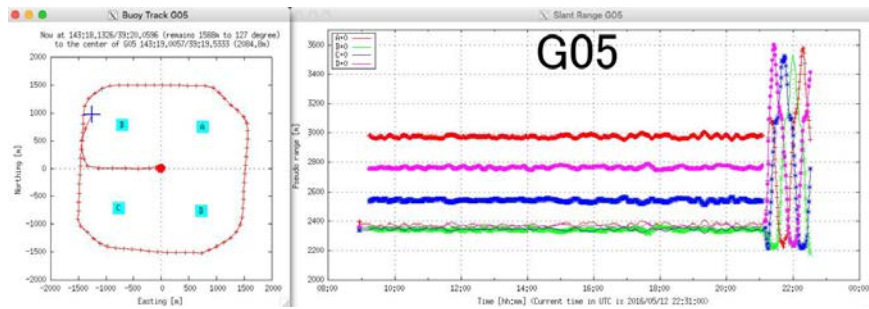
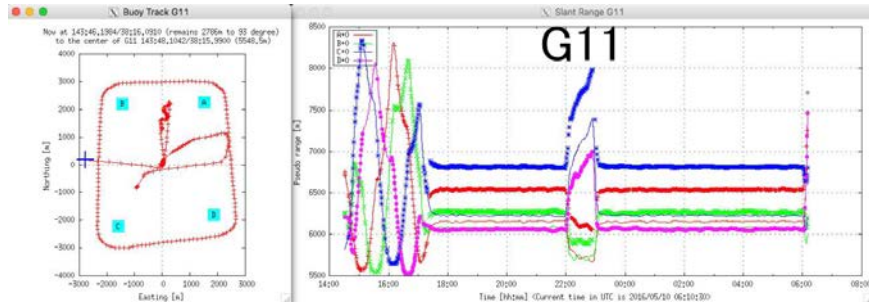
13:00 Yokosuka Unloading

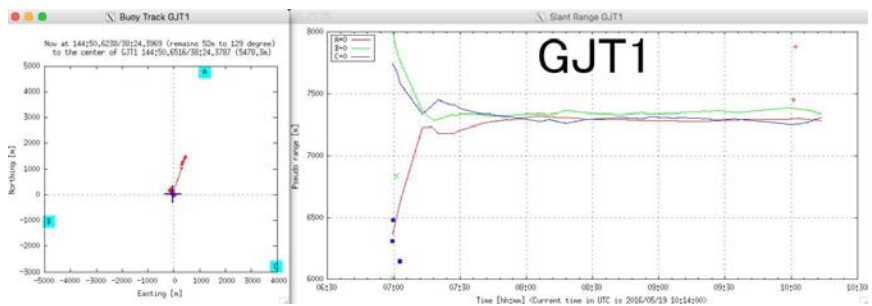
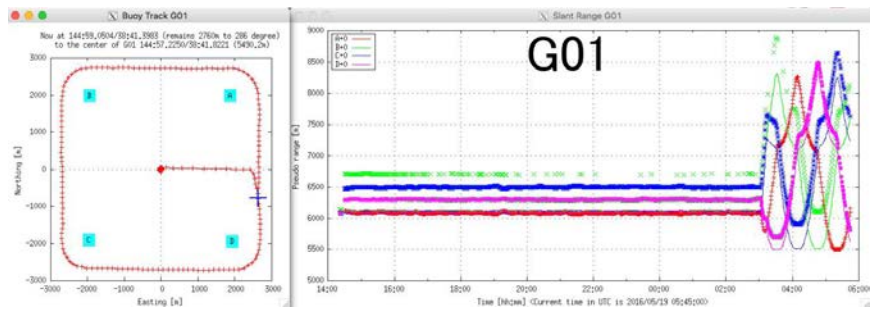
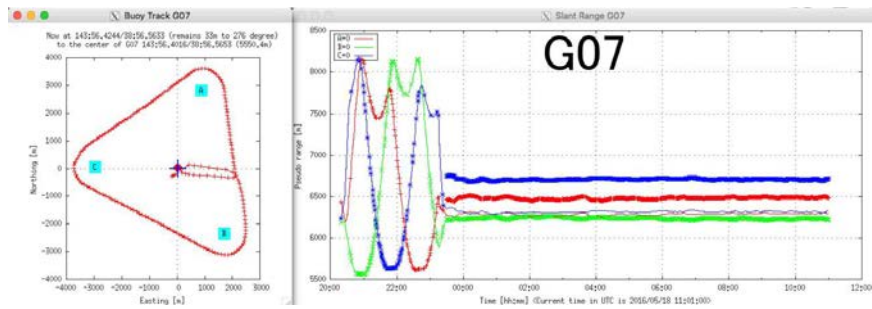
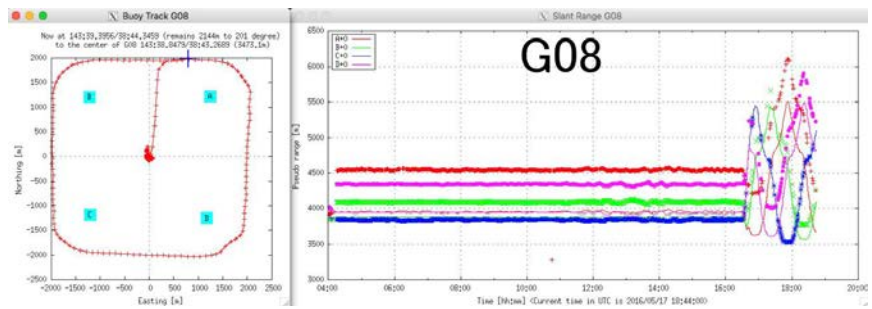
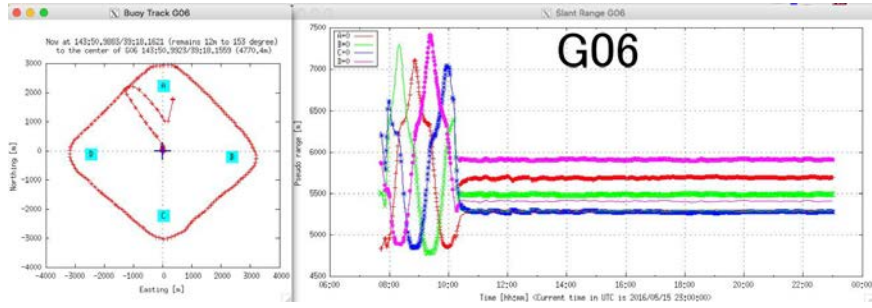
3.6 Research results of GPS/A survey (in UTC)

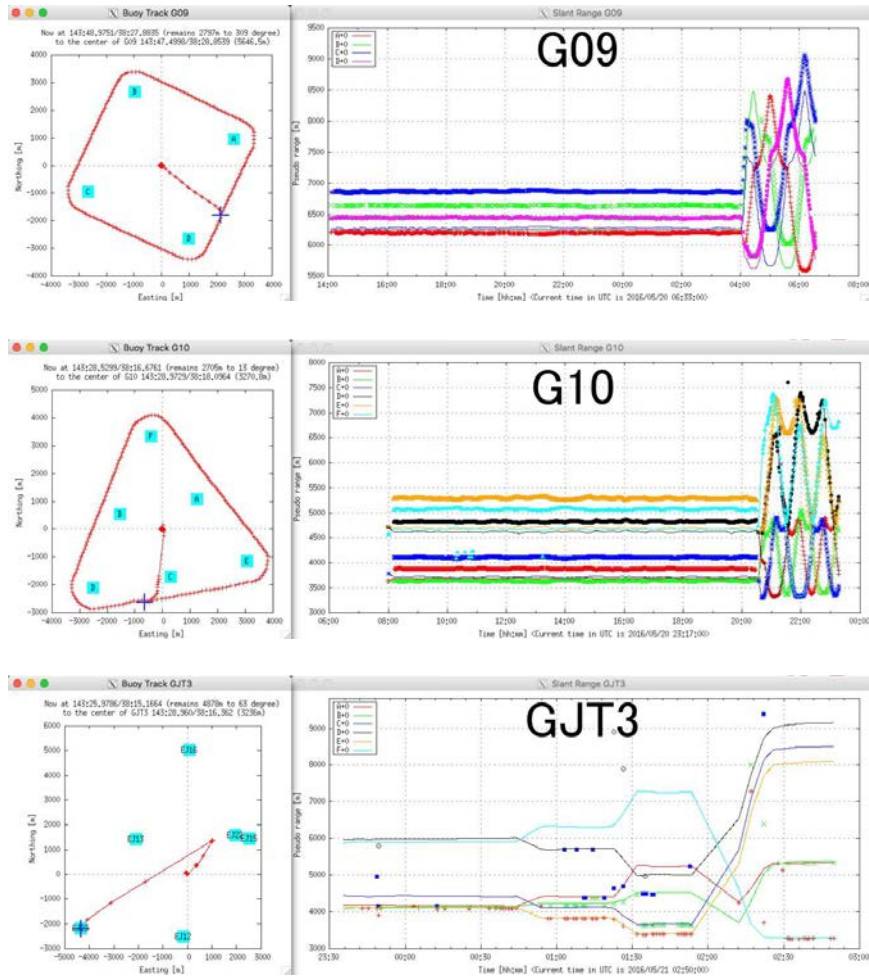
Ship track and ranging result for each site are summarized in order as integrated figures below.





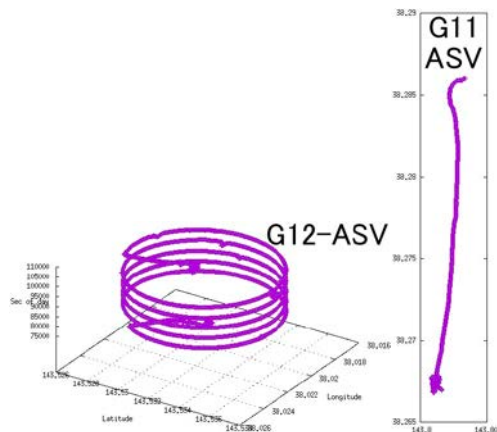


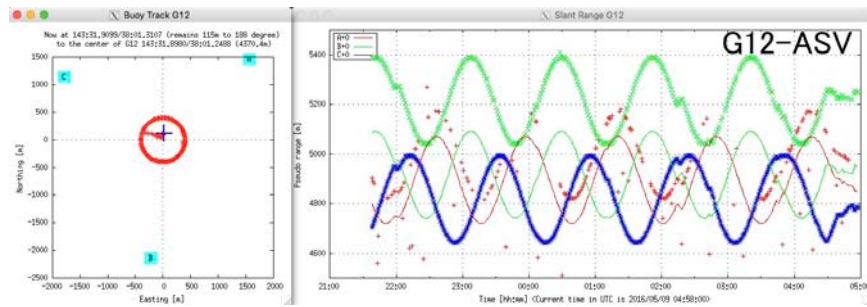




3.7 Autonomous Surface Vehicle (ASV) deployment

On 9th May, ASV was deployed at G12 site and make circling of 400 m radius for 5 times around the ship, while the ship kept point survey. On 10th May, ASV was deployed again at G11 site, but communication error was observed soon after the deployment and started drifting. Then ASV was immediately recovered. Tracks and ASV for G12 and G11, and ranging result for G12 are shown below.





3.8 Research Information

- List of number of shot and duration of sum of point and moving GPS/A surveys

Leg1			Leg2		
site	shot	time[h]	site	shot	time[h]
G20	758	12.99	G05	799	13.59
G19	945	16.24	G02	844	14.22
G18	433	6.98	G03	872	14.78
G17	609	10.43	G04	983	16.56
G16	500	8.48	G06	910	15.29
G14	607	9.85	G08	878	14.70
G15	992	16.85	G07	874	14.70
G12	918	15.47	G01	917	15.38
G12-ASV	441	7.33	GJT1	57	3.22
GBT	786	6.77	G09	984	16.48
G11	932	15.67	G10	902	15.29
			GJT3	37	1.51

- List of XBT measurements

BT-201605011423.XBT	2016/05/01	14:23:02	36-09.4493N	142-04.9450E	(G20)
BT-201605021358.XBT	2016/05/02	13:58:20	36-29.7828N	142-40.2502E	(G19)
BT-201605051149.XBT	2016/05/05	11:49:27	36-53.9366N	142-42.9191E	(G17)
BT-201605051156.XBT	2016/05/05	11:56:17	36-53.9311N	142-42.9111E	(G17)
BT-201605060548.XBT	2016/05/06	05:48:20	37-20.0275N	143-02.8955E	(G16)
BT-201605061756.XBT	2016/05/06	17:56:19	37-53.4974N	142-46.4854E	(G14)
BT-201605100547.XBT	2016/05/10	05:47:04	38-16.0041N	143-48.0929E	(G11)
BT-201605122058.XBT	2016/05/12	20:58:24	39-19.5252N	143-19.0047E	(G05)
BT-201605131457.XBT	2016/05/13	14:57:35	40-44.2253N	144-02.8195E	(G02)
BT-201605141049.XBT	2016/05/14	10:49:15	40-07.5615N	143-58.0409E	(G03)
BT-201605150555.XBT	2016/05/15	05:55:17	39-33.9657N	143-53.8304E	(G04)

BT-201605151857.XBT	2016/05/15	18:57:09	39-18.1459N	143-50.9772E	(G06)
BT-201605171431.XBT	2016/05/17	14:31:16	38-43.2656N	143-38.8385E	(G08)
BT-201605171436.XBT	2016/05/17	14:36:51	38-43.2519N	143-38.8231E	(G08)
BT-201605172352.XBT	2016/05/17	23:52:29	38-56.5591N	143-56.4076E	(G07)
BT-201605181503.XBT	2016/05/18	15:03:05	38-41.8159N	144-57.2238E	(G01)
BT-201605191457.XBT	2016/05/19	14:57:00	38-28.8551N	143-47.4900E	(G09)
BT-201605201853.XBT	2016/05/20	18:53:07	38-18.0942N	143-28.9828E	(G10)

- List of XCTD measurements

CTD-201605030137.RAW	2016/05/03	01:38:13	36-36.9273N	141-58.9706E	(G18)
CTD-201605030217.RAW	2016/05/03	02:17:25	36-36.9360N	141-58.9454E	(G18)
CTD-201605031118.RAW	2016/05/03	11:18:48	(Failed)		
CTD-201605072257.RAW	2016/05/07	22:58:17	37-40.6272N	143-31.2374E	(G15)
CTD-201605072312.RAW	2016/05/07	23:12:38	37-40.6321N	143-31.2572E	(G15)
CTD-201605090228.RAW	2016/05/09	02:28:48	38-01.2386N	143-31.8979E	(G12)

- List of CTD casts

G20_01	2016/05/01	22:21:00	36-09.43N	142-04.96E	2742.0[m]
G19_01	2016/05/02	05:23:01	36-29.79N	142-40.24E	5724.0[m]
G17_01	2016/05/05	04:40:12	36-53.96N	142-42.91E	4232.0[m]
G16_01	2016/05/05	22:55:31	37-20.01N	143-02.87E	4406.0[m]
G14_01	2016/05/06	09:39:52	37-53.53N	142-46.48E	1312.0[m]
G15_01	2016/05/08	04:40:24	37-40.62N	143-31.28E	5263.0[m]
GBT_01	2016/05/09	06:55:12	38-10.27N	143-33.06E	3462.0[m]
G11_01	2016/05/09	23:10:11	38-16.01N	143-48.11E	5548.0[m]
G05_01	2016/05/12	08:16:14	39-15.99N	143-13.38E	2084.0[m]
G02_01	2016/05/13	03:55:13	40-43.08N	144-02.04E	4672.0[m]
G03_01	2016/05/13	22:55:12	40-06.45N	143-58.35E	4218.0[m]
G04_01	2016/05/14	22:40:12	39-33.98N	143-53.82E	4586.0[m]
G06_01	2016/05/15	09:55:12	39-19.72N	143-51.24E	4770.0[m]
G08_01	2016/05/17	03:40:12	38-44.19N	143-36.20E	3473.0[m]
G07_01	2016/05/18	04:17:12	38-56.59N	143-56.41E	5550.0[m]
G01_01	2016/05/18	22:55:11	38-41.82N	144-57.23E	5490.0[m]
G09_01	2016/05/19	22:55:26	38-28.86N	143-47.47E	5646.0[m]
G10_01	2016/05/20	08:25:12	38-18.09N	143-28.95E	3270.0[m]

4. Notice on Using

Notice on using: Insert the following notice to users regarding the data and samples obtained.

This cruise report is a preliminary documentation as of the end of the cruise.

This report may not be corrected even if changes on contents (i.e. taxonomic classifications) may be found after its publication. This report may also be changed without notice. Data on this cruise report may be raw or unprocessed. If you are going to use or refer to the data written on this report, please ask the Chief Scientist for latest information.

Users of data or results on this cruise report are requested to submit their results to the Data Management Group of JAMSTEC.