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"MIRAI" Cruise Report

MR12-01 Leg.2

"Test cruise of observation equipment" and "basic experiment of acoustic communication equipment for Tsunami detecting system at high current area",

Suruga-Bay

20/May/2012 – 30/May/2012

Japan Agency for Marine-Earth Science and Technology

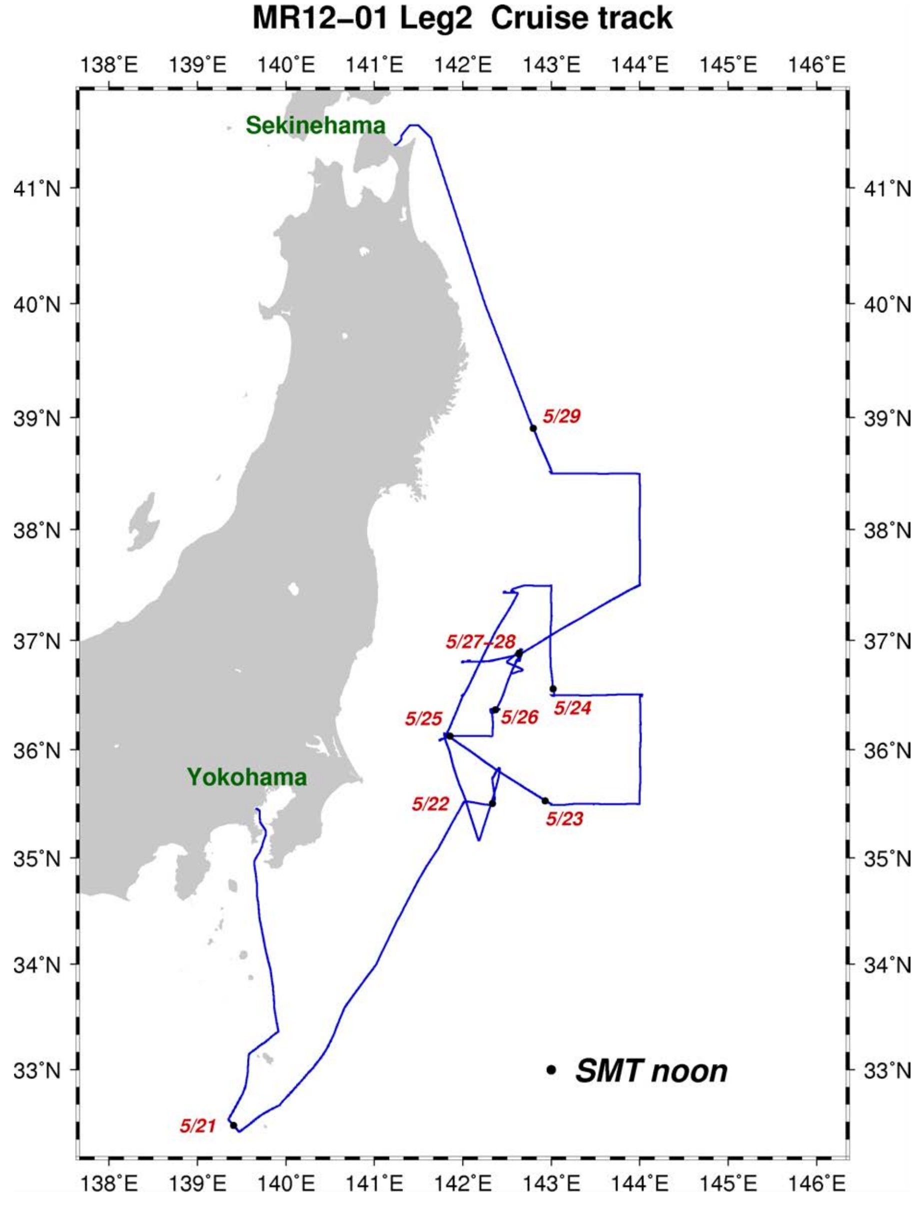
(JAMSTEC)

●**Contents**

Note: This cruise report is not including a monitoring of radioactivity, which was ordered from other category. It should be appeared as a different report.

1. Cruise Information

- Cruise ID: MR12-01 Leg.2
- Name of vessel R/V MIRAI
- Title of the cruise "Test cruise of observation equipment" and "basic experiment of acoustic communication equipment for Tsunami detecting system at high current area"
- Title of proposal Basic experiment of acoustic communication equipment for Tsunami detecting system at high current area
- Cruise period 20/May/2012 – 30/May/2012
- Ports of call Yokohama, Sekinehama
- Research area Hachijyo-jima, Izu-Ogasawara trench and Pacific off east shore of Japan
- Research Map



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3. Purpose

JAMSTEC decided to develop the Tsunami warning buoy system after the big earthquake on 2011/March/11. This system is developing for transmitting detected Tsunami information at far from shore to the land as fast as possible. It will be realized by connect between sea bottom and surface buoy by acoustic link, and by connect between surface buoy and land by satellite link. This system is required highly reliable behavior. So, basically it is developing with using existent technology. But acoustic link is a largest part, which has developing factor. Then, in this cruise, basic experiments to realize a pressure data transmission system by acoustic signal have been executed. The aim of this cruise is to obtain data for the development an acoustic data transmission system between sea bottom and near the surface, which can transmit data reliable and low power consumption.

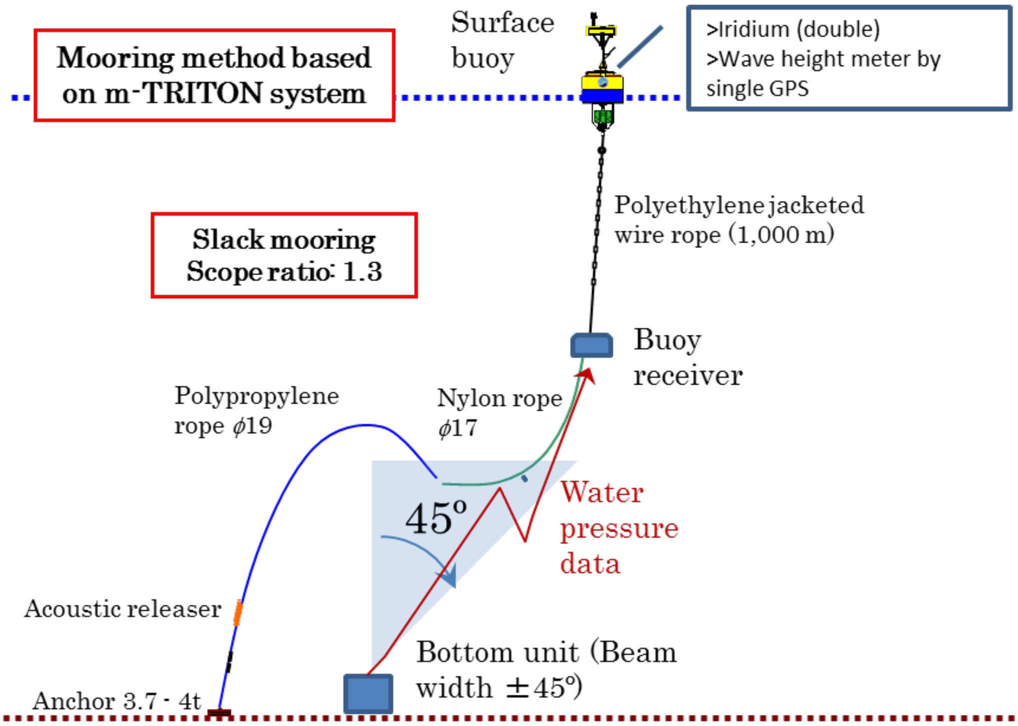

Fig.1 Concept of Tsunami warning buoy system.

4. Experiments

4.1. Overview

A Tsunami warning buoy system must be transmitted water pressure data to the land as fast as possible. And also the system must keep operable two years. So, high reliability and small power consumption are required. We select double pulses transmission method for transmitting water pressure data. Water pressure is assigned to the time difference of double pulses. In these experiments, detection stability of that time difference was estimated.

A bottom station was moored at near the sea bottom, and a buoy station was suspended from R/V MIRAI. Double pulses, which indicate depth as time difference of those pulses for detecting Tsunami, were transmitted repeatedly from a bottom station to a buoy station.

In the cruise of KY12-E07, experiments were planned at southward of the KUROSHIO where around 4,000 m depth area. But, because it was blowing gale during cruise period, we can’t go out from Suruga-Bay. So, experiments have been carried out inside Suruga-Bay, where the depth of 1,300 and 1,500 m area in the cruise of KY12-E07. In the cruise of MR12-01, to estimate its detection stability and its anti-noise performance, experiments were carried out at the area of body of the Kuroshio extension.

4.2. Experimental setup

To estimate the performance of acoustic data transmission system, experiments have been executed like as Figure 2. A bottom station was moored at near the sea bottom that height was approximately 3 m. A buoy station was suspended from R/V MIRAI at 1,000 m deep. R/V MIRAI was drifted around the bottom station as shown in Figures 8-10. From the bottom station, double pulses were transmitted repeatedly, which has a fixed time difference. The buoy station received those pulses and recorded to a compact flash card as digital data, which sampled in 148 kHz of sampling frequency and 16 bits of resolution. Pulse detection has been processed after recovery the both stations. Figure 3 show a bottom station and a buoy station.

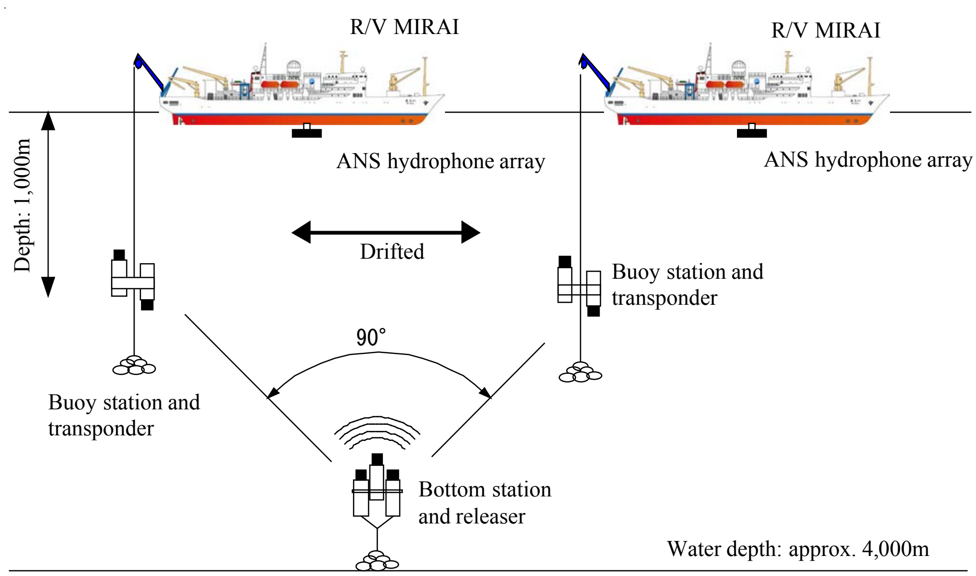

Fig.2 Overview of experiment

Fig.3 Photos of a bottom station (left) and a buoy station (right).

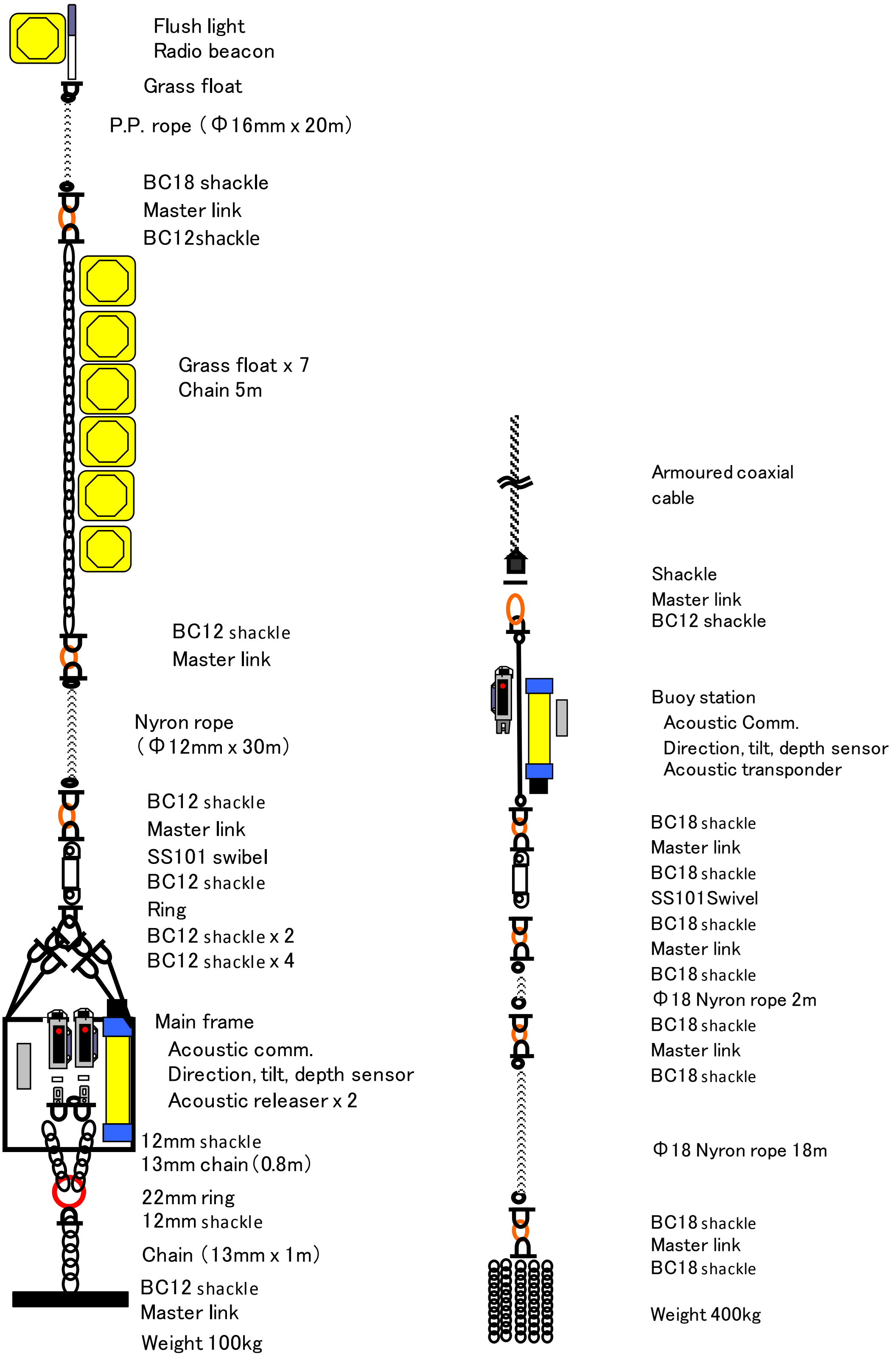

Fig.4 Configuration of the bottom station (left) and the buoy station (right).

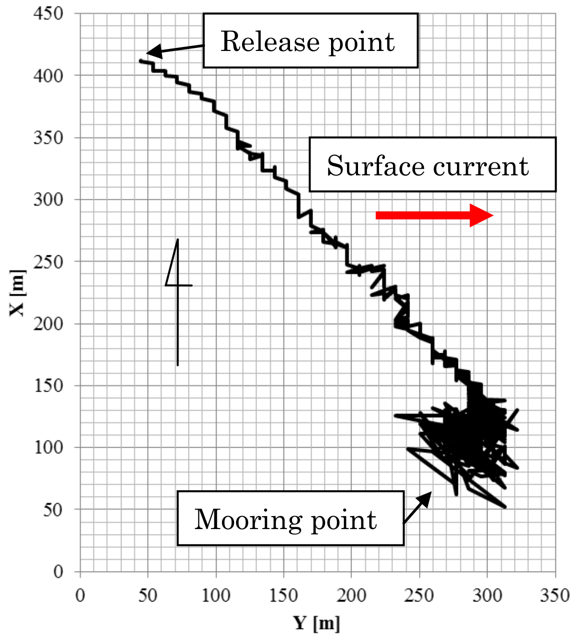

Fig.5 Tracking result of acoustic transponder in the mooring system. (26/May/2012)
Surface current speed: approx. 4 knots, surface current direction: approx. 90 degree.

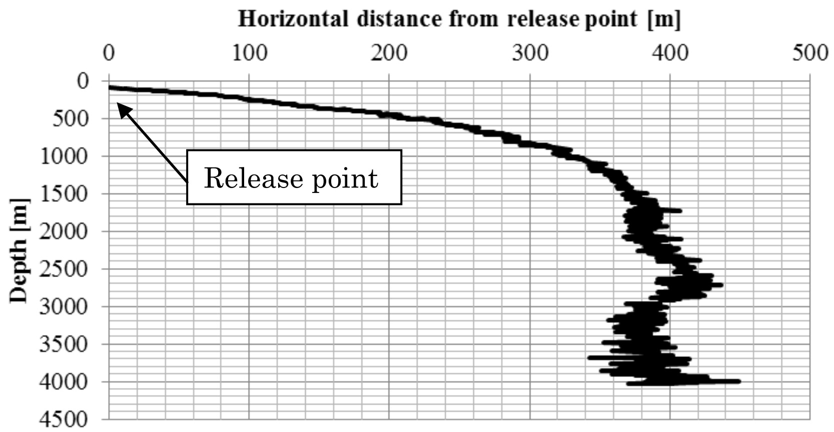

Fig.6 Tracking result of acoustic transponder in the mooring system. (26/May/2012)

Figure 5 and 6 show deploying track of a bottom station in X-Y plane and cross section respectively. At that day, surface current was flowing from West to East in approximately 4 knots. That was drifted approx. 400 m by water current until the depth of 1,500 m.

4.3. Research results

Three times experiments were carried out at off Ibaraki prefecture. Mooring position, depth and wake of R/V MIRAI during experiments are shown in §4.4.

Figure 7 shows an example of measurement results of time difference of double pulses. The time difference of double pulses in transmitter is 1,000 [ms]. It is assumed as true value. Figure 7 includes 119 pulse pairs. Almost of pulse pairs are measured 999.9 ± 0.1 [ms]. Maximum deviation is 0.5 [ms]. It can be said that the resolution is 1 [ms]. It can be seen that there are three groups of interval of double pulse, around 999.5 [ms], 999.9 [ms] and 1,000.3 [ms]. Multipathes are observed in received signal. We think that it is the reason of those fluctuations. From results of overall roughly analyzing, pulse interval modulation is suitable for acoustic transmission method of precise water pressure data. We decide to apply this method to the developing new buoy system of tsunami early detection and warning. Further analysis is processing now.

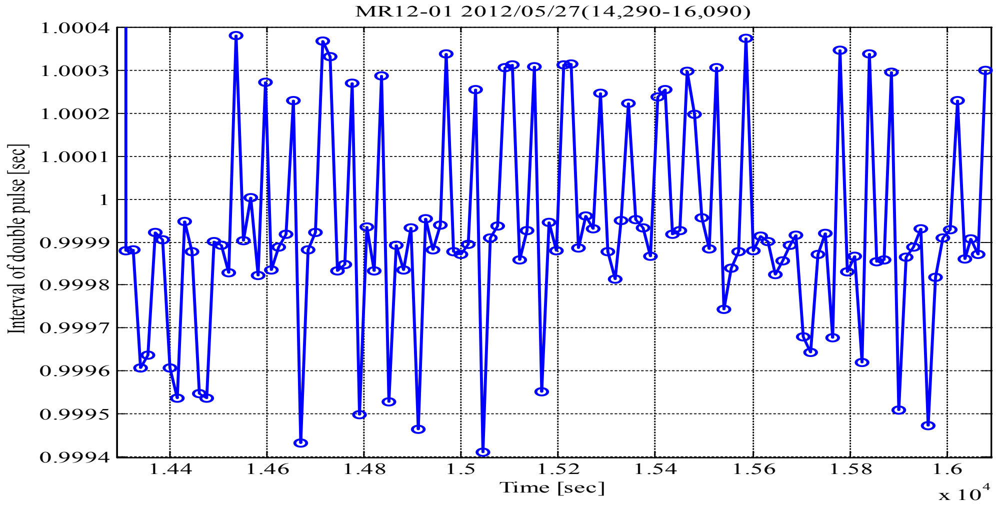

Fig.7 Measurement results of time difference of double pulses. True time difference of double pulses is 1,000 [ms]. Interval of double pulses is 15 seconds. Measured period: 30 minutes. Measured number of double pulses: 119.

4.4. Research Information

- Deployment and recovery information

Moored number	Moored date	Moored point		Depth	Recovery date
		Latitude	Longitude		
#01	2012/05/26	36-21.3237N	142-20.1531E	4,036m	2012/05/26
#02	2012/05/27	36-52.7948N	142-37.9069E	4,081m	2012/05/28

- Cast information of XCTD

Probe type: XCTD-4

Cast number	Date - time	Cast point	
		Latitude	Longitude
#146	2012/05/26 – 04:46 (JST)	36-21.6210N	142-19.7581E
#147	2012/05/26 – 13:43 (JST)	36-22.0439N	142-24.0085E
#148	2012/05/27 – 05:31 (JST)	36-55.0850N	142-39.3050E
#149	2012/05/27 – 13:09 (JST)	36-52.2635N	142-38.3657E
#151	2012/05/28 – 05:31 (JST)	36-52.7197N	142-38.5162E
#152	2012/05/28 – 13:30 (JST)	36-53.1633N	142-38.3997E
#153	2012/05/28 – 14:22 (JST)	36-53.3213N	142-38.1514E

- Maps of wake during acoustic communication test

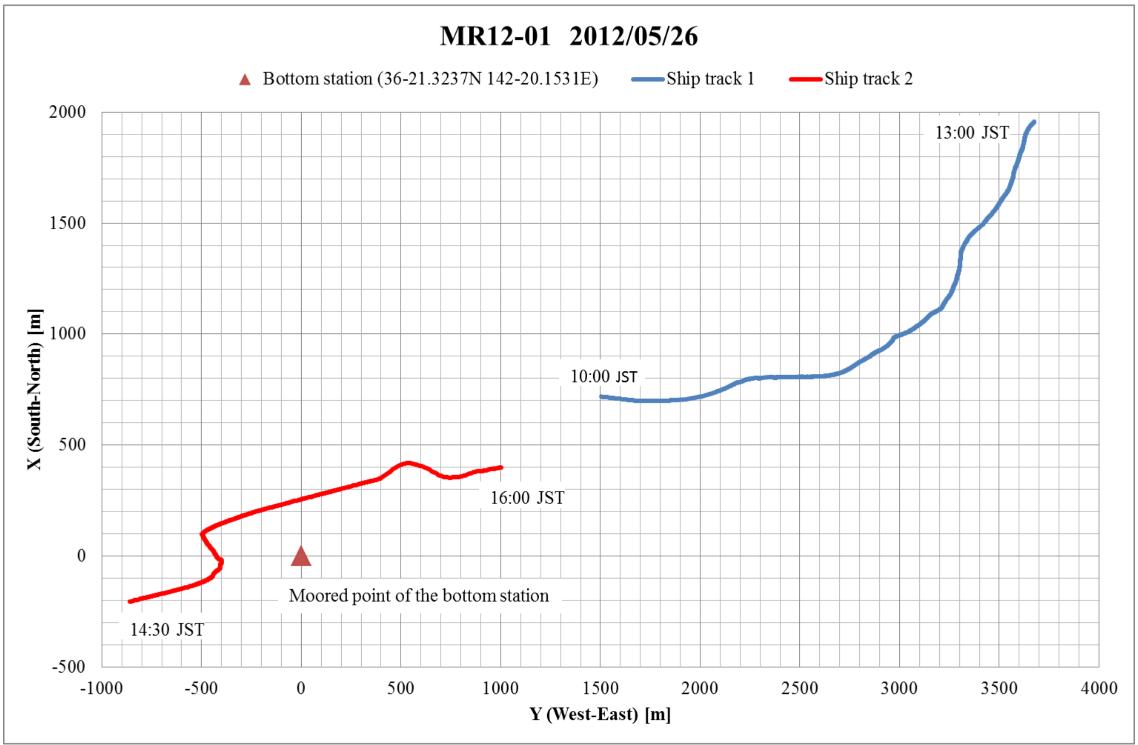

Fig.8 Wake on 26th/May

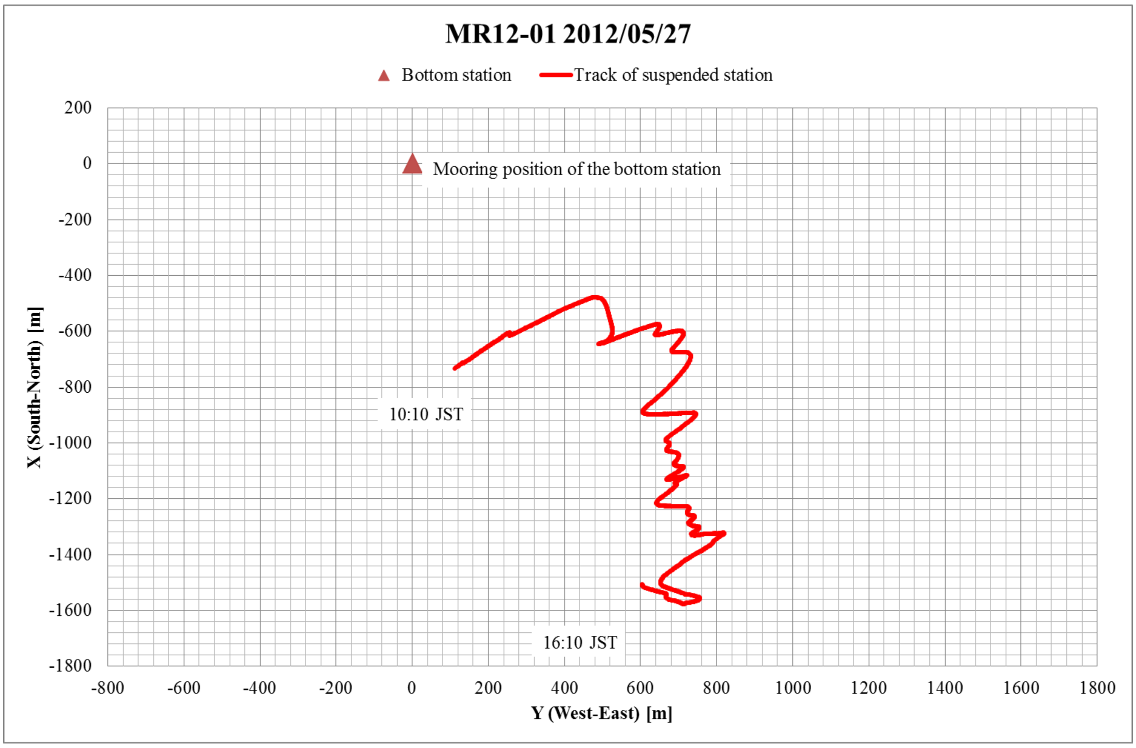

Fig.9 Wake on 27th/May

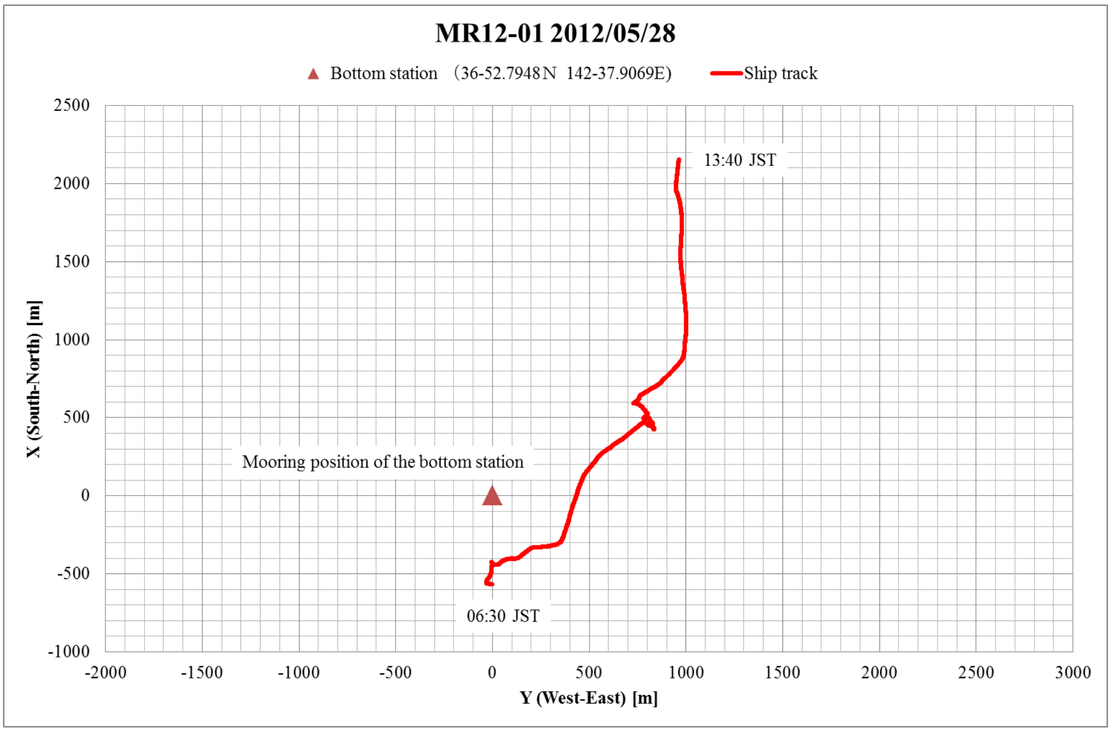

Fig.10 Wake on 28th/May

- Progress report (JST)

20/May

16:50 Leave Yokohama port

21/ May

03:49 XBT

04:24-05:30 MBES test

10:50-17:50 Doppler RADAR test

22/ May

08:48 Monitoring at stn25

11:12-14:30 Free fall of CTD winch

15:24-19:30 CTD on site CTD36

23/May

04:00-06:42 Sea floor survey for piston core sampling

12:18-13:06 Monitoring at stn26

16:42-17:30 Monitoring at stn27

24/ May

06:00-06:48 Monitoring at stn21

10:48-11:36 Monitoring at stn20

16:00-16:48 Monitoring at stn14

19:00-19:50 ADCP test

25/ May

05:30-06:36 Monitoring at stn19

09:00-11:48 Piston core sampling

14:56 XBT

15:00-(26)01:30 ANS test

26/ May

04:46-04:56 XCTD

05:00-05:30 Recover a transponder

05:53 Start mooring

07:15 Touch the sea bottom

07:15-09:25 Calibration

09:25-10:11 Suspend the buoy station to 1,170 m deep (wire length: 1,400 m)

10:16-13:00 Measurement of acoustic transmission of double pulses

13:43-13:53 XCTD

14:30-15:40 Measurement of acoustic transmission of double pulses

15:40 -15:52 Recover the buoy station

16:07-17:30 Recover the bottom station

20:17-22:26 Noise measurement on hydrophone array of acoustic navigation system

27/ May

05:31 XCTD

06:24-06:30 Moor the bottom station

07:46 Touch the sea bottom

07:46-08:16 Calibration

09:37-10:00 Suspend the buoy station to 998 m deep (wire length: 1,000 m)

08:50-16:07 Measurement of double pulses

13:09 XCTD

16:15-16:37 Recover the buoy station

20:00-(28)03:00 MBES test

28/ May

05:30 XCTD

06:05 Enable an acoustic releaser

06:16-06:32 Suspend the buoy station to 1,000 m deep

08:50-11:50 Measurement of double pulses

11:50-13:37 Noise measurement on the buoy system at every 100 m from 1,000 m to 100 m

13:37-13:47 Recover the buoy station

14:16-15:54 Recover the bottom station

14:21-14:31 XCTD

29/ May

01:00-02:00 Monitoring at stn15

06:30-07:30 Monitoring at stn11

11:00-12:00 Monitoring at stn10

30/ May

09:10 Arrive in Sekinehama

5. Notice on Using

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.