



R/V Kaiyo Cruise Report

KY13-06

Recovery of the prototype buoy observation system for tsunami
and crustal movement and recovery of IODP moorings.

Apr.02.2013 - Apr.06.2013

Japan Agency for Marine-Earth Science and Technology (JAMSTEC)

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Note

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.

1. Cruise Information

1.1. Cruise ID

KY13-06

1.2. Ship

R/V Kaiyo (Captain: Yoshiyuki Nakamura)

1.3. Title of cruise

Recovery of the prototype buoy observation system for tsunami and crustal movement and recovery of IODP moorings.

1.4. Title of Proposal

1.4.1. Proposal 1

Recovery of the buoy observation system for tsunami and crustal movement.

1.4.2. Proposal 2

Recovery of mid-depth mooring systems –A site survey for IODP NanTroSEIZE drilling–

1.5. Period

Apr. 02, 2013 – Apr. 06, 2013

1.6. Research area

Kumano basin

2. Introduction and experiments summary

2.1. Introduction

This cruise are consist of two proposals. One is “ Recovery of the prototype buoy observation system for tsunami and crustal movement” and the other is “ Recovery of mid-depth mooring systems –A site survey for IODP NanTroSEIZE drilling-”.

For the proposal 1, regarding of the urgent research for 2011 Off Tohoku Earthquake, It was approved based on the results of the director discussion which is held at 14th June 2012 to develop the Tsunami detection system around strong current area. The buoy observation system for tsunami and crustal movement consist of two subsystem which are an ocean bottom unit located at seafloor and a surface buoy mooring. The water pressure data from the ocean bottom unit are transmitted using acoustic pulse, and the pulse signal are received at wire-end station which are located at 1000m below water surface. The received data are transferred to the surface buoy using inductive modem and the data are transmitted by satellite communication. And there are also another three systems on the surface buoy. They are GNSS antenna and receiver by JAXA, ETS-8 (KIKU No.8) transmitter by JAXA, GPS/Acoustic surface unit by Tohoku University. These purpose are tsunami monitoring and satellite communication and seafloor crustal deformation precise acoustic ranging.

For the proposal 2, for the riser operations under high current conditions near the IODP NanTroSEIZE site, C0002, it is critically important to know how sea currents act on the riser, how the riser is affected and how fatigue is accumulated on the riser. CDEX had attempted to get sea current profiles by means of another mooring systems in 2010, however, we could not obtain adequate data of shallow depths (<100 m) and the duration of observation lasted only for 4 months at that time. Accordingly new mooring systems that were designed so as to obtain data of shallow depths as much as possible were deployed in 2012 again. this operation was aimed at recovering two sets of mid-depth mooring systems that were deployed near the IODP NanTroSEIZE site, C0002, in the KY12-06 cruise (April 1-6, 2012) by CDEX.

The main mission of this cruise is to recovery the prototype buoy for tsunami and crustal movement and to recovery of IODP mid-depth mooring systems.

2.2. Experiments summary

Surface buoy recovery:	1 mooring
Ocean Bottom Unit recovery:	1 mooring
Subsurface ADCP mooring recovery:	2 moorings
XBT (to correction of sound velocity for SSBL):	1 cast

We successfully recovered a prototype buoy mooring and an ocean bottom unit and two subsurface ADCP moorings during this cruise.

3. Cruise period, ports of call, cruise log and cruise track

3.1. Cruise period

Apr. 02, 2013 – Apr. 06, 2013

3.2. Ports of call

Yokosuka, Japan (Departure: Dec. 02, 2013)

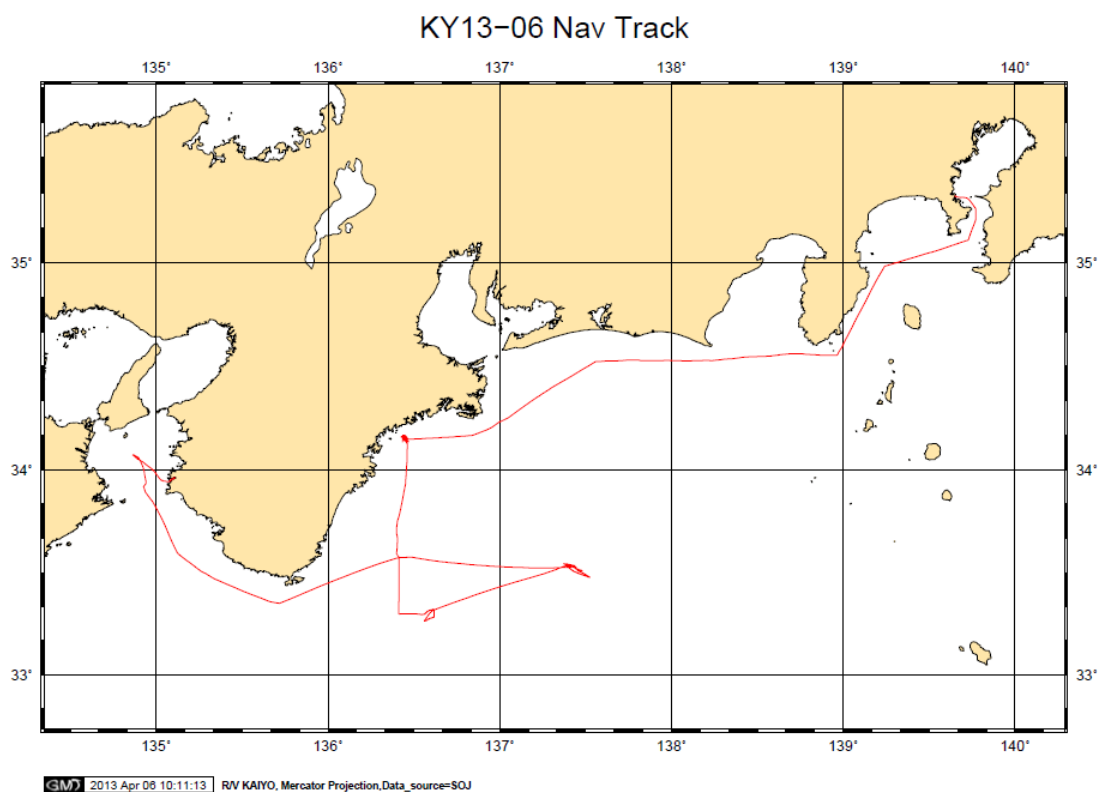
Yura, Japan (Arrival: Apr. 06, 2013)

3.3. Cruise log

SMT	UTC	Event
Apr. 2, (Tue.) 2013		
07:30	22:30	Departure from Yokosuka, Japan
08:30	23:30	Safety Lecture
10:00	01:00	Meeting for recovery operation
Apr. 3, (Wed.) 2013		
01:00	16:00	Arrive at off Owase-wan, Japan
Apr. 4, (Thu.) 2013		
03:00	18:00	Departure from off Owase-wan
08:00	23:00	Arrive at Kumano Basin
08:25-10:35	23:25-01:35	Recovery of IODP subsurface ADCP mooring (CM05) (Anchor position: 33-17.90N 136-33.58E Depth: 1861m)
11:10-12:57	02:10-03:57	Recovery of IODP subsurface ADCP mooring (CM06) (Anchor position: 33-16.00N 136-34.33E Depth: 1744m)
13:33-13:50	04:33-04:50	MBES measurement accuracy test
13:55	04:55	Departure from Kumano basin
17:15	08:15	Arrive at off SE of Kiihanto
18:00	09:00	XBT-1 (33-31.96N 137-26.18E)
18:30-22:51	09:30-13:51	Acoustic Test for prototype Tsunami Monitoring mooring
Apr. 5, (Fri.) 2013		
05:55	20:55	Arrive at off SE of Kiihanto
06:12-10:41	21:12-01:41	Recovery of prototype Tsunami Monitoring mooring (Anchor position: 33-32.48N 137-23.46E Depth: 2971m)
11:37-12:54	02:37-03:54	Recovery of prototype Ocean Bottom Unit (position: 33-32.41N 137-23.46E Depth: 2971m)
13:10	04:10	Departure from off SE of Kiihanto

SMT	UTC	Event
Apr. 6, (Sat.) 2013		
03:00	18:00	Arrive at off Yura, Japan
09:40	00:40	Arrive at Yura, Japan

3.4. Cruise track



4. Researchers

4.1. Chief scientist

Chief Scientist

Tatsuya Fukuda

Engineer

Marine Technology and Engineering Center (MARITEC)

Japan Agency for Marine-Earth Science and Technology (JAMSTEC)

Co - Chief Scientist

Kan Aoike

Researcher

Center for Deep Earth Exploration (CDEX)

Japan Agency for Marine-Earth Science and Technology (JAMSTEC)

4.2. Science Party

4.2.1. Proposal 1

4.2.1.1. Buoy System Engineer

Yasuhisa Ishihara (not on board)

Junichirou Tahara

Tatsuya Fukuda

Yosaku Maeda (not on board)

Masayuki Yamaguchi (not on board)

4.2.1.2. Underwater Acoustic Engineer

Hiroshi Ochi

Takami Mori

4.2.1.3. Earthquake and tsunami Study

Narumi Takahashi

4.2.1.4. GPS/Acoustic Study

Motoyuki Kido

Yusaku Ohta

4.2.1.5. GNSS System Study

Katsuhiko Mutoh

4.2.1.6. ETS-8 Communication Engineer

Gousei Hashimoto

Osamu Motohashi (not on board)

4.2.2. Proposal 2

4.2.2.1. IODP Researcher

Kan Aoike

4.2.2.2. Buoy System Engineer

Shuusuke Machida

Isao Kozono

Takuya Onodera

4.3. R/V Kaiyo Scientist and technical staff

Tatsuya Fukuda	JAMSTEC	Yokosuka - Yura
Narumi Takahashi	JAMSTEC	Yokosuka - Yura
Hiroshi Ochi	JAMSTEC	Yokosuka - Yura
Junichirou Tahara	JAMSTEC	Yokosuka - Yura
Takami Mori	JAMSTEC	Yokosuka - Yura
Katsuhiko Mutoh	JAXA	Yokosuka - Yura
Gousei Hashimoto	JAXA	Yokosuka - Yura
Motoyuki Kido	Tohoku Univ.	Yokosuka - Yura
Yusaku Ohta	Tohoku Univ.	Yokosuka - Yura
Kan Aoike	JAMSTEC	Yokosuka - Yura
Shuusuke Machida	NME	Yokosuka - Yura
Isao Kozono	NME	Yokosuka - Yura
Takuya Onodera	NME	Yokosuka - Yura
Keisuke Matsumoto	MWJ	Yokosuka - Yura
Hirokatsu Uno	MWJ	Yokosuka - Yura
Tomohiko Sugiyama	MWJ	Yokosuka - Yura
Akira Watanabe	MWJ	Yokosuka - Yura

JAMSTEC: Japan Agency for Marine-Earth Science and Technology

JAXA: Japan Aerospace Exploration Agency

Tohoku Univ.: Tohoku University

NME: Nippon Marine Enterprises , Ltd.

MWJ: Marine Works Japan, Ltd.

5. Experiments

5.1. Operation of the prototype buoys for tsunami and crustal movement

5.1.1. Personnel

Tatsuya Fukuda	(JAMSTEC): Principal Investigator
Hiroshi Ochi	(JAMSTEC): Engineer
Narumi Takahashi	(JAMSTEC): Researcher
Junichirou Tahara	(JAMSTEC): Engineer
Takami Mori	(JAMSTEC): Engineer
Katsuhiko Mutoh	(JAXA): Engineer
Gousei Hashimoto	(JAXA): Engineer
Motoyuki Kido	(Tohoku Univ.): Researcher
Yusaku Ohta	(Tohoku Univ.): Researcher
Keisuke Matsumoto	(MWJ): Operation Leader
Akira Watanabe	(MWJ): Technical Staff
Hiroshi Matsunaga	(MWJ): Technical Staff
Tomohiko Sugiyama	(MWJ): Technical Staff

5.1.2. Objectives

The buoy observation system for tsunami and crustal movement consists of two subsystems which are an ocean bottom unit located at seafloor and a surface buoy mooring. The water pressure data from the ocean bottom unit are transmitted using acoustic pulse, and the pulse signal are received at wire-end station which are located at 1000m below from the water surface. The received acoustic pulse data are transferred to the surface buoy through the inductive modem and the data are transmitted by Iridium satellite communication system. And there are also another three systems on the surface buoy. First one is a GNSS system which is supplied by JAXA, ETS-8 (KIKU No.8) satellite communication system which is also supplied by JAXA, GPS/Acoustic surface unit which is supplied by Tohoku University. These purposes are tsunami monitoring and satellite communication and seafloor crustal deformation precise acoustic ranging.

The purpose of this cruise is to recover the prototype buoy and the ocean bottom unit. A prototype of tsunami monitoring buoy and an ocean bottom unit have been successfully recovered during this cruise.

5.1.3. Measured parameters

The prototype buoy for tsunami and crustal movement observes engineering parameters as follows:

Engineering parameters: water depth at 1.5m, currents at 1.5m

Details of the instruments used on the prototype buoy are summarized as follows:

(1) Data logger and Satellite transmitter

1) Data logger

GNSS and Inductive modem are controlled by RS232C.

2) Iridium transmitter

The data in the interval of 60 minutes are being transmitted through Iridium transmitter.

3) ETS-8 transmitter

The data in the interval of 60 minutes are being transmitted through ETS-8 transmitter.

(2) Engineering Sensor

1) CRN (Current meter, Nortek AS)

Aquadopp IM400

Sampling interval: 600sec

Sensor frequency: 2MHz

Velocity Range: $\pm 5\text{m/s}$

5.1.4. Mooring Configuration

(1) The prototype buoy for tsunami and crustal movement

Mooring configuration of the prototype buoy is shown in Fig. 5.1-1.

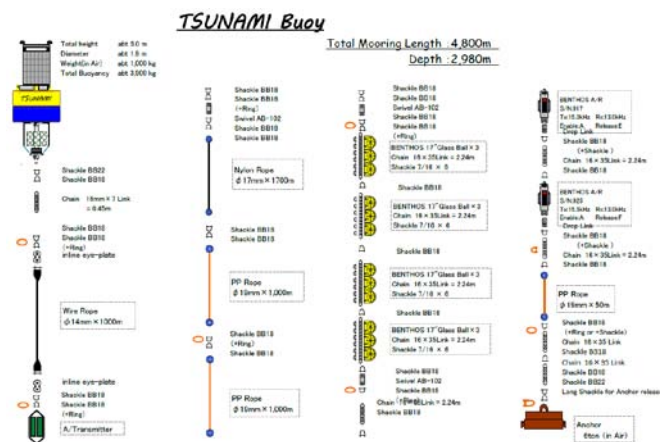


Fig. 5.1-1 Mooring Configuration of the prototype buoy

(2) Ocean Bottom Unit

Mooring configuration of the ocean bottom unit is shown in Fig. 5.1-2.

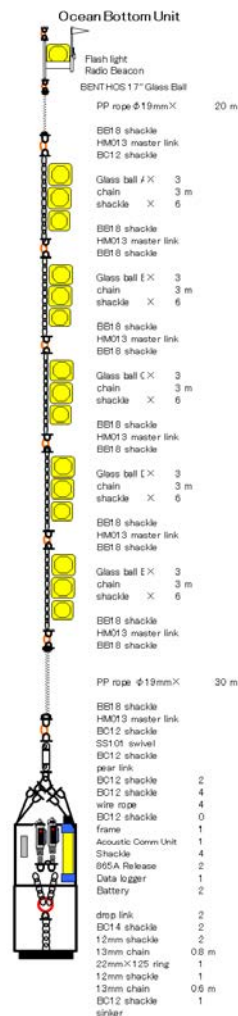


Fig. 5.1-2 Configuration of the ocean bottom unit

5.1.5. Results

Locations of recovery and deployment are as follow:

(1) Locations of Deployment

1) The prototype buoy for tsunami and crustal movement

ARGOS backup PTT number 121999

Deployed date (UTC) 10 Dec. 2012 23:42

Recovered date (UTC) 5 Apr. 2013 01:41

Exact location 33 - 32.48N, 137 - 23.46E

Depth	2,971 m
2) The prototype Ocean Bottom Unit	
Deployed date (UTC)	11 Dec. 2012 02:33
Recovered date (UTC)	5 Apr. 2013 03:54
Exact location	33 - 32.41N, 137 - 23.46E
Depth	2,971 m

We carried out acoustic communication test between vessel and ocean bottom unit prior to their recovery. We attempted to start transmitting acoustic pulse from ocean bottom unit and it started successfully.

(2) Hardware Failures

1) Baseplate of iridium antenna

During recovery operation, the rope hit the baseplate and bent it.

2) GPS/Acoustic transducer

During recovery operation, the transducer hit the three-sides roller and it was deformed.

3) Wire rope

The wire rope from top to 60m depth was injured by fishery line.

4) Wire-end station

Two underwater cables were broken.

There was a crack at the acoustic communication tube and there is electric corrosion at some portions.

The acoustic communication tube and the battery tube are leaked.

5.1.6. Data archive

The data in the interval of 60 minutes were stopped abnormally to transmit via Iridium satellite system and ETS-8 communication system in real time during mooring period. The main reason was failure of underwater acoustic communication and breaking the underwater cables at the wire-end station. The data logger stored the NMEA data from a GNSS receiver, however the main GNSS antenna was broken at middle of mooring periods. The data of current meter is all stored. The data logger at ocean bottom unit is stored water pressure only one week.

5.2. Recovery of Mooring Systems –A Site Survey for IODP NanTroSEIZE drilling-

5.2.1. Personnel

Kan Aoike (CDEX/JAMSTEC): Principal Investigator

Keisuke Matsumoto (MWJ): Chief Technical Staff

Shusuke Machida (NME): Technical Staff

Isao Kozono (NME): Technical Staff

Onodera Takuya (NME): Technical Staff

Hirokatsu Uno (MWJ): Technical Staff

Tomihiko Sugiyama (MWJ): Technical Staff

Akira Watanabe (MWJ): Technical Staff

5.2.2. Objectives

This operation was aimed at recovering two sets of mid-depth mooring systems that were deployed near the IODP NanTroSEIZE site, C0002, in the KY12-06 cruise (April 1-6, 2012) by CDEX. This site is situated at an area where the Kuroshio Current passes constantly in general. These mooring systems, thus, are expected to record profiles of the Kuroshio Current for 12 months. For the riser operations under high current conditions like this area, it is critically important to know how sea currents act on the riser, how the riser is affected and how fatigue is accumulated on the riser. CDEX had attempted to get sea current profiles by means of another mooring systems in 2010, however, we could not obtain adequate data of shallow depths (<100 m) and the duration of observation lasted only for 4 months at that time. Accordingly new mooring systems that were designed so as to obtain data of shallow depths as much as possible were deployed in 2012 again. The data newly retrieved from the mooring systems are supposed to be used for a further riser analysis in order to assess the safety of the next riser operations of NanTroSEIZE.

5.2.3. Location

The two mooring systems had been settled in the west of IODP Site C0002 since April 2, 2012 (Fig. 5-2-1). The positions of the mooring systems (at the releaser) determined by triangulation in the KY12-06 cruise are as follows:

CM05: 33°17.902'N, 136°33.578'E (1861 m @releaser)

CM06: 33°15.996'N, 136°34.334'E (1744 m @releaser)

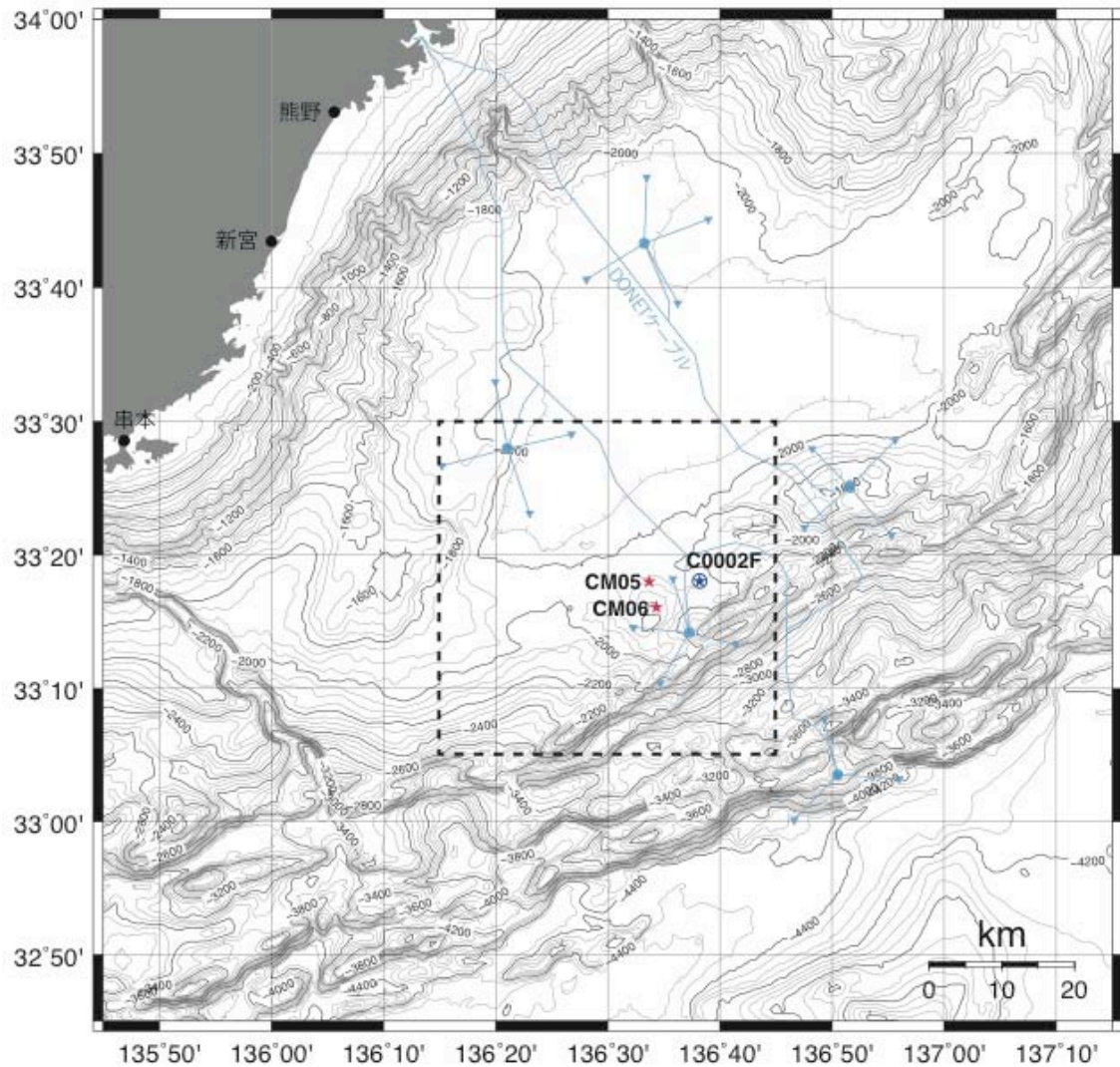


Figure 5-2-4. A map showing the locations of the mooring systems, CM05 and CM04, and IODP Site C0002 (Hole F is the riser hole). Blue lines indicate the DONET submarine cable network.

5.2.4. Configuration of the Mooring Systems

Each mooring system is equipped with a Long-ranger ADCP at the top buoy, a transponder, five single-depth doppler current meters, three conductivity-temperature-depth recorders (CTD) and a set of two acoustic releasers of different manufacturers (Fig. 5-2-2 and Fig. 5-2-3). The top buoy of each mooring system is designed to be placed at 300 m below the sea surface when it stands vertically and to measure shallow depths up to the surface even if the current speed reaches 6 knot. The parameters set at their deployment are summarized in Table 5-2-1.

保留系組立構成図(2000m級_Site_CM05)

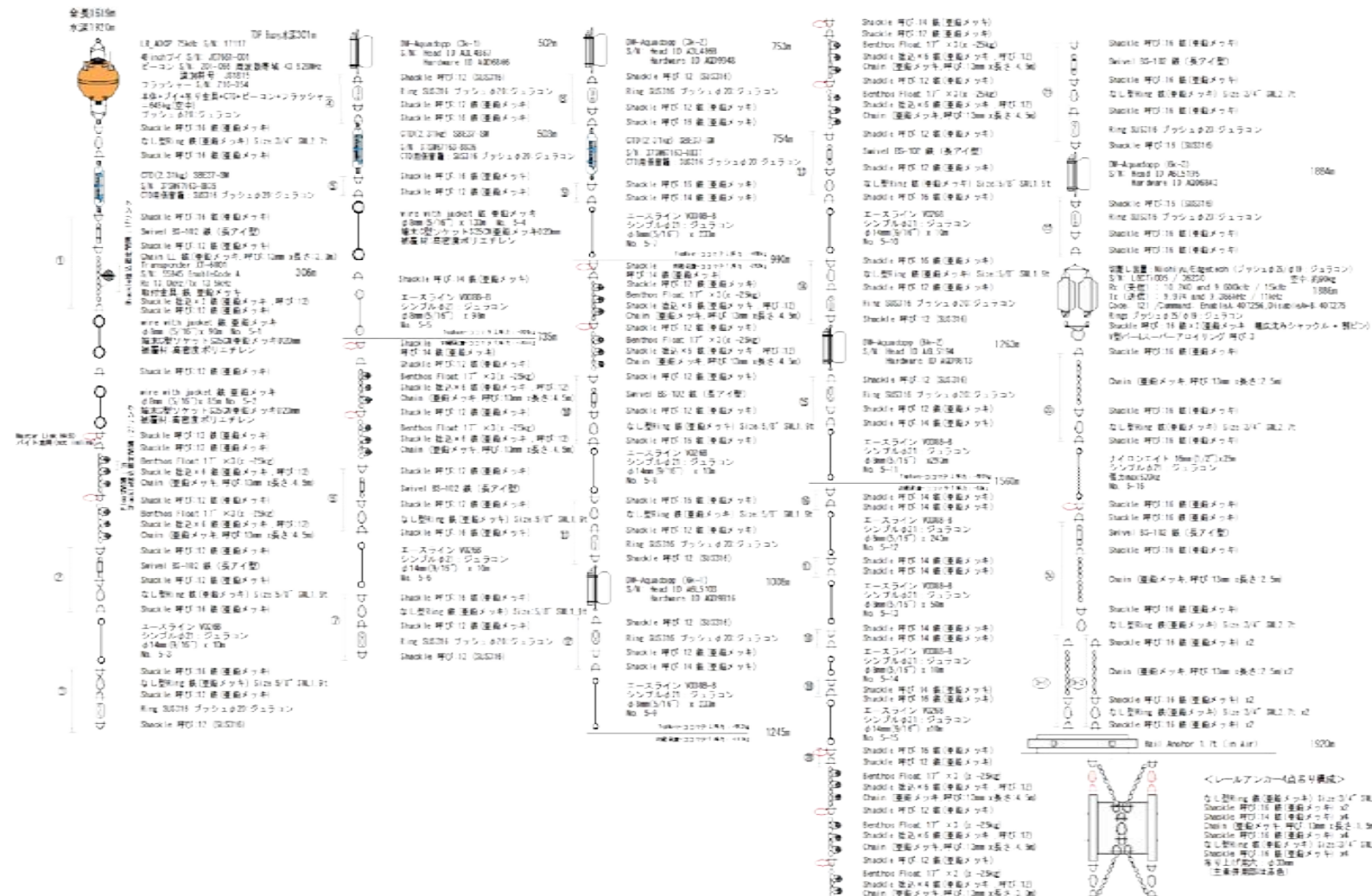


Figure 5-2-2. Configuration of the mooring system at Site CM05

係留系構成図 (2000m級 Site C06)

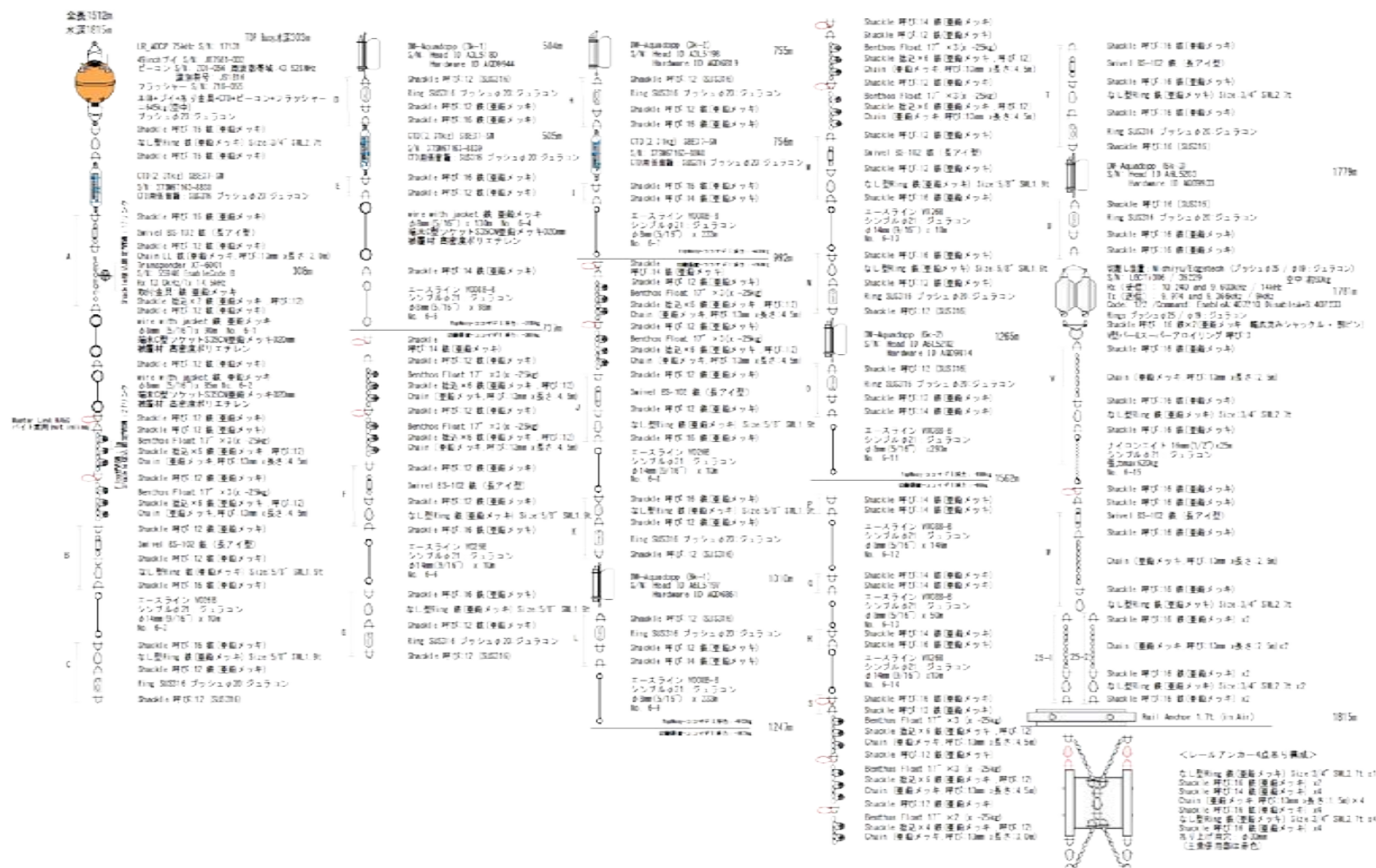


Figure 5-2-3. Configuration of the mooring system at Site CM05

Table 5-2-1. Parameter setup of each mooring system.

LR-ADCP	
Pings per ensemble:	27
Number of depth cells:	65
Depth cell size:	8 m
Ensemble:	1800 s
Ping interval:	5 s
Blank after transmit:	7.04 m
Power Usage:	3804.17 Wh
Standard deviation:	2.81 cm/s
Salinity:	35‰
Temperature:	5 °C
DW-Aquadop	
Measurement interval:	1800 s
Average interval:	35 s
Measurement load:	22%
Compass update rate:	900 s
Salinity:	35‰
SEB37-SM	
Measurement interval:	1800 s

5.2.5. Result

The recovery operations were carried out on April 3, 2013 under a calm sea state, a relatively low current condition (< 2 knot) and a fine weather. We could successfully recover the two mooring systems in about 4.5 hours without either operational trouble or lost of major instrument.

Two sets of LR-ADCP data were downloaded successfully on board and we could confirm that data of shallow depths shallower than 50 m (up to 30 m or so) seemed to be recorded properly. With regard to the other instruments, we checked only if data were recorded without downloading on board. Among the recovered instruments, four major damages were found on board as follows:

1) DW-Aquadop at 1200 m of CM06

No communication. Water penetration inside from the electric communication port was suspected.

Considering a risk of pressurized gas inside due to chemical reaction, we decided to send the instrument to the manufacturer for inspection without further treatment on onboard.

2) LR-ADCP of CM05

Although the data could be downloaded successfully, one of the pins of the communication port was broken and some electric corrosion with aerugo was observed. Fortunately this pin was not for data communication but for external electric power supply.

3) LR-ADCP of CM06

One of four transducers of LR-ADCP of CM06 had a minor damage on the surface. Its urethane form was slightly swelled in part due to probably water immersion.

4) Beacon antenna of CM06

The beacon antenna of the 49" top buoy of CM06 had been lost with the screw being loose probably due to vibration. The other one of CM05 was also loose about to be lost.

In addition, there were some lessons learned for next operations as follows:

- 1) In CM05, because no response was returned from the Nichiyu releaser, we switched to the EdgeTech releaser. Its response, however, was caught not by the dedicated transceiver but by the shipboard transceiver. On the other hand, in CM06, the Nichiyu releaser was activated. Its response, however, was also caught by the shipboard transceiver.
- 2) Anode protections on all instruments seemed to have worked effectively, however, some of which lost most of their anode protections.
- 3) Some sets of glass floats were entangled when retrieved, because no tangle-free rope was affixed to the floats.
- 4) The new winding apparatus, which was used for the first time, did not work as expected while retrieval, because the retrieval speed was too fast for it. Eventually it was switched to the larger winding system of the Tsunami-buoy.

Data download from 9 of 10 DW-Aquadopp and 6 of 6 CTD shall be performed onshore after the all instruments are transported to a maintenance place in Yokosuka.