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# Cruise Report

KY12-06

*R/V Kaiyo*

Mooring System Installation in Kumano-nada

A site survey for IODP Expeditions

2012

Center for Deep Earth Exploration
(CDEX)

Japan Agency for Marine-Science and Technology (JAMSTEC)

# Contents

**Preface**

The R/V Kaiyo KY12-06 cruise was carried out with the aim of installing mid-water mooring systems for monitoring sea currents near IODP site C0002 in the Nankai Trough as a site survey of NanTroSEIZE project. The purpose of the monitoring is to obtain sea current data for a riser analysis of D/V Chikyu for safety assessment of drilling in a high current area where the Kuroshio Current passes. Two mooring systems equipped with a Long-ranger ADCP at the top buoy, five current meters and three CTDs were set successfully on the seafloors of 1920 m and 1890 m in water depth. The top buoy was designed to place at about 300 m below the sea surface in the upright state. Although a sea current survey with mooring systems was conducted previously for about four months in 2010 at almost the same place for the same purpose, we noticed that data of shallow water in a longer observation period is required for more precise riser analysis and for safety improvement of the drilling operations. We intend to perform the sea current survey with the newly designed mooring systems installed in this cruise for a year and to get data for the next riser analysis.

## 1. Participants aboard the R/V Kaiyo cruise KY12-06

### 1) Scientific Party

| | |
|---|---|
| Chief Scientist: | Kan Aoike* |
| Scientists: | Shusuke Machida** |
| | Tomokazu Kurihara** |

*: Center for Deep Earth Exploration, JAMSTEC

**: Nippon Marine Enterprises Co., Ltd.

### 2) Science Support

| | |
|---|---|
| Chief Marine Technician: | Hirokatsu Uno*** |
| Marine Technician: | Takamori Tomoyuki*** |
| | Ueno Tamami*** |

***: Marine Works Japan Co., Ltd.

### 3) Crew

| | |
|---|---|
| Captain: | Masayoshi Ishiwata |
| Chief Officer: | Takaaki Shishikura |
| 2nd Officer: | Takeshi Egashira |
| 3rd Officer: | Hidehiko Konno |
| Chief Engineer: | Tadashi Abe |
| 1st Engineer: | Kazunori Noguchi |
| 2nd Engineer: | Saburo Sakaemura |
| Jr.3rd Engineer: | Shota Nagano |
| Jr.3rd Engineer: | Kento Kame |
| Chief Radio Operator: | Takehito Hattori |
| 2nd Radio Operator: | Isao Kozono |
| Boatswain: | Hatsuo Oda |
| Able Seaman: | Shuichi Yamamoto |
| Able Seaman: | Kaito Murata |
| Able Seaman: | Naoki Iwasaki |
| Sailor: | Shun Abe |
| Sailor: | Hideaki Nakata |
| Sailor: | Tomoaki Kubota |

| | |
|---|---|
| No.1 Oiler: | Junji Mori |
| Oiler: | Yoshinori Kawai |
| Oiler: | Shinya Sugi |
| Oiler: | Yuji Higashikawa |
| Oiler: | Masahiro Matsukawa |
| Chief Steward: | Yukio Tachiki |
| Steward: | Shigeto Ariyama |
| Steward: | Kazuma Sonoda |
| Steward: | Katsuhiro Kawase |
| Steward: | Nakamichi Kanda |

**2. Objectives**

The R/V Kaiyo KY12-06 cruise is aimed at installing two sets of mid-water mooring systems for monitoring sea currents near IODP site C0002 in the Nankai Trough as a site survey of NanTroSEIZE project. The purpose of the monitoring is to get sea current data for a riser analysis of D/V Chikyu for safety assessment of drilling in a high current area where the Kuroshio Current passes.

We did a sea current survey with two sets of mooring systems in the same area for about four months in 2010, however, the data we could obtained were not necessarily sufficient for the riser analysis due to lack of data in the shallow water and less variations of current patterns imputed to a shorter observation period. Thereupon, we decided to survey again with a new designed mooring system for more precise riser analysis and for safety improvement of the drilling operations.

In this cruise, we planed to set two mooring systems equipped with a Long-ranger ADCP at the top buoy to the upstream of the Kuroshio Current from the site C0002. The top buoy was designed to place at about 300 m below the sea surface in the upright state so that we can get data of the shallow water as much as possible.

**3. Survey Area**

The survey area of KY12-06 cruise is located about 60 km southeast of the Kii Peninsula, near IODP Hole C0002F (Fig. 1). We planned to place two sets of mooring systems at sites CM05 and CM06 in the upstream of the Kuroshio Current viewed from the Hole C0002F.

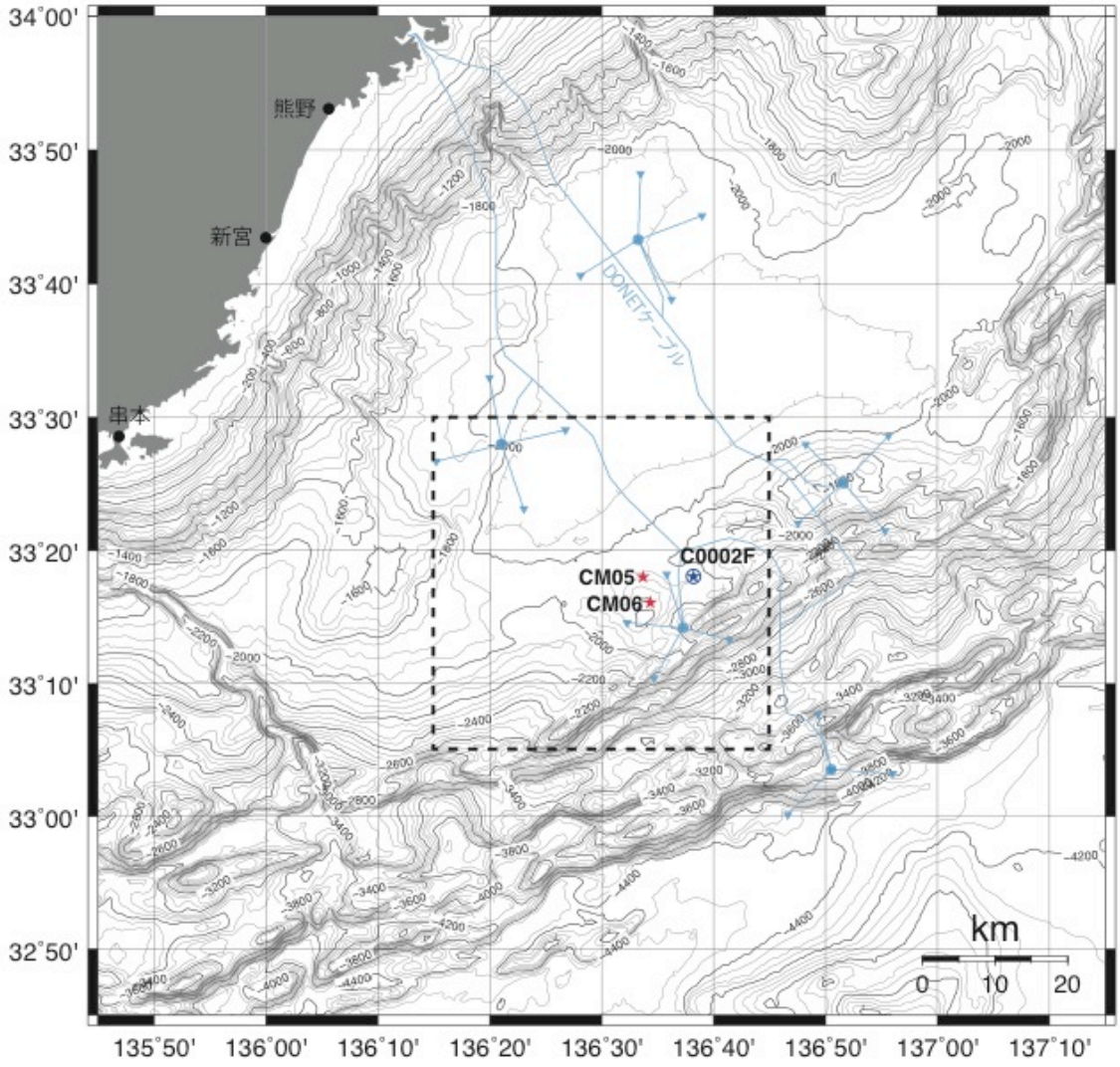


Figure 1. A map showing the survey area of the KY12-06 cruise and the planned locations of mooring systems. Blue lines indicate the DONET submarine cable network.

**4. Activity Log of the Cruise and the Ship Track**

In the original schedule, the cruise should have started on April 2 and the mooring installation operations should have been conducted on April 3. R/V Kaiyo, however, left the JAMSTEC quay on April 1 one day earlier than planned, because a weather forecast reported that we would have a very severe sea condition on April 3. She arrived at the site in the morning on April 2 and we conducted the mooring installation. After completion of the installation, she moved to the Osaka Bay and stay in off Sumoto City, Awaji-shima, on April 3 for evacuation from rough sea condition due to a low pressure

(which developed as strong as a typhoon, passing along the Japan Sea). Finally she was alongside the MES Yura dock in the morning on April 4 as scheduled.

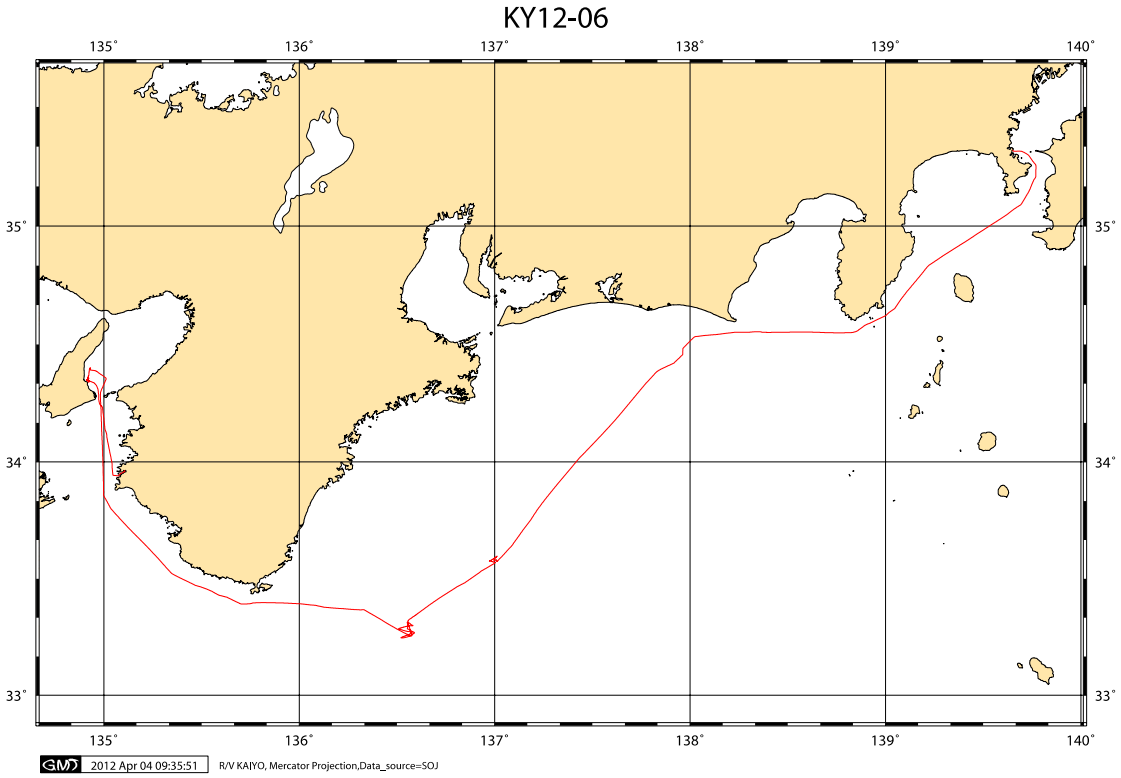


Figure 2. The ship track of the KY12-06 cruise.

Table 1. Event log of the KY12-06 cruise.

| | |
|---|---|
| 2012/04/01 | |
| Position: 34-58.0'N, 139-28.0'E / Weather: cloudy / Wind direction: SW/ Wind force: 7/ Wave: 4 m/ Swell: 3 m/ Visibility: 7 NM (12:00 JST) | |
| ~08:00 | Embarkation of scientists and technicians |
| 09:00 | Departure from the JAMSTEC quay (Yokosuka Headquarters |
| 11:00-11:15 | Briefing on ship's life and safety |
| 16:40-17:00 | Kompira ceremony |
| ~24:00 | Sail to the survey area |
| 2012/04/02 | |
| Position: 33-16.0'N, 136-34.0'E / Weather: fine / Wind direction: NE/ Wind force: 3 / Wave: 2 m/ Swell: 2 m/ Visibility: 8 NM (12:00 JST) | |
| 00:00~ | Sail to the survey area |

| | |
|---|---|
| 04:55-05:00 | XBT survey as an ordinary system check |
| 05:30-05:50 | MBES precision test |
| 08:30 | Arrive at the survey area (near CM05) |
| 08:45-08:50 | XBT survey |
| 09:25-09:55 | MBES survey (along the line from CM05 to CM06) |
| 10:20-12:25 | Deploy the mooring system for site CM06 |
| (12:10) | Drop the anchor |
| 12:30-12:45 | Ranging of the CM06 mooring system above the site |
| 13:30-15:20 | Deploy the mooring system for site CM05 |
| (15:15) | Drop the anchor |
| 15:30-15:50 | Ranging of the CM05 mooring system above the site |
| 16:00-18:00 | Positioning of the CM05 mooring system by triangulation |
| 18:20-19:05 | Positioning of the CM06 mooring system by triangulation |
| 19:10~ | Sail to the Osaka Bay for evacuation from rough sea condition |
| 2012/04/03 | |
| Position: 34-21.6N, 134-55.2E / Weather: rainy / Wind direction: S/ Wind force: 10/ Wave: 4m/ Swell: 2 m/ Visibility: 3 NM (12:00 JST) | |
| 00:00-07:30 | Sail to the Osaka Bay |
| 07:30-24:00 | Evacuation off Sumoto (Tuna Port), Awaji-shima |
| 2012/04/04 | |
| Position: 33-57.7N, 135-06.7E / Weather: but cloudy / Wind direction: NW/ Wind force: 3/ Wave: 1m/ Swell: 0 m/ Visibility: 7 NM (12:00 JST) | |
| 00:00-05:30 | Evacuation off Sukumo |
| 05:30-09:15 | Sail to the Yura Port |
| 09:45 | Alongside the MES Yura quay |
| 10:00-17:00 | Offloading, data/document finalizing |
| 17:00 | Disembarkation of scientists and technicians |

## 5. Results

### 5.1. XBT Measurement

An XBT (Expendable Bathythermograph) survey was carried out at a position in the north of CM05 prior to the bathymetry survey. The result is shown in Fig. 3.

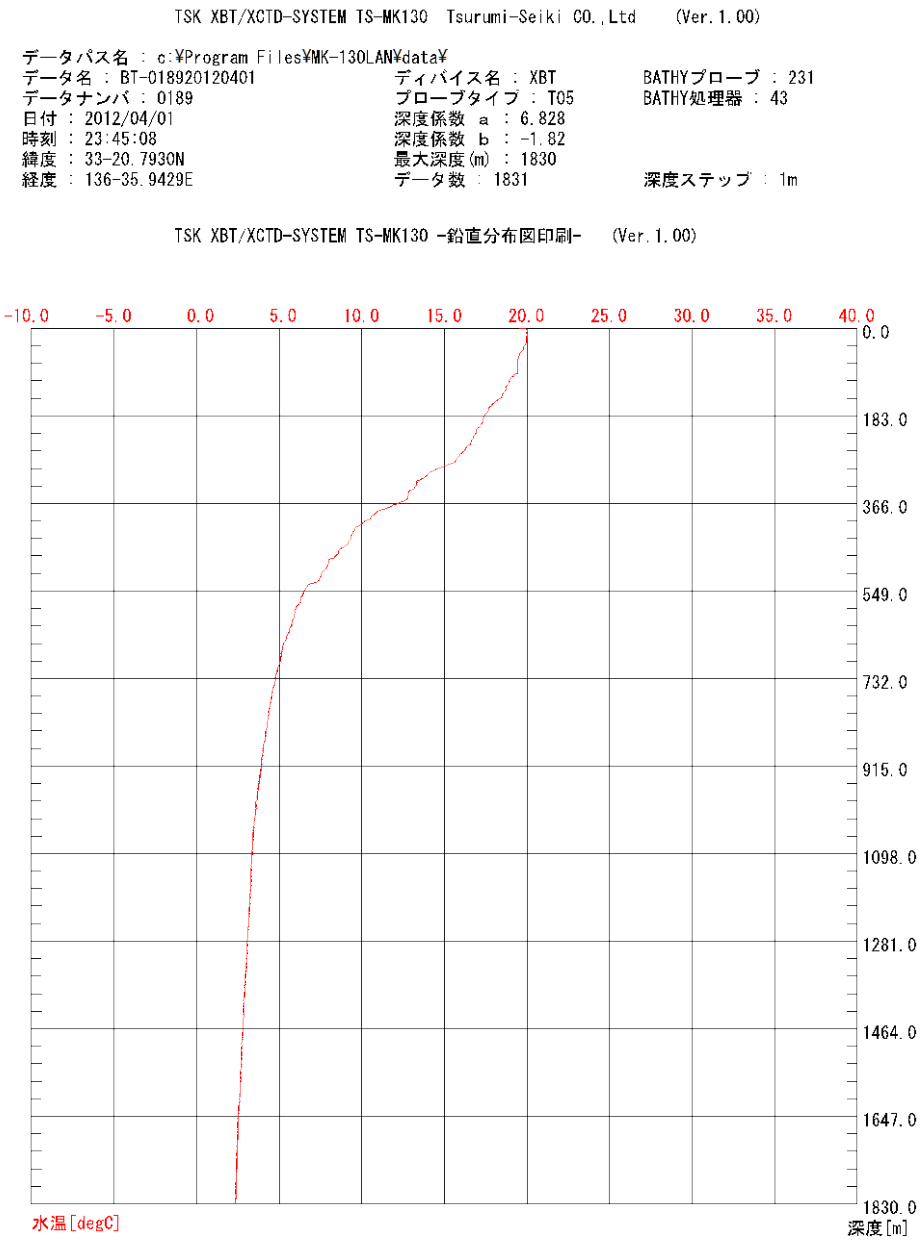


Figure 3. XBT measurement result.

### 5.2. MBES Bathymetry Survey

A bathymetry survey with the hull-mounted multi-beam echo system (MBES) was carried out along a line passing both CM05 and CM06 prior to the mooring systems installation for confirming the topography of the sites. The result is shown in Fig. 4.

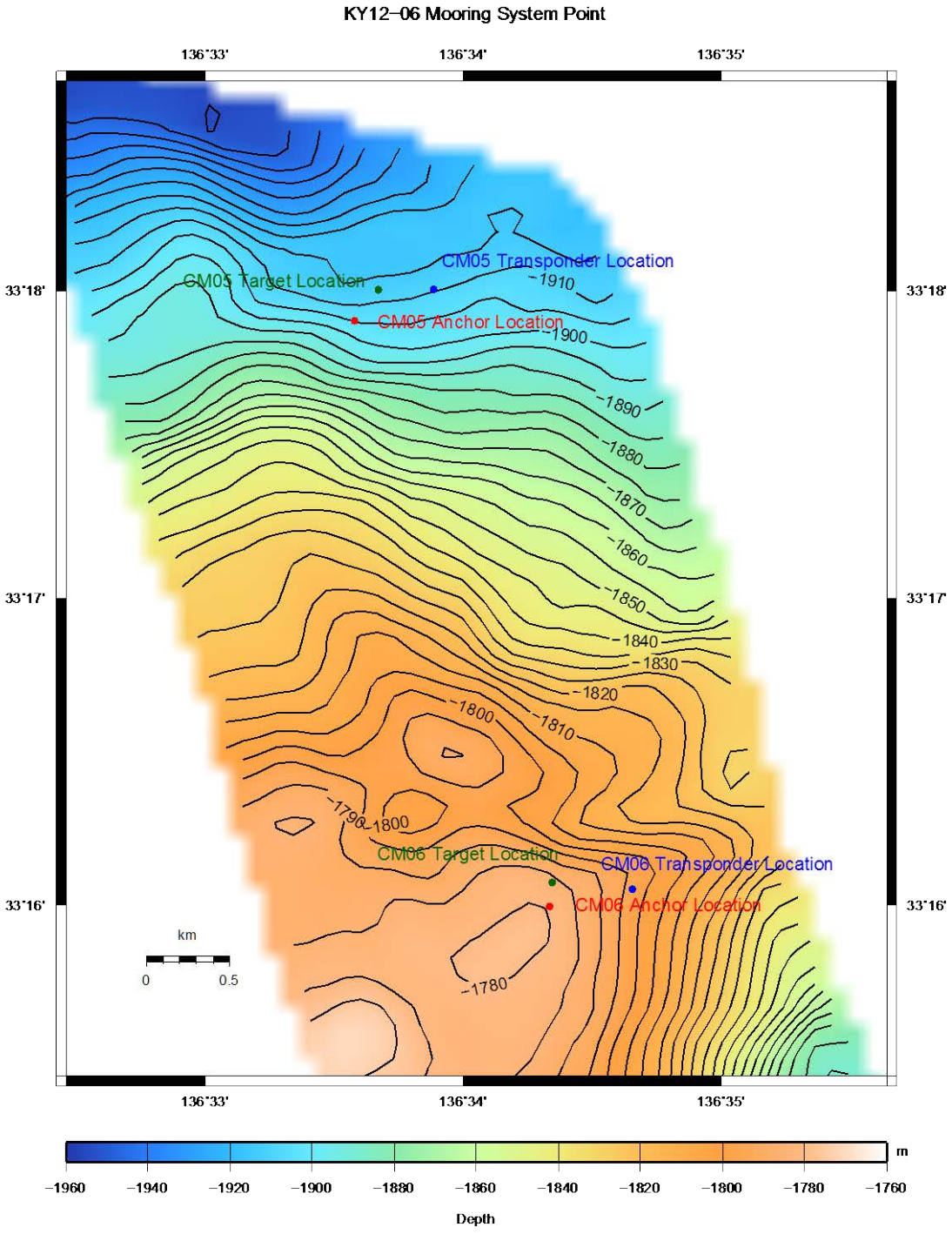


Figure 4. A bathymetry map obtained by the hull-mounted MBES. The planned location, the anchor (releaser) location and the transponder (top buoy) location of each site are also shown in the map.

### 5.3. Mooring System Installation

The mooring system installation operations were carried out at Site CM06 in first

and then CM05 next, and were successfully completed at both sites. The mooring systems were launched from the afterdeck with the A-frame. Each mooring system, which was newly designed and delivered in the end of March in 2012, is equipped with a Long-ranger ADCP at the top buoy, a transponder, five Doppler current meters, three conductivity-temperature-depth recorders (CTD) and a set of two acoustic releasers of different manufacturers (Fig. 5 and Fig. 6). The parameter settings and location summary are shown in Table 2 and Table 3, respectively.

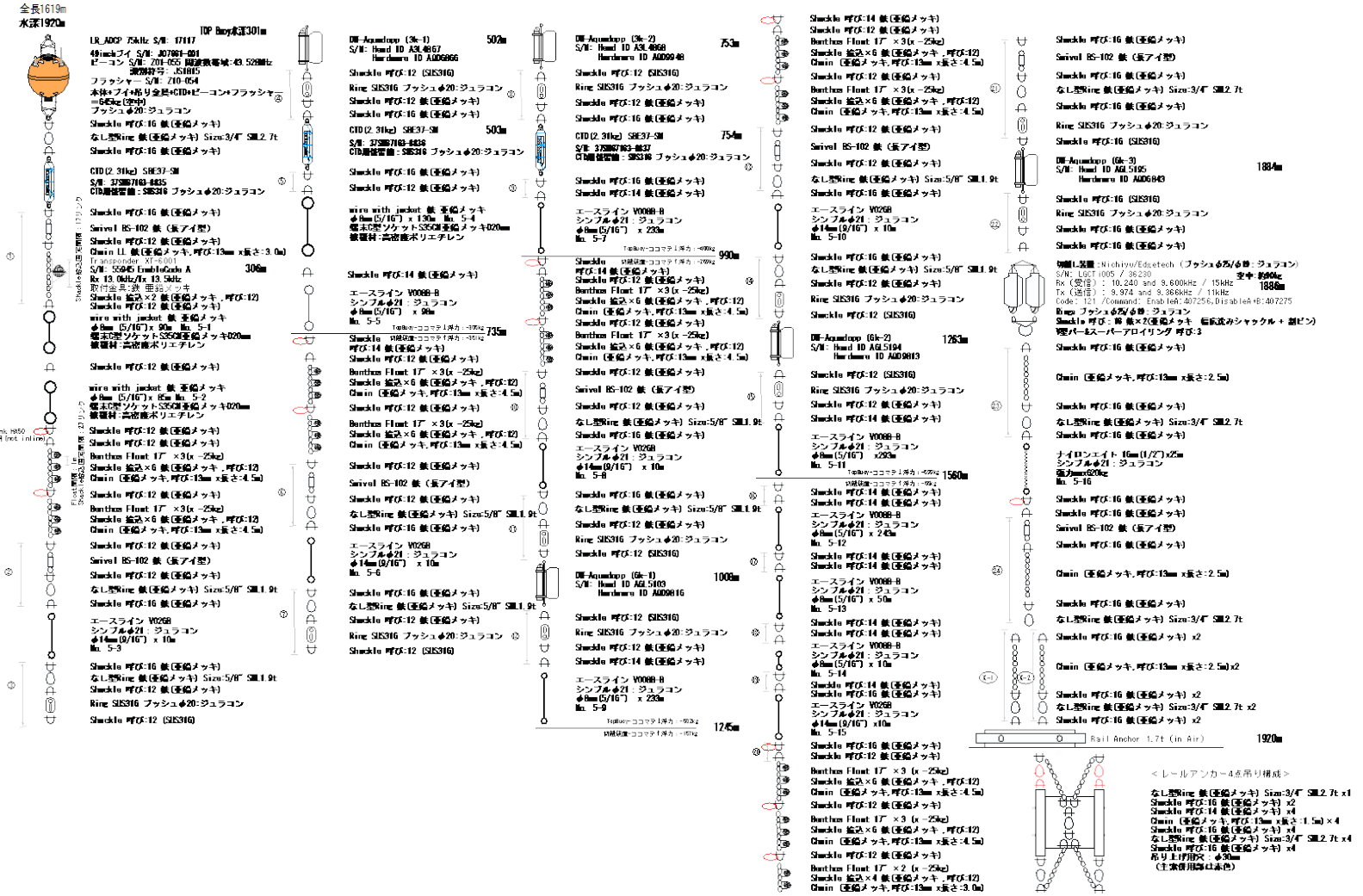


Figure 5. Configuration of the mooring system for Site CM05.

係留系構成図（2000m級_Site_CM06）

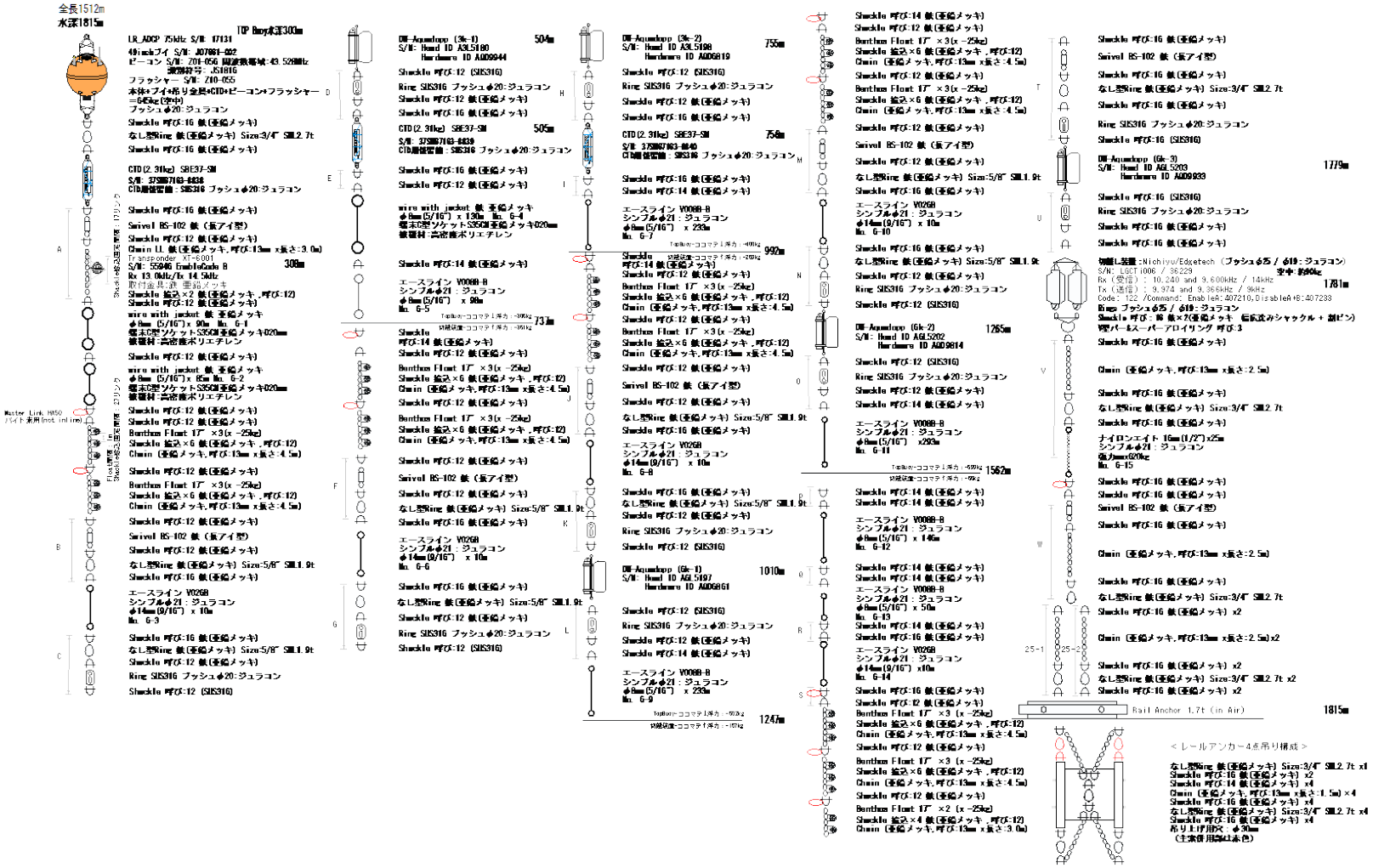


Figure 6. Configuration of the mooring system for Site CM06.

Table 2. 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 ℃ |
| DW-Aquadopp | |
| Measurement interval: | 1800 s |
| Average interval: | 35 s |
| Measurement load: | 22% |
| Compass udate rate: | 900 s |
| Sarinity: | 35‰ |
| SEB37-SM | |
| Measurement interval: | 1800 s |

Table 3. Location summary of the mooring installation

| Site Name | | CM05 | CM06 |
|---|---|---|---|
| Plan | Latitude | 33°18.0035'N | 33°16.0731'N |
| | Longitude | 136°33.6706'E | 136°34.3451'E |
| Dropped | Latitude | 33°17.845'N | 33°15.927'N |
| | Longitude | 136°33.329'E | 136°34.132'E |
| Positioned | Latitude | 33°17.902'N | 33°15.996'N |
| | Longitude | 136°33.578'E | 136°34.334'E |
| | Water Depth (Releaser) | 1861 m | 1744 m |

Note: Releasers are situated at 34 m above the anchor.

### 5.4. Triangulation of Mooring Positions

After completion of the mooring system installation, we carried out triangulation for determining precisely the actual positions of the two mooring systems. In the triangulation, a slant range from the ship to the releasers was measured at three positions around each site. We used primarily the data from the releaser of LGCTi (Nichiyu) whereas subordinately that of ORE8242XS (EdgTech) for comparison (Figs. 5 and 6). Telecommunication of the EdgTech releaser transponder and its shipboard communication station, however, performed improperly sometimes. As having a hang-up trouble in the communication station and loss of signals many times, we abandoned to do ranging with the EdgTech halfway. As a result, the positions of the two systems could be determined with quite small uncertainness (Figs. 7 and 8).

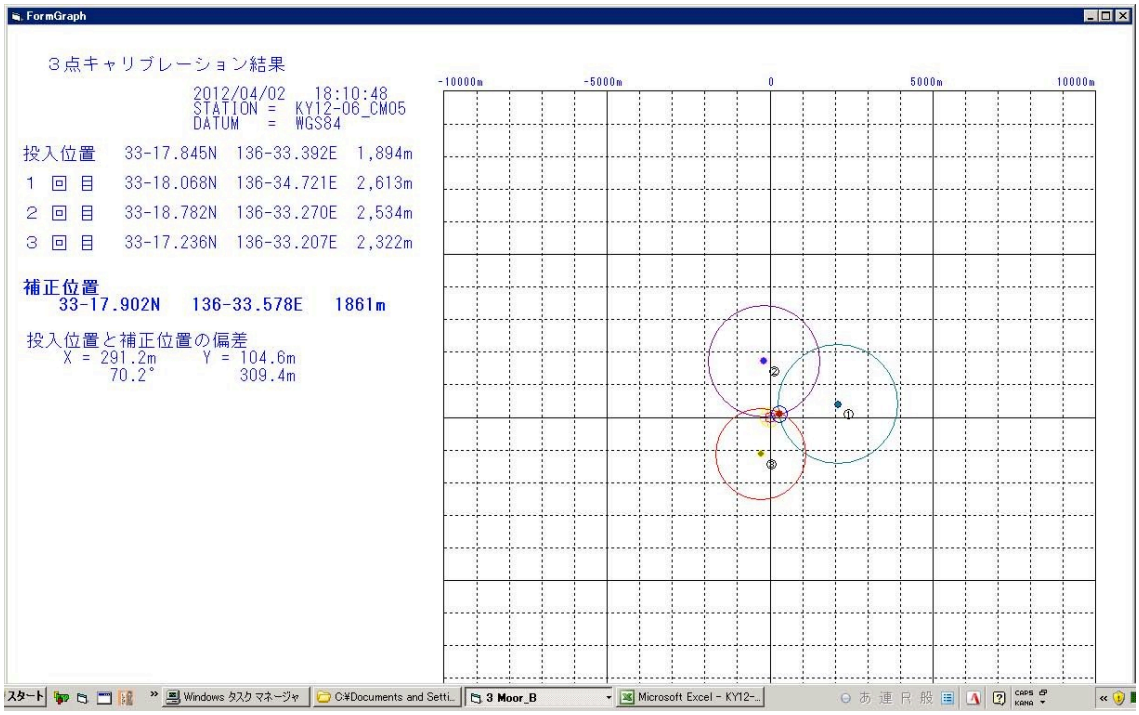


Figure 7. The result of triangulation for CM05.

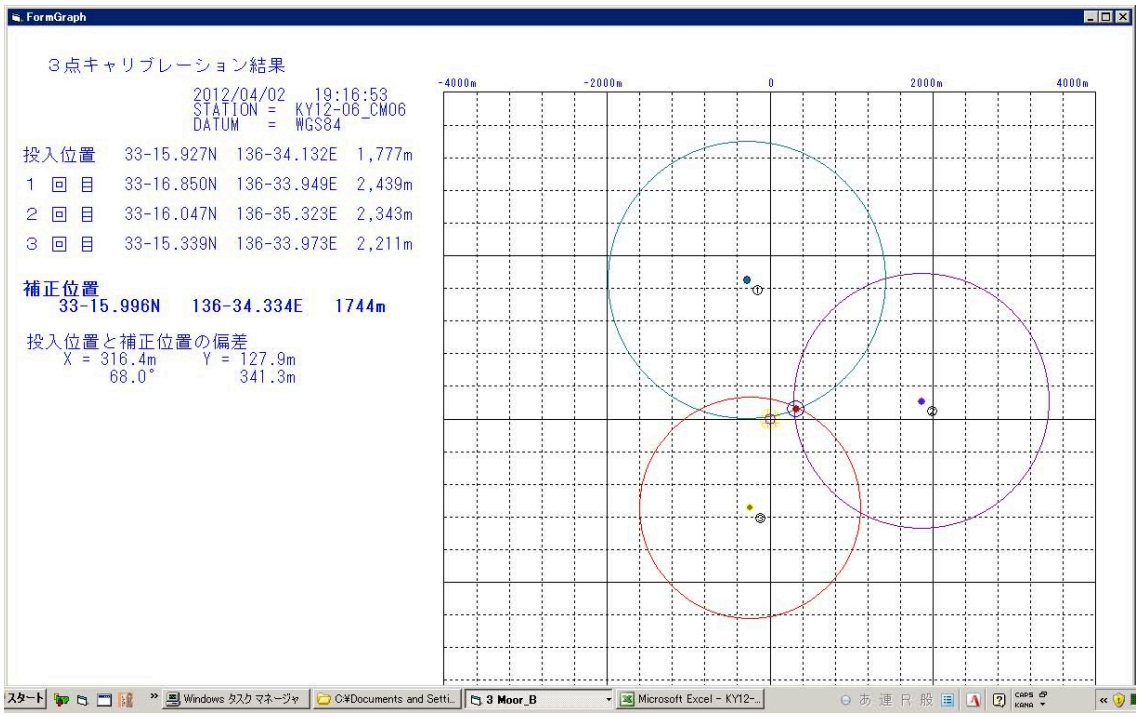


Figure 8. The result of triangulation for CM06.

### 5.5. Hull-mounted ADCP Current Survey

We carried out measurement of sea current direction and speed with the hull-mounted ADCP system during the cruise. The data obtained while staying in the mooring area shall be used as a reference data for the current analysis of Site C0002. Time series profiles of the sea current during being on the sites are shown in Fig. 9.

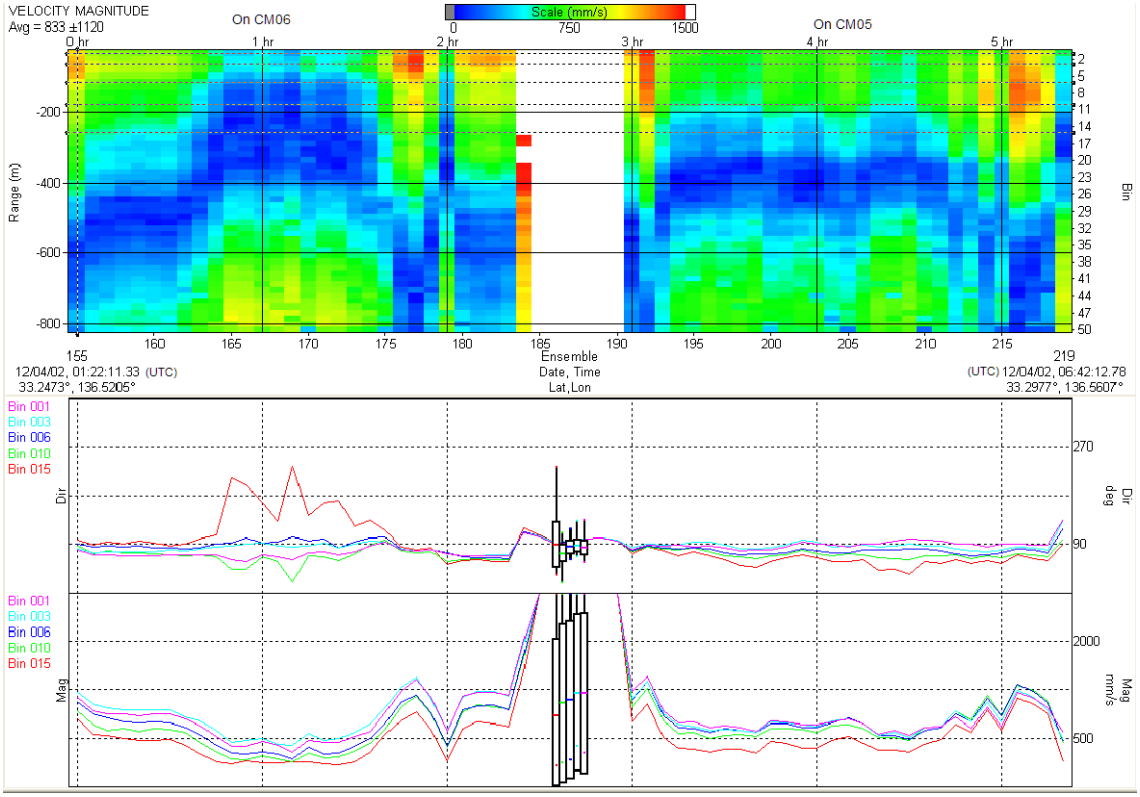


Figure 9. Time series profiles of the sea current during being on sites CM06 and CM05 measured by the hull-mounted ADCP. Times are according to UTC.

## 6. Conclusions

In KY12-06 cruise, we succeeded to install newly designed mid-water mooring systems for Kuroshio Current monitoring to two locations in the west and in the west-southwest of IODP Site C0002, Nankai Trough. The position of each location could be determined precisely by triangular ranging with the acoustic releasers. The mooring systems will be retrieved after one year or earlier.

## Acknowledgement

We are pleased to acknowledge the considerable efforts and assistance of Captain Masayoshi Ishiwata, crew and marine technicians for completing successfully the planned operations during the KY12-06 cruise.

※ Notice on using

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