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)

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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					

· Center for Deep Barth Exploration, Million

**: 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			
2 nd Officer:	Takeshi Egashira			
3 rd Officer:	Hidehiko Konno			
Chief Engineer:	Tadashi Abe			
1 st Engineer:	Kazunori Noguchi			
2 nd Engineer:	Saburo Sakaemura			
Jr.3 rd Engineer:	Shota Nagano			
Jr.3rd Engineer:	Kento Kame			
Chief Radio Operator:	Takehito Hattori			
2 nd 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.

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Table I	Event	102 01	тпе к т	(12-06)	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/ \	/isibility: 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	r: 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.

TSK XBT/XCTD-SYSTEM TS-MK130 Tsurumi-Seiki CO., Ltd (Ver. 1.00)

データパス名 : c:¥Program Files¥NK-130LA	N¥data¥	
データ名 : BT-018920120401	ディバイス名 : XBT	BATHYプローブ:231
データナンバ : 0189	プローブタイブ : TO5	BATHY処理器 : 43
日付 : 2012/04/01	深度係数 a : 6.828	
時刻 : 23:45:08	深度係数 b : -1.82	
緯度 : 33-20.7930N	最大深度(m) : 1830	
経度 : 136-35.9429E	データ数 : 1831	深度ステップ : 1m

TSK XBT/XCTD-SYSTEM TS-MK130 -鉛直分布図印刷- (Ver.1.00)

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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.

係留系組立構成図(2000m級_Site_CM05)

全長1619m									
水沫1920	10P BuowdC#301m	ഷ്		ച്		- A	Shackia 呼び:14 厳(重給メッキ) Shackia 呼び:12 厳(運給メッキ)		
Å.	LR_ADCP_75kHz_S/II: 17117		DII-Aquadopp (3k-1) 50 S/N: Head ID A314967	⁰²	DIII-Aquandapp (3k-2) S/11: Head 10 A3L4868 7	53∎ 🦉	Benthus Flowt $17^{-} \times 3(x - 25kg)$	ΤΨ	Shackle 呼び:16 鉄(亜鉛メッキ)
	49 mshフイ S/11: J0/961-101 ビーコン S/11: Z01-055 周波鉄電域:43.52984z	¥.	Hurdware ID A006866	ų.	Hardmans ID A009948	e e e e e e e e e e e e e e e e e e e	Shanckie 聖廷×6 駅(単編メッキ , 呼(A=12) Chain (重備メッキ, 呼び=13ma x長さ=4.5m)	ĝ	Smivel BS-102 數 (長アイ型)
	第四日子号: JS1815 フラッシャー S/11: Z10-054	Å	Shackle PF(X=12 (SUS316)	. TÁ	Shuckle PFCF:12 (SUS316)	- d	Sheckle 呼び:12 鉄(亜鉛メッキ)	Ŭ	Sheckle 呼び:16 鉄(亜鉛メッキ)
1	本体+ブイ+吊り金具+CID+ビーコン+フラッシャー - 545 (2014)	U)	King SLS316 ファシュゆ20:ジュラコ Sharkin BZ75-12 体(面的オッキ)	lo ()	King ME316 ノッシュクスロンシュフロン (1	ଁ ବ୍ର	Benthus Flowt 17 × 3(x - 25kg) 5 Shart lo MCA x 6 MCA x - 25kg 175 191	0 9	なし型Rine 鉄(亜鉛メッキ) Size:3/4 SII2.7t
₩.	ブッシュ #20: ジュラコン	Å	Sheckle 呼び:16 鉄(重鉛メッキ)	, X	3월348 월7112 월(월월/ 7년)		Chuin (亜鉛メッキ, 呼び:13m x長さ:4.5m)	A	Sheckle 呼び:16 鉄(亜鉛メッキ)
Ť	Sheckle 呼び:16 鉄(亜鉛メッキ) カリアロー Activity カンパーのパークの 3	Ä	CTD (2, 31kg) SBE37-SM 50	03m 🛛 Ä		љ∎ ⊺ ⊕‴	Shuckle 呼び:12 鉄(亜鉛メッキ)	0	Ring SES316 ブッシュφ20ジュラコン
U A	なし至いれる 新に更加メッキリ Sizes Shi Saiz バ Shackle 呼び:16 載(東船メッキ)		5月: 37587月63-6636 CTD-265天前 - 585316 ブッシュル20:ジ	1722	S/1: 37367163-637	Ĥ	Serivel BS-102 鉄 (長アイ型)	- U	Shuckle #\$75:16 (SUS316)
<u>۾</u>	CTD (9 21L-) CDE27 CN	P			Q 1000 位置値:303316 フォシュ∳20:ジュ	レージョン 10 10 10 10	Sheckle 呼び:12 鉄(亜鉛メッキ)	fin.	DNI-Aquandapp (Gk-3) SAL: Head ID ASISISS 1884aa
4	S/11: 375867163-4435	÷.	Simetrie 中(A-10 数(王編スタイ) Simetrie 町77-12 単(王のオッキ)		Shuckle 呼び:16 鉄(亜鉛メッキ)	Ō	なし型Sine 鉄(亜鉛メッキ) Siza:5/8″ SELL S	t 🛄	Hundamana ID A006843
- 🖞 🤟	UD#留容書:SESS ノサジュク20:ジュフヨン →	ö		~ † Å	Shuckle 呼び:14 鉄(亜鉛メッキ)	- _	Shuckle 呼び:16 鉄(亜鉛メッキ)	ΤŮ	Shuckle #774=16 (SUS316)
T Ŭ ŝ	Sheckle 呼び:16 鉄(亜鉛メッキ)	Ť	mire with jacket 鉄 亜鉛メッキ ∳8mm(5/16") x 130m Ma. 5–4	ľ	エースライン ¥00 00 1 シンブルφ21:ジュラコン	Ĭ	エースライン ¥0258 シンプル∳21:ジュラコン 。		Ring SES316 ブッシュφ20ジュラコン
	Sminel BS-102 鉄(長アイ型) Smith 1977-12 鉄(長アイ型)		- 電末(型ソケットS350)重船メッキ() - 被霍特:高密度ポリエチレン	20	¢8aaa(5/16") x 233aa Maa 5−7		∲14ma(9/16") x 10m Ma. 5–10	* U	Shuckle 呼び:16 鉄(亜鉛メッキ)
	Gmin 山 鉄(亜鉛メッキ, 呼び:13m x長さ:3.0m)	Ó			Tapiku oy-ココマテリ浮力:-400 kg	90∎ — 0	Sheekia 時代に16 前(王崎大ッキ)	ΤΨ	Shuckle 呼び:16 鉄(亜鉛メッキ)
8 - C	S/II: 55945 EmbleCade A 306m	A	Santia 成び14 単(系のオッキ)	\sim	Shuckle 対象状態-ココマティメカッ-2004 呼び:14 鉄 (亜鉛メッキ)	ŏ	なし型Ring 鉄(亜鉛メッキ) Size:5/8" SILL 9	t AA	切離し装置 :Nichiyu/Edgetech (ブゥシュタ5/タ巻:ジュラコン) S/N: LGCT 1005 / 36230
871울	Rx 13.0kHz/Tx 13.5kHz 取付金具:鉄 亜鉛メッキ	0		æ	Shuckle 呼び:12 鉄(亜鉛メッキ) Beathrey Flowt 17 ×3(x -25kg)	œ Ă	Sheckle 呼び:12 鉄(亜鉛メッキ)	i ni n	Rx (受信): 10.240 and 9.600kHz / 15kHz 1886
1 Å *	Sheakle 塩込×2 鉄(亜鉛メッキ , 呼び:12) Sheakle 呼び:12 鉄(亜鉛メッキ)	Ĭ	シンプルタ21:ジュラコン	ക	Sheckle 塩込×6 鉄(亜鉛メッキ、呼び	7:12)	Ring S15316 ブッシュ∳20:ジュラコン	$\cup \cup \cup$	Code: 121 / Command: EnableA:407256,DisableA:#B:407275
Ŷ	wire with jucket 鉄 亜鉛メッキ メター (5/16つ・00-16-5-1	4	Man 5–5 Tangkarana a Islah Janakara		unin (王福スツキ,叶O-1300 XRさ) Shedde 呼び:12 鉄(王鉛メッキ)	-•.⊒u ⊥ ⊕ 	Shuckle ##75=12 (SUS316)	ٽچٽ	in noi フランエルスタルマロ:フェフォン Smackin 呼び:前 葉×2(亜鉛メッキ:偏広沈みシャックル + 創ビン)
ļ	電気に型ソケット2550回転数メッキ020mm -	Ť	Shuckle MARKE-DORPTAN-46142	3500 👘	Benthus Float 17" ×3(x -25kg)		Dill-Aquandropp (6k-2) 1263an	<u> </u>	曜パー&スーパーアロイリング 呼び:3
0	■単計·再型量示 フエラレン	\cap	呼び:14 鉄(連絡メッキ) Shaatla 呼び:12 鉄(亜鉛メッキ)	2.99 (1.98	- Shuckle 聖达×6 単し単位メッキー中の - Chain (重備メッキ,呼び:13mm 大振さ:	A.S. Ц.	S/N: Hand ID A6L5194 Hardamra ID A009813	T g	Shackie 呼():IG 獣(重編メッキ)
Ą	Slackle 呼び:12 鉄(亜鉛メッキ)	(a)	Banthos Flowt 17" ×3(x -25kg)		Shuckle 呼び:12 鉄(亜鉛メッキ)	ŦÅ	Shuckle #775-12 (SUS316)	8	Gain (東崎大ッキ 呼び:13mg r長さ:2 5m)
Ŷ	mine mith jucket 鉄 亜鉛メッキ	6	- Shuckle 塩込×6 象し虫船メッキ , 中 Chain (亜鉛メッキ, 中び:13ma x長さ	FCF=123 ⊖ ≥:41.5=0	Surivel BS-102 鉄 (版アイ型)	. ()	Ring SL5316 ブッシュ∳20:ジュラコン	- X	
1 5	電気(型) いかい 10 (10 00 00 00 00 00 00 00 00 00 00 00 00 0	÷	Sheakle 呼び:12 鉄(亜鉛メッキ)	⊕ ⊕	Stackle 呼び:12 鉄(亜鉛メッキ)	Ū.	Simula 呼び:12 鉄(亜鉛メッキ)	D Ŭ	Sheakle 呼び:16 鉄(亜鉛メッキ)
Byter Liek 850	電量者・再始最ポリニナレン Simetia 成な:12 美(画路はゃキ)	Þ	Benthes Float 17" ×3(x -25kg)	O	なし型Rine 鉄(亜鉛メッキ) Size:5/8	rs∎ulsei∯	Shuckle 呼び:14 鉄(亜鉛メッキ)	Q	なし型Nine 鉄(亜鉛メッキ) Size:3/4「 SII2.7t
バイト東用 (not inline)	Simate 呼び:12 鉄(正備メッキ)		- Shuckle 塩込×6 鉄(亜鉛メッキ , 甲 - Chain (亜鉛メッキ, 甲び:13m x長さ	£76≊123⊥⊖ ≛:4.5=0 O	Shuckle 呼び:16 鉄(亜鉛メッキ) エースライン V0260		エースライン ¥0088-8 シンプルφ21:ジュラコン	÷⊖	Shackle 呼び:16 鉄(亜鉛メッキ)
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6	3.maxie 重整へを動しておンティンド(3-12) Chain (亜鉛メッキ,呼び:13m x長さ:4.5m)	A.	Sheckle 呼び:16 鉄(亜鉛メッキ)	0 🛱	Shueldle 呼び:12 鉄(亜鉛メッキ)		シンプルタ21:ジュラコン タ8mm(5/161) × 243m	6	Surivel BS-102 鉄 (長アイ型)
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ģ	エースライン W258	Ă	なし空いing 新江語メッキリ 3128-301 Sheaking 呼びに12 載(東崎メッキ)	Â	Shuckle 4775-12 (SUS316)	Ŷ	10.5-13 Shanh la 1975-14 (年の) オッキ)	Ă	なし型Ring 鉄(亜鉛メッキ) Siza:3/4 SII2.7t
	シンプル+21:ジュラコン 	(1)	Ring SUS316 ブッシュ∳20:ジュラコ	12 0 Q	Ring SUS316 ブッシュ∳20:ジュラヨン	* ® 💆	Slackle 呼び:14 鉄(正鉛メッキ)	TeTe	Simakia 呼び:16 鉄(亜鉛メッキ) x2
Ļ	In . 5-3	Ŭ	Shuckle 1970-12 (SUS316)	t t	Sheckle 呼び:12 鉄(亜鉛メッキ)	9	エースライン ¥0088-8 シンプルφ21:ジュラコン	8 8	
ī ģ	Shuckle 呼び:16 鉄(亜鉛メッキ)			÷Α	Shucidle 呼び:14 厳し重発メッキ)	_ b	φ8ma(5/16") x 10m No 5−14 ~~~~	No 8	Chuin (亜鉛メッキ,呼び:13mm x長さ:2.5m)x2
¢ Q	なし至Kine 気(生給メッキ) Size:5/H SHLL9t Sheatle 呼び:12 鉄(手給メッキ)			ľ	エースライン ¥00 00-0 シンプル タ 21:ジュラコン	° [Ă) <u>Xen</u> X	
n	Ring SES316 ブッシュ # 20:ジュラコン				∳8mm(5/16°) x 233m Ma. 5−9	Ŷ	エースライン 10268	- X Z) Smackie 年(A-10 駅(東海メッキ) X2) なし型Ring 鉄(亜鉛メッキ) Size:3/4「Sma2.7t x2
Ψ	Shackle 4478-12 (SUS316)			6	Topfice ~ ココマテ 1/4カ 502kg 12	5 -	シンフル#21:ジュラコン #14=(9/16*) ×10=	±ă ±ă	Shuckle 呼び:16 鉄(亜鉛メッキ) x2
					特徴装置-ココマテキがカ:- 1614	~~ J	In 5-15 Sample 177-16 (€ (≣ (5) + 1 + 1)	0	O Rail Anchor 1.7t (in Air) 1920
						۵ <u>۲</u> ۵	allickie 呼び:12 鉄(亜鉛メッキ)	t	0 ₩
							Bonthes Float 17" × 3 (x - 25kg)	Q	𝒫 𝔔 < レールアンカー4点吊り構成≥
						j.	annaxie 金込×4 新したロメツヤ ,年(A:12) Chain (重編メッキ,年び:13m x長さ:1,5m)	A	★」 本L型Ring 美(連絡メッキ) Size:3/4「SII2.7t x1
						್ಲಿ	Shackle 呼び:12 鉄(亜鉛メッキ)	-	1000 Sheckle 呼び:16 鉄 運営メッキ) x2
						99 78	Bunthes Flowt 1デ ×3 (x -25kg) Shackle 塩込×6 鉄(亜鉛メッキ ,呼び:12)		〇 〇 〇 〇 〇 〇 〇 〇 〇 〇 〇 〇 〇 〇 〇 〇 〇 〇 〇
						j.	Chuin (重鉛メッキ,咩び:13m x長さ:4.5m)	1	なし整照ing 鉄(亜鉛メッキ) Size:3/4F SE2.7t x4 Size:klg 呼び:16 鉄(亜鉛メッキ) x4
						Ċ	Shackle 呼び:12 鉄(亜鉛メッキ) Boothew Flowt 17 ×2 (x -29-)	Ą	
						(B)	Shuckle 絵込×4 鉄運船メッキ、呼び:12)	Q	\$ <u>\0</u>
						6 3 8	Ghunn (登録メッキ, 呼び:13mm x長さ:3.0m)	A	Y ¥↓

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

係留系構成図(2000m級_Site_CM06)

全長1512	m			-++	Shackle 呼び:14 岐(東崎メッキ)	
水沫1815	TOP Bookt 25300m	ല്	ച്	Ă	Slackla 呼び:12 鉄(亜鉛メッキ)	
<u>a</u>	LR_ADGP 75kHz S/II: 17131	Di Aquadopp (3k-1) 504m	Dill Aquadapp (3k-2) S70: Haad ID 1215109	755a 🕬	Benthos Flout 17" × 3 (x - 25kg)	☆ Sheckle 呼び:16 鉄(亜鉛メッキ)
	49imshブイ S/11: J07981-602 ビーコン S/11: 701-056 国対応のないとよ9 5290052	ther desares 10 A009944	Hundanara ID A006819	e	Sheckle 絵込×6 鉄(亜鉛メッキ,呼び:12) Data (画像オッキ 成び:13-a v長キ:45-a)	☆ Sarivel BS-102 鉄 (長アイ型)
	#2947 57 . JS1816	Shuckle ₩775-12 (SUS316)	:: 📩 Shanckiu P\$775:12 (SUS316)	89	Similar W75:12 単価値大ッキ)	○ ++ Sheakh 呼び:16 美(亜鉛メッキ)
	フラッシャー 安田: 200-055		Ring SUS316 ブッシュ♦20:ジュラ	עב 🕰	Benthma Flout 17" × 3(x - 25kz)	○ 女し教師で 他(単価メッキ) Size:3/4 Sill 2 7t
, in the second se	- 本体・ノイ・ロウラ重要でいいでとーコン・ノノランマー =645kg(空中)	□ 💥 Shackle 呼び:12 鉄(亜鉛メッキ) -	◎ (山田) Shuckle 呼び:12 鉄(亜鉛メッキ)	, and the second s	Sheckle 塩込×6 鉄(亜鉛メッキ , 呼び:12)	
8	ブッシュ∳20:ジュラコン	💮 Sheckle 呼び:16 鉄(亜鉛メッキ)	⊖ Shuckle PF75:16 (#(₩64.× × +)	85	Chain (亜鉛メッキ) 呼び:13m x長さ:4.5m)	
Å	Shackie 呼びには、東山上船メッキ) A. ADD - A.CTALL、A.V.C AVE (1993)	🛱 CTD (2. 31kg) SBE 37-SM 505m	A CTD (9. 911-) CRE97 CH	TA TĂ	Sheckle 呼び:12 鉄(亜鉛メッキ)	King SIS316 ブッシュ∳20:ジュラコン
- Q	なし空外にを 駅(単編メッキ) Size3/4 SHLZ パ の、し、 またたちた みくびない と、たい	\$/II: 375087163-6839		R Bot	Surival BS-102 載 (長子イ琴)	≟Ų, Shanchile r#7(X:16 (SUS316)
	Sinckie Province (CEREX 741)	「「「「「「「「」」」」、「「」」、「「」、「」、「」、「」、「」、「」、「」、	□ Chill 位置値: 38318 ブッシュφ20:	ジュラコン _M Ö	S	Dill-Aquanchapp (Gir-3)
1	CTD (2. 31kg) S8E37-SM	- 〒 🕂 - Shanak la 呼び=16 鉄(亜鉛メッキ)		Ŭ,	た」開始:	S/N: Head ID AGL 5203 17798
	S/11: 3/SHS/163-6638 CTABM研究的 - SHS36 ブッシュよ20:ジュラコン	「⊥」 Shuckle 呼び:12 鉄(亜鉛メッキ)	→ → → → → → → → → → → → → → → → → → →	18	Sample with the (and the tart)	· ==
- The second sec	2 		e	- tt		A Sharakte r≢(X=16 (SUS316)
TV	a) Shanakle 呼び:16 鉄(亜鉛メッキ)	→ Bana (5/16 ⁻¹) x 130a Ba. 6-4	エースライン Y0080-10 シンプル 421:ジュラヨン		シンプルタ21:ジュラコン	Ring SIS316 ブッシュ∳20:ジュラコン
	Serivel BS-102 鉄(長アイ型) E	電気に空ツケット250回車船メッキ020mm 装置は1字改画ポリエチレン	(5/16 [−]) × 233=		φinani(synα) x ion. Ma. 6−10	↓ Shuckle 呼び:16 鉄(亜鉛メッキ)
, Ŭ	E Shackia 呼び:12 鉄(連絡メッキ) ド Decis II 鉄(高のオッキ、成び:12		TapBury-DDV71月45:400	° m – †	分離末期 成びに16 単(単語オッキ)	☆ Sheckle 呼び:16 鉄(亜鉛メッキ)
	Transponder XT-6001		Standale (1882) 10791 (85) 200		なし型Ring 鉄(亜鉛メッキ) Size:5/8" S田1.9t	ー :
8	k contraction in the second se		→ Shuckle 呼び:12 鉄(亜鉛メッキ)	NĂ	Stackle 呼び:12 鉄(亜鉛メッキ)	・
20	- 5 取付金具:鉄 亜鉛メッキ	✓ エースライン ¥0088-8 シンプル★21:ジュラコン	Benthes Float 17" ×3 (x -25kg)	1	Ring SUS316 ブッシュ∳20:ジュラコン	Tx (送信): 3.374 and 3.366kHz / 3kHz 1781■
÷ ě	8 Sheckle 単述×2 数(単語メッキ)。 Sheckle 呼び:12 数(単語メッキ)	¢8mm (5/16°) x 98m	Simukle 塩込×6 鉄(亜鉛メッキ・) ジョン (三の) (三の) (三の) (三の) (三の) (三の) (三の) (三の)	PP7775:120 ₩ i+t:// ₩	Shuckle PF75-12 (SUS316)	Code: 122 /Command: EnableA: 407210, DisableA+B: 407233
Q	wire with jacket 鉄 亜鉛メッキ	C Tapiton-DDRF1#5:-305%2797	 ・・・・・・・・・・・・・・・・・・・・・・・・・・・・・	പ്പി		000 1000 0 000 0 0 0 0 0 0 0 0 0 0 0 0
	● Ben (3/10 J× 900 min 0−1 雪末0型 ソケットS50回 ● 値メッキ020mm	→→→ Shanckie ¹⁹⁸ 年第2日マライメカト-361kg	Benthus Float 17" ×3 (x -25kg)		DW-Aquad app (6k-2) 1265m	◯ 遅パーもスーパーアロイリング 呼び:3
Ó	被雇材:高密産ポリエチレン	呼び:14 鉄(亜鉛メッキ)	Smoothe 塩込×6 鉄 亜鉛メッキ。	PF77:12)	Synt: Hend TD Add.5202 Herdeners ID Add.9814	→ ↔ Shanch le 呼び:16 鉄(亜鉛メッキ)
Ĥ	Shackle 呼び:12 鉄(亜鉛メッキ)	다 Shuckle PF()-12 또(프일/ 카구)	つ し し 語 に 世 語 メッ キ 、 年 () - 、 に) - 、 ・ ・ ・ ・ ・ ・ ・ ・ ・ ・ ・ ・ ・ ・ ・ ・ ・ ・	tean an thài	Shuckle #705-12 (SUS316)	8
Ŷ	wire with jucket 鉄 亜鉛メッキ 1、 本Ame (5/16つ x ASm Ma 6-2	○デ Bunthos Float I/ × 3 (x − 20kg) ※ Shankin 編入×6 単(単価メッキ・PF75:12)		. 0	Ring SUS316 ブッシュ∳20:ジュラコン	○ Gmin (重発メッキ,呼び:13m x長さ:2.5m)
ļ	3 雪末(型ソケット350)重給メッキ(20mm)	🕞 Chuin (亜鉛メッキ,呼び:13m x長さ:4.5	🔄 📋 Serivel BS−102 鉄(銀アイ型)	Ť	Sheckle 呼び:12 鉄(亜鉛メッキ)	○ → Sheath 呼び:16 前(東崎メッキ)
Q	「「「「「「「「「「「「」」」」」」」」」」」」」」」」」」」」」」」」」	Sheckle 呼び:12 鉄(亜鉛メッキ)	┘ ↔ Shuckle 呼び:12 鉄(亜鉛メッキ)	- A	Sheckle 呼び:14 鉄(亜鉛メッキ)	☆1.表記ing 単(単位メッキ) Size:3/4 5目2 7t
Nater Link 1850 〇〇〇 バイト東用(not inline) 〇	andakiu Fr(J-12 新(正備スツキ) 著 Shasha Fr(J-12 新(正備スツキ)	ģ∰e Benthos Floet 17″×3 (x −25kg)	 なし型Rine 鉄(亜鉛メッキ) Size: 	5/8″SELI.9t op	エースライン V0098-8	
(B)	Benthus Float 17" ×3(x -25kg)	Sheckle 塩込×6 鉄(亜鉛メッキ,呼び:12	20、上合 Shackde 呼び:16 鉄(亜鉛メッキ)		シンプルタ21:ジュラコン	0 + 4 0 5 7 4 5 16 - 01/27 - 25-
	HTTR: Sheakle 塩込×6 鉄(亜鉛メッキ、呼び:12) Mán Christian - Frank - Fr				¢than(5/16.) x230an Ma. 6−11	シンプル・421:ジュラコン
	· 문제· Grain (문제2 9 4) 바다.(340 X 중 2:4 34) 특별	→ ▽ Sheckle 呼び:12 鉄(亜鉛メッキ)	≠14m(9/16 ⁻) x 10m	ł		∴ <u>Giljamax620kg</u> No. 6–15
y,	333 Shuckle 呼び:12 鉄(単鉛メッキ) ^{正常} かいけい 「「「」」」	☐ Surivel BS-102 數 (長アイ型)	. <u>⊪</u> . ∈-8		100/100 100/100/100/100/100/100/100/100/	Ò →→ Santa BITI 16 #(BIC) ×>>)
	Bentines Flowt 17 ×3(x =20kg) Sherkin 始み×6 単(単位メッキ・成な:12)	・ ・ ・ ・ ・ ・ ・ ・ ・ ・ ・ ・ ・ ・	☆ ① Shedde 呼び:16 鉄(亜鉛メッキ)	. T ₩	Shecklu 呼び:14 鉄(亜鉛メッキ)	A Shuckin 呼びには 他(手俗メッキ)
Ča:	Chuin (亜鉛メッキ,呼び:13m x長さ:4.5m)	 なし発明ing 載(単価メッキ) Size:5/8「 SP 	L1. HL) なし型Rine 鉄(亜鉛メッキ) Size:	5/8″ S≣L1.9t≟ A	Sheckle 呼び:14 鉄(亜鉛メッキ)	
τŬ	Shuckle 呼び:12 鉄(亜鉛メッキ)	- A Smokle 呼び:16 鉄(亜鉛メッキ)	↓↓ Shuckle 呼び:12 鉄(亜鉛メッキ) K ◎	Ŷ	モースライン Y0088-8	○ ○ Sheetale 時75:16 前(単偽メッキ)
6	Swivel BS-102 鉄(振アイ型)	♀ エースライン ¥0268	[i] Ring SIS316 ブッシュ◆20:ジュラ	עב	シンフルゆ21:シュラコン 参8m(5/16*) × 146m	. 8
в О	Sheckle 呼び:12 鉄(亜鉛メッキ)	シンプルゆ21:ジュラコン	⊥ Ų Shanckie m¥704≑12 (SUS316)		lia. 6–12	- ○
0	なし型Rine 鉄(亜鉛メッキ) Size:5/8「SILL st	, <u>16</u> 66	∰ — OF-Acuadace (Sk-1)	1010	Sheckle 呼び:14 鉄(亜鉛メッキ)	ő
± ₫	Sheckle 呼び:16 鉄(亜鉛メッキ)		S/II: Head ID AGL5197 Headware ID 4005951		Sheckle 呼び:14 鉄(亜鉛メッキ)	♀ ↓ Sheckle 呼び:16 鉄(亜鉛メッキ)
Ý	エースライン V0258			Ŷ	エースライン YUU88-8 シンプルタ21:ジュラコン	↓ () なし型Sine 鉄(亜鉛メッキ) Size:3/4「SII2.7t
	¢14mm (9/16 ⁻) × 10m		A Sharckle म‡77≭:12 (SIIS316)	ļ	¢8mm (5/16") x 50m ΄ № 6-19	□ ① □ ① Shuckle 呼び=16 鉄(亜鉛メッキ) x2
9	Ma. 6−3			⊫ע _פ ⊺ע	Sheckle 呼び:14 鉄(亜鉛メッキ)	8 8
ΤŻ	Sheckle 呼び:16 鉄(重鉛メッキ)		 ・・・・・・・・・・・・・・・・・・・・・・・・・・・・・	<u> </u>	Shuckle 呼び:16 鉄(亜鉛メッキ)	8 0 Gmin (重備メッキ,呼び:13mm x長さ:2.5m)x2
c Q	なし至King 鉄(亜鉛メッキ) Size(5/ビ SELL9) Simple (ボグ・12 株(ボグメッキ)	± ⊖ Sniekie (¢.12 (Sissin)	→ Shuckle 呼び:14 鉄(亜鉛メッキ)	ľ	エースライン W258 25- シンプルゆ21:ジュラコン	8 8
	3.00010 FF(3-12 数(正備2 947) Dia= SIS316 ブッシュ 490-ジュラコン		♀ エースライン ¥0088-8		#14m(9/16") x10m	サーサ Sheckle 呼び:16 鉄(亜鉛メッキ) x2
	Shart In 1975-19 (SIS316)		シンプル #21:ジュラコン #9~15/16つ - x 23~		Sandala 1975-16 (# (# 65 st v.t.)	() () なし空がine 新しきログッキリ Size:3/4 SHZ /t x2
± 0	SINCKIN PTO-12 (SECOND)		Ma. 6-9	°1A	Stackle 呼び:12 鉄(亜鉛メッキ)	
			O TopBusy는ココマテ1件力:-003×2	1267 8	Benthes Float 17 ×3 (x -25kg)	U O Rail Anchor 1.7t (in Air) 1815
			特徴装置-ココマテキ浮力:- 16762	····· (4)	Shuthe 聖法×0 新(聖婦メタイ・)年(4-12) Chain (東崎メッキ・呼び:13m x長さ:4.5m)	tr ot
				-t+	Sheckle 呼び:12 鉄(亜鉛メッキ)	Q え ダ Q < レールアンカー4点吊り構成 >
				~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	Benthos Flowt 17" ×3 (x -25kg)	
					Sheckle 塩込×6 鉄(亜鉛メッキ , 呼び:12) Maio (高のメッキ , 呼び:12	
					unini (北京アッキ) 呼(Jinini Xまされ(m) Sharkin 成な:12 単(玉崎大ッキ)	Smettle 呼び=14 厳(生給メッキ) ×4 
				- <del>d</del>	Banthos Float 17 ×2 (x -25kz)	Simula 呼び:16 鉄連絡メッキ) xi     Simula 呼び:16 鉄連絡メッキ) xi     たし 割時間 鉄 運動メッキ) xi
				( <b>P</b>	Shuckle 論込×4 鉄 運給メッキ ,呼び:12)	· · · · · · · · · · · · · · · · · · ·
				89	unin (連編メッキ) 呼():13m X食さ3.(m)	
						Na Sñ
						Hr H

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

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-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 2. Parameter setup of each mooring system.

Table 3. Location summary of the mooring installation

	5	U	
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	1061	1861 m 1744 m
	(Releaser)	1801 11	

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

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#### * Notice on using

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