



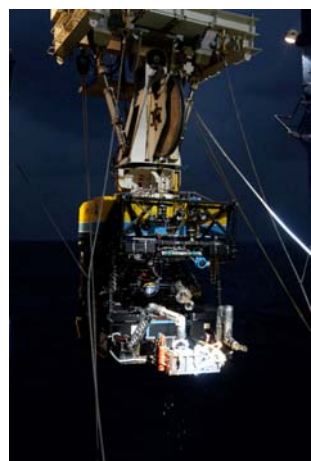
NATSUSHIMA Cruise Report

NT12-02

Research Dive by Hyper Dolphin 3000

NW Pacific Ocean

(SE off Kii Peninsula)



Jan., 16 – 21, 2012

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

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1. Cruise Information

1.1. Cruise Number

NT12-02

1.2. Ship Name

NATSUSHIMA

1.3. Title of the Cruise

Research dives by Hyper Dolphin 3000

1.4. Title of Proposals

Proposal 1

Experimental tilt observation by using latest ocean bottom seismometer technology (Shiobara)

Proposal 2

Do submarine landslides and related event sediments record a history of fault movements ? (Kawamura)

1.5. Cruise Period

Jan., 16 – 21, 2012

1.6. Port Call

JAMSTEC, Yokosuka – JAMSTEC, Yokosuka

1.7. Research Area

NW Pacific Ocean, SE off Kii Peninsula

1.8. Research Map

Refer to Figure 1.

2. Researchers

2.1. Chief Scientist

Hajime Shiobara [ERI, Univ. Tokyo]

2.2. Representative of Science Parties

Proposal 1 Hajime Shiobara [ERI, Univ. Tokyo]

Proposal 2 Kiichiro Kawamura [IFREE, JAMSTEC]

2.3. Science Parties

Proposal 1

Hajime Shiobara [ERI, Univ. Tokyo, chief]

Takehi Isse [ERI, Univ. Tokyo, support]

Aki Ito [IFREE, JAMSTEC, support]

Masanao Shinohara [ERI, Univ. Tokyo, land support]

Hiroko Sugioka [IFREE, JAMSTEC, land support]

Proposal 2

Kiichiro Kawamura [IFREE, JAMSTEC, co-chief]

Toshiya Kanamatsu [IFREE, JAMSTEC, support]

Hiroshi Ikeda [Fukada Geol. Inst., support]

Norio Oyagi [Fukada Geol. Inst., support]

Takashi Shinokawa [Natural History Museum of Osaka, support]

Minoru Sato [Univ. Tsukuba, support]

Ryo Anma [Univ. Tsukuba, land support]

Arito Sakaguchi [IFREE, JAMSTEC, land support]

Masashi Ito [MSD, NME, support]

2.4. Captain, crew and Hyper Dolphin operation team

2.4.1. Captain and crew of the R.V. NATSUSHIMA

Captain	EIKO UKEKURA
Chief Officer	AKIHISA TSUJI
2nd Officer	ISAO MAEDA
3rd Officer	AKIRA SUZUKI
Chief Engineer	HIROYOSHI KIKKAWA
1st Engineer	WATARU KUROSE
2nd Engineer	SABURO SAKAEMURA
3rd Engineer	SHOTA NAGANO
Chief Radio Operator	SATOSHI WATASE
2nd Radio Operator	HIROKI ISHIWATA
Boat Swain	KOZO YATOGO
Able Seamen	KUNIHARU KADOGUCHI
Able Seamen	TADAHIKO TOGUCHI
Able Seamen	NAO ISHIZUKA
Sailer	HIROTAKA SHIGETA
Sailer	KAZUHO IKEDA
Sailer	HIDEO ITO
No.1 Oiler	KIYOSHI YAHATA
Oiler	KAZUO ABE
Oiler	MASANORI UEDA
Oiler	SHIN TORAO
Oiler	RYO MATSUUCHI
Chief Steward	TERUYUKI YOSHIKAWA
Steward	HIDEO FUKUMURA
Steward	TATSUYA YAMAMOTO
Steward	HIROKI FUKUDA
Steward	KEI ITO

2.4.2. Hyper Dolphin operation team

Chief ROV Operator	YOSHINARI ONO
ROV Operator	KATSUSHI CHIBA
ROV Operator	HIROFUMI UEKI
ROV Operator	TEPPEI KIDO
ROV Operator	YUDAI SAKAKIBARA
ROV Operator	ATSUSHI TAKENOUCHI
ROV Operator	RYO SAIGO

3. Observation

3.1. Proposal 1. Experimental tilt observation by using latest ocean bottom seismometer technology

3.1.1. Purpose and background

Our final aim is to realize the spatially dense tilt observation on the sea floor. As the first step of it, we perform a test observation by using the new generation broadband ocean bottom seismometer (BBOBS-NX) for the feasibility study.

We had developed the BBOBS and BBOBS-NX and performed several practical observations in these ten years to create the ocean floor broadband seismology. Now, the BBOBS data is proved to be acceptable for broadband seismic analyses. In these studies, the period range of the data used is about 10 – 200 s, but in longer period range, i.e. geodetic range, is an unknown region in the sea floor observations. The acoustic GPS link observation is one of successful method to know horizontal movement, but it is difficult to obtain continuous data in time. A precise pressure measurement to detect vertical displacement also has difficulty due to the drift of the gauge and some scale of sea level change. The borehole tilt-meter system is ideal for good observational condition, but it is impossible to make spatially dense observation network.

The broadband sensor used in the BBOBS and BBOBS-NX, there is the mass position output feeding acceleration signal. So, it can be used to get the tilt of the mass after it was centered at the beginning of the operation. For the BBOBS deployed above the sea floor, this tilt observation is impossible because of the tilt caused by the bottom current. But, the BBOBS-NX deployed in the sea floor with good coupling to the sediment may be used for it.

The BBOBS-NX had been tested 6 times in 2008 – 2010 by free falling deployment with appropriate penetration to the sea floor sediment. The noise reduction ratio in horizontal components of the BBOBS-NX is more than 10 in the period range longer than 10 s. It means the high possibility of the BBOBS-NX system in the geodetic period range. As we didn't record the mass position signal continuously, a test observation was performed by using the same sensor of the BBOBS-NX comparing with the water tube tilt-meter at the Nokogiriyama observatory in 2010. The results of them are similar in the daily earth tide range.

3.1.2. Observations

During the NT11-11 cruise, the broadband ocean bottom seismo-tilt-meter (BBOBST) and the ocean bottom Doppler current profiler (OBDC) were deployed as shown in Figure 2, to perform continuous observation of about half year long.

3.1.3. Method and Instruments

The main aim of this research is to understand possibility of the tilt observation beneath the sea floor. Because of the time to become the sensor mechanically stable, the continuous observation of more than a few months is required. The BBOBST (Figure 3) is a variation of the BBOBS-NX to be able to record mass position signals of two horizontal components additional to 3 components velocity signals by using our newly developed data recorder for 6 input channels. Based on our long-term OBS and the commercial Doppler current profiler, the OBDC is developed to be able for half year long observation with a 10 s sampling interval by

using the external power supply in the large titanium sphere. This OBDC was used twice when we deployed the BBOBS-NX.

3.1.4. Research Result

- 18th Jan.

We tried acoustic communications with the BBOBST and the OBDC, and the OBDC was recovered safely. The BBOBST had a same trouble in one way, from the ship to the data recorder, as experienced in the deployment. The dive recovery for the BBOBST was planned to do 19th Jan., because of a position of a tuna fishery boat, when the data recording is stopped by the preset timer. The data of the OBDC was obtained throughout the observation period.

- 19th Jan.

The Hyper Dolphin (dive #1346) was landed about 100 m of distance from the BBOBST, and we found it soon. At first, we checked that the sensor unit well penetrated into the sediment could be moved easily. Then, the BBOBST was connected with the rope system for the recovery, and the Hyper Dolphin started ascending to the ship. After the BBOBST was onboard, we found that one of three pressure cases of the sensor unit had some broken bolts of the top lid and there was small amount of water leakage inside. Due to this trouble, the sensor unit could not be powered on when the preset timer of the recorder tried to start the observation, and no valuable data was obtained.

3.2. Proposal 2. Do submarine landslides and related event sediments record a history of fault movements ?

3.2.1. Purpose and background

Main objective for this research is to understand a process of submarine landslide: slope failure induced by earthquake and its mass transfer deposition, and to measure disturbance of the seafloor caused by a strong motion of earthquake in the hanging wall of the mega-splay fault: brecciation of surface-sediment, which was interpreted through a IODP Chikyu expedition study. The former objective needs a detailed surface observation to see how a landslide was proceeded. The later objective needs to verify the interpretation by direct observation and sampling in the bottom surface. If these geological phenomena were well proved, the indicatives could be reliable proxies of past earthquake events.

3.2.2. Observations

We dived on an upper landward slope in the Nankai trough. The dive route acrosses the out-of-sequence thrust (hereafter OOST), which has been excited the tsunamis during 1946 To-nankai earthquake. In this dive site, Sakaguchi et al. (2011; Geology) discovered a paleo-earthquake geologic record “Mud breccia”, which was formed in surface muddy sediment layers by strong earthquake shaking. Aim of this dive survey is to observe detailed

geologic and topographic features across the OOST and surface features of the Mud breccia.

3.2.3. Method and Instruments

MBARI corer x 4

3.2.4. Research Result

The dive #1345 started 9:39 of 18th Jan. The vehicle went down to a seabed. We observed a seabed (mud and debris floor) on 11:39. Surface sediments were sampled on 11:45 (#1345 C-1) using a MBARI corer. After the sampling, the vehicle went to north (head about 350 degree) climbing up the gentle muddy slope. Surface sediments were sampled on 13:53 (#1345 C-2), 13:53 (#1345 C-3), 15:32 (#1345 C-4) using a MBARI corer, and one rock was collected on 16:39 (#1345 C-2). The vehicle was off bottom on 16:46. The dive route is shown in Figure 4.

The core samples C-1, -2, -3 and -4 were 21 cm long, 24 cm long, 24 cm long and 18 cm long, respectively. They were composed of surface oxidized brownish muds and grayish hemipelagic muds. The surface oxidized muds in C-1, -2, -3 and -4 were olive black (5Y3/2) at 0-5 cm below sea floor (hereafter cm-bsf), 0-4 cm-bsf, 0-3 cm-bsf and -04 cm bsf, respectively. The hemipelagic muds were gray (7.5Y4/1) bearing many foraminifer tests.

During the #1346, C-1 was recovered from a mud floor. The core was 19 cm long, and it was composed of surface oxidized muds at 0-4 cm-bsf and hemipelagic muds at 4-19 cm. The colors were same as cores of #1345.

Table 1. Location of samples collected during #1345 and #1346.

sample name	latitude			longitude			depth (m)
C-1	33	12.656	N	136	44.392	E	2874
C-2	33	13.492	N	136	44.246	E	2756
C-3	33	13.660	N	136	44.231	E	2721
C-4	33	14.003	N	136	43.912	E	2519
R-1	33	14.172	N	136	43.765	E	2434
C-1 (#1346)	33	06.727	N	136	30.424	E	2948

3.3. Cruise Log

Date	Local Time	Note	Position / Weather / Wind / Sea condition
16.Jan.2012	9:00	Let go all shore line, left YOKOSUKA. Proceeded to research area.	
	10:00-11:00	Carried out education & training for scientists.	01/16 12:00 (UTC+9h)
	13:00-14:00	Practiced boat station drill.	34-58.6N 139-22.4E
	22:30	Com'ced proceeding to off OWASE due to rough sea.	Overcast
			NNE-6 (Strong breeze)
			3 (Sea slight)
			2 (Low swell long)
			Visibly: 7
17.Jan.2012	7:00	Let go anchor, arrived at off OWASE.	01/17 12:00 (UTC+9h)
	16:00	Heaving anchor, com'ced proceeding to research area.	34-04.4N 136-13.8E
	18:45	Com'ced drifting.	Fine but cloudy
			ESE-2 (Light breeze)
			1 (Calm)
			1 (Low swell sea)
			Visibly: 8
18.Jan.2012	0:00	Finished drifting, com'ced proceeding to research area.	
	4:00	Arrived at research area.	01/18 12:00 (UTC+9h)
	6:42	XBT at 33-06.5089N 136-30.6766E	33-12.7N 136-44.4.E
	8:02	Recovered OBDC.	Fine but cloudy
	9:35	Hoisted up HPD.	NE-3 (Gentle breeze)
	9:40	Launched HPD.	2 (Sea smooth)
	9:57	HPD dove & started her operation #1345.	2 (Low swell sea)
	11:39	HPD Landed on the sea bottom. (D=2874m)	Visibly: 8
	16:46	HPD left the sea bottom. (D=2434m)	
	17:53	HPD refloated.	
	18:11	Recovered HPD & finished above operation.	
19.Jan.2012	6:40	Hoisted up HPD.	
	6:44	Launched HPD.	01/19 12:00 (UTC+9h)
	6:59	HPD dove & started her operation #1346.	33-07.2N 136-31.9E
	8:45	HPD landed on the sea bottom. (D=2948m)	Overcast

	10:08	HPD left the sea bottom. (D=2948m)	ENE-6 (Strong breeze)
	11:40	HPD refloated.	3 (Sea slight)
	11:56	Recovered HPD & finished above operation.	3 (More rate short)
	12:00	Left research area for YOKOSUKA.	Visibly: 7
20.Jan.2012	18:15	Let go anchor, arrived at YOKOSUKA sec. 4.	
			01/20 12:00 (UTC+9h)
			34-53.4N 139-10.8E
			Overcast
			North-9 (Strong gale)
			6 (Very rough)
			4 (Moderate average)
			Visibly: 4
21.Jan.2012	6:30	Heaving anchor, proceeding to YOKOSUKA.	
	7:30	Sent out 1st shore line, then arrived at YOKOSUKA.	

3.4. Dive Information

3.4.1. Dive Numbers

#1345 (proposal 2) and #1346 (proposal 1)

3.4.2. Payloads

#1345

MBARI corer x 4

#1346

The remote commander for the acoustic transponder

MBARI corer x 2

4. Acknowledgements

We thank for the captain and crew of R.V. NATSUSHIMA, the Hyper Dolphin operation team, the cruise management group of JAMSTEC and a scientific support staff of NME. Part of this study (proposal 1) is supported by KAKENHI (23540489).

5. Notice on using

This cruise report is a preliminary documentation as of the end of the cruise. It may not be corrected even if changes on content (i.e. taxonomic classifications) are found after publication. It may also be changed without notice. Data on the cruise report may be raw or not processed. Please ask the Chief Scientist for the latest information before using.

Users of data or results of this cruise are requested to submit their results to Data Integration and Analysis Group (DIAG), JAMSTEC.

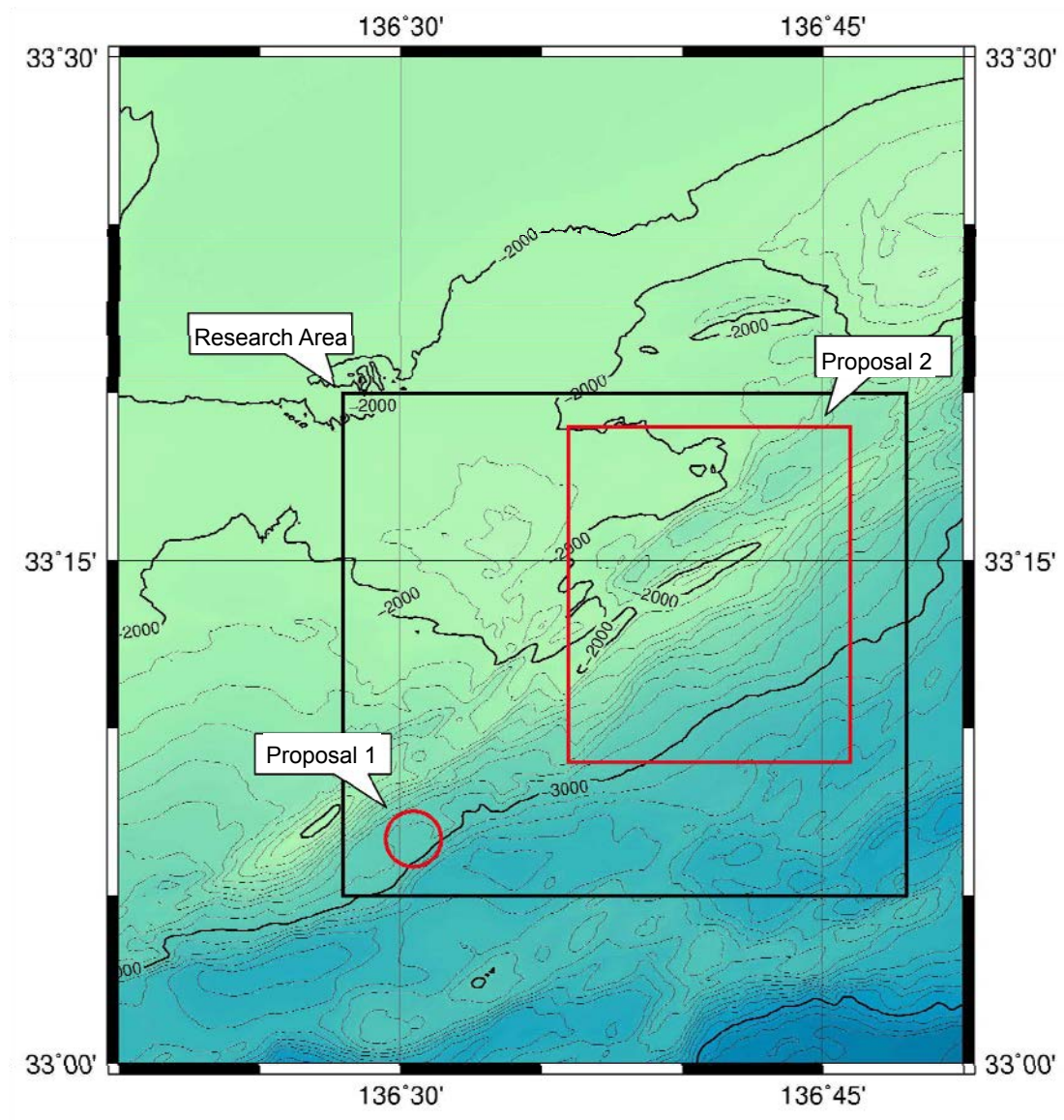


Figure 1. Research map.

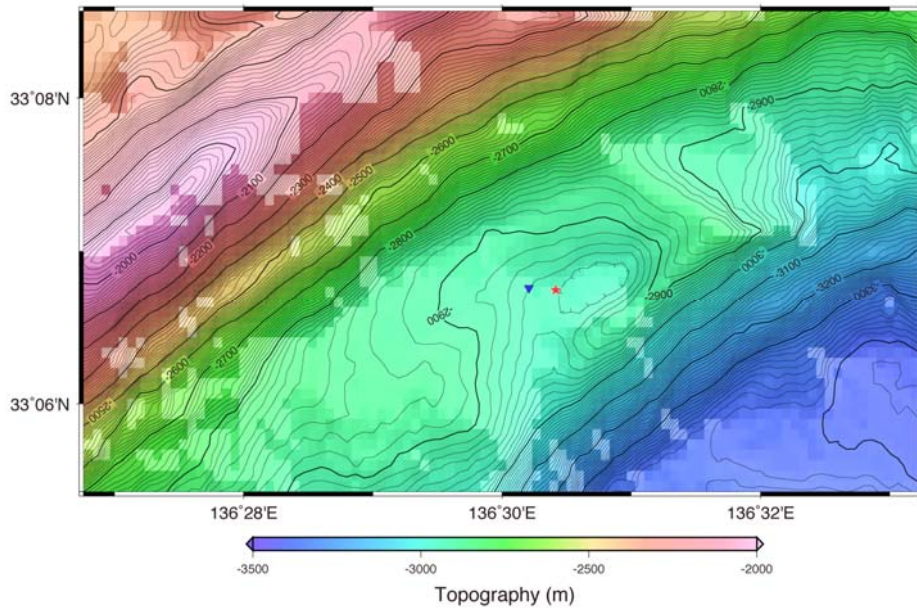


Figure 2. The location of equipments deployed for proposal 1. The inverted triangle and the star show locations of drop (BBOBST) and deployment (BBOBST and OBDC), respectively.

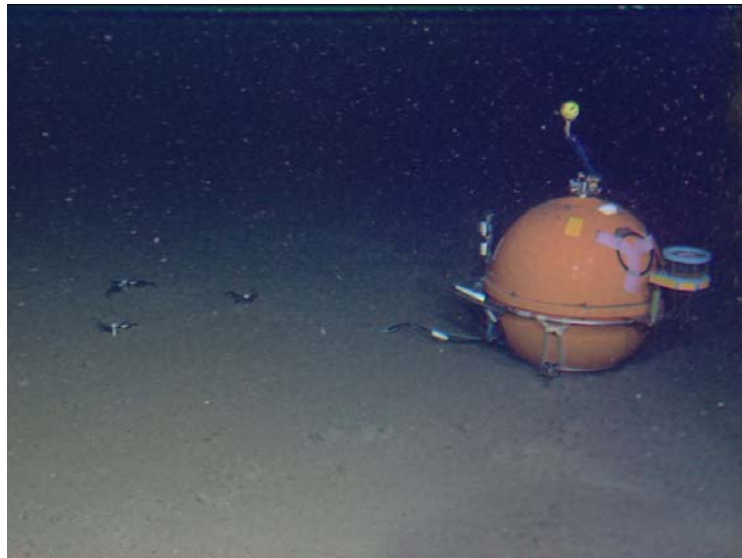


Figure 3. The BBOBST deployed in the NT11-11 cruise by the Hyper Dolphin. The left part is the broadband sensor unit consisting from three bullet shape pressure cases, those contain one component in one case. The right one is the titanium sphere housing contains the recorder and batteries. These two units are connected with an underwater cable and a rope for the recovery.

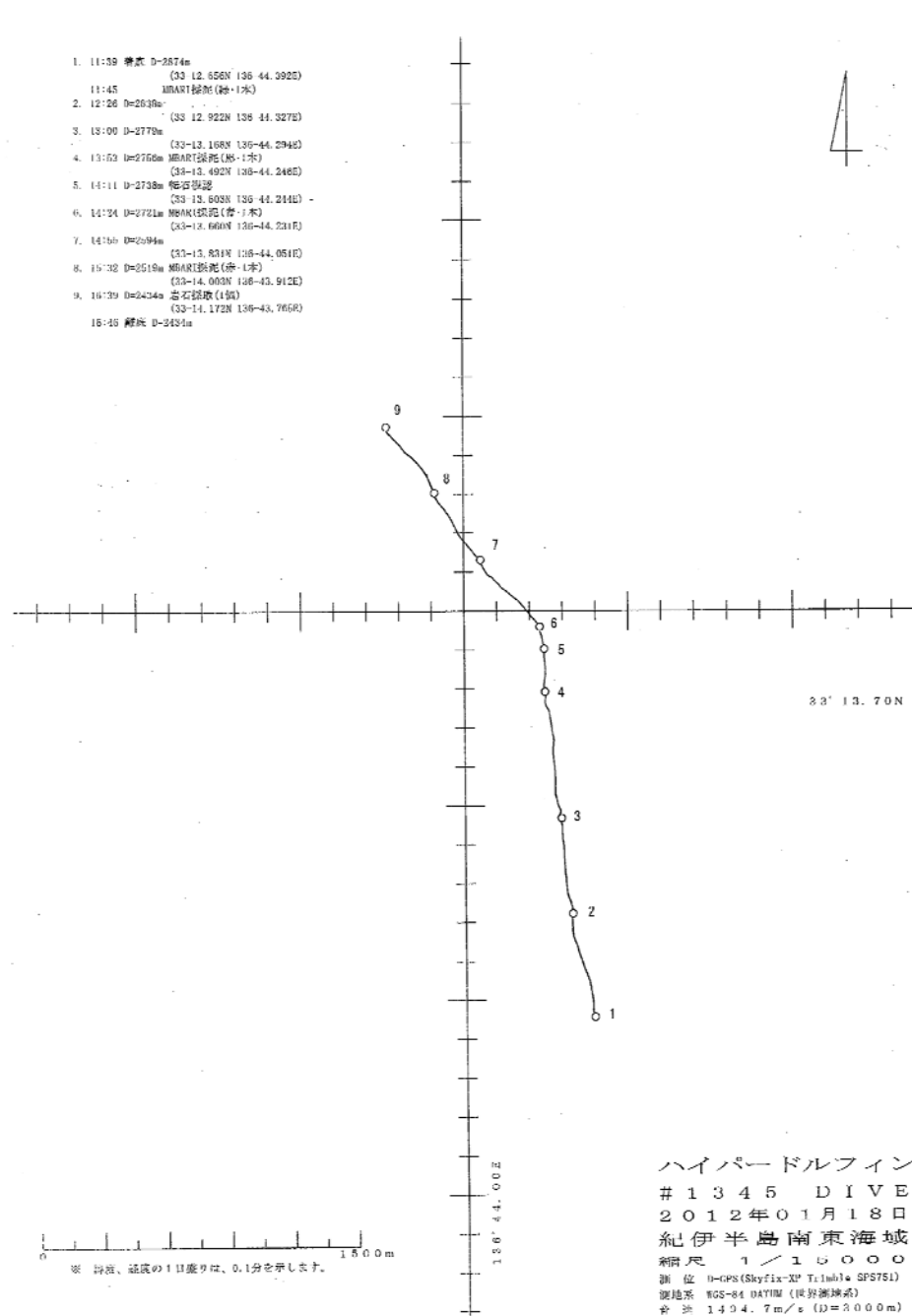


Figure 4. Dive route of proposal 2.