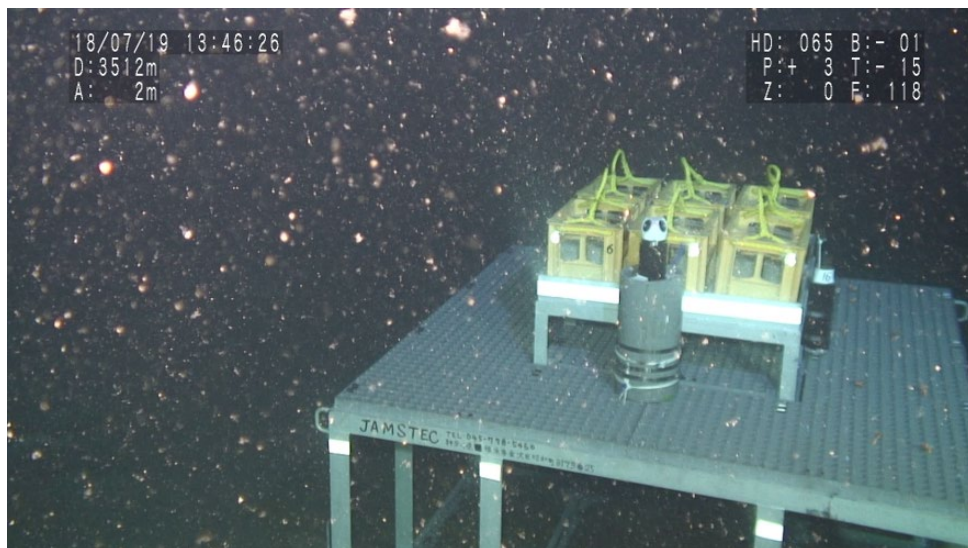




## Yokosuka Cruise Report YK18-09

‘Evaluation research on the chemical and physical  
composition change of concrete in the deep sea’



Nankai Trough North Rim  
17 Jul 2018 – 20 Jul 2018

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

## **Contents**

1. Cruise Information
2. List of participants
3. Cruise Logs
4. Purpose of the cruise and method for observation
5. Instruments and equipments
  - 5.1 Sub-bottom profile
  - 5.2 Temperature profile
  - 5.3 Seabed seating platform
  - 5.4 Basket for concrete specimens
6. Operation report
  - 6.1 Setting the seabed seating platform by "YKDT"
  - 6.2 Carrying the concrete test specimens in plastic baskets by "Shinkai 6500".
7. Notice on Using
8. Acknowledgements

## 1. Cruise Information

Cruise ID: YK18-09

Name of vessel: R/V Yokosuka, YKDT and Shinkai6500

Title of cruise: Evaluation research on the chemical and physical composition change of concrete in the deep sea

Chief Scientist: Shun Nomura (JAMSTEC)

Cruise period: 2018/07/17-2018/07/20

Ports of departure / arrival: Harumi wharf/ Yokosuka JAMSTEC

Research area: Nankai Trough North Rim

Research map

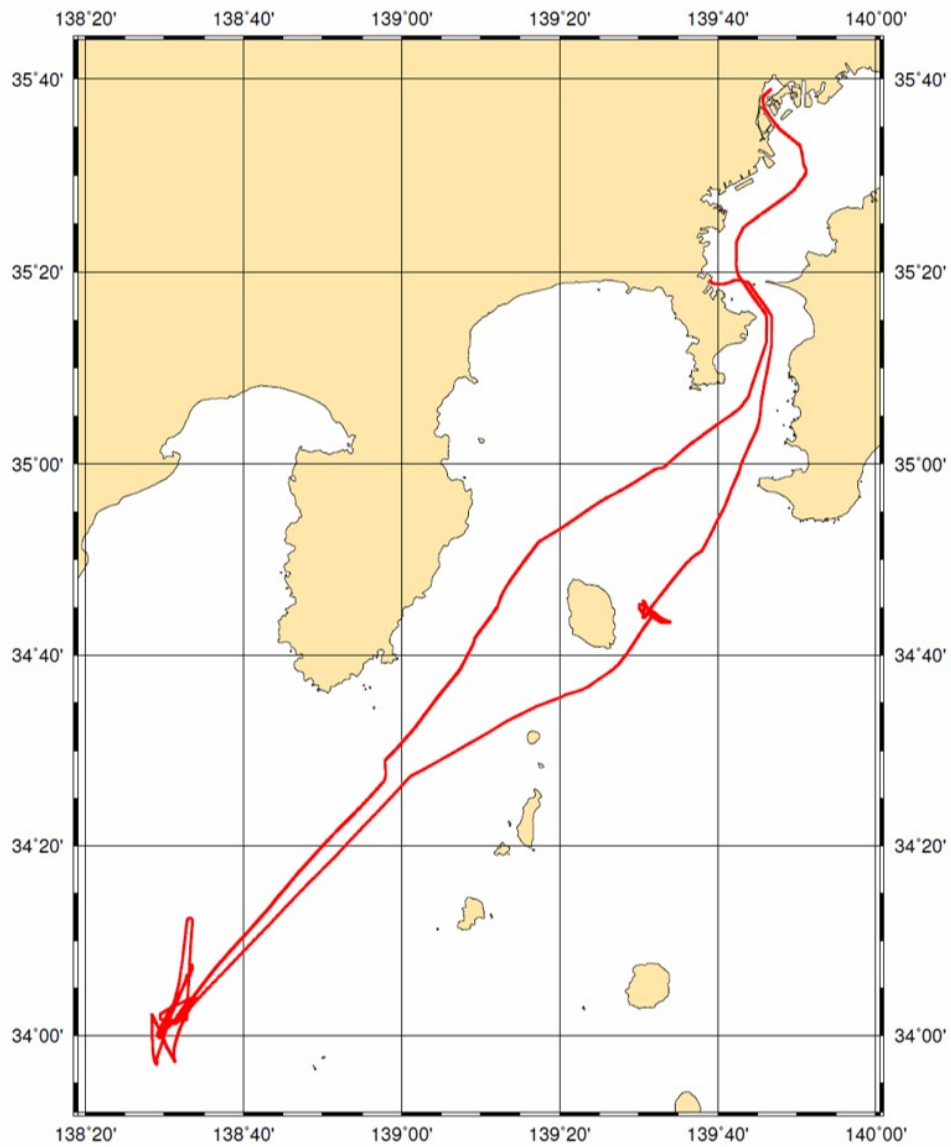


Fig. 1 Ship track of this cruise.

## 2. List of participants

### *Onboard Scientists*

SHUN NOMURA [Japan Agency For Marine-Earth Science And Technology]  
TAKAHUMI KASAYA [Japan Agency For Marine-Earth Science And Technology]

### *Marine Technician*

SATOMI MINAMIZAWA [Marine Technician, Nippon Marine Enterprise Ltd.]

### *R/V YOKOSUKA Officer and Crew*

Captain TAKAFUMI AOKI  
Chief Officer YASUHIKO SAMMORI  
2nd Officer TOSHIYO OHARA  
3rd Officer RYO YAMAGUCHI  
Jr.3rd Officer KANTA OZAWA  
Chief Engineer KAZUNORI NOGUCHI  
1st Engineer WATARU KUROSE  
2nd Engineer KENICHI SHIRAKATA  
3rd Engineer YUNA KAINO  
Chief Electronic Op. YOSUKE KOMAKI  
2nd Electronic Op. RYUJI ONIKUBO  
Boatswain HIDEO ISOBE  
Quarter Master KAITO MURATA  
Quarter Master HIROAKI NAGAI  
Quarter Master KOSEI KAWAMURA  
Sailor SHINYA KOJIMA  
Sailor KYOHEI MURAI  
Sailor TOMOKI ASAKUNI  
Sailor TAKUMA TOKUNAGA  
No.1 Oiler YUKIHIRO YAMAGUCHI  
Oiler TAKUYA WATANABE  
Oiler HIROKI KAITO  
Oiler DAIKI SATO  
Oiler TORU HIDAKA  
Assistant Oiler KENSUKE NAKAMURA  
Steward TATSUNARI ONOUE  
Steward HIDEO FUKUMURA  
Steward HIROYUKI OHBA  
Steward KANJURO MURAKAMI  
Steward KINA ABE  
Steward YUKI SHIRASAKI

### *SHINKAI6500 Operation team*

Submersible Op. Manager TOSHIAKI SAKURAI  
Deputy Submersible Op. Manager KAZUHIRO CHIBA  
1st Submersible Staff MITSUHIRO UEKI  
1st Submersible Staff KEITA MATSUMOTO  
2nd Submersible Staff HIROFUMI UEKI  
2nd Submersible Staff YOUSUKE CHIDA  
2nd Submersible Staff KEIGO SUZUKI  
2nd Submersible Staff TAKUMA ONISHI

2nd Submersible Staff  
3rd Submersible Staff  
3rd Submersible Staff

YOSHIKAZU KURAMOTO  
SATSUKI IIJIMA  
NAOTO MINAMINO

### 3. Cruise Logs

Date/time	Remarks
<b>2018/7/17</b>	<b>HARUMI wharf (35-39.0N,139-46.7E)</b>
	Weather: Cloudy / Wind direction: SSE / Wind force: 4 /
	Wave scale: 1 / Swell scale: 0 / Visibility: 8 miles (12:00 JST)
11:00	Onboarded
13:30-14:00	Carried out education and training for scientist
16:00	Left HARUMI wharf for research area
<b>2018/7/18</b>	<b>NANKAI Trough Northern part (34-01.6N,138-31.5E)</b>
	Weather: Fine but cloudy / Wind direction: SSW / Wind force: 3 /
	Wave scale: 2 / Swell scale: 2 / Visibility: 8 miles (12:00 JST)
05:00	Arrived at research area (NANKAI Trough Northern part)
06:03	Released XBT@ 34-07.1181N,138-33.5438E
06:28-07:20	Carried out MBES site survey
10:27	“YKDT” dove & started her operation (Dive211)
11:52	Commenced to “YKDT” survey
11:57	Finished “YKDT” survey
13:10	Refloated “YKDT”
13:20	Recovered “YKDT” & finished her operation
15:00-16:00	SHINKAI 6500 operation briefing
15:49-16:10	Carried out SBP mapping survey
<b>2018/7/19</b>	<b>NANKAI Trough Northern part (34-01.7N,138-31.6E)</b>
	Weather: Fine but cloudy / Wind direction: SSE / Wind force: 1 /
	Wave scale: 1 / Swell scale: 1 / Visibility: 8 miles (12:00 JST)
09:58	“SHINKAI 6500” dove & started her operation (Dive1523)
11:37	Launched on the sea bottom (Depth = 3513m)
14:10	Left sea bottom (Depth = 3513m)
15:23	Refloated “SHINKAI 6500”
15:50	Recovered “SHINKAI 6500” & finished her operation
16:30	Left research area for YOKOSUKA
<b>2018/7/20</b>	<b>Arrive at YOKOSUKA</b>
10:00	Disembarked YOKOSUKA at JAMSTEC
	Finished YK18-09 cruise

#### #Wind Scale

0	Calm	0~0.2m/s
1	Light air	0.3~1.5m/s
2	Light breeze	1.6~3.3m/s
3	gentle breeze	3.4~5.4m/s
4	Moderate breeze	5.5~7.9m/s
5	Fresh breeze	8.0~10.7m/s
6	Strong breeze	10.8~13.8m/s

#### #Wave scale

0	Calm (Glassy)	0.0m
1	Calm (Rippled)	0~1/10m
2	Smooth (Wavelet)	1/10~1/2m
3	Slight	1/2~1 1/4m
4	Moderate	1 1/4~2 1/2m

#SWELL SCALE

0	No Swell	
1	Low Swell Short or Average	<2m
2	Low Swell Long	<2m
3	Moderate Short	2m~4m

#### **4. Purpose of the cruise and method for observation**

When developing the observation and measurement equipment in the deep sea, it is important to deal with the expected fluctuation by overlooking the entire environment for installation. In the case of long-term deployment, it is necessary to suppress errors due to secular change of installation place with time. At present, for the installation of structures in the deep sea, the concrete material is often used as well in the land or the shallow sea area. However, data of the durability and the aging for concrete material only exists in the land or the shallow sea, thereby there is no data in the deep sea. In the deep sea, concrete is exposed by high water pressure and specific chemical reactions induced by the sea water. There is also concern about deterioration of concrete due to microbial action by unique environment in that place. It is essential to evaluate such complex phenomenon quantitatively.

In this cruise, concrete specimens for long-term expose test were set at Nankai Trough North Rim in the depth of 3515 m with the help of Yokosuka deep tow (YKDT) and deep submergence research vehicle (Shinkai6500) to obtain basic data for the installation of concrete structures in the sea. The following process was mainly taken place during the excursion:

- 1) A seabed seating platform for exposing concrete specimens was set at 3515 m below sea level by "YKDT".
- 2) Concrete specimens in plastic baskets were transported by "Shinkai 6500" to the platform. It is planned that the concrete specimens are picked up in every one or two years to check the physical and chemical reactions and evaluate the long-term durability. After a few years, it is expected that the basic data for the installation of concrete structures will be described, which demand would increase more and more in the future.



## 5. Instruments and equipment

### 5.1 Sub-bottom profile

Based on Multi-beam Echo-sounder System (MBES), bathymetric and subbottom image data in the study area was collected.

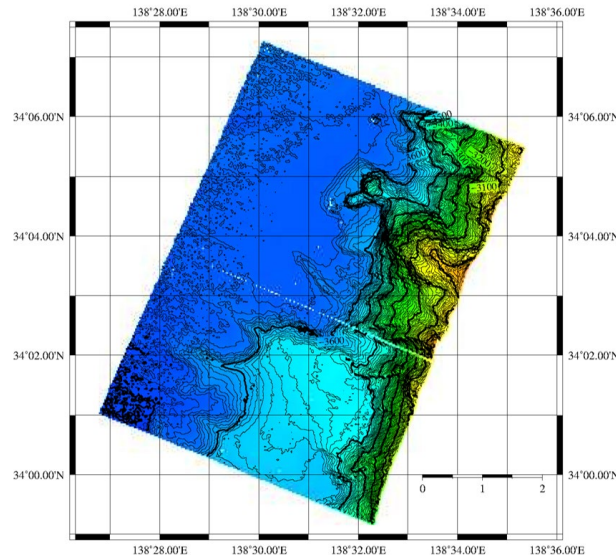


Fig. 2 Subbottom image by Echo system

### 5.2 Temperature profile

The sound velocity profile of the local water column, which was used for calibration of depth, was estimated from a temperature profile at 34-07.118 N, 138-33.544E based on in-situ XBT (Expendable Bathythermograph) measurements.

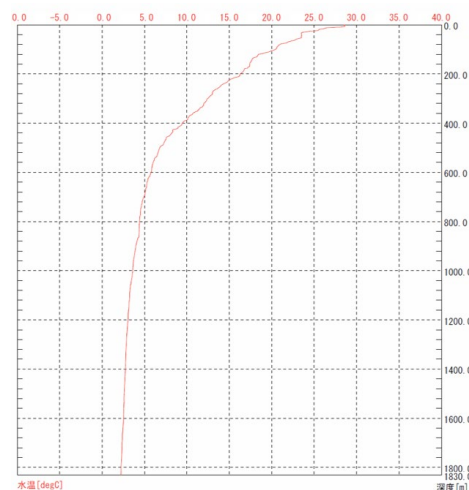


Fig. 3 Temperature profile with the water depth

### 5.3 Seabed seating platform

Seabed seating platform consists of 0.60 t weight, L 2.20 x W 2.20 x H 1.48 m stainless frame with FRP grating panels which enables to expose concrete specimens in its upper part (Fig. 4). To prevent the subduction itself, four stainless discs with  $\phi = 200$  mm are attached in the bottom of the frame. Slings for connecting the platform with 'YKDT' to carry them to the seabed are

installed at the upper corners of lower part. At the top of the platform, frame guides to prevent the basket from falling are placed. All parts of the platform are plated with zinc to prevent corrosion.

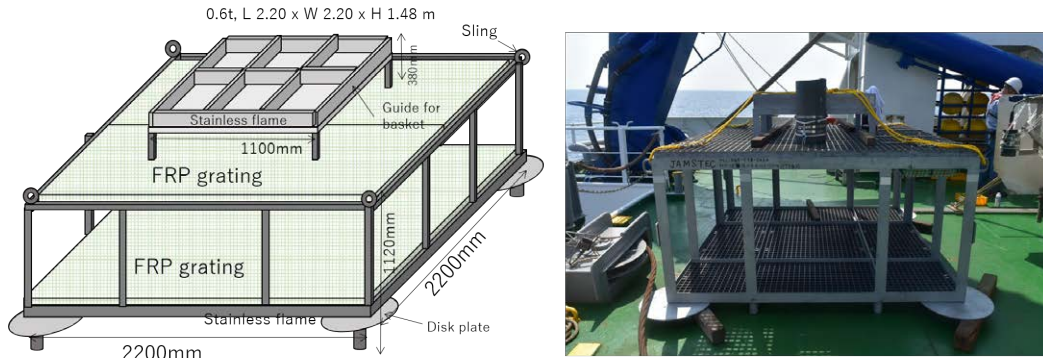


Fig. 4 Concept (left) and image (right) of the platform

#### 5.4 Basket for concrete specimens

The two kinds of plastic baskets called ‘Yellow’ and ‘White’ were prepared for the different type of concrete samples. Yellow baskets to expose 6 set of 6 concrete specimens on the platform consist of L 400 x W 272 x H 300 mm (Fig. 5). The space of the basket was suitable for the size of specimen ( $\phi 100$  x H 200 mm). Their handles made of fiber ropes enable to grab them by the ROV manipulator in the recovery of the specimen. White baskets consist of L 300 x W 400 x H 200 mm made by plastic mesh box. They were covered and banded with chemical fiber net for the collection and placed below the ceiling of the 1<sup>st</sup> floor (Fig. 6). 6 of white basket containing 10 of concrete specimens in each were attached before the dive of YKDT and carried to the seabottom with the platform.

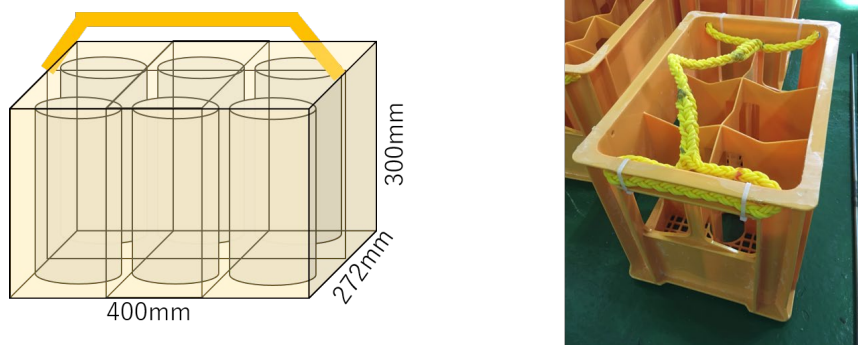


Fig. 5 Concept (left) and image (right) of the yellow basket for concrete specimen



Fig. 6 White basket fixed below the ceiling of the 1<sup>st</sup> floor in the platform

## 6. Operation report

There were 2 days for the research operation on the ‘Yokosuka.’ In the 1<sup>st</sup> day, the platform was carried to the seabed in the depth of 3515 m with the help of ‘YKDT,’ after surveying the geometry of the seabed by MBES. In the 2<sup>nd</sup> day, the concrete specimens in the yellow baskets were brought to the platform by ‘Shinkai6500.’

### 6.1 Setting the seabed seating platform by "YKDT"

After hanging the YKDT by Yokosuka winch, the platform was docked with it by the hoisting rope connected to the steel ring. Then the platform was carried to the seabottom with YKDT by the winch in the speed of 45 m / min. After observing the seabottom by the acoustic system around the height of 60 m from the seabottom, its velocity was reduced to 2-3 m / min. When the seabottom was visually observed at 5.0 m height by the digital camera in YKDT, the winch was stopped and the detaching trigger of YKDT was activated. After confirming that the platform was falling down calmly and landing safely to the seabottom, YKDT is lifted back to the Yokosuka (Fig. 7, 8 and Table 1).

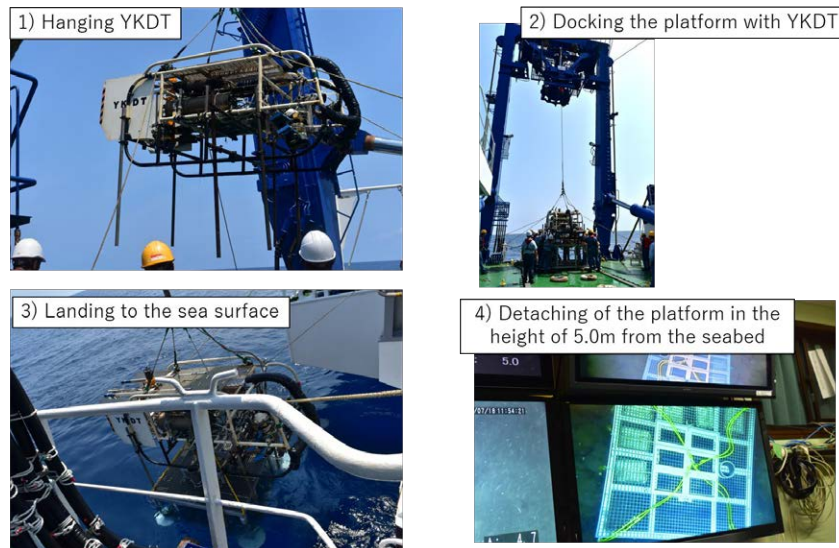


Fig. 7 Operations for carrying the platform to the seabottom

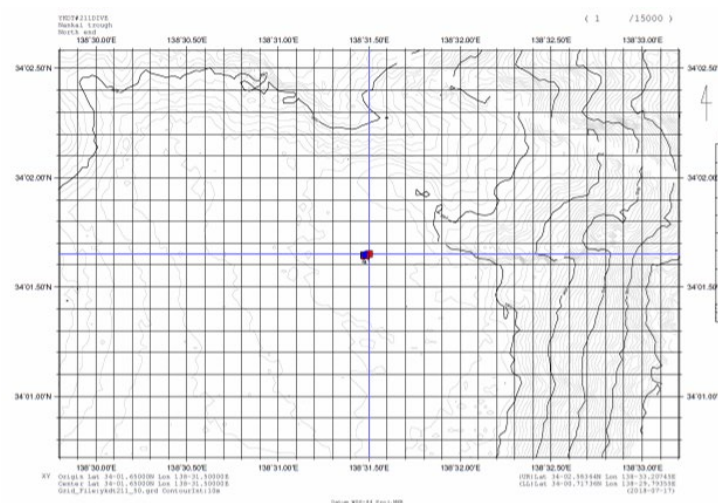


Fig. 8 Dive track of the YKDT#211

Table 1 Location of Events of the YKDT #211:

Time (Local)	Dep. (m)	Pos. Lat	Pos. Lon	Alt. (m)	Head (Deg)	Description
10:14:00						Landing to sea surface
10:27:00						Start diving
11:21:04	2335.6	34 - 1.6528 N	138 - 31.4808 E		204	Falling in 2340m
11:35:42	2998.3	34 - 1.6586 N	138 - 31.4664 E		185	Falling in 3000m
11:36:12	3016.4	34 - 1.6602 N	138 - 31.4669 E		184	Falling in 3470m
11:45:04	3399.9	34 - 1.6633 N	138 - 31.4708 E	116	179	Falling in 3406m
11:47:18	3463	34 - 1.6492 N	138 - 31.4695 E	60	187	Stop winch, Start video recording
11:48:12	3462.3	34 - 1.6472 N	138 - 31.4676 E	59.7	187	Rolling at 45m/min
11:50:41	3506.3	34 - 1.6418 N	138 - 31.4581 E	15.5	167	Stop winch, Rolling at 5m/min
11:51:02	3507.9	34 - 1.6449 N	138 - 31.4853 E			Can't see the seabed due to turbidity of marine snow
11:51:26	3512.3	34 - 1.645 N	138 - 31.4675 E	10.7	168	Stop winch, Rolling at 3m/min
11:51:54	3514.7	34 - 1.6469 N	138 - 31.4731 E	7.4	171	Stop winch, Rolling at 2m/min
11:52:20	3515.8	34 - 1.6435 N	138 - 31.4672 E	5.7	173	Observe the seabottom
11:52:28	3518.3	34 - 1.645 N	138 - 31.4684 E	5.7	174	Stop winch
11:53:24	3517.7	34 - 1.6401 N	138 - 31.4735 E	5.7	180	Rolling at 1m/min
11:53:37	3518	34 - 1.652 N	138 - 31.474 E			Stop winch, Clearly see the seabottom
11:53:46	3518.4	34 - 1.6585 N	138 - 31.4884 E			Decide to place the platform
11:53:51	3519.1	34 - 1.6436 N	138 - 31.483 E			Cutting off
11:53:53	3519.1	34 - 1.6436 N	138 - 31.483 E			Safty landing of the platform
11:55:33	3518.5	34 - 1.6386 N	138 - 31.4822 E	4.4	156	Observing the landing condition. No problem
11:57:56	3504.1	34 - 1.6264 N	138 - 31.4793 E	20	150	Start to winding

### 6.2 Carrying the concrete test specimens in plastic baskets by "Shinkai 6500"

The operation was proceeded on or next to the platform placed in the depth of 3515m from the sea surface by 'Shinkai6500 (6K)'. After landing on the 1<sup>st</sup> floor of platform by 6K, the ropes used to dock with YKDT were cut off in all corner and carried to the container of 6K. Then 6 of yellow plastic baskets containing 6 pieces of concrete specimens were set to the upper surface of platform one by one by the manipulator. The current meter, ADP, was inserted in the tube installed in the 1<sup>st</sup> floor of the platform. Then the steel sticks to fix the white basket were pulled out by the manipulator. After confirming that all planed schedules has been completed, 6K left from the platform and floated to the sea surface. Although the sand was rolled up from the seabottom and visibility got worse occasionally, it recovered with time and the mission was finished without any troubles (Fig 9, 10 and Table 2).

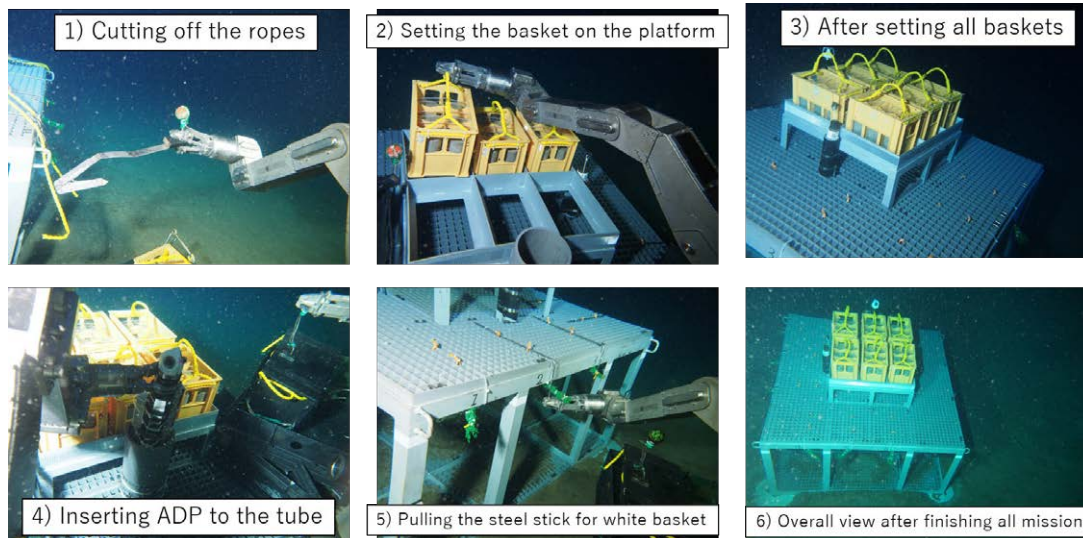


Fig. 9 Operations for setting the concrete baskets on the platform

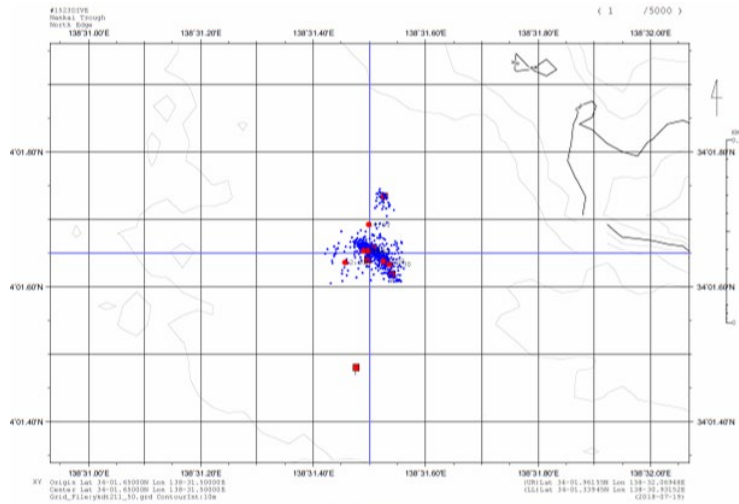


Fig. 10 Dive track of the Shinkai6500#1523

Table 2 Location of Events of the Shunkai6500 #1523:

Time (Local)	Dep. (m)	Pos. Lat (dd-mm.mm N/S)	Pos. Lon (ddd-mm.mm E/W)	latitude	longitude	Pos. X	Pos. Y	Description
11:14:37	3016	34 - 1.6337 N	138 - 31.5467 E	34.0272283	138.525778	-20	40	Falling in 3000m
11:22:43	3325	34 - 1.6438 N	138 - 31.5209 E	34.0273967	138.525348	-30	50	200m high from seabottom
11:37:00						-60	60	Landing to the seabottom
11:42:17	3515	34 - 1.6238 N	138 - 31.5441 E	34.0270633	138.525735			Observing the platform in 100m at 290° by the acoustic device
11:42:41	3516	34 - 1.6281 N	138 - 31.5396 E	34.027135	138.52566			Observing HM(ID16) in 40m
11:49:25	3519	34 - 1.6762 N	138 - 31.5184 E	34.0279367	138.525307	60	-10	Searching platform
11:53:20	3518	34 - 1.6616 N	138 - 31.4787 E	34.0276933	138.524645	30	-40	Unstable in HM value. In 200m at 240° by Shinkai truck
11:55:39	3518	34 - 1.6506 N	138 - 31.4411 E	34.02751	138.524018	0	-120	In 90 m at 110° by acoustic device
11:57:59	3515	34 - 1.6358 N	138 - 31.4344 E	34.0272633	138.523907	-15	-60	Heading to the direction at 110°
12:03:06	3517	34 - 1.6394 N	138 - 31.4972 E	34.0273233	138.524953	-10	0	Visually observing the platform
12:06:49	3518	34 - 1.6535 N	138 - 31.4994 E	34.0275583	138.52499	25	-40	Landing on the platform. Start to cutting the rope
12:09:45	3518	34 - 1.6442 N	138 - 31.5143 E	34.0274033	138.525238			Cutting off 1st rope
12:12:28	3518	34 - 1.665 N	138 - 31.4805 E	34.02775	138.524675	5	0	Cutting off 2nd rope
12:15:57	3518	34 - 1.6651 N	138 - 31.4889 E	34.0277517	138.524815	30	0	Cutting off 3rd rope
12:20:53	3517	34 - 1.6657 N	138 - 31.4891 E	34.0277617	138.524818	30	-20	Can't see the seabed due to turbidity of marine snow
12:22:25	3517	34 - 1.6639 N	138 - 31.4896 E	34.0277317	138.524827	20	-10	Waiting until the turbidity become clear
12:26:20	3516	34 - 1.6448 N	138 - 31.5132 E	34.0274133	138.52522	10	30	Cutting off 3rd rope
12:32:26	3515	34 - 1.6532 N	138 - 31.5064 E	34.0275533	138.525107	10	-20	Collecting the rope by the manipulator
12:39:53	3513	34 - 1.6358 N	138 - 31.5338 E	34.0272633	138.525563	10	-15	Finish collecting
12:42:46	3514	34 - 1.6551 N	138 - 31.4924 E	34.027585	138.524873	20	5	Setting the 1st basket
12:43:45	3514	34 - 1.6623 N	138 - 31.4801 E	34.027705	138.524668	20	5	Setting the 2nd basket
12:54:18	3514	34 - 1.6508 N	138 - 31.5022 E	34.0275133	138.525037	20	-10	Setting the 3rd basket
12:57:34	3515	34 - 1.6662 N	138 - 31.4911 E	34.02777	138.524852	0	-5	Setting the 4-6th basket
13:00:15	3515	34 - 1.647 N	138 - 31.5252 E	34.02745	138.52542			Garbing ADP by manipulator
13:04:48	3514	34 - 1.6374 N	138 - 31.5244 E	34.02729	138.525407	20	-20	Finish setting ADP
13:06:33	3516	34 - 1.6671 N	138 - 31.4944 E	34.027785	138.524907			Confirming the angle of the platform and ADP
13:07:39	3515	34 - 1.6459 N	138 - 31.5202 E	34.0274317	138.525337	30	-10	In front of the ADP, 79° of heading ahead
13:09:18	3516	34 - 1.6503 N	138 - 31.5297 E	34.027505	138.525495			Pressure maker of ADP heading 260°
13:22:11	3516	34 - 1.6479 N	138 - 31.5236 E	34.027465	138.525393	10	-10	Correcting the 1st to 3rd triggers
13:36:36	3516	34 - 1.6453 N	138 - 31.5143 E	34.0274217	138.525238	10	10	Correcting the 4th to 6th triggers
13:38:51	3516	34 - 1.649 N	138 - 31.5138 E	34.0274833	138.52523			Finishing the all tasks around platform
13:40:33	3515	34 - 1.6425 N	138 - 31.5231 E	34.027375	138.525385	-10	30	Confirming the groval position
13:56:46	3512	34 - 1.6511 N	138 - 31.5124 E	34.0275183	138.525207	-10	30	Finishing the all tasks. Leaving the platform
14:04:29	3518	34 - 1.7228 N	138 - 31.5355 E	34.0287133	138.525592	160	40	Head to the North
14:06:20	3519	34 - 1.7307 N	138 - 31.5307 E	34.028845	138.525512			Preparing for heading to the sea surface
14:09:31	3519	34 - 1.7366 N	138 - 31.5254 E	34.0289433	138.525423	150	20	Leaving the sea bottom

## 7. Notice on use

This cruise report is a preliminary documentation as of the end of cruise.

This report is not necessarily corrected even if there is any inaccurate description (i.e. taxonomic classifications). This report is subject to be revised without notice. Some data on this report may be raw or unprocessed. If you are going to use or refer the data on this report, it is recommended to ask the Chief Scientist for latest status.

Users of information on this report are requested to submit Publication Report to JAMSTEC.

<http://www.godac.jamstec.go.jp/darwin/explain/1/e#report>

E-mail: [submit-rv-cruise@jamstec.go.jp](mailto:submit-rv-cruise@jamstec.go.jp)

## 8. Acknowledgements

We would like to thank Captain Mr. Aoki and all ship crew of R/V Yokosuka for their safe cruise. We are grateful to marine technicians of Nippon Marine Enterprise, Ltd. for their operation. We also thank Ms. S. Minamizawa from NME for her active supports. We are pleased to MARITEC/JAMSTEC staff for their supports during our cruise.