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Natsushima Cruise Report
NT12-20

Research cruise Hyper-Dolphin 3000
Ogasawara Plateau

Aug07, 2012-Aug 13, 2012

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

Contents

1. Objectives and Cruise summary of NT12-20 cruise

1.1. Cruise Information

Cruise ID	:	NT12-20
Name of vessel	:	Natsushima
Title of the cruise	:	Research cruise Hyper-Dolphin 3000 Ogasawara Plateau for the development of the Time Domain EM technology
Chief scientist	:	Takashi KASAYA [JAMSTEC]
Representative of the Project	:	Akira SAITO[WASEDA University]
Title of the proposal	:	Research and Development on the electrical and electromagnetic prospecting methods for the exploration of the deep seabed hydrothermal mineral deposits.
Cruise period	:	Aug 7,2012 - Aug 13, 2012
Ports of call	:	JAMSTEC Yokosuka port / JAMSTEC Yokosuka port
Research area	:	Bayonnaise knoll

1.2. Objectives and Overview of the Observation

We have developed the sea floor TDEM (time domain electromagnetic methods) system using MI(magneto-impedance) magnetometers and Square-Array methods, and in the level of testing the system to be practical.

In this cruse, the developed system was tested in the 2 ways, the moving type and the fixed type at HAKUREI site, Bayonnaise Knoll. In the moving type, we installed all the system to HPD (HYPER DORPHINE 3000) , and moved it in 2-3 m height from the seafloor at the speed of around 0.5 knots. The actual seafloor conditions and the electromagnetic responses were continuously monitored in the HPD control room. The measurements were carried out on the two orthogonally intersecting survey lines with the total length of 5km . We could successfully acquire the magnetic and electric responses using the MI-magnetometers and Ag-AgCl electrodes.

The fixed type was designed to be an independent system separated from the HPD to eliminate the electrical noise and mechanical vibration of the HPD to get higher S/N ratio and clear deeper information. Several ocean floor mineral samples and host rocks were also collected to measure their electrical and chemical properties.

1.3. Ship track

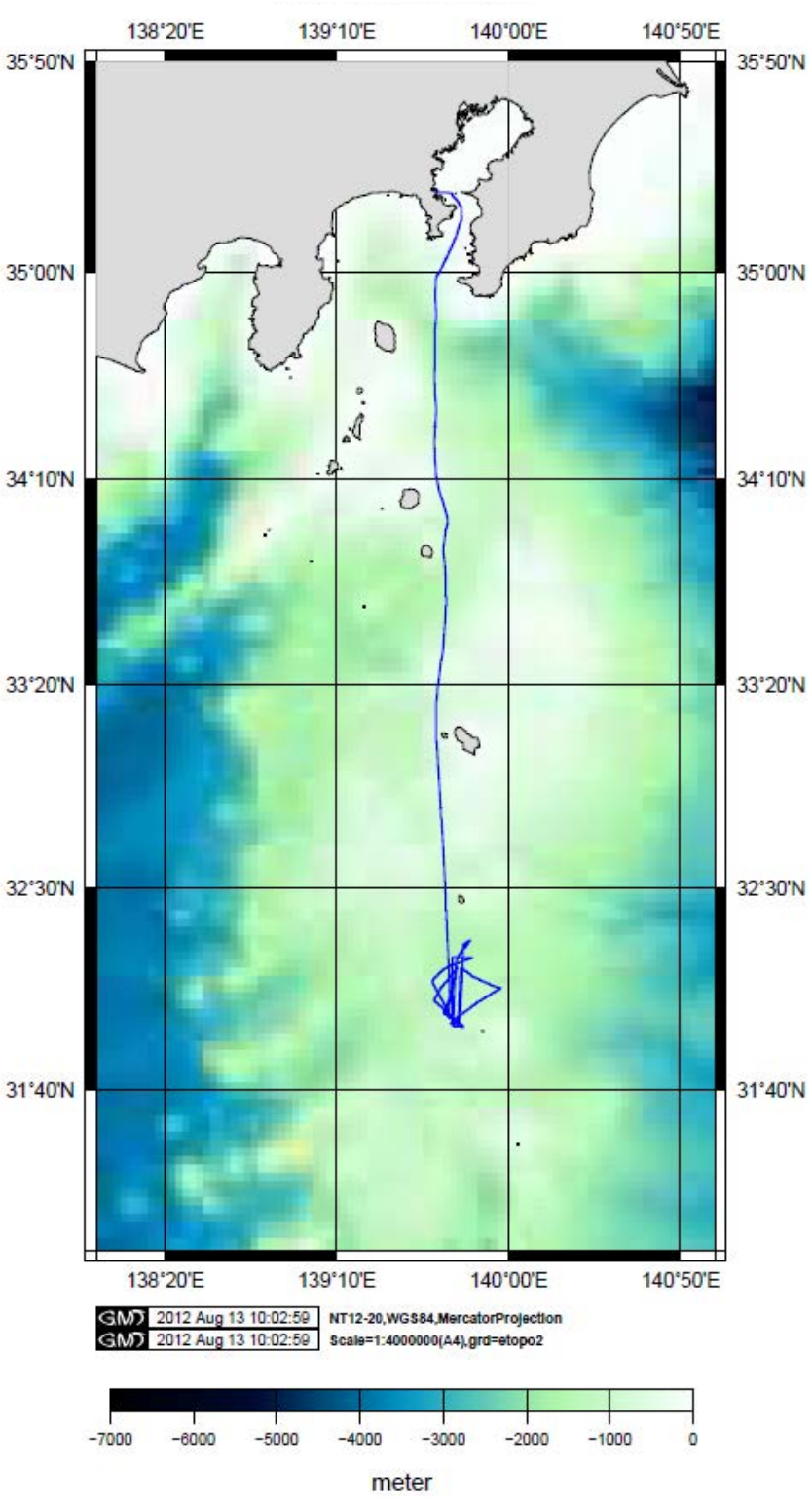

Figure 1 NT12-20 Ship Track

2. List of Participant

2.1. Research group

Takahumi Kasaya	Japan Agency for Marine-Earth Science and Technology
Akira Saito	Waseda University
Keiko Nakayama	Waseda University
Mana Yasui	Waseda University
Keizou Sayanagi	Tokai University
Kou Sano	OYO Corporation
Yoshihiro Yamashita	OYO Corporation
Hiroshi Kisanuki	Waseda University
Tetsurou Takeda	Waseda University
Seiya Sano	Waseda University
Masayuki Motoori	Waseda University
Shinpei Mochiji	Waseda University
Tsutomu Hatano	Waseda University
Toshimasa Nasu	Nippon Marine Enterprise

2.2. Operation team of the Hyper Dolphin

Operation Manager	Yoshinari Ono
2nd Submersible staff	Katsushi Chiba
2nd Submersible staff	Teppei Kido
2nd Submersible staff	Yudai Sakakibara
2nd Submersible staff	Atsushi Takenouchi
2nd Submersible staff	Ryo Saigo
3rd Submersible staff	Daichi Urata

2.3. Captain and crew of the R/V NATSUSHIMA

Captain	Eiko Ukekura
Chief Officer	Naoto Kimura
2nd Officer	Masato Chiba
3rd Officer	Motoi Katsumata
Chief Engineer	Koji Hunae
1st Engineer	Naohito Tadooka
2nd Engineer	Takahiro Mori
3rd Engineer	Koichi Hashimoto
Chief Radio officer	Yoichi Inoue
2nd Electronic Operator	Yohei Yamamoto
Boat Swain	Hatsuo Oda
Able Seaman	Yasuo Konno
Able Seaman	Nobuyuki Ichikawa
Able Seaman	Yukito Isii
Able Seaman	Yoshiaki Matsuo
Sailor	Hideo Ito
Sailor	Yusaku Kanada
No.1 Oiler	Masaru Kitano
Oiler	Tsuneo Harimoto

Assistant Oiler	Toshinori Matsui
Assistant Oiler	Taijun Iwao
Assistant Oiler	Daiki Sato
Chief Steward	Tomihisa Morita
Steward	Shinsuke Tanaka
Steward	Kiyotaka Kosuji
Steward	Hiroyuki Ohba
Steward	Katsuhiro Kawase
Jr.3rd Engnieer	Naoomi Uemura

3. Ship Log

Table 1 NT12-20 Ship Log

Date	Local Time	Note	Description	Position/Weather/Wind/Sea condition
07-Aug-12		**Sail out, proceeding to research area.**		08/7 12:00 (UTC+9h)
	10:00	Left Yokosuka for research area.		Off Suzaki
	10:00-10:30	Carried out shipboard education & training for scientists.		34-51.0N 139-38.7E
	18:00-18:30	Scientist meeting.		Fine but cloudy
				SW-2(light breeze)
				2(sea smooth)
				1(Low swell sea)
				Visibly:7 '
08-Aug-12		**Dive HPD(#1415,#1416)**		08/08 12:00(UTC+9h)
	05:00	Arrived at research area.		Bayonnaise
	05:01-06:22	Carried out MBES site survey.		31-56.7N,139-44.9E
	05:38	Released XBT at 31-56.1064N,139-46.6064E		Cloudy
	09:12	HPD dove & started her operation(#1415).		WSW-4(moderate breeze)
	10:46	HPD landed on the sea bottom(D=632m).		2(Low swell long)
	11:31	HPD left the sea bottom(D=607m).		Visibly:7 '
	12:27	Recovered HPD & finished above operation.		
	13:55	HPD dove & started her operation(#1416).		
	14:55	HPD landed on the sea bottom(D=827m).		
	16:40	HPD left the sea bottom(D=913m).		
	17:22	Recovered HPD & finished above operation.		
	19:00-19:30	Scientist meeting.		
09-Aug-12		**Dove HPD(#1417)**		08/09 12:00(UTC+9h)
	08:49	HPD dove & started her operation(#1417).		Bayonnaise
	09:32	HPD landed on the sea bottom(D=827m).		31-57.4N,139-44.6E
	16:00	HPD left the sea bottom(D=915m).		Fine but cloudy
	16:47	Recovered HPD & finished above		NE-2(light breeze)

		operation.		
	16:57	Recovered Electro-Magnetometer		2(sea smooth)
	19:30-19:50	Scientist meeting.		3(Moderate short)
				Visibly:7'
10-Aug-12		**Dove HPD(#1418)**		08/10 12:00(UTC+9h)
	09:05	HPD dove & started her operation(#1418).		Bayonnaise
	09:32	HPD landed on the sea bottom(D=818m).		31-57.2N,139-45.0E
	16:01	HPD left the sea bottom(D=830m).		Fine but cloudy
	16:54	Recovered HPD & finished above operation.		SSE-2(light breeze)
	18:30-19:00	Scientist meeting.		2(sea smooth)
				4(Moderate average)
				Visibly:7 '
11-Aug-12		**Dove HPD(#1419)**		08/11 12:00(UTC+9h)
	08:22	HPD dove & started her operation(#1418).		Bayonnaise
	09:05	HPD landed on the sea bottom(D=818m).		31-57.6N,139-44.9E
	15:46	HPD left the sea bottom(D=830m).		Fine but cloudy
	16:23	Recovered HPD & finished above operation.		SE-2(light breeze)
	18:30-19:00	Scientist meeting.		2(Low swell long)
				2(Low sea long)
				Visibly:7 '
12-Aug-12		**Dove HPD(#1420)**		08/13 12:00(UTC+9h)
	07:18	HPD dove & started her operation(#1420).		Bayonnaise
	07:54	HPD landed on the sea bottom(D=827m).		31-57.6N,139-44.2E
	12:46	HPD left the sea bottom(D=916m).		Overcast
	13:27	Recovered HPD & finished above operation.		SSW-3(Gentle breeze)
	18:30-18:40	Scientist meeting.		2(Sea Moderate)
				2(Low sea long)
				Visibly:7 '
13-Aug-12		**Arrived at YOKOSUKA**		
		Sent out 1st shore line, arrived at Yokosuka, completed NT12-20		

4. EM survey system

The time Domain EM system and the square array system were designed by Waseda University in the MEXT project. The same transmitter and receiver were implemented for the moving type and fixed type systems.

4.1. The specification of the system.

The developed systems were consists of the transmitter unit (transmitter and transmitter coil), the sensor unit (MI-magnetometer and receiving induction coil and 4 electrodes) and the receiver unit.

- Transmitter
  - Size : 567mm length、320mmϕ
  - Weight : 55kg
  - Power Supply : 6.6V 180Ah(internal battery)
  - Current wave : square wave(8sec Period, Duty cycle 5%)
  - Current : max 100A

Figure 2 Transmitter

- Transmitter coil
  - Size : (moving type) 2.5m rectangle、1 turn
    (fixed type) 3.0m rectangle、1 turn
  - Weight : 30kg
  - Resistance : 0.0686Ω / 16m

- Receiver
  - Size : 567mm length、160mmϕ
  - Weight : 25kg
  - Power Supply : 18V 600mA(internal battery / external power)
  - Record : 16bit 10ch, max 100kHz sampling

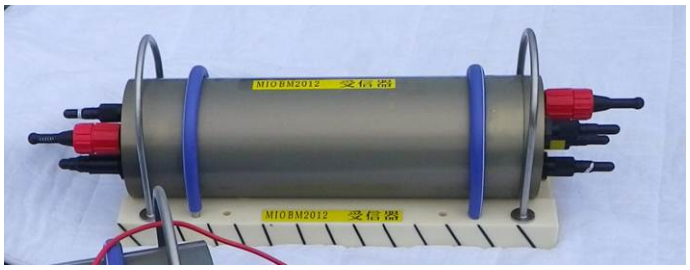

Figure 3　Receiver

・ MI-magnetometers

Two ocean bottom magnetometers using MI(magneto-impedance) sensors for the TDEM measurements were developed. The MI sensors measure magnetic fields using magneto-impedance effects, which is that the electric impedance of the magnetic amorphous wire changes with the varies of the surrounding magnetic fields.

- Size : 105mm length、118mm ϕ
- Weight : 3kg
- Dynamic range : (wide type) ±2,00,000nT/±10V
  (normal type) ±15,000nT/±7.5V, with canceling coil ±65,000nT

Figure 4　MI-magnetometers

・ Receiver coil

- Size : ϕ 1.0m、150 turn
- Weight : 25kg

・ Electrodes

- Size : 185mm length、ϕ 30mm
- Weight : 200g

Figure 5　Electrode

4.2. The moving system

All the components of the system was mounted on the HPD, which moved near the ocean floor at the speed of about 0.5 knots. The pictures of the moving system are shown in Figure 6 and Figure 7.

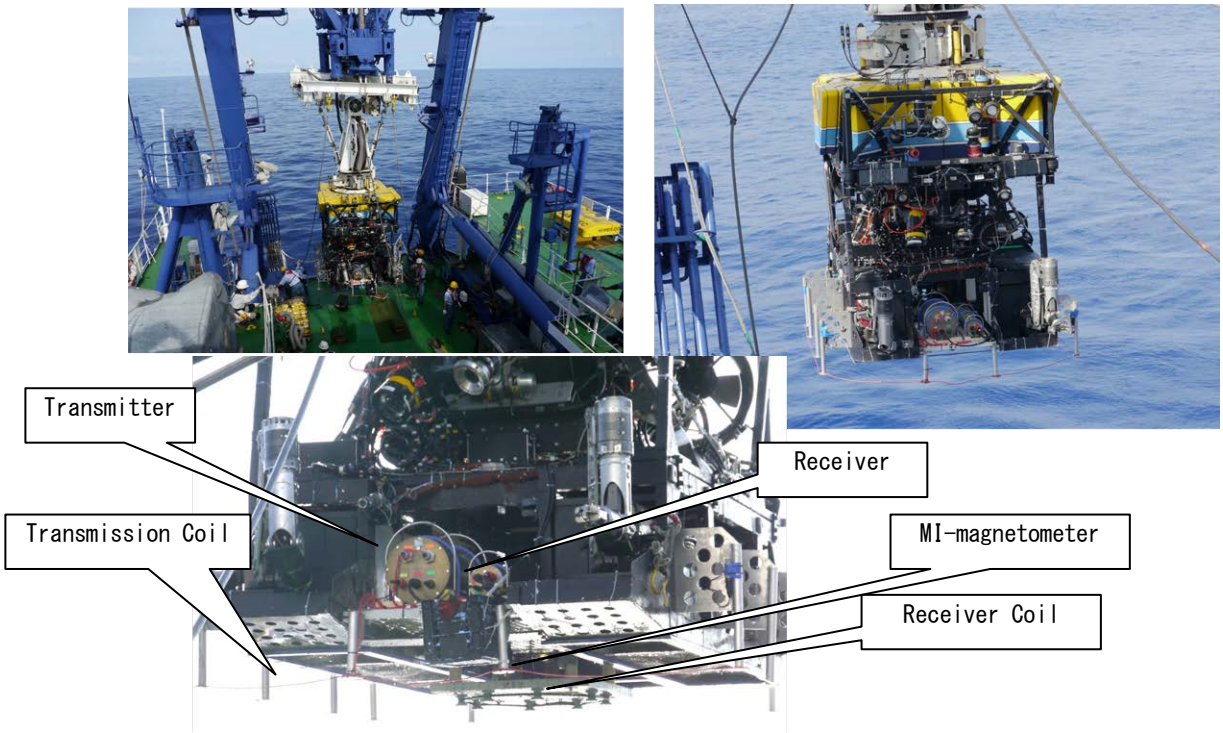

Figure 6　the measurement system installed in the HPD

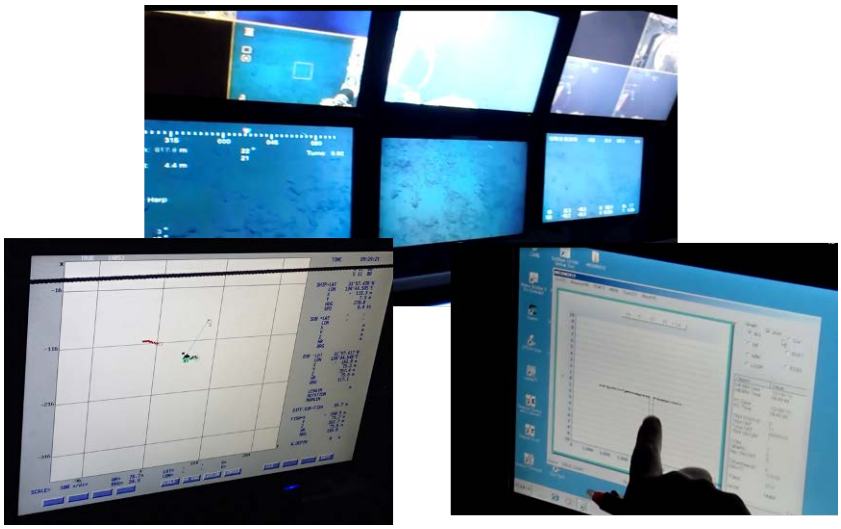

Figure 7　checking ocean bottom with the simultaneous display of the electromagnetic responses

4.3.　The fixed system

The fixed system was placed on the ocean floor, and the HPD moved about 20m away from the system to eliminate the noises due to the HPD. After the measurements, the fixed system was tonged and lifted by the HDP and moved to the next site. All the arms were fold downwards and suspended from the HPD. The main frame and the 4 arms are made of FRP gratings to minimize the water resistance.

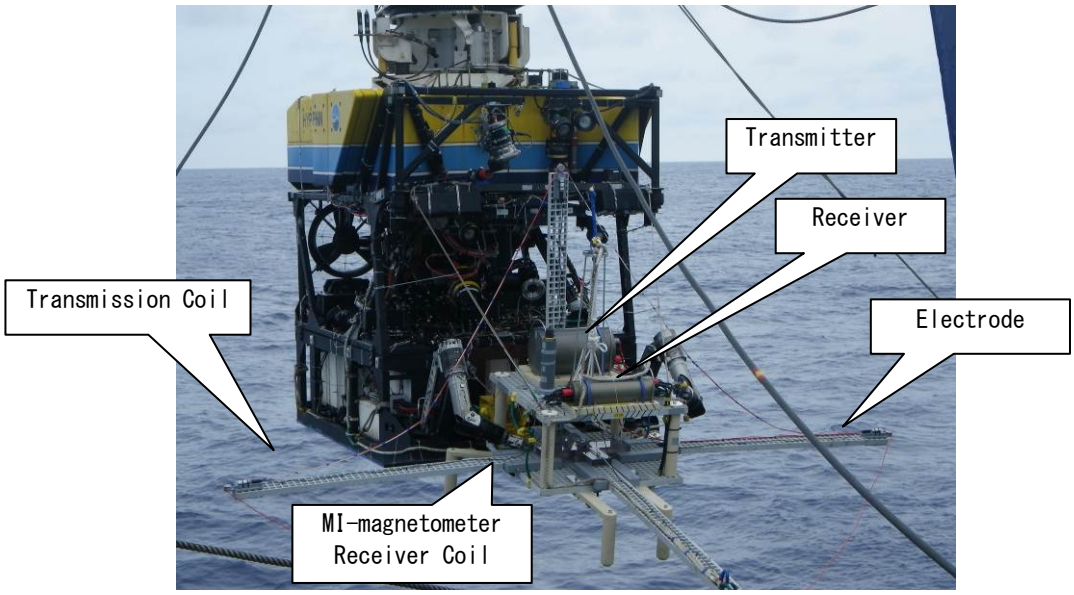

Figure 8　the measurement system folded in the HPD

5. HPD dives

Before HPD dive, we carried out bathymetric survey using MBES system for the safely of HPD dive around the beyonnase knoll. We could carry out six dives in this cruise. Detailed reports of each dive are as follows.

5.1. #dive1415

Objectives of the dive： test of the fixed type system

Contents of the dive ： The fixed type measurement system was held by HPD and dove at 9:12. While HPD was moving down, at 11:31 one arm of the measurement system was dropped off. Since it was not able to put on the seabed, HPD recovered at 12:27. Then the measurement system was revamped.

Table 2 Dive log(#dive1415)

Date	Local Time	Note	Dive Point	Description
08-Aug-12	09:12	HPD dove & started her operation(#1415).		
	10:46	HPD landed on the sea bottom(D=632m).	1	
	11:09	HPD gained altitude and moved. (D=642m).	2	
	11:31	HPD left the sea bottom(D=607m).	3	
	12:27	Recovered HPD & finished above operation.		

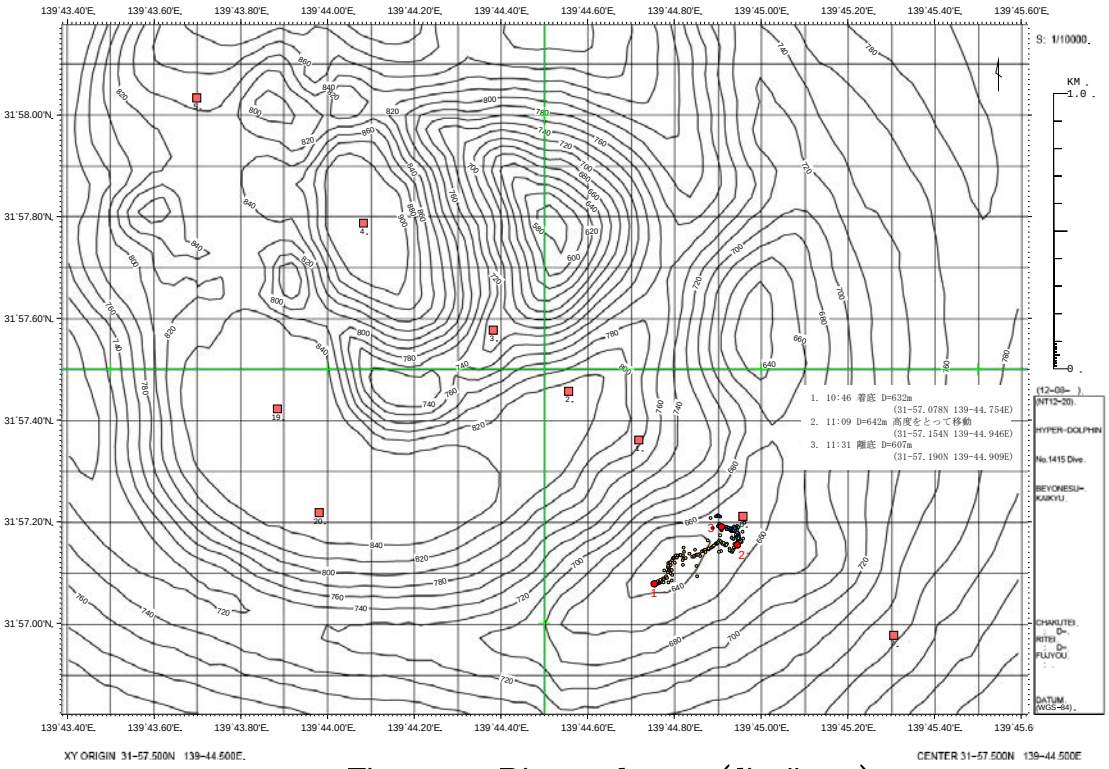

Figure 9 Dive tracks map (dive#1415)

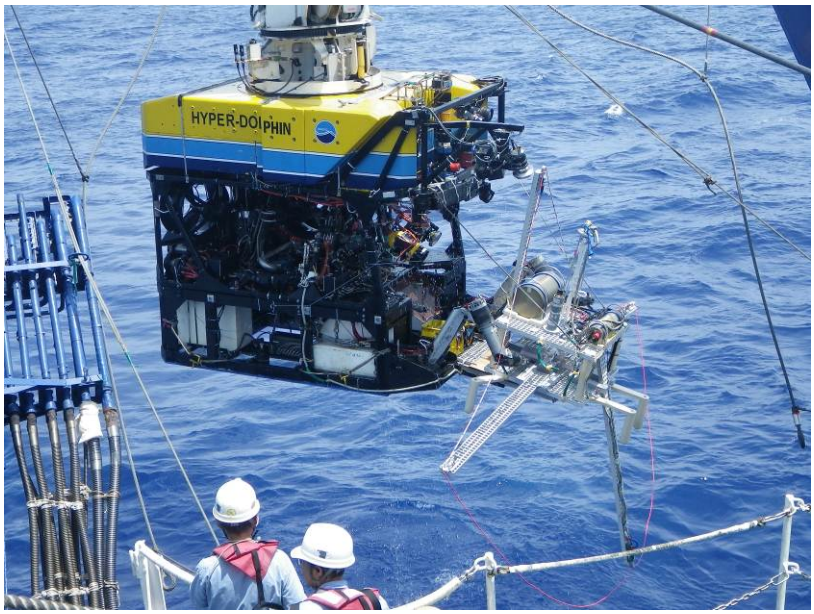

Figure 10　HPD and the measuring system recovered
(one of the arms was dropped off)

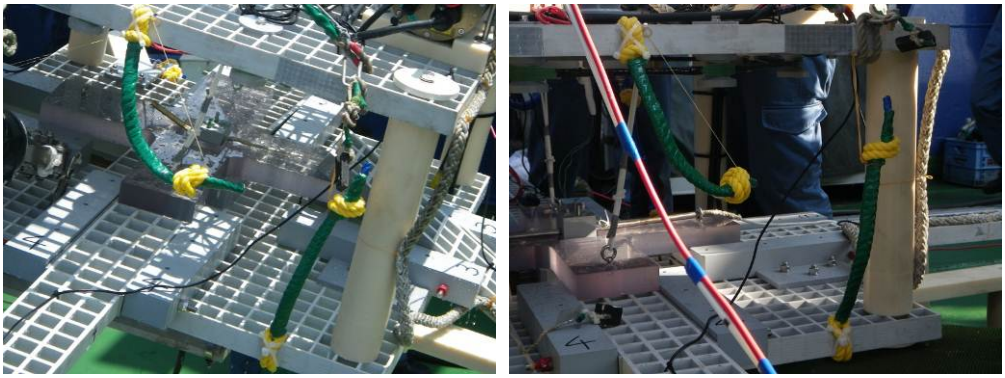

Figure 11　revamping of the measurement system
left（Before）: The pin made from brass changed.
right（After）: The pin was exchanged to made from stainless steel.

5.2.　#dive1416

Objectives of the dive：　check hazards and seafloor observation

Contents of the dive　：　HPD dove at 13:55 and landed on the seabed (Dive Point1) at 14:55. From 15:09 to 16:40, we observed the seafloor and searched the points for the fixed style measurements.

Table 3　Dive log(#dive1416)

Date	Local Time	Note	Dive Point	Description
08-Aug-12	13:55	HPD dove & started her operation(#1416).		
	14:55	HPD landed on the　sea bottom(D=827m).	1	
	15:09	seafloor observation (D=833m).	2	

	15:45	seafloor observation(D=700m).	3	
	16:30	seafloor observation(D=915m).	4	
	16:40	HPD left the sea bottom(D=913m).	5	
	17:22	Recovered HPD & finished above operation.		

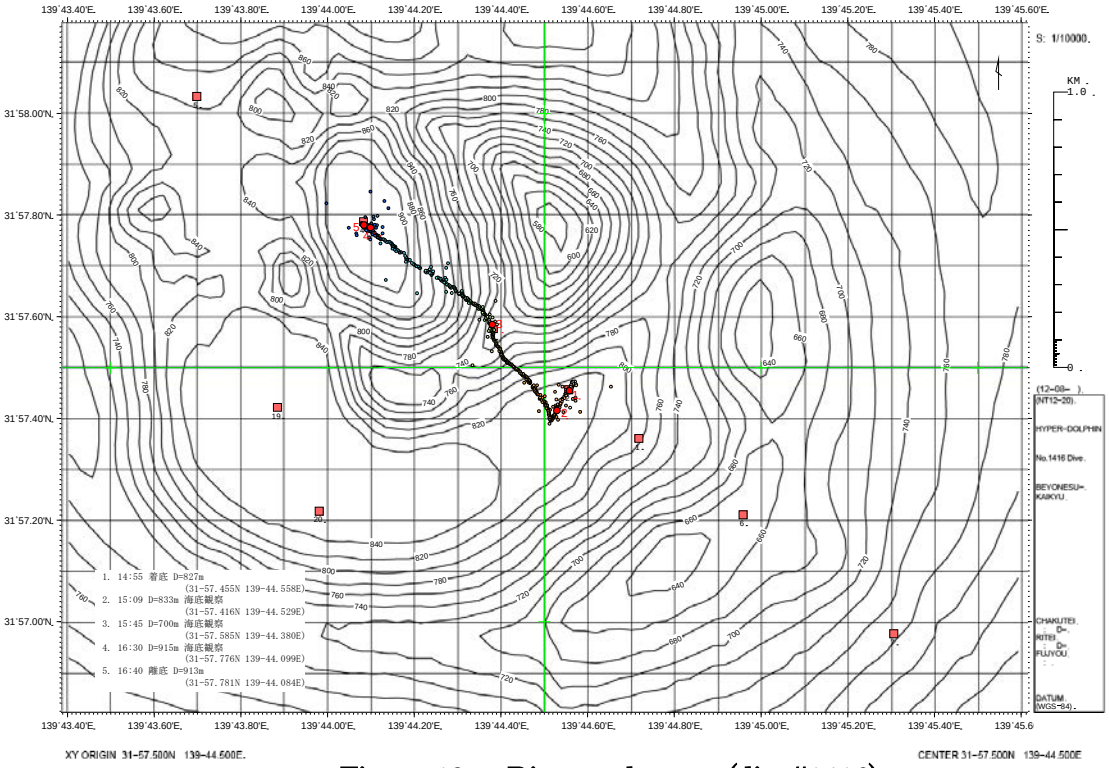

Figure 12 Dive tracks map (dive#1416)

5.3. #dive1417

Objectives of the dive： test of the fixed type system

Contents of the dive ： The revamped measurement system was held by HPD and dove at 8:49. HPD landed on the sea bottom at 9:32. After extending arm of measurement system, we started to measure at 10:17. In this dive, we measured the magnetic and electric responses using the fixed type system in 5 points on the line over HAKUREI site. The procedure in each point is as follows.

1. HPD placed the measurement system on the seabed.
2. HPD moved about 20m away from the measurement system
3. The measurement system records the data of responses for 15 minutes.
4. HPD holds the measurement system and moves to the next measurement point.

All measurement was finished to 15:40. HPD held the rope connected with the measurement system, and was recovered. After that, the measurement system was recovered using the rope with folding down the arms.

Table 4　Dive log(#dive1417)

Date	Local Time	Note	Dive Point	Description
09-Aug-12	8:49	HPD dove & started her operation(#1417).		
	9:32	HPD landed on the　sea bottom (D=827m)	1	
	9:41	Start expanding operation of the measuring system.(D=834m)	2	
	10:03	End expanding operation of the measuring system.		
	10:17	Start the measuring (D=834m)	3	
	10:32	End the measuring(D=830m)	4	
	10:35	Recovered the measuring system(D=834m)	2	
	11:02	Fluctuation visual confirmation by hot water (D=797m)	5	
	11:19	HPD gained altitude and moved. (D=772m)	6	
	11:41	Set up the measuring system (D=812m)	7	
	11:48	Start the measuring(D=814m)	8	
	12:05	End the measuring		
	12:13	Recovered the measuring system (D=806m)	7	
	13:07	Set up the measuring system (D=694m)	9	
	13:18	Start the measuring(D=705m)	10	
	13:33	End the measuring		
	13:38	Recovered the measuring system (D=694m)	9	
	13:42	HPD gained altitude and moved. (D=699m)	11	
	14:38	seafloor visual contact(D=912m)	12	
	14:39	Set up the measuring system		
	14:43	Start the measuring(D=916m)	13	
	14:59	End the measuring		
	15:03	Recovered the measuring system (D=911m)	12	
	15:12	Set up the measuring system (D=914m)	14	
	15:15	Start the measuring(D=915m)	15	
	15:40	End the measuring		
	15:50	Start recovering the measuring system (D=915m)	14	
	16:00	End recovering the measuring system		
	16:00	HPD left the sea bottom (D=915m)		
	16:47	Recovered HPD & finished above operation.		
	16:57	Recovered the measuring system		

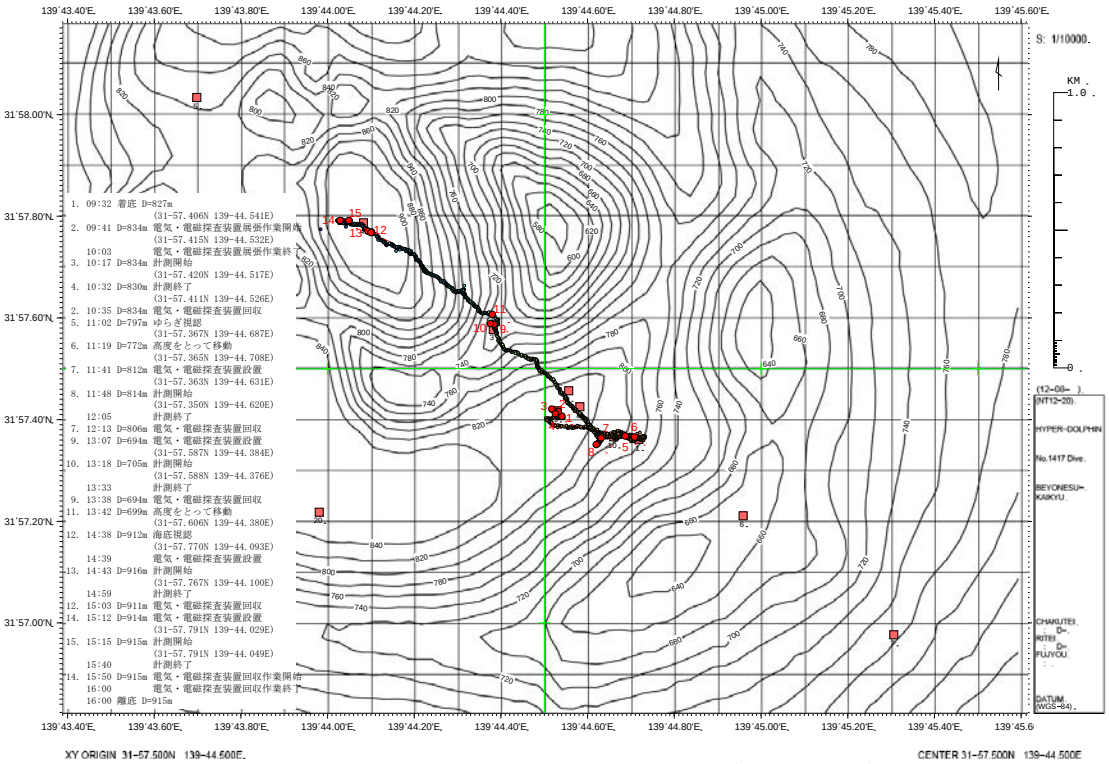

Figure 13 Dive tracks map (dive#1417)

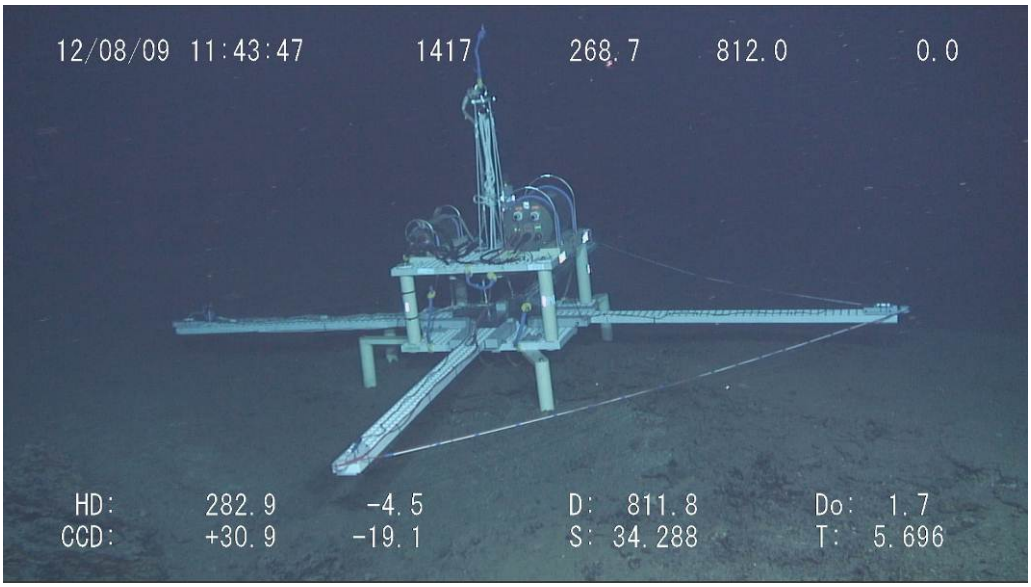

Figure 14 Fixed system on the seafloor

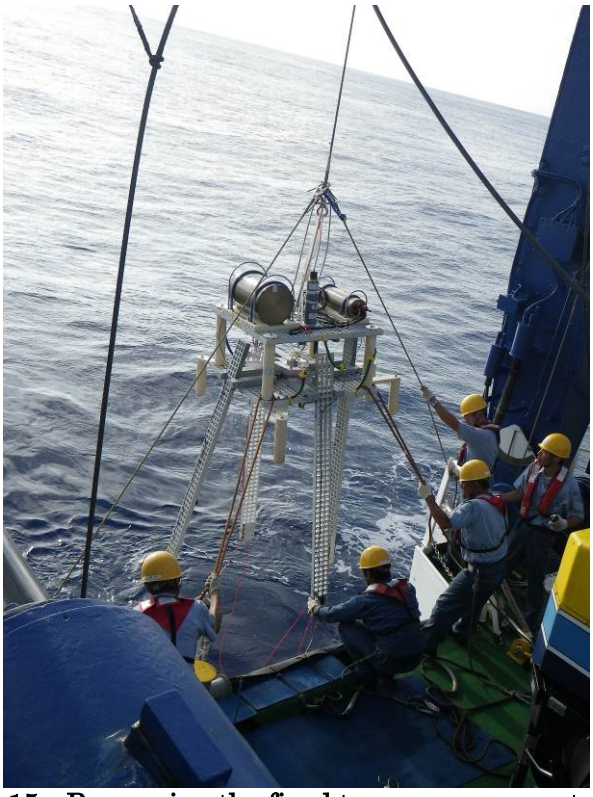

Figure 15　Recovering the fixed type measurement system

5.4.　#dive1418

Objectives of the dive：　test of the moving type system

Contents of the dive　：　In this dive, we measured the electromagnetic response using the moving type system in the 5km survey line directed from northwest to southeast over HAKUREI site. The measurement system was installed to HPD and dove at 9:05. HPD landed on the sea bottom (Dive point 1) at 9:32. HPD moved in the procedure shown below.

1. HPD move near the seafloor going up a slope at the speed of around 0.5 knots.
2. On the top of a slope, HPD gain altitude and turn around.
3. HPD moved to a bottom of another slope on the survey line.
4. HPD get low and turn around, and start measuring again.

All measurement was finished to 16:04. HPD and the measurement system left the sea bottom, and ware recovered.

Table 5　Dive log(#dive1418)

Date	Local Time	Note	Dive Point	Description
10-Aug-12	9:05	HPD dove & started her operation(#1418).		
	9:32	HPD landed on the　sea bottom(D=818m).	1	
	9:38	Start the measuring by the moving system		
	10:00	resurvey the location of　HPS (D=781m)	2	

	10:30	resurvey the location of HPS(D=639m)	3	
	10:32	HPD gained altitude and moved. (D=640m)	4	
	11:00	seafloor visual contact(D=772m)	5	
	11:30	resurvey the location of HPS(D=685m)	6	
	12:00	HPD gained altitude and moved. (D=634m)	7	
	12:30	resurvey the location of HPS(D=725m)	8	
	12:47	seafloor visual contact(D=825m)	9	
	13:07	HPD gained altitude and moved. (D=700m)	10	
	13:49	seafloor visual contact(D=911m)	11	
	14:36	HPD gained altitude and moved. (D=700m)	12	
	15:31	seafloor visual contact(D=911m)	13	
	16:01	HPD left the sea bottom(D=830m).	14	
	16:04	End the measuring by the moving system (D=780m)	15	
	16:54	Recovered HPD & finished above operation.		

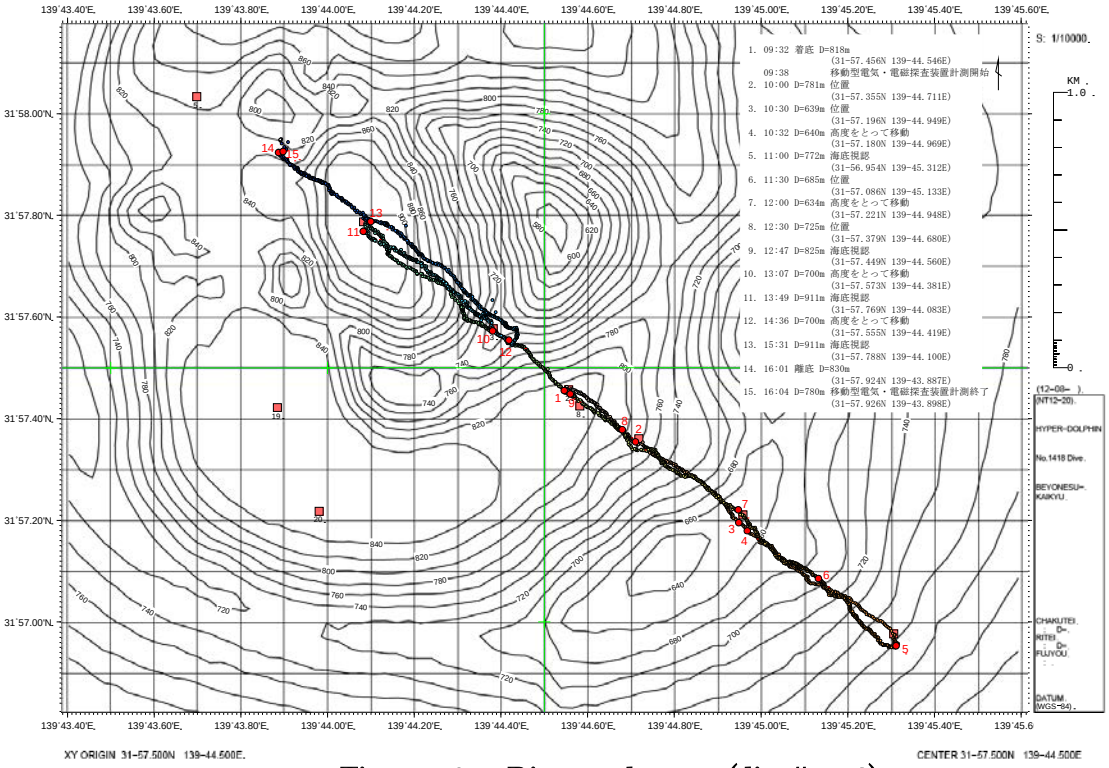

Figure 16 Dive tracks map (dive#1418)

5.5. #dive1419

Objectives of the dive： test of the moving type system

Contents of the dive ： In this dive, we measured the electromagnetic response using the moving type system in the 4km survey line directed from southwest to northeast over HAKUREI site. The measurement system was installed to HPD and dove at 8:22. HPD landed on the sea bottom (Dive point 2) at 9:05. HPD moved in the same way as #dive1418. All measurement was finished to 15:46. HPD and the measurement system left the sea bottom, and ware recovered.

Table 6 Dive log(#dive1419)

Date	Local Time	Note	Dive Point	Description
11-Aug-12	8:22	HPD dove & started her operation(#1418).		
	8:56	Start the measuring by the moving system (D=924m)	1	
	9:05	HPD landed on the sea bottom(D=818m).	2	
	10:00	resurvey the location of HPS(D=809m)	3	
	10:30	resurvey the location of HPS(D=693m)	4	
	10:46	HPD gained altitude and moved. (D=688m)	5	
	11:00	resurvey the location of HPS(D=674m)	6	
	11:29	seafloor visual contact(D=785m)	7	
	12:00	resurvey the location of HPS(D=688m)	8	
	12:06	resurvey the location of HPS(D=673m)	9	
	12:08	HPD gained altitude and moved. (D=669m)	10	
	12:30	resurvey the location of HPS(D=630m)	11	
	13:00	resurvey the location of HPS(D=678m)	12	
	13:29	seafloor visual contact(D=775m)	13	
	14:00	resurvey the location of HPS(D=717m)	14	
	14:31	HPD gained altitude and moved. (D=666m)	15	
	15:00	resurvey the location of HPS(D=647m)	16	
	15:11	seafloor visual contact(D=789m)	17	
	15:30	resurvey the location of HPS(D=737m)	18	
	15:46	End the measuring by the moving system (D=678m)	19	
	15:46	HPD left the sea bottom(D=830m).		
	16:23	Recovered HPD & finished above operation.		

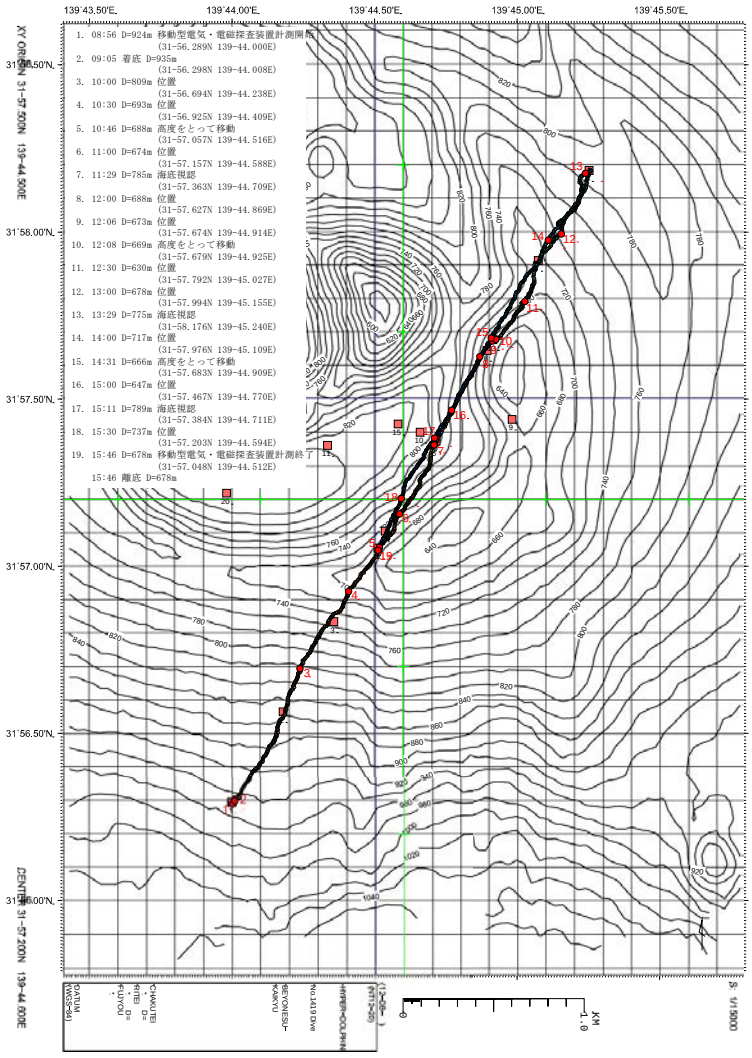

Figure 17　Dive tracks map (dive#1419)

5.6.　#dive1420

Objectives of the dive　:　sampling chimneys, rocks, and clay from ocean floor.

Contents of the dive　:　In the survey area, we obtained samples from chimneys and rocks by manipulator of HPD. And the clays were sampled using the scoop sampler, the M-type corer, the MBARI corer. One sample from chimneys was marked on the top to keep the azimuth direction, using the Blair Cutter.

Table 7　Dive log(#dive1420)

Date	Local Time	Note	Dive Point	Description
12-Aug-12	7:18	HPD dove & started her operation(#1420).		
	7:54	HPD landed on the sea bottom(D=827m).	1	
	8:06	Sampling the clay, using the scoop sampler (D=828m)		
	8:17	Sighting the OBE sinker (D=817m)	2	
	8:48	Sampling the chimneys (D=802m)	3	

	8:59	Sampling the rocks		
	9:15	Sampling the rocks (D=798m)	4	
	9:35	Sighting the shimmer (D=756m)	5	
	9:45	Sampling the rocks (D=749m)	6	
	10:03	Sampling the rocks (D=706m)	7	
	10:09	Sampling the clay and the rocks using the M-type corer.		
	10:34	Sampling the rocks (D=640m)	8	
	10:37	Sampling the rocks		
	10:39	HPD gained altitude and moved.		
	11:47	seafloor visual contact(D=714m)	9	
	11:53	Sampling the rocks		
	11:55	HPD gained altitude and moved.		
	12:34	seafloor visual contact(D=913m)	10	
	12:36	Sighting the trace of landing of HPD		
	12:44	Sampling the clay using the MBARI corer (D=916m)	11	
	12:46	HPD left the sea bottom(D=916m).		
	13:27	Recovered HPD & finished above operation.		

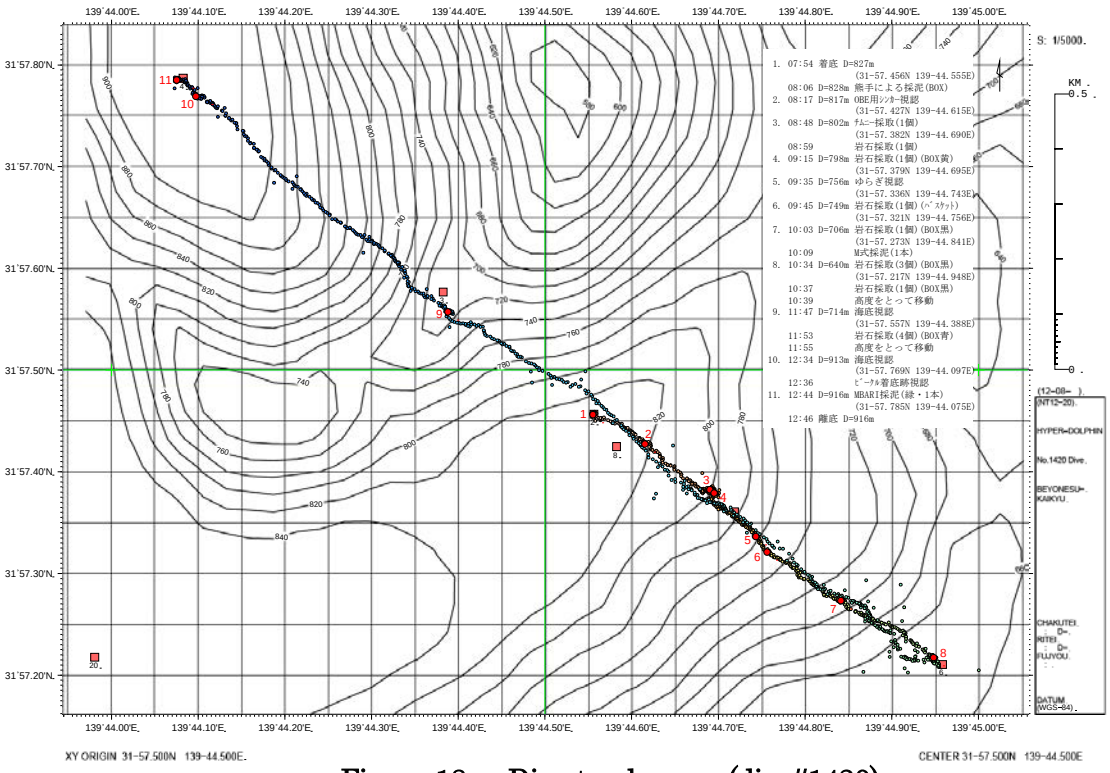

Figure 18 Dive tracks map (dive#1420)

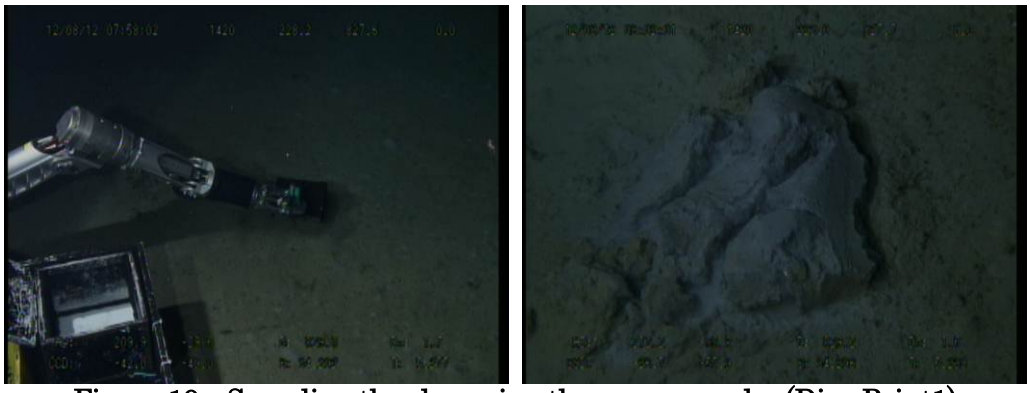

Figure 19　Sampling the clay using the scoop sampler.(Dive Point1)

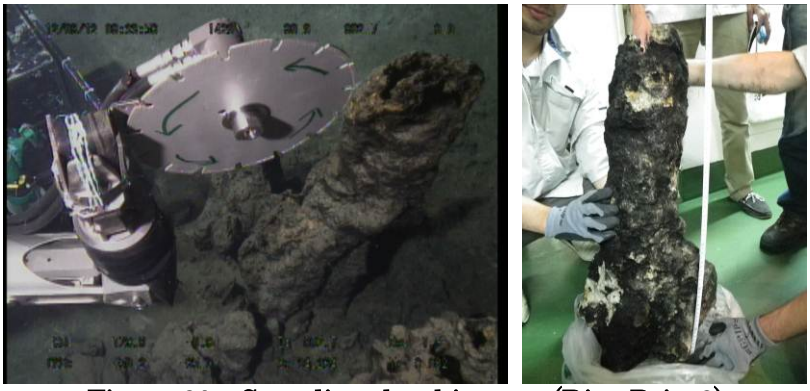

Figure 20　Sampling the chimneys.(Dive Point2)

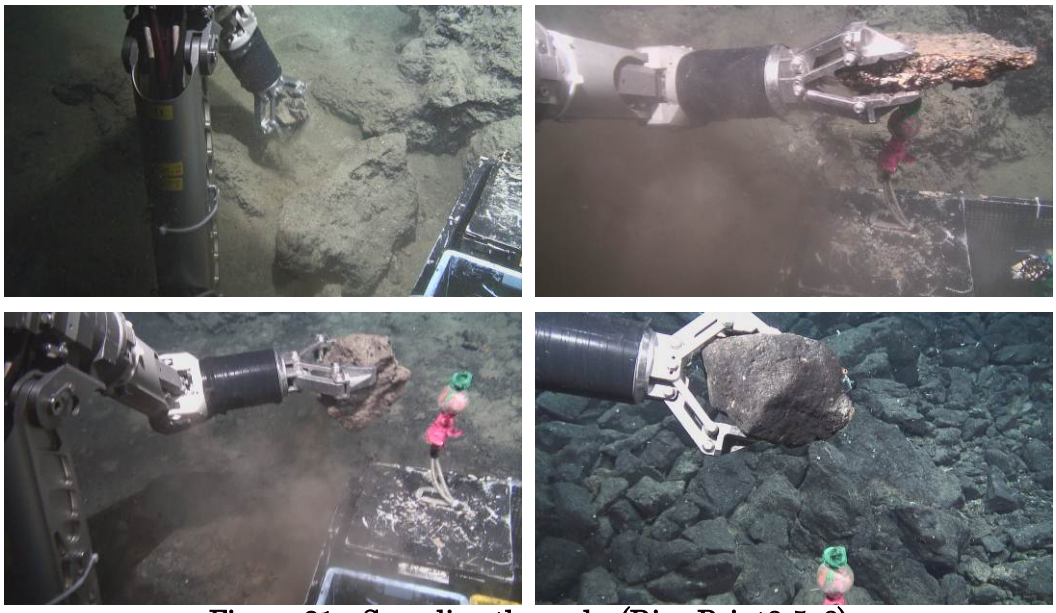

Figure 21　Sampling the rocks.(Dive Point3-5, 8)

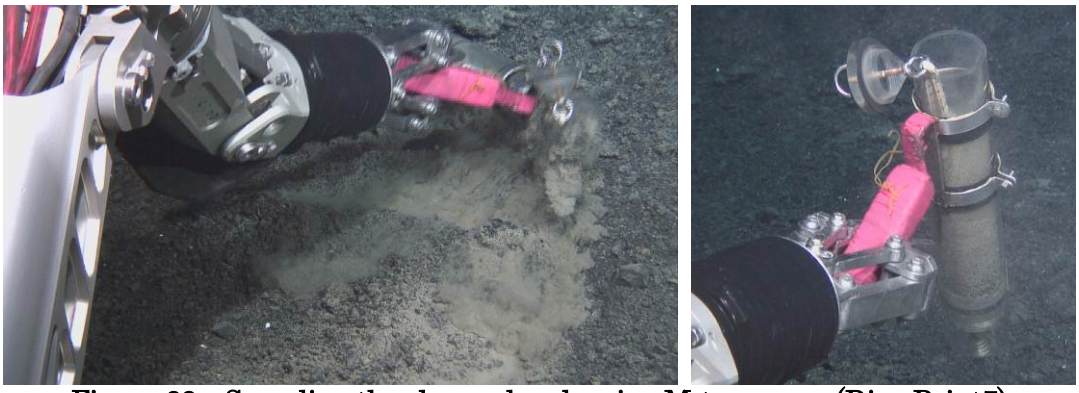

Figure 22　Sampling the clay and rock using M-type corer.(Dive Point7)

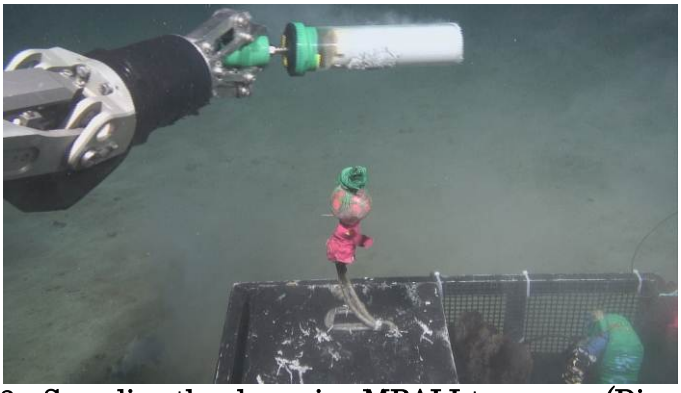

Figure 23　Sampling the clay using MBALI-type corer.(Dive Point11)

6. Summary

In this cruse, it was one of the purposes to obtain the valuable data of the improvement for the deep exploration by high current transmission. Since the power supply offered to a payload from the HPD has restriction (12V, 4A), the batteries were built in the inside of the transmitter, and the current was increased to 80A. However, there is a limit in the power supply from a battery, in order to realize a more practical system, it is necessary to solve the subject of the amount increase of electric supply.

The example of wave forms in the moving type measurements (#dive1418, 1419) is shown in Figure 24.　The 60-Hz noise is contained from the power supply system of HPD. Moreover, the serious noises(8～10sec cycle) were observed by the motion of the mother ship caused by the typhoon.

The example of wave forms in the fixed type measurements (#dive1417) is shown in Figure 25. The reasonably stable data were obtained using the fixed type system.

The sampling of the rocks and minerals were also conducted at the measuring points for the electrical and chemical analysis. By giving a crack in the specific direction, the chimneyies determined the direction and were sampled.

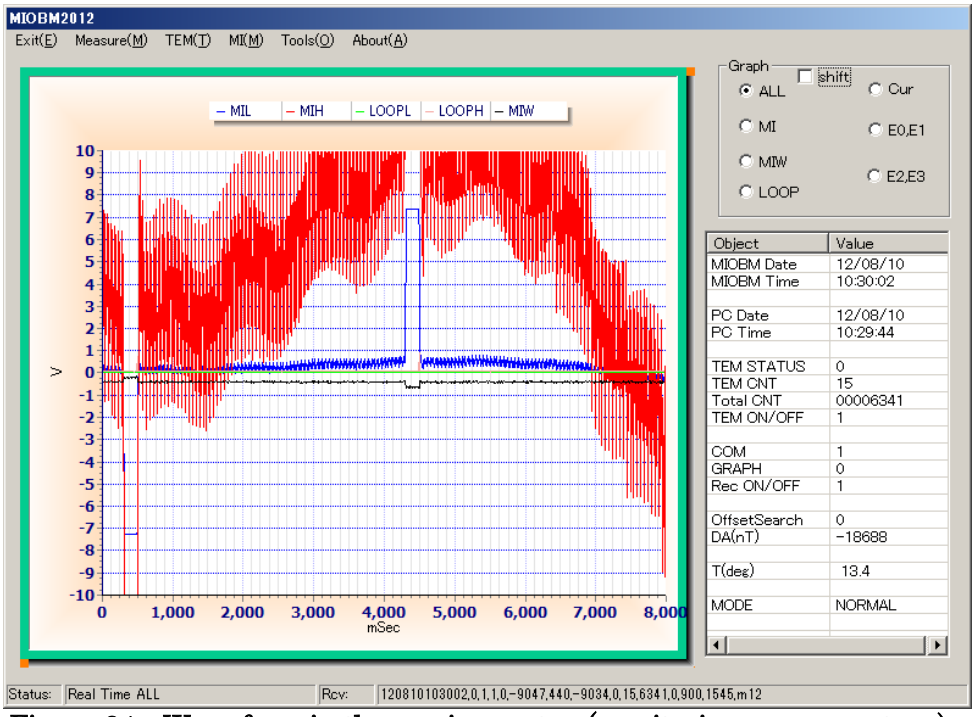

Figure 24　Wave form in the moving system(monitoring screen capture)

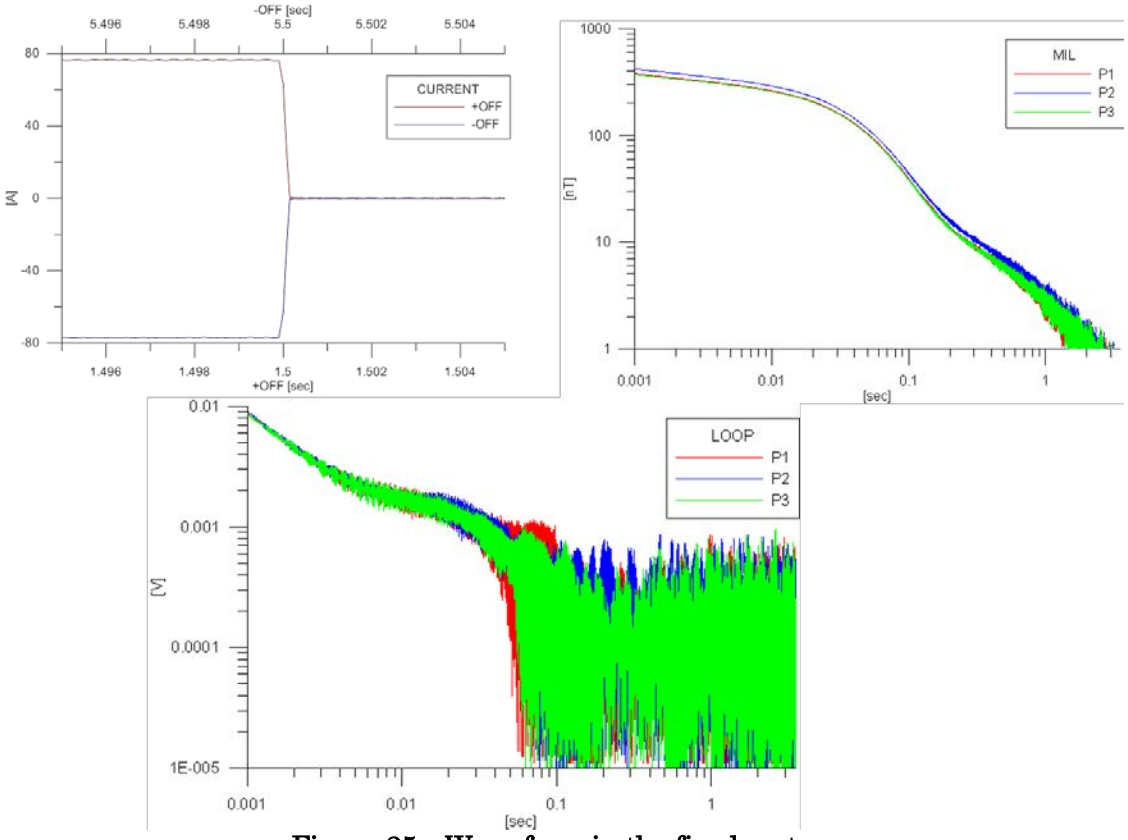

Figure 25　Wave form in the fixed system

Explanatory note

A.1 General information about R/V NATSUSHIMA

Length:67.4m Bow thruster: 4T/1.4T×220kw/110kw×1 1
Width:13.0m Maximum speed:12.0kt
Depth:6.3m Duration:5000 mile
Max capacity: 55 persons (18 scientists)
Gross Tonnage:1739t
Main prop: Variable pitch propeller 2 axis×4 Wing CPP,540N

A.1-1Research equipment

(1) PDR

This can record a water depth at right below and make contour map together with navigation data.

Max depth:	more than 3000m
Record Range:	200～800m (changeable)
Frequency:	12kHz +/-5%
Output:	more than110dB (0dB unbar at 1m)
Directivity:	conical beam pattern
Beam width:	15deg. +/-5 deg. (-3dB)
Pulse width:	1, 3, 10, 30msec

(2) XBT equipment

XBT profile a vertical water temperature by free-fall probe.
Maximum measurable depth:1830m
Measure range:-2 deg.～+35 deg.

(3) Navigation equipment

Position of the ship is measured by DGPS within about 3m error. ROV and transponder are measured by acoustic positioning system.

(4) Laboratory

There are laboratories at the back part of second deck. Each room has AC100V power supply and LAN. The video of HPD diving and deck-camera video are distributed to the laboratories and every cabin.

・Second laboratory: There are two desktop PCs (windows and Mac), equipment for video editing, color copy with printer, meeting desk and white board. Hi-definition video of HPD is distributed to this laboratory. You can copy from a digital ßcam and S-VHS to S-VHS/VHS, Hi8 and DV.

・Third laboratory: There are two sinks, refrigerator (-80deg. low temperature refrigerator, Incubator, domestic refrigerator, ice maker, ice crasher) and reagent water system (ORGANO, Milli-QSPTOC). And sea water for experiment is supply to the sink.

・Dry laboratory: There are a work desk and a shelf for baggage. This room has 4 beds to be used as a private one in case that there are many researchers.

At the work deck, there are rock-cutter rooms

・Rock-cutter room: There are a rock cutter and two grinders. And exclusive video player is set to describe rocks with playing video of ROV diving.

A.2 General information about Hyper Dolphin

Hyper Dolphin is 3000m ROV which was built by SSI (Canada) in 2001. The vehicle has two manipulator, a Hi-definition super harp TV camera, and a color CCD TV camera. In addition,

digital photo camera, black and white TV camera for back side monitoring, altitude sensor, depth sensor (with temperature sensor), sonar for obstacle avoidance sonar.

Principal specification

Length: about 3.0m	Depth capability: Maximum 3000m
Breadth: about 2.0m	Payload weight: -100kg (in the air)
Height: about 2.3m	Speed in the water: 0～3kt
Weight in the air: about 3800kg	Manipulators: 2 sets

(1) Manipulator capability
Pivot: 7 pivoted
Working load: in the water 68kg (max outreach)
Length of arm: 1.53m
Grasping power: 450kg
Hoisting power: max 250kg (vertical)
Hand opening width: right 77mm, left 195mm

(2) TV camera
Super Harp High-definition TV camera: 1
TV camera tube: 2/3"HD Super Harp tube, RGB3 tube
Optics system: F1.8, M type total reflection prism
Lens : F1.8(5.5 ～ 27.5mm)
Field angle : 72°
Sensitivity: 2000Lux @ F5.6 (high-quality mode)
2Lux @ F1.8 (high-sensitive mode)
Pan : +170°～-170°
Tilt : +90°～-90°

Color CCD TV camera 1
Type: ARIES (made by Insite Tritech, Inc)
Image-taking device : 1/2" Interline Transfer, POWER HAD CCD (×3)
Horizontal resolution: 750TVL
Lowest-light intensity: 5Lux @ F1.4
Lens : 5.5mm～77mm, 12×, F1.9～F16
Pan : more than 90°
Tilt : more than 90°

Black-and-white TV camera: 1
Type: EX520 (made by ELIBEX, Inc)
Horizontal resolution: 570TVL
Lowest-light intensity: 0.12Lux
Pan : 180°
Tilt : 180°

(3) Digital still camera
Type : Sea Max (DPC-7000, made by Deep Sea system, Inc)
Imaging sensor : 3.24 megapixel CCD
Lens : widest-angle～28mm～84mm (as 35mm film conversion)
Still image capacity : 2MB/1image
Laser scale : 4 point green laser(3mW), 10cm×10cm sq

(4) High-definition TV camera capture
HD images can capture by mouse click.
Dpi: 2 megapixels

Left clic : 1image(single shoot)
Light clic : 8images(serial shoot)

(5) Obstacle avoidance sonars
Type : SIMRAD MS1000
Range : 10, 20, 25, 50, 100, 200m change
Detective distance: max 100m
Transmission frequency : 330kHz±1kHz

(6) Altitude sonar
Type: SIMRAD MS1007
Frequency: 200 kHz
Measure range: -200m
Accuracy: -2m

(7) Depth sensor (with temperature sensor)
Type: made by Paroscientific,Inc
Range of measuring depth: -4000m
Range of measuring temperature: -2-40deg.

(8)Light
Type: Sea Arc2 (made by Deep Sea P&L, Inc)
Output power : 400W×5

(9) CTD/DO
Type: CTD Sensor : SBE19, DO Sensor;SBE43 (made by Sea Bird,Inc)