

Cruise Report

KY11-E06

R/V Kaiyo & ROV Hyper Dolphin 4500

Condition Assessment of the riser wellhead of Hole
C9001D and the seafloor surrounding, off Shimokita

A Site Survey for IODP Expedition 337

2011

Center for Deep Earth Exploration
(CDEX)

Japan Agency for Marine-Science and Technology (JAMSTEC)

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Preface

KY11-E06 (R/V Kaiko with ROV Hyper Dolphin 4500) cruise was carried out with the aim of confirming the present condition of the wellhead of Hole C9001D, which was drilled by D/V Chikyu during a her shakedown cruise off the Shimoikita Peninsula conducted in 2006. Hole C9001D should have been re-entered in IODP Expedition 337, which was, however, postponed due to the Off the Tohoku Great Earthquake occurred on March 11th, 2011, just before the departure of D/V Chikyu for the expedition. Prior to the expedition resumed from July 2012, we examined if the wellhead stood there in a healthy condition and the seafloor showed abnormal aspects by using the ROV for judging whether we could go for the expedition or not. As a result, no damage or abnormal features affecting the drilling operations were observed on the wellhead and the seafloor, and thus we could confirm that there is no obstacle for implementing the expedition 337.

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Steward:	Rikako Mikami
Steward:	Masaru Takada

2. Objectives

Hole C9001D, which was drilled by D/V Chikyu during a her shakedown cruise off the Shimoikita Peninsula conducted in 2006 (CK06-06), should have been re-entered in IODP Expedition 337 “Deep Coalbed Biosphere Off Shimokita”. However, the expedition, which should have started from March 15th, 2011, was forced to be postponed due to the Off the Tohoku Great Earthquake occurred on March 11th, 2011. The schedule of Expedition 337 is rearranged and is to be resumed July 2012. Nevertheless, if by any chance the wellhead is damaged by the great earthquake, we have to take any countermeasures for it as early as possible prior to the expedition. Hence, KY11-E06 cruise aimed at

- 1) assessing if the wellhead stood there in a healthy condition and the seafloor showed abnormal aspects by means of ROV Hyper Dolphin 4500 for judging whether we could go for the expedition or not, and in addition, and

- 2) taking sediment samples with push corers for microbial-geochemical-geological studies of the very shallow formation from which sufficient samples were not available for such purposes during the shakedown cruise in 2006, on this occasion.

3. Survey Area and Wellhead

1) Survey Area

The survey area, Site C9001, is located 80 km away from the Shimokita Peninsula to the east, on a forearc basin of the northeast Japan (Fig. 1). Hole C9001D is a riser hole, which was drilled down to 645 meter below seafloor (mbsf) and cased down to 511 mbsf in 2006, situated on a muddy very gentle slope in 1180 m water depth inclined eastward (Fig. 2).

2) Hole C9001D Wellhead

The wellhead is 6.5 m high and 3.4 m wide at a maximum, with a funnel and a corrosion cap at the top, and painted in yellow (Fig. 3). Two bull's eyes (levels) are equipped on arms projected from the funnel arranged perpendicularly each other. Those directing southward and westward showed 1° and 0.8° at the last observation in 2006, respectively. Besides, a mud pat, which is fit to the base of the wellhead, should be situated beneath the seabed mud with the wires that connect with the wellhead extending to full length. As a corrosion cap that was firstly tried to set dropped at the foot of the wellhead in the last operations, it should be there as it was.

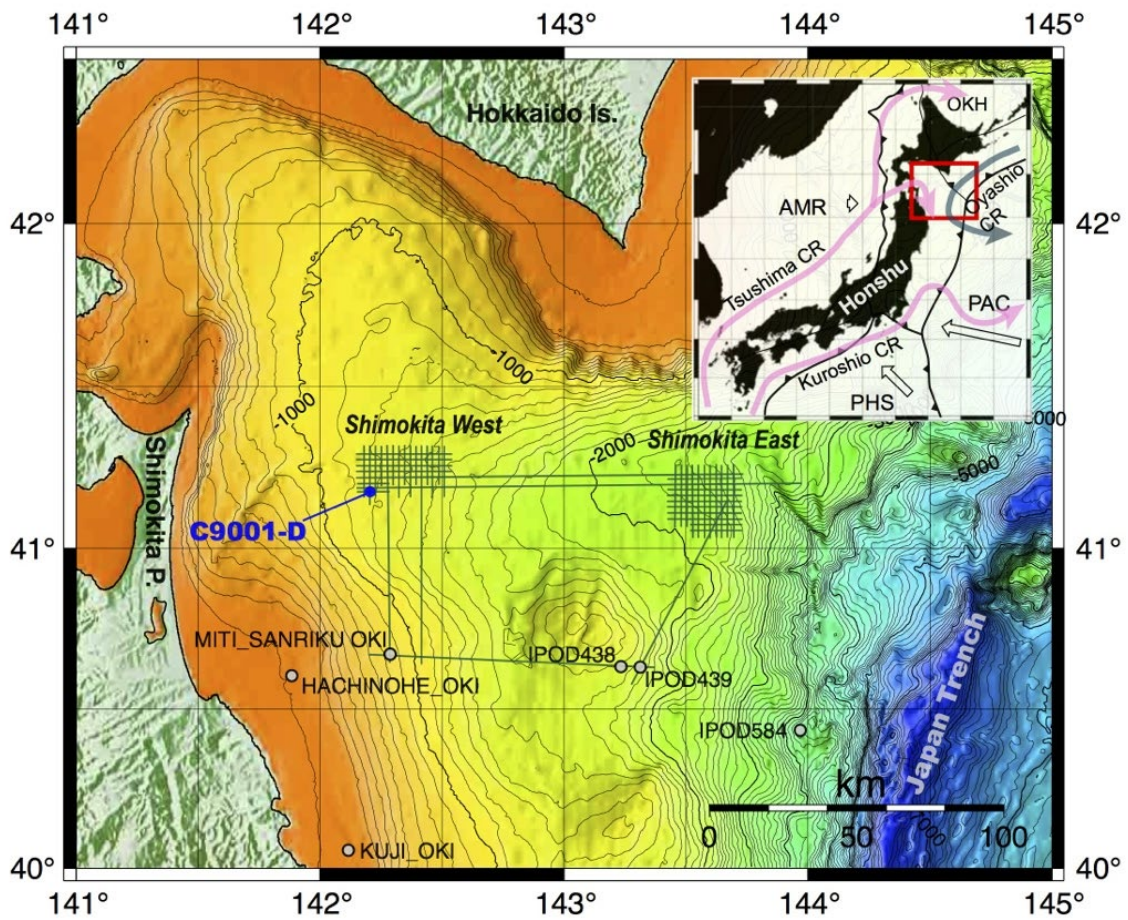


Figure 1. A regional bathymetry map of the area off the Shimokita Peninsula showing the location of the survey site, C9001. The bathymetry data used is J-EGG500. The inset shows the general tectonic and oceanographic background around the Japanese Island arc.

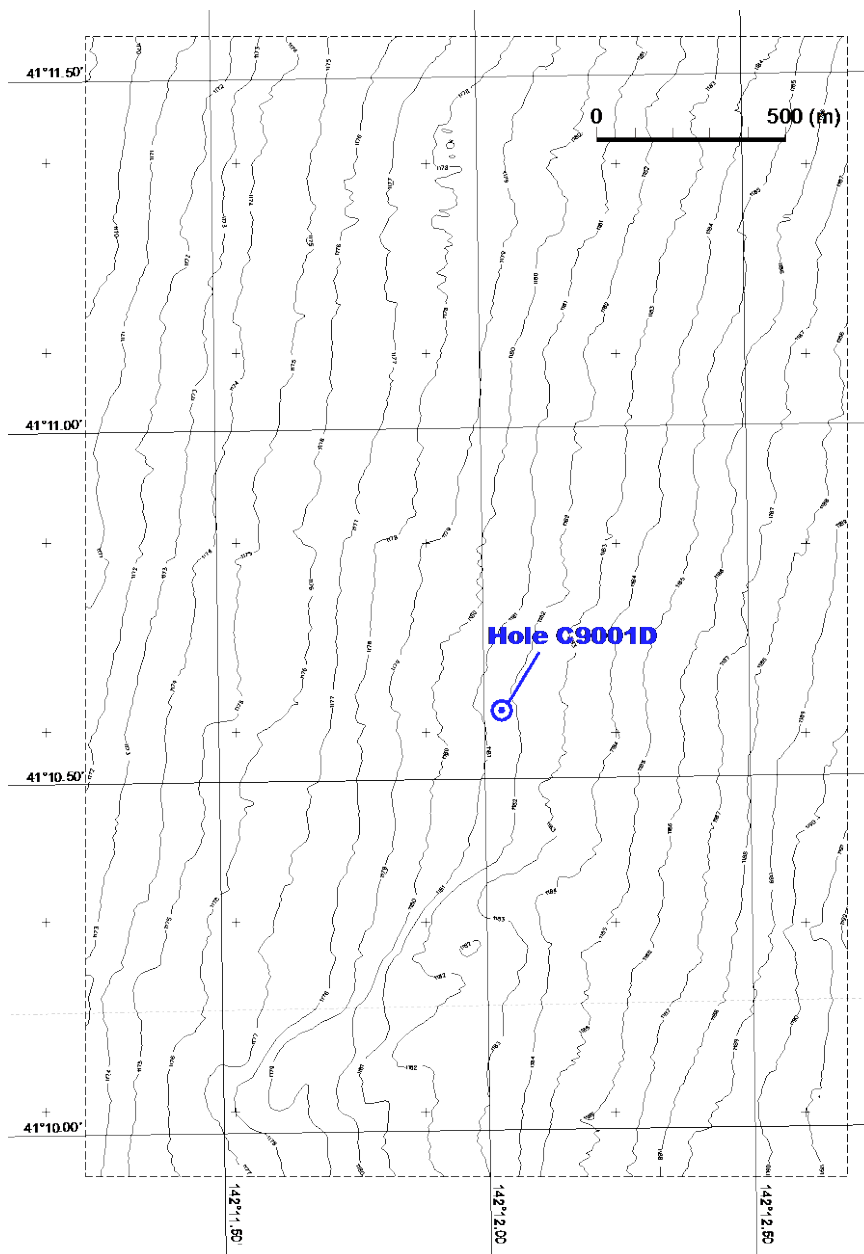


Figure 2. A high resolution bathymetry map around Hole C9001D. The bathymetry data is obtained by CDEX in 2004. The official water depth (1180 m) is, however, based on the length of drill string in the operations.

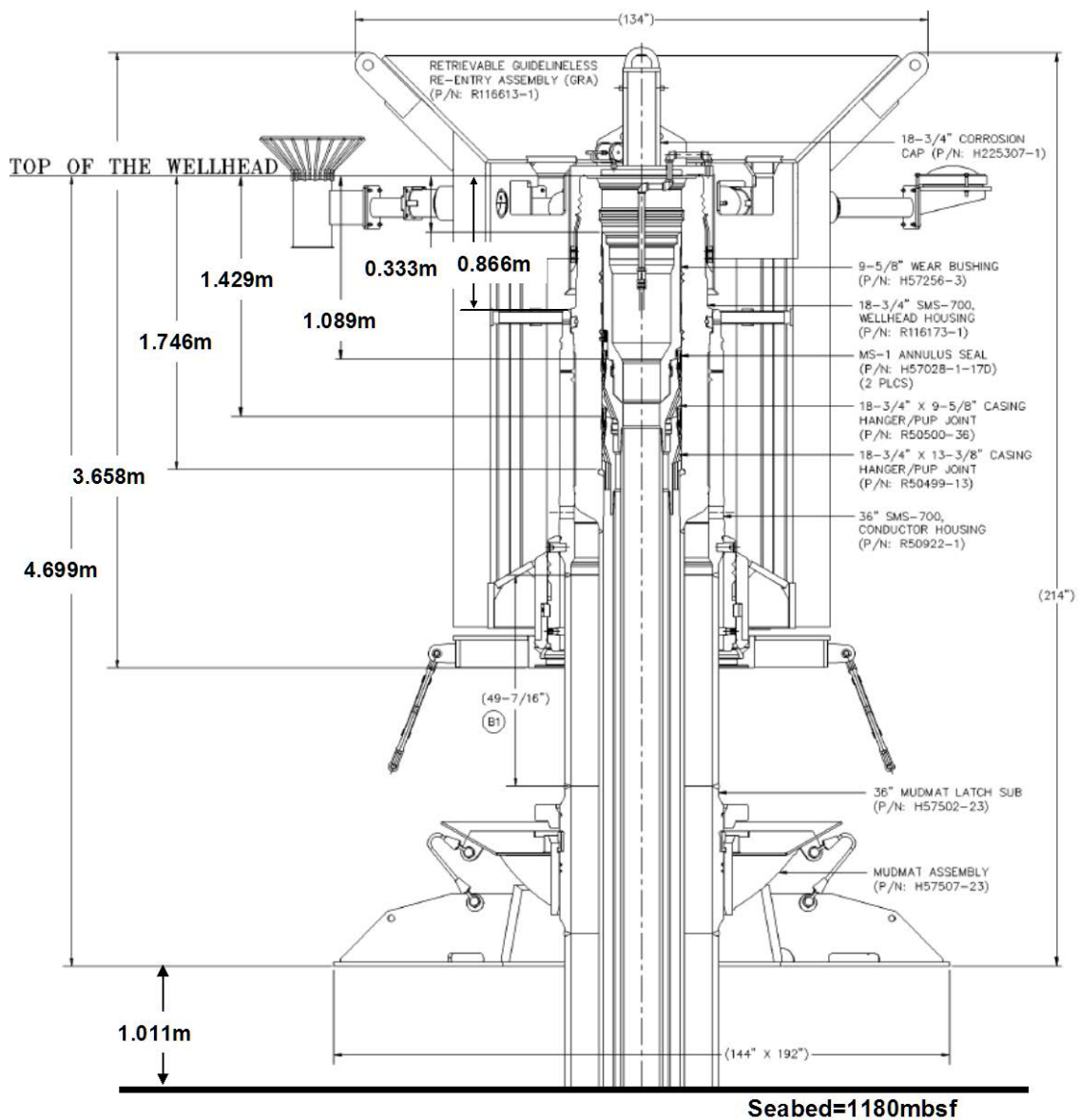


Figure 3. A drawing of the riser wellhead of Hole C9001D.

4. Event Log of the Cruise and the Ship Track

The KY11-E06 cruise was originally scheduled for from Nov. 14 to Nov. 20, 2011 as an emergency cruise. The R/V Kaiyo left the JAMSTEC quay on Nov.14 and then arrived at the site, off Shimokita Peninsula, on Nov. 18 after one-day evacuation off Ofunato from a rough sea condition. The dive of Hyper Dolphin 4500 was successfully carried out on the day, surveying the wellhead of Hole C9001D and sampling sediment with push corers. Upon completion of the dive, she left the site for Yokosuka, however, was forced to evacuate off Onagawa for totally two days due to rough sea conditions.

She finally returned to the JAMSTEC quay on Nov. 22. The ship track of the cruise and the event log are shown in Fig. 4 and Table 1, respectively.

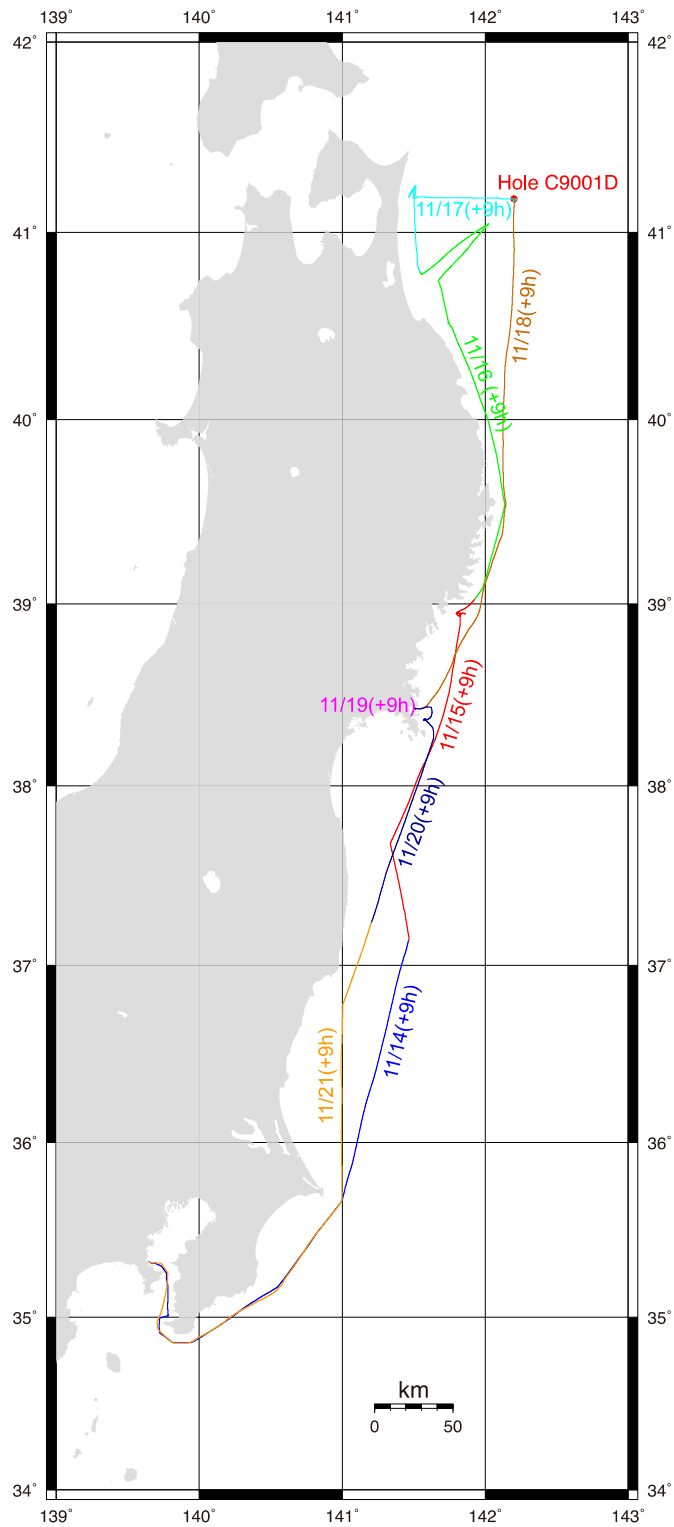


Figure 4. The ship track of the KY11-E06 cruise.

Table 1. Event log of the KY11-E06 cruise.

2011/11/14	
Weather: Fine (12:00 JST)	
~12:00	Embarkation of onboard scientists and marine technicians
13:00	Departure from the JAMSTEC quay, Yokosuka
14:00-14:20	Briefing on ship's life and safety
15:30-16:10	Abandon ship drill with lifeboat drop off Tateyama
17:00	Leave off Tateyama and sail to the offshore Shimokita
2011/11/15	
Position: 34°41.7'N 141°19.3'E, Weather: Cloudy, Temperature: 13°C, Wind: 9 m/s 11°, Current: 0.4 kt 283°, Wave: 1.6 m 6.4s (06:00 JST)	
14:45-15:30	Play a CK06-06 ROV dive video for the HPD team
19:30~	Evacuation off Ofunato
2011/11/16	
Position: 38°56.6'N 141°49.8'E, Weather: Fine, Temperature: 5°C, Wind: 17 m/s 278°, Current: 0.3 kt 206°, Wave: 1 m 5.8 s (06:00 JST)	
09:00	Leave off Ofunato and sail to the offshore Shimokita
20:40	Reach off Hachinohe
20:40~	Evacuation off Hachinohe
2011/11/17	
Position: 41°01.5'N 141°58.8'E, Weather: Fine, Temperature: 7°C, Wind: 18 m/s 296°, 1.4 kt 355°, Wave: 1.5 m 6.1 s, Water Temperature: 15.9°C (06:00 JST)	
03:00	Leave off Hachinohe and sail to the site
05:40	Return to the landward side at a point 10 NM away from Site C9001 due to rough sea condition.
09:00~	Evacuation off Shimokita Peninsula (Hachinohe to Higashidori)
2011/11/18	
Position: 41°10.9'N 142°2.1'E, Weather: Fine, Temperature: 8°C, Wind: 8 m/s 253°, Current: 2.0 kt 5°, Wave: 0.7 m 6.5 s, Water Temperature: 16°C (06:00 JST)	
03:30	Leave off Higashidori and sail to the site
06:00	Arrive at the survey area
06:10-06:15	XBT measurement

06:45-06:55	MBES bathymetry survey
07:45-08:10	Preparation for splashdown of HPD 4500
08:10	Splashdown of HPD 4500
08:27	Start Dive #1339
09:19-11:16	Survey of Hole C9001D wellhead and seafloor, push core sampling
12:10	Retrieve the vehicle
12:10-	Sail to evacuation point
<hr/>	
2011/11/19	
<hr/>	
Position: 38°26.6'N 141°35.5'E, Weather: cloudy, Temperature: 13°C, Wind: 5 m/s 238°, Current: 0.6 kt 183°, Wave: 1.1 m 5.8 s Water Temperature: 16.9°C (06:40 JST)	
07:15	Sail to evacuation point
07:15~	Evacuation in the Onagawa Bay
<hr/>	
2011/11/20	
<hr/>	
Position: 38°25.6'N 141°30.7'E, Weather: cloudy, Temperature: 17°C, Wind: 13 m/s 277°, Current: 0.1 kt 229°, Wave: 0.7 m 5.8 s, Water Temperature: 15.5°C (06:10 JST)	
15:00	Leave the Onagawa Bay, but return to shore side due to still severe sea condition.
16:00~	Evacuation in the north of the Kinkazan
<hr/>	
2011/11/21	
<hr/>	
Position: 37°46.6'N 141°25.6'E, Weather: cloudy, Temperature: 9°C, Wind: 7 m/s 243°, Current: 0.5 kt 217°, Wave: 1.1 m 7.8 s, Water Temperature: 15.4°C (06:10 JST)	
03:00~	Leave the evacuation place and sail to Yokosuka.
<hr/>	
2011/11/22	
<hr/>	
Position: 35°12.5'N 139°46.7'E, Weather: fine, Temperature: 10°C, Wind: 7 m/s 53°, Current: 0.4 kt 214°, Wave: 0.6 m 9.1 s, Water Temperature: 19.2°C (06:10 JST)	
07:30	Alongside the JAMSTEC quay
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5. Preliminary Results

5.1. XBT Survey

A vertical water temperature profile at the survey area was obtained by using XBT tool for calibration of MBES just before the bathymetry survey (Fig. 5).

データベース名 : c:\Program Files\MK-130LAN\data	デバイス名 : XBT	BATHYプローブ : 231
データ名 : BT-015520111117	プローブタイプ : T05	BATHY処理器 : 43
データナンバ : 0155	深度係数 a : 6.828	
日付 : 2011/11/17	深度係数 b : -1.82	
時刻 : 21:12:09	最大深度 (m) : 1830	
緯度 : 41-10.8982N	データ数 : 5821	深度ステップ : ALL
経度 : 142-04.2034E		

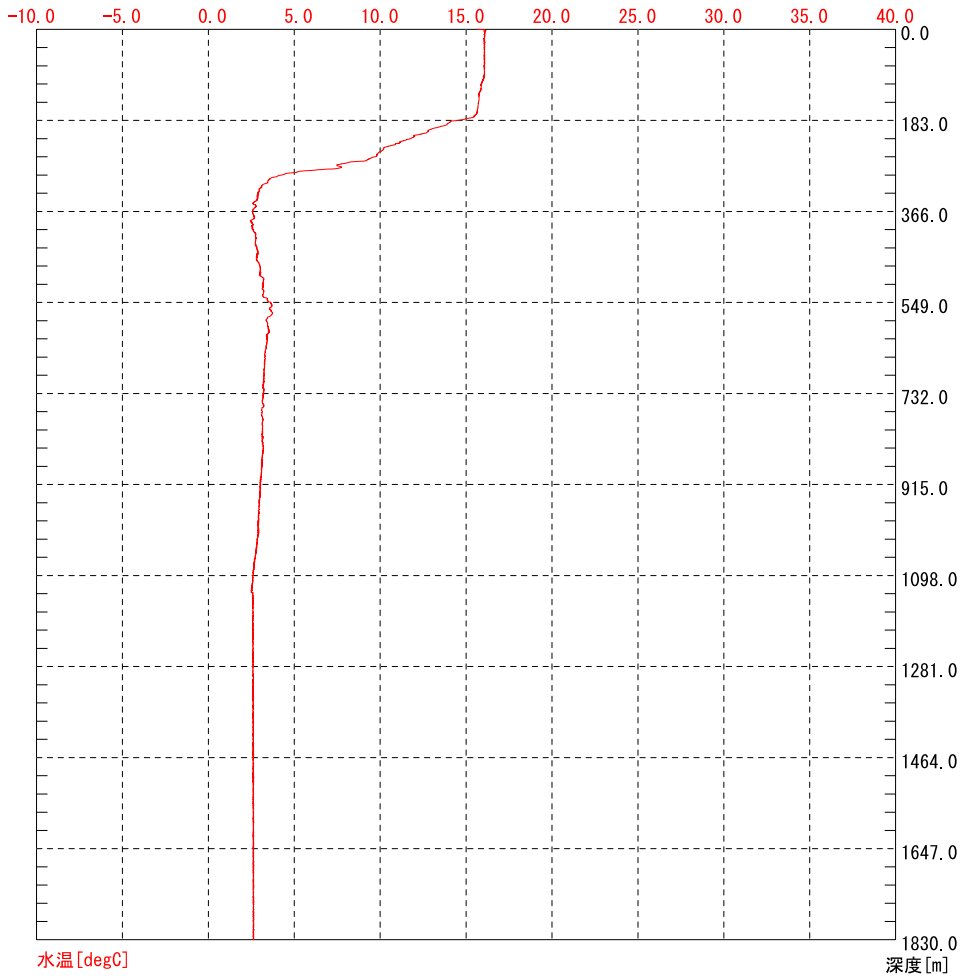


Figure 5. A result of XBT measurement.

5.2. MBES Bathymetry Survey

A bathymetry survey with MBES was carried out on 18 November before the dive for reconfirming the bathymetry around the wellhead. As a result, no obvious difference between the bathymetry this time and that of previous survey was recognized. A bathymetry map based the MBES survey is shown in Fig. 6.

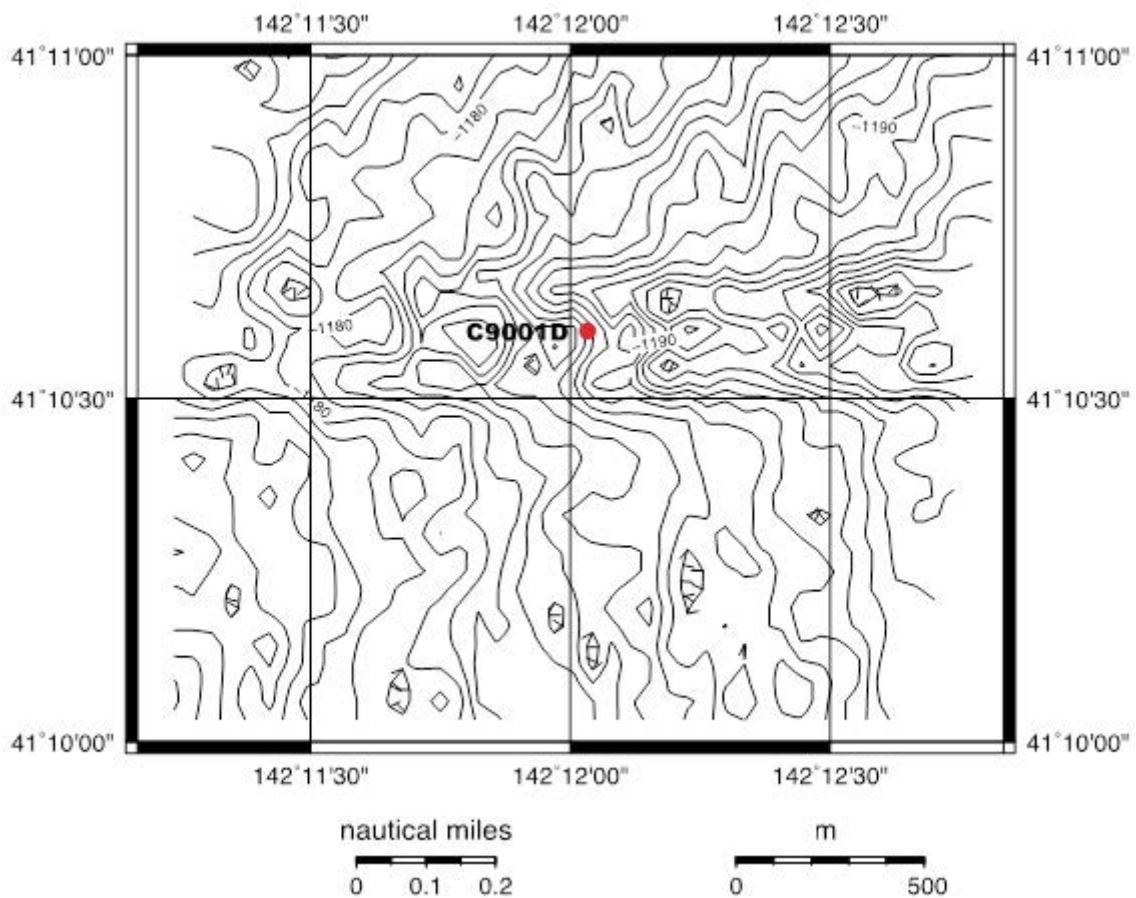


Figure 6. A bathymetry map by MBES survey conducted before the dive.

5.3. Dive #1339

Dive #1339 of Hyper Dolphin 4500 was carried out on 18 November after the MBES bathymetry survey. As the payloads, six tubes of 50 cm long and two tubes of 30 cm long MBARI-type corers were brought. The vehicle approached to the wellhead from the west side, scanning the echo of the target with the sonar. The echo of the wellhead was clearly found and then was visually identified with no difficulty. After confirming the condition of the wellhead, the vehicle moved northward and then push core sampling was conducted. Getting back toward the wellhead, we observed seafloor condition on the way. Since no abnormal features or objects on the seafloor were found, the vehicle left the bottom. The track and an event table of Dive #1339 are shown in Fig. 7 and Table 2.

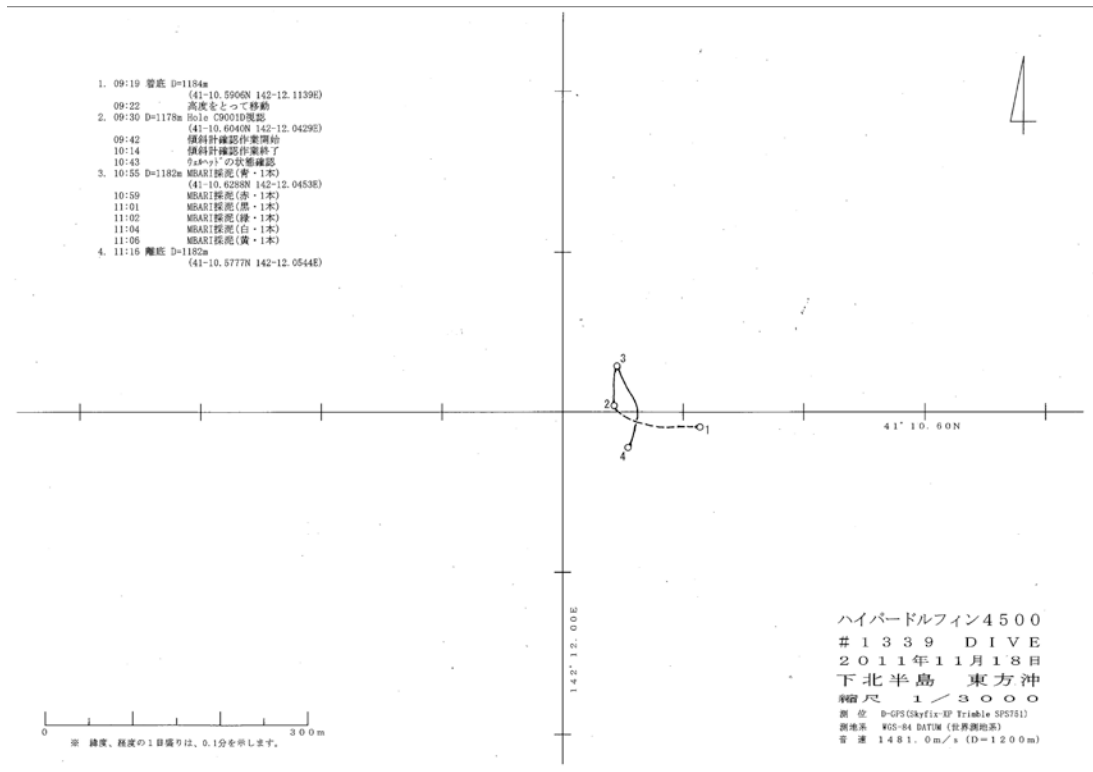


Figure 7. The vehicle's track of Dive #1339.

Table 2. The event log of Dive #1339.

Dive Log of
HPD Dive #1339

East Off Shimokita peninsula

2011/11/18

Time (JST)	Dep. (m)	Alt. (m)	Head (Deg)	Pos. Xm	Pos. Ym	Description	Remarks
08:11						Splash down, no problem on the payload	
08:27						Start dive	
08:30	100						
08:45	500						
09:05	1000						
09:12	1100						
09:19	1184					Landing at the bottom	
09:21	1184					Start tracking	
09:22	1184					Move toward the wellhead	
09:26	1180					Get echo of sonar	
09:29	1178		307			Visually identify Well Head	
09:30	1181		315			Landing again	
09:33	1182		314			Starfish on the upper part of the Well Head	
09:37	1182					Climb up	
09:40	1176		312			Confirm Bull's Eye (south): Tilting = 1.5°	
09:45	1176	5.3	313			Consult with CDEX office how to read Bull's Eye	
09:48	1176	5.5	312			Sweep the Bull's Eye with a bloom	
09:53	1176	5.5	312			A flow upward	
09:55	1176	5.3	312			Glance condition of Corrosion Cap	
09:58	1176	5.3	312			Move to next Bull's Eye (west)	
10:00	1176	5.3	350			Sweep the Bull's Eye with a bloom	
10:02	1176	5.3				Check the read of Bull's Eye Tilting < 1°	
10:09	1176	5.3	350			Move to Corrosion Cap	
10:12	1176	5.3	350			Sweep the top of Corrosion Cap with a bloom	
10:17	1176	5	6			Move to the other side	
10:20	1176	6	108~224			Sweep the top of Corrosion Cap with a bloom	
10:23	1176	5.3	205			Visually identify red rust	
10:27	1176	5.3	225			Sweep the guiding protusions with a bloom	
10:30	1176	5.3	218			Sweep a part of funnel then find a number "1"	
10:33	1176	5.6	189			Climb down the well head	
10:36	1181	0	212~-126			Visually identify the dropped corrosion cap	
10:41	1181	0	133			Starfishes on the corrosion cap	
10:45	1182	0	133			Finish to check the Well Head	
10:47	1181	0	359			Touch the bottom and find a glass bottom with a starfish	
10:52	1182	0	356			Arrive at 50 m north of the Well Head	
10:54	1182	0	357			Sampling with a push core (blue)	
10:57	1182	0	357			Sampling with a push core (red)	
11:00	1182	0	353			Sampling with a push core (black)	
11:01	1182	0	350			Sampling with a push core (green)	
11:03	1182	0	348			Sampling with a push core (white)	
11:05	1182	0	348			Sampling with a push core (yellow)	
11:06	1182	0	344			Finish sampling, then move toward the south side of the well head	
11:16	1182	0	224			Leave the bottom and ascent	
11:50						Resurface	
11:59						Picked up above the sea surface	

5.3.1. Wellhead and Seafloor Conditions

We confirmed the following conditions about the wellhead and the seafloor around the wellhead. Representative photographs are shown in Fig. 8 to 15.

1) Wellhead

- Covered by thin mud with macrobenthos.
- No significant change in tilting of the wellhead.
 - Bull's Eye in the south side: 1° (previous) to 1.5°W (present).
 - Bull's Eye in the west side: 0.8° (previous) to 1.0°SSW (present).
- Wires of the mudpat are fully stretched as they were in 2006.
- No damage in the surface coating except the uppermost part of the corrosion cap.
- The side face of the uppermost part of the corrosion cap was suffered significantly red rust.
 - The eye at the top was under a sound condition
 - The side face of the uppermost part was rusted and two guiding protrusions for the running tool on the face seemed to be rotting. The partial rust is probably caused by that the coating was removed when the running tool was rotated for releasing the corrosion cap.

2) Seafloor surrounding

- A corrosion cap that was dropped on the seafloor at the foot of the wellhead in 2006 was lying as it had been.
- The seafloor around the site was flat, covered by soft mud with abundant asteroidean predominated by ophiuroidea, as same as 2006.
- No larger objects lying and abnormal sediment or structure were recognized on the seafloor at least within 50 m around the wellhead.

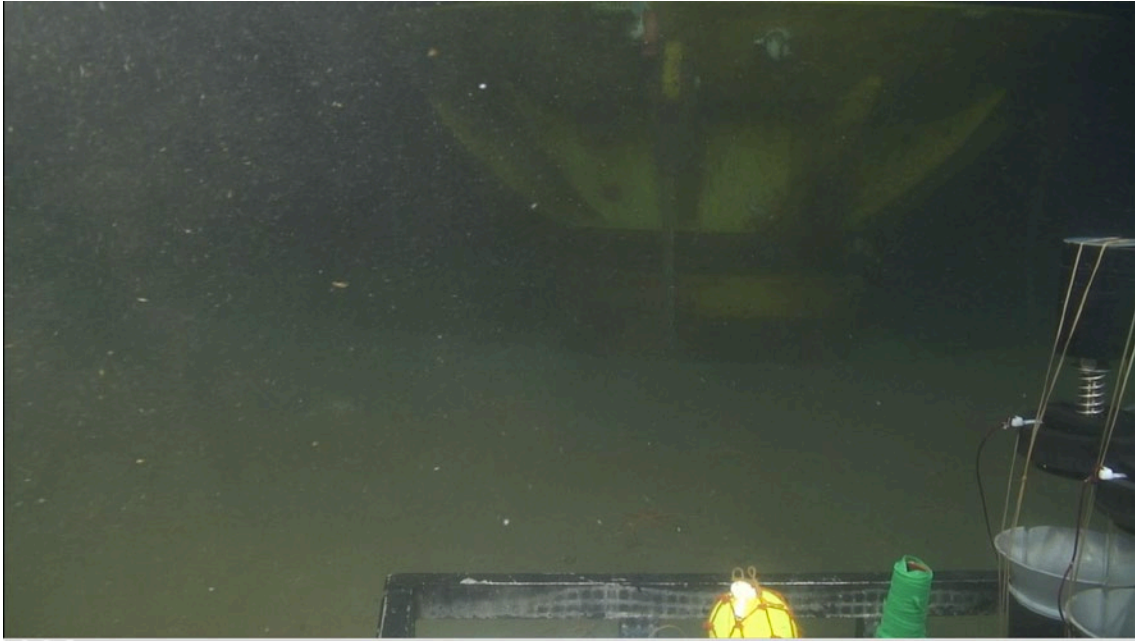


Figure 8. Base part of the wellhead.

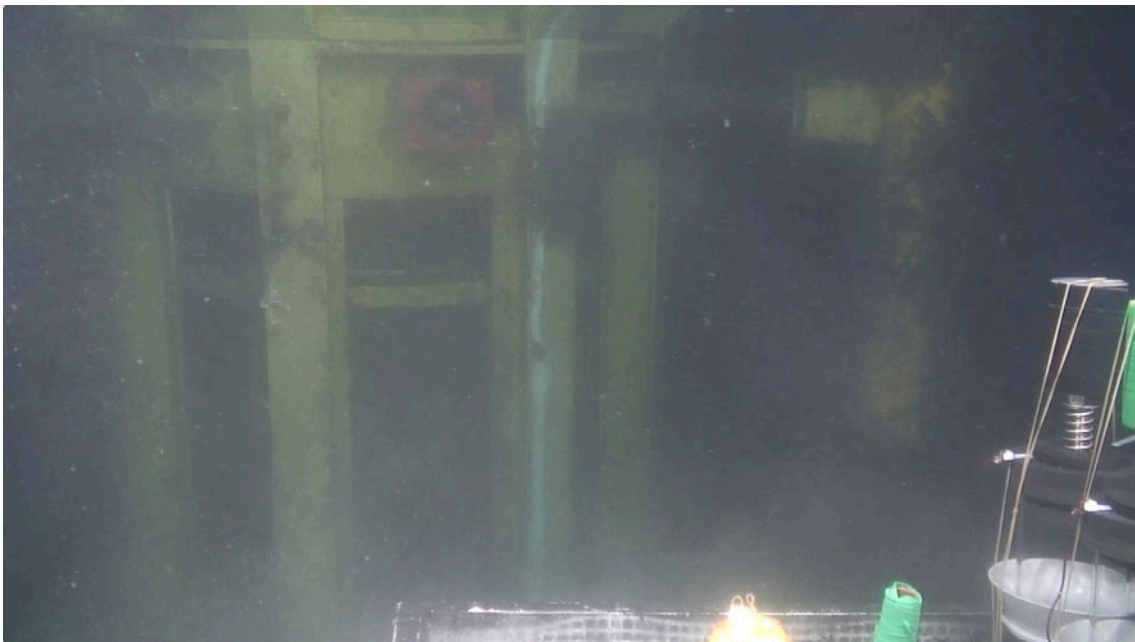


Figure 9. Middle part of the wellhead.

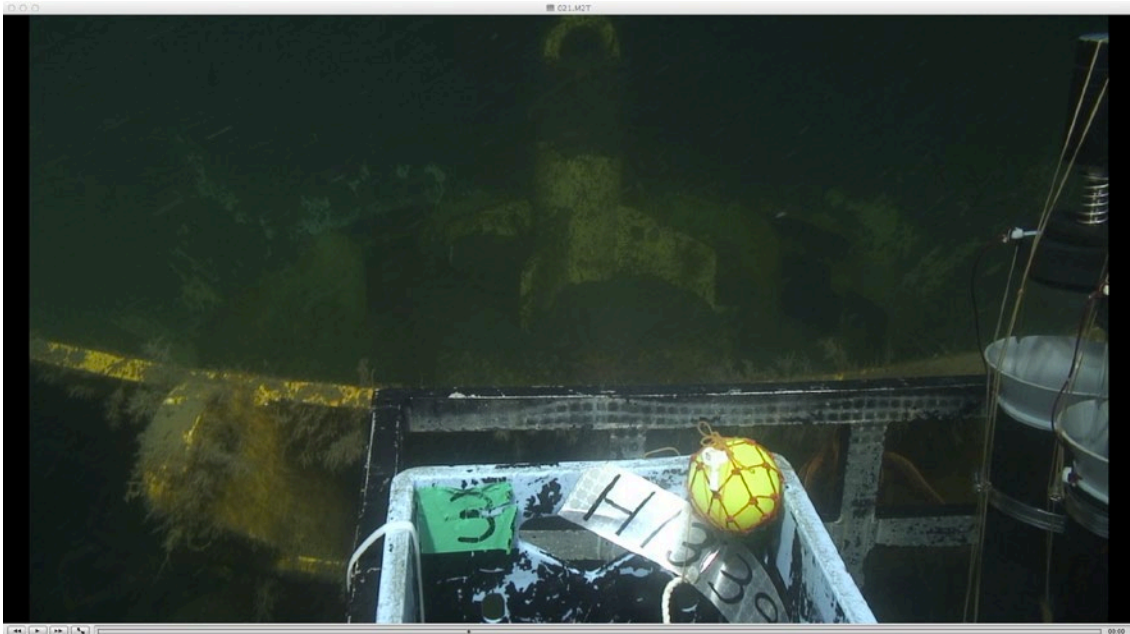


Figure 10. Funnel and corrosion cap



Figure 11. Bull's eye (south side)



Figure 12. Bull's eye (west side)



Figure 13. Close-up of the corrosion cap after sweeping with a broom. The part from which the coating was removed by the running tool during installation is only suffered by red rust.



Figure 14. Flat muddy seafloor with abundant ophiuroidea.



Figure 15. A dropped corrosion cap.

5.3.2. Push Corer Sampling

Sediment sampling was proposed by F. Inagaki, a researcher of KCC/JAMSTEC, for microbial-geochemical-geological studies of the very shallow formation from which sufficient samples were not available for such purposes during the shakedown cruise CK06-06. From the cores taken in CK06-06, most abundant or densest subseafloor

microbes ever seen in the world have been found. Furthermore, it has been proved from a sample at 219 mbsf that many microbes still maintain their bioactivity, suggesting existence of a fertile seafloor biosphere. In this cruise, sediment sampling for supplementing data being lack in the studies of the CK06-06 cores, and in addition, that for a basic methodological study on pore water sampling were planned.

Sediment core samples were taken with MBARI-type push corers at a point 50 m north of the wellhead where no cuttings were apparently distributed. The sampling was performed quite smoothly with obtaining enough amount of sediment inside the corers. The core samples were subdivided into short samples for cell count, RNA, DNA, anaerobic pack and pore water sampling. The sample treatments for taking pore water were performed on board with a centrifuge or a squeezer. A photo of sampling is shown in Fig. 16 and the sample list is shown in Table 3.



Figure 16. A photo of the push corer sampling at a location 50 m north of the wellhead.

Table 3. A list of core samples and subsampling.

Length (cm)	Core#1(Blue)		Core#2 (Red)		Core#3(Black)				Core#4(Green)		Core #5(White)		Core#6 (Yellow)		
	32		41		31				35		31		37		
Sampling interval (cm)	0-2	Cell count (1 cc)	Frozen (next)	0-3	Porewater squeeze (40cc)	0-5	DNA (40cc)	RNA (20cc)	Porewater centrifuge (40cc)	0-5	Aseptic pack	0-5	Pure water (Ribbon rest: frozen)	1-3	Porewater squeeze 35°C (40cc)
	2-4	Cell count (1 cc)	Frozen (next)	4-7	Porewater squeeze (40cc)	5-10	DNA (40cc)	RNA (20cc)	Porewater centrifuge (40cc)	5-10	Aseptic pack	5-10	Pure water (Ribbon rest: frozen)	3.5-8.5	Porewater squeeze 35°C (40cc)
	4-6	Cell count (1 cc)	Frozen (next)	8-12	Porewater squeeze (40cc)	10-15	DNA (40cc)	RNA (20cc)	Porewater centrifuge (40cc)	10-15	Aseptic pack	10-15	Pure water (Ribbon rest: frozen)	10-13	Porewater squeeze 35°C (40cc)
	6-8	Cell count (1 cc)	Frozen (next)	13-18	Porewater squeeze (40cc)	15-20	DNA (40cc)	RNA (20cc)	Porewater centrifuge (40cc)	15-20	Aseptic pack	15-20	Pure water (Ribbon rest: frozen)	14.5-17.5	Porewater squeeze 35°C (40cc)
	8-10	Cell count (1 cc)	Frozen (next)	19-21	Porewater squeeze (40cc)	20-25	DNA (40cc)	RNA (20cc)	Porewater centrifuge (40cc)	20-25	Aseptic pack	20-25	Pure water (Ribbon rest: frozen)	19-22	Porewater squeeze 35°C (40cc)
	10-12	Cell count (1 cc)	Frozen (next)	22-25	Porewater squeeze (40cc)	25-30	DNA (40cc)	RNA (20cc)	Porewater centrifuge (40cc)			25-30	Pure water (Ribbon rest: frozen)	23.5-26.5	Porewater squeeze 35°C (40cc)
	12-14	Cell count (1 cc)	Frozen (next)	27-30	Porewater squeeze (40cc)									27-31	Porewater squeeze 35°C (40cc)
	14-16	Cell count (1 cc)	Frozen (next)	31-34	Porewater squeeze (40cc)									32.5-35.5	Porewater squeeze 35°C (40cc)
	16-18	Cell count (1 cc)	Frozen (next)	35-38	Porewater squeeze (40cc)										
	18-20	Cell count (1 cc)	Frozen (next)												
	20-22	Cell count (1 cc)	Frozen (next)												
	22-24	Cell count (1 cc)	Frozen (next)												
	24-26	Cell count (1 cc)	Frozen (next)												
	26-28	Cell count (1 cc)	Frozen (next)												
	28-30	Cell count (1 cc)	Frozen (next)												
	30-32	Cell count (1 cc)	Frozen (next)												

5.4. ADCP Current Survey

Current survey was carried throughout the cruise by using the hull-mounted ADCP.

6. Conclusions

According to the result of observation by ROV Hyper Dolphin 4500, no significant changes that potentially cause any trouble to the upcoming IODP operations were found on the wellhead of Hole C9001D. In addition, no obvious abnormal features of seafloor related to the great earthquake were observed. The wellhead is considered to be in a sound condition, thus, no obstacle to implement IODP Expedition 337 in terms of the wellhead including the seafloor surrounding was recognized.

Acknowledgement

We are pleased to acknowledge the considerable efforts and assistance of Captain Hitoshi Tanaka, R/V Kaiyo crews, Hyper-Dolphin Operation Manager Kazuya Mitsufuji, Hyper-Dolphin Operation team and the marine technician for completing successfully the planned operations during the KY11-E06 cruise.

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