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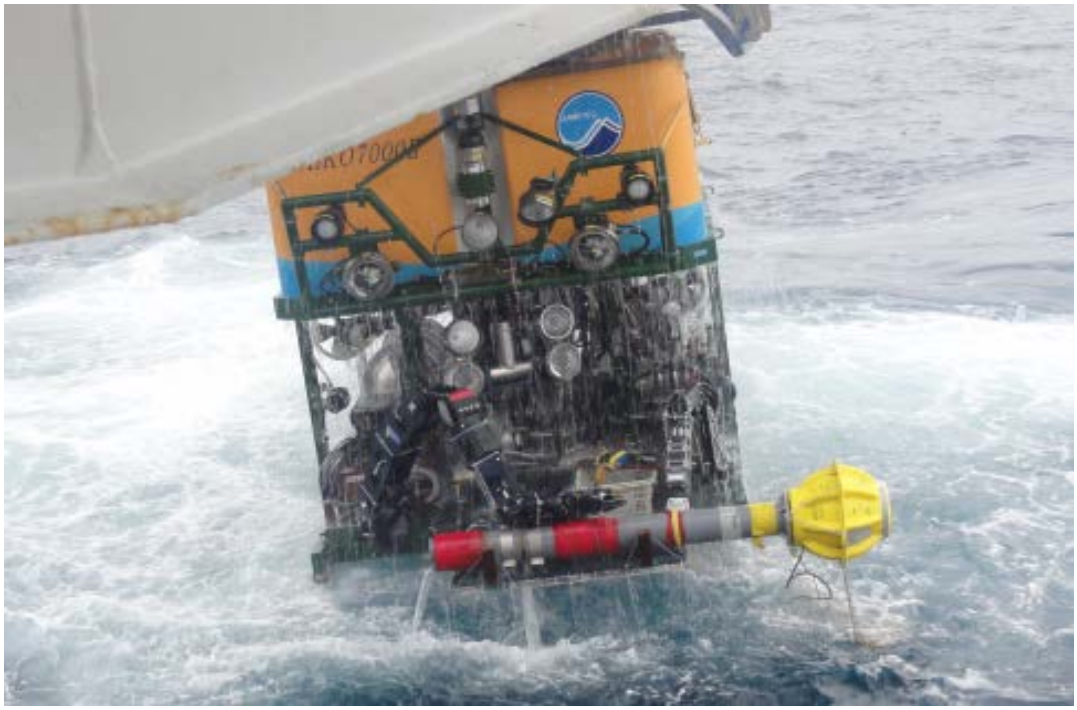
KAIREI Cruise Report
KR12-04



13 Feb. – 17 Feb. 2012

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

Acknowledgements

We would like to thank all ship officers and crew of R/V KAIREI, the operation team of ROV KAIKO and a marine technician of NME for their supports during our cruise. We are pleased to acknowledge a support of the DO-NET member.

KR12-04 Cruise report contents

1. Cruise information and summary

1.1 Cruise information

Ship name	R/V Kairei, ROV Kaiko 7000 II
Chief scientist	Takafumi Kasaya (IFREE, JAMSTEC)
Proposal title	Recovery of long-term ocean bottom sensors attached to the Off-Toyohashi submarine cabled station for monitoring earthquakes and crustal deformations
Date	13 Feb. 2012 – 17 Feb. 2012
Ports of call	Yokohama port – Yokohama port
Research Area	Fig.1

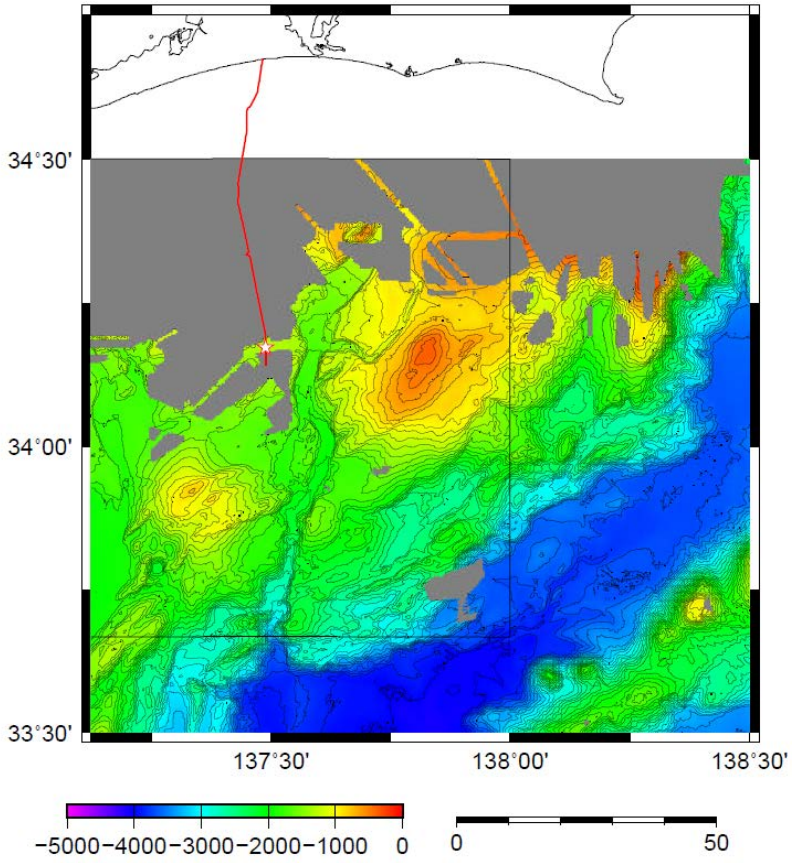


Fig.1.1 Research and operation area of KR12-04 cruise around the Off Toyohashi submarine cable. Red stars show a position of the junction unit. A red line shows the Off Toyohashi submarine cable.

1.2 Cruise objective and summary

The off-Toyohashi seafloor cabled observatory is constructed to obtain the real time data related to seismic events using the many instruments at March. 2007 (Aasakawa et al., 2009; Goto et al., 2009). Figure 1.2 shows the p lain view of the off-Toyohashi submarine cabled observatory. In 2009, the junction unit of observatory system at the tip of the seafloor cable was damaged because of a lighting serge of the falling of thunderbolt around the Toyohashi area. This accident makes an unstable condition of a power supply to seafloor units including some instrument. At the last, we decided to stop the observation. Therefore, we proposed to recover our scientific instrument connected to the junction unit. At first, this cruise planned in May 2011. Because of the Tohoku earthquake, our cruise postponed until Feb 2012.

This cruise carried out from 13 Feb. to 17 Feb. 2012. In this cruise, we tried to recover the Electromagnetic observation system (DOMES) and the seismic observation system package (S-SMAD). We completed all operation using three dives. At 3rd dive, we disconnected the underwater mating connector of the GPS acoustic observation system of University of Tokyo from the junction unit. Figure 1.3 shows the recovered DOMES main unit. In addition, we attached dummy plugs to each connector on the junction box for protection from dust. We also collected the bathymetric data around the off-Toyohashi seafloor cabled observatory for data analysis after this cruise.

Reference

K. Asakawa, T. Yokobiki, T. Goto, E. Araki, T. Kasaya, M. Kinoshita and J. Kojima, New scientific underwater cable system Tokai-SCANNER for underwater geophysical monitoring utilizing a decommissioned optical underwater telecommunication cable, IEEE J. Ocean. Eng, 34, 539-547, 2009.

T-N. Goto, T. Kasaya, M. Kinoshita, E. Araki, K. kawaguchi, K. Asakawa, T. Yokobiki, T. Nakajima, H. Nagao, M. Harada, K. sayanagi, Development of the off-Toyohashi seafloor cabled observatory, JAMSTEC-R IFREE Special Issue, 149-162, 2009.

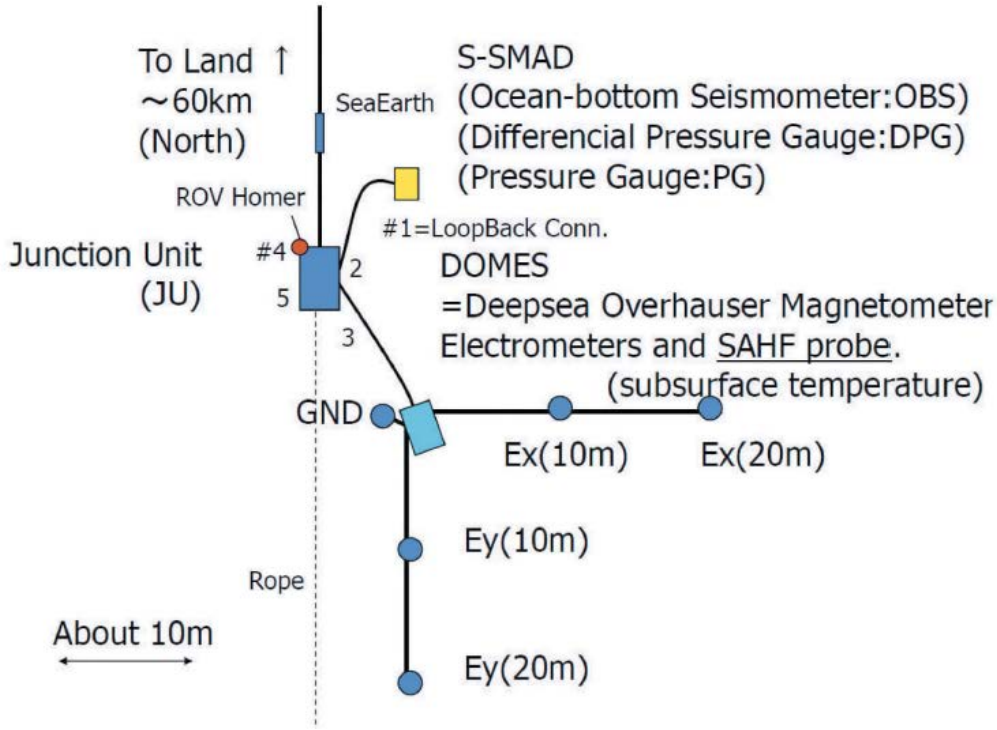


Fig. 1.2 Plain view of the off-Toyohashi submarine cabled observatory. The position of the junction box is 34-10.466 N and 137-29.377 E at the depth of 1310 m (After Goto et al., 2009).

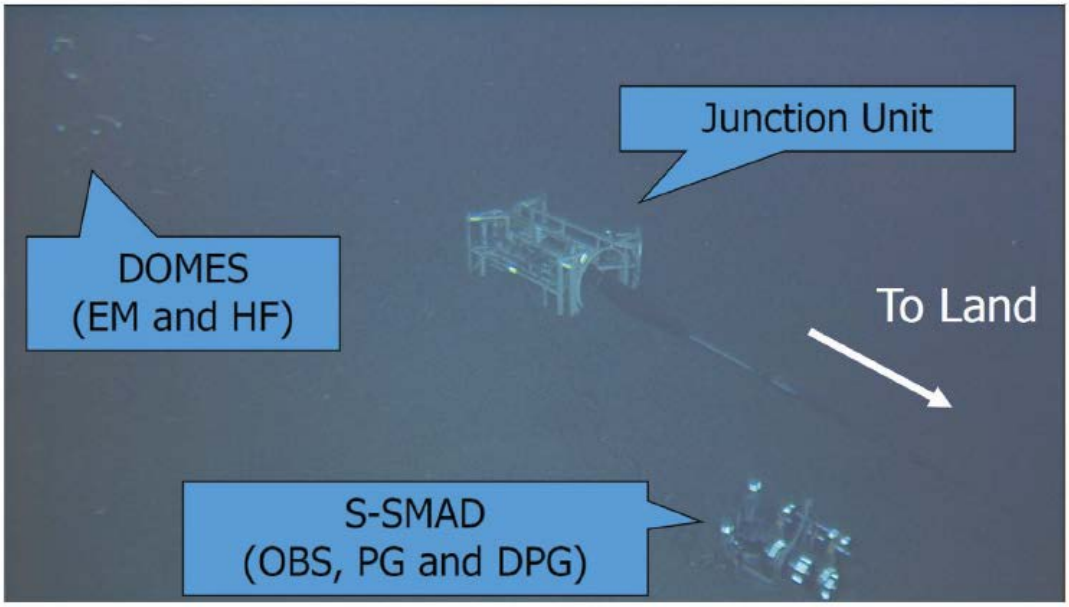


Fig. 1.3 Photo of the off-Toyohashi cable obvservatory (After Goto et al., 2009).

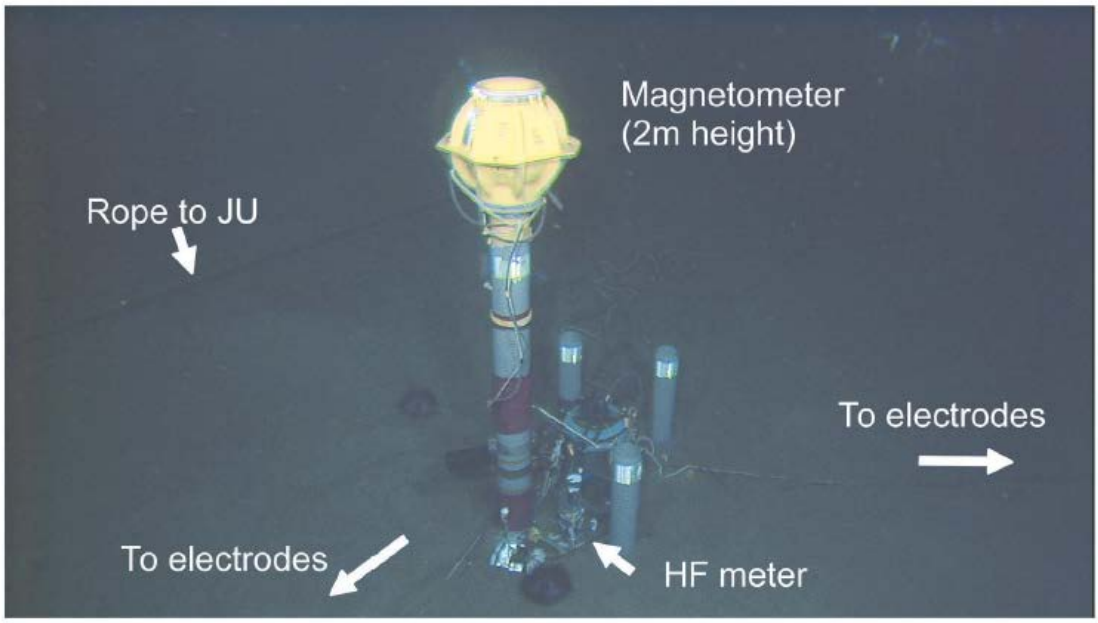


Fig. 1.4 Photo of the DOMES (deep-sea overhauser magnetometer, electrometers, and SAHF prove) system (After Goto et al., 2009).

2. Participants List

Chief Scientist / Representative of the science party:

Takafumi Kasaya	IFREE, JAMSTEC

Science Party:

Takafumi Kasaya	IFREE, JAMSTEC
Eiichiro ARAKI	DONET, JAMSTEC
Hiroshi ICHIHARA	IFREE, JAMSTEC

ROV Kaiko 7000Ⅱ Operation Team

Operation Manager	Yoshinobu NAMBU
1st ROV Operator	Atsumori MIURA 1st ROV Operator Kiyoshi TAKISHITA
2nd ROV Operator	Tetsuya ISHIZUKA
2nd ROV Operator	Tomoe KONDO
2nd ROV Operator	Seiji SHIGETAKE
3rd ROV Operator	Ryu ASAI
3rd ROV Operator	Syota IHARA

R/V YOKOSUKA Crews

Captain	Koji SAMEJIMA
Chief Officer	Takafumi AOKI
2nd Officer	Kazuki MIYAKE
3rd Officer	Yumihiko KOBAYASHI
Chief Engineer	Hiroyuki SHIBATA
1st Engineer	Kouji FUNAE
2nd Engineer	Kenichi SHIRAGATA
3rd Engineer	Syogo YOSHIMURA
Chief Radio Operator	Yoichi INOUE
2nd Radio Operator	Michiyasu KATAGIRI
3nd Radio Operator	Ryosuke KOMATSU
Boat Swain	Kazuo ABE
Able Seamen	Takao KUBOTA
Able Seamen	Yukito ISHII
Able Seamen	Yoshiaki MATSUO
Sailer	Shinsuke UZUKI
Sailer	Toru NAKANISHI
Sailer	Ryoma TAMURA
No.1 Oiler	Masaru KITANO
Oiler	Moriya ABE

Oiler	Toshikazu IKEDA
Oiler	Taijun Iwao
Oiler	Makoto OZAKI
Chief Steward	Isao MATSUMOTO
Steward	Shinsuke TANAKA
Steward	Haruka OKADA
Steward	Kiyotaka KOSUJI
Steward	Haruka KINOSHITA

3. Ship logs

Date	Local Time (UTC+9h)	Note	Position/Weather/Wind/Sea condition
13 Feb.	9:00	Left Yokohama port for the research area	
	12:00		35-55.8N,139-25.3E/bc/north/ 3/2/1/8
	16:59	Released XBT	
	18:29 -5:00 (14th)	Bathymetry Survey (MBES)	
14 Feb.	5:48-6:10	MBES for KAIKO7000II dive	
	8:32-13:14	Kaiko 7000II Dive (1)	34-10.5N,137-29.3E/ o/ North/ 4/ 3/ 2/ 4
	17:20 -5:45 (15th)	Bathymetry Survey (MBES)	
15 Feb.	8:35-11:42	Kaiko 7000II Dive (2)	34-10.5N, 137-29.3E/ r/ NW/ 7/ 4/ 3/ 5
	15:39 -5:14 (16th)	Bathymetry Survey (MBES)	
16 Feb.	11:36-18:28	Kaiko 7000II Dive (3)	34-10.5N, 137-29.3E/o/ NNW/ 6/ 4/ 2/ 5
	19:15	Left for Yokohama port	
17 Feb.	9:15	Arrive at Yokohama port	

4. Dive reports

4.1 Dive 540

Date: Feb. 14, 2012

Site: Near the junction unit of the off-Toyohashi seafloor cabled observatory.

The dive 540 was carried out to recover Electromagnetic observation system (DOMES). At first, we operated to disconnect the underwater mating connectors of our instruments (Fig. 4.1.1) and attached dummy caps to connectors of the junction unit. After this operation, the KAIKO moved to the DOMES (Fig. 4.1.2). Before recovery operation, a signal cable of the overhauser magnetometer was cut to make a recovery operation easy. KAIKO picked it from the DOMES, and put it on the payload stage of the vehicle. Then, we fucked the recovery line to the recovery rope of the DOMES. After confirmation the connection of recovery line, we finished this dive operation at 11:45. We could recover this instrument safety (Fig. 4.1.3). Recovered DOMES almost keeps clean condition after about 5 years settle.

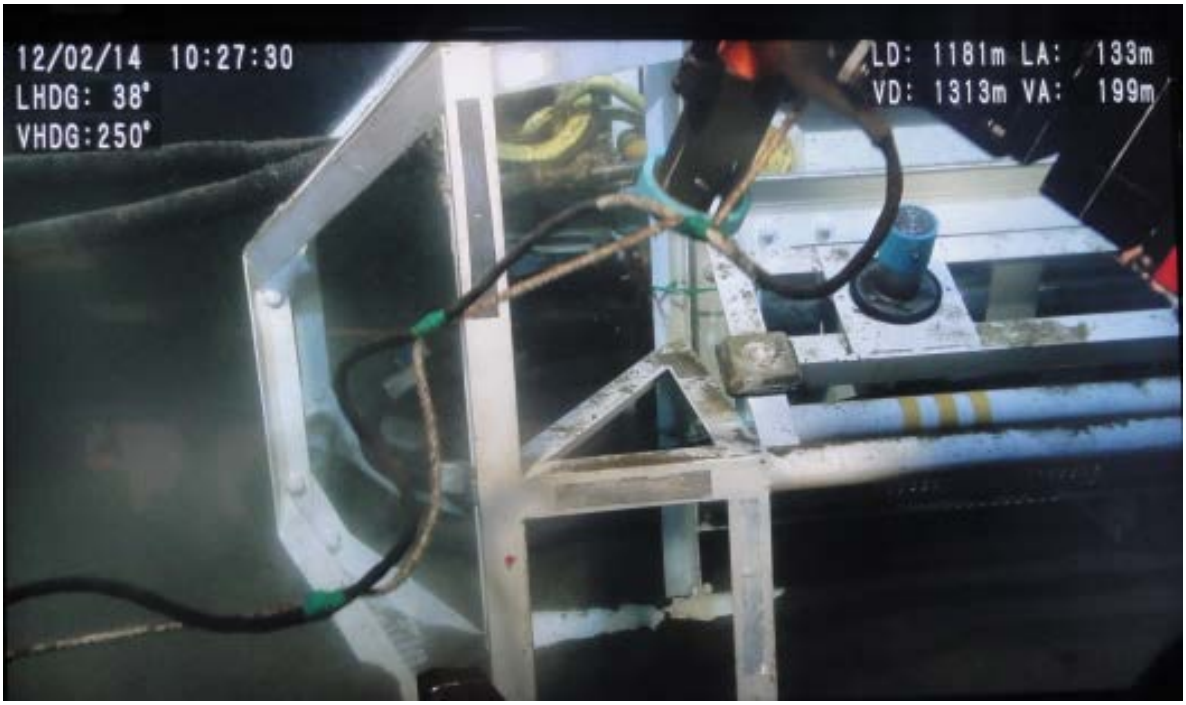


Fig. 4.1.1 Photo of the remove operation the ROV connector from a junction unit.

Fig. 4.1.2 Left panel shows the main unit of DOMES. Right panel shows the overhauser sensor unit with the 13 inch glass sphere.

Fig. 4.1.3 Photo of the recovered DOMES main unit.

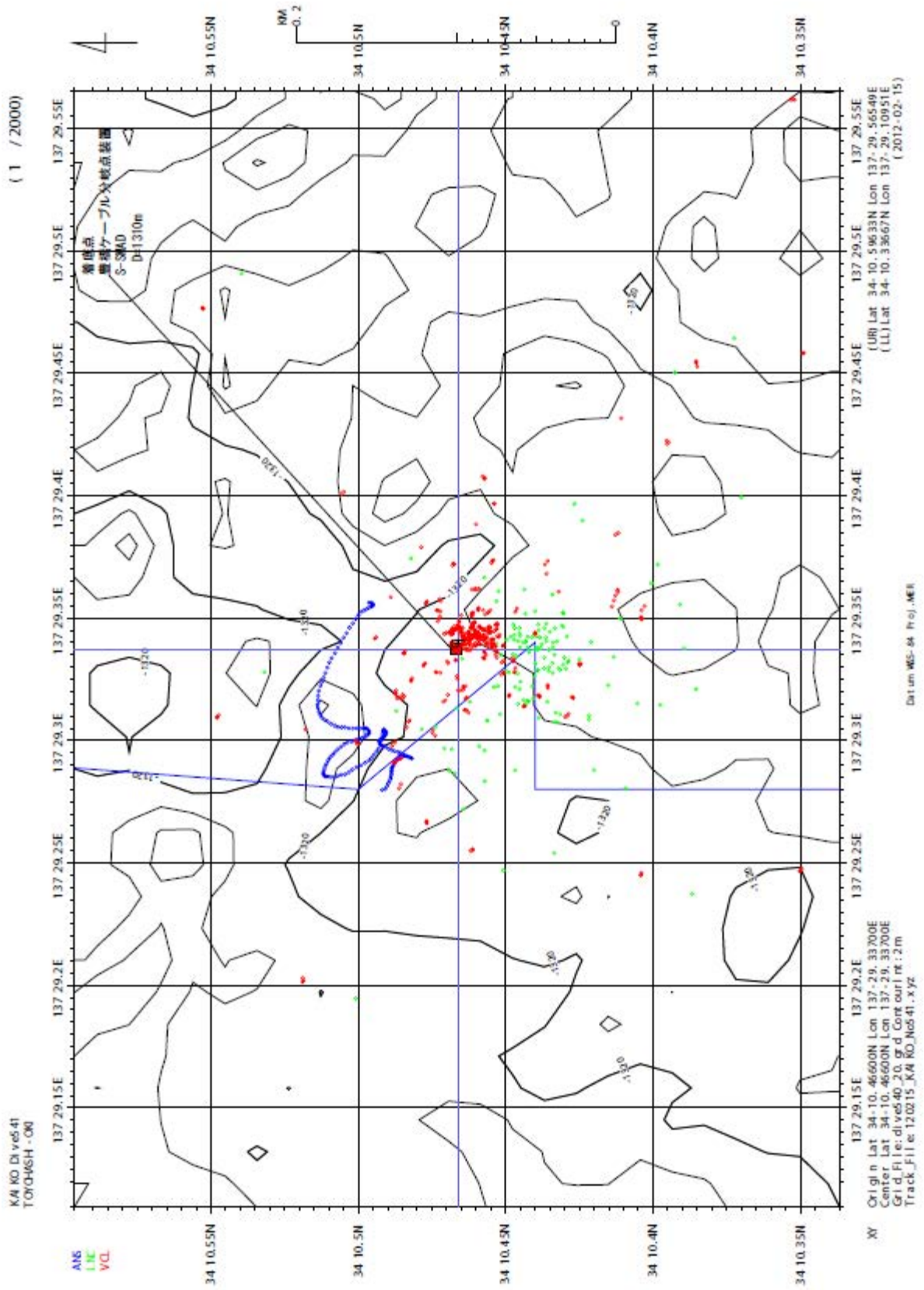


Fig. 4.1.4 Vehicle, launcher and ship track of the dive 540.

4.2 Dive 541

Date: Feb. 15, 2012
Site: Near the observation node of the off Toyohashi cable.

The purpose of the dive 541 is to recover S-SMAD (seismic sensor monitoring and acquisition device) from the off Toyohashi cable. Kaiko dove to the observation node of the cable and disconnected the underwater mating connector for the S-SMAD. Then Kaiko hooked a recovery line to a ring attached to the S-SMAD for recovery purpose. Kaiko vehicle left the seafloor and docked to the launcher and came on the surface. When Kaiko came on the surface, the S-SMAD was lost from the recovery line. It seemed that the ring was unlatched from the hook by chance.

We investigated when the S-SMAD was unlatched and guessed that S-SMAD was lost just before when Kaiko was recovered from the water by the following reasons;

a) A Kaiko team member witnessed S-SMAD near the surface.
b) Altitude sensor of the Kaiko vehicle recorded 10 m throughout after leaving the seafloor, suggesting something had been suspended 10 m below the vehicle.
c) Trim of the Kaiko vehicle after leaving the seafloor was different from before the recovery of the S-SMAD suggesting the S-SMAD left from the seafloor with the vehicle.
d) Kaiko team discovered the ring of the diameter of the S-SMAD can be unlatched from the hook of the recovery line when the tension is not applied to the ring.

We discussed and decided to seek and try to recover the S-SMAD in the next dive if the weather permits. It was discussed that the S-SMAD may be flown southward by the surface current of 0.5-1 knot at the time of unlatching, with these parameters we planned the track route of the Kaiko vehicle in the next dive.

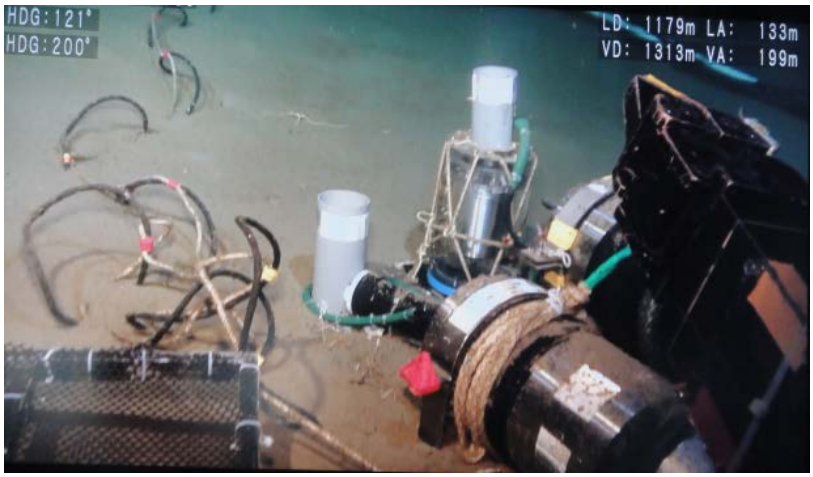


Fig. 4.2.1 Photo of the recovery operation of the S-SMAD.

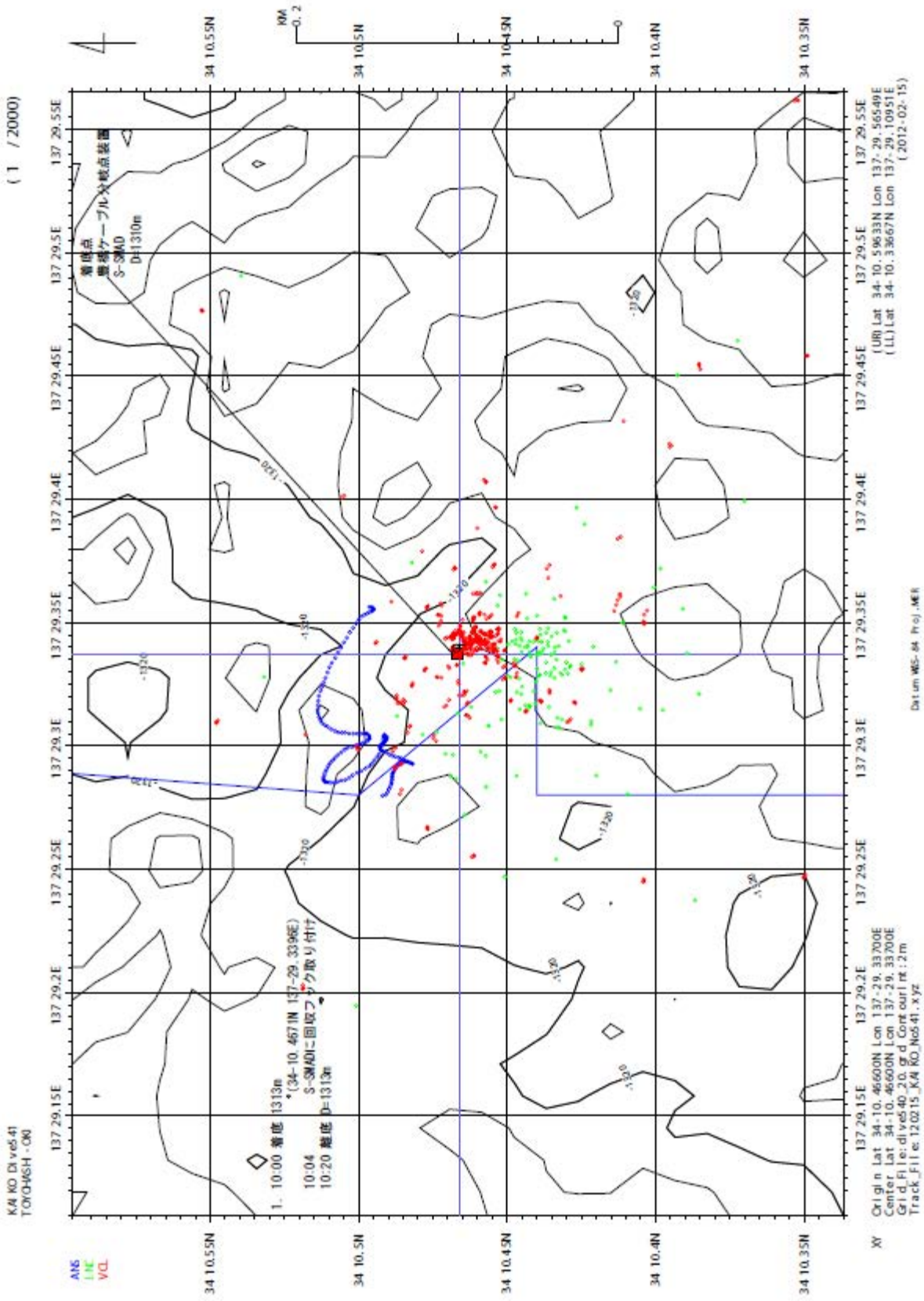


Fig. 4.2.2 Vehicle, launcher and ship track of the dive 541.

4.3 Dive 542

Date: Feb. 16, 2012
Site: Near the observation node of the off Toyohashi cable

Because of rough seastate in the morning, we started to dive late but before afternoon. We arrived near the cable node at the seafloor around 13:00 JST.

During this dive, we first disconnected the underwater mating connector of GPS-acoustic system which was connected to the observation node from 2008 to prepare for the recovery operation of the observation node in the future. This was the last sensor connected to the node. We attached a dummy plug to the connector on the node to protect the connector from dust.

We started to seek for the S-SMAD in the seafloor around 13:15. Firstly, we took east to follow the Kaiko vehicle track during the Dive 541. Then we started to take west to west-north-west direction and sought the S-SMAD by sonar (with 100 and 150 m ranges) and cameras. After reaching near the suspected lost point we went around the route. It was not until 16:12 to identify the S-SMAD by camera, before we planned to shut down the seek dive on 16:15. We tried to recover the S-SMAD but it took more than a half hour to put the S-SMAD on the sample basket of the Kaiko vehicle and hooked at two points, because of bad visibility from very muddy seafloor condition. Finally we left the seafloor on 17:00 with the S-SMAD on the basket and safely recovered the instrument on deck (this time). The instrument was inspected by eye and it looked without any significant damage.

Fig. 4.3.1 Photo of the S-SMAD when HDV camera catched.

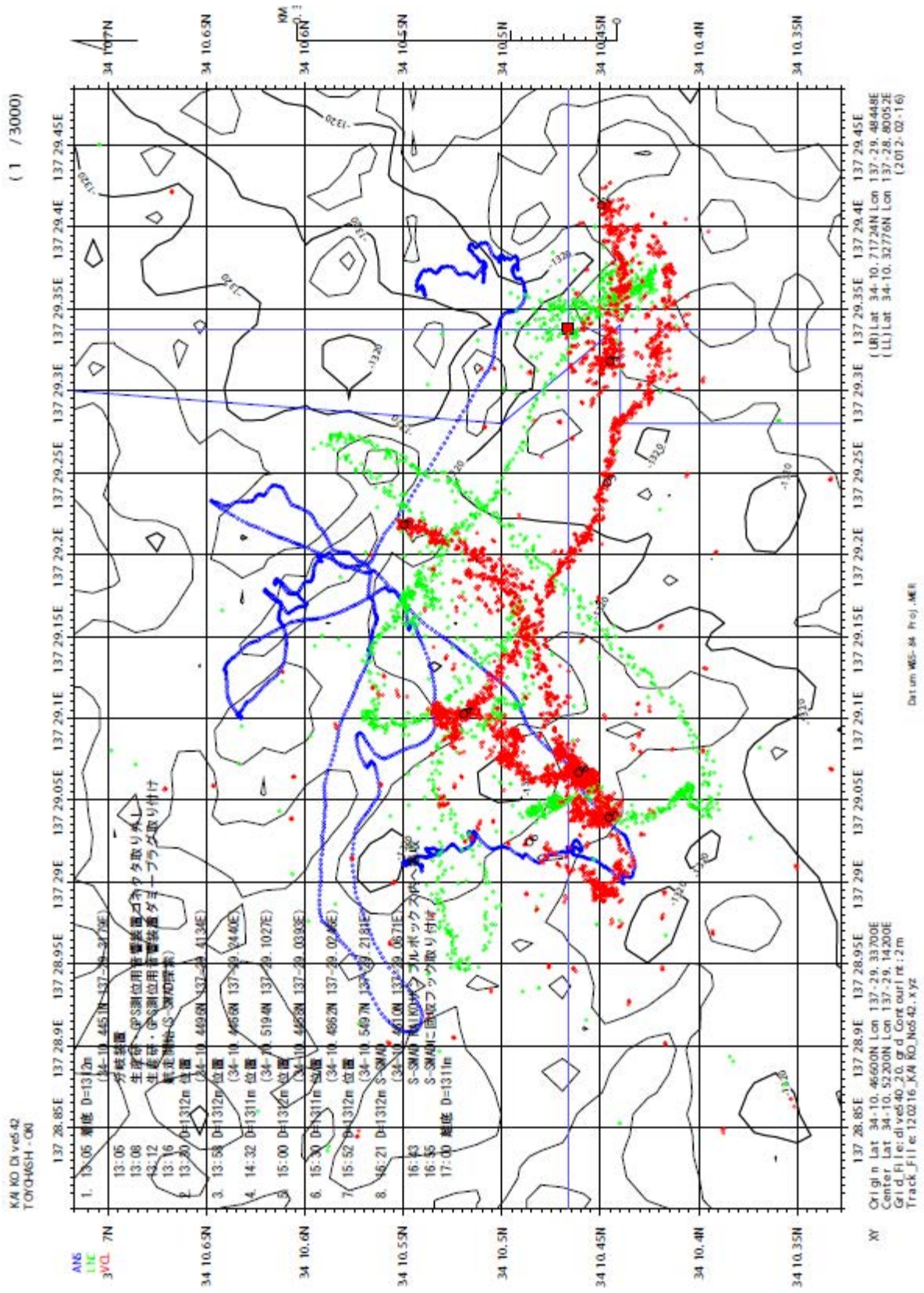


Fig. 4.3.2 Vehicle, launcher and ship track of the dive 542.

4.4 Dive logs

Dive 540

Time	Remarks
8:26	つり上げ
9:41	ビークル離脱
9:35	高度 130m　下降終了・分離準備
9:39	離脱準備完了
9:41	離脱
9:52	海底視認・着底(1320m)
	ヒトデだらけ
9:55	ケーブル
10:00	離底
10:01	DOMES 視認(生産研機材もあり)
10:05	観測機器側に移動して着底するも巻き上げひどい
10:08	移動。東に抜けて回頭。
10:14	分岐装置そばに着底(ビークル方位 250 度)
10:22	S-SMAD コネクタ抜き。ダミーキャップかぶせ
10:27	DOMES コネクタ抜き。ダミーキャップかぶせ
10:35	離底
10:36	着底(DOMES 西側、捨てケーブル近傍)
10:42	上昇　DOMES 横へ
10:44	着底
10:50	寄って着底。さらに前進
10:56	センサーケーブルを左手で切断
11:03	テンションメンバーロープも切断
11:16	オーバーハウザー取り外し
11:19	オーバーハウザーステージに
11:29	回収索にフック
11:45	離底
11:46	分岐装置の離底を視認
11:59	結合
12:00	上昇開始

Dive 541

Time	Remarks
8:31	つり上げ
9:40	ビークル離脱
9:53	海底視認・着底(1320m)
9:57	ケーブル視認
9:59	分岐装置視認
10:00	S-SMAD 横に着底
	現状観察
10:05	回収作業開始
10:08	回収リングにフックを掛ける
	ロープ繰り出し
10:20	離底
10:34	結合

Dive 542

Time	Remarks
11:32	つり上げ
12:42	ビークル離脱
12:54	海底視認
12:58	GPS 観測装置視認
13:01	分岐装置東側へ
13:05	分岐装置横に着底
13:08	GPS 観測装置 ROV コネクタ取り外し
13:13	ダミーキャップ取り付け終了
	周辺観察。周囲に S-SMAD なし。
13:15	離底。捜索開始
	落下点向け移動
14:03	漁具？
14:04	前探ソナーに感。複数回消えず
14:10	ゴミ
14:28	反転
14:49	アンカー？
15:23	way point 7 の南西 200m から変針
15:45	再度 way point 7 へ向け南西
16:12	S-SMAD 発見。裏返し状態。
	way point7 の西南西 100m 付近
	視界待ち
16:21	S-SMAD へ移動
16:29	回収作業開始
16:35	S-SMAD 持ち上げて裏返し。
16:40	持ち上げ、ペイロードステージへ。
16:56	フック掛け
16:59	ロボットアームで固定
17:00	離底

5. Bathymetry data

We carried out multi-beam echosounders (MBES) survey by SeaBeam2100 system equipped by R/V Kairei (**Table 5.1**). The depth of the survey area is between 100 and 2000 meters. The obtained data were calibrated based on the velocity data based on expendable bathythermograph (XBT) that injected before the MBES survey.

Table 5.1 Bathymetric survey lines

Line name	Start day	Time (UTC)	Lat.	Lon.	End day	Time (UTC)	Lat.	Lon.
E-1	2/13	09:29	34-15.9861N	138-00.0445E	2/13	11:15	34-15.9915N	137-42.9492E
E-2	2/13	11:27	34-17.1687N	137-42.8549E	2/13	13:09	34-17.1904N	138-00.0055E
E-3	2/13	13:21	34-18.2039N	138-00.1968E	2/13	15:31	34-18.1979N	137-39.1617E
E-4	2/13	15:40	34-19.0796N	137-38.8028E	2/13	17:36	34-19.0858N	138-00.4211E
E-5	2/13	17:48	34-19.9120N	138-00.3323E	2/13	20:00	34-19.8972N	137-37.7718E
Dive540 事前調査	2/13	20:48	34-12.0504N	137-30.5905E	2/13	21:10	34-09.6169N	137-28.6226E
W-1	2/14	08:20	34-02.0066N	137-27.6920E	2/14	09:00	34-01.9753N	137-34.1102E
W-2	2/14	09:17	34-03.9855N	137-34.0274E	2/14	09:58	34-04.0022N	137-14.0524E
W-3	2/14	11:31	34-06.0326N	137-13.7878E	2/14	12:10	34-05.9887N	137-34.0091E
W-5	2/14	14:06	34-09.9644N	137-34.2233E	2/14	14:40	34-10.0053N	137-10.1593E
W-4	2/14	16:50	34-08.0415N	137-13.0060E	2/14	19:19	34-07.9935N	137-33.7930E
W-6	2/14	19:25	34-11.4526N	137-34.6207E	2/14	20:45	34-11.4967N	137-22.0441E
W-7	2/15	07:04	34-11.5178N	137-19.4559E	2/15	09:17	34-20.0086N	137-10.8992E
W-8	2/15	09:30	34-20.1942N	137-12.5050E	2/15	10:47	34-11.4867N	137-21.2833E

W-9	2/15	10:58	34-11.4809N	137-23.0960E	2/15	13:30	34-20.0029N	137-14.5239E
W-10	2/15	13:45	34-20.1141N	137-16.1041E	2/15	15:06	34-11.3775N	137-24.9197E
W-11	2/15	15:27	34-11.3640N	137-26.7151E	2/15	17:35	34-20.1036N	137-17.9453E
W-12	2/15	17:49	34-20.1727N	137-19.6152E	2/15	19:14	34-11.6112N	137-28.4134E

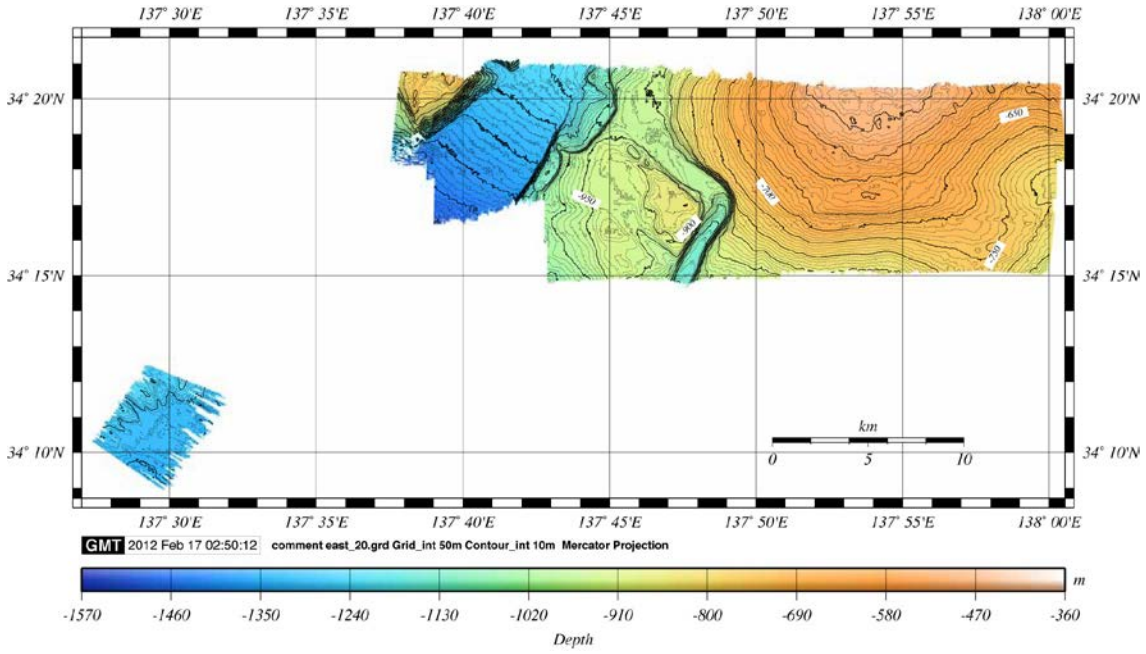


Fig. 5.1 Bathymetric map by the KR12-04 cruse (East)

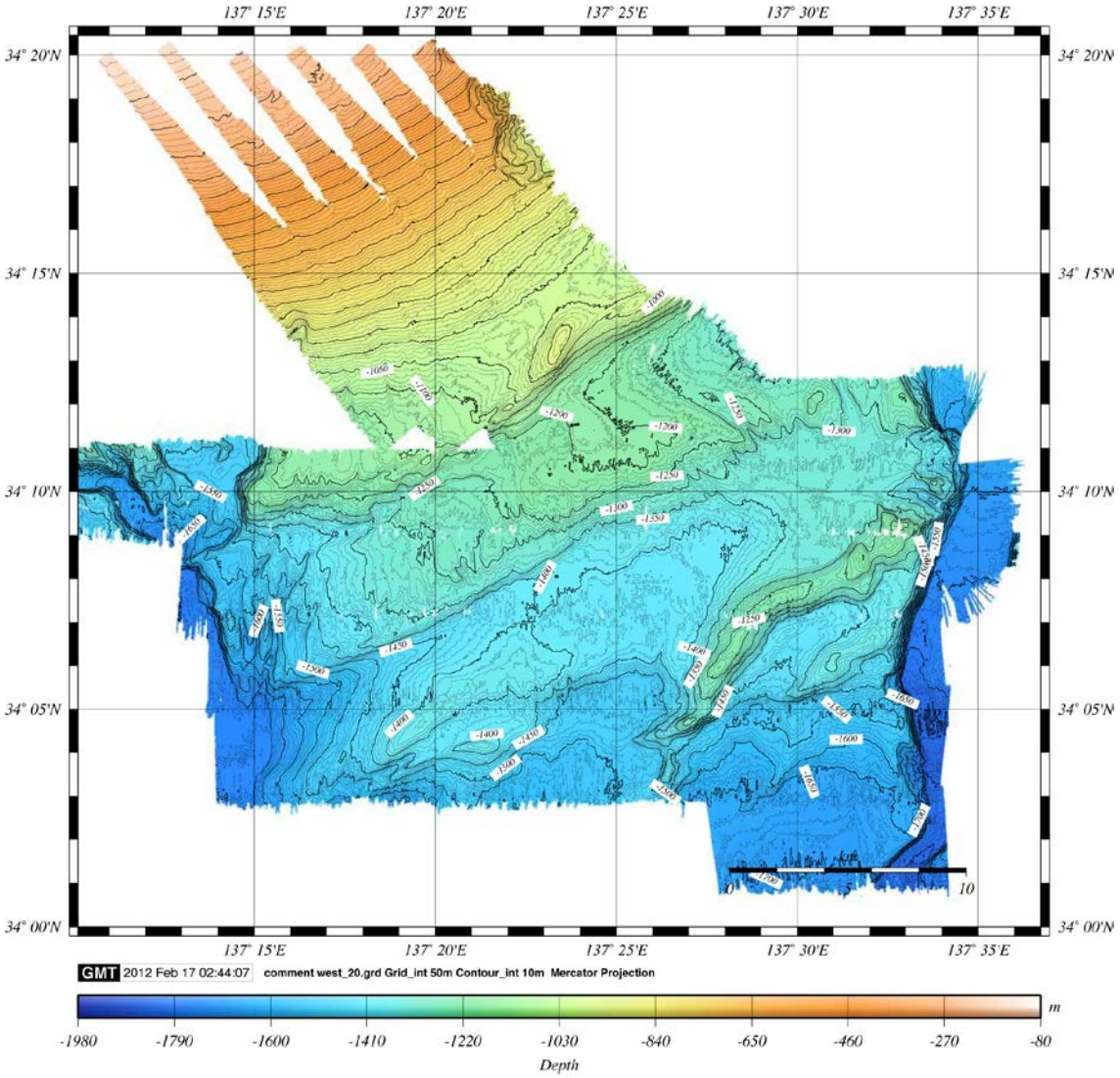


Fig. 5.2 Bathymetric map by the KR12-04 cruse (East)

Appendix
Explanatory notes
A.1 Research Vessel Kairei

Length overall	10 m
Beam overall	16.0 m
Draft	4.5 m
Gross tonnage	4,628 tons
Service speed	16.7 knot
Complement	
Crew	29 persons
Researchers and operation staff	31 persons
Total	60persons
Main propulsion system	Diesel engines: 2,206kW x 2
Main propulsion method	Controllable pitch propeller x 2

Table A-1 The principal specifications of R/V Kairei

A.2 ROV KAIKO 7000 II

Dimensions (Launcher)	Length(m) Width(m) Height(m) Weight(ton)	5.2 2.6 3.2 5.8 (in air)
Dimensions (Vehicle)	Length(m) Width(m) Height(m) Weight(ton)	2.8 2.5 2.0 2.9 (in air)
Max Depth	7000 m	
Equipments	Side Scan Sonar Sub bottom profiler CTDO CCD TV camera Digital still camera	

Table A-2 The specifications of ROV KAIKO