doi : 10.17596/0003081

RV-Natsushima-HyperDolphin Cruise Report

NT12-16

Study on the giant squid, *Architeuthis dux*, off Ogasawara island

Jun.26, 2012-July 3, 2012

Japan Agency for Marine-Earth Science and Technology

(JAMSTEC)

●Contents

1. Cruise Information

● Cruise ID: NT12-16

● Name of vessel: RV NATSUSHIMA

● Title of the cruise: Study of the giant squid, *Architeuthis dux*, off Ogasawara

● Title of proposal (If there are no scientific proposals, it is not necessary to fill this section for exception)

Study of the giant squid, *Architeuthis dux*, off Ogasawara

● Cruise period: June 26 – July 3, 2012

● Ports of call: Yokosuka, JAMSTEC wharf

● Research area was off Ogasawara islands and is shown in Figure 1.

2. Researchers, Hyper Dolphin Operation team and crews

Research Scientists

● Chief scientist [Affiliation]

Tadashi Maruyama [Marine Biodiversity Research Program, JAMSTEC]

● Science party (List) [Affiliation, assignment etc.]

Shinji Tsuchida [JAMSTEC]

Shuichi Shigeno [JAMSTEC]

Yoshio Yuki [NHK]

Masayoshi Watanabe [NHK]

Kazuhiko Kosai [Matsuken Co., Ltd]

Hirotaka Maruyama [NHK]

Katsunori Mizuno [University of Tokyo]

Shusuke Machida [Nippon Marine Enterprise, Ltd.]

Hyper Dolphin 3000 Operation Team

Operation Manager	Satoshi Wakamatsu
Operation Co-Manager	Kazuhiro Chiba
1st Submersible Staff	Kazuki Iijima
1st Submersible Staff	Masanobu Yanagitani
1st Submersible Staff	Kazuya Mitsufuji
1st Submersible Staff	Keita Matsumoto
2st Submersible Staff	Hirofumi Ueki
2st Submersible Staff	Yosuke Chida
2st Submersible Staff	Keigo Suzuki
2nd Submersible Staff	Takuma Onishi

2nd Submersible Staff	Masaya Katagiri
3rd Submersible Staff	Hitomi Ikeda
3rd Submersible Staff	Shouta Ihara

R/V NATSUSHIMA Crews

Captain	Eiko Ukekura
Chief Officer	Yasuhiko Sammori
2nd Officer	Tomoyuki Takahashi
3rd Officer	Hiroharu Omae
Chief Engineer	Eiji Sakaguchi
1st Engineer	Takashi Ota
2nd Engineer	Kenta Ikeguchi
3rd Engineer	Koichi Hashimoto
Chief Radio Operator	Fukuo Suda
2nd Radio Operator	Hiroki Ishiwata
3rd Radio Operator	Takatomo Shirozume
Boat Swain	Yoshiaki Kawamura
Able Seamen	Tsuyoshi Chimoto
Able Seamen	Masanori Ohata
Able Seamen	Yuki Yoshino
Able Seamen	Takuya Miyashita
Sailer	Shinya Ueno
Sailer	Yuta Motooka
No.1 Oiler	Kozo Miura
Oiler	Katsuyuki Miyazaki
Oiler	Sota Misago
Oiler	Katsuyuki Miyazaki
Assistant Oiler	Eiji Aratake
Assistant Oiler	Daiki Sato
Chief Steward	Tomihisa Morita
Steward	Yoshinobu Hasatani
Steward	Tatsunari Onoue
Steward	Toru Wada
Steward	Takahiro Abe
Steward	Masaru Takada

3. Scientific Research

- Purpose, Objectives, background

The giant squid is the most well known sea monster, the leviathan or the kraken. It is one of the most mysterious animals in the world but it is a really existing large cephalopod, *Architeuthis dux*, with 2-2.5 m long mantle with 2 long feeding tentacle of more than 15 m. Sperm whales are known to feed sometimes on this large animal and traces of the sucker are often found on the whale skin. It is thought to live from 500 m to 1500 m depth in the ocean. In recent years, records of the observation of the giant squid have been accumulated in the sea around Ogasawara, island, where whale watching of sperm whales is a popular tourism. Several years ago, Kubodera and Mori succeeded to get photopictures of a living *A. dux* attacking on a bait on a fishing line equipped with a deep-sea camera off Ogasawara island (Kubodera and Mori, 2005).

For this cruise, we prepared a mooring system with a bait (dead red squid), a pseudo-bait (squid shaped bait) and a trigger-deep-sea camera. In this cruise, by deploying this mooring system, we tried to get movie pictures of the giant squid and to capture the living giant squid. We also used an active sonar system, quantitative fish detector, for obtaining the signal (reflected sonar) of the giant squid. XCTD is also employed to get depth profiles of the environmental parameters, salinity, temperature and density.

The Mooring system

The mooring system has a weight of 185 kg, a double releaser system, 1100 m rope, the second (upper) releaser, three fishing gears to get the giant squid (Figures 2 and 3).

Quantitative fish finder (echo sounder)

We used a quantitative fish finder (QFD) of Simrad ER60, which was equipped on the RV-Natsushima. It has two channels of sound waves, 38 kHz and 120 kHz.

Research results

The mooring system, fishing gears and the trigger camera.

The mooring system was successfully deployed at the position of 26-27.400N, 142-30.282E, depth of 1880m, at17:00 on June 28th . It was left for 2 days and recovered at 17:00 on June 30th (Figure 4). Three fishing gears were attached to the upper part of the mooring system (Figure 5). In the morning of the 2nd day (June 30th), neither squid nor fish was caught by any of the fishing gears (Figure 6).

Hyper dolphin divings.

Dive # 1396. At 8:30 on July 29, the dive of HPD started and went to take a look of the mooring system. Howver, nothing was captured by the fishing gears (Figure 6). We took a close look of the trigger system

of the trigger camera and found out that the trigger was not released yet (Figure 7). After observing the mooring system, the HPD kept the depth (700 m) and went away from the mooring system (HPD should be more than 1 nautical mile away from the mooring system). It dived to the bottom and observed organisms on the sea-floor (Figure 9). The dive log is shown in table 1.
The sea-floor seemed to be made of lava like rocks, which were covered with thin layer of whitish marine snow like materials. Some organisms observed on the sea floor are shown in Figure 10.

Dive #1397. At 8:00 on July 30th, the HPD dive was started to go and see the mooring system. Unfortunately, nothing was trapped by the fishing gears on the mooring system. Then we tried to release the trigger of the camera (Figure 8). We used one arm of the HPD to grab the pseudo-bait, which is connected to the camera, and pulled it (Figure 8B). One of two lights of the camera was turned on (Figure 8C), but the other light did not. The HPD left the mooring system with the light kept on.

After the camera was recovered, we checked the movie recorded by the camera. Unfortunately, nothing except some plankters and a tiny jelly fish was recorded. We thought the camera recorded HPD. But it was out of the photograph frame and was not recorded.
The dive log of HPD dive #1397 is shown in Table 2.

After checking the mooring system, the HPD moved 1 nautical mile away from this system, and started the survey of marine organisms and environments near on the sea-floor in this area (Figure 11). We found many sponges, cnidarians, echinoderms and some fish (Figure 12) on the sea floor of this area.

Echo sounder (Quantitative Fish Finder) signals of a large animal moving in the deep.

Before getting the photographic images of squid or equivalent animals, we used the quantitative fish finder (QFF: echo-sounder) to catch the HPD (Figure 13). The upward moving HPD was detected at the bottom (over 16oo m depth) until it moved up to shallower depth of 900 m where it dissapeared from the detection range of the QFD (Figure 13). The mooring system was also detected and some of their componetns (the upper buoys, lower buoys and the trigger camera with the pseudo-bait) clearly recognized (Figure 14). The signals of transponder of the RV Natsushima were also detected and clearly distinguished from background noises (Figure 15). The HPD generated enormous noises, which was clearly detected when it entered the water (Figure 16). These data indicate that when we try to get signals from deep-sea animals, we should avoid to use HPD at the same time. We then tried to catch signals of animals in the area with the eco-sounder (Figure 17). The signals were obtained and thought to indicate some single freely swimming animals in the deep. If we postulate them as signals from a squid, the size of the animal was calculated from the signal intensities based on the reported parameters (Benoit-Bird et al. 2008). They were estimated to be about 5 m long, which is roughly equivalent to that of the giant squid.

XCTD data

XCTD analysis was undertaked off Ogasawara and the data are shown in Figures 18-25.

Detailed Sea-floor map made by SeaBat system

Before the NT12-16 cruise, we did not have a detailed sea-floor map of the study area (Figure 26). So that, we surveyed the A area by using the SeaBat and obtained the detailed sea-floor map (Figure 27).

Future study plans

In NT12-16 cruise, we failed to get images or samples of live giant squid, *Architeuthis dux*. However, we realized that the echo-sounder, Quantitative Fish Finder, was a powerful tool to find large animals in the deep (even deeper than 1000 m). In the next time, if you get a chance to work on the giant squid, we survey the animal in the deep-sea with the echo-sounder before deploy any type of fishing gears such as the mooring system. The mooring system may be a good method to fish the squid but we need more fishing gears and have to find better place to eploy it.

References.

T. Kubodera and K. Mori (2005) First-ever observations of a live giant squid in the wild. Proc. R. Soc. B. 272, 2583-2586.

K.J.Benoit-Bird, W.F. Gilly, W.W. L. Au, B. Mate (2008) Controlled and in situ target strengths of the jumbo squid Docidicus gigas and identification of potential acoustic scattering sources. J. Acoust. Soc. Am. 123, 1318-1328.

Table 1. Dive log of the HPD Dive #1396.

Dive Log of HPD Dive #1396						**Area Name: Off Hahajima, Ogasawara**	**2012/6/29th**
Time (JST)	Dep. (m)	Alt. (m)	Head (Deg)	Pos. Xm	Pos. Ym	Description	Remarks
						L26.27.321N; 142.30.217L	
08:40	0	0	263.3	13.5	51.3	着水	
08:54	0	0	260	8.8	56.4	潜航開始	
08:57	60	0	318	5.5	54		
09:02	100	0	40.6	1.3	49.1		26.27.419N:142.30.286
09:07	200	0	86	91	171		
09:12	306	0	146	102.2	115.8	manupilator positional change	
09:17	450	0	140	145	102		26.27.344;142.30.188
09:20	504	0	137	170.3	84.9		
09:24	591	0	131	213.7	34.1	jellyfish?	
09:25	616	0	132	241.8	3.9	jelly?	
09:28	700	0	0	256.6	11.2	white plankton	
09:31	700	0	3	213.3	19	jellyfish, salpas, shrimp	
09:33	700	0	0	205.2	26.6	salps?	
09:36	700	0	20	152.2	22	jellyfish	
09:38	700	0	20	135.3	22.3	shrimps	
09:48	700	0	31	68	31	approaching to jigging tags	
09:51	700	0	30	65	31	ctenophore CCD camera	
09:54	716	0	36	62	40	fish, eel	
09:56	722	0	40	63	60	ctenophoreCCD	
10:00	740	0	40	40	51	line found	
10:02	737		39	42	55	salps	
10:04	723	0	40	41	54	buoys, stream check	
10:11	736		37	43	55	salps/ jelly?	
10:14	748	0	31	40	56	top tags, squid food	
10:17	750	0	74	28	51	light flashing	
10:21	758	0	73	32	54	2nd light. 2nd jigging	
10:26	782	0	74	38	47	3rd light, camera	
10:29	787	0	136	27	48	camera appraoching	
10:42	705	0	230	71	1	long jellyfish	
10:52	679	0	350	25	151	moving 1km at the same hight	
10:54	676		352	3	172	detail observation; ctenophore,	
11:17	674	0	2	156	97	red shrimps	
11:33	655	0	338	405	226	jellyfish	
11:37	660	0	340	443	272	ctenophore CCD camera	
12:10	663			730	-590	triple jelyfish	
12:14	666			730	-610	Start to descent for bottom	
12:22	826			800	-636	Arrive at Edvent mark No. 4	
12:31	1114	0	360	798	-646	intermediate size squid?	
12:39	1400	0	357	801	-662	depth	
12:49	1745	61	358	809	-643	approaching to the bottom	
12:52	1809	1	1	789	-646	bottom, sand, rock	
12:55	1810	0	3	792	-648	wood?	
13:01	1811	1.3	351	864	-629	sponges	
13:12	1829	1	350	934	-642	sea urchin	
13:22	1829	0.7	351	951	-641	sea pen?	
13:29	1824	4.3	357	1028	-671	sponge. Shrimp	
13:39	1815	1.5	81	1061	-638	coral-like polyps pink, kinuami sponge sampling	
13:54	1814	1	80	1058	-621	coral?	
13:56	1817	1.3	81	1057	-584	sokodara eyeless?	
14:01	1824	0.8	80	1075	-551	sponge strange shape in box	
14:19	1825	0	62	1054	-541	purple jelly fish observation	
14:32	1824	0	71	1057	-472	starfish	
14:40	1815	1.3	73	1058	-345	fish	
14:43	1813	3	70	1071	-315	eel, observation	
14:50	1817	0	71	1077	-327	sea anemone	
14:55	1816	0	72	1005	-200	sea pen?	
15:00	1810	0.5	70	1065	-262	sea anemone, res shrimp	
15:04	1806	0.5	67	1079	-107	starfish with sponge, sampling	
15:16	1805	0.5	68	1084	-235	sponge, starfish, sea pens, itoashi shrimps (sampling), sea urchin?	
15:22	1800	1.2	68	1084	-233	sponge pink, bristle star	
15:25	1798	0.5	69	1068	-225	red fish, sampling	
15:39	1781	1	71	1103	-142	coral pink, sea anemone	
15:42	1777	1.5	70	1113	-120	stalked beautifl coral, sea anemone	
15:49	1752	1	80	1117	-46	sponge, kairoudouketsu,	
16:00	1731	0.8	60	1143	62	sea cucumber, observation, sampling	
16:12	1732	0	24	1078	39	finish to survay	

Table 2. Dive log of HPD #1397 dive

Dive Log of						Area Name: Off Hahajima, Ogasawara	2012/6/30th
Time (JST)	Dep. (m)	Alt. (m)	Head (Deg)	Pos. Xm	Pos. Ym	Description	Remarks
						26.27.439N. 142.30.284E	
07:47	0	0	170	0	0	surface of water	
08:00	0	0	0	0	0	start to survay	
08:24	523	0	332	-136	77	reflective flash for planktons?	
08:28	722	0	4	-82	59	reflective flash for planktons?	
08:29	720	0	13	-60	48	fish	
08:33	720	0	35	5	44	strange salps?, big image	
08:34	720	0	65	4	49	line buoy	
08:38	727	0	78	10	53	fluorescent ctenophore	
08:42	759	0	78	13	55	first squid food.	
08:43	773	0	79	8	64	jelly fish ccd	
08:45	783	0	78	10	62	2nd jigging, camera, with big jellyfish	
08:57	772	0	92	8	63	3rd jigging	
09:00	754	0	89	9	65	again squid food,	
09:09	788	0	88	2	70	jigging capture	
09:15	789	0	180	9	87	big ctenophore with hyper photo	
09:25	728	0	4	-6	80	big jelyfish, buoy	
10:04	690	0	13	1920	44	moving to research point	
10:11	687	0	33	1018	46	moving to deep: 26.27.971N; 142.30.279	
10:21	747	0	44	1051	87	fish	
10:43	1055	0	3	1031	75	fish	
11:09	1744	3.3	60	979	83	reach the botom, long sea pen?	
11:14	1739	0.7	64	979	90	fish, sokodara? eso?	
11:17	1730	1	61	999	123	sponge beds, stripe rocks	
11:22	1723	0	62	1036	155	red ankou, again, sampling loss	
11:36	1710	1	61	1072	213	mushroom sponge	
11:41	1706	0	60	1095	234	more sand bottom	
11:48	1702	0.7	71	1137	286	sea pen, rock cliff, brittle star,	
11:57	1700	0	74	1134	308	sea urchin	
12:00	1698					sponge, asteroid	
12:05	1698					echinoderms	
12:08	1697					gorgonian	
12:12	1698					sponge and Nematocarcinus shrimp	
12:20	1698			1170	350	two sponge sampling	
12:23	1697			1180	350	tripod fish observing, sandy bottom	
12:35	1397	91				fish, sampling, long fish	
12:43	1695	0	69	1180	412	sea pen, sponge, sea pen, shrimp sampling	
12:54	1693	0/7	70	1196	444	sponge sampling, shrimp,	
13:11	1694	0.7	50	1215	503	sponge	
13:34	1693	0.7	157	1302	423	fish (eel) observation, sampling	
13:45	1964	0.7	162	1273	445	leave bottom	
14:05	1521	0	344	1170	520	1500m survay	
14:10	1501	122	178	1157	531	jellyfish, salps,	
14:20	1498	0	186	1110	515	jelly ball	
14:25	1498	0	174	1100	509	finish to survey	

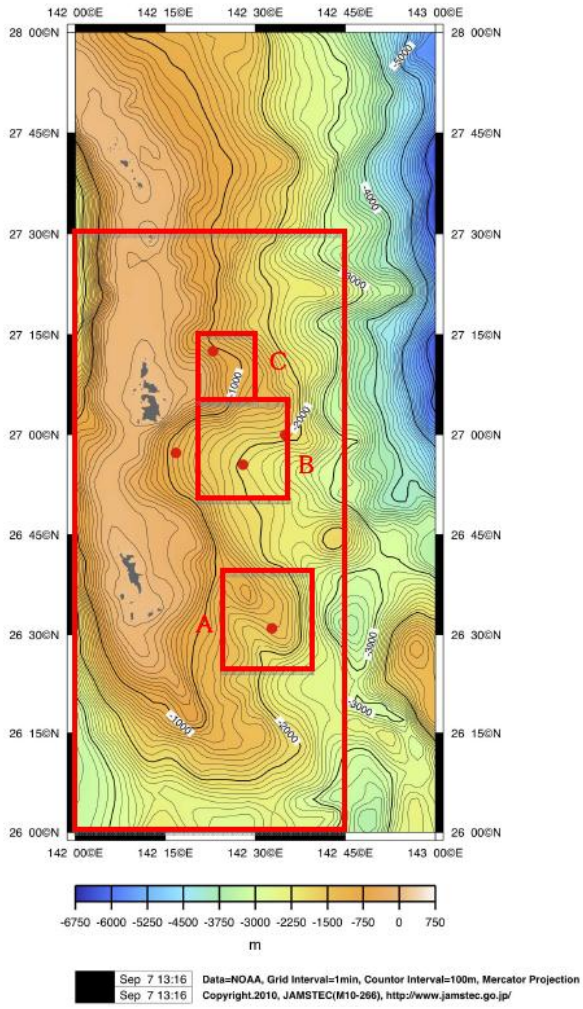

Figure 1. Map of the studied area. In the A-area, we deployed the mooring system and made observations of the sea-floor.

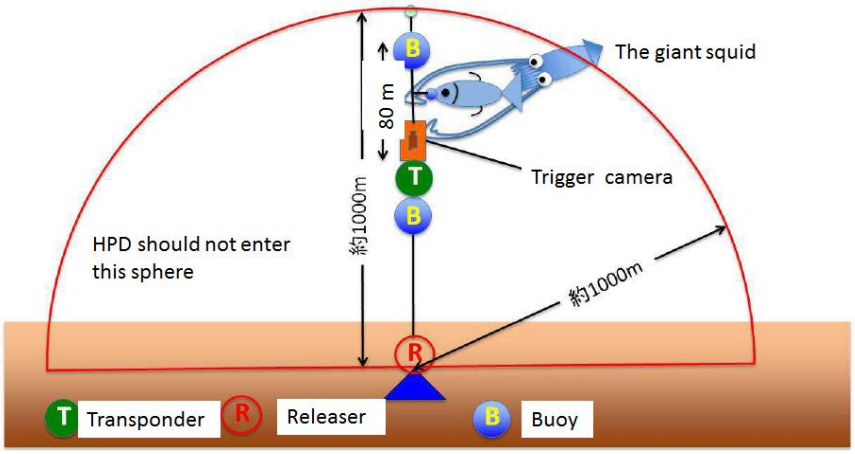

Figure 2. Schematic drawing of the mooring system for the giant squid.

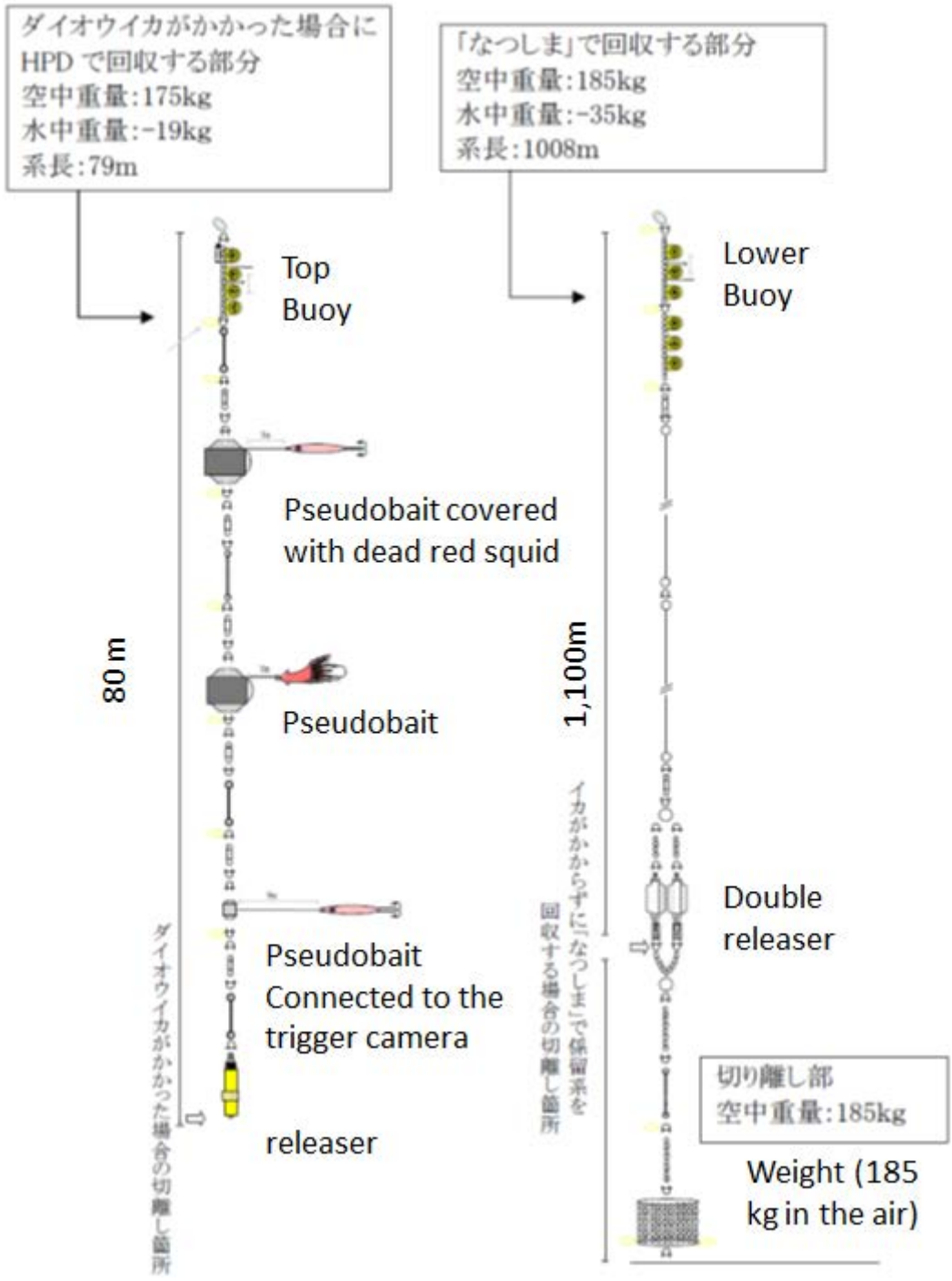

Figure 3. Detailed drawing of the mooring system. Left: the upper part of the morring system. The upper releaser is connected to the lower part of the mooring sytem (Right). Rigt: Lower part of the mooring system having a double releaser and a set of lower buoy.

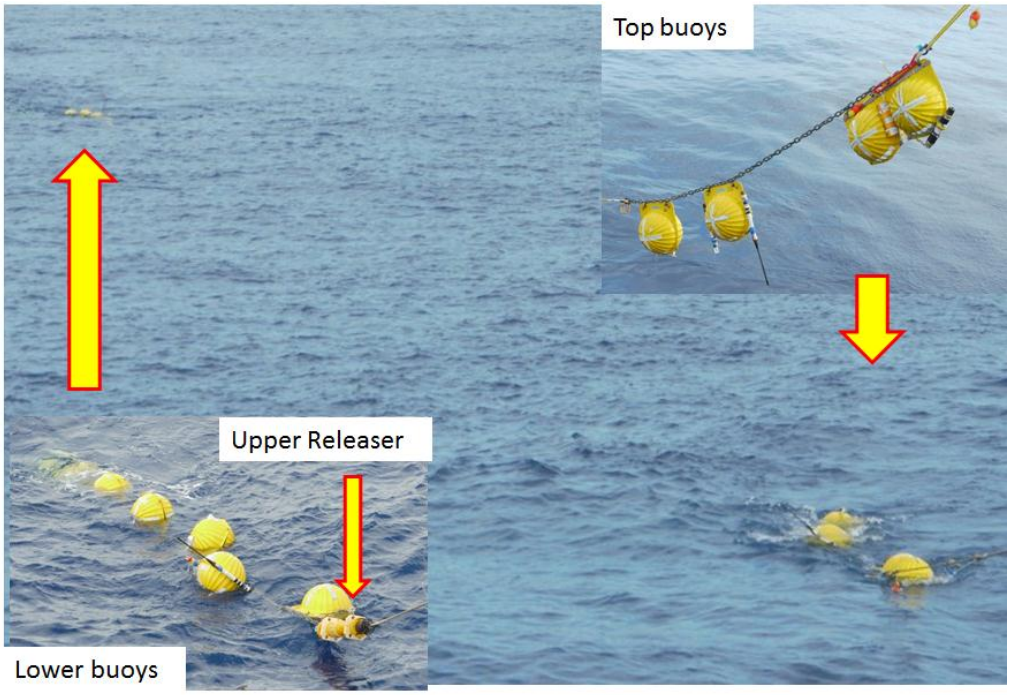

Figure 4. The mooring system floating on the sea surface when it was recovered. Two floating systems (upper float and lower float) are seen.

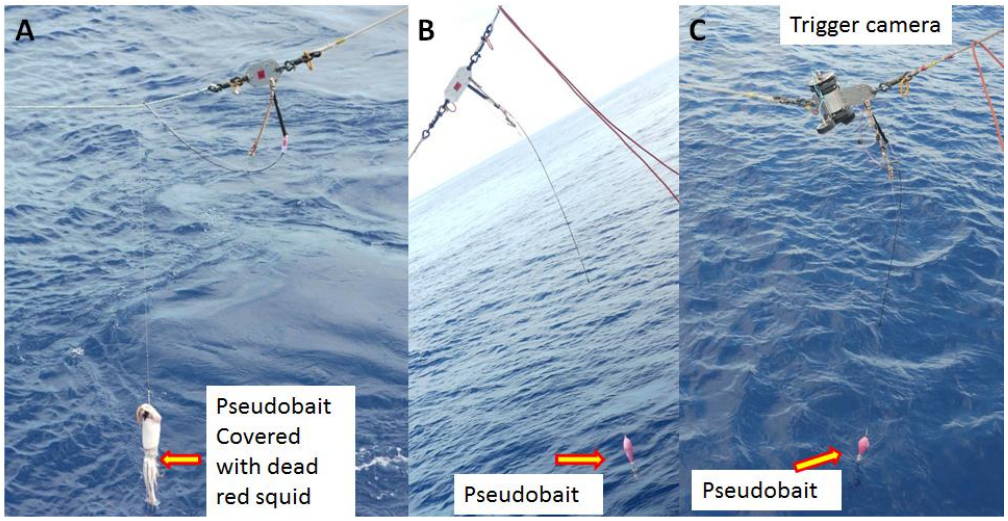

Figure 5. Three fishing gears and the trigger camera pictured on their recoveries.

The uppermost fishing gear had a pseudobait with hooks covered with a dead red squid (A). The second one has a pseudobait with hooks (B), and the lower fishing gear had a trigger camera and a pseudobait with hooks(C).

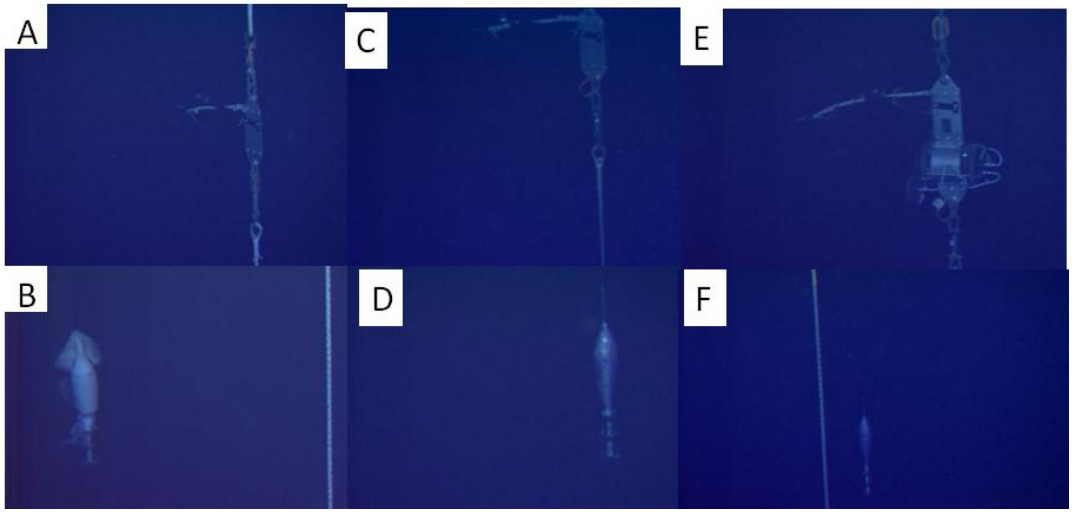

Figure 6. *In situ* photopictures of the three fishing gears and the trigger camera (June 29th, the dive # 1396). A, Top-fishing gears with the pseudobait covered with dead red squid (B). C, the middle (2nd) fishing gear with a pseudobait (D). E, The 3rd fishing gear equipped with the trigger camera and a pseudobait (F).

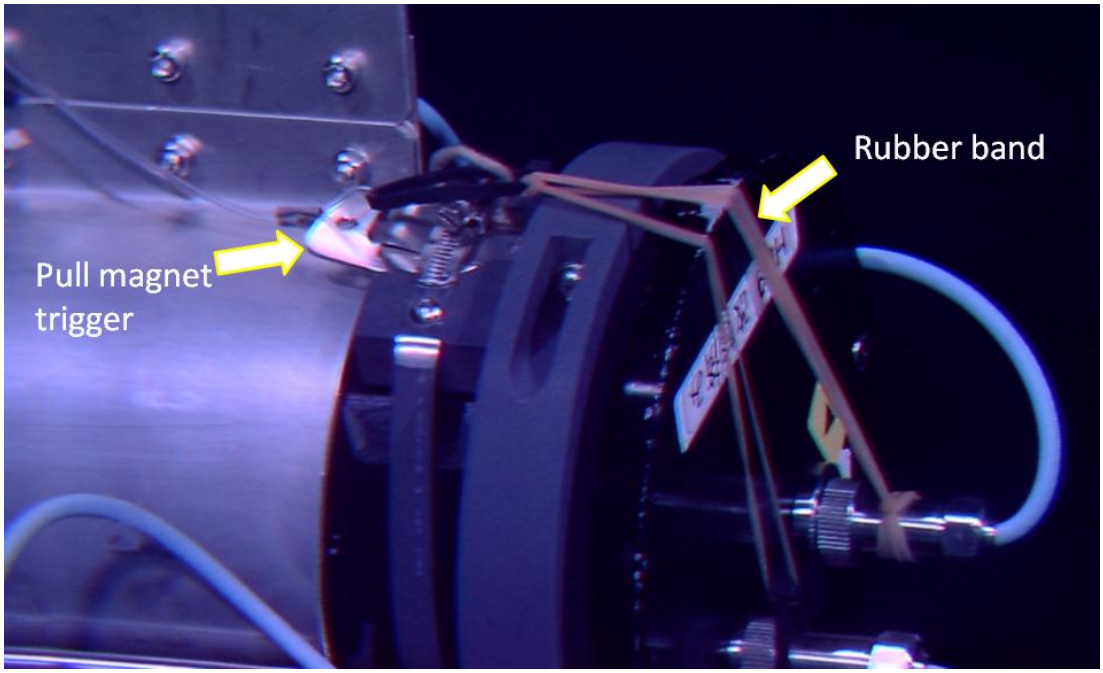

Figure 7. Magnified *in situ* photopicture of the trigger of the trigger camera. The pull trigger was securely anchored with rubber bands and was yet to be released.

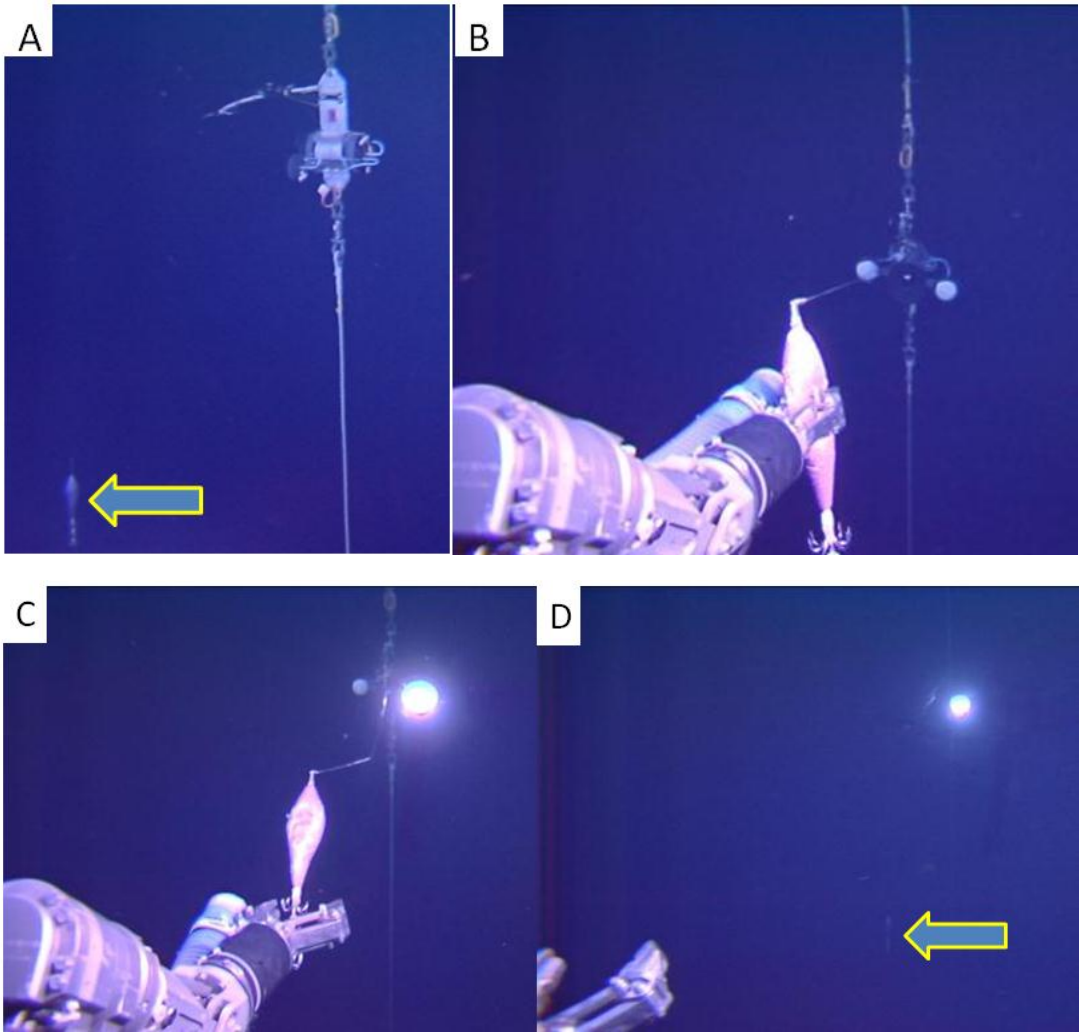

Figure 8. Triggered the trigger camera (June 30th, Dive #1397). A, Before pulling the trigger. B, Grabbing the pseudobait to trigger the camera. Note the lights were off. C. After pulling the trigger, the light was on. D. The light was kept on and the pseudobait was hanging (arrow) still.

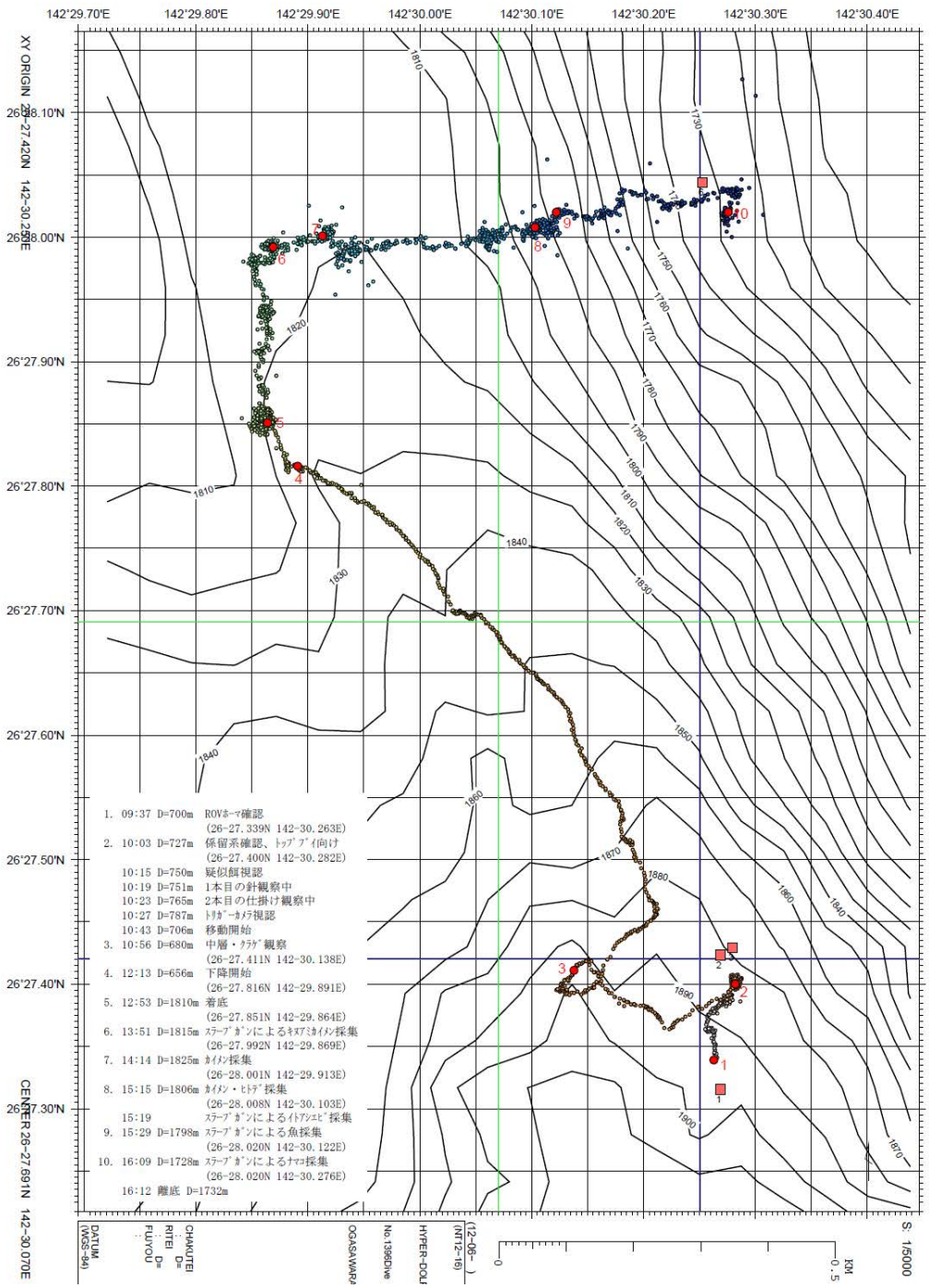

Figure 9. Dive map of the HPD dive # 1396.

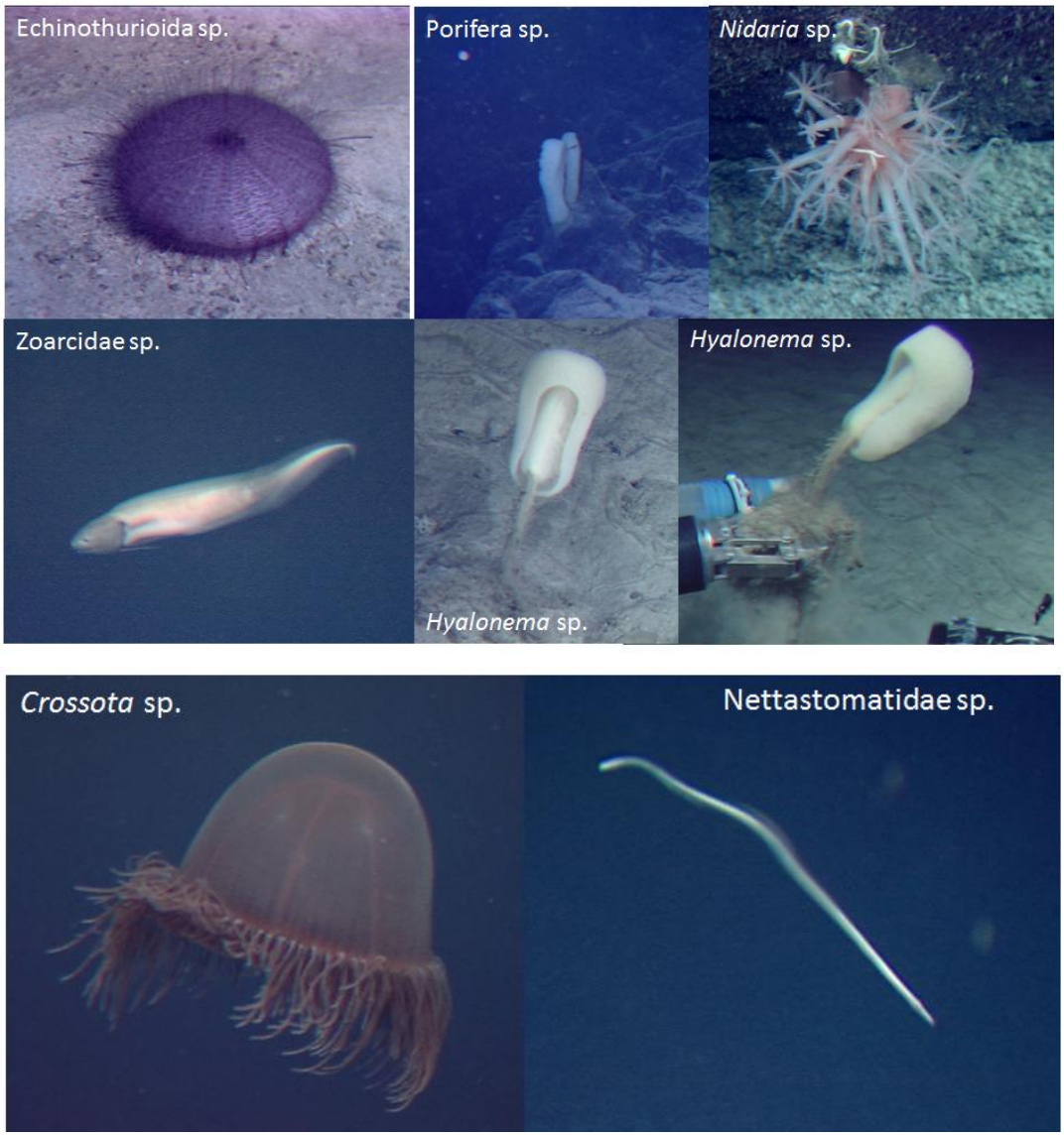

Figure 10. Some organisms found during the HPD dive #1396. They were temporarily identified consulting with a text book (Deep-sea life-biological observations using research submaersibles. Eds. Fujikura, Okutani and Maruyama. 2008).

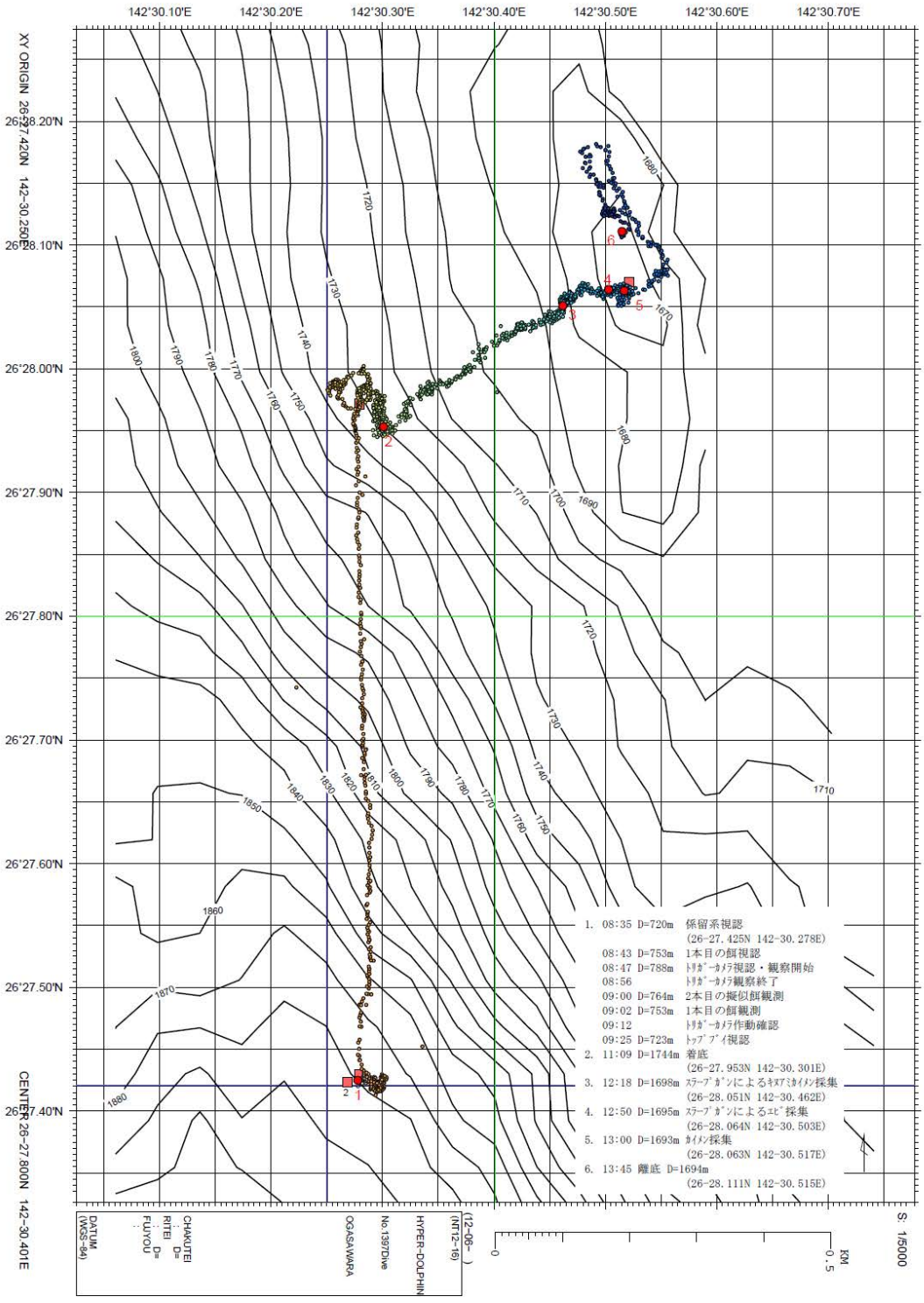

Figure 11. Dive record of HPD dive # 1397 on the sea floor map.The box 1 indicates the place of the mooring system.

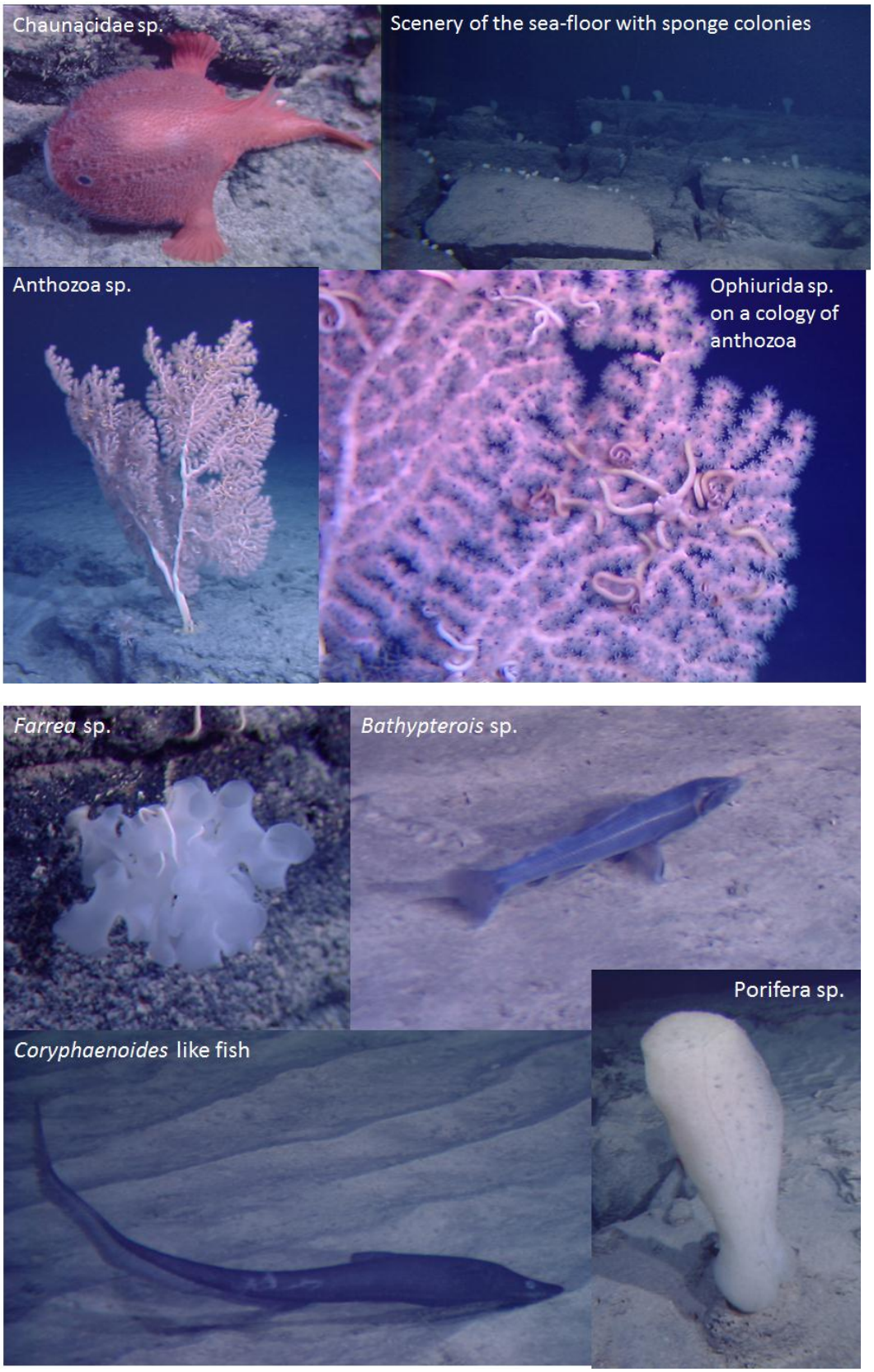

Figure 12. Some oranisms observed on the sea-floor during the dive #1397.

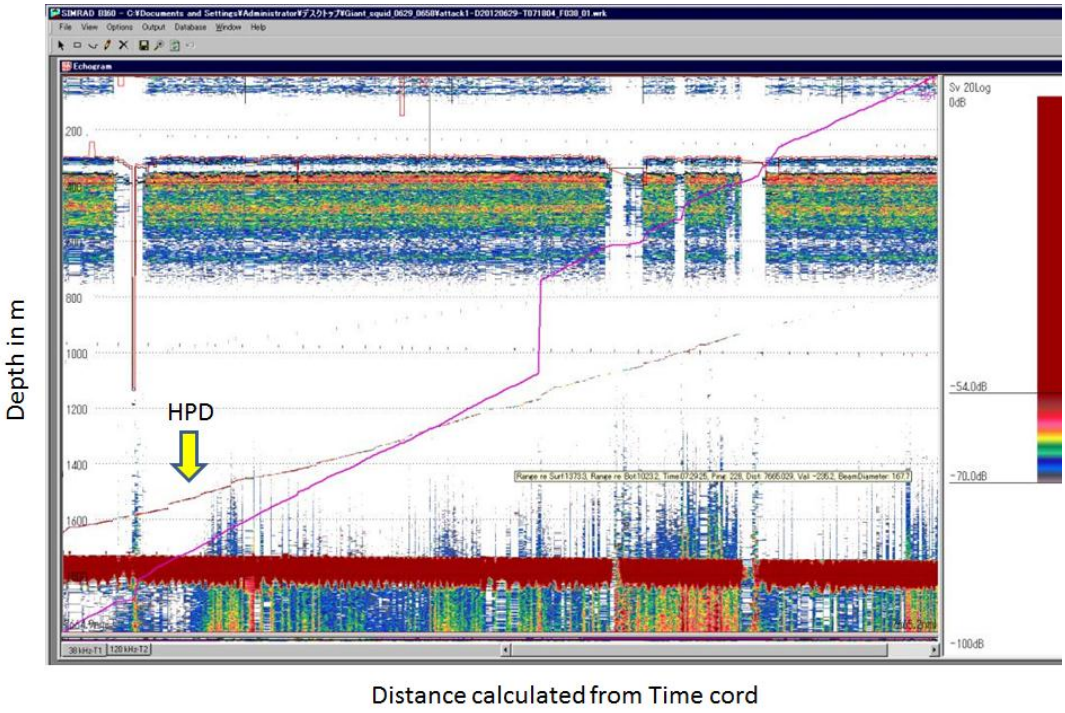

Figure 13. Eco-sounder (Quantitative Fish Finder) image profile of diving track of the HPD off Ogasawara

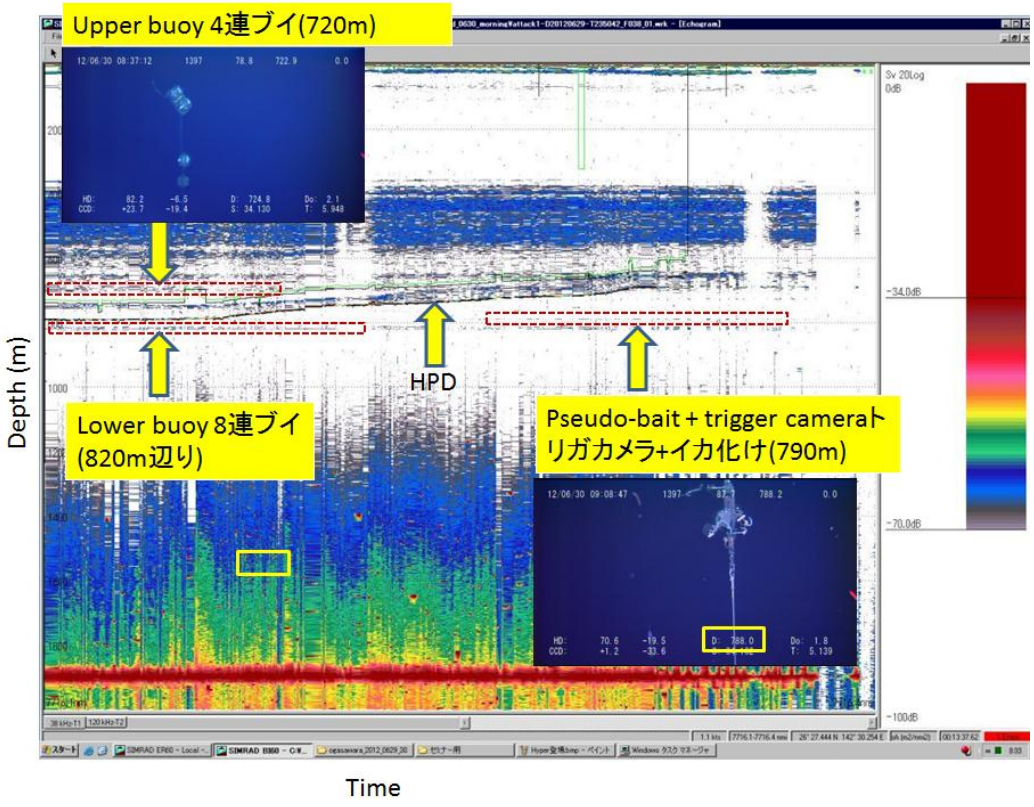

Figure 14. The mooring system detected by the eco-sounder (Quantitative Fish Finder)

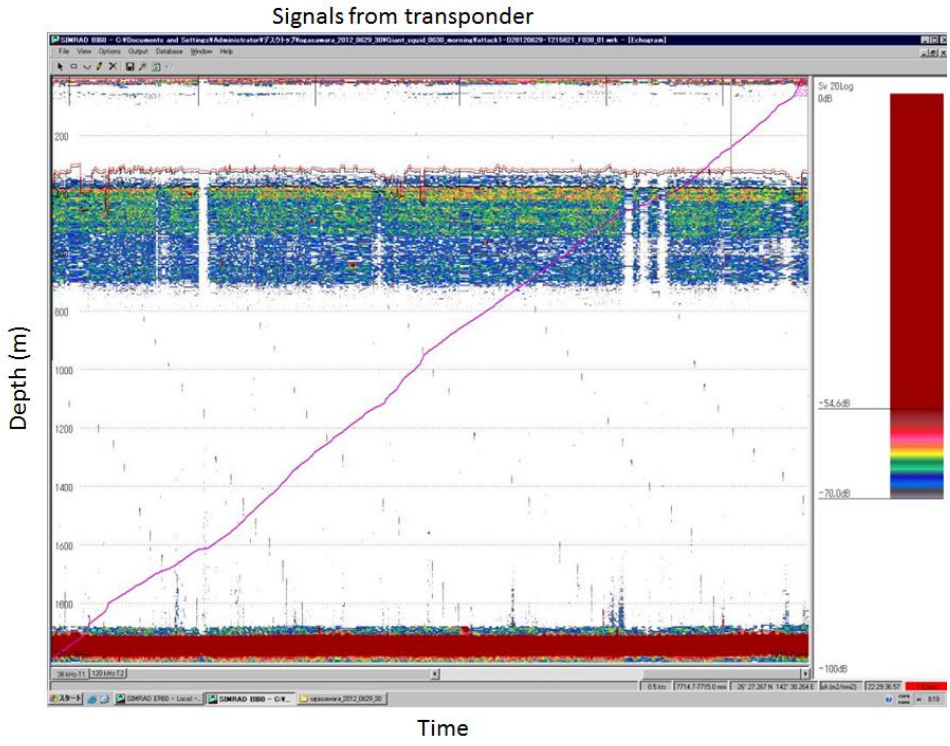

Figure 15. Signals from transponder.

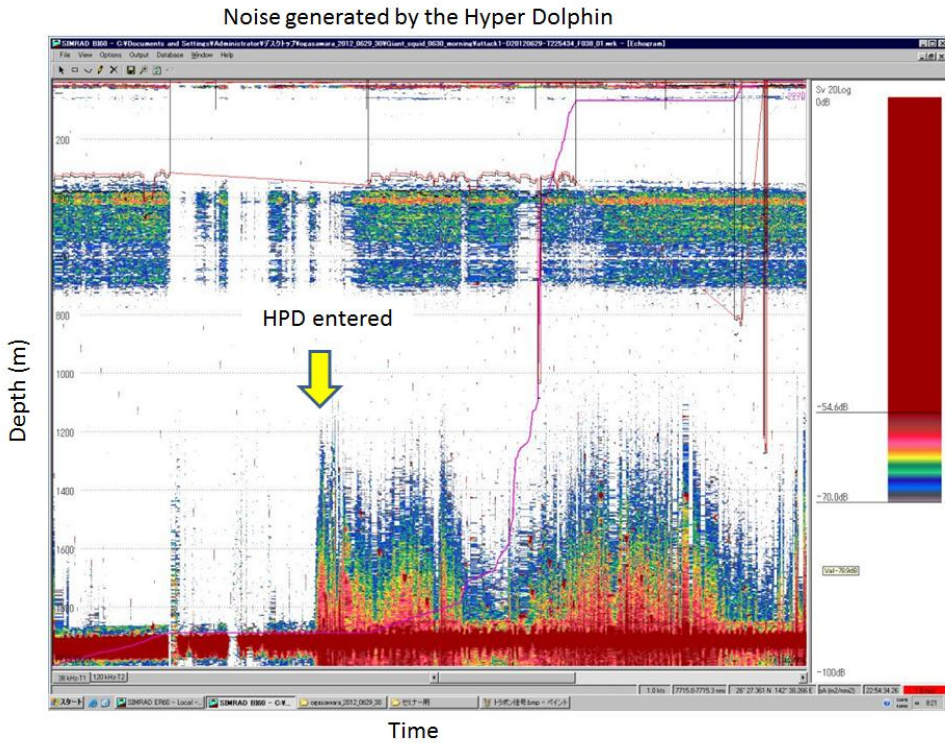

Figure 16. Noises generated by the HyperDolphin

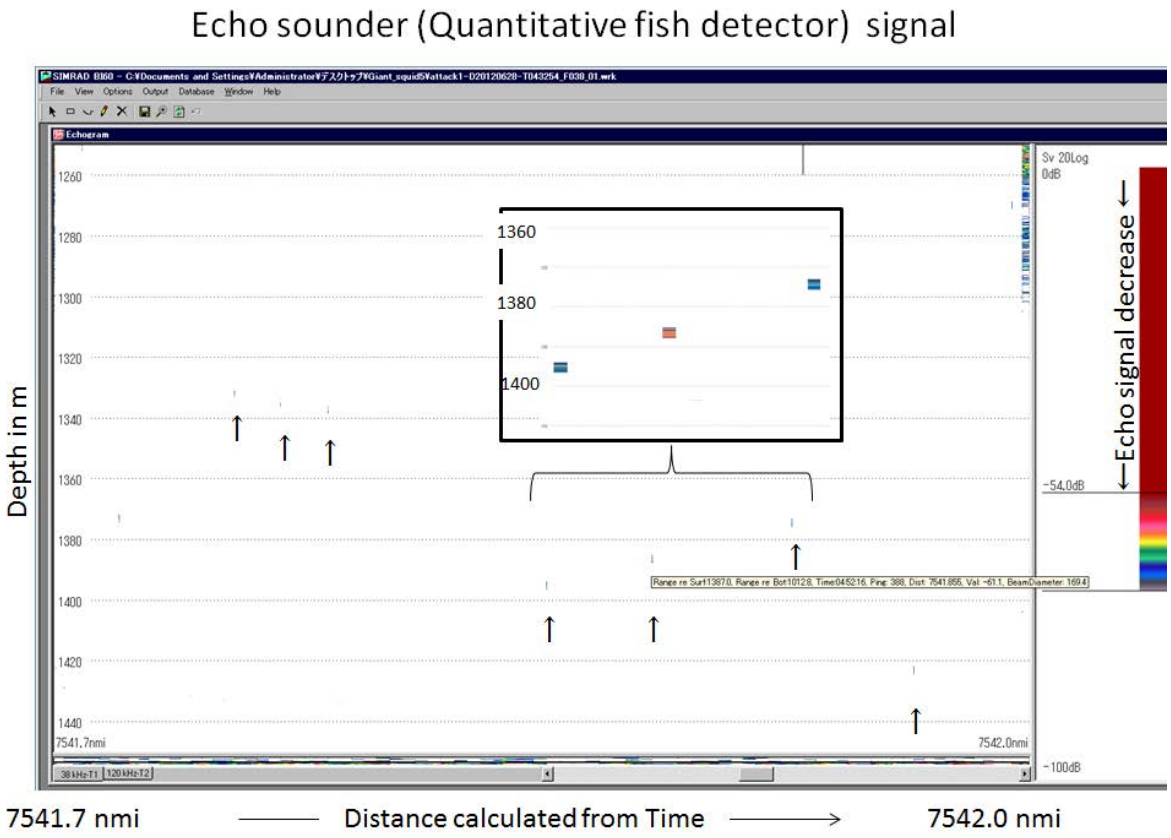

Figure 17. Signals (arrows) obtained with the quantitative fish detector (Echo-sounder). They were possibly from a large animal swimming in the deep-sea. Insert is the enlarged images of the part of this figure.

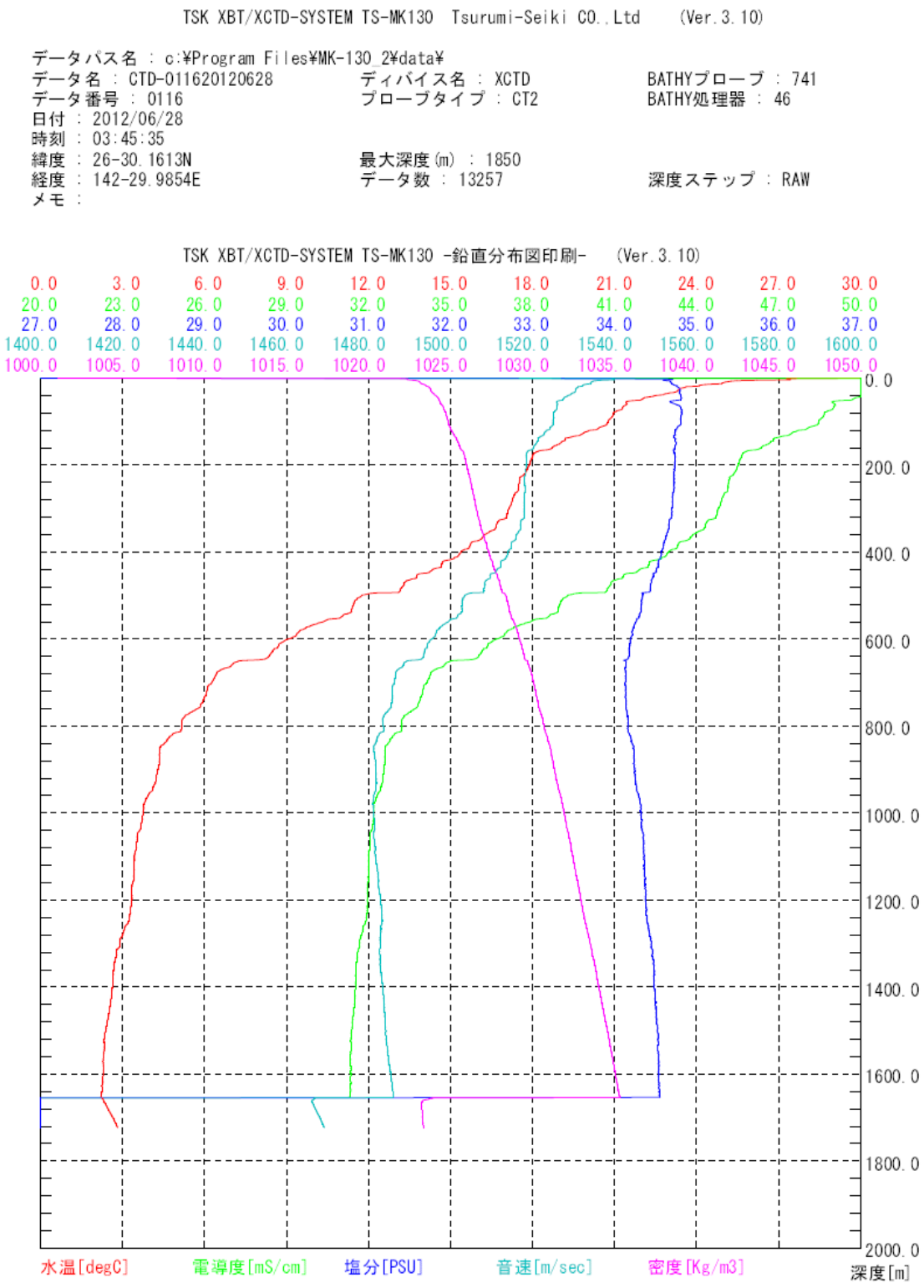

Figure 18. XCTD data taken at 26-30.1613N, 142-29.9854E.

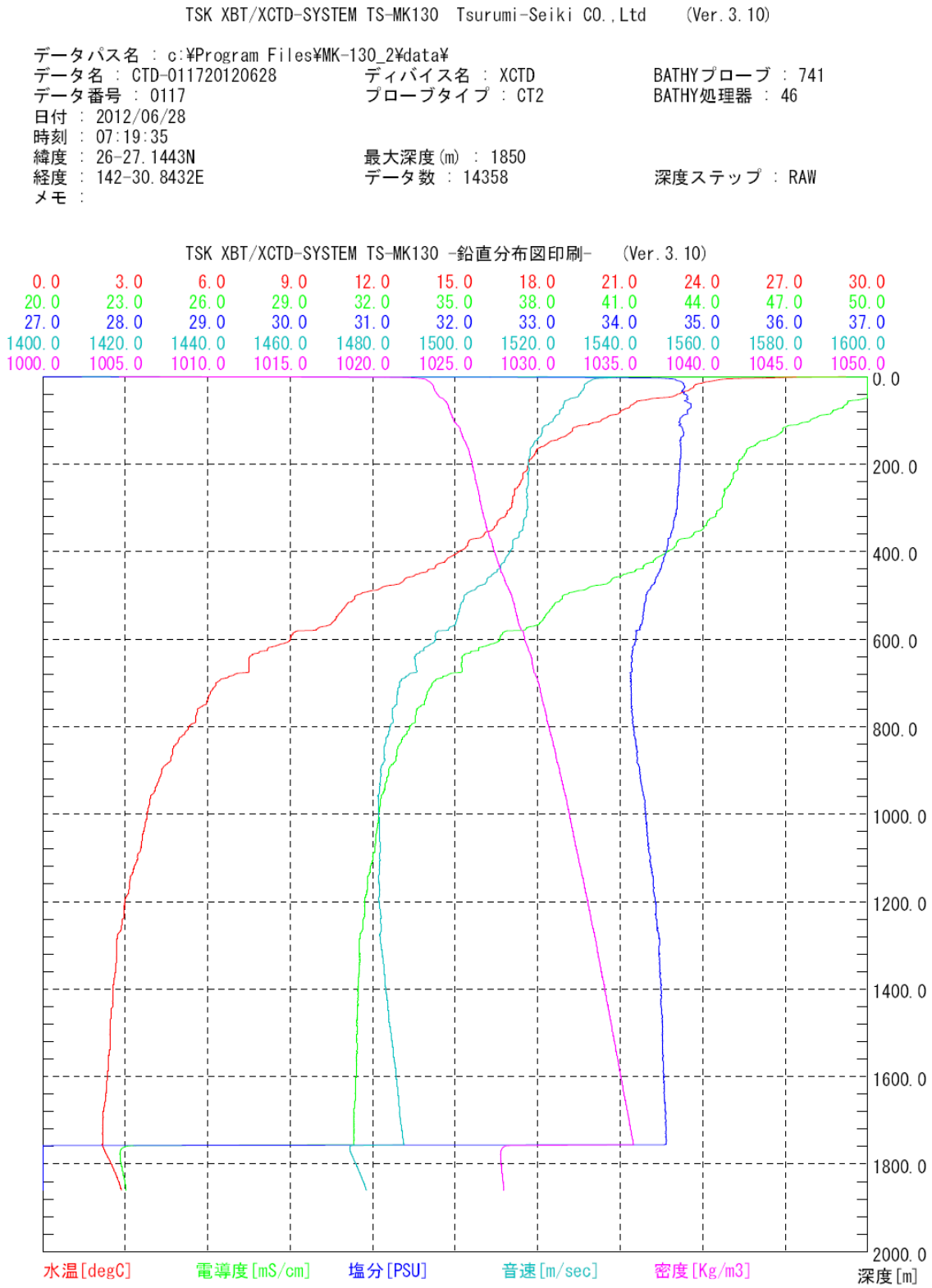

Figure 19. XCTD data obtained at 26-27.1443N, 142-30.8432E.

TSK XBT/XCTD-SYSTEM TS-MK130 Tsurumi-Seiki CO.,Ltd (Ver.3.10)

データパス名 : c:¥Program Files¥MK-130_2¥data¥
データ名 : CTD-011820120628
データ番号 : 0118
日付 : 2012/06/28
時刻 : 08:29:42
緯度 : 26-27.1152N
経度 : 142-24.9579E
メモ :

ディバイス名 : XCTD
プローブタイプ : CT2
最大深度(m) : 1850
データ数 : 11403

BATHYプローブ : 741
BATHY処理器 : 46
深度ステップ : RAW

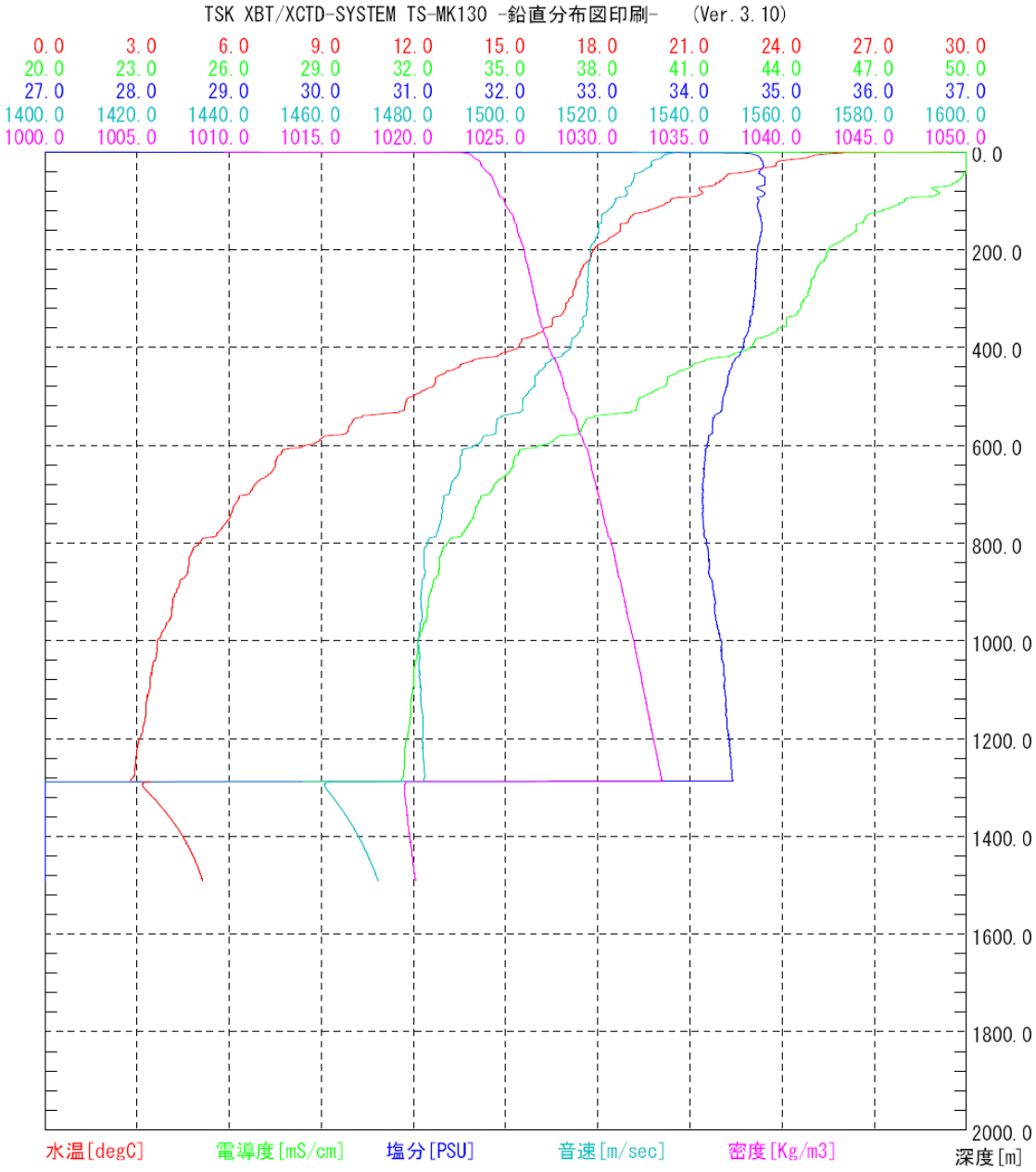

Figure 20. XCTD data taken at 26-27.1152N, 142-24.9579E.

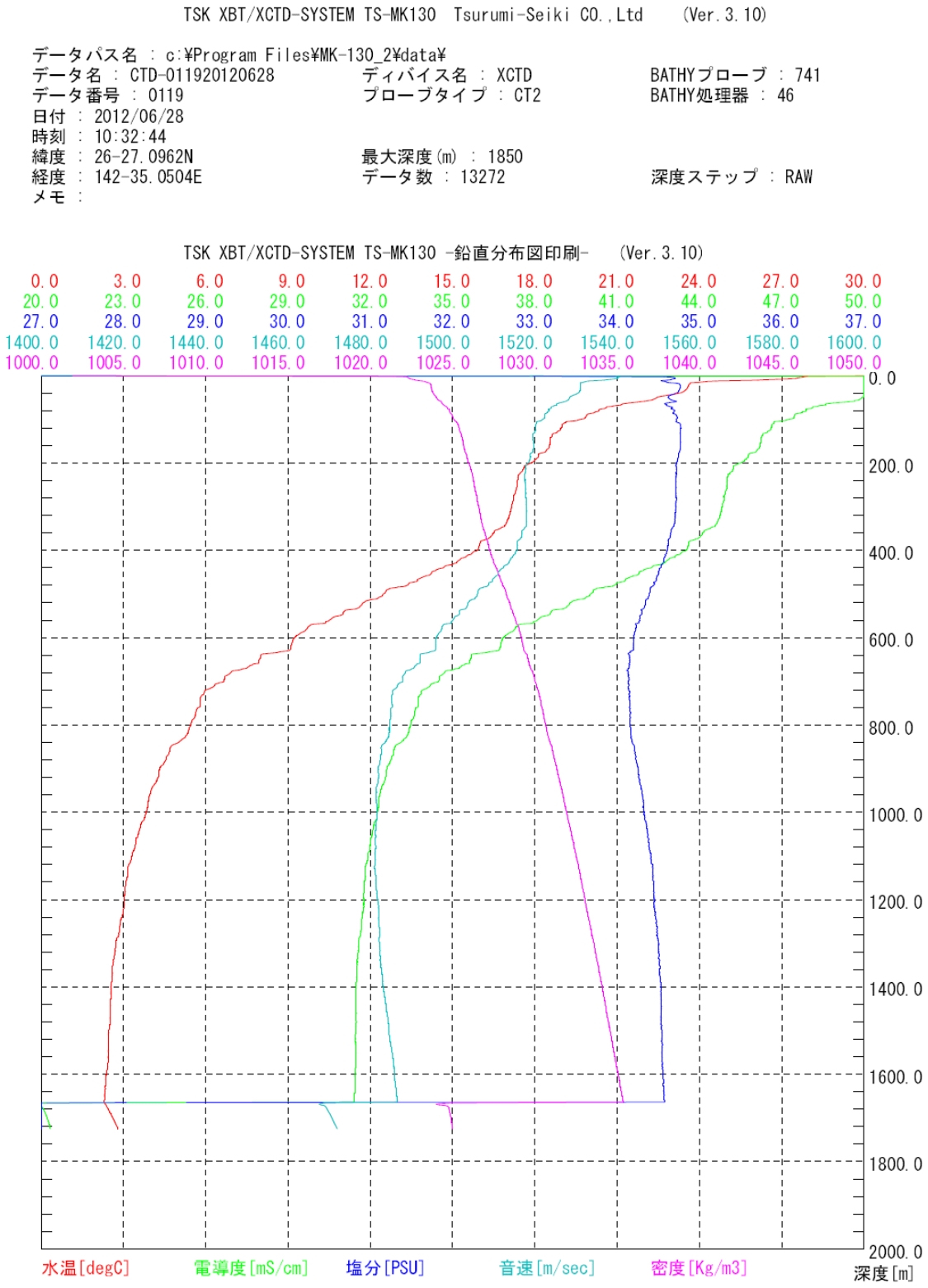

Figure 21. XCTD data taken at 26-27.0962N, 142-35.0504E.

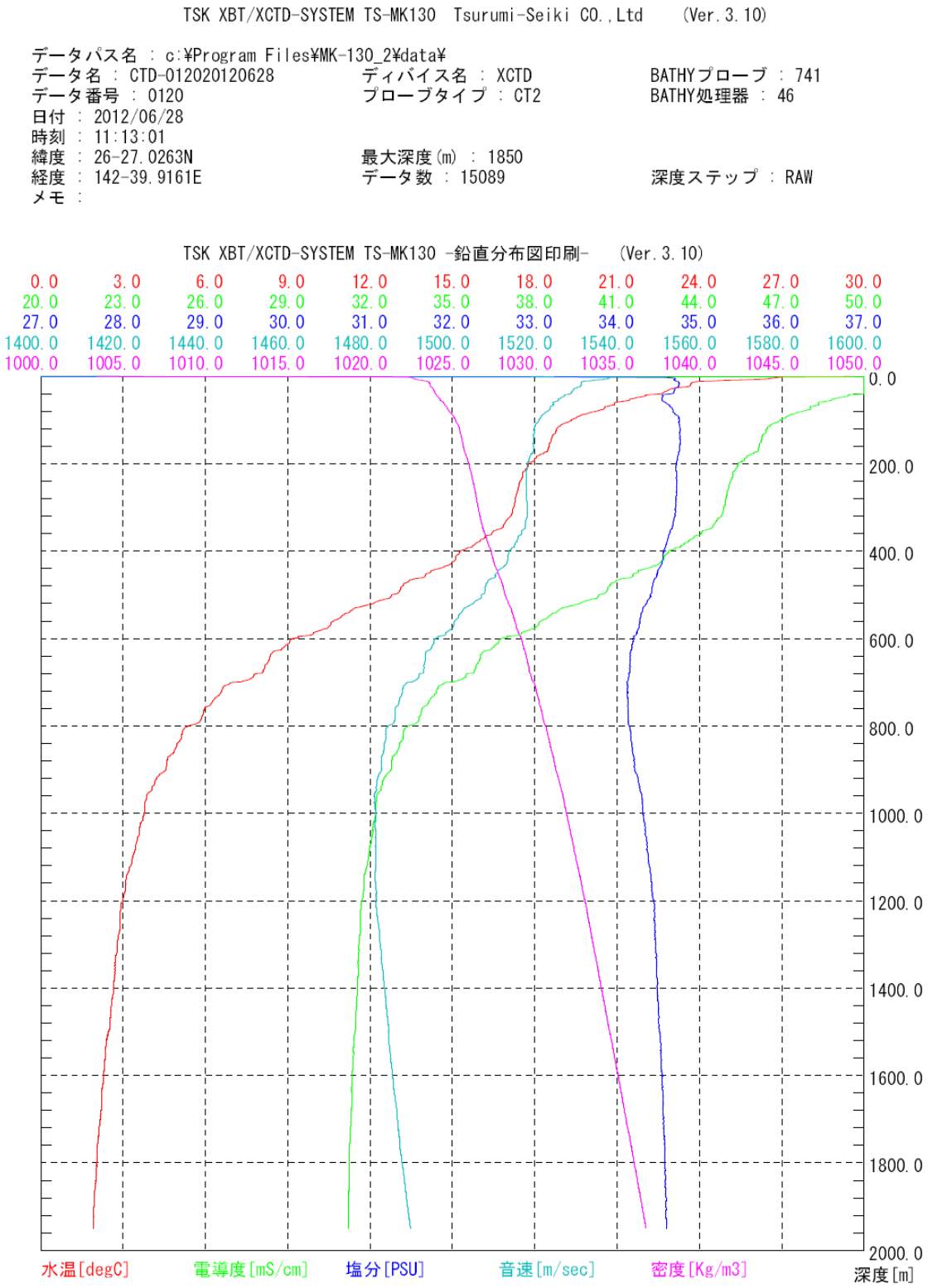

Figure 22. XCTD data taken at 26-27.0263N, 142-39.9161E.

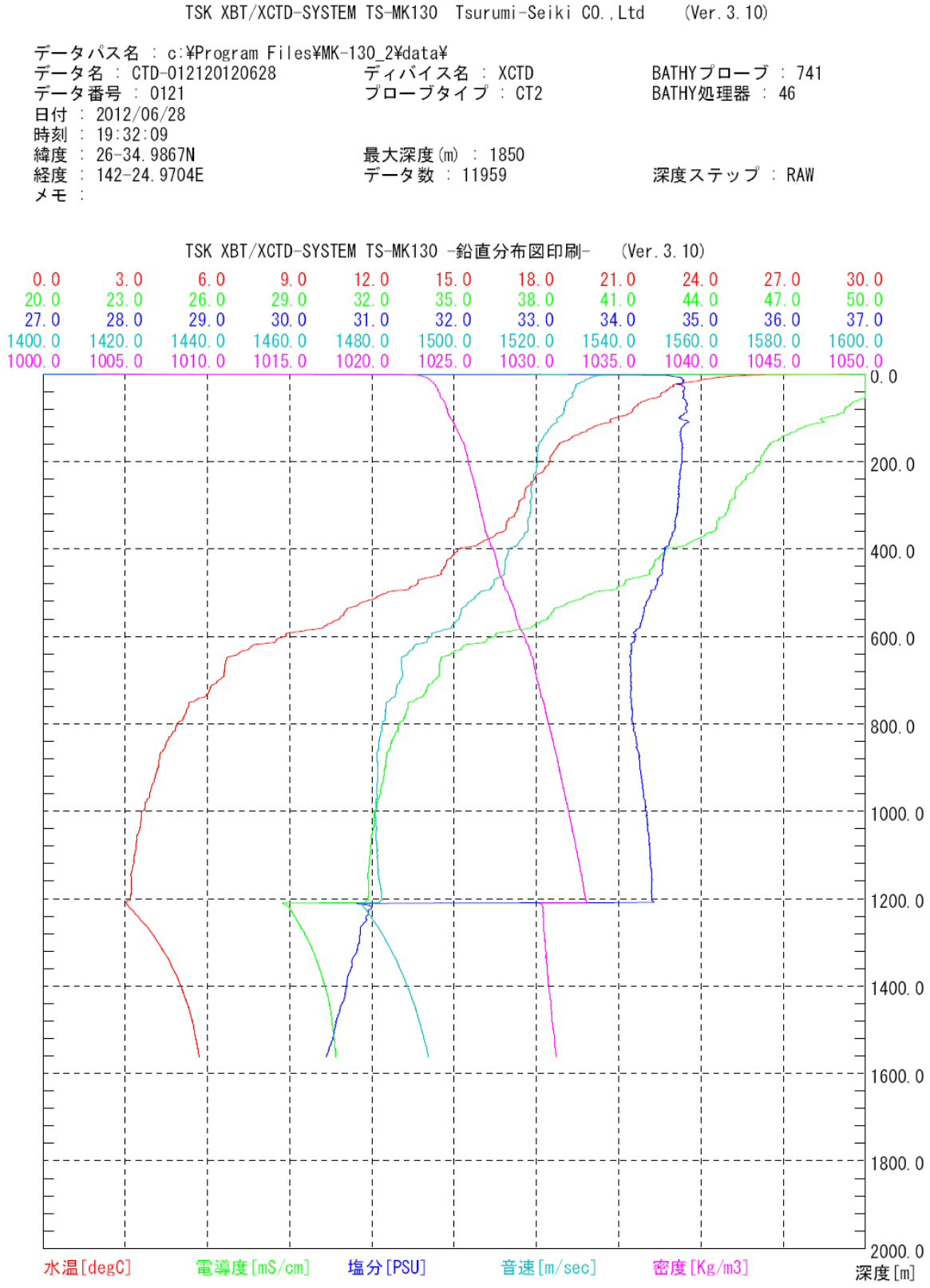

Figure 23. XCTD data taken at 26-34.9867N, 142-24.9704E.

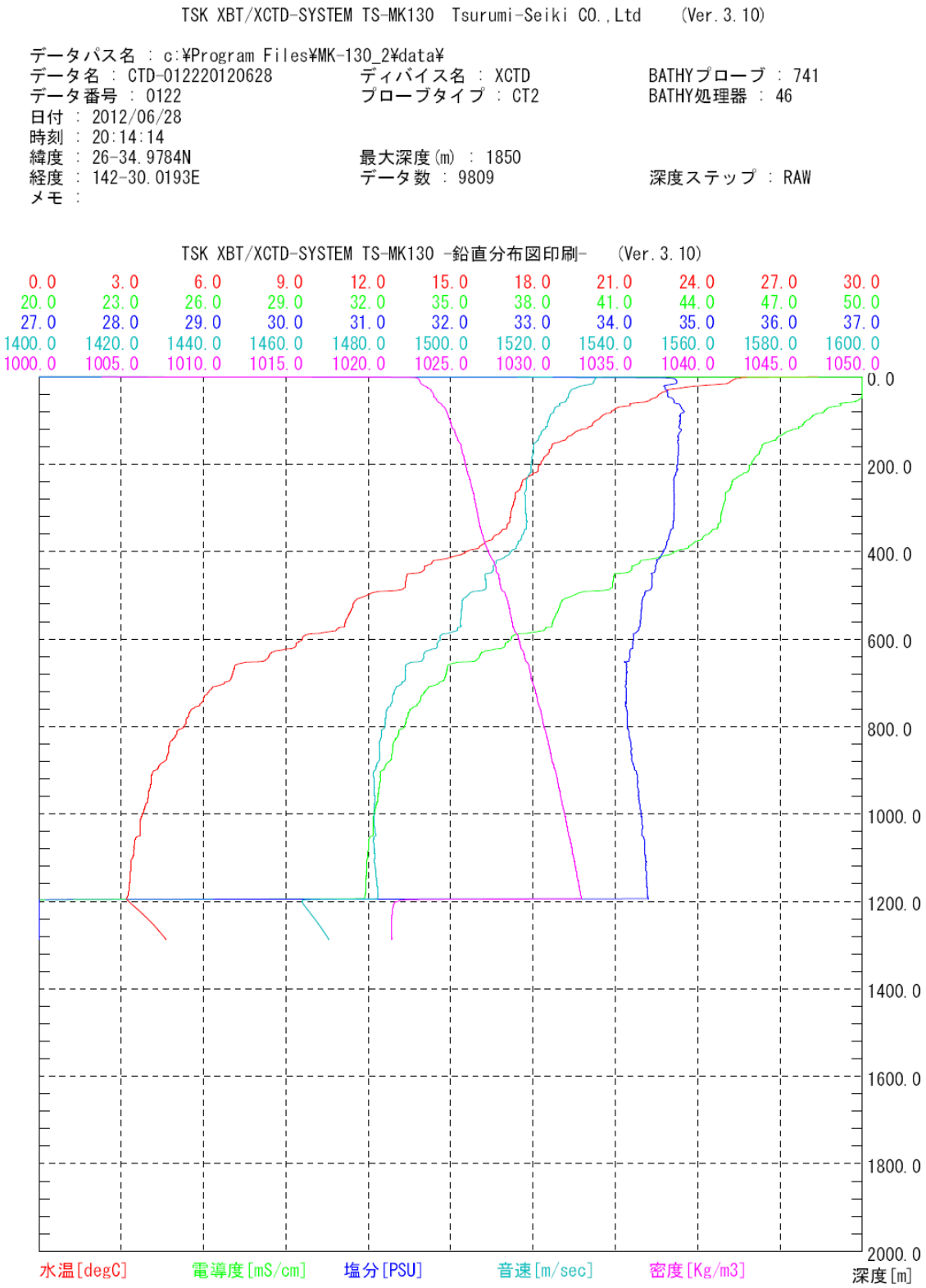

Figure 24. XCTD data taken at 26-34.9784N, 142-30.0193E.

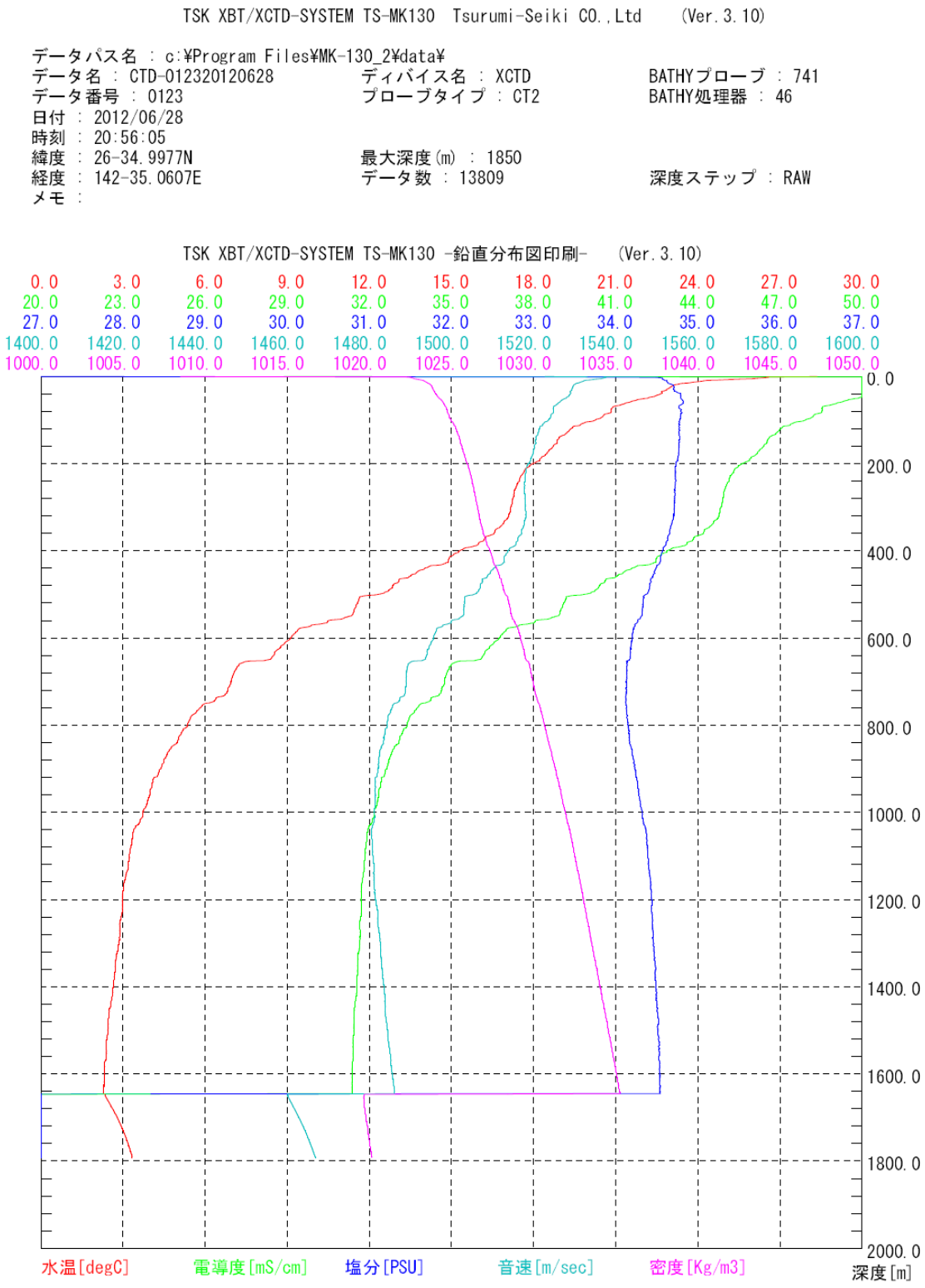

Figure 25. XCTD data taken at 26-34.9977N, 142-35.0607E.

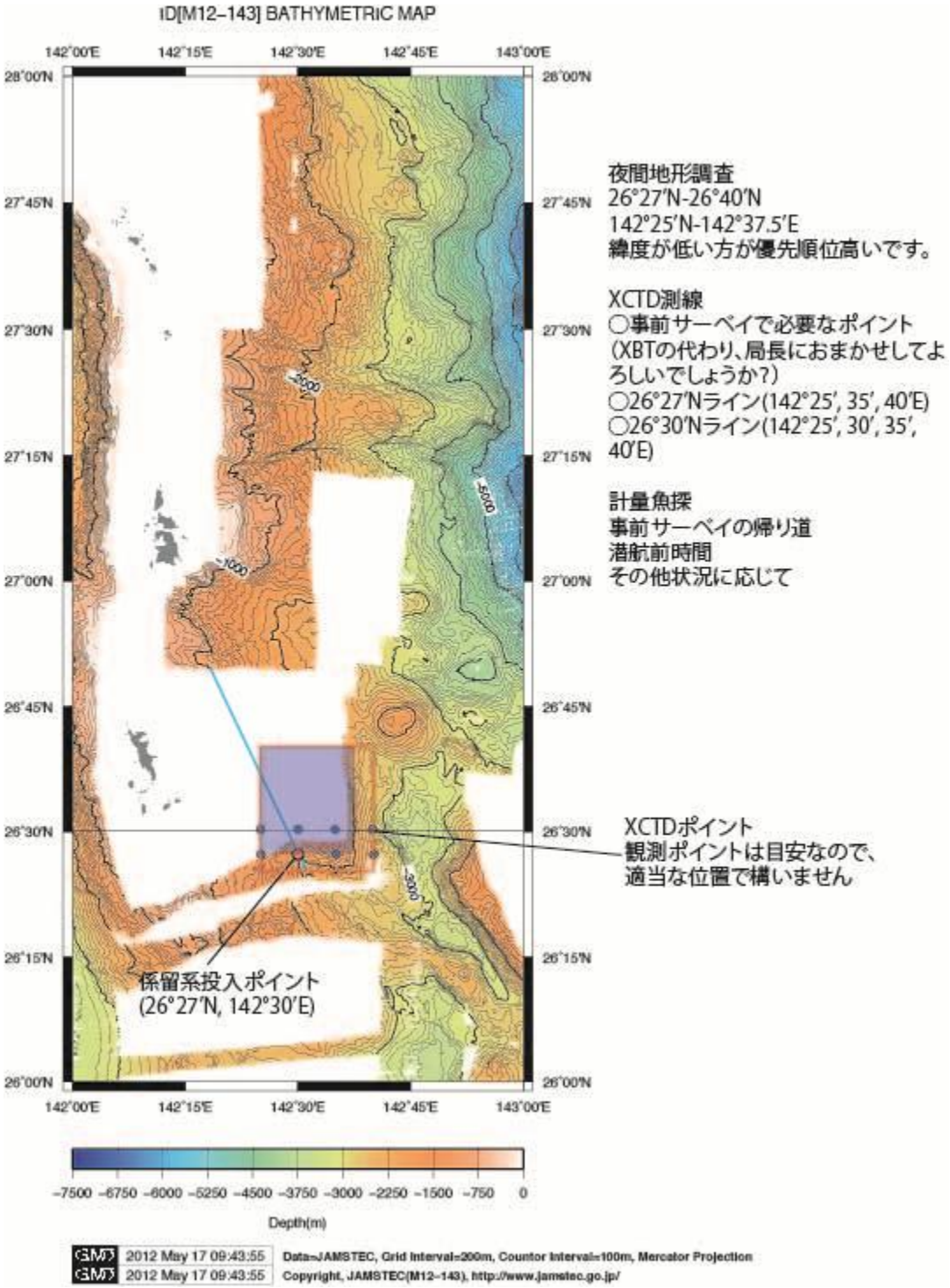

Figure 26. Detailed sea-floor map we had before NT12-16 cruise. The study area (A-region: blue region) is the are we surveyed in NT12-16 by SeaBat.

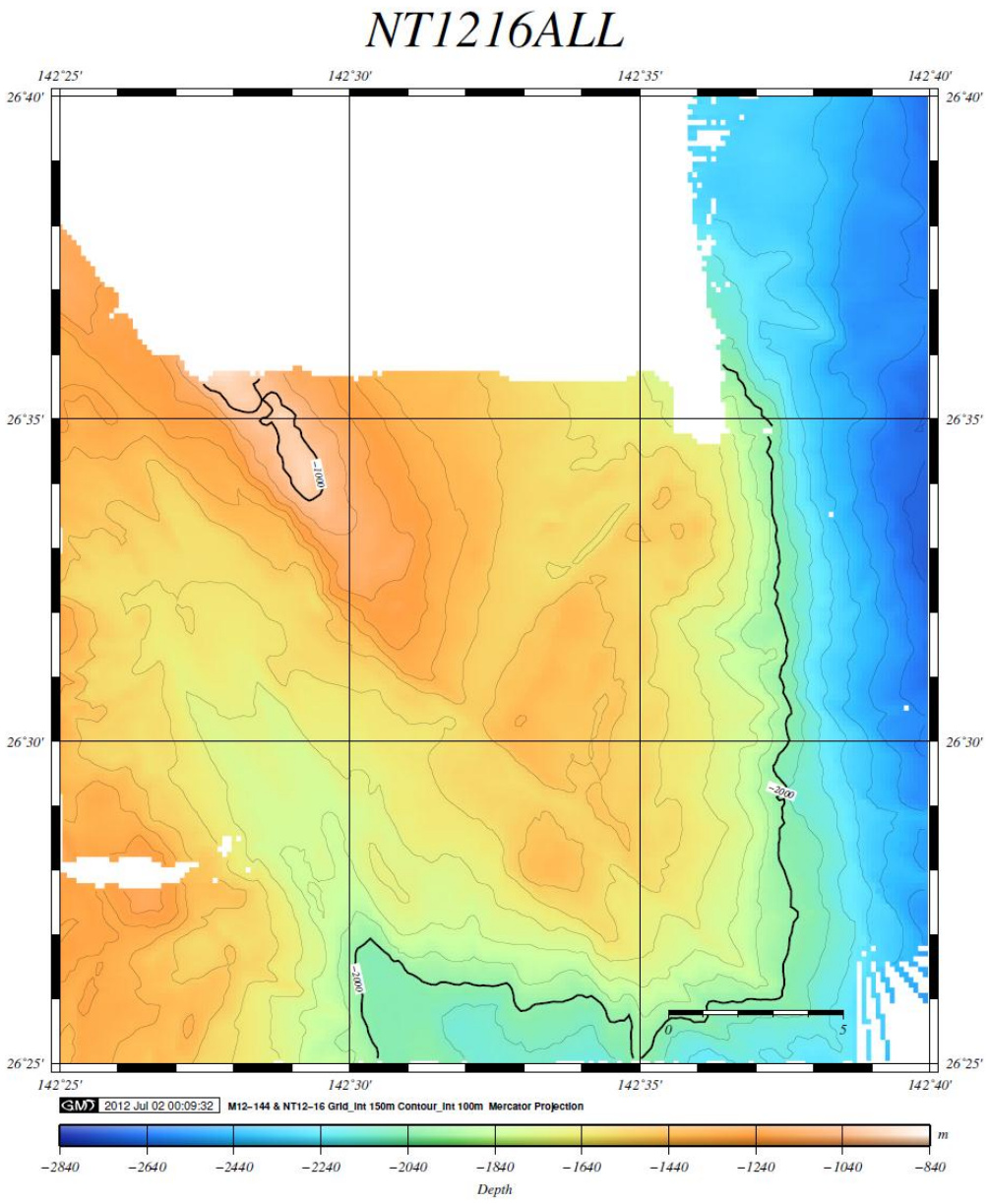

Figure 27. Detailed sea-floor map of the A region obtained in NT12-16 by the SeaBat.

4. Notice on Using

Notice on using: Insert the following notice to users regarding the data and samples obtained.

This cruise report is a preliminary documentation as of the end of the cruise.
This report may not be corrected even if changes on contents (i.e. taxonomic classifications) may be found after its publication. This report may also be changed without notice. Data on this cruise report may be raw or unprocessed. If you are going to use or refer to the data written on this report, please ask the Chief Scientist for latest information.
Users of data or results on this cruise report are requested to submit their results to the Data Management Group of JAMSTEC.