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YOKOSUKA “Cruise Report”

YK14-E01

(Off Tohoku)

Nov.13th, 2014-Nov.28th, 2014

Japan Agency for Marine-Earth Science and Technology

(JAMSTEC)

YK14-E01 cruise report Contents

1. Cruise Information

Cruise ID: YK14-E01
Name of vessel: YOKOSUKA
Title of the cruise: Geological and geophysical surveys for understanding Mega-earthquake and Tsunami mechanism in subduction zone: Paleoseismilogy: piston coring.
Chief scientist [Affiliation]: Toshiya Kanamatsu [CEAT-JAMSTEC]
Representative of Science Party [Affiliation]: Shuichi Kodaira [CEAT-JAMSTEC]
Title of proposal: Geological and geophysical surveys for understanding Mega-earthquake and Tsunami mechanism in subduction zone: Paleoseismilogy: piston coring.
Cruise period: 13th, Nov – 28th, Nov 2014
Ports of call: Sumitomo, Yokosuka -Hachinohe
Research area: Off Tohoku
Research map: Figure 1

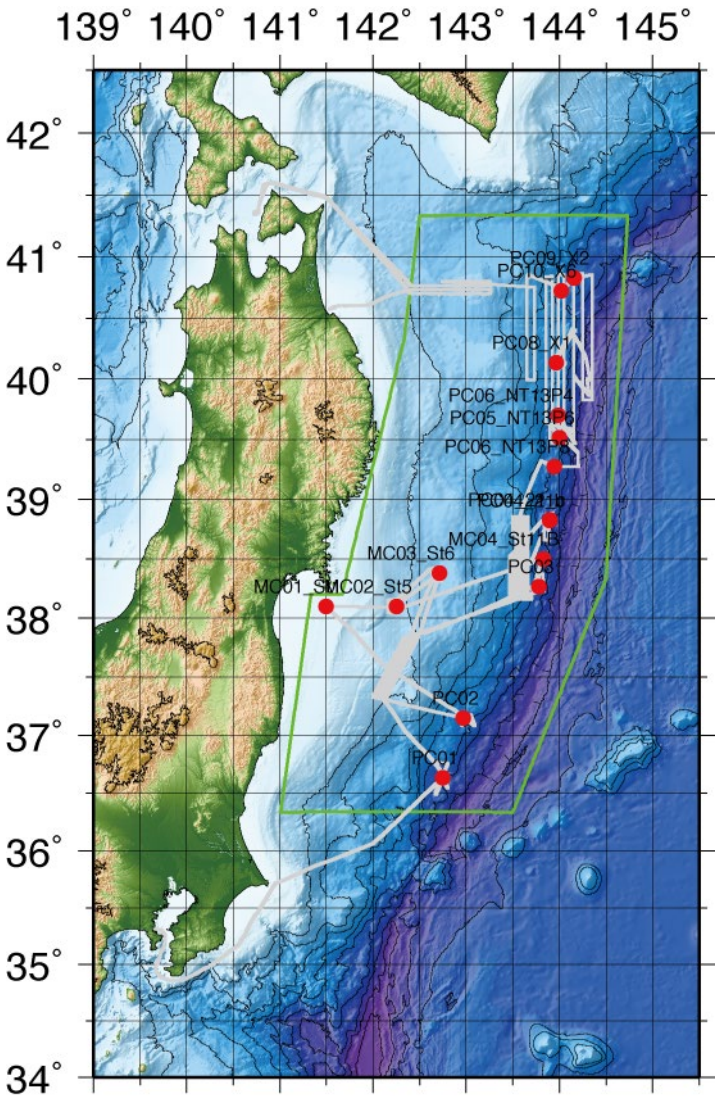


Figure 1: Sites for piston-coring and multiple-coring during YK14-E01 cruise

2. Participant list

Scientific party

Toshiya Kanamatsu	JAMSTEC
Ken Ikehara	AIST
Kazuko Usami	AIST
Kazuhiro Yoshida	Marine Works Japan Ltd
Akira Soh	Marine Works Japan Ltd
Hiroaki Hayashi	Marine Works Japan Ltd
Keiko Fujino	Marine Works Japan Ltd

R/V YOKOSUKA Ship Crew

Captain	SATOSHI SUSAMI
2nd Officer	HIROYUKI KATO
1st Officer	TAKAFUMI AOKI
2nd Officer	TOMOYUKI TAKAHASHI
3rd Officer	YUSUKE ISHI
Chief Engineer	KIYONORI KAJINISHI
1st Engineer	WATARU KUROSE
2nd Engineer	KATSUTO YAMAGUCHI
3rd Engineer	KAZUKI ONO
Chief Electronic op.	TAKEHITO HATTORI
2nd Elect. Op.	TAKATOMO SHIROZUME
3rd Elect. Op.	RYOSUKE KOMATSU
Boatswain	HATSUO ODA
Quarter Master	KAZUMI OGASAWARA
Quarter Master	YUKI YOSHINO
Quarter Master	TAKUMI YOSHIDA
Sailor	KAZUHO IKEDA
Sailor	RYOMA TAMURA
Sailor	YUTA MOTOOKA
No.1 Oiler	KAZUAKI NAKAI
Oiler	YUJI HIGASHIGAWA
Oiler	KOTA AIZAWA
Oiler	TOSHINORI MATSUI
Assistant Oiler	ATSUMU HARA
Chief Steward	TERUYUKI YOSHIKAWA
Steward	AKIO SUZUKI
Steward	YOSHIO OKADA
Steward	KENTO OKAZAKI
Steward	MANAMI TAKAHASHI

3. Cruise Log

YK14-E01 Cruise Log

Nov. 2014	
13	Left Yokosuka for the research area.
14	Site survey and coring at PC01 (36°38'N, 142‡°45'E WD 6200m)
15	Site survey and multiple-coring at MC01 and M C02 1、141°29.9904 38°6.0576（KT11-17_St.1）122m ２、142°15.0426 38°6.0151（KT11-17_St.5）893m night: site survey
16	Site survey and coring at PC02 (37°08'N, 143°00' WD: 5200m)
17	Site survey and coring at PC03(29b°38°16'N, 143°47.5'E)
18	Site survey and coring at MC3 (St.6 38°22.9121', 142°42.9633'（1446m）
19	Site survey and coring at MC4 (38°29.8344'N , 143°49.6504'E 5522m)
20	Site survey and coring at PC04(38°49.5'N、143°54'E (21C) 6000-6200m
21	Site survey and coring at PC05(39°16.4448'N , 143°56.6842'E) NT13-19PC08 (OSL)
22	Site survey and coring at PC06(39°30.9067'N , 143°59.9871'E NT13-19PC06 (OSL)
23	Site survey and coring at PC07(39°41.9525'N, 143°59.1968'E(NT13PC04)
24	Site survey and coring at PC08(40°08'N, 143°58'E (X1)
25	Site survey and coring at PC09&10 X2 40-49.7 N 144-09.5 E (5400m) and X6 40-43.5 N 144-01.5 E (4600m)
26	Box survey (multi-narrow & SBP)
27	Box survey (multi-narrow & SBP)
28	Arrived in port of Hachinohe

4. Objective and summary of observation

A long term prediction for earthquake in a subduction zone should be based on its recurrence interval and past displacements of a megathrust. Unfortunately no such research has been conducted in the deep Japan Trench subduction zone before the 2011 Tohoku earthquake. The recurrence of earthquakes could be understood by evaluating timing of event deposits in the sequences. In this study, not only in the trench axis where the most prominent displacement occurred, in the forearc basin and the landward slope areas. We first aim to document the evidence of the 2011 Tohoku-oki earthquake in the surface sediment, and then establish the earthquake recurrence in Tohoku-oki by identifying similar evidences in the past strata.

The target area in this cruise was the terrace in the lower landward slope: so called mid slope terrace. The water depth ranges from 4000 to 6000m.We visited the area, where was not been surveyed during the previous cruise NT13-19 for piston coring. Additionally multiple coring were conducted to investigate the surface sediment alteration after 2011 event in shallow water depth. Bathymetric and sub bottom surveys were also conducted. We conducted ten piston coring, and four multiple coring operations.

5. Instruments and Operation

5.1. Piston corer and Multiple corer

Piston corer system consists of 0.48 ton weight, 4 m and/or 6 m long stainless steel barrels trigger which works as the balance and a pilot core sampler. In addition, the polyvinyl chloride (PVC) liner tube is inside of the stainless steel barrel. The inner diameter (I.D.) of liner tube is 75 mm. The total weight of the system is approximately 0.7 ton. In this cruise, we used the piston for PVC liner tube. The PVC piston is composing of two or five O-rings (size: P63).

For a pilot core sampler, we used a "74 mm diameter long-type pilot corer". Pilot corer consists of 112 kg weight, 70 cm long stainless steel barrel and polycarbonate liner tube. The I.D. of polycarbonate liner tube is 74 mm.

The inclinometer (Alec-electronics ltd., APC-USB; maximum depth 7,000 m) was attached to the head of the PC weight to monitor the PC actions (including inclination, compass, acceleration and depth sensors).

The transponder (Benthos ltd., XT-6001 10 inch; maximum depth 6,000 m) was attached to the winch wire above or over 50 m from the PC to monitor the PC position.

About "K-value"

"K-value" means the hardness barometer of the sea floor sediment.

K-value = pure pull out load / (outer diameter of outer pipe * penetration length).

Because of winding power of the winch, we were requested to choose pipe length with referring "K-value".

Winch operation

When we started lowering PC, a speed of wire out was set to be 20 m/min, and then gradually increased to the maximum of 50 m/min. The corers were stopped at a depth about 100 m above the seafloor for about 3 minutes to reduce some pendulum motion of the system. After the corers were stabilized, the wire was started out at a speed of 20 m/min, and we carefully watched a tension meter. When the corers touched the bottom, wire tension abruptly decreases by the loss of the corer weight. Immediately after confirmation that the corers hit the bottom, wire out was stopped and winding of the wire was started at a speed of 20 m/min, until the tension gauge indicates that the corers were lifted off the bottom. After leaving the bottom, winch wire was wound in at the maximum speed.

Core splitting

The sediment sections are longitudinally cut into working and archive halves by a splitting devise and a nylon lineInstruments and Operation of Multiple corer (MWJ)

Multiple corer (MC)

Multiple corer (MC) consists of body (620 kg in weight) and four or eight sub-corer attachments. The sediment coring pipes are used the acryl pipes, those are 60 cm in length, and the diameter is 74 mm.

The transponder (Benthos ltd., XT-6001 10 inch; maximum depth 6,000 m) was attached to the winch wire above 50 m from the MC to monitor the MC position in MC03 and MC04.

Winch operation

When we started lowering MC, a speed of wire out was set to be 20 m/min, and then gradually increased to the maximum of 50 m/min. The corers were stopped at a depth about 50 m above the seafloor for about 3 minutes. After that, the wire is run in 20 m/min, and we carefully watched a tension meter. The changes of wire tension value are used whether MC arrive or leave from the sea floor. After leaving the bottom, winch wire was wound in at the maximum speed. The MC come back on the deck, sub-corer attachments are detached from the body.

Core splitting

The sediment sections are longitudinally cut into working and archive halves by a splitting devise and a nylon line or a stainless wire.

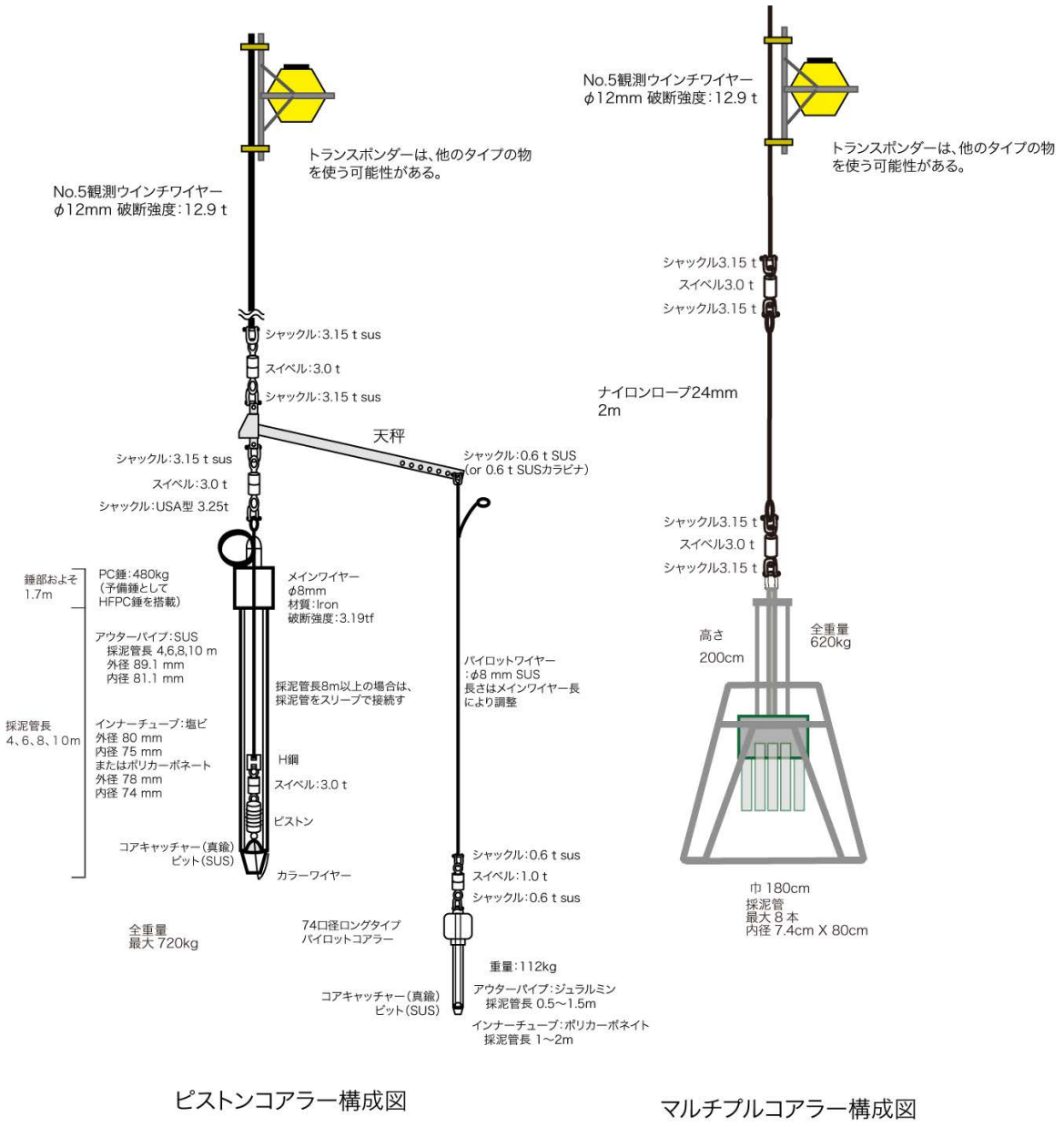


Figure 5.1. piston corer and multiple corer systems

5.2. Multi-narrow beam and subbottom profiler

Kongsberg EM122 Multi beam Echo sounder system, and EdgeTec 3300-HM SBP systems were used to collect bathymetric and subbottom image data in the study area. General specifications data are followings

EM 122 performance data

Operating frequency: 12 kHz（10.5kHz～13kHz）

288 beams with width of 2°

EdgeTec 3300-HM performance data

Frequency range: 2～16kHz, Center Frequency

Pulse type: FM

Pulse length 5～100ms

XBP measurement

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

Data Num	Date	time	Lat	Long	Probe Type	Max depth (m)
85	20141113	195646	36-37.3623N	142-44.0681E	T05	1831
86	20141114	121346	37-19.8932N	142-05.9115E	T07	761
87	20141114	212226	38-06.6292N	141-29.6979E	T07	761
88	20141115	85153	37-53.1846N	142-25.2703E	T07	761
90	20141116	224632	38-13.2492N	143-46.2133E	T05	1831
93	20141117	120735	37-52.1218N	142-28.0060E	T07	761
94	20141119	95409	38-29.6408N	143-33.9911E	T07	761
95	20141120	145754	38-49.3465N	143-34.0201E	T07	761
96	20141121	111100	40-16.4806N	144-02.9980E	T07	761
97	20141121	143406	40-48.4797N	143-59.3078E	T07	761
98	20141122	55225	39-41.4114N	143-51.3023E	T07	761
99	20141124	93522	40-32.3901N	144-15.0041E	T07	761
100	20141125	173052	40-45.2849N	143-43.9993E	T07	761
101	20141125	234828	40-47.9906N	142-40.3822E	T07	761

6. Preliminary Results

6.1. Summary of Piston coring Operation

Operations are summarized in Tables 6.1.1. and 6.1.2.

Table 6.1.1. : Summary of piston coring during YK14-E01 cruise.

Date (UTC) yyyy/mm/dd	Core ID	Location	Water Depth (m)	Position			Corer type		Core length (m)		Tension MAX (kN)	K value**
				Latitude	Longitude	Type	Type*	Weight	PC	PL		
2014/11/14	PC01	Off Tohoku	6,217 [1]	36_38.1220N	142_45.2801E	Transponder	IN PC	480 kg	4.752 / 6	1.190	54	0.28
2014/11/16	**PC02**	**Off Tohoku**	**5,186**	**37_08.7032N**	**142_57.9646E**	**Transponder [2]**	**IN PC**	**480 kg**	**5.379 / 6**	**1.185**	**40**	**0.14**
2014/11/17	PC03	Off Tohoku	5,611	38_16.0210N	143_46.7009E	Transponder	IN PC	480 kg	6.500 / 8	none	45	0.16
2014/11/20	**PC04**	**Off Tohoku**	**6,176**	**38_49.7313N**	**143_53.7937E**	**Transponder**	**IN PC**	**480 kg**	**4.105 / 8**	**none**	**48**	**0.29**
2014/11/21	PC05	Off Tohoku	4,963	39_16.4407N	143_56.7456E	Transponder	IN PC	480 kg	8.227 / 10	0.558	44	0.15
2014/11/22	**PC06**	**Off Tohoku**	**4,858**	**39_30.8680N**	**144_00.0161E**	**Transponder**	**IN PC**	**480 kg**	**8.171 / 10**	**0.306**	**44**	**0.17**
2014/11/23	PC07	Off Tohoku	4,722	39_41.9944N	143_59.2006E	Transponder	IN PC	480 kg	7.999 / 10	0.565	44	0.18
2014/11/24	**PC08**	**Off Tohoku**	**4,203**	**40_08.0264N**	**143_57.9590E**	**Transponder**	**IN PC**	**480 kg**	**4.829 / 6**	**0.950**	**36**	**0.34**
2014/11/24	PC09	Off Tohoku	5,381 [3]	40_50.1189N	144_09.5359E	Transponder [4]	IN PC	480 kg	5.195 / 6	none	42	0.15
2014/11/25	**PC10**	**Off Tohoku**	**4,640 [5]**	**40_43.5536N**	**144_01.4267E**	**Transponder**	**IN PC**	**480 kg**	**4.798 / 6**	**none**	**42**	**0.24**

***K value is the strength barometer of the sea floor sediment; K value = pure pull out load / (outer diameter of outer pipe * penetration length).

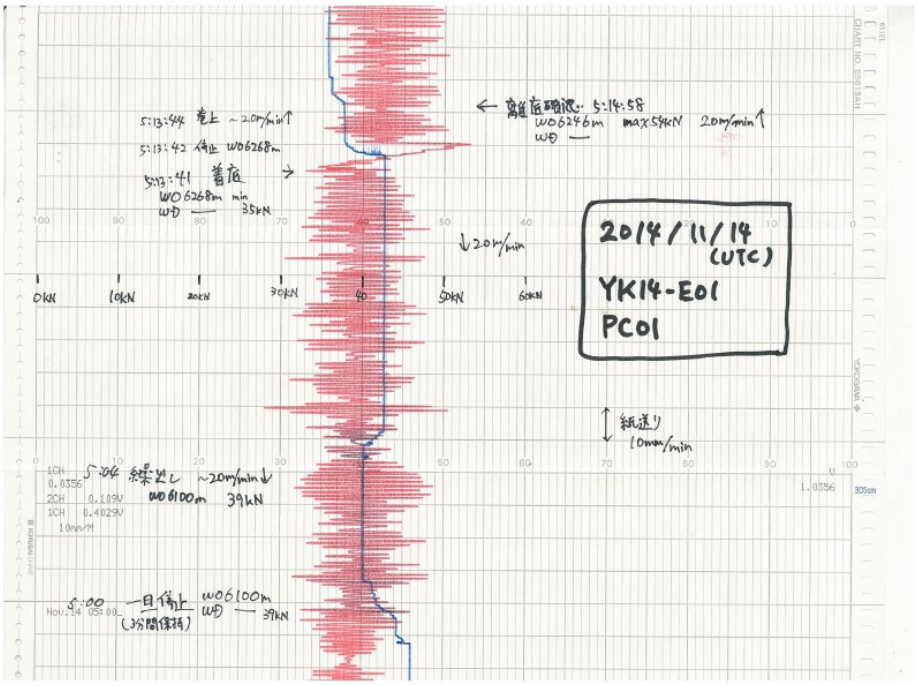
Table 6.1.2. : Summary of multiple coring during YK14-E01 cruise

Date (UTC) yyyy/mm/dd	Core ID	Frame No.	Location	Water Depth (m)	Position			Corer type		Core length (m)	Tension MAX (t)
					Latitude	Longitude	Type	Type*	Weight	(m) / HAND No.	
2014/11/14	MC01	改5	Off Tohoku	121	38-06.1102N	141-29.9740E	Ship	Acrylic	620 kg	0.320 / 1	8
		改3								0.325 / 4	
		改2								0.328 / 5	
		1								0.265 / 8	
2014/11/15	MC02	6	Off Tohoku	884	38-06.0623N	142-15.0009E	Ship	Acrylic	620 kg	0.260 / 1	19
		改1								0.305 / 4	
		改2								0.320 / 5	
		改4								0.305 / 8	
2014/11/17	MC03	1	Off Tohoku	1,422 [1)]	38_22.9302N	142_42.9411E	Transponder [2)]	Acrylic	620 kg	0.320 / 1	18
		14								0.325 / 4	
		改5								0.330 / 5	
		改3								0.315 / 8	
2014/11/18	MC04	改4	Off Tohoku	5,544	38_29.8524N	143_49.6653E	Transponder [3)]	Acrylic	620 kg	0.320 / 1	40
		改5								0.325 / 2	
		1								0.320 / 3	
		6								0.305 / 4	
		改1								0.320 / 5	
		14								0.325 / 6	
		改3								0.320 / 7	
		2								0.320 / 8	

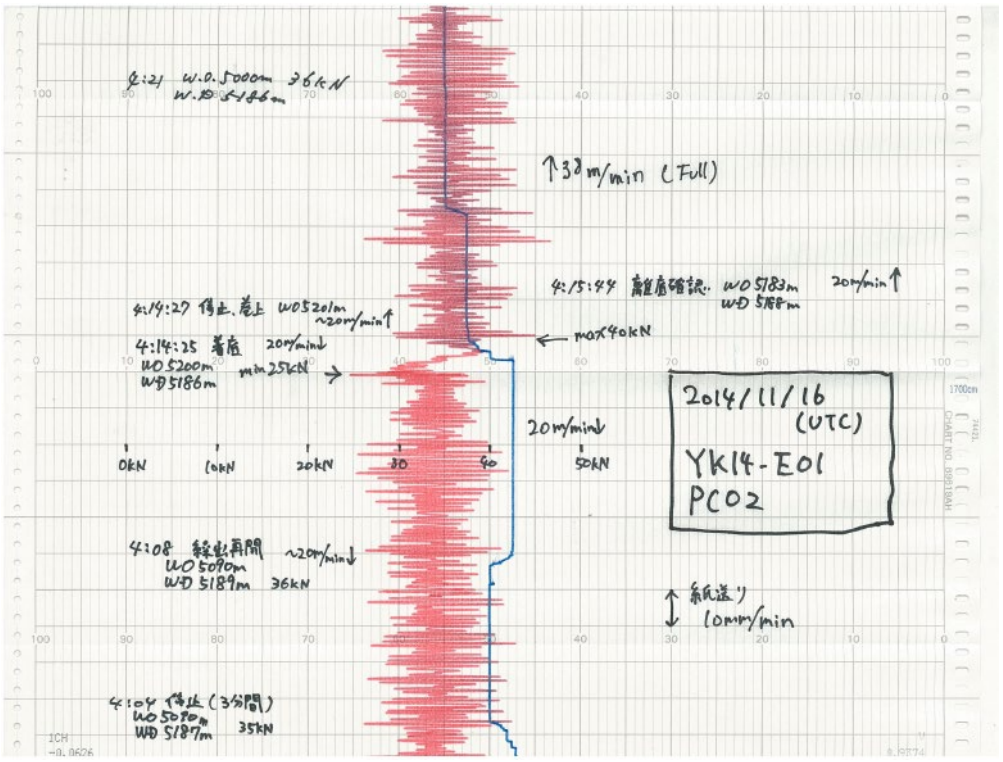
6.2. Winch wire tension records of the piston corer and multiple corer operations

Tension records of each operation are shown in figures below.

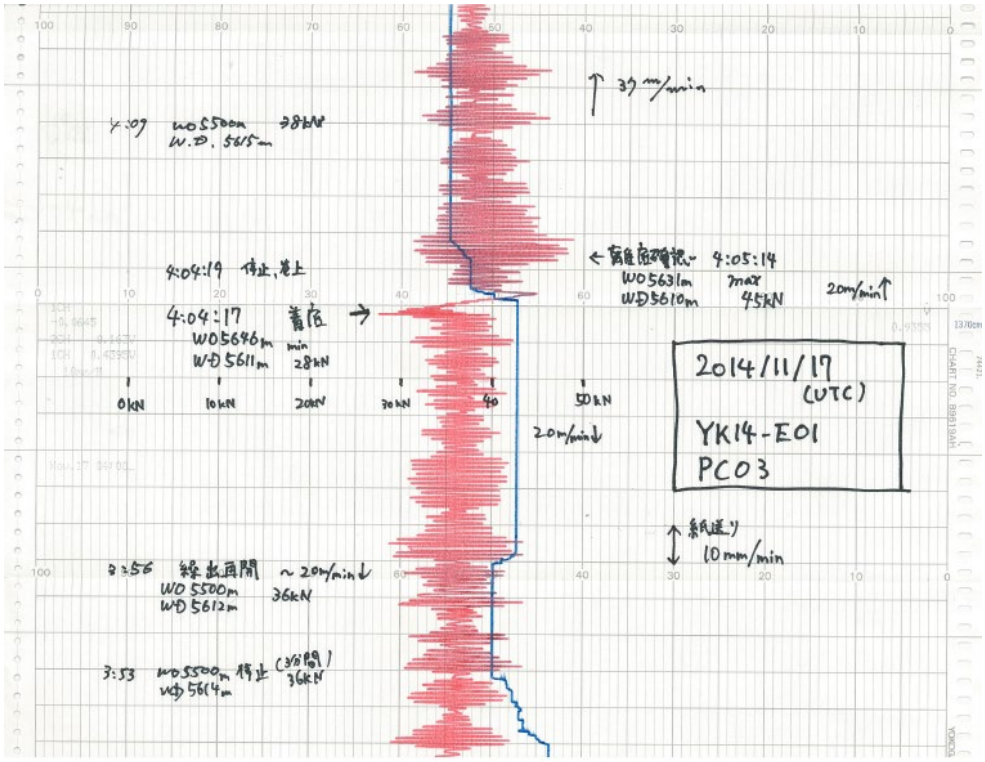
YK14-E01 PC01



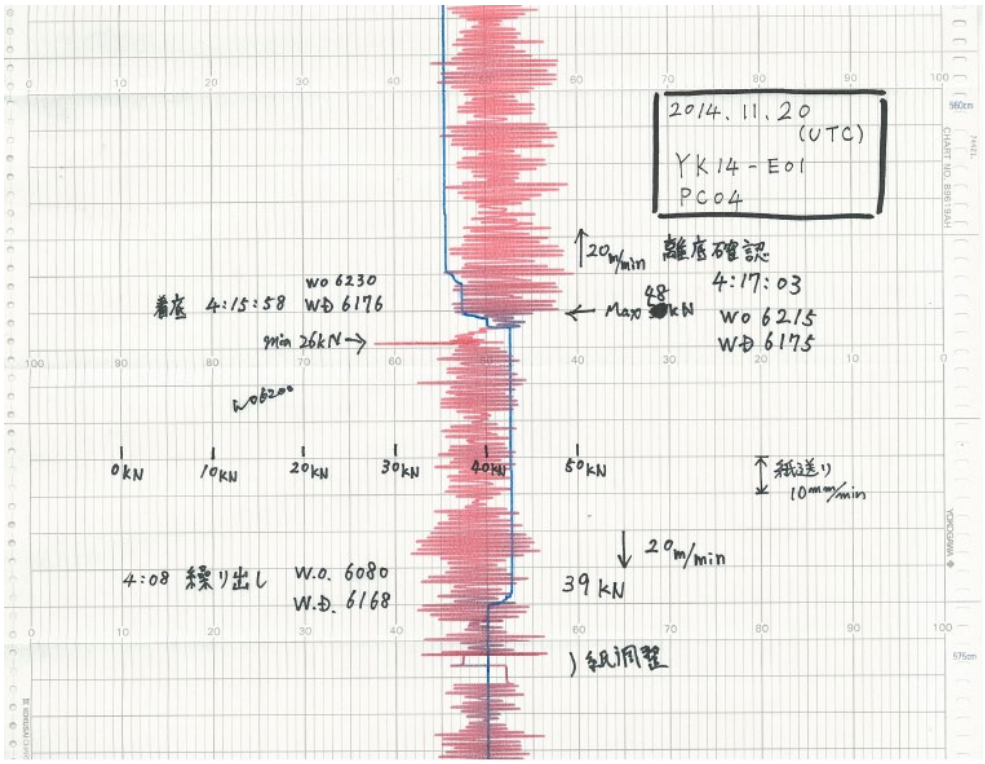
YK14-E01 PC02



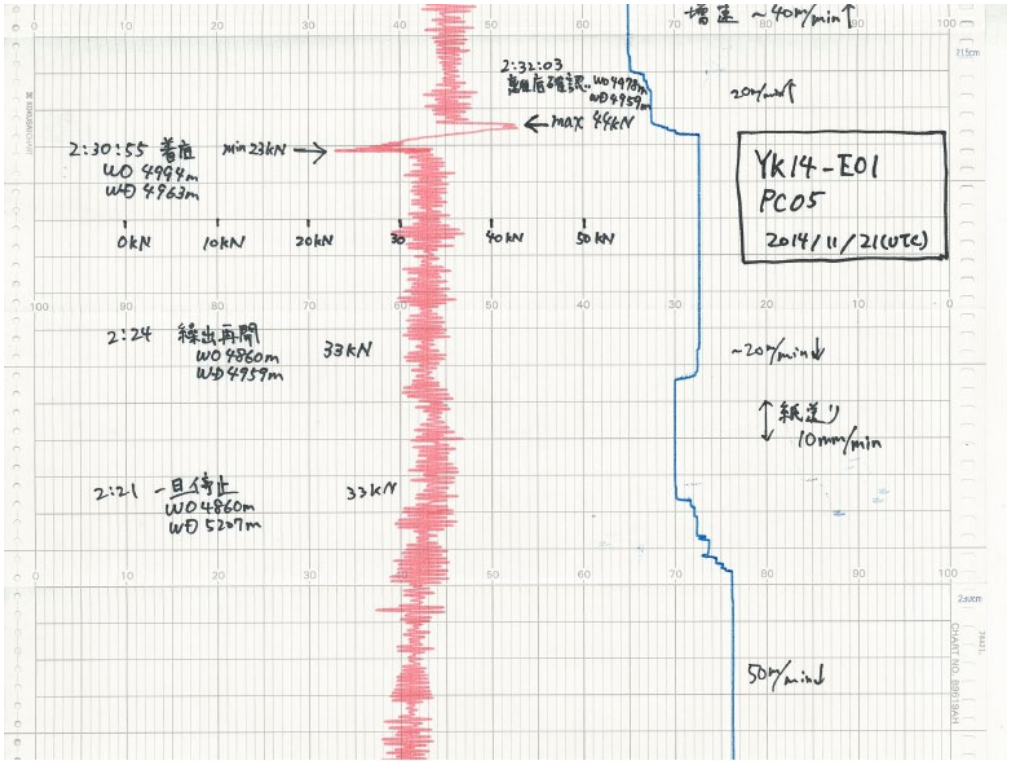
YK14-E01 PC03



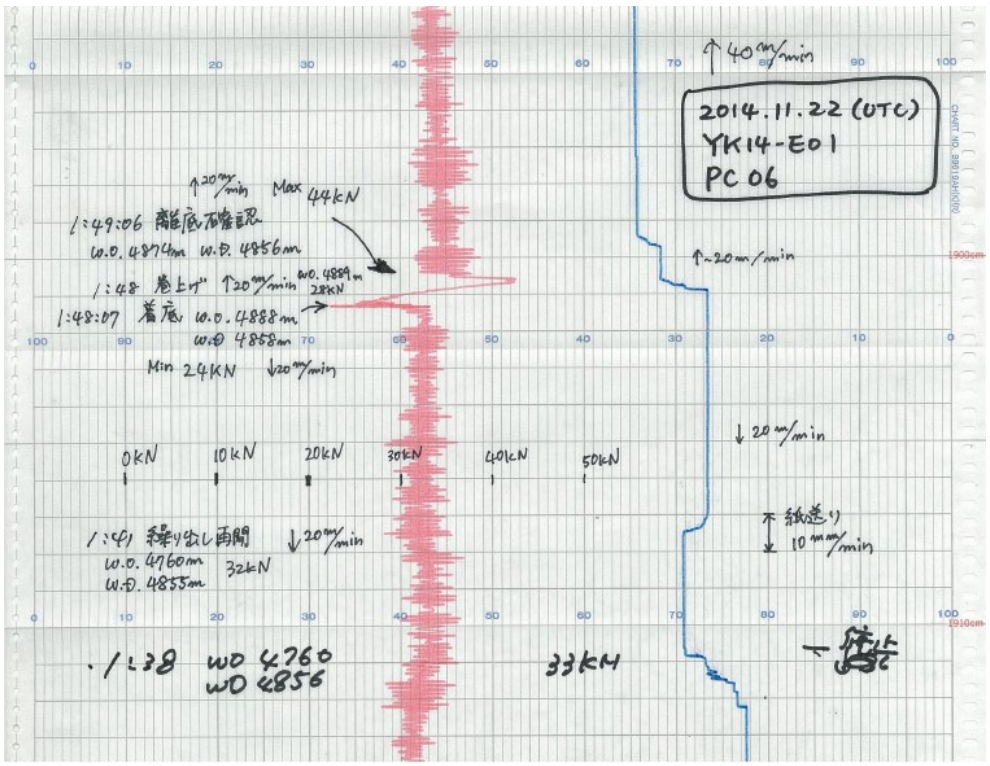
YK14-E01 PC04



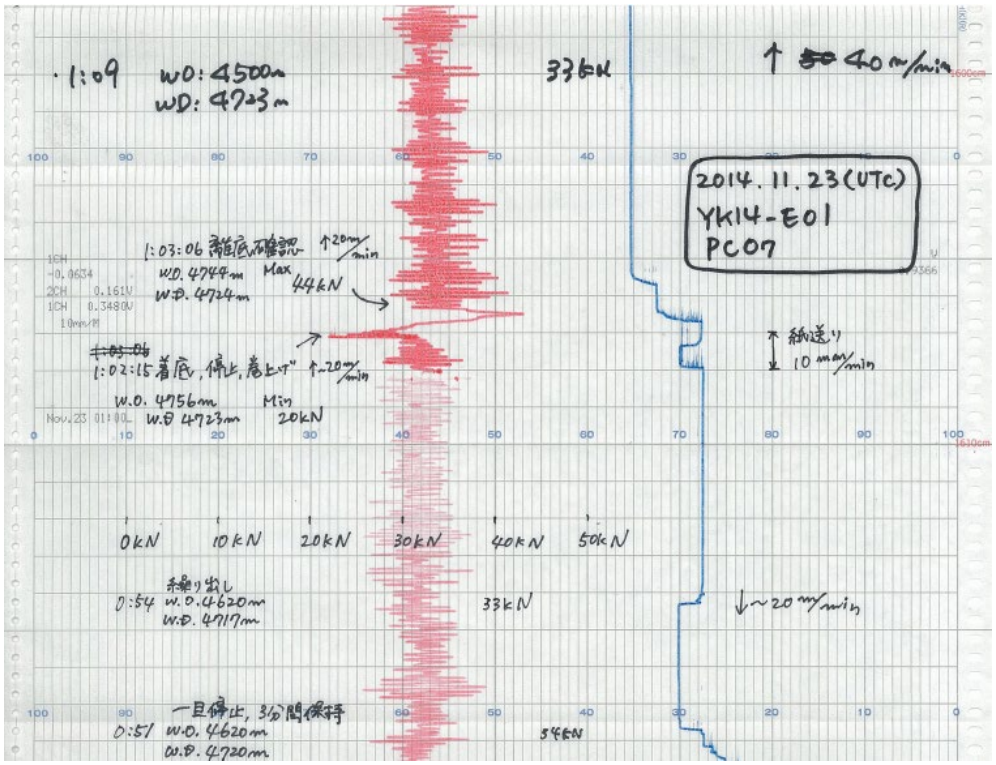
YK14-E01 PC05



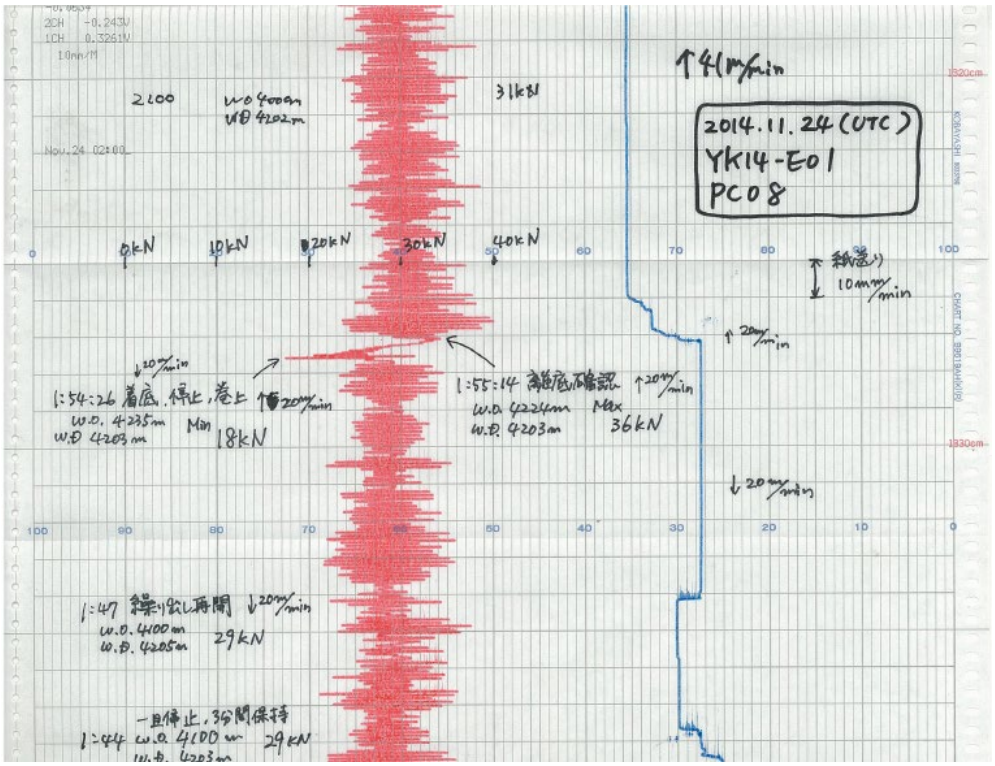
YK14-E01 PC06



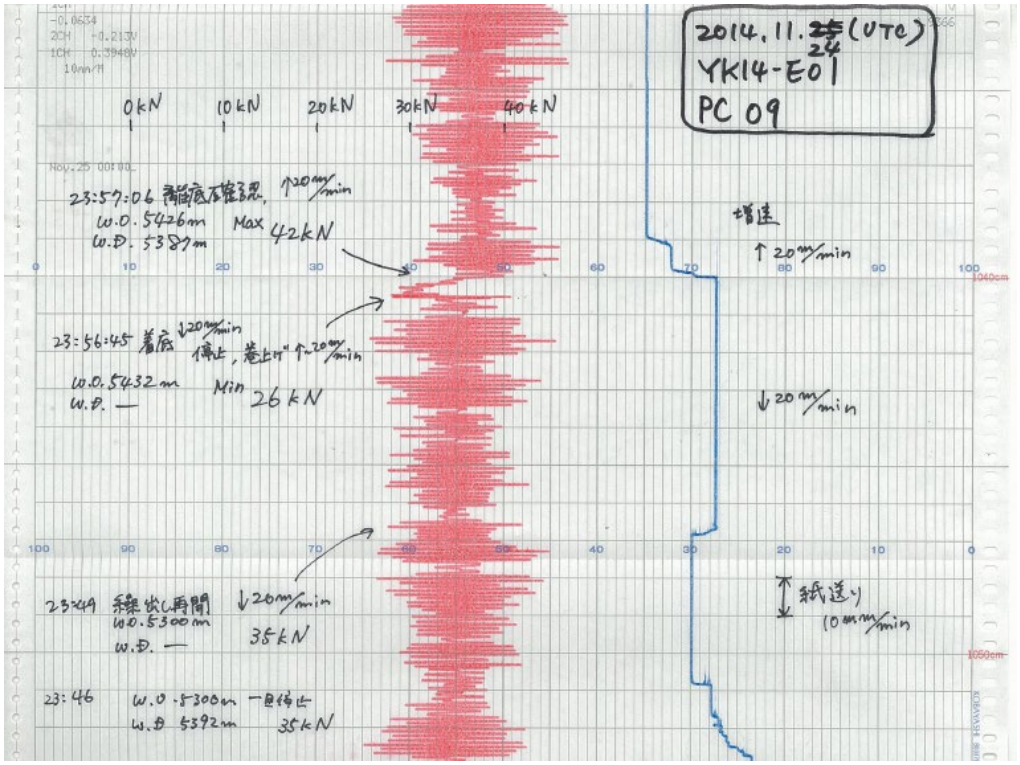
YK14-E01 PC07



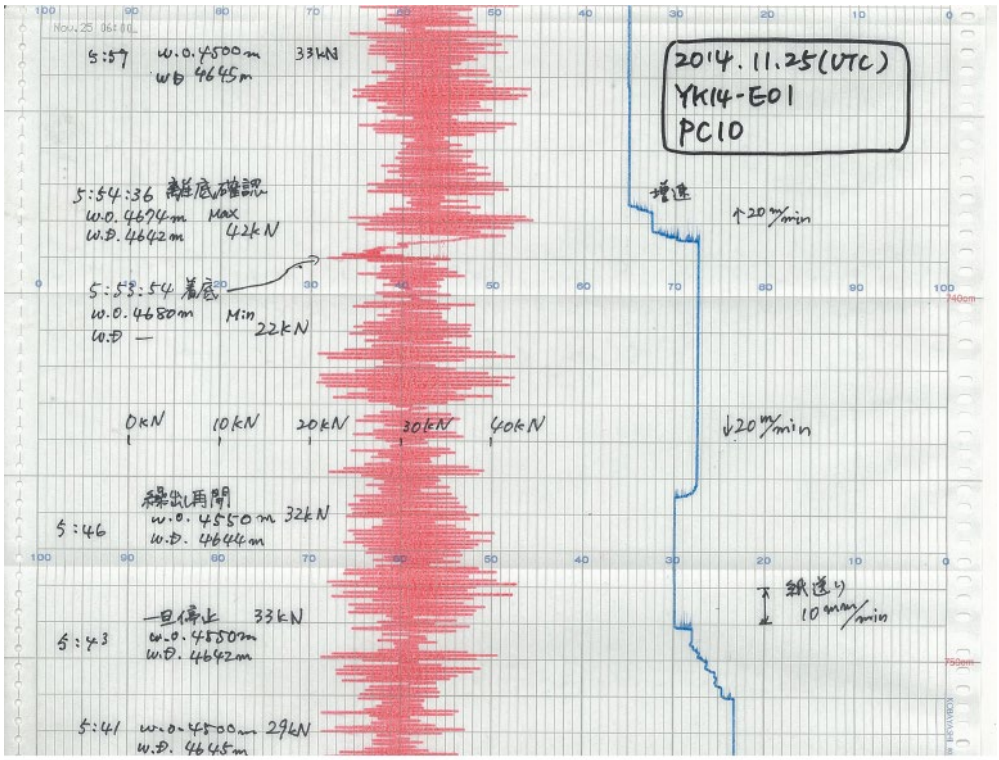
YK14-E01 PC08



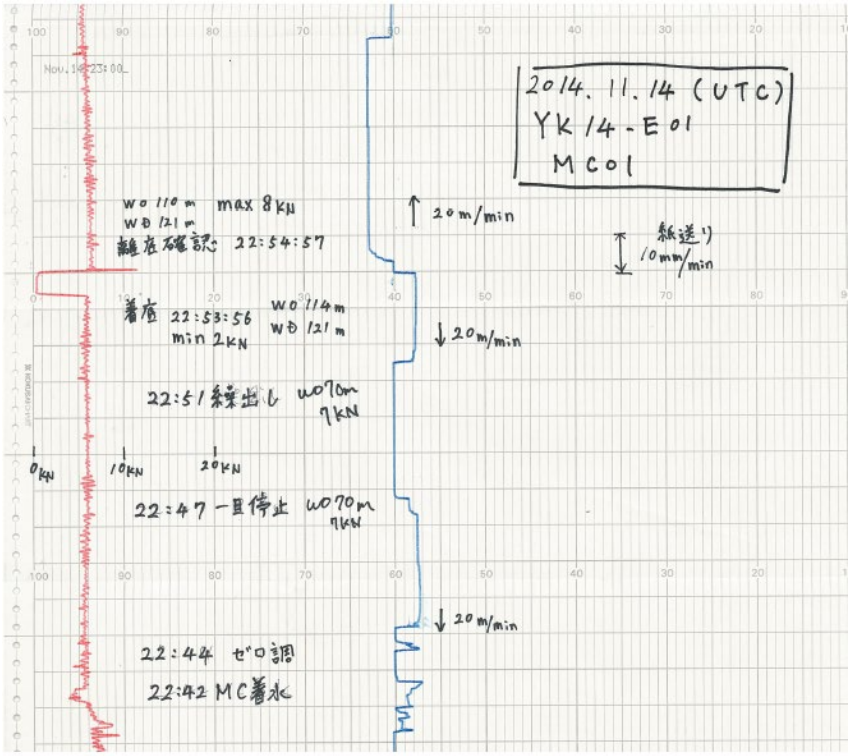
YK14-E01 PC09



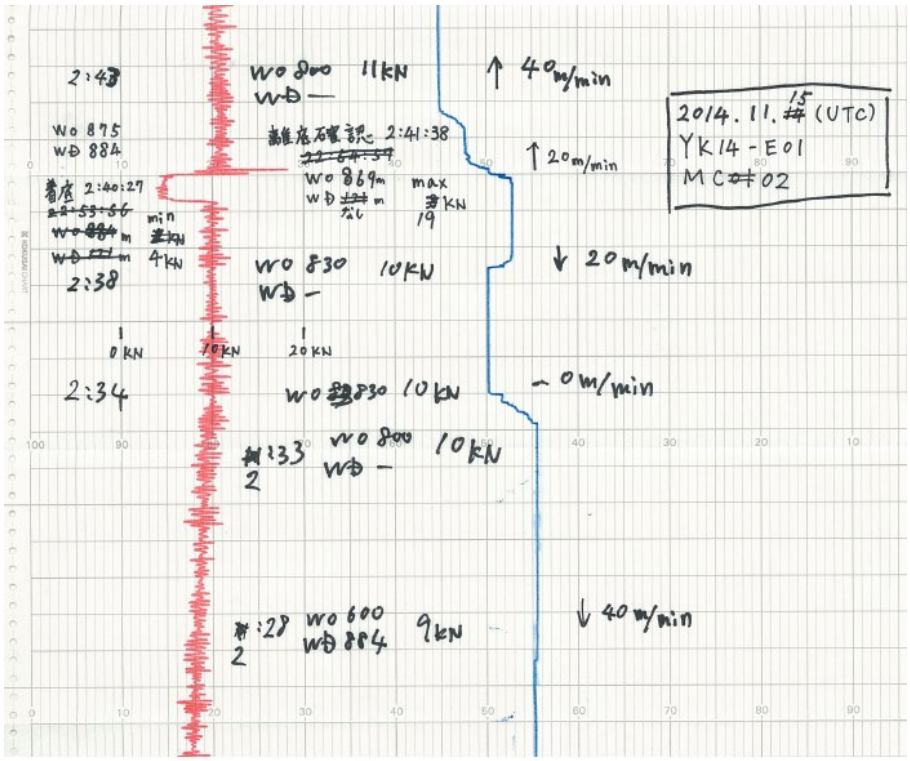
YK14-E01 PC10



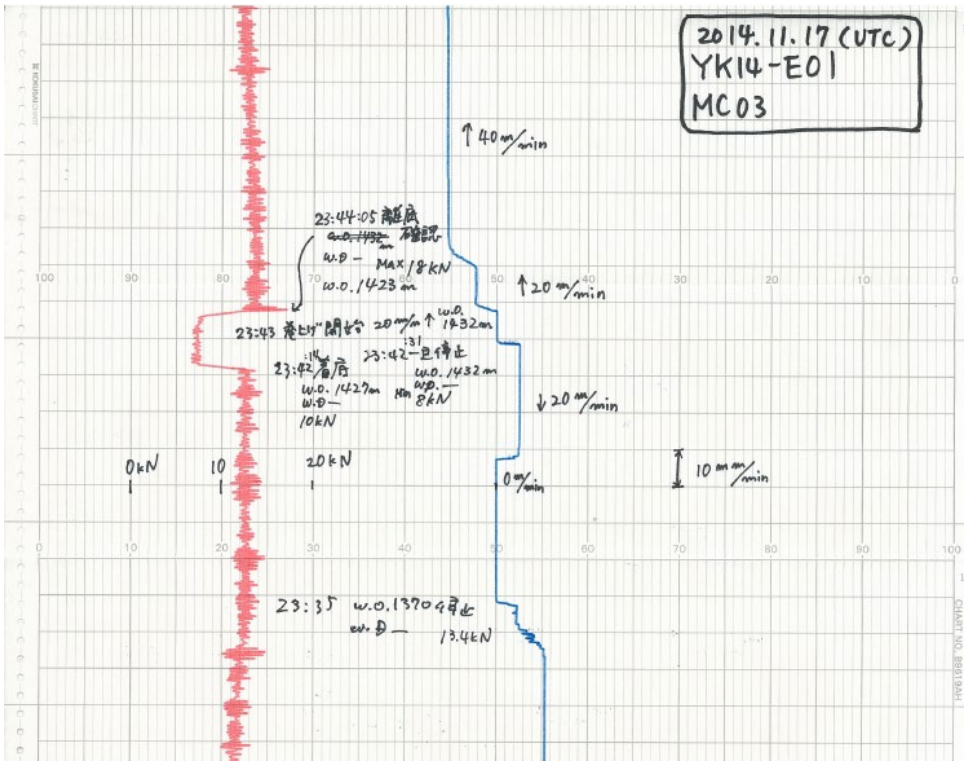
YK14-E01 MC01



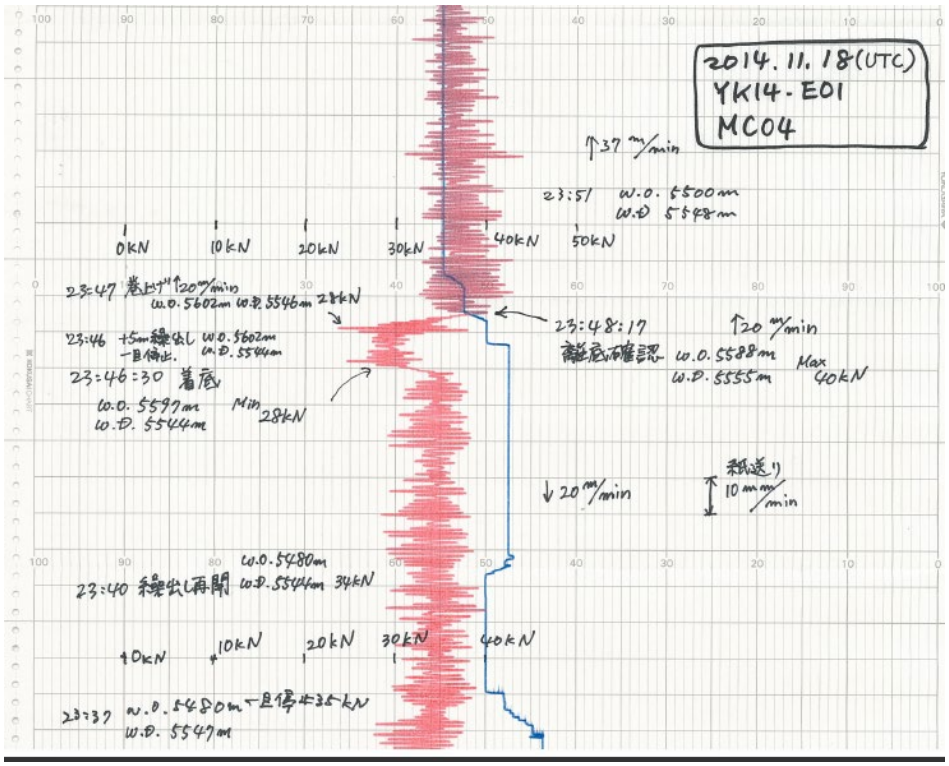
YK14-E01 MC02



YK14-E01 MC03



YK14-E01 MC04



6.3. Lithology of Piston cores and Multiple cores

Ken Ikehara (Geological Survey of Japan, AIST)

Core lithology is summarized in the **Figs. 6.3.1 – Figs. 6.3.3**

Note: Because PC05 & PC06 were for OSL measurements and were not split to halved sections, there were no figures for PCs. Length of sections area summarized in **Table 6.3.1**

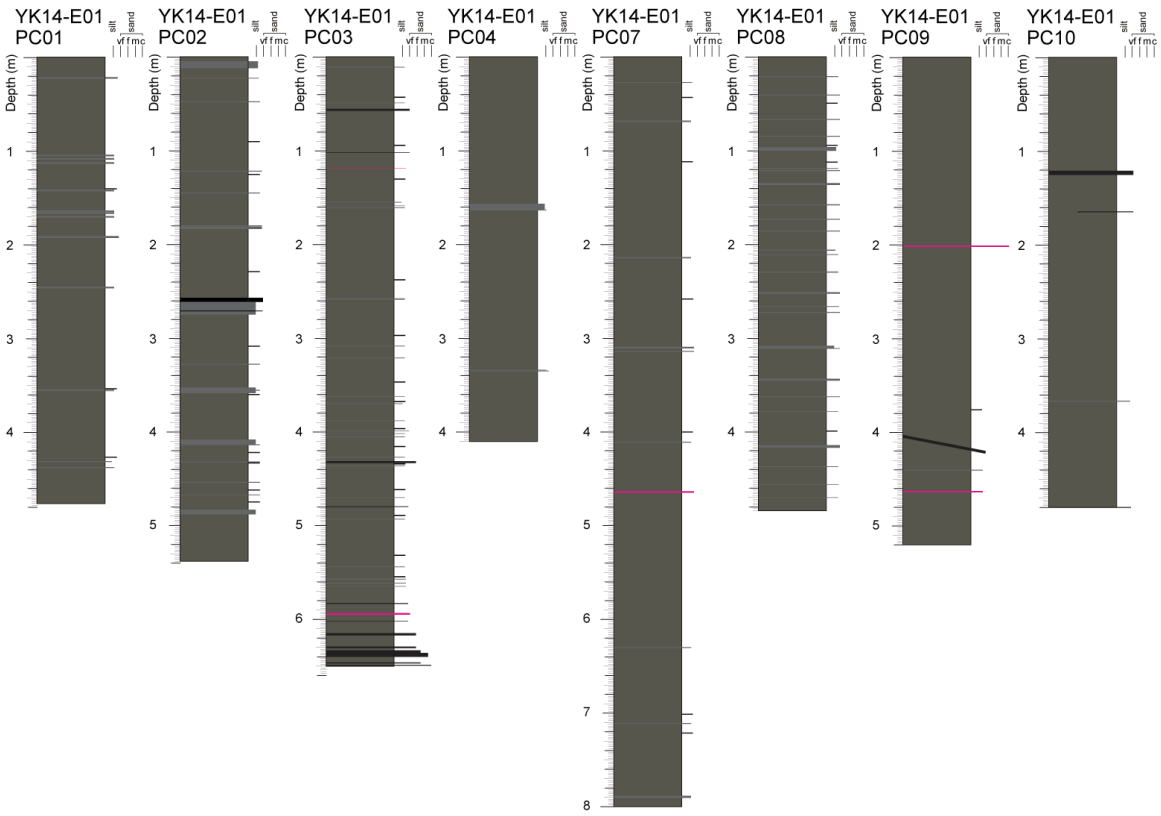


Fig. 6.3.1. lithology of piston cores taken during YK14-E01

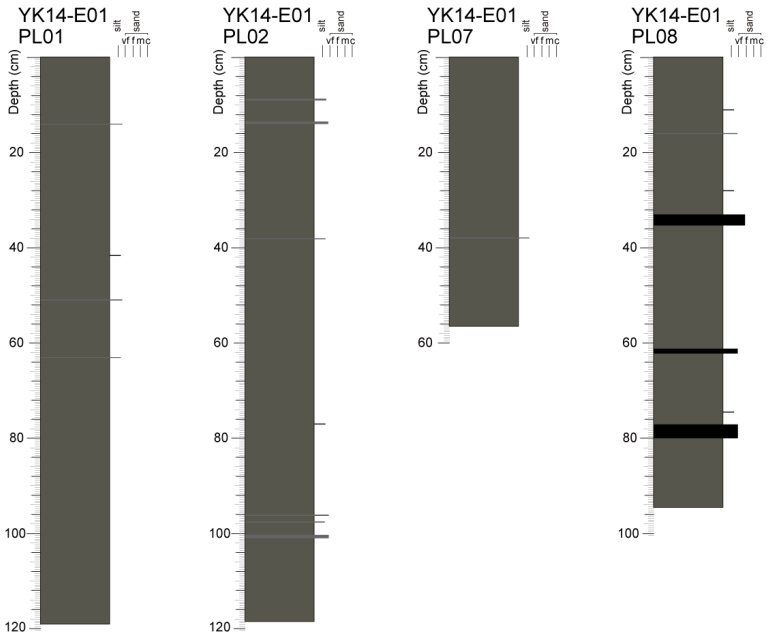


Fig. 6.3.2. lithology of PL cores taken during YK14-E01

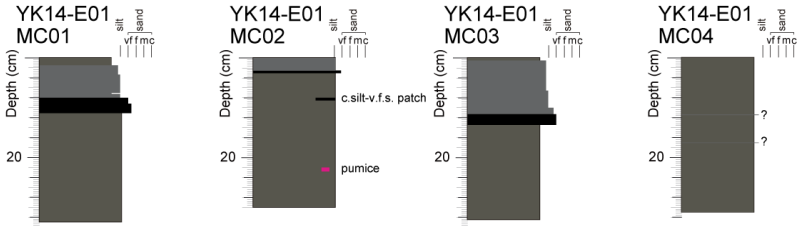


Fig. 6.3.3. lithology of MC cores taken during YK14-E01

Table 6.3.1. : Section Length of cores obtained during YK14-E01

NT14-E01 Section Length

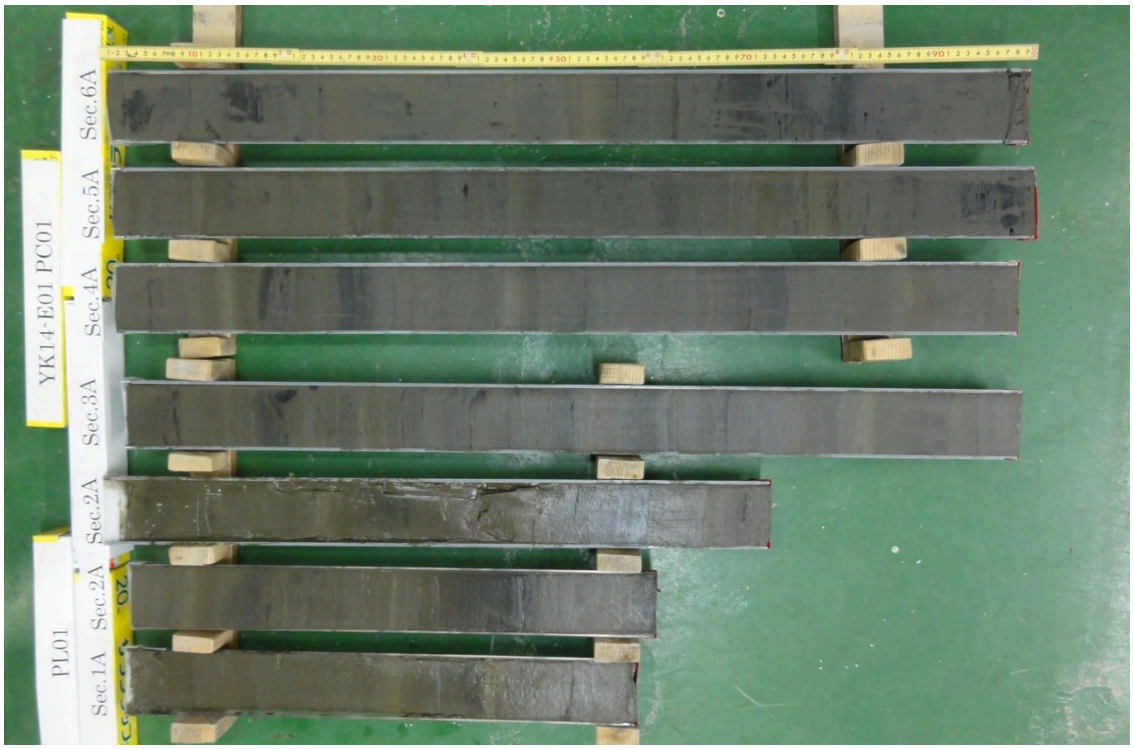
Core	Section No.	Section Length (cm)	Total Length (cm)
PC01	2	74.0	
	3	100.3	
	4	99.7	
	5	101.2	
	6	100.0	
			475.2
PL01	1	58.5	
	2	60.5	
			119.0
PC02	1	39.5	
	2	100.0	
	3	99.7	
	4	100.0	
	5	100.2	
	6	98.5	
			537.9
PL02	1	80.0	
	2	38.5	
			118.5
PC03	2	44.5	
	3	100.0	
	4	100.0	
	4-2	10.5	
	5	99.5	
	6	100.0	
	7	100.0	
	8	95.5	
			650.0
PL03	1	0.0	
			0.0
PC04	1	12.5	
	2	100.0	
	3	100.0	
	4	100.0	
	5	95.0	
			410.5
PL04	1	0.0	
			0.0
PC05	2		
	3		
	4		
	5		
	6		
	7		
	8		
	9		
	10		
	cc		
PL05	1		
PC06	2		
	3		
	4		
	5		
	6		
	7		
	8		
	9		
	10		
	cc		
PL06	1		

Core	Section No.	Section Length (cm)	Total Length (cm)
PC07	2	2.0	
	3	99.7	
	4	99.5	
	5	100.0	
	6	100.0	
	7	100.0	
	8	100.0	
	9	100.2	
	10	98.5	
			799.9
PL07	1	56.5	
			56.5
PC08	2	85.0	
	3	100.2	
	4	99.9	
	5	99.8	
	6	98.0	
			482.9
PL08	1	95.0	
			95.0
PC09	1	22.5	
	2	100.3	
	3	100.0	
	4	99.9	
	5	99.8	
	6	97.0	
			519.5
PL09	1	0.0	
			0.0
PC10	2	73.5	
	3	100.3	
	4	99.7	
	5	99.8	
	6	94.5	
	cc	12.0	
			479.8
PL10	1	0.0	
			0.0

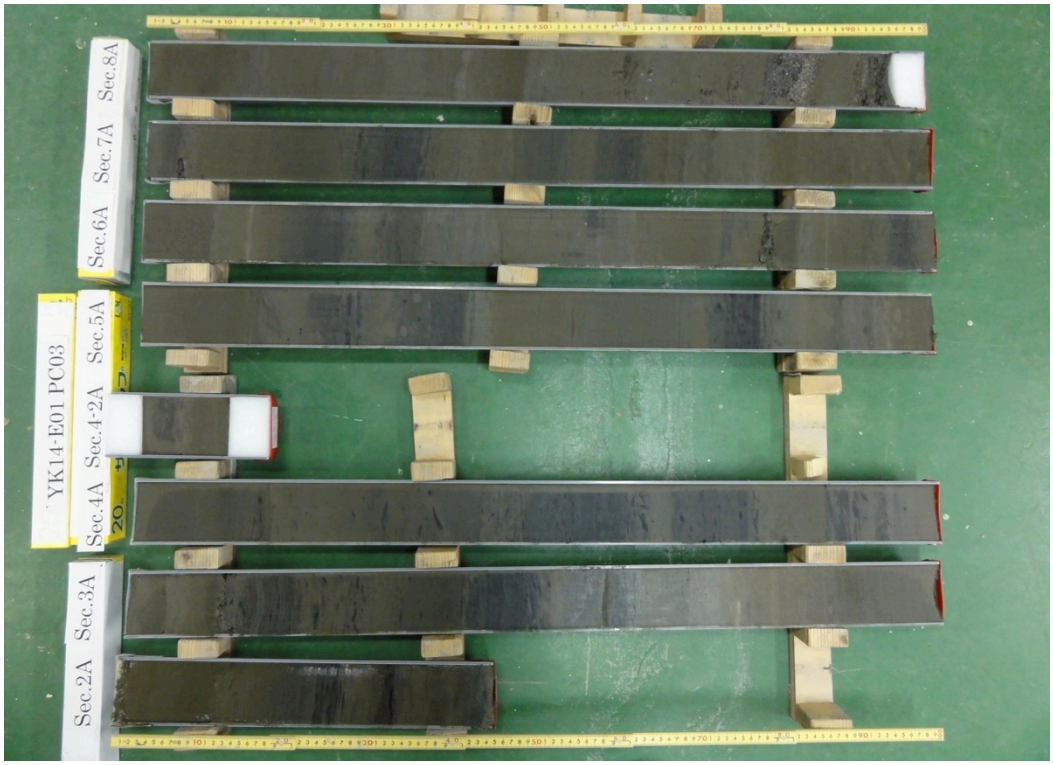
6.4. Core Photographs

Core photographs of split sections are shown below.

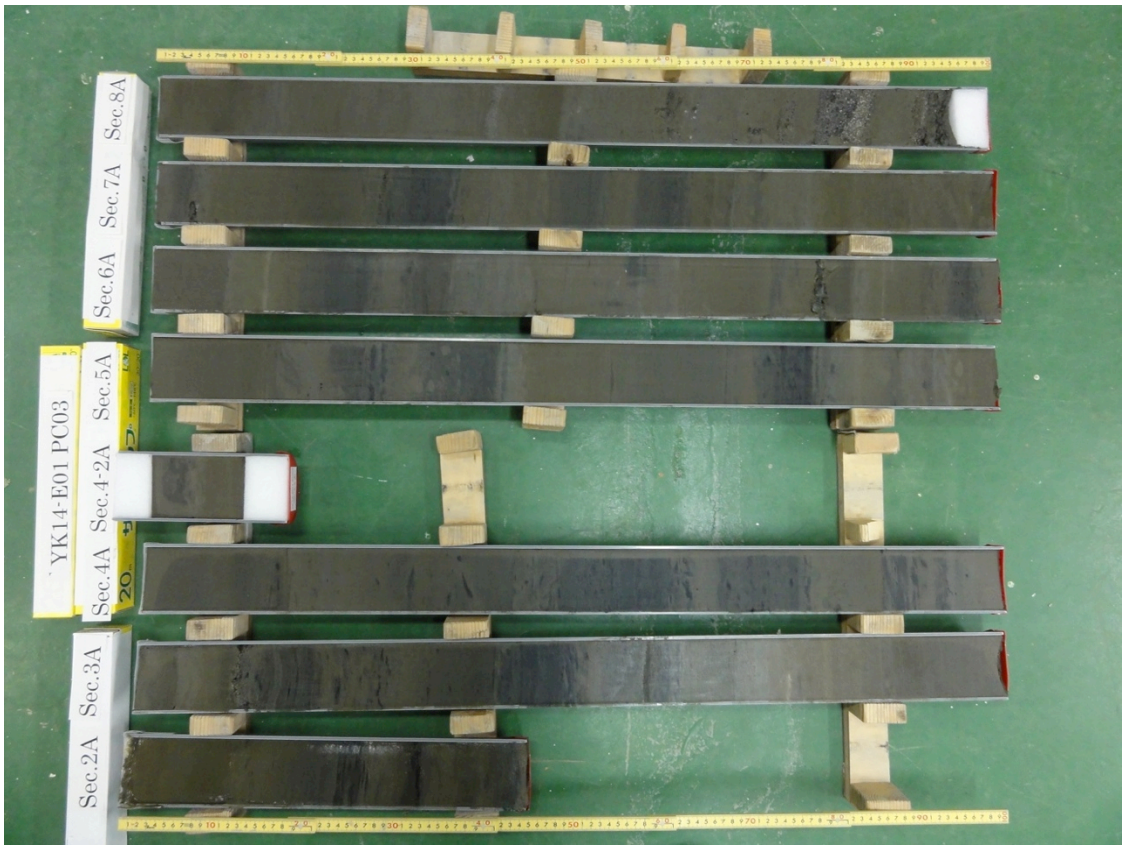
YK14-E01 PC-01



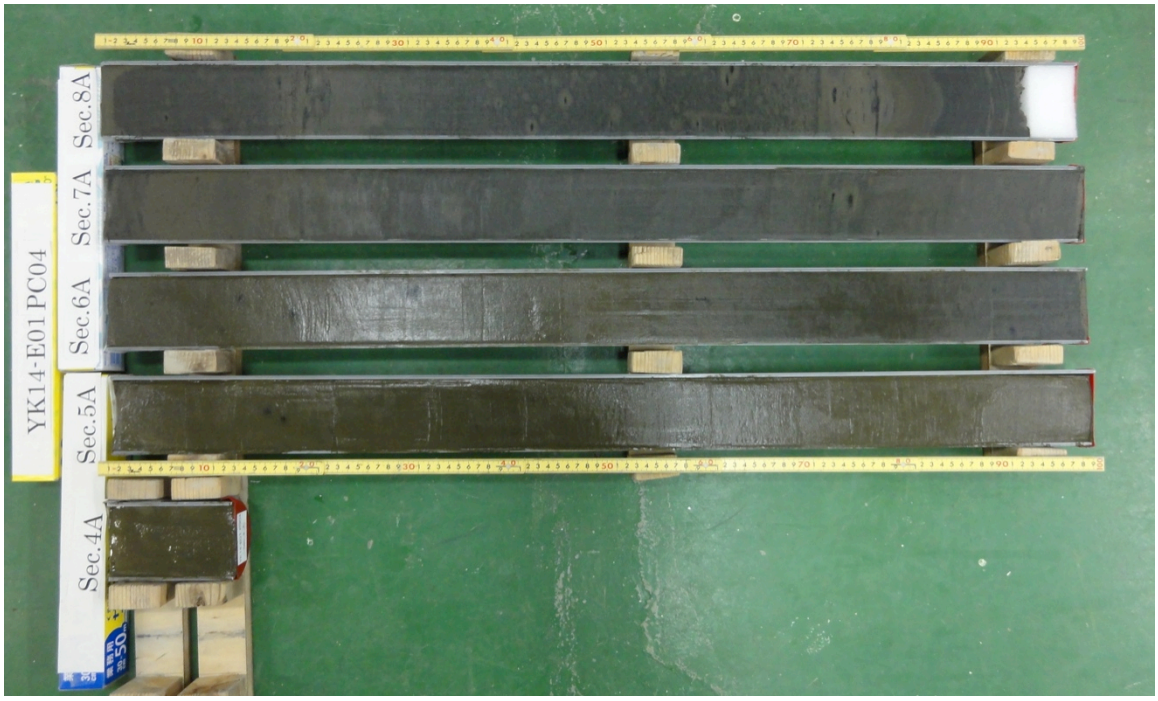
YK14-E01 PC-02



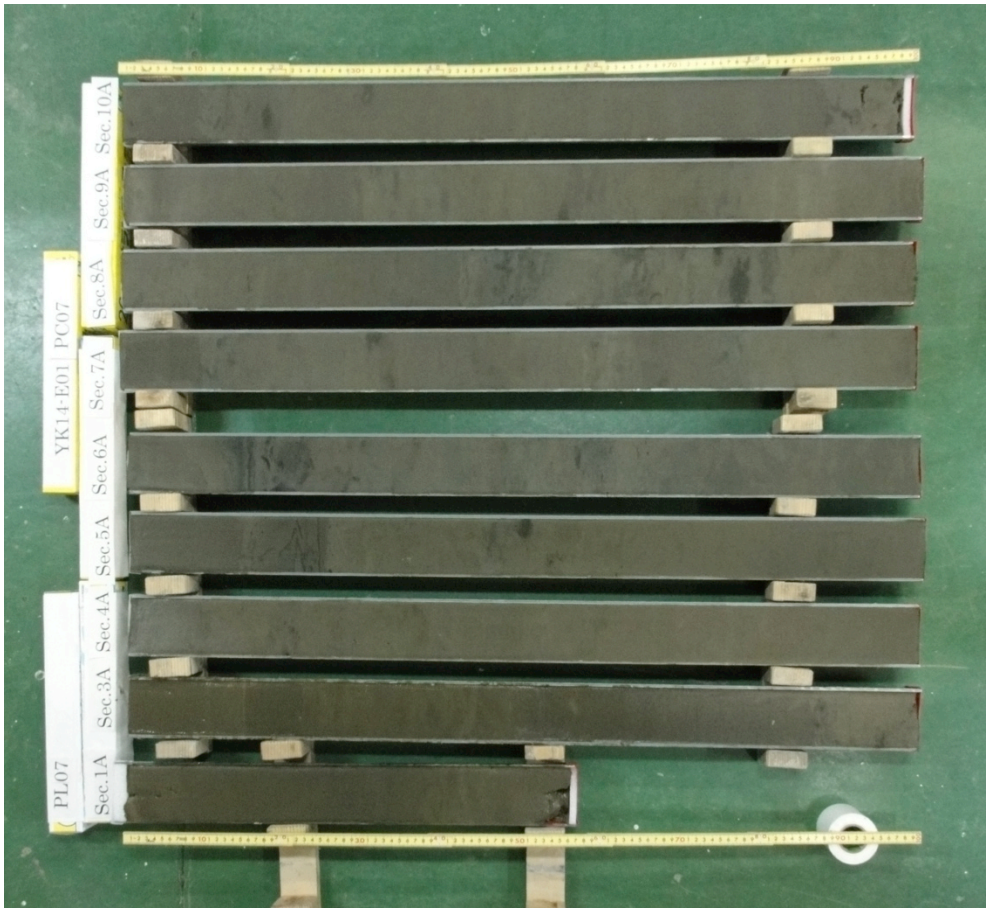
YK14-E01 PC-03



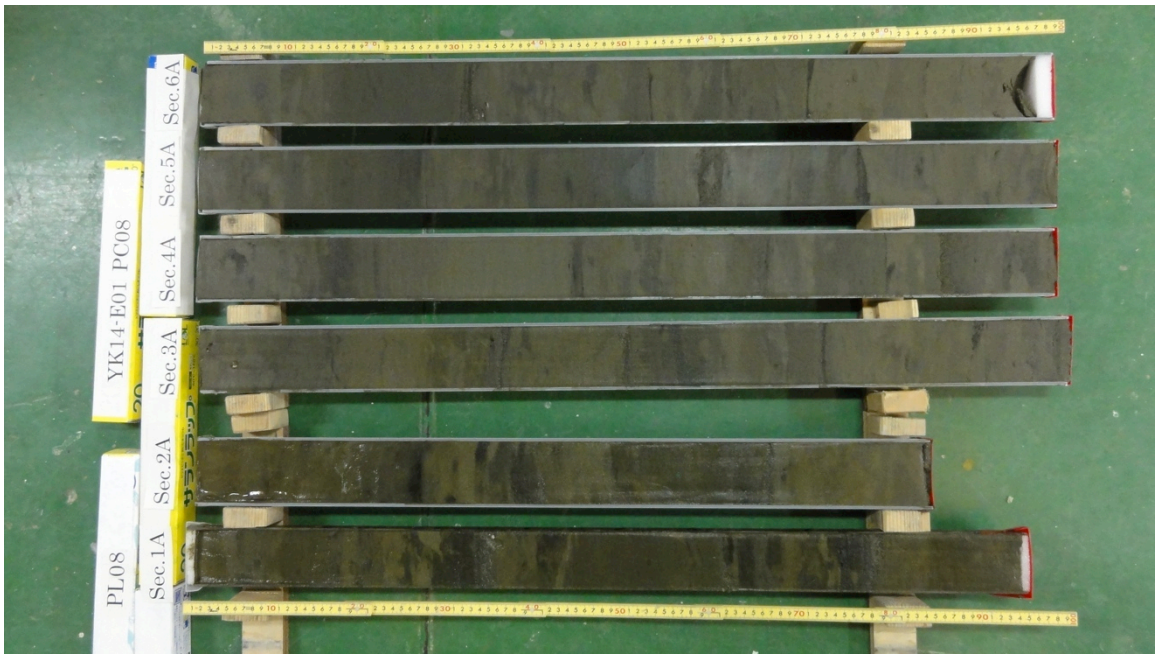
YK14-E01 PC-04



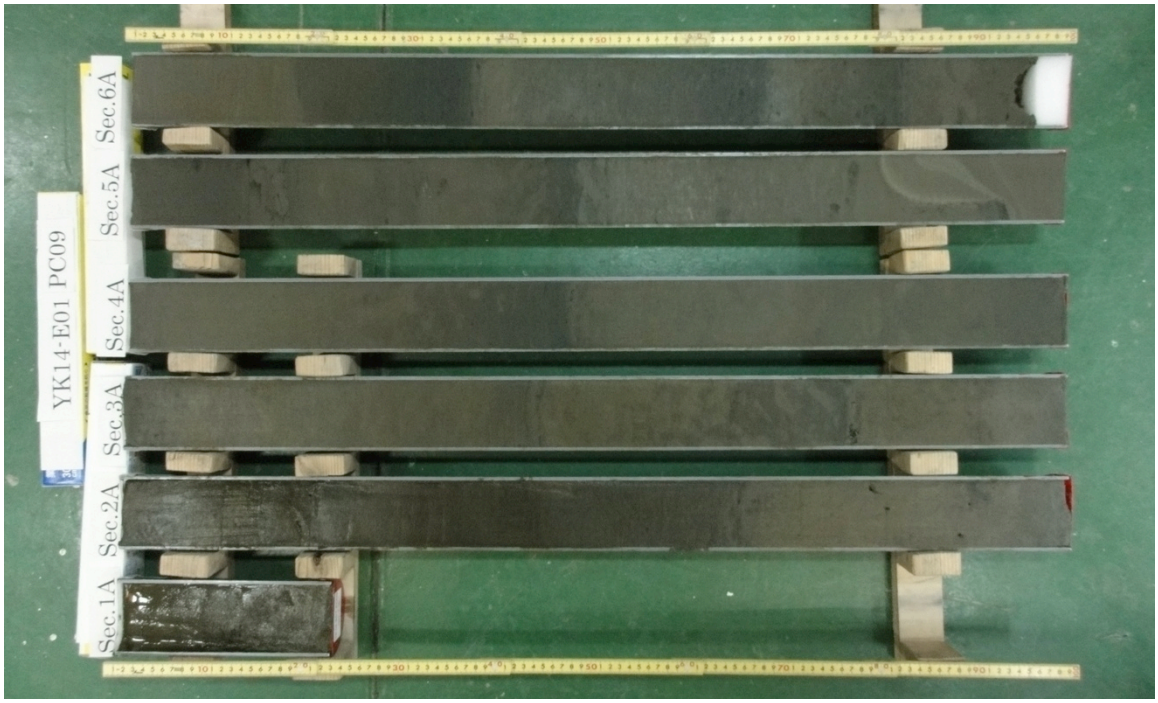
YK14-E01 PC-07



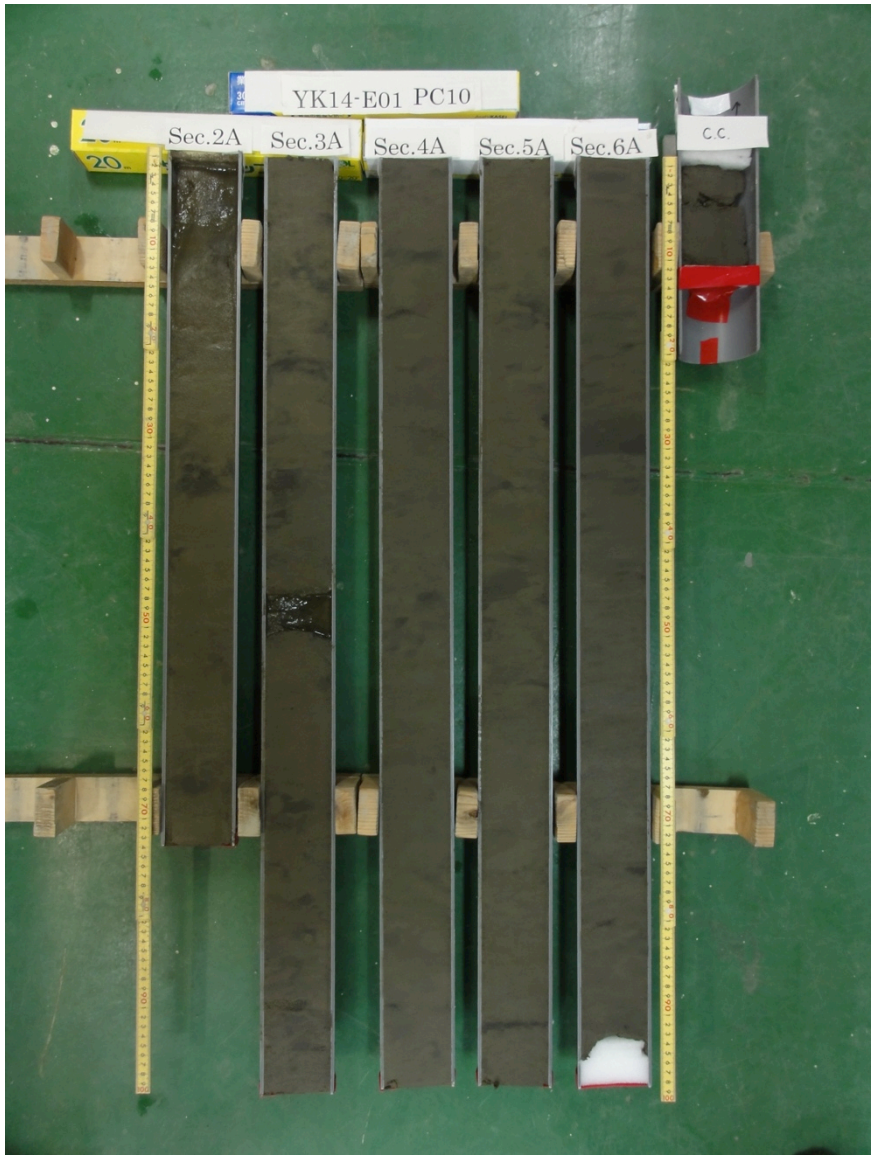
YK14-E01 PC-08



YK14-E01 PC9



YK14-E01 PC10


YK14-E01 PC10
Sec.2A
Sec.3A
Sec.4A
Sec.5A
Sec.6A
C.C.

7. Multi-narrow beam survey

Bathymetric data were collected by a hull-mounted multi-narrow beam mapping system. Figure 7 shows the mapped areas during the cruise. Detail maps are shown below.

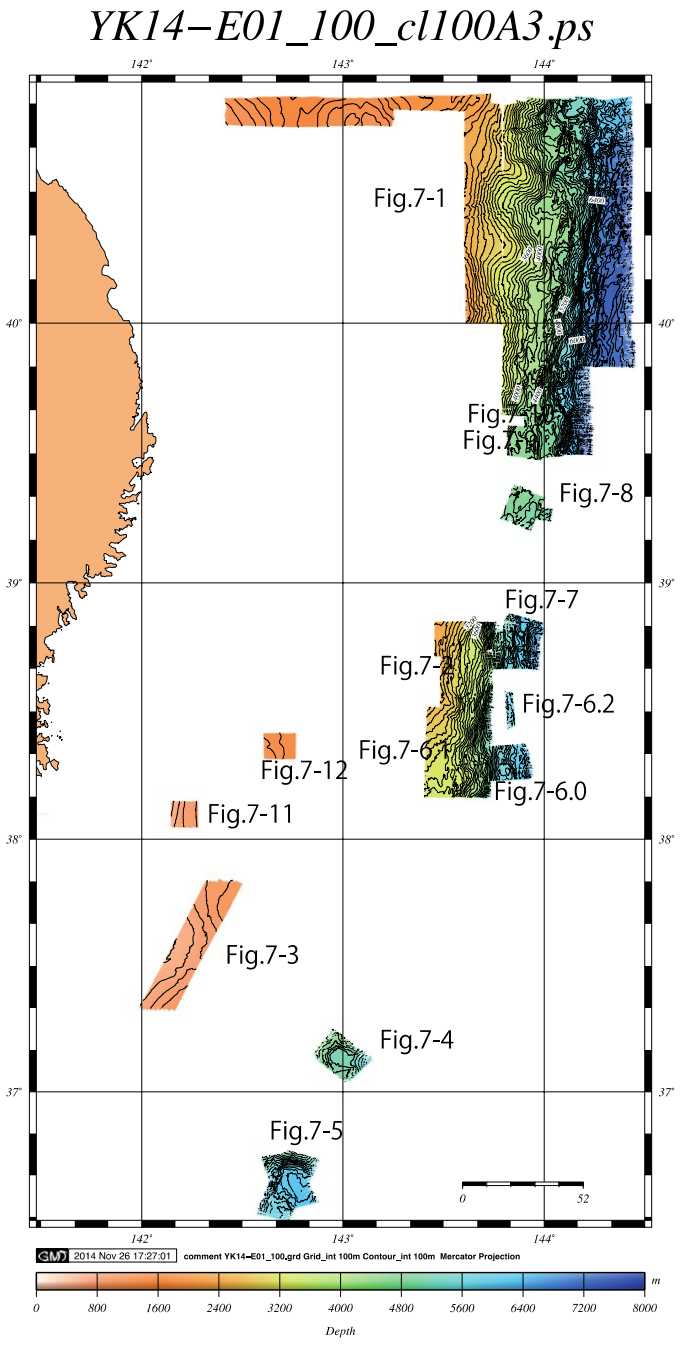


Figure 7 Legend map of topographic survey .

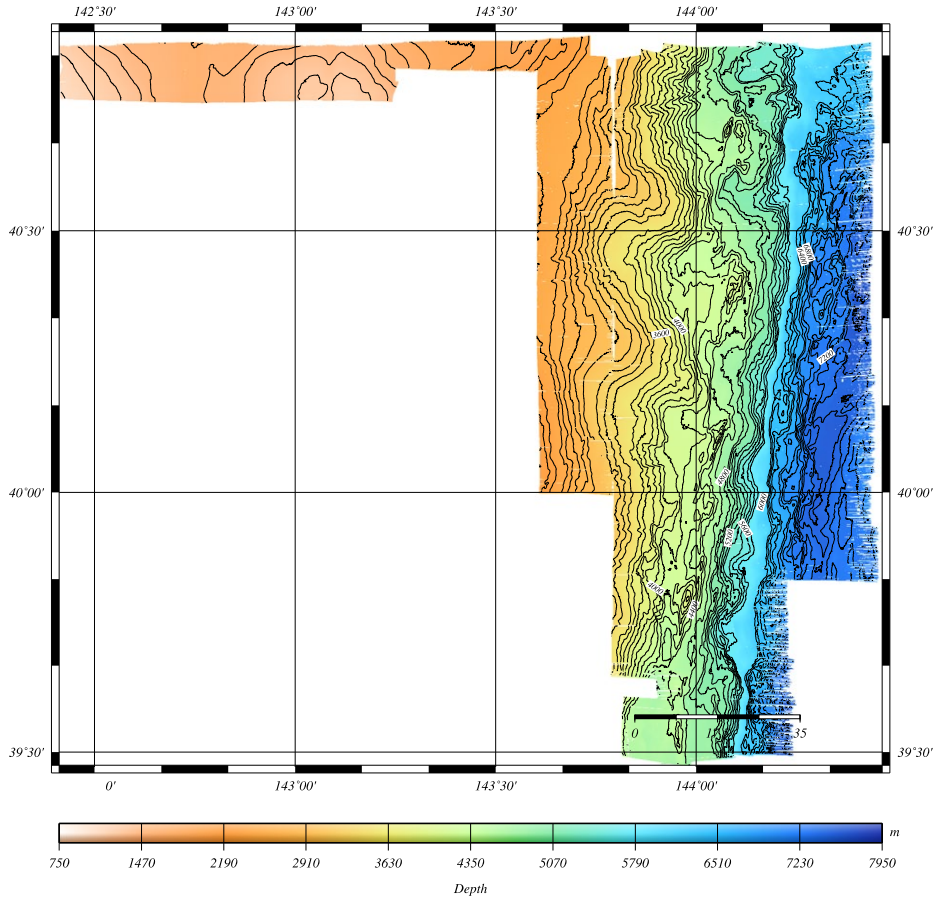

142°30'
143°00'
143°30'
144°00'
40°30'
40°00'
39°30'
0
35
m
750
1470
2190
2910
3630
4350
5070
5790
6510
7230
7950
Depth

Fig. 7-1

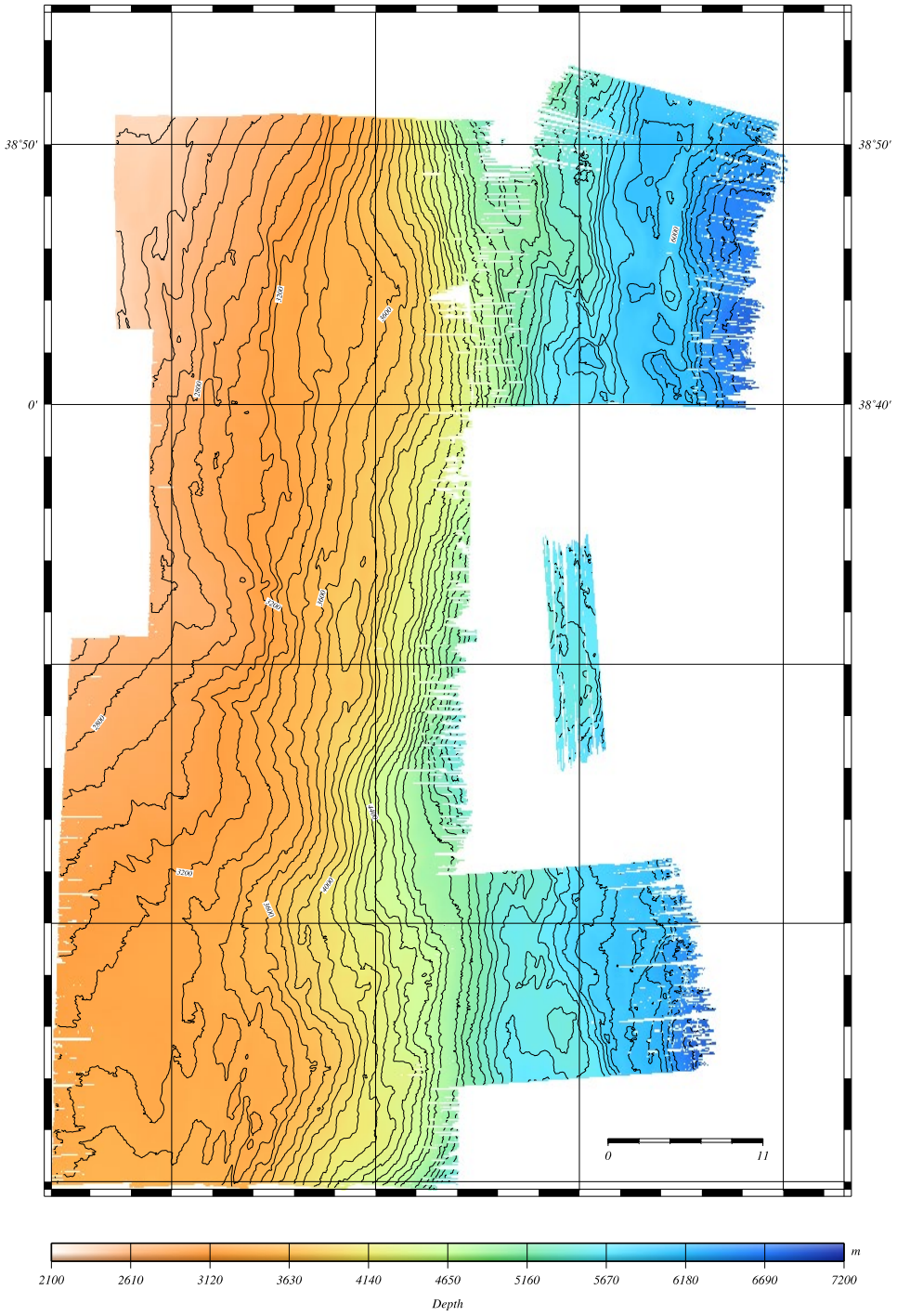

38°50'
38°50'
0'
38°40'
0
11
2100
2610
3120
3630
4140
4650
5160
5670
6180
6690
7200
m
Depth

Fig. 7-2

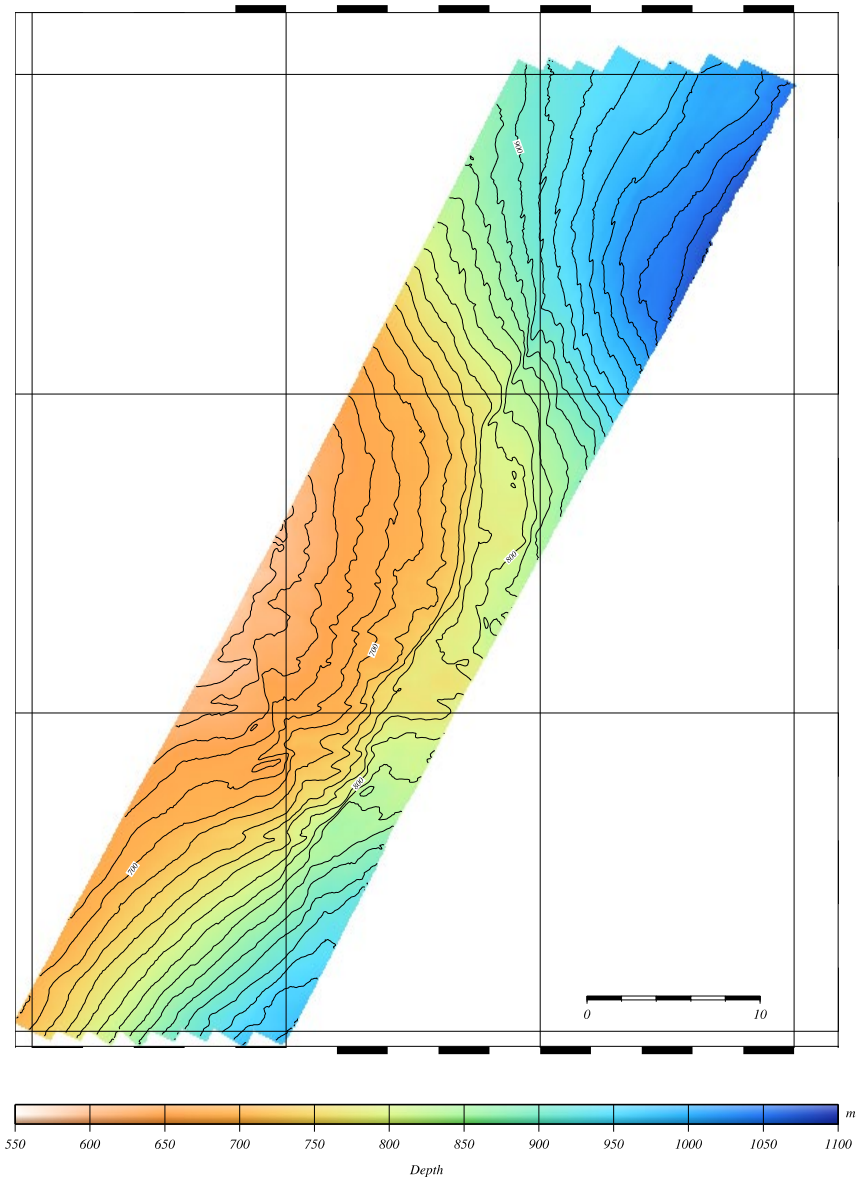


Fig. 7-3

PC02_20141116_100_cl20A3.ps

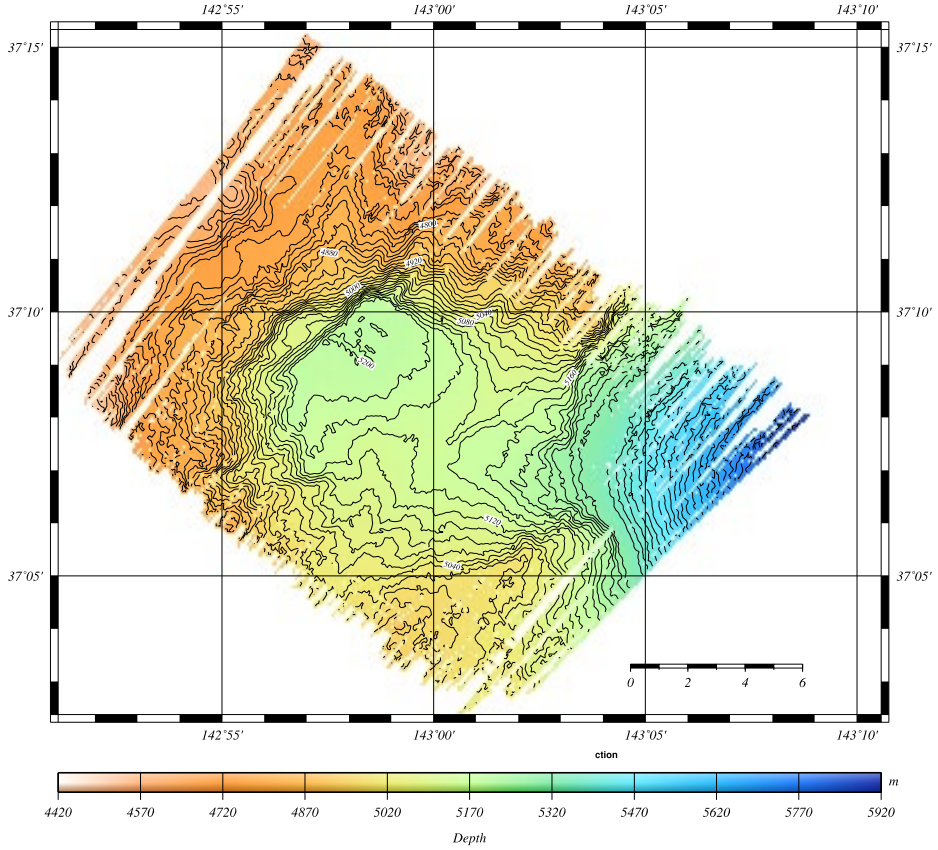


Fig. 7-4

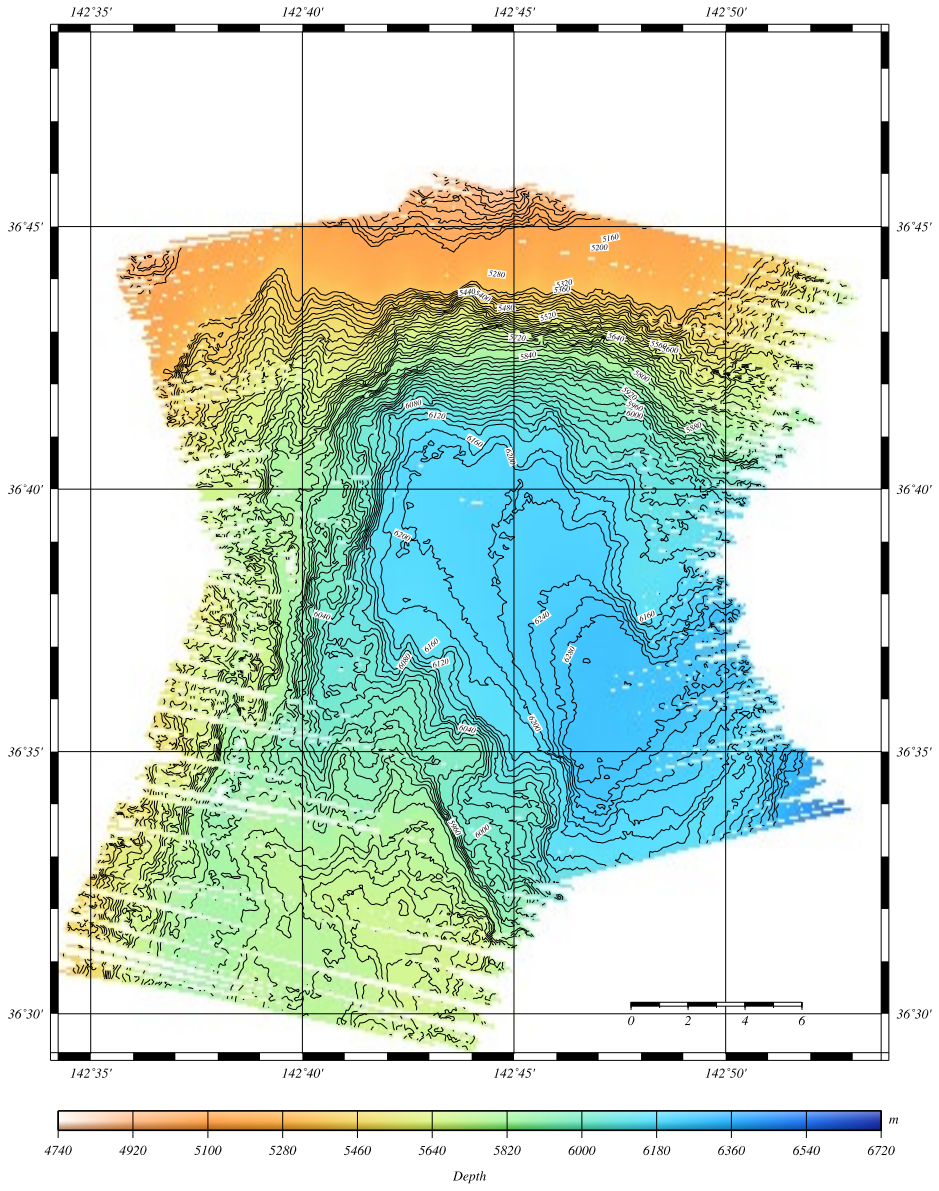

100_cl20A3.ps
142°35'
142°40'
142°45'
142°50'
36°45'
36°40'
36°35'
36°30'
0
2
4
6
m
4740
4920
5100
5280
5460
5640
5820
6000
6180
6360
6540
6720
Depth

Fig. 7-5

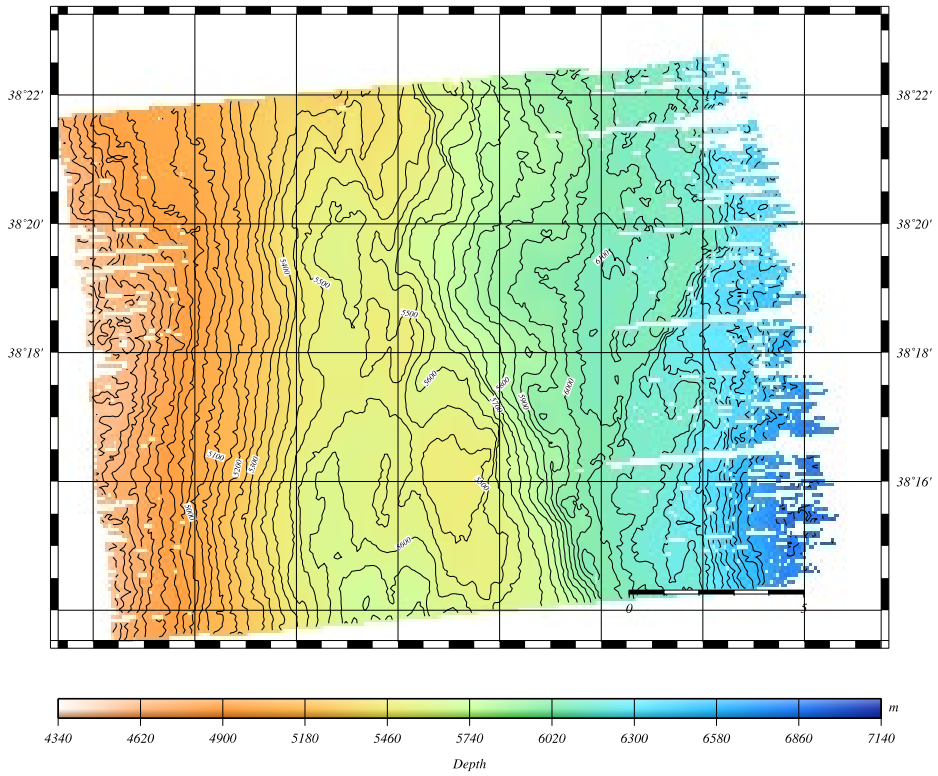

38°22′
38°20′
38°18′
38°16′
0
3
m
4340
4620
4900
5180
5460
5740
6020
6300
6580
6860
7140
Depth

Fig.7-6

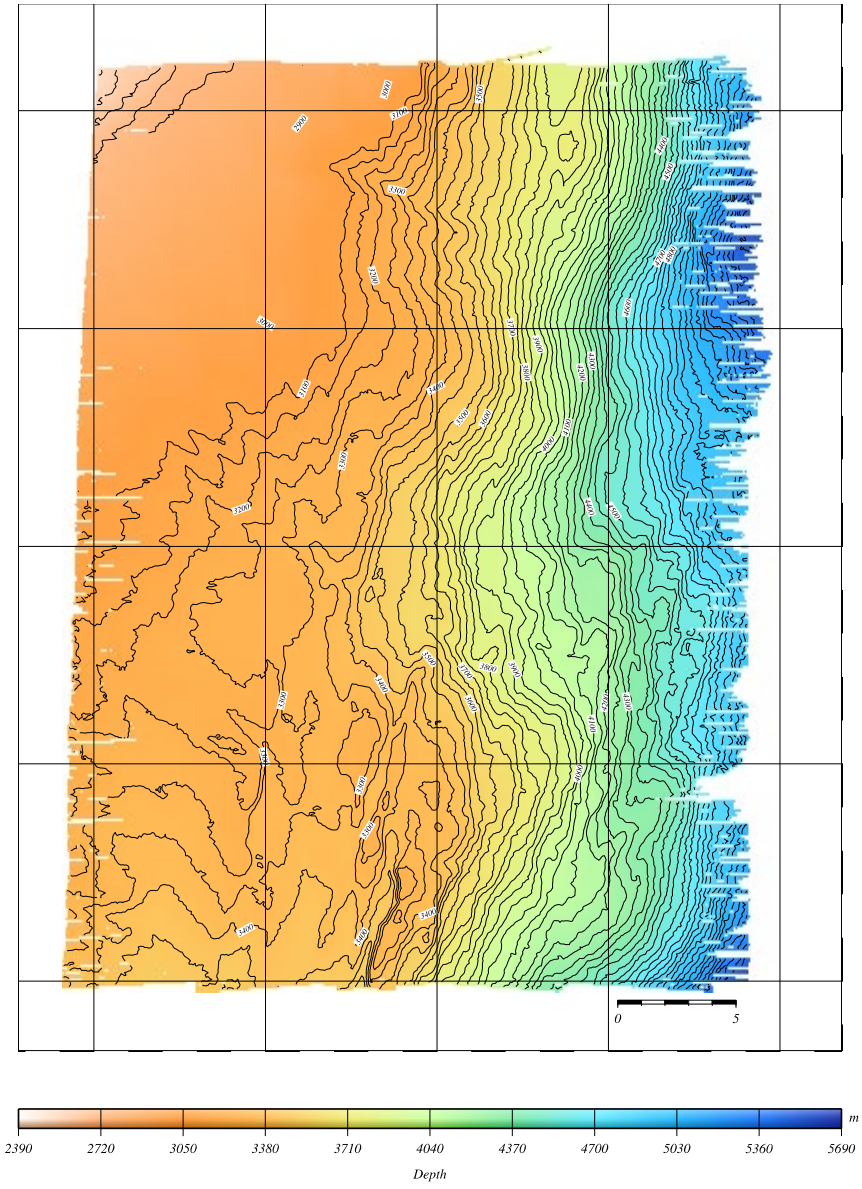

0
5
m
2390
2720
3050
3380
3710
4040
4370
4700
5030
5360
5690
Depth

Fig.7-6.1

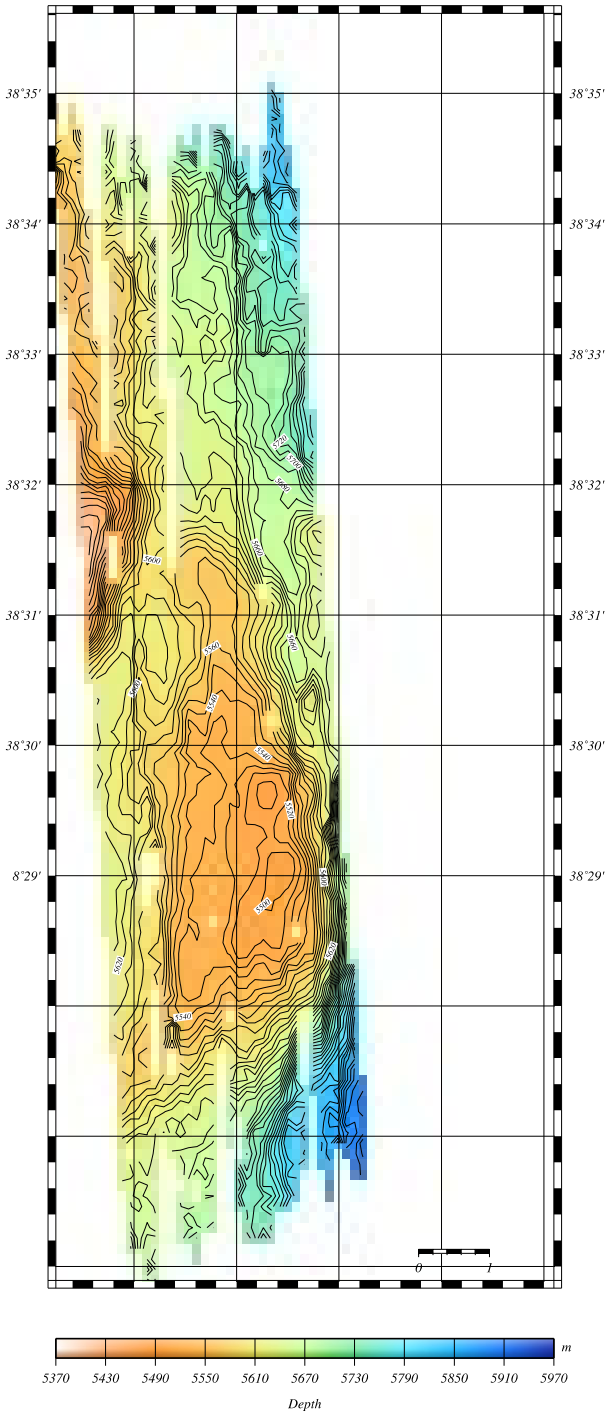

38°35′
38°34′
38°33′
38°32′
38°31′
38°30′
8°29′
0
1
m
5370
5430
5490
5550
5610
5670
5730
5790
5850
5910
5970
Depth

Fig.7-6.2

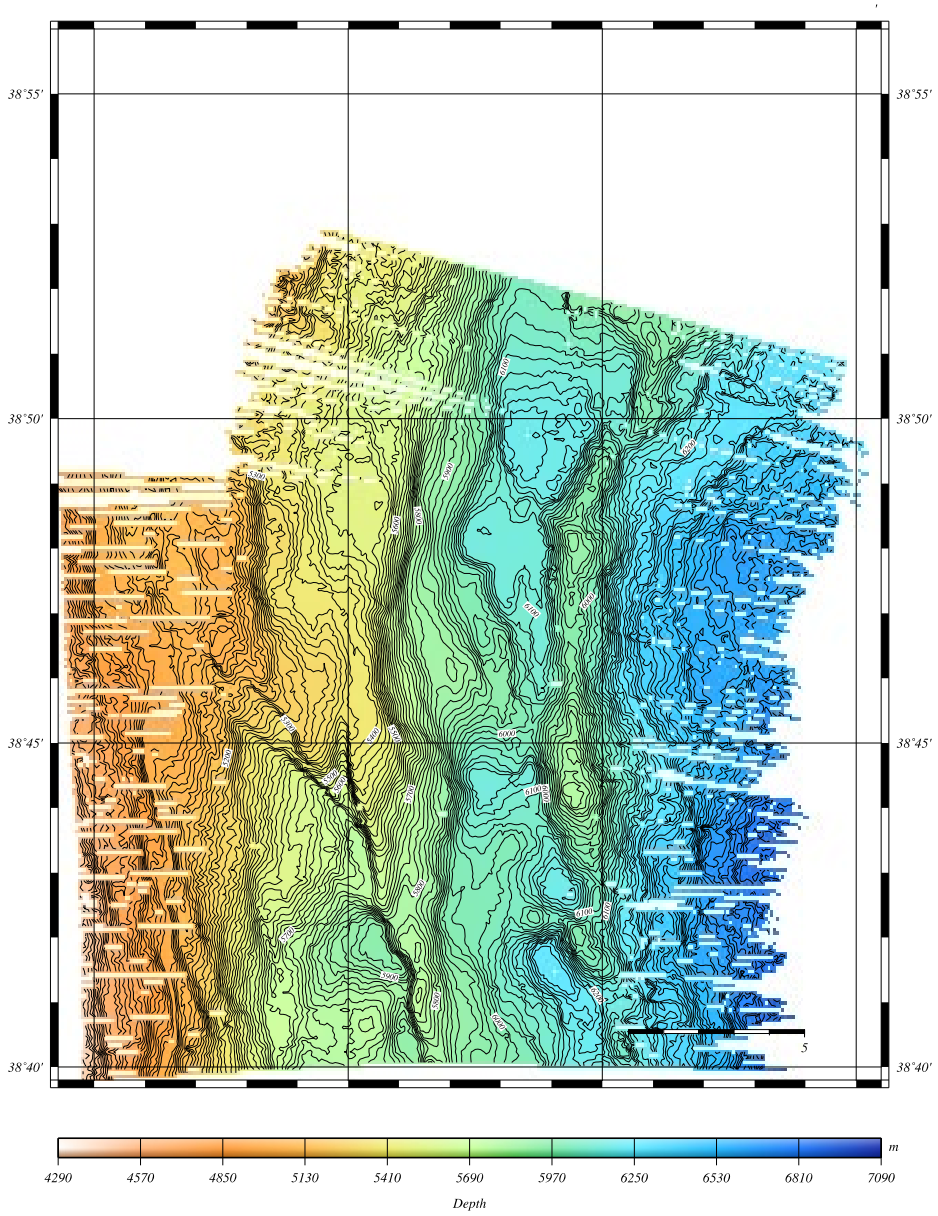

38°55'
38°50'
38°45'
38°40'
5
4290
4570
4850
5130
5410
5690
5970
6250
6530
6810
7090
m
Depth

Fig.7-7

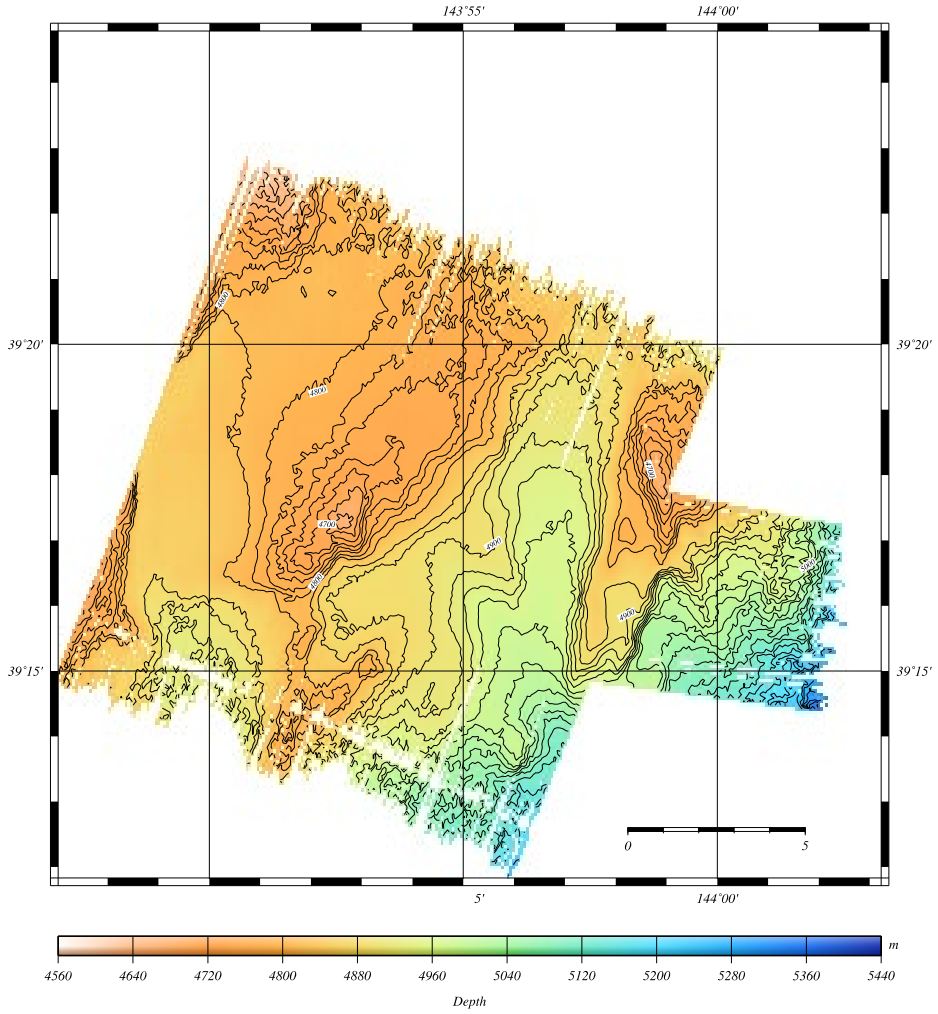

143°55'
144°00'
39°20'
39°15'
5'
0
5
4560
4640
4720
4800
4880
4960
5040
5120
5200
5280
5360
5440
m
Depth

Fig.7-8

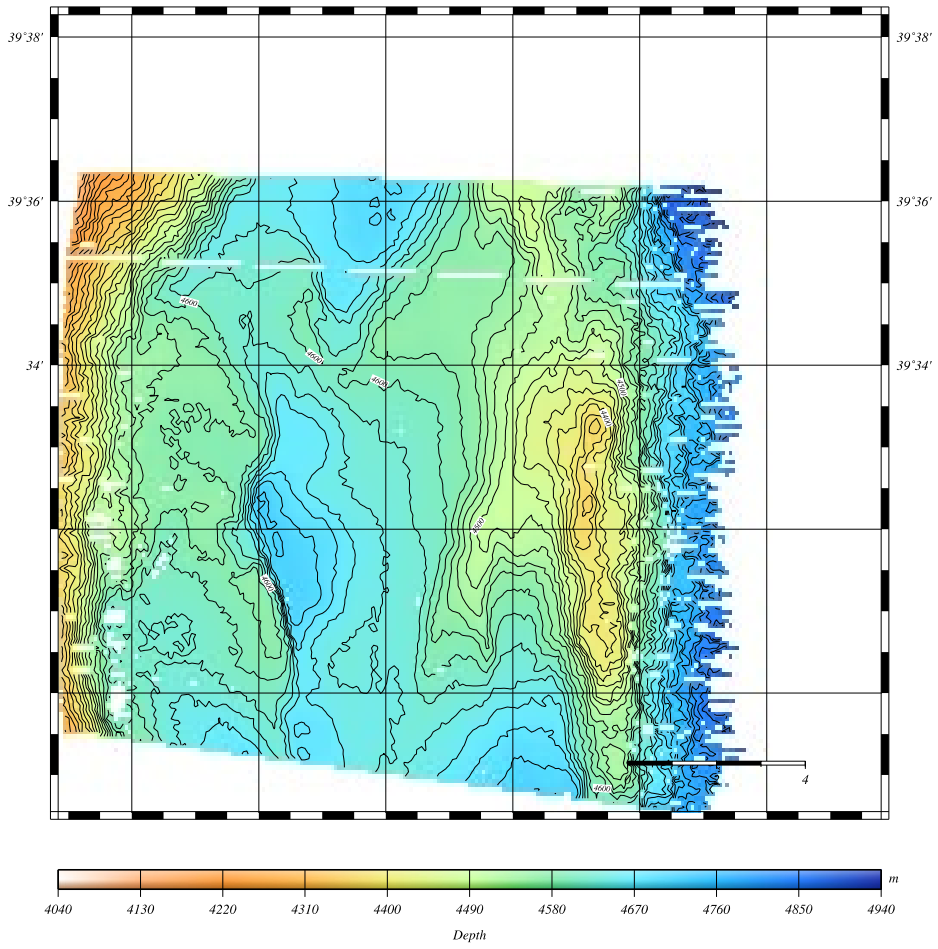

39°38'
39°38'
39°36'
39°36'
34'
39°34'
4600
4600
4600
4600
4600
4600
4600
4
m
4040
4130
4220
4310
4400
4490
4580
4670
4760
4850
4940
Depth

Fig.7-9

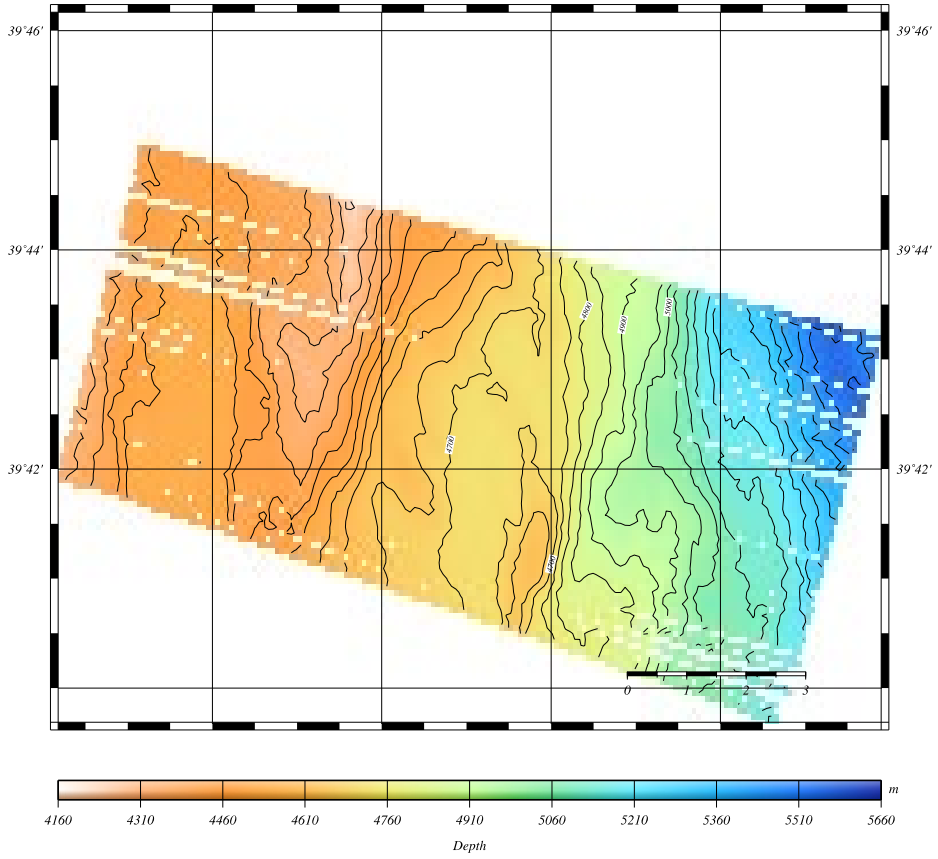

39°46'
39°44'
39°42'
0
1
2
3
4160
4310
4460
4610
4760
4910
5060
5210
5360
5510
5660
m
Depth

Fig.7-10

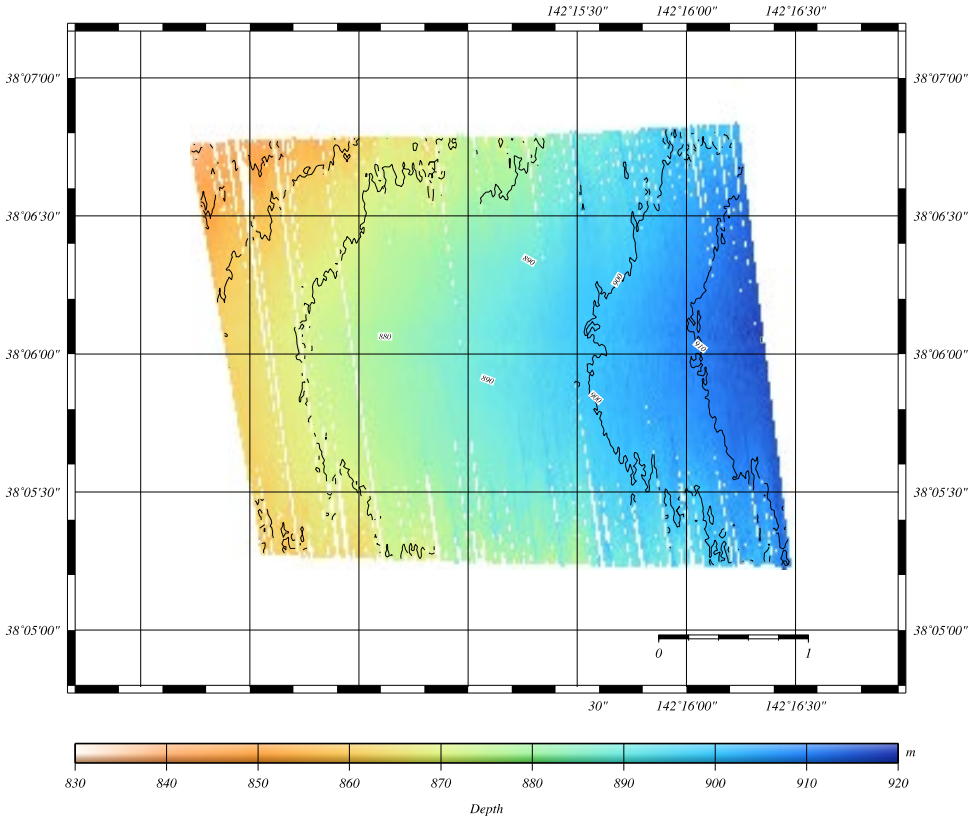

142°15'30"
142°16'00"
142°16'30"
38°07'00"
38°06'30"
38°06'00"
38°05'30"
38°05'00"
0
1
m
830
840
850
860
870
880
890
900
910
920
Depth

Fig.7-11

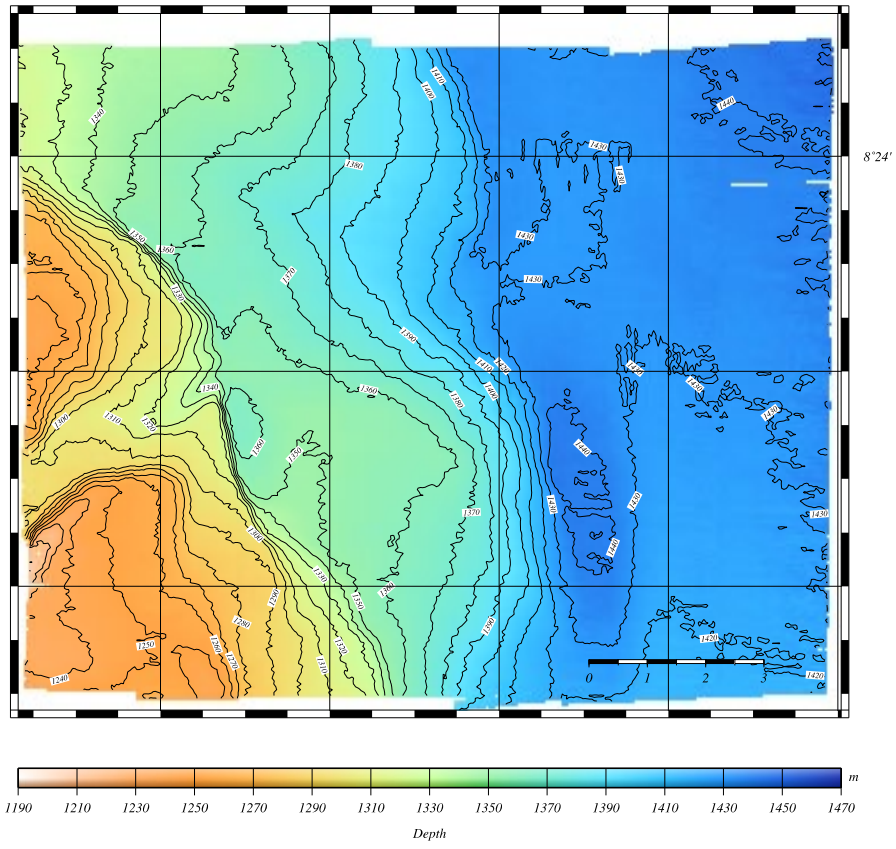

8°24'
0
1
2
3
m
1190
1210
1230
1250
1270
1290
1310
1330
1350
1370
1390
1410
1430
1450
1470
Depth

Fig.7-12

8. 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.