doi : 10.17596/0002979

Kaiyo "Cruise Report"

KY13-17

Nankai Trough regional earthquake disaster prevention research project

Survey and deployment for Dense Ocean-floor Network System for Earthquakes and Tsunamis

(Kii-suido, Kumano nada)

Nov. 8th-Nov.17th, 2013

Japan Agency for Marine-Earth Science and Technology

(JAMSTEC)

KY13-17 cruise report Contents

1. Cruise Information

Cruise ID: KY13-17

Name of vessel: KAIYO

Title of the cruise:

Nankai Trough regional earthquake disaster prevention research project, and

Survey and deployment for Dense Ocean-floor Network System for Earthquakes and Tsunamis

Chief scientist [Affiliation]: Toshiya Kanamatsu [IFREE-JAMSTEC]

Research project 1: Lead proponent [Affiliation] : Yoshiyuki Kaneda [DONET-JAMSTEC]

Title of proposal: Nankai Trough regional Earthquake disaster Prevention research project

Research project 2: Lead proponent [Affiliation] : Yoshiyuki Kaneda [DONET-JAMSTEC]

Title of proposal: Survey and deployment for Dense Ocean-floor Network System for Earthquakes and Tsunamis (DONET)

Cruise period: Nov. 8th-Nov. 17th, 2013

Ports of call: Wakayama and JAMSTEC, Yokosuka

Research area: Kii-suido, Kumanonada (Figure 1-1)

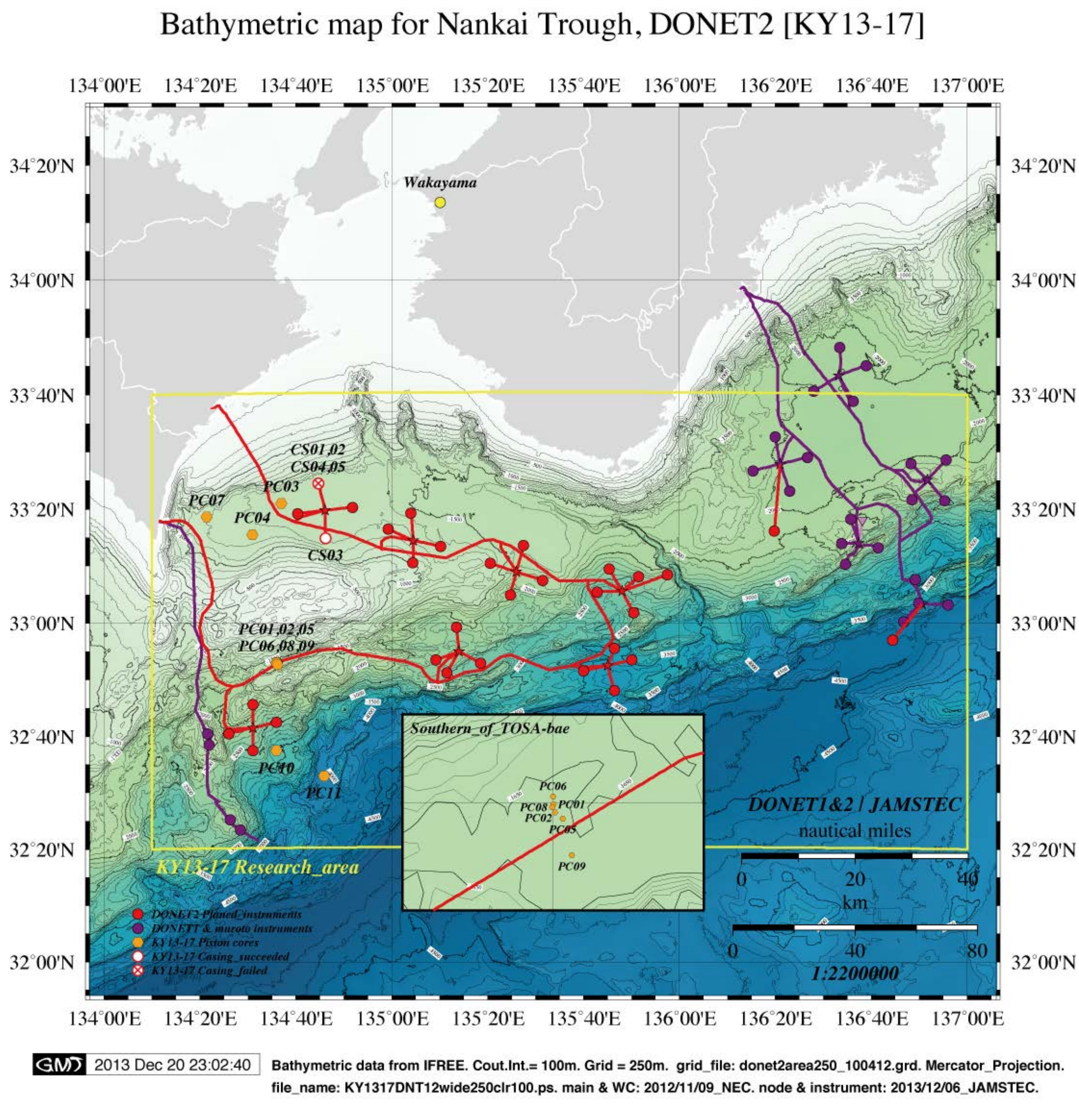


Figure 1-1: Working areas for KY13-17 cruise.

2. Participant list

Onboard scientists	
Toshiya Kanamatsu	JAMSTEC
Hiroyuki Matsumoto	JAMSTEC
Shuhei Nishida	JAMSTEC
Tohru Kodera	JAMSTEC
Ken Ikehara	AISTO
Masao Iwai	Kochi University
Munemasa Kobayashi	Kochi University
Eri Shimizu	Kochi University
Toshio Sugisaki	Rigo Co., LTD.
Hiroyuki Hayashi	Marine Works Japan Ltd
Yasumi Yamada	Marine Works Japan Ltd
Yuuki Miyajima	Marine Works Japan Ltd
Mika Yamaguchi	Marine Works Japan Ltd

R/V Kaiyo Ship Crew	
Captain	Eiko Ukekura
Chief Officer	Takaaki Shishikura
2nd Officer	Masato Chiba
3rd Officer	Tomohiro Yukawa
Chief Engineer	Tadashi Abe
1st Engineer	Takashi Ota
2nd Engineer	Saburo Sakaemura
3rd Engineer	Shohei Miyazaki
Chief Radio Operator	Takehito Hattori
2nd Radio Operator	Shunsuke Fukagawa
Boat Swain	Kazuo Abe
Able Seaman	Nobuyuki Ichikawa
Able Seaman	Yuki Yoshino
Able Seaman	Yoshiaki Matsuo
Sailor	Hirotaka Shigeta
Sailor	Ryoma Tamura
Sailor	Yusaku Kanada
Sailor	Yosuke Horii
No.1 Oiler	Hiroyuki Oishi
Oiler	Keita Funawatari
Assistant Oiler	Ryo Sato
Assistant Oiler	Aoi Takamiya
Assistant Oiler	Naoto Mitsuo
Chief Steward	Tomihisa Morita
Steward	Kazuhiro Hirayama
Steward	Hiroaki Morimoto
Steward	Haruka Kinoshita
Steward	Manami Takahashi

3. Preface and Cruise Log of KY13-17

3.1 Preface

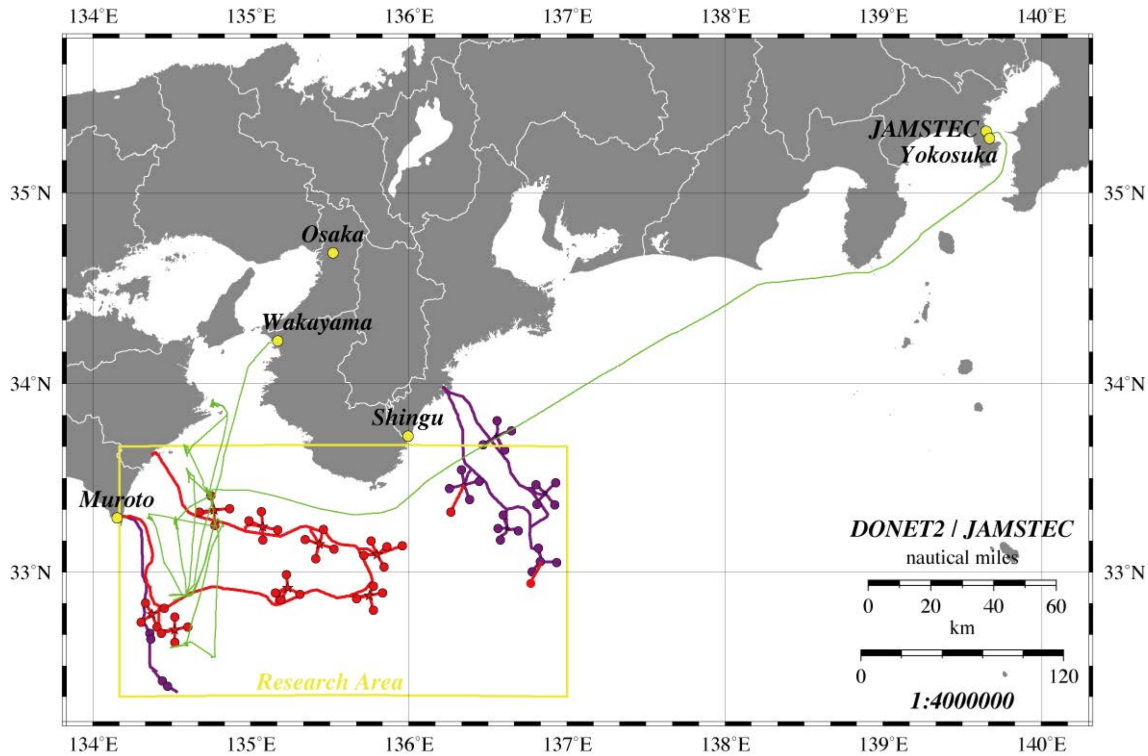
Kanamastu, T. and Matsumoto, H.

KY13-17 (Figure 1) cruise was planed to conduct two missions, one is for paleoseismological study using marine sediment in Muroto area, the other is for construction of real-time seafloor observatory network off Muroto "DONET2." Both projects are aiming to understand Nankai earthquake, and contribute the disaster prevention and mitigation for Nankia earthquake.

Surface sediment sampling to understand earthquake recurrence were conducted around 1946 Nankai earthquake focal region as a part of "Nankai Trough regional earthquake disaster prevention research project". Core samples were collected from three research areas: Muroto trough, Tosabae trough, and slope basins off Muroto. Identification of event deposits induced by past earthquakes, and estimation of their recurrence cycle will be studied using those samples.

A renewed bottom caisson installing system for DONET2 was trialed. The bottom caisson is a platform of the bottom seismometer to deploy under the ocean bottom. The bottom caisson installation is carried out by using the similar system as the piston corer since the DONET1 construction. The corer contains the releaser, tilt-meter, and landing detector, which can be communicated between in-situ and the onboard in terms of acoustic signal. Additionally, accelerometer and tilt-meter are attached with the corer. These accelerometer and tilt-meter have been replaced just before the present cruise in order to be used in the deeper depth. This is why the total weight has changed and the relevant balance would be adjusted. The first trial is to confirm the applicability of renewed the corer and to tune in necessary. If the tuning has been completed, the bottom caisson would be installed at some DONET observatories.

KY13-17 R/V KAIYO Ship Track. 2013/11/08 - 2013/11/17



GMT 2013 Nov 17 09:26:33 **Site_survey for DONET2 System by 6,000m class Dee-tow. 2013/11/08 Wakayama - SHI_yokosuka 2013/11/17.**
file_name: KY1317_index.ps. Mercator Projection.

3.2. Cruise Log of KY13-17

Date Time		Weather/wave/wind
2013/11/08 Fri.	Ship noon position：34-12.9'N、135-08.5'E（WakayamaShimotsu） time zone：UT C+9h（J ST）	bc / 1 / West-2
14:00	Scientific party embarked	
15:00	Leave port	
15:30-16:20	Briefing onboard life @research room	
16:23-16:35	Making cruise plan @research room	
16:40-17:00	Konpirasan@ bridge	
23:20	Arrived at survey area	
	Drifting during night time	
2013/11/09 Sat.	Ship noon position：32-52.8'N、134-34.7'E（stand by） time zone：UT C+9h（J ST）	bc / 2 / East-3
6:42	XBT	
08:18-10:08	Piston coring _4m @F1	PC01@South Tisabae（F1）
13:04-14:53	Piston coring _8m @D	PC02@South tisabae（D）
15:18-15:26	MBES	MBES@Tosabae
18:00	XBT	
18:00-18:18	Science meeting @research room	
	Drifting during night time	
2013/11/10 Sun.	noon：33-53.0'N、 135-45.0'E（wait on weather） time zone：UT C+9h（J ST）	c / 2 / SSW-6
6:15	Arrived at CS-01（2A -1a）	
06:34-08:30	Bottom casing deployment @2A-1a --> retrieved without casing deployment	CS-01@2A-1a
8:45	Headed for Komatsujima for wait on weather	
11:30	Arrived at Komatsujima wait on weather	
18:00-18:05	Science meeting @research room	
22:40	Head for Hiwasa to change anchoring point due to strong window	
	Shifting during night	
2013/11/11 Mon.	Ship noon position ：33-16.5'N、134-32.0'E（stand by）time zone : UT C+9h（J ST）	bc / 3 / NNE-5
1:00	Arrived at Hiwasa	
07:01-08:54	Bottom casing deployment(2) @2A-1a --> retrieved without casing deployment	CS-02@2A-1a

9:45	Arrived at PC03（S t.94）	
Date Time		**Weather/wave/wind**
09:46-11:20	Piston coring_8m	PC03@NW-Muroto Basin
11:20	Head for PC04 point	
12:15	Arrived at PC04 point	
13:35-15:06	Piston coring_8m	PC04@NW-Muroto Basin
18:00-18:08	Science meeting @research room	
	Drifting during night time	
2013/11/12 Tue.	Ship noon position：32-53.3'N、134-37.3'E（shift） time zone：UT C+9h（J ST）	bc / 2 / NNE-5
1:40	arrived at PC05 point（S150）	
07:01-08:54	Piston coring_8m @S150	PC05@S150
10:00-11:47	Piston coring_8m @N75	PC06@N75
11:50	Head for CS-03 point（2A -3a）	
14:00	Canceled CS-03 and Head for PC07 point	
15:50	Arrived at PC07 point	
15:54-17:20	Piston coring_8m	PC07
18:20-21:20	DONET team meeting @control room	
23:51	Head for PC08 point（F1）	
	Drifting during night	
2013/11/13 Wed.	Ship noon position：32-52.8'N、134-37.3'E（Shifting） time zone：UT C+9h（J ST）	bc / 3 / NNE-5
3:10	Arrived at PC08 point（F1）	
07:03-08:50	Piston coring_8m @F1	PC08@F1
10:01-11:53	Piston coring_8m	PC09@NW-Muroto Basin
11:53	Head for CS-03 point（2A -3a）	
14:05	Arrived at CS-03 point（2A -3a）	
14:10-16:05	Bottom casing deployment @2A-3a-->deployed casing	CS-03@2A-3a
17:58-18:07	science meeting @research room	
18:30-19:47	DONET team meeting @control room	
	drifting at survey area	
2013/11/14 Thu.	Ship noon position：32-33.0'N、134-46.0'E（stand by） time zone：UT C+9h（J ST）	bc / 2 / ENE-4
2:35	arrived at PC10 point	
08:00-10:58	piston coring_8m	PC10@Off Muroto Splay fault
17:58-18:07	science meeting @research room	

18:30-19:47	DONET team meeting @control room	
Date Time		**Weather/wave/wind**
	Drifting in survey area during night	
2013/11/14 Thu.	Ship noon position：32-33.0'N, 134-46.0'E （stand by） time zone：UT C+9h（J ST）	bc / 2 / ENE-4
2:35	Arrived at PC10	
08:00-10:58	Piston coring_8m	PC10@Off Muroto Splay fault
10:58	Head fro PC11	
11:50	Arrived at PC11	
12:34-15:58	Piston coring_8m	PC11@Off Muroto Splay fault
16:00	Head for CS-04 point（2A-1a）	
17:55-18:01	science meeting @research room	
18:10-19:12	DONET team meeting @research room	
	Drifting in research area during night	
2013/11/15 Fri	Ship noon position : 32-26.1'N、134-53.1'E （shifting） time zone：UTC+9h（JST）	r / 4 / NNE-7
06:05-08:00	Bottom casing deployment@2A-1a-->retrieved without deplymentCS-04@2A-1a	
09:06-11:02	Bottom casing deployment@2A-1a-->retrieved without deplymentCS-05@2A-1a	
11:15	Left research area for Yokosuka	
15:05-16:45	DONET team meeting @control room	
17:59-18:08	science meeting @research room	
	Shifting to Yokosuka during night	
2013/11/16 Sat	Ship noon position：35-02'N、139-40'E （shifting） time zone：UTC+9h（JST）	b/3/NNE-4
14:15	arrived at Yokosuka	
15:00-16:22	seminar @research room	
18:00-18:10	science meeting @research room	
	Drifting off Sumikyu dock	
2013/11/17 Sun		
9:00	Berthed in Sumijyu dock pier	
12:00	Scientific party disembarked	

*Weather；bc (Fine but Cloudy), c (Cloudy), o (Overcast), r (Rain)
*Wave ; 0（Calm (Glassy)）, 1（Calm (Rippled)）, 2 (Smooth), 3 (Slight), 4（Moderate）, 5（Rough）
*Wind ; 2 (Light breeze; 1.6-3.3m/s), 3 (Gentle breeze; 3.4-5.4m/s), 4 (Moderate breeze; 5.5-7.9m/s), 5 (Fresh breeze; 8.0-10.7m/s), 6（Strong breeze; 10.8-13.8m/s）, 7（Near gale; 13.9-17.1m/s）

4. Objectives

4.1 Piston coring

4.1.1 Objectives of piston coring in the Muroto Trough

Ikehara, K.

Taira and Murakami (1984) is a pioneer paper on the deep-sea turbidite paleoseismology around the Japanese islands. Strong ground motion by the large earthquakes along the plate convergent margins around the Japanese islands has increased the water pressure of the interstitial water among the sediments, and has made instability of the marine sediments. As shown by the classic paper by Heezen and Ewing (1952), the earthquake is a trigger mechanism of the submarine slope failures, the generation of turbidity currents, and deposition of turbidites. Therefore, the Muroto Trough is a potential area for the turbidite paleoseismology. Although of Taira and Murakami (1984)'s pioneer work, they did not have enough age control to discuss the exact past earthquake events. Thus, we should examine the potential of the Muroto Trough sediments for the turbidite paleoseismology. Arita and Kinoshita (1990) and Inouchi and Kinoshita (1977) reported the surface sediment distribution around the Muroto Trough. These data indicated that the decreasing of surface sediment grain size eastward in the western Muroto Trough. Also, Arita and Kinoshita (1990) indicated the same lithostratigraphy (thin sand deposition) of the surface sediments (around 20 cm) at some sampling stations in the western Muroto Trough. This means the western Muroto Trough sediments have enough potential for the turbidite paleoseismology, but we still do not have enough data on the occurrence of turbidite in the western Muroto Trough.

To understand the depositional processes in the Muroto Trough, we selected three sites for the sediment coring in this cruise. All of the sites had the same lithostratigraphy (thin sand occurrence) (Arita and Kinoshita, 1990). Using the cored sediments, we would like to examine the occurrence of the turbidite formed by the 1946 Showa Nankai earthquake, and to clarify the potential of the Muroto Trough sediments for the turbidite paleoseismology.

References

Arita, M. and Kinoshita, Y., 1990. Sedimentological Map Offshore of Cape Muroto. Marine Geological Map series, no. 37, Geological Survey of Japan, 36p.

Heezen, B.C. and Ewing, M., 1952. Turbidity currents and submarine slumps, and the 1929 Grand Banks earthquake. Am. J. Sci., 250, 849-873.

Inouchi, Y. and Kinoshita, Y., 1977. Sedimentological Map of the South of Kii Strait. Marine Geological Map series, no. 6, Geological Survey of Japan.

Taira, A. and Murakami, H., 1984. Past Nankai and Tokaido earthquakes recorded as turbidites =Possibility of turbidite paleoseismology=. Programme and Abstract of the Seismological Society of Japan, 2, 195.

4.1.2 Tosabae Trough: Stratigraphic record of turbidite deposition in an isolated slope basin as a paleoseismometer of Nankai Great Earthquakes.

Iwai, M. (Kochi University), primary proponent
Ikehara, K. (AIST), co-proponent
Kanamatsu, T. (JAMSTEC), chief scientist of the KY13-17 Cruise

Objectives

Main objectives of geologic and bathymetric survey in the Tosabae Trough were

- to obtain cored sediments to reveal temporal and spatial distribution of coseismic turbidites in the Tosabae Trough, and
- to make coring nearby a normal fault within the Tosabae Trough and to get samples for assessment of the deep-sea submarine fault activity.

Background

An isolated basin on the landward continental slope is one of the best places to access large thrust earthquakes along subduction zones. Tosabae Trough is a tectonic basin between the Tosabae and the Minamitosabae, outer ridges of western Nankai Trough off Muroto Peninsula (Okamura and Joshima, 1986; Blum and Okamura, 1992). This small trough, 10km (EW) x 2km (NS), is located on the center of Nankai Great Earthquake rupture zone (Ando, 1975; Kimura and Okano, 1998; Okano et al., 2002), and a subducted seamount making an asperity is seismically revealed (Yamazaki and Okamura, 1989; Kodaira et al., 2000a, b). Tosabae Trough has no submarine channel directly connected to terrigenous resource area (Shimamura, 1989, 2008). Tosabae Trough is situated in the most sensitive region to monitor the Nankai Great Earthquakes, and sedimentary sequence in this basin has a potential to be a natural sediment trap recording past historic and prehistoric great earthquakes.

A total of ~260m thick sediments, Mt2 formation of Minamitosabae Group, fill the Tosabae Trough (Okamura and Joshima, 1986). 2-D seismic profiles show a normal fault in the Tosabae Trough has been active throughout the late Quaternary (Okamura and Joshima, 1986; Iwai et al., 2004). Previous study revealed that the average sedimentation rate of the Holocene section in Core KR9705P1 from the Tosabae trough was 0.5-1.0m/k.y.(Iwai et al., 2004). A total of 31 turbidite layers had been visually detected from this core, and some of those turbidite layers had been correlated to historic and archeological paleoseismic records (Iwai et al., 2004). The mean recurrence interval of paleoearthquakes revealed from turbidites was 215±21 years (median=186 years) and it was consistent to the result of Muroto Trough (Taira and Murakami,1984), but two times larger than the average value of 114years for the historic great earthquakes occurred within the last half millennium (Iwai et al., 2004).

Site-specific objectives and coring summary

PC01/PL01 (F1)

This site located nearby a normal fault in the Tosabae Trough. 4m-long piston core sampler was used for testing the k value in this basin.

Date: November 9, 2013

Latitude: 32-52.9957'N Longitude: 134-36.0040'E Water depth: 1647m

Core barrel length: PC01=4m, PL01=1m

Penetration depth: PC01=4.5m

Cored length: PC01=167.5cm, PL01=95cm

PC02/PL02 (D/S75)

This site located at 75m south from the normal fault was designed to obtain continuous Holocene section from hanging wall.

Date: November 9, 2013

Latitude: 32-52.9508'N Longitude: 134-36.0143'E Water depth: 1651m

Core barrel length: PC02=8m, PL02=1m

Penetration depth: PC02=7.0m

Cored length: PC02=586cm, PL02=86cm

PC05/PL05 (S150)

This site located at 150m south from the normal fault was designed to obtain continuous Holocene section from hanging wall.

Date: November 11, 2013

Latitude: 32-52.9163'N Longitude: 134-36.0647'E Water depth: 1650m

Core barrel length: PC05=8m, PL05=1m

Penetration depth: PC05=5.9m

Cored length: PC05=466cm, PL05=49cm

PC06/PL06 (N75)

This site at 75m north from the normal fault was designed to obtain continuous Holocene section from footwall. This site is located at the mid point between F1(main fault) and F2(minor fault splayed from F1).

Date: November 12, 2013

Latitude: 32-53.0388'N Longitude: 134-35.9997'E Water depth: 1647m

Core barrel length: PC06=8m, PL06=1m

Penetration depth: PC06=6.6m

Cored length: PC06=542cm, PL06=101.5cm

PC08/PL08 (F1)

This site located nearby the normal fault as same as PC01.

Date: November 12, 2013

Latitude: 32-52.9788'N Longitude: 134-35.9933'E Water depth: 1646m

Core barrel length: PC08=8m, PL08=1m

Penetration depth: PC08=7.2m

Cored length: PC08=554.8cm, PL08=93.3cm

PC09/PL09 (S500')

This site located at 500m south from the normal fault F1 and designed to obtain continuous Holocene section as a reference.

Date: November 13, 2013

Latitude: 32-52.7086'N Longitude: 134-36.1248'E Water depth: 1653m

Core barrel length: PC09=8m, PL09=1m

Penetration depth: PC09=7.1m

Cored length: PC09=572.5cm, PL09=61.2cm

＊ Latitude and longitude is the position of transponder settled on winch wire at 50 m up from piston coring system. We used supper short base line (SSBL) system of R/V Kaiyo for acoustic underwater positioning and navigation.

References

Ando, M., 1975, Source mechanisms and tectonic significance of historical earthquakes along the Nankai Trough, Japan. *Tectonophysics*, 27, 119-140.

Blum, P. and Okamura, Y., 1992, Pre-Holocene sediment dispersal systems and effects of structural controls and Holocene sea-level rise from acoustic facies analysis; SW Japan forearc. Marine Geology, 108, 295-322.

Okamura, Y., and Joshima, M., 1986, Explanatory notes of Geological map off Muroto Zaki 1:200000. Marine Geology Map Series, 28, Geological Survey of Japan. (in Japanese with English Abstract)

Okano, K., Kimura, S., and Nakamura, M., 2002, The hypocenter location of the 1946 Great Nankai Earthquake. *Research Reports of Kochi University, Natural Science*, 51, 13-22. (in Japanese with English Abstract)

Iwai, M., Fujiwara, O., Momma, H., Iwasaki, N., Kano, H., Oda, M., Matsuoka, H., and Okamura, M., 2004, Holocene seismoturbidites from the Tosabae Trough, a landward slope basin of Nankai Trough off Muroto: Core KR9705P1. *Mem. Geol. Soc. Japan*. (58), 137-152. (in Japanese with English Abstract)

Kimura and Okano, 1998, Source region of the 1946 Nankai earthquake inferred from its aftershock distribution. Zishin (Journal of the Seismological Society of Japan, 2^{nd} ser.), 50 (4), 461-470. (in Japanese with English Abstract)

Kodaira, S., Takahashi, N., Nakanishi, A., Miura, S., and Kaneda, Y., 2000a, Subducted seamount imaged in the rupture zone of the 1964 Nankaido earthquake. *Science*, 289, 104-104.

Kodaira, S., Takahashi, N., Park, J.O., Mochizuki, K., Shinohara, M., and Kimura, S., 2000b, Western Nankai trough seismogenic zone: Results from wideangle ocean bottom seismic survey. *Jour. Geophys. Res*., 105, 5887-5905.

Shimamura, K., 1989, How do the submarine canyons grow ?:The chart of submarine canyon systems around the Japanese Islands. *Journal of the Geological Society of Japan*, 95(10), 769-780, DOI: http://dx.doi.org/10.5575/geosoc.95.769 (in Japanese with English Abstract)

Shimamura, K., 2008, Revised chart of the submarine canyon and valley systems around the Japanese Islands : on their topographic features and their unsettled questions. *Journal of the Geological Society of Japan*, 114(11), 560-576. DOI: http://dx.doi.org/10.5575/geosoc.114.560 (in Japanese with English Abstract)

Yamazaki and Okamura, 1989, Subducting seamounts and deformation of overriding forearc wedges around Japan. *Tectonophysics*, 160, 207-229. (in Japanese with English Abstract)

4.1.3. Objectives of piston coring in slope basins, off Muroto

Kanamatsu, T.

The detail crustal structure of the area was densely survived by 3-D reflection seismic survey (Kuramoto et al., 2000). The survey result revealed large thrust sheets zone in the middle slope. The thrusts are identified as out-of-sequence thrusts (OSTs). Contrary seafloor surface observations off Muroto by Shinkai 6500 dives were conducted during YK00-10 Leg-1 (Kuramoto et al., 2001). Dives discovered cold seeps in the large thrust slice zone in area close to ODP drilling site 1175. It indicates that the thrusts are active. Meanwhile IODP expedition 316 cored a hanging wall of splay fault, Tonankai area. It has previously been interpreted that the area has ruptured coseismically during megathrust earthquakes. The uppermost core at one site contains repeated occurrences of mud breccia (Sakaguchi et al., 2011). The deposition time of one mud breccia is estimated as 1944. It suggests that the mud-breccia was formed by episodic brecciation caused by seismic shaking. Because the thrusts off Muroto are active currently, fault rapturing in 1944 or 1946 earthquakes might propagate through these thrusts, and the similar ground shaking as Tonankai earthquake might make mud brecciation. In order to verify this hypothesis, we planed to sample surface sediment during this cruise.

References

Sakaguchi et al., 2011 documented a brecciation of surface sediment by a strong earthquake motion in a hanging wall of a splay fault in the Kumano trough.

Kuramoto, S., Taira, A., Bangs, N.L., Shipley, T.H.,Moore, G.F. and EW99-07, 08 Scientific Parties,"Seismogenic zone in the Nankai accretionary wedge general summary of Japan-U.S. collaborative 3-D seismicinvestigation", J. Geography, 109, 531-539 (2000).

Shin'ichi KURAMOTO, Juichiro ASHI, Jens GREINERT, Sean GULICK, Toyoho ISHIMURA, Sumito MORITA, Ko-ichi NAKAMURA, Makoto OKADA, Takuji OKAMOTO, Dirk RICKERT, Saneatsu SAITO, Erwin SUESS, Urumu TSUNOGAI, Takashige TOMOSUGI, Surface Observations of Subduction Related Mud Volcanoes and Large Thrust Sheets in the Nankai Subduction Margin ;Report on YK00-10 and YK01-04 Cruises, JAMSTEC J. Deep Sea Res., 19（2001）

4.2 Bottom Casing Deployment System

Matsumoto,H. and Nishida, H.

Seismic sensors attached to the network system will be buried below the seafloor. The platform for the seismic sensors is designed as a borehole. The platform is called the bottom casing. Although pelagic sediments such as mud or silt are predominant in the deep-sea area, we should evaluate how deep the bottom casing can be deployed below the seafloor. Therefore, detailed sediment types are classified by recovering marine sediment by using a piston corer.

A piston corer consists of a heavy weight and a long pipe to collect the sediment core samples. We used 4 meter pipe with a 0.8 tons weight (Figs 4.2-2 and 4.2-3). Recovery of marine sediment could be done at 24 candidates of observatory by one cruise so far. Almost collected samples suggest that it is soft enough to deploy 2 meters bottom casing at the observatory. Shear strength was also measured in terms of torque force. Then, a couple of bottom casing with short pipe and long one has been deployed at the central Kumano Trough by using a piston corer.

A procedure to deploy the bottom casing below the seafloor is as follows Fig 4.2-4. A piston corer covered with a bottom casing pipe penetrates into sediment layer as usually done. After landing a piston corer at the seafloor, an outer bottom casing pipe is released. And only a piston corer pipe is recovered with remaining the bottom casing below the seafloor. Finally, the bottom casing is simply deployed.

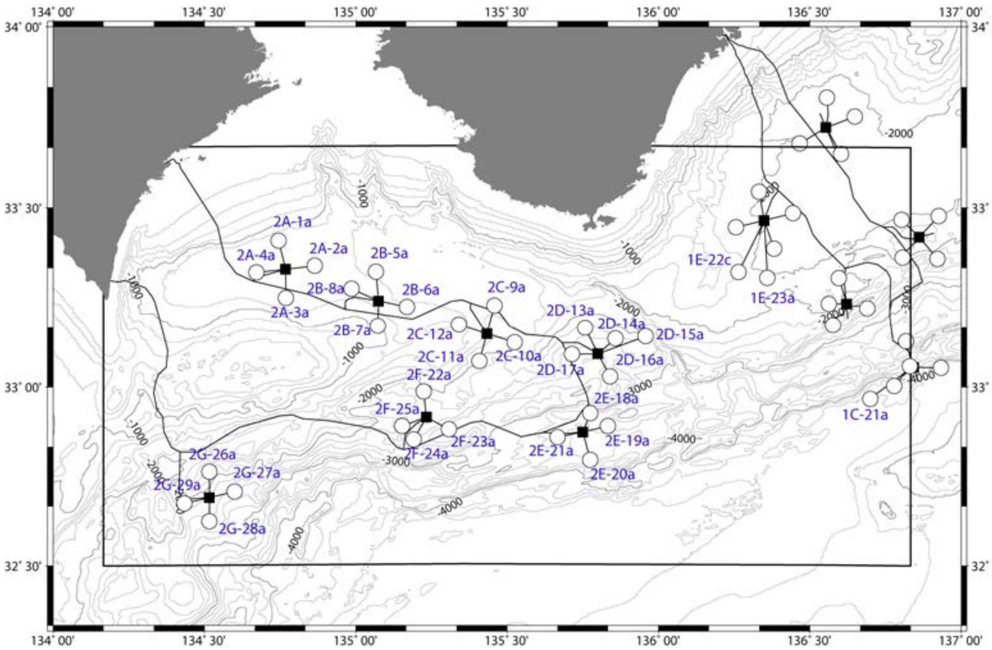


Fig. 4.2-1　The Research Area of KY13-17

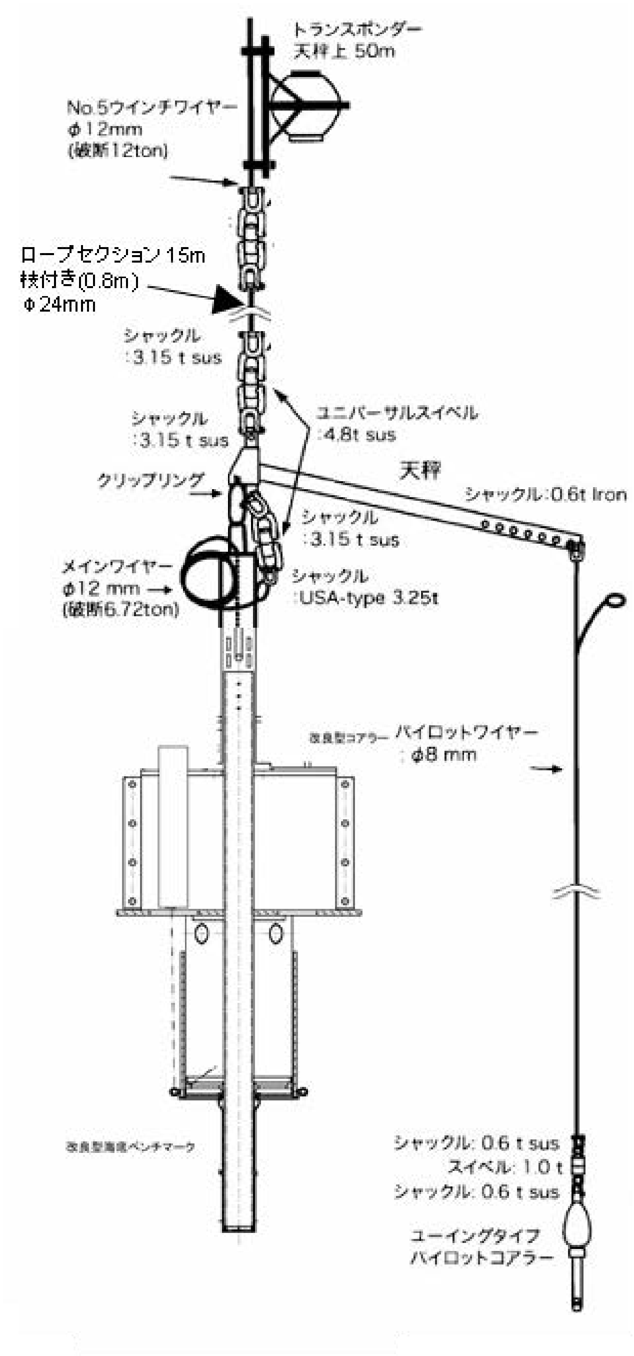


Figure 4.2-2　A configuration of the Bottom casing deployment system

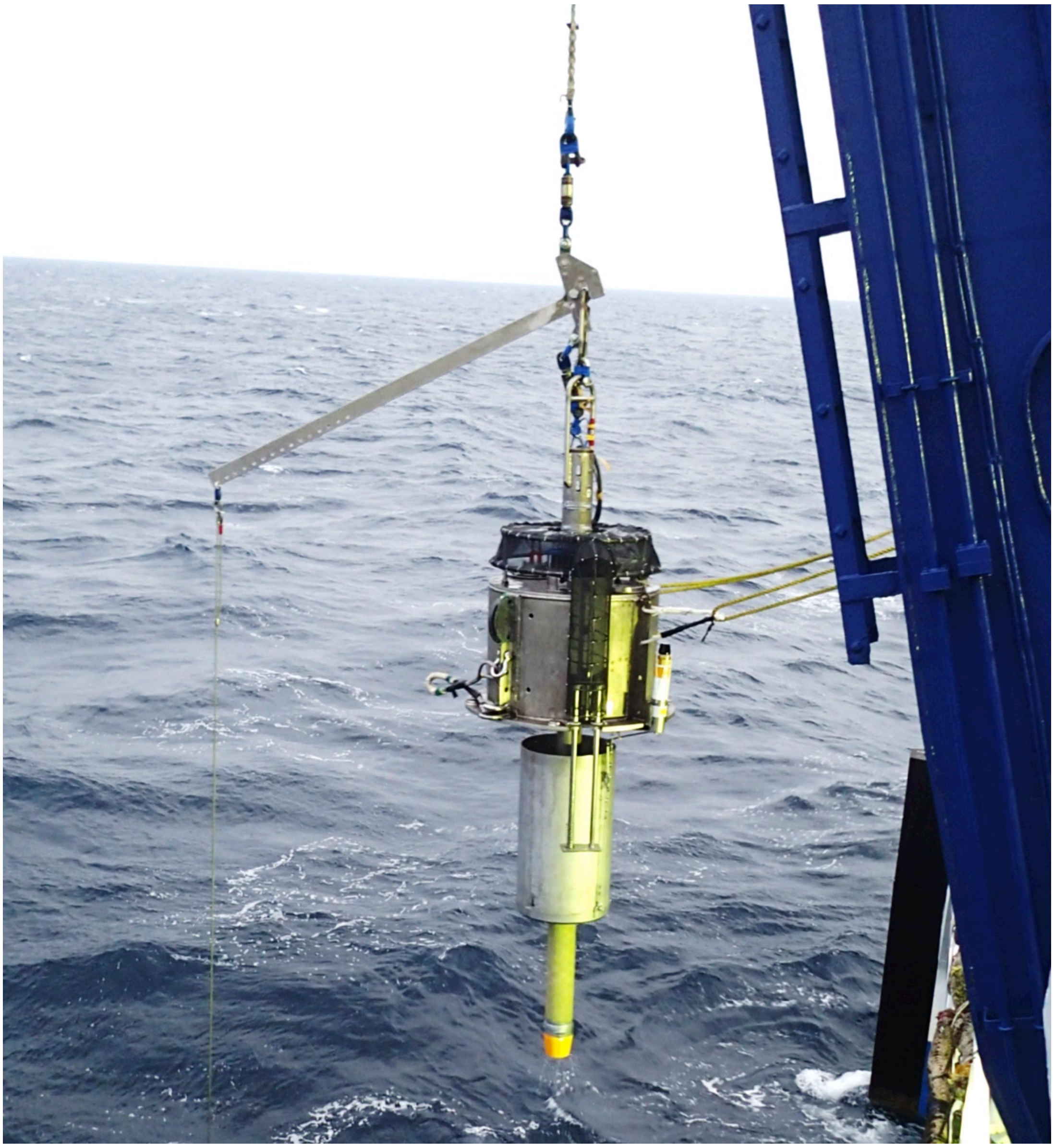


Figure 4.2-3 The Overview of the Bottom Casing Deployment System

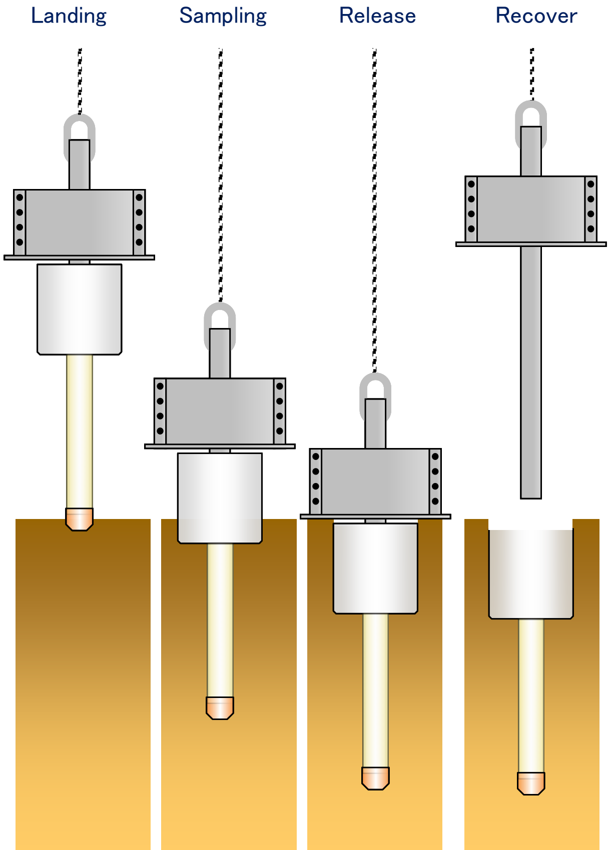


Figure 4.2-4　Schematic figure of bottom casing deployment using piston corer.

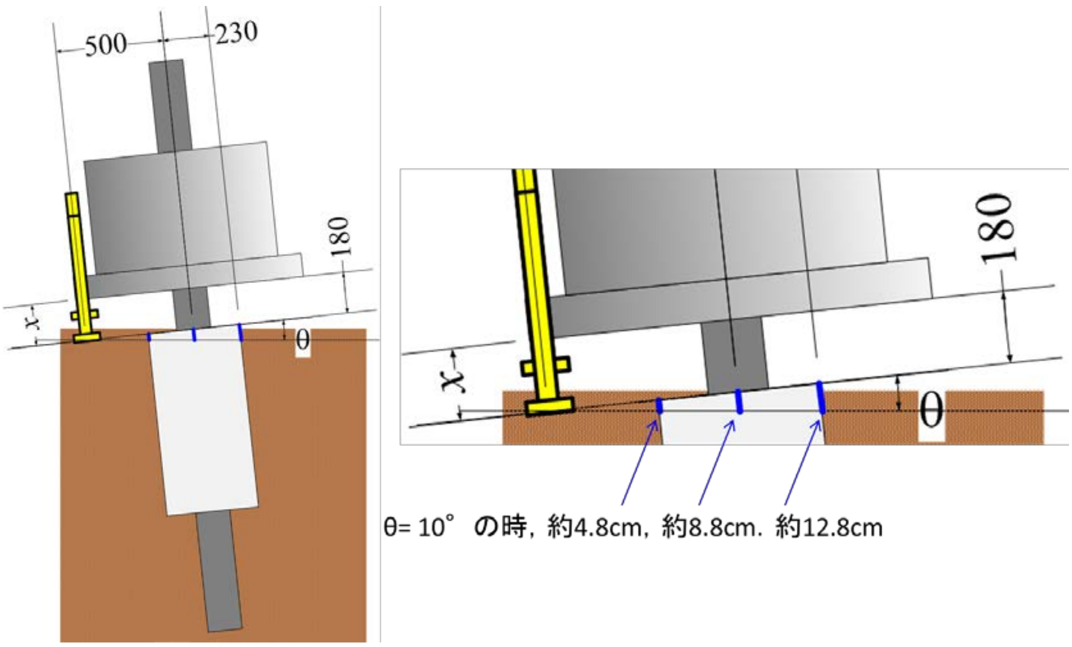


Figure 4.2-5　Schematic figure of penetration of bottom casing deployment using piston corer.

5. Instruments and Operation of Piston corer

Marine Works Japan

Piston corer system (PC) **Figure 5-1**

Piston corer system consists of 0.48 ton weight, long stainless steel barrel with polycarbonate liner tube and a pilot core sampler. The inside diameter (I.D.) of polycarbonate liner tube is 74 mm. The total weight of the system is approximately 0.7 ton. The length of the core barrel is 4 m, 6 m and 8m that is decided by site survey data and “K-value”.

In this cruise, we used a 74 mm diameter corer for a pilot core sampler and used brass body piston that are composing of two O-rings (size: P63).

Also, we set the Piston wire to the transponder, above 50 m from the PC.

“K-value”

“K-value” is the hardness parameter of the sea floor sediment.

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

For the protection of the No.5 winch, we choice the pipe length at the 2nd time base on the “K-value” at the 1st piston coring.

		4 m piston coring	6 m piston coring	8 m piston coring
K value:	0.34 or less	OK	OK	OK
	0.34 ~ 0.46	OK	OK	NG
	0.46 ~ 0.74	OK	NG	NG

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 60 m/min. The corers were stopped at a depth about 100 m above the seafloor for about 5 minutes to reduce some pendulum motion of the system. After the corers were stabilized, the wire was stored 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 20m/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 line.

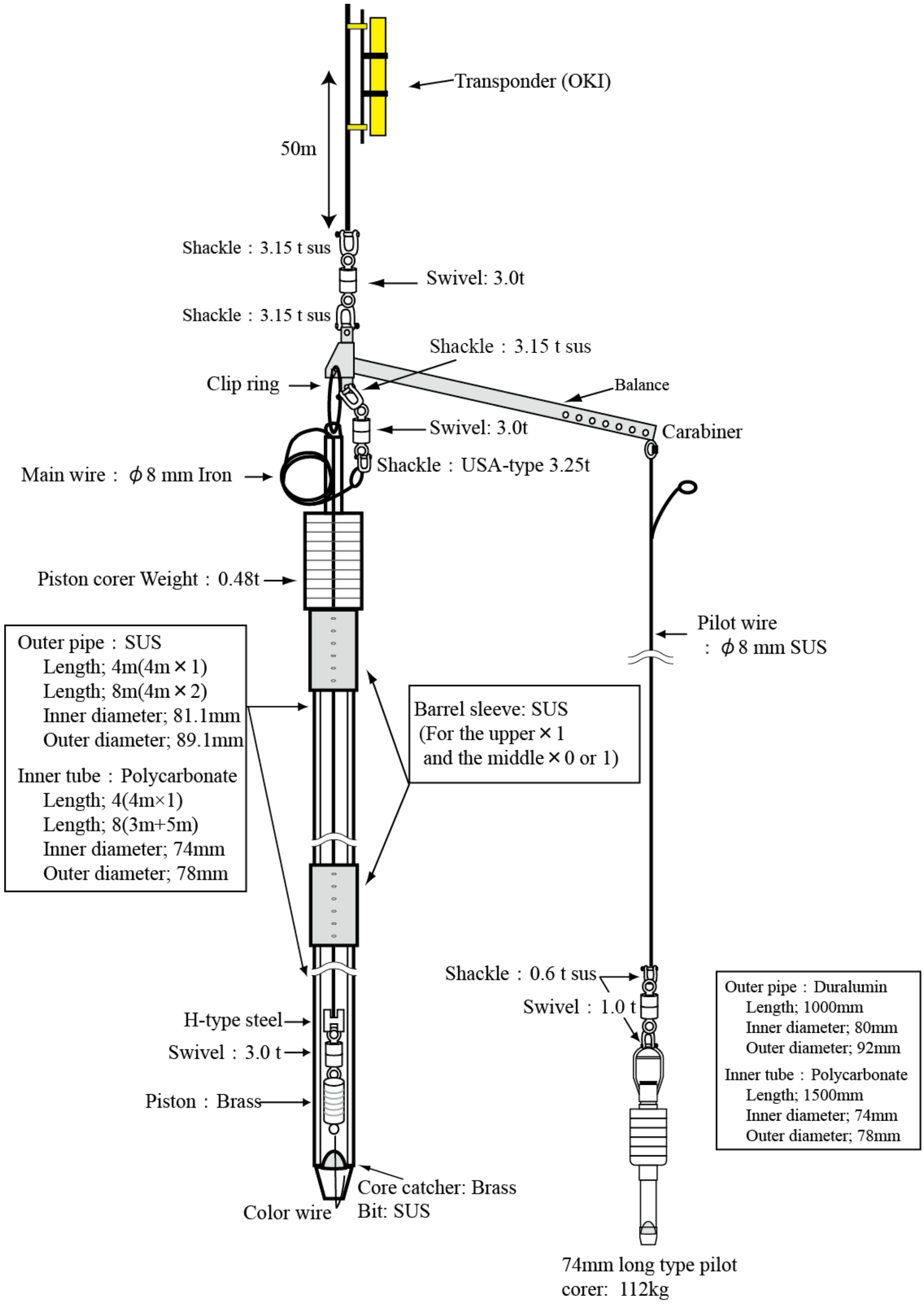


Fig. 5-1 General description of 8m Piston Corer

6. Results:

6.1 Piston coring initial results:

6.1.1. Lithology of piston cores

Ikehara, K.

Eleven piston cores with 11 gravity cores were collected from three major target areas, namely Tosa-bae Trough, Muroto Trough and forerac slope, during the KY13-17 cruise (Table 6.1.1-1). Lithology of these cores is described visually on board, and is summarized in Fig. 6.1.1-1 and Table 6.1.1-2. Original VCD sheets are attached in this cruise report as PDF files. In this section, lithological characteristics of each area will be described.

6.1.1.1 Tosa-bae Trough

Six cores (PC01, PC02, PC05, PC06, PC08 and PC09) were recovered from Tosa-bae Trough located between Tosa-bae and Minami-Tosa-bae banks. Principle lithology was the same for all cores; grayish olive-gray highly bioturbated silt intercalated with numerous olive black coarse silt-very fine sand thin (a few mm to a few cm in thickness) layers, although the upper part of core PC09 showed a slightly different lithology. Some of the coarse layers were bioturbated and were occurred as coarse silt patches. In general, the layers had the sharp and erosional basal contact and sharp or gradual upper contact. Upward fining graded structure was observed at some layers, especially for very fine sand layers. Parallel and/or cross lamination was recognized in some layers. These sand layers correspond to division Tc of Bouma (1962) and to subdivision T_0 of Stow and Shanmugam (1980). In some layers, thin regular laminae were observed. These might be correlative to division Te of Bouma (1962) and to subdivisions T_2 and T_3 of Stow and Shanmugam (1980). These facts suggest that the coarse layers are turbidite. No clear turbidite mud was observed visually. Some turbidite layers were highly destroyed by the post-depositional benthos activities. Frequency of the turbidite layers ranged from 3 to 7 in a section (around 1 m in thickness). Foraminifera tests occasionally found in the layers. Lithology of the lowermost part of the cores was slightly coarser than the upper part, reflecting the abundant occurrence of volcanic glass shards. A tephra layer with pumice type glass shards was found in core PC09. Upper part of core PC09 was a little different from the other cores. Dark and light color banding was a typical character of the core. Very thin layer with coarser grains than the surroundings was sometimes recognized at the base of dark colored layers. This suggests that the color banding might be formed in relation with supply of coarse materials (turbidite deposition?).

6.1.1.2 Muroto Trough

Three cores (PC03, PC04 and PC07) were collected from Muroto Trough. Major lithology of the cores was grayish olive-gray highly bioturbated silty clay with thin very fine sand-coarse silt layers of olive black in color as minor lithology. Thickness of the layers ranged from a few mm to ten cm. The layers had sharp and erosional basal contact and upward-fining graded structure. Parallel, cross and ripple-cross lamination was found in the layers. These layers correspond to division Tc of Bouma (1962) and to subdivision T_0 of Stow and Shanmugam (1980). In some layers, thin regular laminae with and without ripple lamination were observed. These are correlative to subdivision T_2 and T_3 of Stow and Shanmugam (1980), respectively, and both are to division Td of Bouma (1962). These structures suggest that the coarse layers are turbidite. Some layers were destroyed by benthos activities, and were occurred as sand patches. Frequency of the layers ranged from a few to 8 in a section (around 1 m in thickness). Frequency was high in core PC03 but low in core PC07. A tephra layer occurred at the bottom of core PC04.

6.1.1.3 Forearc slope

Two cores (PC10 and PC11) were obtained from forearc slope of the Nankai Trough off Cape Muroto. Both cores were composed of dark greenish gray highly bitoturbated silty clay. Only a coarse grained layer with around 10 cm in thickness occurred at the upper part of each core. The layer composed of muddy coarse sand-granule in the lower part, and of upward-fining fine-medium sand to coarse silt in the upper part. A thick tephra layer with bubble-wall type glass shards was recognized at 178-205.5 cm horizon in core PC11.

References

Bouma, A.H., 1962. Sedimentology of some flysch deposits. Elservier, Amsterdam, 168pp.

Stow, D.A.V. and Shanmugam, G., 1980. Sequence of structures in fine-grained turbidites: Comparison of recent deep-sea and ancient flysch sediments. Sedimentary Geology, 25, 23-42.

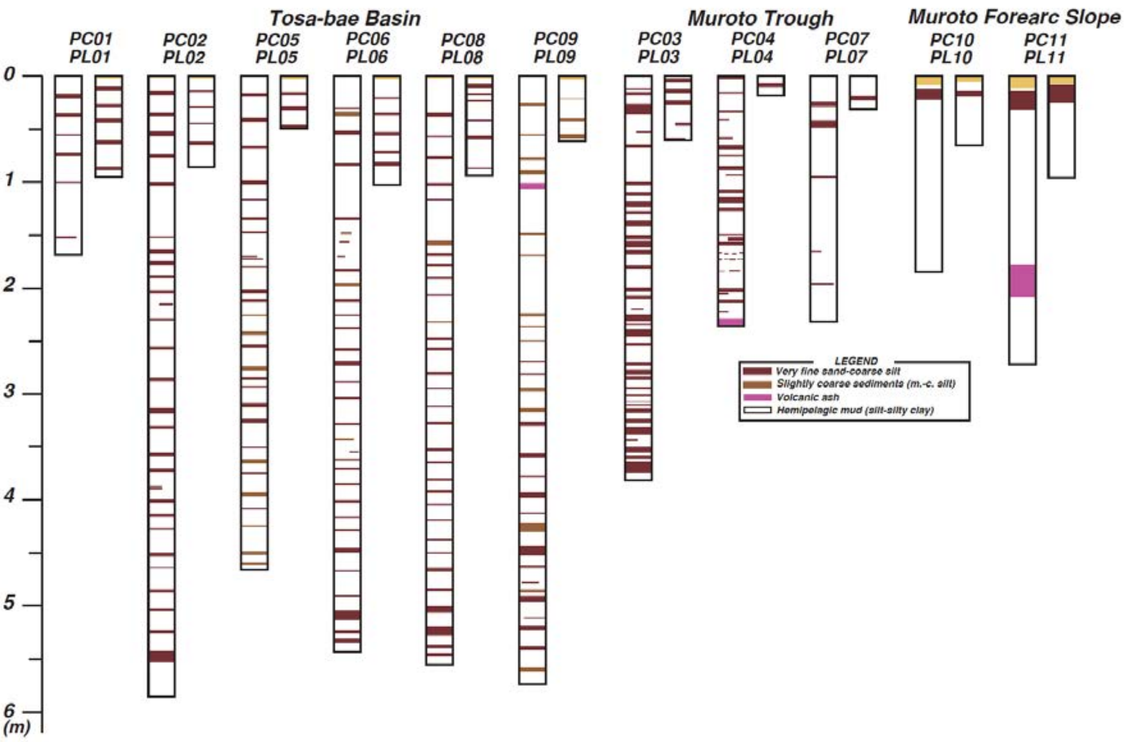


Figure 6.1.1-1 Simplied columnar section of piston cores obtained during KY13-17 cruise**.**

6.1.1 Piston core preliminary Results

Table 6.1.1-1 coring summary during KY13-17

Core ID	Corer type*	Location	Lat. (TP**)	Lon. (TP**)	Lat. (Ship)	Lon. (Ship)	Depth (m)	Corebarrel length (m)	Tension max. (kN)	K value***	Core length (cm) ****
PC01	Inner type PC	Off Kiisuido	32°52.9957' N	134°36.0040' E	32°52.9952' N	134°35.9497' E	1,647	4	16.0	0.02	172.5
PL01	74 corer							1			95
PC02	Inner type PC	Off Kiisuido	32°52.9508' N	134°36.0143' E	32°52.9493' N	134°35.9600' E	1,651	8	21.0	0.09	586
PL02	74 corer							1			86
PC03	Inner type PC	Off Kiisuido	33°21.0201' N	134°36.9684' E	33°20.9993' N	134°36.9566' E	1,368	8	25.0	0.27	383
PL03	74 corer							1			60
PC04	Inner type PC	Off Kiisuido	33°15.5230' N	134°30.9101' E	33°15.5241' N	134°30.9422' E	1,258	8	30.0	0.66	236
PL04	74 corer							1			16
PC05	Inner type PC	Off Kiisuido	32°52.9163' N	134°36.0647' E	32°52.9088' N	134°35.9865' E	1,650	8	21.0	0.11	466
PL05	74 corer							1			49
PC06	Inner type PC	Off Kiisuido	32°53.0388' N	134°35.9997' E	32°53.0213' N	134°35.9095' E	1,647	8	23.0	0.13	542
PL06	74 corer							1			101.5
PC07	Inner type PC	Off Kiisuido	33°18.6049' N	134°21.3953' E	33°18.6219' N	134°21.3782' E	1,200	4	18.0	0.15	231.5
PL07	74 corer							1			42
PC08	Inner type PC	Off Kiisuido	32°52.9788' N	134°35.9933' E	32°52.9659' N	134°35.9089' E	1,646	8	21.0	0.09	554.8
PL08	74 corer							1			93.3
PC09	Inner type PC	Off Kiisuido	32°52.7086' N	134°36.1248' E	32°52.6999' N	134°36.0278' E	1,653	8	20.0	0.07	572.5
PL09	74 corer							1			61.2
PC10	Inner type PC	Off Kiisuido	32°37.4735' N	134°35.9726' E	32°37.4800' N	134°35.9094' E	2,940	4	24.0	0.08	183
PL10	74 corer							1			76.5
PC11	Inner type PC	Off Kiisuido	32°32.9893' N	134°45.9095' E	32°32.9910' N	134°45.9469' E	4,163	4	34.0	0.14	271
PL11	74 corer							1			94.5

*Weight of the PC is 480 kg.
**"TP" is position by the transponder.
***K value is the strength parameter of the sea floor sediment; K value = pure pull out load / (outer diameter of outer pipe * penetration length).
****Core length is W-half measured after splitting.

Table 6.1.1-2 Summary of lithology of piston cores obtained during KY13-17 cruise

Core	Section	Core/Section Length (cm)	Area	Lithological summary
PC01	3, 4	167.5	Tosa-bae Trough	Gray homogeneous-bioturbated silt with olive black coarse (very fine sand-medium silt) beds
	3	71.5		Gray homogeneous-bioturbated silt with olive black parallel laminated coarse-medium silt beds
	4	96		Gray highly bioturbated silt with olive black coarse silt-very fine sand beds
PL01		95		Gray homogeneous silt with olive black parallel laminated coarse-medium silt beds
PC02	3, 4, 5, 6, 7, 8, CC	586	Tosa-bae Trough	Gray highly bioturbated silt with olive black coarse silt-very fine sand beds
	3	78.5		Gray highly bioturbated silt with olive black parallel laminated coarse silt-very fine sand beds
	4	99.5		Gray highly bioturbated silt with olive black parallel laminated coarse silt beds
	5	101.5		Gray highly bioturbated silt with olive black parallel laminated coarse silt beds
	6	99.5		Gray highly bioturbated silt with olive black parallel laminated or multi-layered coarse silt beds
	7	100		Gray highly bioturbated silt with olive black parallel laminated or multi-layered coarse silt-very fine sand beds
	8	98		Gray highly bioturbated silt with olive black parallel laminated coarse silt beds
	CC	9		Olive black medium-coarse silt, volcanic glass shard rich
PL02		86		Gray highly bioturbated silt with coarse silt-very fine sand beds
PC03	5, 6, 7, 8	383	Muroto Trough	Grayish olive highly bioturbated clayey silt with olive black coarse silt beds
	5	88		Grayish olive highly bioturbated clayey silt with olive black coarse silt-very fine sand beds
	6	99.7		Grayish olive highly bioturbated clayey silt with olive black coarse silt beds

	7	100.3		Grayish olive highly bioturbated clayey silt with olive black coarse silt beds
	8	95		Grayish olive highly bioturbated clayey silt with olive black coarse silt beds
PL03		60		Gray-Grayish olive clayey highly bioturbated silt with olive black very fine sand-coarse silt beds
PC04	6, 7, 8	236	Muroto Trough	Grayish olive highly bioturbated clayey silt with olive black coarse silt beds
	6	39		Grayish olive highly bioturbated-homogeneous silt with olive black coarse silt beds
	7	99.7		Grayish olive highly bioturbated silt with olive black coarse silt beds
	8	97.3		Grayish olive highly bioturbated silt with olive black coarse silt beds, and a brownish gray volcanic ash bed at bottom
PL04		16		Grayish olive highly bioturbated silt with a olive black parallel laminated coarse silt bed
PC05	3, 4, 5, 6, 7, 8	466	Tosa-bae Trough	Grayish olive-gray highly bioturbated silt with olive black coarse silt beds
	3	64.5		Grayish olive highly bioturbated silt with olive black medium-coarse silt beds
	4	50		Grayish olive highly bioturbated silt with a olive black coarse silt beds
	5	55		Grayish olive highly bioturbated silt with olive black coarse-medium silt beds
	6	100		Grayish olive highly bioturbated silt with olive black coarse-medium silt beds
	7	100		Grayish olive highly bioturbated silt with olive black coarse silt beds
	8	96.5		Gray highly bioturbated silt with olive black coarse-medium silt beds
PL05		49		Grayish olive bioturbated silt with olive black coarse silt beds
PC06	3, 4, 5, 6, 7, 8	542	Tosa-bae Trough	Grayish olive-gray highly bioturbated silt with olive black coarse silt beds
	3	43.5		Grayish olive highly bioturbated silt with a olive black parallel laminated coarse silt bed

	4	99.8		Grayish olive highly bioturbated silt with olive black coarse silt beds
	5	100		Grayish olive highly bioturbated silt with olive black coarse silt beds
	6	100.2		Grayish olive highly bioturbated silt with olive black coarse silt beds
	7	100		Gray highly bioturbated silt with olive black coarse silt beds
	8	98.5		Grayish olive highly bioturbated silt with olive black coarse silt beds
PL06		101.5		Gray highly bioturbated silt with olive black coarse silt beds
PC07	2, 3, 4	231.5	Muroto Trough	Grayish olive highly bioturbated silt with olive black very fine sand-coarse silt beds
	2	35		Grayish olive highly bioturbated silt with a olive black very fine sand bed
	3	100		Grayish olive highly bioturbated silt with olive black very fine sand beds
	4	96.5		Grayish olive highly bioturbated silt with olive black bioturbated coarse silt beds
PL07		42		Grayish olive bioturbated silt with a olive black very fine sand bed
PC08	3, 4, 5, 6, 7, 8	554.8	Tosa-bae Trough	
	3	57		Gray highly bioturbated silt with olive black coarse silt beds
	4	100.5		Grayish olive highly bioturbated silt with olive black coarse silt beds
	5	100		Grayish olive highly bioturbated silt with olive black coarse silt beds
	6	100		Grayish olive highly bioturbated silt with olive black coarse silt beds
	7	99.8		Grayish olive highly bioturbated silt with olive black coarse silt beds
	8	97.5		Grayish olive highly bioturbated silt with olive black coarse silt beds
PL08		93.3		Gray highly bioturbated silt with olive black coarse silt-very fine sand beds

PC09	3, 4, 5, 6, 7, 8	572.5	Tosa-bae Trough	Gray-grayish olive-olive black color banded silt in the upper part, grayish olive silt with coarse silt beds in the lower part
	3	74.5		Gray-grayish olive-olive black silt, color banded
	4	100		Grayish olive-olive black silt, color banded, with a yellowish gray volcanic ash bed
	5	100		Grayish olive-olive black silt, color banded
	6	100.5		Gray-grayish olive-olive black silt, color banded
	7	100		Grayish olive highly bioturbated silt with olive black coarse silt beds
	8	97.5		Grayish olive silt with olive black coarse silt beds
PL09		61.2		Gray-Grayish olive silt, color banded
PC10	3, 4	183	Forearc slope	Dark olive gray highly bioturbated silty clat with a dark olive gray graded fine-very fine sand bed
	3	84.5		Dark olive gray highly bioturbated silty clat with a dark olive gray graded fine-very fine sand bed
	4	98.5		Dark olive gray homogeneous-highly bioturbated silty clay
PL10		76.5		Dark olive gray highly bioturbated silty clay with a dark olive gray graded very fine sand bed
PC11	2, 3, 4	271	Forearc slope	
	2	75		Dark olive gray highly bioturbated silty clay with a dark olive gray graded coarse silt bed with muddy granule-coarse sand
	3	100		Dark olive gray highly bioturbated silty clay
	4	96		Dark olive gray highly bioturbated silty clay with a brownish gray-yellowish gray-gray-grayish olive volcanic ash bed
PL11		94.5		Dark olive gray highly bioturbated silty clay with a dark olive gray graded coarse silt bed with muddy coarse sand-granules

6.1.2 Magnetic susceptibility

Iwai, M. (Kochi University), operation chief

Kobayashi, M. (Kochi University), operator

Shimizu, E. (Kochi University), operator

Kanamatsu, T. (JAMSTEC), technical advisor

Whole core magnetic susceptibility measurement was performed in every 2 cm interval for all cored sediments during the Cruise KY13-17 except the DONET cores. We used Bartington Instruments magnetic susceptibility meter Model MS3 and MS2C core logging sensor (inner diameter 10 cm) (Figs. 6.1.2-1 and 6.1.2-2). Air calibration was done before each section measurement.

Downcore profiles of volume magnetic susceptibility were shown in Figs 6.1.2-3, 6.1.2-4, and 6.1.2-5. Profiles show different aspects from basin to basin, however, very similar within each site and each basin. Especially in the Tosabae Trough, cores were easily able to correlate each other (Fig. 6.1.2-3). Compering to those pattern in Core KR9707P1 (Iwai et al., 2004) and Cores KR9911PC1 and PC2 (Kitamura, 2004MS), it is presumed that all cores recovered without any significant core disturbance and/or gap, and Cores PC02, PC06, and PC08 provide, at least, continuous sedimentary sections to assess sedimentary history for last ~7000 years.

References

Iwai, M., Fujiwara, O., Momma, H., Iwasaki, N., Kano, H., Oda, M., Matsuoka, H., and Okamura, M., 2004. Holocene seismoturbidites from the Tosabae Trough, a landward slope basin of Nankai Trough off Muroto: Core KR9705P1. Mem. Geol. Soc. Japan. No.58, p.137-152. (in Japanese with English Abstract)

Kitamura, K., 2004MS. Sediments and sedimentary process of landside slop in the Nankai Trough off Muroto Peninsula: KR9911PC2 and PC2. Bachelor thesis, Department of Geology, Kochi University. (in Japanese)

Fukusawa, H., "Non-glacial varved lake sediment as a natural timekeeper and detector on environmental changes", The Quaternary Research, vol. 34, 1995, p.135-149. (in Japanese with English Abstract)

Fig. 6.1.2-1. Magnetic susceptibility mesurement system used during the Cruise KY13-17.

Fig. 6.1.2-2. Close up photograph of the magnetic susceptibility meter Model MS3 (Bartington Instruments Ltd.)

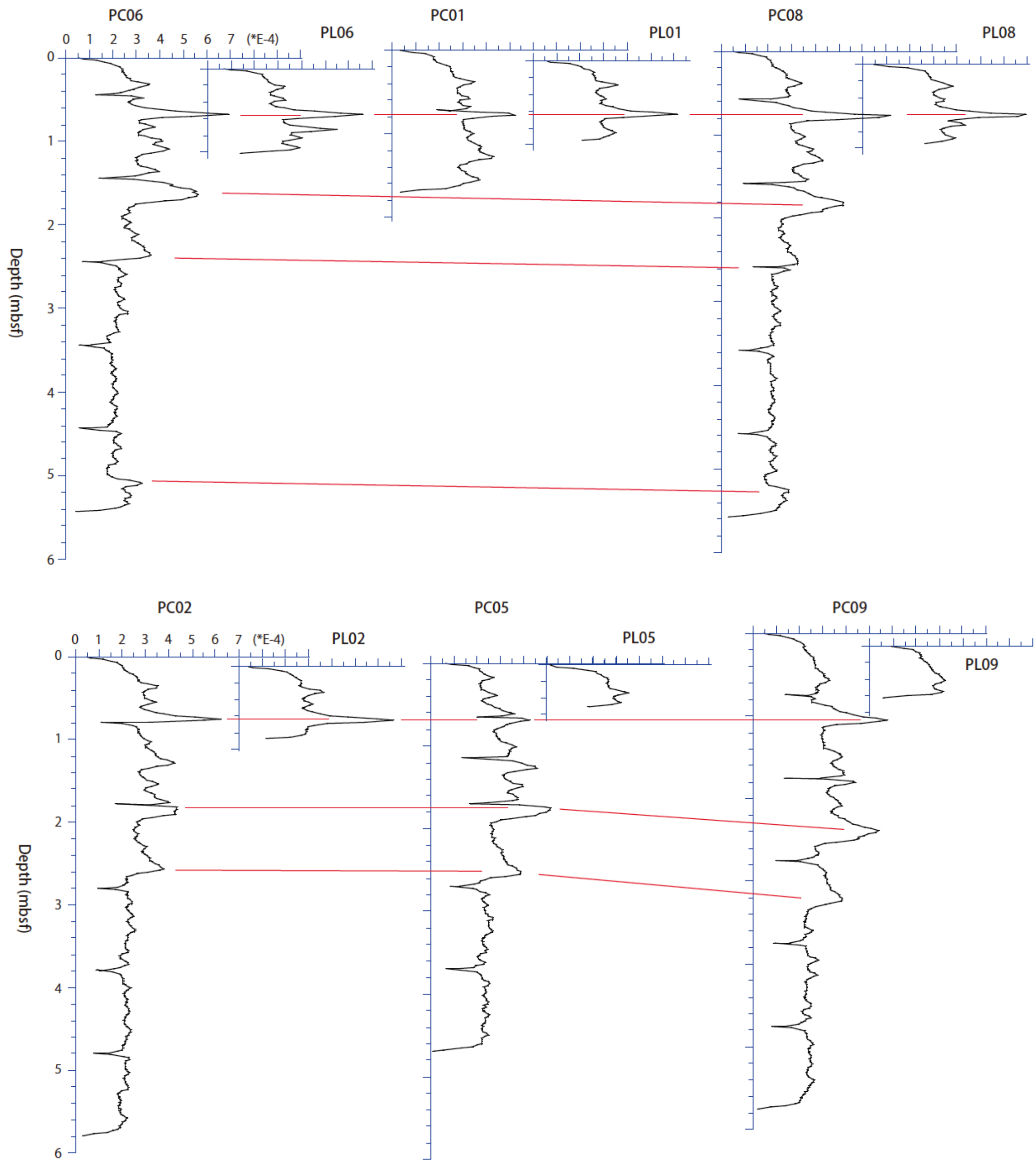


Fig. 6.1.2-3. Down core profiles of volume magnetic susceptibility (SI unit) for cores obtained from Tosabae Trough during the KY13-17 cruise. Coring sites were arranged along the sub-bottom profile line SBP2 of Iwai et al. (2004). Depth is shown in meter below sea floor (mbsf). PC06: northernmost. PC09: the southernmost. PC: piston core. PL: pilot core.

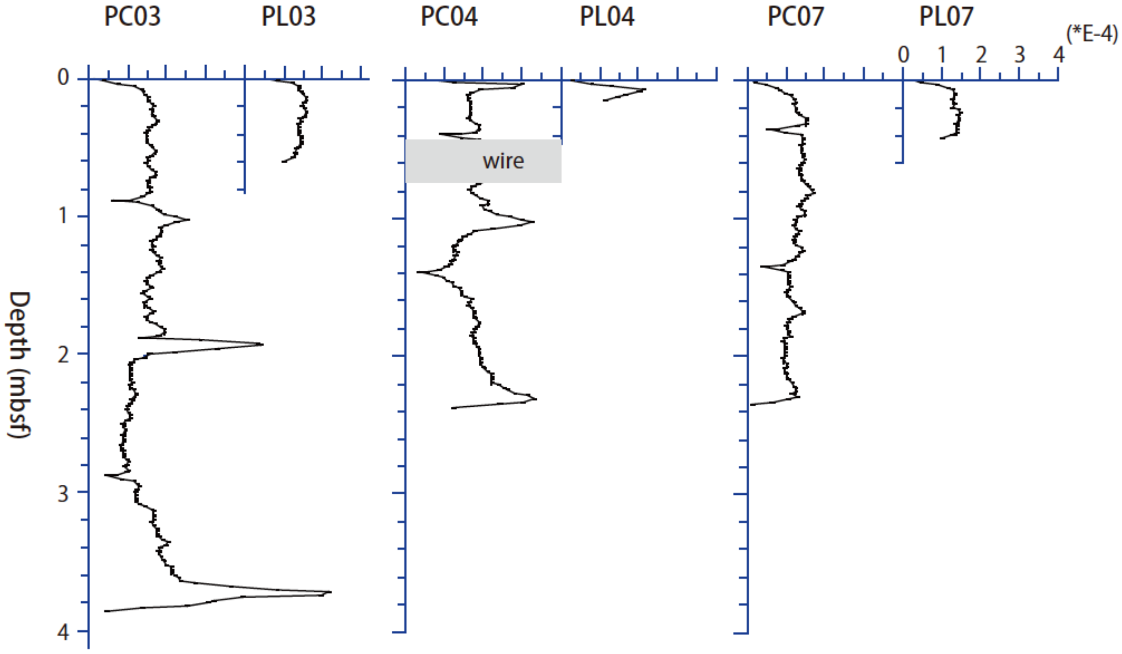


Fig. 6.1.2-4. Down core profiles of volume magnetic susceptibility (SI unit) for cores obtained from Muroto Trough during the KY13-17 cruise. Depth is shown in meter below sea floor (mbsf). PC: piston core. PL: pilot core.

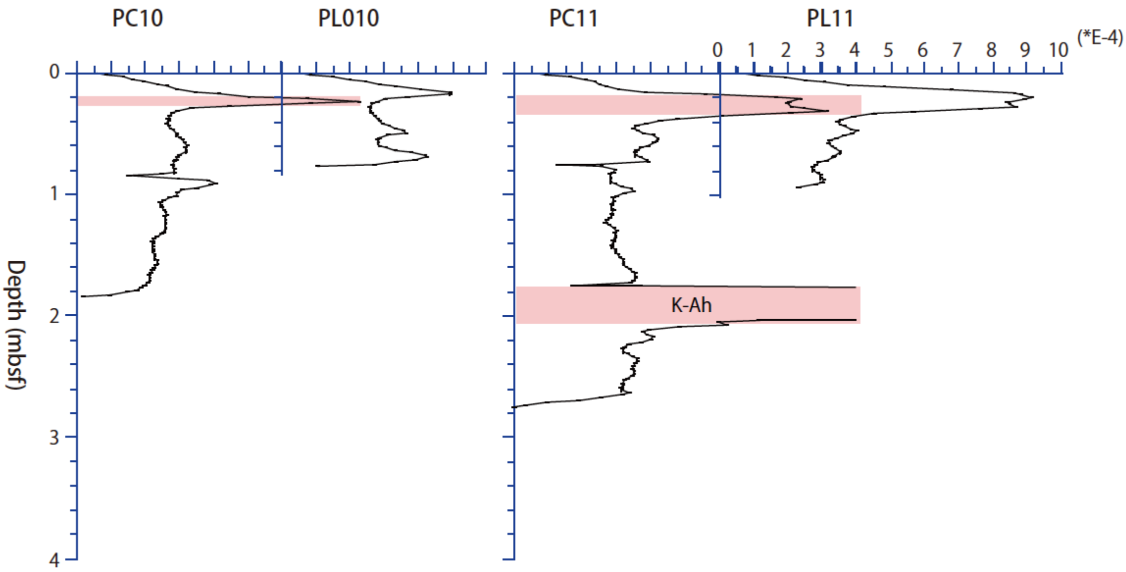


Fig. 6.1.2-5. Down core profiles of volume magnetic susceptibility (SI unit) for cores obtained from lower landward slope of Nankai Trough off Muroto Peninsula during the KY13-17 cruise. Ash layers were shown in red shade box. Lower ash layer in Core KY13-17PC11 was tentatively identified as K-Ah ash (7280 Cal BP; Fukusawa, 1995).

6.1.3. Color spectroscopy

Kanamatsu, T.

Reflectance spectra on split fresh surfaces of all the pilot and piston cores were measured onboard. The colorimetric information was recorded in the L*a*b* color space systems which expressed color as a function of lightness (L*) and color values a* and b* using “Konica Minolta CM700d CM-700d Portable Spectrophotometer”. The initial observations of the data plotted versus depth for each core show that large-scale variability in the signals (Figures 6.1.3). Post-cruise analyses will extract more detailed information about these measurements.

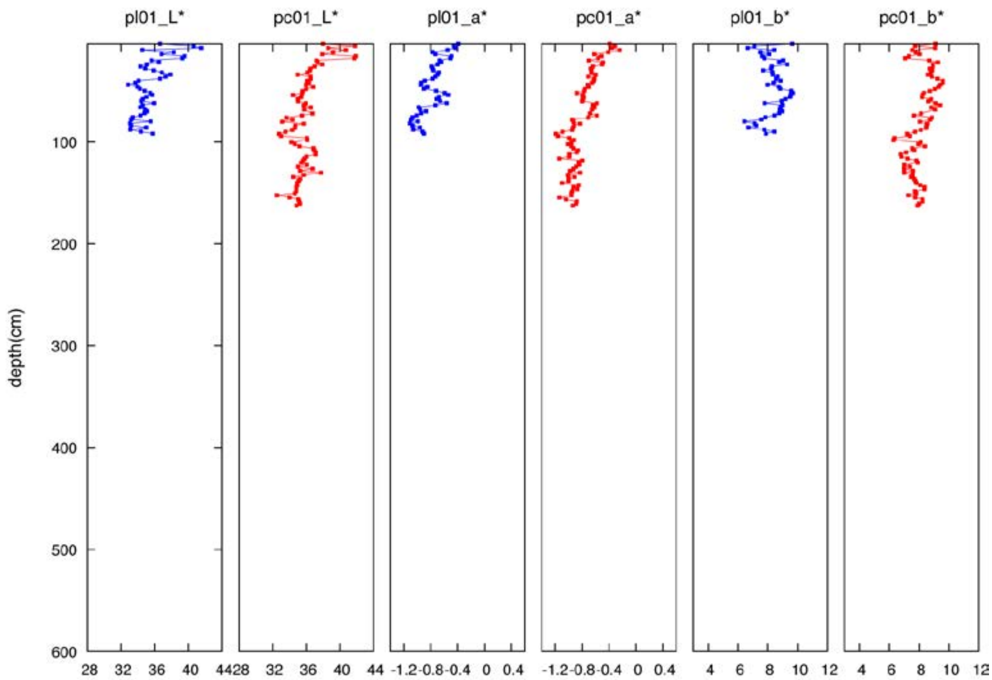


Figure 6.1.3-1 L*, a*,b* of PL01 and PC01

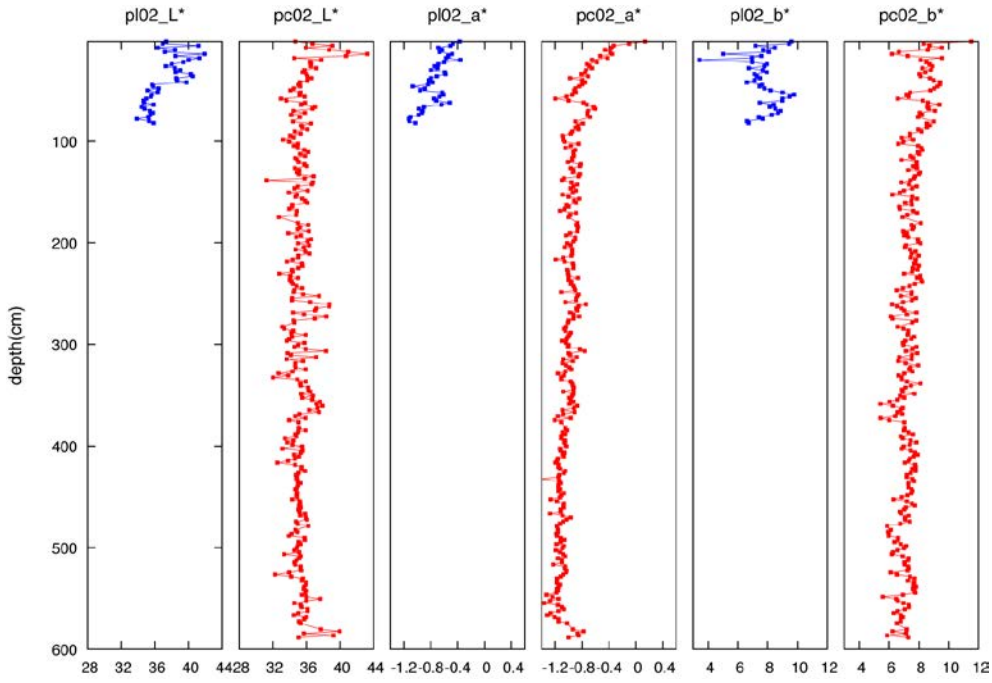


Figure 6.1.3-2 L*, a*,b* of PL02 and PC02

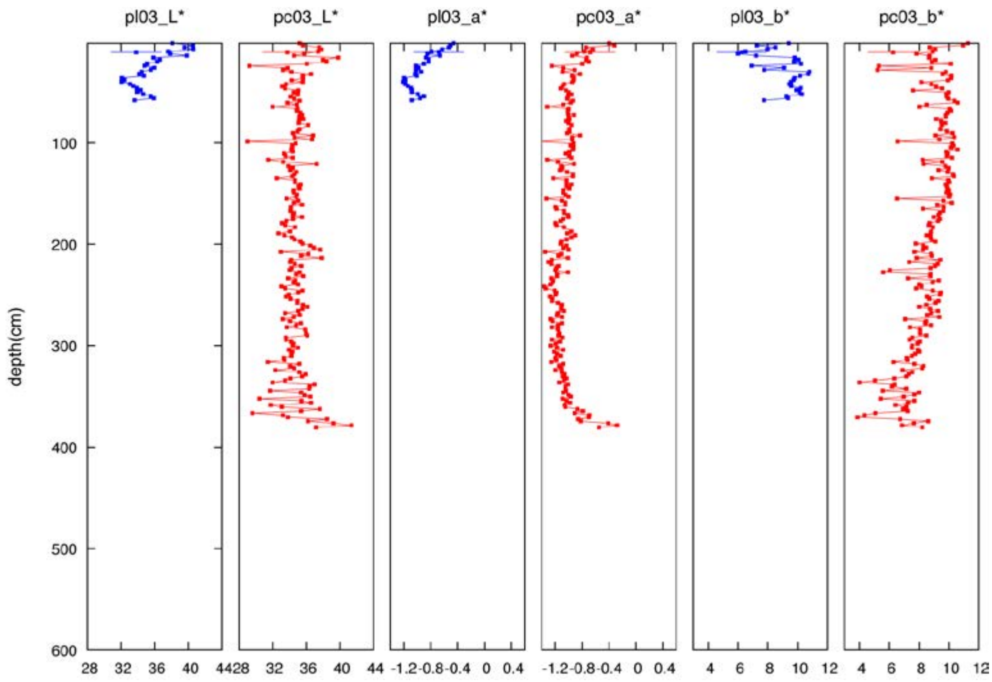


Figure 6.1.3-3 L*, a*,b* of PL03 and PC03

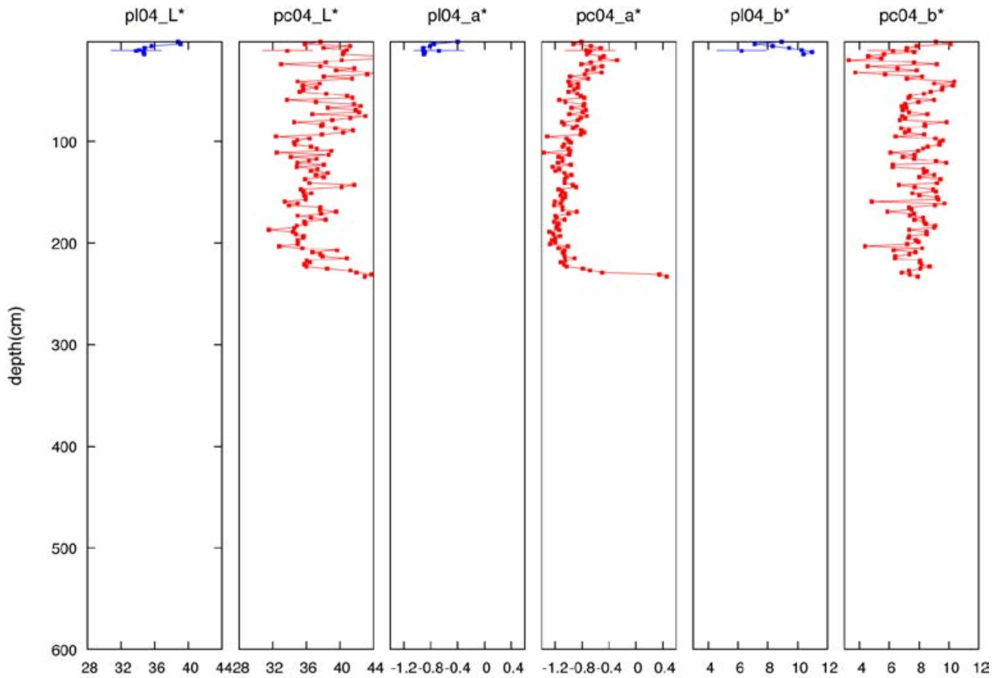


Figure 6.1.3-4 L*, a*,b* of PL04 and PC04

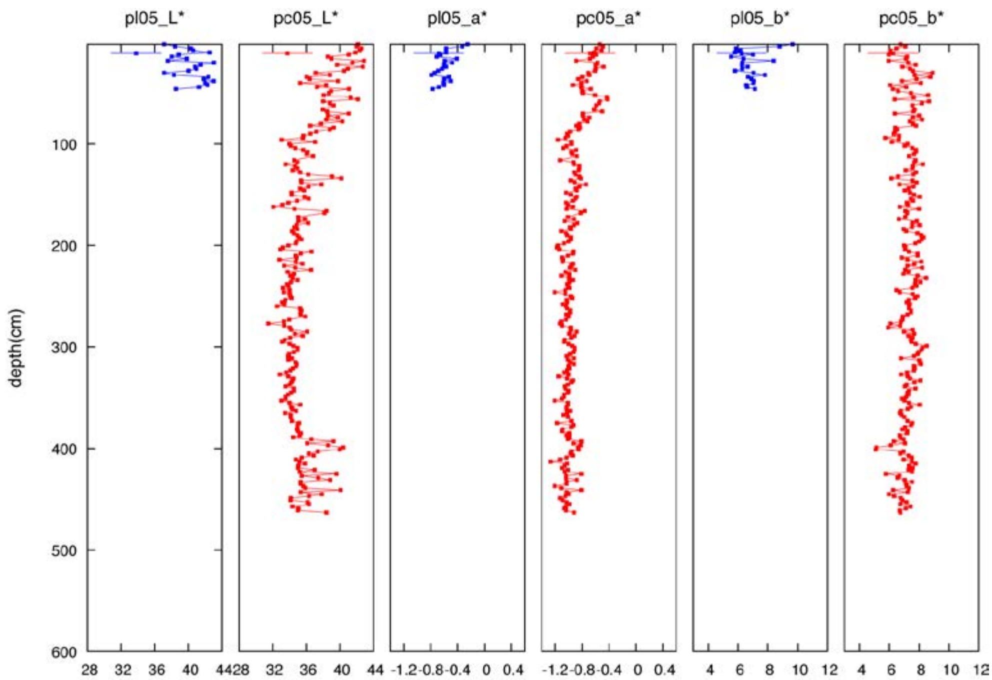


Figure 6.1.3-5 L*, a*, b* of PL05 and PC05

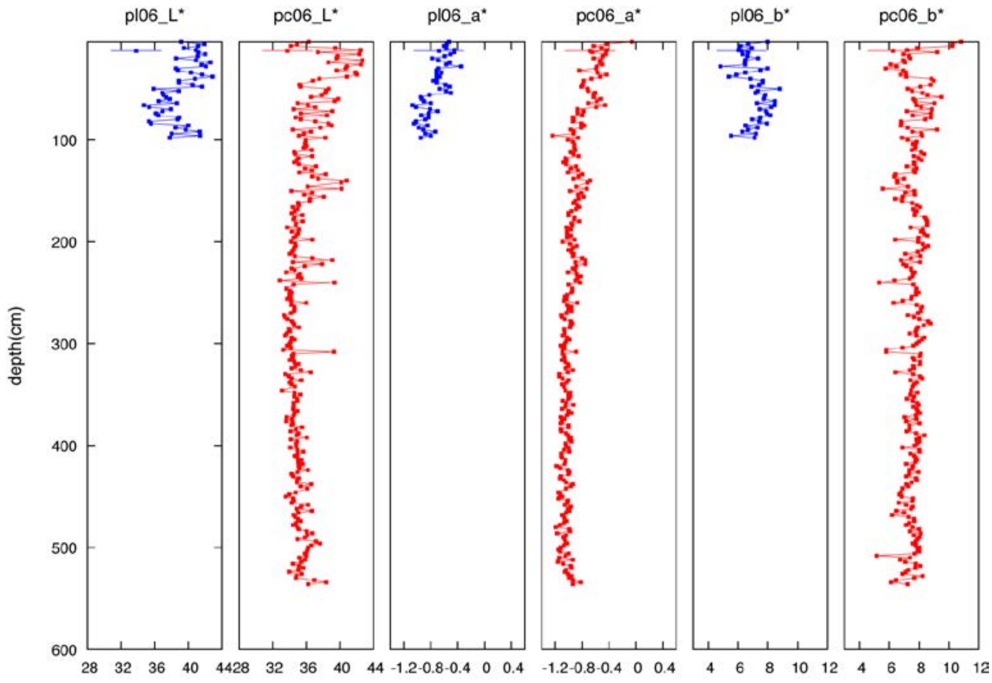


Figure 6.1.3-6 L*, a*, b* of PL06 and PC06

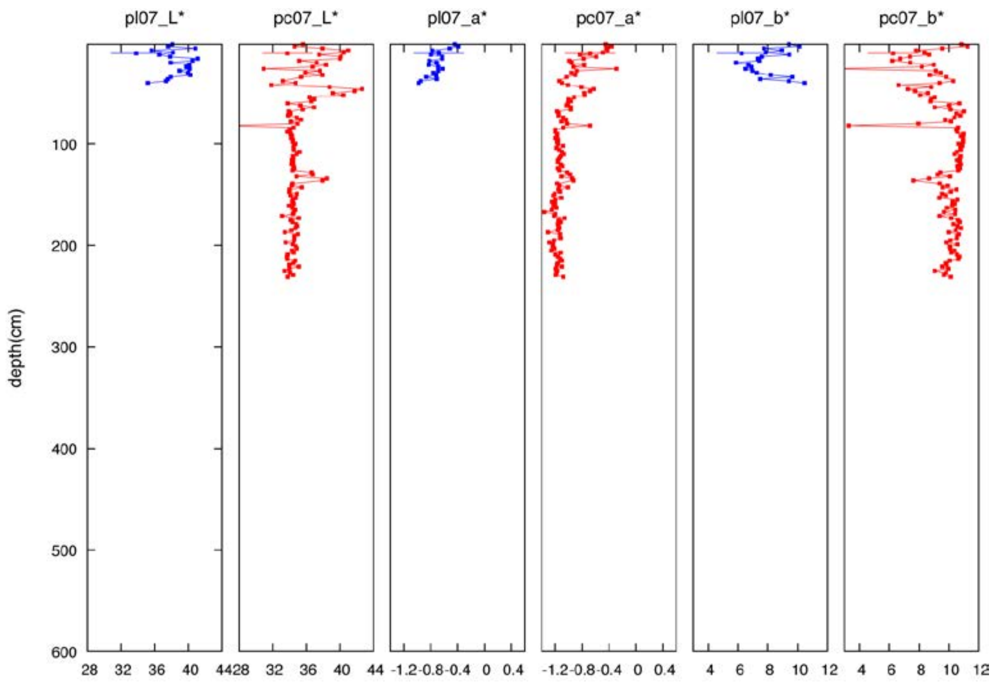


Figure 6.1.3-7 L*, a*, b* of PL07 and PC07

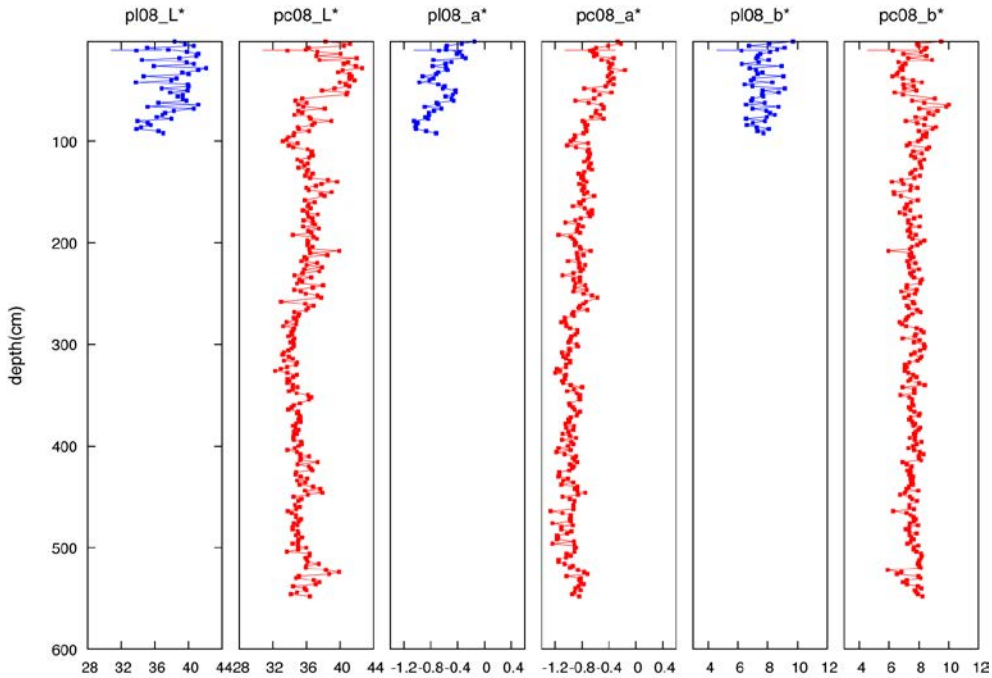


Figure 6.1.3-8 L*, a*, b* of PL08 and PC08

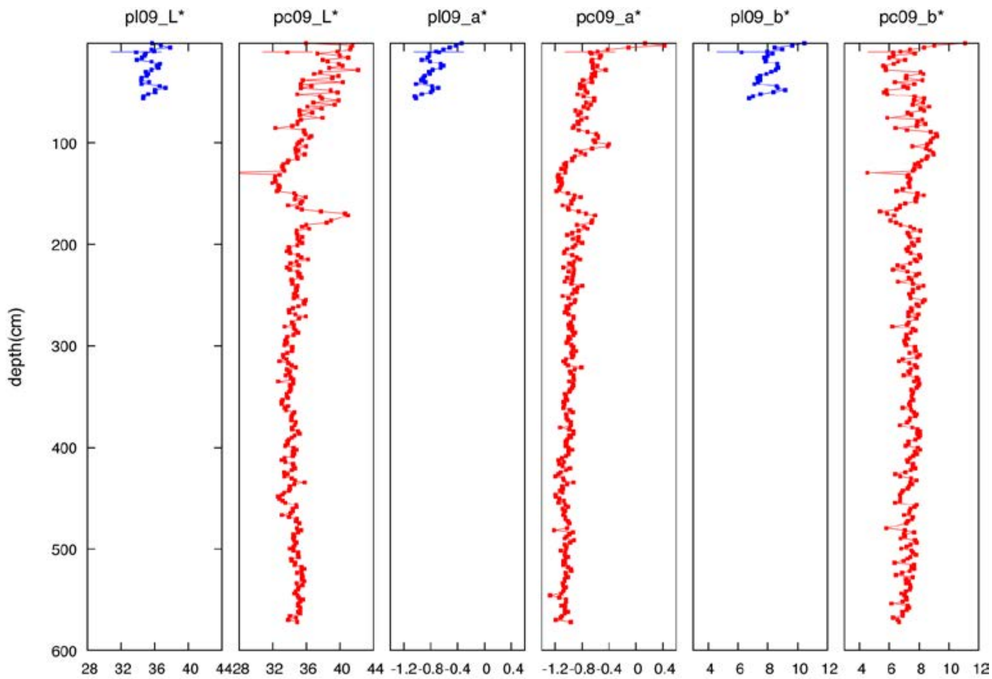


Figure 6.1.3-9 L*, a*, b* of PL09 and PC09

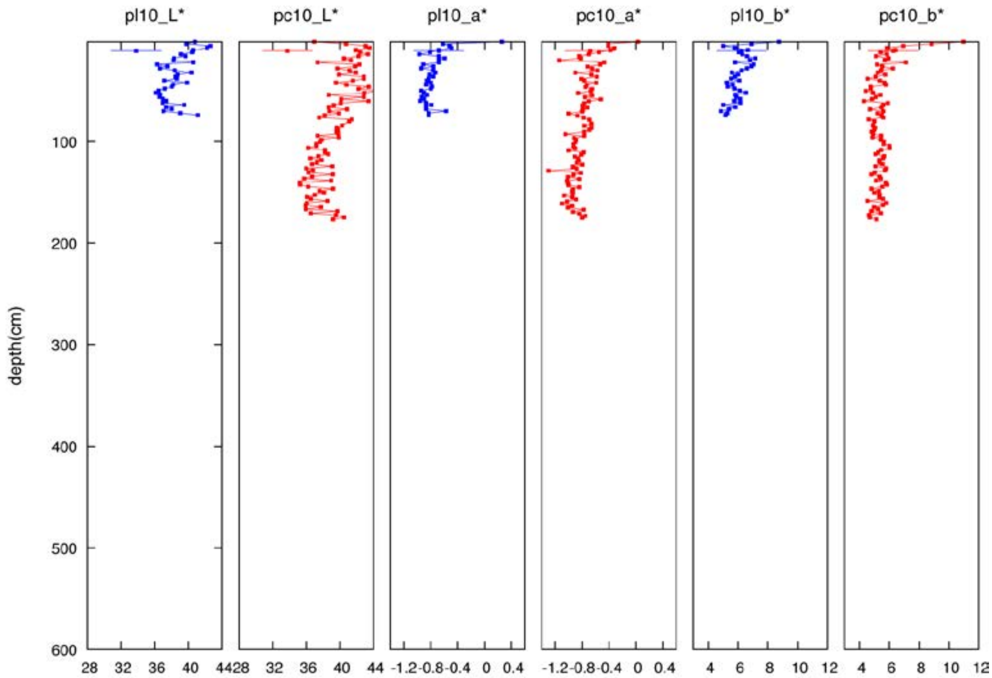


Figure 6.1.3-10 L*, a*, b* of PL10 and PC10

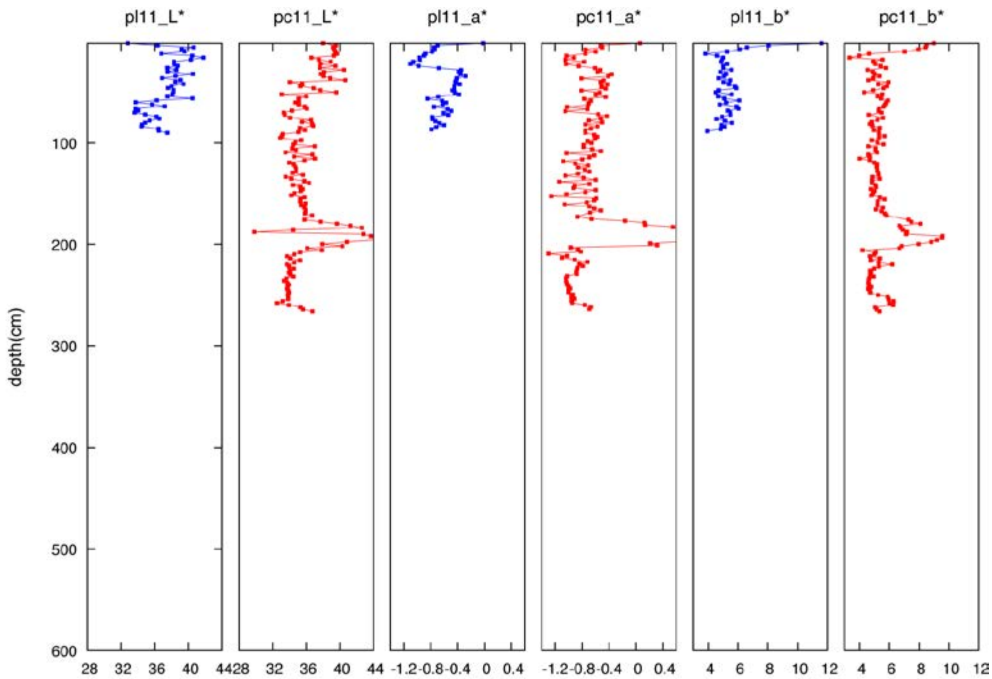


Figure 6.1.3-11 L*, a*, b* of PL11 and PC11

6.2 Bottom casing installation result

Nishida, H.

Tables below bottom show positions for casing operations, and detail records of operations.

Table 6.2-1 target positions

Observatory No.	Latitude	Longitude	Depth
2A-1	33-19.801	136-16.202	1843
2A-3	33-19.802	136-16.200	1839

Table 6.2-2 Results of operations

	Observatory No	Tilt [°]	Outcrop Length [cm]	Weight [kg]	Latitude	Longitude	Depth [m]
CS01	2A-1	>10	-23～2	0, 7, 19	33-24.4965 N	134-44.7142 E	1344.8
CS02	2A-1	>10	-8～12	0, 7, 9	33-24.4990 N	134-44.7085 E	1345.3
CS03	2A-3	<10	-23～2	10, 7, 9	33-14.9375 N	134-46.1537 E	1323.1
CS04	2A-1	<10	-13～7	10, 7, 9	33-24.4972 N	134-44.6973 E	1348.3
CS05	2A-1	<10	-8～12	10, 7, 9	33-24.4976 N	134-44.7017 E	1347.6

7. Multi narrow beam survey

Iwai, M. (Kochi University), Proposer
Kanamatsu, T. (JAMSTEC), Chief Scientist
Hattori, T., Chief Radio Operator of R/V KAIYO
Fukagawa, S., 2nd Radio Operator of R/V KAIYO

For the last decade, many bathymetric surveys by using multi-beam echo sounder have been done in the Nankai Trough off Muroto Peninsula (e.g. KR9911,). Minimum bathymetric survey on a single line of 2.5km along the coring sites in the Tosabae Trough had been done during the KY13-17.

We used SEA BEAM 2100 multi-beam echo sounder system (SeaBeam Instruments, Inc., 1997, 1999) equipped on the R/V KAIYO, a semi-submerged catamaran or SWATH-type vessel. SEA BEAM 2100 has beam frequency of 12 kHz, swath width of 80 degree, and depth range from 100 to 11000 m. Ship operation speed was 10 knt during the bathymetric survey.

To obtain sound velocity profile for water depth correction, expendable bathythermograph (XBT) measurements were carried out at Tosabae Trough (32-53.0663'N, 134-35.5444'E, 24.58 degree C on surface) on November 8, 2013, and at Muroto Trough (33-19.4707'N, 134-38.9755'E, 23.97 degree C on surface) on November 9, 2013. The water temperature profiles were shown in Figure 7-1.

Bathymetric map was shown in Figure 7-2 with cored sites PC01, PC02, PC05, PC06, PC08, PC09 (KY13-17) and P1 (KR9705).

References

SeaBeam Instruments, Inc. (1999), Sea Beam 2100 Manual Supplement (RV-08AGS), Sea Beam 2100 Operator's Manual, No. 2125-8004, Revision A, 5-6.

SeaBeam Instruments, Inc. (1999), Sea Beam 2100 Factory Acceptance Test, Sea Beam 2100 Series Multibeam Bathymetric Survey System, No.2101-8237, Revision G,1-1.

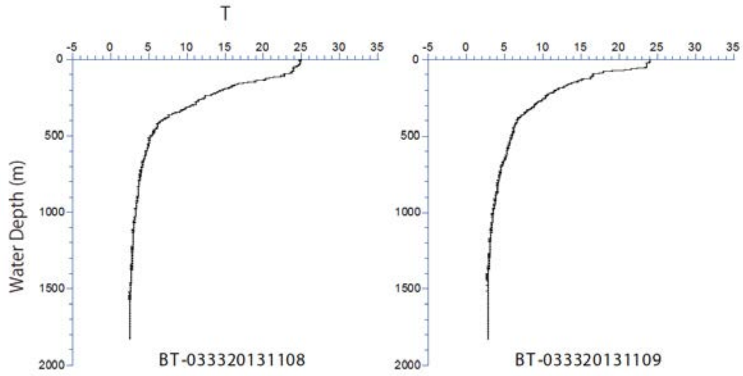


Fig. 7-1. Water temperature profiles at Tosabae Trough (left) and Muroto Trough (right)

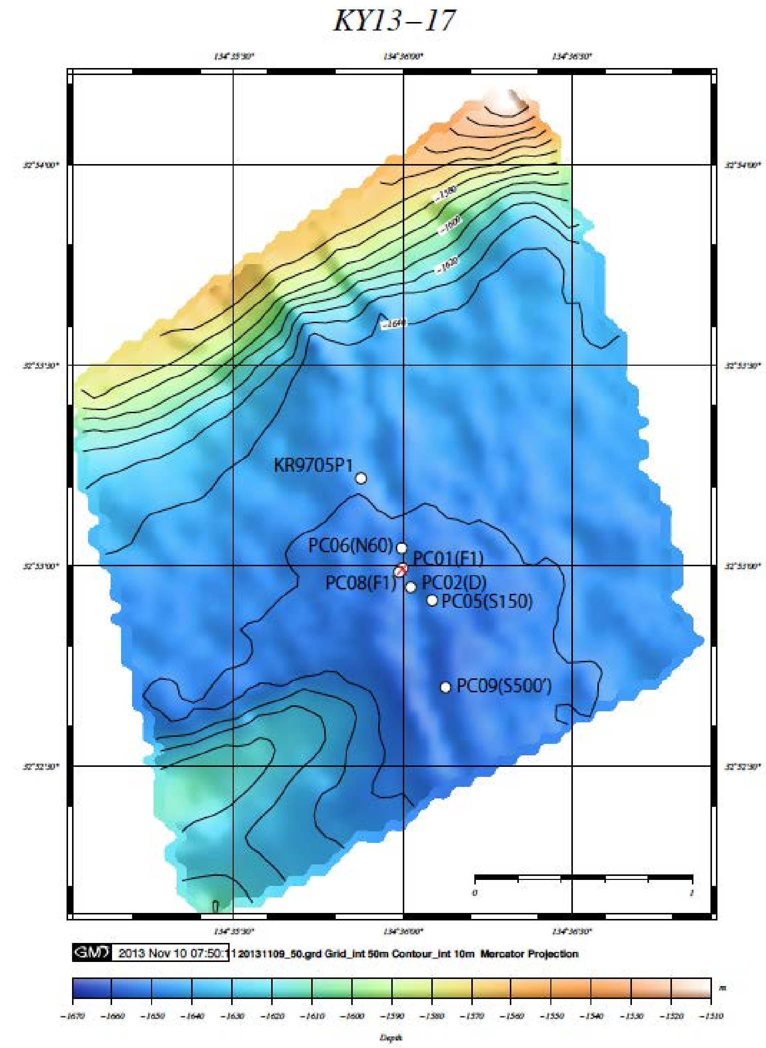


Fig. 7-2. Bathymetric map with cored sites (white circles) in the Tosabae Trough. Contour lines shown in every 10m. Red cross shows position of normal fault on the sub-bottom profiler line SBP2 of Iwai et al. (2004).

8. Acknowledgement

We gratefully recognize the efforts of the officers and crew of the R/V Kaiyo during the cruise. We thank all the support from staffs in Research Fleet Department, JAMSTEC. Especially thanks to Mr. Ken Yatsu.

9 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.

Appendix

Appendix. Core image scanning and photographs

Iwai, M. (Kochi University), operation chief
Shimizu, E. (Kochi University), operation support
Sugisaki, T. (RIGO Co., Ltd.), operation support
Kobayashi, M. (Kochi University), operation support

After whole core magnetic susceptibility measurement, all sections including pilot cores were split into working half and archive half on the board of R/V KAIYO during the KY13-17 cruise. Following core split, archive halve images were captured every 20 to 30 cm by using overhead color scanner ScanSnap SV600 (Fujitsu Limited; Figure APX-1) with 300 dpi scanning resolution. Working halves were used for visual core description, and forwarded to take a core photograph of each coring site by using digital cameras (e.g. SONY alfa350 with Minolta AF75-300).

Note: Working halves were always downside of core onboard until core split.

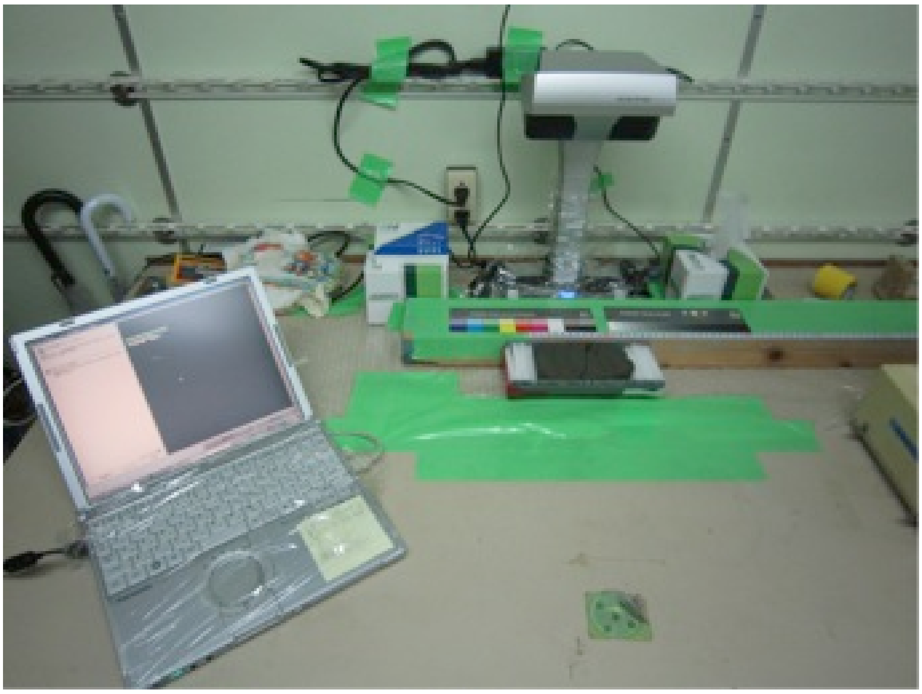


Figure APX-1. Overhead color scanner ScanSnap SP600 (Fujitsu Limited).

Core Photo

Plate 1. Photographic image of Cores KY13-17 PC01 and PL01.

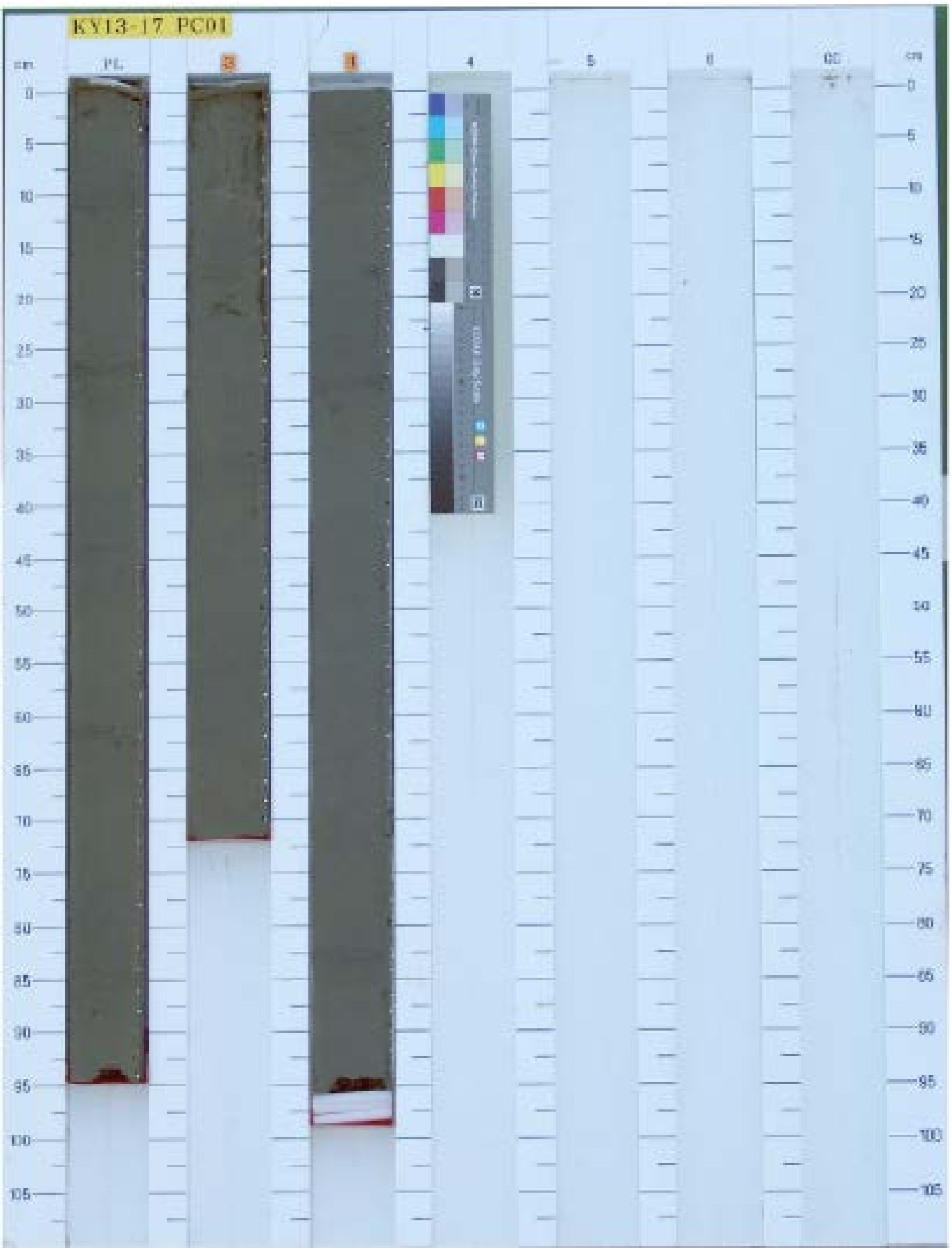


Plate 2. Photographic image of Cores KY13-17 PC02 and PL02.

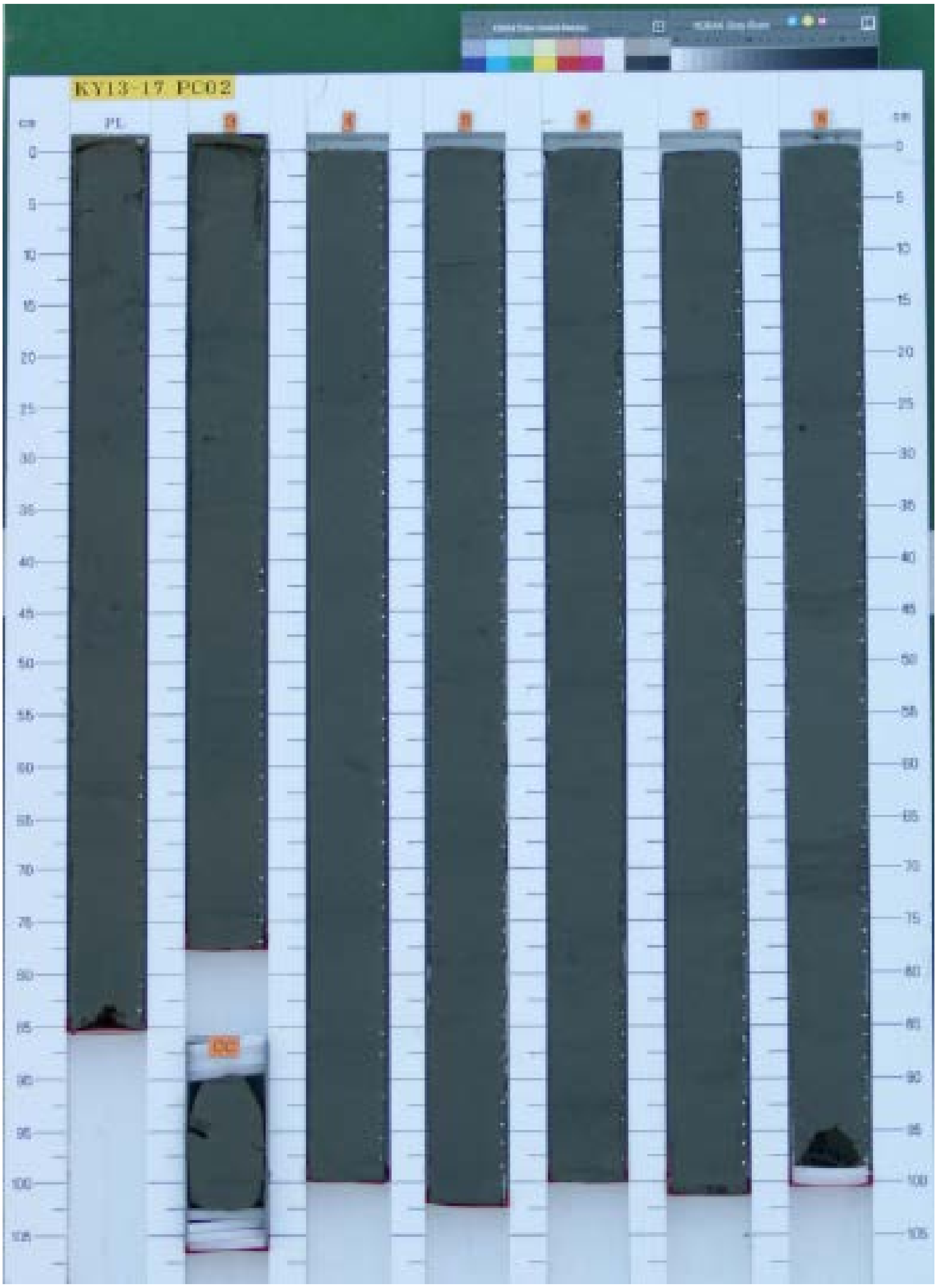


Plate 3. Photographic image of Cores KY13-17 PC03 and PL03.

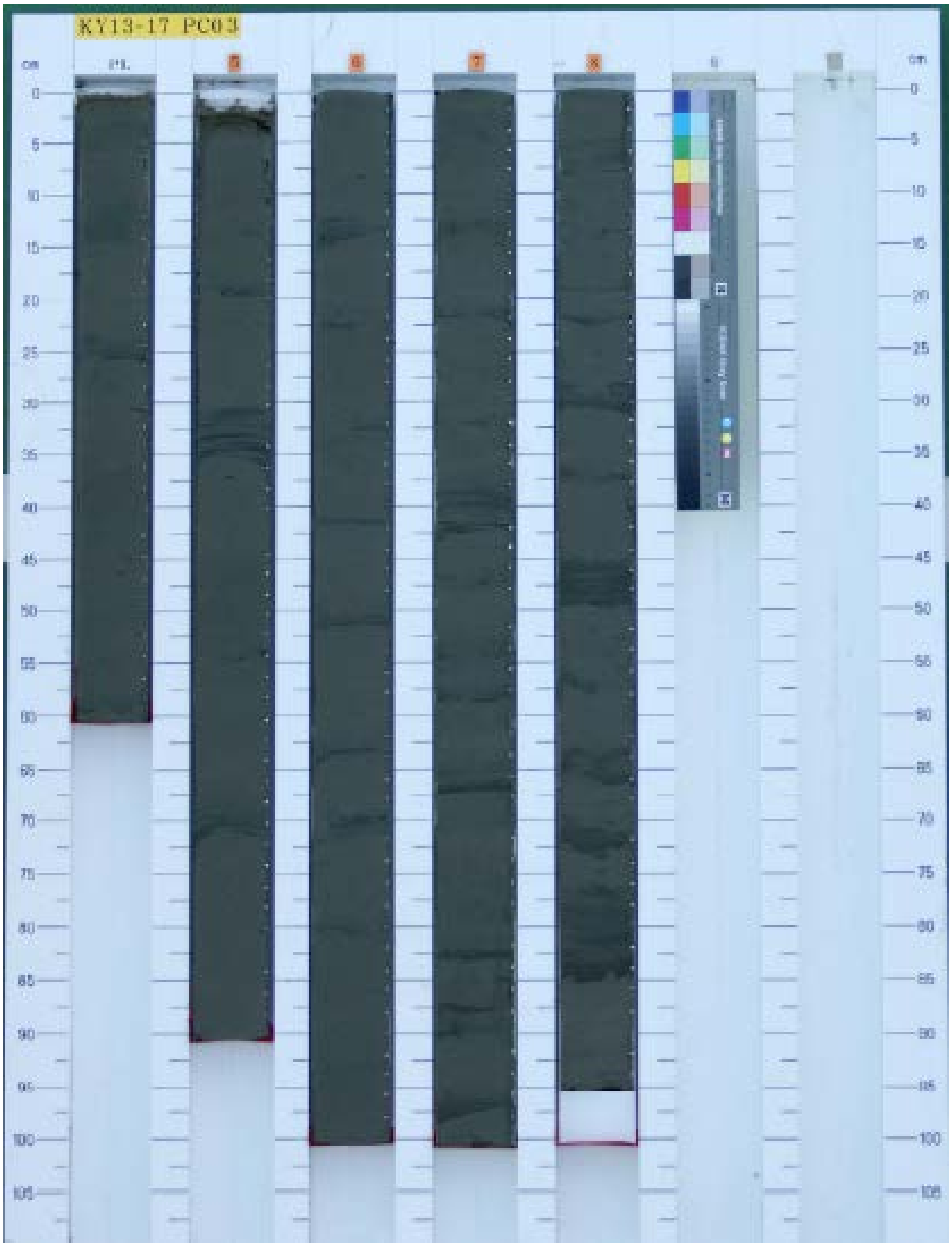


Plate 4. Photographic image of Cores KY13-17 PC04 and PL04.

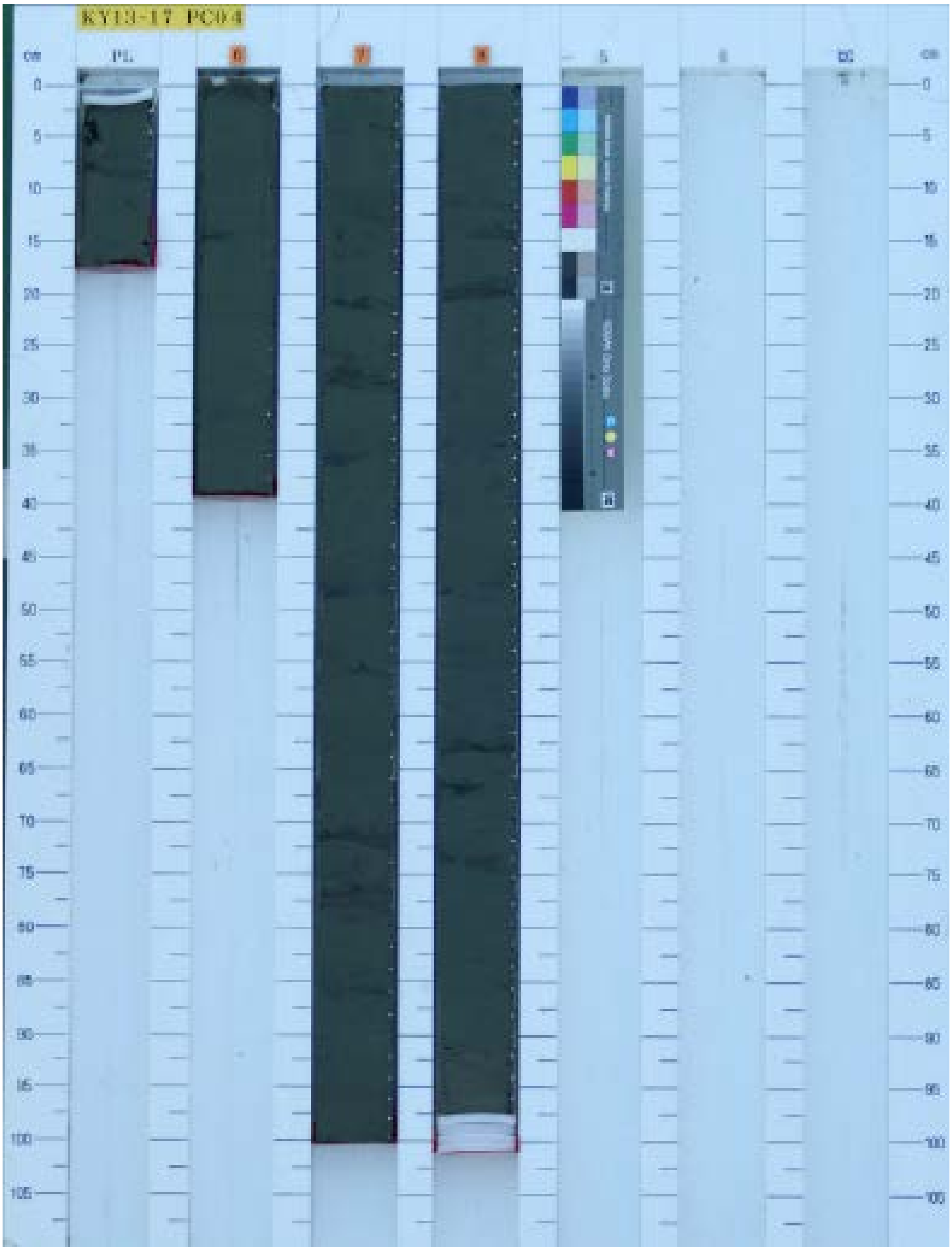


Plate 5. Photographic image of Cores KY13-17 PC05 and PL05.

Plate 6. Photographic image of Cores KY13-17 PC06 and PL06.

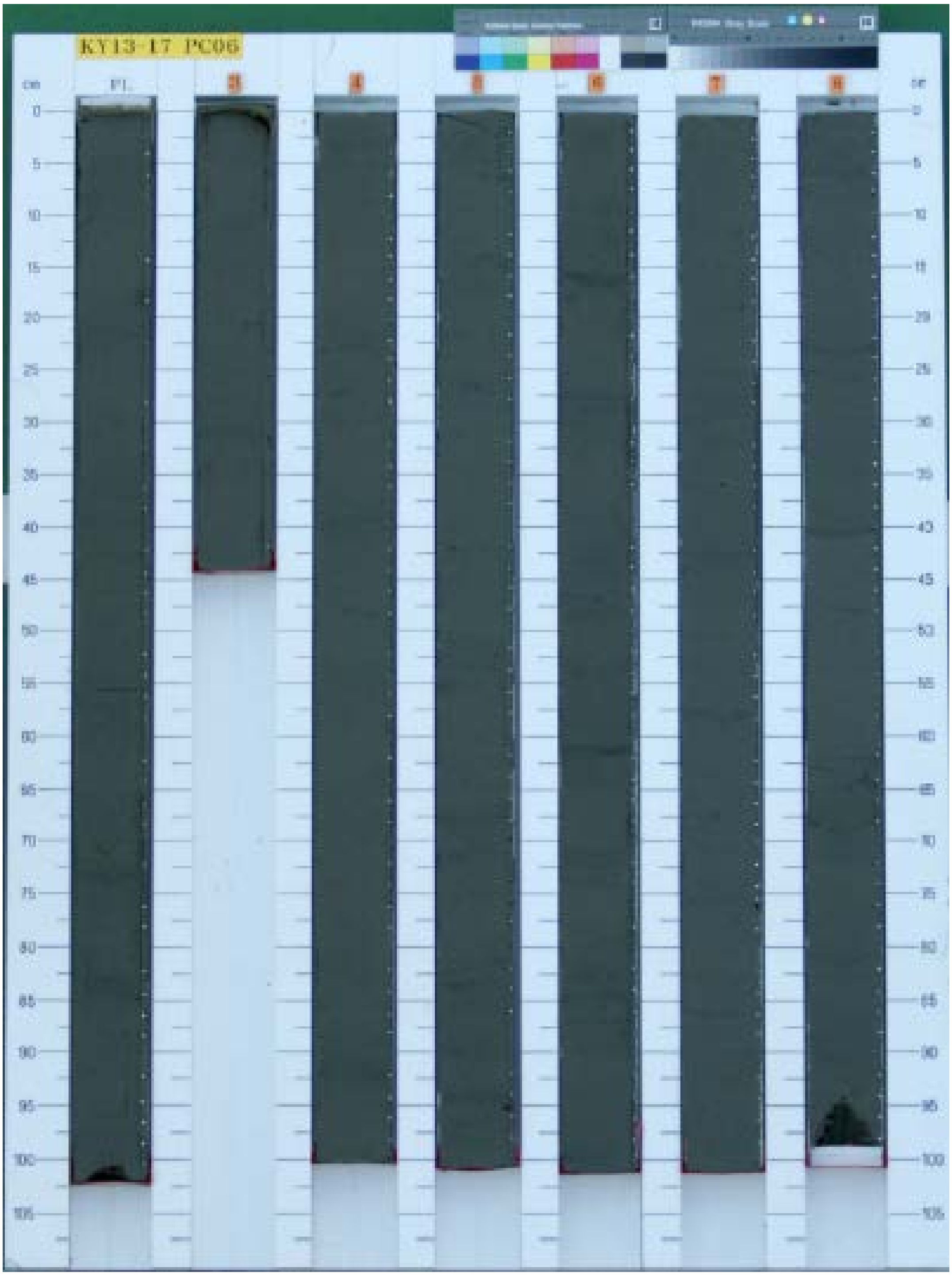


Plate 7. Photographic image of Cores KY13-17 PC07 and PL07.

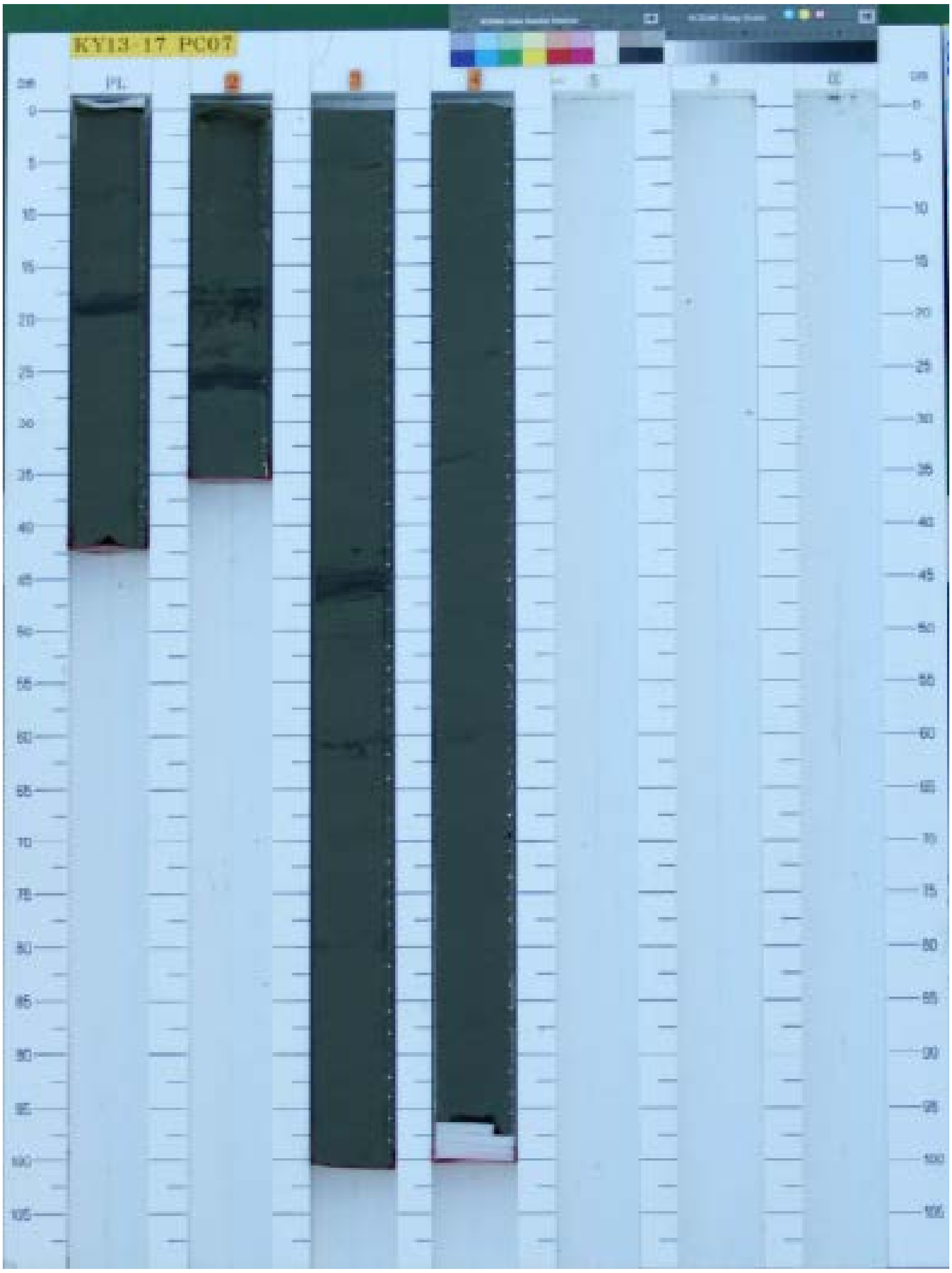


Plate 8. Photographic image of Cores KY13-17 PC08 and PL08.

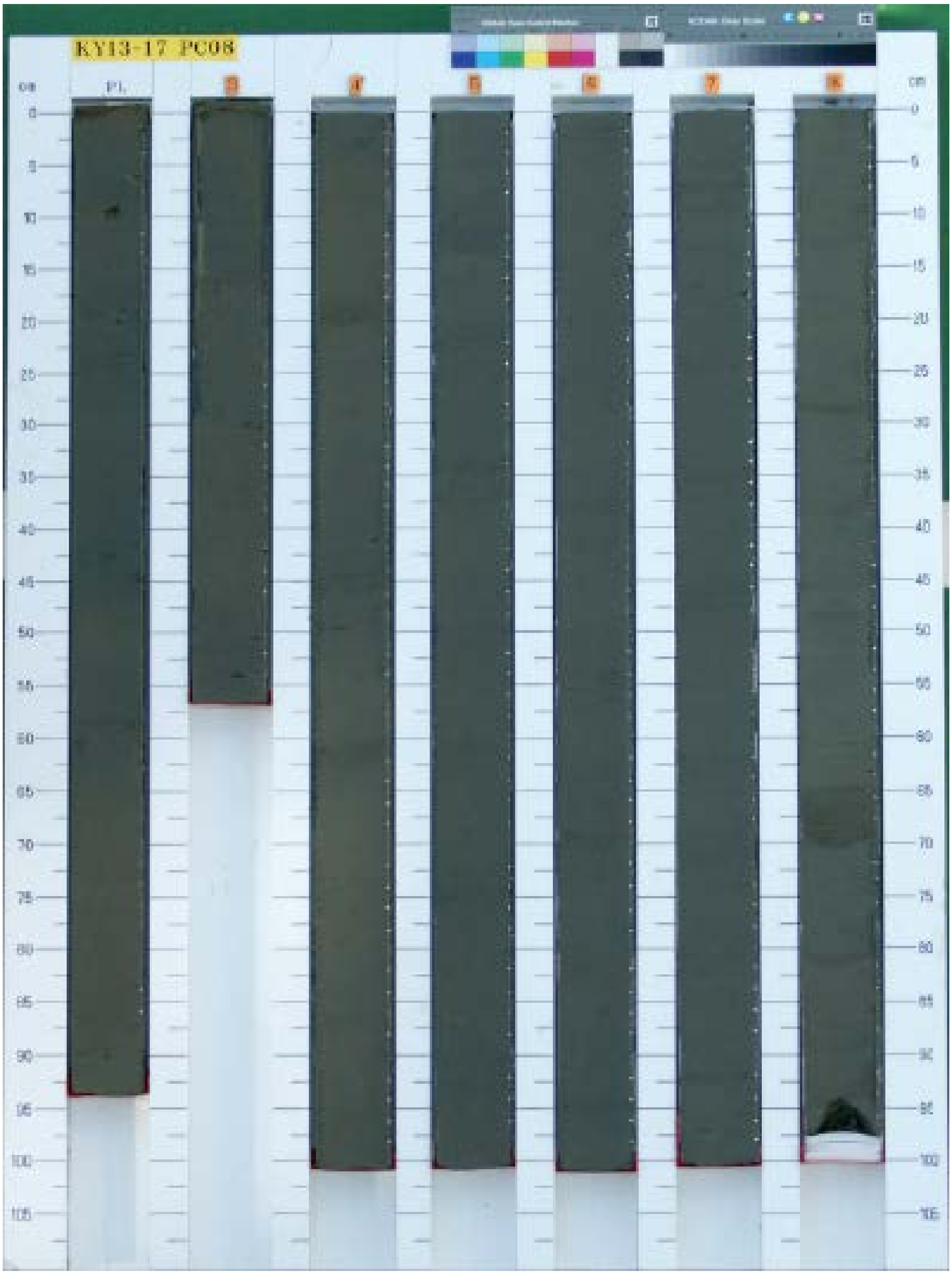


Plate 9. Photographic image of Cores KY13-17 PC09 and PL09.

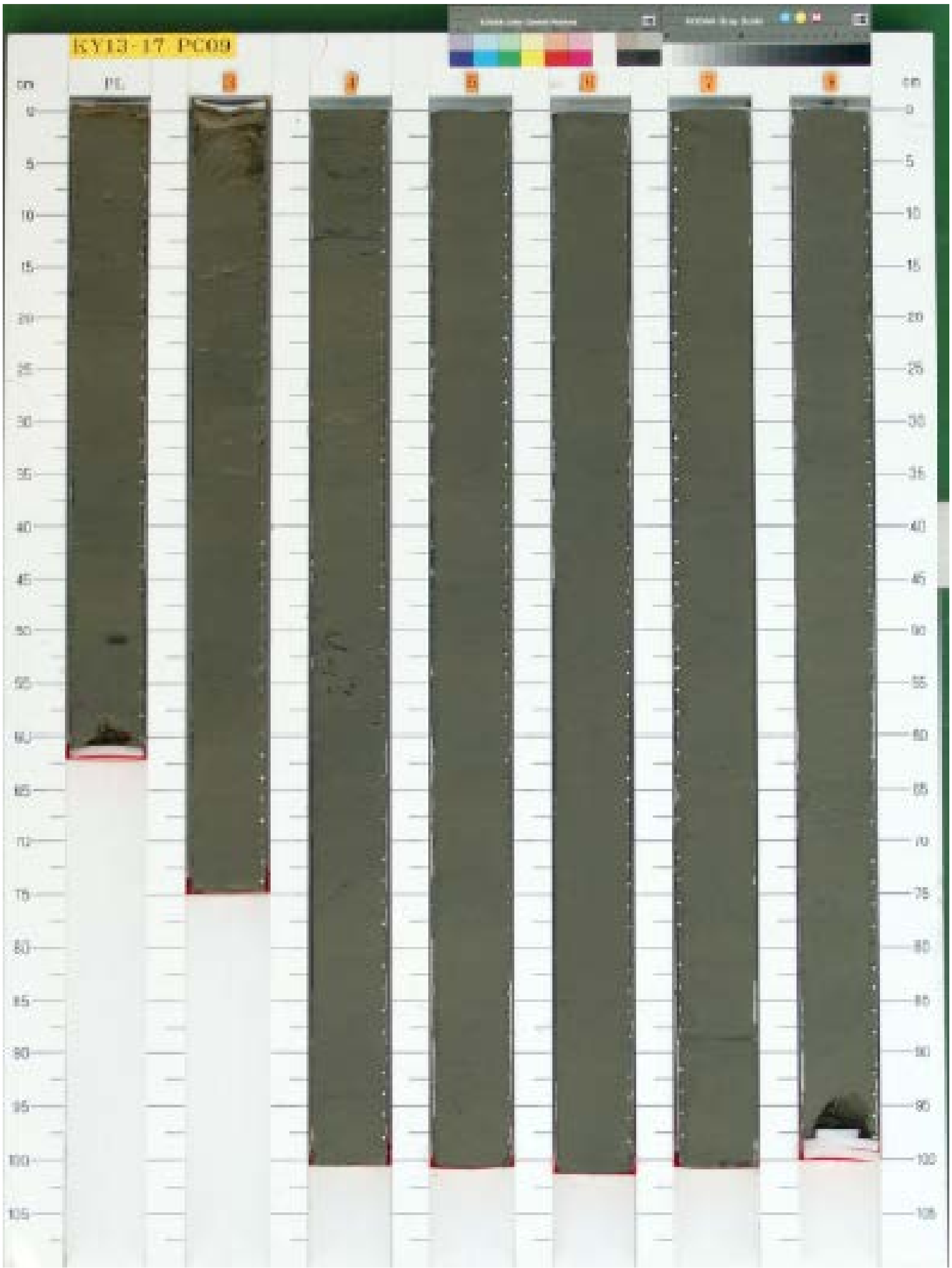


Plate 10. Photographic image of Cores KY13-17 PC10 and PL10.

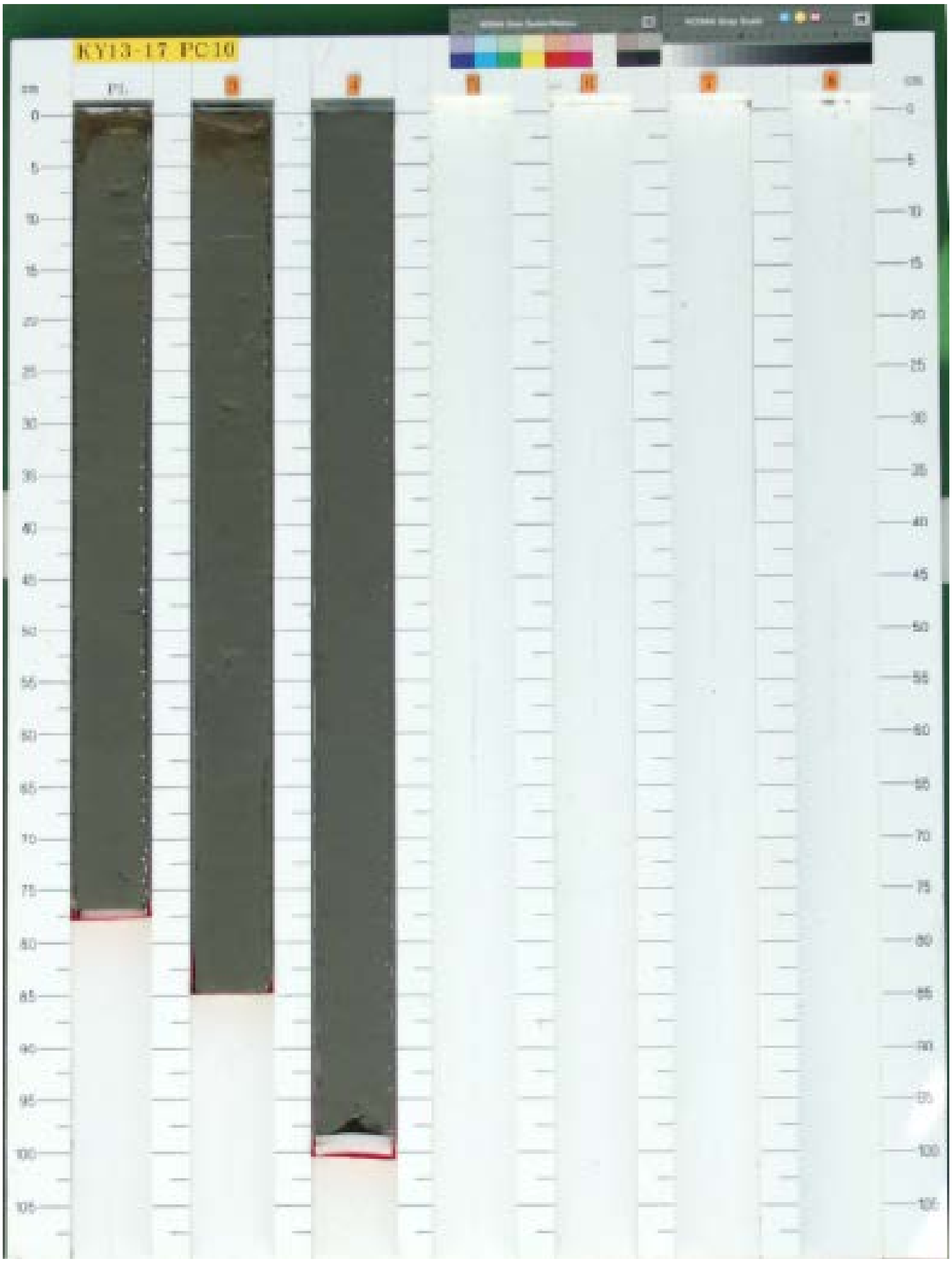


Plate 11. Photographic image of Cores KY13-17 PC11 and PL11.