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KR09-15

Cruise Report

Study on geological record of seismogenic faulting in Kumano Trough subduction zone

October 22nd, – October 25th, 2009
Wakayama – JAMSTEC

Institute for Frontier Research on Earth Evolution (IFREE)
Japan Agency for Marine-Earth Science and Technology (JAMSTEC)

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Remarks

This cruise report documents preliminary results of KR0915, and note that data in shown could be corrected.

Shipboard scientific party

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Captain and crew of the R/V KAIREI

Captain	HITOSHI TANAKA
Chief Officer	YOSHIYUKI NAKAMURA
2nd Officer	TATSUO ADACHI
3rd Officer	RYO YAMAGUCHI
Chief Engineer	MINORU TSUKADA
1st Engineer	KOJI FUNAE
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Able Seaman	TADAHIKO TOGUCHI
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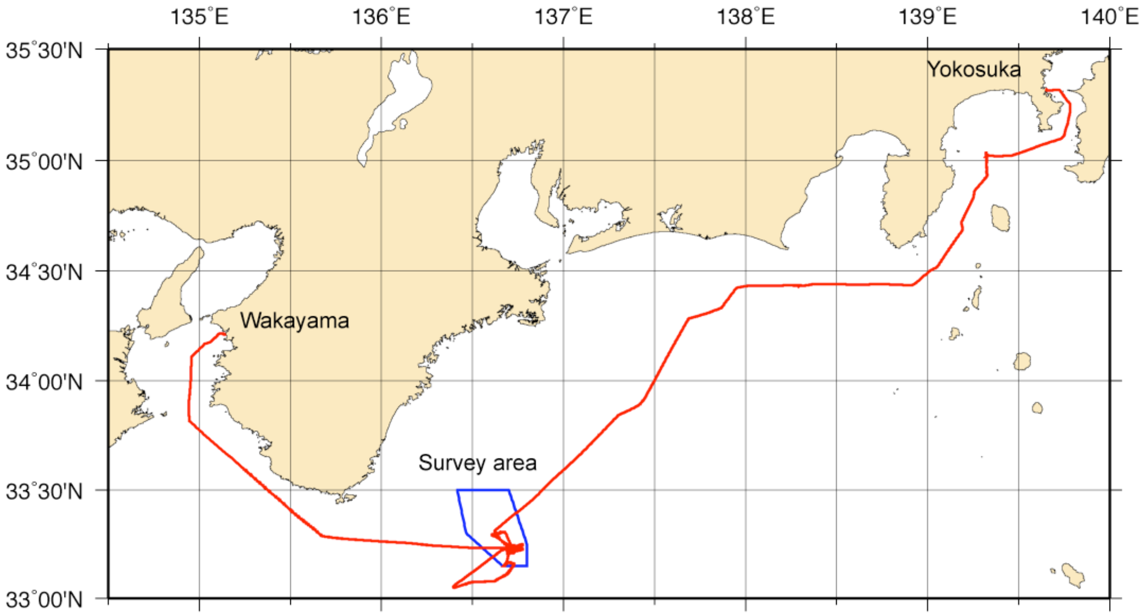
Steward	SHIGETO ARIYAMA
Steward	HIDEO FUKUMURA
Steward	MIZUKI NAKANO
Steward	KANA YUASA

KR09-15 Ship Track



KR09-15 Shipboard Log:

2009/10/22	Weather: fine but cloudy	Wind direction: NE Wind force: 3
Wave: 1 m	Swell: 0 m	Visibility: 8 nautical miles (12:00 JST)

Time	Log
13:00	Onboard
14:00	Departure from Wakayama port
15:00-15:40	Briefing about ship's life and safety
15:45-16:20	Scientific meeting
16:40-17:00	Pray for safety of cruise to KONPIRASAN
	Transit to survey area" Kumano Nada"

2009/10/23	Weather: fine but cloudy Wind direction: NE Wind force: 4	
Wave: 3 m	Swell: 3 m	Visibility: 10 nautical miles (12:00 JST)

Time	Log
05:00	Arrival at survey area" Kumano Nada"

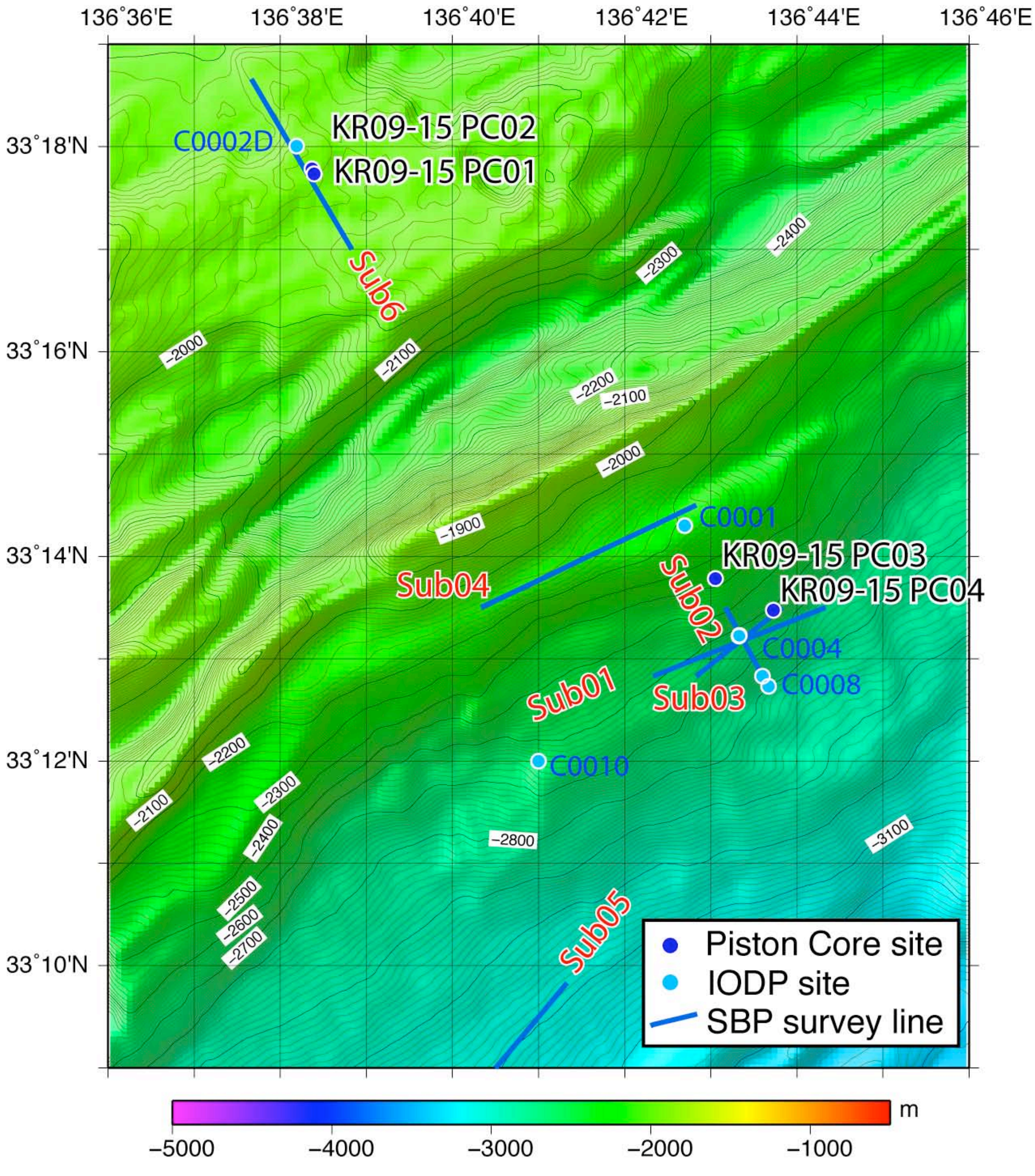
05:07	XBT
06:01-06:21	Sub Bottom Profile (SBP) survey in Line SB01
06:34-06:41	SBP survey in Line SB02
07:34-09:37	Piston Coring at "F03"
11:07-13:12	Piston Coring at "F02"
15:07-17:15	Piston Coring at "F01"
18:15-18:32	SBP survey in Line SB03
18:48-19:27	SBP survey in Line SB04

2009/10/24	Weather: overcast	Wind direction: NE Wind force: 7
Wave: 5 m	Swell: 4 m	Visibility: 6 nautical miles (12:00 JST)

Time	Log
06:00-06:18	SBP survey in Line SB05
07:14-09:30	Piston Coring at "SL02"
10:40	Piston Coring operation was cancelled due to bad sea condition
11:28-11:51	SBP survey in Line SB06
11:51	Transit to JAMSTEC

2009/10/25	
09:00	Arrival at JAMSTEC, End of cruise

Piston coring point & SBP Survey Line



Piston coring position List

date	pc	pilot	area	water depth(m)	lat N(°)	long E(°)
09/10/23	PC01	PL01	Kumano Trough	1951	33°17.7348	136°38.3966
09/10/23	PC02	PL02	Kumano Trough	1949	33°17.7792	136°38.3698
09/10/23	PC03	PL03	Kumano Trough	2374	33°13.7833	136°43.0566
09/10/24	PC04	PL04	Kumano Trough	2545	33°13.4712	136°43.7264

SBB Survey Line List

Line		lat N(°)	long E(°)
sub01	start	136:44.33	33:13.50
	end	136:42.33	33:12.83
sub02	start	136:43.60	33:12.83
	end	136:43.17	33:13.50
sub03	start	136:43.83	33:13.50
	end	136:42.83	33:12.83
sub04	start	136:42.83	33:14.50
	end	136:40.33	33:13.50
sub05	start	136:41.33	33:09.83
	end	136:40.50	33:09.00
sub06	start	136:38.833	33:17.00
	end	136:37.666	33:18.66

1. Cruise Summary

Cruise number and ship name

KR09-15"KAIREI", *RV KAIREI*

Title of research proposal

"Study on geological record of seismogenic faulting in Kumano Trough subduction zone"

Chief scientist & representative of science party

Toshiya Kanamatsu

Research Scientist, Institute for Frontier Research on Earth Evolution (IFREE),

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

Cruise Period and Port call

October 22nd – October 25th, 2009

Wakayama-Shimotsu Port, Wakayama City – JAMSTEC pier, Yokosuka.

Research area（Fig. 1）

Kumano Trough (water depth：2000m—3400 m): Area surrounded with lines connected with the following points.

33°30'N 136°42'E, 33°15'N 136°48'E,

33°09'N 136°48'E, 33°09'N 136°40'E,

33°18'N 136°28'E, 33°30'N 136°25'E.

Overview of Cruise

Objectives:

The decollement fault and Mega-Splay faults are developing in the Kumano Trough area. Identification of a fault which caused a earthquake, and observation of its behavior are essential for understanding the seismozenic zone earthquake. Tsunami inversion and strong motion analyses are possible approaches to define these phenomena, but those methods do not strictly define the fault. For example, it is not clear that which fault: Decollement or Mega-Splay, was activated in the 1944 Tonankai earthquake. But because fairly high energy must have been released during the earthquake, an extraordinary geological phenomenon should take place near the sea bottom. The results of NanTroSEIZE stage 1A, and researches advanced to the project documented key records to understand fault behaviors in the mega-splay area, and the fore-arc basin. In order to confirm these evidences, a series of surface sediments collections was designed.

Achievement:

During “KR09-15” piston coring, and sub-bottom acoustic profiling were conducted. Although 3 days were originally planed for this research, it was shorten to 1.5 days due to high sea condition caused by typhoon No. 20. In spite of that situation four piston coring and six sub-bottom profiling were completed. No visual description of cored sediment was carried out onboard. Only microfossil (planktonic foraminifer) observation in top and bottom of cores was conducted. Sub bottom profile images were acquired from the fore-arc basin area, and the splay fault area in the landward slope. These shallow structures were interpreted onboard.

Post-cruise core measurements: scanogram imaging of the whole round sections, scanning core images of archive sections, description of archive sections, discrete sampling from working sections were carried out in Kochi Core Center during 24 - 27th November, 2009.

Acknowledgements

We are grateful to Captain Tanaka and the crew of the R/V KAIREI for their professional and outstanding efforts to make this scientific cruise successful in spite of bad weather. We also thank ship management divisions of JAMSTEC for their helpful support while organizing the cruise.

2. Instrumentation and general plan of measurement

2-1. Piston coring

2.1.1 Parameters

Piston corer system (PC)

Piston corer system consists of 1.25t-weight, 5m-long duralumin barrel with polycarbonate liner tube and a pilot core sampler. The inner diameter (I.D.) of polycarbonate liner tube is 74mm. The total weight of the system is approximately 1.5t. The length of the core barrel was 10m or 15m that was decided by site survey data. We used a giant Ewing type corer and a small multiple corer (“Ashura”) for a pilot core sampler.

The piston that was used in this cruise is composing of stainless steel body and two O-rings (size: P63).

2.1.2 Instruments and methods

Winch operation

When we started lowering PC, the speed of wire out was set to be 20m/min., and then gradually increased to the maximum of 60m/min. The corer were stopped at a depth about 100 m above the seafloor for 5～10 minutes to reduce some pendulum motion of the system. After the corer were stabilized, the wire was stored out at a speed of 20-25m/min., and we carefully observed a tension meter. When the corer hit the bottom, wire tension abruptly decreases by the loss of the corer weight. After that, immediately wire out was stopped and winding of the wire was started at a speed of 20m/min., until the tension gauge indicates that the corer was lifted off the bottom. After leaving the bottom, winch wire was wound in at the maximum speed.

2-2. Sub-bottom profiler

A sub-bottom profiler system of 4-kHz acoustic beam is equipped as one function of a multiple narrow-beam echo sounder system (Seabeam 2112) with R/V KAIREI. The system can provide acoustic image of sedimentary structure as much as ca. 75m deep on the sea floor. The sub-bottom profiler was used for surveying shallow sediment structure in the study area. One Expendable Bathythermograph (XBT) dropped to measure the temperature structure of water column. It is necessary to correct the acoustic speed which is converted to water depth.

2-3. Numbering of cores and Onboard Core treatment

Cores sampled during KR09-15 were numbered with a prefix "KR09-15" (e.g. KR09-15 PC01). “Inner tube” installed in each core barrel were marked into 1.0-m length sections and numbered serially from “1” beginning at the top section before the piston core deployment. If the recovered tube was not filled with sediment, all sections were re-numbered without empty section (Table section name).

Table section name. Section names onboard were changed sequentially to avoid any confusion in post-cruise phase.

Sufix	sec name onboard	**changed sec name**	Length onboard (cm)
KR0915	PL01	**PL01**	16
KR0915PC01	2	**1**	100
KR0915PC01	3	**2**	99.8
KR0915PC01	4	**3**	100
KR0915PC01	5	**4**	100
KR0915PC01	6	**5**	100.7
KR0915PC01	7	**6**	100
KR0915PC01	8	**7**	100.4
KR0915PC01	9	**8**	101.3
KR0915PC01	10	**9**	100.4
KR0915PC01	CC	**CC**	NA
KR0915	PL02	**PL02**	11
KR0915PC02	11	**1**	15.4
KR0915PC02	12	**2**	100.4
KR0915PC02	13	**3**	100.3
KR0915PC02	14	**4**	100.4
KR0915PC02	15	**5**	100.4

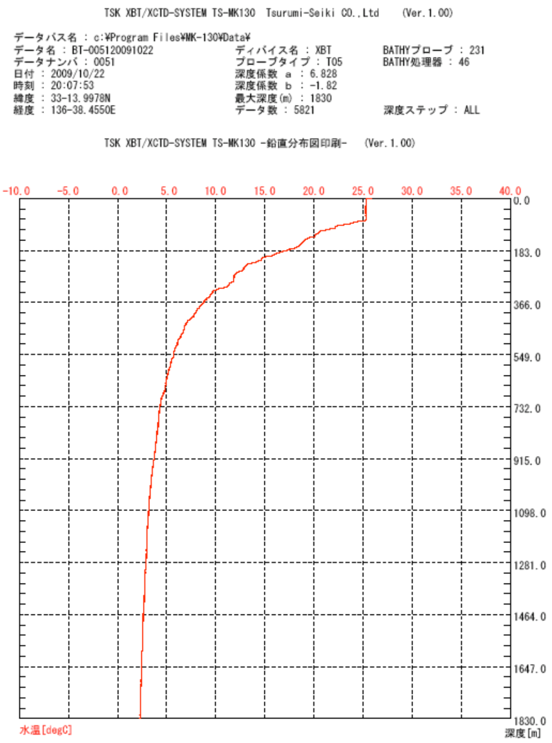
Sufix	sec name onboard	**changed sec name**	Length onboard (cm)
KR0915	PL03-Hand01	PL03-Hand01	7
KR0915	PL03-Hand03	PL03-Hand03	Plastic bug
KR0915PC03	10	**1**	68.6
KR0915PC03	11	**2**	100
KR0915PC03	12	**3**	1100
KR0915PC03	13	**4**	103.4
KR0915PC03	14	**5**	99.6
KR0915PC03	15	**6**	98.4
KR0915PC04	4	**1**	61.3
KR0915PC04	5	**2**	100.1
KR0915PC04	6	**3**	100.5
KR0915PC04	7	**4**	100.1
KR0915PC04	8	**5**	100.1
KR0915PC04	9	**6**	100.5
KR0915PC04	10	**7**	100.7

Because we planed to measure X-CT image of whole round core on shore, cores were not split into halved sections. We just cut tubes into 1-m length whole sections. They were stored in a refrigerator with 4°C during the cruise. On 24^{th} -27^{th} November, post-cruise core treatments were carried out in Koch Core Center. Following procedures were performed. 1) X-CT scanogram images of whole round sections, 2) core image of split sections, 3) lithologic core description, 4) sampling.

3. Results

3.1 XBT

The following figure shows a result of XBT deployment to measure temperatures from the surface to 1800 m on 22th Oct. 2009. A constant salinity value (34.5) was applied for the calculation of sound speed. Temperature values for the depth deeper than 1800 m were used the previously obtained data by ROV KAIKO (KAIKO 08100801).



音速補正リスト.xls 1/2

音速補正データ

	日付	時刻(UTC)	使用SVファイル名
使用開始	2009.10.22	20:29	
使用終了	2009.10.24	07:54	20091022xbt

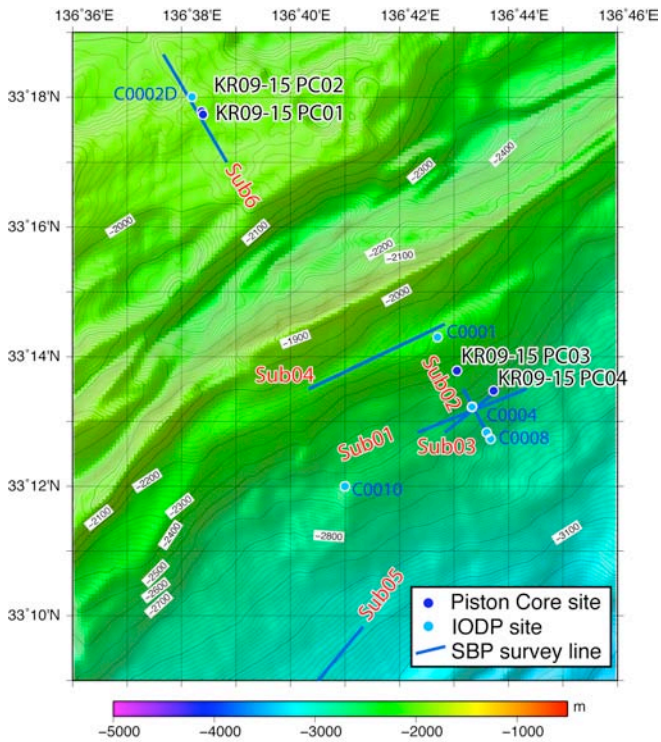
深度(m)	音速(m/sec)	深度(m)	音速(m/sec)
4.5	EXTERNAL	550.0	1481.8
10.0	1534.6	600.0	1480.9
20.0	1534.7	800.0	1479.5
30.0	1534.9	1000.0	1479.8
50.0	1535.2	1200.0	1481.3
80.0	1534.3	1500.0	1484.7
100.0	1528.4	1800.0	1488.5
150.0	1520.4	2000.0	1491.4
200.0	1511.7	2500.0	1497.7
250.0	1502.9	3000.0	1505.6
300.0	1498.9	3500.0	1514.2
350.0	1491.9	4000.0	1523.1
400.0	1488.2	5000.0	1541.3
450.0	1484.6		
500.0	1482.8		

◎備考	使用データ種類	ファイル名
使用データ情報	XBT使用	BT-005120091022.XBT
	測定位置	33-13.9978N,136-38.4550E
	塩分濃度	一定値 34.5使用
使用音速計算式	音響航法装置プログラム(Mackenzie1981)	
	2000～5000mは下記温度を使用	
	KAIKO(08100801.ctd 32-21.2150N,134-56.7000	
	2000m=2.20℃ 2500m=1.79℃ 3000m=1.60℃	
	3500m=1.54℃ 4000m=1.56℃ 4500m=1.60℃	
	5000m=1.64℃	

3-2 Sub-bottom profiling image

Observed area and depth

Detail sub bottom profiling has been carried out at 4 areas that three areas at around the megasplay fault and another is at submarine landslide area. Because the profiler affects topographic effect, the observation area should be chosen at flat sea floor. The hanging wall of the megasplay fault, however, is topographic high. Three observation lines, relatively small depth difference, were chosen to cross cut the fault zone. The line gradually cuts with fault and contour line (Line 1: Sub01). The line cross cuts perpendicular with fault and contour lines (Line 2 Sub02). The Line is along contour line and across the fault with low angle (Line 3 Sub03). Additionally to this, the line along a contour line is at the terrace of submarine landslide area in toe of the accretionary prism. The sub bottom profiler can make cross section image of depth of 0.1s in two way time. If we assume the wave velocity through surface sediment is close to a velocity in seawater, the profiler images 75-100 m below sea floor.



Results

Line 1 (Sub01): Gradually cuts with fault and contour line

This line gradually cuts with fault and contour line (Fig. 1). Most parts are gentle slop and, no reflection has observed (Fig. 2). In both east and west tips on flat seafloor, some horizontal reflective layers are found. The western section is the expected area for megasplay fault, and the east tilting reflective layer is observed. The occurrence of this possible fault is consistent with expected fault location and tilting directions. This possible fault seems to connect with seafloor surface.

Line 2 (Sub02): Perpendicular with fault and contour lines

This line cross cuts perpendicular with fault and contour lines (Fig. 1). No reflective layer is found owing to topographic effect (Fig. 3).

Line 3 (Sub03): Along contour line and across the fault with low angle

The megasplay fault turns to north to cross cut the contour line at center of this profile. This line is along contour line and across the fault with low angle (Fig. 2). Although the profile affects topographic effect slightly, many reflective layers are observed (Fig. 3a). Especially western part many layers observed below flat seafloor. Western part of the profile is relatively darker than eastern part of the profile image, though both parts are deposit at slope basin. The boundary between western dark and eastern parts tilts to east, and the eastern basin seems to be thrust on the western basin. The location of this boundary consists with expected location of the megasplay fault. The possible fault penetrates surface layer. The interpretation is shown at figure 3b.

Line 4 (Sub04): Terrace at the seaward slope of the Kumano Basin outer arc high

Flat terrace in where C0001 is located was surveyed in NE-SW direction. Well stratified acoustic structure was observed at 15-20m (0.02s of two ways travel time).

Line 5 (Sub05): Terrace of submarine landslide area in toe of the accretionary prism

One of largest submarine landslides at toe of the Nankai accretionary prism, Kumano area has step and terraces. The sub bottom profile along terrace is shown at figure 5. Many horizontal reflective layers are observed without any deformations. Although some debris flow and landslide blocks were expected, any strong reflection is not found.

Line 6 (Sub06): Across the normal fault systems

This line cross cuts perpendicular to normal fault systems at Kumano basin. Topographic rise at center, many horizontal reflective layers and normal faults are observed in this line (Fig. 6). Relative dark layer at 15-20m (0.02s of two ways travel time) are covers on surface in this section. The largest normal fault in this profile is at south of the rise. The dark layer is thickened at north of the normal fault, and the offset of the base of the dark layer is approximately 30m (0.04s of two ways travel time).

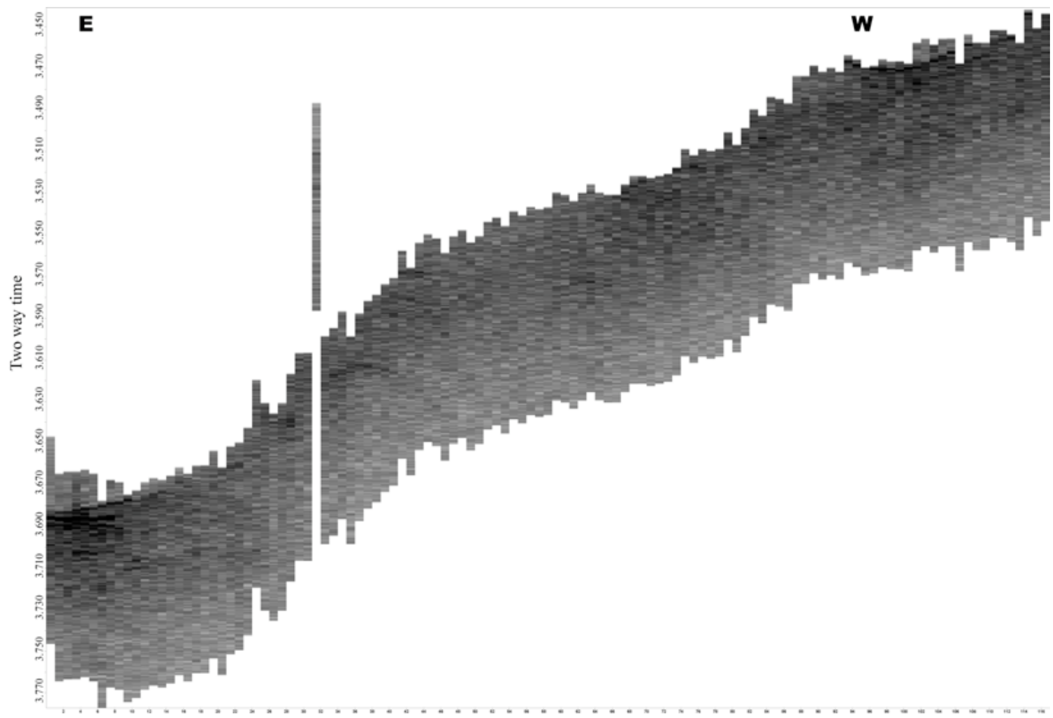


Fig.1. Gradually cuts with fault and contour line

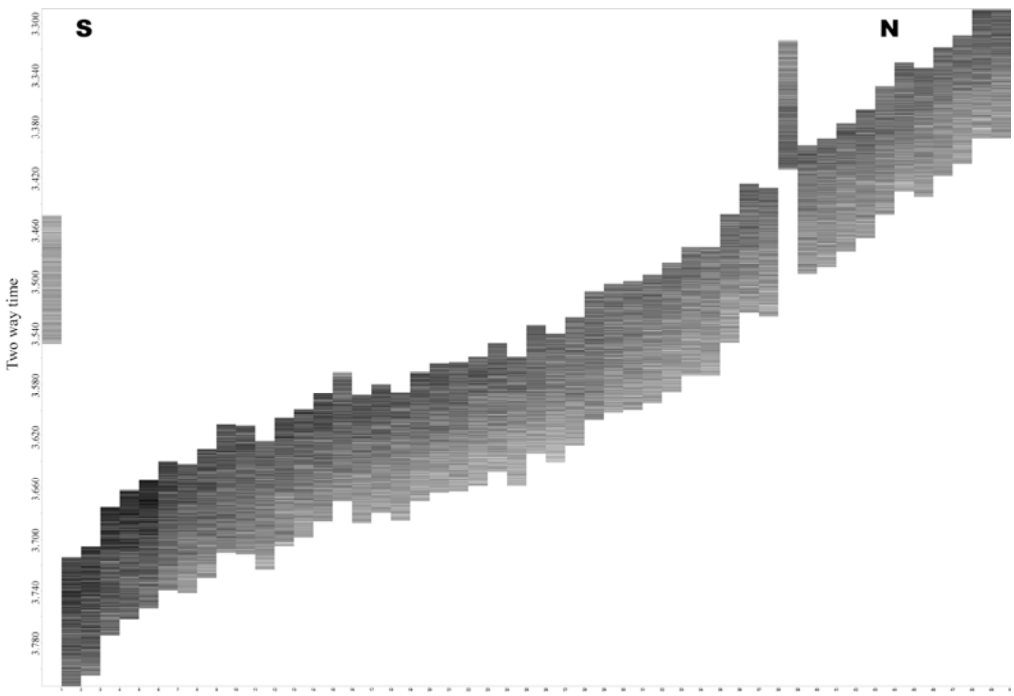


Fig.2. Perpendicular with fault and contour lines

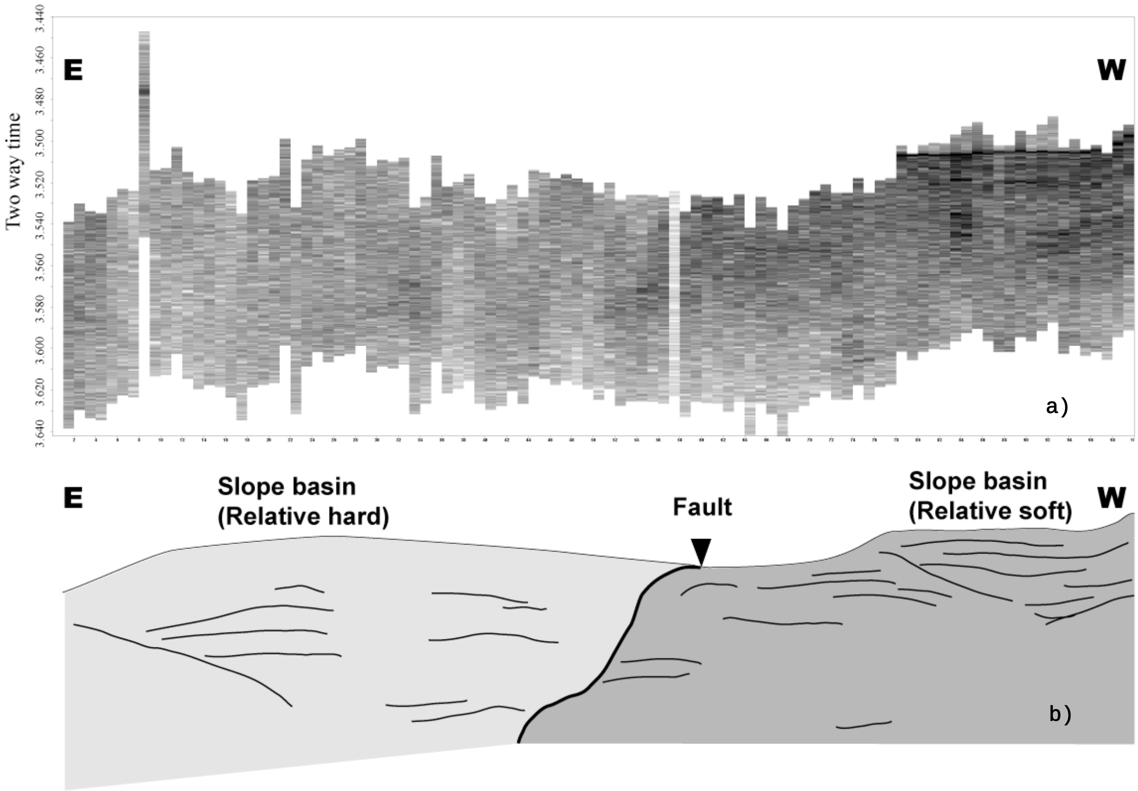


Fig.3. **a)** Along contour line and across the fault with low angle. **b)** interpretation of the image.

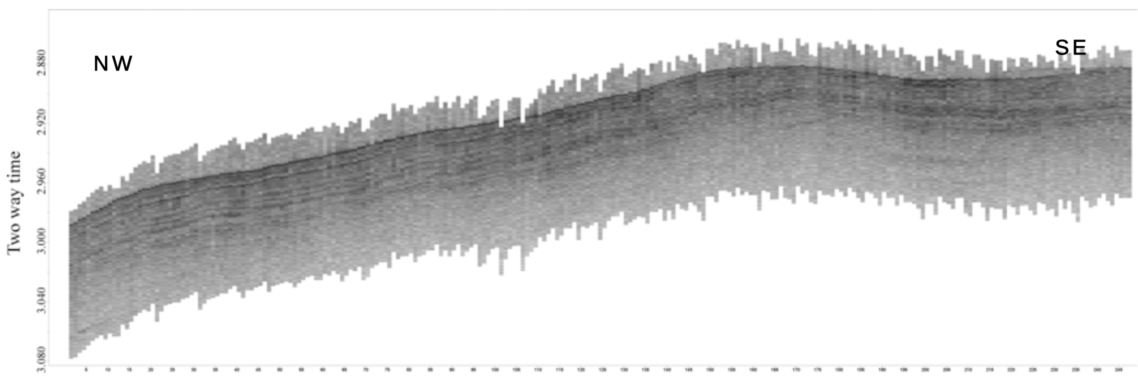


Fig.4. Terrace at the seaward slope of the Kumano Basin outer arc high (Line 4)

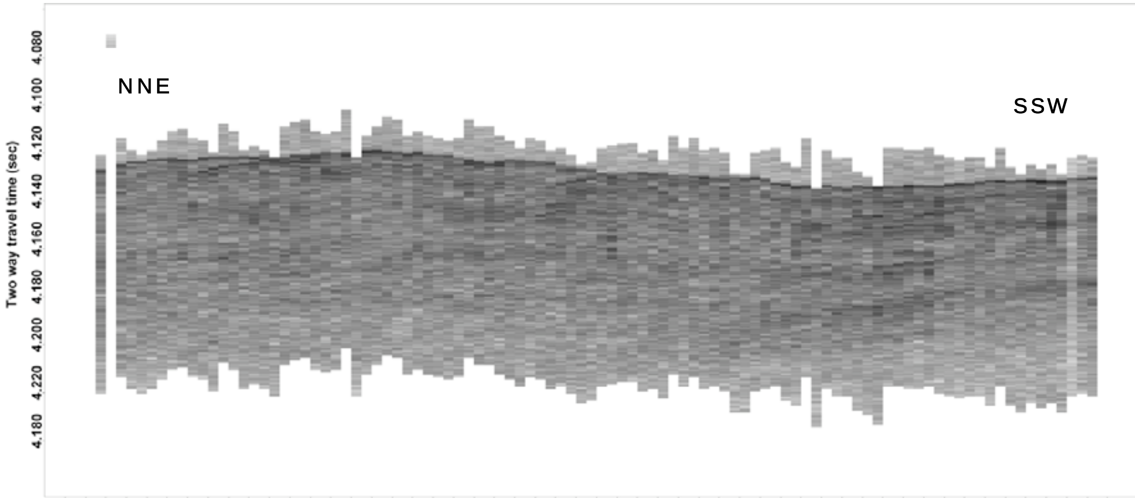


Fig.5. Terrace of submarine landslide area in toe of the accretionary prism (Line 5)

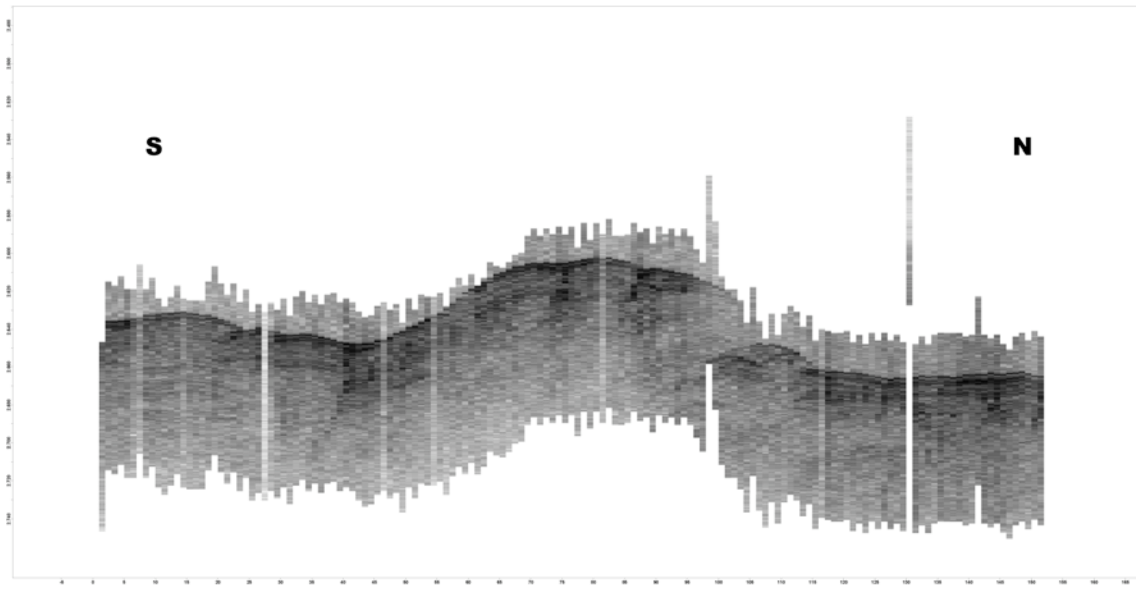


Fig.6. Across the normal fault systems.

3.3 Coring operation

During operation of KR09-15 PC01, PC02, PC03 and PC04, aboard wire tension were measured continuously to monitor the piston corer system behavior in real time, especially to know penetrating to and leaving from the bottom.

KR09-15 PC01

The first sudden tension drop obviously indicates that the weight had been released from the balance system. During winch winding, a subsequent tension increasing and a sudden tension drop which indicates a complete leaving of the piston corer system from sediment, was observed.

KR09-15 PC02

The first sudden drop obviously indicates the tension release by the triggering a weight from the balance system. A subsequent gradual tension increasing was observed. then a sharp drop was observed during winch winding. This pattern suggested that a gradual pulling up a bended pipe caused by imperfect penetration. Finally a sudden tension drop indicates a complete leaving of the piston corer system from bottom was recognized.

KR09-15 PC03

The tension record is similar to that of KR0915PC01. The first sudden tension drop obviously indicates that the weight had been released from the balance system. During winch winding, a subsequent tension increasing and a sudden tension drop which indicates a complete leaving of the piston corer system from sediment, was observed.

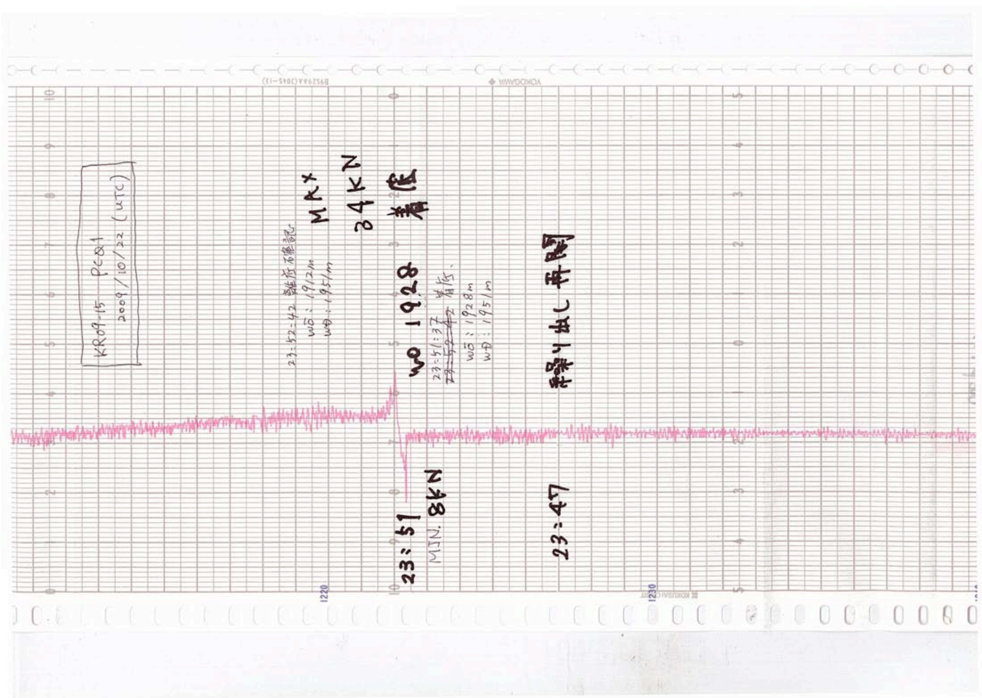
KR09-15 PC04

The tension record is similar to that of KR0915PC01. But more noisy oscillation in back ground tension is observed, probably because of a high see condition.

KR09-15 PC01

Cruise ID	KR09-15					
Date	09/10/23				Operater	Hatakeyama
Core ID	PC01					
Pilot ID	PL01					
Survey area	Kumano Trough					
point ID	F03					
corer type	inner tube					
pipe length	10	m				
pilot	Large diameter Ewing					
pilot weight	110	kg				
pilot wire length	18.6	m				
main wire length	18.8	m				
free fall	4.7	m				
weather	fair with sometime clouds					
wind direction	357	deg	speed	7.1	m/s	
current direction	90.9	deg	speed	2.7	knt	

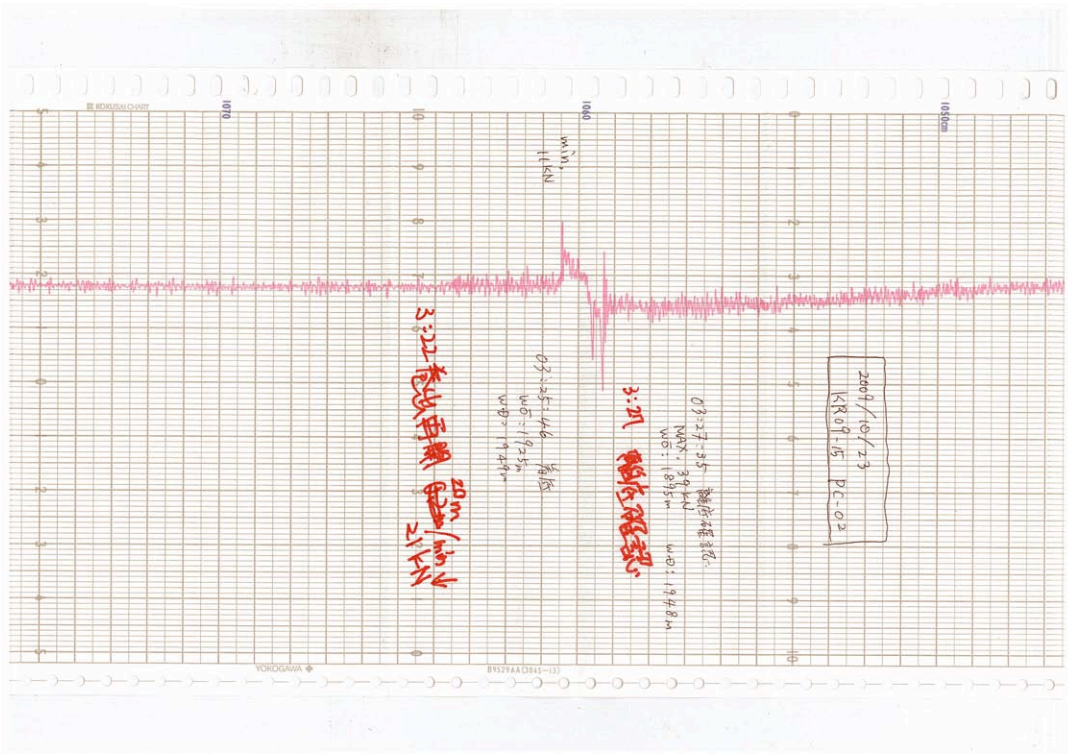
time (JST)	water depth(m)	wire out (m)	Lat*	Long*	Tension (kN)	wire out speed (m/min)		note
7:26	1973	-			-	-	-	hang up corer
7:46	**1950**	**0**	**33°17.7332 N**	**136°37.0929 E**	**13**	**~20**	**-**	**wire 0m reset, start lowering**
8:04	1947	500			13	60	↓	
8:12	1946	1000			16	60	↓	
8:21	1944	1500			19	60	↓	
8:27	1948	1850			20	-	-	stop lowering
8:47	1956	1850			22	~20	↓	restart lowering
8:51:37	**1951**	**1928**	**33°17.7348 N**	**136°38.3966 E**	**8**	**20**	↓	**hit bottom Lat/Long Transponder**
			33°17.7532 N	**136°38.3622 E**				**hit bottom Lat/Long Ship**
8:52:42	**1951**	**1912**	**33°17.7290 N**	**136°38.3968 E**	**34****	**20**	↑	**leave bottom Lat/Long Transponder**
			33°17.7535 N	**136°38.3523 E**				**leave bottom Lat/Long Ship**
9:03	1946	1200			23	70	↑	
9:06	1945	1000			21	70	↑	
9:15	1952	300			16	70	↑	
9:25	**1972**	**0**	**33°18.0175 N**	**136°38.8712 E**	**-**	**20**	↑	**wire length 0m**
9:39	-	-			-	-	-	complete recoverying
			*GPS: WGS84		** Max tension in pull up			



KR09-15 PC02

Cruise ID	KR09-15						
Date	09/10/23					Operator	Taketomo
Core ID	PC02						
Pilot ID	PL02						
Survey area	Kumano Trough						
Position ID	F02						
corer type	inner tube						
pipe length	15	m					
pilot	Large diameter Ewing						
pilot weight	110	kg					
pilot wire length	23.6	m					
main wire length	23.8	m					
free fall	4.7	m					
weather	fair						
wind direction	4	deg	speed	6.5	m/s		
current direction	87.9	deg	speed	3.1	knt		

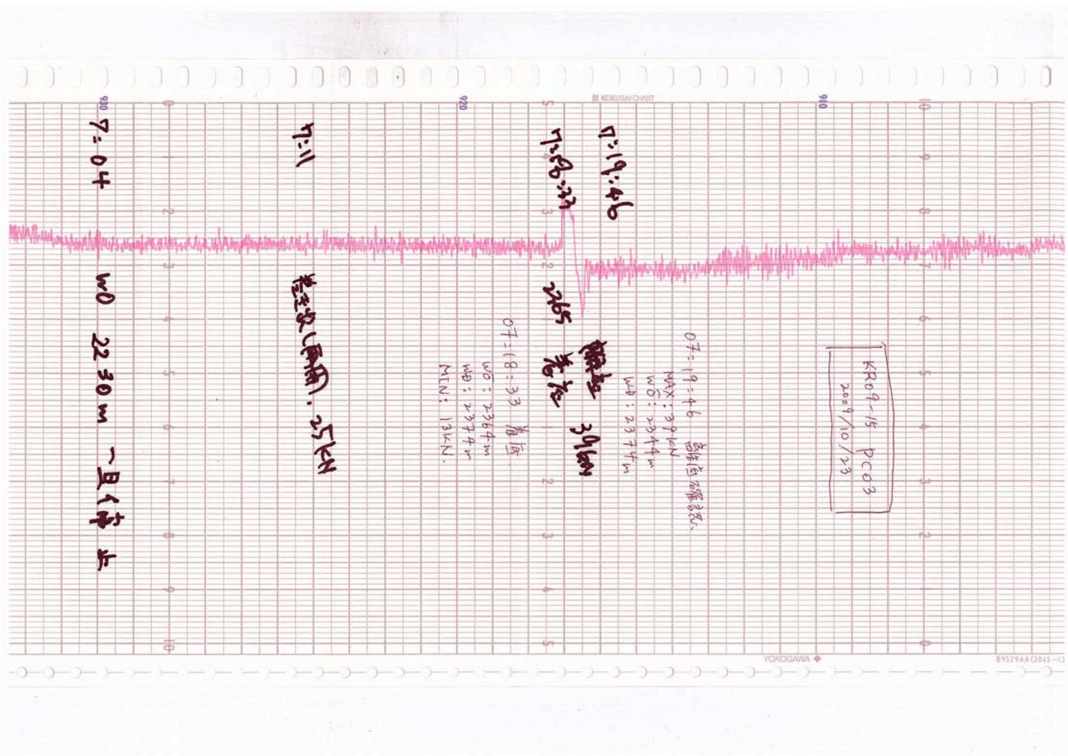
time (JST)	water depth(m)	wire out (m)	Lat*	Long*	Tension (kN)	wire out speed (m/min)		note
11:01	1938	-			-	-	-	hang up corer
11:19	**1954**	**0**	**33°17.8940 N**	**136°38.5064 E**	**13**	**～20**	-	**wire 0m reset, start lowering**
11:39	1963	500			14	60	↓	
11:47	1966	1000			17	60	↓	
11:55	1959	1500			20	60	↓	
12:02	1950	1860			22	0	-	stop lowering
12:22	1952	1860			20	～20	↓	restart lowering
12:25:46	**1949**	**1925**	**33°17.7792 N**	**136°38.3698 E**	11	**20**	↓	**hit bottom Lat/Long Transponder**
			33°17.7880 N	**136°38.2815 E**				**hit bottom Lat/Long Ship**
12:27:35	**1948**	**1895**	**33°17.7643 N**	**136°38.3494 E**	**39****	**20**	↑	**leave bottom Lat/Long Transponder**
			33°17.7876 N	**136°38.2786 E**				**leave bottom Lat/Long Ship**
12:37	1952	1200			23	70	↑	
12:47	-	500			19	70	↑	
12:58	**1965**	**0**	**33°18.1017 N**	**136°39.0060 E**	-	**20**	↑	**wire length 0m**
13:13	2001	-			-	-	-	complete recoverying
			*GPS: WGS84		** Max tension in pull up			



KR09-15 PC03

Cruise ID	KR09-15				
Date	09/10/23			Operator	宗
Core ID	PC03				
Pilot ID	PL03				
Survey area	Kumano Trough				
point ID	SL01				
corer type	inner tube				
pipe length	10 m				
pilot	Ashura				
pilot weight	100 kg				
pilot wire length	18.6 m				
main wire length	17.8 m				
free fall	4.7 m				
weather	fair				
wind direction	31 deg	speed	7.7 m/s		
current direction	87.5 deg	speed	3.1 knt		

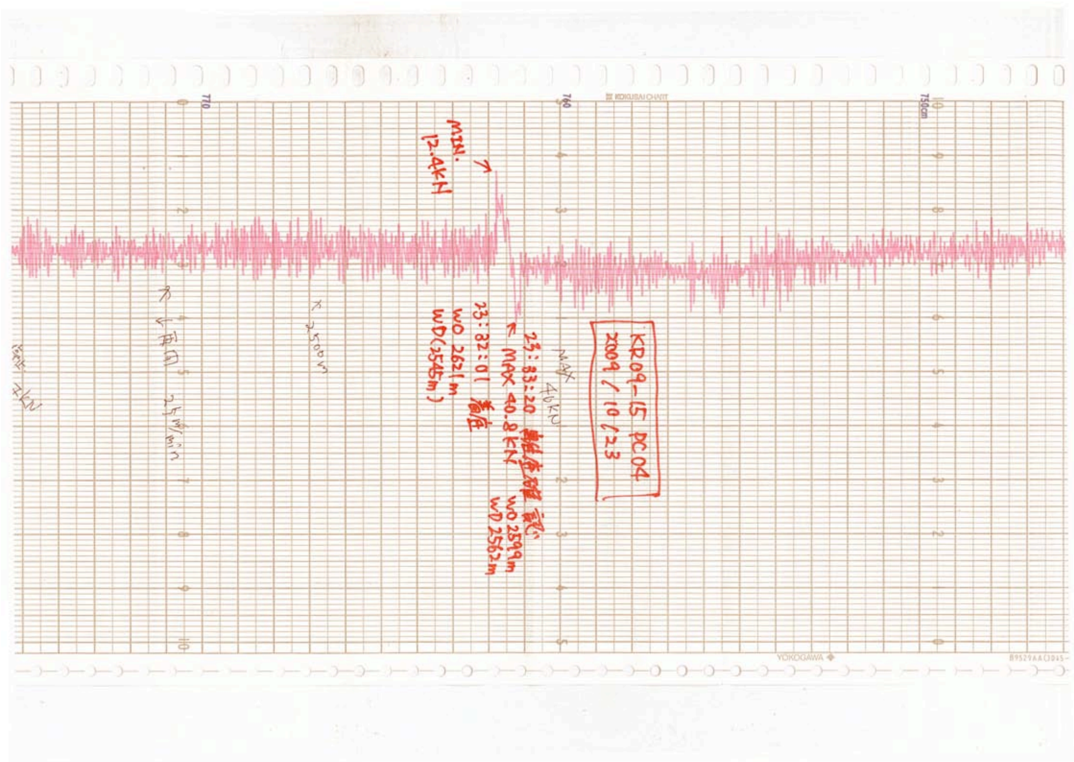
time (JST)	water depth(m)	wire out (m)	Lat*	Long*	Tension (kN)	wire out speed (m/min)		note
15:02	2421	-			-	-	-	hang up corer
15:17	**2362**	**0**	**33°13.5765 N**	**136°42.0005 E**	**13**	**~20**	**-**	**wire 0m reset, start lowering**
15:33	2349	500			14	60	↓	
15:41	2339	1000			17	60	↓	
15:50	2348	1500			19	60	↓	
16:00	2354	2000			22	60	↓	
16:04	2372	2230			25	0	-	stop lowering
16:11	2362	2230			25	~20	↓	restart lowering
16:18:33	**2374**	**2364**	**33°13.7833 N**	**136°43.0566 E**	**13**	**20**	↓	**hit bottom Lat/Long Transponder**
			33°13.7620 N	**136°43.0146 E**				**hit bottom Lat/Long Ship**
16:19:46	**2374**	**2344**	**33°13.7748 N**	**136°43.0711 E**	**39****	**20**	↑	**leave bottom Lat/Long Transponder**
			33°13.7546 N	**136°43.0132 E**				**leave bottom Lat/Long Ship**
16:26	2381	2000			29	70	↑	
16:34	2381	1500			25	70	↑	
16:42	2381	1000			22	70	↑	
16:49	2320	500			17	70	↑	
17:03	**2489**	**0**	**33°14.3263 N**	**136°44.2528 E**	**16**	**20**	↑	**wire length 0m**
17:18	-	-			-	-	-	complete recoverying
			*GPS: WGS84		** Max tension in pull up			



KR09-15 PC04

Cruise ID	KR09-15					
Date	09/10/24				Operator	松浦
Core ID	PC04					
Pilot ID	PL04					
Survey area	Kumano Trough					
point ID	SL02					
corer type	inner tube					
pipe length	10	m				
pilot	Large diameter Ewing					
pilot weight	110	kg				
pilot wire length	18.6	m				
main wire length	17.8	m				
free fall	4.7	m				
weather	fair					
wind direction	37	deg	speed	10.1	m/s	
current direction	93.3	deg	speed	3.0	knt	

time (JST)	water depth(m)	wire out (m)	Lat*	Long*	Tension (kN)	wire out speed (m/min)		note
7:09	2542	-			-	-	-	hang up corer
7:26	**2557**	**0**	**33°13.3182N**	**136°43.1864 E**	**12**	**～20**	**-**	**wire 0m reset, start lowering**
7:45	2576	500			14	60	↓	
7:53	2605	1000			15	60	↓	
8:01	2583	1500			19	60	↓	
8:10	2576	2000			23	60	↓	
8:17	2576	2400			27	-	-	stop lowering
8:22	2614	2400			26	～25	↓	restart lowering
8:32:01	**2545**	**2621**	**33°13.4712N**	**136°43.7264 E**	12	**25**	↓	**hit bottom Lat/Long Transponder**
			33°13.4923N	**136°43.7102 E**				**hit bottom Lat/Long Ship**
8:33:20	**2562**	**2599**	**33°13.4800N**	**136°43.7079 E**	**41****	**20**	↑	**leave bottom Lat/Long Transponder**
			33°13.4925N	**136°43.7084 E**				**leave bottom Lat/Long Ship**
8:42	2567	2000			34	70	↑	
8:50	2568	1500			26	70	↑	
8:58	2567	1000			22	70	↑	
9:07	2658	500			18	70	↑	
9:21	**2770**	**0**	**33°13.8664N**	**136°45.1052 E**	**15**	**20**	↑	**wire length 0m**
9:30		-			-	-	-	complete recoverying
			*GPS: WGS84		** Max tension in pull up			



3-3 Onboard analysis of planktonic foraminifera

We conducted an onboard analysis of planktonic foraminifera obtained from four sites during KR09-15 Cruise off the Kumano district, central Honshu, Japan.

Materials and Methods

We collected eight samples from four sites during the cruise. Two samples were obtained from the piston core PC01; the core-top sample (PC01-ML) and the core-catcher sample (PC01-CC), respectively. At Site PC02, each core-catcher sample was collected by the pilot (PL02-CC) and piston (PC02-CC) corers. Sample PL03, 6-7 cm is a core sample from 6-7 cm in deep collected by the pilot corer at Site PC03. At the same site, Sample PC03-CC was obtained from the core catcher of the piston core. The core-top (PC04-ML) and core-catcher (PC04-CC) samples were collected from the piston core PC04.

These sediment samples were treated at the Rock and Sediment Laboratory of Kairei. Each sediment sample was wet-sieved through a 63 μm opening screen and oven-dried. Foraminiferal specimens were picked from dried residues coarser than 125 μm. Fossil preservation and relative abundance were recorded in the faunal list (Table 1).

Results

All of samples yield abundant planktonic foraminifers including 27 taxa (Table 1). Fossil preservation of each sample is generally good, in spite of some specimens are broken or infilled. The fauna of the present area is dominated by two species, namely, *Neogloboquadrina incompta* and *Globoconella inflata.* Species belonging to *Globigerina, Globigerinita* and *Globigerinoides* also occur commonly. The age-diagnostic species *Globigerinoides ruber* (pink) is detected from Sample PC01-CC. Therefore the last occurrence (LO) is recognized between Samples PC01-CC and PC01-ML. The LO of *Globigerinoides ruber* (pink) is 0.12 Ma (MIS5) in Pacific Ocean (Thompson et al., 1979). It indicates that the piston core PC01 should reach into the last interglacial period.

References

Thompson, D.R., Be_, A.W.H., Duplessy, J.C., and Shackleton, N.J., 1979. Disappearance of pink- pigmented *Globigerinoides ruber* at 120,000 yr B.P. in the Indian and Pacific Oceans. Nature, 280:554–558.

Table 1. Planktonic foraminifers obtained from KR09-15 Cruise.

	PC01-ML	PC01-CC	PL02-CC	PC02-CC	PL03, 6-7 cm	PC03-CC	PC04-ML	PC04-CC
Globigerina bulloides	C	R	C	C	R	+	C	
Globigerina falconensis	R	C	C	A	+	+	C	R
Globigerinella calida	+	+		+			+	
Globigerinella siphonifera	+	+	+				+	
Globigerinita glutinata	R	C	C			+	R	R
Globigerinoides conglobatus		+	+	+			+	+
Globigerinoides ruber (white)	C	R	C	+	+		C	R
Globigerinoides ruber (pink)		+						
Globigerinoides sacculifer	+	+	+	+	+		+	+
Globoconella inflata	R	A	A	A	A	VA	C	VA
Globorotalia crassaformis		+	+		+			+
Globorotalia crassaformis hessi		+			+			
Globorotalia hirsuta	+						+	
Globorotalia scitula	+	+		+	+		+	+
Globorotalia truncatulinoides	+	+				+	+	
Globorotalia tumida	+	+	+	+	+	+	+	+
Globorotaloides hexagona				+				
Globoturborotalita rubescens	+	+	+	+				
Globoturborotalita tenella	+		+					
Menardella menardii	+	+	+	+	+	+	+	
Neogloboquadrina dutertrei	C	R	C	C	R		C	R
Neogloboquadrina incompta	A	VA	C	VA	VA	VA	A	VA
Neogloboquadrina pachyderma sinistral form	+	+			+			
Orbulina universa	+	+	+	+	+	+	+	
Pulleniatina obliquiloculata dextral form	R	+	+	+	R	+	R	+
Pulleniatina obliquiloculata sinstral form				+	+			
Sphaeroidinella dehiscens			+				+	+
Turborotalita quinqueloba	+	+		+	C			
Preservation	G	VG	VG	G	M	VG	G	G

VA: >32%, A: 32–16%, C: 16–8%, R: 8–4%, +: <4%

Preservation: VG: very good, G: good, M: moderate, P: poor, VP: very poor

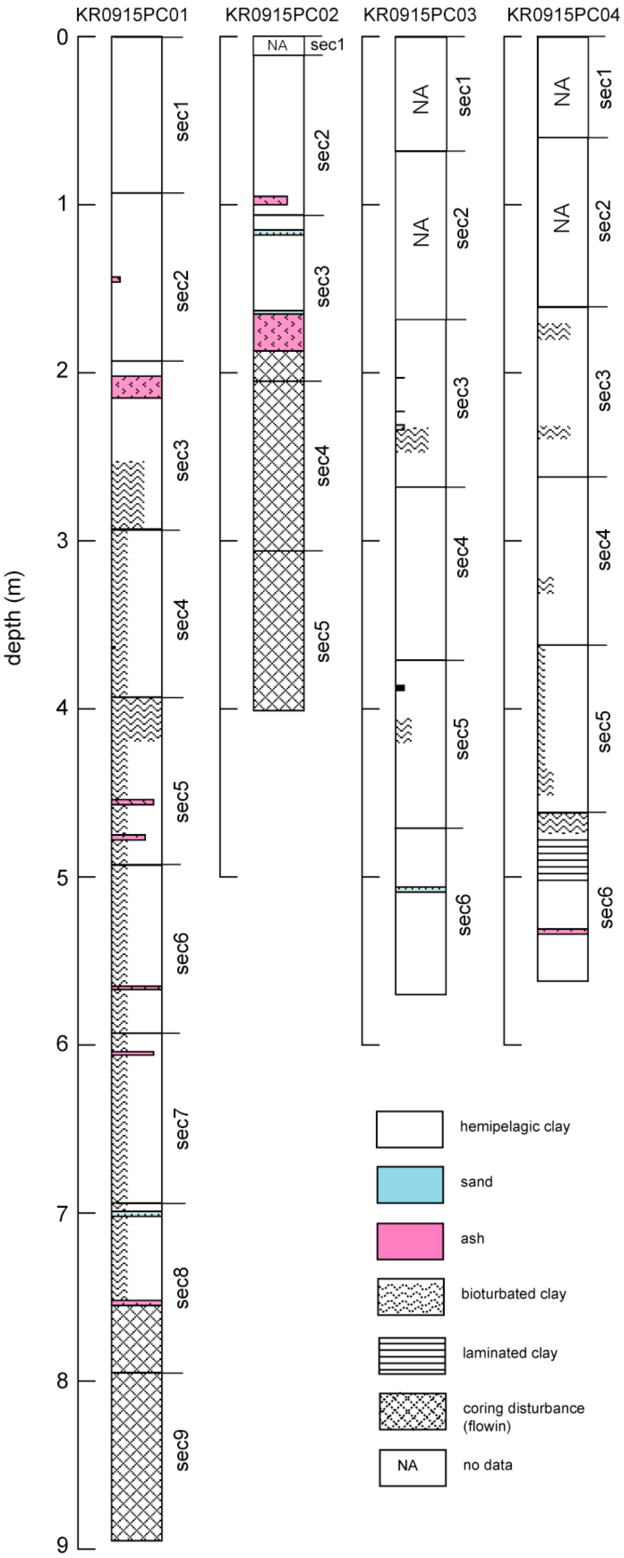
4. Post-cruise core analysis

Post-cruise measurements were carried out in Kochi Core Center during 24 - 27th November, 2009 with following order. 1) Scanogram imaging of the whole round sections, 2) Splitting whole-round sections into archive and working sections. 3) Scanning core images of archive sections. 4) Description of archive sections, 5) discrete sampling from working sections 6) Storing of sections. Note that sections KR0915PC03-01, KR0915PC03-02, KR0915PC04-01, and KR0915PC04-02 will be treated in a different procedure apart from the above Kochi procedure.

Summary of analysis

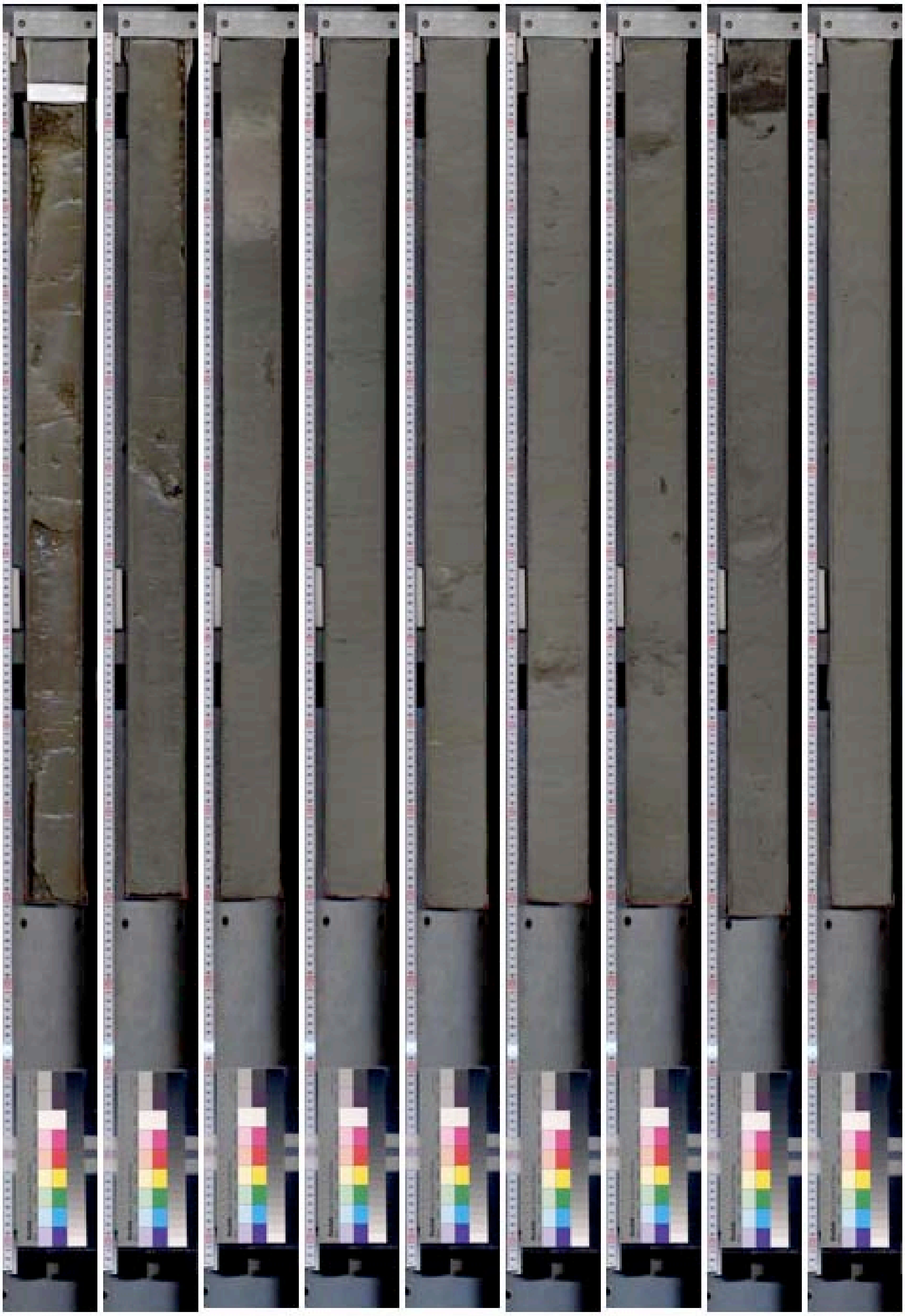
It was found that both KR0915PC01 and KR0915PC02 involve flowin sections (PC03: a lower part of section 8, and section 9, KR0915PC04: a lower part of sections 3, 4, and 5). KR0915PC01 and KR0915PC02 obtained from the Kumano Basin mainly consist of hemipelagic clay containing several ash layers and patches. PC02 involves two distinct sand layers in section 3. KR0915PC03 consist of hemipelagic clay with occasional sand patches. A distinct sand layer presents in section 6. KR0915PC04 mainly consists of hemipelagic clay. X-ray images and visual description of KR0915PC04 indicate frequent inclined layers.

KR0915 Piston core lithologic summary



KR0915PC01 core image

sec01 sec02 sec03 sec04 sec05 sec06 sec07 sec08 sec09



KR0915PC01 scanogram image

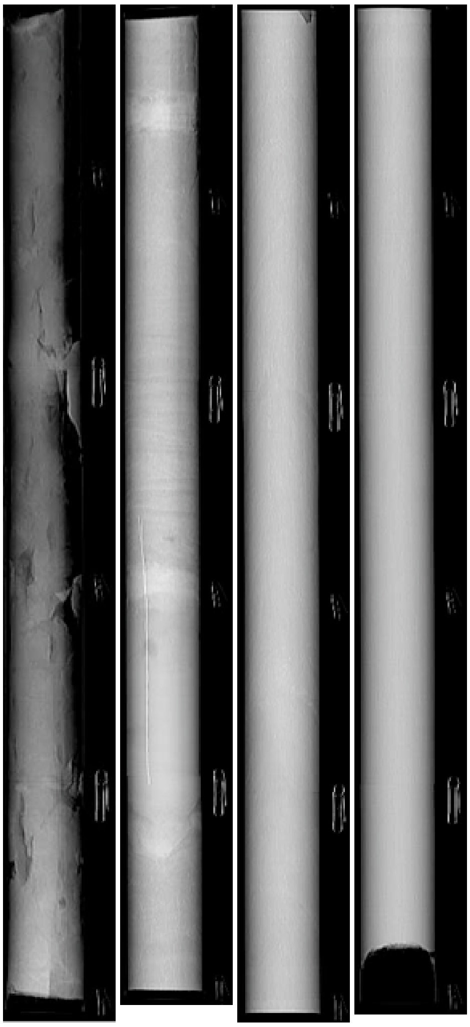
sec01 sec02 sec03 sec04 sec05 sec06 sec07 sec08 sec09

KR0915PC02 core image

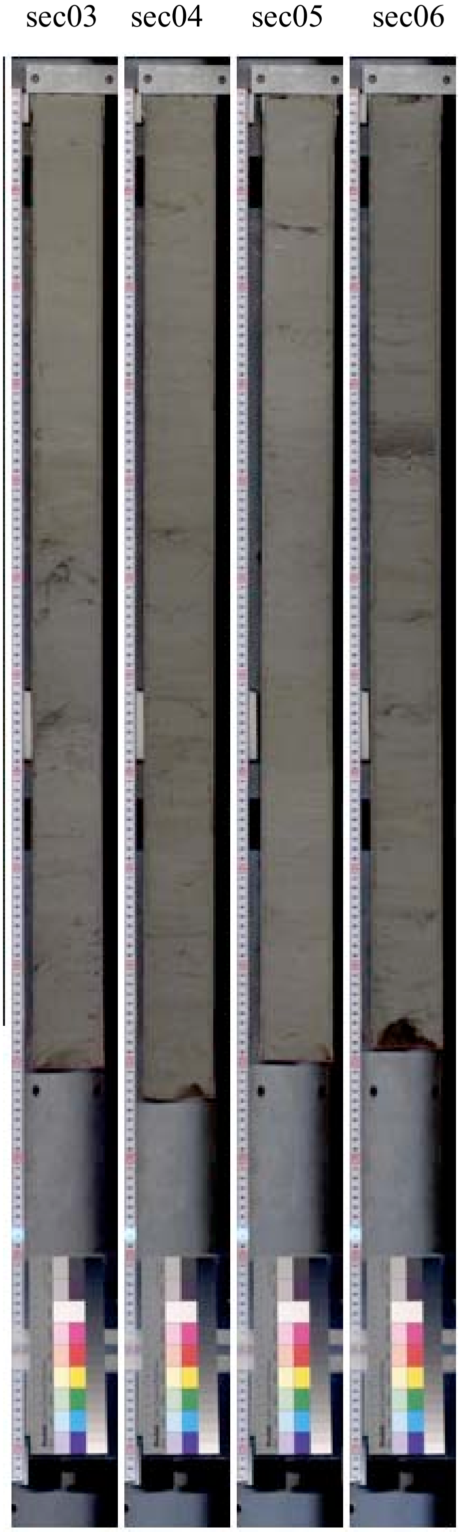
sec02 sec03 sec04 sec05

KR0915PC02 scanogram image

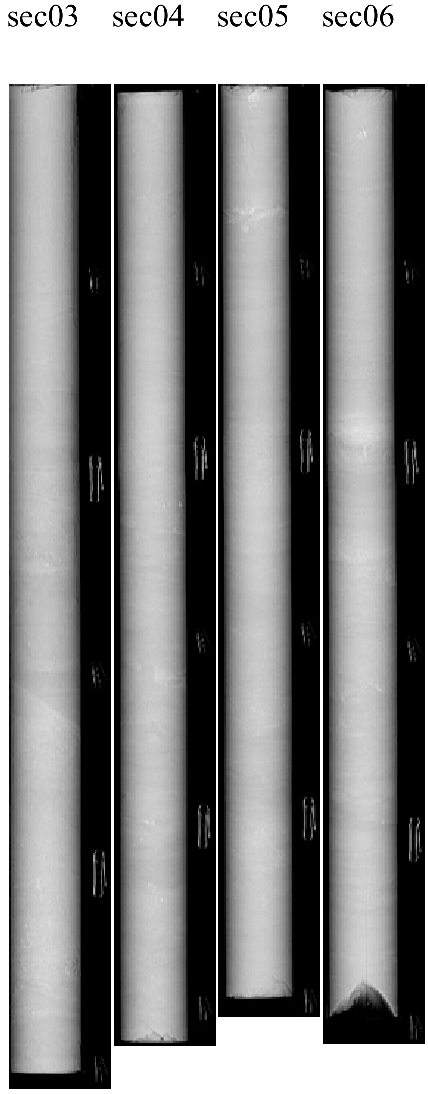
sec02 sec03 sec04 sec05



KR0915PC03 core image

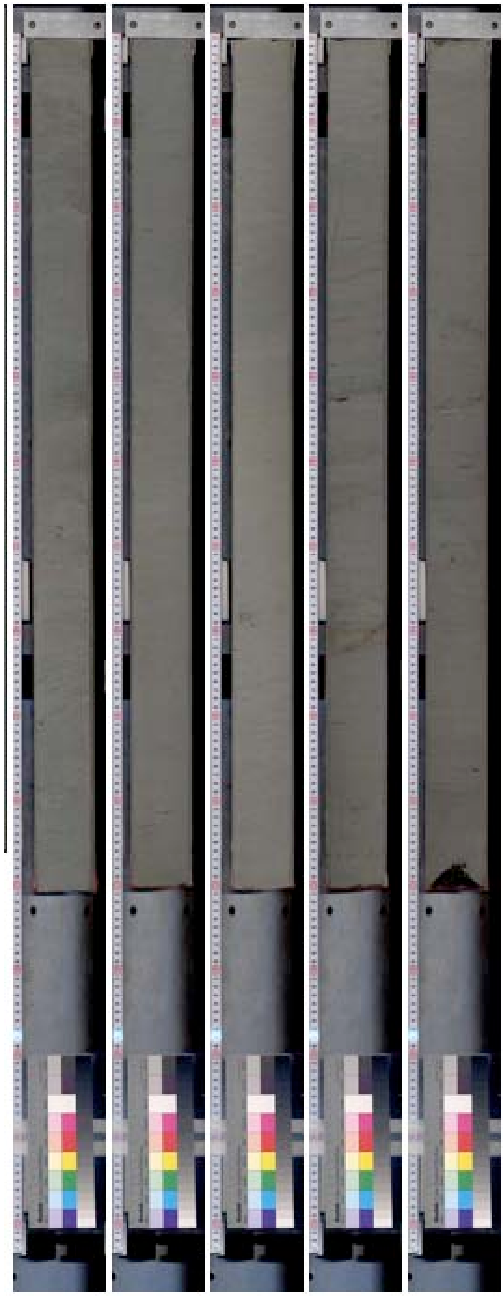


KR0915PC03 scanogram image



KR0915PC04 core image

sec03 sec04 sec05 sec06 sec07



KR0915PC04 scanogram image

sec03 sec04 sec05 sec06 sec07