doi : 10.17596/0002682

MIRAI "Cruise Report"

MR18-01C

Research Project for Compound Disaster Mitigation on the Great Earthquakes and Tsunamis around the Nankai Trough Region

Jan. 21th, 2018-Feb. 5th, 2018

Japan Agency for Marine-Earth Science and Technology

(JAMSTEC)

MR18-01C Cruise Report Contents

1. Cruise Information

Cruise ID: MR18-01C

Name of vessel: R/V MIRAI

Title of cruise: Research Project for Compound Disaster Mitigation on the Great Earthquakes and Tsunamis around the Nankai Trough Region

Chief scientist [Affiliation]: Toshiya Kanamatsu [CEAT JAMSTEC]

Representative of the Science Party [Affiliation]: Toshiya Kanamatsu [CEAT JAMSTEC]]

Proposal representative [affiliation]: Shuichi Kodaira [CEAT JAMSTEC]

Cruise period: Jan. 21th, 2018-Feb.5th, 2018

Ports of departure / arrival: Shimizu Nakagusuku (**Figure 1**)

Research area: Nansei-shoto (**Figure 2**)

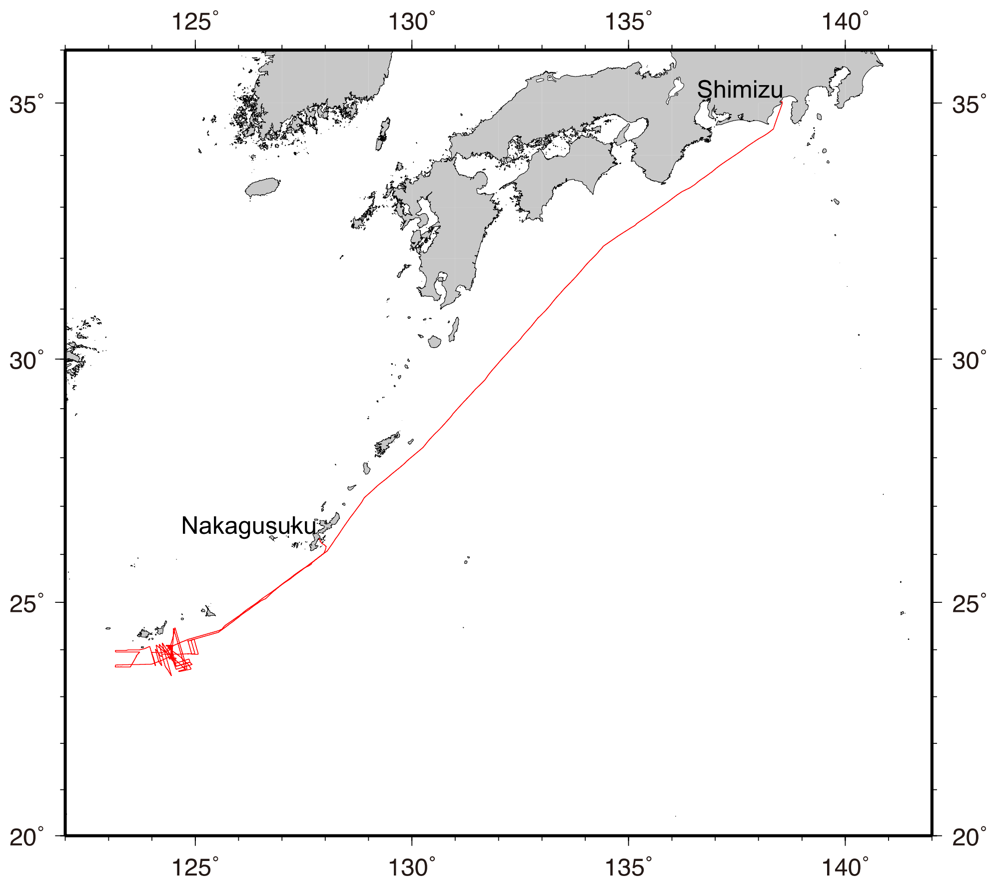


Figure 1. Red line: ship track of MR18-01C

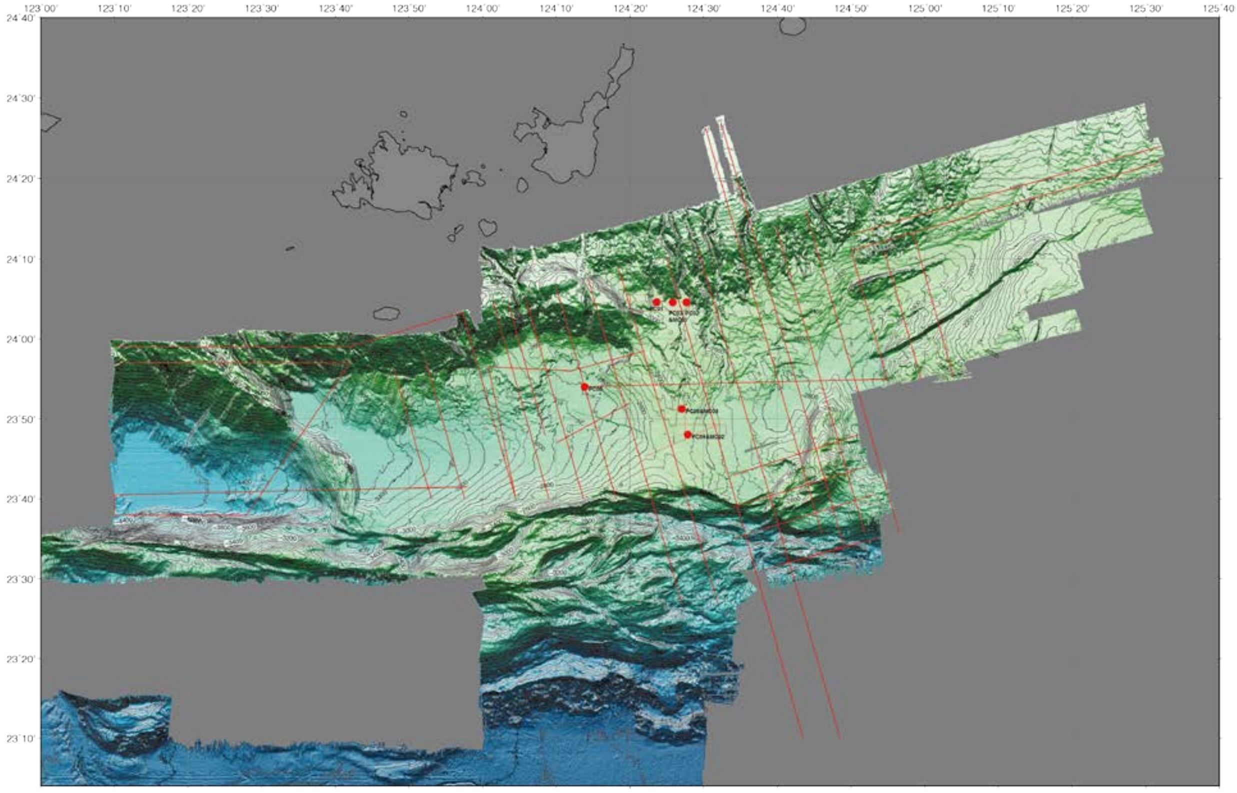


Figure 2. MR18-01C research area: Brown line: ship track, Red line: SBP and MBES Lines. Red circle: coring point

2. Participant list

Scientific party

Toshiya Kanamatsu	CEAT, JAMSTEC
Ken Ikehara	Geological Survey of Japan, AIST
Ayanori Misawa	Geological Survey of Japan, AIST
Yutaro Murakami	Nippon Marine Enterprise
Shinya Okumura	Nippon Marine Enterprise
Mika Yamaguchi	Marine Works Japan Ltd
Ei Hatakeyama	Marine Works Japan Ltd
Hiromichi Soejima	Marine Works Japan Ltd
Takehiro Kanii	Marine Works Japan Ltd

RV Mirai Ship Crew

Haruhiko Inoue	Master
Hiroyuki Kato	Chief Officer
Yuki Furukawa	1st Officer
Kanto Asaji	2nd Officer
Shintaro Kan	3rd Officer
Shuichi Hashide	Chief Engineer
Jun Takahashi	1st Engineer
Kenta Ikeguchi	2nd Engineer
Akihiro Demura	3rd Engineer
Masanori Murakami	Chief Radio Operator
Kazuyoshi Kudo	Boatswain
Tsuyoshi Sato	Quarter Master
Tsuyoshi Monzawa	Quarter Master
Ishii Yukito	Quarter Master
Shuji Komata	Quarter Master
Hideaki Tamotsu	Quarter Master
Saikan Hirai	Quarter Master
Masaya Tanikawa	Quarter Master
Shohei Uehara	Quarter Master
Hideyuki Okubo	Sailor
Nasu Kenta	Sailor
Yoshihiro Sugimoto	No.1 Oiler
Fumihito Kaizuka	Oiler
Toshiyuki Furuki	Oiler
Kazumi Yamashita	Oiler
Daisuke Taniguchi	Oiler
Shintaro Abe	Oiler
Kiyotaka Kosuji	Chief Steward
Tamotsu Uemura	Steward
Yukio Chiba	Steward
Murakami Toru	Steward
Toshiyuki Asano	Steward

3. Cruise Log

Date	Remarks
22th Jan	
	Embarkation of all participant
22th Jan	
09:00	Departure from Shimizu
10:00-10:30	Briefing for safety and onboard life
13:15-	Fire drill
15:00-15:30	Research meeting
	Transit to the survey area
23th Jan	
	Transit to the survey area
24th Jan	
	Transit to the survey area
25th Jan	
18:00-	SBP and MBES surveys (SV01 to SV02)
26th Oct	
06:00-	SBP and MBES surveys (SV25th01 to SV25th09)
13:00	Piston coring at PC01 (failed)
	Figure-eight turn around 24-05.06'N 124-24.48'E
17:00-	SBP and MBES surveys (SV14 to SV16)
27th Jan	
08:00	Piston coring (PC01)
13:30	Piston coring (PC02)
17:30-	SBP and MBES surveys (SV28th05 to SV28th08; SV28th09 to SV28th11; SV10 to SV09)
28th Jan	
08:00	Piston coring (PC03)
13:00	Piston coring (PC04)
	SBP and MBES surveys (SVpc5a to SVpc5b; msw 12s to msw 12n)
29th Jan	
	SBP and MBES surveys (msw 7n to msw 7s; msw 6s to msw 6n)

30th Jan	
08:00	Piston coring (PC05) SBP and MBES surveys (SV05 to SV06; SV07 to SV08)
31th Jan	
	figure-eight turn around 23-51.5'N, 123-37'E SBP and MBES surveys (SV33-SV36; msw 3n to msw 3s: SV18 to SV17)
1st Feb	
	SBP and MBES surveys (msw 13n to msw 13s; SV40 to SV41)
2nd Feb	
08:00	Multiple coring (MC01) @PC03 point
12:30	Multiple coring (MC02) @PC04 point
15:10	Multiple coring (MC03) @PC05 point
	SBP and MBES surveys (msw5n to msw 45n)
3rd Feb.	
8:00	Piton coring (PC06) Figure-eight turn around 23-55.00'N, 124-50.00E' SBP and MBES surveys (msw 18s to msw 16n; SV04 to SV03)
4th Feb.	
	Transit to Nakagusuku
5th Feb.	
10:30	Arrival in Nakagusuku port (end of the cruise).

4. Objectives

This cruise was carried out under “Research Project for Compound Disaster Mitigation on the Great Earthquakes and Tsunamis around the Nankai Trough Region” entrusted by the Ministry of Education, Culture, Sports, Science, and Technology. The purpose is to investigate evidences of past -Tsunami in marine sediments. We planed to make piston coring and multiple coring operations, bathymetric and shallow sub-seafloor acoustic imaging surveys using a multi-beam echo-sounder system and sub-bottom profiler, gravity and three-component magnetic measurements, physical property measurements on the sediment core using a multi-sensor core logger, visual core description, and sub-sampling for post-cruise researches on obtained samples during the cruise. Onboard results are reported in the followings sections.

5. Instruments and Operations

5-1. Multi-beam Echo-sounder System and Sub-bottom profiler

The ***SeaBeam3012*** Multi beam Echo sounder system (MBES), and ***Bathy 2010*** sub-bottom profiler (SBP) equipped with RV MIRAI were used to collect bathymetric and sub-bottom data in the study area. General specifications of the systems are summarized below.

MBES:	Frequency	12kHz
	Depth range	50～11,000m
	Swath width	Max150°(90° at Water depth 11000m)
	Max beam number	301beams
	Beam width	2°×1.6°
SBP:	Frequency	3.5 kHz
	Beam width	20°
	Depth range	10～12,000m

5-2. Temperature profile

The sound velocity profile of the local water column, which was used for calibration of depth data for the bathymetry, was estimated from a temperature profile based on in-situ Expendable Conductivity Bathythermograph (XCTD). Locations of XCTD measurements and temperature depth profile are shown in **Table 5-2-1** and **Figure 5-2-1.**

Table 5-2-1. Positions of XCTD measurements.

Num	Date	time	Lat.	Long.	Probe Type	Max depth (m)
1159	2018/01/25	08:25:25	24-25.7198N	125-36.6447E	CT-2	1287
1160	2018/02/01	20:55:04	23-58.1918N	124-28.3318E	CT-2	2000

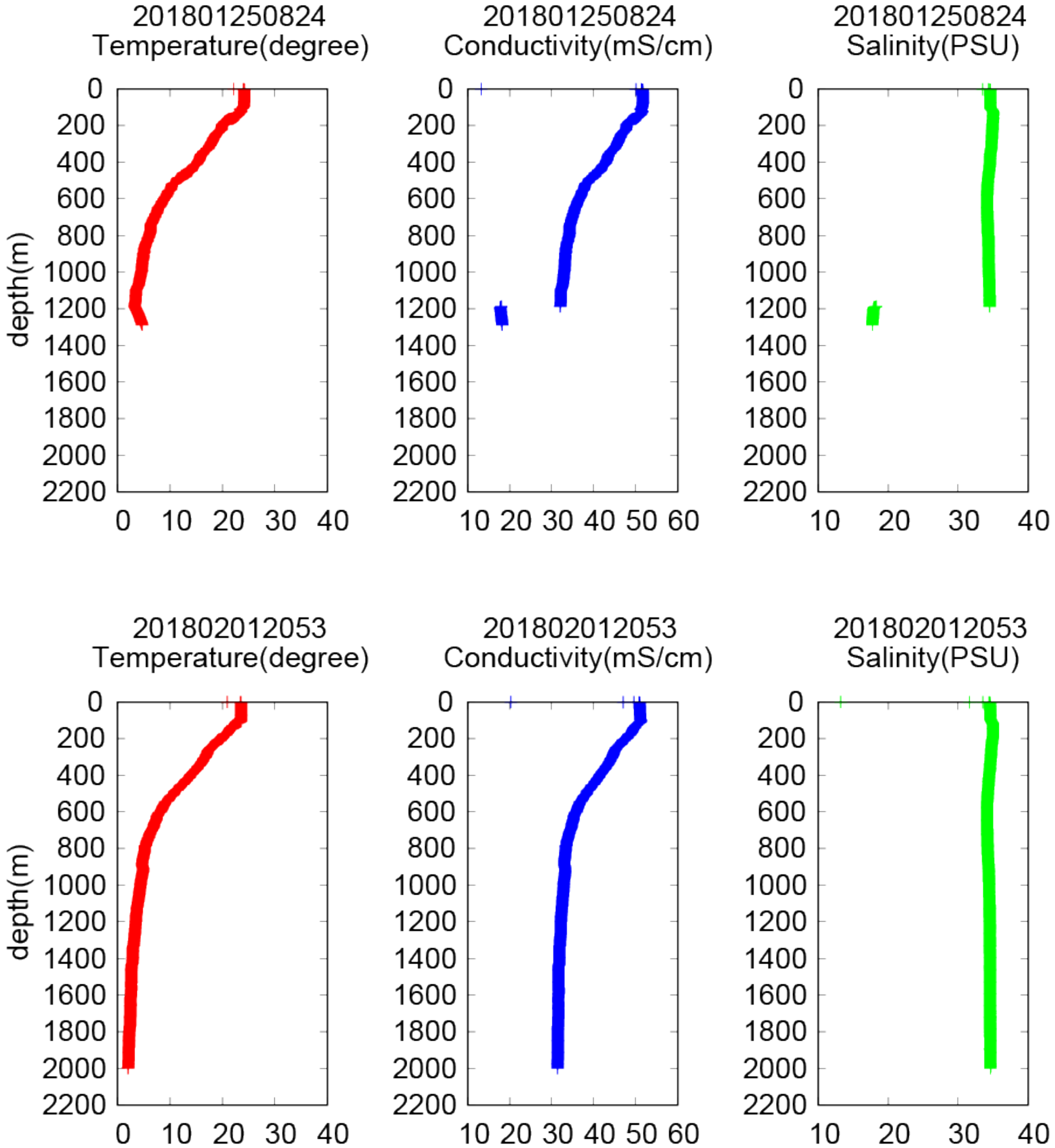


Figure 5-2-1. Temperature, conductivity and salinity profiles obtained by XCTD measurement on 2018/01/25 and 2018/02/12.

5-3. Shipboard gravity meter and three component magnetometer

-Shipboard gravity meter

The system consists of two main assemblies; the gyro-stabilized platform including the gravity sensor and the data handling & control system. Detailed specification is as followings

LaCoste & Romberg LLC S-116

Range: 12,000 mGal

Accuracy: 1.0 mGal

Drift rate:

better than 3.0 mGal/month

-Three Component Magnetometer (STCM)

Three-axes flux-gate sensors with ring-cored coils were fixed on the roof of the bridge. Detailed specification is as followings. In order to detect the ship apparent magnetic influence, eight-figure turns were carried out three times during this cruise.

Tierra Technica Ltd. SFG1214

Range: -100,000 to +100,000 nT
Accuracy: better than 100 nT
Resolution: 1 nT

5-4. Piston corer system

5-4-1. Piston corer system (Figure 5-4-1)

A piston corer system consists of 0.59 ton weight, 4 m 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. The piston is composing of two O-rings (size: P63). For a pilot core sampler, we used a "74 mm diameter long-type pilot corer". The pilot corer consists of 112 kg weight, 50 cm or 70 cm long aluminum barrels and polycarbonate liner tube. The I.D. of polycarbonate liner tube is 74 mm. The transponder (SI2-1KP, Kaiyo Denshi co. Ltd.; maximum depth 10,000 m) was attached to the winch wire above or over 50 m from the PC to monitor the PC position.

5-4-2. K-value

K-value means the hardness barometer of the seafloor 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".

5-4-3. Winch operation

In the beginning of operation of the PC, a speed of wire out was set to 0.5 m/s, and then increased lowering speed up to 1.0 m/s gradually. Heave compensators was active from 500 m water depth. Wire out was stopped at a depth about 100 m above the seafloor for about 3 minutes to stabilize some pendulum motion of the system. After the wire tension was stable, the wire out was restarted at a speed of 0.3 m/s, and we carefully watched a tension meter to observe reaching of the PC to seafloor. When the corer reached to seafloor, wire tension abruptly decreased by the loss of the corer weight. Wire out was stopped immediately when the corer hit to seafloor. Winding of the wire was started at a speed of 0.3 m/s until the tension gauge indicates that the corers were lifted off seafloor. After leaving of the PC from seafloor, winch wire was wound at the maximum speed.

5-5. Shipboard core flow

Before core physical property measurements, cores were equilibrated with room temperature (~20°C). Then Whole-round core sections were processed in the multisensor core logger (Geoteck Multi-Sensor Core Logge: MSCL) to measure gamma ray attenuation (GRA) density, magnetic susceptibility, natural gamma radiation, *P*-wave (compressional) velocity, and electrical resistivity.

The whole-round core sections were horizontally split half as working and archive halves with the core splitter and nylon wires. Images of archive sections were obtained by MSCL-I. After measurements, core treatments were followed as described in a chart (**Figure 5-5-1**)

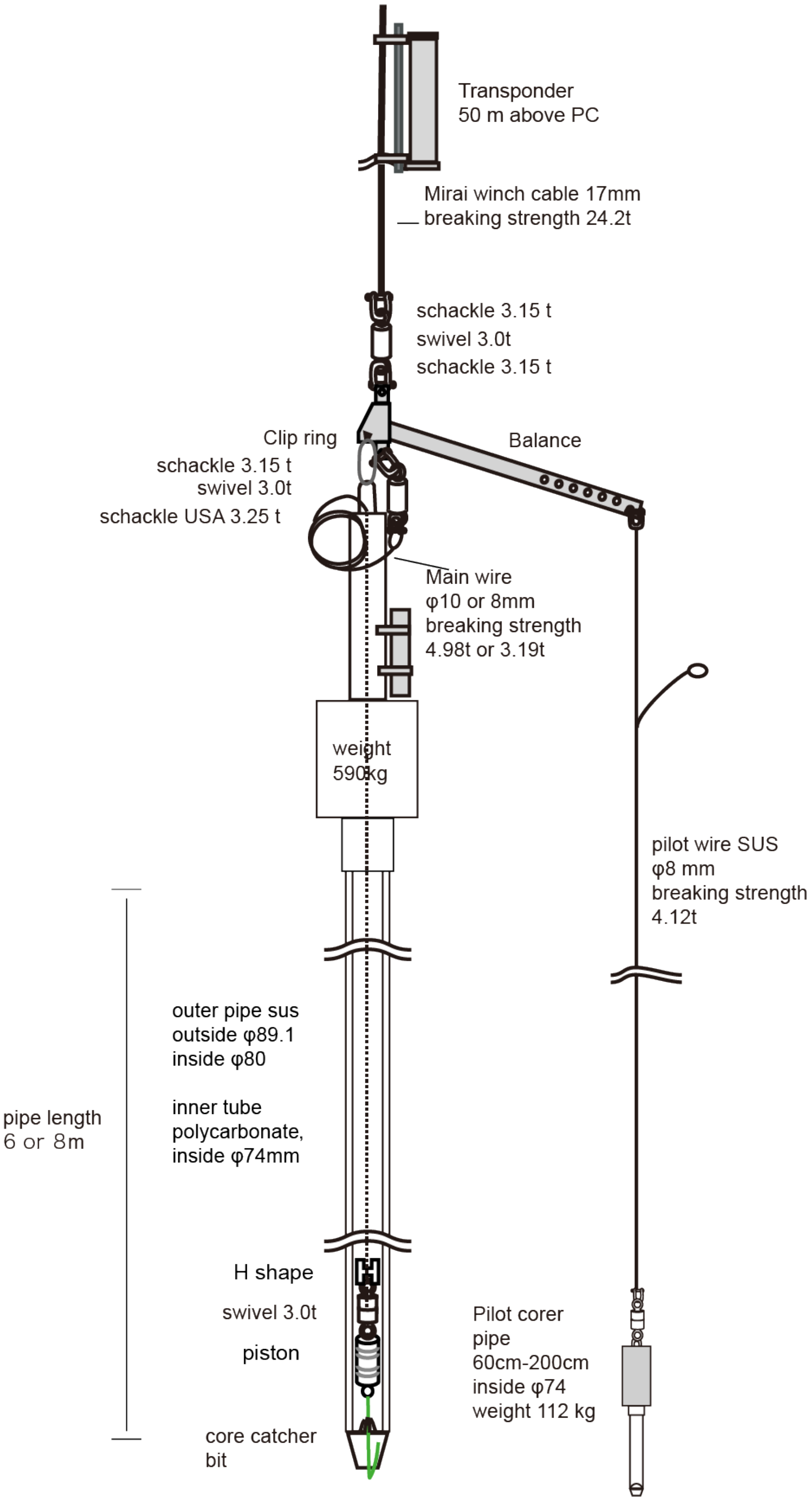


Fig. 5-4-1: Specifications of piston-corer system used for MR18-01C.

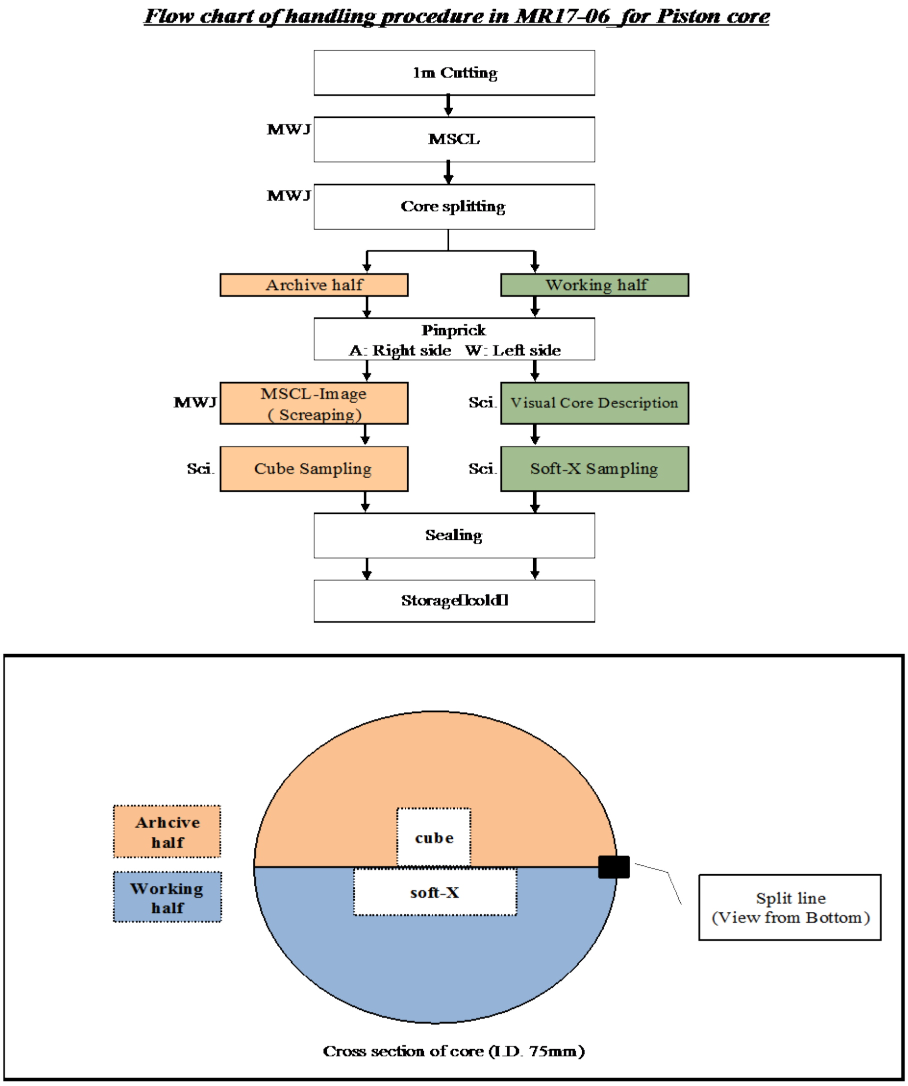


Figure 5-5-1. Shipboard core flow for MR18-01C

6. Preliminary results

Survey lines for MBES and SBP are listed in **Table 6-1.** Surveys were carried out with **5knot.**

Table 6-1 survey line list

DATE	Way point	LAT(N) [deg.]	LAT(N) [min.]	LONG(E) [deg.]	LONG(E) [min.]
1/25	SV01	24	24.00	125	32.00
	SV02	24	13.00	124	50.00
1/26	SV25th01	24	4.60	124	28.00
	SV25th02	24	4.60	124	27.00
	SV25th03	24	4.60	124	24.00
	SV25th04	24	4.60	124	20.00
	SV25th05	24	5.50	124	20.00
	SV25th06	24	5.50	124	21.50
	SV25th07	24	5.50	124	28.00
	SV25th08	24	3.50	124	28.00
	SV25th09	24	3.50	124	20.00
	SV14	23	39.00	124	34.00
	SV13	23	44.00	124	52.00
	SV15	23	41.00	124	55.00
	SV16	23	35.00	124	34.00
1/27	SV28th05	23	48.00	124	26.00
	KR16PC01	23	48.00	124	32.00
	SV28th06	23	48.00	124	33.00
	SV28th07	23	49.30	124	33.00
	SV28th08	23	49.30	124	26.00
	SV28th09	23	52.30	124	27.50
	SV28th10	23	48.00	124	27.50
	SV28th11	23	47.30	124	27.50
	SV10	23	43.00	124	34.00
	SV09	23	48.00	124	51.00
1/28	SVpc5a	23	51.25	124	25.50
	SVpc5b	23	51.25	124	28.00
	Way point	LAT(N) [deg.]	[min.]	LONG(E) [deg.]	[min.]

	msw12s	24	26.24	124	30.26
	msw12n	23	35.80	124	46.00

1/29	Way	LAT(N)		LONG(E)	
	point	[deg.]	[min.]	[deg.]	[min.]
	msw7n	24	7.52	124	14.31
	msw7s	23	27.00	124	27.00

Way	LAT(N)		LONG(E)	
point	[deg.]	[min.]	[deg.]	[min.]
msw6s	23	40.00	124	18.10
msw6n	24	6.50	124	10.00

1/30	Way	LAT(N)		LONG(E)	
	point	[deg.]	[min.]	[deg.]	[min.]
	SV05	23	41.50	123	58.00
	SV06	23	40.50	123	10.00
	SV07	23	38.00	123	10.00
	SV08	23	38.00	123	30.00

1/31	Way	LAT(N)		LONG(E)	
	point	[deg.]	[min.]	[deg.]	[min.]
	SV33	23	57.00	123	42.00
	SV34	23	57.00	123	10.00
	SV35	23	59.00	123	10.00
	SV36	23	59.00	123	42.00

Way	LAT(N)		LONG(E)	
point	[deg.]	[min.]	[deg.]	[min.]
msw3n	24	3.33	123	57.26
msw3s	23	40.00	124	4.50

Way	LAT(N)		LONG(E)	
point	[deg.]	[min.]	[deg.]	[min.]
SV18	23	56.50	124	0.80
SV17.5	23	56.00	124	12.00
SV17	23	58.50	124	22.00

2/1	Way	LAT(N)		LONG(E)	
	point	[deg.]	[min.]	[deg.]	[min.]
	msw13n	24	26.87	124	32.37
	msw13s	23	35.80	124	48.50

Way	LAT(N)		LONG(E)	
point	[deg.]	[min.]	[deg.]	[min.]
SV40	23	32.10	124	38.00
SV41	23	35.20	124	54.00

2/2	Way	LAT(N)		LONG(E)	
	point	[deg.]	[min.]	[deg.]	[min.]
	msw5n	24	5.03	124	5.85
	msw5s	23	40.00	124	13.70
	msw45s	23	48.00	124	8.50
	msw45n	24	4.50	124	3.48

6-1. Bathymetric survey

Bathymetric data obtained during this cruise is shown in **Figure 6-1-1.** We filled blank areas in the previous cruises.

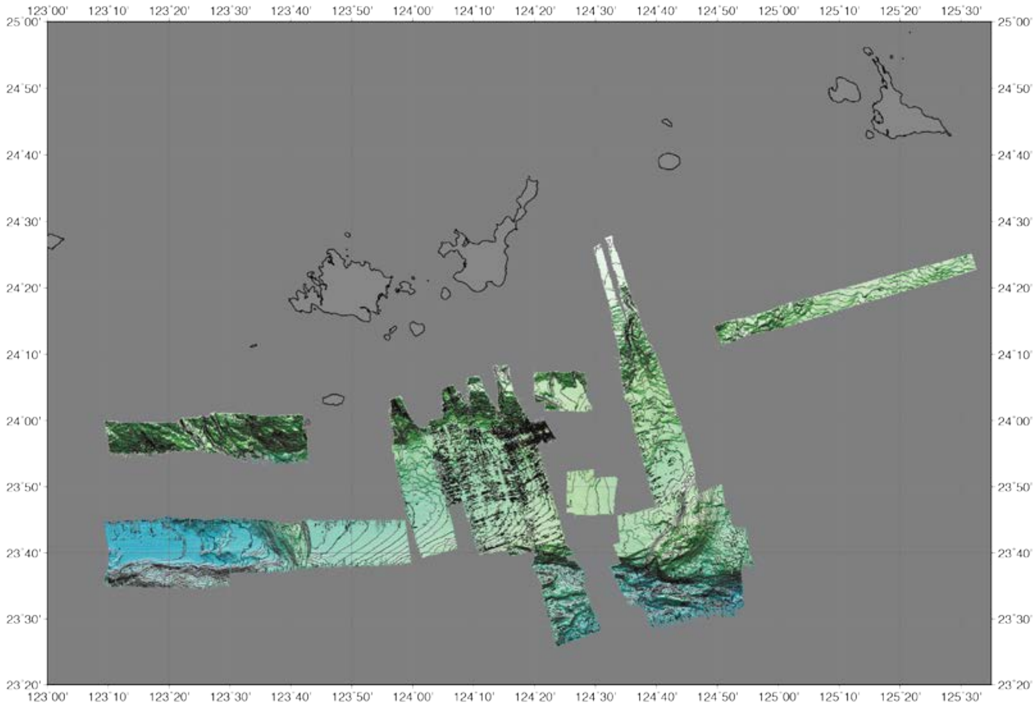


Figure 6-1-2. All mapped areas with MBES

6-2. SBP survey

SBP images obtained are shown in the figures from **Figure 6-2-3 to Figure 6-2-35**. Refer **Figures. 6-2-1** for the locations of survey lines. **Figures. 6-2-2a** and **b** are enlarged map around coring points.

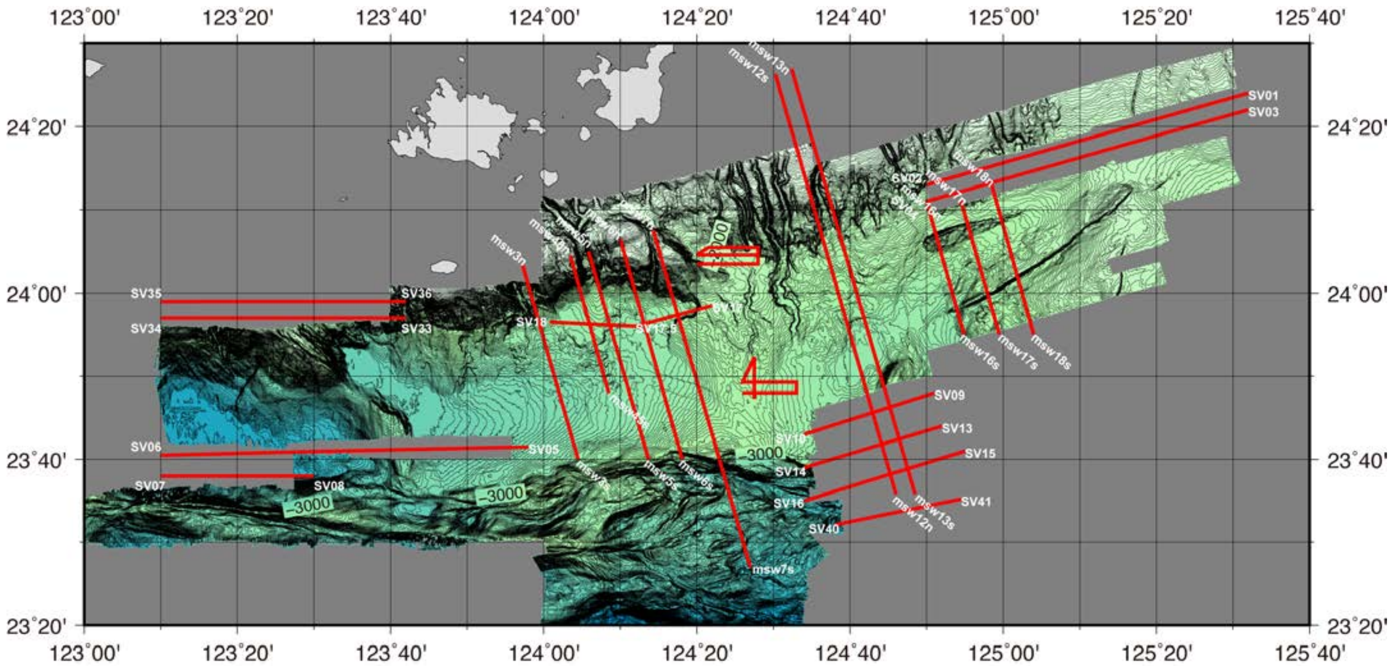


Figure 6-2-1: MBES and SBP ship track

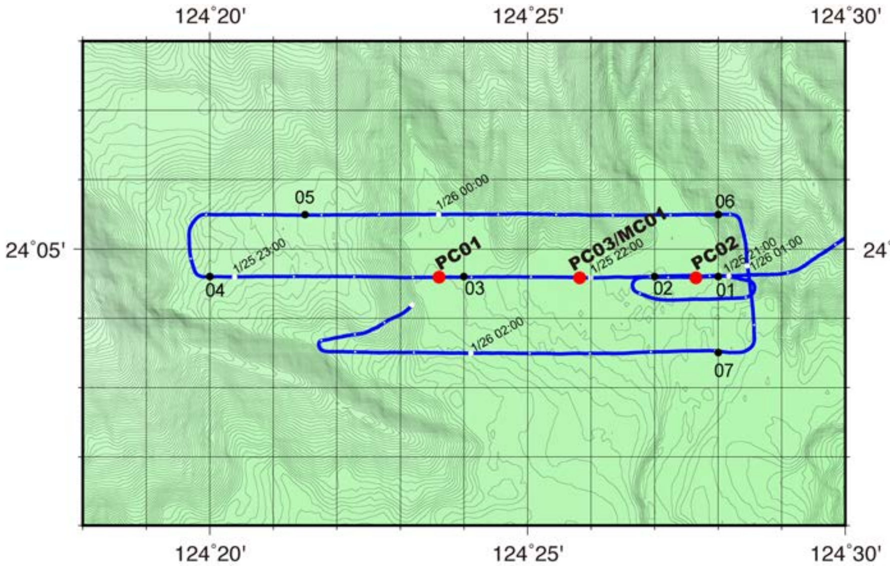


Figure 6-2-2a: Close up of MBES and SBP ship track around coring points

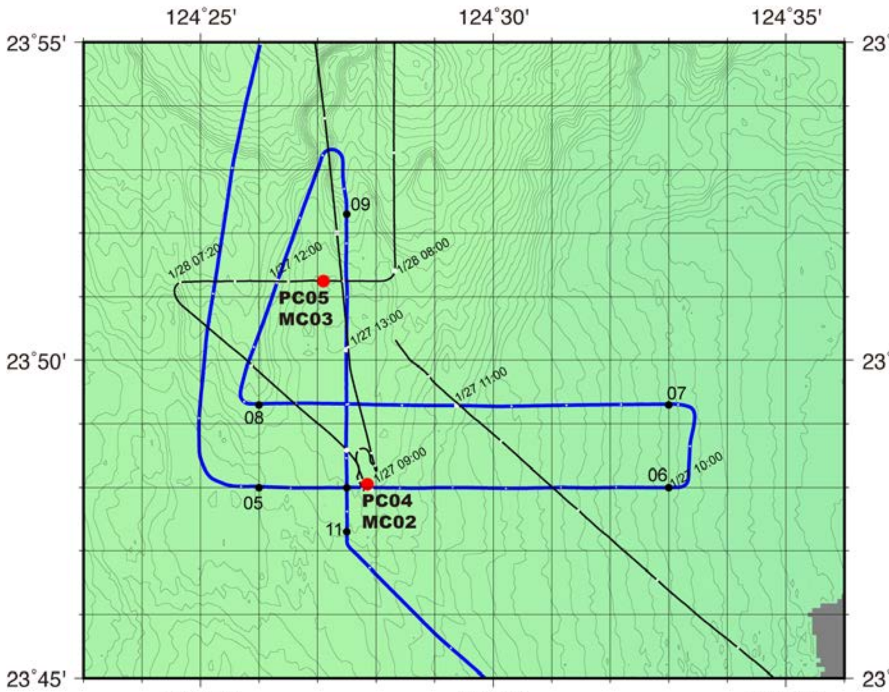


Figure 6-2-2b: Close up of MBES and SBP ship track around coring points

0125_SV01-SV02

WSW ENE

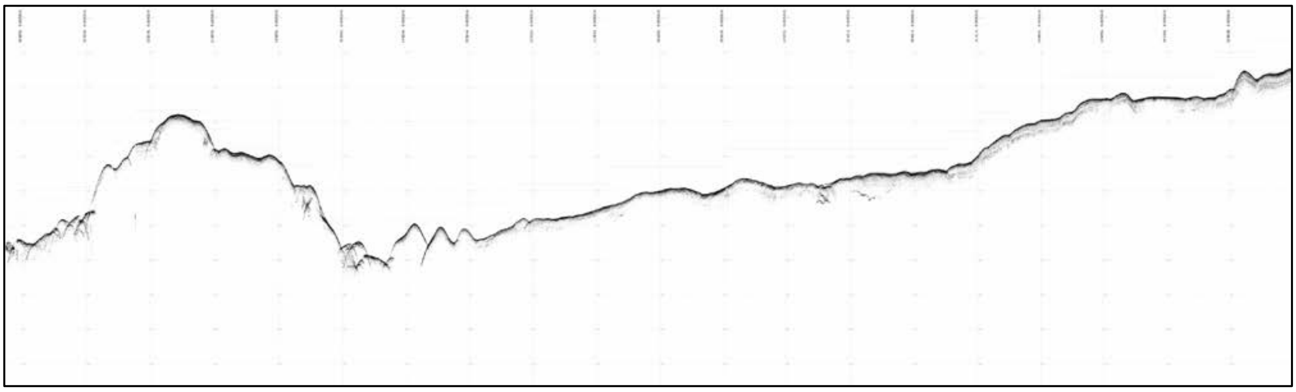


Figure 6-2-3: SBP image of Line 0125_SV01-SV02 (reference map **Fig. 6-1-2**)

0126_SV14-SV13

WSW ENE

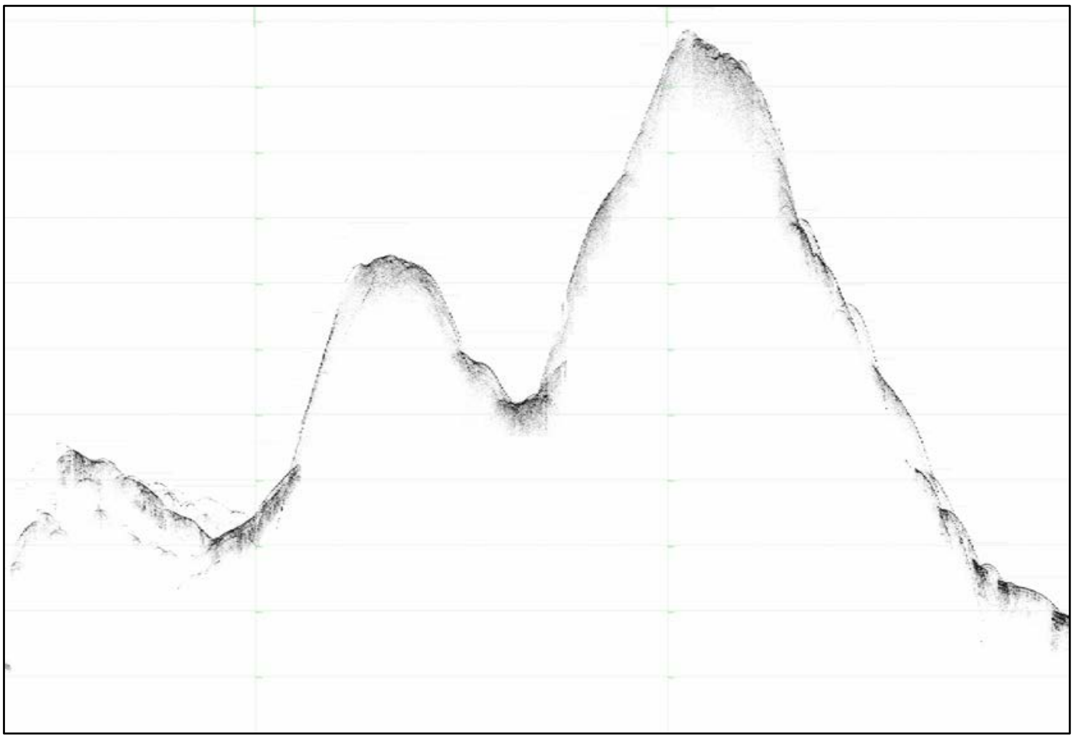


Figure 6-2-4: SBP image of Line 0126_SV14-SV13 (reference map **Fig. 6-1-2**)

0126_SV15-SV16

WSW ENE

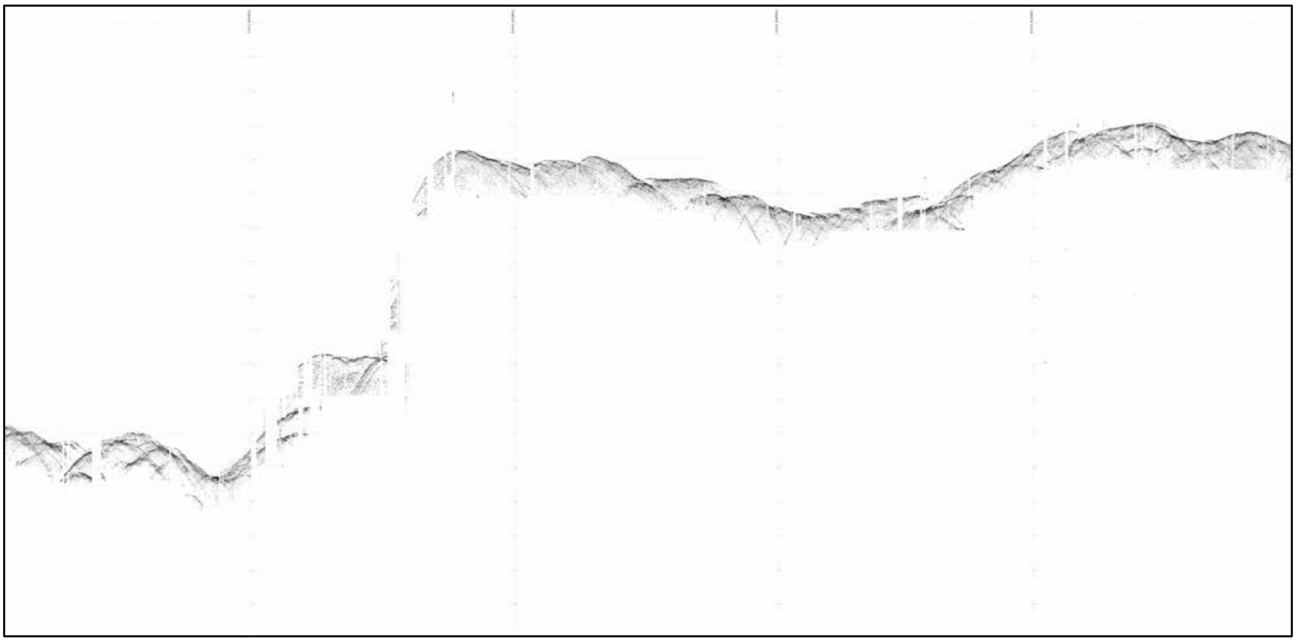


Figure 6-2-5: SBP image of Line SV15-SV16

0126_SV25th01- SV25th04

W E

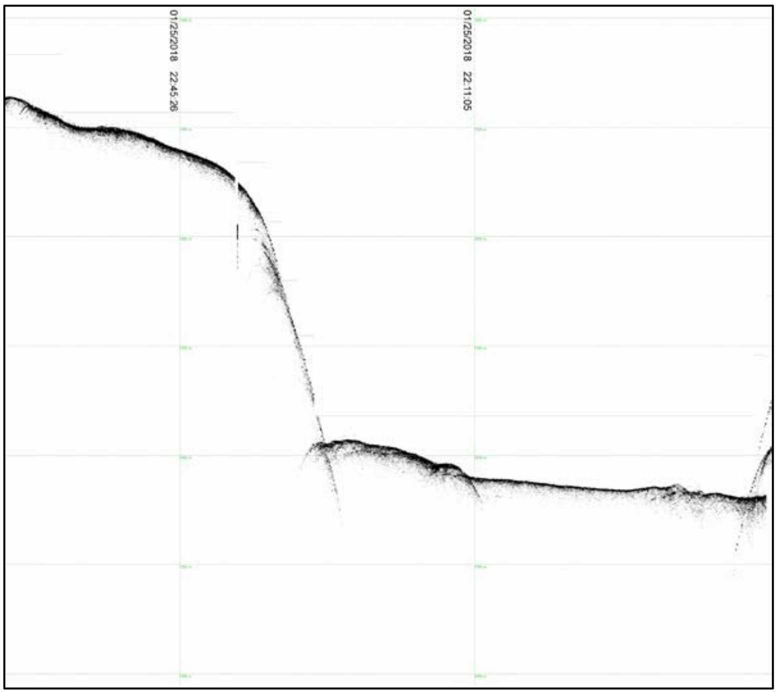


Figure 6-2-6: SBP image of Line V25th01- SV25th04

0126_SV25th05- SV25th07

W E

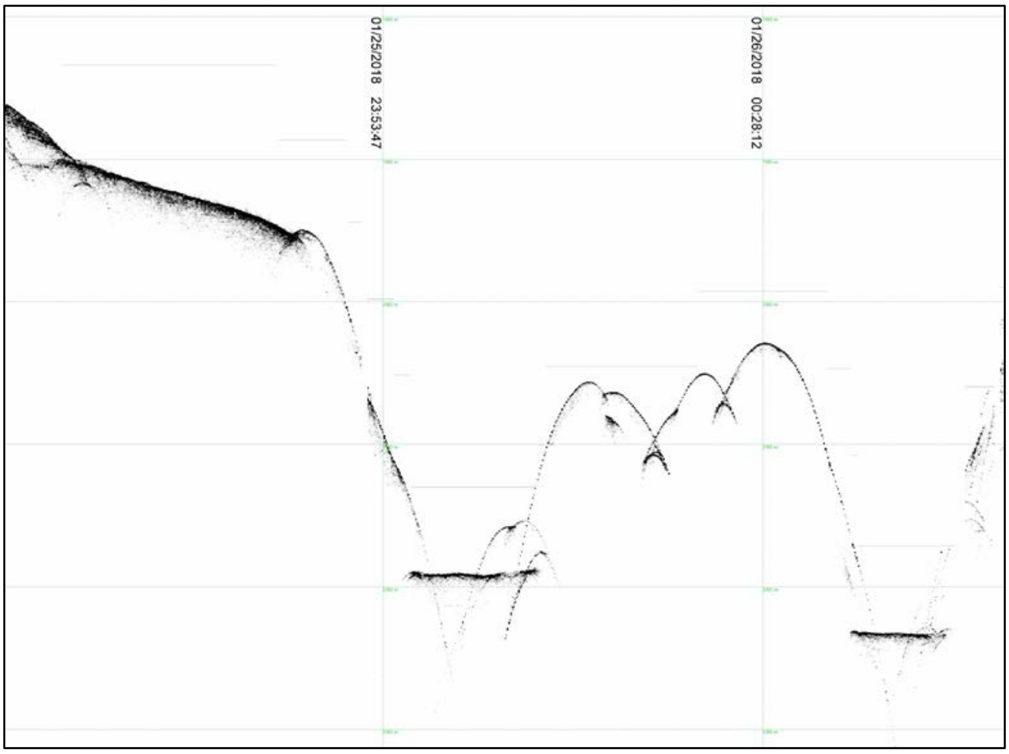


Figure 6-2-7: SBP image of Line SV25th05- SV25th07

0126_SV25th08- SV25th09

W E

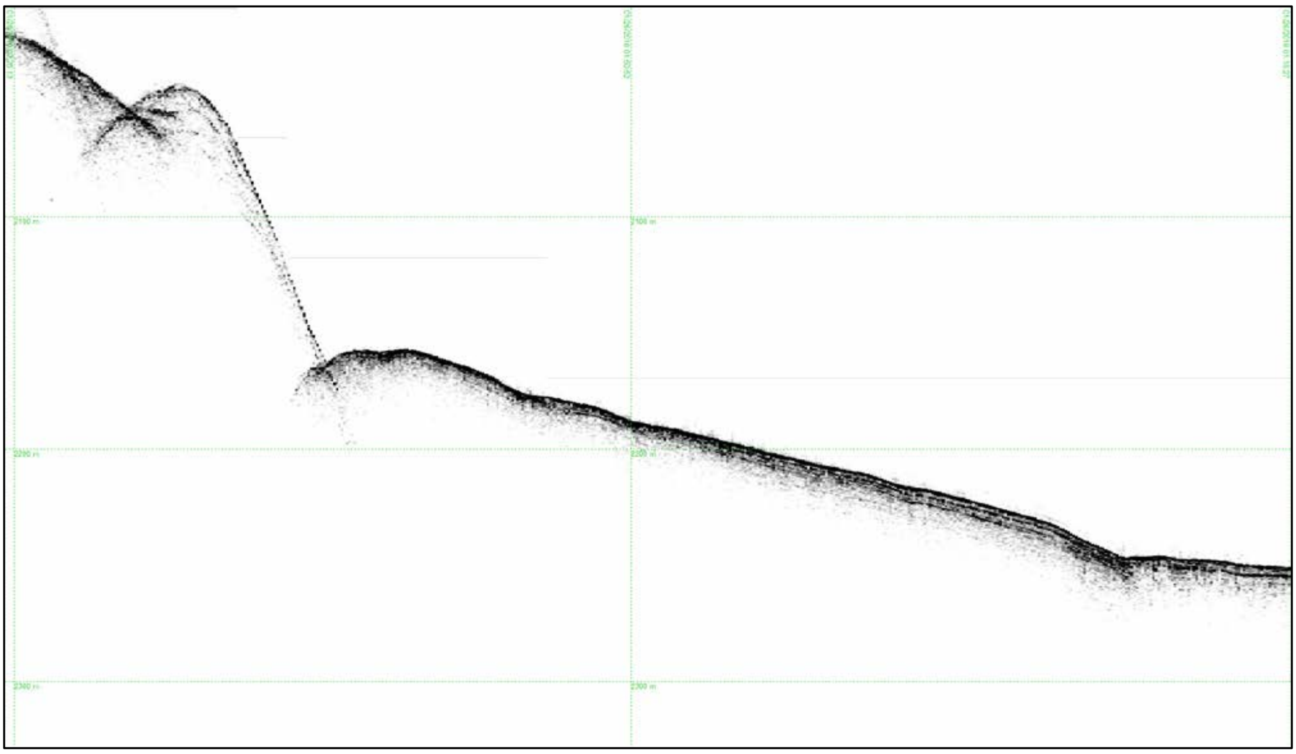


Figure 6-2-8: SBP image of Line SV25th08- SV25th09 (reference map **Fig. 6-1-2**)

0127_SV28th05- SV25th06

W E

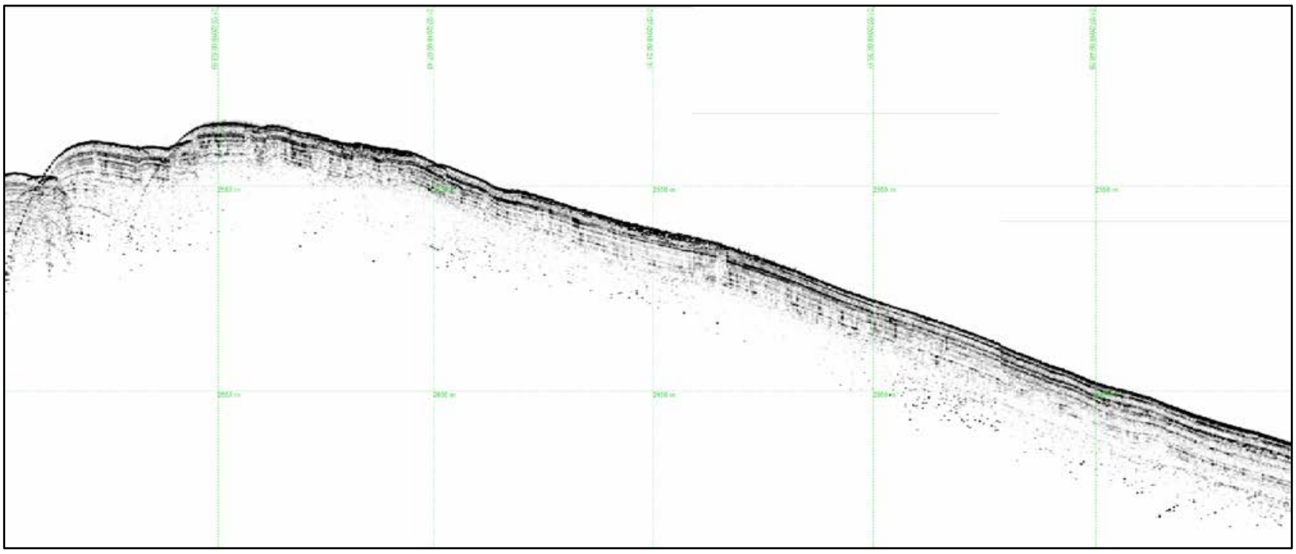


Figure 6-2-9: SBP image of Line SV28th05- SV25th06

0127_SV28th06- SV25th07

S W

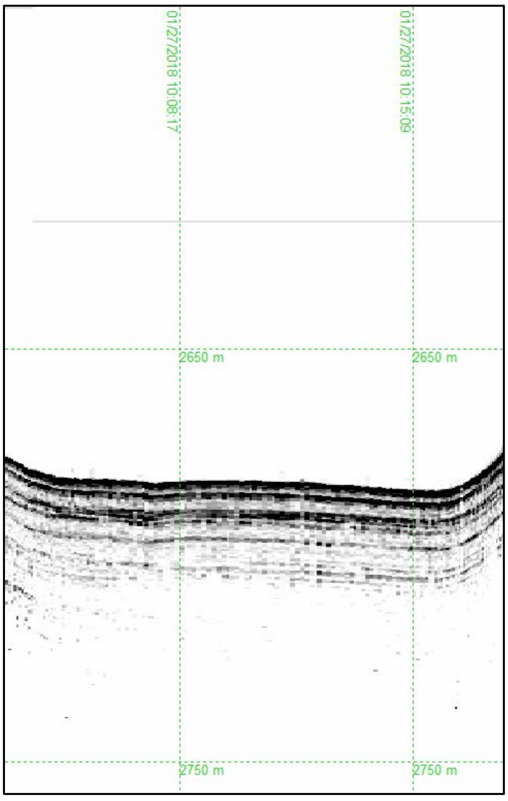


Figure 6-2-10: SBP image of Line SV28th06- SV25th07

0127_SV28th07- SV25th08

W E

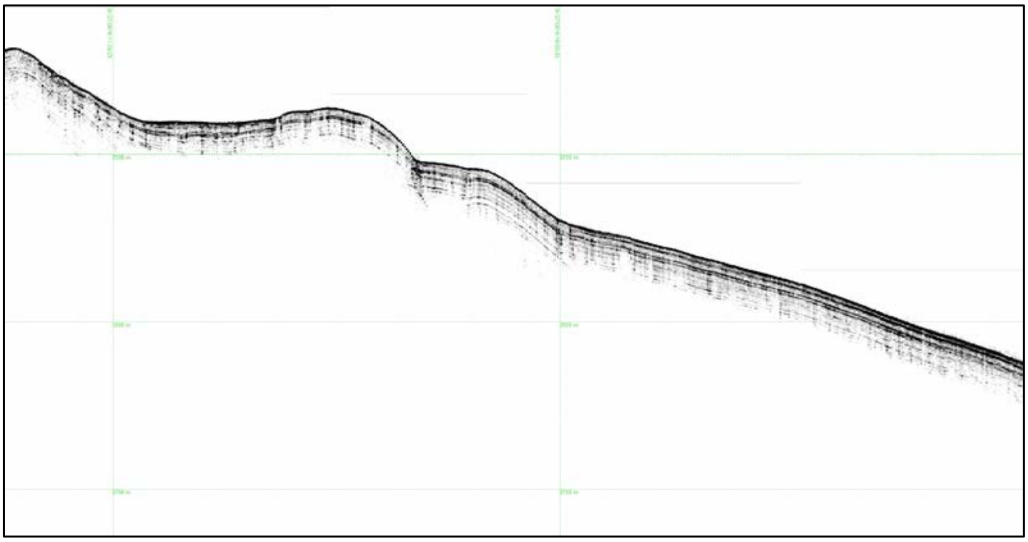


Figure 6-2-11: SBP image of Line SV28th07- SV25th08

0127_SV28th09- SV25th11

N S

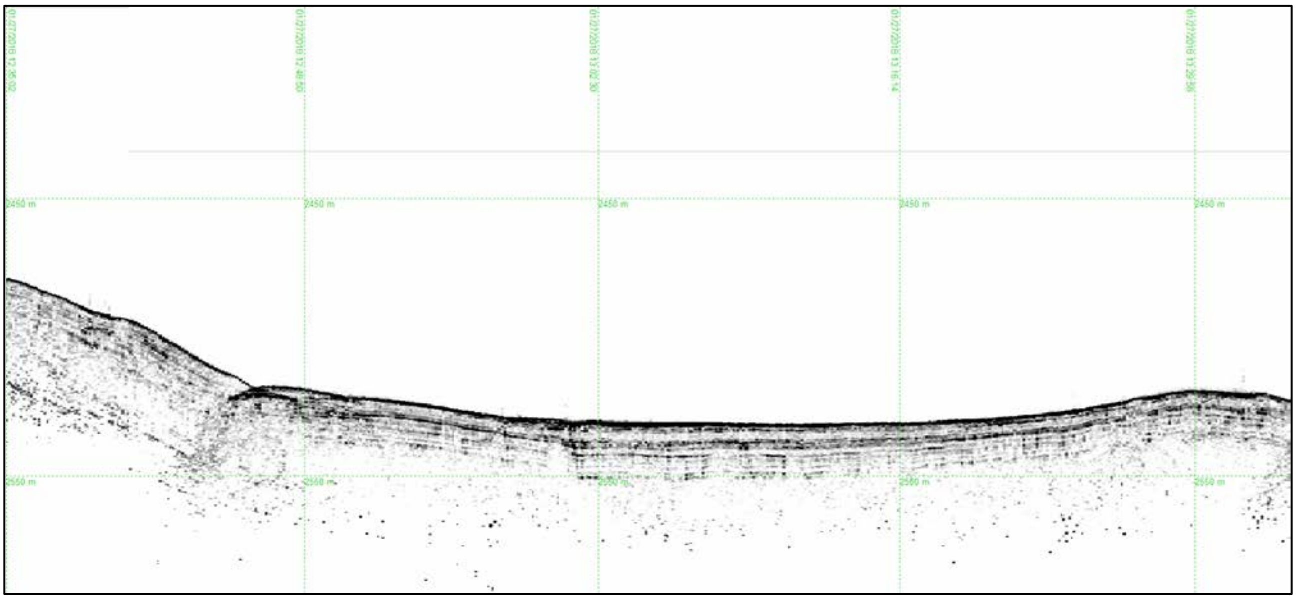


Figure 6-2-12: SBP image of Line SV28th09- SV25th11

0128_msw12n- msw12s_1

NNW SSE

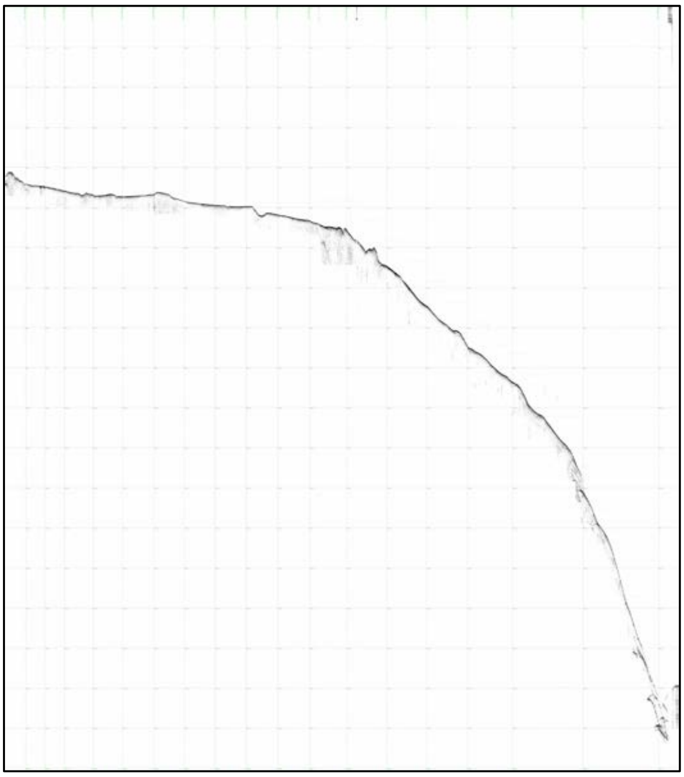


Figure 6-2-13: SBP image of Line msw12n- msw12s_1

0128_msw12n- msw12s_2

NNW SSE

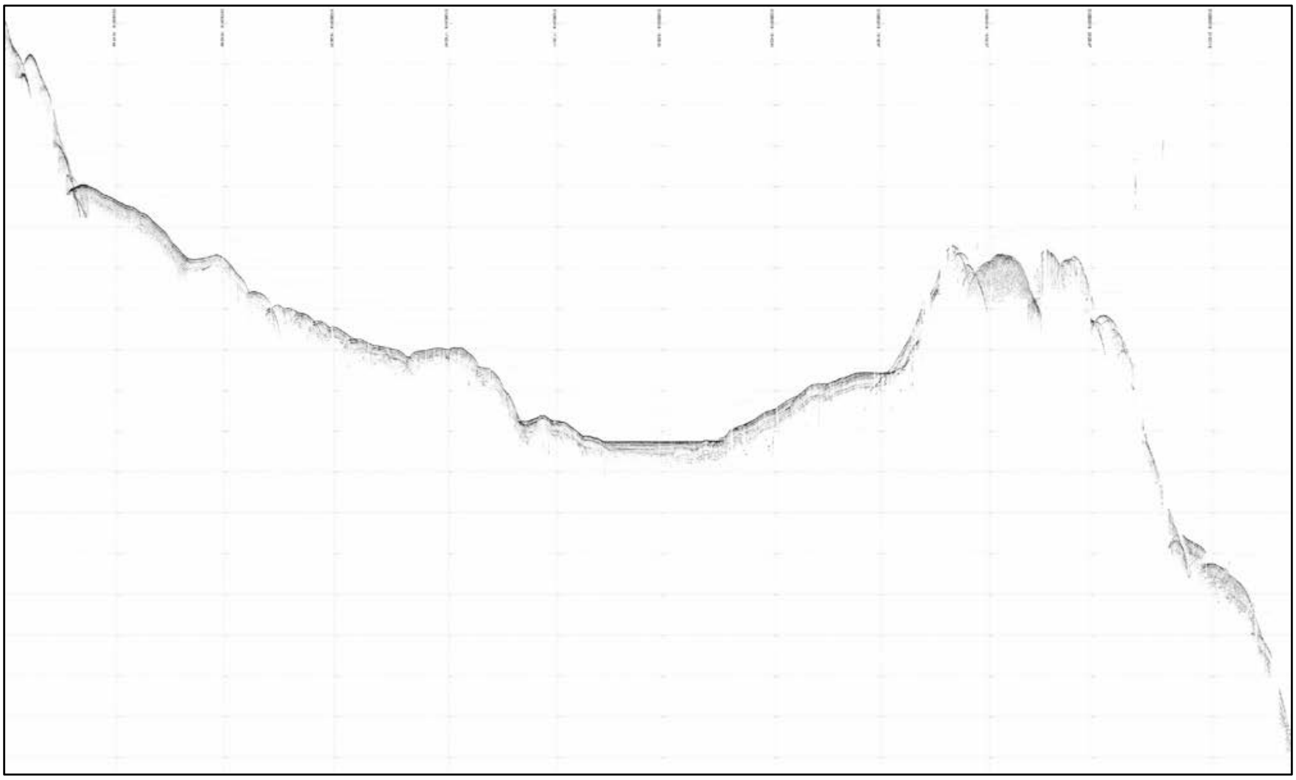


Figure 6-2-14: SBP image of Line msw12n- msw12s_2

0128_SV10-SV09_1

WSW ENE

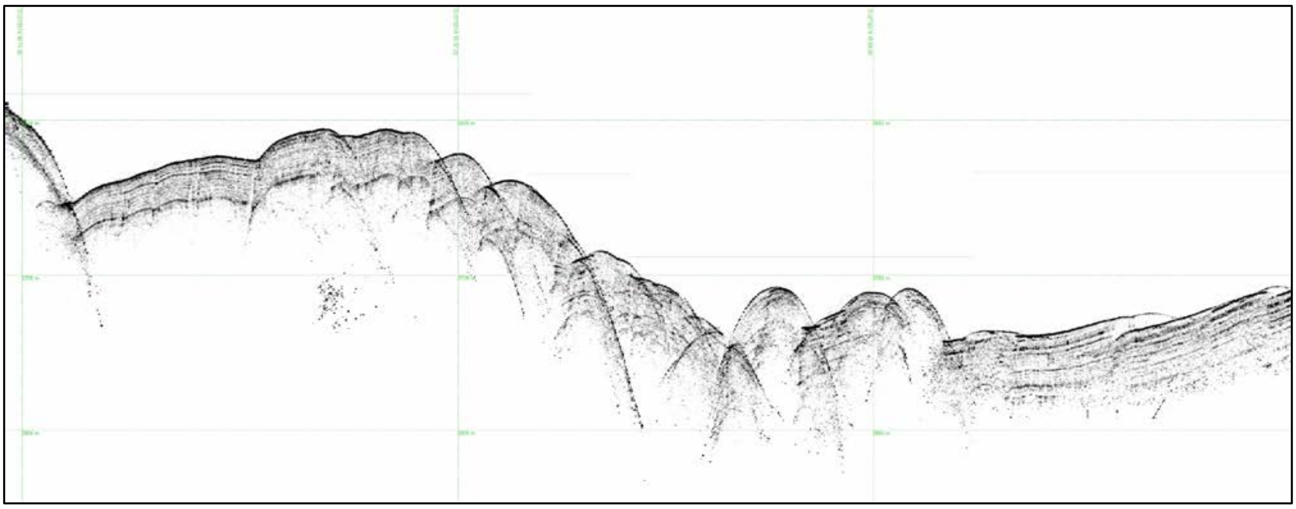


Figure 6-2-15: SBP image of Line SV10-SV09_1

0128_SV10-SV09_2

WSW ENE

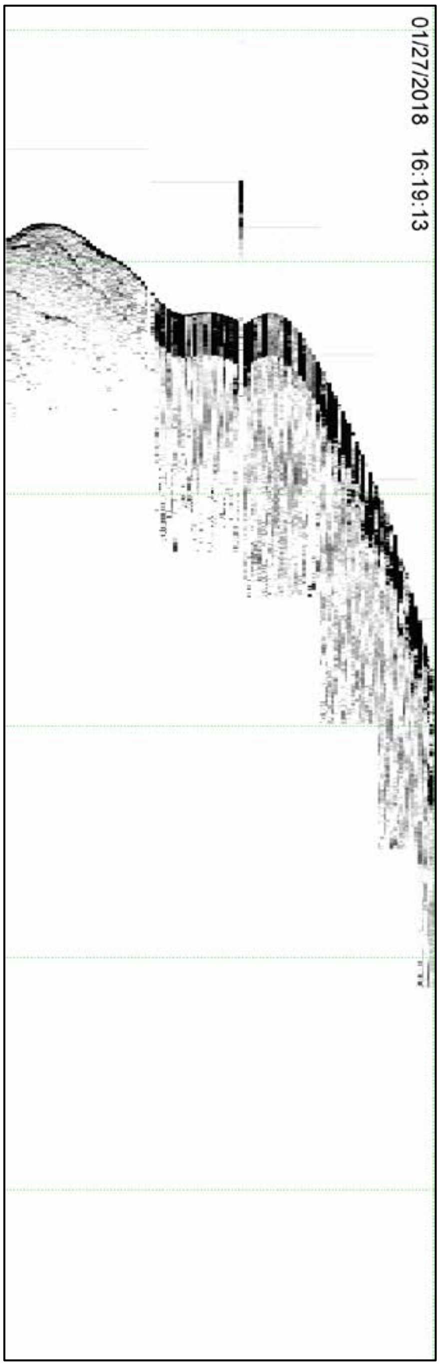


Figure 6-2-16: SBP image of SV10-SV09_2

0128_SV10-SV09_3

WSW ENE

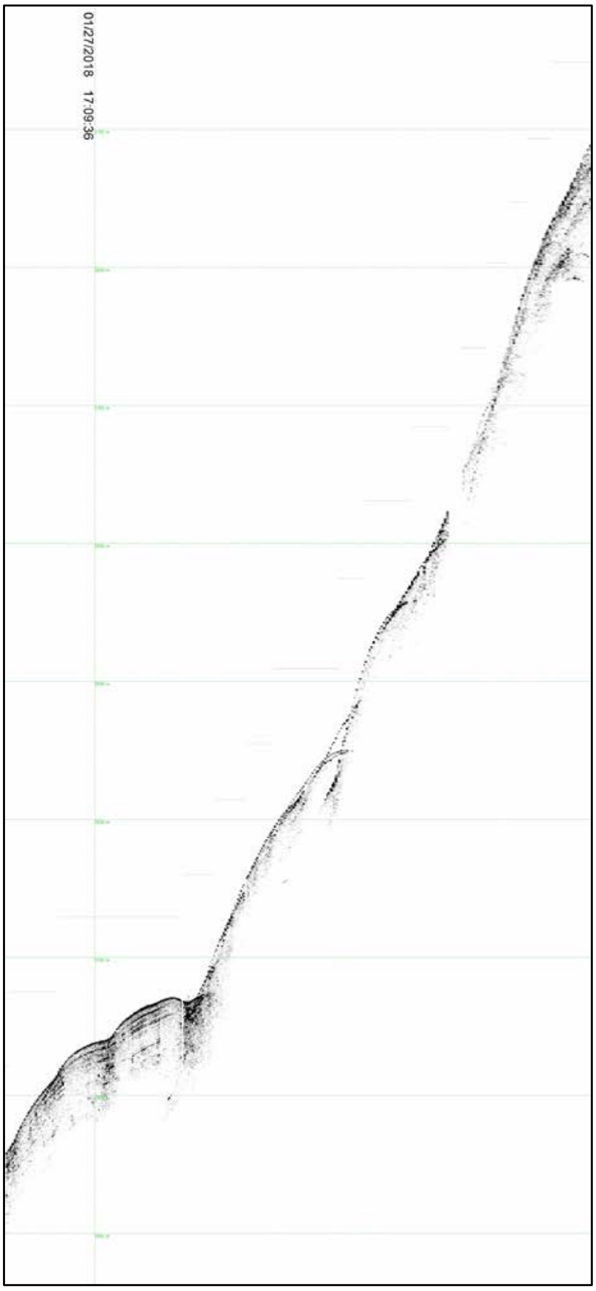


Figure 6-2-17: SBP image of Line SV10-SV09_3

0128_SVpc5a-SVpc5c

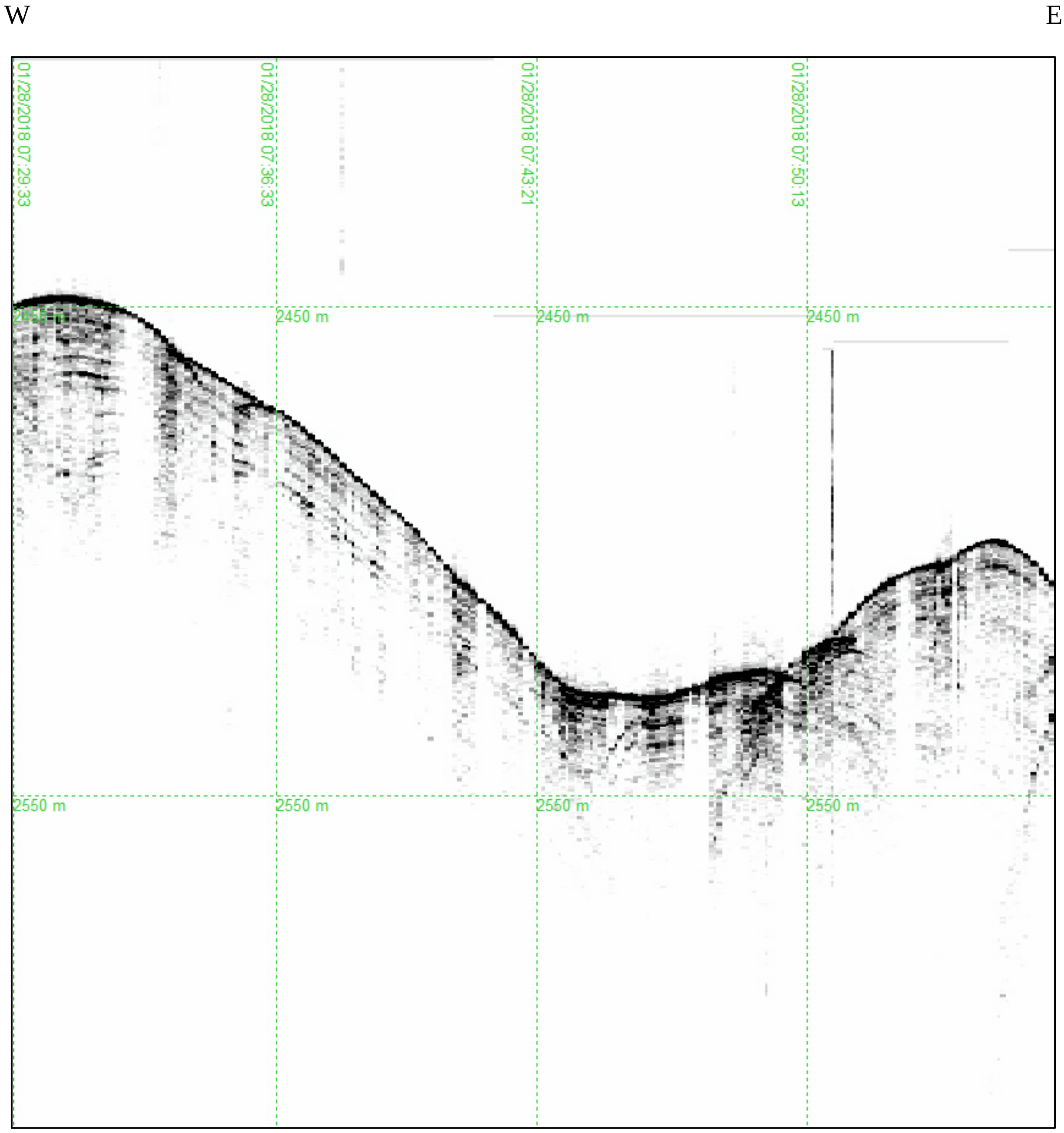


Figure 6-2-18: SBP image of Line _SVpc5a-SVpc5c

0129_msw6s-msw6n

NNW SSE

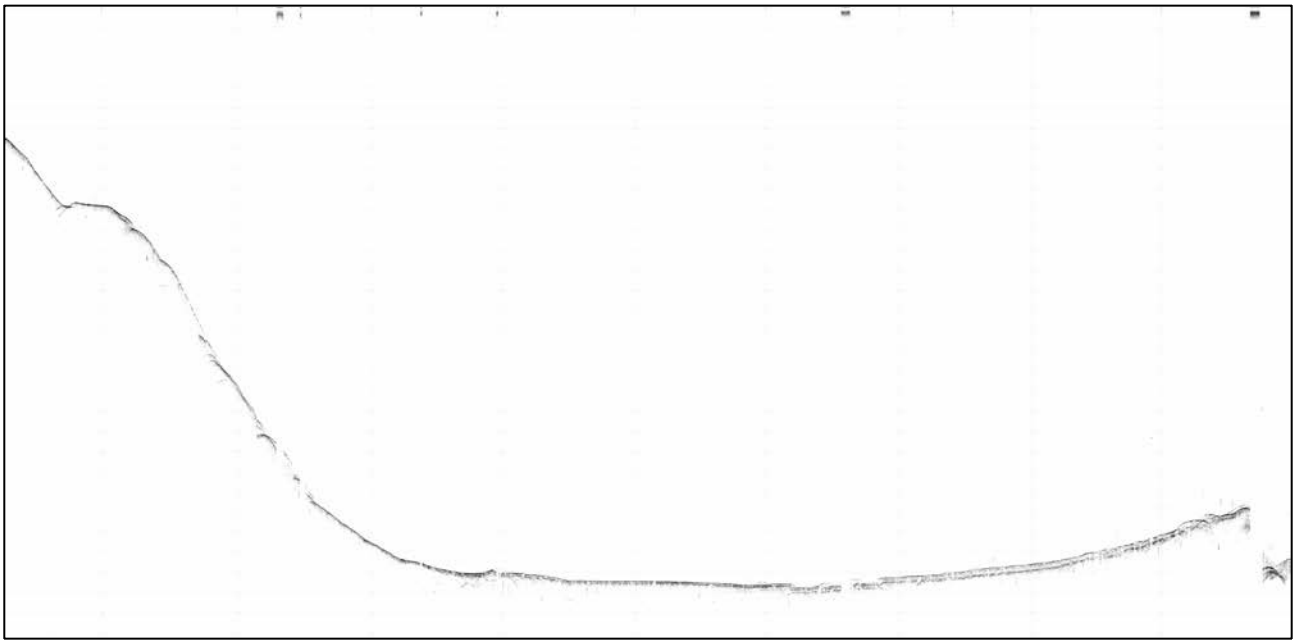


Figure 6-2-19: SBP image of Line msw6s-msw6n

0129_msw7s-msw7n

NNW SSE

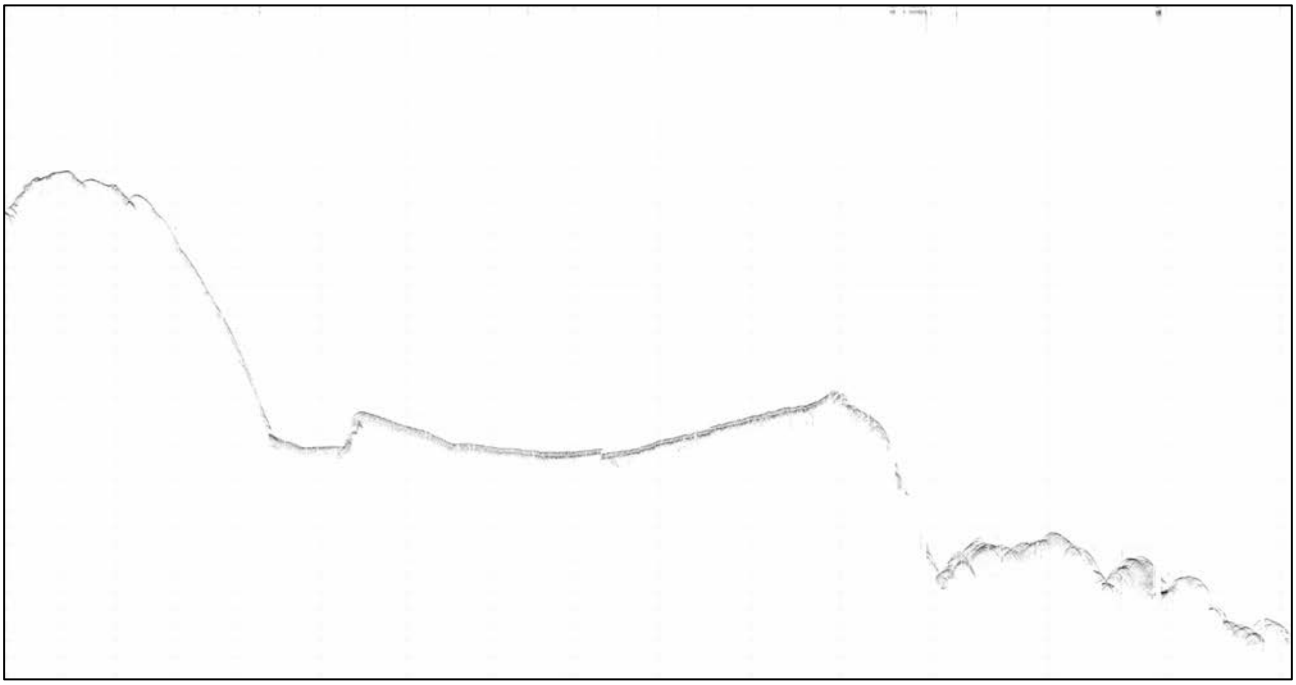


Figure 6-2-20: SBP image of msw7s-msw7n

0130_SV05-SV06

W E

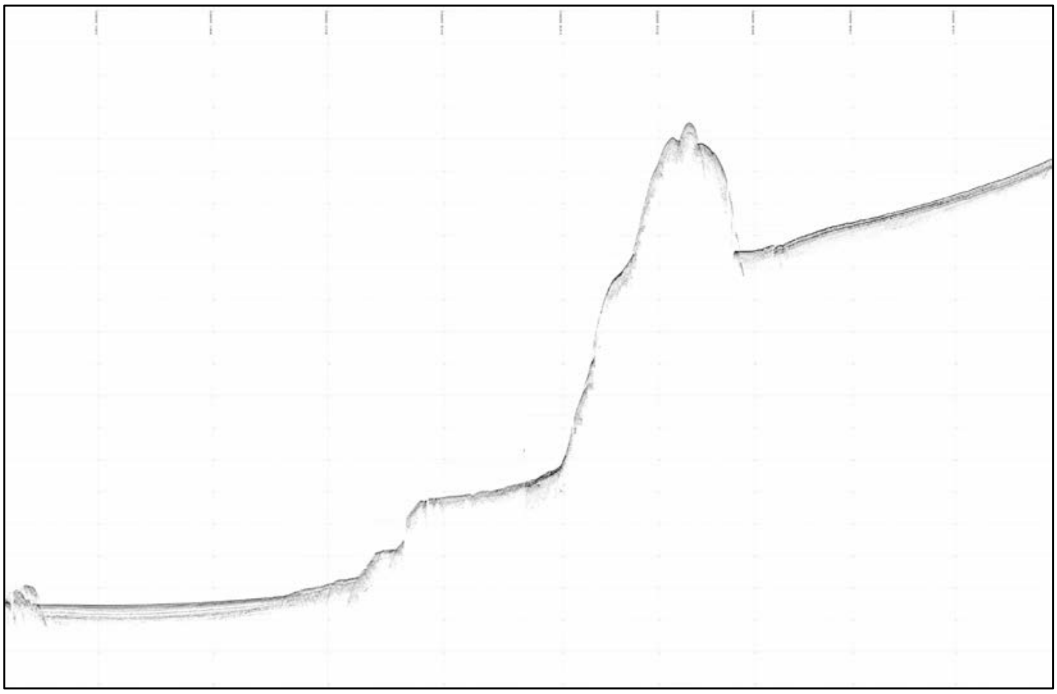


Figure 6-2-21: SBP image of SV05-SV06

0130_SV07-SV08

W E

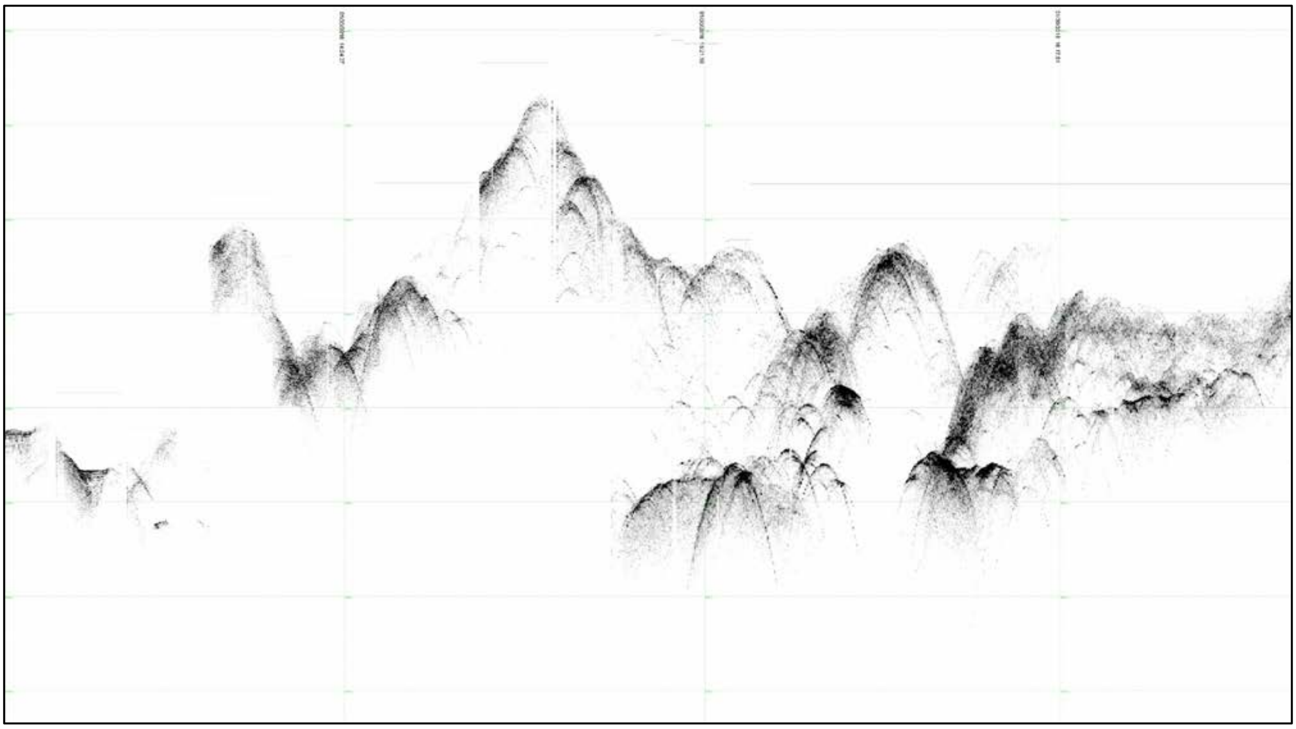


Figure 6-2-22: SBP image of SV07-SV08

0130_SV33-SV34

W E

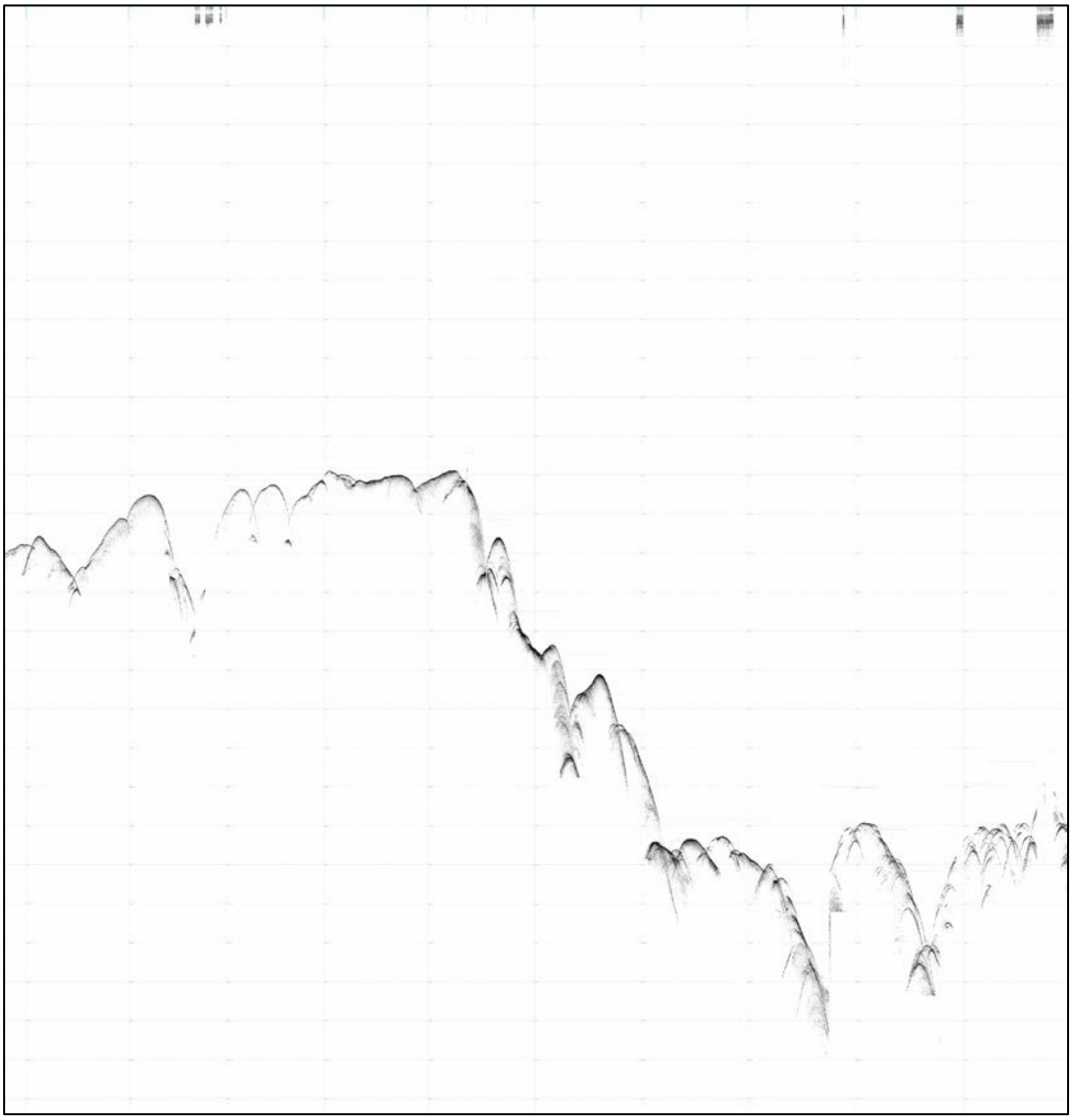


Figure 6-2-23: SBP image of SV33-SV34

0131_msw3n-msw3s

NNW SSE

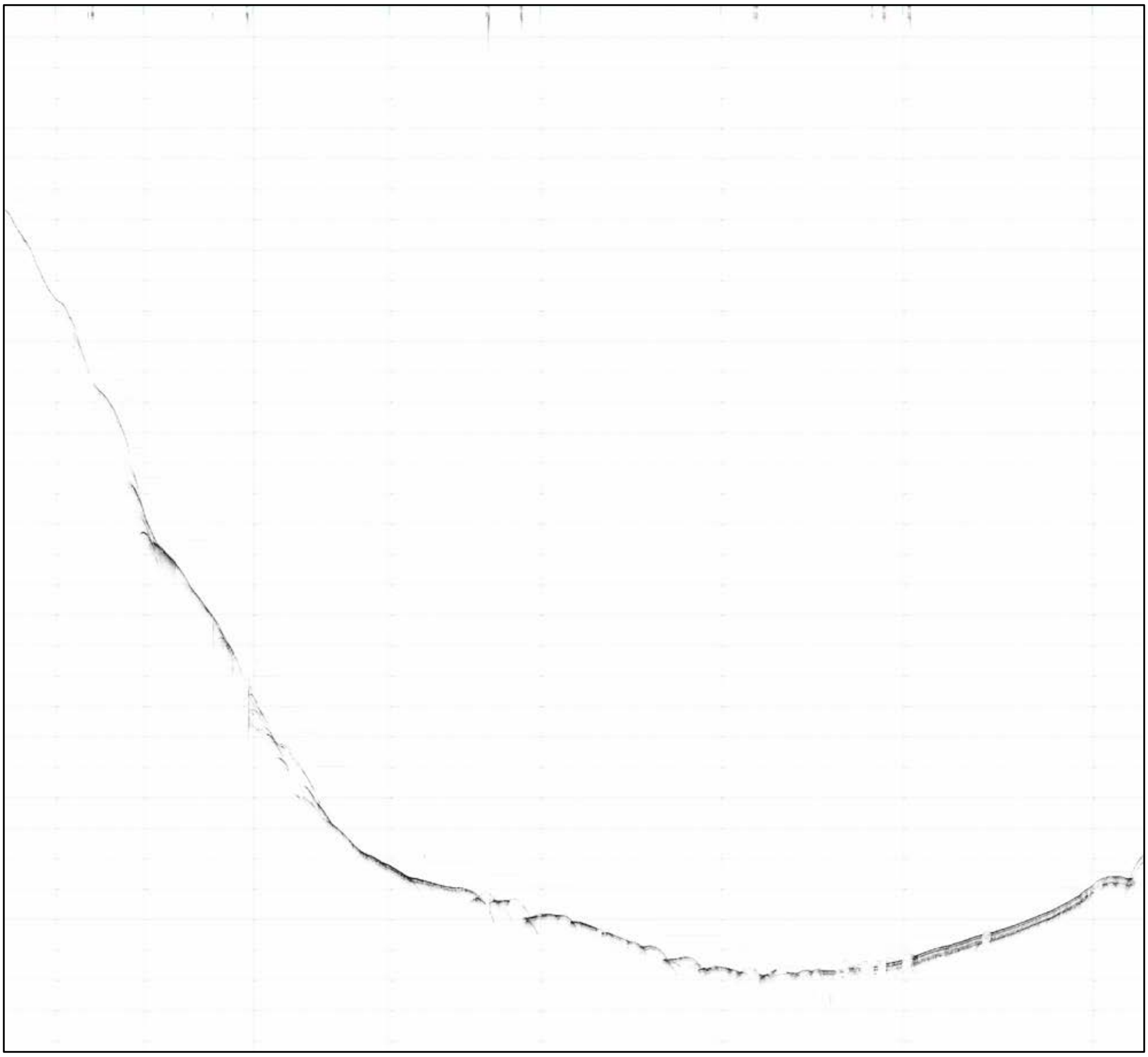


Figure 6-2-24: SBP image of msw3n-msw3s

0131_SV17-SV17.5

SW NE

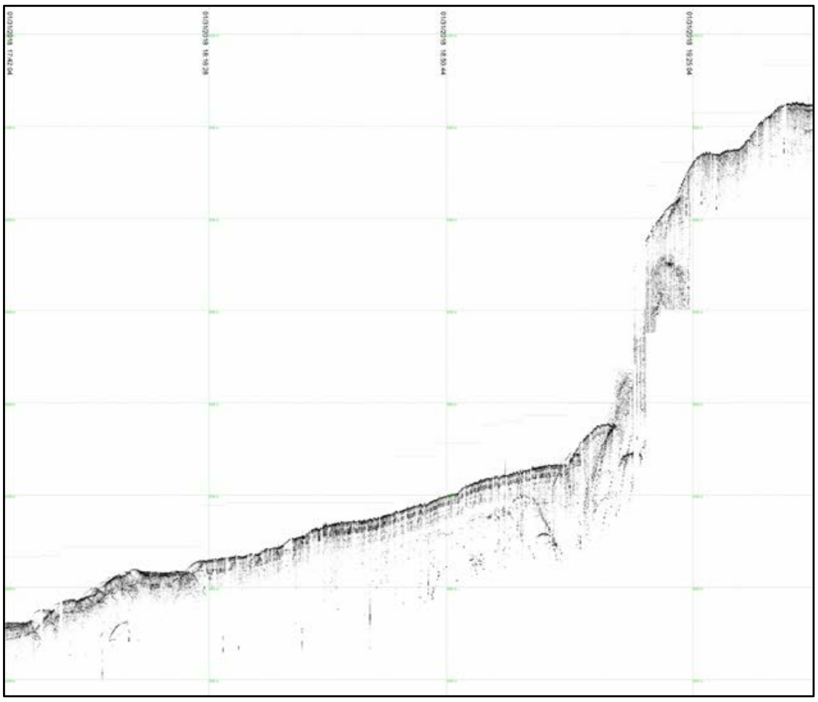


Figure 6-2-25: SBP image of SV17-SV17.5

0131_SV18-SV17.5

W E

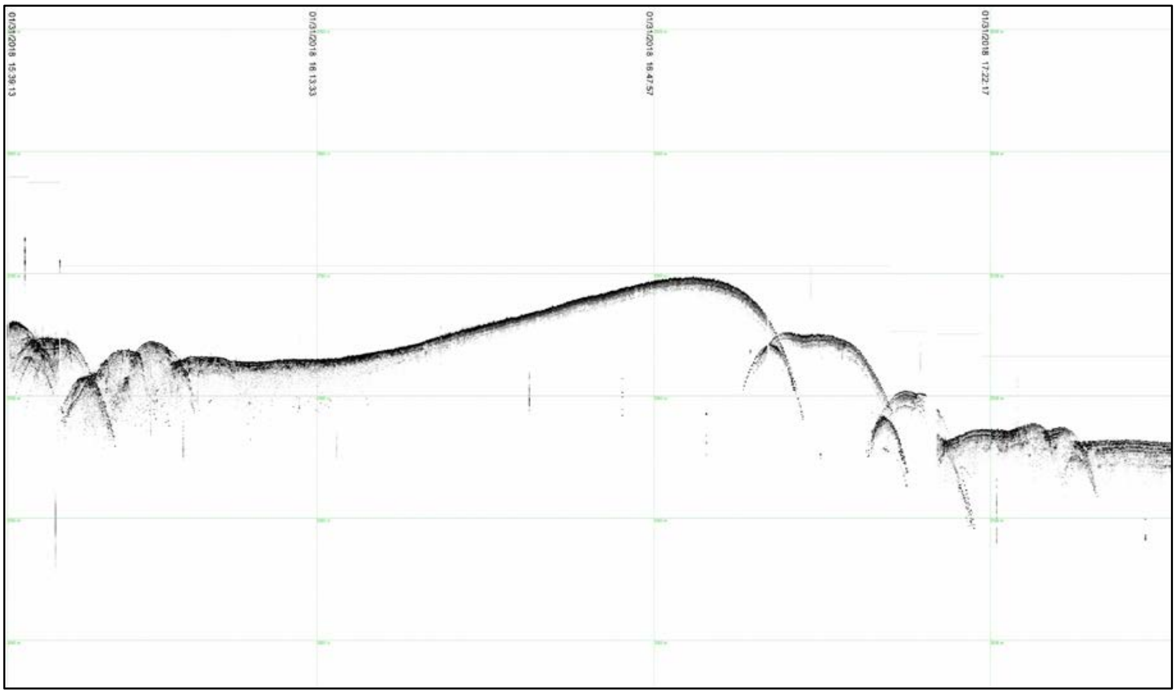


Figure 6-2-26: SBP image of SV18-SV17.5

0131_SV35-SV36

W E

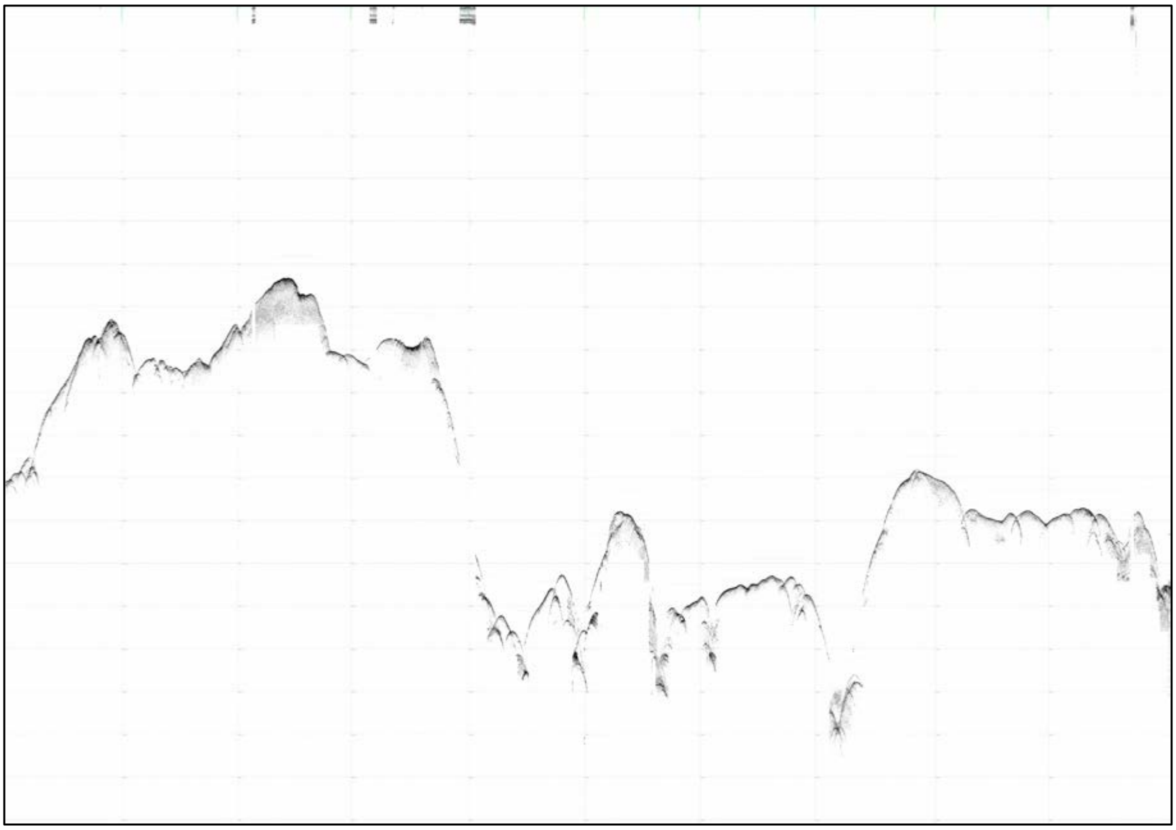


Figure 6-2-27: SBP image of SV35-SV36

0201_msw13n-msw13s

NNW SSE

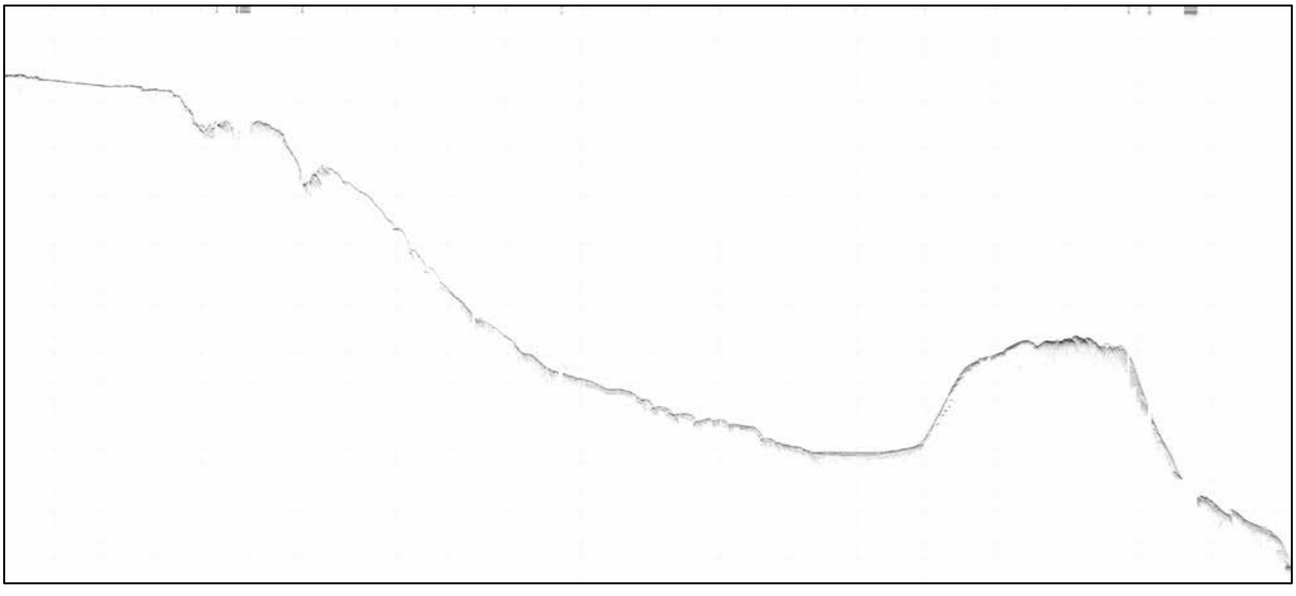


Figure 6-2-28: SBP image of msw13n-msw13s

0201_SV40-SV41

WSW ENE

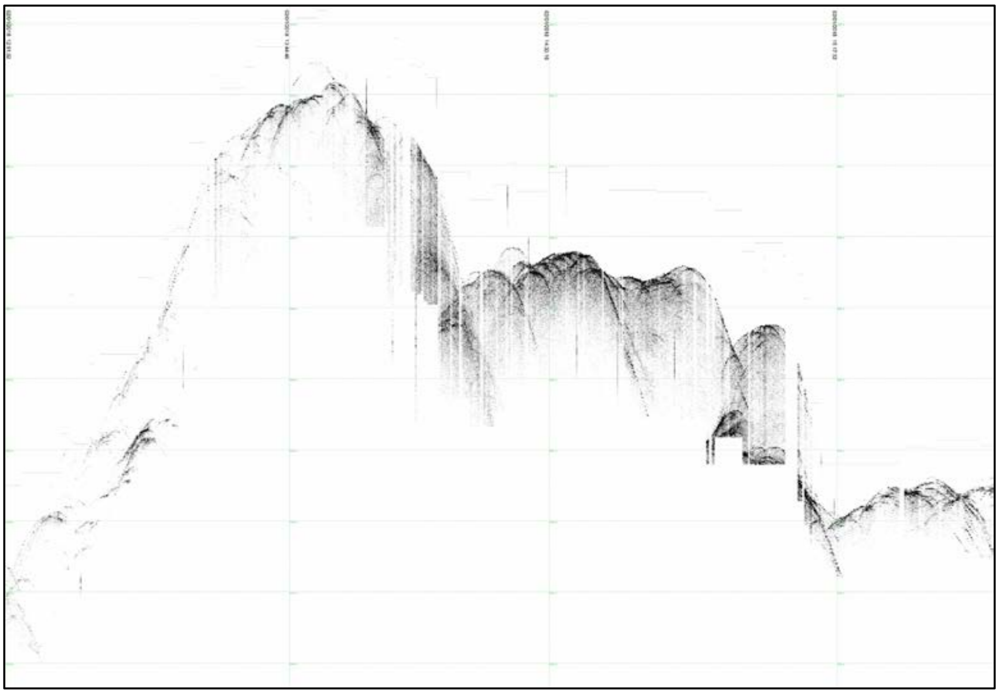


Figure 6-2-29: SBP image of SV40-SV41

0202_msw4.5s-msw4.5n

NNW SSE

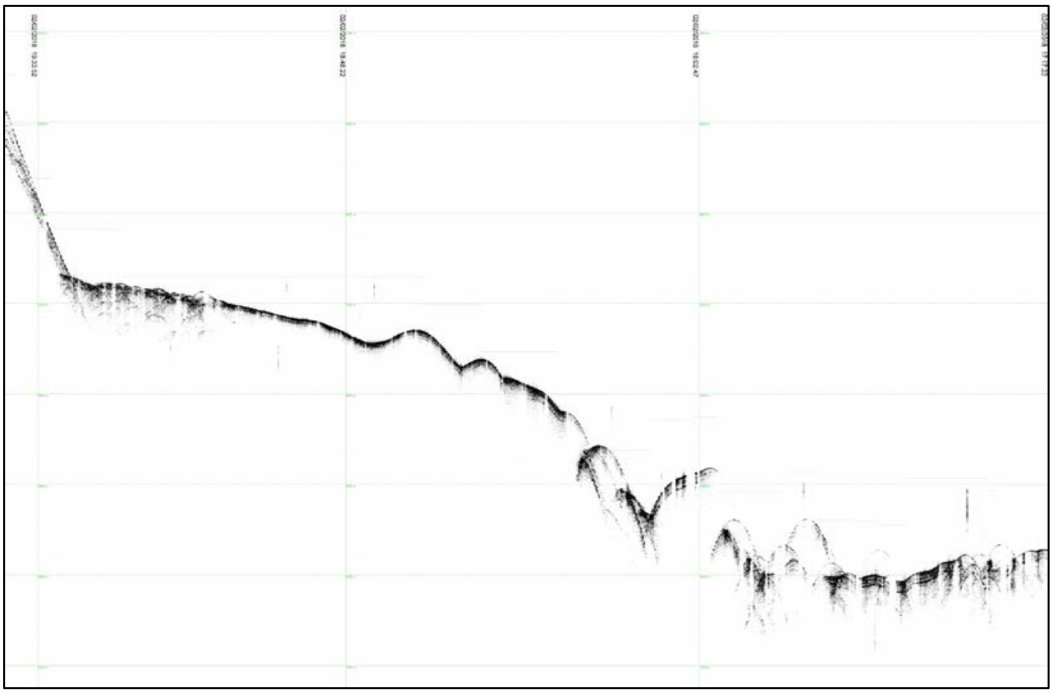


Figure 6-2-30: SBP image of msw4.5s-msw4.5n

0202_msw5n-msw5s

NNW SSE

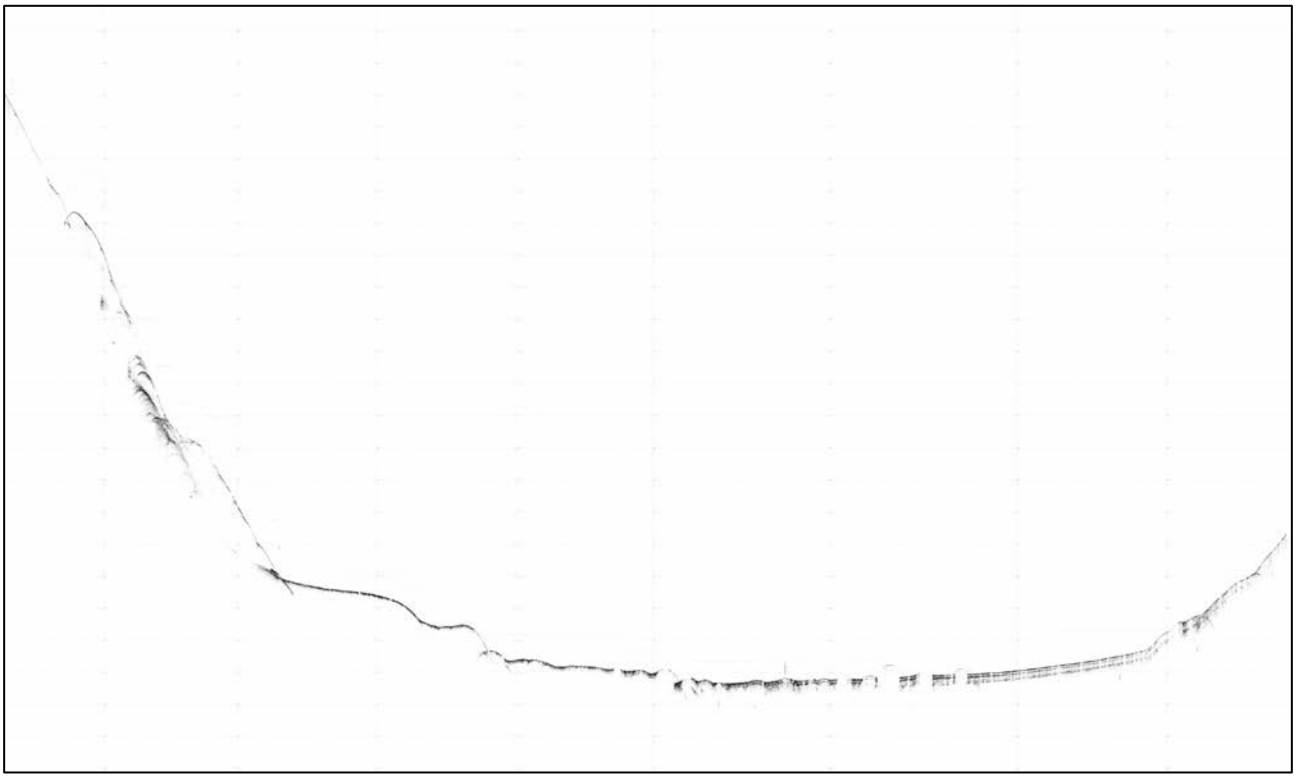


Figure 6-2-31: SBP image of msw5n-msw5s

0203_msw18s-msw18n

NNW SSE

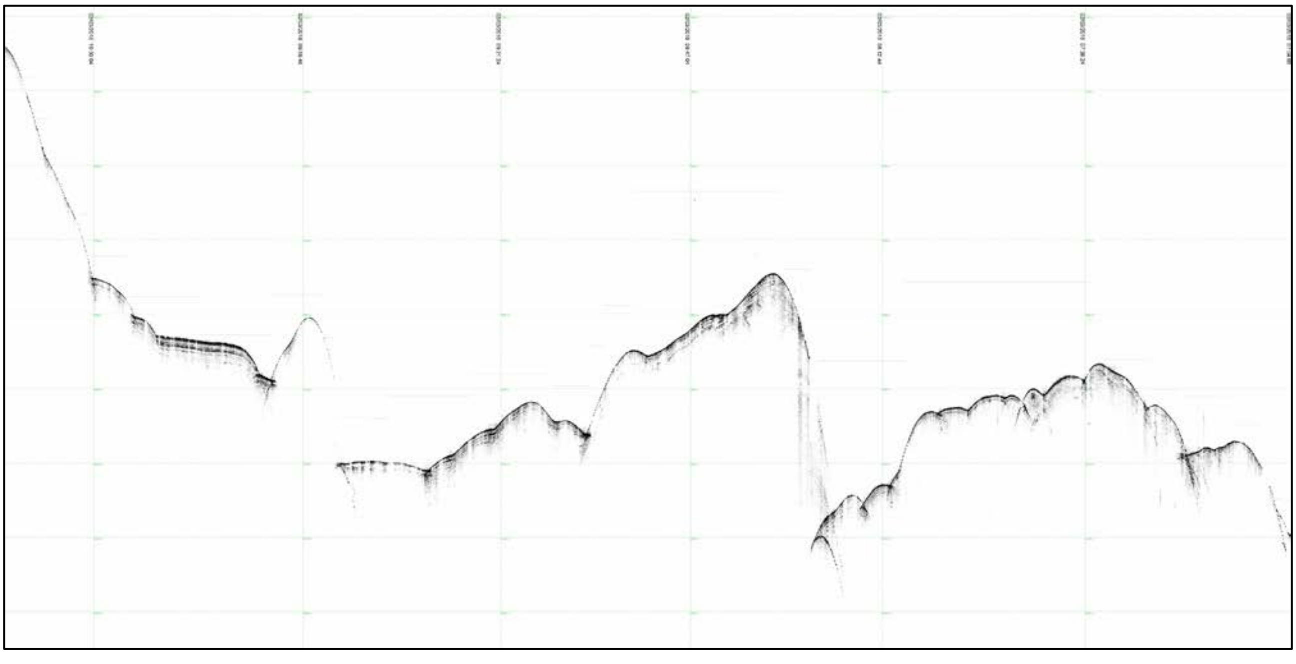


Figure 6-2-32: SBP image of msw18s-msw18n

0203_msw17n-msw17s

NNW SSE

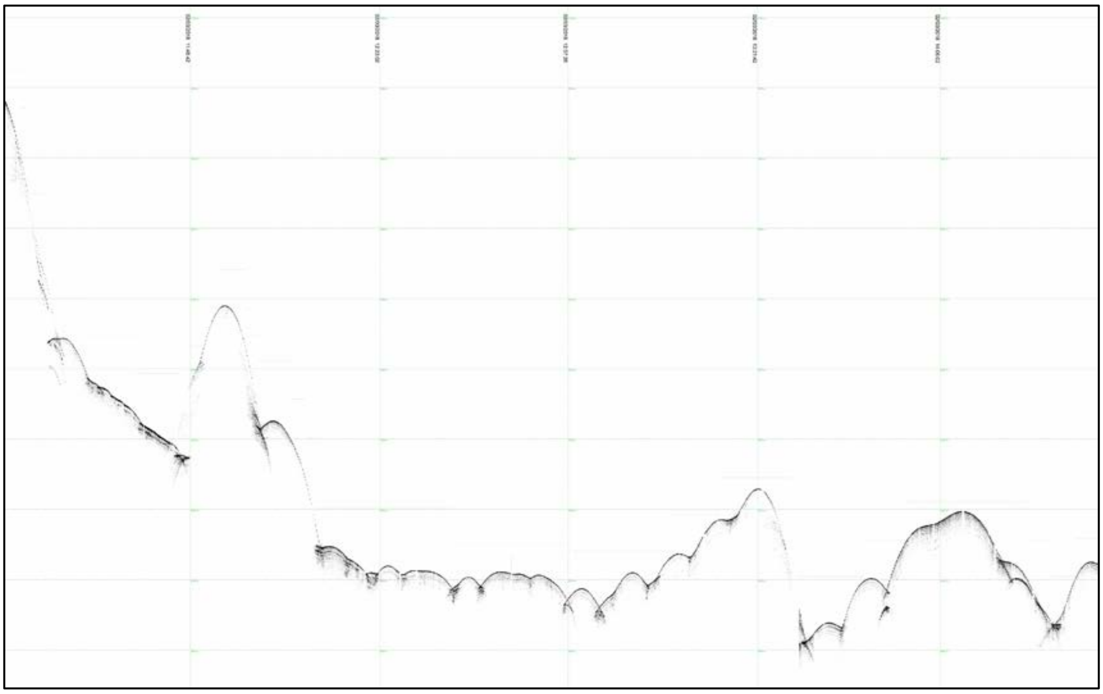


Figure 6-2-33: SBP image of msw17n-msw17s

0203_msw16s-msw16n

NNW SSE

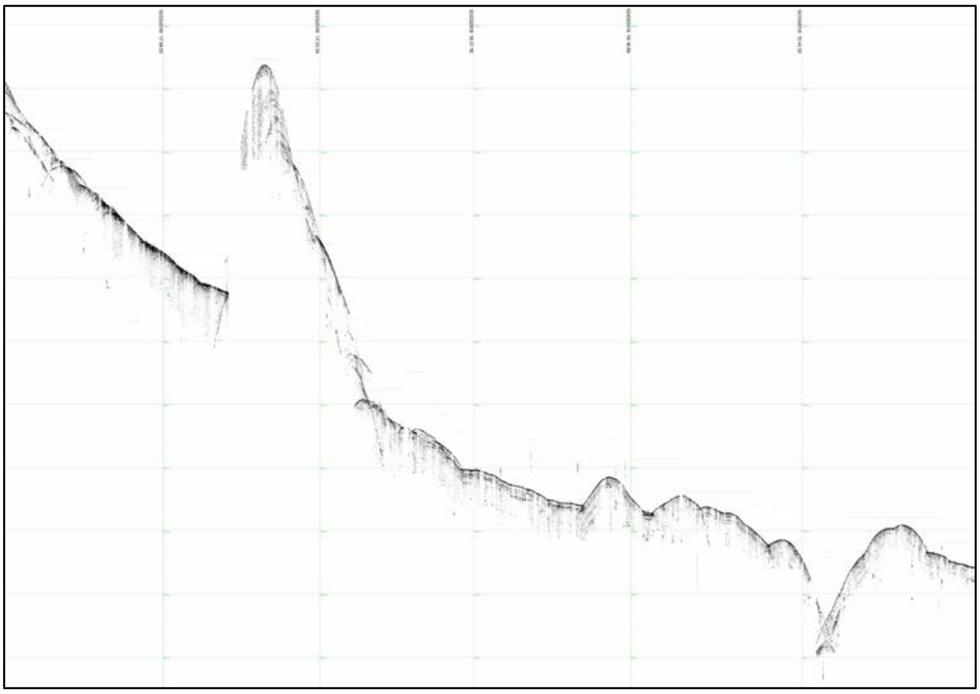


Figure 6-2-34: SBP image of msw16s-msw16n

0203_SV04-SV03

WSW ENE

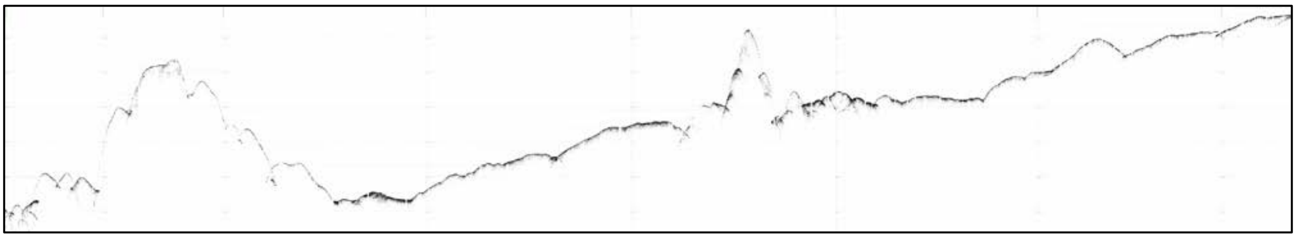


Figure 6-2-35: SBP image of SV04-SV03

6-3. Sea surface gravity

Introduction

The gravity is an important parameter to estimate the density structure of the sub-seafloor. We collected gravity data at the sea surface during the MR18-01c cruise from 22th JAN 2018 to 5th FEB 2018.

Parameters

Relative Gravity [CU: Counter Unit] [mGal] = (coef1: 0.9946) * [CU]

Data Acquisition

We measured relative gravity value using LaCoste and Romberg air-sea gravity meter S-116 (Micro-g LaCoste, LLC). The gravimeter is installed on Gravity meter room (4.8m from the base line). Sampling rate is 1 sec and QC gravity is filtered by 120 sec Exact Blackman filter. To convert the relative gravity value to absolute one, we used 979729.79.12 mGal as the absolute gravity, which is measured at Shimizu in 21 JAN 2018.

Preliminary Results

Absolute gravity shown in **Table 6-3-1**.

Table 6-3-1. List of absolute gravity value

No	Date	UTC	Port	Absolute Gravity (mGal)	Sea Level (cm)	Draft (cm)	Gravity at Sensor*1 (mGal)	L&R Gravity*2 (mGal)
#01	2018/1/21	22:49	Shimizu	979729.01	172	640	979729.79	12011.93
#02	2018/2/12	1:12	Shimizu	979729.58	231	620	979730.49	12013.88

*1: Gravity at Sensor = Absolute Gravity + Sea Level*0.3086/100 + (Draft-530)/100*0.2222
*2: LaCoste and Romberg air-sea gravity meter S-116

Data Archives

Surface gravity data obtained during this cruise will be submitted to the Data Management Group (DMG) in JAMSTEC, after the expiration of the data.

6-4. Three-component magnetometer

Introduction

Magnetic anomaly field caused by crustal magnetization is key to understand structures of crust. The magnetic anomaly field can be obtained from geomagnetic field observations. During the R/V *MIRAI* MR18-01c cruise from 22th JAN 2018 to 5th FEB 2018, we measured geomagnetic field using a three-component magnetometer.

Data acquisition

An SFG1214 shipboard three-component magnetometer system (Tierra Tecnica) is equipped on-board R/V *MIRAI*. Three-axes flux-gate sensors with ring-cored coils are fixed on the fore mast. Outputs from the sensors are digitized by a 20-bit A/D converter (1nT/LSB) and sampled at 8 times per second. Heading, pitch, and roll of the ship are measured by the Inertial Navigation System for controlling attitude of a Doppler radar. Position and speed of the ship are taken from LAN every second to the

SFG1214 system.

Figure-eight turn

In order to correct the magnetic field due to the magnetization of ship, we made a “figure-eight” turn observations (a pair of clockwise and anti-clockwise rotation). These observations were carried out as follows (see appendix for tracks).

1st: 26th Jan. 2018, 07:06 – 07:28 UTC around at 24-05.10N, 124-24.27E
2nd: 30th Jan. 2018, 18:20 – 18:41 UTC around at 23-51.60N, 123-38.50E
3rd: 2rd Feb. 2018, 05:13 – 05:40 UTC around at 23-54.68N, 124-49.96E

Principle of ship-board geomagnetic vector measurement

The relationship between a magnetic-field vector observed on-board H_{ob} (in the ship's fixed coordinate system) and the geomagnetic field vector F (in the Earth's fixed coordinate system) is expressed as:

H_{ob} = A R P Y F + H_p, (1)

where R, P, and Y are the matrices of rotation due to roll, pitch and heading of a ship, respectively. A is a 3 x 3 matrix which represents magnetic susceptibility of the ship, and H_p is a magnetic field vector produced by a permanent magnetic moment of the ship's body. Rearrangement of Equation (1) makes

R H_{ob} + H_{bp} = R P Y F, (2)

where R = A-1, and H_{bp} = -R H_p. The F can be obtained by measuring R, P, Y and H_{ob}, if R and H_{bp} are known. Twelve constants in R and H_{bp} can be determined by measuring variation of H_{ob} with R, P and Y at a place where the F is known.

Data Archives

Surface gravity data obtained during this cruise will be submitted to the Data Management Group (DMG) in JAMSTEC, after the expiration of the data.

6-5. PC and MC operation

Records of PC and MC coring operations are summarized in **Tables 6-5-1, and 6-5-2**. Graphical tension records of wire winch during the operations are attached to the APPENDIX. Coring positions were measured by a transponder “OKI SB-1018 (S/N 08209)”. K values (see **5-4-2**) are calculated to estimate strength barometer of the sea bed sediment.

Table 6-5-1. Summary of PC operation during MR18-01C

Date (UTC)	Core ID	Water depth (m)	Position		Core Length/Pipe		Winch wire Tension Max(ton)	K
			Latitude	Longitude	PC	PL		
20180127	PC01	2,190	24-04.5998N	124-23.6320E	0.00	0.05	3.2	-
20180127	PC02	2,239	24-04.5882N	124-27.6599E	2.56	0.09	3.3	0.27
20180128	PC03	2,229	24-04.5826N	124-25.8288E	2.55	0.08	3.3	0.28

20180128	PC04	2,533	23-48.0456N	124-27.8484E	4.71	0.00	4.0	0.23
20180130	PC05	2,531	23-51.2605N	124-27.0450E	3.53	0.20	3.4	0.09
20180203	PC06	2,848	23-54.0114N	124-13.8548E	5.06	0.19	3.8	0.07

Corer: Inner tube PC (480kg weight)

** "K value" is the strength barometer of the sea floor sediment

Table 6-5-2. Summary of MC operation during MR18-01C.

Date (UTC)	Core ID	Water depth (m)	Position		Core Length/Pipe		Winch wire Tension Max(ton)
			Latitude	Longitude	PC	PL	
2018/02/02	MC01	2,229	24-04.5800N	124-25.8231E	HND2	26.5	3.2
					HND3	26.0	
					HND6	26.0	
					HND7	26.0	
2018/02/02	MC02	2,532	23-48.0425N	124-27.8573E	HND2	19.5	3.3
					HND3	20.0	
					HND6	20.0	
					HND7	18.5	
2018/02/02	MC03	2,529	23-51.2567N	124-27.0376E	HND2	19.5	3.3
					HND3	20.0	
					HND6	20.0	
					HND7	18.5	

6-6. Lithology of piston cores

Sediment lithology of the obtained piston, pilot gravity and multiple cores are summarized as **Figs. 6-6-1** and **6-6-2**. Core length of each core section on the visual description sheet is summarized in **Table 6-6-1**. We use the core length from **Table 6-6-1** for the core summary in this section. Detailed visual description is available in Appendix. Based on the lithological characteristics, three major depositional areas are recognized; the mid slope terrace (Sts. PC01, PC02 and PC03), the terminal canyon basin (Sts. PC04 and PC05), and the forearc basin (St. PC06). Sediment lithology of each area are summarized as below.

The mid slope terrace

We obtained two piston cores with three pilot gravity cores from three sites on a terrace at mid slope, south of Ishigaki-jima Island. A multiple core sample was recovered from a piston core site (PC03). Two canyons join at the terrace. Three major acoustic facies are recognized in the SBP profiles. Three coring sites were selected for typical location of each acoustic facies.

PL01: No piston core sediment was recovered. Only a 9.2 cm long pilot gravity core (PL01) was obtained from weakly stratified acoustic facies with hyperbolic surface reflector. The core composed of brownish calcareous silt with bioturbation.

PC02 & PL02: A piston core (PC02: 255.9 cm long) with a short pilot gravity core (PL02: 5 cm) was collected from the central part of the terrace. Major lithology of the piston core was chaotic mud except of the uppermost 20 cm. Various sized mud clasts are characteristic of the chaotic mud. Some mud clasts have inclined bedding. Coarse carbonate bioclasts of coarse sand- to granule-sized occur at the top of the chaotic mud. Three thin sand layers found in the uppermost sequence. These have the upward-fining grading structure, and erosional and sharp bottom contact. The pilot gravity core was composed of brownish bioturbated silt.

PC03, PL 03 & MC01: A main piston core (PC03) with 255.3 cm long and a pilot gravity core (PL03) with 7.9 cm long was collected from the eastern part of the terrace near the eastern canyon. Lithology and stratigraphy of the main piston core was similar to those of core PC02. Chaotic mud characterized by various type of mud clasts with the uppermost alternation of thin sand layers and hemipelagic mud composed of the piston core. Thickness of the uppermost sequence is 33.5 cm, and hemipelagic silt is slightly thicker than that of core PC02. The lowermost 66 cm is flow-in. Brownish bioturbated silt composed of the pilot core. To obtain more complete surface sediment stratigrahy, a multiple core was recovered. The obtained core (MC01) was 26.2 cm long, and composed of brownish silt with bioturbation (upper 17 cm and lowermost 1.1 cm) intercalated with a 9 cm thick very fine sand layer.

The terminal canyon basin

Two piston and multiple cores were recovered from a basin at south of Ishigaki-jima Island. A major canyon from the mid slope terrace opens at the north of the basin. Finely stratified acoustic facies is characteristic in the basin. Thickness of the facies is almost the same in the basin floor but becomes thinner north- and southward.

PC04 & MC02: Only a piston core (PC04: 471.3 cm long) was collected near the southern end of the distribution of finely stratified acoustic facies. Major lithology of the piston core was bioturbated silt. A 13 cm thick sand layer occurred near the core top. Another 12.5 cm thick sand layer was recognized at the upper part of the core. A thick volcanic ash bed found near the core bottom just above the sediments with flow-in structure. The lowermost 90.8 cm is flow-in. To establish the surface sediment stratigraphy, sediment sampling using a multiple corer was conducted. Major lithology of the recovered sample (MC02) with 19.9 cm long was brownish bioturbated silt. Planktonic foraminiferal coarse silt layer occurs at the lowermost part of the core (17.6-19.9 cm interval).

PC05, PL05 & MC03: The coring site locates near the canyon mouth at the northern part of the basin. Finely stratified acoustic facies was recognized at the site. A piston core (PC05) with 353.1 cm in length and a pilot gravity core (PL05) with 20 cm in length was recovered. Major lithology of the piston core was bioturbated silt, and was almost the same as that of core PC04. Three sand layers were occurred at the upper part of the core. Lower part of the core with lighter color than upper part was slightly consolidated. Two thin sand layers were also found near the core bottom. Brownish silt with bioturbation is a major lithology of the pilot core. For the surface sediment stratigraphy, a multiple core (MC03) was recovered from the same location. The core was 19.8 cm in length. Core lithology was very similar to that of core MC02, and brownish bioturbated silt was a major lithology. Calcareous very fine sand found at the lowermost part of the core below 19.5 cm.

The forearc basin

A piston core was obtained from the eastern end of a forearc basin, south of Iriomote-jima Island. There is a horse-shoe shaped cliff in the forearc slope. The topographic feature indicates a potential of submarine landslide. To clarify the occurrence of recent submarine landslides of the slope, a piston coring was carried out at the foot-of-slope.

PC06 & PL06: A main piston core with 505.6 cm long and a pilot gravity core with 18.8 cm long was obtained from the forearc basin floor. Major lithology of both cores was bioturabted silt. A few very fine sand-coarse silt layers in the main piston core were observed. Even a very fine sand layer was found near the core top of main piston core, no sand layer near the core top of pilot gravity core. A very fine sand patch occurred near the core bottom (17.4-18.4 cm interval) of pilot gravity core.

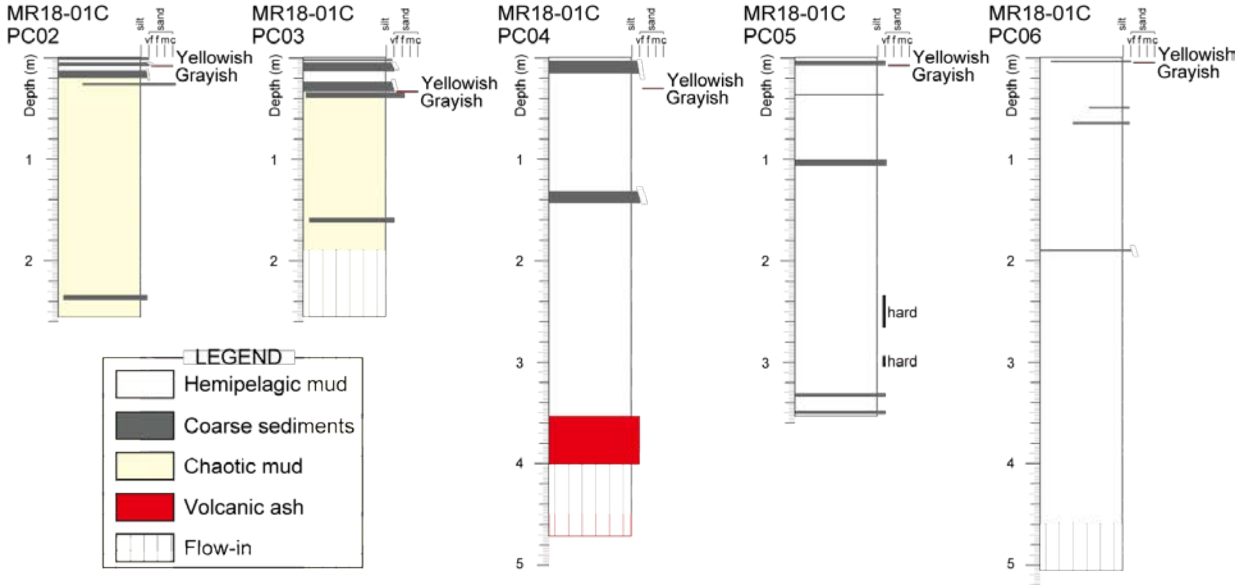


Fig. 6-6-1 Columnar section of each piston core

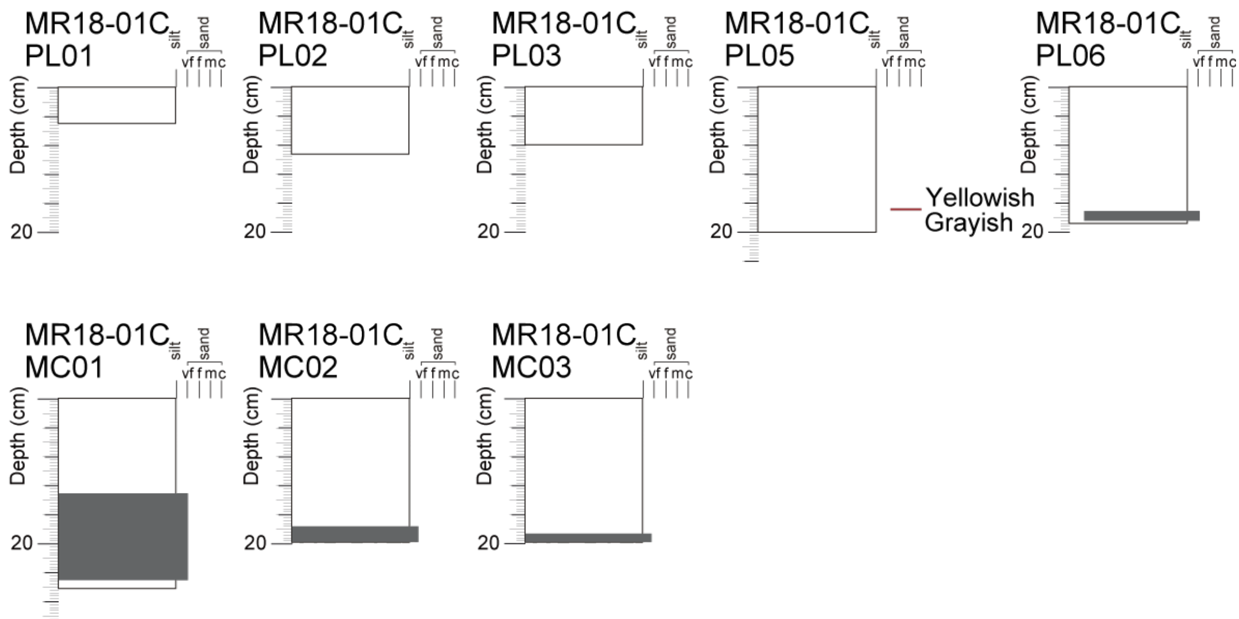


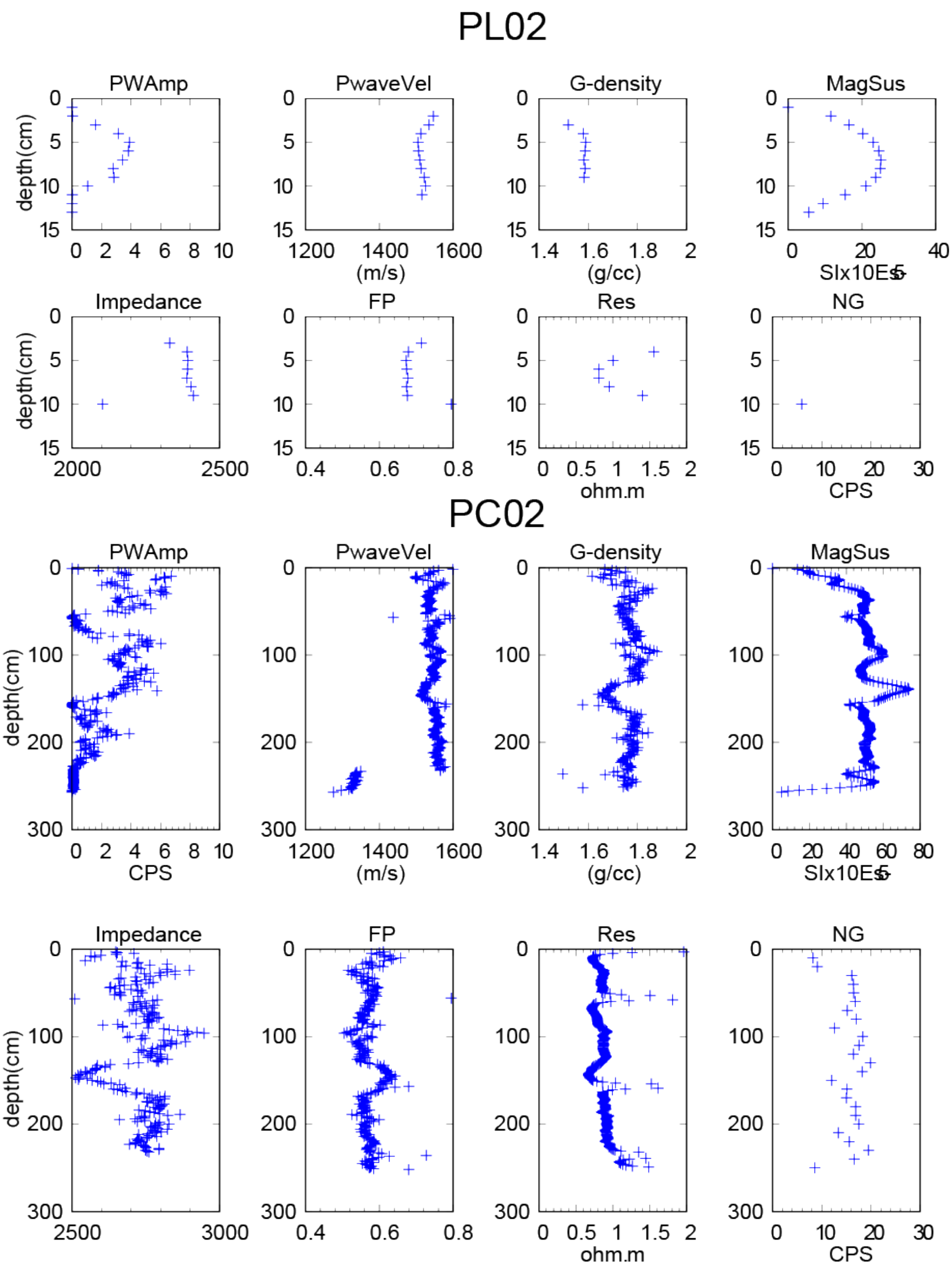
Fig. 6-6-2 Columnar section of each pilot and multiple core (Legend is the same as Fig. 6-4-1)

Table 6-6-1 Core length of each core section

Core	Sec. 1	Sec. 2	Sec. 3	Sec. 4	Sec. 5	Sec. 6	CC	Total (cm)	Remarks
	9							19.9	HAND 3

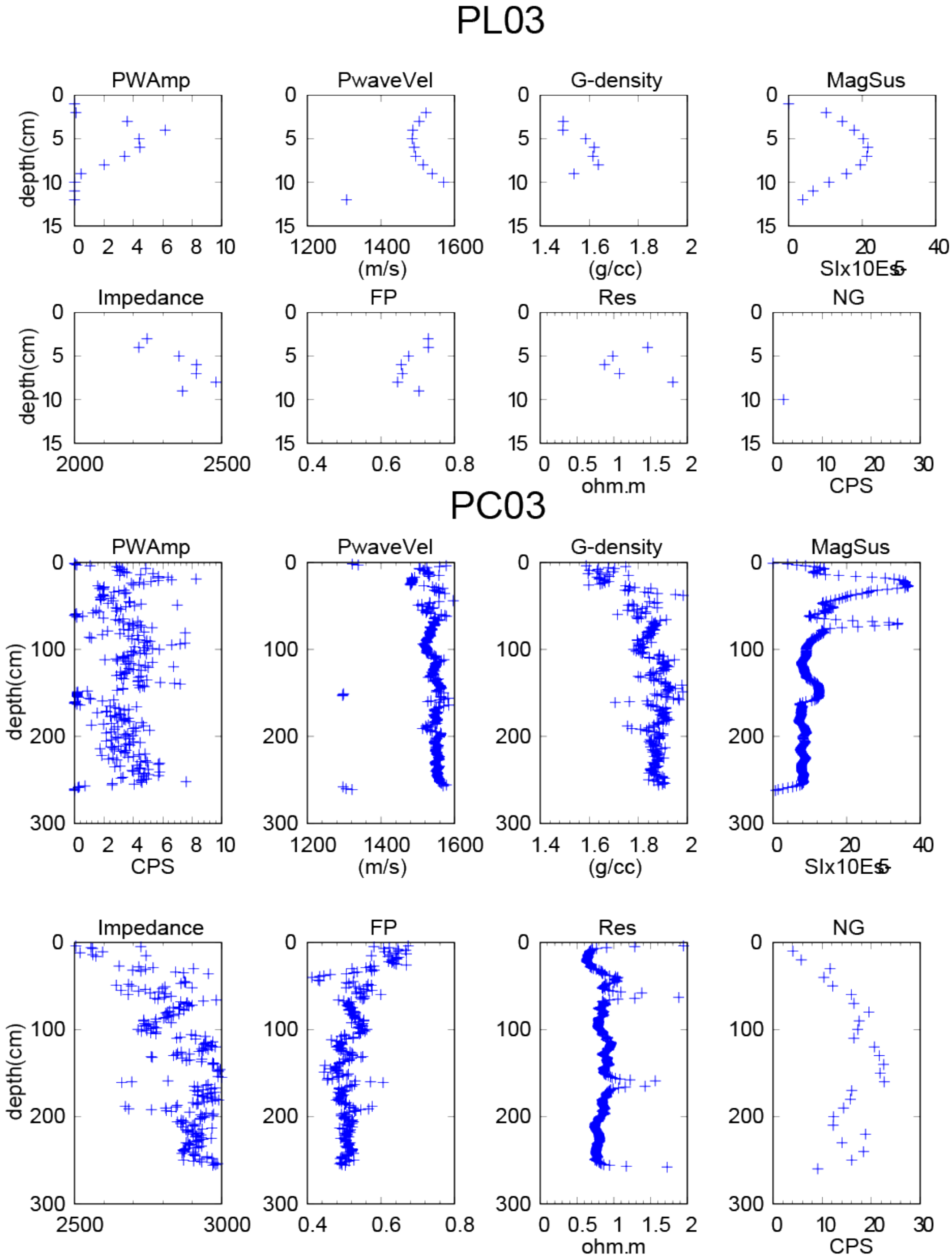
6-7. MSCL measurements

Physical properties of cores measured by MSCL are shown in following figures (from **Figures 6-7-1** to **6-7-6**). Gamma density, P-wave, resistivity, natural gamma count were calibrated using special-pieces before measurements.

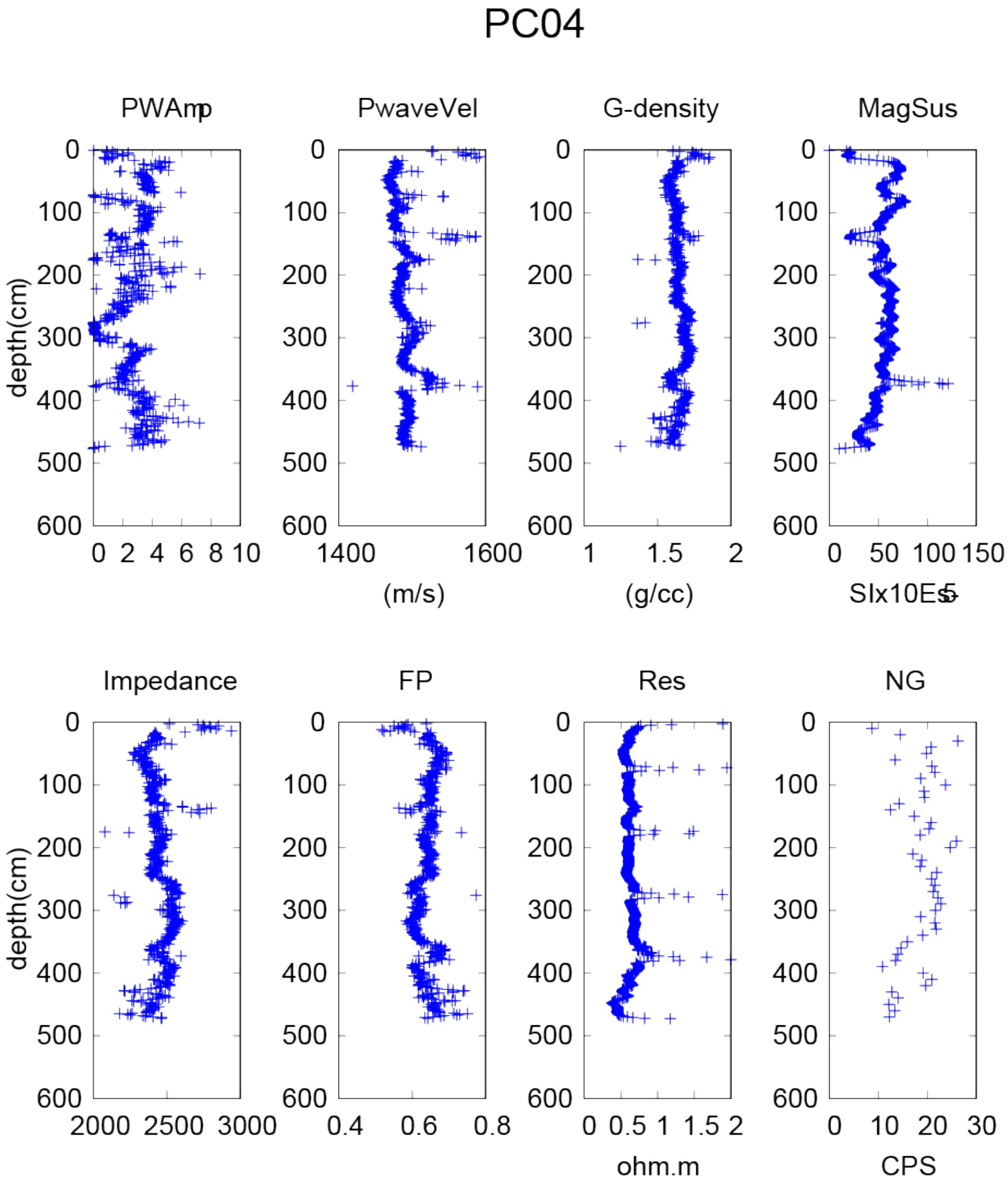


Figures 6-7-1. Physical properties of PL02 and PC02. Abbreviations used in the figure represent following parameters. PWAmp: P-wave amplitude, PWVel: P-wave velocity, G-density: gamma-ray

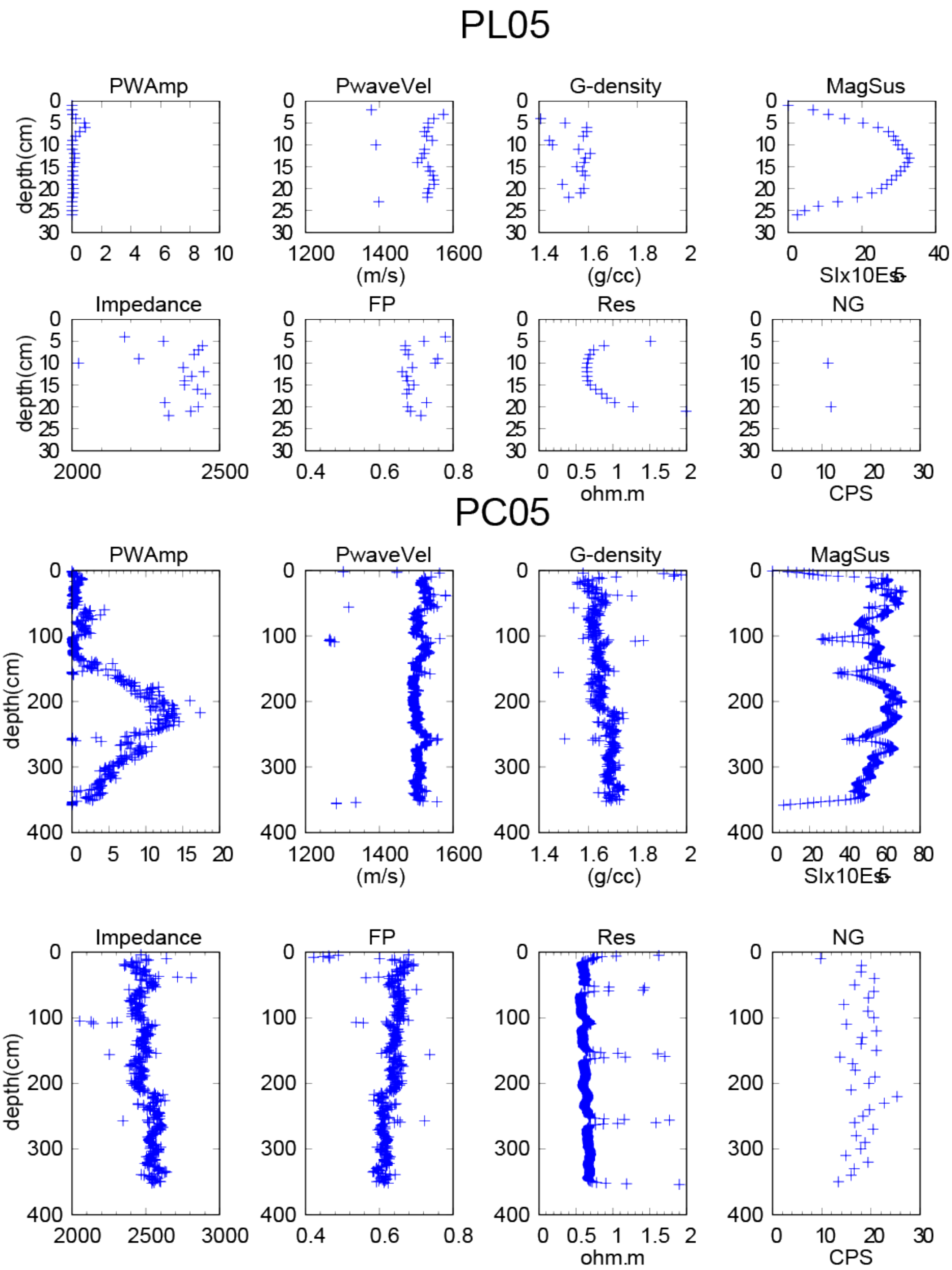
density, MagSus: Magnetic susceptibility, Impedance: acoustic impedance, FP: fractional porosity, Res: Non-Contact Resistivity, NG: Natural Gamma Ray Radiation.



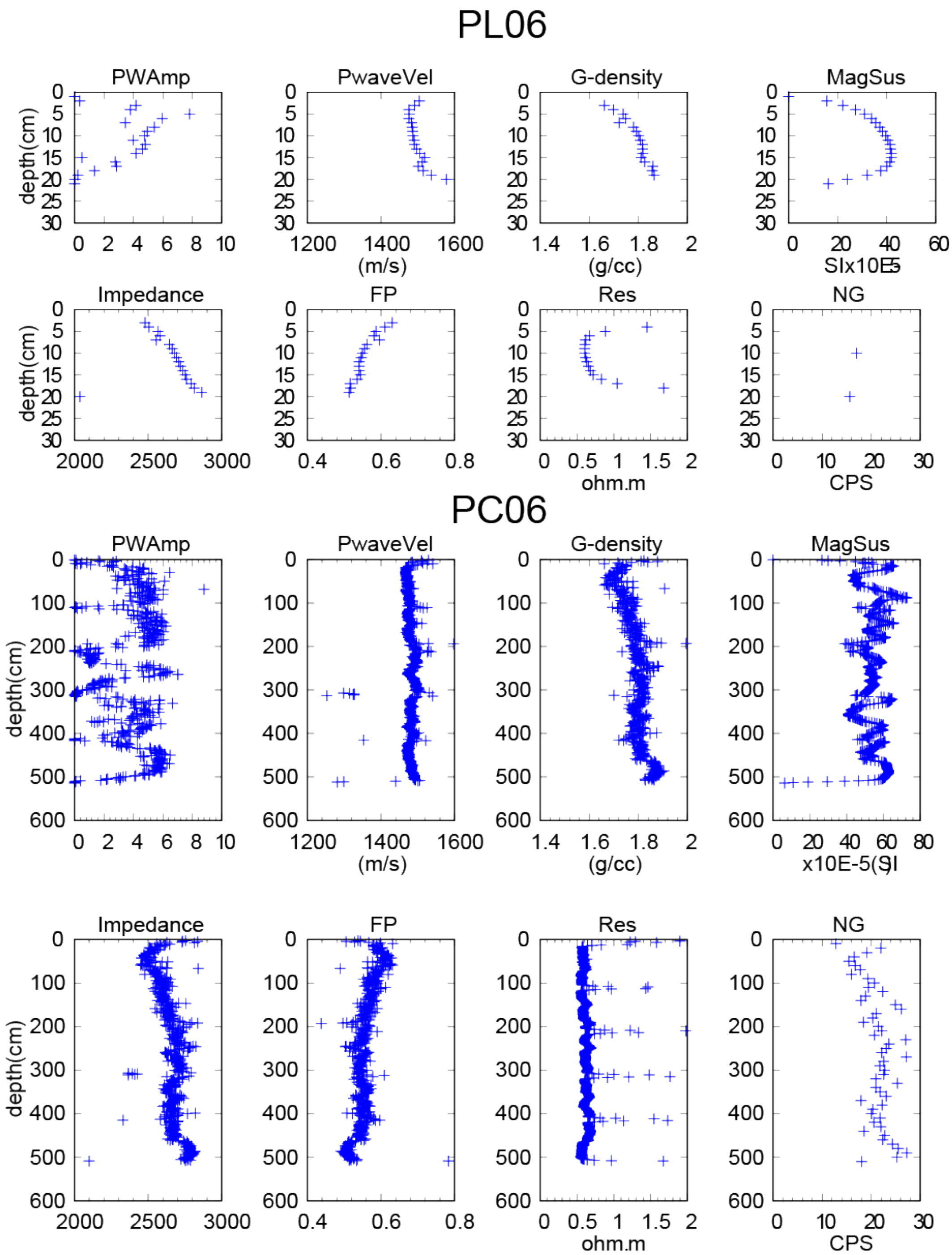
Figures 6-7-2. Physical properties of PL03 and PC03. Abbreviations are same as **Figures 6-7-1**.



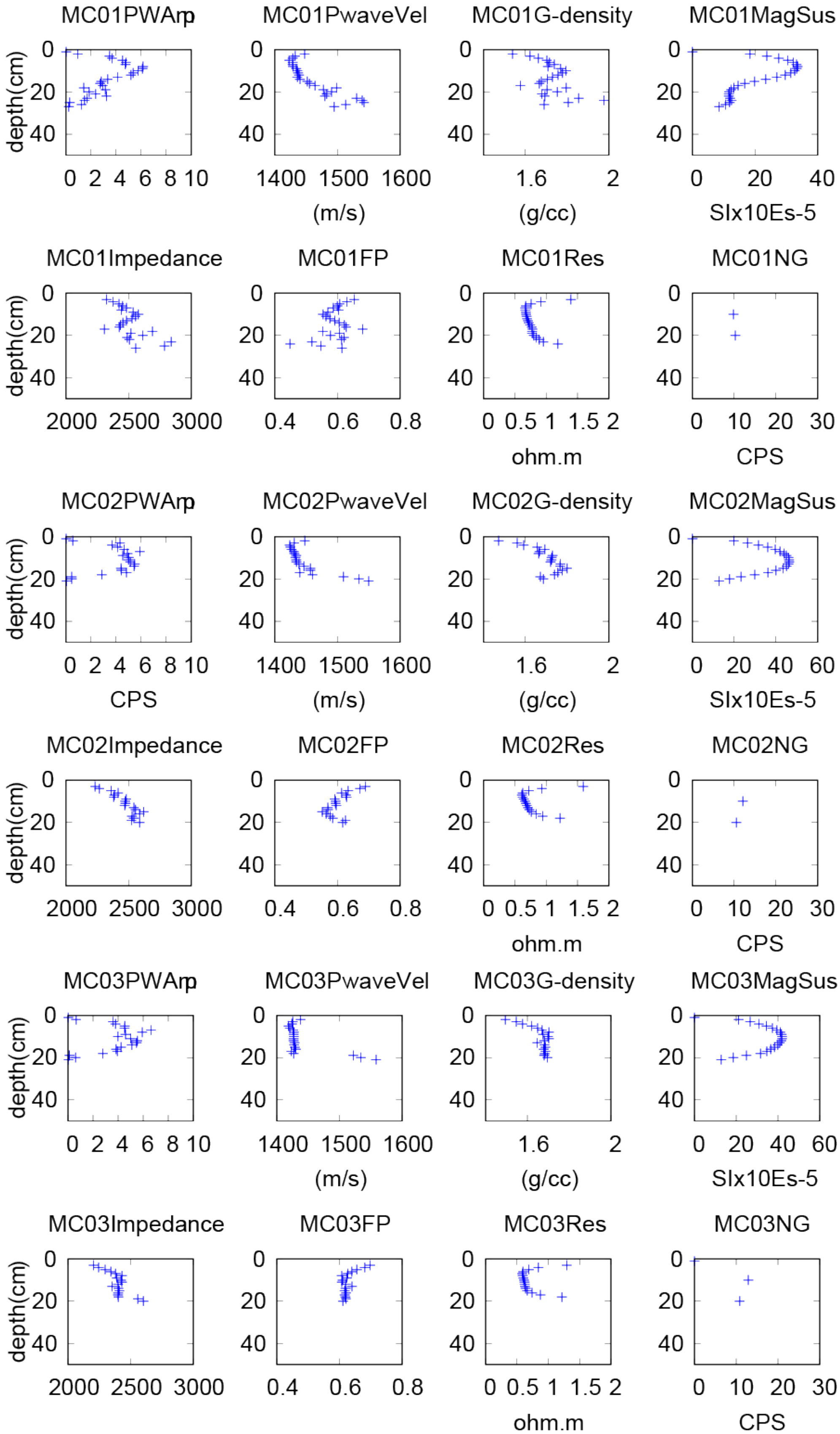
Figures 6-7-3. Physical properties of PC04. Abbreviations are same as **Figures 6-7-1**.



Figures 6-7-4. Physical properties of PL05 and PC05. Abbreviations are same as **Figures 6-7-1**.



Figures 6-7-5. Physical properties of PL06 and PC06. Abbreviations are same as **Figures 6-7-1**.



Figures 6-7-6. Physical properties of MC01, MC02, and MC03. Abbreviations are same as **Figures 6-7-1**.

7. Acknowledgement

We are grateful for the efforts of Captain Inoue and his crews during the cruise. We thank all the support from staffs in JAMSTEC. Especially thanks to Mr. Omae in the Research Fleet Department for his considerable efforts.

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.

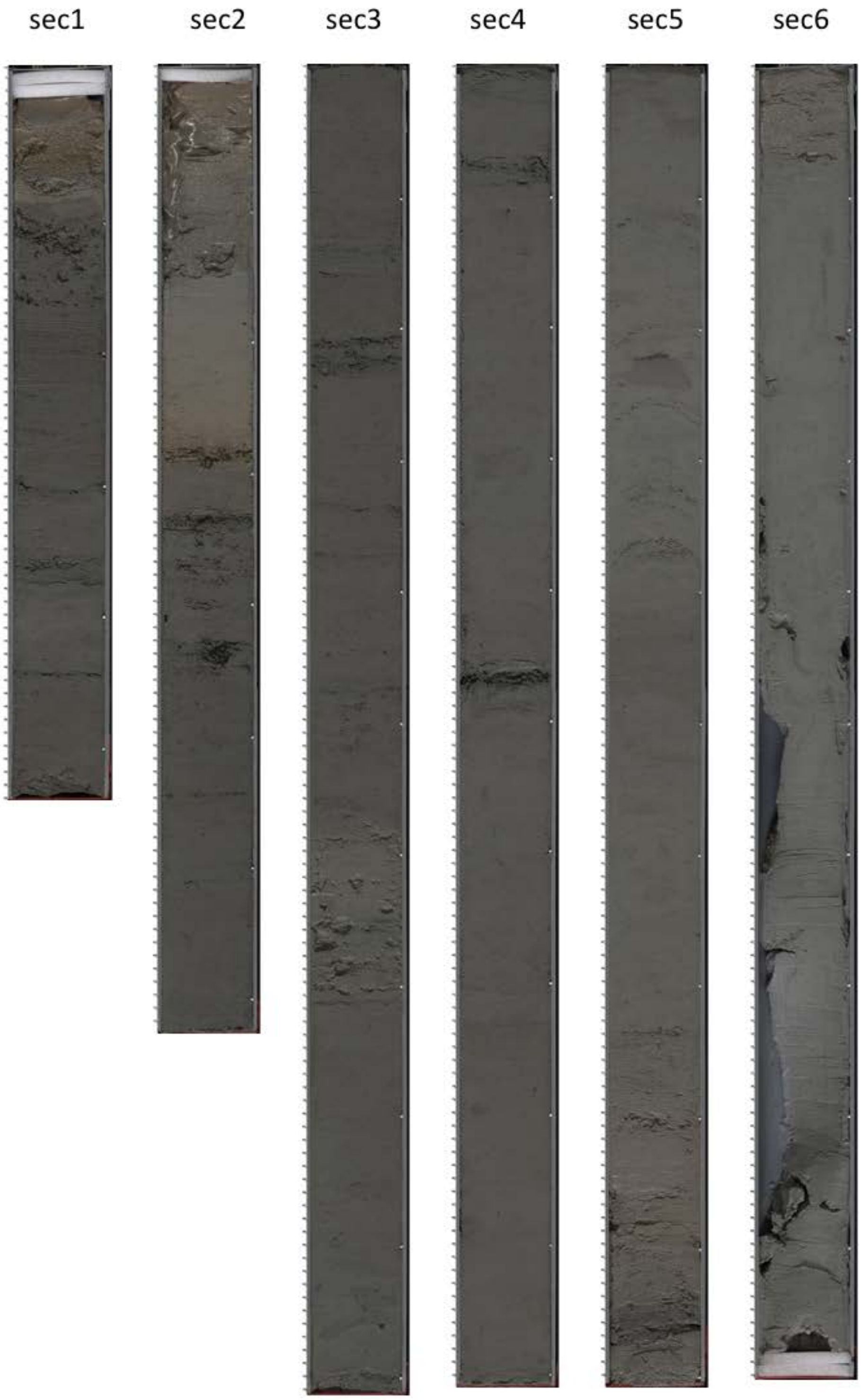
APPENDIX

Core Photo

(scale is beside of each section)

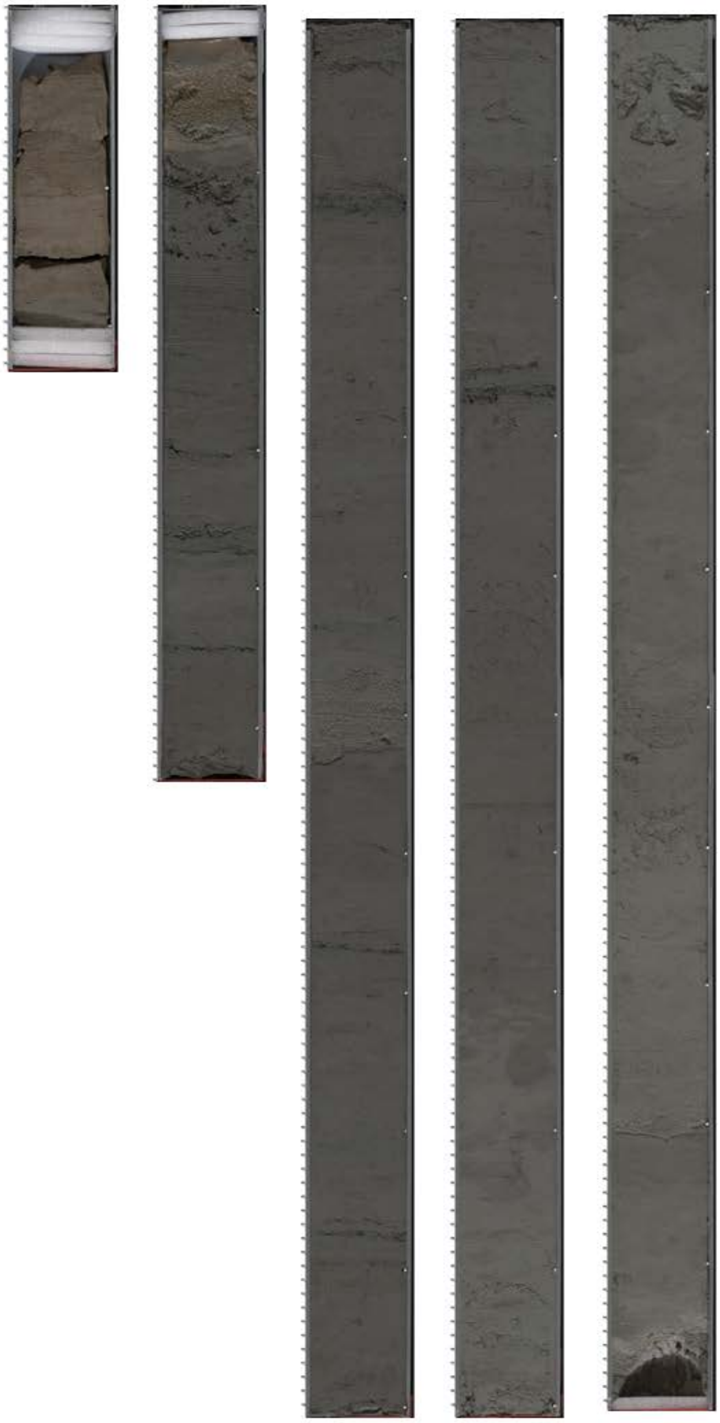

PL02
PC02
PL03
PC03
sec1
sec1
sec2
sec3
sec1
sec1
sec2
sec3

PL04 PC04



PL05 PC05

sec1 sec1 sec2 sec3 sec4



PL06 PC06

sec1 sec1 sec2 sec3 sec4 sec5 sec6

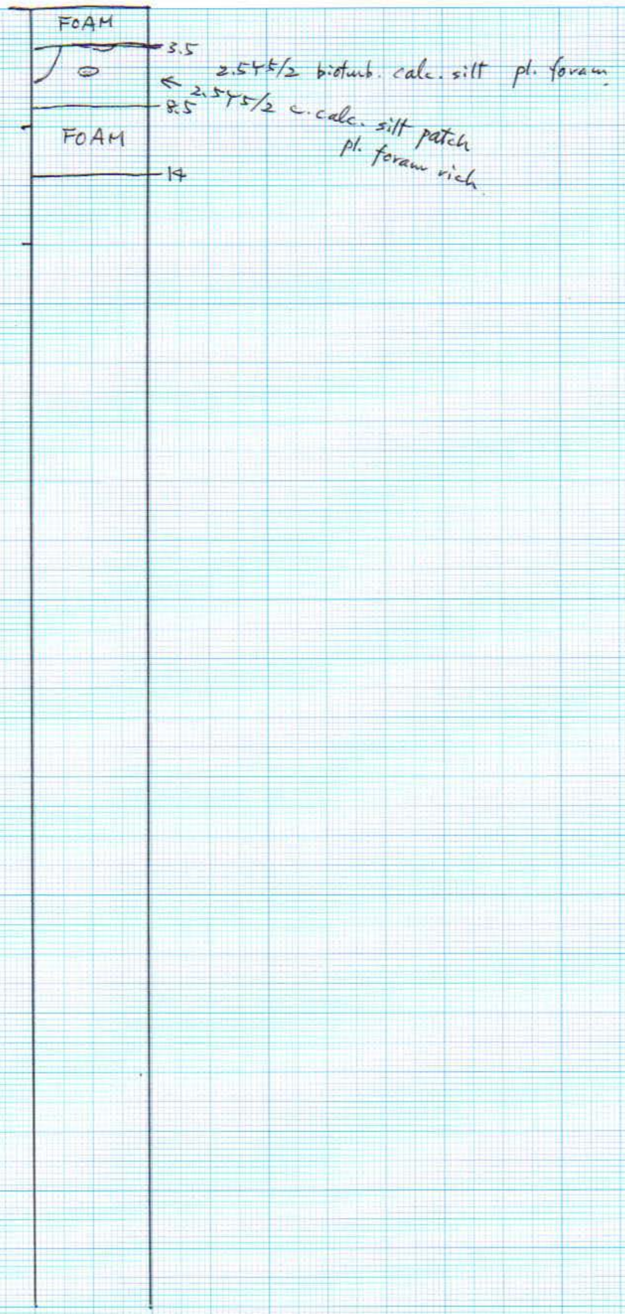
MC01 MC02 MC03

Visual Core Description

MR18-01C PC01

No sample

MR18-01C PL01 1W



3.5–8.5 (0–5)

JIS-A4 1mm (250×180) コクヨ ホ-19

MR18-01C PC02 sec. 2 W

FOAM

- 1 – 5Y 5/2 v.f.s. pl. foram. lithic. erosional base?
- 3.5 – 2.5Y 5/2 sandy silt pl. foram bearing
- 6 – 2.5Y 5/2 c.silt pl. foram. graded.
- 9.5 – 5Y 5/2 v.f.s pl. foram rich, lithic erosional base
- pin → 5Y 5/1 silt pl. foram
- 5Y 5/2
- 7.5Y 5/2 c.silt pl. foram paral laminated graded.
- erosional base
- 21 – c.s.-granule carbonate bioclast patches (BF, shell frag)
- 7.5Y 4/1 silt
- ← c.s.-granule size carbonate bioclast (BF) patch.
- 7.5Y 5/1 silt pl. foram. biotub.
- 7.5Y 4/1 silt pl. foram biotub.

brown ↕ gray

23-24 subsurface glassy-like greenish pebble

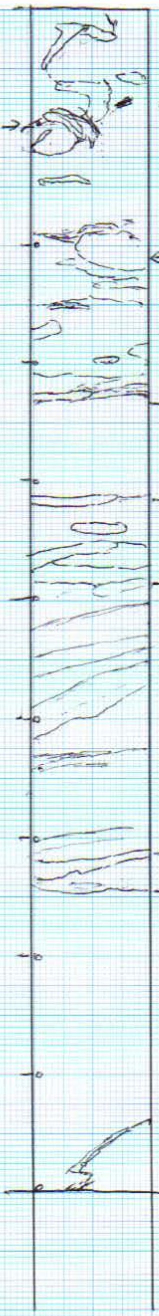
chaotic subaqueous PF deposit?

54.9

1 - 54.9 (0 - 53.9)

JIS A4 1mm (250×180)

MR18-01C PC02 sec. 3 W



7.5Y4/1 silt pl. foram (black)
biotub.

8.5cm ← bryozoa

pin →

7.5Y4/2 silt pl. foram (black)
biotub.

←7.5Y4/2 c. silt pl. foram (black) rich.

7.5Y4/1 silt pl. foram (black)

33.5

7.5Y5/1 silt pl. foram (black)

42

7.5Y4/1 silt biotub. ← 45cm subsurface glaucony-like greenish part.

chaotic subaqueous DF deposit ?

48.5

7.5Y 4/1 clayey silt bedded inclined.

71.5

74.5 7.5Y5/1 silt foram (white) biotub.

7.5Y4/1 silt

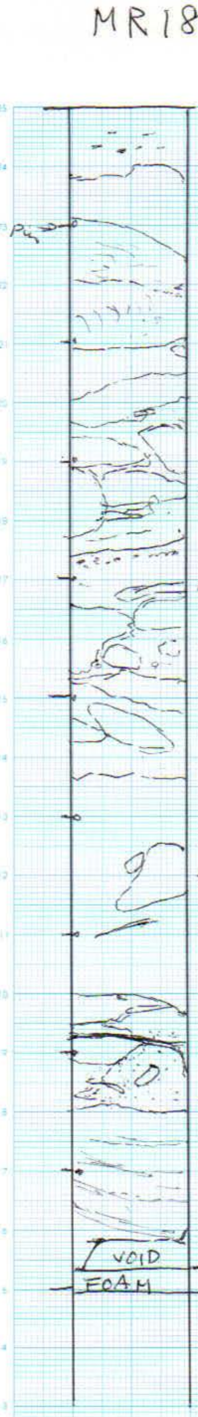
7.5Y5/1 silt pl. foram (white-gray), BF

100

0 - 100 (53.9 - 153.9)

JIS-A4 1mm 250×180 コクヨ ホ-19

MR18-01C PC02 4W



7.5Y5/1 silt with black sandy silt patches
pl. foram (black)

7.5Y4/1 silt

7.5Y5/1 silt

7.5Y4/1 silt

25.5-26.5 pebble?
subsurface

chaotic
subaqueous
DF. deposit?

7.5Y5/1 sandy silt pl. foram rich (gray)

2.5GY4/1 clayey silt (sandy) 38-38.5 greenish discontinuous layer?

← 7.5Y3/1 silt pl. foram (black)

7.5Y4/1 sandy silt pl. foram (white-gray) Ⓐ 48cm granule

7.5Y4/2 silt massive

← 7.5Y5/1 silt pl. foram (white. gray)

← injected? 7.5Y5/1

7.5Y4/1 sandy silt pl. foram (white. gray)
crack (78.8-79)

— 7.5Y4/1 c. silt pl. foram (gray)

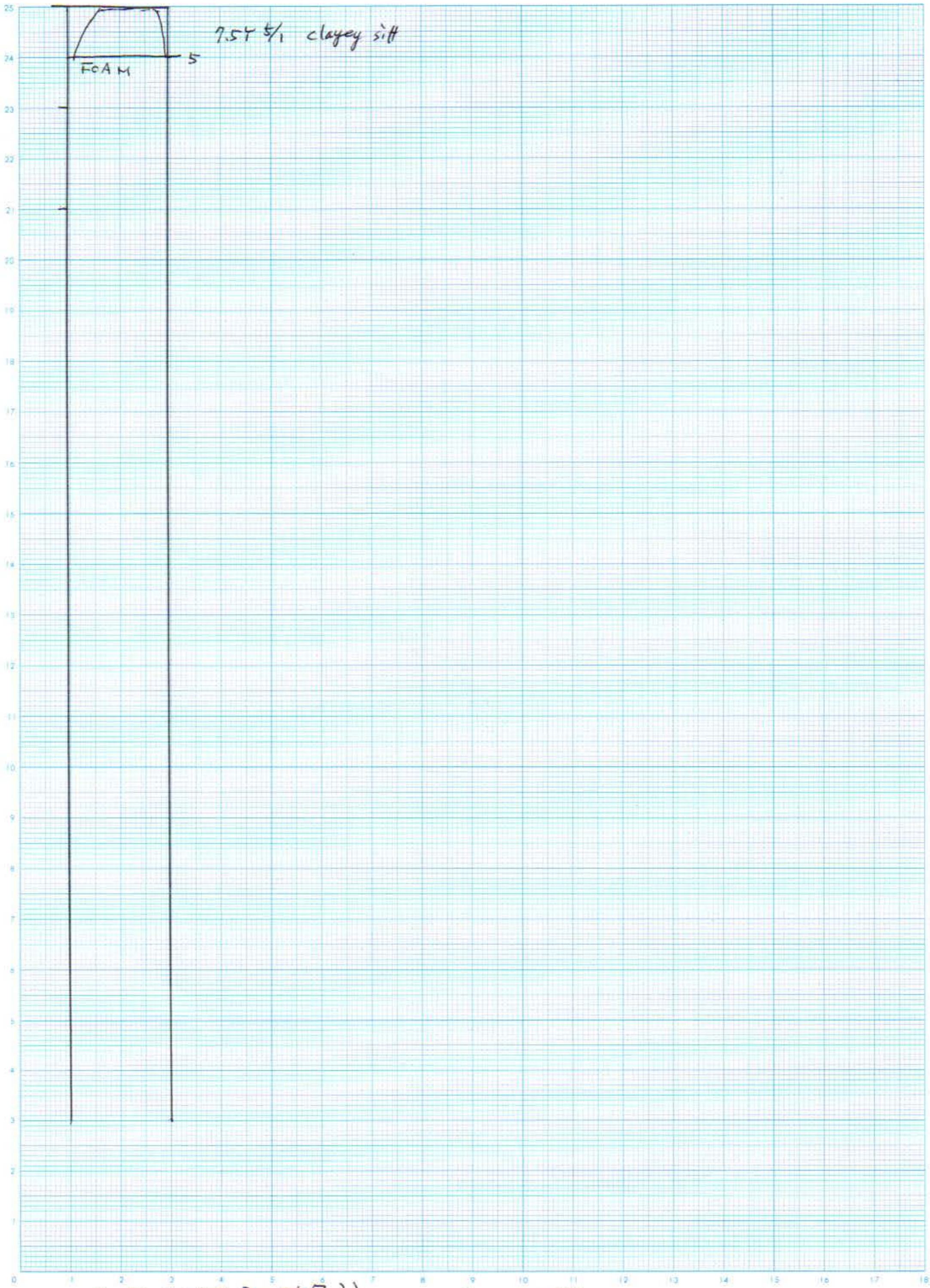
7.5Y5/1 silt bedded (inclined)
small pl. foram (gray)

— 98.4
100.3

0 - 98.4 (153.9 - 252.3)

JIS A4 1mm 250×180 コクヨ ホ-19

MR18-01C PC02 CC W



0-5 (252.3 - 257.3) (250.9 - 255.9)
-1.4 -1.4

JIS-A4 1mm (250×180) コクヨ ホ-19

MR18-01C PL02 1W

FOAM

2 — 2.5Y 5/2 calc. silt pl. foram

2.5Y 5/2 calc. silt pl. foram (slightly yellowish than upper) bioturb.

11.2 — 5Y 5/2 calc. silt pl. foram.

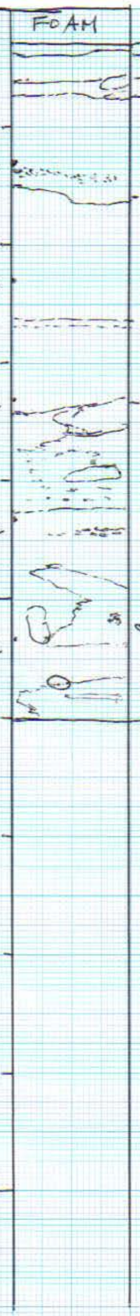
FOAM

13.2

no pin

2 − 11.2 (0 − 9.2)

MR18-01C PC03 2W



3 7.5Y4/1 silt loose
4 7.5Y5/2 calc. c.silt - erosional base
6 2.5Y4/2 sandy silt biotub.
7.5 ~~7.5Y4/1 silt pl. foram biotub~~
↑ 5Y5/2 c.silt - v.f.s pl. foram, lithic. graded
← black layer? black pl foram
16 5Y4/2 v.f.s. pl. foram, BF, shell frag. erosional base
7.5Y4/1 silt pl. foram biotub.
7.5Y5/2 silt pl. foram biotub.
7.5Y5/1 silt pl. foram biotub.
26 7.5Y4/1 m-c.silt black-gray pl. foram.
↑ 7.5Y5/1 c.silt lithic. qtz. graded
33.5 7.5Y5/1 c.silt - v.f.s. pl. foram. (gray, black), lithic erosional base
← 7.5Y3/1 c.silt mudclast
7.5Y4/2 muddy c.s - granule carbonate bioclasts (coral, BF, shell frag) ↓ DF
← muddy c.s bioclasts.
7.5Y5/1 silt black-gray pl. foram.
7.5Y4/1 silt black pl foram, lithic
← bioclast patch
← BF
60.3

3 - 60.3 (0 - 57.3)

MR18-01C PC03 3W

7.5Y 5/1 silt

← 10Y 3/2 silt black pl. foram

← black pl. foram layer

7.5Y 4/1 silt

← 5mm φ subrounded granule

← 1cm φ subangular pebble

7.5Y 5/1 silt

chaotic.

← 7.5Y 4/1 silt gray pl. foram.

← bioclast rich.

7.5Y 4/1 m. silt

← BF

7.5Y 5/1 silt

← ~1cm φ subangular pebble

7.5Y 4/1 silt highly distorted.

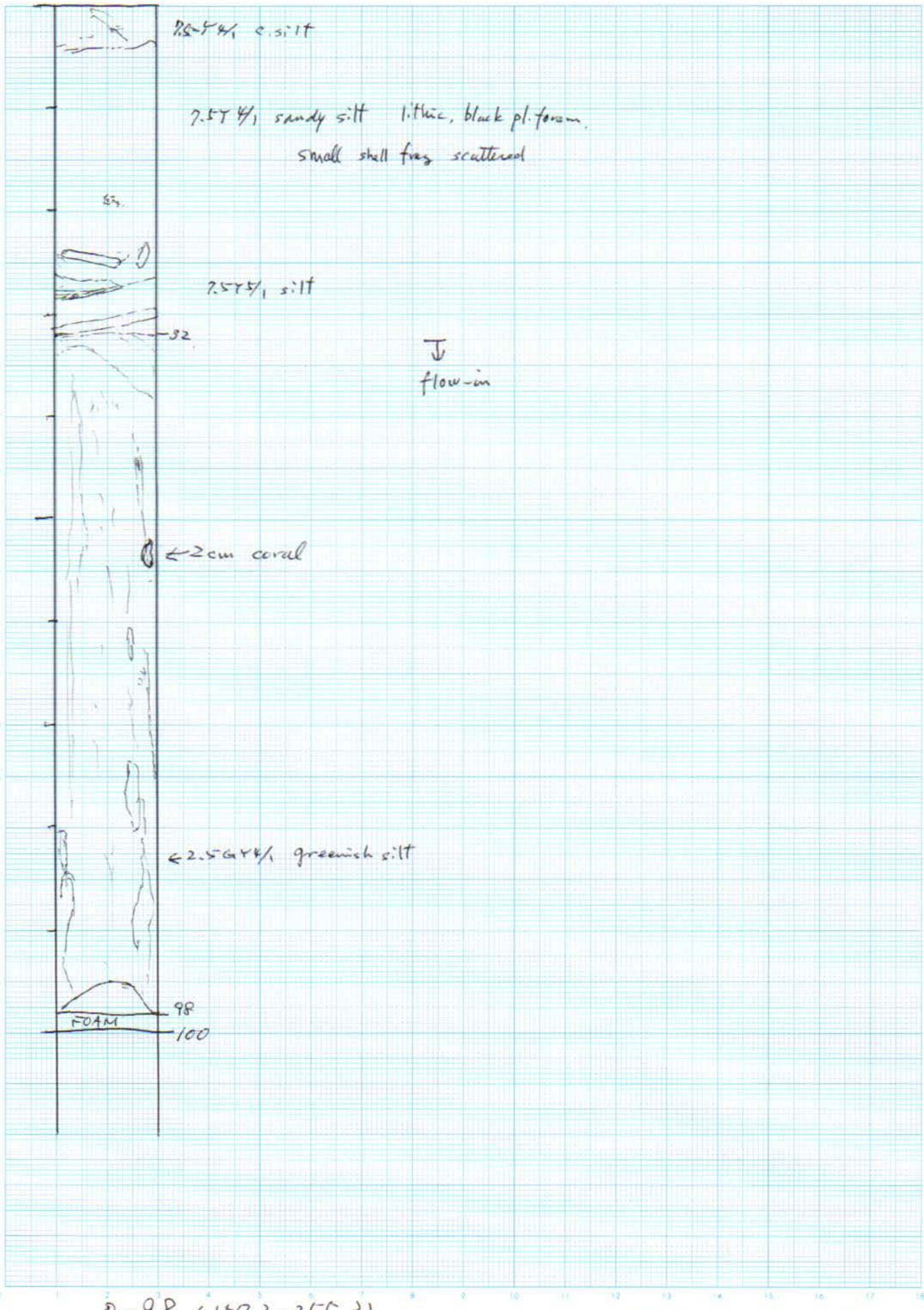
← 7.5Y 5/1 c. silt - v.f.s lithic, pl. foram..

100

0-100 (57.3-157.3)

JIS-A4 1mm (250×180) コクヨ ホ-19

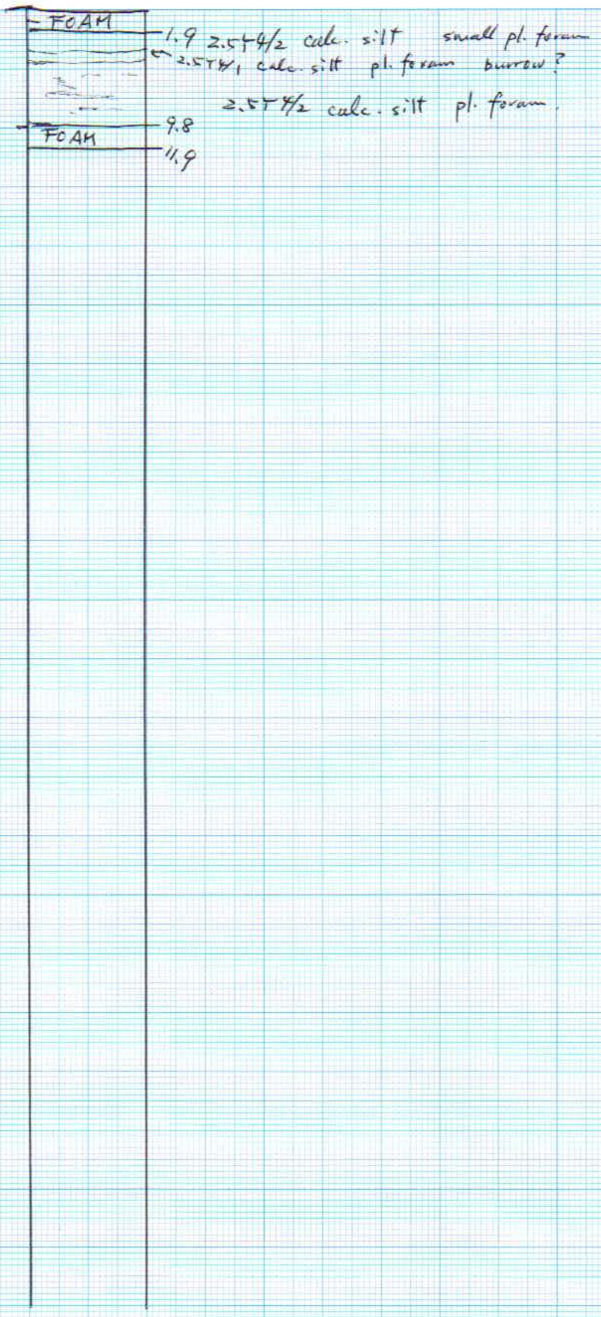
MR18-01C PC03 4W



0-98 (157.3-255.3)

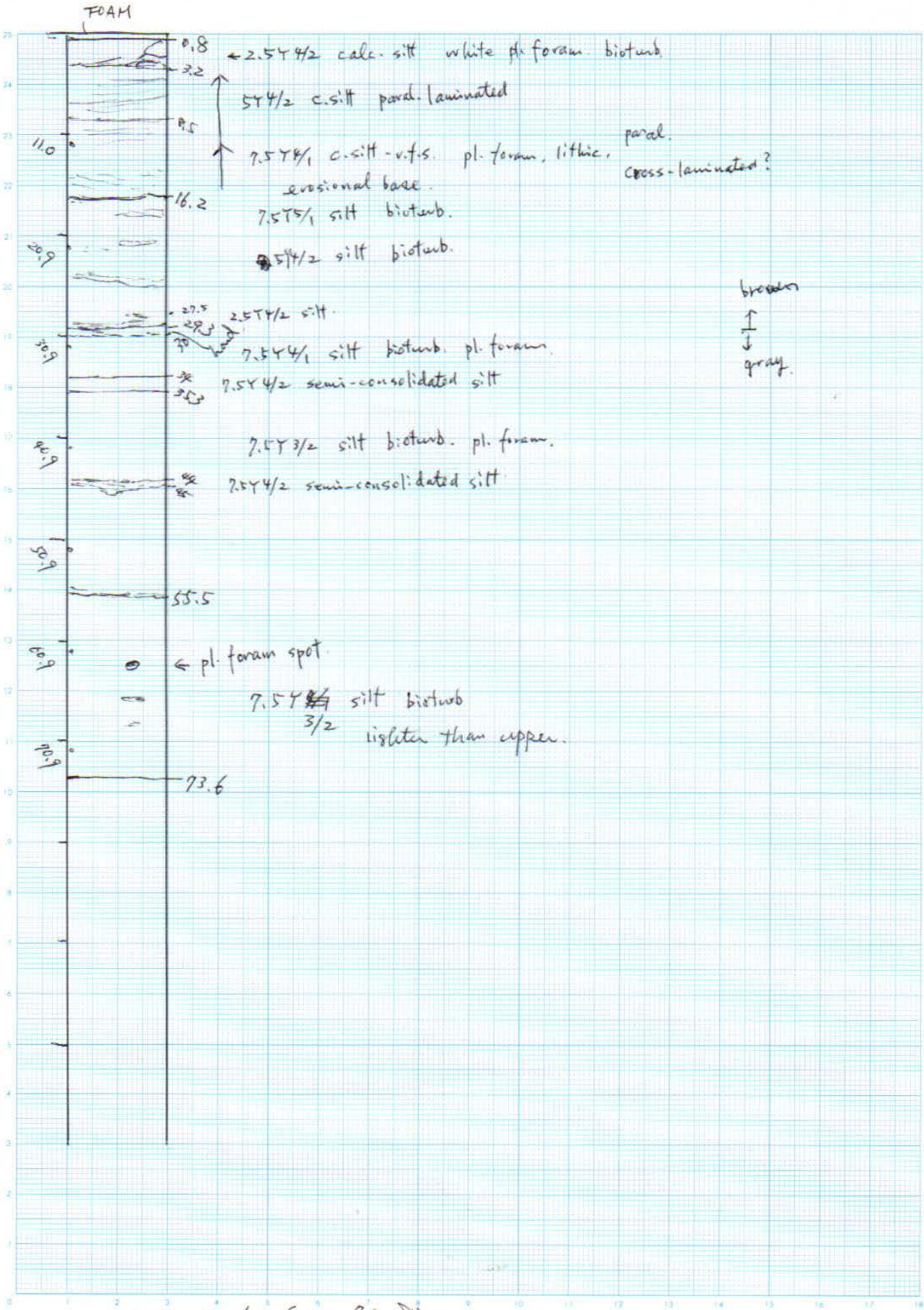
JIS-A4 1mm 250×180 コクヨ ホ-19

MR18-01C PL03 1W



1.9-9.8 (0-7.9)

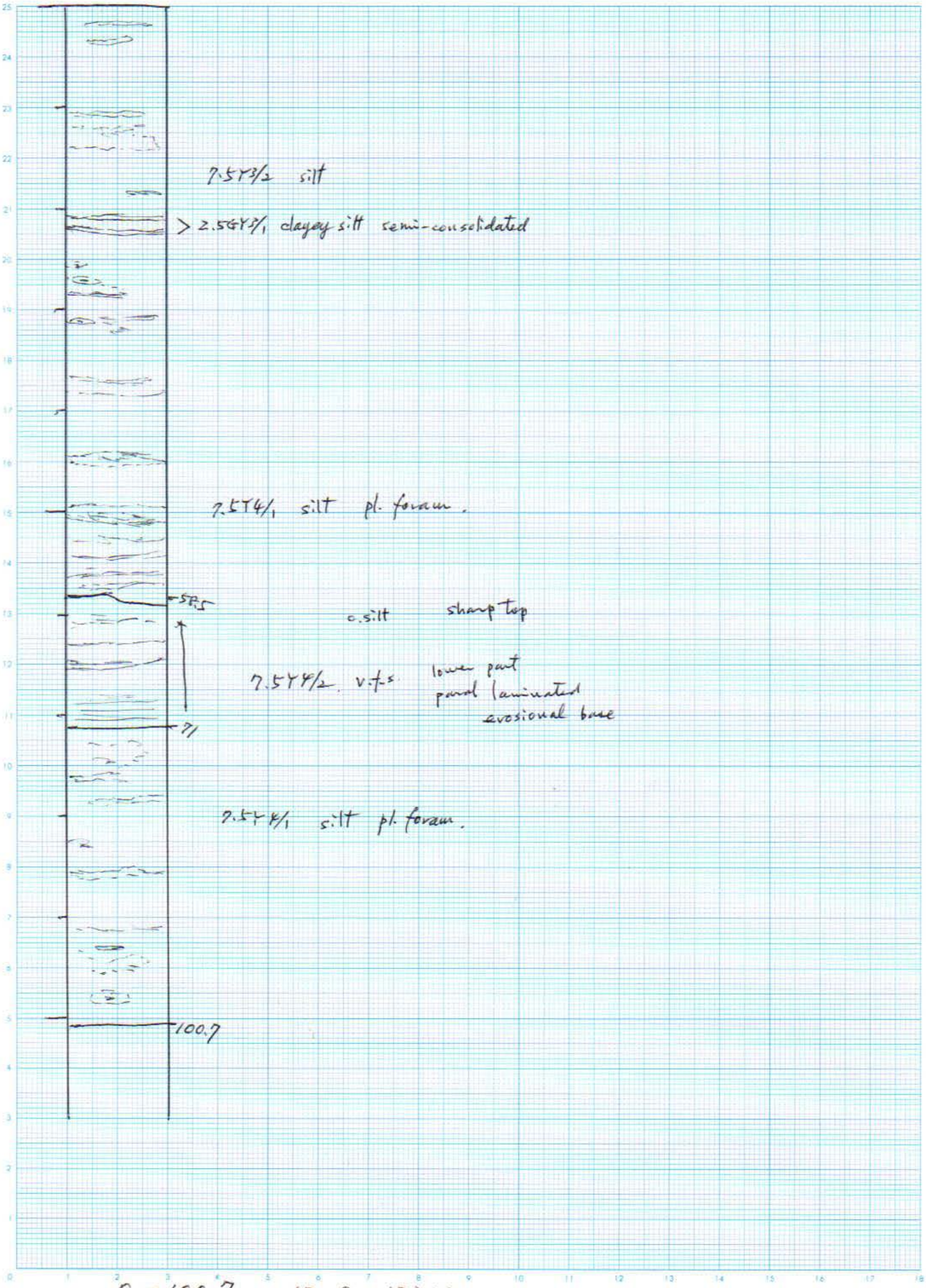
MR18-01C PC04 2W



0.8-73.6 (0-72.8)

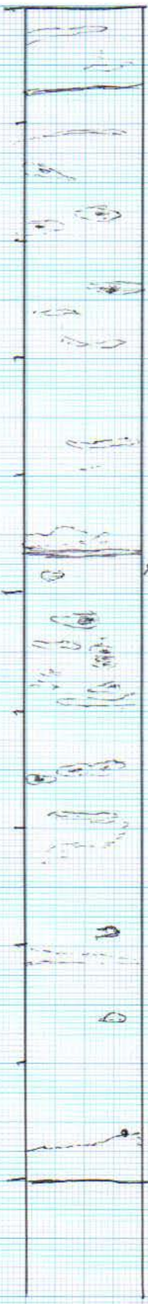
JIS A4

MR18-01C PC04 3W



0 - 100.7 (72.8 - 173.5)

MR18-01C PC04 4W



72-75 2.5GY4/1 clayey silt

7.5Y4/1 silt pl. foram biotub.

96
96.3 2.5GY3/1 semi-consolidated clayey silt

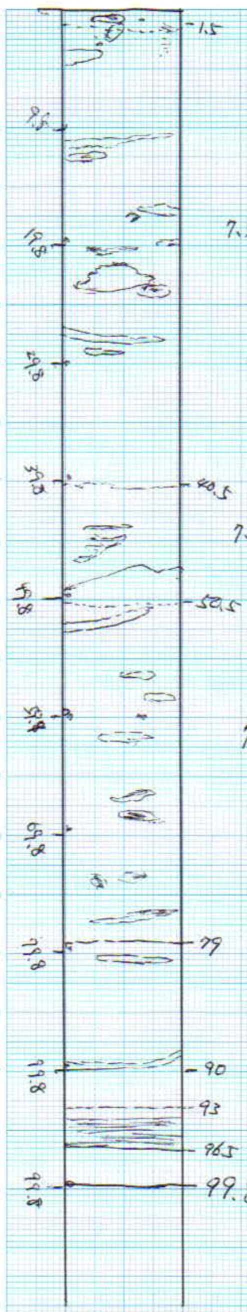
7.5Y4/1 silt pl. foram biotub

5mmφ
← subrounded scoria
-97

100.2 7.5Y4/1 silt lighter than upper biotub

0 – 100.2 (173.5 – 273.7)

MR18-01C PC04 5W



7.5Y 4/1

7.5Y 5/1 silt pl. foram biotub.

7.5Y 4/2 silt pl. foram biotub.

7.5Y 5/1 silt pl. foram biotub.

biotub boundary.

5Y 5/2 m.-c. silt sized ash glass rich

5Y 4/1 m.-c. silt sized ash glass rich

7.5Y 4/1 c. silt sized ash glass + HM minerals paral. laminated gradual top sharp base

5Y 5/2 c. silt sized ash glass rich minor HM

0 - 99.8 (273.7 - 373.5)

MR18-01C   PC04   6W

5Y 5/2 c. silt-sized ash glass-rich
5Y5/1 c. silt-sized ash glass-rich
greenish glass + minor HM
5Y5/1 c. silt-sized ash glass-rich.

↓
flow-in

7.5Y5/1 silt pl. foram.

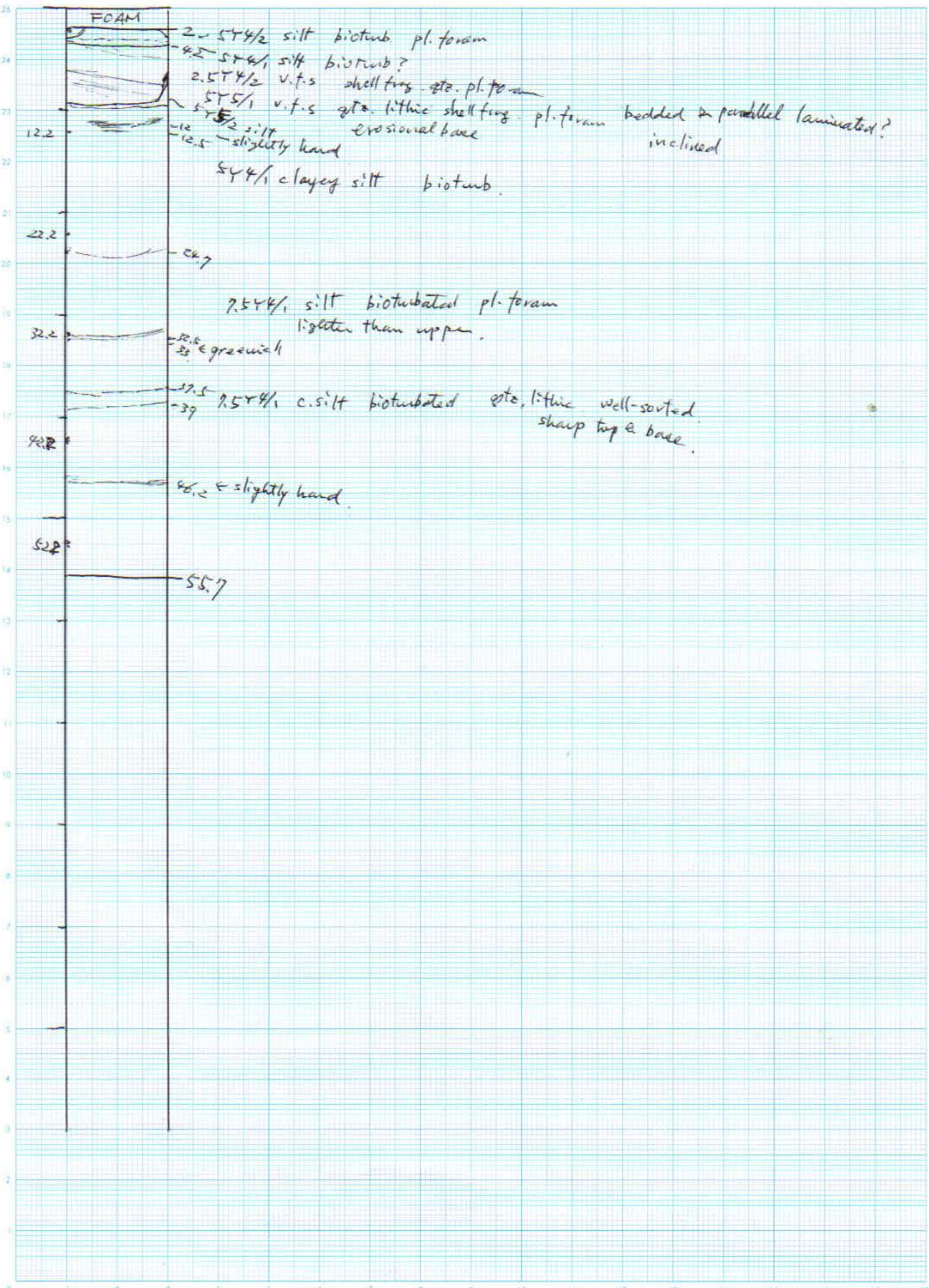
0 - 97.8 (373.5 - 471.3)

JIS-A4 1mm 250×180 コクヨ ホ-19

MR18-01C PL04

No sample

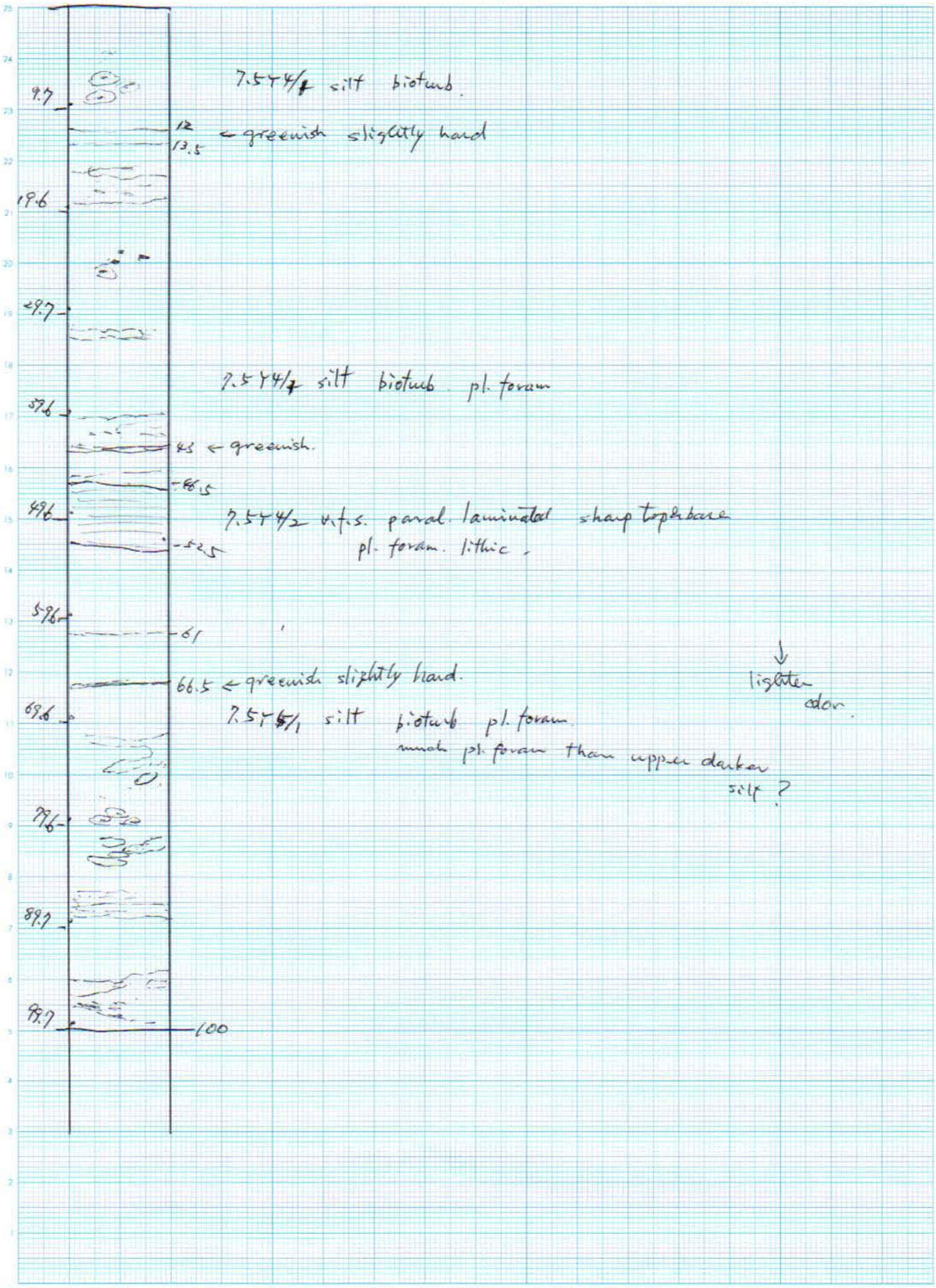
MR18-01C PC05 1W



2-55.7 (0-53.7)

JIS-A4 1mm (250×180) コクヨ ホ-19

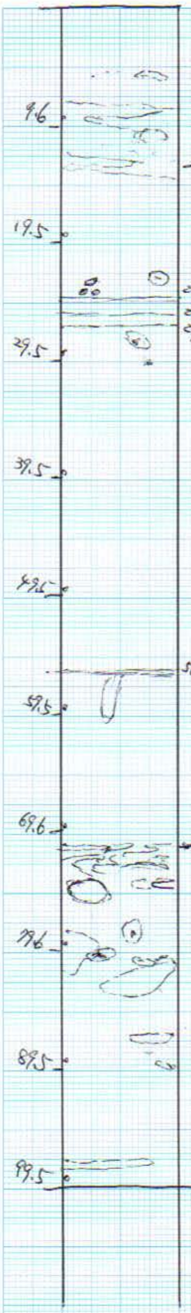
MR18-01C PC05 2W



0 -100 (53.7-153.7)

JIS-A4 1mm (250×180)

MR18-01C PC05 3W



7.5Y5/1 silt. biotub.

-13.5

7.5Y4/1 silt biotub pl. foram

24.5 23-24.5 ash? spots.?

26 25 ← greenish

27 ← greenish slightly hard and clayey (2.5GY4/1)

7.5Y4/1 silt biotub

56.5 ← greenish

-71

7.5Y5/1 silt biotub

↓ more lighter.

↓ semi-consolidated

-100

0-100 (153.7-253.7)

JIS A4

MR18-01C PC05 4W

7.5Y 5/1 silt biotub pl. foram-rich

semi-consolidated ↑

7.5Y 4/1 silt bioturb. pl. foram

← scoria 5mm φ

7.5Y 5/1 silt biotub pl. foram

slightly hard (semi-consolidated)

7.5Y 5/2 silt biotub pl. foram

7.5Y 5/1 v.f.s pl. foram parallel laminated sharp base biotub top

7.5Y 4/1 silt pl. foram biotub. homogeneous ?

7.5Y 5/1 silt biotub. pl. foram

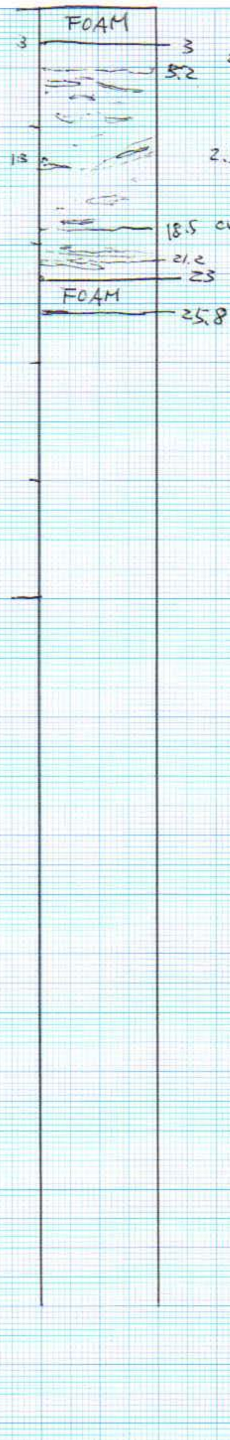
7.5Y 6/1 v.f.s shell frag, qtz, lithic, biotub.

99.4 7.5Y 4/1 silt clayey

0-99.4 (253.7-353.1)

JIS-A4 1mm (250×180) コクヨ ホ-19

MR18-01C ~~PC05~~ PL05 1W



3 – 5.2: 2.5Y4/2 silt homogeneous pl. foram

2.5Y5/2 calc. silt bioturb. pl. foram

18.5 crack.

21.2 – 23: 5Y4/1 silt homogeneous pl. foram (black)

25.8

3-23 (0-20)

JIS-A4 1mm (250×180) コクヨ ホ-19

MR18-01C PC06 sec. 1 W

1.8 2.5Y5/2 silt biotub.

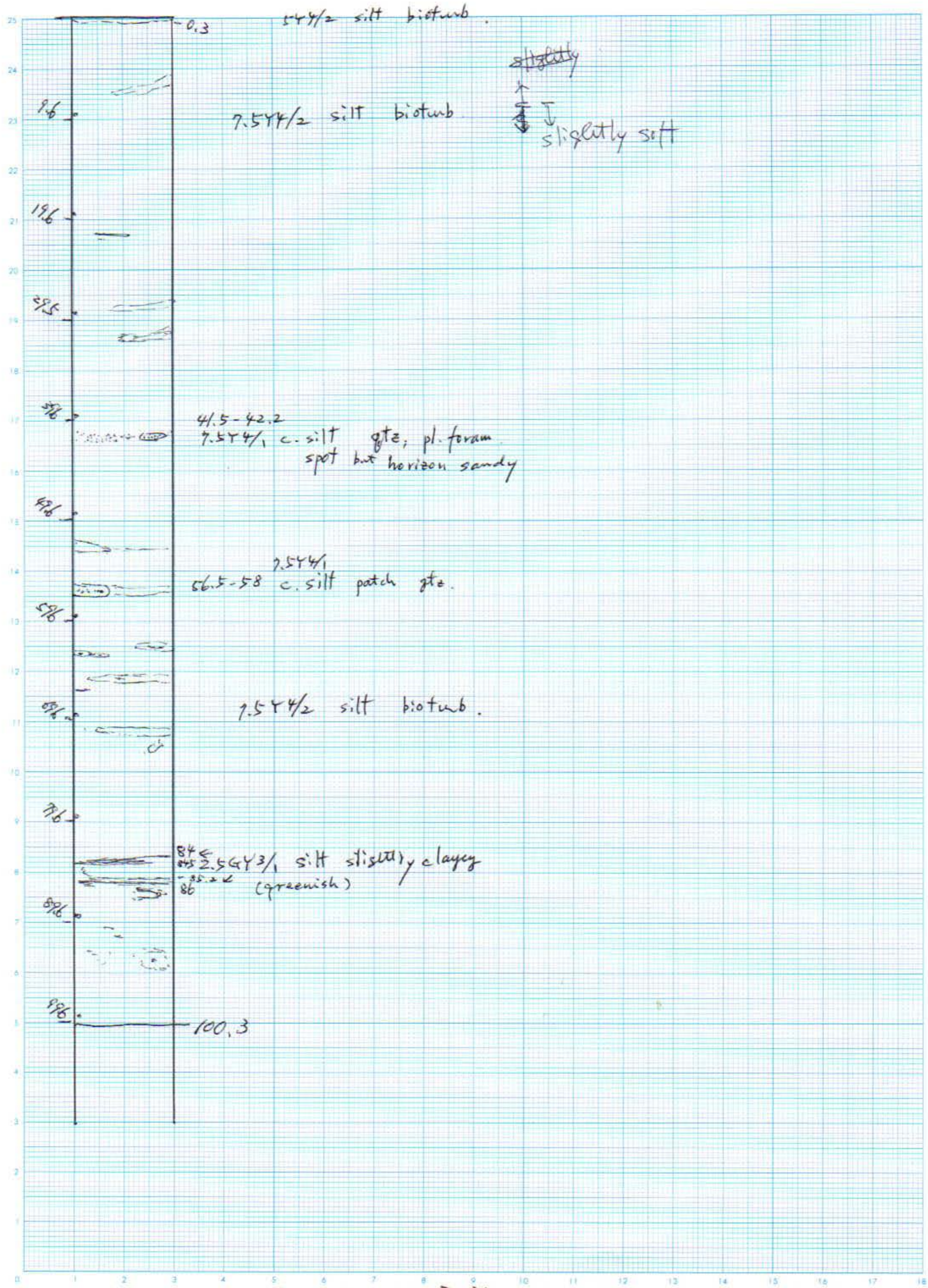
4.8 – 6 2.5Y5/2 v.f.s sharp top & base pl. foram. 沢山?

8.8 5Y4/1 silt biotub.

Yellow ↕ gray

1.8 – 8.8 (0 – 7)

MR18-01C PC06 2W



0-100.3 (7-107.3)

JIS-A4 1mm (250×180) コクヨ ホ-19

MR18-01C PC06 3W

6.5 ← c.silt ash? spot

19.7 c.silt tiny pl. foram spot?

7.5Y4/2 silt bioturb.

← 2.5GY3/1 slightly clayey silt

← 2.5GY3/1

← 2.5GY3/1

← 2.5GY3/1

7.5Y4/2 silt bioturb. pl. foram.

← 2.5GY3/1

↓ slightly lighter

82 – 83.5 ↑ 7.5Y4/1 v.f.s. graded parall-cross laminated? sharp base
pl. foram, qtz bioturb. top

← 2.5GY3/1

100

0 – 100 (107.3 – 207.3)

MR18-01C PC06 sec. 4W

7.5Y4/1 silt biotub.

← 7.5Y4/1 w. silt pl. foram ~~s~~lighter than upper & lower
burrow?

← white spot (sponge ??)

7.5Y 4/1 silt biotub.

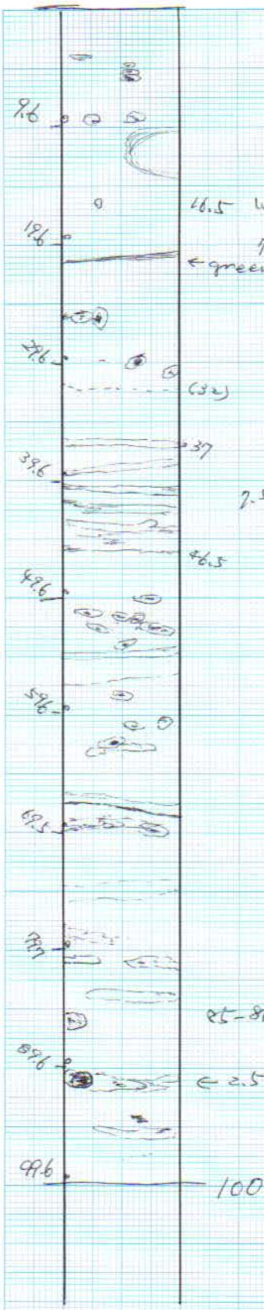
← slightly greenish

← 2.5GY4/1 silt
(greenish)

100.3

0 - 100.3 (207.3 - 307.6)

MR18-01 C PC06 5W



16.5 white tiny pl. foram? spot.

7.5Y4/1 silt biotub

← greenish

slightly lighter than upper

7.5Y4/1 silt biotub. pl. foram
lighter than upper & lower

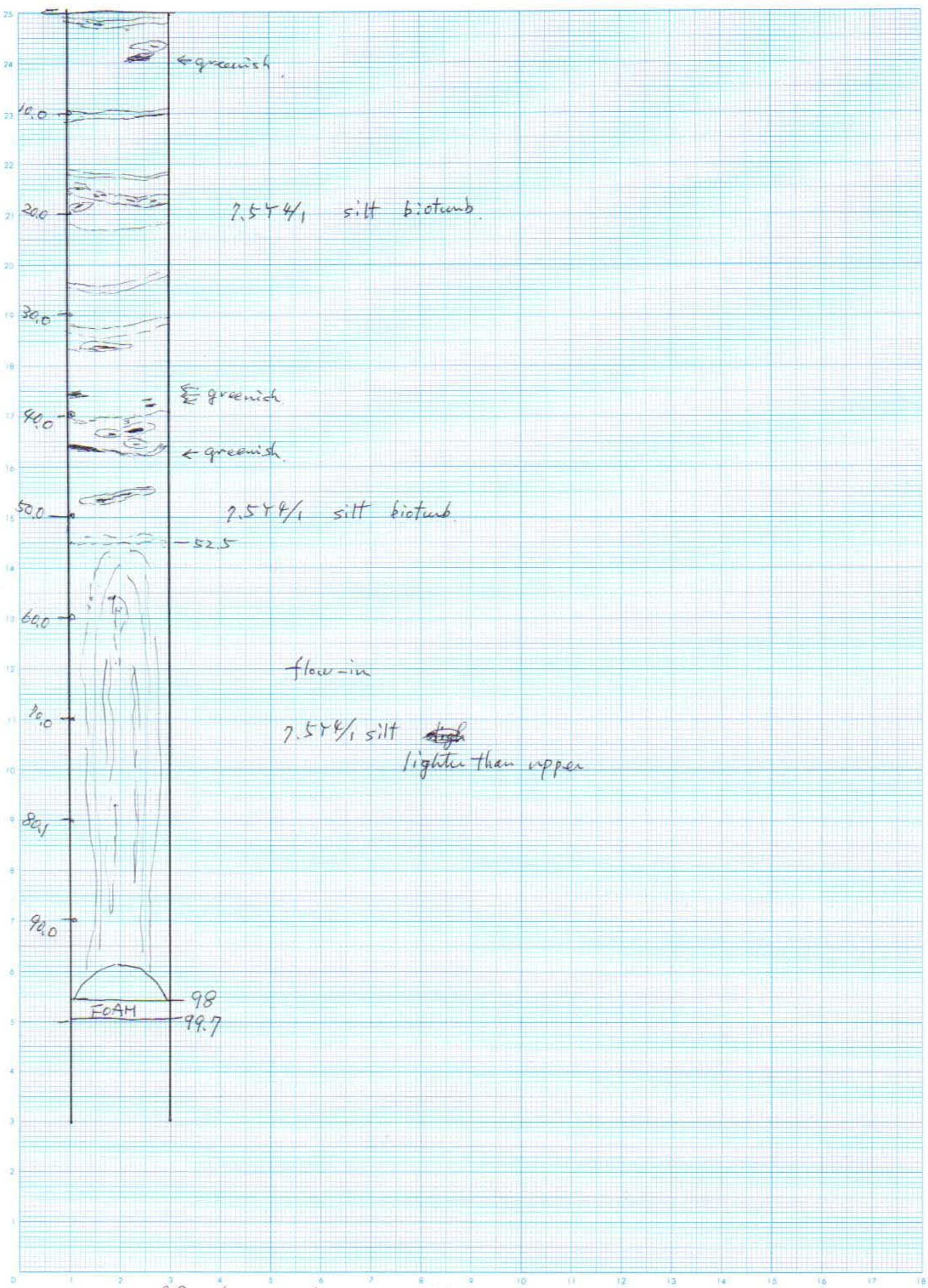
7.5Y4/1 silt biotub.

85–86.5 7.5Y4/2 muddy v.f.s. pl. foram patch

← 2.5GY4/1 slightly clayey silt
(greenish).

0–100 (307.6–407.6)

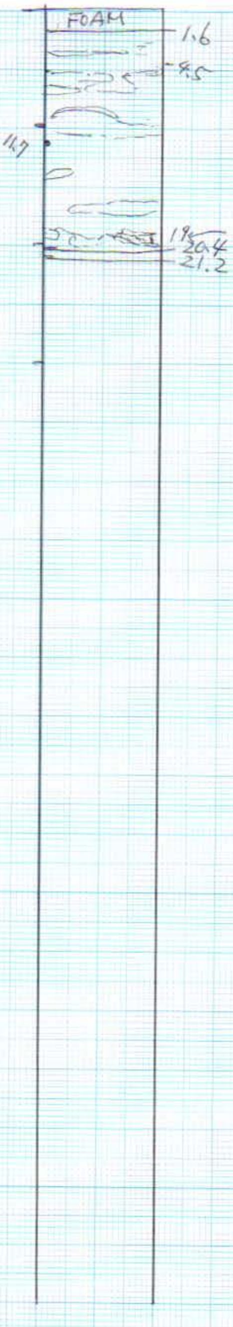
MR18-01C PC06 6W



0-98 (407.6 - 505.6)

JIS-A4 1 mm (250×180) コクヨ ホ-19

MR18-01C PL06 1W



2.5Y 4/2 silt biotub . pl. foram

2.5Y 5/2 silt biotub pl. foram

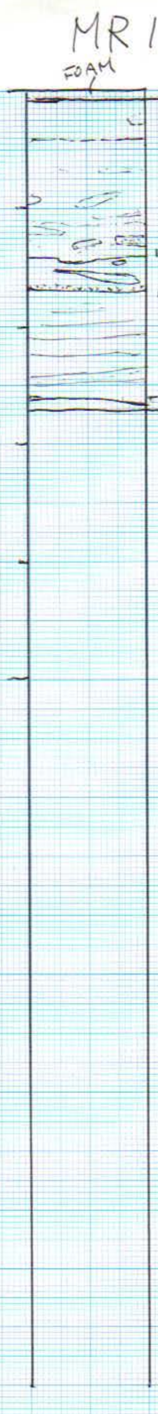
2.5Y 5/2 silt biotub pl. foram
ligetter than upper

2.5Y 4/2 v.f.s pl. foram biotub top
patch ??

1.6-20.4 (0-18.8)

MR18-01C MC01 W

FOAM



0.9 2.5Y5/2 silt pl. foram.

2.5Y5/2 silt bioturbated slightly lighter than top

14

2.5Y6/1 v.f.s pl. foram bioturbated top

17 ← 2.5Y4/1 v.f.s shell frag.

2.5Y6/2 v.f.s. paral. laminated pl. foram., lithic
sharp base

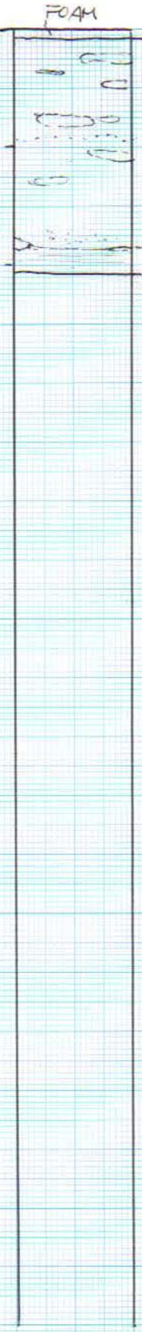
26

27.1 2.5Y4/2 silt pl. foram

0.9-27.1 (0-26.2)

MR18-01C MC02 W

FOAM



0.9 2.5Y4/2 silt biotubated pl. foram.

9.5 ↓ gradual & biotub. boundary,

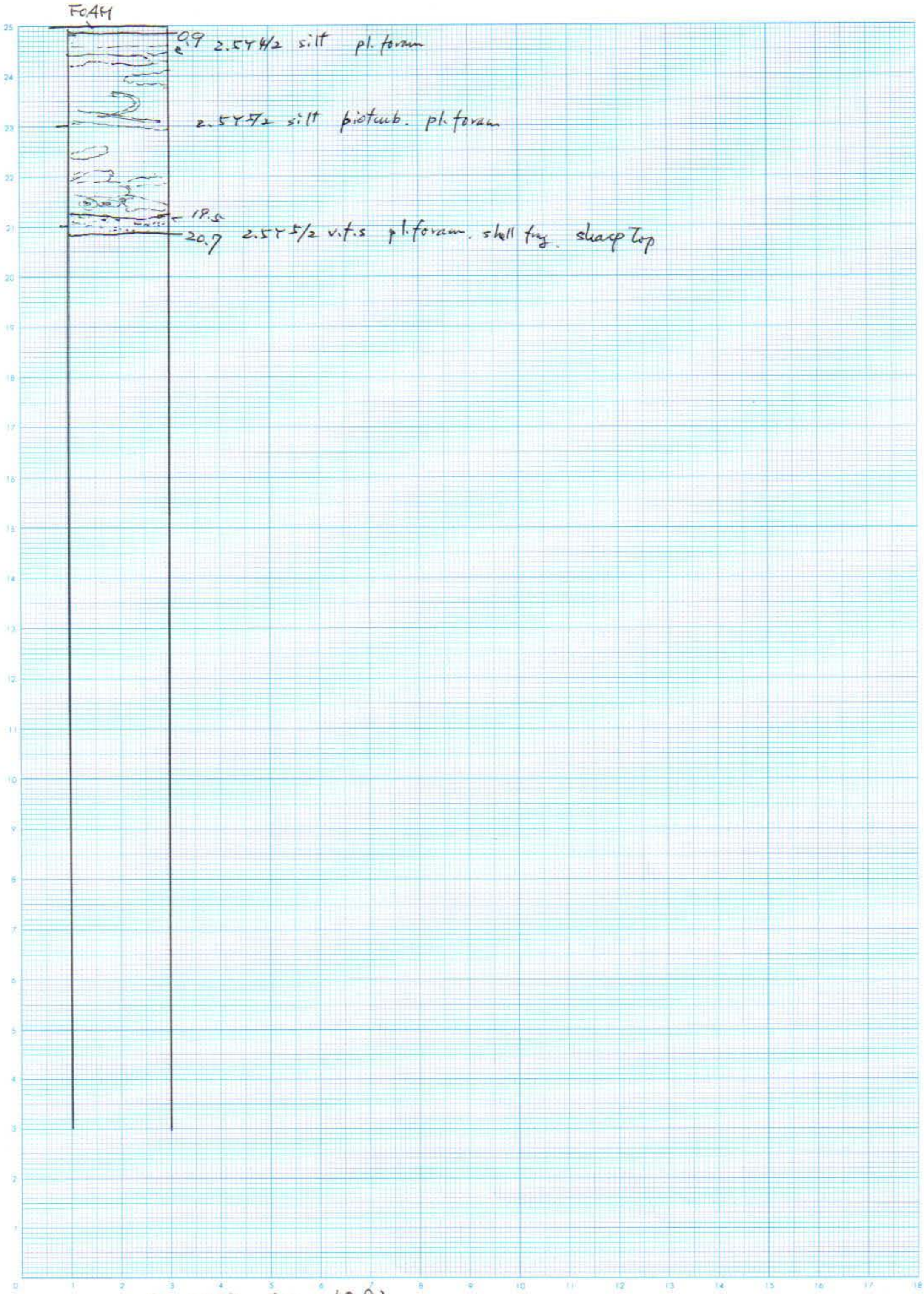
2.5Y5/2 silt biotub pl. foram

18.5

20.8 2.5Y5/2 c. silt paral. laminated pl. foram. biotub. boundary
graded?

0.9-20.8 (0-19.9)

MR18-01C MC03 W



0.9 - 20.7 (0 - 19.8)

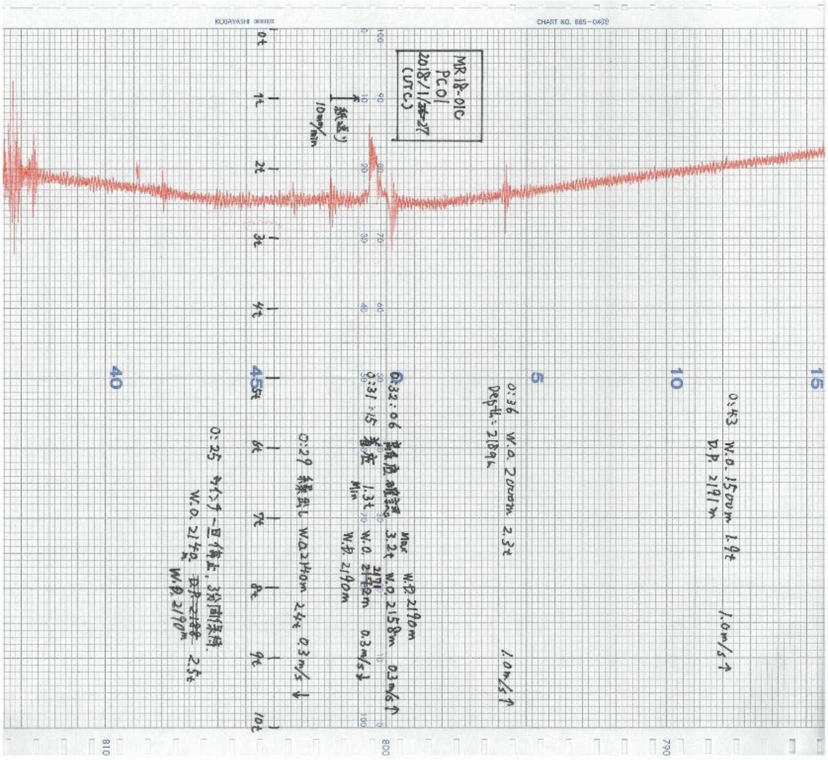
JIS-A4 1mm (250×180) コクヨ ホ-14

Operation Inventory
Winch Cable Tension record

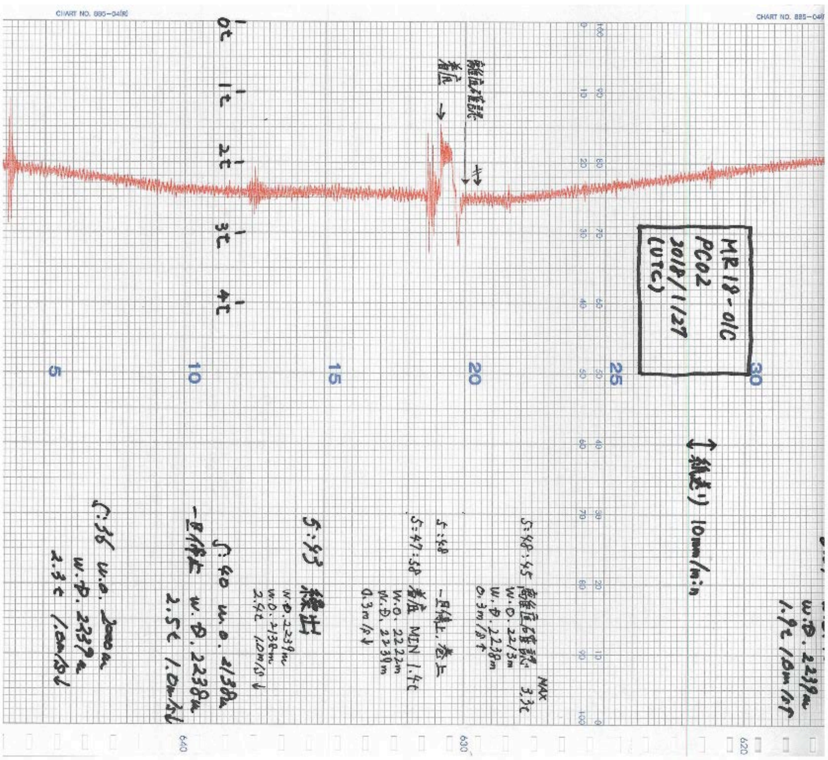
Vertical axis: tension (kn)

Horizontal axis: time

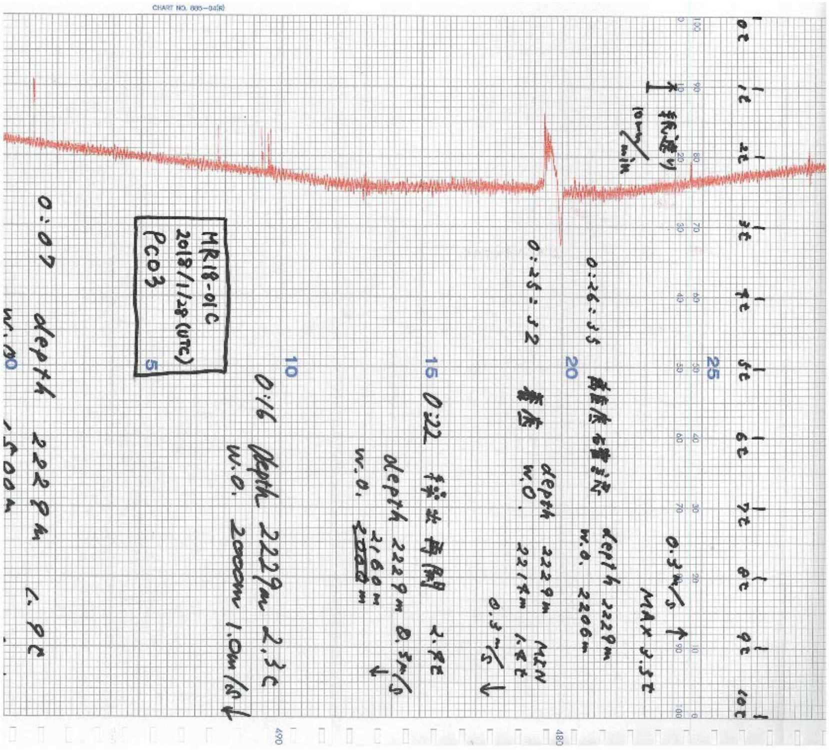
Annotation: Events



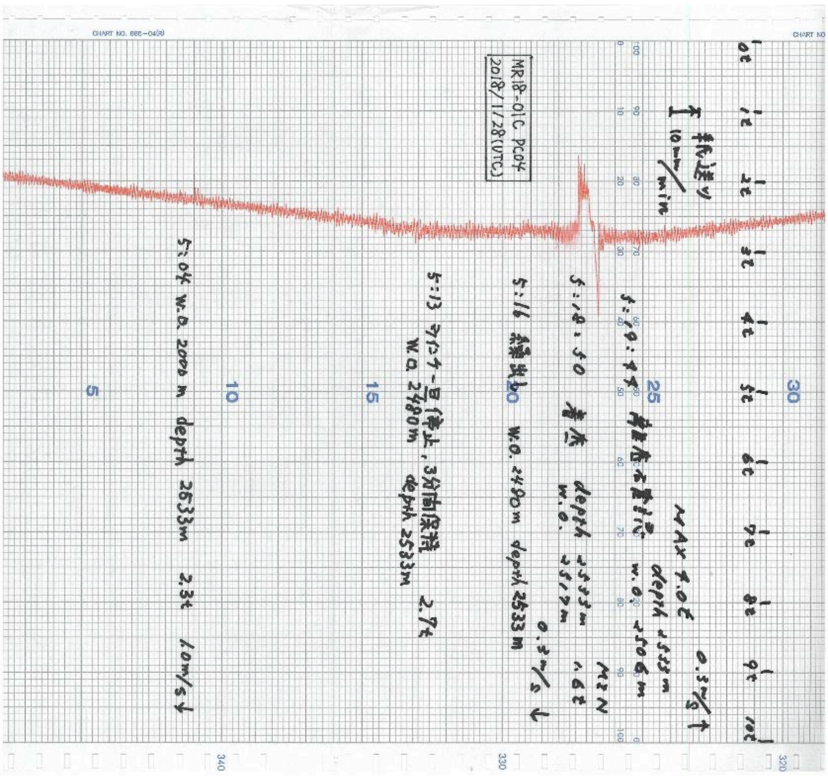
PC01 winch tension record



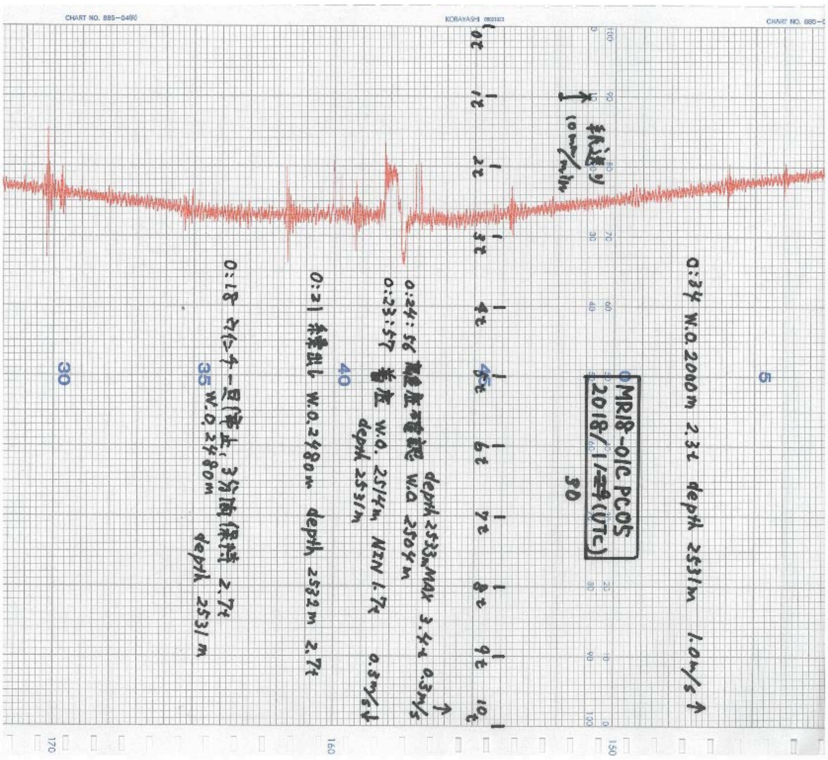
PC02 winch tension record



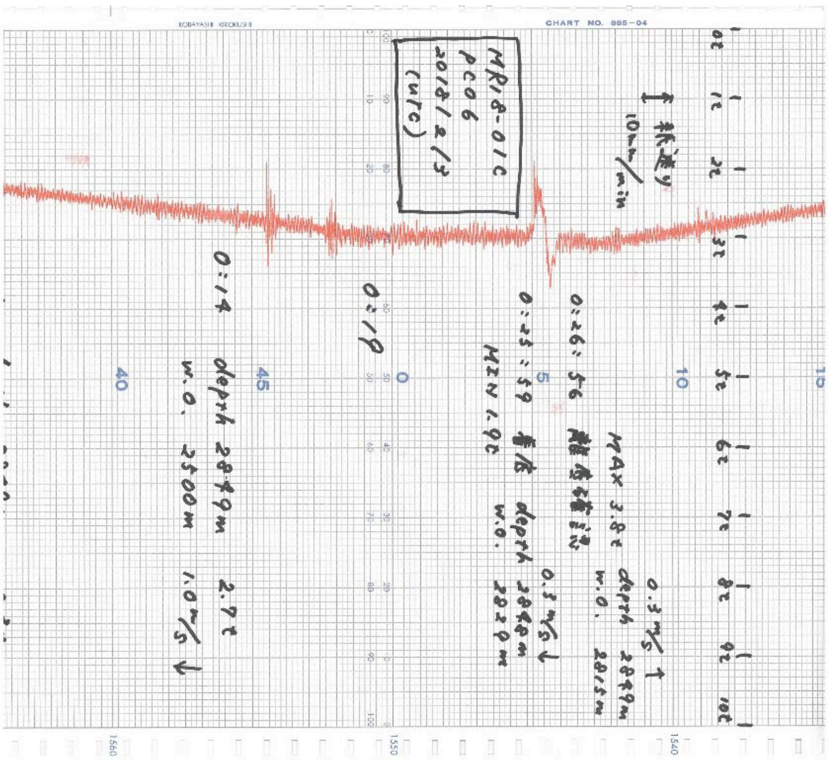
PC03 winch tension record



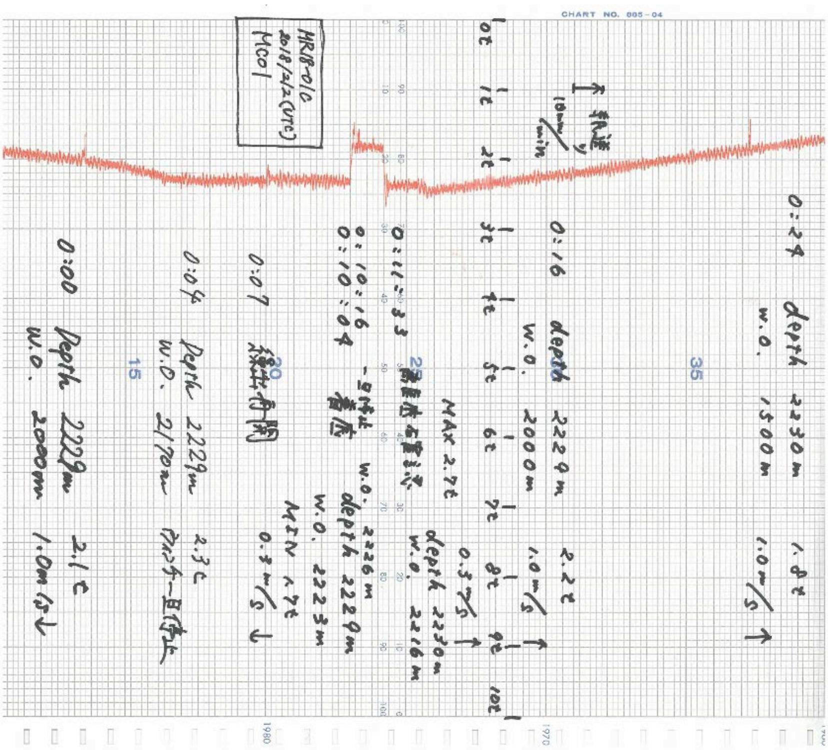
PC04 winch tension record



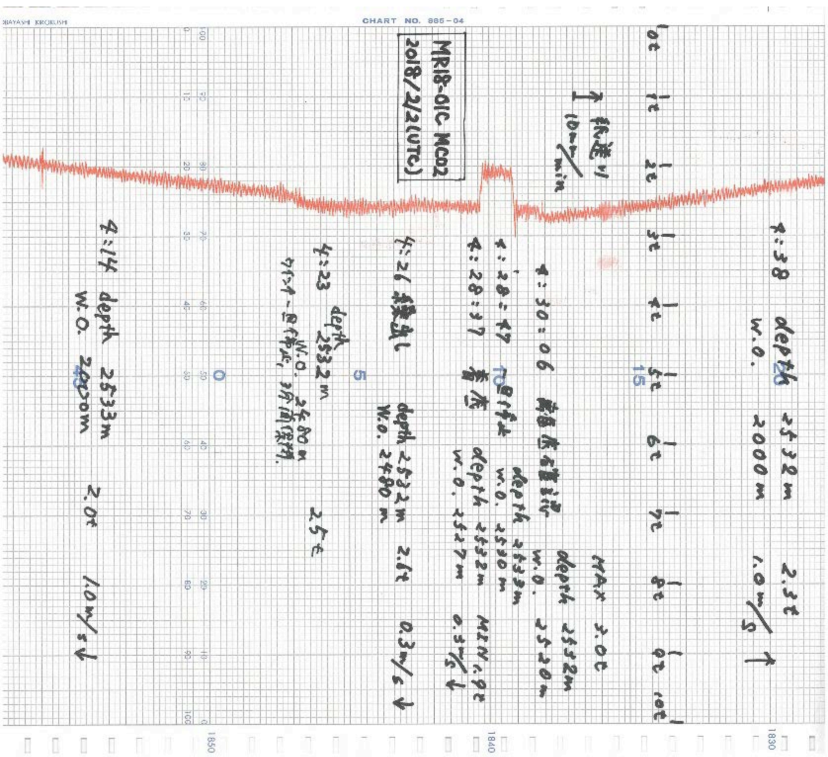
PC05 winch tension record



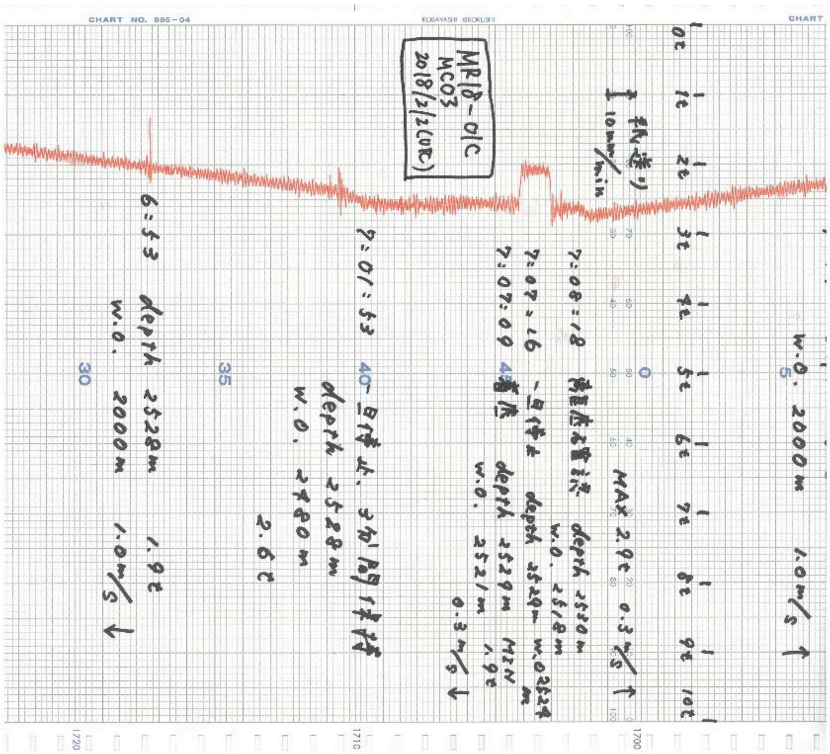
PC06winch tension record



MC01 winch tension record

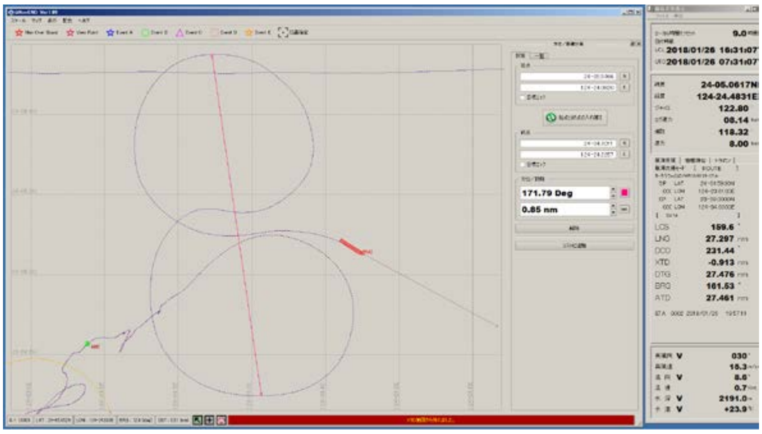


MC02 winch tension record

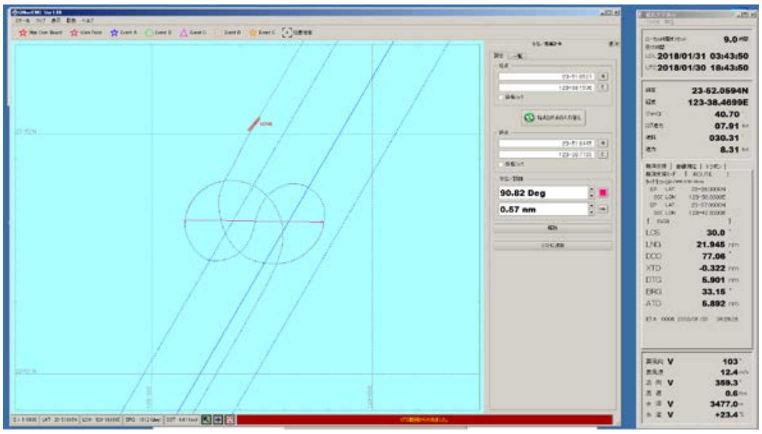


MC03 winch tension record

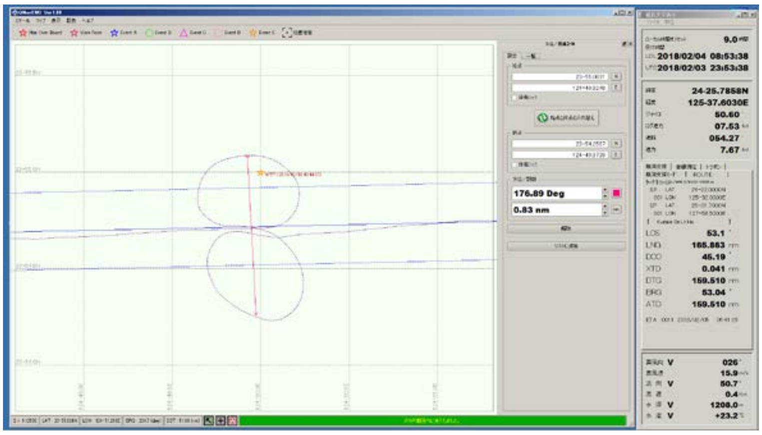
Tracks of eight figure turn



07:06 – 07:28 UTC around at 24-05.10N, 124-24.27E 2018/01/26



18:20 – 18:41 UTC around at 23-51.60N, 123-38.50E 2018/01/31



05:13 – 05:40 UTC around at 23-54.68N, 124-49.96E 2018/02/3