



Preliminary Report
of
the *R/V YOKOSUKA* Cruise YK13-07

High Resolution Topographical and Geological Mapping Survey
of Mud Volcanoes off Tanega-Shima

Aug. 10 - 19, 2013



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

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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.

1. Cruise Information

- Cruise ID YK13-07
- Name of vessel YOKOSUKA and URASHIMA
- Title of the cruise High resolution topographical and geological mapping survey of mud volcanoes off Tanega-shima
- Title of proposal High resolution topographical and geological mapping survey of mud volcanoes off Tanega-shima, southwestern Japan.
- Implication for research on the potential of huge hydrocarbon resources -
- Cruise period Aug. 10 - 19, 2013
- Ports of call Shimizu - Yokosuka
- Research area Off Tanega-shima
- Research Map

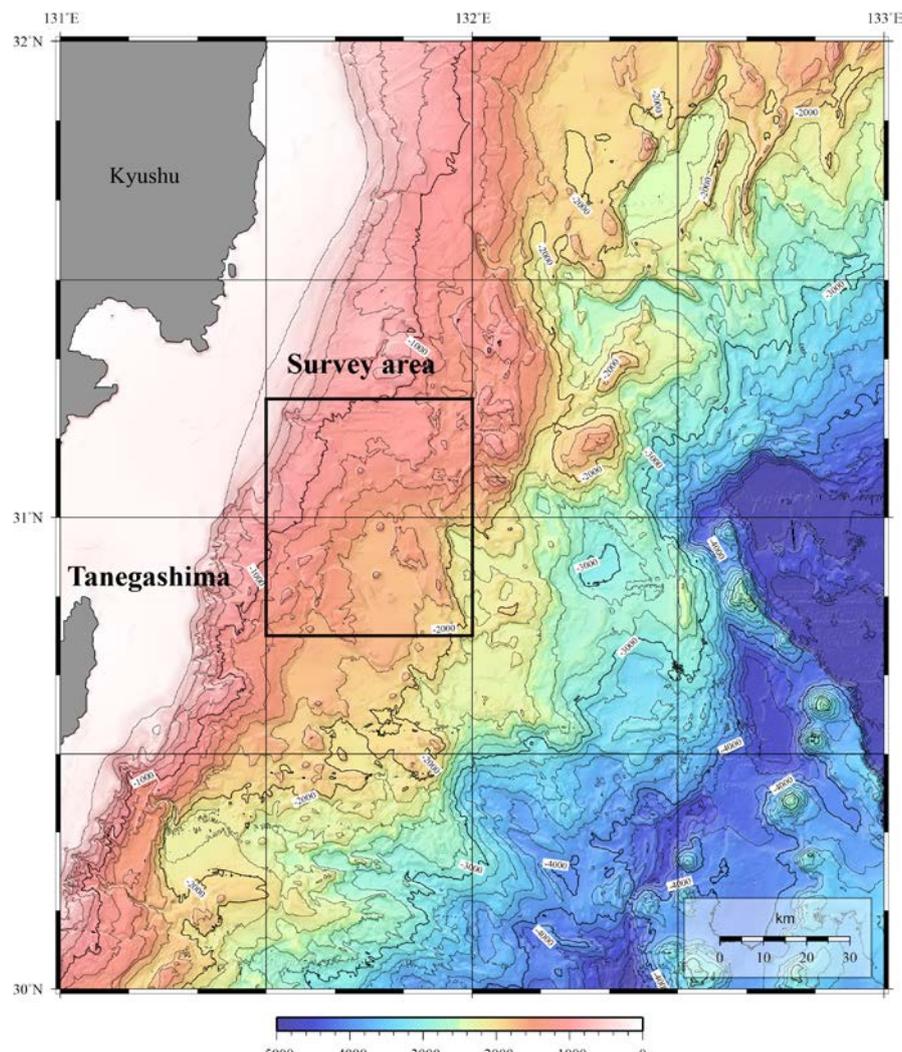


Figure 1 Index map of the survey area

2. Scientific Party

Chief scientist [Affiliation]

Fujio Yamamoto [Japan Agency for Marine-Earth Science and Technology]

Representative of the science party [Affiliation]

Fumio Inagaki [Japan Agency for Marine-Earth Science and Technology]

Participants aboard the R/V YOKOSUKA cruise YK13-07

Fujio Yamamoto [Japan Agency for Marine-Earth Science and Technology]

Koichi Iijima [Japan Agency for Marine-Earth Science and Technology]

Yuka Masaki [Japan Agency for Marine-Earth Science and Technology]

Further details are in Appendix A-1.

3. Introduction

We have completed a total of 3 AUV Urashima dives to collect high resolution topographical and geological data and, magnetometer data. In addition, SeaBeam bathymetric survey and single-channel seismic survey were conducted to understand the detailed the mud volcano structures off Tanega-shima. The details of the shipboard log is shown in Appendix A-2.

4. Objectives

There are more than 50 mud volcanoes off Tanega-shima. Mud volcanoes, common geological features in forearc basin of the plate convergent margin, act as “windows” to depths otherwise inaccessible to sampling, as gas, liquid, and solid particles from up to several kilometers are transported to the Earth’s surface. Also, it has been known that sedimentary samples of fore-arc mud volcanoes sometimes includes methane hydrate. Therefore, it is also expected the fore-arc mud volcano as natural pipeline of methane resource. To reveal the fluid regime in accretionary prism and the potential for methane resource, we investigate mud volcanoes of off Tanega-shima, which have been not investigated well.

5. Operation

In this cruise, a detailed seafloor survey using AUV Urashima, bathymetric survey and a SCS sub seafloor structural survey were conducted. Fig. 2 shows planned SCS survey lines and Urashima survey area (circles).

5.1. Bathymetric survey

Bathymetric survey by using ship's hull mounted SeaBeam2112 (12kHz) was conducted to understand seafloor topography in the survey area.

5.2. Single Channel Seismic survey (SCS)

To understand the seafloor structure, a single channel seismic survey was conducted in the survey area. Bolt's 2800LL-X Cluster gun and SIG 16 streamer cable were used for the SCS survey. The cluster gun system is effective to obtain images for the shallower part, down to a few hundred meters. Specifications for the cluster gun system and SIG streamer cable are as follows.

- Cluster gun system

Manufacturer: Bolt Technology

Type of air gun: 2800LL-X Cluster

Volume: 40 cuin×2

Air pressure: 2000 psi

Source depth: 2.0 m

Dominant frequency (-6 dB): 50 Hz – 300 Hz

- SIG 16 streamer cable

Manufacturer: SIG

Length: 47 m

No. of hydrophones: 48

Hydrophone interval: 1 m

Frequency: 10 – 1,000 Hz

Streamer depth: 4.0 m

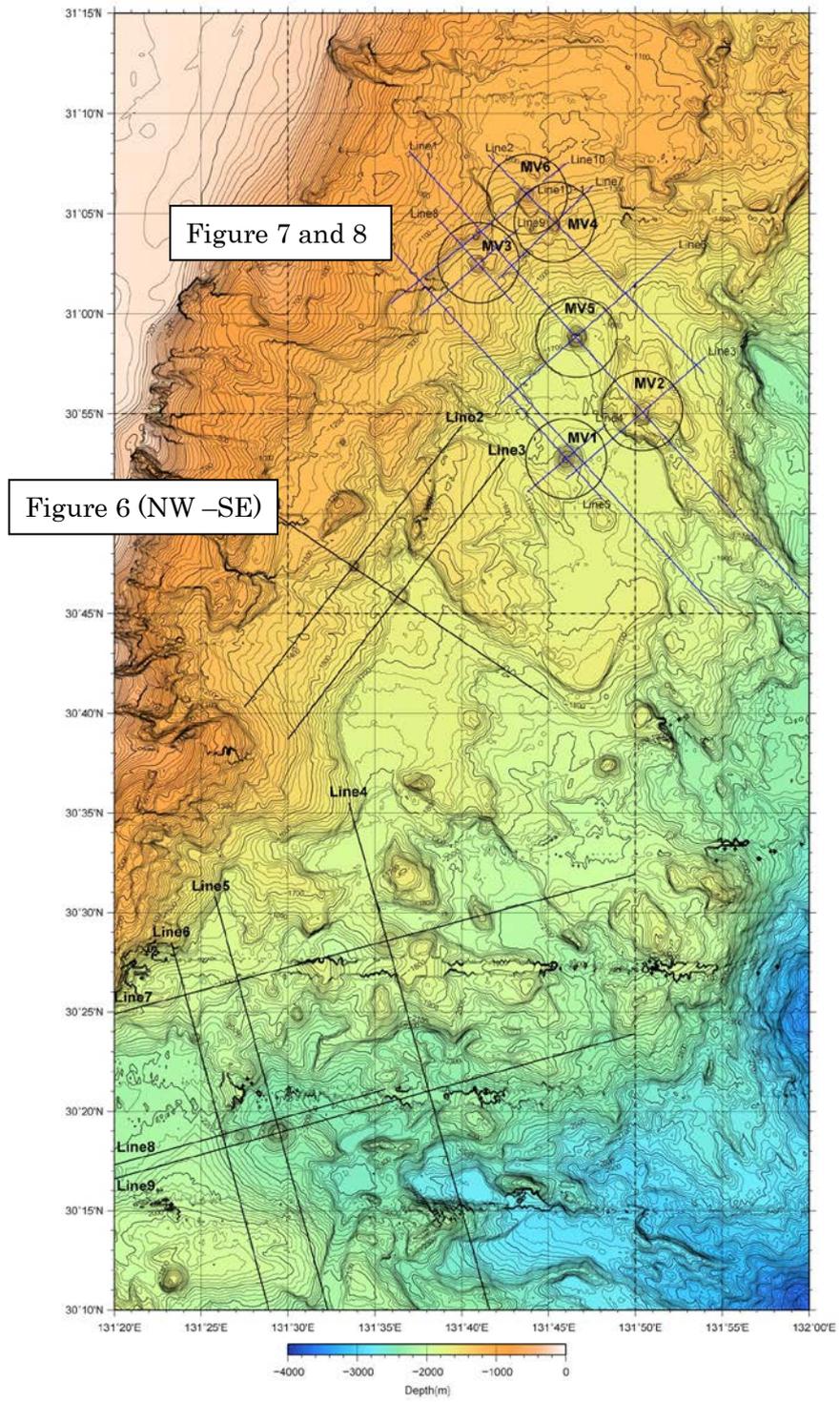


Figure 2 Planned SCS survey lines and Urashima survey area (circles).

5.3. Urashima

The specification of the Urashima is shown in appendix A-3. For the AUV survey, besides the standard acoustic apparatus on Urashima (i.e. SeaBat7125 MBES, Edgetch2000M Side Scan Sonar/Sub Bottom Profiler), following equipments were applied fluxgate magnetometer as the payload.

5.4. Magnetometer

Three-axis flux gate magnetometers were mounted in the payload space on the Urashima. They were still under development as a fundamental tool for seafloor resource study (under a project funded by MEXT); then, their details will be reported elsewhere. One of three was attached to the head part of AUV in the syntactic from buoyancy medium, and other two were to the port and starboard side of the payload space. Appendix A-4 shows the description of the magnetometer.

5.5. Cruising single channel seismic survey

While Urashima was cruising under the water, cruising single channel seismic survey was conducted simultaneously. The system used in this survey consists of 2 parts, data acquisition pressure case and hydrophones.(Fig. 3 and 4). On surface, one cluster gun array (40 cu in*2) towed behind the vessel was used to produce seismic signal.

To receive air-gun signal coming from surface, 10 hydrophones are mounted inside the URASHIMA. Data acquisition pressure case is also mounted in the payload space in the Urashima.

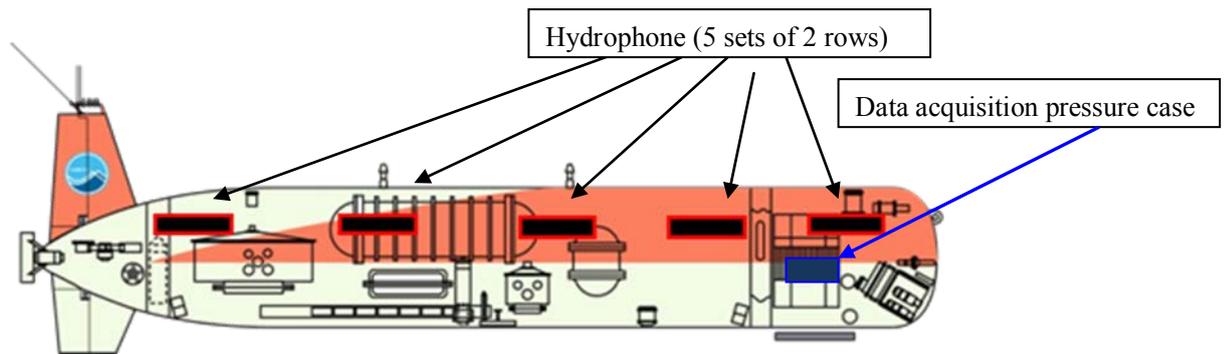


Figure 3 Hydrophones layout



Figure 4 Hydrophone mounted on the Urashima vehicle

6. Cruise track

YK13-07 cruise was started from off Shimizu on Aug. 10 and then, the vessel went to the off Tanega-shima area. 2 dives for AUV Urashima, Single Channel Seismic Survey, and a bathymetric survey were conducted in this area. Finally, the vessel arrived at Yokosuka pier on Aug. 19 and we ended YK13-07 cruise. Fig. 5 shows ship's tracks for the entire YK13-07 cruise and table 1 shows activity log during the cruise.

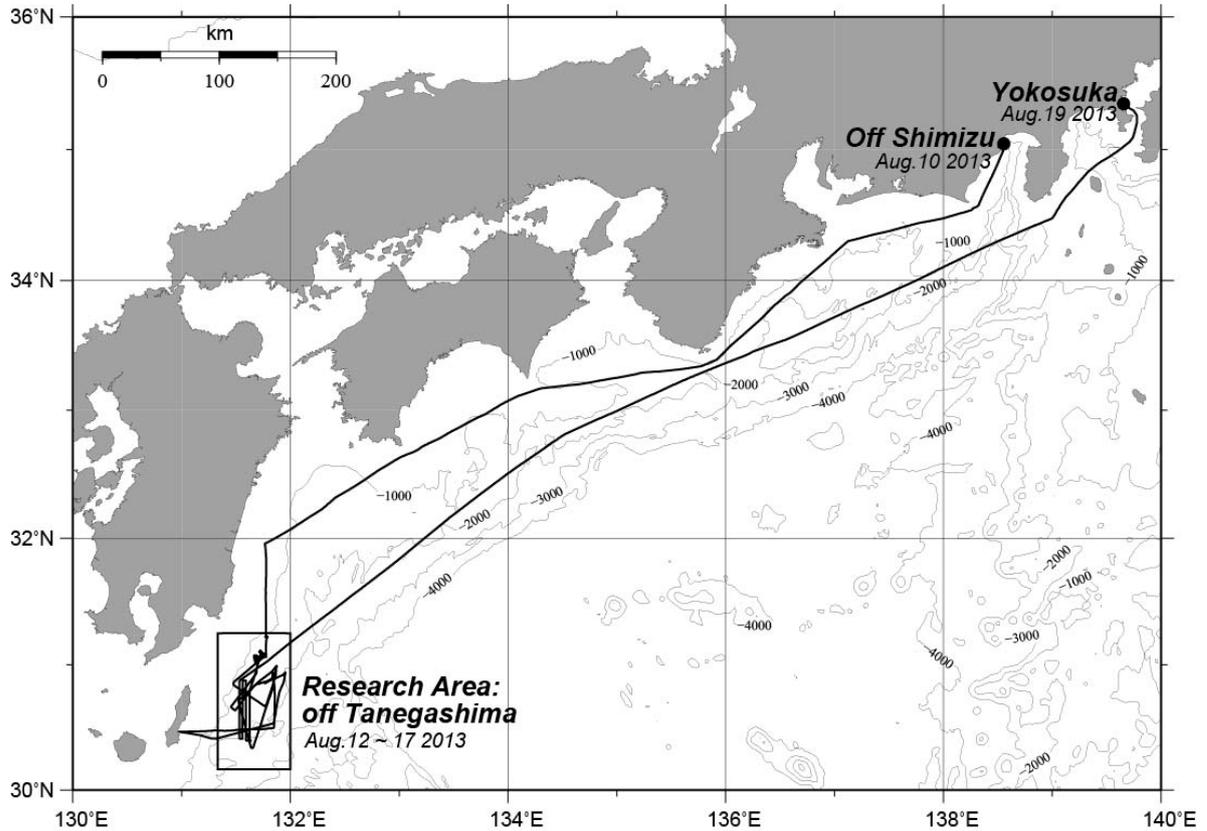


Figure 5 Ship's tracks for the entire YK13-07 cruise

Table 1 Cruise log

Date	Remarks
August 10	Departure from off Shimizu, transit to survey area
11	Transit to survey area
12	Arrival at survey area, XBT measurement, Urashima Dive 156, SCS
13	Urashima Dive 157, SCS
14	SCS
15	SCS, Urashima Dive 158, SCS
16	SCS, Urashima Dive 159, bathymetric survey, XBT measurement
17	Bathymetric survey, transit to Yokosuka
18	Transit to Yokosuka
19	Arrive at Yokosuka

7. Preliminary results

7.1. Bathymetric survey and Single Channel Seismic survey (SCS)

Fig. 6 shows the results of bathymetric survey and SCS conducted during the cruise. A total of 310 km of SCS data was collected in the survey area. Differential Global Positioning System (DGPS) of WGS84 was used for the positioning. Raw SCS reflection data was processed for the purpose of quality control during the cruise. Onboard data processing includes noisy-trace editing, 25 – 500 Hz band-pass filtering. Fig. 7 shows one of the results of the onboard data processing. Interpretation will be performed afterwards.

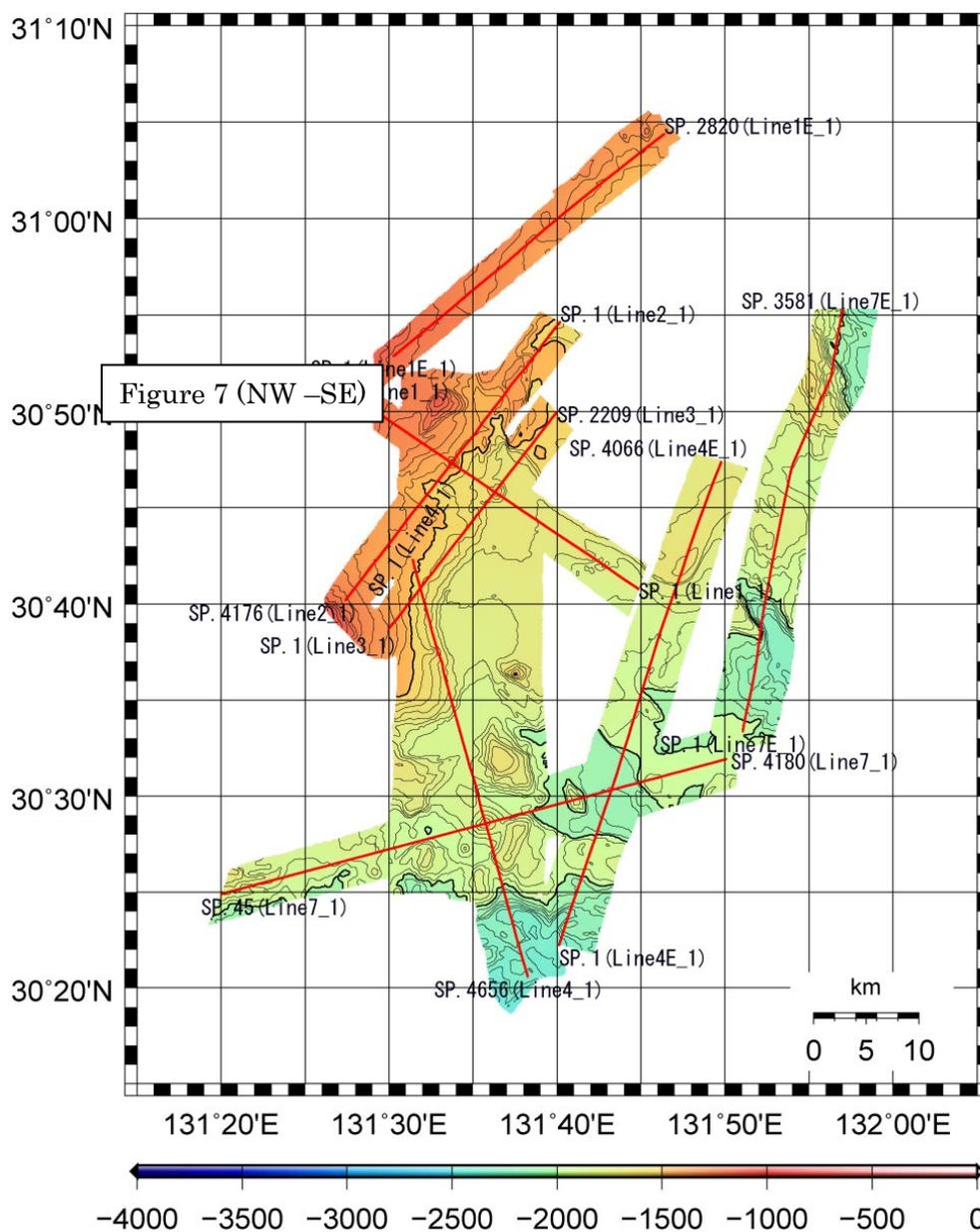


Figure 6 Bathymetric survey lines and SCS lines conducted during YK13-07

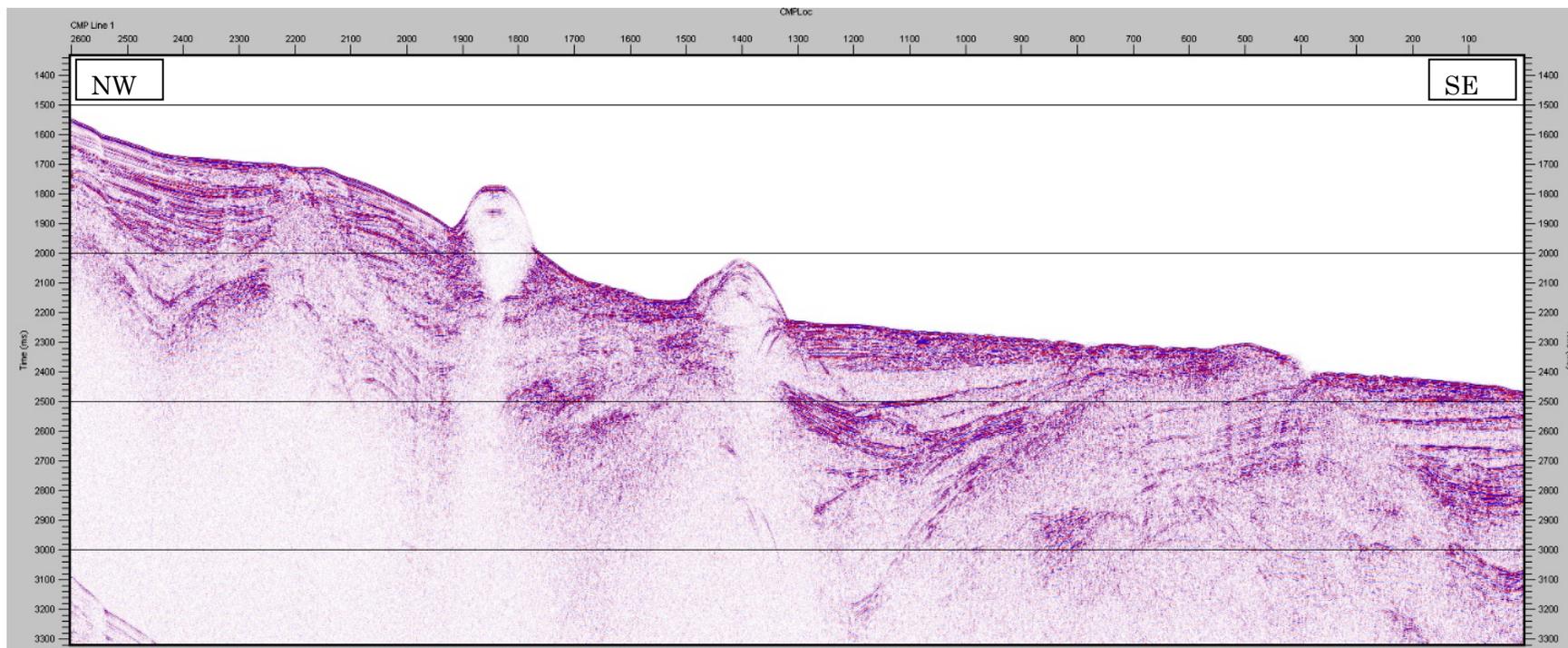


Figure 7 SCS profile along 2 mud volcanoes

7.2. Urashima survey

A total of 71 km of high resolution bathymetric and side scan data were collected in the survey area. Fig. 8 and Fig. 9 show the results of onboard data processing for the Urashima side scan sonar and multi beam echo sounder. MV3 mud volcano is clearly imaged on these figures. Interpretation will be performed afterwards.

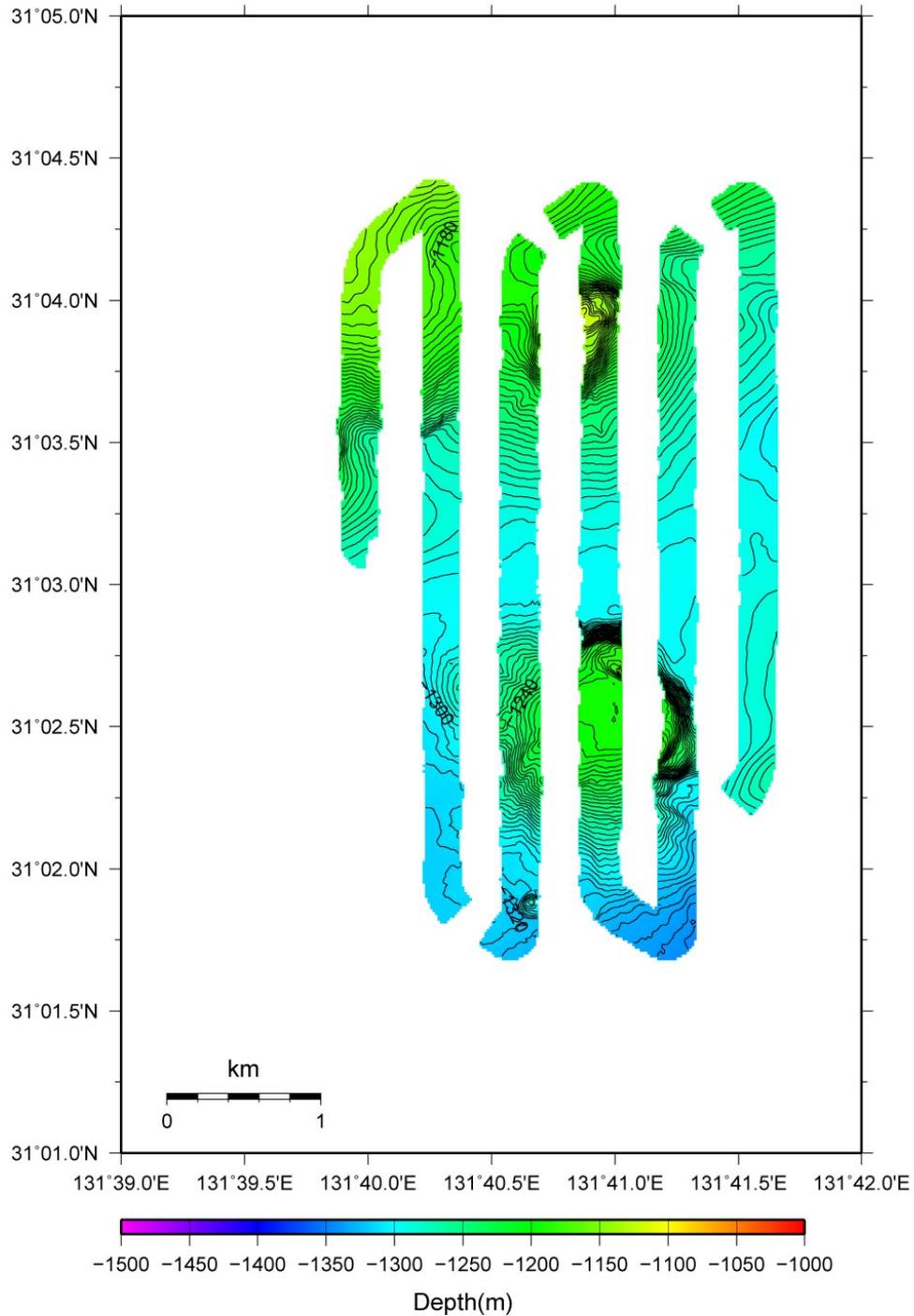


Figure 8 MV3 Bathymetry

YK13-07 URASHIMA_Dive159

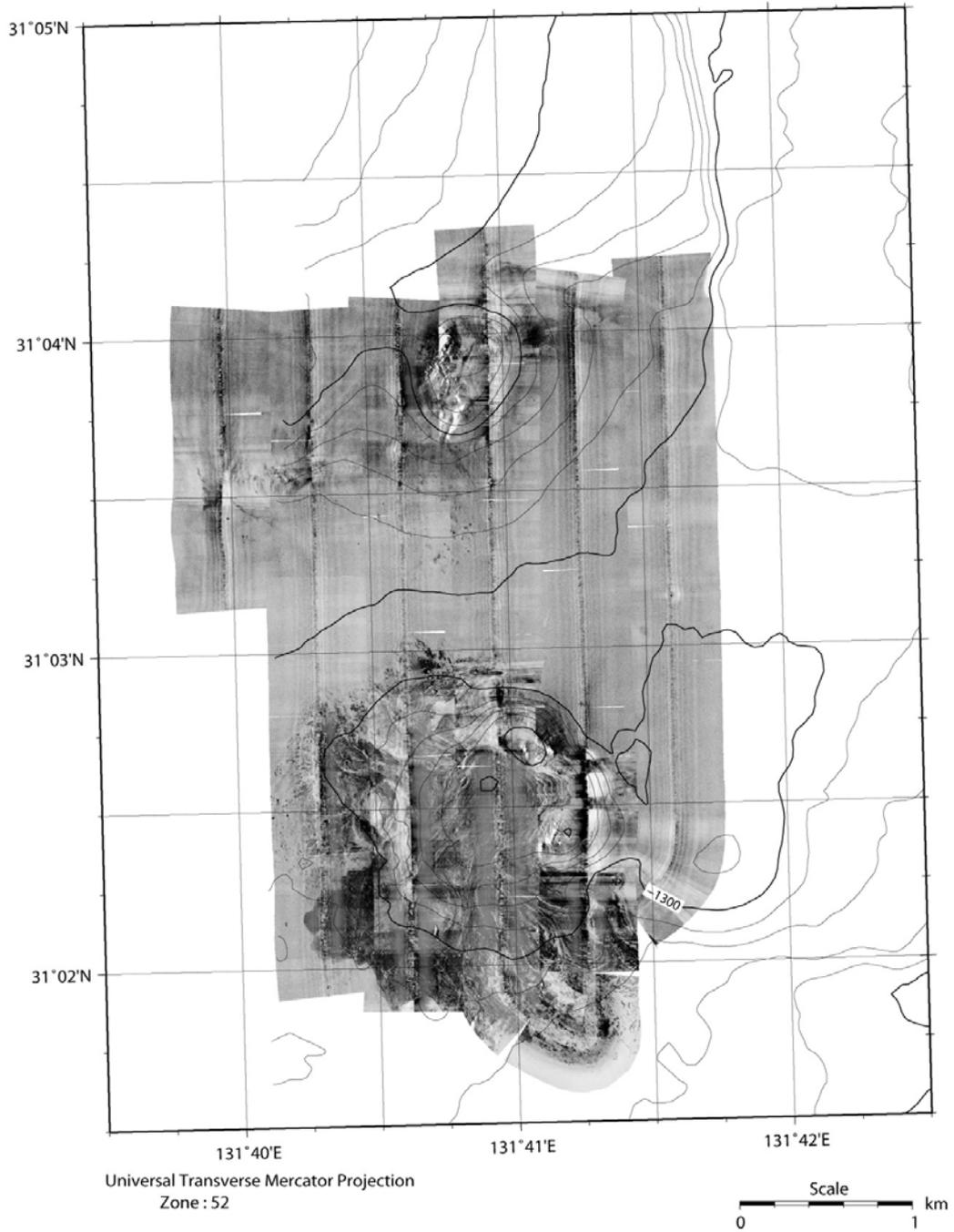


Figure 9 MV3 side scan sonar image overlaid with SeaBeam bathymetry

7.3. Magnetometer

Correction for the vehicle magnetization will be applied for offline data processing. Interpretation will be performed afterwards.

7.4. Cruising single channel seismic survey

Data editing with air gun shot time and band-pass filtering will be applied for offline data processing. Interpretation will be performed afterwards.

8. Acknowledgements

Here we express our sincere appreciation for the excellent support and assistance by Captain Tanaka and his crew, and the operation manager of Urashima, Matsumoto, and his AUV team throughout the cruise.

Appendix A-1

List of participants

Scientists Parties

Fujio Yamamoto	Japan Agency for Marine-Earth Science and Technology
Koichi Iijima	Japan Agency for Marine-Earth Science and Technology
Yuka Masaki	Japan Agency for Marine-Earth Science and Technology

Marine Technician

Masayuki Toizumi	Nippon Marine Enterprises, LTD.
Satoshi Okada	Nippon Marine Enterprises, LTD.
Satomi Minamizawa	Nippon Marine Enterprises, LTD.
Masashi Ito	Nippon Marine Enterprises, LTD.
Toshimasa Nasu	Nippon Marine Enterprises, LTD.

Operation team of URASHIMA

1 st Submersible Technical Officer	Keita Matsumoto
1 st Submersible Technical Officer	Shinobu Omika
2 nd Submersible Technical Officer	Akihisa Ishikawa
2 nd Submersible Technical Officer	Teppey Kido
2 nd Submersible Technical Officer	Seiji Shigetake
2 nd Submersible Technical Officer	Takuma Onishi
3 rd Submersible Technical Officer	Yuta Sakakibara
3 rd Submersible Technical Officer	Masaya Katagiri
3 rd Submersible Technical Officer	Yudai Tayama

Captain and crew of the R/V YOKOSUKA

Captain	Hitoshi Tanaka
Chief Officer	Hiroaki Masujima
2 nd Officer	Tetsuo Shirayama
3 rd Officer	Hiroharu Omae
Chief Engineer	Eiji Sakaguchi
1 st Engineer	Takashi Ota
2 nd Engineer	Kenta Ikeguchi
3 rd Engineer	Shota Nagano
Chief Electronic Operator	Masamoto Takahashi
2 nd Electronic Operator	Hiroki Ishiwata

3 rd Electronic Operator	Ryousuke Komatsu
Boat Swain	Masanori Ohata
Able Seaman	Kazumi Ogasawara
Able Seaman	Naoki Iwasaki
Able Seaman	Jiro Hanazawa
Sailor	Hiroataka Shigeta
Sailor	Yoshihiro Ogawa
No.1 Oiler	Kazuaki Nakai
Oiler	Yuji Higasigawa
Oiler	Masayuki Fujiwara
Oiler	Toshinori Matsui
Assistant Oiler	Ryo Sato
Chief Steward	Sueto Sasaki
Steward	Hideo Fukumura
Steward	Masanao Kunita
Steward	Kazuma Sonoda
Steward	Nakamichi Kanda

Appendix A-2

YK13-07 Shipboard Log

Date	Local Time	Note	Position/Weather/Wind/Sea condition
10-Aug-13		Left SHIMIZU then started YK13-07	8/10 12:00(UTC+9h)
	16:05	8 persons(scientists & marine technicians) came onboard by traffic board.	34-56.5N 138-37.9E
	16:15	Com'ced proceeding to research area, then started YK13-07.	Fine but cloudy South-2(Light breeze) 2(Sea smooth) 1(Low swell sea) Visibly:4'
11-Aug-13		Proceeding to research area	8/11 12:00(UTC+9h)
	8:30-9:00	On board education for scientists.	33-10.7N 134-25.3E
			Fine but cloudy NE-2(Light breeze) 2(Sea smooth) 1(Low swell sea) Visibly:4'
12-Aug-13		URASHIMA#156 & S.C.S survey	8/12 12:00(UTC+9h)
	4:30	Arrived at research area.	31-05.2N 131-44.8E
	4:30-4:50	Carried out figure 8 turn.	Fine but cloudy
	5:58	Released XBT.	NE-2(Light breeze)
	7:28	URASHIMA dove & started her operation#156.	2(Sea smooth)
	8:38-8:45	Launched AIR-GUN.	1(Low swell sea)
	9:01-9:08	Veered out streamer cable.	Visibly:6'
	9:25	Com'ced S.C.S. survey.	
	14:25	Finished S.C.S. survey.	
	14:25-14:30	Took in streamer cable.	
	14:57-15:00	Recovered AIR-GUN.	
	17:17	Recovered URASHIMA, then finished above operation.	
	18:33-18:40	Launched AIR-GUN.	
18:42-18:45	Veered out streamer cable.		
19:38	Com'ced S.C.S. survey.		
13-Aug-13		URASHIMA#157 & S.C.S survey	8/13 12:00(UTC+9h)
	6:00	Finished S.C.S. survey.	30-57.1N 131-51.9E
	6:01-6:05	Took in streamer cable.	Fine but cloudy
	6:06-6:15	Recovered AIR-GUN.	West-2(Light breeze)
	9:46	URASHIMA dove & started her operation#157.	2(Sea smooth)
	13:44	Recovered URASHIMA, then finished above operation.	1(Low swell sea)
	15:57-16:03	Veered out streamer cable.	Visibly:8'
16:05-16:07	Launched AIR-GUN.		
16:23	Com'ced S.C.S. survey.		
14-Aug-13		Suspended URASHIMA operation & carried out S.C.S survey	8/14 12:00(UTC+9h)
	6:00	Finished S.C.S. survey.	30-28.7N 131-25.8E
	6:01-6:06	Took in streamer cable.	Fine but cloudy
	6:07-6:17	Recovered AIR-GUN.	NNW-2(Light breeze)
	7:55	Suspended URASHIMA operation, due to mechanical trouble.	2(Sea smooth)
	16:10	1 person came onboard(scientist) by traffic boat.	1(Low swell sea)
17:33-17:44	Launched AIR-GUN.	Visibly:8'	
17:34-17:39	Veered out streamer cable.		
18:10	Com'ced S.C.S. survey.		
15-Aug-13		URASHIMA#158 & S.C.S survey	8/15 12:00(UTC+9h)
	6:00	Finished S.C.S. survey.	30-54.7N 131-51.4E
	6:00-6:05	Took in streamer cable.	Fine but cloudy
	6:06-6:12	Recovered AIR-GUN.	SE-3(Gentle breeze)
	8:33	URASHIMA dove & started her operation#158.	2(Sea smooth)
	11:30-11:40	Launched AIR-GUN.	1(Low swell sea)
	11:40	Com'ced S.C.S. survey.	Visibly:7'
	13:06	Finished S.C.S. survey.	
	13:07-13:11	Took in streamer cable.	
	13:12-13:19	Recovered AIR-GUN.	
16:42	Recovered URASHIMA, then finished above operation.		
18:24-18:29	Veered out streamer cable.		
18:30-18:34	Launched AIR-GUN.		
18:42	Com'ced S.C.S. survey.		

16-Aug-13		URASHIMA#159 & S.C.S survey	8/16 12:00(UTC+9h)
	3:30	Finished S.C.S. survey.	31-03.4N 131-40.9E
	5:59-6:05	Took in streamer cable.	Fine but cloudy
	6:06-6:15	Recovered AIR-GUN.	East-2(Light breeze)
	7:15	URASHIMA dove & started her operation#159.	2(Sea smooth)
	9:45-9:49	Launched AIR-GUN.	1(Low swell sea)
	9:56	Com'ced S.C.S. survey.	Visibly:8'
	11:39	Finished S.C.S. survey.	
	11:45-11:50	Recovered AIR-GUN.	
	14:54-15:00	Launched AIR-GUN.	
	15:04	Com'ced S.C.S. survey.	
	15:37	Finished S.C.S. survey.	
	15:39-15:46	Recovered AIR-GUN.	
	16:39	Recovered URASHIMA, then finished above operation.	
	18:40	Com'ced MBES mapping survey.	
	20:44	Released XBT.	
	20:55-21:16	Carried out figure 8 turn.	
17-Aug-13		Left research area	8/17 12:00(UTC+9h)
	6:04	Finished MBES mapping survey.	31-44.9N 132-52.4E
	6:04	Left research area, then com'ced proceeding to YOKOSUKA.	Fine but cloudy
			ESE-4(Moderate breeze)
			2(Sea smooth)
			1(Low swell sea)
			Visibly:8'
18-Aug-13		Proceedint to YOKOSUKA	8/18 12:00(UTC+9h)
	15:50	Let go anchor, then arrived at YOKOSUKA section4.	34-48.3N 139-17.8E
			Fine but cloudy
			SSW-4(Moderate breeze)
			2(Sea smooth)
			1(Low swell sea)
			Visibly:8'
19-Aug-13		Arrived at YOKOSUKA	
	8:00	Heaving anchor, then com'ced proceeding to YOKOSUKA.	
	8:55	Sent out 1st shore line,arrived at YOKOSUKA, then completed YK13-07.	

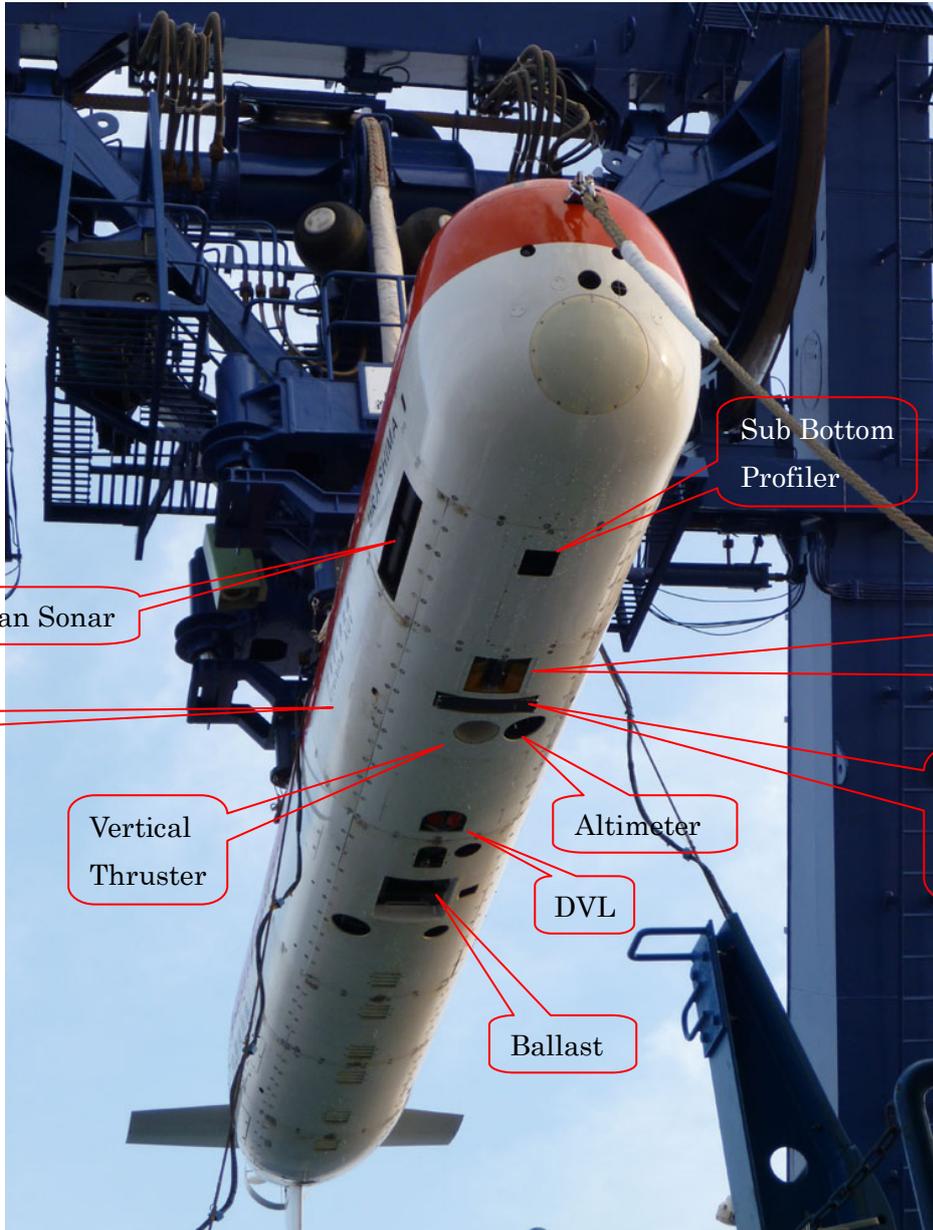
Appendix A-3

General description of AUV Urashima

Autonomous Underwater Vehicle (AUV) Urashima is cruised by itself for built in control system. It is not connected by the cable between the mother vessel, therefore it can survey the sea floor widely and clearly. There are acoustic sonar equipments and sensors, Side Scan Sonar, Sub Bottom Profiler, Multi Narrow Beam Echo Sounder, and CTDO sensor.

Table A. : The specifications of AUV Urashima

Dimensions	Length (m)	10
	Width (m)	1.3
	Height (m)	1.5
	Weight (t)	6.5
Max Depth	3500 m	
Cruising Speed	3 kt	
Positioning	Inertial Navigation System Doppler Sonar SSBL Sonar	
Operation Mode	Autonomous Remote (Acoustic, Optical)	
Payload	200 kg in air	
Equipments	Side Scan Sonar (2200-M / Edge Tech Sub Bottom Profiler (DT106 / Edge Tec) Multi Narrow Beam Echo Sounder (SeaBat 7125 / Reson) CTDO (SBE9plus / SeaBird ELC.)	



Side Scan Sonar

CTDO

Vertical Thruster

Ballast

Sub Bottom Profiler

Altimeter

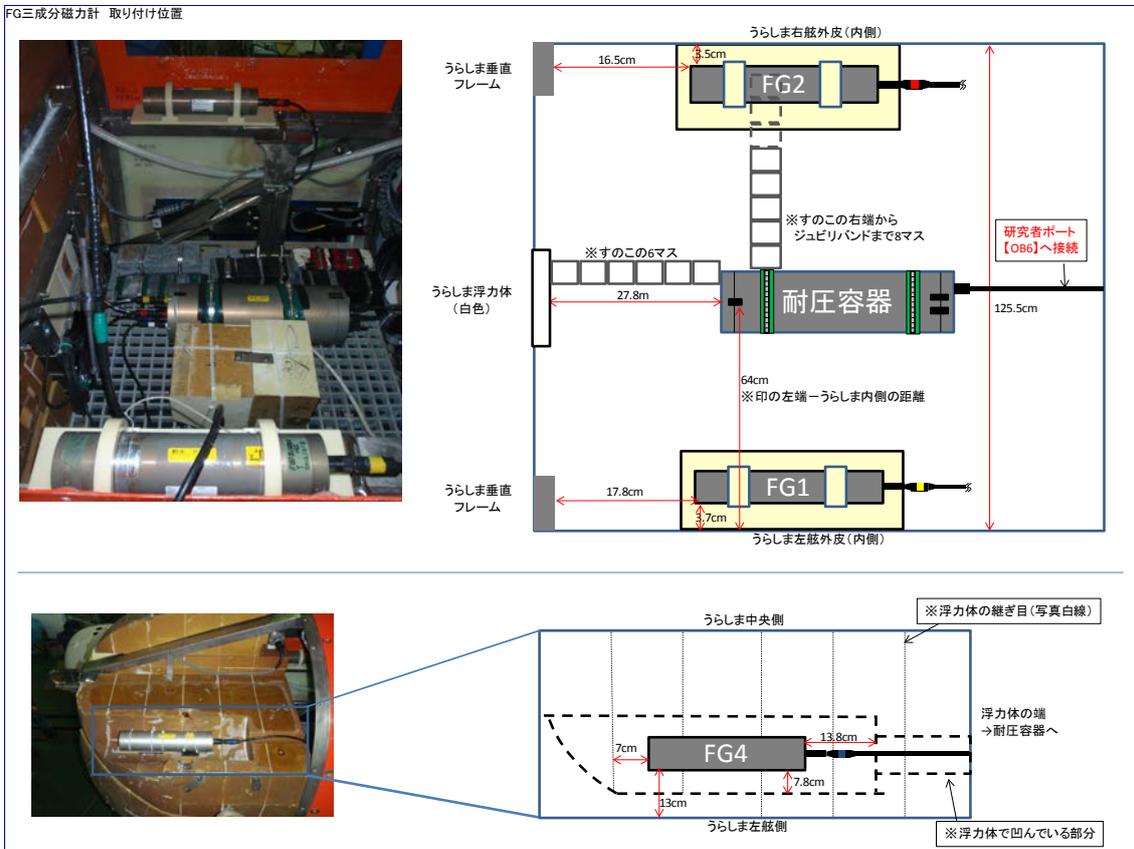
DVL

Multi Beam Echo Sounder : Projector

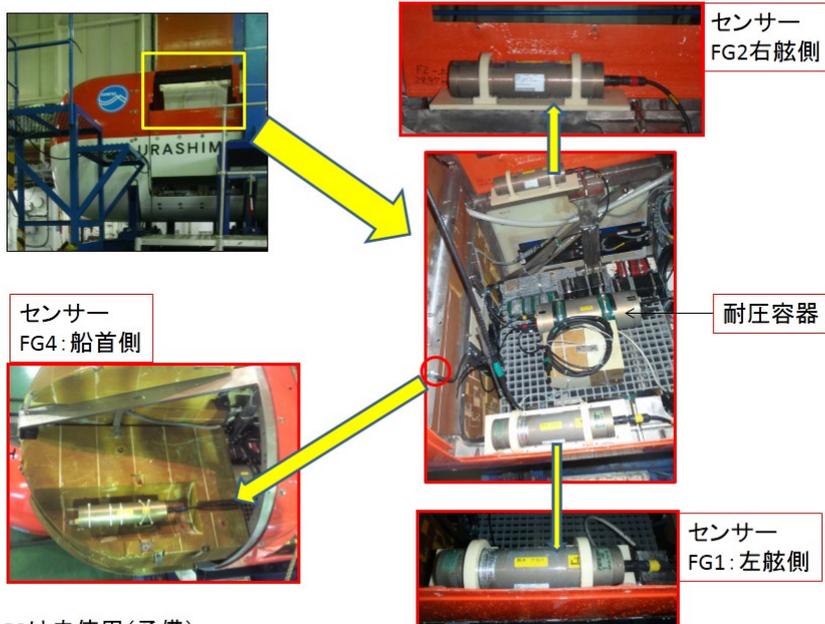
Multi Beam Echo Sounder : Receiver

Appendix A-4

General description of Three-axis flux gate magnetometers



FG3成分磁力計



※FG3は未使用(予備)