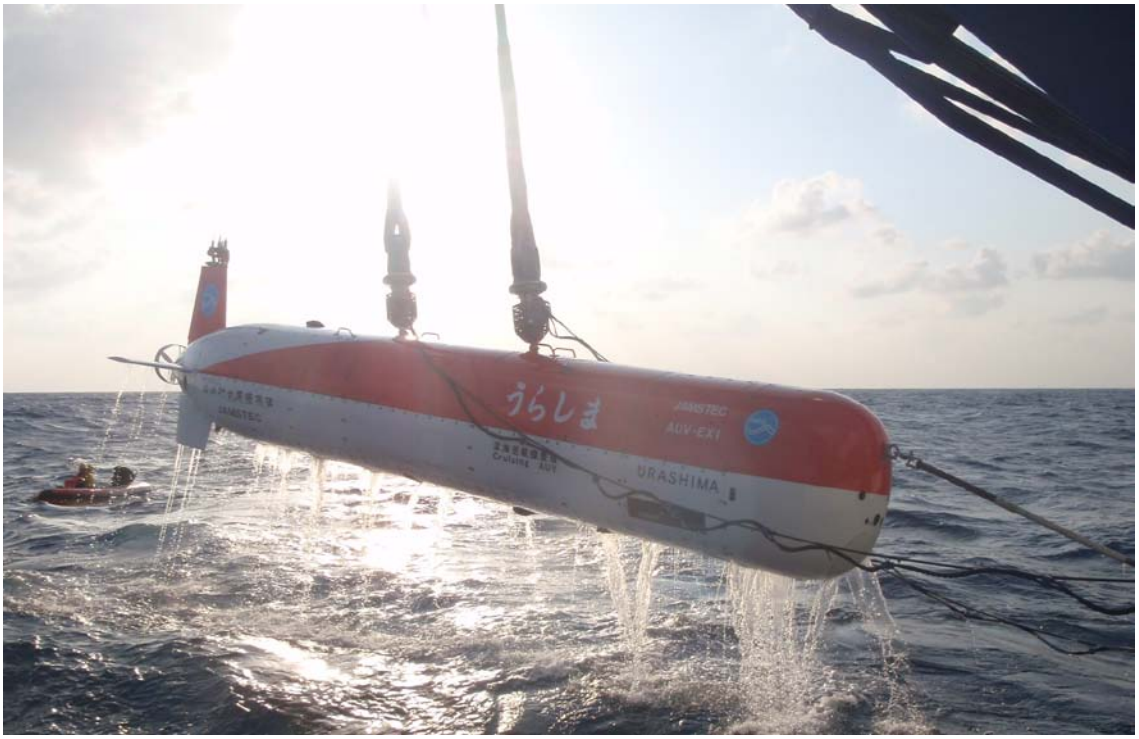
doi : 10.17596/0003063

Yokosuka/Urashima “Cruise Report”

YK12-16



The first trial of wholesale arrests of hydrothermalism in Mid-Okinawa Trough

Sept.24, 2012-Oct.03, 2012

Japan Agency for Marine-Earth Science and Technology

(JAMSTEC)

● Contents ●

1. Cruise Information

● Cruise ID: YK12-16

● Name of vessel: Yokosuka/Urashima

● Title of the cruise: The first trial of wholesale arrests of hydrothermalism in Mid-Okinawa Trough

● Title of proposal: Distribution estimate of Hydrothermalism in Mid-Okinawa Trough

● Cruise period: Sept. 24 – Oct. 3, 2012

● Ports of call: Naha - Naha

● Research area: Iheya-Small Ridge (or Iheya-Depression Median Ridge), Mid Okinawa Trough

● Research Map

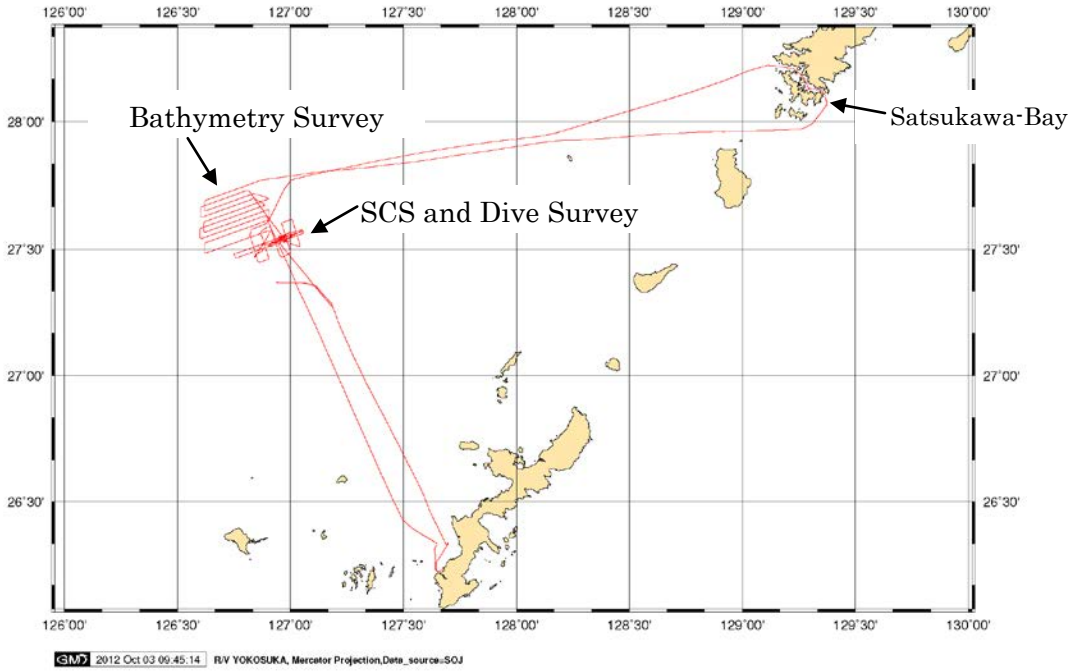


Figure 1: Navigation Track of YK12-16 Cruise

2. Scientific Party

● Chief scientist:

Hidenori Kumagai [Seafloor Resources Research Project/ IFREE, JAMSTEC]

● Representative of the science party:

Hidenori Kumagai [Seafloor Resources Research Project/ IFREE, JAMSTEC]

● Science party:

Hideaki Machiyama [Assoc. Chief Sci., Seafloor Resources Research Project, JAMSTEC]

Yoshiro Nishio [On-Board Sci., Seafloor Resources Research Project, JAMSTEC]

Kentaro Nakamura [Shore-based Sci., Seafloor Resources Research Project/PEL, JAMSTEC]

Shinsuke Kawagucci [Shore-based Sci., Seafloor Resources Research Project/BioGeos, JAMSTEC]

Kei Okamura [Shore-based Sci., Kochi Univ.]

Takafumi Kasaya [Shore-based Sci., Seafloor Resources Research Project/ IFREE, JAMSTEC]
Takeshi Tsuji [Shore-based Sci., Seafloor Resources Research Project, JAMSTEC/ Univ. Kyushu]
Miho Asada [Shore-based Sci., Seafloor Resources Research Project/IFREE, JAMSTEC]
Yuka Masaki [Shore-based Sci., Seafloor Resources Research Project/IFREE, JAMSTEC]
Further details are in Appendix A-1.

3. Introduction

3.1. Objectives

In order to start some quantitative evaluation for seafloor resources (metal/metal sulfide), current status of the seafloor resource research is quite insufficient. To overwhelm this situation, less-biased systematic recognition of the seafloor hydrothermalism is required. As the first step, a total capture of hydrothermal activity in particular area is needed. However, traditional method of discovery to any hydrothermal activities seems not to be suitable for this demand. Thus, we planned a methodological trial using couples of remote-sensing sensors without water sampling.

3.2 Backgrounds

Mid Okinawa Trough is the first discovery area of hydrothermalism in Western Pacific in mid-80s (Kimura et al., 1987). After the discovery, extensive dive or deep-tow survey were carried out in late 80s and early 90s to locate hydrothermalism. The hydrothermal sites found by those explorations are relatively shallow, shallower than 2000m W.D., Shinkai2000 was mainly used even though Shinkai6500 be in service. After the retirement of shinkai2000, rather limited dive surveys were carried out besides the two vicinity areas (Izena cauldron and Iheya-North knoll). Recent rapid growing interests in sea floor resources, hydrothremalism in Mid Okinawa Trough attracts much more interests as potential sites for metal sulfide resources in public. In this context, Iheya-North Knoll and Izena-Hole have been much extensively studied these a few years. In contrast, the earliest known hydrothermal sites on Iheya-small Ridge have not studied intensively to date. It may relate to the rather low temperature activity compared to the above described two sites. However, in terms of the amounts of resources, active vent areas may be young, which seems to be disadvantage to obtain precipitated sulfides. On the other hand, an old and inactive vent areas may face to its termination due to the self-sealing of their fluid path, which may result in the rather large piles of deposits.

Thus, in this cruise, a total capture of hydrothermal activity in the study area was planned because some large-size hydrothermal sulfide deposits have been anticipated in Mid-Okinawa Trough. As the first step, mapping of acoustic scattering in water column coupled with chemical and physical sensing was carried out at Iheya-small ridge (or Iheya-Depression Median Ridge) by using AUV Urashima. Further, Single channel seismic survey (SCS survey) was also conducted in order to investigate shallow sedimental/crustal structure being fluid/water path for hydrothermal activities.

In the studied area, there is a well known hydrothermal field, the CLAM site, 27.55°N, 126.97°E The area was extensively studied on their fluid chemistry, geological nature and biota in late 1980s to early 1990s (cf. Tanaka et al.,1989; Gamo et al., 1991). Its recent activity was observed at Dive#1183 of HyperDolphin in NT10-17 cruise (Observer: K. Fujikura).

4. Operation

This expedition was planned as a 10-days cruise including seven Urashima dives and 1-day SCS survey; the original proposal consisted of 15 Urasima-dives and a 2-day SCS. The cruise commenced from Naha-port on 24th September, 2012 and headed to the survey area. The first dive in this cruise was done on 25th September (Dive #149). On the evening of 25th September, an extreme typhoon 1217 approached to the survey area, then, SCS survey was carried out besides the AUV dive survey. During the SCS survey, fifth track of seven planned ones, the survey ceased and the vessel started escape from the typhoon. The evacuation lasted four days at/around Koniya-Bay near Amami-O shima. The vessel returned the survey area on the evening of 1st October to start the regional bathymetric survey. On 2nd October, the second Urashima-AUV dive was carried out in the vicinity of the previous dive. The expedition was ended on 3rd October at Naha port (Figure 1). Detailed cruise (ship) log are in Appendix A-2.

4.1 Methods and equipments

In this cruise, a detailed seafloor survey using AUV Urashima and a SCS sub seafloor structural survey were conducted.

Although the standard method to locate some hydrothermal activities are a series of CTD-casts and following ROV/HOV survey to confirm the active vents, such method is time and manpower consuming. Thus, in this survey, an acoustic-base method coupling w/ chemical and (geo-) physical sensors were applied (Kumagai et al., 2010). Basic properties of AUV-Urahsima are in appendix A-3.

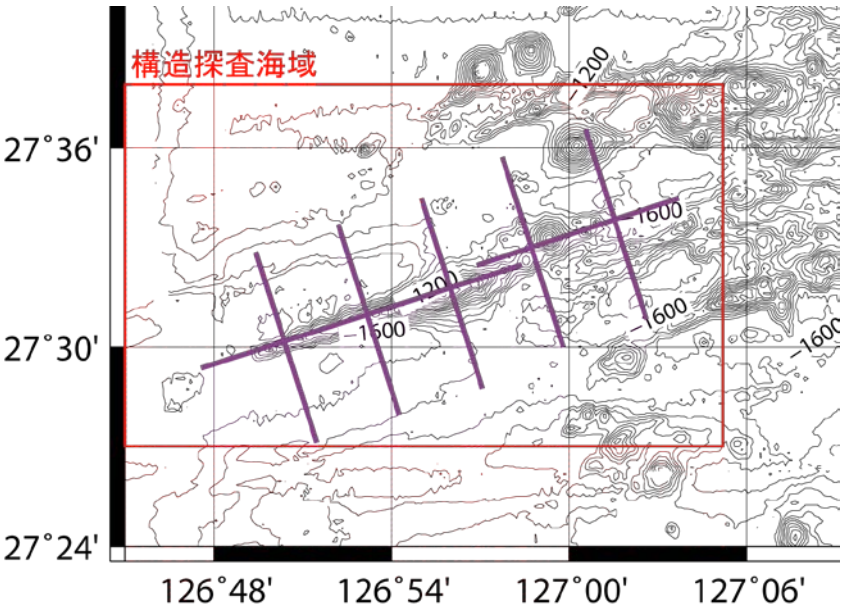


Figure 2: SCS survey tracks proposed (solid purple lines). Red box is the proposed survey area.

In order to obtain shallow sub seafloor structure, SCS survey was planned on the five across ridge lines and two along ridge lines (Figure 2). Detailed assemblages of the SCS survey are in appendix A-4.

For the AUV survey, besides the standard acoustic apparatus on Urashima (i.e. SeaBat7125 MBES, Edgetech2000M Side Scan Sonar/Sub Bottom Profiler), following equipments were applied as the payloads: three components fluxgate magnetometer, turbidity meters and Oxidation-Reduction Potential sensor (ORP sensor). Assemblage of sensors in each dive is in Appendix A-5. Instrumental details of equipments are as follows.

4.1.1 Magnetometer

Three of three-component flux gate magnetometers were attached as payloads for 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 form buoyancy medium (Figure 3), and other two were to the port and starboard side of the payload space (Figure 4).

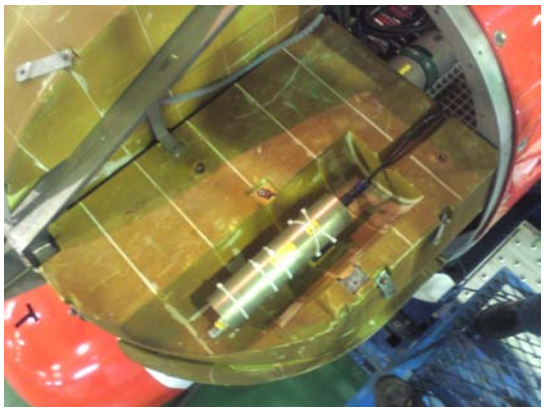


Figure 3: magnetometer in buoyancy medium

Figure 4: magnetometers in the payload space

4.1.2 Turbidity meter

Two of a commercial turbidity meter, ATU3-CMP (Alec Electronics Co Ltd, Kobe, Japan) were used in this survey. This is a standalone infrared back scattering sensor type apparatus. Urashima is also has its own turbidity meter in its bottom part. One of two was attached as down-looking setting nearby the Urashima's one and the other was upward looking setting in the front of the upper tail wing of Urashima.

4.1.3 Oxidation-Reduction Potential sensor (ORP sensor).

Recently remote-sensing-base method is widely applies to hydorthermal explorations (e.g. Yoerger et al., 2007). In such method, Eh-sensor using Pt-electrodes is usually applied (e.g. Stranne et al., 2010). In this cruise, similar sensor developing by K. Okamura is also partly used. This apparatus is still under development, details will be reported elsewhere.

4.2 Dive information

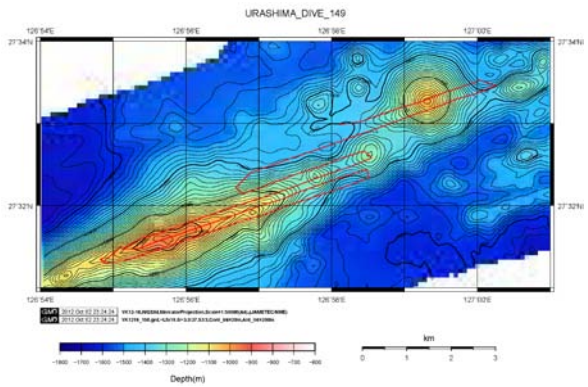


Figure 5: Dive track at 149th dive of Urashima.

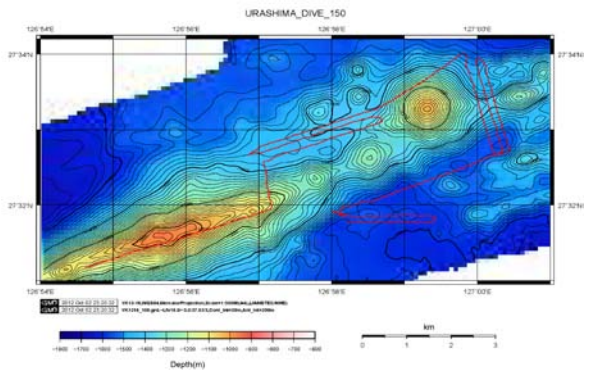


Figure 6: Dive track at 150th dive of Urashima.

Two dives were carried out in this cruise; Dive#149 and #150. Details are as follows.

4.2.1 Dive # 149

Date: Sept. 25, 2012

Location: Natsushima 86-2 Knoll, Iheya-small Ridge;

Start of survey: 08:40 (JST), 27°31.382'N, 126°54.829'E, WD= 1054m

End of survey: 16:17(JST), 27°32.955'N, 126°58.154'E, WD= 1395m

Natsushima 86-2 Knoll is 2 miles southwestward from the well known hydrothermal area, "CLAM (Calyptogena) site." The Natsushima 86-2 Knoll is a linear-shaped one, which trends ENE-WSW and of which top water depth is approx. 950m on gridded seabeam map (Figure 5). Only one dive survey has been carried out by J. Naka as the 233th dive of Shinkai2000. Although some pillow lava fragments were obtained by dredging, none of such outcrops were observed. Instead, basaltic breccias and scoria were widely covered on the hillcrest (Kimura et al., 1987).

Survey Plan:

The survey starts from the southern frank of Natsushima 86-2 Knoll, where estimated water depth is 1160m. AUV keeps its altitude 80-100m from the seafloor and heads towards 72°N. At the saddle point between the small associated hills, AUV will transfer into the northern next survey lines with 0.1 mile interval. Following the parallel seven survey lines with three miles in each length, AUV proceeds to the 1.9 mile extension of the survey line ENE-ward which covers on a conical cone with base diameter is approx. 1 mile and with altitude 400m (Appendix A-6). On the western flank of the cone, the well known CLAM site develops. These initially proposed survey tracks exceed 32 miles in total that is equivalent to roughly 2days survey of Urashima; typical survey length of Urashima is approx. 30km in length/dive.

Acoustic sensing with geophysical and chemical sensors was planned in the whole sections of survey lines. Neither water sampling nor visual imagery is included.

Observation:

Due to the severe weather forecast, some survey lines were forced to be skipped. Thus, AUV got into the second survey line originally planned, which made a shift of 0.1knautical mile northward as the commencement. In addition, as a result of follow a contingency plan in case for no more dive survey is available, the northwestern quadrant, western part of 5th-7th of lines of the survey plan of Natsushima 86-2 Knoll was skipped and AUV proceeded into the northeastern extension area of the survey tracks. Here, the well-known CLAM-site is just north of the end of track (Figure 5; Appendix A-7).

Numerous acoustic anomalies were widely recorded within the water column part of the Side Scan Sonar thorough the dive track. There is very limited number of the filamentous-shape echo only on the western part of the second line, however, dense foggy scattering were much widely observed compared to the Iheya-North Knoll hydrothermal site (Kumagai et al., 2010). Even well known CLAM site is outside the survey area, temperature and red-ox anomalies were clearly recognized accompanied with acoustic anomalies on eastern part of the survey tracks. Because some spider-net-like material adhered on the vertical fin and turbidity meter was found at the retrieval of AUV (see Figure 7), no clear anomaly on the turbidity record was recognized; it may cause the sudden increase of the

measured value of #3 turbidity meter recorded at 11:01 (JST).

Figure 7: spider-net-like material adhered on the window of left-handed turbidity meter

4.2.2 Dive # 150:

Date: Oct. 2, 2012

Location: Natsushima 86-2 Knoll and 126°59.3'E Knoll, Iheya-small Ridge;

Start of survey: 08:52 (JST), 27°31.382'N, 126°54.829'E, WD= 1054m

End of survey: 16:18(JST), 27°32.955'N, 126°58.154'E, WD= 1580m

As well as the previous dive, this dive also dedicated to locate hydrothermal activity in the studied area. Due to the very limited opportunity of the AUV dive in this expedition, we made AUV fly on the potential points where hydrothermal activity anticipated as many as possible (Appendix A-6).

Natsushima 86-2 Knoll is 2 miles southwestward from the well known hydrothermal area, "CLAM (Calyptogena) site." The Natsushima 86-2 Knoll is a linear-shaped one, which trends ENE-WSW and of which top water depth is approx. 950m on gridded seabeam map (Figure 5). Only one dive survey has been carried out by J. Naka as the 233th dive of Shinkai2000. Although some pillow lava fragments were obtained by dredging, none of such outcrops were observed. Instead, basaltic breccias and scoria were widely covered on the hillcrest (Kimura et al., 1987).

Survey Plan:

The survey also starts from the southern frank of Natsushima 86-2 Knoll; the first line of this dive is 0.1 nautical miles southward from the southernmost survey line of the previous dive (on the southernmost line originally planned in the previous dive, dive #149), where estimated water depth is 1160m. AUV also keeps its altitude 80-100m from the seafloor and heads towards 72°N to confirm some acoustic anomalies found in the starboard side at the previous dive. At the saddle point between the small associated hills, AUV will transfer into the northern survey lines. Those next three survey lines have 0.1 mile interval each other that fully cover above the area of CLAM site. The AUV flies on the northern frank of the conical cone, then, covers on the eastern saddle point between the small associating knoll by similar three NNW-SSE trending tracks 1.2 miles in length having 0.1 miles in intervals. These initially proposed survey tracks was as long as 15 miles in total that is equivalent to roughly 5 hours survey of Urashima; thus the finishing these proposed track, AUV head to the some waypoints to be investigated in the southern flank and deep of the eastern cone,

126°59.3’ Knoll (Figure 6).

Acoustic sensing with geophysical sensors was in the whole sections of survey lines (ORP sensor was not available). No water sampling or visual imagery were planned.

Observation:

Numerous acoustic anomalies, typically foggy ones, were also widely recorded within the water column part of the Side Scan Sonar thorough the dive track as well as the previous dive (Dive #149). It was also partly associated with the temperature and/or turbidity anomalies. After the finishing the planned lines beforehand, one more line was set to fly on the two small cones found in the southern depression of the 126°59.3’ Knoll; one of which a rather high crustal heatflow was recorded (Kinoshita et al., 1995).

4.3 Seabeam survey

To conduct the AUV dive operation, a set of MNBES survey using SeaBeam 2112 of R/V Yokosuka was carried out although MNBES bathymetry has been obtained in KR01-09 Cruise (Chief. Sci. K. Takai). The original plan of the regional seabeam survey focuses on the continental slope, however, the severe T1217 forces R/V Yokosuka to evacuate in Satsukawa Bay of Amami-Oshima. Instead, the scientific party decided to fill the blank of seabeam bathymetry near the dive survey area (see Figure 8 as the modified plan of survey lines). The eastern boundary of the survey line was determined to overlap significantly (up to 5 minutes in longitude) to the data area of KR01-09.

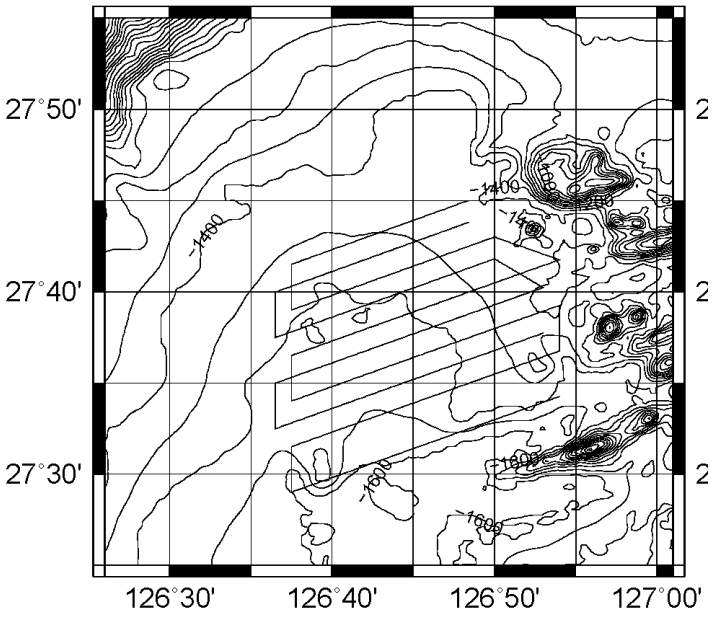


Figure 8: Modified lines for bathymetric survey shown as a couple of solid lines. Contours are on the gridded data both from satellite gravimetry and from KR01-09 bathymetry.

4.4 SCS seismic

Across ridge SCS seismic survey was carried out in this cruise (Figure 9). In all five tracks, well recognized reflection from the seafloor was clearly recorded except for the part of ridge flanks and top under ridge-perpendicular geometry. In the basin area with flat topography, some clear reflections were also recognized within the thick sediments associated with frequent normal-fault-like sharp displacements. Further descriptions and investigations will be carried out later.

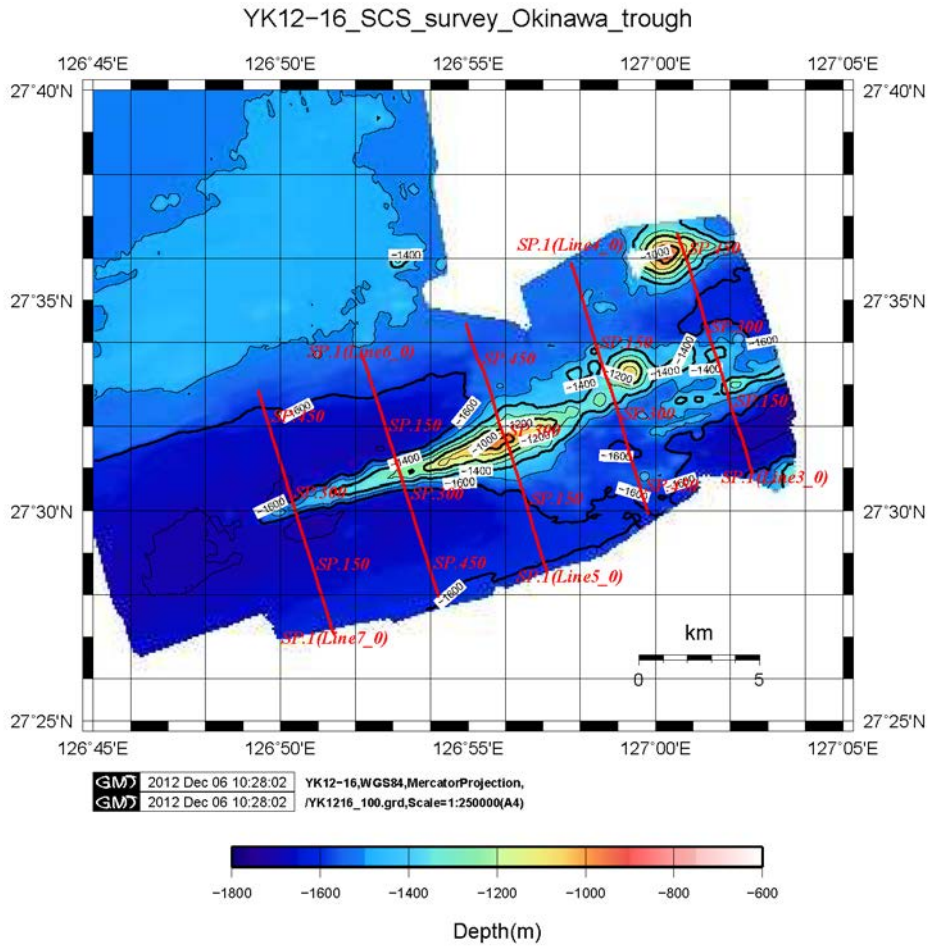


Figure 9: SCS tracks surveyed drawn on the newly obtained bathymetry in the cruise.

5. Future Plan and Data QC, etc.

QC of magnetometer will be carried on land by shore-based scientific team led by T. Kasaya. The result will also be submitted by T. Kasaya. QC of ORP sensor data will be done w/ technical development by K. Okamura. After the standard post processing of Urashima MNBES and SSS/SBP, these acoustic data will be investigated by M. Asada and her collaborators. SCS seismic data will be investigated by T. Tsuji for tectonic interpretations. Final compilation including turbidity data will be done by H. Kumagai. Brief summary will be submitted to G-cubed by H. Kumagai. Position of potential hydrothermal activity is used for future pin-point dive survey to evaluate the total mass of the hydrothermal deposits by SRRP, JAMSTEC; K. Nakamura and S. Kawagucci may lead further surveys.

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7. Notice on Using

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 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 contact the Chief Scientist (H. Kumagai) 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.

8. Acknowledgements

Here we express our sincere appreciation for the excellent support and assistance by Captain Ukekura and his crew, and the Operation Manager of Urashima, Kazuhiro Chiba, and his AUV team throughout the cruise. We also thank the JAMSTEC Cruise Management Division, Seafloor Resources Research Project and all shore-based colleagues on their supports.

Appendix A-1: List of participants

1.Research group

Hidenori Kumagai	Japan Agency for Marine-Earth Science and Technology
Hideaki Machiyama	Japan Agency for Marine-Earth Science and Technology
Yoshiro Nishio	Japan Agency for Marine-Earth Science and Technology
Satoshi Okada	Nippon Marine Enterprise
Mitsuteru Kuno	Nippon Marine Enterprise
Satomi Minamizawa	Nippon Marine Enterprise
Akie Suzuki	Nippon Marine Enterprise
Toshimasa Nasu	Nippon Marine Enterprise

2.Operation team of the AUV URASHIMA

Operation Manager	Kazuhiro Chiba
1st Submersible staff	Shinobu Omika
1st Submersible staff	Keita Matsumoto
2nd Submersible staff	Akihisa Ishikawa
2nd Submersible staff	Takuma Onishi
2nd Submersible staff	Masaya Katagiri

3.Captain and crew of the R/V YOKOSUKA

Captain	Eiko Ukekura
Chief Officer	Yasuhiko Sammori
2nd Officer	Shozo Fujii
3rd Officer	Motoi Katsumata
Chief Engineer	Eiji Sakaguchi
1st Engineer	Kimio Matsukawa
2nd Engineer	Daisuke Gibu
3rd Engineer	Kota Kataoka
Chief Radio officer	Takehito Hattori
2nd Electronic Operator	Yosuke Komaki
3rd Electronic Operator	Ryousuke Komatsu
Boat Swain	Masanori Ohata
Able Seaman	Kazumi Ogasawara
Able Seaman	Yuki Yoshino
Able Seaman	Hiroaki Murase
Able Seaman	Takuya Miyashita

Sailor	Shinsuke Uzuki
Sailor	Toru Nakanishi
No.1 Oiler	Kozo Miura
Oiler	Katsuyuki Miyazaki
Oiler	Hiroyuki Oishi
Oiler	Yoshinori Kawai
Assistant Oiler	Makoto Kozaki
Assistant Oiler	Eiji Aratake
Assistant Oiler	Naoto Mitsuo
Chief Steward	Sueto Sasaki
Steward	Shigeto Ariyama
Steward	Yoshinobu Hasatani
Steward	Tatsunari Onoue
Steward	Seiji Honda

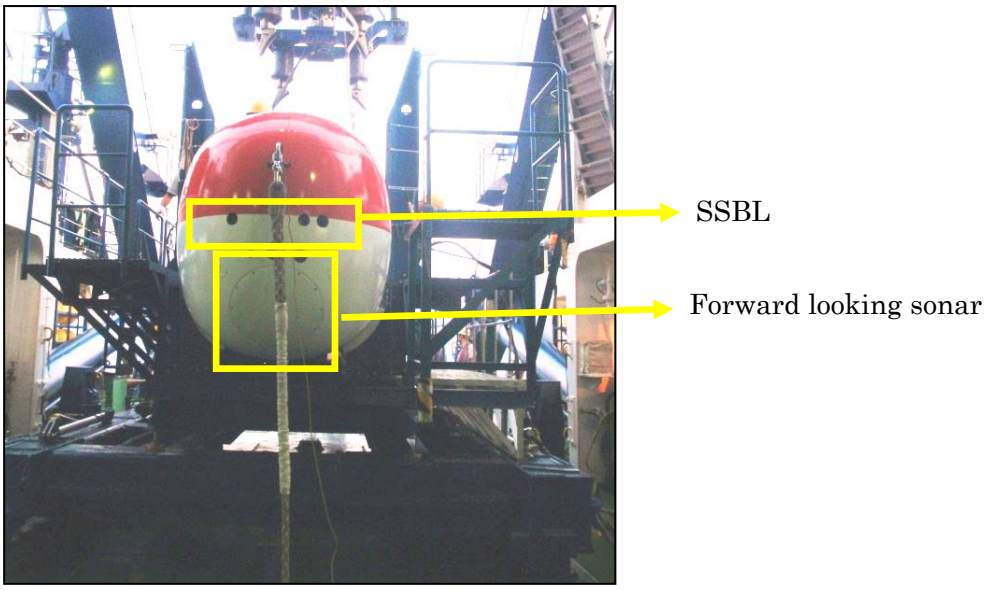
日付 Date	時間 Local Time	内容 Note	特記事項 Description	本船位置／気象／海象 Position/Weather/Wind/Sea condition
24-Sep-12		**Sail out, proceeding to research area**		09/24 12:00(UTC+9h)
	13:00	Boarded.		26-14.3N, 127-40.8E
	14:00	Let go all shore line, left NAHA.		NAHA-SHIN KO
	15:32	Hoisted up “AUV-URASHIMA” .		Cloudy
	15:43	Launched above “AUV-URASHIMA” & started her operation test.		ENE-3 (Gentle breeze)
	16:09	Hoisted up above “AUV-URASHIMA” .		2 (Sea smooth)
	16:18	Recovered “AUV-URASHIMA” & finished her operation test.		1 (Low swell sea)
	17:25	Com’ced proceeding to research area.	For OKINAWA TROUGH	Visibly: 7'
	19:00-19:30	Carried out onboard education & training for scientists.		
	21:10	Arrived at research area.		
	21:33	Releaced XBT.	27-15.7885N,127-11.4483E	
25-Sep-12		**Dive URASHIMA(#149) & SCS Survey (Line3)**		09/25 12:00(UTC+9h)
	3:03-5:13	Carried out MBES mapping survey.		27-31.5N, 126-55.4E
	6:00	Arrived at dive point.		OKINAWA TROUGH
	6:47	Hoisted up “AUV-URASHIMA” .		Fine but clowdy
	6:55	Launched above “AUV-URASHIMA” .		ENE-5 (Fresh breeze)
	6:58	“AUV-URASHIMA” dove & started her operation(#149).		4 (Sea moderate)
	17:01	Refloated “AUV-URASHIMA” .		3 (Moderate short)
	17:19	Hoisted up above “AUV-URASHIMA” .		Visibly: 7'
	17:30	Recovered “AUV-URASHIMA” & finished her operation(#149).		
	17:55-19:36	Carried out MBES mapping survey.		
	19:45-19:58	Lounched GI gun.		
	20:01-20:04	Lounched streamer cable.		
	20:35	Com’ced SCS survey on line 3.		
	21:56	Cleaed out line 3.		
	22:36	Com’ced SCS survey on line 4.		
26-Sep-12		**SCS survey(Line4,Line5,Line6 and Line7)**		09/26 12:00(UTC+9h)
	0:05	Cleaed out line 4.		27-55.8N, 127-55.5E
	0:54	Com’ced SCS survey on line 5.		WEST OFF AMAMI OSHIMA
	2:25	Cleaed out line 5.		Fine but clowdy
	3:15	Com’ced SCS survey on line 6.		ENE-6 (Strong breeze)
	4:45	Cleaed out line 6.		5 (Sea rough)
	5:27	Com’ced SCS survey on line 7.		4 (Moderate average)
	6:52	Cleaed out line 7 & finished SCS survey.		Visibly: 7'
	6:58-7:08	Recovered GI gun.		
	7:11-7:18	Recovered streamer cable.		
	7:20	Com'ced proceeding to KONIYAWAN .		
	18:00	Let go anchor arrived at KONIYAWAN.		
27-Sep-12		**Anchoring at KONIYAWAN**		09/27 12:00(UTC+9h)
	13:24	Hoisted up “AUV-URASHIMA” .		28-07.7N, 129-17.7E
	13:31	Launched above “AUV-URASHIMA” & started her operation test.		KONIYAWAN
	15:02	Hoisted up above “AUV-URASHIMA” .		Fine but clowdy
	15:10	Recovered “AUV-URASHIMA” & finished her operation test.		ENE-5 (Fresh breeze)
	16:00-16:50	Scientist meeting.		3 (Sea slight)
				1 (Low swell sea)
				Visibly: 7'
28-Sep-12		**Anchoring at KONIYAWAN**		09/28 12:00(UTC+9h)
	9:00-9:30	On bord seminar.		28-07.7N, 129-17.7E
				KONIYAWAN
				Overcast
				ENE-5 (Fresh breeze)
				3 (Sea slight)
				1 (Low swell sea)
				Visibly: 5'
29-Sep-12		**Anchoring at KONIYAWAN**		09/29 12:00(UTC+9h)
				28-07.7N, 129-17.7E
				KONIYAWAN
				Overcast
				EAST-6 (Strong breeze)
				4 (Sea moderate)
				2 (Low swell long)
				Visibly: 5'
30-Sep-12		**Anchoring at KONIYAWAN**		09/30 12:00(UTC+9h)
				28-07.7N, 129-17.7E
				KONIYAWAN
				Fine but clowdy
				NW-6 (Strong breeze)
				4 (Sea moderate)
				1 (Low swell sea)
				Visibly: 7'
01-Oct-12		**Proceeding to research area.**		10/01 12:00(UTC+9h)
	6:45-6:48	Brought up anchor,left KONIYAWAN proceeding to research area.	For OKINAWA TROUGH	27-55.2N, 128-10.4E
	16:45	Arrived at survey area.		WEST OFF AMAMI OSHIMA
	16:54	Com’ced MBES mapping survey.		Fine but clowdy
				NW-4 (Moderate breeze)
				3 (Sea slight)
				2 (Low swell long)
				Visibly: 7'
02-Oct-12		**Dive URASHIMA(#150)**		10/02 12:00(UTC+9h)
	1:04	Finished MBES mapping survey.		27-33.2N, 126-58.6E
	1:42	Releaced XBT.	27-28.2049N,126-50.4764	OKINAWA TROUGH
	2:18-4:00	Carried out MBES mapping survey.		Fine but clowdy
	7:13	Hoisted up “AUV-URASHIMA”.		NNW-4 (Moderate breeze)
	7:21	Launched above “AUV-URASHIMA”.		3 (Sea slight)
	7:28	“AUV-URASHIMA” dove & started her operation(#150).		2 (Low swell long)
	16:49	Refloated “AUV-URASHIMA”.		Visibly: 7'
	17:12	Hoisted up above “AUV-URASHIMA”.		
	17:20	Recovered “AUV-URASHIMA” & finished her operation(#150).		
	18:40	Proceeded to MBES mapping survey area.		
	18:47	Arrived at above area & com'ced MBES mapping survey.		
03-Oct-12		**Arrived at NAHA**		10/03 12:00(UTC+9h)
	0:02	Finished MBES mapping survey & left from reserch area for NAHA.		NAHA-SHIN KO
	9:00	arrived at NAHA.		
	12:00	disembarked from YOKOSUKA.		
		Concluded YK12-16 cruise.		

Appendix A-3: General description of AUV Urashima

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



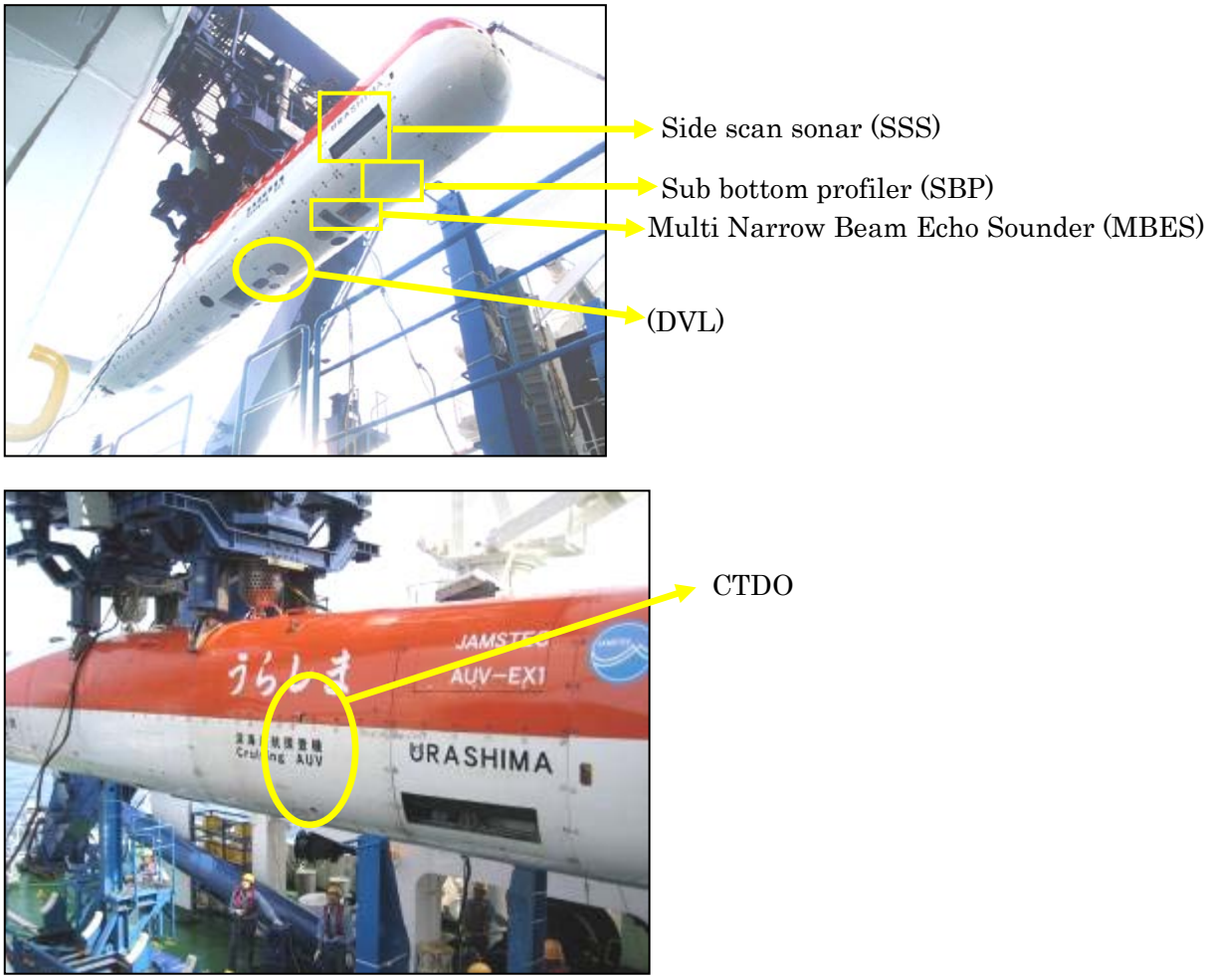


Fig.A.1 Equipments of AUV Urashima

NME SINGLE CHANNEL SEISMIC SURVEY GENERAL INFORMATION

YK12-16

GENERAL

CLIENT	JAMSTEC	
CRUISE	YK12-16	
AREA	Okinawa Trough	
LINE	Line3_0	
DIRECTION (°)	343.5	
DATE	2012/09/25(UTC)	
WEATHER	Fine but cloudy	
WIND	ENE Strong breeze	
SEA CONDITION	Moderate	
FIRST SHOT POINT	SP No.	1
FIRST GOOD SHOT POINT	SP No.	1
	N	27-30.95455
	E	127-02.56989
	Time (UTC)	11:35:03
	Water Depth (m)	1610.0
LAST SHOT POINT	SP No.	478
LAST GOOD SHOT POINT	SP No.	478
	N	27-36.68209
	E	127-00.54840
	Time (UTC)	12:56:59
	Water Depth (m)	1326.0

SOURCE

GUN TYPE	Sercel GI-Gun
SHOT TYPE	GI-simultaneous
SHOT MODE	Time
SHOT INTERVAL	10 sec
NUMBER OF STRINGS	1
TOTAL VOLUME	150 cu.in
CONFIGURATION	45(G) + 105(I) cu.in
GUN DEPTH	3.0m
AIR PRESSURE	13.5 MPa
GUN CONTROLLER	Hotshot ver 3.005
GUN TOWING WIRE LENGTH	26.6m

RECEIVER

RECEIVER TYPE	SIG Streamer
HYDROPHONE	S.I.G.16
NUMBER OF CHANNEL	1
NO. OF HYD./GROUP	48
SENSITIVITY	90.0 +/- 1 dB ref 1V/ubar
CABLE DEPTH	3.0m
ACTIVE SECTION	47m
LEAD-IN SECTION	131.9m

RECORDING

RECORDING SYSTEM	Geode ver 9.28.0.0
SAMPLE FREQUENCY	1000Hz
RECORDING LENGTH	7,000 msec
WATER DELAY	0 msec
RECORDING FORMAT	SEG-D 8058 Rev.1
ANALOG PREAMP	39dB
HICUT FILTER	None
LOWCUT FILTER	None
SYSTEM DELAY	100ms (from start recording to gun fireing)
GPS SYSTEM	SkyFix XP(DGPS) No.1 Antenna
NAVIGATION SYSTEM	Navlog ver 1.0.64

DATA

SEISMIC DATA	1.sgd - 478.sgd
	(Folder name : Line3_0)
NAVIGATION DATA	Line3_0_Shot.csv
	Line3_0_LOG.csv

REMARKS

SHIP SPEED AGAINST GROUND : 4.44 knot
SHIP SPEED AGAINST WATER : 3.93 knot
Cross point of Line2_0: Shot No.252 09/25 12:18(UTC)
Set air pressure is 13.5MPa,but true air pressure is 12.0MPa.

PROCESSING

BAND PASS FILTER	15-20-200-250
STATIC CORRECTION	96msec.
SPHERICAL DIVERGENCE CORR.	g=t^2

OBSERVER

Satoshi Okada , Mitsuteru Kuno , Akie Suzuki , Toshimasa Nasu

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NME SINGLE CHANNEL SEISMIC SURVEY GENERAL INFORMATION

YK12-16

GENERAL

CLIENT	JAMSTEC	
CRUISE	YK12-16	
AREA	Okinawa Trough	
LINE	Line4_0	
DIRECTION (°)	163.8	
DATE	2012/09/25(UTC)	
WEATHER	ine but cloudy	
WIND	ENE Fresh breeze	
SEA CONDITION	Moderate	
FIRST SHOT POINT	SP No.	1
FIRST GOOD SHOT POINT	SP No.	1
	N	27-35.79918
	E	126-57.79037
	Time (UTC)	13:36:53
	Water Depth (m)	1535.0
LAST SHOT POINT	SP No.	518
LAST GOOD SHOT POINT	SP No.	518
	N	27-29.84676
	E	126-59.85489
	Time (UTC)	15:05:41
	Water Depth (m)	1600.0

SOURCE

GUN TYPE	Sercel GI-Gun
SHOT TYPE	GI-simultaneous
SHOT MODE	Time
SHOT INTERVAL	10 sec
NUMBER OF STRINGS	1
TOTAL VOLUME	150 cu.in
CONFIGURATION	45(G) + 105(I) cu.in
GUN DEPTH	3.0m
AIR PRESSURE	13.5 MPa
GUN CONTROLLER	Hotshot ver 3.005
GUN TOWING WIRE LENGTH	26.6m

RECEIVER

RECEIVER TYPE	SIG Streamer
HYDROPHONE	S.I.G.16
NUMBER OF CHANNEL	1
NO. OF HYD./GROUP	48
SENSITIVITY	90.0 +/- 1 dB ref 1V/ubar
CABLE DEPTH	3.0m
ACTIVE SECTION	47m
LEAD-IN SECTION	131.9m

RECORDING

RECORDING SYSTEM	Geode ver 9.28.0.0
SAMPLE FREQUENCY	1000Hz
RECORDING LENGTH	7,000 msec
WATER DELAY	0 msec
RECORDING FORMAT	SEG-D 8058 Rev.1
ANALOG PREAMP	39dB
HICUT FILTER	None
LOWCUT FILTER	None
SYSTEM DELAY	100ms (from start recording to gun fireing)
GPS SYSTEM	SkyFix XP(DGPS) No.1 Antenna
NAVIGATION SYSTEM	Navlog ver 1.0.64

DATA

SEISMIC DATA	1.sgd - 518.sgd
	(Folder name : Line4_0)
NAVIGATION DATA	Line4_0_Shot.csv
	Line4_0_LOG.csv

REMARKS

SHIP SPEED AGAINST GROUND : 4.27 knot
SHIP SPEED AGAINST WATER : 5.06 knot
Cross point of Line2_0: Shot No.230 09/25 14:16(UTC)
Cross point of Line1_0: Shot No.260 09/25 14:21(UTC)
Set air pressure is 13.5MPa,but true air pressure is 12.0MPa.

PROCESSING

BAND PASS FILTER	15-20-200-250
STATIC CORRECTION	96msec.
SPHERICAL DIVERGENCE CORR.	g=t^2

OBSERVER

Satoshi Okada , Mitsuteru Kuno , Akie Suzuki , Toshimasa Nasu

NME SINGLE CHANNEL SEISMIC SURVEY GENERAL INFORMATION

YK12-16

GENERAL

CLIENT	JAMSTEC	
CRUISE	YK12-16	
AREA	Okinawa Trough	
LINE	Line5_0	
DIRECTION (°)	342.5	
DATE	2012/09/25(UTC)	
WEATHER	Fine but cloudy	
WIND	ENE Fresh breeze	
SEA CONDITION	Moderate	
FIRST SHOT POINT	SP No.	1
FIRST GOOD SHOT POINT	SP No.	1
	N	27-28.64182
	E	126-57.07809
	Time (UTC)	15:54:20
	Water Depth (m)	1593.0
LAST SHOT POINT	SP No.	529
LAST GOOD SHOT POINT	SP No.	529
	N	27-34.54330
	E	126-54.94492
	Time (UTC)	17:25:04
	Water Depth (m)	1541.0

SOURCE

GUN TYPE	Sercel GI-Gun
SHOT TYPE	GI-simultaneous
SHOT MODE	Time
SHOT INTERVAL	10 sec
NUMBER OF STRINGS	1
TOTAL VOLUME	150 cu.in
CONFIGURATION	45(G) + 105(I) cu.in
GUN DEPTH	3.0m
AIR PRESSURE	13.5 MPa
GUN CONTROLLER	Hotshot ver 3.005
GUN TOWING WIRE LENGTH	26.6m

RECEIVER

RECEIVER TYPE	SIG Streamer
HYDROPHONE	S.I.G.16
NUMBER OF CHANNEL	1
NO. OF HYD./GROUP	48
SENSITIVITY	90.0 +/- 1 dB ref 1V/ubar
CABLE DEPTH	3.0m
ACTIVE SECTION	47m
LEAD-IN SECTION	131.9m

RECORDING

RECORDING SYSTEM	Geode ver 9.28.0.0
SAMPLE FREQUENCY	1000Hz
RECORDING LENGTH	7,000 msec
WATER DELAY	0 msec
RECORDING FORMAT	SEG-D 8058 Rev.1
ANALOG PREAMP	39dB
HICUT FILTER	None
LOWCUT FILTER	None
SYSTEM DELAY	100ms (from start recording to gun fireing)
GPS SYSTEM	SkyFix XP(DGPS) No.1 Antenna
NAVIGATION SYSTEM	Navlog ver 1.0.64

DATA

SEISMIC DATA	1.sgd - 529.sgd
	(Folder name : Line5_0)
NAVIGATION DATA	Line5_0_Shot.csv
	Line5_0_LOG.csv

REMARKS

SHIP SPEED AGAINST GROUND : 4.11 knot
SHIP SPEED AGAINST WATER : 3.07 knot
Cross point of Line1_0: Shot No.293 09/25 16:44(UTC)
Cross point of Line2_0: Shot No.322 09/25 16:49(UTC)
Set air pressure is 13.5MPa,but true air pressure is 12.0MPa.

PROCESSING

BAND PASS FILTER	15-20-200-250
STATIC CORRECTION	96msec.
SPHERICAL DIVERGENCE CORR.	g=t^2

OBSERVER

Satoshi Okada , Mitsuteru Kuno , Akie Suzuki , Toshimasa Nasu

NME SINGLE CHANNEL SEISMIC SURVEY GENERAL INFORMATION

YK12-16

GENERAL

CLIENT	JAMSTEC	
CRUISE	YK12-16	
AREA	Okinawa Trough	
LINE	Line6_0	
DIRECTION (°)	163.6	
DATE	2012/09/25(UTC)	
WEATHER	Fine but cloudy	
WIND	East Strong breeze	
SEA CONDITION	Moderate	
FIRST SHOT POINT	SP No.	1
FIRST GOOD SHOT POINT	SP No.	1
	N	27-33.65753
	E	126-52.18918
	Time (UTC)	18:15:21
	Water Depth (m)	1538.0
LAST SHOT POINT	SP No.	528
LAST GOOD SHOT POINT	SP No.	522
	N	27-27.92690
	E	126-54.22943
	Time (UTC)	19:44:54
	Water Depth (m)	1609.0

SOURCE

GUN TYPE	Sercel GI-Gun
SHOT TYPE	GI-simultaneous
SHOT MODE	Time
SHOT INTERVAL	10 sec
NUMBER OF STRINGS	1
TOTAL VOLUME	150 cu.in
CONFIGURATION	45(G) + 105(I) cu.in
GUN DEPTH	3.0m
AIR PRESSURE	13.5 MPa
GUN CONTROLLER	Hotshot ver 3.005
GUN TOWING WIRE LENGTH	26.6m

RECEIVER

RECEIVER TYPE	SIG Streamer
HYDROPHONE	S.I.G.16
NUMBER OF CHANNEL	1
NO. OF HYD./GROUP	48
SENSITIVITY	90.0 +/- 1 dB ref 1V/ubar
CABLE DEPTH	3.0m
ACTIVE SECTION	47m
LEAD-IN SECTION	131.9m

RECORDING

RECORDING SYSTEM	Geode ver 9.28.0.0
SAMPLE FREQUENCY	1000Hz
RECORDING LENGTH	7,000 msec
WATER DELAY	0 msec
RECORDING FORMAT	SEG-D 8058 Rev.1
ANALOG PREAMP	39dB
HICUT FILTER	None
LOWCUT FILTER	None
SYSTEM DELAY	100ms (from start recording to gun fireing)
GPS SYSTEM	SkyFix XP(DGPS) No.1 Antenna
NAVIGATION SYSTEM	Navlog ver 1.0.64

DATA

SEISMIC DATA	1.sgd - 528.sgd
	(Folder name : Line6_0)
NAVIGATION DATA	Line6_0_Shot.csv
	Line6_0_LOG.csv

REMARKS

SHIP SPEED AGAINST GROUND : 4.09 knot
SHIP SPEED AGAINST WATER : 4.98 knot
Cross point of Line2_0: Shot No.236 09/25 18:55(UTC)
Set air pressure is 13.5MPa,but true air pressure is 12.0MPa.

PROCESSING

BAND PASS FILTER	15-20-200-250
STATIC CORRECTION	96msec.
SPHERICAL DIVERGENCE CORR.	g=t^2

OBSERVER

Satoshi Okada , Mitsuteru Kuno , Akie Suzuki , Toshimasa Nasu

NME SINGLE CHANNEL SEISMIC SURVEY GENERAL INFORMATION

YK12-16

GENERAL

CLIENT	JAMSTEC	
CRUISE	YK12-16	
AREA	Okinawa Trough	
LINE	Line7_0	
DIRECTION (°)	343.6	
DATE	2012/09/25(UTC)	
WEATHER	Fine but cloudy	
WIND	East Strong breeze	
SEA CONDITION	Moderate	
FIRST SHOT POINT	SP No.	1
FIRST GOOD SHOT POINT	SP No.	2
	N	27-27.13852
	E	126-51.38809
	Time (UTC)	20:27:10
	Water Depth (m)	1620.0
LAST SHOT POINT	SP No.	498
LAST GOOD SHOT POINT	SP No.	498
	N	27-32.92831
	E	126-49.36844
	Time (UTC)	21:52:24
	Water Depth (m)	1564.0

SOURCE

GUN TYPE	Sercel GI-Gun
SHOT TYPE	GI-simultaneous
SHOT MODE	Time
SHOT INTERVAL	10 sec
NUMBER OF STRINGS	1
TOTAL VOLUME	150 cu.in
CONFIGURATION	45(G) + 105(I) cu.in
GUN DEPTH	3.0m
AIR PRESSURE	13.5 MPa
GUN CONTROLLER	Hotshot ver 3.005
GUN TOWING WIRE LENGTH	26.6m

RECEIVER

RECEIVER TYPE	SIG Streamer
HYDROPHONE	S.I.G.16
NUMBER OF CHANNEL	1
NO. OF HYD./GROUP	48
SENSITIVITY	90.0 +/- 1 dB ref 1V/ubar
CABLE DEPTH	3.0m
ACTIVE SECTION	47m
LEAD-IN SECTION	131.9m

RECORDING

RECORDING SYSTEM	Geode ver 9.28.0.0
SAMPLE FREQUENCY	1000Hz
RECORDING LENGTH	7,000 msec
WATER DELAY	0 msec
RECORDING FORMAT	SEG-D 8058 Rev.1
ANALOG PREAMP	39dB
HICUT FILTER	None
LOWCUT FILTER	None
SYSTEM DELAY	100ms (from start recording to gun fireing)
GPS SYSTEM	SkyFix XP(DGPS) No.1 Antenna
NAVIGATION SYSTEM	Navlog ver 1.0.64

DATA

SEISMIC DATA	1.sgd - 498.sgd
	(Folder name : Line7_0)
NAVIGATION DATA	Line7_0_Shot.csv
	Line7_0_LOG.csv

REMARKS

SHIP SPEED AGAINST GROUND : 4.30 knot
SHIP SPEED AGAINST WATER : 3.62 knot
Cross point of Line2_0 : Shot No.268 09/25 21:13(UTC)
Set air pressure is 13.5MPa,but true air pressure is 12.0MPa.
Line7_0_LOG.csv file (Navigation data file) was same as
Line7_0_Shot.csv file.

PROCESSING

BAND PASS FILTER	15-20-200-250
STATIC CORRECTION	96msec.
SPHERICAL DIVERGENCE CORR.	g=t^2

OBSERVER

Satoshi Okada , Mitsuteru Kuno , Akie Suzuki , Toshimasa Nasu

Single Channel Seismic Equipment and Survey Specification for YK12-16

The single channel seismic survey equipment and specification is as follows.

Streamer

Manufacturer	S.I.G
Active section length	47m
Hydrophone Interval	1m
Type of Hydrophone	S.I.G.16
Hydrophone output	-90 dB,re 1V/μbar, ±1dB
Frequency	flat from 10Hz to 1000Hz
Depth sensor	Yes
Preamplifier	gain 39
Lead in cable	131.9m
Receiver depth	See General Information

Source

Manufacturer	Sercel
Type of airgun	GI-GUN
Volume	150cu.in. [45(G)+105(I)]
Air pressure	122.4kg/cm^2：(150cu.in.)
Source depth	See General Information
Depth sensor	No
Gun Controller	Hotshot ver. 3.005

Air Compressor

Manufacturer	Service Engineering co., ltd.
Type of machine	4SA30-A150K
Air supply Capacity	2m^3/min.

Recording System

Manufacturer	GEOMETRICS
Type of system	Geode ver. 9.28.0.0
Recording format	SEG-D 8058 Rev.1

Recording length	7,000msec
Water Delay	0msec
Sample rate	1msec
High cut filter	None
Low cut filter	None
Recording media	Hard Disk

GPS System

Manufacturer	Fugro
Type of system	SkyFix XP MultiFix6
DGPS Reference Station	Multi Reference Station (ALL)

GPS System

Manufacturer	MARIMEX JAPAN
Type of system	Nav log ver. 1.0.64

Shot Point Geometry

Time mode shooting	See General Information

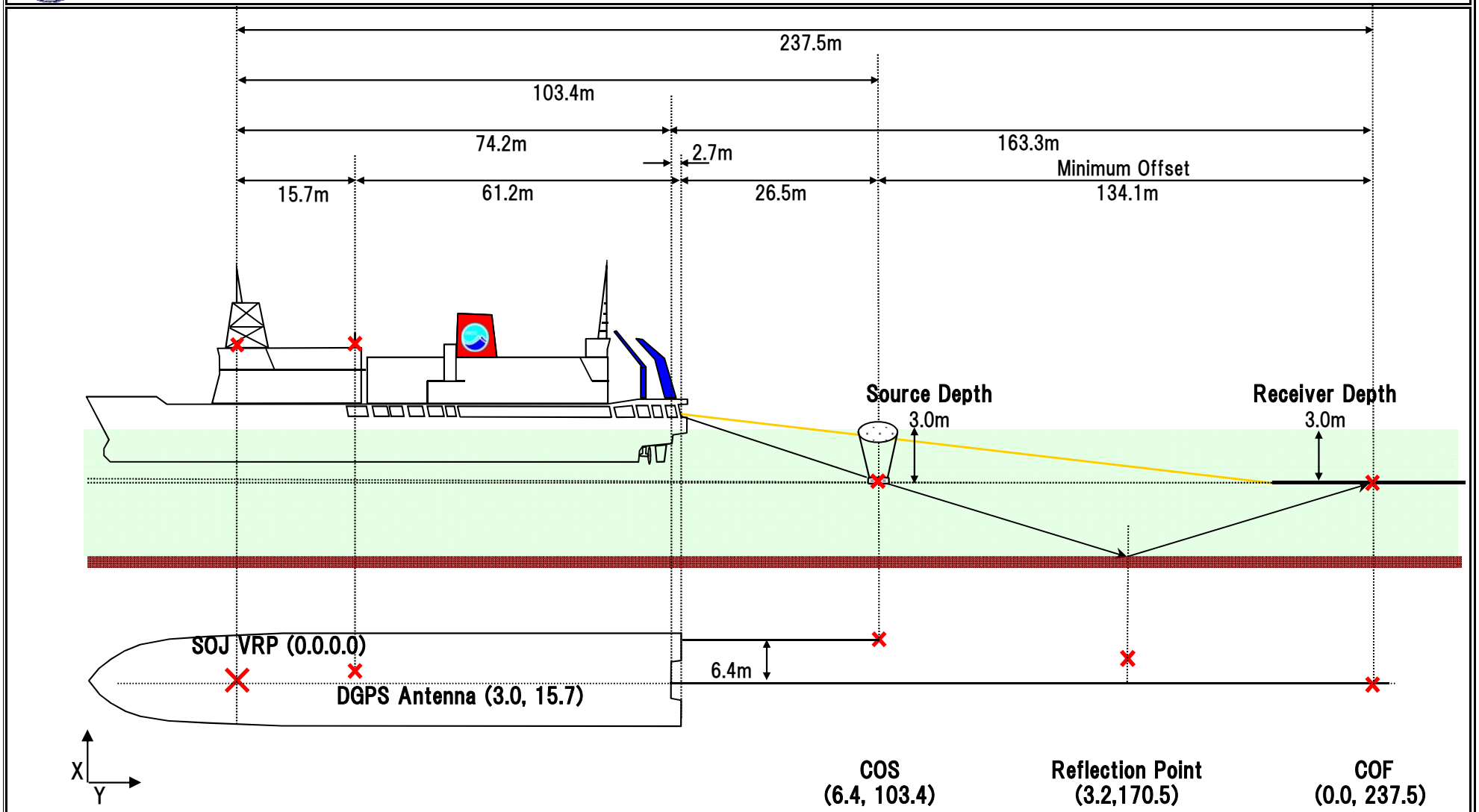
Geodetic Parameter

Spheroid	WGS84
Semi-major Axis	6,378,137m
Inverse Flattening	298.26
Projection	U.T.M
	Zone52

AIST/NME MULTI AND SINGLE CHANNEL SEISMIC SURVEY LINE LIST YK12-16

Line No.	Date (UTC)	Time (UTC)	Passing Point	Shot No.	Vessel Position				Length [m]	Direction [deg]	Remarks
					Lat.		Lon.				
Line3_0	2012/9/25	11:35:03	F.G.S.P	1	27-30.95455	N	127-02.56989	E	11,090	343.5	
	2012/9/25	12:56:59	L.G.S.P	478	27-36.68209	N	127-00.54840	E			
Line4_0	2012/9/25	13:36:53	F.G.S.P	1	27-35.79918	N	126-57.79037	E	11,508	163.8	
	2012/9/25	15:05:41	L.G.S.P	518	27-29.84676	N	126-59.85489	E			
Line5_0	2012/9/25	15:54:20	F.G.S.P	1	27-28.64182	N	126-57.07809	E	11,452	342.5	
	2012/9/25	17:25:04	L.G.S.P	529	27-34.54330	N	126-54.94492	E			
Line6_0	2012/9/25	18:15:21	F.G.S.P	1	27-33.65753	N	126-52.18918	E	11,106	163.6	
	2012/9/25	19:44:54	L.G.S.P	522	27-27.92690	N	126-54.22943	E			
Line7_0	2012/9/25	20:27:10	F.G.S.P	2	27-27.13852	N	126-51.38809	E	11,200	343.6	
	2012/9/25	21:52:24	L.G.S.P	498	27-32.92831	N	126-49.36844	E			

NME SINGLE CHANNEL SEISMIC SURVEY OFFSET DIAGRAM YK12-16(SCS)

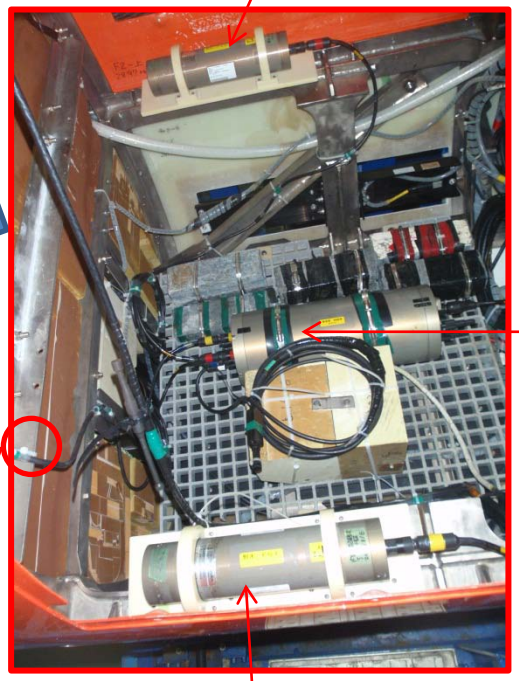


VRP : Vessel Reference Point
COS : Centre of Source
COF : Centre of First receiver channel

X : Stb+/Port-, Y : Forward+/Aft-

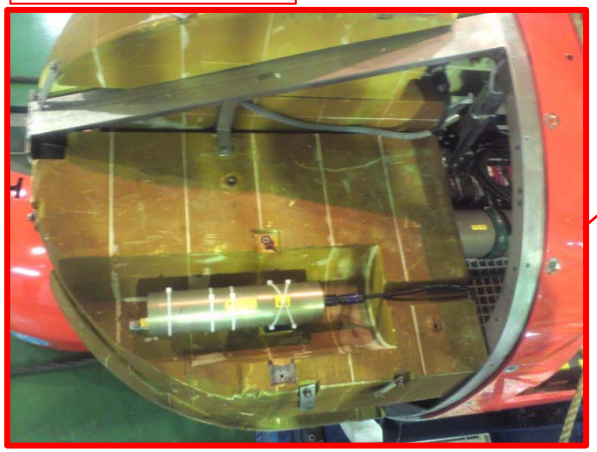
FG3成分磁力計

センサー
FG2右舷側



耐圧容器

センサー
FG4：船首側



センサー
FG1：左舷側

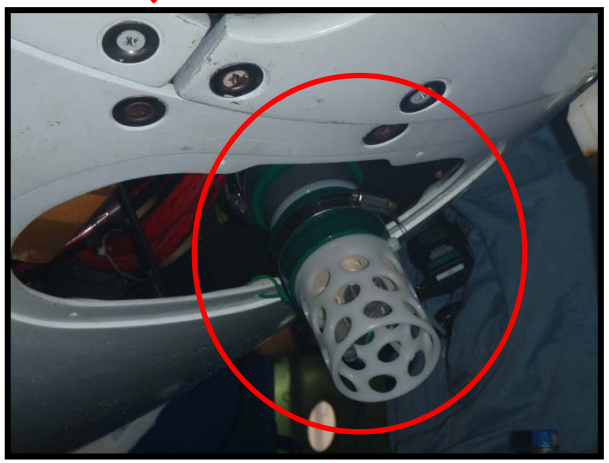
※FG3は未使用（予備）

濁度計

濁度計2番（黄色）

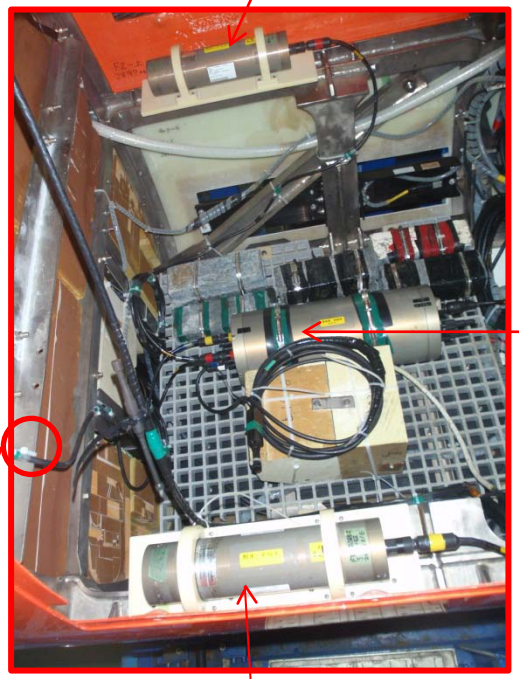
濁度計3番（緑色）

酸化還元電位センサー



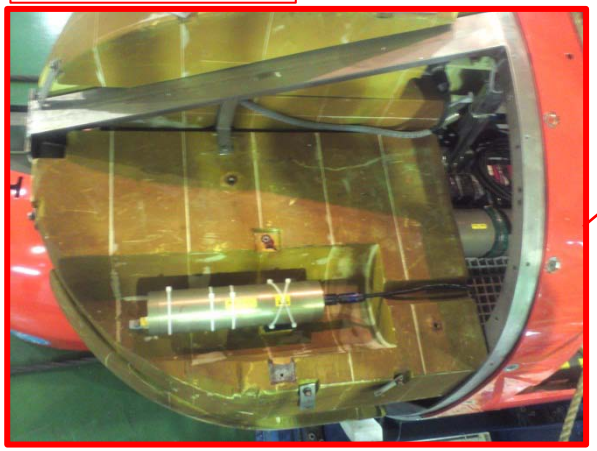
FG3成分磁力計

センサー
FG2右舷側



耐圧容器

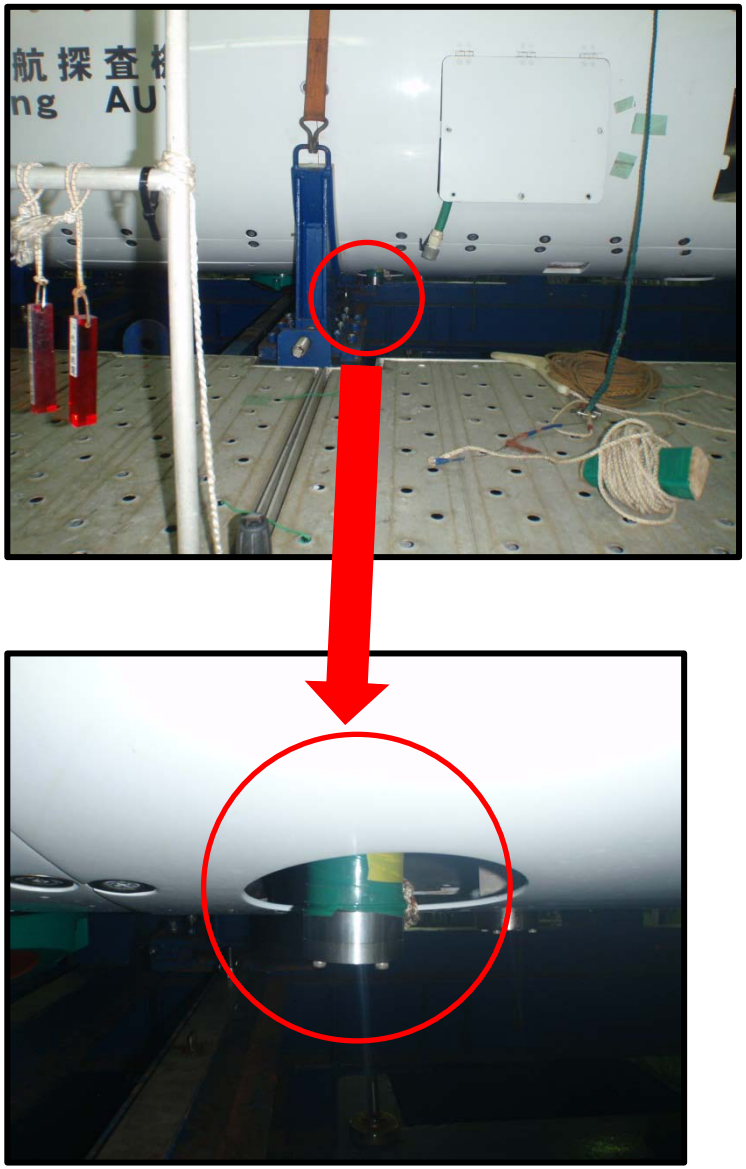
センサー
FG4：船首側



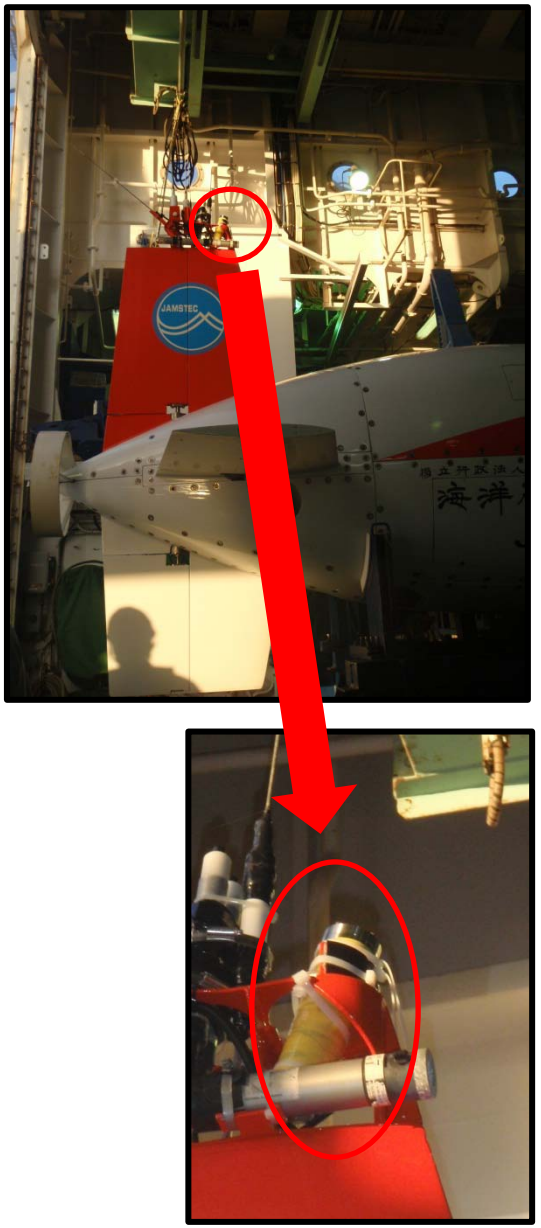
センサー
FG1：左舷側

※FG3は未使用（予備）

濁度計



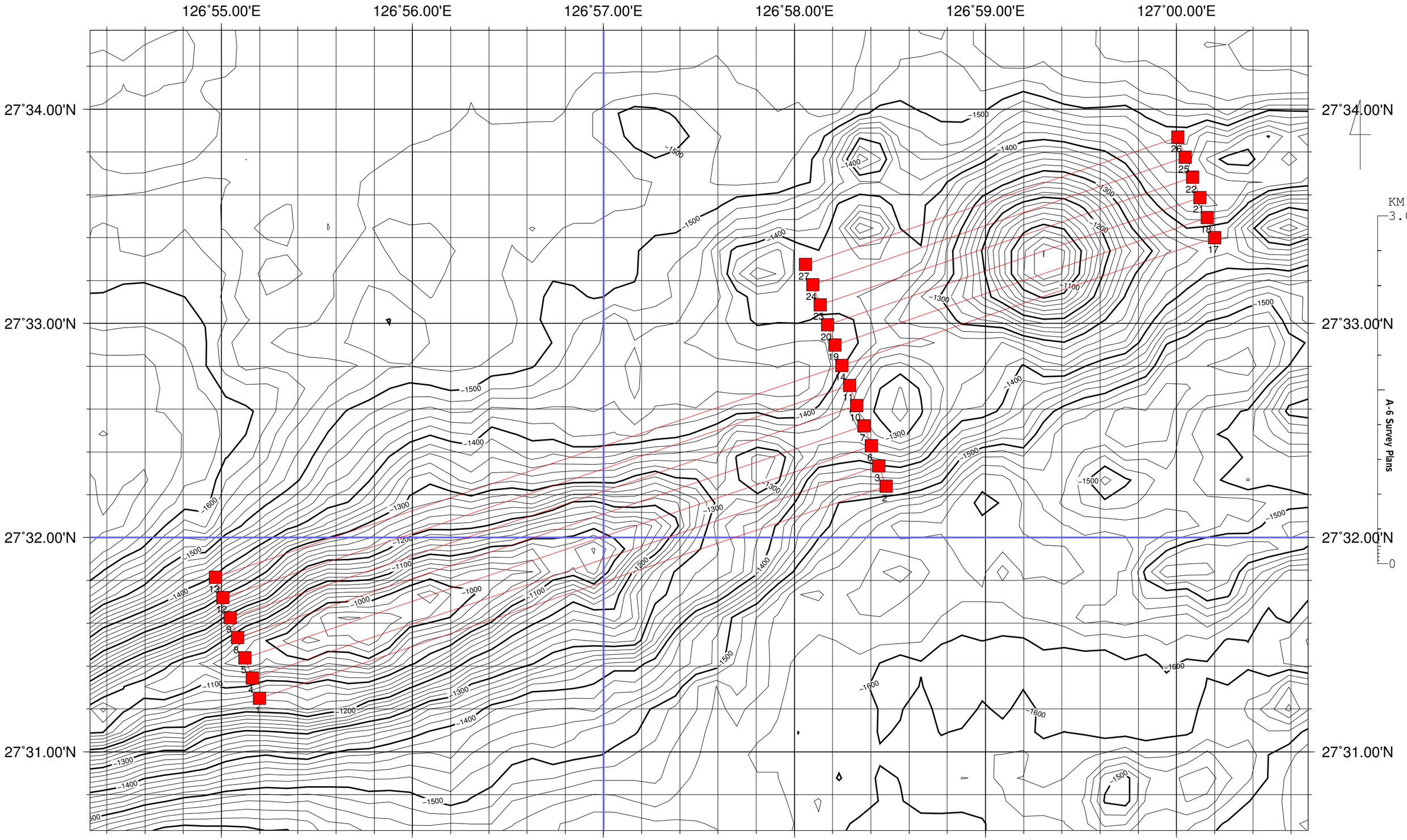
濁度計3番（緑色）



濁度計2番（黄色）

Urashima#149DIVE
OKINAWA-TORAHU

(1 /30000)



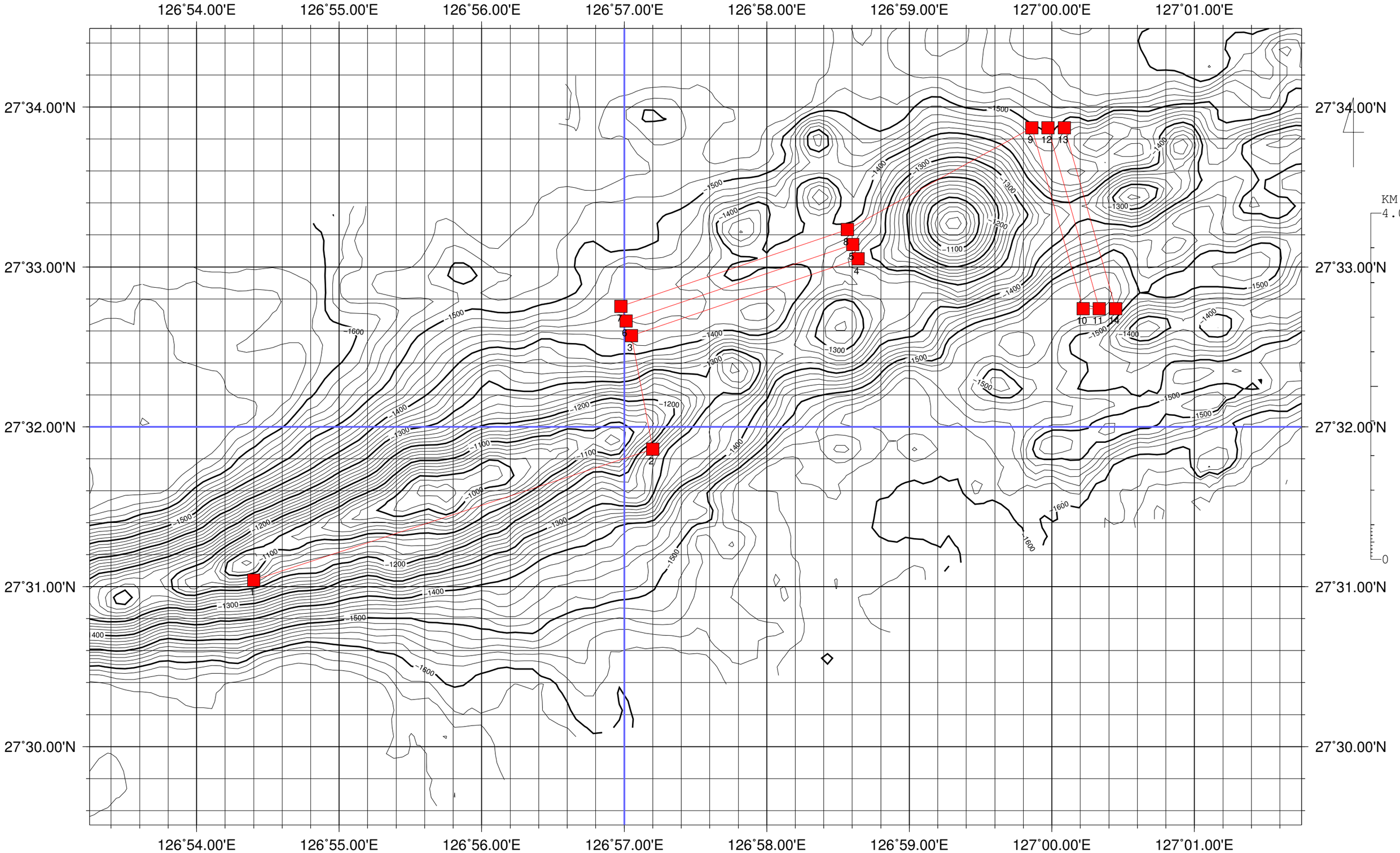
XY Origin Lat 27-32.00000N Lon 126-57.00000E
Center Lat 27-32.50000N Lon 126-57.50000E
Grid_File:KR01-09_200m.grd ContourInt:20m

Datum WGS-84 Proj.MER

(UR)Lat 27-34.36875N Lon 127-00.68897E
(LL)Lat 27-30.63225N Lon 126-54.31203E
(2012-09-25)

Urashima#150DIVE
OKINAWA-TROUGH

(1 /40000)



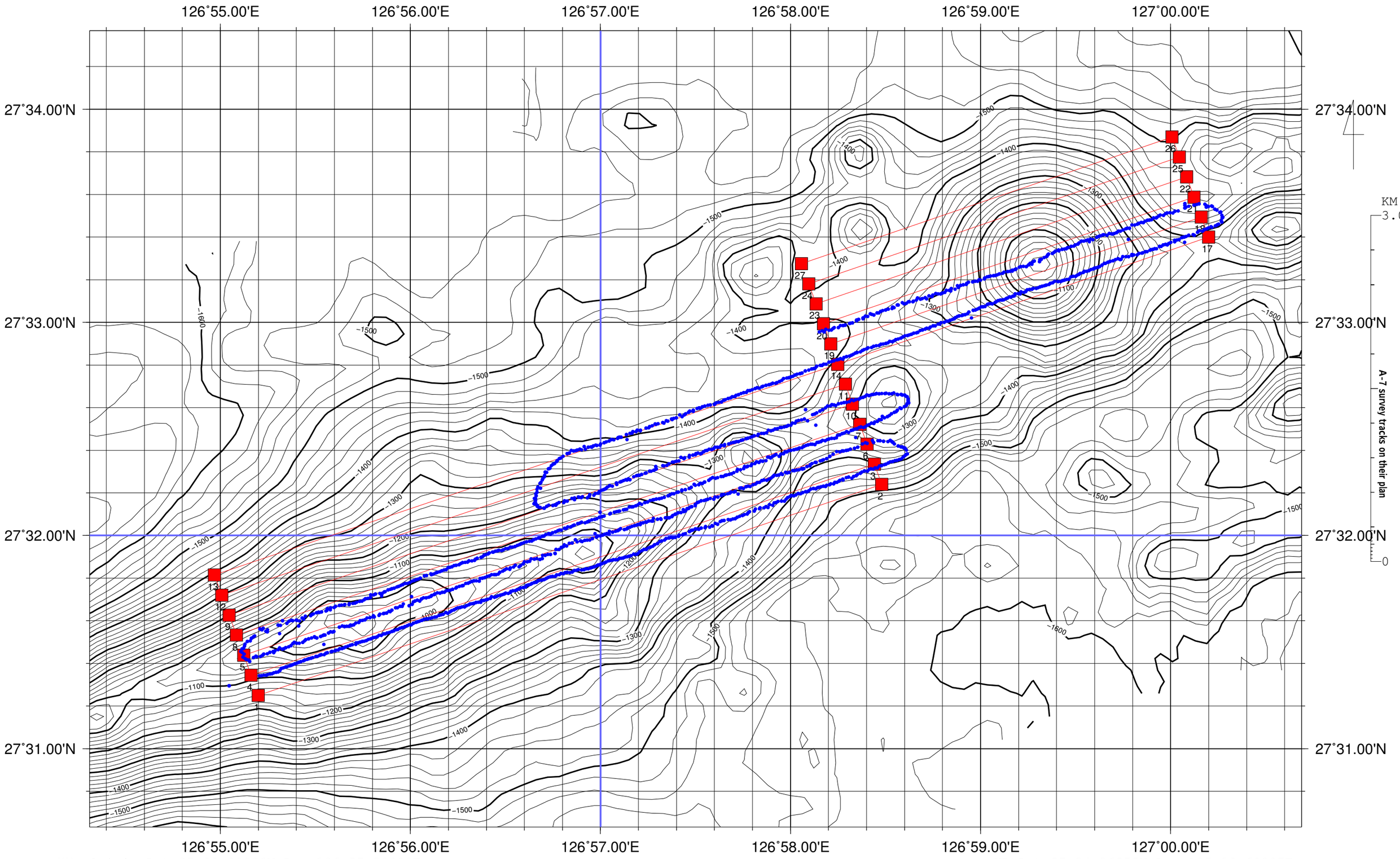
XY Origin Lat 27-32.00000N Lon 126-57.00000E
Center Lat 27-32.00000N Lon 126-57.50000E
Grid_File:YK1216_100.grd ContourInt:20m

Datum WGS-84 Proj.MER

(UR)Lat 27-34.49151N Lon 127-01.75179E
(LL)Lat 27-29.50949N Lon 126-53.24921E
(2012-10 -02)

Urashima#149DIVE
OKINAWA-TOROUGH

(1 /30000)



XY Origin Lat 27-32.00000N Lon 126-57.00000E
Center Lat 27-32.50000N Lon 126-57.50000E
Grid_File:KR01-09_200m.grd ContourInt:20m

Datum WGS-84 Proj.MER

(UR)Lat 27-34.36875N Lon 127-00.68897E
(LL)Lat 27-30.63225N Lon 126-54.31203E
(2012-09-25)

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OKINAWA-TROUGH

(1 /40000)

126°54.00'E 126°55.00'E 126°56.00'E 126°57.00'E 126°58.00'E 126°59.00'E 127°00.00'E 127°01.00'E

27°34.00'N
27°33.00'N
27°32.00'N
27°31.00'N
27°30.00'N

KM
4.0
0

XY Origin Lat 27-32.00000N Lon 126-57.00000E
Center Lat 27-32.00000N Lon 126-57.50000E
Grid_File:YK1216_100.grd ContourInt:20m

Datum WGS-84 Proj.MER

(UR)Lat 27-34.49151N Lon 127-01.75179E
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(2012-10 -02)