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Kairei Cruise Report

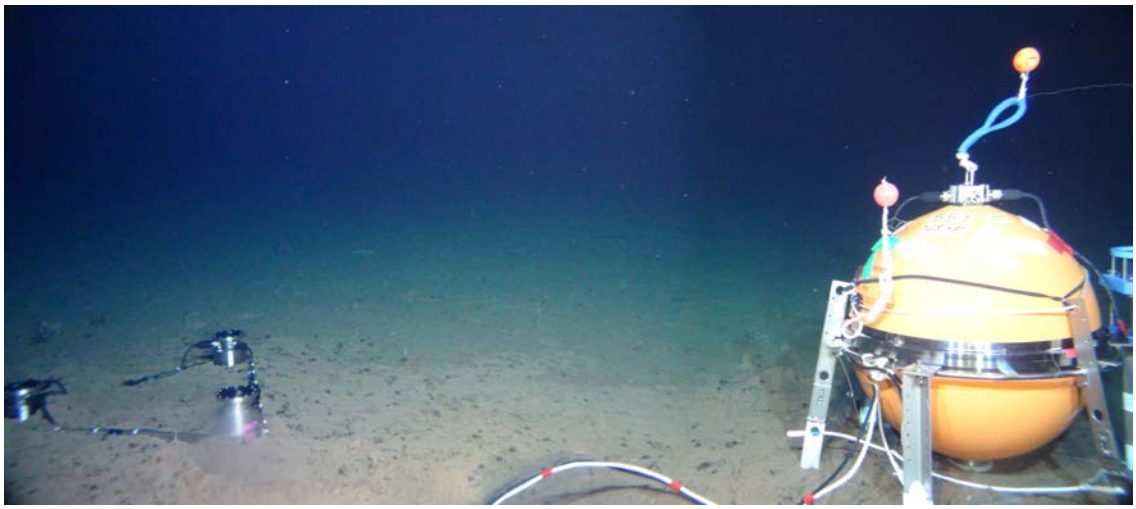
KR12-14

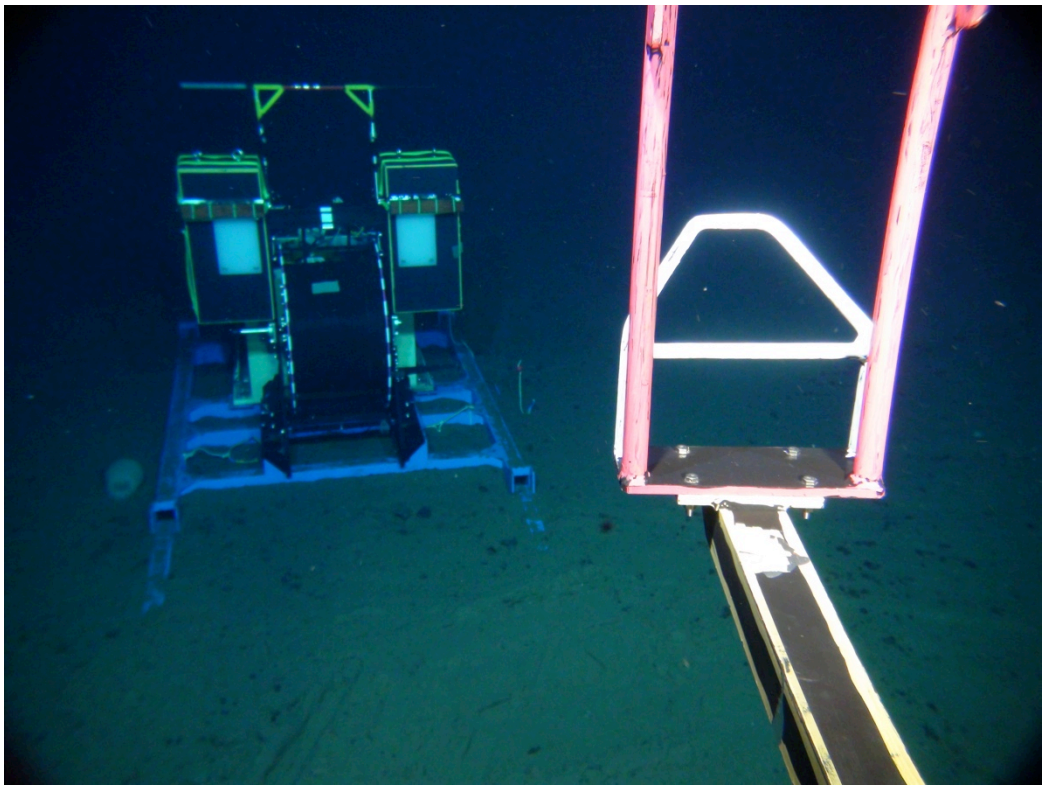
Deployment and recovery of ocean bottom geophysical instruments in the Northwest Pacific Ocean

Aug. 17 – Sep. 05, 2012

Japan Agency for Marine-Earth Science and Technology

(JAMSTEC)





Above: BBOBS-NX at NM15 after rearrangement of sensor and titanium sphere by KAIKO 7000-II.

Below: EFOS at NM16 when KAIKO 7000-II is approaching to pick up the cable drum.

Contents

1. Cruise Information

●Cruise ID KR12-14

●Name of vessel Kairei

●Title of the cruise Deployment and recovery of ocean bottom geophysical instruments in Northwest Pacific Ocean

●Title of proposal New phase of Ocean Hemisphere Project: Imaging the normal oceanic mantle by advanced ocean bottom observations (The NOMan Project)

●Cruise period Aug. 17– Sep. 05, 2012

●Ports of call Sendai - JAMSTEC Yokosuka

●Research area Northwest Pacific Ocean (Northwest and southeast of the Shatsky Rise)

●Research Map

See Fig. 1 in Section 3.2.

2. Participants list

2.1. Researchers

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Co-chief Scientist

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Marine Technician

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Captain	SHINYA RYONO
Chief Officer	AKIHISA TSUJI
Jr.Chief Officer	TATSUO ADACHI
2nd Officer	ISAO MAEDA
3rd Officer	KANTO ASAJI
Chief Engineer	HIROYUKI SHIBATA
1st Engineer	TADASHI ABE
Jr.1st Engineer	KENZO KATO
2nd Engineer	KENTA IKEGUCHI
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Able Seaman	TADAHIKO TOGUCHI
Able Seaman	SAIKAN HIRAI
Able Seaman	DAISUKE YANAGITANI
Sailor	HIROTAKA SHIGETA
Sailor	RYOMA TAMURA
Sailor	KENTA NASU
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Oiler	MASANORI UEDA
Oiler	YUJI HIGASHIGAWA
Oiler	MASAKI TANAKA
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Chief Steward	YUKIO TACHIKI
Steward	HIDEO FUKUMURA
Steward	KAZUHIRO HIRAYAMA
Steward	HIROKI FUKUDA
Steward	SHIHO SHIMIZU

2.3 ROV KAIKO7000-II operation team

Operation Manager	ATSUMORI MIURA
Operation Manager	TOSHIAKI SAKURAI
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2nd ROV Operator	TOMOE KONDO
2nd ROV Operator	TETSUYA ISHITSUKA
2nd ROV Operator	SEIJI SHIGETAKE
3rd ROV Operator	RYU ASAI
3rd ROV Operator	SHOTA IHARA
3rd ROV Operator	TAKUMA GOTO

3. Observation

3.1 Purpose and background

We proposed and funded by Grant-in-aid for specially promoted research (JSPS) to conduct a research program in 5 years toward understanding of the mantle dynamics from an innovative observational approach by answering two fundamental questions in Earth science:

(a) ***What is the physical condition for the lithosphere-asthenosphere boundary (LAB)?***

(b) ***Is the mantle transition zone (MTZ) a major water reservoir of the Earth?***

The "normal" ocean floor is the best window to approach these questions as it allows us to see the inside of the Earth through it without the disturbance due to the thick and heterogeneous continental crust. However, any approach, if ever attempted, has not yet been successful because of technological difficulties in obtaining high-quality geophysical data in the ocean.

The present investigators had led the Ocean Hemisphere network Project (OHP) in 1996-2001, in which a network of geophysical observatories was built in the western Pacific region. Data from the OHP network, especially from broadband seismographs on land and under water, precise magnetometers, submarine cables to measure electric field, successfully provided improved global images of the Earth's interior in terms of seismic velocities and electrical conductivity (e.g., Utada et al., *GRL,* 2003). During the OHP project, we had also developed a set of new portable ocean bottom instruments, broadband ocean bottom seismometers (BBOBSs) and ocean bottom electro-magnetometers (OBEMs).

These new observation technologies have been fully utilized in the 5-year Stagnant Slab Project (SSP) that succeeded the OHP since 2004. In the SSP, we have carried out a long-term (3 years in total) joint observation of BBOBSs and OBEMs in the Philippine Sea (Shiobara et al., *EOS,* 2009) to study the upper matnle and the MTZ where the subducted Pacific slab appears to be stagnating. We have made significant contributions to the SSP by obtaining results such as the estimation of water content in the MTZ by joint interpretation of seismic and electromagnetic tomography (Koyama, Utada et al., *AGU Monograph*, 2006; Utada et al., EPSL, 2009) and the seismic evidence for water transportation deep into the mantle by subducting slab (Kawakastu & Watada, *Science*, 2007). We also revealed the upper mantle structure in this region by analyzing BBOBS data (Isse et al. *PEPI*, 2010) and OBEM data (Baba et al., *PEPI*, 2010). From the northwest Pacific Ocean, Kawakatsu et al. (*Science*, 2009) presented seismic evidence that indicates the lithosphere-asthenosphere boundary to be a sharp seismic discontinuity. Integration of these pieces of evidence obtained by existing technology is undoubtedly useful to solve two questions, but it is not enough.

Recently, we developed (e.g. Shiobara et al. 2011) further innovative instruments (BBOBS-NX: broadband ocean bottom seismometer next generation; EFOS: Earth electric field observation system). By improving the mechanical coupling between the sensor housing and seafloor sediments, the BBOBS-NX enables us to record horizontal seismic motions, as well as vertical ones, with a typical noise level comparable to land observations. This gives us a strong advantage over other OBS's because it

allows us to apply station-based powerful seismic analysis methods commonly used on land, such as the receiver function and shear-wave splitting analyses, for ocean bottom data. The EFOS, on the other hand, measures the electric voltage difference at the seafloor by using a 10 km long cable. Compared to the OBEM measuring the electric field with a spacing of only 5 m, it successfully reduces the noise level to 1/10 or lower so as to provide reliable estimates of electromagnetic responses in a wide period range (1,000-500,000 s) that have high sensitivity to the electrical conductivity in the upper mantle and in the MTZ. Therefore, we are now capable of providing strong constraints to answer the two questions (a) and (b) listed above by applying our advanced observational technologies to the "normal oceanic mantle" (as opposed to the mantle beneath subduction zones, hot spots or mid-oceanic ridges). Therefore we call the project as **the NOMan project**.

In KR10-08 conducted in June 2010, we started a pilot experiment of the NOMan project, in which two BBOBS-NX's and one EFOS are deployed together for the first time in our experience, as well as 3 BBOBS's and 5 OBEM's of conventional type. We expected this pilot experiment would provide us a

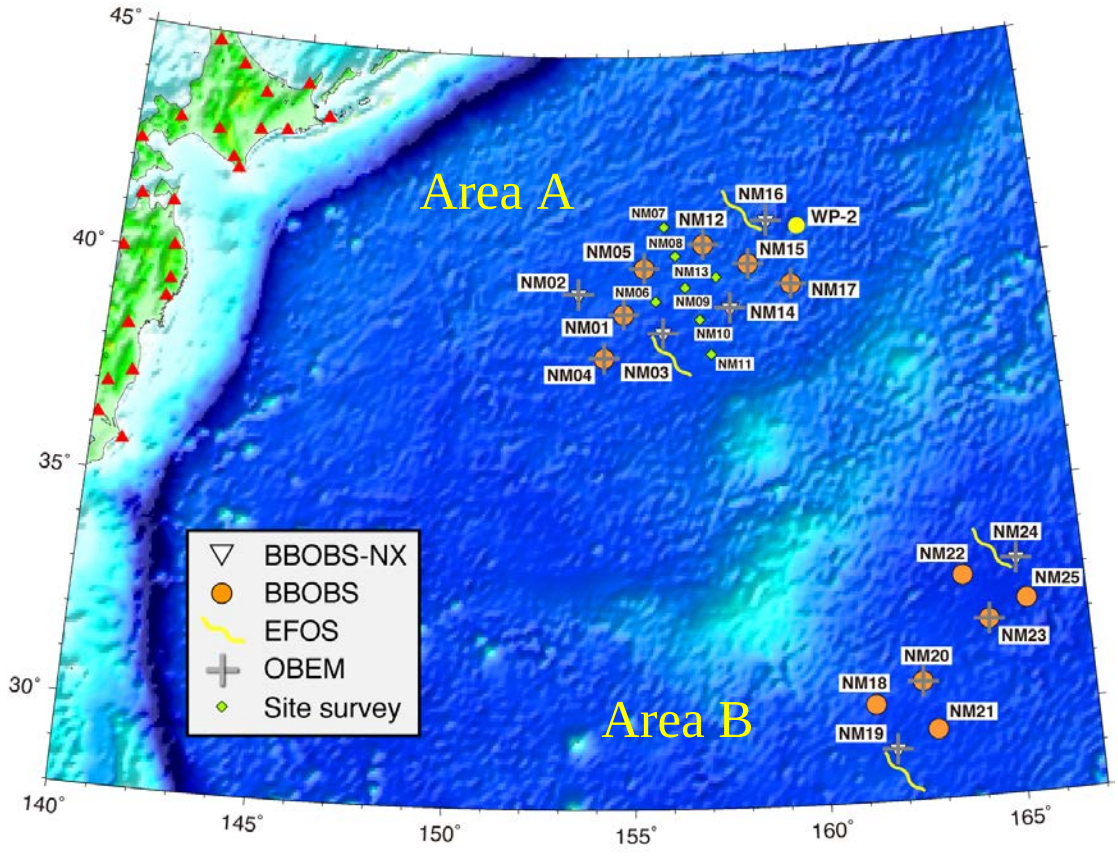


Fig. 1. Locations of two target areas of the present cruise and site distribution conducted and planned in the entire project.

good opportunity to train ourselves for instrumentations, observations, data processing and analyses.

The previous cruise of the NOMan project, KR11-10 was planed as the first phase of the main observation of the project, recovering instruments deployed in the pilot experiment, and deploying more number of BBOBS-NX's and EFOS's as well as BBOBS's and OBEM's. However, we had to change our cruise plan so that only conventional instruments (BBOBS's and OBEM's) which do not need KAIKO 7000-II dive operation are going to be recovered and deployed. The recovery and deployment of advanced instruments (BBOBS-NX's and EFOS's) are postponed to be conducted in the summer of 2012, which is the present cruise KR12-14. The KR11-10 cruise was carried out from November 16 to 30, 2011. Due to a bad weather condition, we recovered only one BBOBS and one OBEM at the site NM04, and re-installed them in the area A. In the area B, we successfully deployed 8 BBOBS's and 8 OBEM's, respectively. Every instrument was equipped with batteries sufficient for two-year deployment, so to be recovered in the summer of 2013.

The present cruise is the most important one in the NOMan Project. We plan to recover 5 BBOBS's, 2 BBOBS-NX's, 1 EFOS recorder and 4 OBEM's from the pilot and 1st experiments, and deploy 6 BBOBS-NX's and 4 EFOS's (one replacement and three new installations), as well as 6 BBOBS's and 8 OBEM's. Most of the instruments will be recovered in the summer of 2014 after two years' deployment.

3.2. Research Areas

The NOMan project has two target areas A and B in the northwest Pacific Ocean (Fig. 1). The area A (northwest of the Shatsky Rise) is the main target of the project where the sea floor is considered as 'normal'. The area B (southeast of the Shatsky Rise) is the second target, selected for testing generality of the result. Locations of observation sites in plan to be visited in KR12-14 cruise are summarized in Table 1a.

Table 1a. Locations of observation sites in plan of the KR12-14 cruise. Sites from NM01 to NM17 belong to the area A, while those from NM19 to NM24 belong to the area B

Site	Lat. (N)	Lon. (E)	Site	Lat. (N)	Lon. (E)	Site	Lat. (N)	Lon. (E)
NM01	39 12.06	154 47.04	NM06	39 28.98	155 43.02	NM15	40 16.98	158 27.00
NM02	39 42.06	153 21.30	NM08	40 30.00	156 19.02	NM16	41 13.98	159 03.00
NM03	38 45.72	155 54.60	NM09	39 46.98	156 34.98	NM17	39 46.98	159 40.98
NM04	38 12.60	154 12.18	NM10	39 03.00	156 58.98	NM19	29 09.00	161 46.44
NM05	40 15.06	155 24.54	NM12	40 45.00	157 09.00	NM24	33 13.02	165 15.72

In area A, we plan to recover and deploy BBOBS-NX at 2 sites (NM02 and NM03) and at 4 sites (NM02, NM03, NM16, NM14). We also recover one EFOS from NM03 that is replaced by a new recorder, and deploy EFOS with 2 km cable at 1 site (NM16). Recovery and deployment of BBOBS are planed at 3 sites (NM04, NM01, NM05) and at 6 sites (NM01, NM04, NM05, NM12, NM15, and NM17), respectively. Recovery and deployment of OBEM are planned at 4 sites (NM01, NM02, NM03 and NM05) and at 8 sites (NM02, NM03, NM05, NM12, NM16, NM15, NM17, and NM14), respectively. In

area B, we plan to deploy BBOBS-NX at 2 sites (NM24 and NM19). We also deploy EFOS at 2 sites (NM24 and NM19). Recovery of BBOBS is planned at 2 sites (NM24 and NM19).

3.3.a Change of the cruise plan

Because of the trouble of KAIKO 7000-II at the beginning of the cruise and limited ship time, it was considered as difficult to complete the original cruise plan if we do not cut several installations. After a serious discussion with participated scientists, we decided to give up to visit area B and to install as many instruments as possible in area A.

In summary, installations at sites NM19 and NM24 in area B are cancelled. In the new plan, we added NM14 in area A as a site with installation by KAIKO 7000-II dive operation. Site NM01 was also change to a site with installation by dive operation.

On the transit from NM12 to NM 16, there was a serious trouble of MNBES for many hours. Because a dive operation is not allowed without bathymetric survey data, we decided to change the location of NM16 about 16 miles to the south where bathymetry is available. In order to avoid unexpected trouble of MNBES for remaining sites of the cruise, we selected substitute locations for MN17 and MN14 where bathymetry is not available.

Table 1b. Observation sites of the KR-12-14 cruise after changing the cruise plan. All sites belong to the area A.

Site	Lat.	Lon.	Site	Lat.	Lon.
NM01	**39 12.06**	**154 47.04**	**NM09***	**39 46.98**	**156 34.98**
NM02	**39 42.06**	**153 21.30**	**NM10***	**39 03.00**	**156 58.98**
NM03	**38 45.72**	**155 54.60**	**NM11***	**38 16.00**	**157 17.50**
NM04	**38 12.60**	**154 12.18**	**NM14**	**39 02.00**	**158 01.00**
NM05	**40 15.06**	**155 24.54**	**NM15**	**40 20.680**	**158 25.150**
NM06*	**39 28.98**	**155 43.02**	**NM16**	**41 00.90**	**159 11.50**
NM08*	**40 30.00**	**156 19.02**	**NM17**	**39 41.50**	**160 00.00**
NM12	**40 49.30**	**157-6.85**			

* MNBES

3.3. Type of instruments

3.3.1 BBOBS

BBOBS's have been used in many of our previous projects, and are to be used in the present project. It consists of a pressure housing, hydrophone for acoustic release system, and an anchor. A broadband sensor, batteries and recording unit are contained in the pressure case (a 65 cm diameter sphere) made of titanium alloy (Fig. 2). It is deployed by free-fall and recovered by self pop-up system. The instruments

deployed in this cruise are supposed to be recovered in next summer (in 2013).

3.3.2 OBEM

OBEM's have also been used in our previous projects together with BBOBS's. It consists of two grass spheres, frame made of titanium, an acoustic release system, and an anchor. There two types of OBEM deployed in this cruise. One is ERI type (OBEM-ERI) and the other is JAMSTEC type (OBEM-JM). OBEM-ERI is equipped with a three-component fluxgate sensor and recording unit are installed in one sphere and batteries in the other (Fig. 3a), while OBEM-JM is equipped with a flaxgate sensor in a titanium cylinder and recoding unit and batteries in a glass sphere (Fig. 3b). Either OBEMis deployed by free-fall and recovered by self pop-up system. The OBEM's deployed in this cruise are also planned to be recovered in next summer (in 2013), except those deployed at NM03 and NM16 which are scheduled to operate for two years.

3.3.3 BBOBS-NX

BBOBS-NX (Fig. 4) is an advanced ocean bottom seismometer newly developed by our group (Shiobara et al., 2011). It is deployed by free-falling with the recording unit temporally fixed above the sensor unit. After confirming that the sensor unit is penetrated into the sediment deeply enough, the recording unit is released from the sensor unit, and it is replaced on the seafloor nearby the sensor unit by ROV KAIKO 7000-II. This operation enables us to make seismic noise level as low as those at normal land observatories at the period band (10-1000 seconds) important for the present purpose. During this cruise, we plan to recover two sites (NM02 and NM03) installed with this seismometer in June of 2010 to recover and replace new one by KAIKO 7000-II operation. We also plan to install four more BBOBS-NX's at NM14, NM16, NM19 and NM24. To prepare the BBOBS-NX more quickly in this tight ship time, the fixing mechanism between the sensor unit and the recording unit is totally changed from the previous used in the 2010 deployment.

3.3.4 EFOS

EFOS (Earth's electric field observation system is an advanced ocean bottom instrument for measuring the electric field by using a long cable. It consists of a cable bobbin and data recorder which are deployed from the ship by a buoy system with an acoustic release system. The buoy is released after landing the ocean bottom. Then KAIKO 7000-II picks up and tow the cable bobbin to lay a cable in a particular direction. The electrical potential difference between electrodes at the end of the cable and near the recorder is measured and recorded at a sampling interval of 1 s. In the pilot experiment, we tried to deploy a system with 6 km long cable (EFOS-6) at site NM03 but had to terminate the installation at the cable length of 3 km due to the weather condition. The cable installation is going to be completed in the present cruise. The recording unit will be replaced for further two-year long observation. We also plan to

install 3 sets of EFOS with 2 km cable (EFOS-2) at NM16, NM24 and NM19 in this cruise.

3.3.5 Instrument photos

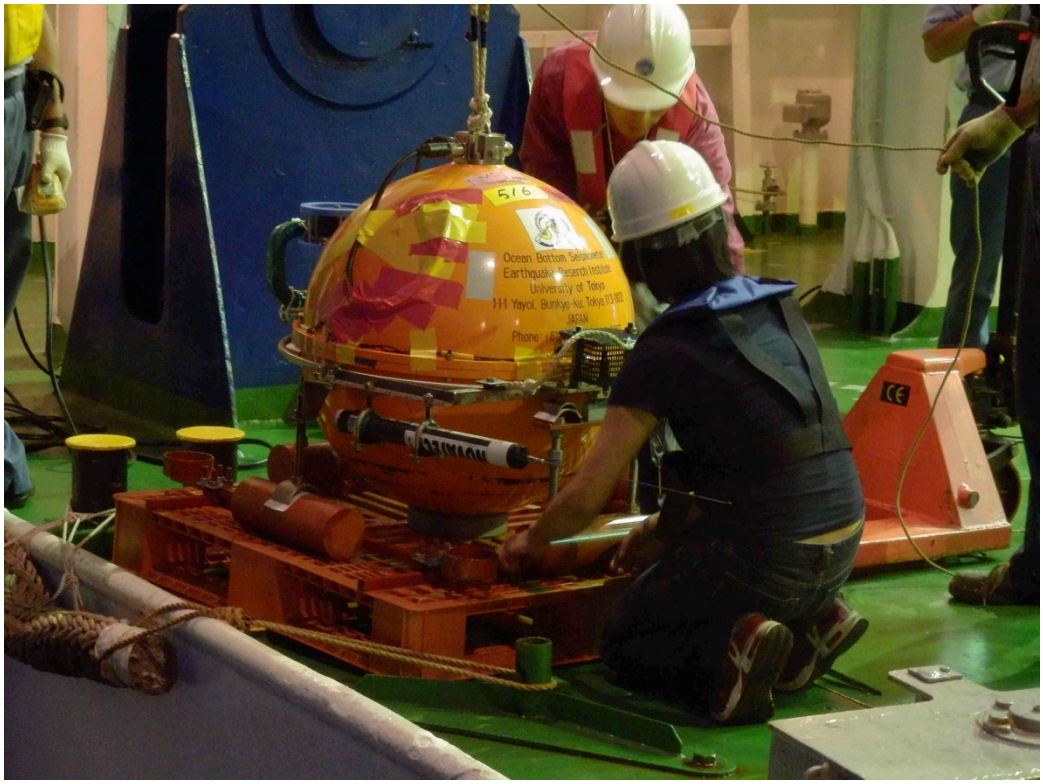


Fig. 2 Preparation of BBOBS to be recovered and deployed in the present cruise. The photo was taken before the deployment from Kairei at site NM16.

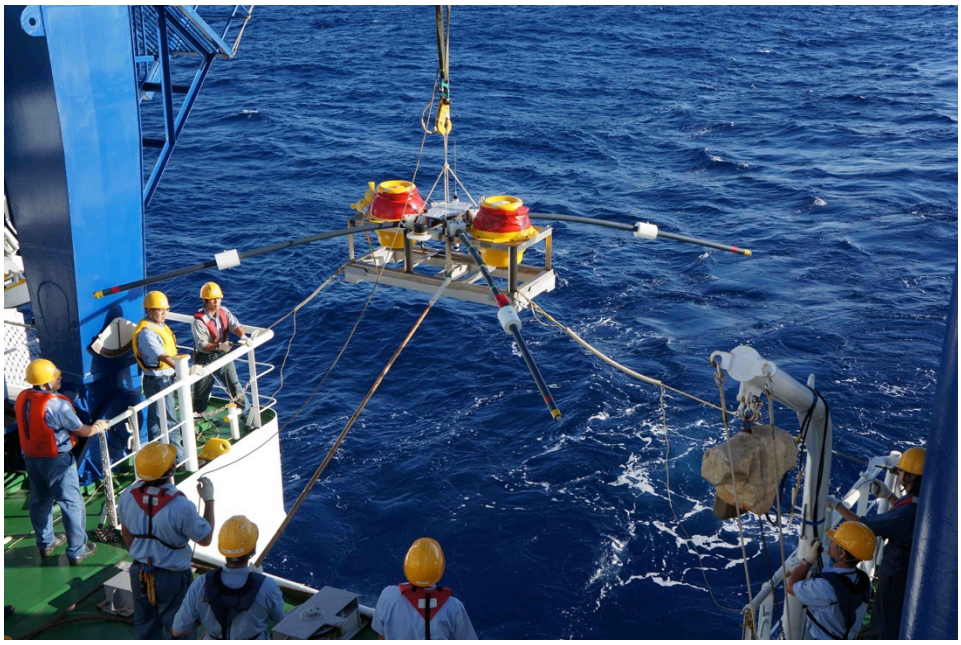


Fig. 3a OBEM-ERI to be recovered and deployed in the present cruise. The photo was taken at the deployment from Kairei at site NM05.

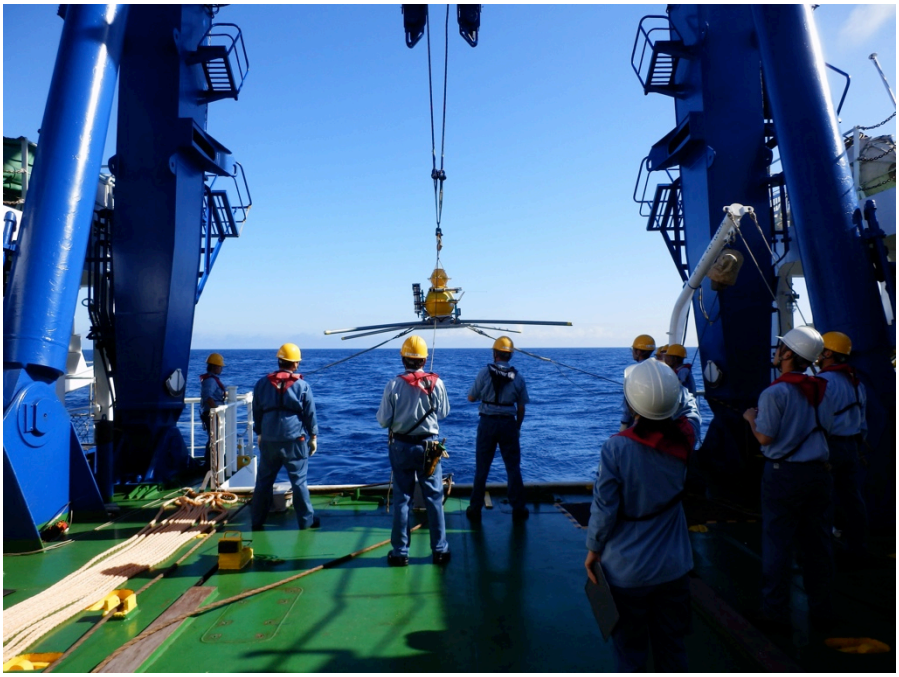


Fig. 3b OBEM-JM deployed at NM02 in the present cruise.

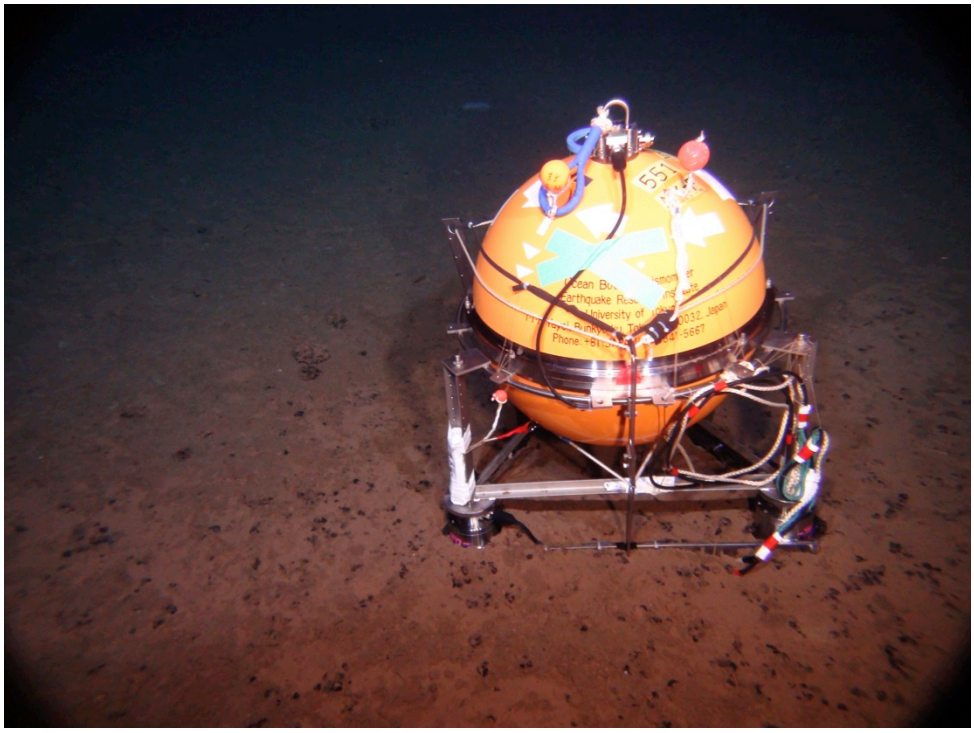


Fig. 4 BBOBS-NX deployed at seafloor site NN15. The titanium sphere containing data recorder and batteries is decoupled from the 3 component sensor by KAIKO 7000-II.

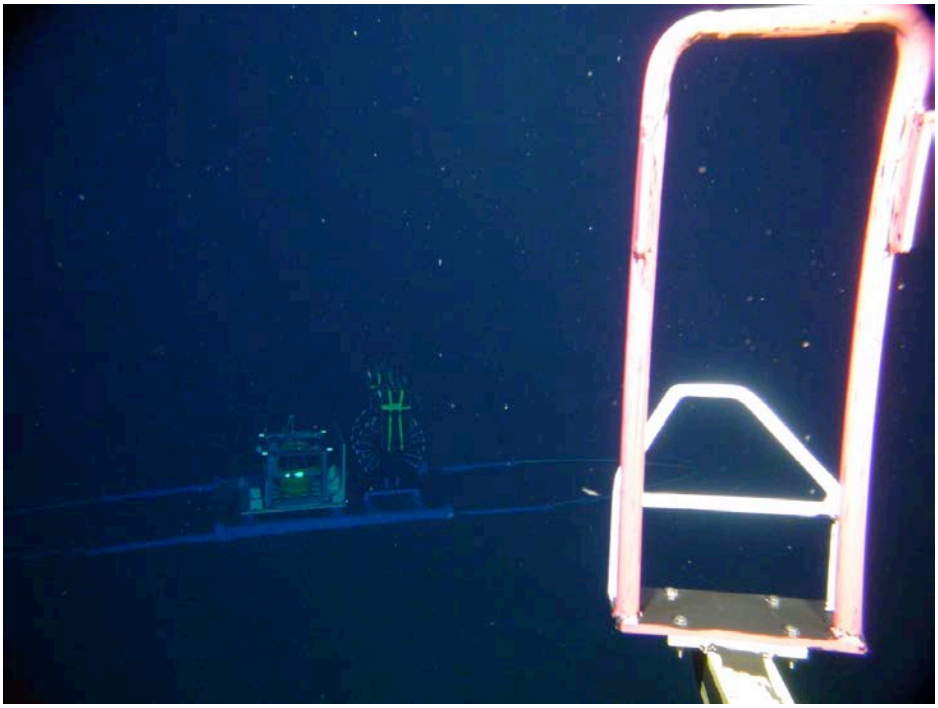


Fig. 5. EFOS at the seafloor viewed down from KAIKO 7000-II when she approaches the site. Seen in front is an cable drum suspension arm.

3.4. Cruise Log

Date	Local Time	Note	Description	Position/Weather/ Wind/Sea condition
17-Aug-12		**Sail out, proceeding to research area**		8/17 12:00 (UTC+9h)
	08:00	boarded		38-11.4'N, 141-49.4'E
	09:00	let go all shore line, left SENDAISHIOGAMA-KO		East off Kinkazan
	10:00-11:00	carried out onboard education & training for scientists		Fine but cloudy
	11:00-11:30	breefing for KAIKO 7000II		East-2 (Light breeze)
	13:00-14:00	meeting for KAIKO 7000II operation		1 (Sea calm)
	16:40-17:00	Konpira ceremony		1 (Low swell short)
	18:15-18:30	scientific meeting		Visibly: 8'
18-Aug-12		**Proceeding to research area**		8/18 12:00 (UTC+10h)
	00:00	Time adjustment – 1hour ahead (JST +1 h)		39-00.6'N, 148-06.8'E
	08:30-09:30	practiced life boat, fire and callision station drill		East off Sanriku
	18:00-18:15	scientific meeting		Fine but cloudy
				SSW-4 (Moderate breeze)
				3 (Sea slight)
				1 (Low swell short)
				Visibly: 8'
19-Aug-12		**Deploy OBEM&BBOBS-NX, and Dive#557 at site NM02**		8/19 12:00 (UTC+10h)

	07:00	arrived at research area		39-42.6'N, 153-20.8'E
	07:07	released XBT @ 39-42.0760'N, 153-21.3076'E		Northwest Pacific
	08:23	deployed OBEM @ site NM02 (39-41.9683'N, 153-21.3932'E)	Depth = 5728 m	Fine but cloudy
	08:46	deployed BBOBES-NX @ site NM02 (39-41.9596'N, 153-21.3339'E)	Depth = 5731 m	WSW-4 (Moderate breeze)
	10:20-10:47	carried out calibration of BBOBS-NX		3 (Sea slight)
	11:21	Re-floated OBEM @ site NM02 (39-43.0034'N, 153-21.2529'E)	Depth = 5723 m	1 (Low swell short)
	11:46	recovered OBEM		Visibly: 8'
	12:46-14:04	carried out MBES mapping survey		
	15:25	hoisted up KAIKO 7000II		
	15:30	launched KAIKO 7000II, and started 7K#557 dive operation	Dive#557	
	19:06	landed at sea bottom	Depth = 5732 m	
	19:51	left bottom	Depth = 5732 m	
	20:30-20:50	scientific meeting		
	22:19	hoisted up KAIKO 7000II		
	22:30	recovered KAIKO 7000II		
	23:15	commenced proceeding to site NM04		
20-Aug-12		**Deploy BBOBS at site NM04 & NM01, and recoverd OBEM at site NM01**		8/20 12:00 (UTC+10h)
	06:00	arrived at site NM04		38-37.5'N, 154-26.7'E
	06:56	deployed BBOBS @ site NM04 (38-12.6047'N, 154-12.1824'E)	Depth = 5949 m	Northwest Pacific
	08:18	Re-floated BBOBS @ site NM04 (38-12.6605'N, 154-12.6378'E)	Depth = 5952 m	Fine but cloudy
	08:29	recovered BBOBS @ site NM04 (38-12.5648'N, 154-12.4024'E)	Depth = 5952 m	West-3 (Gentle breeze)
	08:30-10:10	carried out calibration of BBOBS		2 (Sea smooth)

	10:10	commenced proceeding to site NM01		1 (Low swell short)
	14:50	arrived at site NM01		Visibly: 8'
	15:51	deployed BBOBS @ site NM01 (39-12.0354'N, 154-47.0046'E)	Depth = 5732 m	
	18:21	Re-floated OBEM @ site NM01 (39-12.4791'N, 154-46.2221'E)	Depth = 5739 m	
	18:42	recovered OBEM		
	19:05-20:05	carried out calibration of BBOBS		
	20:15	commenced proceeding to site NM05		
21-Aug-12		**Deploy OBEM&BBOBS at site NM05, and Dive#558 at site NM02**		8/21 12:00 (UTC+10h)
	02:00	arrived at site NM05		40-00.9'N, 154-34.5'E
	04:40	deployed OBEM @ site NM05 (40-15.0133'N, 155-24.3444'E)	Depth = 5600 m	Northwest Pacific
	05:13	deployed BBOBS @ site NM05 (40-15.0697'N, 155-24.5214'E)	Depth = 5601 m	Cloudy
	05:39	Re-floated BBOBS @ site NM05 (40-15.0560'N, 155-24.8849'E)	Depth = 5611 m	WSW-5 (Fresh breeze)
	05:47	recovered BBOBS @ site NM05 (40-15.1082'N, 155-24.8391'E)	Depth = 5612 m	4 (Sea moderate)
	07:10	Re-floated OBEM @ site NM05 (40-15.1105'N, 155-25.1954'E)	Depth = 5605 m	3 (Moderate short)
	08:00	recovered OBEM		Visibly: 8'
	08:19-09:00	carried out calibration of BBOBS and OBEM		
	09:00-09:21	scientific meeting		
	09:05	commenced proceeding to site NM02		
	16:00	arrived at site NM02		
	17:22	hoisted up KAIKO 7000II		
	17:29	launched KAIKO 7000II, and started 7K#558 dive operation	Dive#558	
	20:20	landed at sea bottom	Depth = 5732 m	

22-Aug-12		**Dive#558 at site NM02, and deploy OBEM&BBOBS-NX at site NM03**		8/22 12:00 (UTC+10h)
	01:53	left bottom	Depth = 5728 m	39-10.8'N, 154-46.9'E
	06:03	hoisted up KAIKO 7000II		Northwest Pacific
	06:15	recovered KAIKO 7000II		Fine but cloudy
	06:49	recovered BBOBS-NX		NNE-3 (Gentle breeze)
	07:10	commenced proceeding to site NM03		2 (Sea smooth)
	15:50	arrived at site NM03		2 (Low swell long)
	16:35	deployed OBEM @ site NM03 (38-45.7248'N, 155-54.5216'E)	Depth = 5765 m	Visibly: 8'
	17:25	deployed BBOBS-NX @ site NM03 (38-45.8464'N, 155-54.7395'E)	Depth = 5764 m	
	17:40	released XBT @ 38-46.3501'N, 155-54.7679'E		
	18:58-20:30	carried out calibration of BBOBS-NX and OBEM		
	21:29	commenced MBES mapping survey		
	21:00-21:30	scientific meeting		
23-Aug-12		**Dive#559 at site NM03**		8/23 12:00 (UTC+10h)
	02:15	finisfed MBES mapping survey		38-45.7'N, 155-54.5'E
	07:32	hoisted up KAIKO 7000II		Northwest Pacific
	7:37	launched KAIKO 7000II, and started 7K#559 dive operation		Fine but cloudy
	12:10	landed at sea bottom	Depth = 5759 m	NNE-3 (Gentle breeze)
	15:36	left bottom	Depth = 5761 m	2 (Sea smooth)

	17:55-18:03	scientific meeting		2 (Low swell long)
	18:11	hoisted up KAIKO 7000II		Visibly: 8'
	18:21	recovered KAIKO 7000II		
	18:54	recovered BBOBS-NX		
	19:42	commenced proceeding to site NM03		
24-Aug-12		**Dive#560 at site NM03**		8/24 12:00 (UTC+10h)
	04:04	finisfed MBES mapping survey		38-45.9'N, 155-54.8'E
	07:25	hoisted up KAIKO 7000II		Northwest Pacific
	7:30	launched KAIKO 7000II, and started 7K#560 dive operation	Dive#560	Cloudy
	10:06	landed at sea bottom	Depth = 5763 m	NNE-4 (Moderate breeze)
	14:58	left bottom	Depth = 5762 m	3 (Sea slight)
	17:30	hoisted up KAIKO 7000II		2 (Low swell long)
	17:35	recovered EFOS's recorder		Visibly: 8'
	17:41	recovered KAIKO 7000II		
	18:40	commenced proceeding to site NM15		
	19:30-19:40	scientific meeting		
25-Aug-12		**Deploy OBEM&BBOBS-NX, and Dive#561 at site NM15**		8/25 12:00 (UTC+10h)
	04:30	arrived at site NM15		40-21.4'N, 158-24.1'E
	04:40-05:15	carried out MBES mapping survey		Northwest Pacific
	06:14	deployed OBEM @ site NM15 (40-21.4606'N, 158-23.9396'E)	Depth = 5570 m	Overcast
	06:39	deployed BBOBES-NX @ site NM15 (40-21.4316'N, 158-23.9812'E)	Depth = 5573 m	NW-5 (Fresh breeze)

	06:48	released XBT @ 40-21.5329'N, 158-24.0230'E		3 (Sea slight)
	07:52-09:13	carried out calibration of BBOBS-NX		2 (Low swell long)
	10:49	hoisted up KAIKO 7000II		Visibly: 8'
	10:54	launched KAIKO 7000II, and started 7K#561 dive operation	Dive#561]	
	13:39	landed at sea bottom	Depth = 5580 m	
	14:25	left bottom	Depth = 5580 m	
	16:57	hoisted up KAIKO 7000II		
	17:04	recovered KAIKO 7000II		
	17:50	commenced proceeding to site NM12		
	21:00-21:15	scientific meeting		
	22:06	commenced MBES mapping survey		
26-Aug-12		**Deploy OBEM&BBOBS at site NM12,**		8/26 12:00 (UTC+10h)
		and deploy EFOS, OBEM and BBOBS-NX at site NM16		41-10.7'N, 158-41.1'E
	02:15	finished MBES mapping survey		Northwest Pacific
	03:30	arrived at site NM12		Fine but cloudy
	04:18	deployed OBEM @ site NM12 (40-49.0632'N, 157-06.4624'E)	Depth = 5504 m	ENE-5 (Fresh breeze)
	04:21	deployed BBOBS @ site NM12 (40-49.0896'N, 157-06.5197'E)	Depth = 5507 m	4 (Sea ,moderate)
	05:42-06:20	carried out calibration of BBOBS		2 (Low swell long)
	06:50	commenced proceeding to site NM16		Visibly: 8'
	12:50	arrived at site NM16		
	12:59	released XBT @ 41-14.6328'N, 158-58.3693'E		
	17:36	released XBT @ 41-01.2470'N, 159-10.4444'E		
	18:04	deployed EFOS mooring system @	Depth = 5571 m	

		site NM16 (41-00.9132'N, 159-11.5398'E)		
	18:26	deployed OBEM @ site NM16 (41-00.9158'N, 159-11.5416'E)	Depth = 5571 m	
	21:17-21:45	carried out calibration of EFOS		
	22:05	deployed BBOBS-NX @ site NM16 (41-01.1440'N, 159-11.3623'E)	Depth = 5583 m	
	22:41	Re-floated EFOS mooring system @ site NM16 (41-01.6041'N, 159-11.1766'E)	Depth = 5583 m	
	23:05	recovered EFOS mooring system @ site NM16 (41-01.6808'N, 159-11.1482'E)	Depth = 5583 m	
	23:07	commenced calibration of BBOBS-NX		
27-Aug-12		**Dive#562 at site NM16**		8/27 12:00 (UTC+10h)
	00:05	finished calibration of BBOBS-NX		41-01.3'N, 159-11.2'E
	00:22-04:05	carried out MBES mapping survey		Northwest Pacific
	05:30	hoisted up KAIKO 7000II		Fine but cloudy
	05:36	launched KAIKO 7000II, and started 7K#562 dive operation	Dive#562	ESE-3 (Gentle breeze)
	08:14	landed at sea bottom	Depth = 5576 m	2 (Sea smooth)
	19:35	left bottom	Depth = 5569 m	2 (Low swell long)
	21:59	hoisted up KAIKO 7000II		Visibly: 8'
	20:00-20:10	scientific meeting		
	22:11	recovered KAIKO 7000II		
	22:51-23:14	carried out figure eight turn measurement		
28-Aug-12		**Deploy BBOBS at site NM17,**		8/28 12:00 (UTC+10h)

		Deploy EFOS, OBEM and BBOBS-NX at site NM14		39-16.6'N, 158-38.0'E
	05:00	arrived at site NM17		Northwest Pacific
	05:15	deployed BBOBS @ site NM17 (39-46.1223'N, 159-50.9221'E)	Depth = 5548 m	Fine but cloudy
	06:17-07:24	carried out calibration of BBOBS		SSE-5 (Fresh breeze)
	07:30	commenced proceeding to site NM14		3 (Sea slight)
	14:20	arrived at site NM14		3 (Moderate short)
	14:24	released XBT @ 39-03.2534'N, 158-00.9832'E		Visibly: 8'
	15:07	deployed EFOS mooring system @ site NM14 (39-01.9802'N, 158-01.0406'E)	Depth = 5508 m	
	15:33	deployed OBEM @ site NM14 (39-01.9685'N, 158-01.0057'E)	Depth = 5508 m	
	17:58-18:40	carried out calibration of EFOS		
	19:38	Re-floated EFOS mooring system @ site NM14 (39-03.1022'N, 158-00.4633'E9	Depth = 5514 m	
	19:54	recovered EFOS mooring system @ site NM14 (39-03.1491'N, 158-00.2301'E)	Depth = 5512 m	
	20:23	deployed BBOBS-NX @ site NM14 (39-02.4491'N, 158-00.6856'E)	Depth = 5513 m	
	20:35-20:44	scientific meeting		
	21:36-22:32	carried out calibration of BBOBS-NX		
	23:15	commenced MBES mapping suevey		
29-Aug-12		**Suspended KAIKO7000II dive**		8/29 12:00 (UTC+10h)
	02:50	finishude MBES mapping survey and commenced proceeding to dive point		38-35.1'N, 157-46.9'E
	04:00	arrived at #563 dive point		Northwest Pacific

	05:00	suspended KAIKO7000II diving operation due to rough sea		Rain
	06:25-23:24	carried out MBES mapping survey		SSE-6 (Strong breeze)
	18:00-18:10	scientific meeting		5 (Sea rough)
				4 (Moderate average)
				Visibly: 5'
30-Aug-12		**Suspended KAIKO7000II dive**		8/30 12:00 (UTC+10h)
	05:30	suspended KAIKO7000II diving operation due to rough sea		39-54.5'N, 156-53.2'E
	06:42	commenced MBES mapping survey		Northwest Pacific
	18:00-18:15	scientific meeting		Fine but cloudy
				South-5 (Fresh breeze)
				4 (Sea moderate)
				4 (Moderate average)
				Visibly: 8'
31-Aug-12		**Dive#563 at site NM14**		8/31 12:00 (UTC+10h)
	03:20	finished MBES mapping survey		39-02.6'N, 158-00.6'E
	04:00	arrived at #563 dive point of NM14		Northwest Pacific
	05:36	hoisted up KAIKO 7000II		Fine but cloudy
	05:42	launched KAIKO 7000II, and started 7K#563 dive operation		SSE-5 (Fresh breeze)
	08:31	landed at sea bottom	Depth = 5508 m	4 (Sea moderate)
	18:53	left bottom	Depth = 5506 m	3 (Moderate short)
	19:10-19:20	scientific meeting		Visibly: 8'
	21:19	hoisted up KAIKO 7000II		

	21:31	recovered KAIKO 7000II		
	22:05	commenced proceeding to NM01		
	22:09	commenced MBES mapping survey		
01-Sep-12		**Deploy EFOS, OBEM and BBOBS-NX, and Dive#564 at site NM01**		9/1 12:00 (UTC+10h)
	08:30	released XBT @ 39-11.2797'N, 154-48.1084'E		39-11.3'N, 154-47.3'E
	08:43	finished MBES mapping survey		Northwest pacific
	08:45	arrived at site NM01		Fine but cloudy
	09:16	deployed EFOS mooring system @ site NM01 (39-12.4773'N, 154-46.5397'E)	Depth = 5752 m	SSW-2 (Light breeze)
	09:32	deployed OBEM @ site NM01 (39-12.4846'N, 154-46.5442'E)	Depth = 5756 m	2 (Sea smooth)
	12:21-13:44	carried out calibration of EFOS		2 (Low swell long)
	14:12	deployed BBOBS-NX @ site NM01 (39-12.2370'N, 154-46.1511'E)	Depth = 5753 m	Visibly: 8'
	15:04	Re-floated EFOS mooring system @ site NM01 (39-12.2280'N, 154-46.1224'E)	Depth = 5754 m	
	15:21	recovered EFOS mooring system		
	15:28-16:11	carried out calibration of BBOBS-NX		
	16:58	hoisted up KAIKO 7000II		
	17:04	launched KAIKO 7000II, and started 7K#564 dive operation		
	18:00-18:10	scientific meeting		
	21:09	landed at sea bottom	Depth = 5749 m	

02-Sep-12		**Dive#564 at site NM01**		9/2 12:00 (UTC+10h)
	07:32	left bottom	Depth = 5756 m	39-03.3'N, 154-46.0'E
		hoisted up KAIKO 7000II		Northwest pacific
		recovered KAIKO 7000II		Fine but cloudy
		carried out MBES mapping survey		NNE-3 (Gentle breeze)
	18:00-18:10	scientific meeting		2 (Sea smooth)
				2 (Low swell long)
				Visibly: 8'
03-Sep-12		**Transit to JAMSTEC**		9/3 12:00 (UTC+10h)
	09:00	onboard seminar		37-20.1'N, 150-14.3'E
	13:00-15:00	onboard tour		Northwest Pacific
	M.N.	Time adjustment – 1hour back (JST + 0 h)		Fine but cloudy
				SSE-3 (Gentle breeze)
				2 (Sea smooth)
				2 (Low swell long)
				Visibly: 8'
04-Sep-12		**Transit to JAMSTEC**		9/4 12:00 (UTC+9h)
	18:00-18:10	scientific meeting		35-40.8'N, 143-26.5'E

				East off Inubousaki
				Fine but cloudy
				SSE-4 (Moderate breeze)
				3 (Sea slight)
				2 (Low swell long)
				Visibly: 8'
05-Sep-12		**Arrived at JAMSTEC**		
	09:00	arrived at YOKOSUKA		
	10:00	disembarked from KAIREI		
		finished KR12-14 cruise		

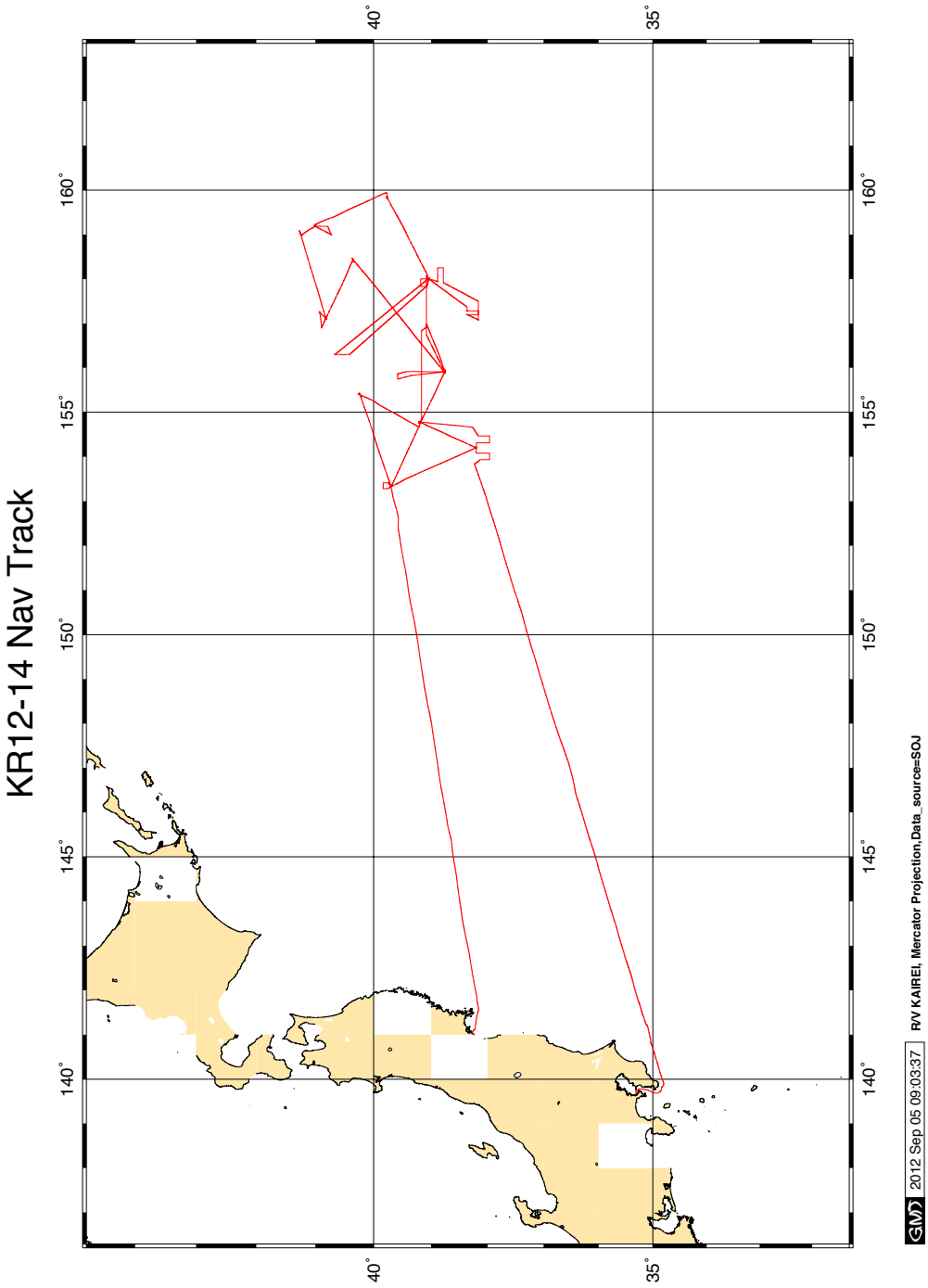
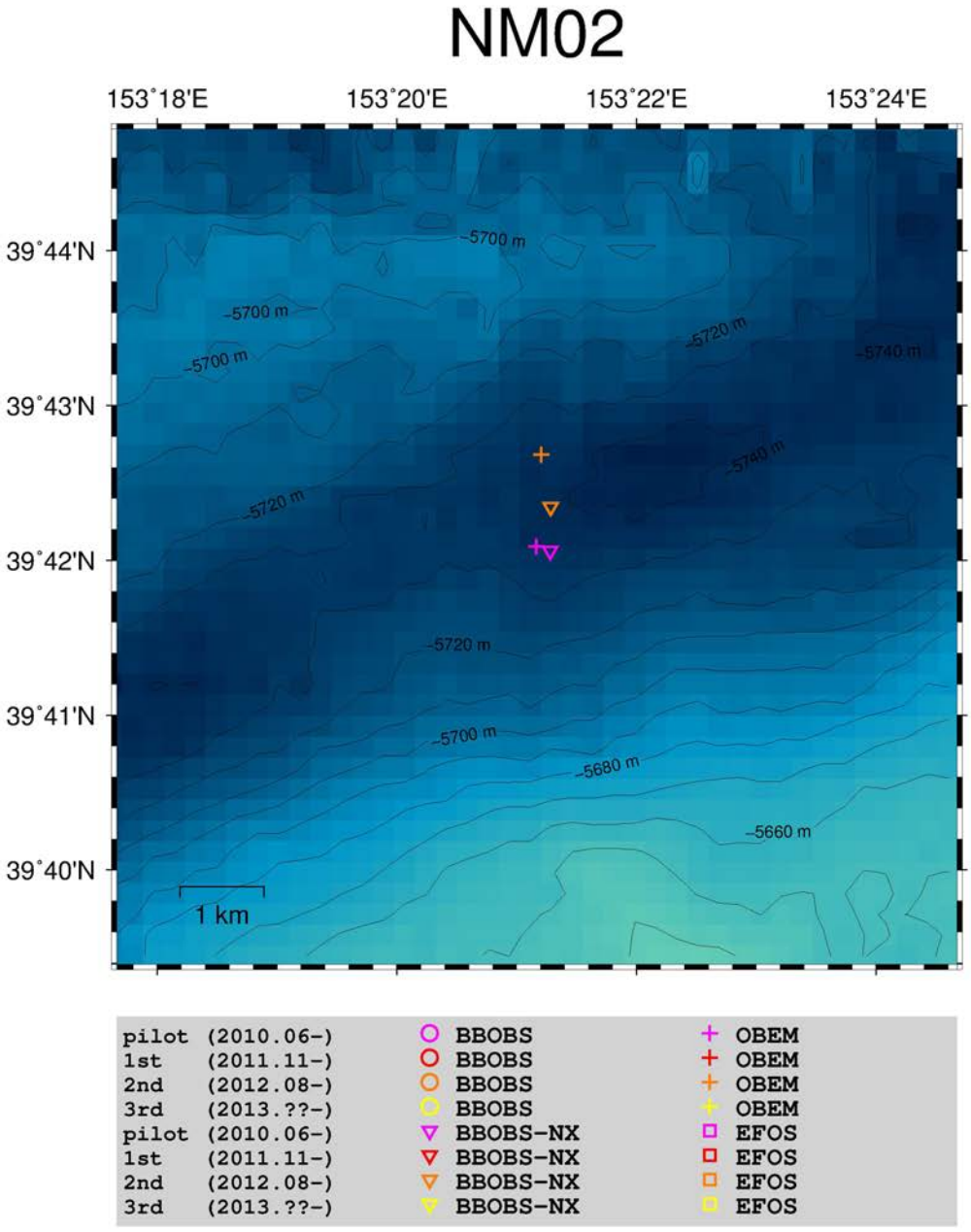


Fig. 5 Map of research area with vessel track of KR12-14.

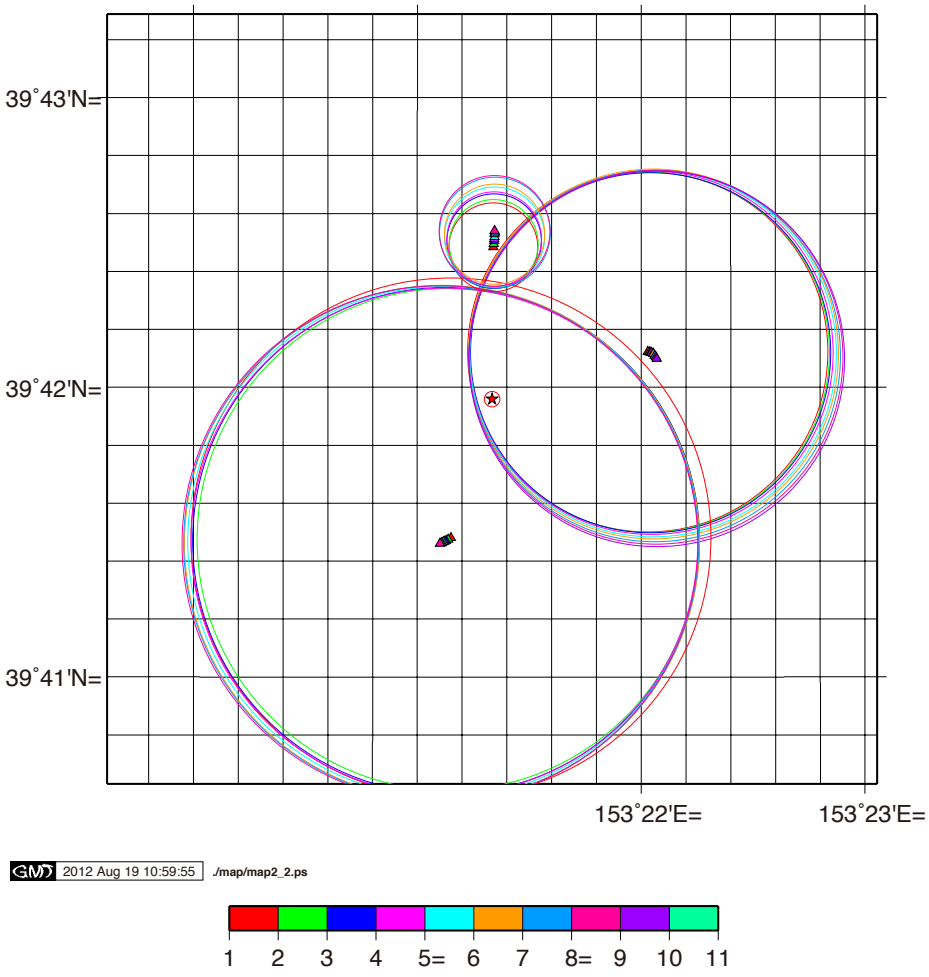
3.5. Installation point information

Due to the limitation of available ship time, we have changed the cruise plan on 7th day of the cruise when we were installing site NM03. Visits to sites in the area B were postponed to the cruise in next year. In the area A, We have completed recovery of two BBOBS-NX's, two BBOBS's, two OBEM and one EFOS recorder, installation of 6 BBOBS-NX's, 5 BBOBS's, 8 OBEM's and 3 EFOS's. We failed to recover one BBOBS and one OBEM. Thus we conclude that the result of the present cruise was quite satisfactory. Given below is installation point information for each site in the order of deployment completion in KR12-14, including detailed bathymetric map and result of positioning by LLBL (in case applicable).

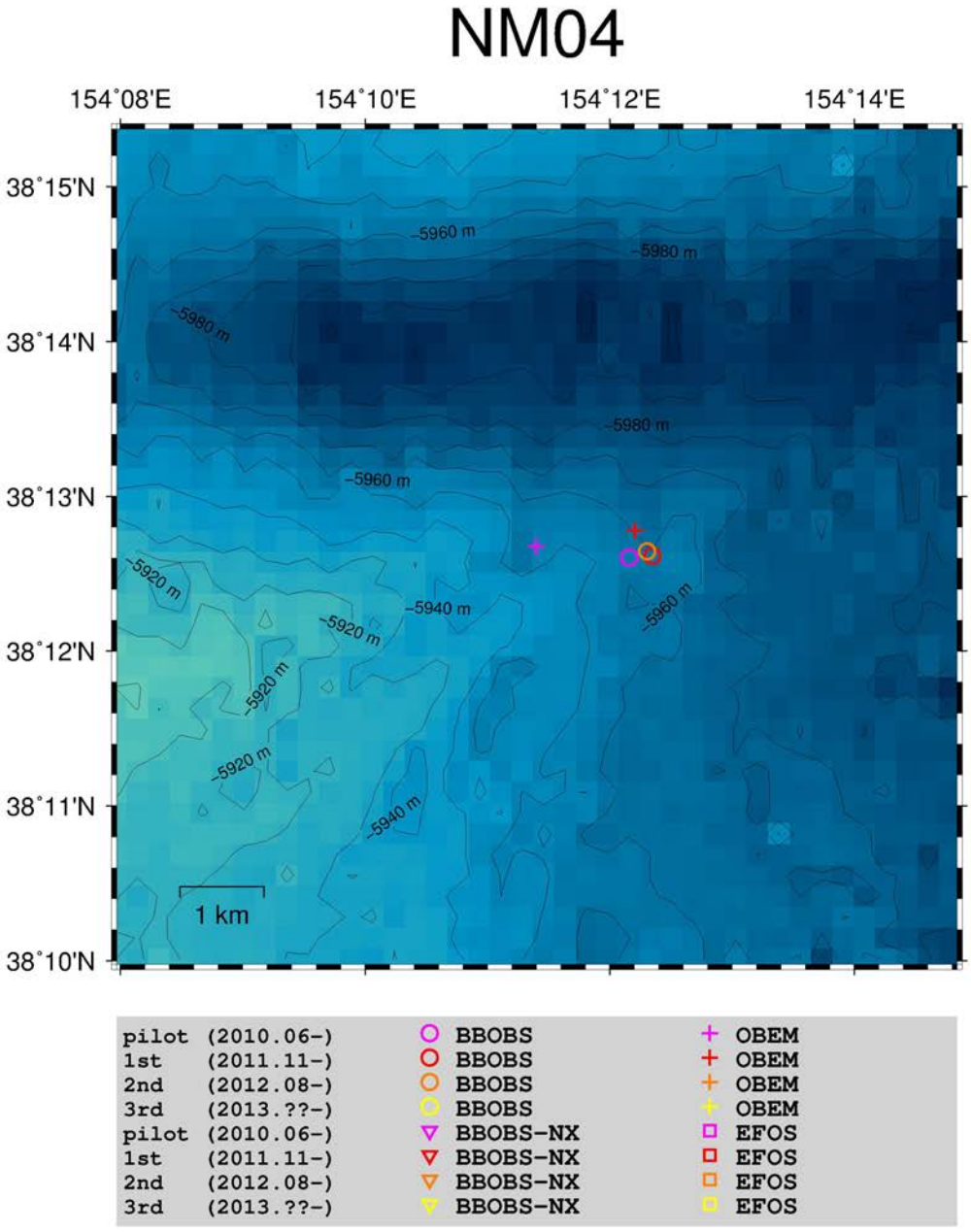
3.5.1. NM02


NM02
153˚18'E
153˚20'E
153˚22'E
153˚24'E
39˚44'N
39˚43'N
39˚42'N
39˚41'N
39˚40'N
-5700 m
-5700 m
-5700 m
-5720 m
-5740 m
-5740 m
-5720 m
-5720 m
-5700 m
-5680 m
-5660 m
1 km
pilot (2010.06-) BBOBS OBEM
1st (2011.11-) BBOBS OBEM
2nd (2012.08-) BBOBS OBEM
3rd (2013.??-) BBOBS OBEM
pilot (2010.06-) BBOBS-NX EFOS
1st (2011.11-) BBOBS-NX EFOS
2nd (2012.08-) BBOBS-NX EFOS
3rd (2013.??-) BBOBS-NX EFOS

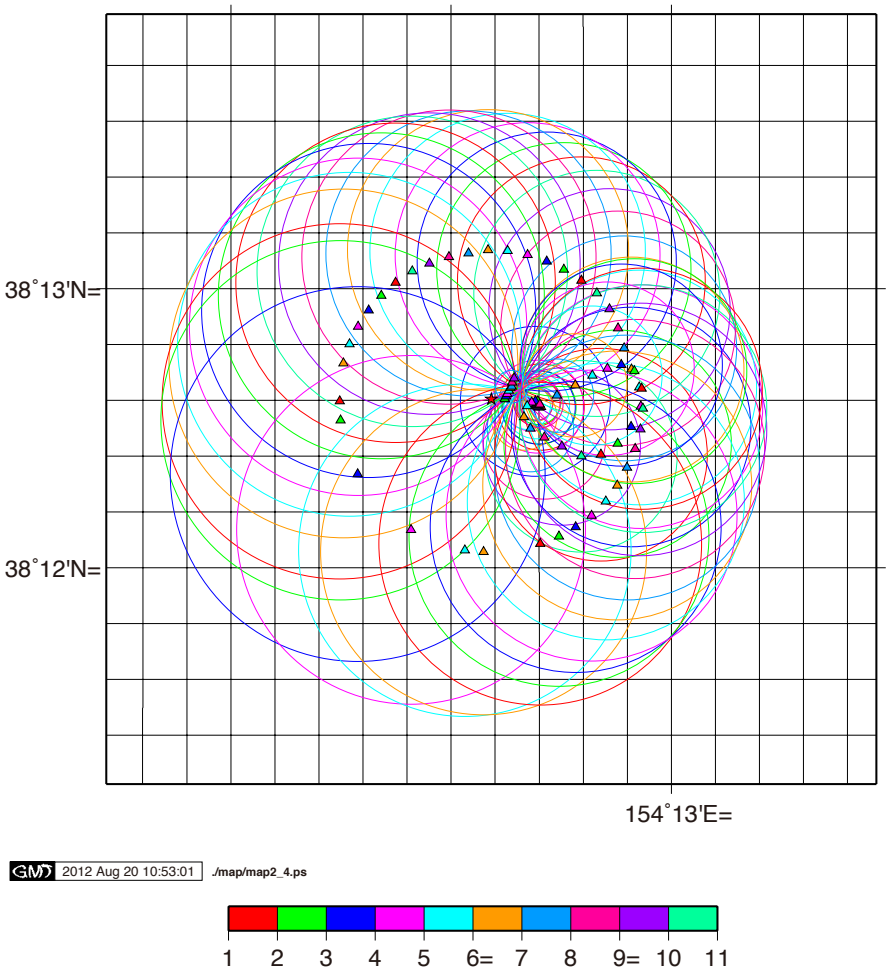
KR12-14 NM02 BBOBS-NX (NX-B)
39˚ 42.3435' N 153˚ 21.2833' E 5711m
dx= -72m dy= 710m=



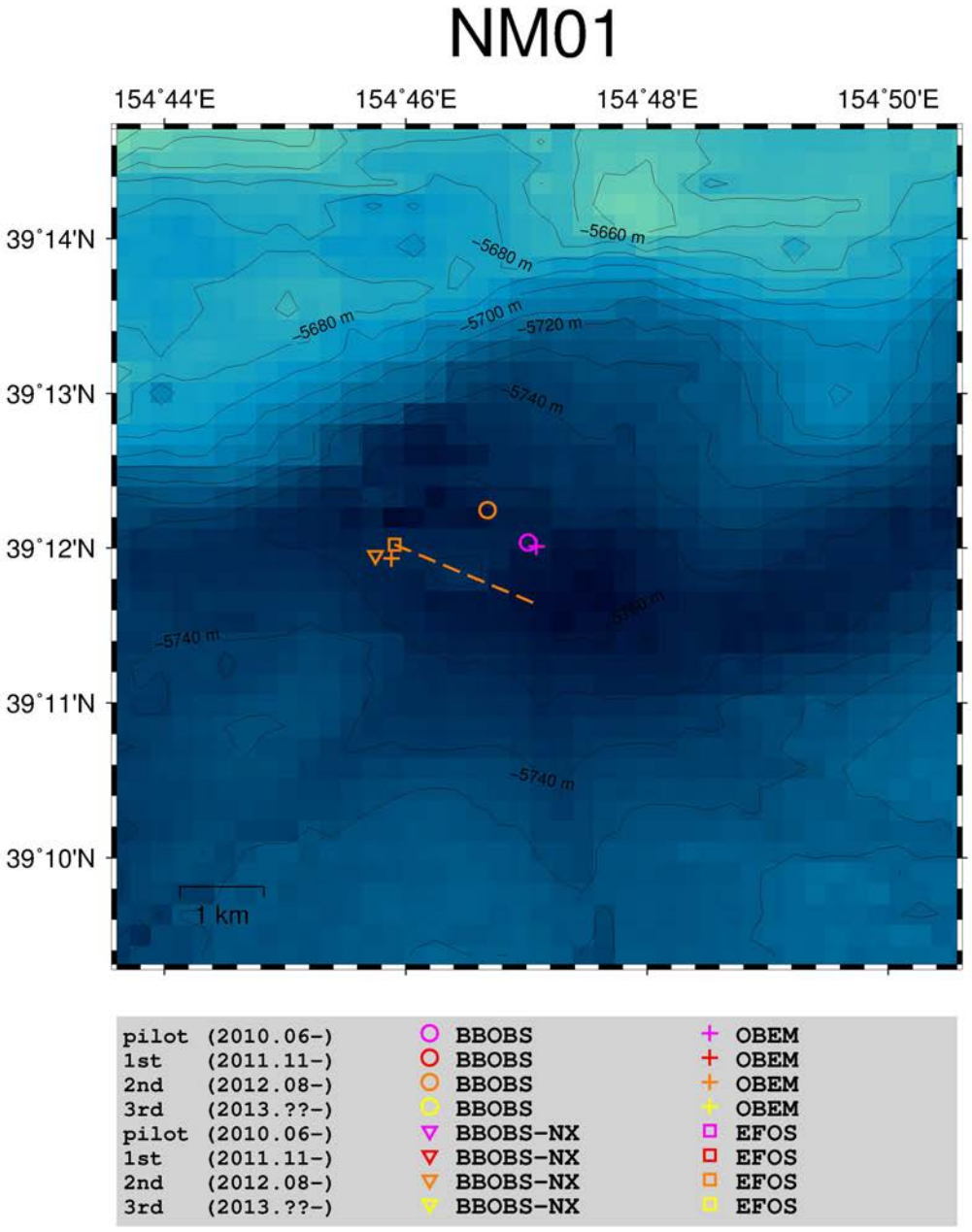
3.5.2. NM04


NM04
154˚08'E
154˚10'E
154˚12'E
154˚14'E
38˚15'N
38˚14'N
38˚13'N
38˚12'N
38˚11'N
38˚10'N
-5960 m
-5980 m
-5980 m
-5980 m
-5960 m
-5920 m
-5940 m
-5920 m
-5960 m
-5920 m
-5920 m
-5940 m
1 km
pilot (2010.06-) BBOBS OBEM
1st (2011.11-) BBOBS OBEM
2nd (2012.08-) BBOBS OBEM
3rd (2013.??-) BBOBS OBEM
pilot (2010.06-) BBOBS-NX EFOS
1st (2011.11-) BBOBS-NX EFOS
2nd (2012.08-) BBOBS-NX EFOS
3rd (2013.??-) BBOBS-NX EFOS

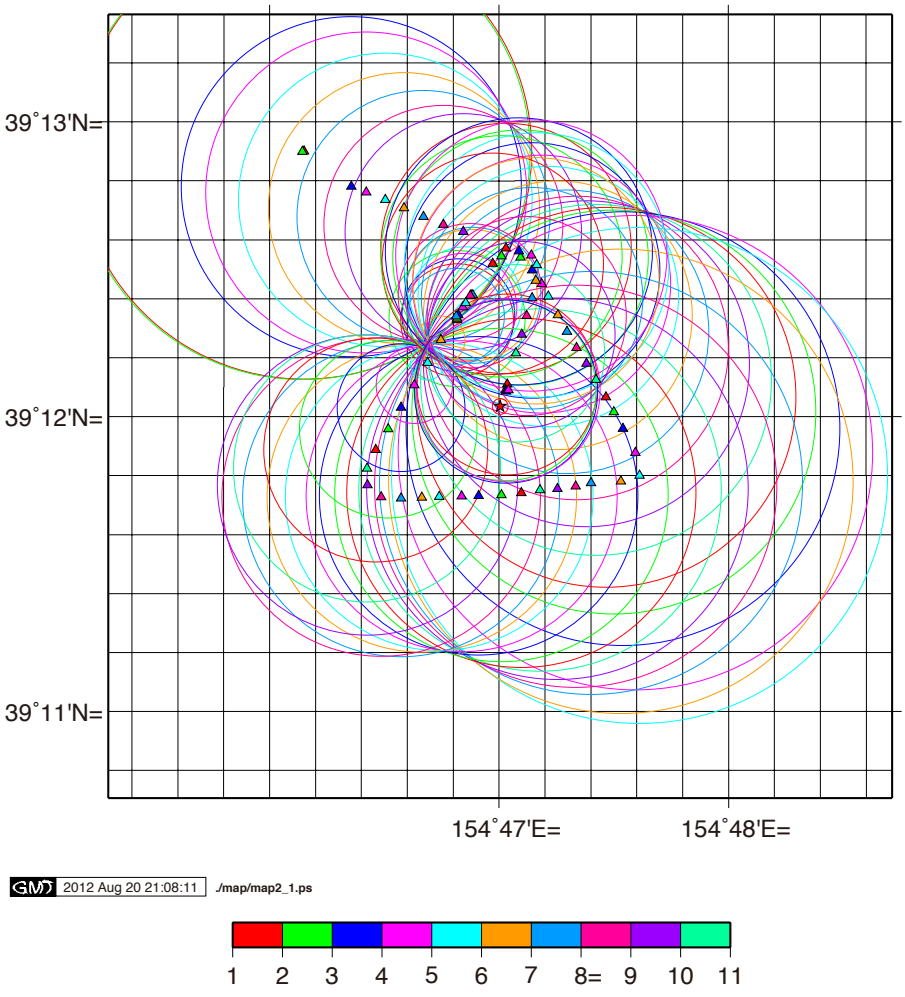
KR12-14 NM04 BBOBS (517)
38˚ 12.6437' N 154˚ 12.3043' E 5916m
dx= 178m dy= 72m=



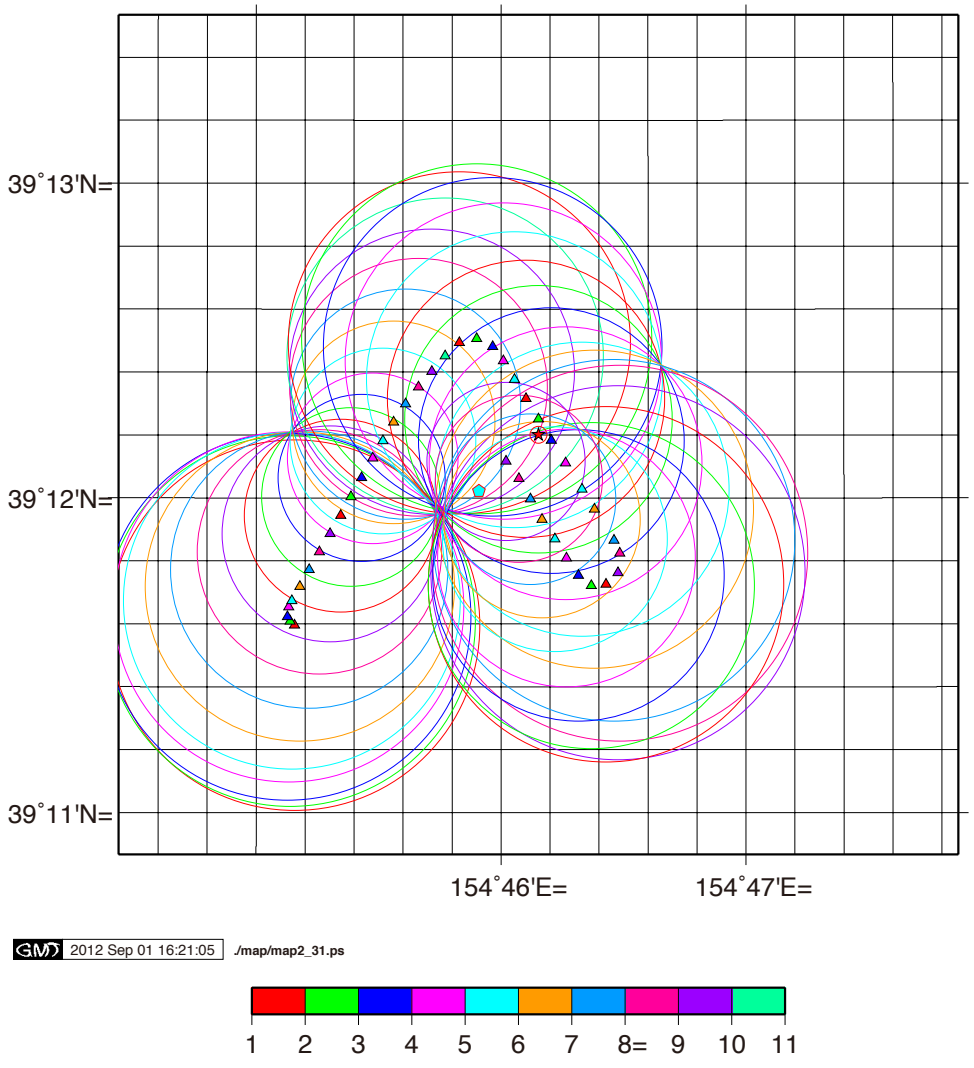
3.5.3. NM01


NM01
154˚44'E
154˚46'E
154˚48'E
154˚50'E
39˚14'N
39˚13'N
39˚12'N
39˚11'N
39˚10'N
-5660 m
-5680 m
-5680 m
-5700 m
-5720 m
-5740 m
-5740 m
-5740 m
-5740 m
1 km
pilot (2010.06-) BBOBS OBEM
1st (2011.11-) BBOBS OBEM
2nd (2012.08-) BBOBS OBEM
3rd (2013.??-) BBOBS OBEM
pilot (2010.06-) BBOBS-NX EFOS
1st (2011.11-) BBOBS-NX EFOS
2nd (2012.08-) BBOBS-NX EFOS
3rd (2013.??-) BBOBS-NX EFOS

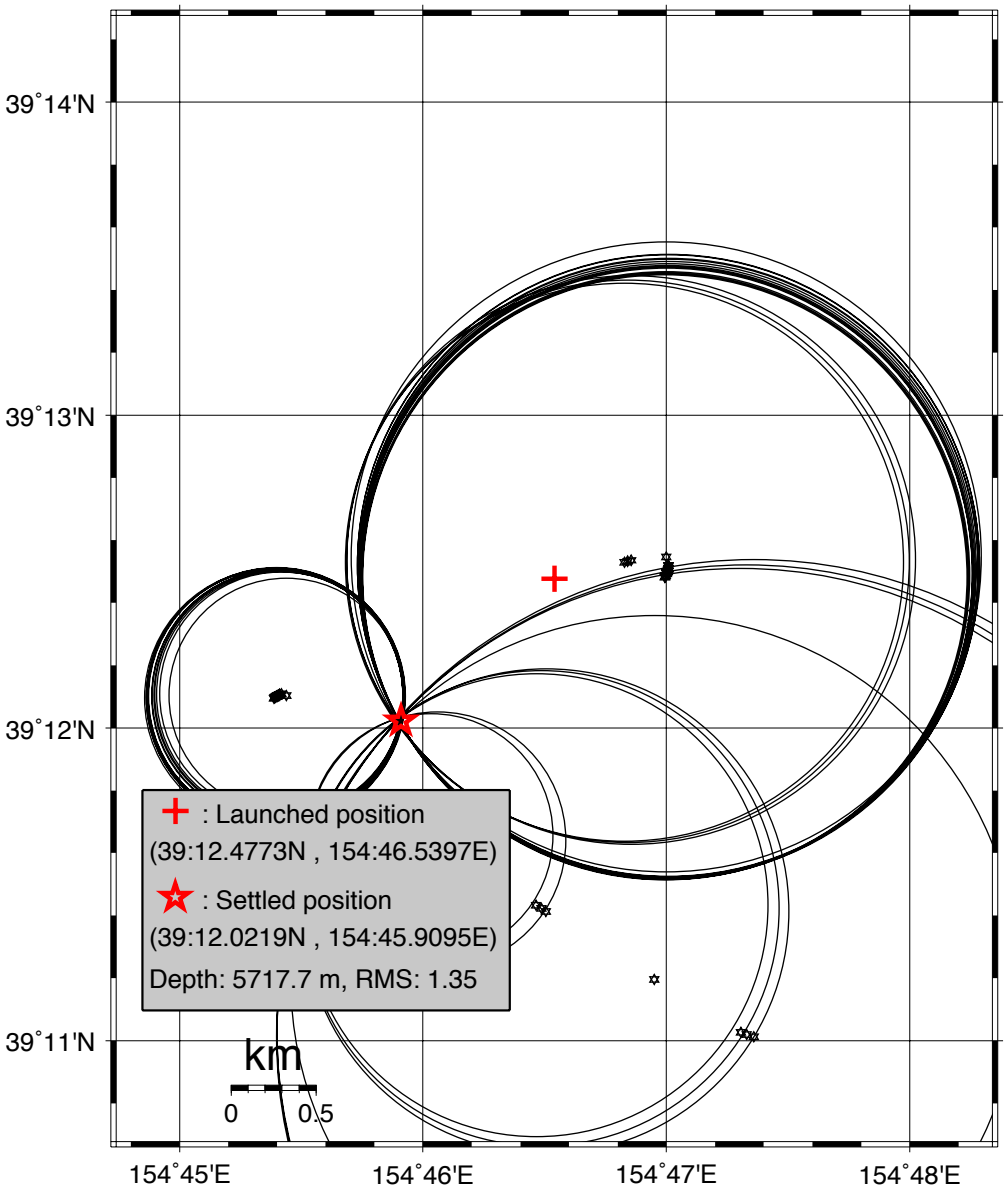
KR12-14 NM01 BBOBS (500)
39˚ 12.2433' N 154˚ 46.6805' E 5719m
dx= -467m dy= 385m=



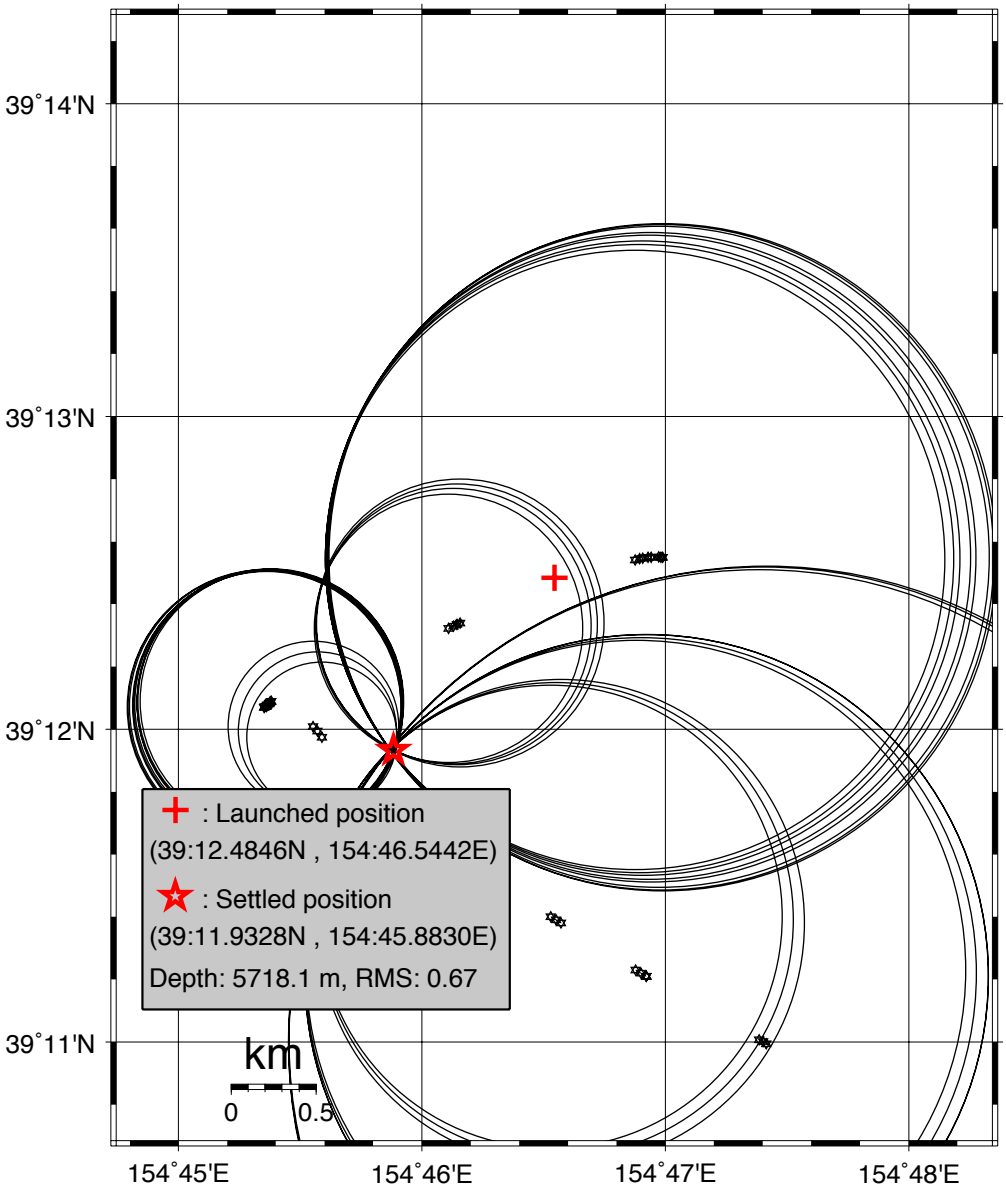
KR12-14 NM01 BBOBS-NX (NX-E)
39˚ 11.9527' N 154˚ 45.7490' E 5723m'
dx= -581m dy= -460m'
dist. to target= 264m'=



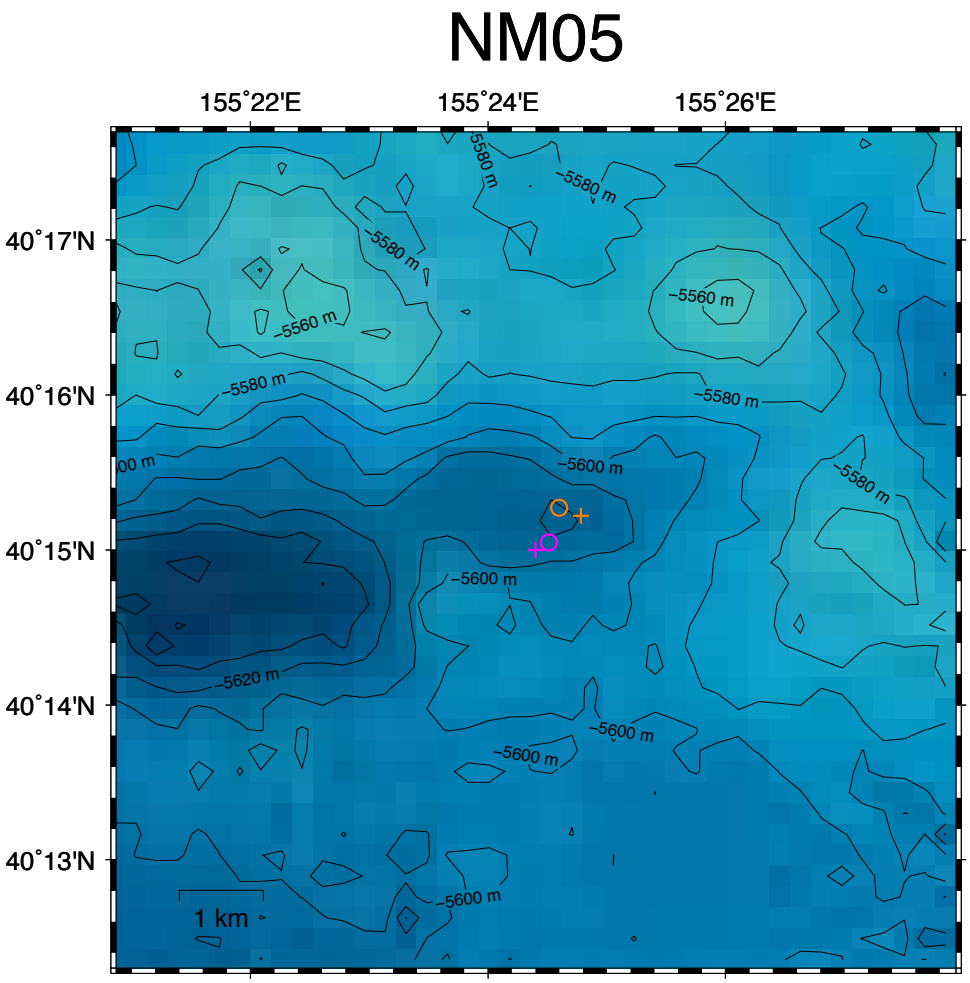
NM01–2 (EFOS6)


39˚14'N
39˚13'N
39˚12'N
39˚11'N
154˚45'E
154˚46'E
154˚47'E
154˚48'E
: Launched position
(39:12.4773N , 154:46.5397E)
: Settled position
(39:12.0219N , 154:45.9095E)
Depth: 5717.7 m, RMS: 1.35
km
0
0.5

NM01–2 (ERI4)

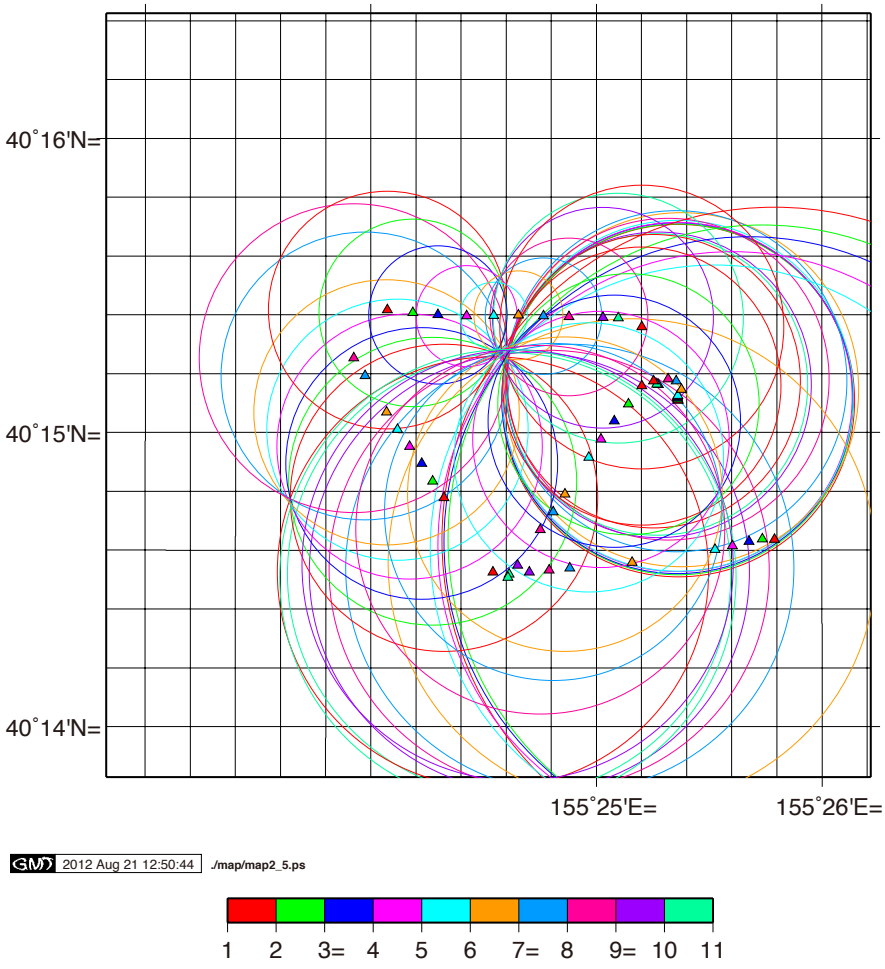

39˚14'N
39˚13'N
39˚12'N
39˚11'N
154˚45'E
154˚46'E
154˚47'E
154˚48'E
: Launched position
(39:12.4846N , 154:46.5442E)
: Settled position
(39:11.9328N , 154:45.8830E)
Depth: 5718.1 m, RMS: 0.67
km
0
0.5

3.5.4. NM05

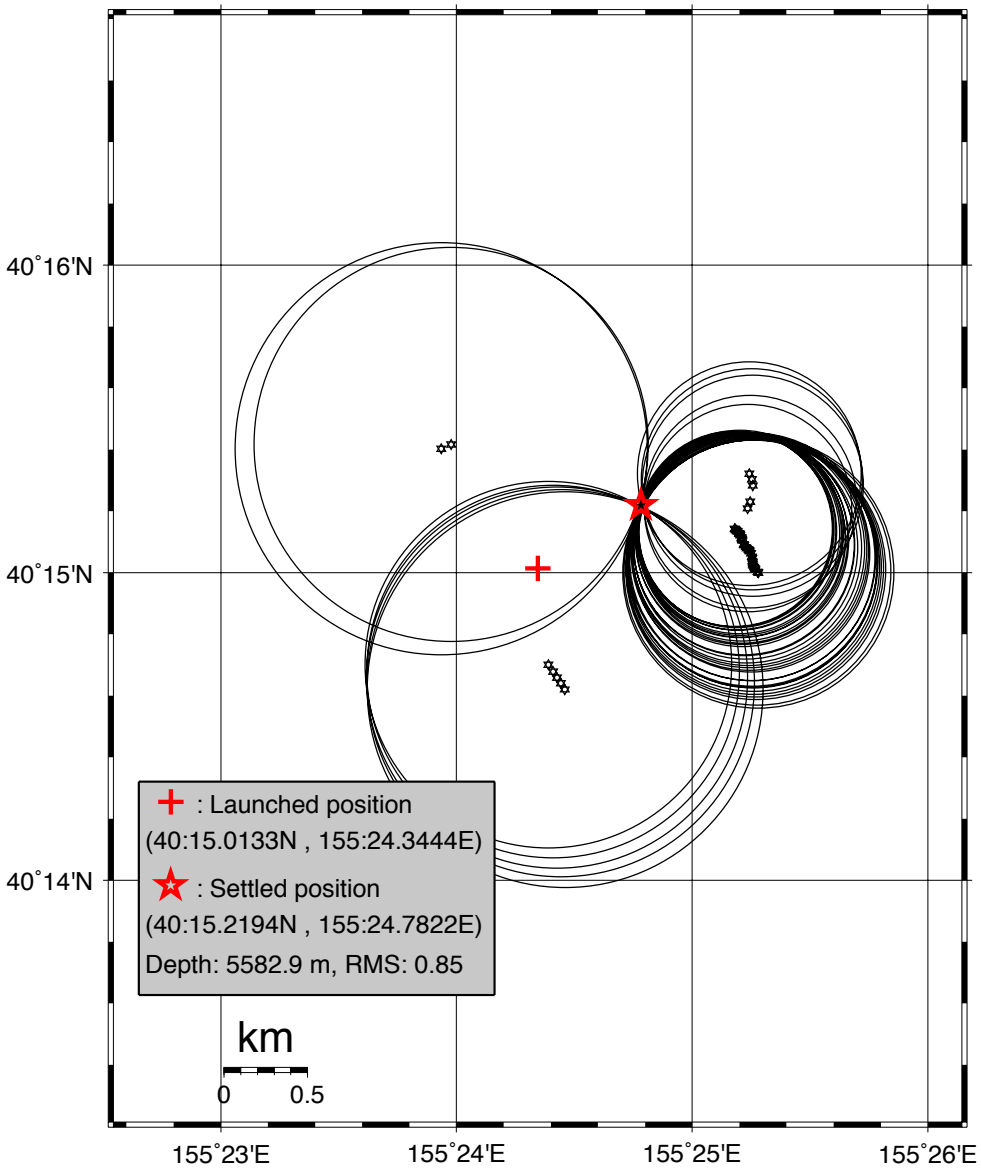


pilot	(2010.06-)	○	BBOBS	+	OBEM
1st	(2011.11-)	○	BBOBS	+	OBEM
2nd	(2012.08-)	○	BBOBS	+	OBEM
3rd	(2013.??-)	○	BBOBS	+	OBEM
pilot	(2010.06-)	▽	BBOBS-NX	□	EFOS
1st	(2011.11-)	▽	BBOBS-NX	□	EFOS
2nd	(2012.08-)	▽	BBOBS-NX	□	EFOS
3rd	(2013.??-)	▽	BBOBS-NX	□	EFOS

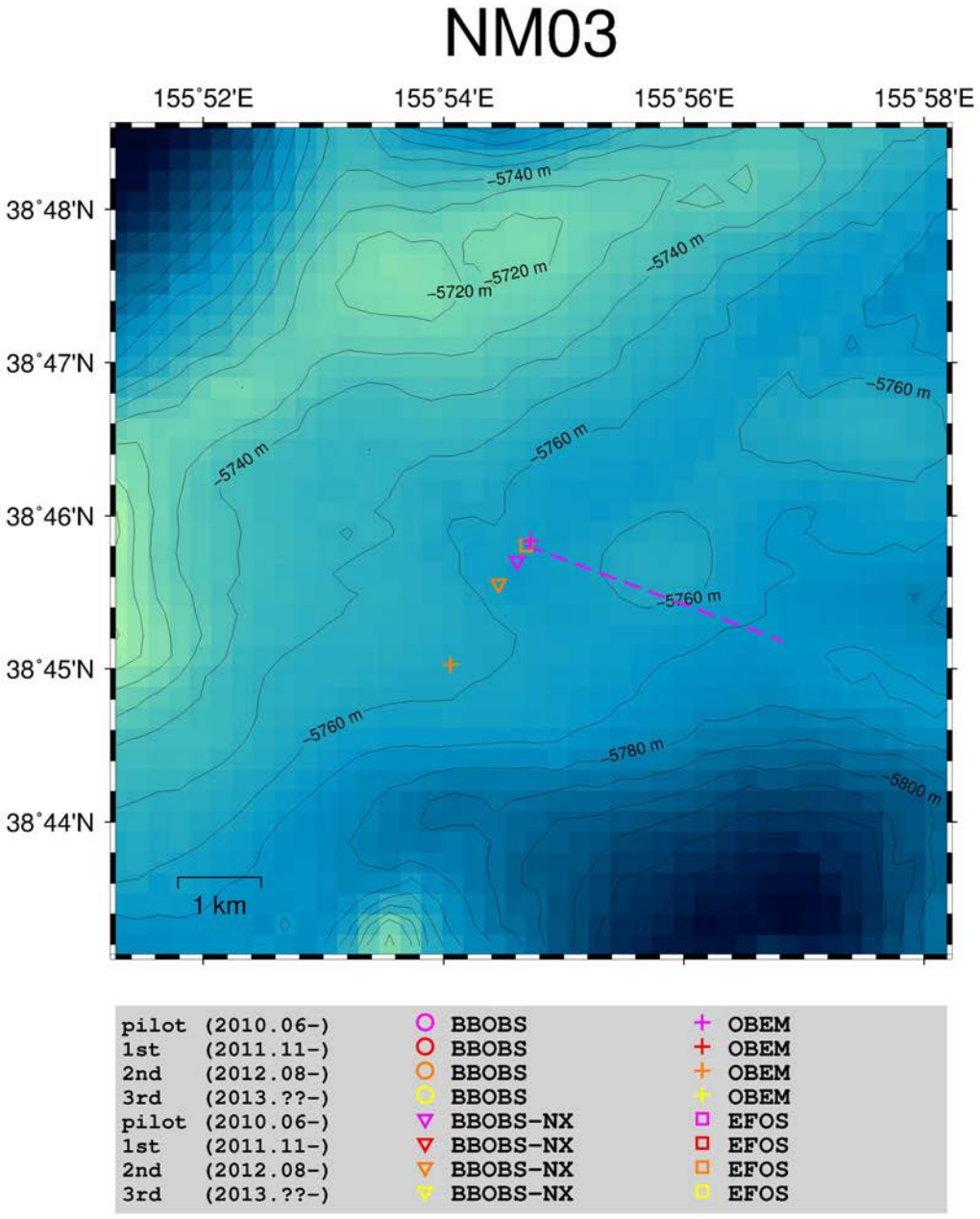
KR12-14 NM05 BBOBS (502)
40˚ 15.2707' N 155˚ 24.5993' E 5593m
dx= 110m dy= 266m=



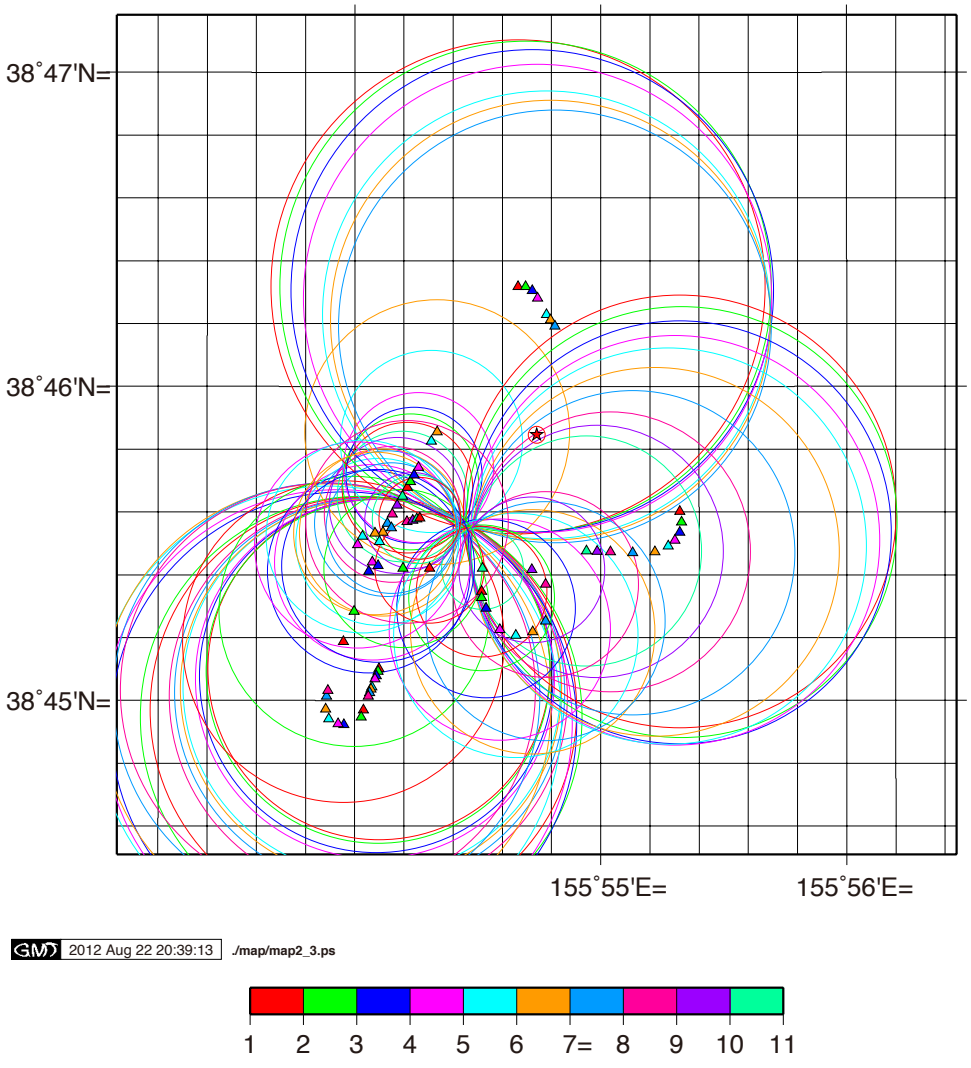
NM05–2 (ERI15)


40˚16'N
40˚15'N
40˚14'N
155˚23'E
155˚24'E
155˚25'E
155˚26'E
: Launched position
(40:15.0133N , 155:24.3444E)
: Settled position
(40:15.2194N , 155:24.7822E)
Depth: 5582.9 m, RMS: 0.85
km
0
0.5

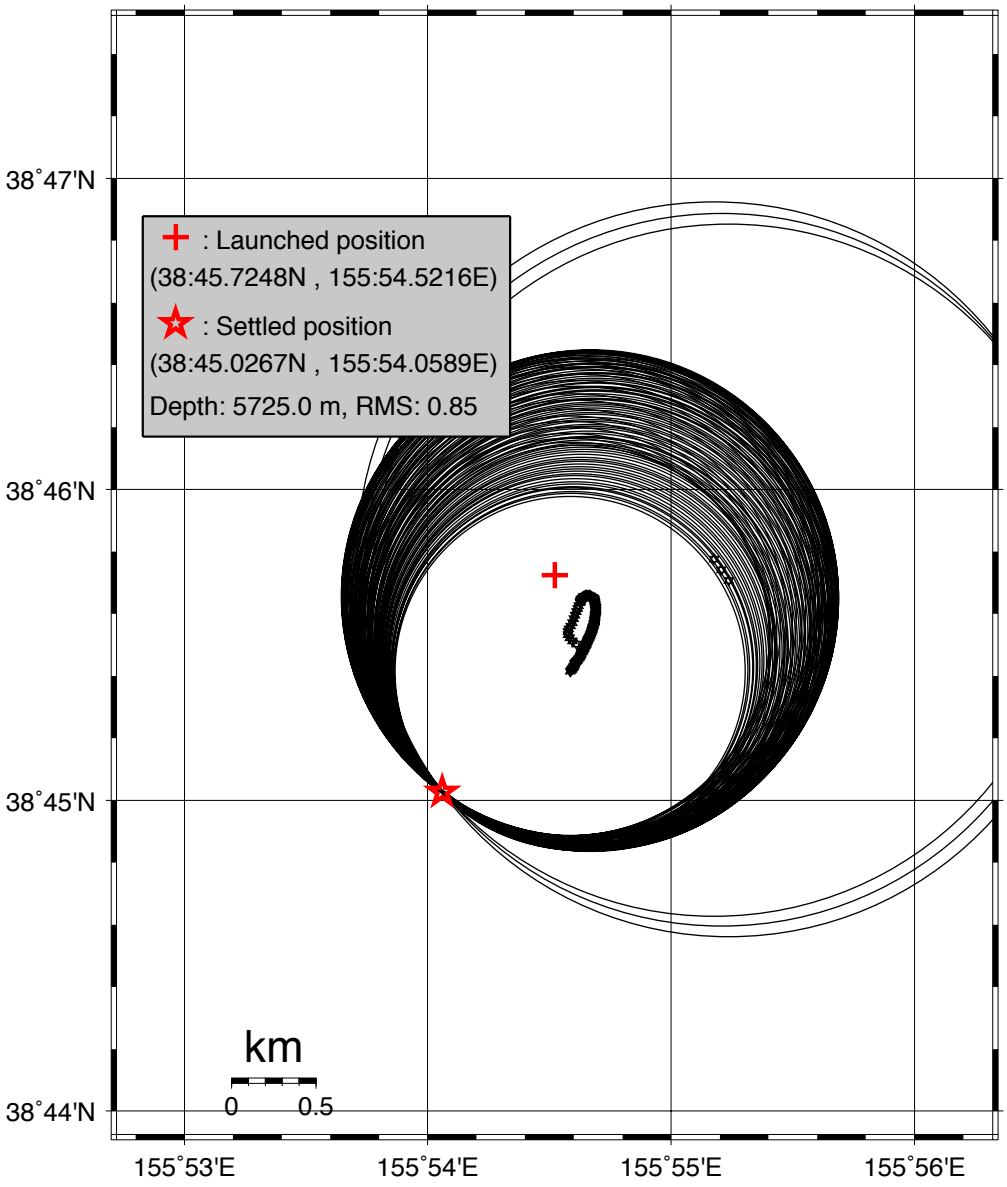
3.5.5 NM03


NM03
155°52'E
155°54'E
155°56'E
155°58'E
38°48'N
38°47'N
38°46'N
38°45'N
38°44'N
-5740 m
-5720 m
-5720 m
-5740 m
-5760 m
-5740 m
-5760 m
-5760 m
-5760 m
-5780 m
-5800 m
1 km
pilot (2010.06-)
1st (2011.11-)
2nd (2012.08-)
3rd (2013.??-)
pilot (2010.06-)
1st (2011.11-)
2nd (2012.08-)
3rd (2013.??-)
BBOBS
BBOBS
BBOBS
BBOBS
BBOBS-NX
BBOBS-NX
BBOBS-NX
BBOBS-NX
OBEM
OBEM
OBEM
OBEM
EFOS
EFOS
EFOS
EFOS

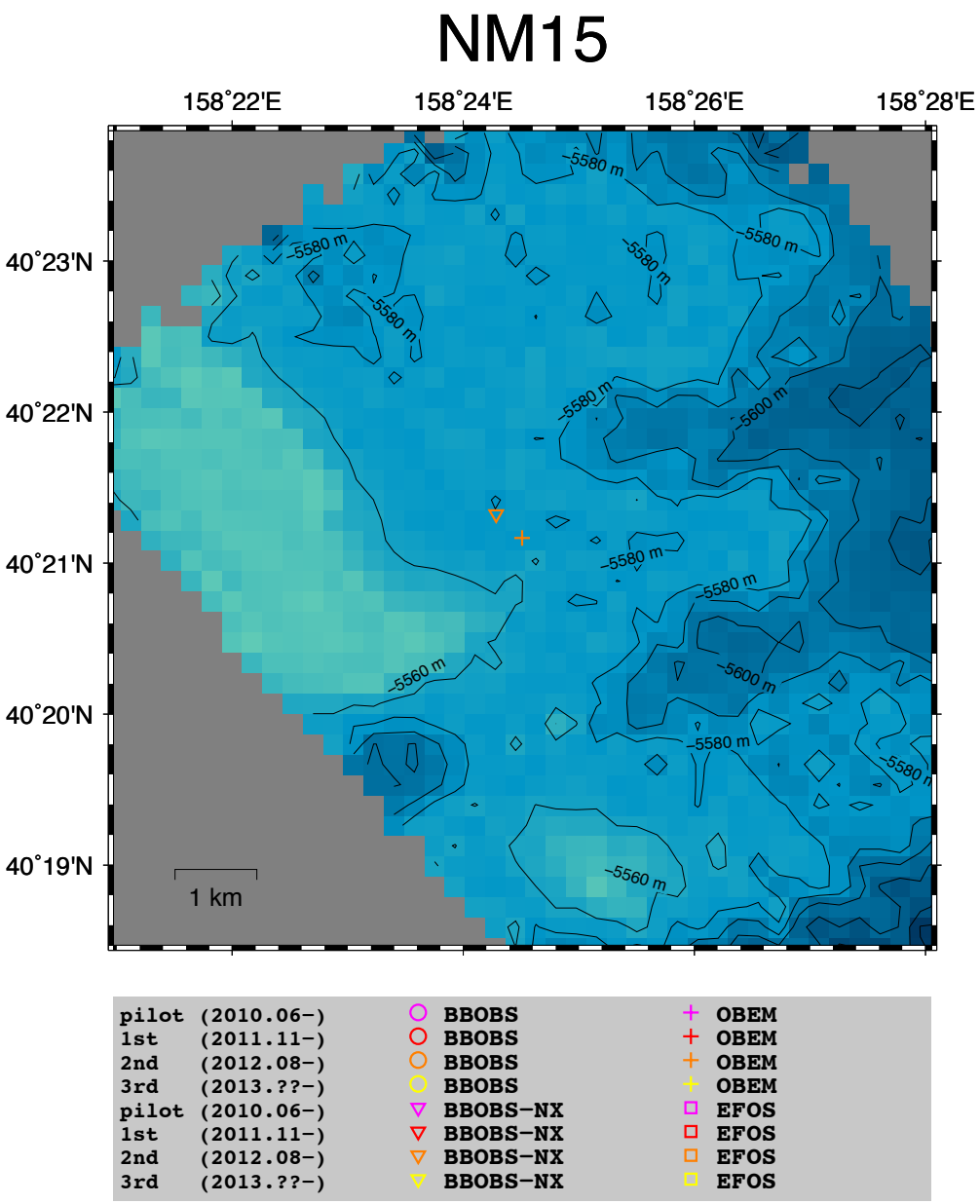
KR12-14 NM03 BBOBS-NX (NX-D)
38˚ 45.5537' N 155˚ 54.4584' E 5732m
dx= -407m dy= -542m=



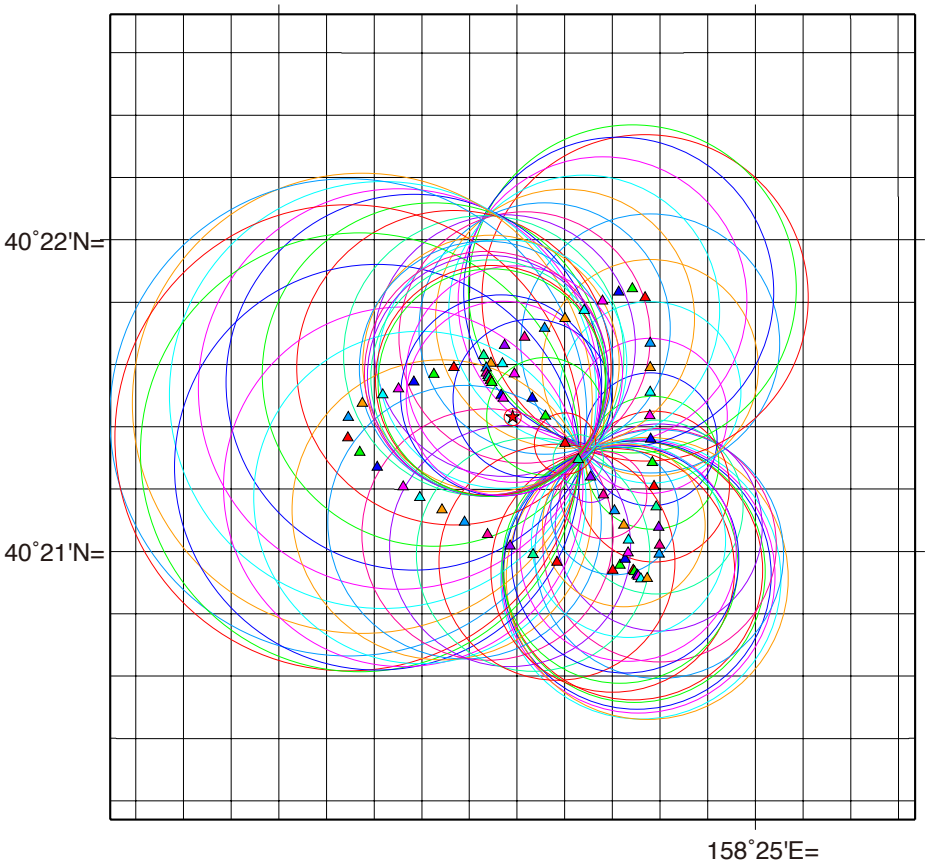
NM03–2 (ERI3)


: Launched position
(38:45.7248N , 155:54.5216E)
: Settled position
(38:45.0267N , 155:54.0589E)
Depth: 5725.0 m, RMS: 0.85
38˚47'N
38˚46'N
38˚45'N
38˚44'N
155˚53'E
155˚54'E
155˚55'E
155˚56'E
km
0
0.5

3.5.6. NM15

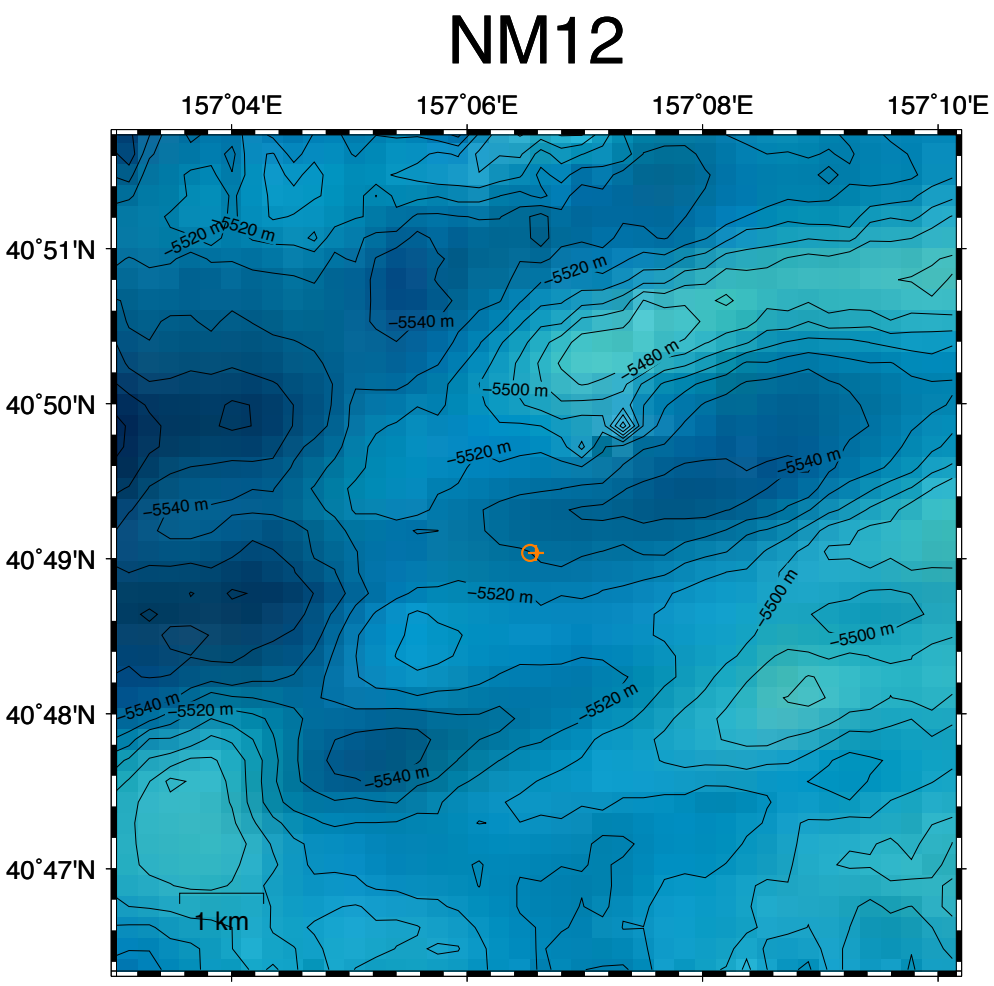

NM15
158˚22'E
158˚24'E
158˚26'E
158˚28'E
40˚23'N
40˚22'N
40˚21'N
40˚20'N
40˚19'N
-5580 m
-5600 m
-5560 m
1 km
pilot (2010.06-)
1st (2011.11-)
2nd (2012.08-)
3rd (2013.??-)
pilot (2010.06-)
1st (2011.11-)
2nd (2012.08-)
3rd (2013.??-)
BBOBS
BBOBS
BBOBS
BBOBS
BBOBS-NX
BBOBS-NX
BBOBS-NX
BBOBS-NX
OBEM
OBEM
OBEM
OBEM
EFOS
EFOS
EFOS
EFOS

KR12-14 NM15 NX-F (551)
40˚ 21.3227' N 158˚ 24.2830' E 5558m
dx= 427m dy= -202m=



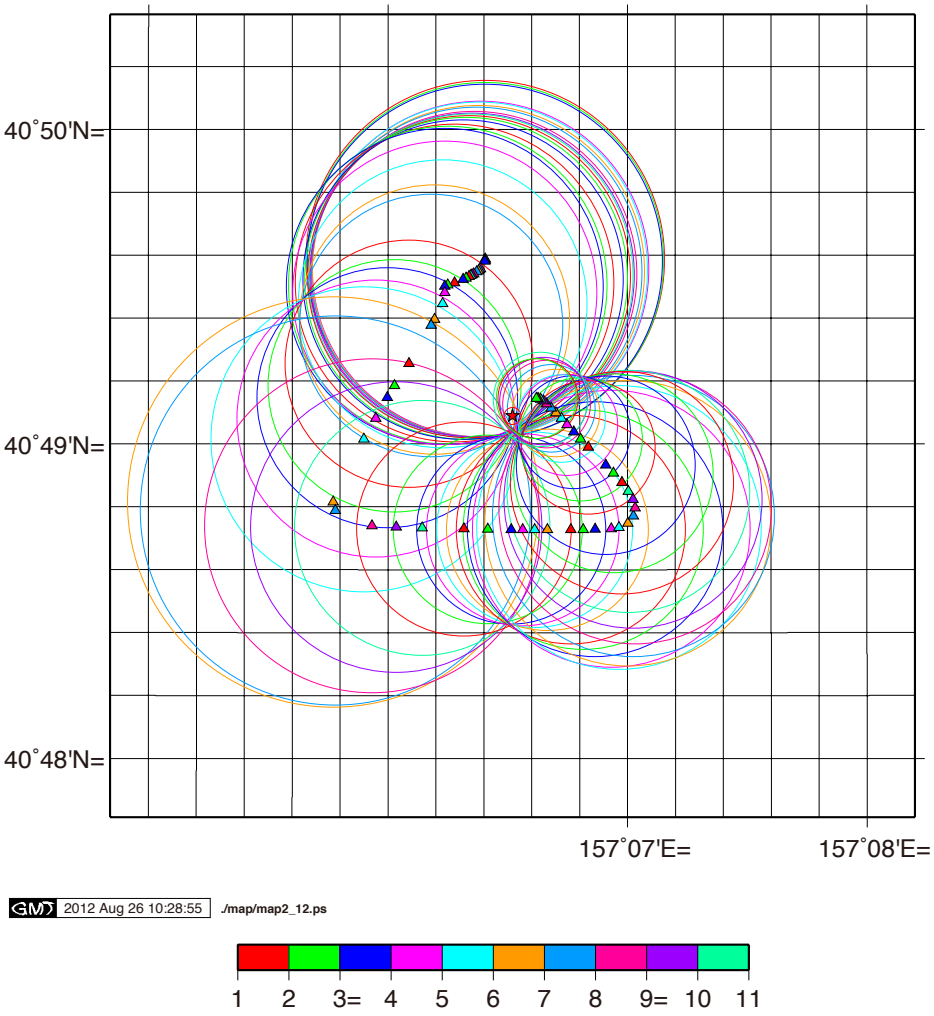
GMT 2012 Aug 25 09:11:51 ./map/map2_15.ps

3.5.7. NM12

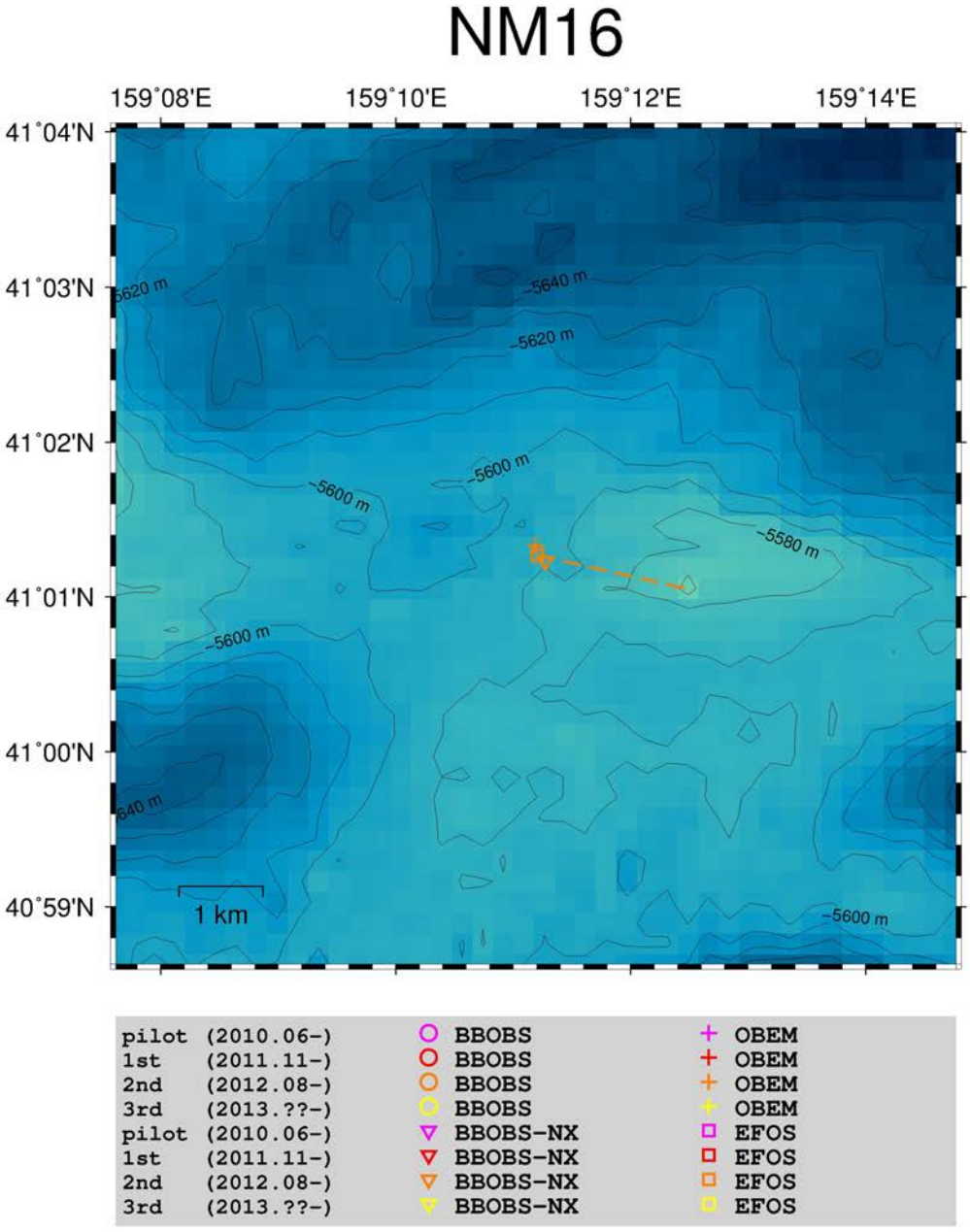


pilot	(2010.06-)	BBOBS	OBEM
1st	(2011.11-)	BBOBS	OBEM
2nd	(2012.08-)	BBOBS	OBEM
3rd	(2013.??-)	BBOBS	OBEM
pilot	(2010.06-)	BBOBS-NX	EFOS
1st	(2011.11-)	BBOBS-NX	EFOS
2nd	(2012.08-)	BBOBS-NX	EFOS
3rd	(2013.??-)	BBOBS-NX	EFOS

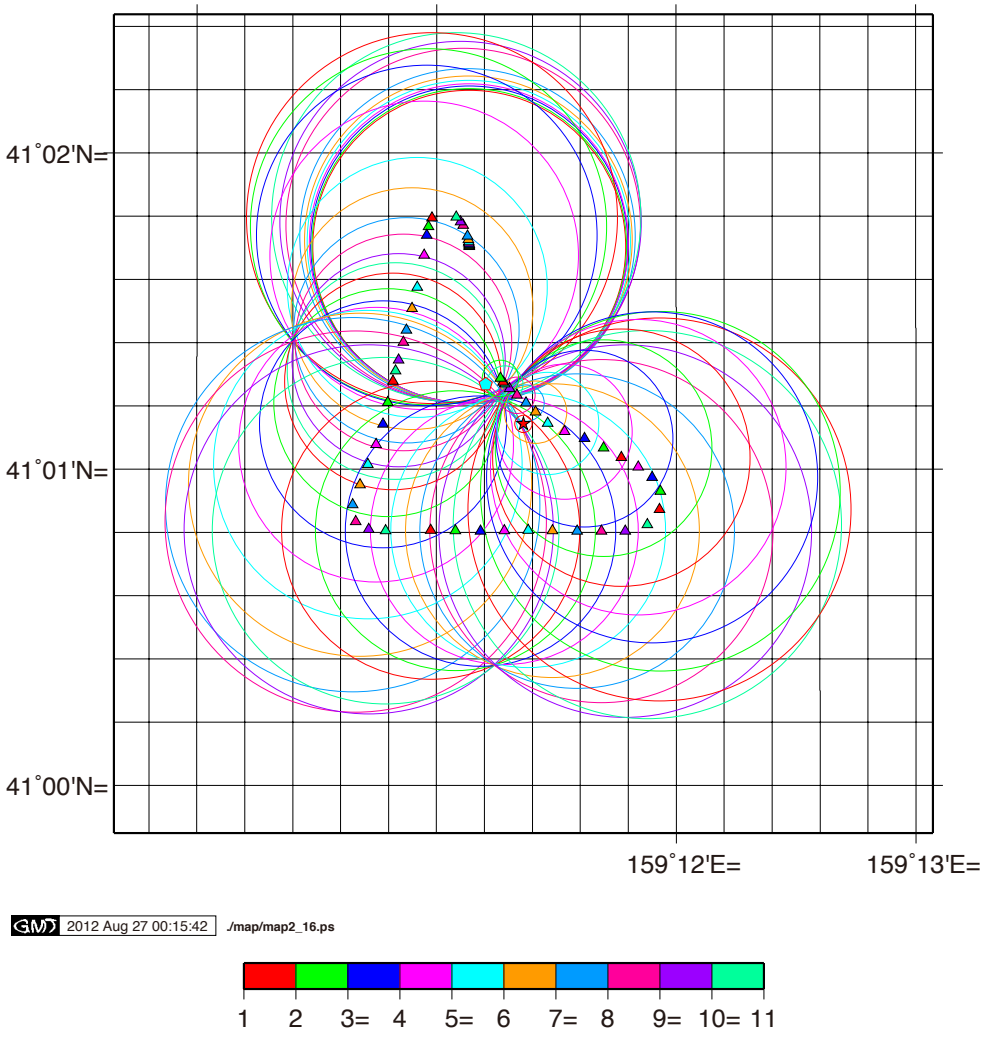
KR12-14 NM12 BBOBS (516)
40˚ 49.0363' N 157˚ 06.5341' E 5501m
dx= 20m dy= -99m=



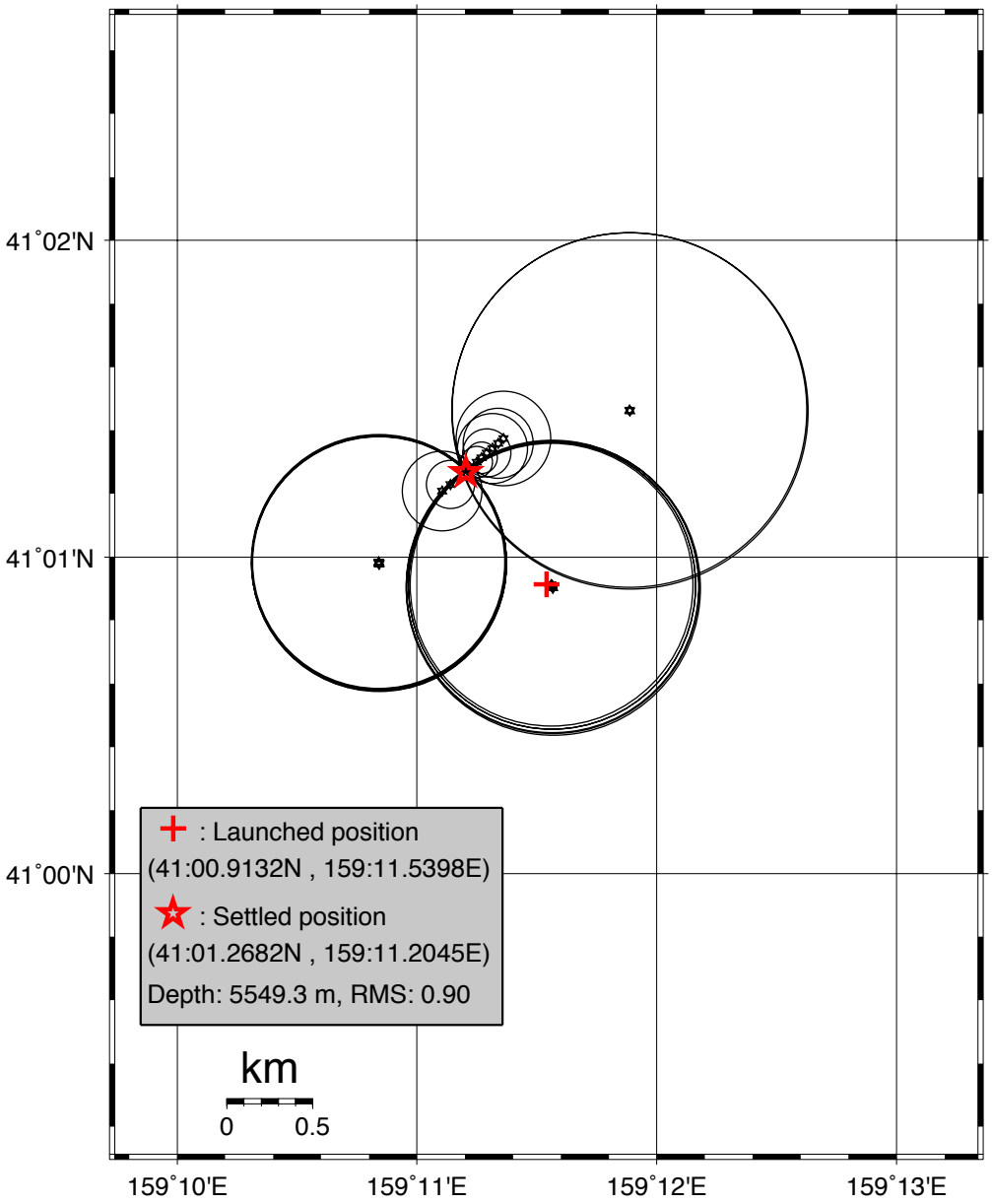
3.5.8. NM16


NM16
159°08'E
159°10'E
159°12'E
159°14'E
41°04'N
41°03'N
41°02'N
41°01'N
41°00'N
40°59'N
5620 m
5640 m
5620 m
5600 m
5600 m
5580 m
5600 m
640 m
1 km
5600 m
pilot (2010.06-) BBOBS OBEM
1st (2011.11-) BBOBS OBEM
2nd (2012.08-) BBOBS OBEM
3rd (2013.??-) BBOBS OBEM
pilot (2010.06-) BBOBS-NX EFOS
1st (2011.11-) BBOBS-NX EFOS
2nd (2012.08-) BBOBS-NX EFOS
3rd (2013.??-) BBOBS-NX EFOS

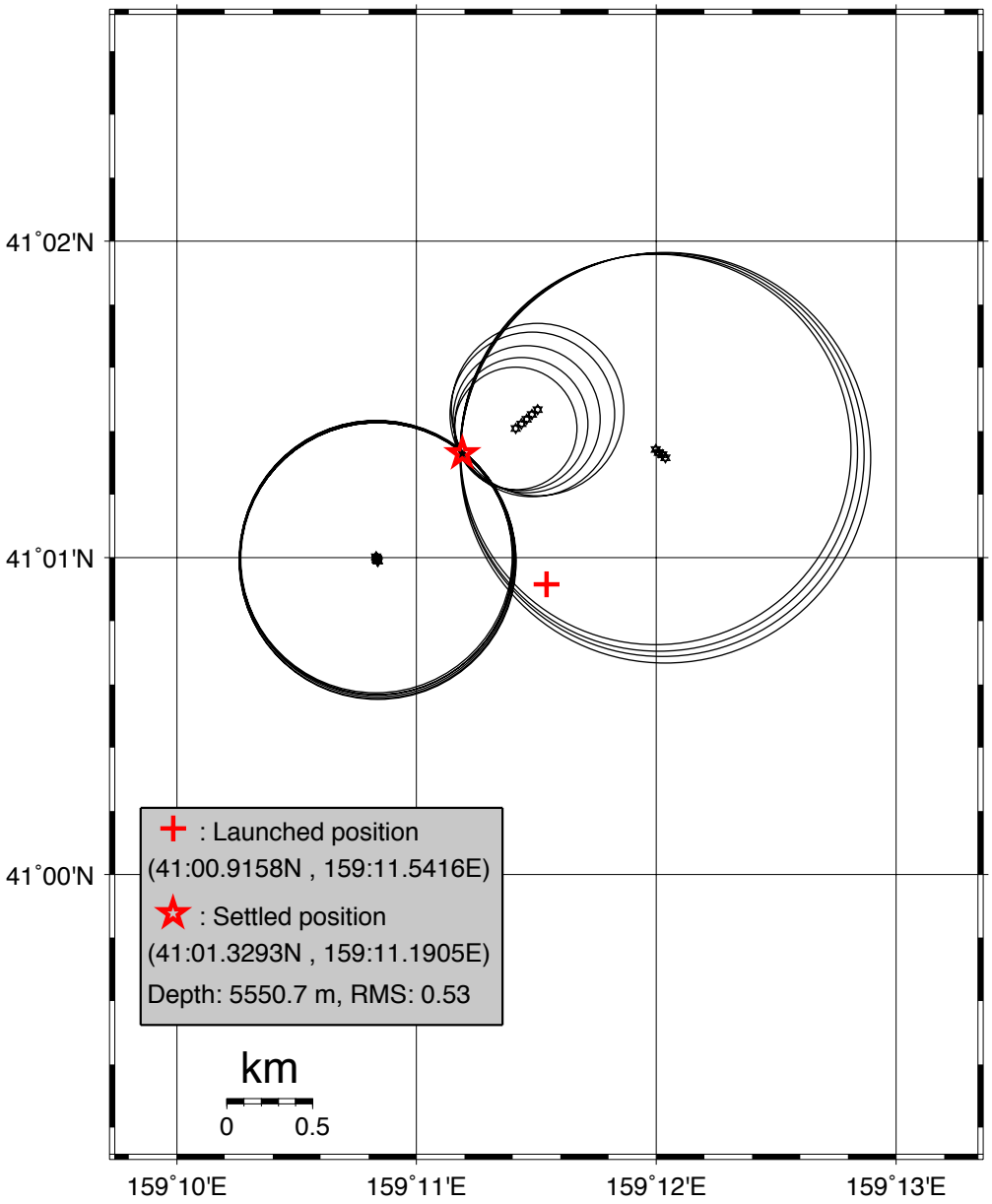
KR12-14 NM16 BBOBS-NX (NX-A)
41˚ 01.2315' N 159˚ 11.2745' E 5554m
dx= -123m dy= 162m=



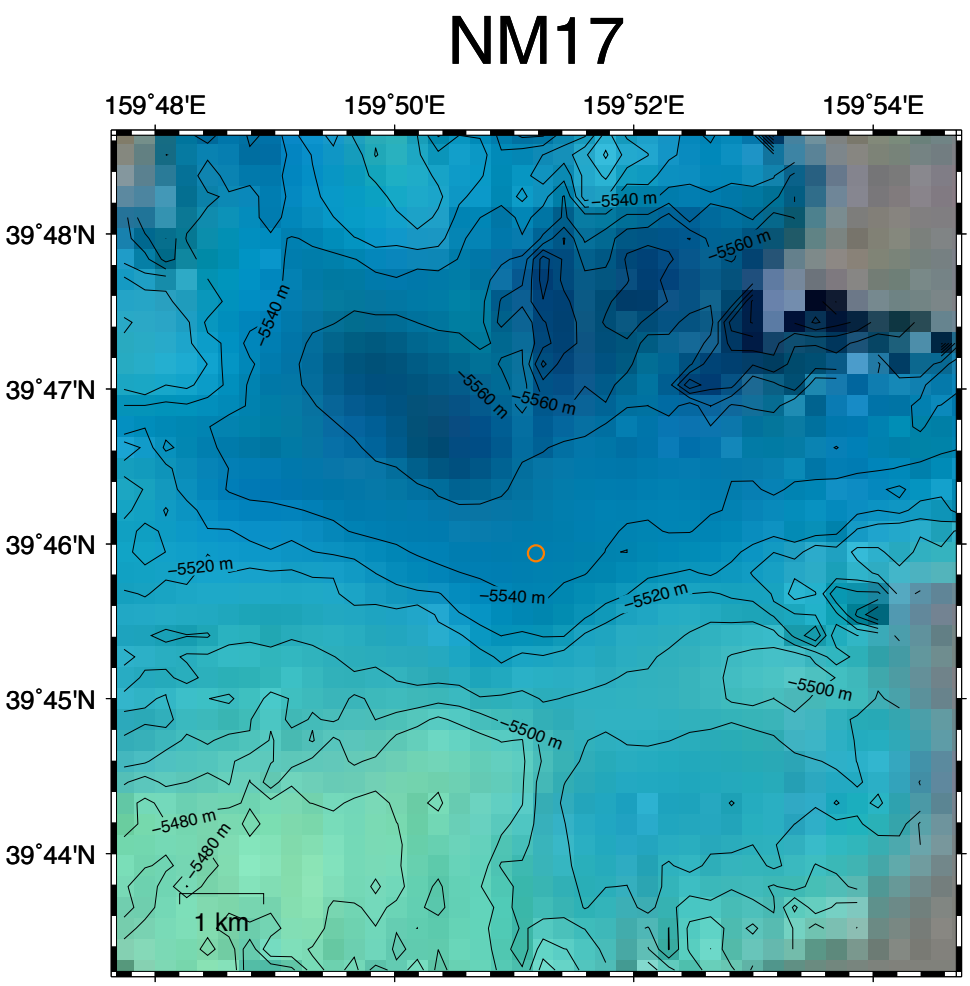
NM16–2 (EFOS)


41˚02'N
41˚01'N
41˚00'N
159˚10'E
159˚11'E
159˚12'E
159˚13'E
: Launched position
(41:00.9132N , 159:11.5398E)
: Settled position
(41:01.2682N , 159:11.2045E)
Depth: 5549.3 m, RMS: 0.90
km
0
0.5

NM16–2 (ERI14)

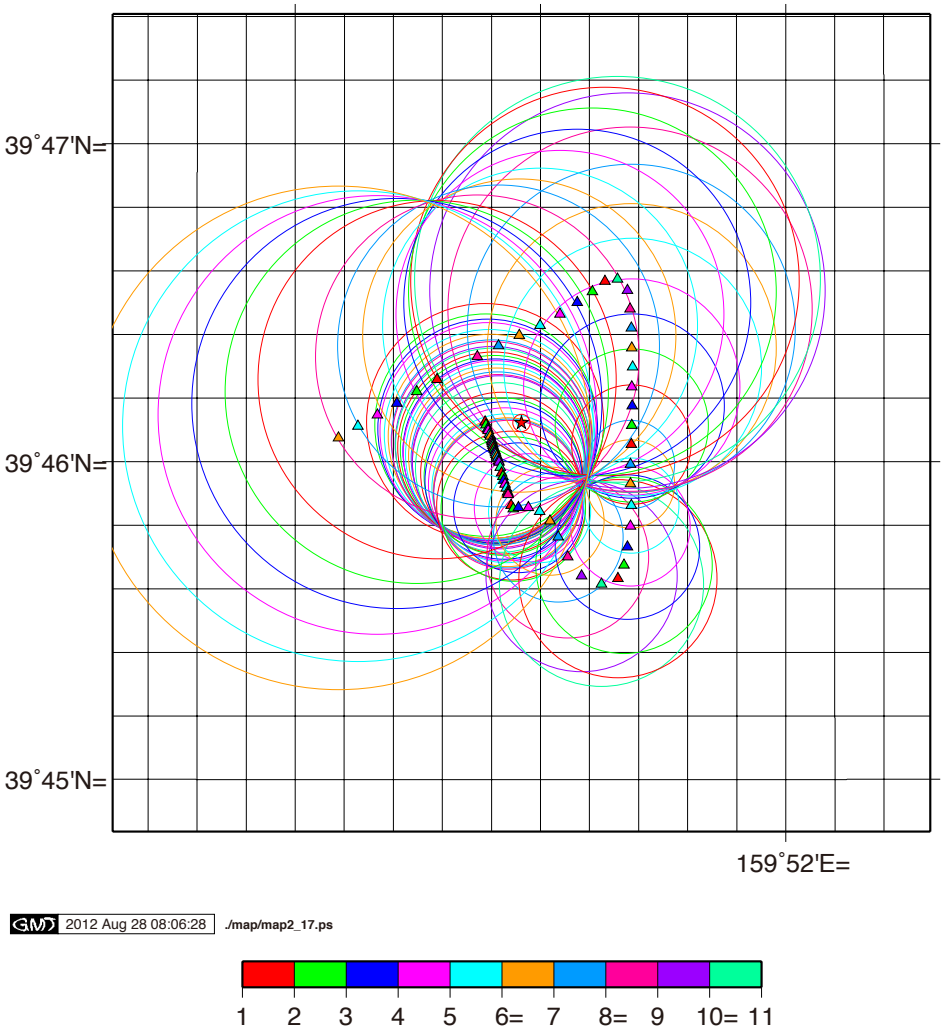

41˚02'N
41˚01'N
41˚00'N
159˚10'E
159˚11'E
159˚12'E
159˚13'E
: Launched position
(41:00.9158N , 159:11.5416E)
: Settled position
(41:01.3293N , 159:11.1905E)
Depth: 5550.7 m, RMS: 0.53
km
0
0.5

3.5.9. NM17

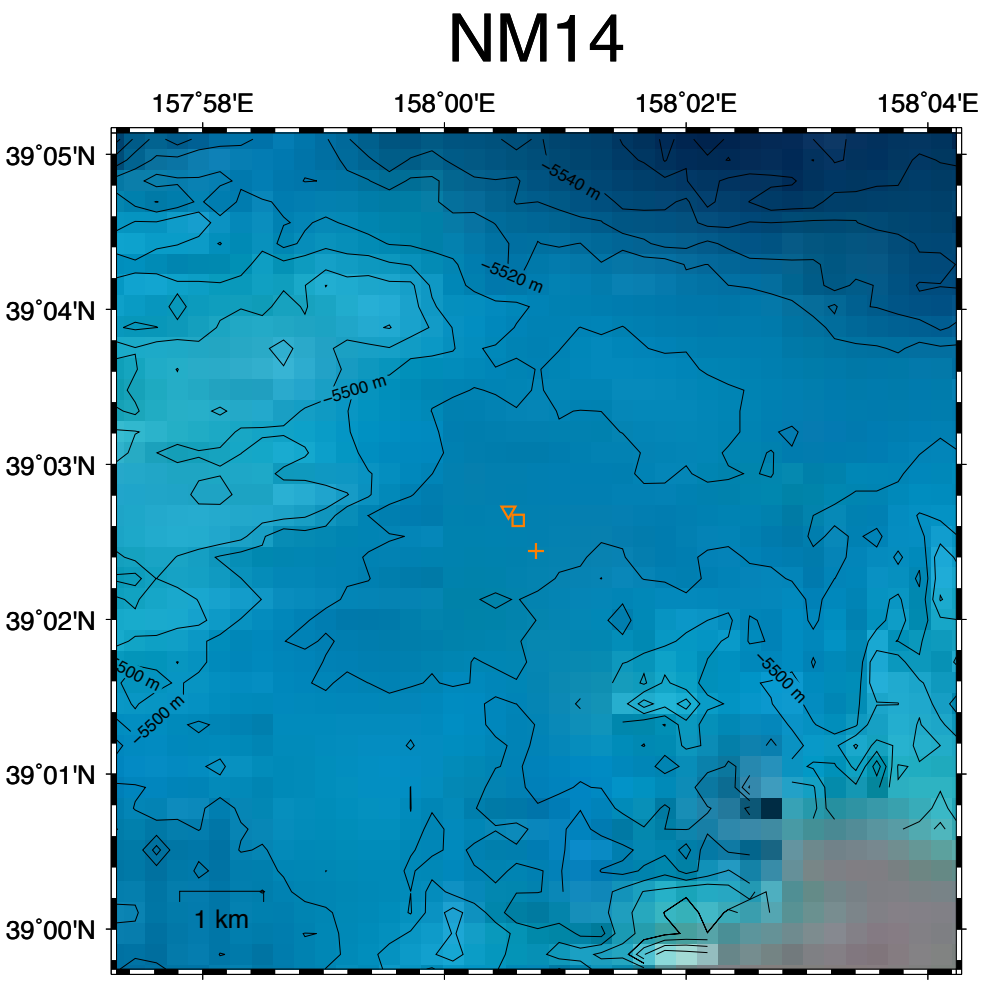


pilot	(2010.06-)	○	BBOBS	+	OBEM
1st	(2011.11-)	○	BBOBS	+	OBEM
2nd	(2012.08-)	○	BBOBS	+	OBEM
3rd	(2013.??-)	○	BBOBS	+	OBEM
pilot	(2010.06-)	▽	BBOBS-NX	□	EFOS
1st	(2011.11-)	▽	BBOBS-NX	□	EFOS
2nd	(2012.08-)	▽	BBOBS-NX	□	EFOS
3rd	(2013.??-)	▽	BBOBS-NX	□	EFOS

KR12-14 NM17 BBOBS (537)
39˚ 45.9388' N 159˚ 51.1823' E 5519m
dx= 372m dy= -340m=

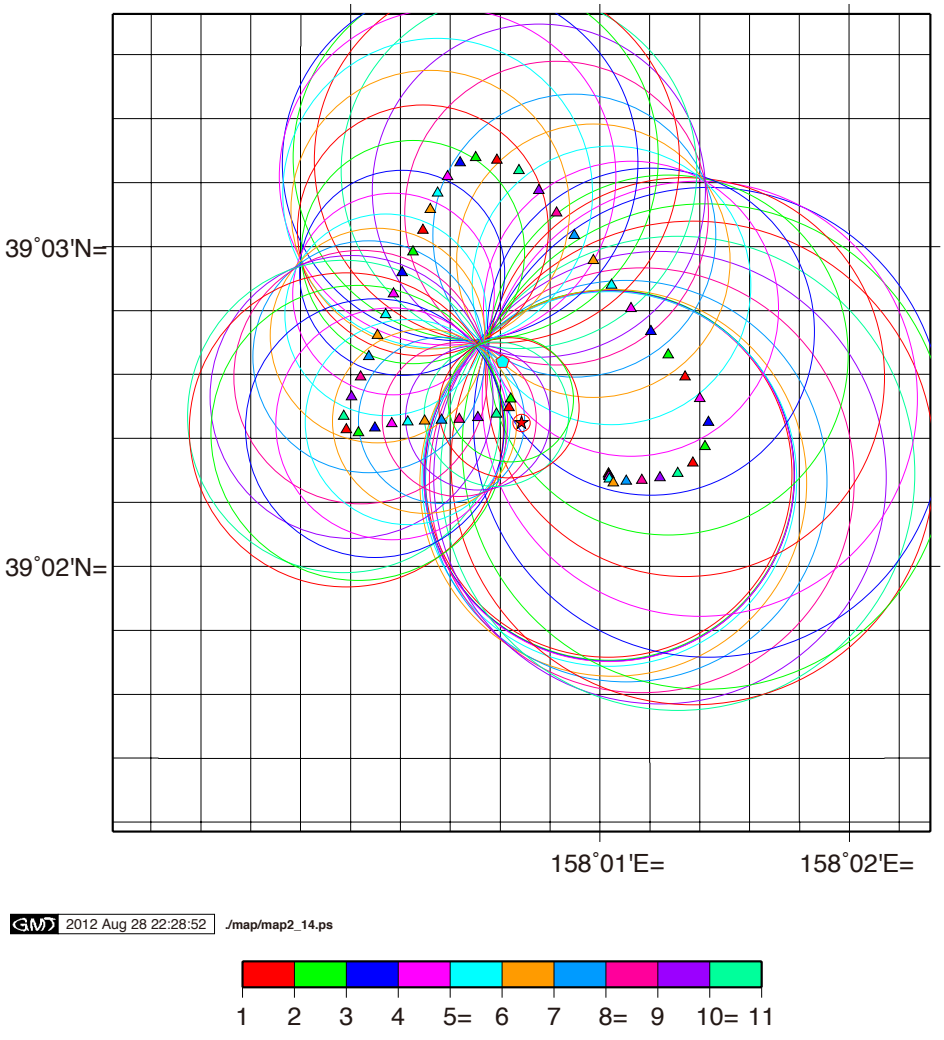


3.5.10. NM14

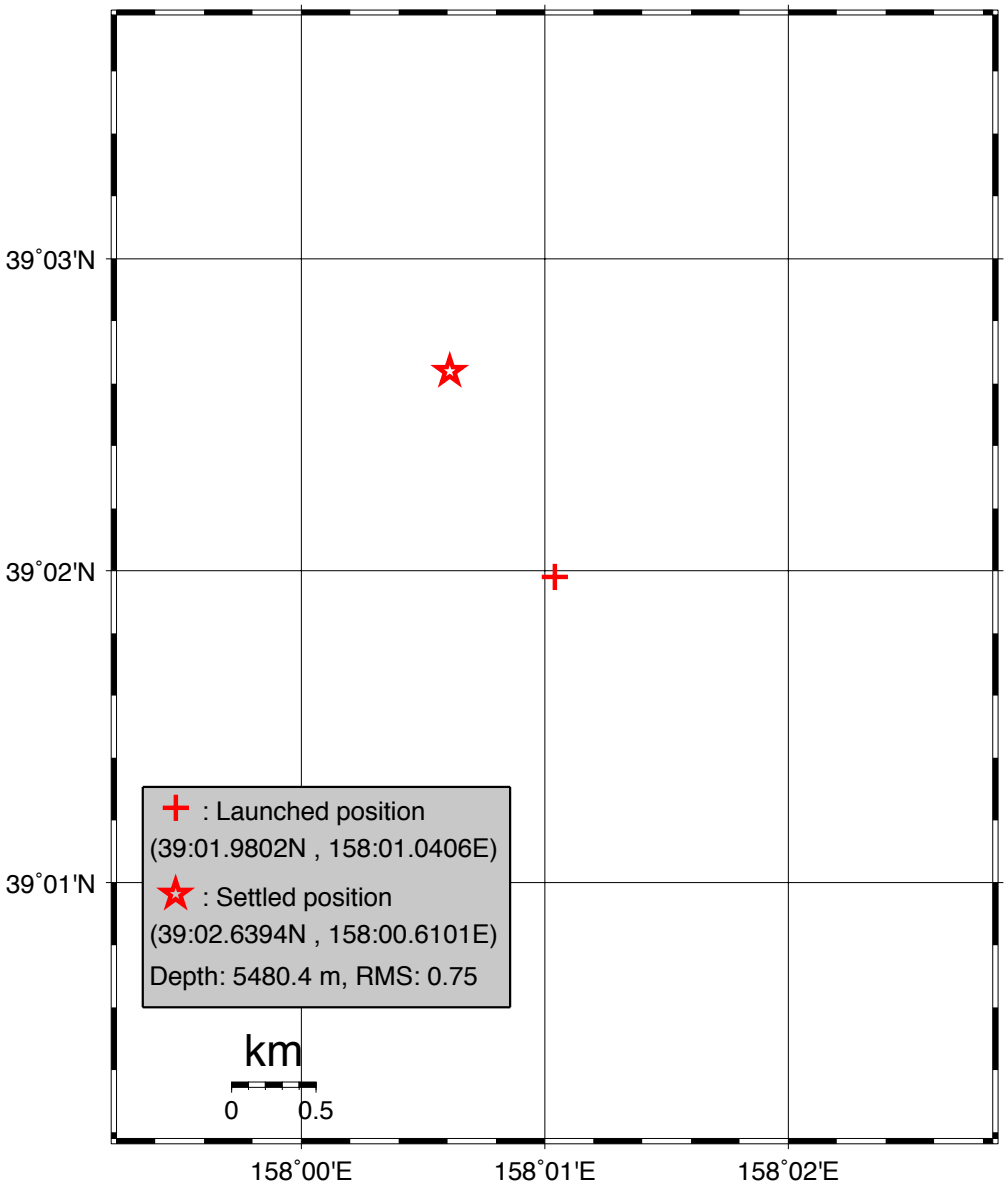


pilot	(2010.06-)	BBOBS	OBEM
1st	(2011.11-)	BBOBS	OBEM
2nd	(2012.08-)	BBOBS	OBEM
3rd	(2013.??-)	BBOBS	OBEM
pilot	(2010.06-)	BBOBS-NX	EFOS
1st	(2011.11-)	BBOBS-NX	EFOS
2nd	(2012.08-)	BBOBS-NX	EFOS
3rd	(2013.??-)	BBOBS-NX	EFOS

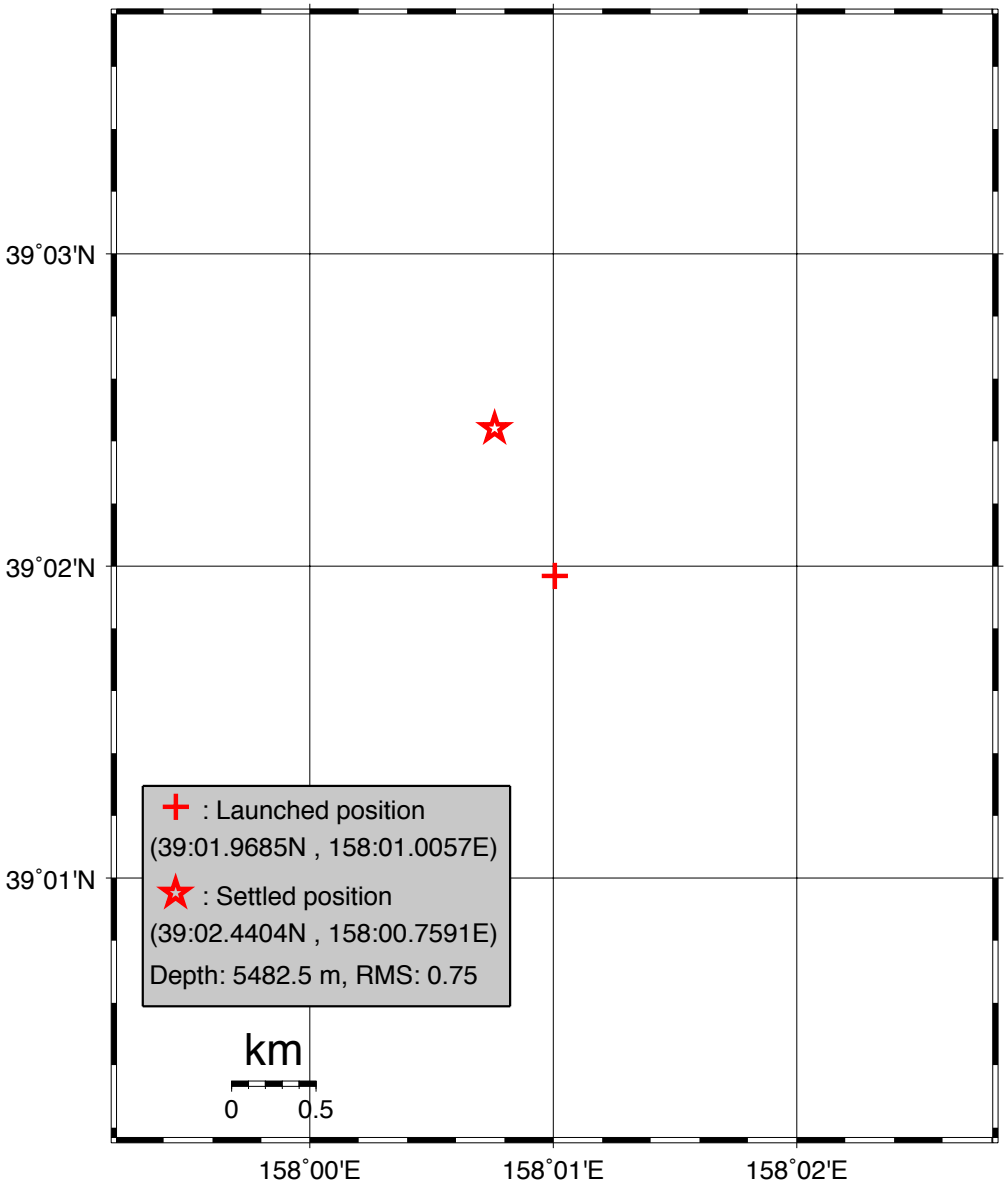
KR12-14 NM14 BBOBS-NX (NX-C)
39˚ 02.7004' N 158˚ 00.5291' E 5487m'
dx= -226m dy= 465m'
dist. to target= 162m'=



NM14–2 (EFOS5)


39˚03'N
39˚02'N
39˚01'N
158˚00'E
158˚01'E
158˚02'E
: Launched position
(39:01.9802N , 158:01.0406E)
: Settled position
(39:02.6394N , 158:00.6101E)
Depth: 5480.4 m, RMS: 0.75
km
0
0.5

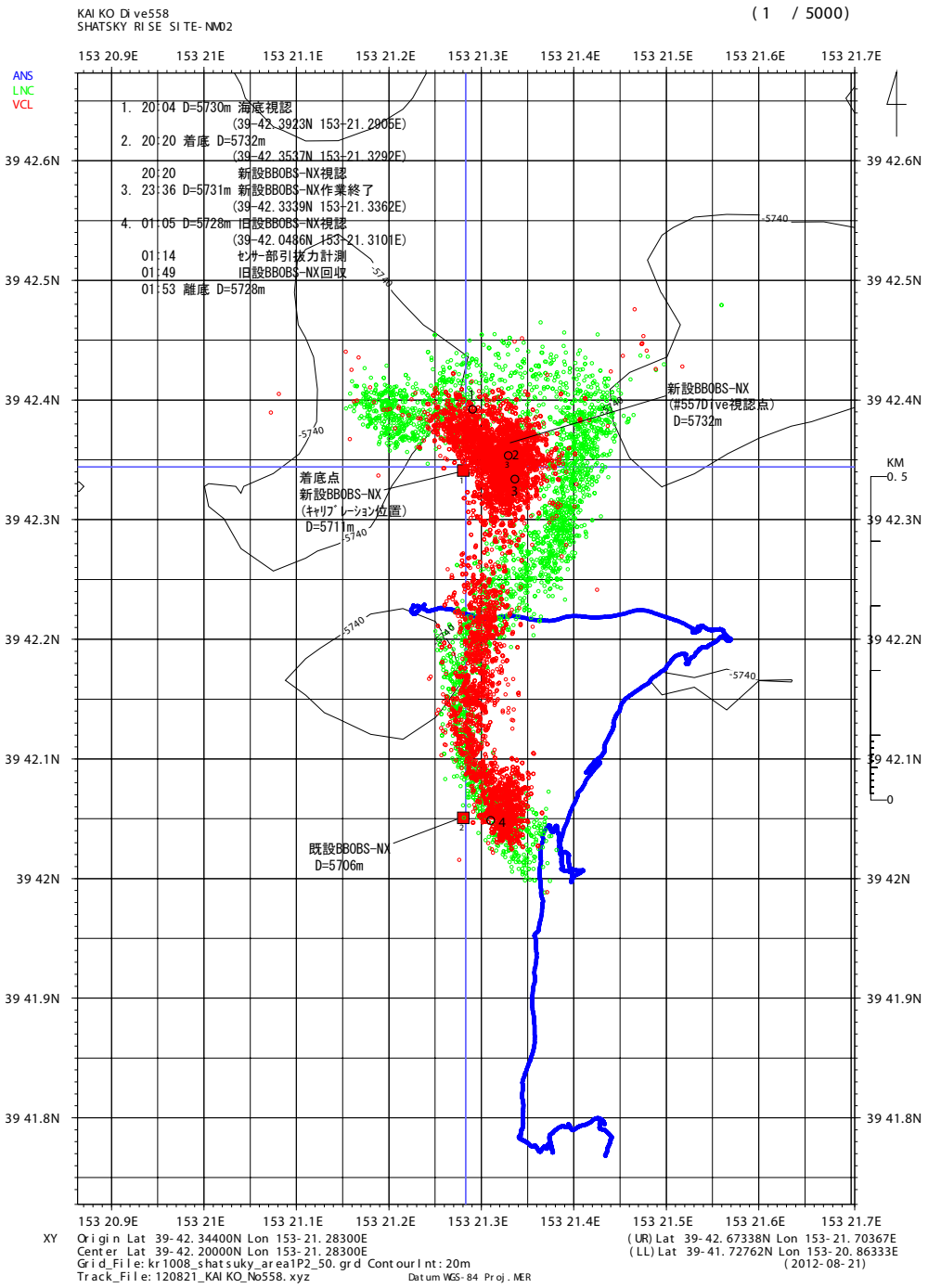
NM14–2 (JM107)


39˚03'N
39˚02'N
39˚01'N
158˚00'E
158˚01'E
158˚02'E
: Launched position
(39:01.9685N , 158:01.0057E)
: Settled position
(39:02.4404N , 158:00.7591E)
Depth: 5482.5 m, RMS: 0.75
km
0
0.5

3.6. KAIKO 7000-II track

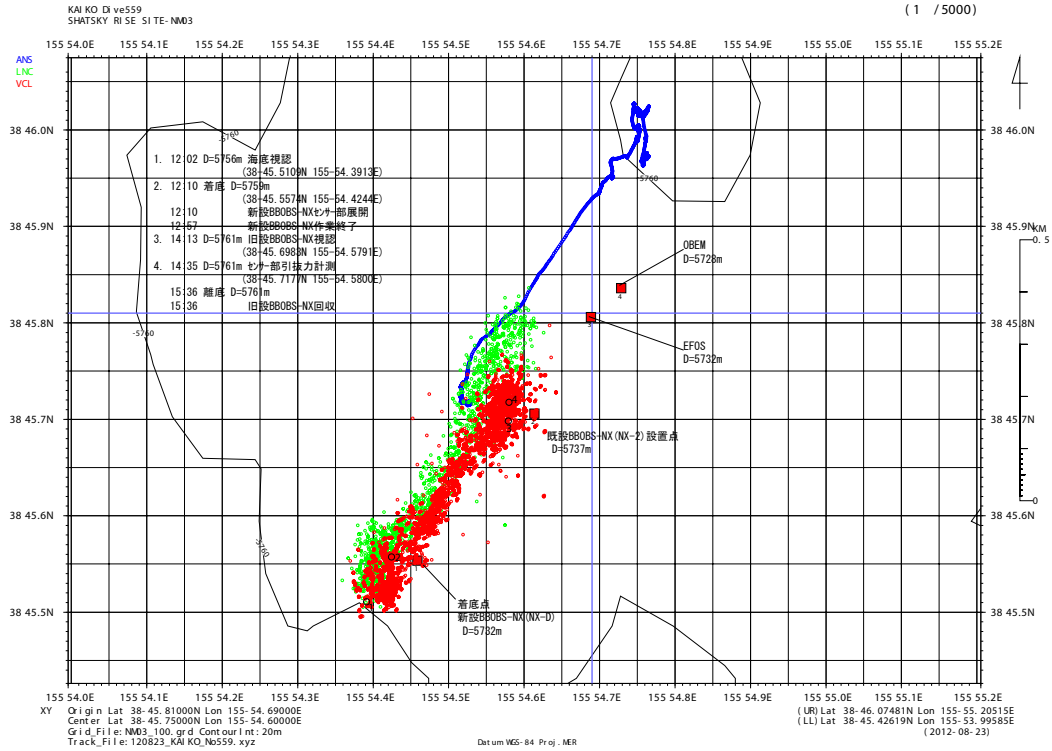
3.6.1. NM02

Dive #558

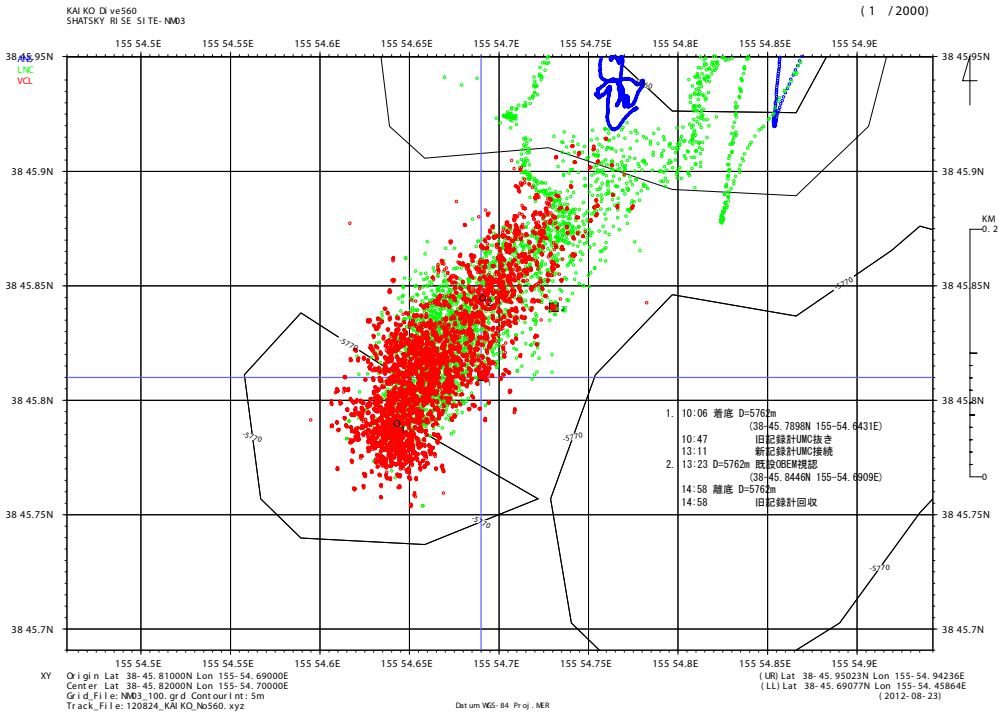


3.6.2. NM03

Dive #559

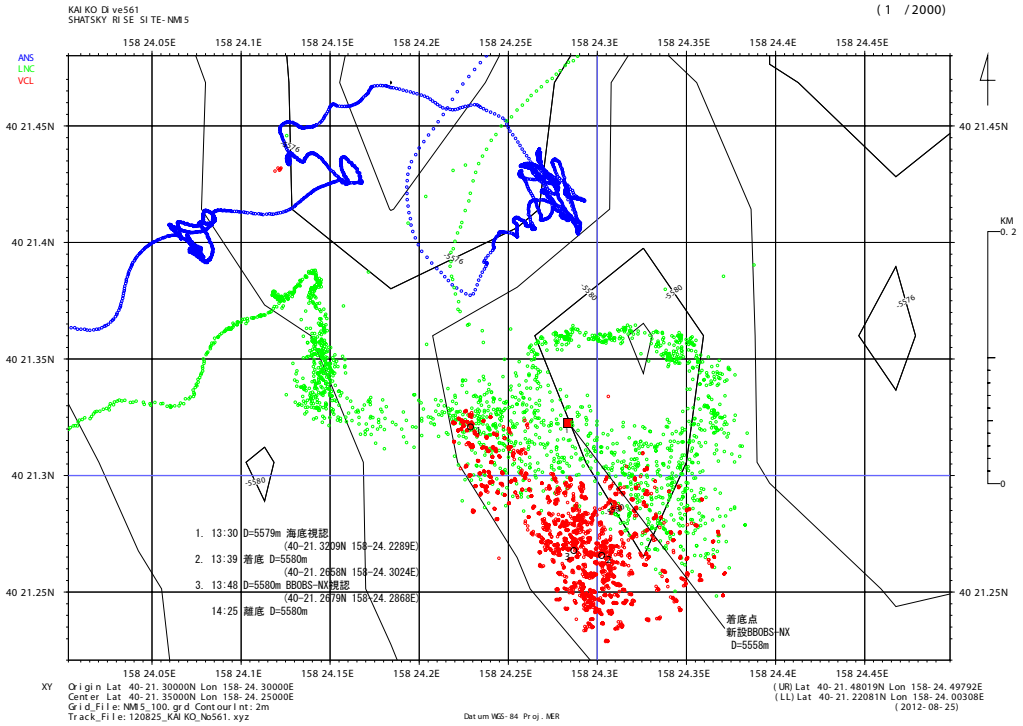


Dive #560



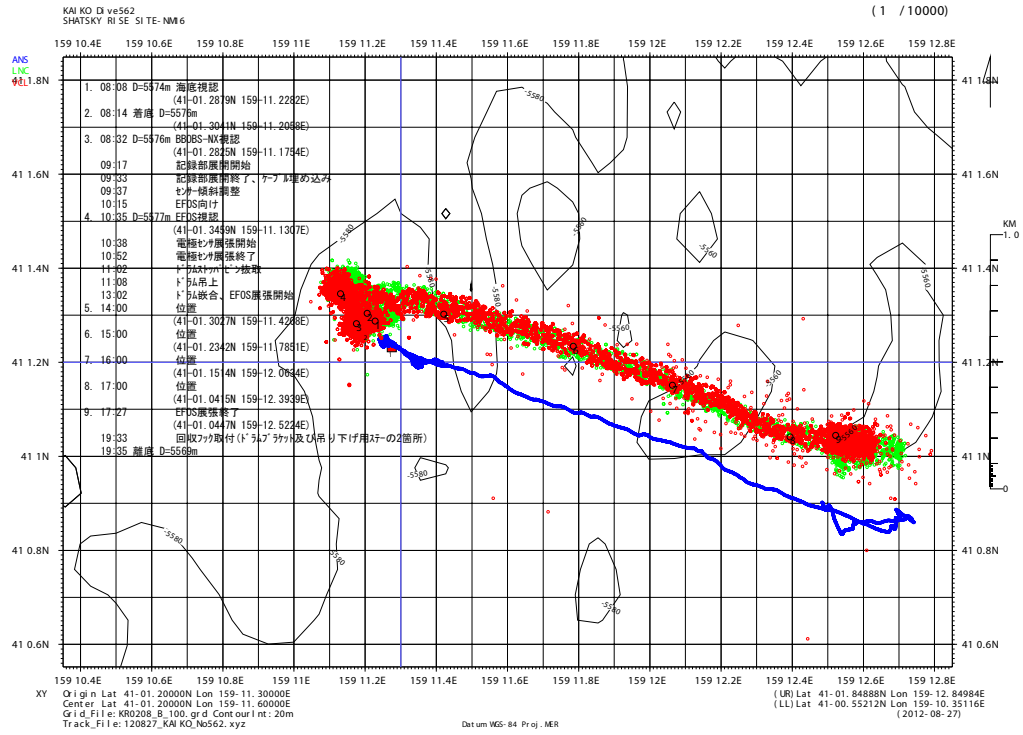
3.6.3. NM15

Dive #561



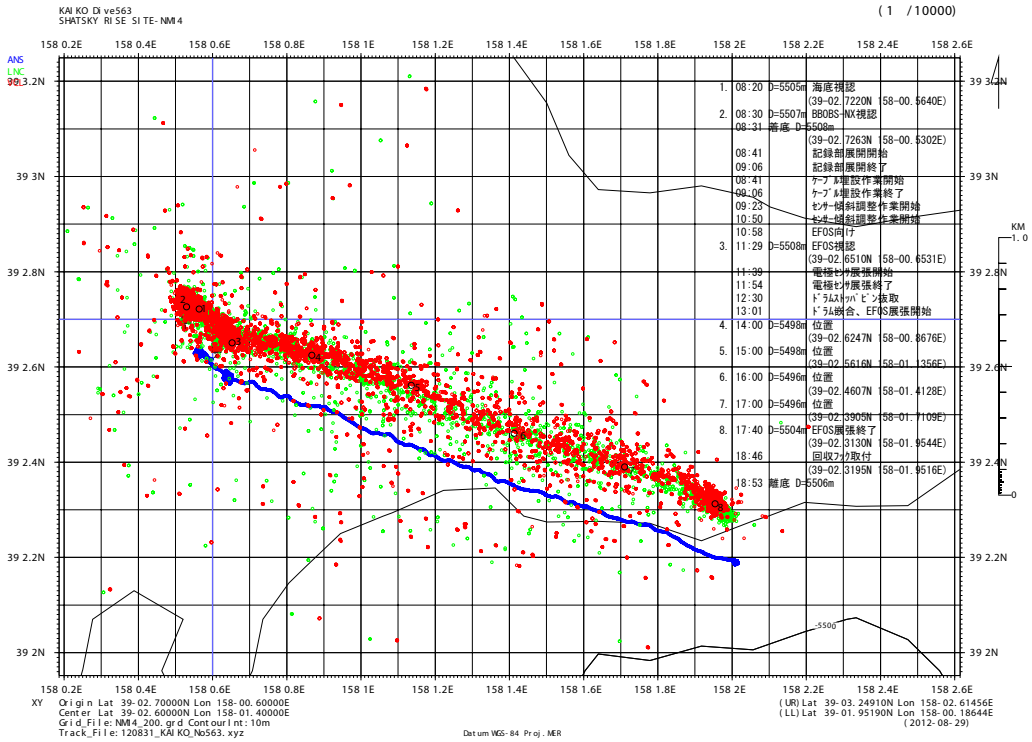
3.6.4. NM16

Dive #562



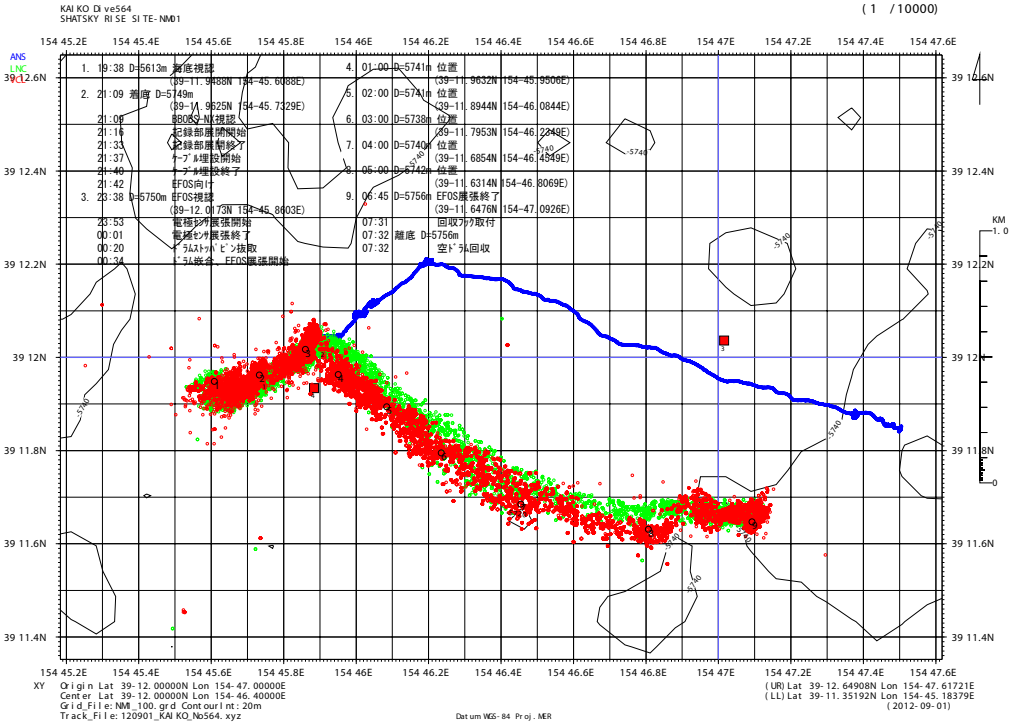
3.6.5. NM14

Dive #563

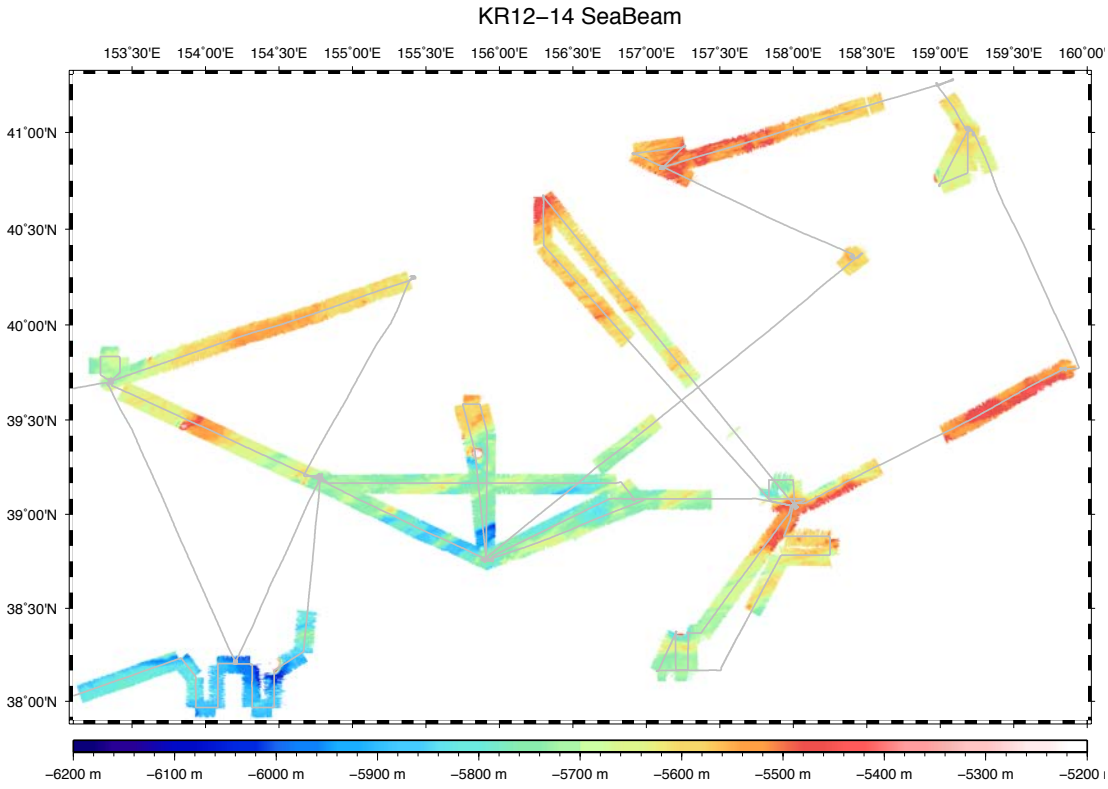


3.6.6. NM01

Dive #564



3.7. MNBES



3.8. Summary of Results

The present cruise, KR12-14, was originally planned for 20 days with 7 days for surface deployment and recovery, 7 days for KAIKO 7000-II dive operation, and 6 days for transit. We planned to visit 15 sites in the study area, including 13 sites in area A and 2 in area B. However, the plan was changed during the initial stage of the cruise to visit sites only in area A in order to optimize the observation network within the available ship time. As a result, we visited 10 sites for deployment and/or recovery of ocean bottom instruments, and 4 sites to conduct MNBES for future deployment. Thus the present cruise completed building the observation network in area as planned except the EFOS-6 at site NM03. Installation of several advanced instruments and replacement of conventional instruments have to be carried out in area B in next summer, in addition to planned deployment/recovery of instruments in 2013.

In the following, results of observation are summarized in the order of completion.

August 19 (Area A, NM02): Recovery of OBEM. Deployment of BBOBS-NX and OBEM. Positioning of settled points. Bottom installation of BBOBS-NX by KAIKO 7000-II was not completed due to a trouble (dive #557).

August 20 (Area A: NM04): Recovery of and deployment of BBOBS. Positioning of settled point. Call of OBEM at the bottom.

August 20 (Area A, NM01) No replay from BBOBS at the bottom. Recovery of OBEM. Deployment of BBOBS and positioning of its settled point.

August 21 (Area A, NM05): Recovery and deployment of BBOBS and OBEM. Positioning of settled points.

August 21 (Area A, NM02) Rearrangement of BBOBS-NX by KAIKO 7000-II (dive #558).

August 22 (Area A, NM03) No reply from OBEM deployed in 2010, Deployment of OBEM and BBOBS-NX. Positioning of settled points. A return trip to NM10 for bathymetric survey by MNBES.

August 23 (Area A, NM03) Rearrangement and recovery of BBOBS-NX by KAIKO 7000-II (dive #559). A return trip to NM06 for bathymetric survey by MNBES.

August 24 (Area A, NM03) Recovery and replacement of data recorder of EFOS by KAIKO 7000-II. Observation of implosion of glass sphere of OBEM by KAIKO 7000-II (dive #560).

August 25 (Area A, NM15) Deployment of BBOBS-NX and OBEM. Positioning of settled points. Rearrangement of BBOBS-NX by KAIKO 7000-II (#561).

August 26 (Area A, NM12) Deployment of BBOBS and OBEM. Positioning of settled points.

August 26 (Area A, NM16) Deployment of EFOS, OBEM and BBOBS-NX. Positioning of settled points.

August 27 (Area A, NM16) Rearrangement of BBOBS-NX and installation of EFOS cable by KAIKO 7000-II (dive #562).

August 28 (Area A, NM17) Deployment of BBOBS. Positioning of settled point.

August 28 (Area A, NM14) Deployment of EFOS, OBEM and BBOBS-NX. Positioning of settled points.

August 29 (Area A, NM11) Bathymetric survey by MNBES.

August 30 (Area A, NM08) Bathymetric survey by MNBES.

August 31 (Area A, NM14) Rearrangement of BBOBS-NX and installation of EFOS cable by KAIKO 7000-II (dive #563).

September 1 (Area A, NM01) Deployment of EFOS, OBEM and BBOBS-NX

September 1 (Area A, NM01) Rearrangement of BBOBS-NX and installation of EFOS cable by KAIKO 7000-II (dive #564).

Table 2a. Installation locations of KR12-14 for self pop-up instruments

Site	Date of deploy	BBOBS			OBEM		
		Lat.	Lon.	Depth	Lat. (N)	Lon. (E)	Depth
NM01	2012/08/20	39_12.2433	154_46.6805	5719	39_12.0102	154_47.0852	5718
NM02	2012/08/19				39_42.6816	153_21.2063	5727
NM03	2012/08/23				38_45.0267	155_54.0589	5725
NM04	2012/08/20	38_12.6437	154_12.3043	5916			
NM05	2012/08/21	40_15.2707	155_24.5993	5593	40_15.2194	155_24.7822	5583
NM12	2012/08/26	40_49.0363	157_06.5341	5501	40_49.0374	157_06.5844	5526
NM14	2012/08/26				39_02.4404	158_00.7591	5483
NM15	2012/08/25				40_21.1667	158_24.5009	5571
NM16	2012/08/26				41_01.3293	159_11.1905	5551
NM17	2012/08/28	39_45.9388	159_51.1823	5519			

Table 2b. Installation locations of KR12-14 for advanced instruments

Site	Date of deploy	BBOBS-NX			EFOS		
		Lat.	Lon.	Depth	Lat. (N)	Lon. (E)	Depth
NM01	2012/09/01	39_11.9527	154_45.7490	5723	39_12.0219	154_45.9095	5718
NM02	2012/08/21	39_42.3435	153_21.2833	5711			
NM03	2012/08/23	38_45.5537	155_54.4584	5732	38_45.8504	155_54.6883	5732
NM14	2012/08/28	39_02.7004	158_00.5291	5487	39_02.6394	158_00.6101	5480
NM15	2012/08/25	40_21.3227	158_24.2830	5558			
NM16	2012/08/26	41_01.2315	159_11.2745	5554	41_01.2682	159_11.2045	5549

Table 3. NOMan Project BBOBS information

Site	Type, specification	Tx code	Radio freq. (MHz)	Date of deploy	Date of recover	Latitude (deg)	Longitude (deg)	Depth
NM01	BBOBS 400 days	505	159.200	2010/6/15		39.2006	154.7836	5725
	BBOBS 400 days	500	159.250	2012/8/20		39.2057	154.7780	5719
	BBOBS-NX 800 days	550	----------	2012/9/1		39.1992	154.7625	5723
NM02	BBOBS-NX 400 days	515	----------	2010/6/19	2012/8/21	39.701	153.3547	5704
	BBOBS-NX 800 days	547	----------	2012/8/21		39.7057	153.3547	5711
NM03	BBOBS-NX 400 days	522	----------	2010/6/13	2012/8/23	38.7618	155.9102	5737
	BBOBS-NX 800 days	549	----------	2012/8/23		38.7592	155.9076	5732
NM04	BBOBS 400 days	500	159.150	2010/6/15	2011/11/27	38.2101	154.2027	5923
	BBOBS 600 days	503	159.200	2011/11/27	2012/8/20	38.210253	154.205828	5917
	BBOBS 400 days	517	159.150	2012/8/20		38.2107	154.2051	5916
NM05	BBOBS 400 days	523	159.300	2010/6/20	2012/8/21	40.2508	155.4086	5598
	BBOBS 400 days	502	159.200	2012/8/21		40.2545	155.4100	5593
NM12	BBOBS 400 days	516	159.150	2012/8/26		40.8173	157.1089	5501
NM14	BBOBS-NX 800 days	548	----------	2012/8/31		39.0450	158.0088	5487
NM15	BBOBS-NX 800 days	551	----------	2012/8/25		40.3554	158.4047	5558
NM16	BBOBS-NX 800 days	546	----------	2012/8/27		41.0205	159.1879	5554
NM17	BBOBS 400 days	537	159.300	2012/8/28		39.7656	159.8530	5519
NM18	BBOBS 600 days	501	159.250	2011/11/21		30.185602	161.293362	5927
NM19	BBOBS 600 days LS9K	521	159.200	2011/11/20		29.150477	161.773978	5877
NM20	BBOBS 600 days	536	159.250	2011/11/22		30.641308	162.549613	5913
NM21	BBOBS 600 days	524	159.300	2011/11/21		29.54192	162.85846	5936
NM22	BBOBS 600 days	513	159.300	2011/11/23		32.951896	163.811207	6118
NM23	BBOBS 600 days	538	159.250	2011/11/22		31.923572	164.407187	6011
NM24	BBOBS 600 days	533	159.250	2011/11/23		33.216633	165.261605	6059
NM25	BBOBS 600 days	539	159.150	2011/11/22		32.315722	165.444458	6057