JAMSTEC Report of Research and Development, Volume 6, November 2007, 39–51

Wide-angle seismic experiment crossing the southern Izu-Ogasawara Arc and multi-channel seismic profiling of the Ogasawara Plateau –KR07-03 cruise-

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Abstract We carried out a wide-angle reflection and refraction experiment using 100 ocean bottom seismographs on a 536-km long seismic line crossing the southern Izu-Ogasawara Arc, and a multi-channel seismic reflection profiling of 204-channel hydrophone streamer on a 318-km long seismic line transecting from the Ogasawara Trough to the Ogasawara Plateau. The cruise was conducted by R/V Kairei of Japan Agency for Marine-Earth Science and Technology from March 4 to 30, 2007. The objectives of the cruise are to reveal the crustal structure of the southern Izu-Ogasawara Arc and detailed shallow structure of the Ogasawara Plateau and to understand the continental crustal formation and the collision style of oceanic plateau against to the subduction zone. In this paper, we summarize the seismic experiments and show the acquired data of ocean bottom seismographs and multi-channel seismic survey.

Keywords: Izu, Ogasawara, OBS, MCS, seismic

1. Introduction

An intra-oceanic island arc is one of important tectonic locations to study the crustal growth generating the andesitic continental crust[1)], whereas basaltic magmatism is predominant in the recent Earth. To solve this dilemma, several models have been proposed[2)]. According to a concept named "subduction factory" by Tatsumi and Kogiso[2)], raw materials, such as oceanic sediments, oceanic crust and mantle lithosphere, are fed into the factory and are manufactured into arc magmas and continental crust. The waste materials processed in this factory, such as chemically modified oceanic crust/sediments and delaminated lower continental crust, sink into the deep mantle and are likely to have greatly contributed to mantle evolution. Especially, Izu-Ogasawara Arc is a best region to invest that for the following two reasons: the Izu-Ogasawara Arc is isolated oceanic island arc excepting the northernmost part collision zone, and the discovery of large volume middle crust with 6 km/s P-wave velocity is regarded as andesitic layer[3)4)].

The Izu-Ogasawara Arc belongs to the eastern edge of the Philippine Sea Plate where the Pacific Plate is subducting with NW direction[5)]. The Izu-Ogasawara Arc is about 1000 km long with NNW-SSE trend from the collision zone with Honshu Arc to the Volcanic Islands including Iwo-jima (Figure 1). In the middle of the Izu-Ogasawara Arc, the Sofu-gan tectonic line exists as a tectonic boundary between northern and southern parts of the arc[6)]. The Ogasawara Ridge is located in the vicinity of the Izu-Ogasawara Trench only in southern part of the Sofu-gan tectonic line. Between the Ogasawara Ridge and the Izu-Ogasawara Arc, Ogasawara Trough is an elongated basin parallel to the arc. The Parece Vera and Shikoku Basins are back arc basins west of the Izu-Ogasawara Arc separating the arc and the Kyushu-Parau Ridge.

The Izu-Ogasawara Arc was formed by igneous activities associated with the subduction of the Pacific Plate and back-arc spreading of the Shikoku-Parece Vela Basins[7)]. At this point, we summarize the brief history of the Izu-Ogasawara Arc based on the review[7)]. The timing of the

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lithospheric subsidence prior to subduction is constrained about 50 Ma from the age of the Izu-Ogasawara forearc basement[8]. The subduction was initiated during 50-40 Ma, and probably 43 Ma is a key timing since the drastic direction change of the Pacific Plate migration[9]. The early arc associated with the subduction was formed stably during 40-30 Ma, followed by the rifting and spreading of the Parece Vela Basin during 30-15 Ma, which was associated with the separation of Kyushu-Parau Ridge. The collision of the northernmost part of the Izu-Ogasawara Arc with Honshu Arc was started about 15 Ma, and the spreading of the Parece Vera Basin and Shikoku Basin ceased[10].

The Ogasawara Plateau, which was formerly named as Michelson Ridge[11], is a large bathymetric high colliding with the Izu-Ogasawara Trench at latitude 26N where is slightly north of the junction of the Izu-Ogasawara and Mariana Trenches (Figure 1). The Ogasawara Plateau seems to be cut by several faults associated with plate bending near the trench (Figure 1). The tectonics associated faulting is an interesting feature. Large bathymetric highs, such as oceanic plateaus, seem to be difficult to subduct smoothly because of thick crust and buoyancy[11]. For example, the Ontong Java Plateau is accreted 20% of crust with the Solomon Island Arc[12]. The collision style of oceanic plateaus at trenches is also an important point.

To reveal the crustal structure of the southern Izu-Ogasawara Arc and the Ogasawara Plateau, a seismic experiment has been conducted in March, 2007. The cruise was KR07-03 conducted by the R/V Kairei of Japan Agency for Marine-Earth Science and Technology (JAMSTEC), which was composed of two seismic lines: one is Line SPr3 crossing the southern Izu-Ogasawara Arc for wide-angle reflection/refraction survey using ocean bottom seismographs (OBS), and another is Line OGr4 transecting the Ogasawara Plateau for multi-channel seismic (MCS) survey (Figure 1). The objectives of the cruise are to reveal the crustal structure of the southern Izu-Ogasawara Arc and detailed shallow structure of the Ogasawara Plateau and to understand the continental crustal formation and the collision style of oceanic plateau

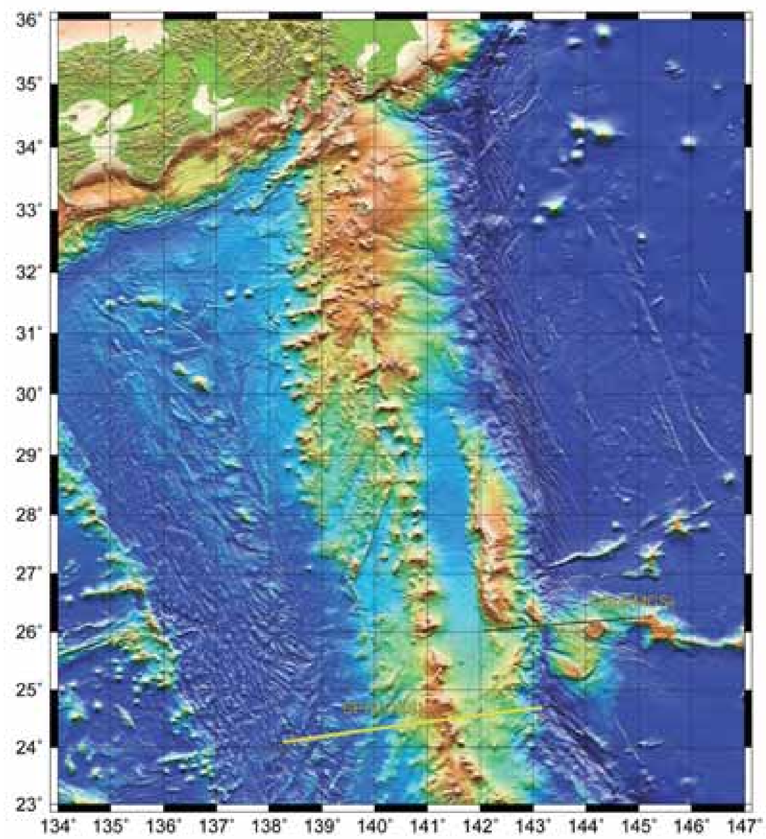

Figure 1: Bathymetric map of the experimental area. A black line with yellow circles, which are ocean bottom seismographs (OBS), is a seismic line for wide-angle reflection/refraction experiment using OBS (Line SPr3). A black line is a seismic line for multi-channel seismic (MCS) reflection profiling (Line OGr4).

Table 1: Activity log during KR0703 cruise

Date	Remarks
March 04	Departure from Yokohama
March 05	Transit
March 06	OBS deployment (Site#001-Site#013)
March 07	OBS deployment (Site#014-Site#034)
March 08	OBS deployment (Site#035-Site#056)
March 09	OBS deployment (Site#057-Site#073)
March 10	OBS deployment (Site#074-Site#088)
March 11	OBS deployment (Site#089-Site#100)
March 12	SPr3obs_0 airgun shooting
March 13	SPr3obs_0 airgun shooting
March 14	SPr3obs_0 airgun shooting
March 15	SPr3obs_0 airgun shooting and OBS retrieval (Site#001-Site#010)
March 16	OBS retrieval (Site#011-Site#033)
March 17	OBS retrieval (Site#034-Site#050)
March 18	OBS retrieval (Site#051-Site#063)
March 19	OBS retrieval (Site#064-Site#075)
March 20	OBS retrieval (Site#076-Site#087)
March 21	OBS retrieval (Site#088-Site#095)
March 22	OBS retrieval (Site#096-Site#100) and transit
March 23	OGr4_2 airgun shooting
March 24	OGr4_2 airgun shooting
March 25	OGr4_2 airgun shooting and transit
March 26	OGr4_3 airgun shooting
March 27	OGr4_3 airgun shooting
March 28	Transit
March 29	Transit
March 30	Transit and arrived at JAMSTEC

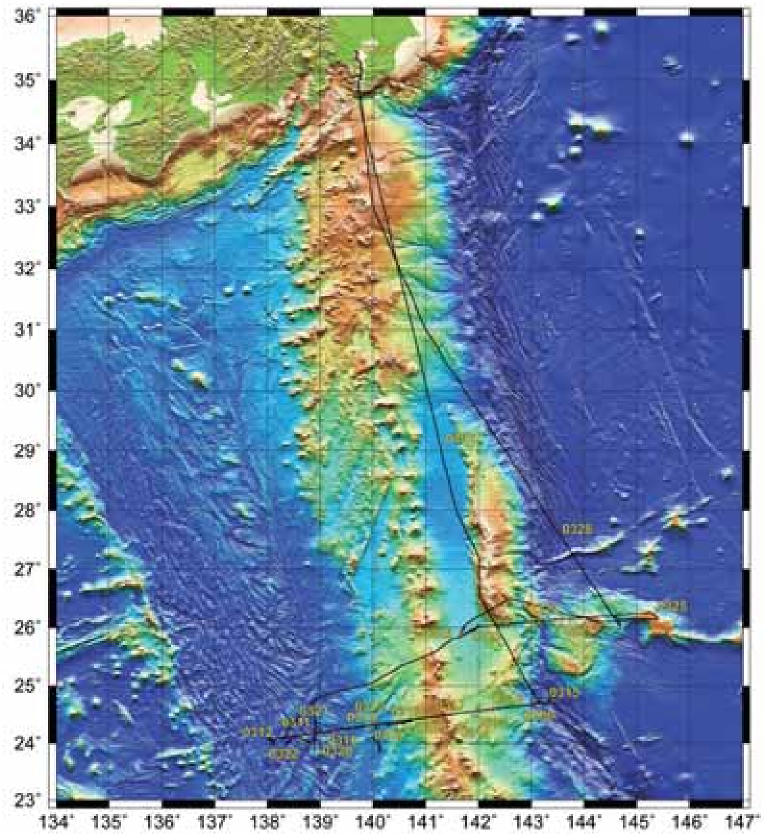

Figure 2: Map for ship's track. Red crosses and yellow four-digits indicate the position at noon in global standard time and date, respectively.

against to the subduction zone.

2. Data Acquisition

The outline of the KR07-03 cruise and shiptracks are respectively shown by Table 1 and Figure 2. The specifications of the data acquisition were basically same as those of surveys conducted by JAMSTEC in Izu-Ogasawara region (e.g. KR05-06[13] and KR06-01[14]). The R/V Kairei left the Yokohama port in March 4. From March 6 to 11, OBS deployment was conducted. The airgun was shot with 200-m interval on the Line SPr3 for OBS survey during March 12 and 15. After the airgun shooting, OBS retrieval was conducted until March 22. MCS survey on Line OGr4 was conducted from March 23 to March 27 with two 100-m interval shooting because of compressor trouble, which was enabled to obtain the MCS data with 50-m shooting interval. The cruise was finished in March 30 arriving to the JAMSTEC port. During the cruise, the planned survey was mostly finished without serious weather influence.

2.1. Airgun shooting

The seismic source of the cruise was an airgun array of BOLT1500LL type on the R/V Kairei. Total chamber size was 12000 cu. in. (200 l), which was composed of eight 1500 cu. in. airguns. Air pressure was 200 psi (140 atm). Towing depth of the airgun array was about 10 m. The eight airguns were shot simultaneously within 1msec (Figures 3,4).

The Line SPr3 for the OBS survey was 536-km length from the Parece Vera Basin to forearc region crossing the southern IBM arc. The both ends for the Line SPr3 were extended 20-km outside of OBS locations: the western end was 20-km west from OBS100 and the eastern end was 20-km east from OBS001. The shooting interval was 200-m, which was about 97 s with 4 knot ship speed. Total shot number was 3691 (Table 2).

The Line OGr4 for the MCS survey was 318-km length from the Ogasawara Trough to the Ogasawara Plateau. As mentioned above, data acquisition for 50-m interval was realized by two 100-m interval shooting because of compressor trouble. The shooting interval of 100-m was about 49 s with 4 knot ship speed. The shotpoint numbers (SP) for the two shootings were respectively from 9675 to 16039 and from 9630 to 14646, whose increments were two because the SP interval was 50 m. Total shot numbers for two acquisition were 3182 (SP9675-16039) and 2508 (SP9630-14646), respectively (Table 2).

2.2. OBS

The wide-angle reflection and refraction survey for OBS was conducted in the Line SPr3. One hundred OBSs

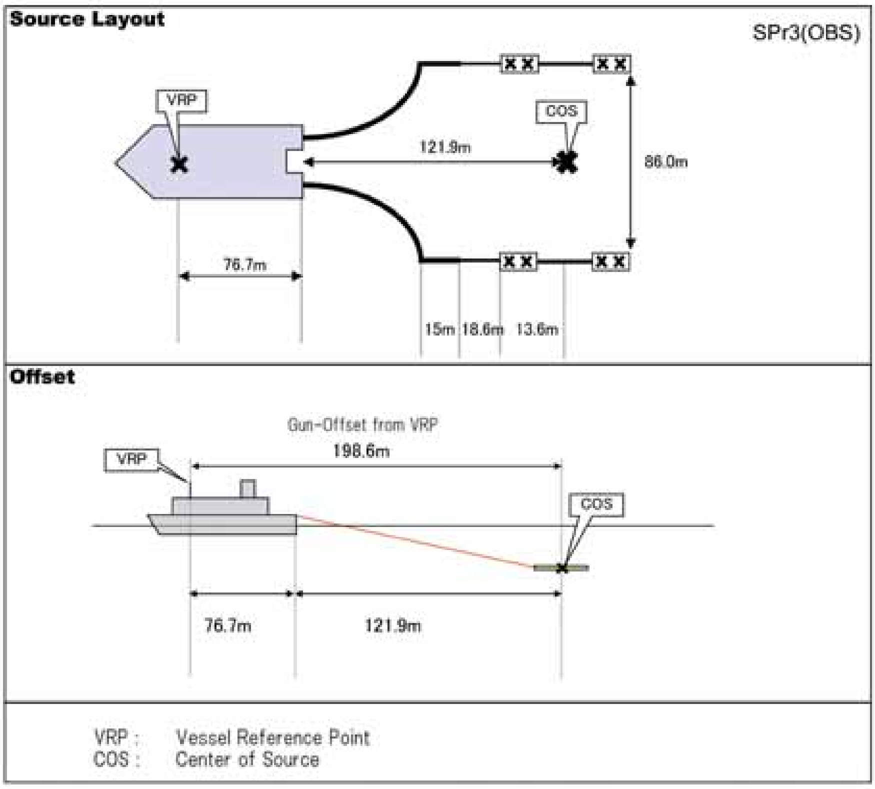

Figure 3: Geometry of the airgun system for OBS survey (Line SPr3)

Table 2: Airgun shooting log

SPr3obs_0	Time (UTC)	Latitude (N)	Longitude (E)	Depth (m)	SP
First shot	2007/3/11 23:35	24° 4.1134′	138° 6.4293′	4279	1001
First good shot	2007/3/11 23:35	24° 4.1134′	138° 6.4293′	4279	1001
Last good shot	2007/3/14 20:55	24° 42.6362′	143° 20.5897′	8038	3681
Last shot	2007/3/14 20:55	24° 42.6362′	143° 20.5897′	8038	3681
OGr4_2	**Time (UTC)**	**Latitude (N)**	**Longitude (E)**	**Depth (m)**	**SP**
First shot	2007/3/23 7:16	26° 1.5099′	142° 3.9838′	3142	9633
First good shot	2007/3/23 7:31	26° 1.6198′	142° 5.2366′	2991	9675
Last good shot	2007/3/24 20:43	26° 15.5919′	145° 15.3691′	1146	16037
Last shot	2007/3/24 20:44	26° 15.5962′	145° 15.4292′	1146	16039
OGr4_3	**Time (UTC)**	**Latitude (N)**	**Longitude (E)**	**Depth (m)**	**SP**
First shot	2007/3/26 5:08	26° 1.4994′	142° 3.8943′	3158	9630
First good shot	2007/3/26 5:09	26° 1.5099′	142° 4.0136′	3144	9634
Last good shot	2007/3/27 10:05	26° 12.8953′	144° 33.7734′	3177	14646
Last shot	2007/3/27 10:05	26° 12.8953′	144° 33.7734′	3177	14646

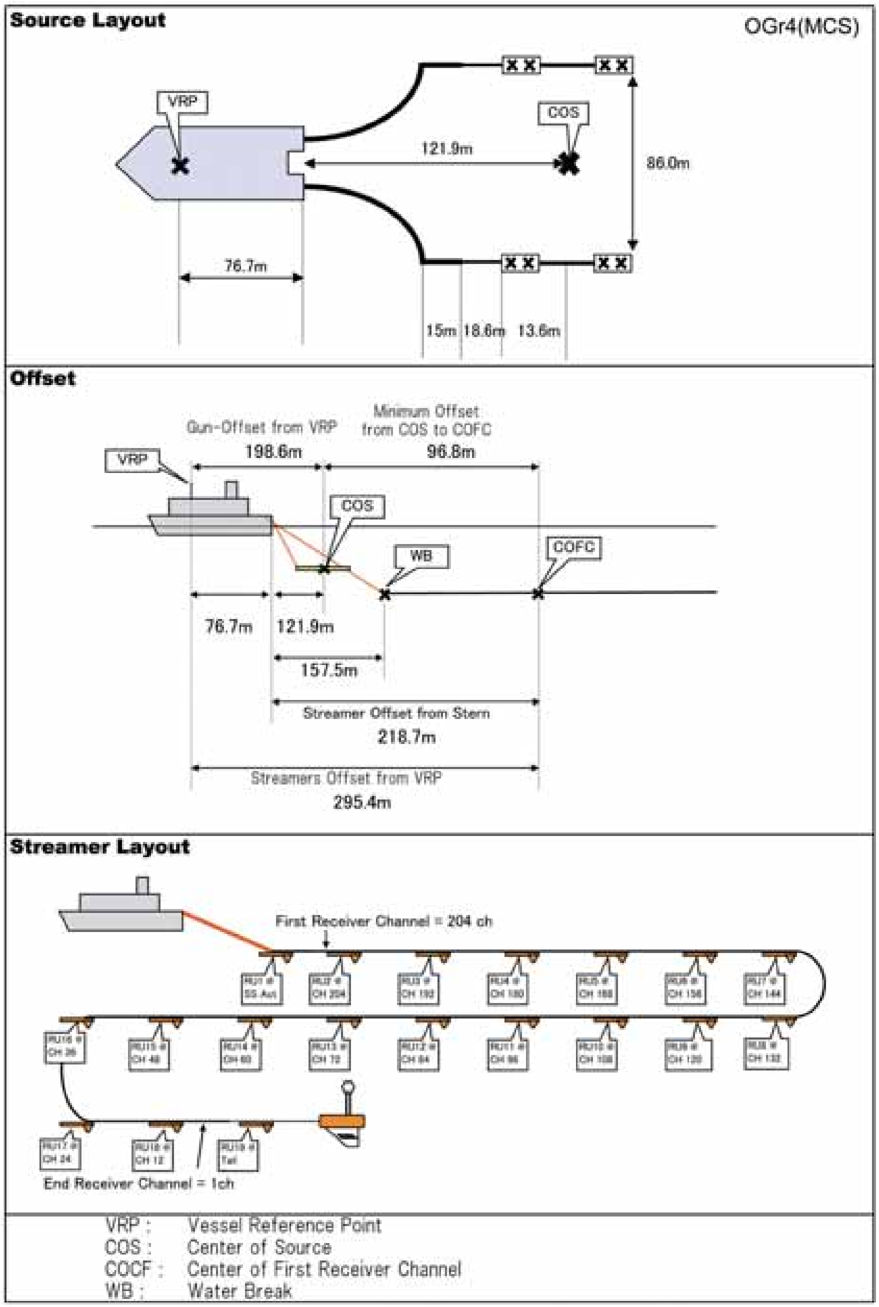

Figure 4: Geometry of the airgun system and hydrophone streamer geometry for MCS survey (Line OGr4).

were deployed with 5-km interval. The OBS and the digital recorder system were originally designed by Kanazawa and Shiobara[15)] and Shinohara et al.[16)]. The sensors of the OBS are 4.5 Hz geophones for one vertical and two horizontal components and one hydrophone (Table 3). The signals recorded by hard disk drive (HDD) after 16 bit A/D converter with 100 Hz sampling rate (10 ms). The power supply for the electric is rechargeable battery, which is effective for one month survey. The time shifts between the interval clock of OBS and reference time (GPS) were measured before the deployment and after the retrieval for calibration during OBS deployment on seafloor.

The transponders of Kaiyodenshi type (KYD) and System Giken type (SYG) were used for communication in seawater to cut iron anchor and to measure the distance: the transponders for OBS001-066 and OBS067-100 were KYD and SYG, respectively. Although the descending speeds are about 82 m per minute for both types, cutting time and ascending speed are different each other. The cutting times for iron anchor are about 15 minutes for KYD and 22 minutes for SYG, respectively. The ascending speeds for KYD and SYG are respectively 63 m per minutes and 68 m per minutes.

We deployed 100 OBSs taking acoustic communication between the R/V Kairei and OBSs to measure the location on seafloor. Most OBSs were located within 100-m diameter from planned position. However, several OBSs were positioned about 300-m away from the aimed position. Moreover, OBS090 was deployed at the 500-m northwestern point from the first planned position avoiding the steep slope.

2.3. Streamer Cable

We adopted SYNTRAK RDA Streamer System of Sercel Inc. as the streamer cable for the MCS survey (Figure 4). The length of the streamer cable was 5200 m, which was 5100 m active section and 100 m lead-in cable. The active section has 204 channels with an group interval of 25 m, which composed of 32 hydrophones (Benthos Reduce Diameter Array Hydrophone). The signals of hydrophones in each channel were stacked and A/D converted by 24 bit A/D converter, followed by transmission to the recording system mentioned below. The depth of the streamer cable was controlled about 15-m depth by the depth control device (Digi Cource System3 of I/O Inc.).

2.4. Recording and Navigation Systems

The recording system is the SYNTRACK960-24 of Sercel Inc., which outputs the seismic data into 3590E tapes with SEG-D 8048 format. The sampling rate and recording length were respectively 4 msec and 18 sec, which were enable to resolve the structures from shallow sedimentary sequences to deep reflecting events.

The navigation of the survey was StarFire system, which was a Differencial Global Positioning System (DGPS), enabling to navigate the R/V Kairei within 0.4 m accuracy. The software SPECTRA of Concept Inc. was used to control the navigation system. The positioning data from the StarFire was sent to RTNμ (a network interface made by Concept Inc.) via a terminal server in the LAN system of the R/V Kairei. The RTNμ acquire the time signal of the StarFire from the original antenna. The navigation data is sent to the PC Linux machine installing the SPECTRA. The shottime and SP were set by the SPECTRA and trigger signals were sent to the recording system and the airgun control system (GCS90).

The schematic diagrams of navigation and recording system is shown by Figure 5. At first, SPECTRA send the starting signal (System-start-signal) to the central control device and recording system bia RTNμ (Real Time Navigation Unit). Soon after, the recording system sends back the ready signal (System-ready-signal) to SPECTRA. The streamer cable is ready for signal acquisition. Secondly, SPECTRA send the trigger signal (Shot-trigger) to the airgun control system (GCS90) and the recording

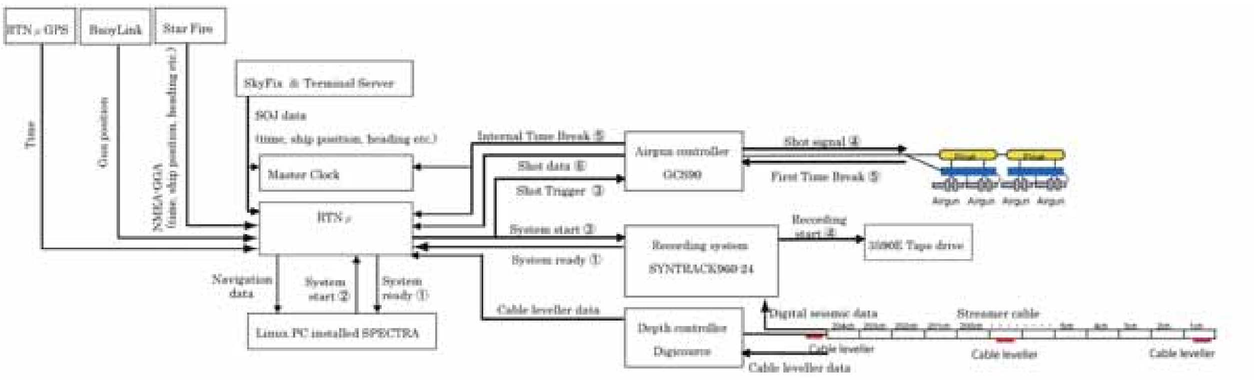

Figure 5: Navigation and recording system of R/V Kairei. Circled numerals show the signal transfer flow in the system.

Table 3: OBS information. The “H” for “Rec” column show the type of recorder as hard disk drive. The "B" and "H" mean that makers of the hydrophone sensor are Benthos Inc. and High Tech Inc., respectively. The “KYD” and “SYG” indicate the type of transponder Kaiyodenshi and System-Giken, respectively.

SITE	Deployment				Retrieval				Relocation					Rec	Hyd	Transponder
	Time	Coordinate			Time	Coordinate			Coodinate							
	UTC	Lat(N)	Lon(E)	Depth	UTC	Lat(N)	Lon(E)	Depth	Lat(N)	Lon(E)	Depth	x	y			
1	2007/03/05 21:01:00	24_41.3805	143_08.6683	5228.0	2007/03/15 02:46:00	24_41.7571	143_08.5455	5282	24_41.4639	143_08.5964	5231.6	150.0	−120.0	H	H	KYD
2	2007/03/05 22:42:00	24_41.0437	143_05.6925	4875.0	2007/03/15 04:19:00	24_41.3726	143_05.6963	4963	24_41.1362	143_05.7208	4903.9	124.0	4.0	H	B	KYD
3	2007/03/06 00:18:00	24_40.7633	143_02.7425	4789.0	2007/03/15 05:54:00	24_41.0631	143_02.8351	4838	24_40.8703	143_02.8251	4817.5	214.0	94.0	H	B	KYD
4	2007/03/06 01:58:00	24_40.4188	142_59.8029	4529.0	2007/03/15 07:21:00	24_40.6415	142_59.9085	4580	24_40.5386	142_59.8468	4573.9	184.0	44.0	H	H	KYD
5	2007/03/06 03:33:00	24_40.1101	142_56.8379	3671.0	2007/03/15 08:42:00	24_40.3167	142_56.9981	3654	24_40.1701	142_56.9433	3665.5	88.0	120.0	H	B	KYD
6	2007/03/06 04:55:00	24_39.7967	142_53.8948	3510.0	2007/03/15 09:54:00	24_40.0094	142_54.0464	3546	24_39.8450	142_53.9618	3487.5	74.0	64.0	H	B	KYD
7	2007/03/06 06:16:00	24_39.4866	142_50.9309	3179.0	2007/03/15 11:08:00	24_39.7034	142_51.1306	3163	24_39.5017	142_51.0541	3162.3	28.0	132.0	H	B	KYD
8	2007/03/06 07:37:00	24_39.1554	142_48.0372	3159.0	2007/03/15 12:15:00	24_39.3670	142_48.0921	3184	24_39.2126	142_48.0247	3157.1	84.0	−6.0	H	B	KYD
9	2007/03/06 08:56:00	24_38.8445	142_45.0826	2874.0	2007/03/15 13:20:00	24_39.0990	142_45.1267	2973	24_38.9161	142_45.0298	2867.8	128.0	86.0	H	B	KYD
10	2007/03/06 10:08:00	24_38.5204	142_42.1394	2902.0	2007/03/15 14:29:00	24_38.7620	142_42.1290	2892	24_38.5775	142_42.0660	2904.1	96.0	−114.0	H	B	KYD
11	2007/03/06 11:19:00	24_38.2055	142_39.1865	2887.0	2007/03/15 15:34:00	24_38.4490	142_39.1800	2886	24_38.2846	142_39.2268	2889.2	150.0	68.0	H	B	KYD
12	2007/03/06 12:32:00	24_37.8894	142_36.2431	2881.0	2007/03/15 16:39:00	24_38.1656	142_36.2251	2864	24_38.0025	142_36.2765	2876.2	226.0	62.0	H	B	KYD
13	2007/03/06 13:49:00	24_37.5417	142_33.3012	2936.0	2007/03/15 17:43:00	24_37.8671	142_33.3249	2918	24_37.6545	142_33.3467	2928.5	182.0	90.0	H	B	KYD
14	2007/03/06 15:01:00	24_37.2254	142_30.3147	2907.0	2007/03/15 18:48:00	24_37.4585	142_30.3630	2902	24_37.3066	142_30.3508	2916.6	140.0	6.0	H	B	KYD
15	2007/03/06 16:17:00	24_36.8997	142_27.3732	2878.0	2007/03/15 19:53:00	24_37.1458	142_27.4471	2878	24_36.9329	142_27.3858	2889.2	52.0	−26.0	H	B	KYD
16	2007/03/06 17:31:00	24_36.5753	142_24.4279	2868.0	2007/03/15 20:56:00	24_36.8310	142_24.4449	2865	24_36.6200	142_24.4128	2883.3	78.0	−72.0	H	H	KYD
17	2007/03/06 18:43:00	24_36.2287	142_21.4788	2733.0	2007/03/15 21:57:00	24_36.4574	142_21.4882	2744	24_36.2725	142_21.4402	2732.1	42.0	−118.0	H	B	KYD
18	2007/03/06 19:55:00	24_35.9190	142_18.5433	2642.0	2007/03/15 23:02:00	24_36.1669	142_18.5181	2640	24_35.9793	142_18.4843	2640.8	108.0	−136.0	H	B	KYD
19	2007/03/06 21:07:00	24_35.5842	142_15.5933	2522.0	2007/03/16 00:03:00	24_35.8846	142_15.5813	2509	24_35.6527	142_15.5418	2485.5	114.0	−132.0	H	B	KYD
20	2007/03/06 22:16:00	24_35.2384	142_12.6372	2494.0	2007/03/16 01:06:00	24_35.5807	142_12.6328	2493	24_35.3392	142_12.5852	2509.3	146.0	−152.0	H	B	KYD
21	2007/03/06 23:20:00	24_34.9211	142_09.7110	2527.0	2007/03/16 02:04:00	24_35.1966	142_09.7148	2542	24_35.0117	142_09.6954	2534.6	154.0	−60.0	H	H	KYD
22	2007/03/07 00:25:00	24_34.5783	142_06.7731	2557.0	2007/03/16 03:06:00	24_34.8016	142_06.8240	2559	24_34.6659	142_06.8046	2563.5	130.0	30.0	H	B	KYD
23	2007/03/07 01:30:00	24_34.2615	142_03.8253	2586.0	2007/03/16 04:06:00	24_34.4175	142_03.8915	2587	24_34.3203	142_03.8749	2588.4	108.0	54.0	H	B	KYD
24	2007/03/07 02:39:00	24_33.9147	142_00.8869	2598.0	2007/03/16 05:06:00	24_34.0253	142_00.9664	2595	24_33.9499	142_00.9491	2602.0	42.0	84.0	H	H	KYD
25	2007/03/07 03:44:00	24_33.5893	141_57.9323	2601.0	2007/03/16 06:16:00	24_33.6565	141_58.0329	2602	24_33.6197	141_57.9855	2618.3	52.0	50.0	H	B	KYD
26	2007/03/07 04:51:00	24_33.2482	141_54.9969	2556.0	2007/03/16 07:18:00	24_33.3031	141_55.0521	2555	24_33.2582	141_55.0578	2554.7	6.0	76.0	H	B	KYD
27	2007/03/07 06:01:00	24_32.9148	141_52.0664	2565.0	2007/03/16 08:19:00	24_32.9295	141_52.1580	2527	24_32.9228	141_52.1020	2550.9	10.0	54.0	H	B	KYD
28	2007/03/07 07:13:00	24_32.5528	141_49.1020	2525.0	2007/03/16 09:18:00	24_32.5746	141_49.2333	2521	24_32.5519	141_49.1641	2530.5	−50.0	62.0	H	B	KYD
29	2007/03/07 08:23:00	24_32.2511	141_46.1469	2499.0	2007/03/16 10:19:00	24_32.2723	141_46.3236	2500	24_32.2309	141_46.1898	2500.3	−16.0	8.0	H	B	KYD
30	2007/03/07 09:27:00	24_31.0919	141_43.2005	2456.0	2007/03/16 11:19:00	24_31.9244	141_43.4232	2443	24_31.8732	141_43.2301	2470.8	−48.0	−22.0	H	B	KYD
31	2007/03/07 10:29:00	24_31.5623	141_40.2597	2393.0	2007/03/16 12:20:00	24_31.5397	141_40.4176	2392	24_31.5448	141_40.3108	2396.0	−24.0	16.0	H	H	KYD
32	2007/03/07 11:34:00	24_31.2310	141_37.3265	2349.0	2007/03/16 13:24:00	24_31.0991	141_37.5047	2349	24_31.2199	141_37.3918	2349.6	8.0	54.0	H	B	KYD
33	2007/03/07 12:40:00	24_30.8595	141_34.3888	2257.0	2007/03/16 14:26:00	24_30.7875	141_34.4851	2252	24_30.8636	141_34.4577	2256.0	−16.0	66.0	H	B	KYD
34	2007/03/07 13:50:00	24_30.5064	141_31.4681	1962.0	2007/03/17 04:24:00	24_30.4676	141_31.4773	1968	24_30.5033	141_31.5238	1987.5	−46.0	78.0	H	B	KYD
35	2007/03/07 14:53:00	24_30.1773	141_28.5316	1620.0	2007/03/17 03:27:00	24_30.1180	141_28.5772	1627	24_30.1387	141_28.6304	1629.7	−82.0	158.0	H	B	KYD
36	2007/03/07 15:51:00	24_29.8421	141_25.5884	940.0	2007/03/17 02:39:00	24_29.7966	141_25.6154	970	24_29.7893	141_25.6746	982.6	−68.0	132.0	H	B	KYD
37	2007/03/07 16:39:00	24_29.4860	141_22.6543	622.0	2007/03/17 01:44:00	24_29.4577	141_22.6697	629	24_29.4823	141_22.7001	620.9	−14.0	74.0	H	B	KYD
38	2007/03/07 17:24:00	24_29.1475	141_19.7092	843.0	2007/03/17 00:54:00	24_29.1201	141_19.7047	839	24_29.1268	141_19.7543	851.5	−28.0	64.0	H	H	KYD
39	2007/03/07 18:17:00	24_28.7928	141_16.7660	1094.0	2007/03/16 23:53:00	24_28.7909	141_16.8140	1129	24_28.7714	141_16.8099	1102.6	−40.0	56.0	H	B	KYD
40	2007/03/07 19:14:00	24_28.4545	141_13.8333	1292.0	2007/03/16 22:53:00	24_28.4838	141_13.8645	1480	24_28.4183	141_13.8588	1290.6	−46.0	36.0	H	B	KYD
41	2007/03/07 20:09:00	24_28.1026	141_10.8825	1421.0	2007/03/16 21:49:00	24_28.1716	141_10.8775	1470	24_28.0902	141_10.0150	1423.0	−4.0	28.0	H	B	KYD
42	2007/03/07 21:04:00	24_27.7538	141_07.9427	1598.0	2007/03/16 20:49:00	24_27.8202	141_07.8816	1610	24_27.7644	141_07.9560	1604.0	44.0	−6.0	H	B	KYD
43	2007/03/07 22:04:00	24_27.3956	141_04.9992	1844.0	2007/03/16 19:51:00	24_27.4513	141_04.8686	1843	24_27.4172	141_05.0341	1843.0	54.0	22.0	H	B	KYD
44	2007/03/07 23:12:00	24_27.0053	141_02.0754	1919.0	2007/03/16 18:44:00	24_27.1466	141_01.9242	1902	24_27.0516	141_02.1017	1903.1	32.0	32.0	H	B	KYD
45	2007/03/08 00:18:00	24_26.6834	140_59.1320	2048.0	2007/03/16 17:37:00	24_26.8516	140_59.0391	2031	24_26.7425	140_59.1803	2048.1	116.0	60.0	H	B	KYD
46	2007/03/08 01:28:00	24_26.3235	140_56.2036	2124.0	2007/03/17 07:22:00	24_26.6079	140_56.1752	2106	24_26.4249	140_56.3504	2113.4	186.0	242.0	H	B	KYD
47	2007/03/08 02:39:00	24_25.9758	140_53.2518	2165.0	2007/03/17 08:18:00	24_26.1708	140_53.2375	2166	24_26.0359	140_53.3206	2166.6	126.0	86.0	H	B	KYD
48	2007/03/08 03:48:00	24_25.5916	140_50.3207	2106.0	2007/03/17 09:13:00	24_25.7417	140_50.3740	2111	24_25.6470	140_50.4095	2111.8	68.0	130.0	H	B	KYD
49	2007/03/08 05:01:00	24_25.2484	140_47.3804	2297.0	2007/03/17 10:10:00	24_25.4504	140_47.6039	2218	24_25.3482	140_47.5933	2224.4	178.0	334.0	H	B	KYD
50	2007/03/08 06:19:00	24_24.8956	140_44.4448	2394.0	2007/03/17 11:09:00	24_25.0160	140_44.6500	2379	24_24.9445	140_44.5183	2395.4	96.0	100.0	H	B	KYD
51	2007/03/08 07:30:00	24_24.5206	140_41.5152	2418.0	2007/03/17 19:58:00	24_24.5223	140_41.5189	2417	24_24.5615	140_41.5488	2415.2	54.0	44.0	H	B	KYD
52	2007/03/08 08:40:00	24_24.1646	140_38.5719	2429.0	2007/03/17 20:59:00	24_24.2097	140_38.5577	2424	24_24.1959	140_38.5880	2422.4	46.0	2.0	H	B	KYD
53	2007/03/08 09:46:00	24_23.8023	140_35.6299	2419.0	2007/03/17 22:04:00	24_23.8481	140_35.7135	2410	24_23.8121	140_35.6557	2418.7	6.0	8.0	H	B	KYD
54	2007/03/08 10:50:00	24_23.4516	140_32.7088	2656.0	2007/03/17 23:04:00	24_23.4275	140_32.7465	2654	24_23.4728	140_32.7321	2656.8	50.0	28.0	H	B	KYD
55	2007/03/08 12:00:00	24_23.0909	140_29.7699	2449.0	2007/03/18 00:16:00	24_23.1445	140_29.9177	2469	24_23.1543	140_29.8135	2463.3	134.0	56.0	H	B	KYD
56	2007/03/08 13:08:00	24_22.7189	140_26.8500	2783.0	2007/03/18 01:21:00	24_22.6921	140_27.0130	2705	24_22.7200	140_26.9187	2763.5	6.0	124.0	H	B	KYD
57	2007/03/08 14:19:00	24_22.3572	140_23.9027	3224.0	2007/03/18 02:37:00	24_22.5166	140_23.8388	3339	24_22.5447	140_23.7807	3343.3	358.0	−220.0	H	B	KYD
58	2007/03/08 15:35:00	24_21.9850	140_20.9438	3629.0	2007/03/18 03:56:00	24_21.9841	140_21.0515	3596	24_21.9785	140_21.0144	3618.0	−10.0	64.0	H	B	KYD
59	2007/03/08 16:57:00	24_21.6135	140_18.0118	3911.0	2007/03/18 05:20:00	24_21.5632	140_18.0327	3907	24_21.5771	140_18.0637	3906.2	−72.0	36.0	H	H	KYD
60	2007/03/08 18:23:00	24_21.2475	140_15.0755	4038.0	2007/03/18 06:42:00	24_21.2069	140_15.0565	4036	24_21.2149	140_15.1158	4040.9	−60.0	12.0	H	B	KYD
61	2007/03/08 19:51:00	24_20.8682	140_12.1515	4043.0	2007/03/18 08:09:00	24_20.8641	140_12.1207	4043	24_20.8333	140_12.1669	4045.0	−62.0	−14.0	H	B	KYD
62	2007/03/08 21:18:00	24_20.5117	140_09.2132	4134.0	2007/03/18 09:37:00	24_20.5608	140_09.1887	4138	24_20.4886	140_09.2018	4142.7	−34.0	−68.0	H	B	KYD
63	2007/03/08 22:47:00	24_20.1382	140_06.2929	4096.0	2007/03/18 11:06:00	24_19.9873	140_06.1896	4181	24_19.9296	140_06.2157	4076.8	−380.0	−158.0	H	B	KYD
64	2007/03/09 00:12:00	24_19.7716	140_03.3556	4088.0	2007/03/18 20:14:00	24_19.8007	140_03.3474	−	24_19.7705	140_03.3882	4083.5	14.0	20.0	H	B	KYD
65	2007/03/09 01:39:00	24_19.3684	140_00.3604	3759.0	2007/03/18 21:36:00	24_19.3925	140_00.3614	3744	24_19.3505	140_00.3897	3756.4	−72.0	−92.0	H	H	KYD
66	2007/03/09 02:58:00	24_19.0173	139_57.5114	3557.0	2007/03/18 22:50:00	24_19.0573	139_57.5707	3572	24_19.0194	139_57.5936	3563.9	8.0	138.0	H	B	KYD
67	2007/03/09 04:18:00	24_18.6343	139_54.5658	3698.0	2007/03/19 00:23:00	24_18.6415	139_54.6691	3701	24_18.6235	139_54.6560	3690.8	−30.0	128.0	H	B	SYG
68	2007/03/09 05:38:00	24_18.2599	139_51.6140	3922.0	2007/03/19 01:48:00	24_18.2287	139_51.6945	3916	24_18.2689	139_51.6677	3921.2	10.0	32.0	H	B	SYG
69	2007/03/09 07:00:00	24_17.8812	139_48.6829	4145.0	2007/03/19 03:14:00	24_17.8715	139_48.6972	4156	24_17.9210	139_48.7082	4150.5	64.0	−16.0	H	B	SYG
70	2007/03/09 08:27:00	24_17.5198	139_45.7495	4307.0	2007/03/19 04:49:00	24_17.4814	139_45.6288	4325	24_17.5180	139_45.7584	4307.8	18.0	−48.0	H	B	SYG
71	2007/03/09 09:57:00	24_17.1357	139_42.8259	4301.0	2007/03/19 06:14:00	24_17.1338	139_42.6907	4303	24_17.1443	139_42.8478	4300.6	28.0	−14.0	H	B	SYG
72	2007/03/09 11:27:00	24_16.7458	139_39.8986	4367.0	2007/03/19 07:47:00	24_16.7652	139_39.8400	4376	24_16.7654	139_39.9294	4370.1	30.0	6.0	H	B	SYG
73	2007/03/09 13:05:00	24_16.3823	139_36.9655	4434.0	2007/03/19 09:26:00	24_16.4859	139_36.9723	4443	24_16.3865	139_36.9958	4431.9	34.0	0.0	H	B	SYG
74	2007/03/09 14:37:00	24_15.9897	139_34.0541	4417.0	2007/03/19 11:02:00	24_16.1085	139_34.1294	4414	24_16.0155	139_34.0708	4413.8	54.0	8.0	H	B	SYG
75	2007/03/09 16:07:00	24_15.6108	139_31.1338	4546.0	2007/03/19 12:42:00	24_15.7273	139_31.3098	4541	24_15.6489	139_31.1911	4544.1	84.0	92.0	H	B	SYG
76	2007/03/09 17:38:00	24_15.2285	139_28.1840	4507.0	2007/03/19 15:03:00	24_15.3482	139_28.3234	4523	24_15.3129	139_28.2123	4539.6	172.0	8.0	H	B	SYG
77	2007/03/09 19:07:00	24_14.8480	139_25.2670	4786.0	2007/03/19 16:48:00	24_14.8413	139_25.3400	4782	24_14.8090	139_25.2799	4784.2	−48.0	2.0	H	H	SYG
78	2007/03/09 20:40:00	24_14.4462	139_22.3275	4806.0	2007/03/19 18:41:00	24_14.4313	139_22.2412	4811	24_14.4093	139_22.3313	4798.5	−74.0	−32.0	H	B	SYG
79	2007/03/09 22:13:00	24_14.0789	139_19.4093	4803.0	2007/03/19 20:37:00	24_14.1207	139_19.2054	4806	24_14.0509	139_19.4550	4803.2	−22.0	56.0	H	B	SYG
80	2007/03/09 23:46:00	24_13.7052	139_16.4587	4753.0	2007/03/19 22:26:00	24_13.8324	139_16.2651	4704	24_13.6309	139_16.4360	4753.5	−82.0	−98.0	H	B	SYG
81	2007/03/10 01:17:00	24_13.2813	139_13.5229	4734.0	2007/03/20 00:12:00	24_13.3371	139_13.5358	4732	24_13.2219	139_13.5309	4725.0	−120.0	−60.0	H	B	SYG
82	2007/03/10 02:48:00	24_12.9054	139_10.5921	4732.0	2007/03/20 02:00:00	24_13.0024	139_10.7039	4729	24_12.8607	139_10.6331	4724.5	−68.0	−10.0	H	B	SYG
83	2007/03/10 04:22:00	24_12.4915	139_07.6807	4574.0	2007/03/20 03:31:00	24_12.5102	139_07.8182	4604	24_12.4530	139_07.7237	4601.6	−100.0	20.0	H	B	SYG
84	2007/03/10 05:56:00	24_12.1092	139_04.7570	4059.0	2007/03/20 05:00:00	24_12.0463	139_04.8513	4064	24_12.0651	139_04.8016	4057.8	−94.0	28.0	H	B	SYG
85	2007/03/10 07:23:00	24_11.7273	139_01.8499	5100.0	2007/03/20 06:46:00	24_11.6187	139_01.9054	5091	24_11.7282	139_01.8918	5102.3	8.0	56.0	H	B	SYG
86	2007/03/10 09:00:00	24_11.3104	138_58.9269	5333.0	2007/03/20 08:34:00	24_11.3119	138_58.7524	5326	24_11.3330	138_58.9089	5322.6	4.0	−40.0	H	B	SYG
87	2007/03/10 10:47:00	24_10.9289	138_56.0043	5273.0	2007/03/20 10:25:00	24_10.9526	138_55.8111	5265	24_10.9475	138_56.0244	5271.4	20.0	30.0	H	B	SYG
88	2007/03/10 12:58:00	24_10.5414	138_53.0934	5223.0	2007/03/20 20:34:00	24_10.4794	138_52.8146	5262	24_10.4822	138_53.0091	5230.9	−110.0	−122.0	H	B	SYG
89	2007/03/10 14:35:00	24_10.1403	138_50.1482	5352.0	2007/03/20 22:20:00	24_10.0802	138_50.0318	5405	24_10.0950	138_50.1949	5329.8	−94.0	66.0	H	B	SYG
90	2007/03/10 16:50:00	24_09.9358	138_46.9537	4651.0	2007/03/21 00:02:00	24_09.8683	138_46.7470	4645	24_09.8635	138_46.9028	4604.2	−132.0	−58.0	H	B	SYG
91	2007/03/10 18:21:00	24_09.3496	138_44.2720	5256.0	2007/03/21 02:01:00	24_09.2810	138_44.2893	5159	24_09.2842	138_44.3004	5172.9	−124.0	−10.0	H	B	SYG
92	2007/03/10 20:07:00	24_09.0246	138_41.3398	5245.0	2007/03/21 03:47:00	24_08.9207	138_41.3662	5245	24_08.9549	138_41.3725	5239.4	4.0	−16.0	H	B	SYG
93	2007/03/10 21:48:00	24_08.5464	138_38.4160	4729.0	2007/03/21 05:25:00	24_08.4870	138_38.3408	4723	24_08.4805	138_38.4402	4731.8	−134.0	−30.0	H	B	SYG
94	2007/03/10 23:22:00	24_08.1443	138_35.4990	4860.0	2007/03/21 07:11:00	24_08.0547	138_35.4008	4877	24_08.1060	138_35.4740	4861.2	−86.0	−102.0	H	B	SYG
95	2007/03/11 00:55:00	24_07.7431	138_32.5795	4856.0	2007/03/21 08:47:00	24_07.6169	138_32.4415	4858	24_07.7176	138_32.5599	4856.1	−62.0	86.0	H	B	SYG
96	2007/03/11 02:29:00	24_07.3473	138_29.6459	5131.0	2007/03/21 21:30:00	24_07.3204	138_29.5449	5131	24_07.3412	138_29.6380	5131.2	−14.0	84.0	H	B	SYG
97	2007/03/11 04:11:00	24_06.9412	138_26.7296	4842.0	2007/03/21 23:15:00	24_06.9458	138_26.7003	4835	24_06.9737	138_26.8569	4839.4	52.0	156.0	H	B	SYG
98	2007/03/11 05:47:00	24_06.5346	138_23.8290	5143.0	2007/03/22 01:07:00	24_06.5178	138_23.8060	5183	24_06.5229	138_23.8447	5180.2	−34.0	4.0	H	B	SYG
99	2007/03/11 07:32:00	24_06.1279	138_20.8969	5110.0	2007/03/22 03:06:00	24_06.1162	138_20.8984	5161	24_06.1589	138_20.8682	5136.3	42.0	−68.0	H	B	SYG
100	2007/03/11 09:12:00	24_05.7218	138_17.9521	4722.0	2007/03/22 05:05:00	24_05.6631	138_17.8857	4778	24_05.7323	138_17.9179	4741.3	4.0	−136.0	H	B	SYG

system send the recording start signal (data-acquisition-start-signal) to the streamer cable. The GCS90 sends the signal (Internal-time-break-signal) back to the RTNμ and the recording system, and simultaneously send the trigger signal to each airgun. The wave forms recorded by the monitor hydrophone are sent to the GCS90 and the airgun position is sent to the RTNμ. The seismic data is transmitted by active modules of streamer cable to the recording system. After that, the positions of airguns and streamer cable are sent to recording system. Finally, the seismic and navigation data are recorded to 3590E tape, which were used in data processing stage (Figure 6).

3. Data

3.1. OBS

The recording condition was good enough to identify the airgun signals to 250-km offset distances in some data. Figure 7 shows vertical component data of OBS009, 044 and 096. All traces were processed by 3-12 Hz band pass filter, deconvolution, and auto gain control of 1 sec.

OBS009 was located in the forearc region. Apparent velocities of first arrivals in eastern side of the OBS in 7-21 km and 25-47 km are 4.6 km/s and 5.7 km/s, respectively. Those in western side of the OBS in 6-18 km, 18-21 km, 21-35 km and 35-45 km are 6.0 km/s, 4.5 km/s,

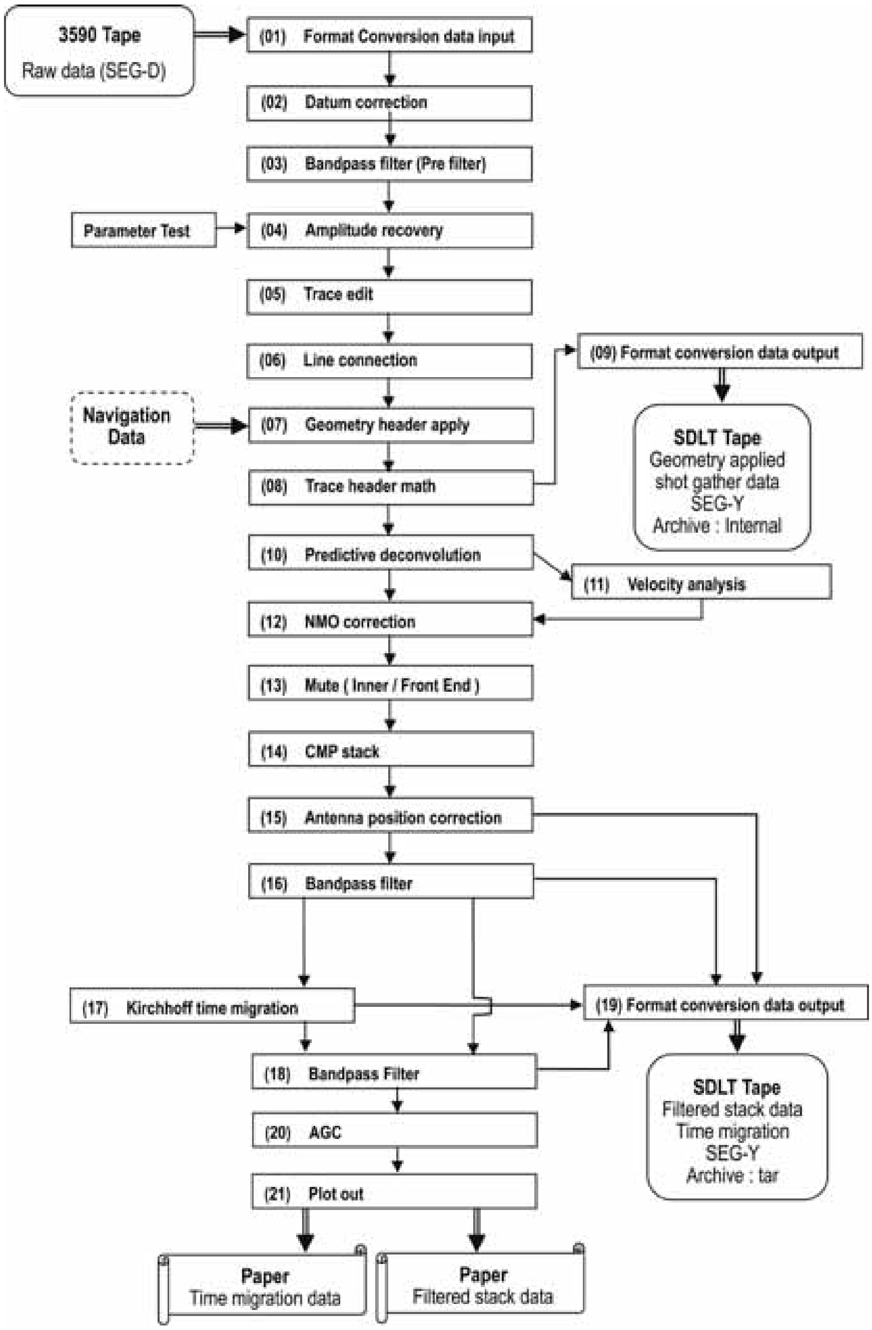

Figure 6: Flow chart of on-board processing of MCS data

6.7 km/s and 7.2 km/s, respectively. The apparent velocity over 45 km west is continuously changed by seafloor topography until 200 km offset.

OBS044 was on the Izu-Ogasawara Arc region. Apparent velocities of first arrivals in eastern side of the OBS in 4-8 km, 8-19 km, 19-34 km, 34-60 km, 60-75 km and 75-81 km are respectively 3.3 km/s, 6.4 km/s, 8.8 km/s, 5.0 km/s, 5.6 km/s and 7.3 km/s. Those in western side of the OBS in 3-7 km, 7-35 km, 35-42 km, 55-70 km are 2.8 km/s, about 6 km/s, 7.2 km/s and 5.0 km/s, respectively. The apparent velocity between 80 and 280 km west of the OBS was continuously changed about 8 km/s for seafloor topography. In both sides of the OBS, there are clear later phases thought to be reflection signals from deep interfaces in 80-km offset distances.

OBS096 was positioned near the axis of the Parece Vela Basin. Apparent velocities of first arrivals in eastern side of the OBS in 4-11 km and 11-22 km are 4.6 km/s and 7.8 km/s, respectively. The apparent velocity between 22 and 240 km are continuously changed about 8 km/s. Those in western side of the OBS in 4-8 km and 8-12 km are 5.7 km/s and 4.1 km/s, respectively. The apparent velocity over 12 km west is continuously changed by seafloor topography.

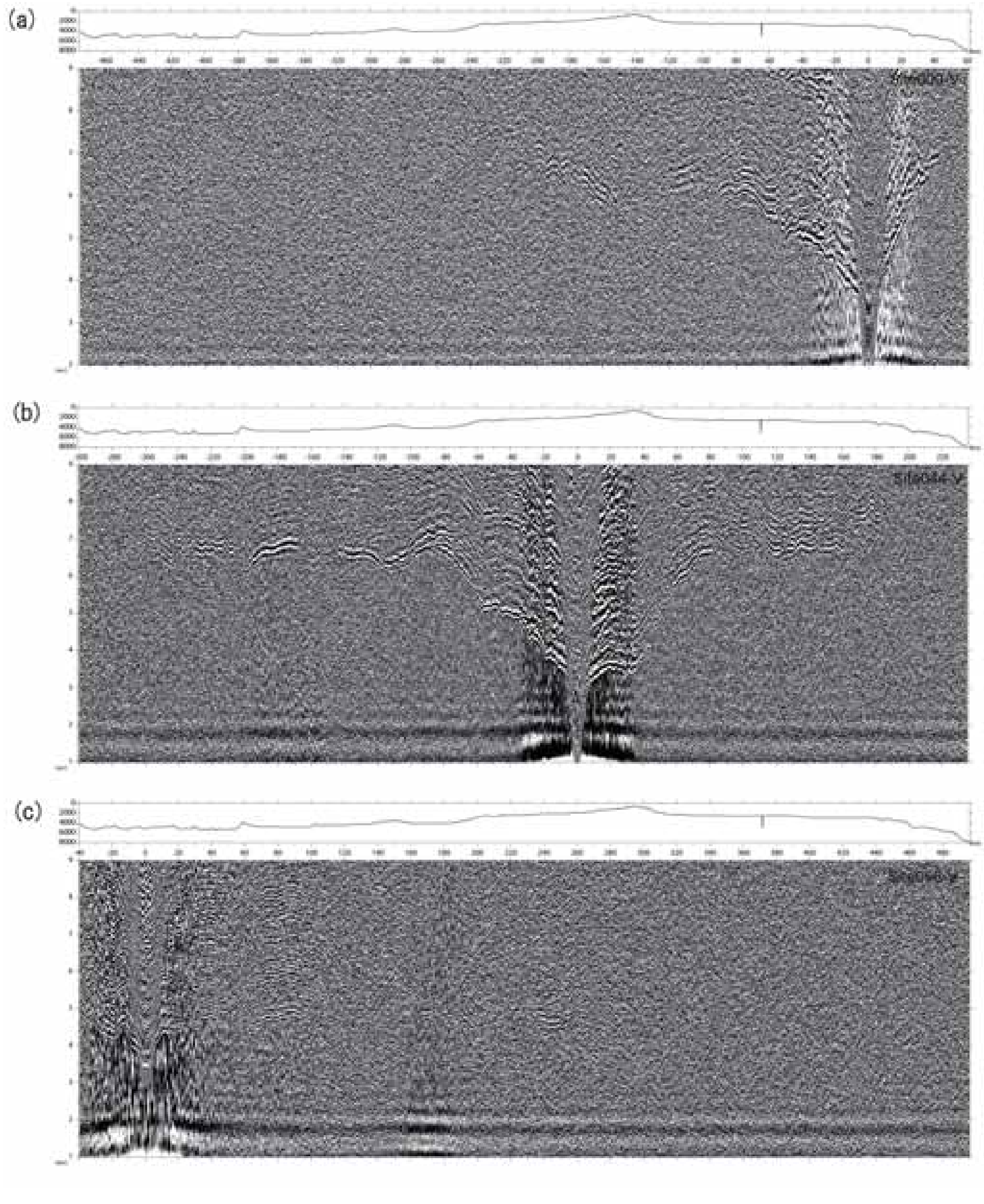

Figure 7: OBS data of vertical component of three sites: (a) Site009, (b) Site044, and (c) Site096. All traces are filtered by 5-15 Hz. Vertical and horizontal axes are offsets from OBS and reduced traveltimes by 8 km/s, respectively. The bathymetries of the OBS data are also shown above the sections.

From the general information of these OBS records, the crustal thickness are suggested as thick in arc and forearc region, and thin in backarc region.

For an example of horizontal component, Figure 8 shows the two horizontal component data of OBS096. All traces were processed by 3-12 Hz band pass filter, deconvolution, and auto gain control of 1 sec. In the eastern side of the OBS between 20 and 100 km offset and 6 sec, there are clear signals with 4.6 km/s apparent velocity, which are thought to be converted signals from P to S at deep interfaces.

3.2. MCS

For checking the data quality and brief interpretation, MCS data was processed as shown in Figure 6, which contains datum correction, 5-103 Hz band-pass filtering, amplitude recovery, trace editing, line connection to make 50-m interval data from two 100-m interval shooting data, predictive deconvolution with a 24-msec-length operator, velocity analysis, muting, common depth point (CDP) stack, and Kirchhoff time migration. The tentative time-migrated section of the Line OGr4 is shown in Figure 9 for an example. The recoding condition was good and there is no significant noise of bad weather.

Thick sediments with two-way travel time (TWT) of 1 sec are clearly imaged in the Ogasawara Trough (CDP 35000-36000), underlaid by acoustic basement at the Ogasawara Ridge (CDP 35900-36200). The sediments are relatively thin from the Ogasawara Ridge to the Hahajima Seamount (CDP36200-44500). In the eastern side of trench axis (CDP44500-46000), thick sedimentary layers as 2 sec in TWT exist on the Ogasawara Plateau. There are many normal faults in the eastern side of the thick sediments (CDP46500-49000). Surface sediments on a bathymetric high (CDP51000-52000) are thinner than 0.5 sec in TWT. The acoustic basement is descending from the bathymetric high to the foot of the bathymetric high. Moreover, there are several deep events below the acoustic basement, and further processing may improve the deep image.

4. Summary

We have conducted a seismic cruise in the southern Izu-Ogasawara region of wide-angle reflection and refraction experiment using OBSs and near vertical MCS survey during March 4-30, 2007. The acquisition was suc-

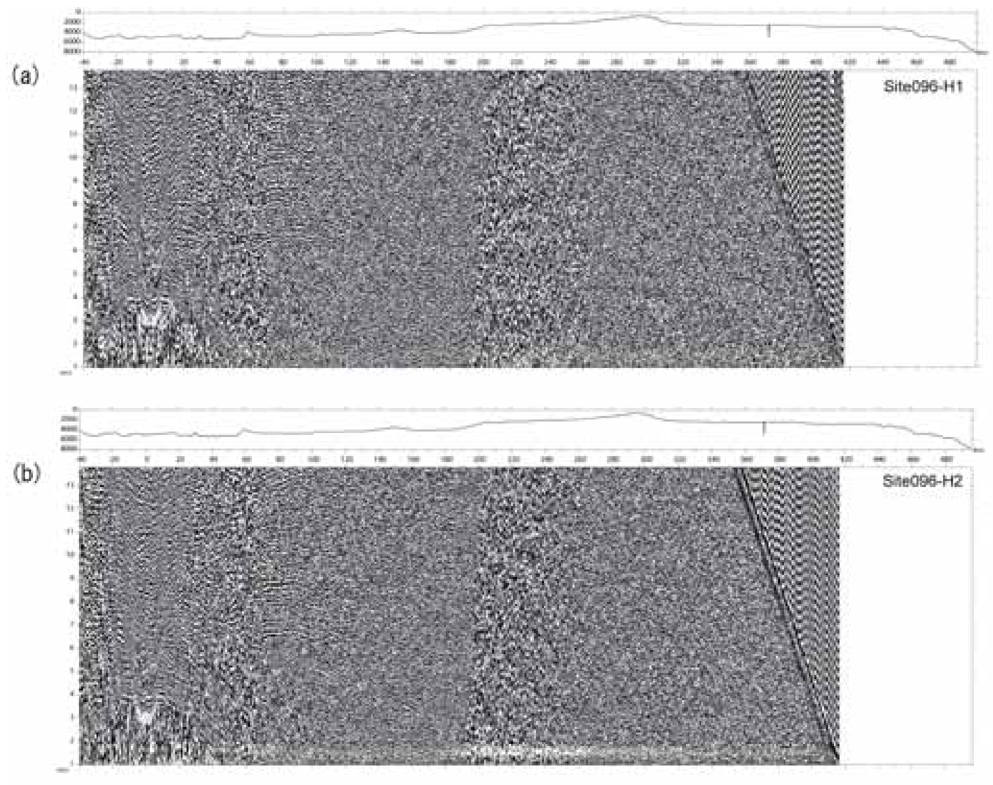

Figure 8: OBS data of horizontal component of Site096: (a) H1, and (b) H2. All traces are filtered by 5-15 Hz. Vertical and horizontal axes are offsets from OBS and reduced traveltimes by 4.6 km/s, respectively. The bathymetries of the OBS data are also shown above the sections.

cessfully finished and data quality is very good. For example, a part of the OBS data of vertical component has clear first arrivals until an offset of 250 km. Some clear signals in horizontal component data are thought to be P-S converted signals at the deep interfaces. From the information of apparent velocities, the crustal thicknesses of the southern Izu-Ogasawara Arc and the forearc region are thick, although the crustal thickness in the Parece Vera Basin is thin. The MCS data is also good quality with no significant noise disturbance. The distributions of surface sediments and character of acoustic basement are clearly observed in whole of the seismic line. Deep events below the acoustic basement are expected to be improved by further processing. In the future, we will constrain the velocity model transecting the southern Izu-Ogasawara Arc, followed by the interpretation for arc evolution associated with the andesitic crust, formation of back-arc basins using the OBS data. The tectonics associated with the collision of the Ogasawara Plateau against to the Izu-Ogasawara Arc is also an important target of the MCS data.

Acknowledgement

We would like to appreciate the following members of KR07-03 cruise shipboard party for their skilled work. We thank Dr. Y. Kaiho, Dr. T. Sato, Dr. M. Yamashita, Mr. T.

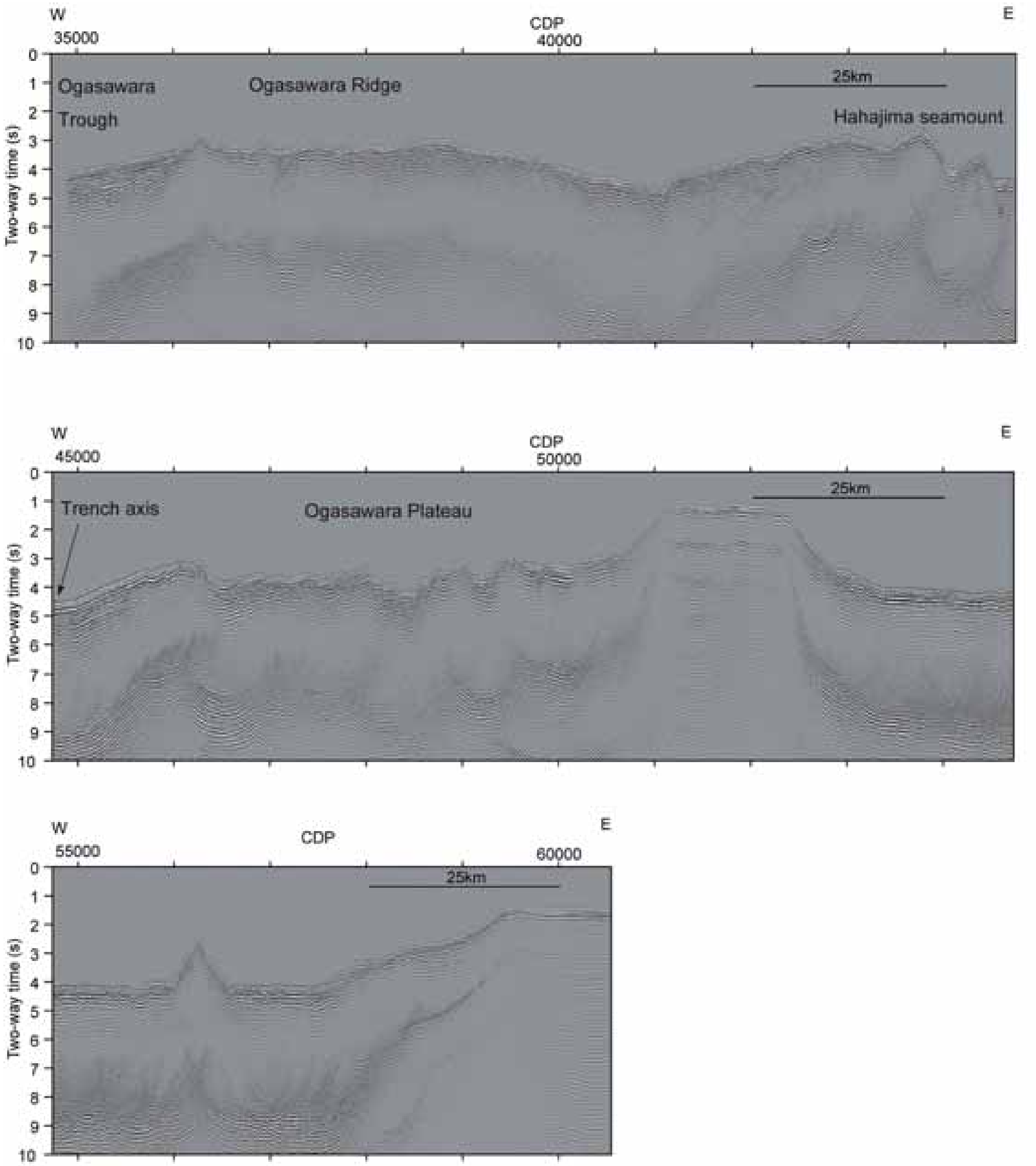

Figure 9: MCS profile of the MCS survey (Line OGr4). Vertical and horizontal axes are two-way travel time (s) and CDP, respectively (2000CDP=25km).

No and Ms. K. Takizawa for discussions of cruise planning and supports.

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Chief Officer	Shinichi Kusaka
Second Officer	Naoto Kimura
Third Officer	Jun Takao
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(Received July 11, 2007)