Wide-angle seismic profiling of oceanic island arc in the southern Izu-Ogasawara arc – KY0502 cruise –

Yuka Kaiho¹, Narumi Takahashi¹, Takeshi Sato¹, Go Fujie¹, Shuichi Kodaira¹ and Yoshiyuki Kaneda¹

Abstract We carried out a deep wide-angle seismic experiment using a large airgun array and 110 ocean-bottom seismographs (OBSs) in the southern Izu-Ogasawara arc area. The experiment was conducted on the R/V Kaiyo of the Japan Agency for Marine-Earth Science and Technology (JAMSTEC) from 12 February to 11 March 2005 (KY05-02 cruise). Objectives of this cruise were to determine the velocity structure of the entire arc-backarc system and the difference of crustal structures formed in the Oligocene, Eocene and the present to elucidate crustal growth. An airgun-OBS seismic line was set from the Izu-Ogasawara Trench near Chichijima to the Shikoku Basin across the southern Izu-Ogasawara arc in the arc-backarc system. The OBSs and a 12-channel hydrophone streamer recorded seismic signals, which were shot using a large airgun array with total capacity of 12,000 cubic inches. In this paper, we summarize information of the seismic experiments and introduce OBS data and reflection data.

Keywords: crustal structure, seismic, wide-angle data, OBS, Izu-Ogasawara

1. Introduction

The southern Izu-Ogasawara arc-backarc system is a good example to study processes of crustal growth in oceanic island arc-backarc systems because the three parallel topographic highs, which are separated by two troughs, were formed in different ages. These highs are the Ogasawara Ridge, the present volcanic arc, and the Nishi-Shichito Ridge (Honza and Tamaki, 1985), which are located between the Izu-Ogasawara Trench and the Shikoku Basin. The two troughs are the Ogasawara Trough and the Nishinoshima Trough; the former is located between the Ogasawara Ridge and the present volcanic arc; the latter is located between the present volcanic arc and the Nishi-Shichito Ridge. The Ogasawara Ridge, which is located in the eastern side, was formed in the Eocene(e.g. Bloomer et al., 1995). The Nishi-Shichito Ridge, which is located westward from the present volcanic arc, was formed in the Oligocene (e.g. Bloomer et al., 1995) as an old rift zone of the northern end of the Parece Vela basin and the Sofugan tectonic line, which is located at the western wall of the Nishinoshima Trough (Yuasa, 1985).

Based on detailed mapping of magnetic anomalies and topography, the Shikoku Basin was formed from 30 to 15 Ma (Okino *et al.*, 1994). As described above, in the southern Izu-Ogasawara arc-backarc system, velocity structures might vary depending on the tectonic stage at each location. However, a few velocity structures have been determined in the southern Izu-Ogasawara arc-backarc system. We need to know the differences of crustal structures in response to these tectonic stages to understand crustal growth history.

Objectives of this research are to determine the crustal structure of the southern Izu-Ogasawara arcbackarc system and to investigate the variation of velocity structures associated with tectonic age.

2. Experiment

We carried out a wide-angle seismic survey using an airgun array and ocean bottom seismographs (OBSs) to achieve the above objectives (Fig. 1). This cruise of the R/V "Kaiyo" of Japan Agency for Marine-Earth Science and Technology (JAMSTEC) comprised two legs. The first leg was from 12 February to 25 February; the second leg was from 25 February to 11 March. The R/V Kaiyo departed from JAMSTEC on 12 February and started OBS deployment from the eastern end of the survey line on 14 February. Airgun shooting was carried out during 16-18 February at the eastern half of the line. After airgun shooting, we recovered 32 OBSs during 19-21 February. We deployed 28 OBSs again on the western part of the survey line until 22 February. The next airgun shooting was carried out until 24 February. We stopped at Port Futami of the Chichijima to change researchers on 25 February. We retrieved OBSs on the western part of the line from 26 February

¹ Japan Agency for Earth-Marine Science and Technology

to 4 March. After OBS retrieval, we conducted a sea trial of a new transponder system. We left the survey area on 10 March and arrived at Shingu port on 11



Figure 1: Map of the experimental area. Solid circles represent OBSs. We shot an airgun array on the thick black line.

March. These activities are listed in Table 1.

To clarify the arc structure of different tectonic stage and characteristics of oceanic arc-backarc growth, we need to traverse the Eocene old arc, active volcanic arc and old arc for investigating differences of seismic structures among forearc, arc, rifted zone and backarc basins by long seismic line extension. Considering the above issues, we set the main line with length of about 600 km from near the Izu-Ogasawara Trench to the old spreading center of the Shikoku Basin. The line runs near the northern side of the Chichijima on the Ogasawara Ridge, off Nishinoshima located on the volcanic front, the Nishinoshima Trough, the Sofugan tectonic line, the Tenpo seamount, and the Shikoku Basin. The eastern and western ends of the main line (Fig. 1) were located respectively at (27°27.1598'N, 143°19.6739'E) and (26°57.1936'N, 137°16.8553'E).

For deep profiling of the entire crust, the relative powerful source and many OBSs are required to obtain the crustal image with high resolution. We used 110 OBSs and an airgun array with 12,000 cubic inch capacity. Along the line, we towed a 12-channel hydrophone

Table 1: Activity log during KY0502 cruise.

Date	Remarks
February 12	Departure from Yamashita pier of Yokohama port
February 13	Transit
February 14	OBS deployment (OBS#1-OBS#20) and emergency retrieval of OBS27
February 15	OBS deployment (OBS#27, OBS#31-OBS#72)
February 16	OBS deployment (OBS#73-OBS#81) and SPr2-1 airgun shooting
February 17	SPr2-1 airgun shooting
February 18	SPr2-1 airgun shooting
February 19	OBS retrieval (OBS#1-OBS#13)
February 20	OBS retrieval (OBS#14-OBS#27)
February 21	OBS retrieval (OBS#28-OBS#32) and OBSdeployment (OBS#82-OBS#86)
February 22	OBSdeployment (OBS#87-OBS#110) and SPr2-2 airgun shooting
February 23	SPr2-2 airgun shooting
February 24	SPr2-2 airgun shooting and transit to Futami port of Chichijima
February 25	Stopped at Futami port of Chichijima
February 26	OBS retrieval (OBS#33-OBS#43)
February 27	OBS retrieval (OBS#44-OBS#57)
February 28	OBS retrieval (OBS#58-OBS#70)
March 01	OBS retrieval (OBS#71-OBS#82)
March 02	OBS retrieval (OBS#83-OBS#93)
March 03	OBS retrieval (OBS#94-OBS#103)
March 04	OBS retrieval (OBS#104-OBS#110)
March 05	Sea trial of new transponder system
March 06	Sea trial of new transponder system
March 07	Escape for bad weather
March 08	Sea trial of new transponder system and MCS with 50 m interval gun shooting
March 09	MCS with 50 m interval gun shooting
March 10	Transit
March 11	Transit and arrival at Shingu port

streamer to determine the nature of the shallow structure attributable to severe variation of topography. The OBSs and a 12-channel hydrophone streamer recorded airgun signals.

2.1 Airgun shooting

The airgun array, with total capacity of 12,000 cubic inches, consists of eight Bolt long life airguns with 1,500 cubic inches capacity each. The air pressure sent to the chambers was 2,000 psi. The seismic experiment apparatus is shown in Fig. 2. Two floats with two airguns each were deployed respectively from port and starboard sides. The airgun array's size is 14 m length \times 20 m width. The airgun's shooting position was located 135.87 m behind the ship position (respective distances from ship antenna to tail of the ship, and from tail of ship to center of the airgun array, are 29.5 m and 106.37 m). The StarFire system for seismic navigation system was used as the differential global positioning system (DGPS) of the ship navigation system. The accuracy of the shooting position was about 5 m.

2.2 Ocean Bottom Seismographs

We deployed 110 OBSs on the survey line with 5 km

spacing (Fig. 1, Table 3). We recovered 109 OBSs, but one OBS was not recovered and two OBSs had no data because of recording system troubles.

All OBSs were equipped with three-component geophones (vertical and two horizontal components perpendicular to each other) using gimbal-leveling mechanisms and a hydrophone sensor. The natural frequency of these geophones was 4.5 Hz. Table 4 shows sensitivities of geophone and hydrophone sensors. Our OBSs have a digital recorder system that used a 16-bit and 20bit A/D converter and stored data on digital audiotape or a hard disk sampling continuously with the original format (Shinohara et al., 1993). The electronic power supply for the recorder system of OBS is lithium-ion batteries. The geophone sensors with a gimbal-leveling mechanism, batteries and the recorder system were installed in a 17-inch glass sphere made by Teledyne Benthos, Inc. The glass sphere was stored in a yellow hard hat. Each OBS is attached to a flashlight and a beacon with coded signals to facilitate OBS retrieval at the sea surface.

The OBSs were deployed by free fall and retrieved using an electric corrosion releaser composed of stainless steel plates connecting the OBS with a weight when



Figure 2: Geometry of the airgun system and the hydrophone streamer.

SPr2-obs-1	Time (UTC)	Latitude (N)	Longitude (E)	Depth (m)	SP
First shot	2005.2.16 10:41	27° 6.8745'	138° 55.9202'	4447	2198
First good shot	2005.2.16 10:41	27° 6.8745'	138° 55.9202'	4447	2198
Last good shot	2005.2.18 20:48	27° 27.1598'	143° 19.6739'	8975	4382
Last shot	2005.2.18 20:48	27° 27.1598'	143° 19.6739'	8975	4382
SPr2-obs-2	Time (UTC)	Latitude (N)	Longitude (E)	Depth (m)	SP
First shot	2005.2.22 17:32	26° 57.1936'	137° 16.8553'	4504	1374
First good shot	2005.2.22 17:32	26° 57.1936'	137° 16.8553'	4504	1374
Last good shot	2005.2.24 15:02	27° 16.3364'	140° 45.2561'	1448	3105
Last shot	2005.2.24 15:02	27° 16.3364'	140° 45.2561'	1448	3105

Table 2: Airgun shooting log.

Table 3: OBS information. Each recorder using DAT or hard disk is shown by each abbreviation of DAT or "HD". The "BTS" and"HIGH" respectively indicate makers of the hydrophone sensors: Teledyne Benthos Inc. and High Tech Inc.

Image Continue Continue Continue Continue Continue Top Top 1 212230 7234780 1423480 500 212341 1423480 500 212341 1423480 500 213241 1423480 500 213241 1423480 400 123481 141 41		Deployment			Retrieval		Calibration							
Sime Uff2 Lat(N) Lat(N) <thlat(n)< th=""></thlat(n)<>		Time		Coordinate		Time		Coordinate			Coordinate		HD	Hydrophone
1 1 1 1 1 2 2 5 2 2 1	Site	UTC	Lat (N)	Lon (E)	Dep (m)	UTC	Lat (N)	Lon (E)	Dep (m)	Lat (N)	Lon (E)	Dep (m)	Туре	Туре
1 1	1	2.13 22:56	27_25.8726	142_58.4260	5680	2.18 17:48	27_25.5724	142_58.4586	5653	27_25.6401	142_58.3629	5666.9	HD	BTS
1 1 0 12 22 23 23 14 23 14 14 0 12 14 14 14 14 14 14 14 14 14 14 15 15 14 15 12 15 12 15 12 15 14 15 12 15 14 15 14 15 15 15 15 15 15 15 15 15 15 15 15 15 16	2	2.13 23:31	27_25.6431	142_55.4030	4798	2.18 20:10	27_25.4918	142_55.4764	4818	27_25.4308	142_55.4450	4815.2	HD	BTS
4 21 100 12 123 12 14 12 14 12 14 12 14 13 14	3	2.14 0:07	27_25.4333	142_52.3808	4270	2.18 22:19	27_25.2923	142_52.3420	4205	27_25.2975	142_52.3440	4238.9	HD	BTS
5 1	4	2.14 0:44	27_25.2530	142_49.3373	3822	2.19 0:15	27_25.1330	142_49.2916	3850	27_25.1826	142_49.3128	3851.6	HD	BTS
6 1 151 22,34809 142,3529 316 17,34579 142,4229 32,34599 142,4219 32,3459 142,4219 32,3459 142,3129 32,3459 142,31192 32,3459 142,31192 32,3419 142,31192 142,31192 142,31192 142,31192 142,31192 142,31192 142,31192 142,31192 142,31194 142,31192 142,31194 142,31192 142,311947 141,41194 142,41194	5	2.14 1:18	27_25.0549	142_46.3122	3437	2.19 1:57	27_25.0059	142_46.2453	3435	27_24.9638	142_46.2794	3446.1	HD	BTS
1 1 2 22 21.9 51.7 72.4473 142.2057 22.005 IID DTS 2 14 53.7 72.44493 142.2152 201 12.4403 12.31181 210 B<	6	2.14 1:51	27_24.8609	142_43.2824	3371	2.19 3:45	27_24.8897	142_43.1899	3363	27_24.7765	142_43.2644	3369.3	HD	BTS
8 1.4 25.0 7.2.4.001 1.42 7.2.4.001 1.42 7.2.4.001 1.42 7.2.4.001 1.42 7.2.4.001 1.42 7.2.4.001 1.42 1.42 1.00 1.13 1.00 1.44 4.02 7.2.4.001 1.01 1077 110 1078 12 1.44 4.03 7.2.3.4081 142,2.3.114 102 1.2.3.114 102 1.116 1.2.3.114 107 110 1078 12 1.44 4.2.3.1454 142,2.3.0467 142,2.3.0478 142,2.3.0478 142,2.3.0478 142,2.3.0478 142,2.3.0478 142,2.3.0478 142,2.3.0478 142,2.3.0478 142,2.3.0478 142,2.3.0478 142,2.3.0478 142,2.3.0478 142,3.0.02	7	2.14 2:22	27_24.6733	142_40.2561	2922	2.19 5:17	27_24.6713	142_40.1793	2908	27_24.5969	142_40.2261	2920.5	HD	BTS
9 2.44 4.33 2.7.24/081 442.34190 2.00 2.19 807 7.2.4183 142.31184 210.00 100 PTS 11 2.14 44.2 7.2.36861 142.31188 210.00 110 PTS 12 2.14 54.2 7.2.36861 142.21188 21.2 110 PTS 12.3.1581 142.31184 1100 PTS 13 2.14 54.2 7.2.36861 142.2.21868 142.2.21864 142.2.1945 12.2.5181 142.2.1945 199.01 PTS 14 2.44 57.2.24869 142.2.1949 142.1.2945 12.2.2.181 142.0.2.945 199.01 PTS 17 2.44 63.7.2.2.4369 142.0.2.941 17.2.2.405 142.0.2.941 12.2.2.1.1441.412.1.9418 162.0.2.941 100 PTS 12 2.144.903 7.2.2.4051 142.0.2.941 12.2.2.1.914 142.0.2.941 100 PTS 12 2.144.903 7.2.2.4051 142.0.3.941 142.0.2.941 141.946 <td>8</td> <td>2.14 2:56</td> <td>27_24.4629</td> <td>142_37.2285</td> <td>2694</td> <td>2.19 6:42</td> <td>27_24.5259</td> <td>142_37.1384</td> <td>2701</td> <td>27_24.4012</td> <td>142_37.1927</td> <td>2689.6</td> <td>HD</td> <td>BTS</td>	8	2.14 2:56	27_24.4629	142_37.2285	2694	2.19 6:42	27_24.5259	142_37.1384	2701	27_24.4012	142_37.1927	2689.6	HD	BTS
10 14 403 27,24004 142,31188 120 92.0 27,23062 142,3114 127 140 BTS 12 144 51.2 7,23469 142,23148 162 72,3768 142,23149 1108 BTS 12 144 52 7,23484 142,2049 100 BTS 100,2007 100 122,33143 142,20497 180 BTS 12 144 52 7,23484 142,20491 122,19210 72,23904 142,1018 142,20497 142,20497 142,8019 140 DTS 122,19210 142,9019 142,1018 142,0014 142,1939 142,1018 142,0014 142,19349 142,1018 140,9014 142,19349 142,1018 140,9014 141,118 141,118 141,118 141,118 142,1018 140,9173 141,1110 111110 111110 111110 111110 111110 111110 111110 111110 111110 111110 111110 111110 111110 111110 <	9	2.14 3:32	27_24.2619	142_34.1904	2400	2.19 8:07	27_24.2953	142_34.1222	2419	27_24.1893	142_34.1384	2403.8	HD	BTS
11 21.4 44.4 27.23.869 142.28.140 167 2.37.869 142.28.110 168 27.23.769 142.28.110 168 27.23.769 142.28.110 168 27.23.769 142.28.110 168 27.23.769 142.28.108 142.28.108 142 27.23.769 142.28.108 142.28.108 142.28.108 142.28.108 142.28.108 142.28.108 142.28.108 142.28.108 142.28.108 142.28.108 142.28.108 142.19.101 352 22.22.028 142.19.103 59.11 159 144 142.19.28.11 142.19.28.11 142.19.28.11 140.28.108 142.19.28.11 149.38.12 142.05.28.11 142.08.12 142.08.12 144.79.12 144.90 142.05.12 144.90.12 142.08.12 144.90.12 144.91 148.11 142.05.12 144.91.14 141.141 141.141 141.141 141.141 141.141 141.141 141.141 141.141 141.141 141.141 141.141 141.141 141.141 141.141 141.141 141.141 141.141 141.141 14	10	2.14 4:05	27_24.0614	142_31.1588	2183	2.19 9:27	27_24.0477	142_31.2003	2200	27_23.9623	142_31.1814	2170	HD	BTS
12 21.4 51.2 72.35752 142_25097 1102 1172 72.35752 142_25047 1102 1100<	11	2.14 4:40	27_23.8671	142_28.1402	1657	2.19 10:42	27_23.8253	142_28.1109	1648	27_23.7669	142_28.1114	1672.1	HD	BTS
14 24.4 27.23458 142.24.075 806 210/23 27.23378 142.22007 800 27.23300 142.20047 828 110 PTS 15 21.4 656 7.23408 142.100115 224 220212 27.23420 142.12931 12 27.23420 142.12934 120212 27.22480 142.12934 120318 120212 27.22480 142.12934 120318 120329 77.22480 142.00135 120318 127.22187 142.00843 120 127.22187 140.00581 120 127.22187 142.00842 120.8187 127.22187 142.00845 142.197.198 140.018 110 110 110 110 110 110 110 110 110 110 110 111 127.21314 141.577.183 147.547.05 217.1 110 110 110 110 111 110 110 110 110 110 110 110 110 110 110 110 110 110 110	12	2.14 5:14	27_23.6598	142_25.0986	1108	2.19 11:48	27_23.6063	142_25.1180	1125	27_23.5725	142_25.0911	1119.2	HD	BTS
14 2.14 6.05 72.3.3484 142.9.001 500 72.3.3484 142.9.001 500 72.3.3484 142.9.001 500 72.3.448 142.9.008 140 155 72.2.2.455 142.0.010 72.3.448 142.9.9902 145.9902 21.9 140 BTS 16 2.14 72.2.2455 142.00916 162 72.2.2455 142.00916 172 72.2.205 142.00916 172 72.2.205 142.00847 176 72.2.205 142.00847 176 72.2.206 142.00389 97.1.175 142.0.3816 97.1175 142.0.3816 97.1175 142.0.3816 97.1.175 142.0.3816 97.1.175 142.0.3816 97.1.175 142.0.3816 97.1.175 142.0.3816 97.1.175 142.0.3816 97.1.175 142.0.3816 97.1.175 142.0.3816 97.1.175 142.0.378 110.0.778 110.0.788 142.0.787 110.0.788 172.1.175 142.0.3816 97.0.788 110.0.787 110.0.788 110.0.786 110.0.786 110.0.786 110.0.187 110.0.187 <td>13</td> <td>2.14 5:50</td> <td>27_23.4545</td> <td>142_22.0765</td> <td>806</td> <td>2.19 12:51</td> <td>27_23.3754</td> <td>142_22.0957</td> <td>813</td> <td>27_23.3501</td> <td>142_22.0647</td> <td>828</td> <td>HD</td> <td>BTS</td>	13	2.14 5:50	27_23.4545	142_22.0765	806	2.19 12:51	27_23.3754	142_22.0957	813	27_23.3501	142_22.0647	828	HD	BTS
1 1 2 2 2 2 2 2 2 2 2 2 2 1 D BTS 1 2 4 8 7 2 2 1 1 2 1 1 2 1	14	2.14 6:23	27_23.2508	142_19.0411	593	2.19 21:23	27_23.1378	142_19.0697	600	27_23.1484	142_19.0153	594.1	HD	BTS
10 2 21 222 21 222 21 222 21 222 21 222 21 222 21 222 21 222 21 222 21 222 21 222 21 222 21 21 22 21	15	2.14 6:56	27_23.0493	142_16.0119	234	2.19 22:10	27_22.9820	142_16.0137	235	27_22.9923	142_15.9802	239.1	HD	BTS
1 2.14 8.10 2.7.224.83 14.2.0.09128 1967 DAT HIGH 19 21.44 9.37 7.2.24.80 14.2.0.6804 17.6 HD BTS 19 21.44 9.37 7.2.2.008 14.2.0.87.04 9.997.7 110 BTS 12 14.19.37 7.2.1.970 14.2.0.87.06 9.997.7 110 BTS 12 14.10.37 7.2.1.970 14.2.0.7806 14.5.77.65 2.0.1.4.11 11.1.5 14.1.5.67 2.0.1.4.11 11.1.5 14.1.5.67 2.0.1.5.1 14.1.5.67 2.0.1.5.1 14.1.5.67 2.0.1.5.1 14.1.5.67 301.0 110 BTS 2.14.11.05 2.7.2.1.071 14.1.2.5.78 304 2.2.0.9.44 17.2.1.660 41.1.4.5.7.165 401.0 14.2.6224 405.6 HD BTS 2.14.11.05 2.7.2.0.9.71 14.1.2.5.098 400.2 7.2.0.0.804 14.1.2.6224 405.6 HD BTS 2.14.11.05 2.7.2.0.9.71 14.1.2.5.0.0 14.2.2.0.2	16	2.14 7:28	27_22.8469	142_12.9919	192	2.19 22:56	27_22.8114	142_12.8818	193	27_22.8103	142_12.9345	199.6	HD	BTS
18 214 93.7 22.20.018 27.22.008 17.6 27.22.018 14.20.8643 17.6 17.22.018 14.20.86478 17.6 27.22.1187 14.20.806803 17.4 110 BTS 20 21.4 97.7 7.21.9709 14.20.80480 220 21.21.1714 14.15.7716 220.4 17.21.21.864 14.15.7712 220 21.21.1715 14.15.7716 320.5 21.41.115 14.15.7716 320.5 21.41.115 14.15.7716 320.5 21.9714 14.15.5716 320.6 11.15.781 320.5 22.0 22.0 21.04.12.6 37.21.0002 14.14.56322 402.6 11.0 BTS 21.41.125 27.20.871 14.12.672.4 47.00.2037 14.13.8674 407.0 27.20.0871 14.12.6522 402.8 11.0 37.20.0871 14.12.6522 402.8 11.0 37.21.0062 14.12.6524 402.8 10.0 27.20.0871 14.12.6522 402.8 10.0 77.20.0871 14.12.6522 402.8 10.0 17.20.0060 14.13.8789		2.14 8:01	27_22.6435	142_09.9506	186	2.19 23:39	27_22.6259	142_09.8993	187	27_22.6218	142_09.9128	196.7	DAT	HIGH
9 2 2.14 9.7 2.19 9.7 2.20 57 2.20 57 2.20 57 2.20 57 2.20 57 2.20 57 2.20 57 2.20 57 2.20 57 2.20 57 2.20 58 2.20 57 2.20 58 2.20 57 2.21 57 1.10 BTS 2 2.14 1.03 2.21 1.41 1.47 1.47 3.73 1.10 BTS 2 2.14 1.24 1.44 1.44 3.70 7.20 1.41 4.6530 3.70.8 1.10 BTS 2 2.14 1.26 7.20.4971 1.41 2.20 1.41 3.630 4.063 1.10 BTS 2 2.14 1.40 3.90 1.41 3.6302 4.062.4 1.10 1.13 6.064 4.00 7.20.239 1.14 4.14 4.050 7.20.239 1.14 4.064.83 1.00	18	2.14 8:31	27_22.4367	142_06.9145	177	2.20 0:16	27_22.4052	142_06.8478	176	27_22.4108	142_06.8643	174.6	HD	BTS
	19	2.14 9:03	27_22.2003	142_03.8912	982	2.20 1:17	27_22.1655	142_03.8280	1012	27_22.1575	142_03.8196	999.7	HD	BTS
12 12 <td< td=""><td>20</td><td>2.14 9:57</td><td>27_21.9970</td><td>142_00.8698</td><td>2258</td><td>2.20 2:37</td><td>27_22.0663</td><td>142_00.6451</td><td>2280</td><td>27_21.9769</td><td>142_00.7503</td><td>2264.4</td><td>HD</td><td>HIGH</td></td<>	20	2.14 9:57	27_21.9970	142_00.8698	2258	2.20 2:37	27_22.0663	142_00.6451	2280	27_21.9769	142_00.7503	2264.4	HD	HIGH
12 14 10.08 12/2 14	21	2.14 10:11	27_21.7800	141_57.8436	2172	2.20 4:11	27_21.8478	141_57.7242	2791	27_21.7314	141_57.7165	2817.1	HD	BTS
13 24 111 22 24 113 24 113 141 3208 141 3308 141 3308 141 3308 141 3308 141 3308 141 3308 141 3308 141 3308 141 3308 141 3308 141 3308 141 3308 141 3308 141 3308 141 3308 141 3308 141 3308 141 3308 141 3308 141	22	2.14 10:38	27_21.5491	141_54.7885	3129	2.20 5:49	27_21.5813	141_54.8158	3123	27_21.5153	141_54.7807	3120.9	HD	HIGH
12 12 12 11 11 12 13 13 14 14 12 14 14 13 14<	23	2.14 11:07	27_21.3400	141_51./5/8	3245	2.20 7:26	27_21.4137	141_51.7317	3250	27_21.3328	141_51.6471	3266.8	HD	BTS
12 2 14 12.0 12	24	2.14 11:50	27_20.0078	141_48.7409	3749	2.20 9:04	27_21.2620	141_48.7861	3744	27_21.0692	141_48.6580	3730.8	HD	HIGH
$ \begin{array}{c} 10 \\ 12 \\ 12 \\ 14 \\ 14 \\ 12 \\ 12 \\ 14 \\ 14$	25	2.14 12:05	27_20.9078	141_45./140	4007	2.20 10:57	27_21.0462	141_45.7663	4010	27_20.8674	141_45.6322	4028.4	HD	BTS
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	20	2.14 12.33	27_20.08/1	141_42.0908	4055	2.20 12:55	27_20.8267	141_42.7888	4051	27_20.7167	141_42.6224	4054.6	HD	BTS
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	28	2.14 10.10	27_20.4741	141_39.0998	4008	2.20 14:54	27_20.5956	141_39.7649	4070	27_20.4987	141_39.6609	4065.8	HD	BTS
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	20	2.14 13.35	27_20.2333	141_30.0322	4071	2.20 10:51	27_20.5174	141_30.7221	4075	27_20.2593	141_36.6302	4062.2	HD	BTS
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	30	2.14 14.00	27_20.0233	141_33.0099	4008	2.20 18:50	27_10.7628	141_33.0893	4072	27_20.0200	141_33.6008	4048.3	HD	BTS
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	31	2.14 17.37	27 19 5863	141_30.5703	4057	2.20 20.48	27_19.7028	141_30.7222	4008	27_19.8208	141_30.6187	4074.5	DAI	BIS
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	32	2.14 17.57	27_19.3503	141_27.5525	4017	2.20 22.51	27_19.3909	141_27.7088	4047	27_19.0087	141_27.6000	4054.8	HD	BIS
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	33	2.14 18.39	27 19 1352	141 21 4861	3972	2.21 0.32	27_19.3078	141_24.7237	3965	27_19.3010	141_24.0103	4024.2	HD	BIS
$ \begin{array}{c} 1 \\ 2 \\ 2 \\ 1 \\ 1 \\ 1 \\ 1 \\ 2 \\ 1 \\ 1 \\$	34	2.14.19.12	27 18 9170	141 18 4722	3874	2.25 21.21	27_19.0500	141_21.5705	3905	27_19.0073	141_21.0050	3930.3		BIS
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	35	2.14 19:44	27 18.6754	141 15.4322	3697	2.26 1.07	27 18 5674	141 15 5269	3700	27_18_6043	141_15.0309	3607.6		UICU
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	36	2.14 20:18	27 18.4542	141 12.4169	3532	2.26 2:54	27 18.3770	141 12 5348	3533	27_18.4143	141_12_3885	3524.7	HD	RTS
38 2.14 2.14 2.14 2.14 2.14 2.14 2.14 2.14 2.14 2.20 2.17,7849 141,00.3933 3033 2.26 6.31 2.7,17,846 141,00.4221 3040 2.7,17,8614 141,00.4173 3040.4 HD BTS 40 2.14 2.20 2.7,17,518 141,00.3349 2.247 2.26 8.08 27,17,5486 141,00.3480 2.268.2 HD HIGH 41 2.14 2.333 2.7,17,518 141,00.5173 140,57,3312 1729 HD BTS 42 2.14 2.335 2.7,17,0477 140,51,2705 816 2.26 140,57,375 1730 140,54,3363 1053.6 HD HIGH 43 2.15 0.90 2.7,16,481 140,51,2705 816 2.26 140,45,2319 1404 2.7,16,6373 140,45,2422 1442.4 1453 746 2.7,16,4610 140,48,2424 1439 DAT BTS 140 2.16,563 140,42,1817 132.7 HD BTS 45 2.15 1.45 2.7,16,0102	37	2.14 20:51	27 18.2186	141 09.4055	3307	2.26 4:51	27 18.2249	141 09 4488	3312	27 18 2786	141_09_3283	3327.5	HD	BTS
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	38	2.14 21:25	27_17.9911	141_06.3933	3033	2.26 6:31	27 17.8168	141 06.4221	3040	27 17.8614	141_06.4173	3040.4	HD	BTS
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	39	2.14 22:00	27_17.7549	141_03.3549		2.26 8:08	27 17.5486	141 03.2868	2663	27 17.5860	141_03.3450	2688.2	HD	HIGH
412.142.3:0327_17.2906140_57.337517302.2610:4727_17.3216140_57.3501173627_17.2719140_57.33121729HDBTS422.1423:3527_17.0477140_54.298610462.2611:5527_117.1014140_54.4071107427_17.0489140_54.33631053.6HDHIGH432.150:0927_16.8140140_51.27058162.2613:0527_16.6372140_51.435774627_16.8422140_51.2723816.4HDHDBTS442.150:4127_16.3369140_45.221414372.2615:3627_16.6392140_42.3231144027_16.3661140_42.2221442.4DATBTS452.151:4527_16.1002140_42.198613012.2616:5427_16.092140_42.1308125827_16.1448140_45.221414371327.7HDBTS472.152:1627_15.3726140_33.122121542.2623:4327_15.3936140_3.31548216927_15.3810140_33.0992164.9HDHIGH482.153:4827_15.1411140.30.104115042.271:0027_15.2171140_30.1703155027_15.1717140_30.07731535.5HDBTS512.153:4827_14.320140_2.4.049933612.274:272:71.4.29940_2.1.048727_14.3268140_2.2.0981338.5HDBTS </td <td>40</td> <td>2.14 22:31</td> <td>27_17.5181</td> <td>141_00.3399</td> <td>2247</td> <td>2.26 9:32</td> <td>27_17.4529</td> <td>141 00.2719</td> <td>_</td> <td>27 17.4798</td> <td>141 00.3174</td> <td>2247.3</td> <td>HD</td> <td>BTS</td>	40	2.14 22:31	27_17.5181	141_00.3399	2247	2.26 9:32	27_17.4529	141 00.2719	_	27 17.4798	141 00.3174	2247.3	HD	BTS
42 2.14 23:35 27_17.0477 140_54.2986 1046 2.26 11:55 27_17.1014 140_54.4071 1074 27_17.0489 140_54.3363 1053.6 HD HIGH 43 2.15 0:09 27_16.8140 140_51.2705 816 2.26 13:01 27_16.6392 140_48.3399 1421 27_16.6010 140_48.2422 1439 HD HIGH 44 2.15 0:41 27_16.3639 140_45.2214 1437 2.26 16:54 27_16.092 140_442.1308 1258 27_16.16363 140_45.2422 142.4 DAT BTS 45 2.15 1:45 27_16.1002 140_42.1986 1301 2.26 16:54 27_16.092 140_42.1308 1258 27_16.1448 140_42.1817 132.77 HD BTS 47 2.15 2.16 27_15.6511 140_38.1068 2017 27_15.6673 140_3.3.1975 1878.9 HD HIGH 48 2.15 2:46 27_15.613 140_30.1041 1504 2.27 1:50326 140_30.1073 1555 27_15.811 140_30.0773 1555.5 HD HTS	41	2.14 23:03	27_17.2906	140_57.3375	1730	2.26 10:47	27_17.3216	140_57.3501	1736	27_17.2719	140 57.3312	1729	HD	BTS
43 2.15 0:09 27_16.8140 140_51.2705 816 2.26 13:01 27_16.8727 140_51.4537 746 27_16.8422 140_51.2723 816.4 HD HIGH 44 2.15 0:41 27_16.5777 140_48.2470 1437 2.26 14:21 27_16.6392 140_45.2319 1404 27_16.6533 140_45.2422 1443 DAT BTS 45 2.15 1:45 27_16.6369 140_42.1308 1258 27_16.1448 140_42.1817 1327.7 HD BTS 46 2.15 2:16 27_15.6611 140_3.9.1734 1893 2.26 19:06 27_15.6519 140_3.8008 2017 27_15.8610 140_3.102 119 HD BTS 47 2.15 3:16 27_15.3726 140_3.31.221 2154 2.26 23:43 27_15.2217 140_3.01703 1550 27_15.1717 140_3.0073 1535.5 HD BTS 51 2.15 3:40 27_14.8723 140_27.0237 255 2.27 2:32 27_14.920 3322 27_14.3268 140_2.0.981 330.5.5 HD BTS	42	2.14 23:35	27_17.0477	140_54.2986	1046	2.26 11:55	27_17.1014	140_54.4071	1074	27_17.0489	140_54.3363	1053.6	HD	HIGH
44 2.15 0:41 27_16.5777 140_48.2470 1437 2.26 14:21 27_16.6392 140_48.3399 1421 27_16.6010 140_48.2422 1439 DAT BTS 45 2.15 1:13 27_16.3669 140_45.2214 1453 2.26 15:36 27_16.3666 140_45.2319 1440 27_16.3653 140_45.2422 1442.4 DAT BTS 46 2.15 1:45 27_16.1002 140_42.1286 1301 2.26 16:54 27_16.0992 140_42.1308 1258 27_16.1448 140_42.1817 1327.7 HD BTS 47 2.15 2:16 27_15.5716 140_38.0608 2017 27_15.8612 140_39.1975 1878.9 HD HIGH 48 2.15 2:16 27_15.5716 140_33.1548 2169 27_15.3717 140_30.0703 1550 27_15.1717 140_30.073 1555.5 HD BTS 51 2.15 4:20 27_14.8723 140_27.0237 2655 2.27 2:34 27_14.9020 140_21.0487 27_14.5932 140_2.3.9946	43	2.15 0:09	27_16.8140	140_51.2705	816	2.26 13:01	27_16.8727	140_51.4537	746	27_16.8422	140_51.2723	816.4	HD	HIGH
45 2.15 1:13 27_16.369 140_45.2214 1453 2.26 15:36 27_16.3666 140_45.2319 1440 27_16.3653 140_45.2422 1442.4 DAT BTS 46 2.15 1:45 27_16.1002 140_42.1986 1301 2.26 16:54 27_16.0992 140_42.1308 1258 27_16.1448 140_42.1817 1327.7 HD BTS 47 2.15 2:16 27_15.6158 140_39.1734 1893 2.26 19:06 27_15.6519 140_38.0608 2017 27_15.8822 140_39.1975 1878.9 HD HIGH 48 2.15 2:46 27_15.1572 140_33.1212 2154 2.26 23:43 27_15.2217 140_31.0103 1550 27_15.1717 140_30.0073 1535.5 HD BTS 51 2.15 3:48 27_14.6104 140_24.0499 361 2.27 2:37 2:47 2:47 140_24.24090 3222 27_14.5818 140_26.9851 260.7 140_24.993 338.5 HD BTS 52 2.15 5:02 27_14.3565 140_21	44	2.15 0:41	27_16.5777	140_48.2470	1437	2.26 14:21	27_16.6392	140_48.3399	1421	27_16.6010	140_48.2422	1439	HD	BTS
46 2.15 1:45 27_16.1002 140_42.1986 1301 2.26 16:54 27_16.0992 140_42.1308 1258 27_16.1448 140_42.1817 1327.7 HD BTS 47 2.15 2:16 27_15.8611 140_39.1734 1893 2.26 19:06 27_15.519 140_38.0608 2017 27_15.8222 140_39.1975 1878.9 HD HIGH 48 2.15 2:46 27_15.53726 140_33.1221 2154 2.26 23:43 27_15.2217 140_30.1703 1550 27_15.1717 140_30.0773 1535.5 HD BTS 51 2.15 4:20 27_14.8723 140_27.0237 2655 2.27 2:34 27_14.5905 140_21.0173 1502 27_14.8618 140_23.9946 338.5 HD BTS 52 2.15 4:50 27_14.8723 140_21.0259 3477 2.27 6:15 27_14.2499 140_21.0487 27_14.5932 140_20.9871 3500.5 HD BTS 54 2.15 5:49 27_14.3872 140_14.9863 3491 2.27 9:47 27_13.1707 140_1	45	2.15 1:13	27_16.3369	140_45.2214	1453	2.26 15:36	27_16.3666	140_45.2319	1440	27_16.3653	140_45.2422	1442.4	DAT	BTS
47 2.15 2:16 27.15.8611 140.39.1734 1893 2.26 19:06 27.15.6519 140.38.0608 2017 27.15.8822 140.39.1975 1878.9 HD HIGH 48 2.15 2:46 27.15.6158 140.33.1221 2154 2.26 23:43 27.15.3936 140.33.1548 2169 27.15.3810 140.30.0099 2164.9 HD HIGH 50 2.15 3:48 27.15.1411 140.30.1041 1504 2.27 1:00 27.15.2217 140.30.1703 1550 27.15.1717 140.30.0773 1535.5 HD BTS 51 2.15 4:50 27.14.6104 140.24.0499 3361 2.27 2:34 27.14.5965 140.24.2090 3322 27.14.5932 140.23.9946 338.5 HD BTS 53 2.15 5:20 27.14.5126 140.21.0259 3477 2.27 6:15 27.14.2499 140.21.0487 - 27.14.3268 140.20.9871 3500.5 HD BTS 54 2.15 5:49 27.14.1280 140.18.0059 3499 2.27	46	2.15 1:45	27_16.1002	140_42.1986	1301	2.26 16:54	27_16.0992	140_42.1308	1258	27_16.1448	140_42.1817	1327.7	HD	BTS
48 2.15 2:46 27_15.6158 140_36.1496 2120 27_15.6673 140_36.1102 2119 HD BTS 49 2.15 3:16 27_15.3726 140_33.1221 2154 2.26 23:43 27_15.3936 140_33.1548 2169 27_15.3810 140_33.0909 2164.9 HD HIGH 50 2.15 3:48 27_15.1411 140.30.1041 1504 2.27 1:00 27_15.2217 140_30.1703 1550 27_14.8618 140_26.9851 2640.7 HD BTS 51 2.15 4:50 27_14.6104 140_24.0499 3361 2.27 4:23 27_14.5965 140_24.0490 3322 27_14.3268 140_20.9871 350.5 HD BTS 53 2.15 5:20 27_14.1280 140_140.8059 3499 2.27 8:04 27_13.9924 140_17.9280 3507 27_14.0908 140_17.9588 3496.7 HD BTS 54 2.15 6:48 27_13.8729 140_14.9866 3497 2.27 9:47 27_13.508 140_11.9205 3217.2 HD BTS </td <td>47</td> <td>2.15 2:16</td> <td>27_15.8611</td> <td>140_39.1734</td> <td>1893</td> <td>2.26 19:06</td> <td>27_15.6519</td> <td>140_38.0608</td> <td>2017</td> <td>27_15.8822</td> <td>140_39.1975</td> <td>1878.9</td> <td>HD</td> <td>HIGH</td>	47	2.15 2:16	27_15.8611	140_39.1734	1893	2.26 19:06	27_15.6519	140_38.0608	2017	27_15.8822	140_39.1975	1878.9	HD	HIGH
49 2.15 3:16 27_15.3726 140_33.1221 2154 2.26 23:43 27_15.3936 140_33.1548 2169 27_15.3810 140_33.0909 2164.9 HD HIGH 50 2.15 3:48 27_15.1411 140.30.1041 1504 2.27 1:00 27_15.2217 140_30.1703 1550 27_14.8618 140_26.9851 264.7 HD BTS 51 2.15 4:50 27_14.6104 140_24.0499 3361 2.27 4:23 27_14.5965 140_24.090 3322 27_14.3268 140_2.3.9946 3338.5 HD BTS 53 2.15 5:20 27_14.3565 140_21.0259 3477 2.27 6:15 27_14.2499 140_17.9280 3507 27_14.9081 140_17.9588 3496.7 HD BTS 54 2.15 6:49 27_13.8729 140_14.9866 3497 2.27 9:47 27_13.7107 140_17.9280 3507 27_14.9098 140_17.9588 3496.7 HD BTS 55 2.15 6:46 27_13.8729 140_014.9866 3497 2.27 9:	48	2.15 2:46	27_15.6158	140_36.1496	2120					27_15.6673	140_36.1102	2119	HD	BTS
50 2.15 3:48 27_15.1411 140.30.1041 1504 2.27 1:00 27_15.2217 140_30.1703 1550 27_15.1717 140_30.0773 1535.5 HD BTS 51 2.15 4:20 27_14.8723 140_27.0237 2655 2.27 2:34 27_14.9020 140_27.1526 2607 27_14.8618 140_26.9851 2640.7 HD BTS 52 2.15 4:50 27_14.3565 140_21.0259 3477 2.27 6:15 27_14.2499 140_21.0487 - 27_14.3268 140_2.09871 350.5 HD BTS 54 2.15 5:49 27_14.1280 140_14.9866 3497 2.27 8:04 27_13.9924 140_17.9280 3507 27_14.0908 140_17.9588 3496.7 HD BTS 55 2.15 6:46 27_13.8729 140_14.9866 3497 2.27 9:47 27_13.508 140_11.9025 3217.2 HD BTS 56 2.15 6:46 27_13.3874 140_09.9380 3305 2.27 1:3.143 140_08.9937 329 <t< td=""><td>49</td><td>2.15 3:16</td><td>27_15.3726</td><td>140_33.1221</td><td>2154</td><td>2.26 23:43</td><td>27_15.3936</td><td>140_33.1548</td><td>2169</td><td>27_15.3810</td><td>140_33.0909</td><td>2164.9</td><td>HD</td><td>HIGH</td></t<>	49	2.15 3:16	27_15.3726	140_33.1221	2154	2.26 23:43	27_15.3936	140_33.1548	2169	27_15.3810	140_33.0909	2164.9	HD	HIGH
51 2.15 4:20 27_14.8723 140_27.0237 2655 2.27 2:34 27_14.9020 140_27.1526 2607 27_14.8618 140_26.9851 2640.7 HD BTS 52 2.15 4:50 27_14.6104 140_24.0499 3361 2.27 4:23 27_14.5965 140_24.090 3322 27_14.5932 140_23.9946 3338.5 HD BTS 53 2.15 5:20 27_14.1280 140_12.0259 3477 2.27 6:15 27_14.2499 140_21.0487 - 27_14.3268 140_2.0.9871 3500.5 HD BTS 54 2.15 5:49 27_14.1280 140_14.9866 3497 2.27 9:47 27_13.9924 140_17.9280 3507 27_14.0908 140_17.9588 3496.7 HD BTS 55 2.15 6:46 27_13.8729 140_14.9866 3497 2.27 9:47 27_13.1707 140_14.9319 - 27_13.5768 140_11.9025 3217.2 HD BTS 56 2.15 7:45 27_13.13847 140_09.9380 3305 2.27	50	2.15 3:48	27_15.1411	140.30.1041	1504	2.27 1:00	27_15.2217	140_30.1703	1550	27_15.1717	140_30.0773	1535.5	HD	BTS
52 2.15 4:50 27_14.6104 140_24.0499 3361 2.27 4:23 27_14.5965 140_24.2090 3322 27_14.5932 140_23.9946 3338.5 HD BTS 53 2.15 5:20 27_14.3565 140_21.0259 3477 2.27 6:15 27_14.2499 140_21.0487 27_14.3268 140_20.9871 3500.5 HD BTS 54 2.15 5:49 27_14.1280 140_14.9866 3497 2.27 8:04 27_13.9924 140_17.9280 3507 27_14.0908 140_17.9588 3496.7 HD BTS 55 2.15 6:46 27_13.8729 140_14.9866 3497 2.27 9:47 27_13.5008 140_11.920 27_13.5768 140_11.9025 3217.2 HD BTS 56 2.15 7:45 27_13.13847 140_09.9380 3305 2.27 1:31 140_08.9937 3329 27_13.2966 140_08.8801 3304.8 HD HIGH 58 2.15 7:45 27_13.1357 140_05.9244 3605 2.27 1:41 <t< td=""><td>51</td><td>2.15 4:20</td><td>27_14.8723</td><td>140_27.0237</td><td>2655</td><td>2.27 2:34</td><td>27_14.9020</td><td>140_27.1526</td><td>2607</td><td>27_14.8618</td><td>140_26.9851</td><td>2640.7</td><td>HD</td><td>BTS</td></t<>	51	2.15 4:20	27_14.8723	140_27.0237	2655	2.27 2:34	27_14.9020	140_27.1526	2607	27_14.8618	140_26.9851	2640.7	HD	BTS
53 2.15 5:20 27_14.3565 140_21.0259 3477 2.27 6:15 27_14.2499 140_21.0487 — 27_14.3268 140_20.9871 3500.5 HD BTS 54 2.15 5:49 27_14.1280 140_18.0059 3499 2.27 8:04 27_13.9924 140_17.9280 3507 27_14.0908 140_17.9588 3496.7 HD BTS 55 2.15 6:18 27_13.8729 140_14.9866 3497 2.27 9:47 27_13.7107 140_14.9319 — 27_13.5768 140_11.9025 3217.2 HD BTS 56 2.15 6:46 27_13.3847 140_09.9380 3305 2.27 13.143 140_08.9937 3329 27_13.2966 140_08.8801 3304.8 HD HIGH 58 2.15 7:45 27_13.1357 140_05.9244 3605 2.27 16:31 27_12.9174 140_03.0653 3477 27_12.8406 140_02.9045 353.9 HD HIGH 59 2.15 8:43 27_12.6128 139_59.8873 3778 2.27 18:24 27_12.9174<	52	2.15 4:50	27_14.6104	140_24.0499	3361	2.27 4:23	27_14.5965	140_24.2090	3322	27_14.5932	140_23.9946	3338.5	HD	BTS
54 2.15 5:49 27_14.1280 140_18.0059 3499 2.27 8:04 27_13.9924 140_17.9280 3507 27_14.0908 140_17.9588 3496.7 HD BTS 55 2.15 6:18 27_13.8729 140_14.9866 3497 2.27 9:47 27_13.7107 140_14.9319 27_13.7985 140_11.9025 3217.2 HD BTS 56 2.15 6:46 27_13.3847 140_09.9380 3305 2.27 13.2713 140_011.9320 27_13.5768 140_11.9025 3217.2 HD BTS 57 2.15 7:45 27_13.3847 140_09.9380 3305 2.27 14:12 27_13.3143 140_08.9937 3329 27_13.2966 140_08.8801 3304.8 HD HIGH 58 2.15 7:45 27_12.1839 140_05.9244 3605 2.27 16:31 27_12.9174 140_03.0653 3477 27_12.8406 140_02.9045 353.9 HD HIGH 59 2.15 8:43 27_12.6128 139_59.8873 3778 2.27 12.2599 140_	53	2.15 5:20	27_14.3565	140_21.0259	3477	2.27 6:15	27_14.2499	140_21.0487	—	27_14.3268	140_20.9871	3500.5	HD	BTS
55 2.15 6:18 2/_13.8/29 140_14.9866 3497 2.27 9:47 27_13.7107 140_14.9319 — 27_13.7985 140_14.9683 3510.1 HD BTS 56 2.15 6:46 27_13.6271 140_11.9660 3203 2.27 11:25 27_13.5008 140_11.9320 — 27_13.5768 140_11.9025 3217.2 HD BTS 57 2.15 7:16 27_13.3847 140_09.9380 3305 2.27 13:00 27_13.3143 140_08.9937 3329 27_13.2966 140_08.8801 3304.8 HD HIGH 58 2.15 7:45 27_12.1357 140_05.9244 3605 2.27 14:41 27_13.0012 140_06.1660 3566 27_12.9559 140_06.0093 3624.7 HD HIGH 59 2.15 8:14 27_12.6128 139_59.8873 3778 2.27 18:24 27_12.9174 140_03.0653 3477 27_12.8406 140_02.9045 3531.9 HD BTS 61 2.15 9:11 27_12.6128 139_59.86873 3780 2.27 <td>54</td> <td>2.15 5:49</td> <td>27_14.1280</td> <td>140_18.0059</td> <td>3499</td> <td>2.27 8:04</td> <td>27_13.9924</td> <td>140_17.9280</td> <td>3507</td> <td>27_14.0908</td> <td>140_17.9588</td> <td>3496.7</td> <td>HD</td> <td>BTS</td>	54	2.15 5:49	27_14.1280	140_18.0059	3499	2.27 8:04	27_13.9924	140_17.9280	3507	27_14.0908	140_17.9588	3496.7	HD	BTS
50 2.15 0:40 2/_13.02/1 140_11.9600 3203 2.27 11:25 27_13.5008 140_11.9320 — 27_13.5768 140_11.9025 3217.2 HD BTS 57 2.15 7:16 27_13.3847 140_09.9380 3305 2.27 13:00 27_13.3143 140_08.9937 3329 27_13.2966 140_08.8801 3304.8 HD HIGH 58 2.15 7:45 27_13.1357 140_05.9244 3605 2.27 12:41 27_13.0012 140_06.1660 3566 27_12.9559 140_06.0093 3624.7 HD HIGH 59 2.15 8:14 27_12.6128 139_59.8873 3778 2.27 16:31 27_12.9174 140_03.0653 3477 27_12.8406 140_02.9045 3531.9 HD BTS 60 2.15 8:43 27_12.6128 139_59.8873 3778 2.27 18:24 27_12.2599 140_00.0033 3774 27_12.25466 139_59.8688 3786.7 HD BTS 61 2.15 9:11 27_12.1612 139_56.8773 3780 2.27	55	2.15 6:18	27_13.8729	140_14.9866	3497	2.27 9:47	27_13.7107	140_14.9319		27_13.7985	140_14.9683	3510.1	HD	BTS
57 2.15 7:10 2/_15.384/ 140_09.9380 3305 2.2/ 13:00 27_13.3143 140_08.9937 3329 27_13.2966 140_08.8801 3304.8 HD HIGH 58 2.15 7:45 27_13.1357 140_05.9244 3605 2.27 14:41 27_13.0012 140_06.1660 3566 27_12.9559 140_06.0093 3624.7 HD HIGH 59 2.15 8:14 27_12.1628 139_59.8873 3778 2.27 16:31 27_12.9174 140_03.0653 3477 27_12.2466 140_02.9045 3531.9 HD HD BTS 60 2.15 8:43 27_12.6128 139_59.8873 3778 2.27 18:24 27_12.2599 140_00.0033 3774 27_12.25466 139_59.8688 378.7 HD BTS 61 2.15 9:11 27_12.1620 139_56.8773 3780 2.27 22:12 27_12.2468 139_56.9297 3806 27_12.2853 139_56.8682 378.4 DAT HIGH 62 2.15 9:40 27_12.1101 139_53.8556 382	56	2.15 6:46	27_13.6271	140_11.9660	3203	2.27 11:25	27_13.5008	140_11.9320	_	27_13.5768	140_11.9025	3217.2	HD	BTS
50 2.15 7:45 21_15.1557 140_05.9244 3605 2.27/14:41 27_13.0012 140_06.1660 3566 27_12.9559 140_06.0093 3624.7 HD HIGH 59 2.15 8:14 27_12.8839 140_03.9061 3543 2.27/16:31 27_12.9174 140_03.0653 3477 27_12.8406 140_02.9045 3531.9 HD BTS 60 2.15 8:43 27_12.6128 139_59.8873 3778 2.27 18:24 27_12.5999 140_00.0033 3774 27_12.25466 139_59.8688 378.7 HD BTS 61 2.15 9:11 27_12.13620 139_56.8773 3780 2.27 20:20 27_12.2468 139_56.9297 3806 27_12.2853 139_56.8682 378.4 DAT HIGH 62 2.15 9:40 27_12.1101 139_53.8556 3826 2.27 21:13 27_12.1020 139_553.8059 3818 27_12.1463 139_53.7973 3824.2 HD BTS 63 2.15 10:10 27_118.868 139_50.8336 3825 2.28 0.04 27_111.7540 139_50.9457	57	2.15 7:16	27_13.3847	140_09.9380	3305	2.27 13:00	27_13.3143	140_08.9937	3329	27_13.2966	140_08.8801	3304.8	HD	HIGH
57 2.13 6.14 2.1 1.40 0.3.063 3477 27 12.8406 140 0.2.9045 3531.9 HD BTS 60 2.15 8:43 27 12.6128 139 59.8873 3778 2.27 18:24 27 12.5999 140 00.0033 3774 27 12.5466 139 59.8688 378.7 HD BTS 61 2.15 9:11 27 12.3620 139 56.8773 3780 2.27 22.21 27 12.2468 139 56.9297 3806 27 12.2853 139 56.8682 378.4 DAT HIGH 62 2.15 9:40 27 12.101 139 53.8556 3826 2.27 21.3 27 12.1020 139 53.8059 3818 27 12.1463 139 50.8324 HD BTS 63 2.15 10:10 27 11.8368 139 50.8336 3825 2.28 0.04 27 11.7540 139 50.9457 2925 27 1.7547	50	2.15 7:45	27_13.1357	140_05.9244	3605	2.27 14:41	27_13.0012	140_06.1660	3566	27_12.9559	140_06.0093	3624.7	HD	HIGH
00 2.15 0.43 2.1_12.0128 139_59.8613 37/8 2.2.1 18:24 2/_12.5999 140_00.0033 3774 27_12.5466 139_59.8688 3786.7 HD BTS 61 2.15 9:11 27_12.3620 139_56.8773 3780 2.27 20:20 27_12.2468 139_56.9297 3806 27_12.2853 139_56.8682 378.4 DAT HIGH 62 2.15 9:40 27_12.1101 139_53.8556 3826 2.27 22:13 27_12.1020 139_53.8059 3818 27_12.1463 139_53.7973 3824.2 HD BTS 63 2.15 10:10 27 11 8368 139 50 8336 3825 2.28 0.04 27 11 7540 139 50 921 3224 HD BTS	20	2.15 8:14	27_12.8839	140_03.9061	3543	2.27 16:31	27_12.9174	140_03.0653	3477	27_12.8406	140_02.9045	3531.9	HD	BTS
61 2.15 9.11 21_12_12.3020 139_50.8773 3780 2.21/2020 21_12.2468 139_56.9297 3806 27_12.2853 139_56.8682 3784.4 DAT HIGH 62 2.15 9:40 27_12.1101 139_53.8556 3826 2.27 22:13 27_12.1020 139_53.8059 3818 27_12.1463 139_53.7973 3824.2 HD BTS 63 2.15 10:10 27 11 8366 139 50 8365 329.5 27 11 7540 139 50 9457 329.5 27 127 127 129 50 92.16 139 50 92.16 139 50 92.16 139 50 92.16 139 50 92.16 139 50 92.16 139 50 92.16 139 50 92.16 139 50 92.16 139 50 92.16 139 139 50 92.16 139 139 139 139 139 139 139 139 139 139 139 139 147 14	60	2.13 8:43	27_12.0128	139_39.8873	5778	2.2/18:24	27_12.5999	140_00.0033	3774	27_12.5466	139_59.8688	3786.7	HD	BTS
63 2.15 10:10 27 11 8368 139 50 8336 3825 2 28 0.04 27 11 7540 139 50 0457 3925 27 11 7547 130 50 0457 3921 C VID	62	2.15 9:11	27 12 1101	139_30.8//3	5/80	2.27 20:20	27_12.2468	139_56.9297	3806	27_12.2853	139_56.8682	3784.4	DAT	HIGH
	63	2.15 9:40	27_12.1101	139 50 8336	3825	2.2/ 22:13	27_11.7540	139_55.8059	3818	27_11.7617	139_53.7973	3824.2	HD	BIS

Table 3: (Continued).

	Deployment		Retrieval			Calibration							
	Time		Coordinate Time Coordinate Coordinate		HD	Hydrophone							
Site	UTC	Lat (N)	Lon (E)	Dep (m)	UTC	Lat (N)	Lon (E)	Dep (m)	Lat (N)	Lon (E)	Dep (m)	Туре	Туре
64	2.15 10:41	27_11.5836	139_47.8171	3804	2.28 1:53	27_11.5456	139_47.9183	3800	27_11.5190	139_47.8128	3799.6	HD	BTS
65	2.15 11:10	27_11.3220	139_44.7975	3280	2.28 3:39	27_11.2013	139_44.9172	3368	27_11.1745	139_44.7815	3325	HD	HIGH
66	2.15 11:40	27_11.0578	139_41.7790	2544	2.28 5:14	27_10.9762	139_41.9169		27_10.9797	139_41.8388	2550.3	HD	BTS
67	2.15 12:08	27_10.7968	139_38.7526	1197	2.28 6:25	27_10.7862	139_38.8149	1180	27_10.7535	139_38.8028	1208	HD	BTS
68	2.15 12:39	27_10.5334	139_35.7438	1419	2.28 7:37	27_10.5233	139_35.8033	1410	27_10.5210	139_35.7909	1413.7	HD	BTS
69	2.15 13:09	27_10.2645	139_32.7208	2855	2.28 9:12	27_10.2709	139_32.6990	2795	27_10.2235	139_32.7063	2855.2	HD	BTS
70	2.15 13:39	27_10.0053	139_29.7034	3356	2.28 10:56	27_09.9849	139_29.6510	3365	27_09.9694	139_29.6725	3362.6	HD	BTS
71	2.15 14:10	27_09.7347	139_26.6876	2952	2.28 12:26	27_09.6982	139_26.6462		27_09.6721	139_26.6543	2939.9	HD	BTS
72	2.15 14:39	27_09.4590	139_23.6722	2933	2.28 13:53	27_09.4367	139_23.7338	2890	27_09.3934	139_23.7100	2903.6	HD	BTS
73	2.15 15:10	27_09.1999	139_20.6474	3206	3. 1 0:38	27_09.1549	139_20.7075		27_09.1233	139_20.7222	3193.1	HD	BTS
74	2.15 15:40	27_08.9293	139_18.6336	3426	3. 1 2:24	27_08.8952	139_17.7972	3421	27_08.9108	139_17.6675	3428.8	HD	BTS
75	2.15 16:12	27_08.6606	139_15.6128	4162	3. 1 4:16	27_08.6538	139_14.7839	4121	27_08.6885	139_14.6311	4153.6	DAT	BTS
76	2.15 16:43	27_08.3873	139_11.6036	3919	3. 1 6:05	27_08.2432	139_11.7079	3920	27_08.3873	139_11.6393	3895.6	HD	HIGH
77	2.15 17:13	27_08.1073	139_08.5810	4060	3. 1 7:59	27_07.9569	139_08.6473	4084	27_08.1198	139_08.6221	4070.1	HD	BTS
78	2.15 17:42	27_07.8388	139_05.5633	4215	3. 1 9:52	27_07.7063	139_05.6515	—	27_07.8577	139_05.5928	4207.3	HD	BTS
79	2.15 18:11	27_07.5593	139_02.5582	4252	3. 1 11:50	27_07.4504	139_02.6304	—	27_07.5698	139_02.5853	4257.8	HD	BTS
80	2.15 18:42	27_07.2778	138_59.5376	4366	3. 1 13:46	27_07.2136	138_59.6606	4369	27_07.2603	138_59.5521	4369.5	HD	BTS
81	2.15 19:11	27_06.9996	138_56.5156	4433	3. 1 15:41	27_06.9452	138_56.6925	4448	27_06.9509	138_56.5516	4438.6	HD	BTS
82	2.21 12:37	27_06.7162	138_53.5138	4405	3. 1 17:46	27_06.6818	138_53.6493	—	27_06.7002	138_53.5354	4409.5	HD	BTS
83	2.21 13:13	27_06.4371	138_50.4949	4365	3. 1 20:08	27_06.3623	138_50.5526		27_06.3953	138_50.4476	4352.4	HD	BTS
84	2.21 13:44	27_06.1662	138_47.4883	3981	3. 1 22:19	27_06.0884	138_47.4310	3935	27_06.1273	138_47.4520	3994	HD	BTS
85	2.21 14:14	27_05.8876	138_44.4676	3613	3. 2 0:02	27_05.8573	138_44.4815	3500	27_05.9102	138_44.4743	3533.2	HD	BTS
86	2.21 14:46	27_05.5975	138_41.4487	4560	3. 2 2:02	27_05.6662	138_41.4565	4572	27_05.5916	138_41.4361	4550.9	HD	BTS
87	2.21 15:20	27_05.3077	138_38.4402	4739	3. 2 4:05	27_05.3708	138_38.4748	4732	27_05.2924	138_38.4352	4733.3	HD	BTS
88	2.21 15:51	27_05.0294	138_35.4244	4802	3. 2 6:04	27_05.1100	138_35.4554	4799	27_05.0097	138_35.3641	4796.9	DAT	BTS
89	2.21 16:22	27_04.7447	138_32.4126	4899	3. 2 8:19	27_04.7551	138_32.4607		27_04.7627	138_32.3922	4900.8	HD	BTS
90	2.21 16:53	27_04.4551	138_29.3963	4834	3. 2 10:27	27_04.4202	138_29.4061	4834	27_04.4942	138_29.4058	4835.8	HD	BTS
91	2.21 17:23	27_04.1631	138_26.3801	4914	3. 2 12:35	27_04.1006	138_26.3256	4918	27_04.1618	138_26.3021	4909.8	HD	BTS
92	2.21 17:53	27_03.8739	138_23.3721	4551	3. 2 14:47	27_03.9099	138_23.3951	4643	27_03.8989	138_23.3615	4632.2	HD	BTS
93	2.21 18:22	27_03.5832	138_20.3459	4824	3. 2 17:27	27_03.6594	138_20.3624	4791	27_03.5722	138_20.2588	4815.7	HD	BTS
94	2.21 18:51	27_03.2952	138_17.3450	5013	3. 2 19:46	27_03.3351	138_17.3384	5027	27_03.2379	138_17.2516	5004.1	HD	HIGH
95	2.21 19:21	27_02.9993	138_14.3266	4586	3. 2 22:02	27_02.9629	138_14.2603	4584	27_02.9243	138_14.3700	4583.6	HD	BTS
96	2.21 19:49	27_02.7138	138_11.3346	4878	3. 3 0:22	27_02.6490	138_11.2604	4810	27_02.6174	138_11.2719	4858.6	HD	BTS
97	2.21 20:18	27_02.4098	138_08.3094	4559	3. 3 2:22	27_02.3211	138_08.2339	4544	27_02.2823	138_08.2101	4536.3	HD	BTS
98	2.21 20:47	27_02.1199	138_05.3027	5081	3. 4 9:30	27_01.9743	138_05.4378	5080	27_02.0437	138_05.3346	5077.6	HD	BTS
99	2.21 21:17	27_01.8174	138_02.2966	5006	3. 4 11:40	27_01.6826	138_02.3546	4980	27_01.6655	138_02.2281	4989.2	DAT	BTS
100	2.21 21:46	27_01.5170	137_59.2831	4948	3. 4 13:52	27_01.3808	137_59.3374	_	27_01.3957	137_59.2048	4944.8	HD	BTS
101	2.21 22:15	27_01.2221	137_56.2823	4713	3. 4 16:05	27_01.0295	137_56.2659	4689	27_01.1032	137_56.1972	4754.4	HD	BTS
102	2.21 22:43	27_00.9273	137_53.2698	4648	3. 4 18:14	27_00.7801	137_53.2988	4729	27_00.8011	137_53.2196	4686.9	HD	BTS
103	2.21 23:10	27_00.6151	137_50.2533	4930	3. 4 20:25	27_00.4631	137_50.2904	4924	27_00.4959	137_50.2157	4919.1	HD	BTS
104	2.21 23:37	27_00.3095	137_47.2414	4853	3. 4 22:30	27_00.0885	137_47.2693	4850	27_00.1809	137_47.2417	4846.4	HD	BTS
105	2.22 0:05	27_00.0104	137_44.2294	4608	3. 5 0:28	26_59.7737	137_44.2521		26_59.8877	137_44.1975	4601.2	HD	BTS
106	2.22 0:32	26_59.6990	137_41.2239	4421	3. 5 1:05	26_59.4385	137_41.1690	4460	26_59.5686	137_41.1462	4426	HD	BTS
107	2.22 0:59	26_59.4020	137_38.2236	5215	3. 5 3:16	26_59.1321	137_38.1167	5232	26_59.3124	137_38.1418	5220.9	HD	BTS
108	2.22 1:25	26_59.1008	137_35.2075	5160	3. 5 4:03	26_58.8705	137_35.1483	5210	26_59.0173	137_35.1652	5171.8	HD	BTS
109	2.22 1:51	26_58.7937	137_32.2023	4676	3. 5 6:10	26_58.5813	137_32.0796	4689	26_58.7743	137_32.1536	4701.1	HD	BTS
110	2.22 2:18	26_58.4736	137_29.2071	4426	3. 5 6:52	26_58.3487	137_29.1420	4423	26_58.4154	137_29.0912	4407.8	HD	BTS

Table 4: Sensitivities of geophone and hydrophone sensors.

Sensor type	Sensor name	Maker	Sensitivity	Sensitivity	Frequency	
Geophone	L-281 B H V	Mark Products	0.69 V/in/sec	0.69 V/in/sec	A 5Hz (natural freq.)	
(three components)	L-20LD.II. V	Mark 1 Toddets	0.09 1/11/300	0.07 11/300	4.5112 (natural freq.)	
Hydrophone	AQ-18	Benthos, inc.	-169 dB	-169 dB	1Hz - 12kHz	
Hydrophone	HTI-99DY	HIGH TECH, inc	-165dB	-165dB	2Hz - 20kHz	

a transponder system receives an acoustic signal sent from a vessel. This acoustic communication between the OBS and the vessel was performed using transducers installed on the vessel. Positions of OBSs on the sea bottom are estimated by SSBL of the vessel's positioning system during the cruise.

After the cruise, we edited continuous OBS data to lengths of 70 s and SEG-Y format. Simultaneously, calibration of the OBS clock for GPS time was carried out using differences between OBS clock time and GPS time, which were measured immediately before OBS deployment and immediately after OBS retrieval.

2.3 Multichannel hydrophone streamer

During airgun shooting, we towed a 12-channel hydrophone streamer to probe the shallow structure, in particular, a distribution of sediments with low P-wave velocity (Fig. 2). The hydrophone streamer cable was a Stealtharray ST-48 made by Sercel Inc. The interval of each channel was 25 m. The respective lengths of active section and read-in cable until the ship end were 300 m and 150 m. Hydrophone sensors (free-field 1/2 microphone; Brüel & Kjaer) with sensitivity of -25.9 dB re1V/Pa (50.4 mV/Pa) were used. Analog signals from five sensors in same channel were stacked before A/D conversion. The A/D conversion kit was attached in the recording system, the StrataVisor NX Marine made by Geometrics Inc.; digitized data were recorded on DLT tapes with SEG-D format. No recording delay was set. The sampling rate was 4 ms and the record length was 13.5 s. Seismic records from the eighth channel were not good during this cruise. For that reason, we omitted the traces.

2.4 Seismic recording/shooting system

The seismic system of R/V "Kaiyo" consists of a navigation system with SPECTRA software, a recording system (StrataVisor NX Marine; Geometrics Inc.) and a gun controller system (GCS90). Those systems are connected via RTN. As mentioned above, we adapted Starfire as a seismic system navigation source. Navigation data collected from Starfire and Skyfix for the ship's navigation system were sent to the RTNµ via the terminal server connecting the LAN of the ship and this MCS system. The RTNµ obtains time signals of GPS (Starfire) from the original antenna. Then, the navigation data are sent to the PC Linux machine with installed SPECTRA software and monitored on the display. Timing of the system start, shot number, and so on, are set on the SPECTRA software. The system start signal generated from SPECTRA was sent to the gun controller and the recording system as a trigger signal via the RTN μ . The gun controller sent back the internal time break signal to the master clock and RTN μ immediately after getting trigger signals. The trigger signals were sent to eight airguns as shot signals, and the recording system started to record seismic data from a hydrophone streamer. The first break signal was sent to the gun controller from the airguns at same timing with the shot. Then the gun controller sent the shot data to RTN μ .

3. Data

In this chapter, we introduce examples of the seismic data obtained by OBSs deployed on the Ogasawara Ridge (OBS#6), the Nishinoshima Trough (OBS#63) and the Shikoku Basin (OBS#91). Vertical components of OBS#6, OBS#63 and OBS#91 and horizontal components of OBS#6 and OBS#91 are described in section 3.1.

3.1 OBS

The data quality of available OBSs is good. We can trace the first phases on vertical records to 200 km distance from each OBS. Horizontal records also show good quality despite a poorer S/N ratio than the vertical. We describe characteristics of OBS data using vertical record sections of OBS#6 (Fig. 3), OBS#63 (Fig. 4) and OBS#91 (Fig. 5) as follows. These records suggested a thick crust in the Ogasawara Trough and a thin crust in the Shikoku Basin. In the Nishinoshima Trough and the western slope of Nishi-shichito Ridge, the crusts might be thicker than typical oceanic crust.

The OBS#6 was deployed on the eastern slope of the Ogasawara Ridge. We can trace first arrivals up to an offset of 170 km from the OBS in the western side (Fig. 3). The apparent velocities of the first arrival phases are 4.3 km/s at 5-30 km offsets in the eastern side. In the western side, apparent velocities of first arrivals are about 6.2 km/s at 4-14 km offsets, 8.4 km/s at 14-22 km, about 10 km/s at 22-38 km, 6.0 km/s at 68-74 km, 7.3 km/s at 100-115 km, 7.2 km/s at 120-130 km and 8.2 km/s at 140-150 km. Variations of these apparent velocities are caused by a rough topography of some ridges and troughs. Reflections from the Moho (PmP) with high amplitudes are apparent around an offset of 120 km. The Pn can trace over the offset of 160 km. In the horizontal record, large P wave conversion phases prevent observation of clear S arrivals. The S-wave apparent velocity is about 2.9 km/s at 6-16 km distance at the western side of OBS (Fig. 3).

The OBS#63 was deployed on the Nishinoshima Trough. We can trace first arrivals up to an offset of



Figure 3: Vertical and horizontal record section recorded by OBS#6. All traces are filtered using 5–15 Hz. Vertical and horizontal axes are offsets from OBS. The vertical section shows travel times reduced by 8 km/s. The horizontal section shows travel times reduced by 4.62 km/s.



Figure 4: Vertical record sections of two overlapped airgun shootings recorded by OBS#63. The details are same as for Fig. 4.



Figure 5: Vertical and horizontal record section recorded by OBS#91. The details are identical to those for Fig. 3.

170 km from the OBS in the eastern side and 240 km offset in the western side (Fig. 4). The apparent velocities of the first arrival phases at the eastern side are 4.5 km/s at 3-13 km offsets, 7.8 km/s at 30-37 km offsets and 5.0 km/s at 100-130 km offset. The PmP with high amplitudes are also apparent around an offset of 120 km. The Pn can trace around the offset of 140 km. In the western side, apparent velocities of first arrivals are more over 10 km/s at 13-21 km offsets, 3.9 km/s at 22-35 km offsets, 5.3 km/s at 44-60 km, 7.1 km/s at 68-82 km, 8.9 km/s at 82-100 km and 8.0 km/s at 120-145 km. The first arrivals are apparent down convex at offset 22 km, 42 km and 110 km because of the topographic high. PmP with high amplitudes are also apparent around an offset of 90 km. The Pn can be traced over the offset of 200 km.

The OBS#91 was deployed on the Shikoku Basin near the southern elongation of the Kinan escarpment. In the eastern side, apparent velocities of first arrivals are 3.8 km/s, 8.5 km/s and 8.0 km/s at offsets of 8-12 km, 12-25 km and 38-75 km (Fig. 5). Because of the topographic high, these phases are apparent down convex at offsets of 33 km, 100 km and 120 km. On the western side, apparent velocities of first arrivals are 5.6 km/s and 8.0 km/s, respectively, in offsets of 5-17 km and 37-55 km. These arrivals are apparent

down convex at offsets of 22 km, 33 km, 75 km and 97 km. These variations of phases are caused by rough topography of the old spreading center of the Shikoku Basin. In the horizontal record, apparent velocities are 3.8 km/s at the 22-27 km distance of the eastern side of OBS and 4.5 km/s at the 17-43 km distance of the western side of OBS (Fig. 5).

3.2 MCS

Reflection data recorded by the 12-channel hydrophone streamer have sufficient quality to pick the acoustic basement (Fig. 6). Data processing was a collection of spherical divergence, editing bad quality traces, deconvolution, an NMO correction with water velocity of 1500 m/s, tacking, a time variant band pass filter of 20-60 Hz, time migration, and auto gain control. Because of the channel interval of 25 m and the shot interval of 200 m, the fold number was 1 or 2.

We next describe rough characteristics of reflection images. In the upper part of the forearc slope, thick sediments cover the rough basement. A steep slope and normal faults characterize the eastern wall of the Ogasawara Trough. In contrast, the western wall of the trough is covered with thick sediments, which might be supplied from the present volcanic front. A thick sediment and a rough acoustic basement characterize the



Figure 6: MCS profile of KY0502 cruise. The 12ch hydrophone streamer and 12000 cubic inch airgun were used.

Nishinoshima Trough. It is divided into two parts by the basement high. The eastern part of the trough is covered with the sediment, which might be supplied from both sides of the slope. On the other hand, isopachous sedimentary layers characterize the western part of the trough because volcanic sediments from the present volcanic arc are trapped at the eastern side of this trough by a basement high. From the western slope of the Nishi-Shichito Ridge to the extension of the Kinan escarpment, several saw-tooth concavities are distributed. A sharp western wall and westward thickening sediments in each saw tooth characterize them. From the extension of the Kinan escarpment to the extension of Kinan seamount chain, thin sediment covers the basement.

4. Summary

This paper summarized the specifications and arrangements of seismic experiments carried out in the southern Izu-Ogasawara arc area and introduced seismic data. Because of the good data quality of the OBSs, we were able to trace the first P-arrivals to the offsets of 100 km from each OBS. We will investigate the velocity structural variation across the arc-backarc system and general oceanic arc to clarify the oceanic arc growth at different tectonic stages.

Acknowledgements

We greatly appreciate the following members of KY0502 cruise shipboard party described in the following. We would not have been able to conduct this seismic experiment without their efforts. We thank Dr. T. Tsuru, Dr. S. Miura, Dr. A. Nakanishi, and Dr. J-O Park for planning discussions of this cruise.

Marine technicians

Third Officer

Chief Engineer

First Engineer

Second Engineer

Third Engineer

Chief Technician Makoto Ito Technician Hitoshi Tanaka Technician Masato Sugano Technician Yuki Ohwatari Technician Nobuo Kojima Technician Hiroyoshi Shimizu Technician Michiaki Kudoh Technician Yuko Yamakawa Technician Kimiko Serizawa Technician Toru Koizumi Technician Kazuhiro Nakagawa Technician Kaoru Kashihara Technician Makoto Saito Technician Kotaro Nakao Crew Captain Shinya Ryono Chief Officer Yoshiyuki Nakamura Second Officer Yasuo Deai Second Officer Akihisa Tsuji

Yoshiki Kon Hiroyuki Shibata Masahiro Kajiwara Chikara Onohara Naohiro Tatooka

Chief Radio Officer	Hiroyasu Saichiku
Second Radio Officer	Kiyotaka Yamashita
Third Radio Officer	Yusuke Takeuchi
Boatswain	Yasuyoshi Kyuki
Able seaman	Kozo Yatogo
Able seaman	Katsuhiko Sato
Able seaman	Yoshihiro Kinoshita
Able seaman	Kengo Fujino
Able seaman	Yutaka Sato
Able seaman	Hiroaki Nagai
No. 1 Oiler	Masaru Kitano
Oiler	Hiroyuki Sato
Oiler	Yoshinori Kawai
Oiler	Hisao Shigeyuki
Oiler	Shota Watanabe
Chief Steward	Takeshi Miyauchi
Steward	Sueto Sasaki
Steward	Teruyuki Yoshikawa
Steward	Tomoyoshi Matsuo
Steward	Takahiro Abe

References

- Bloomer, S. H., B. Taylor, C. J. MacLeod, R. J. Stern, P. Fryer, J. W. Hawkins and L. Johnson, Early arc volcanism and ophiolite problem: *A perspective from drilling in the western pacific*, Active margins and marginal basins of the Western Pacific, B. Taylor and J. Natland eds., The American Geophysical Union, Washington, 1-30 (1995).
- Honza, E. and K. Tamaki, The Bonin Arc, *The Ocean Basins and Margins*, A. E. M. Nairn *et al.* eds., Plenum Co., New York, 7, 459-502 (1985).

- Ikari, K. and A. Nishimura, Geologic history of the Tenpo Seamount of the Nishi-Shichito Ridge, the Izu-Bonin Arc, *Bulletin of the Geological Survey of Japan*, **42**(1), 19-41, (1991)
- Karig, D. E. and G. F. Moore, Tectonic complexities in the Bonin arc system, Tectonophysics, 27, 97-118 (1975).
- Okino, K., S. Shimakawa and S. Nagaoka, Evolution of the Shikoku Basin, J. Geomag. Geoelectr., 46, 463-479 (1994).
- Okino, K., S. Kasuga and Y. Ohara, A new scenario of the Parece Vela Basin Genesis, *Mar. Geophys. Res.*, **20**, 21-40 (1998).
- Shinohara, M., K. Suyehiro, S. Matsuda and K. Ozawa, Digital recording ocean bottom seismometer using portable digital audio tape recorder. J. Jpn. Soc. Mar. Surv. Tech., 5, 21-31 (1993). (Japanese with English abstract)
- Taylor, B., Rifting and the volcanic-tectonic evolution of the Izu-Bonin-Mariana arc, *Proc. ODP, Sci. Results, 126*,
 B. Taylor, K. Fujioka, *et al.*, Ocean Drilling Program, College Station, 627-653, (1992).
- Yuasa, M. Sofugan Tectonic Line, a new tectonic boundary separating northern and southern part of the Ogasawara (Bonin) Arc, northwest Pacific, *Formation of Active Ocean Margins*, N. Nasu *et al.* eds., Terra pub. Tokyo, 483-496, (1985).
- Yuasa, M. Origin of along-arc geologic variations on the volcanic front of the Izu-Ogasawara (Bonin) Arc, *Bulletin of the Geological Survey of Japan*, 43(7), 457-466, (1992).

(Received January 24, 2006)