Wide-angle seismic profiling of arc-arc collision zone in the northern Izu-Ogasawara arc – KY0408 cruise –

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Abstract We carried out a deep wide-angle seismic experiment using a large airgun array and total 103 ocean bottom seismographs (OBSs) in the northern Izu-Ogasawara arc area, which was conducted by R/V Kaiyo of Japan Agency for Marine-Earth Science and Technology (JAMSTEC) from July 8, 2004 to July 22 (KY04-08 cruise). Objectives of this cruise are to know a velocity structure of the arc-arc collision zone and to understand relationship between the crustal growth and the arc collision, which is one of important parameters to clarify nature of the oceanic arc growth. An airgun-OBS seismic line was set from western Sagami Bay near granitic Izu peninsula to Tori-shima along the direction of the volcanic front. We shot a large airgun array with total volume 12,000 cu. in. and recorded the seismic signals on OBSs with four components and a hydrophone streamer. 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, granitic layer

1. Introduction

An oceanic island arc is one of the best examples to study a process of crustal growth, because the crustal growth had been started by a subduction of an oceanic crust beneath the other oceanic crust and because the tectonic history is simpler than that of a continental arc, which had been separated from the continental margin with complex structure. An oceanic arc crust is constructed by 'a subduction factory' (e.g., Tatsumi, 2002), however, it is said that it is difficult to make a continental crust only by subduction (Taira et al., 1997). It is thought that the arc-arc collision is one of the important elements to construct granitic middle crust, whose process is however, still poorly understood.

The Izu-Ogasawara arc has granitic middle crust with P-wave velocity (Vp) of 6 km/s and relatively thick lower crust (e.g., Suyehiro et al., 1996). And the crust of the northern Izu-Ogasawara arc is regarded as a matured island arc crust. The crustal growth has been started by a subduction between two oceanic plates located western old Pacific since Eocene time (e.g., Karig and Moore, 1975), and it is said that the initial oceanic arc did not have the granitic layer (e.g., Tatsumi et al., 2004). Macpherson and Hall (2001) suggested that there was initial plume activity with basalt-type magmatism and that the granitic crust has been generated at almost same time with high heat flow. This story is a little different with that of Karig and Moore (1975), however, it is common that there was no granitic layer in the initial stage of arc generation. After the Shikoku and the Parece Vela basins spread during about 30-15 Ma (e.g., Okino et al., 1998), newly volcanism had started near current position of the arc and the oceanic arc has been growing. We believe that these crustal structures have information related such crustal growth history.

To understand above crustal growth history, we focus the crustal growth by arc-arc collision and image crustal thickening and shortening. A basement high called the Shinkurose in the northern Izu-Ogasawara arc had been developed by the crustal thickening (Aoike et al., 2001). A wide-angle refraction study (Nakanishi et al., 1998), a reflection study (Takahashi et al., 2002) and a microseismicity study (Shiobara et al., 1996) ahve revealed that the initiation of new subduction at southern foot of the Zenisu ridge has been occurred by. The crustal shortening should be possible on the northern part of this arc extended from the southern foot of the Zenisu ridge.

Recently, the hot finger hypothesis was proposed by Tamura et al. (2002). It is said that the "hot finger" exists in upper mantle and causes the spatial heterogeneity of the volcanoes along the arc. If there are such variations of the upper mantle, the degree of the crustal differentiation might be also difference between the hot and the cold areas.

The objectives of this cruise are to image above crustal thickening and shortening by arc-arc collision and the heterogeneous structure along the arc, and understand natures of the crustal growth and differentiation not only by a subduction factory but also by an arcarc collision.



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

2. Experiment

We carried out a wide-angle seismic survey using an airgun array and ocean bottom seismographs (OBSs) to achieve above objectives (Figure 1). This cruise using R/V "Kaiyo" of Japan Agency for Marine-Earth Science and Technology (JAMSTEC) consists of two legs; first leg is from July 8 to July 20 and second leg is from July 20 to July 27. The R/V Kaiyo departed from JAMSTEC (Yokosuka) at July 8 and started OBS deployment from the northern part until July 11. Then airgun shooting was carried out until July 14 in northern half of the line.

Then, we recovered 27 OBSs deployed in northern part during July 15 to 17. After that, we deployed OBSs again in the southern part until July 18. Airgun shooting was carried out until July 20, and then we stopped at Port Sokodo, Hachijo Island to change researchers. On the same day, The R/V Kaiyo departed there and we started airgun shooting again from July 21 to 24. Then we recovered 76 OBSs until July 27 and arrived at JAMSTEC at July 28. The actual activities are shown in Table 1 and Figure 2.

To clarify heterogeneous structure by arc-arc colli-

Date	Remarks
July 08	Departure from JAMSTEC, staring OBS deployment (OBS#1-OBS#18)
July 09	OBS deployment (OBS#19-OBS#60)
July 10	KY0408-1 airgun shooting
July 11	KY0408-1 airgun shooting and stopping shooting for emergency retrieval of OBS21
July 12	OBS21 retrieval
July 13	OBS21 deployment again and re-starting KY0408-1 airgun shooting
July 14	KY0408-2 airgun shooting
July 15	Finish of KY0408-2 airgun shooting and starting OBS retrieval (OBS#27-OBS#21)
July 16	OBS retrieval (OBS#1-OBS#17)
July 17	OBS retrieval (OBS#18-OBS#23) and OBSdeployment (OBS#61-OBS#79)
July 18	Finish of OBS deployment (OBS#80-OBS#103) and starting KY0408-3 airgun shooting
July 19	KY0408-3 airgun shooting
July 20	KY0408-3 airgun shooting and , stopped at Hachijo Is.
July 21	Re-starting KY0408-3 airgun shooting and KY0408-4 airgun shooting
July 22	KY0408-4 airgun shooting
July 23	KY0408-4 airgun shooting
July 24	Finish of KY0408-4 airgun shooting and starting OBS retrieval (OBS#103-OBS#91)
July 25	OBS retrieval (OBS#90-OBS#67)
July 26	OBS retrieval (OBS#66-OBS#43)
July 27	OBS retrieval (OBS#42-OBS#28)
July 28	Transit and arrival at JAMSTEC

Table 1: Activity log during KY0408 cruise.

sion and characteristics of matured oceanic arc, we need a long line to cover the whole collision zone. Seismic line was settled as the following requirements are satisfied: (1) to locate near the Izu Peninsula with the granitic block, (2) the position of the seismic line to be basement highs within the rifted zone, because characteristics of the seismic structure are different between the rifted zone and the forearc region, (3) to avoid small basins in the rift area near the Hachijo Island, the Sumisu Island and Tori-shima, because crustal deformation with low velocity block should be by rifted activity with a lot of normal faults, and (4) to take tie with previous seismic lines by Suyehiro et al (1996) and Nishizawa et al (2003) to keep the reliability. Considering the above issues, we set the main line with the length of about 540 km from the Sagami Bay to the Tori-shima. The line runs through the western side of the volcanic front and avoids the depression areas within the rifted zone. The northern and southern ends of the main line are (35°10'57.49"N, 139°11'31.98"E) and (30°26'2.81"N, 140°12'19.05"E), respectively. If the line locates on or nearby islands, we moved the line about two miles from coastline for safety (Figure 1).

One of typical structural characteristics of arc-arc collision might be expressed as a variety of crustal thickness and heterogeneousness along the arc. To detect deep seismic structure to the upper mantle, a length of the seismic line should be longer than a few hundred kilometers and airgun signals from long offset should be recorded on each OBS. To detect heterogeneity of the crust by past tectonics and the distribution of volcanoes, the obtained structure should have high resolution less than 10 km for deeper part. Therefore, we deployed 103 OBSs with an interval of 5 km and an airgun array with 12,000 cubic inches capacity as the source to realize the above requests. This area has complicated sedimentary structure relating to distribution of volcanoes. We recorded airgun signals by not only OBSs but also a 12channel hydrophone streamer to know nature of the shallow structure.

2.1 Airgun shooting

Due to high topographic variation, expected S/N ratio of a part of the OBS records are low. To keep good quality of the OBS data, we took duplicated high spatial shooting with 100 m interval (about 70-100 sec interval depending on the ship speed). Because the length of the seismic line is relatively long, we separated the line into two parts (northern and southern part) to reduce risk against bad weather and severe sea statement by typhoons and low pressures (Figure 3). The northern part is from northern end of the line to Aoga-shima (Lines ky0408-1 and ky0408-2) and southern is from Mikura Island to Tori-shima (Lines ky0408-3 and ky0408-4). Table 2 shows the shooting log.

The airgun array with total capacity of 12,000 cubic inches consists of eight Bolt Longlife Airguns with 1,500 cubic inches capacity each. The air pressure sent to the chamber was 2,000 psi. The geometry of the seismic experiment is shown in Figure 4. The two floats





with two airguns each were deployed from port and starboard sides, respectively. The airgun array's size is 34.56 m length x 21.3 m width. Airgun's position was kept 148.2 m behind the ship position (distances from ship antenna to the stern, and from the stern to center of the airgun array, are 30 m and 110.2 m, respectively).

As the differential global positioning system (DGPS) of the ship navigation system, Skyfix system was used (Sapporo as the nearest station). However, because we have experienced the emergency stop of airgun shooting due to non-succession of GPS data in the past, we intro-

duced StarFire system for seismic navigation system in this cruise. Ship navigation system by Skyfix was used as backup of the seismic navigation system. The accuracy of shooting position was about 10 m.

2.2 Ocean Bottom Seismographs

We deployed 103 OBSs on the seismic line (Figure 1, Table 3). The interval of each OBS is 5 km and was decided by 2-D ray tracing using expected velocity model referring to that of Izu-Ogasawara arc (Suyehiro et al., 1996; Takahashi et al., 1998). However, because



Figure 3: Map of airgun shooting. Blue arrows show a direction of the shooting.

there is a regular course of general ships between the Oshima and the Sagami Bay, we did not deploy OBSs in the area. All OBSs were recovered, however, five OBSs has no data due to troubles of recording system.

All OBSs were equipped with three-component geophones (vertical and two horizontal components perpendicular each other) using gimbal-leveling mechanisms and a hydrophone sensor. Natural frequency of these geophones was 4.5 Hz. The sensitivities of a geophone and hydrophone sensors are shown in Table 4. Our OBSs and the digital recorder system were originally designed by Kanazawa and Shiobara (1994) and Shinohara et al. (1993) as shown in Figure 5. The digital recorder used a 16-bit A/D converter and stored data on

KY0408-1	Time (UTC)	Latitude (N)	Longitude (E)	Depth(m)	SP
First shot	2004.7.11 7:07	32° 26.9835'	139° 49.2772'	531	1005
Stop shot	2004.7.12 11:59	34° 12.9647'	139° 24.4757'	438	2006
Restart shot	2004.7.13 2:03	34° 11.2585'	139° 24.8345'	434	1990
Last shot	2004.7.13 14:51	35° 10.9582'	139° 11.5330'	775	2551
KY0408-2	Time (UTC)	Latitude (N)	Longitude (E)	Depth(m)	SP
First shot	2004.7.13 15:24	35° 11.0153'	139° 11.5403'	820	1001
Stop shot	2004.7.14 17:58	33° 34.7277'	139° 32.8533'	1629	1906
Restart shot	2004.7.15 0:16	33° 38.9915'	139° 31.9193'	1618	1866
Last shot	2004.7.15 17:31	32° 26.6372'	139° 49.4603'	499	2551
KY0408-3	Time (UTC)	Latitude (N)	Longitude (E)	Depth(m)	SP
First shot	2004.7.19 7:04	30° 26.0468'	140° 12.3175'	1160	995
Stop shot	2004.7.19 22:32	33° 11.6065'	139° 37.8302'	872	2559
Restart shot	2004.7.20 23:45	33° 11.2860'	139° 37.8940'	858	2556
Last shot	2004.7.20 10:59	33° 51.4243'	139° 29.2403'	1415	2933
KY0408-4	Time (UTC)	Latitude (N)	Longitude (E)	Depth(m)	SP
First shot	2004.7.20 11:34	33° 51.9748'	139° 29.0687'	1409	1744
Stop shot	2004.7.21 0:36	33° 26.8860'	139° 39.2947'	537	2191
Restart shot	2004.7.21 2:48	33° 63.7060'	139° 39.2225'	493	2191
Last shot	2004.7.22 20:44	30° 54.2260'	140° 13.7095'	1545	3748

Table 2: Airgun shooting log.





digital audiotape or a hard disk sampling continuously with original format (Shinohara et al., 1993). The electronic power for the recorder system of OBS is supplied by rechargeable lithium-ion or alkali batteries. Above geophone sensors with gimbal-leveling mechanism, batteries and a recorder system are installed in 15 inch glass sphere by Benthos, Inc. The glass sphere is stored in the yellow hard hat. To enable easy OBS retrieval after arriving at sea surface, each OBS is attached to a flash light and a beacon with coded signals.

An OBS is deployed by free fall and retrieved by melting releaser composed of stainless steel plates connecting the OBS with a weight when a transponder system receives 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 sea bottom are estimated by SSBL of the vessel's positioning system during the cruise.

After the cruise, we edited the continuous OBS data with length of 70 sec and SEG-Y format. At the same time, calibration of the OBS clock for GPS time was carried out using difference times between OBS clock and GPS time, which measured just before OBS deployment and just after OBS retrieval.

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14 7.8 12.45 34'28.327C 139'20.9857' 248 7.161'1.14' 44'28.215' 139'21.0904' 10 HIGH 15 7.8 13.47 34'26.865' 139'22.0365' 108 7.161'2.06 39'21.7004' 139'22.5440' 237 DAT HIGH 17 7.8 14.19 34'20.4285' 139'22.030' 382 7.161'1.09 34'20.5484' 139'22.5460' 237 DAT HIGH 17 7.8 15.23 34'15.1387' 139'22.8080' 342'17.700' 139'22.546' 393' DAT HIGH 19 7.8 15.23 34'15.1387' 139'25.048' 371 1.161:00 34'12.4592' 393' DAT HIGH 27 7.8 15.1 34'04.5009' 139'26.8003' 14'1 1.161:4' 39'22.045' 39'22.045' 39'22.045' 39'22.045' 39'22.045' 39'22.045' 39'22.045' 39'22.045' 39'22.045' 39'22.045' 39'22.045' 39'22.045' 39'22.045' 39'22.045''3'3'14'16'' <td>13</td> <td>7.8</td> <td>12:12</td> <td>34°31.0507'</td> <td>139°20.4428'</td> <td>301</td> <td>7.16 10:18</td> <td>34°31.2592'</td> <td>139°20.6534'</td> <td>297</td> <td>DAT</td> <td>BTS</td>	13	7.8	12:12	34°31.0507'	139°20.4428'	301	7.16 10:18	34°31.2592'	139°20.6534'	297	DAT	BTS
15 7.8 13.17 34*25.6855 139*21.6055 106 7.16 12.06 34*22.2706 139*22.5404 120 DAT HIGH 16 7.8 14.49 34*10.4285 139*22.3806 238 7.16 14.09 34*22.2766 398 DAT HIGH 17 8 14.49 34*10.7792 139*22.38081 388 7.16 16.00 34*15.0877 139*22.3786 393 HD BTS 20 7.8 15.26 34*01.51.387 139*22.39861 384 7.16 16.63 34*12.4462 139*25.7881 285 HD HIGH 21 7.11 22.58 34*00.5007 139*25.6003 314 7.16 16.94 34*01.5007 319*25.7881 285 HD HIGH 27 7.8 15.51 34*01.9004 139*26.8042 388 7.15 543 34*04.5006 39*22.7731 H4 HD HIGH 27.8 14.53 34*04.5016 139*22.9191 1400 7.15 7.64 33*56.2562 139*22.6031 1290 DAT	14	7.8	12:45	34°28.3876'	139°20.9857'	248	7.16 11:14	34°28.4215'	139°21.0912'	251	DAT	HIGH
16 7.8 13/47 34/23.0837 139'22.2356' 208 7.16 130'23.2706' 139'22.4506' 139'22.4506' 139'23.2850' 139'23.4840' 237 DAT HIGH 19 7.8 15.23 34'17.7722' 139'23.9801' 389 7.16 16100' 34'15.0677' 139'23.48768' 393 HD BTS 27.8 15.56 34'12.4668' 139'24.5943' 451 7.16 160'0' 34'15.0677' 139'25.786' 381 HD HIGH 27.8 15.56 34'10.4500' 139'25.0148' 378 7.16 160''' 39'27.0446' 292 HD HIGH 27.8 17.45 34'00.4500' 139'26.0504' 285 7.15 8.55 35'56.2760' 139'27.0446' 292 HD HIGH 27.8 18.53 35'55.2761' 139'27.77' 139'23.077' 139'23.077' 139'23.056' HD HIGH 27.7 7.8 19.32 35'55.276''' 139'27.7''' 33'55.267''' 139'28.6903''' 1250'''' DAT HIGH 27.8 19	15	7.8	13:17	34°25.6855'	139°21.6055'	106	7.16 12:06	34°25.7198'	139°21.7904'	110	HD	HIGH
17 7.8 14:19 34'20.4285 139'22.8091 394 7.16 150'5 34'12.7721 139'23.2876 381 DAT HIGH 19 7.8 15:23 34'15.1387 139'23.8881 389 7.16 16:00 34'15.0677 139'23.8768 381 DAT HIGH 12 7.8 15:55 34'12.46861 139'25.6403 314 7.16 16:00 34'12.5737 188 HD HIGH 12 7.8 16:51 34'0.90.00' 139'25.6604 285 7.16 20:33'44'0.93.6604 282 HD HIGH 14 7.8 17.45 34'0.19.004' 139'25.6604 285 35'5.355 35'5.2595' 139'27.7731 492 HD HIGH 16 7.8 18:58 35'5.2895' 139'27.4411 1028'7.5'75' 33'5.65760' 139'28.2696' 39' LDD DAT HIGH 17.8 18:52 33'53.890'1 33'2.0864' 139'32.046'1 139'27.441'1 1028'1 7.27'5'47'1 33'48.4937'139'20.654'161'7 HD HIGH 17.8	16	7.8	13:47	34°23.0837'	139°22.2356'	208	7.16 13:03	34°23.2706'	139°22.5440'	237	DAT	HIGH
18 7.8 14:49 34*17.7/42 139*23.3800 382 7.16 15:15 34*17.7/01 139*23.8766 381 DAI HIGH 20 7.8 15:56 34*12.4668 139*24.5943 451 7.16 16:60 34*15.667 139*25.7881 285 HD HIGH 21 7.11 225 34*09.8007 139*26.6042 285 7.16 16:01 139*26.0466 292 HD HIGH 23 7.8 17.45 34*04.5006 139*26.0464 292 HD HIGH 24 7.8 17.45 34*04.5006 139*26.0464 292 HD HIGH 25 7.8 17.45 34*04.5006 139*27.0845 376 DAT HIGH 26 7.8 17.23 35*35.576 139*28.0903 120 DAT HIGH 27 7.48 33*45.8606 139*30.2811 1689 7.27 4:4 33*45.8907 139*28.0903 120 DAT HIGH 27 7.8 21.34 33*43.29491 139*30.2021 1	17	7.8	14:19	34°20.4285'	139°22.8091'	394	7.16 14:09	34°20.5849'	139°22.8506'	400	DAT	HIGH
19 7.8 15.23 3415.1367 139/23.2861 369 7.16 10.00 3413.0477 3457 DAT HIGH 21 7.8 15.56 3470.24668 139/25.0148 378 7.16 18.07 34709.3949 139/25.7367 318 HD HIGH 22 7.8 17.20 139/25.6603 314 7.16 139/25.7367 318 HD HIGH 23 7.8 17.20 34'04.5004 139/25.6603 314 7.15 9.51 34'04.9066 139/22.0465 378 DAT HIGH 24 7.8 18:58 33'95.2411 139/27.411 102 7.15 6.63 35'5.2867 139/28.0403 1250 DAT HIGH 26 7.8 18:58 33'93.039/3 139/28.8313 120 DAT HIGH 27 7.8 21:34 33'35.2897 139/30.8261 1617 HD HIGH 27 7.8 21:34 33'35.28971	18	7.8	14:49	34°17.7792'	139°23.3800°	382	7.16 15:05	34°17.7701	139°23.2575	381		HIGH
103 1	20	7.0	15.25	34 15.1567	139 23.9001	309 451	7.16 16.00	34 15.0077 34°12 4592'	139 23.0700	393 457		HIGH
22 7.8 16:51 34*07.2018 139*25.6803* 314 7.16 19:42 34*07.1887* 139*25.7367* 318 HD HIGH 23 7.8 17:20 34*04.5009 139*26.0604* 285 7.16 20:33 34*04.5006 139*26.0446* 292 HD HIGH 24 7.8 17:45 33*59.2419 139*27.4990* 511 7.15 8:56 35:56:69 95 HD HIGH 27 7.8 18:58 35:56:511 139*27.2921*14 10:28 7.15 6:48 33*53.8057 139*28.256* 95 HD HIGH 27 7.8 19:32 33*51.2589 139*29.1191* 1400 7.27 5:44 33*35.127 139*30.0545 1617 HD BTS 37.8 21:04 33*36.2997 139*30.3821* 1660 7.27 1:43 33*36.517 139*33.239* 1611 HD BTS 37.8 22:30 33*37.244* 133*36.517 139*33.239	21	7.11	22:58	34°09.8507'	139°25.0148'	378	7.16 18:07	34°09.3949'	139°25.7881'	285	HD	HIGH
22 7.8 17.20 34°0.4.5009 139°26.0446 292 HD HIGH 24 7.8 17.15 951 34°0.1.9006 139°26.0446 292 HD HIGH 25 7.8 18:15 33°56.2511 139°27.4990 511 7.15 8:55 33°56.2562 139°27.7731 492 HD HIGH 26 7.8 18:58 33°56.5311 139°27.9411 1028 7.15 7:56 33°56.2567 139°28.2596 995 HD HIGH 27 7.8 20:04 33°51.2589 139°29.1191 1401 7.27 7:04 33°51.2887 139°28.2596 995 HD HIGH 28 7.8 20:04 33°4.8600 139°28.104647 139°30.0545 1617 HD HIGH 27 7.8 21:34 33°32.6341 1666 7.27 31°33.3217 139°31.0977 1661 HD HIGH 37 7.8 22:10 33°37.9795 139°32.6224 1611 7.27 228 33°38.1325 139°32.49977 1629 HD	22	7.8	16:51	34°07.2018'	139°25.6803'	314	7.16 19:42	34°07.1387'	139°25.7367'	318	HD	HIGH
24 7.8 17.45 34*01.9816 139*27.0847 378 DAT HIGH 25 7.8 18:15 35*02.419 139*27.4990 511 7.15 8:55 33*56.5760 139*28.2596 995 HD HIGH 27 7.8 19:32 33*55.39034 139*27.9411' 1028 7.15 6:48 33*53.8957 139*28.6903' 1250 DAT HIGH 27 7.8 19:32 33*46.016' 139*29.7104' 1603 7.27 5:47 33*48.4937' 139*30.0577' 1616 HD HIGH 30 7.8 2:134 33*43.2949' 139*30.859' 165 7.27 14:10 33*3.217' 139*31.070'' 1642 HD HIGH 37 7.8 2:104 33*35.299'' 139*32.6232' 1610 7.26 2:3*33*3.55.510' 139*33.239'' 1642 HD HIGH 37 7.8 2:341 33*32.6349' 139*33.724' 132'' 132''' 139*33.339'' 1611 HD HD HIGH 37 7.9 0.47	23	7.8	17:20	34°04.5009'	139°26.0504'	285	7.16 20:33	34°04.5006'	139°26.0446'	292	HD	HIGH
25 7.8 18:16 33*69.2419 139*27.4911 1028 7.15 8:56 33*69.2525 139*27.7731 492 HD HIGH 26 7.8 18:68 33*65.5111 139*27.9411 1028 7.15 7.56 33*65.5760 139*28.2596 995 HD HIGH 27 7.8 120:34 33*48.6016 139*29.21141 1061 7.27 7.47 33*48.4937 139*30.6045 1617 HD HD HIGH 30 7.8 21:04 33*43.80616 139*30.8859' 1666 7.27 4:14 33*43.0077' 1661 HD BTS 31 7.8 22:07 33*40.6062' 139*31.4765 1664 7.27 1:48 33*43.3217' 139*31.6077' 1629 HD HIGH 37 7.8 23:03 33*32.5297' 139*32.0204' 1631 7.27 1:48 33*40.6447' 139*31.7900' 1642 HD HIGH 37 7.9 0:12 33*32.5297' 139*33.1111' 1655 7.26 2:043 33*32.936'1611 HD <td>24</td> <td>7.8</td> <td>17:45</td> <td>34°01.9004'</td> <td>139°26.8982'</td> <td>388</td> <td>7.15 9:51</td> <td>34°01.9816</td> <td>139°27.0845'</td> <td>378</td> <td>DAT</td> <td>HIGH</td>	24	7.8	17:45	34°01.9004'	139°26.8982'	388	7.15 9:51	34°01.9816	139°27.0845'	378	DAT	HIGH
26 7.8 18392 33*56.57.01 139*28.2936 995 HD HIGH 27 7.8 139:28 33*51.2589 139*28.5313 139*28.713 139*28.6903 1250 DAT HIGH 28 7.8 20:34 33*48.6016 139*29.7104 1603 7.27 5:47 33*364.9377 139*30.0645 1667 HD HIGH 29 7.8 21:04 33*45.860 139*30.3281 1669 7.27 3:14 33*346.9173 139*30.0677 1661 HD BTS 31 7.8 22:07 33*40.6062 139*31.4765 16641 7.27 1:44 33*40.6447 139*31.9970 1642 HD HIGH 34 7.8 22:07 33*30.52997 139*32.2024 1611 7.26 2:14 33*35.510 139*32.4997 1629 HD HIGH 34 7.8 23:41 33*22.9327 1610 7.26 2:14 33*35.510 139*33.2386 1611 HD HIGH 36 7.9 0:47 33*22.46798 139*33.7284	25	7.8	18:15	33°59.2419'	139°27.4990'	511	7.15 8:55	33°59.2952'	139°27.7731'	492	HD	HIGH
21 7.8 19.22 33'53.933' 1240 7.13' 6.46' 33'35.1288' 139'20.933' 1290' DA1' HIGH 29 7.8 20.43 33'46.6016' 139'29.1191' 1401 7.27' 7.44' 33'45.9173' 139'30.0645' 161' HD HIGH 30 7.8 21.34' 33'43.2949' 199'30.8689' 1666 7.27' 31'4' 139'31.0977' 1661 HD BTS 31 7.8 22.19 33'37.9755' 139'32.0214' 1631' 7.27' 120''' 33''''' 139'''''' 1629''' HD HIGH 34 7.8 23.10''' 33'''''''''''''' 139''''''''''''''''''''''''''''''''''''	26	7.8	18:58	33°56.5311	139°27.9411'	1028	7.15 7:56	33°56.5760	139°28.2596	995	HD	HIGH
17.8 20.34 33°48.6016 139°29.7104 1603 7.27 5.47 33°48.4937 139°30.0545 1617 HD HIGH 30 7.8 21:34 33°48.6016 139°29.7104 1603 7.27 5.47 33°48.4937 139°30.0545 1661 HD BTS 31 7.8 21:34 33°44.80606 139°30.8855 1666 7.27 1:41 33°40.6447 139°31.0977 1661 HD BTS 32 7.8 22:10 33°32.6362 1610 7.27 1:44 33°40.6447 139°31.7900 1642 HD HIGH 34 7.8 22:10 33°32.6957 139°32.0227 1610 7.26 2:14 33°35.5310 139°33.2396 1611 HD BTS 37 7.9 0:12 33°24.9277 139°33.2372 1087 33°44.8147 1087 HD BTS 37 7.9 0:12 33°24.0204 139°34.8214 1087 HD HIGH 38 7.9 1:22 33°24.0703 139°35.633 199°35.633 19	21	7.0 7.8	19.32 20.04	33°53.9034	139'20.5313	1240	7.15 0.46	33°51 2887'	139°20.0903	1250	DAT	HIGH
30 7.8 21:04 33°45.8860' 139°30.3281' 1669 7.27 4:18 33°45.9173' 139°30.6077' 1675 HD BTS 31 7.8 21:34 33°43.2949' 139°30.8859 1656 7.27 3:01 33°43.217' 139°31.0977' 1661 HD BTS 32 7.8 22:07 33°40.6062' 139°31.4765' 1641 7.27 3:01 33°43.217' 139°31.2007' 1629 HD HIGH 34 7.8 22:39 33°37.9795' 139°32.6232' 1610 7.26 22:04 33°38.1335' 139°33.2396' 1611 HD BTS 35 7.8 23:41 33°3.2639' 139°3.26424' 1312' 7.26 22:04 33°3.0.000' 139°3.4.3128' 1375 HD BTS 37 7.9 0.47 33°2.7.098' 139°3.4.3128' 1375 HD BTS 37 7.9 0.47 33°2.7.098' 139°3.6.433 139°3.6.438 199' HD HIGH 38'7.9 1.02 33°2.0.038' 139°3.6.638' 199' HD<	29	7.8	20:34	33°48.6016'	139°29.7104'	1603	7.27 5:47	33°48.4937'	139°30.0545'	1617	HD	HIGH
31 7.8 21:34 33°43.2499 139°30.8859 1656 7.27 3:01 33°43.3217 139°31.0977 1661 HD BTS 32 7.8 22:07 33°40.6062 139°31.4765 1641 7.27 1:44 33°40.6447 139°31.7900 1642 HD HIGH 34 7.8 23:10 33°35.2997 139°32.6232 1610 7.26 23:14 33°35.5310' 139°33.2396' 1611 HD BTS 35 7.8 23:41 33°32.6349' 139°33.244' 1312' 7.26 20:43 33°30.3000' 139°33.4633' HD BTS 37 7.9 0:47 33°22.0932' 139°35.649' 205 7.26 133'3 139'36.833' 1402 DAT HIGH 38 7.9 1:42 33°22.0034' 139°35.649' 205 7.26 13'3'32.207' 139'35.633' 199 HD HIGH 40 7.9 2:42 33°14.068' 139°37.551' 855 7.26 16:67 33°14.068' 139'37.551' BD HD HIGH	30	7.8	21:04	33°45.8860'	139°30.3281'	1669	7.27 4:18	33°45.9173'	139°30.6077'	1675	HD	BTS
32 7.8 22:07 33°40.6062' 139°31.4765' 1641 7.27 1:44 33°40.6447' 139°31.7900' 1642 HD HIGH 33 7.8 22:39 33°37.9795' 139°32.0204' 1631 7.27 0:28 33°35.1335' 139°32.4997' 1629 HD HIGH 34 7.8 23:41 33°32.6349' 139°33.7284' 1312 7.26 22:04 33°32.9126' 139°33.8683' 1462 DAT HIGH 36 7.9 0:12 33°27.2991' 139°33.7284' 1312 7.26 22:04 33°32.7103' 139°34.3128' 1375 HD BTG 37 7.9 0:47 33°27.2991' 139°34.5049' 205 7.26 17:31 33°22.0073' 139°35.6481' HD HIGH 38 7.9 1:22 33°14.0669' 139°37.1986' 792 7.26 16:37 33°14.073' 139°36.181' 215 DAT HIGH 40 7.9 3:56 33°14.0669' 139°37.1986' 722 7.26 15:09 33°14.0731' 139°36.181' 139°37.2607' 788 DAT	31	7.8	21:34	33°43.2949'	139°30.8859'	1656	7.27 3:01	33°43.3217'	139°31.0977'	1661	HD	BTS
33 7.8 22:39 33"37.9795 139"32.0204" 1631 7.27 0:28 33"33.81.135" 139"32.4997" 1629 HD HIGH 34 7.8 23:10 33"35.2997" 139"32.0232" 1610 7.26 22:14 33"35.5310" 139"33.2964 1611 HD BTS 35 7.8 23:41 33"2.6349 139"33.7284' 1312 7.26 20:45 33"30.3000 139"34.3128' 1375 HD BTS 37 7.9 0:47 33"2.034' 139"35.049' 205 7.26 17:31 33"22.0073' 139"35.6383' 199 HD HIGH 39 7.9 2:09 33"2.0034' 139"35.049' 205 7.26 16:47 33"19.4103' 139"36.683' 199 HD HIGH 40 7.9 2:42 33"14.0669' 139"37.1988' 792 7.26 16:59 33"16.737' 139"36.1891' 215 DAT HIGH 41 7.9 3:56 33"0.103' 139"37.7551' 855 7.26 14:14 33"14.0681' 139"37.8104' 856 HD HIGH	32	7.8	22:07	33°40.6062'	139°31.4765'	1641	7.27 1:44	33°40.6447'	139°31.7900'	1642	HD	HIGH
34 7.6 23.3 33.33.2997 139.32.6232 1610 7.26 23.14 33.33.3030 139.33.2683 1611 DAT HIGH 35 7.8 23.41 33'22.639 139'33.2684 1312 7.26 22.04 33'23.2683 1462 DAT HIGH 36 7.9 0:47 33'22.69927 139'33.6683 1109 7.26 122 33'24.6798 139'34.659 1109 7.26 139'34.2216' 139'35.6483' 199 HD HIGH 37 7.9 0:47 33'22.0034' 139'35.5049' 205 7.26 16:47 33'93.6.883' 199 HD HIGH 40 7.9 2:42 33'91.301' 139'36.6658' 199 7.26 16:47 33'91.4103' 139'36.787' 455 HD HIGH 41 7.9 3:17 33'14.484' 139'37.7551' 855 7.26 16:01' 139'37.8104' 856 HD HIGH 42 7.9 5:05 33'06.1083' 139'38.136' 552 7.26 13:0'33'08.7967' 139'38.26	33	7.8	22:39	33°37.9795'	139°32.0204'	1631	7.27 0:28	33°38.1335'	139°32.4997'	1629	HD	HIGH
36 7.9 2.14 33 22.9.9827 139°33.7124 1312 7.26 22.045 33°30.3000 139°33.43128 1375 HD BTS 37 7.9 0:47 33°27.2991' 139°34.3659' 1109 7.26 19:33 33°24.7132' 139°35.6383' 199 HD HIGH 38 7.9 2:09 33°22.034' 139°34.9178' 355 7.26 18:20 33°22.073' 139°35.6383' 199 HD HIGH 39 7.9 2:42 33°14.0868' 139°36.6452' 450 7.26 16:47 33°14.081' 139°36.1891' 215 DAT HIGH 41 7.9 3:17 33°14.0868' 139°37.1988' 792 7.26 15:59 33°14.6081' 139°37.8104' 856 HD HIGH 41 7.9 5:55 33°06.1083' 139°37.755' 855 7.26 15:59 33°14.6081' 139°37.8104' 856 HD HIGH 43 7.9 5:55 33°06.1083' 139°37.755' 855 7.26 14:14' 33°11.488' 139°37.8104' 856 HD HIGH 4	34	7.0	23:10	33°32,2997	139'32.0232	1635	7.20.23.14	33°32,0310	130°33 8683'	1/62		ысн
37 7.9 0.47 33°27.2991' 139°34.3659 1109 7.26 19:33 33°27.4036 139°34.8214' 1087 HD HIGH 38 7.9 1:22 33°24.6798' 139°34.9178' 355 7.26 18:20 33°24.7132' 139°35.6383' 199 HD HIGH 39 7.9 2:09 33°22.0034' 139°35.6049' 205 7.26 17:31 31°37.56383' 199 HD HIGH 40 7.9 2:42 33°14.0669' 139°37.1988' 792 7.26 15:59 33°16.7371' 139°36.6452' 450 7.26 15:9' 33°16.7371' 139°36.7871' 455 HD HIGH 41 7.9 4:30 33°14.0869' 139°37.1988' 792 7.26 15:0' 33°16.7371' 139°38.8406' HIGH 430°17.488' 139°38.180' HD HIGH 43 7.9 5:33 33°06.1083' 139°38.8406' 413 7.26 12:32 33°06.1681' 139°38.2210' 515 DAT HIGH 46 7.9 6:31	36	7.9	0:12	33°29,9827'	139°33,7284'	1312	7.26 20:45	33°30.3000'	139°34,3128'	1375	HD	BTS
38 7.9 1:22 33°24.6798 139°34.9178' 355 7.26 18:20 33°24.7132' 139°35.2047' 456 HD HIGH 39 7.9 2:09 33°22.0034' 139°35.6049' 205 7.26 17:31 33°22.0073' 139°36.6833' 199 HD HIGH 40 7.9 2:42 33°14.0869' 139°36.6452' 450 7.26 15:59 33°16.737' 139°36.787' 455 HD HIGH 41 7.9 3:05 33°14.0869' 139°37.7551' 855 7.26 14:14 33°11.4384' 139°37.7551' 855 7.26 14:14 33°1.4088' 139°38.2210' 515 DAT HIGH 44 7.9 5:05 33°06.1083' 139°38.8406' 613 7.26 12:20 33°08.767' 139°38.220' 515 DAT HIGH 45 7.9 6:33 33°0.8140' 139°38.8406' 522 7.26 11:02 33°0.90.204' 139°41.3244' 53	37	7.9	0:47	33°27.2991'	139°34.3659'	1109	7.26 19:33	33°27.4036'	139°34.8214'	1087	HD	HIGH
39 7.9 2:09 33°22.0034' 139°35.5049' 205 7.26 17:31 33°22.0073' 139°35.6383' 199 HD HIGH 40 7.9 2:42 33°19.3701' 139°36.6652' 450 7.26 16:47 33°14.403' 139°36.1881' 215 DAT HIGH 41 7.9 3:76 33°16.7327' 139°36.6452' 450 7.26 15:99 33°14.4081' 139°37.2967' 788 DAT HIGH 43 7.9 4:30 33°14.4086' 139°37.7551' 855 7.26 14:14 33°11.4838' 139°37.8104' 856 HD HIGH 44 7.9 5:05 33°08.7407' 139°38.8406' 413 7.26 15:20 33°08.7699' 421 HD HIGH 45 7.9 5:35 33°06.10831' 139°38.8406' 413 7.26 11:32 33°01.8181' 139°37.8104' 555 HD HIGH 46 7.9 6:33 33°03.80811' 139°38.8406' 413 7.26 11:32 33°01.9204' 139°40.1344' 553 HD HIGH 47 7.9 <td>38</td> <td>7.9</td> <td>1:22</td> <td>33°24.6798'</td> <td>139°34.9178'</td> <td>355</td> <td>7.26 18:20</td> <td>33°24.7132'</td> <td>139°35.2047'</td> <td>456</td> <td>HD</td> <td>HIGH</td>	38	7.9	1:22	33°24.6798'	139°34.9178'	355	7.26 18:20	33°24.7132'	139°35.2047'	456	HD	HIGH
407.92:4233°19.3701'139°36.0658'1997.26 16:4733°19.4103'139°36.0787'215DATHIGH417.93:1733°16.7327'139°36.6452'4507.26 15:5933°16.7371'139°36.7787'455HDHIGH427.93:5633°14.0869'139°37.198'7927.26 15:5933°14.6081'139°37.2967'788DATHIGH437.94:5033°11.4384'139°37.7551'8557.26 14:1433°14.4838'139°37.8104'856HDHIGH447.95:0533°06.1083'139°38.1896'5067.26 12:2233°06.1814'139°37.8104'856HDHIGH457.96:3333°0.8181'139°39.5133'5527.26 11:5133°03.5681'139°34.01344'553HDHIGH477.96:3133°0.8181'139°40.6825'4597.26 11:0233°0.9204'139°40.7186'460DATHIGH487.96:5632°58.1394'139°40.6825'4597.26 11:0233°0.9204'139°40.7186'460DATHIGH497.97:2332°55.5031'139°41.2187'4647.26 9:1732°58.1566'139°41.2256'466DATBTS507.97:5132°52.8479'139°41.8167'4887.26 6:3332°47.5342'139°43.4645'464HDBTS517.98:1932°50.1914'139°43.4758'4567.26	39	7.9	2:09	33°22.0034'	139°35.5049'	205	7.26 17:31	33°22.0073'	139°35.6383'	199	HD	HIGH
41 7.9 3:17 33°16.7327 139°36.6452' 450 7.26 15:59 33°16.7371' 139°36.787' 455 HD HIGH 42 7.9 3:56 33°14.0869' 139°37.1988' 792 7.26 15:09 33°14.6081' 139°37.2967' 788 DAT HIGH 43 7.9 4:30 33°14.4384' 139°37.7551' 855 7.26 14:14 33°14.6081' 139°38.220' 515 DAT HIGH 44 7.9 5:05 33°08.7407' 139°38.8406' 413 7.26 12:32 33°08.7967' 139°38.7599' 421 HD HIGH 45 7.9 5:35 33°0.1083' 139°39.5133' 552 7.26 11:02 33°0.0204' 139°40.1344' 553 HD HIGH 46 7.9 6:61 32°58.1394' 139°40.1269' 564 7.26 10:09 32°58.1757' 139°40.1344' 553 HD HIGH 47 7.9 6:51 32°55.5031' 139°41.2187' 464 7.26 9:17 32°58.1757' 139°41.2266' 466 DAT HIGH <t< td=""><td>40</td><td>7.9</td><td>2:42</td><td>33°19.3701'</td><td>139°36.0658'</td><td>199</td><td>7.26 16:47</td><td>33°19.4103'</td><td>139°36.1891'</td><td>215</td><td>DAT</td><td>HIGH</td></t<>	40	7.9	2:42	33°19.3701'	139°36.0658'	199	7.26 16:47	33°19.4103'	139°36.1891'	215	DAT	HIGH
42 7.9 3.30 3.314.0609 139'37.1966 792 7.26 13.09 3.3'14.081 139'37.2907 786 DAI HIGH 43 7.9 4:30 33'11.4384' 139'37.7551' 855 7.26 14:14 33'11.4383' 139'37.8104' 856 HD HIGH 44 7.9 5:05 33'08.7407' 139'38.1896' 506 7.26 13:20 33'08.7667' 139'38.2210' 515 DAT HIGH 45 7.9 6:03 33'00.8181' 139'39.5133' 552 7.26 11:51 33'00.9204' 139'40.1344' 553 HD HIGH 47 7.9 6:31 33'00.8181' 139'40.6825' 459 7.26 10:09 32'58.1757' 139'40.7186' 460 DAT HIGH 48 7.9 6:56 32'55.031' 139'41.2187' 464 7.26 9:17 32'55.5063' 139'41.2256' 466 DAT HIGH 49 7.9 7:51 32'55.0914' 139'42.3731' 492 7.26 7:26 7:30 32'51.916' 139'42.4449' 498 HD BTS <td< td=""><td>41</td><td>7.9</td><td>3:17</td><td>33°16.7327</td><td>139°36.6452'</td><td>450</td><td>7.26 15:59</td><td>33°16.7371'</td><td>139°36.7787'</td><td>455</td><td>HD</td><td>HIGH</td></td<>	41	7.9	3:17	33°16.7327	139°36.6452'	450	7.26 15:59	33°16.7371'	139°36.7787'	455	HD	HIGH
44 7.9 5:05 33°08.7407' 139°38.1896' 506 7.26 132°38.2210' 515 DAT HIGH 45 7.9 5:35 33°06.1083' 139°38.8406' 413 7.26 12:32 33°06.1814' 139°38.2210' 515 DAT HIGH 46 7.9 6:03 33°03.3890' 139°39.5133' 552 7.26 11:51 33°03.5681' 139°39.4259' 600 HD HIGH 47 7.9 6:31 33°00.8181' 139°40.1269' 564 7.26 11:02 33°00.9204' 139°40.1344' 553 HD HIGH 48 7.9 6:56 32°55.5031' 139°41.2187' 464 7.26 9:17 32°55.063' 139°41.2256' 466 DAT HIGH 49 7.9 7:51 32°55.031' 139°42.3731' 492 7.26 7:30 32°50.1916' 139°42.4449' 498 HD BTS 52 7.9 8:48 32°47.5329' 139°43.4758' 456 7.26 5:44 32°42.2137' 139°43.4645' 464 HD	42	7.9	3.50 4·30	33°14.0609	139°37.1966	792 855	7.26 15.09	33°14.0001 33°11 4838'	139°37.2907	700 856		HIGH
45 7.9 5:35 33°06.1083' 139°38.8406' 413 7.26 12:32 33°06.1814' 139°38.7699' 421 HD HIGH 46 7.9 6:03 33°03.3890' 139°39.5133' 552 7.26 11:51 33°03.5681' 139°39.4259' 600 HD HIGH 47 7.9 6:31 33°00.8181' 139°40.1269' 564 7.26 11:02 33°00.9204' 139°40.1344' 553 HD HIGH 48 7.9 6:56 32°58.1394' 139°40.6825' 459 7.26 10:09 32°55.5063' 139°40.7186' 460 DAT HIGH 49 7.9 7:23 32°55.031' 139°41.2187' 464 7.26 9:17 32°55.5063' 139°41.8712' 495 DAT HIGH 50 7.9 7:51 32°50.1914' 139°42.3731' 492 7.26 7:30 32°50.1916' 139°42.4449' 498 HD BTS 52 7.9 8:48 32°47.5329' 139°43.4758' 456 7.26 5:44 32°44.9238' 1	44	7.9	5:05	33°08.7407'	139°38.1896'	506	7.26 13:20	33°08.7967'	139°38.2210'	515	DAT	HIGH
46 7.9 6:03 33°03.3890' 139°39.5133' 552 7.26 11:51 33°03.5681' 139°39.4259' 600 HD HIGH 47 7.9 6:31 33°00.8181' 139°40.1269' 564 7.26 11:02 33°00.9204' 139°40.1344' 553 HD HIGH 48 7.9 6:56 32°58.1394' 139°40.6825' 459 7.26 10:09 32°58.1757' 139°40.7186' 460 DAT HIGH 49 7.9 7:23 32°55.5031' 139°41.2187' 464 7.26 9:17 32°55.5063' 139°41.2256' 466 DAT BTS 50 7.9 7:51 32°50.1914' 139°42.3731' 492 7.26 7:30 32°50.1916' 139°42.4449' 498 HD BTS 52 7.9 8:48 32°47.5329' 139°43.4758' 456 7.26 5:44 32°44.9238' 139°43.4645' 464 HD BTS 54 7.9 9:40 32°42.2446' 139°44.0417' 441 7.26 4:03 32°39.5290' 139°44.4857' 547 HD HIGH 55 </td <td>45</td> <td>7.9</td> <td>5:35</td> <td>33°06.1083'</td> <td>139°38.8406'</td> <td>413</td> <td>7.26 12:32</td> <td>33°06.1814'</td> <td>139°38.7699'</td> <td>421</td> <td>HD</td> <td>HIGH</td>	45	7.9	5:35	33°06.1083'	139°38.8406'	413	7.26 12:32	33°06.1814'	139°38.7699'	421	HD	HIGH
477.96:3133°00.8181'139°40.1269'5647.26 11:0233°00.9204'139°40.1344'553HDHIGH487.96:5632°58.1394'139°40.6825'4597.26 10:0932°58.1757'139°40.7186'460DATHIGH497.97:2332°55.5031'139°41.2187'4647.26 9:1732°55.5063'139°41.2256'466DATBTS507.97:5132°52.8479'139°41.8167'4887.26 8:2232°52.8576'139°41.8712'495DATHIGH517.98:1932°50.1914'139°42.3731'4927.26 7:3032°50.1916'139°42.4449'498HDBTS527.98:4832°47.5329'139°42.9557'4867.26 6:3332°47.5342'139°43.4645'464HDBTS537.99:1432°44.9051'139°43.4758'4567.26 5:4432°44.9238'139°43.4645'464HDBTS547.99:4032°42.2446'139°44.0417'4417.26 4:5532°42.2137'139°43.9542'440HDHIGH557.910:0632°39.5916'139°45.1628'8867.26 3:0632°36.8652'139°45.0266'914HDBTS567.910:3232°31.6313'139°45.7883'9987.26 2:0232°31.5825'139°45.7067'1007HDHIGH587.911:2832°31.6313'139°47.7877'6797.25 23	46	7.9	6:03	33°03.3890'	139°39.5133'	552	7.26 11:51	33°03.5681'	139°39.4259'	600	HD	HIGH
48 7.9 6:56 32°58.1394' 139°40.6825' 459 7.26 10:09 32°58.1757' 139°40.7186' 460 DAT HIGH 49 7.9 7:23 32°55.5031' 139°41.2187' 464 7.26 9:17 32°55.5063' 139°41.2256' 466 DAT BTS 50 7.9 7:51 32°52.8479' 139°41.8167' 488 7.26 8:22 32°55.5063' 139°41.8712' 495 DAT HIGH 51 7.9 8:19 32°50.1914' 139°42.3731' 492 7.26 7:30 32°50.1916' 139°42.4449' 498 HD BTS 52 7.9 8:48 32°47.5329' 139°42.9557' 486 7.26 6:33 32°47.5342' 139°43.4645' 464 HD BTS 54 7.9 9:40 32°42.2446' 139°44.0417' 441 7.26 4:55 32°42.2137' 139°43.8645' 464 HD HIGH 55 7.9 10:06 32°39.5916' 139°44.6195' 558 7.26 4:03 32°36.8652' 139°45.0266' 914 HD HIGH 56 </td <td>47</td> <td>7.9</td> <td>6:31</td> <td>33°00.8181'</td> <td>139°40.1269'</td> <td>564</td> <td>7.26 11:02</td> <td>33°00.9204'</td> <td>139°40.1344'</td> <td>553</td> <td>HD</td> <td>HIGH</td>	47	7.9	6:31	33°00.8181'	139°40.1269'	564	7.26 11:02	33°00.9204'	139°40.1344'	553	HD	HIGH
49 7.9 7:23 32°55.5031 139°41.2187 464 7.26 9:17 32°55.5063 139°41.2256 466 DAI BTS 50 7.9 7:51 32°52.8479' 139°41.8167' 488 7.26 8:22 32°52.8576' 139°41.8712' 495 DAT HIGH 51 7.9 8:19 32°50.1914' 139°42.3731' 492 7.26 7:30 32°50.1916' 139°42.4449' 498 HD BTS 52 7.9 8:48 32°47.5329' 139°42.9557' 486 7.26 6:33 32°47.5342' 139°43.4645' 464 HD BTS 53 7.9 9:14 32°42.2446' 139°44.0417' 441 7.26 4:55 32°42.2137' 139°43.4645' 464 HD BTS 54 7.9 9:40 32°42.2446' 139°44.0417' 441 7.26 4:03 32°30.5290' 139°44.4857' 547 HD HIGH 55 7.9 10:32 32°36.9336' 139°45.1628' 886 7.26 3:06 32°34.2505' 139°45.026	48	7.9	6:56	32°58.1394'	139°40.6825'	459	7.26 10:09	32°58.1757'	139°40.7186'	460	DAT	HIGH
50 7.3 7.	49 50	7.9	7:23	32°55.5031 32°52.8470'	139°41.2187 130°/1 8167'	464	7.26 9:17	32°55.5063	139°41.2256 139°41.8712'	400		RI2
52 7.9 8:48 32°47.5329' 139°42.9557' 486 7.26 6:33 32°47.5342' 139°42.9881' 491 DAT HIGH 53 7.9 9:14 32°44.9051' 139°43.4758' 456 7.26 5:44 32°44.9238' 139°43.4645' 464 HD BTS 54 7.9 9:40 32°42.2446' 139°44.0417' 441 7.26 4:55 32°42.2137' 139°43.4645' 464 HD HIGH 55 7.9 10:06 32°39.5916' 139°44.6195' 558 7.26 4:03 32°39.5290' 139°43.4645' 404 HD HIGH 56 7.9 10:32 32°36.9336' 139°45.1628' 886 7.26 3:06 32°36.8652' 139°45.0266' 914 HD BTS 57 7.9 10:58 32°31.6313' 139°45.7883' 998 7.26 2:02 32°31.5825' 139°45.7067' 1007 HD HIGH 58 7.9 11:28 32°31.6313' 139°47.7877' 679 7.25 23:59 32°28.9835' 139°47.7030' <td>51</td> <td>7.9</td> <td>8:19</td> <td>32°50,1914'</td> <td>139°42.3731'</td> <td>400</td> <td>7.26 7:30</td> <td>32°50,1916'</td> <td>139°42,4449'</td> <td>498</td> <td>HD</td> <td>BTS</td>	51	7.9	8:19	32°50,1914'	139°42.3731'	400	7.26 7:30	32°50,1916'	139°42,4449'	498	HD	BTS
537.99:1432°44.9051'139°43.4758'4567.265:4432°44.9238'139°43.4645'464HDBTS547.99:4032°42.2446'139°44.0417'4417.264:5532°42.2137'139°43.9542'440HDHIGH557.910:0632°39.5916'139°44.6195'5587.264:0332°39.5290'139°44.4857'547HDHIGH567.910:3232°36.9336'139°45.1628'8867.263:0632°36.8652'139°45.0266'914HDBTS577.910:5832°34.2739'139°45.7883'9987.262:0232°31.5825'139°45.7067'1007HDHIGH587.911:2832°31.6313'139°46.4117'9857.261:0232°31.5825'139°46.3564'989HDHIGH597.912:0232°20.0668'139°47.7877'6797.25 23:5932°26.49835'139°47.7030'652DATHIGH607.912:3632°26.6013'139°49.5222'5127.25 23:0032°26.4984'139°49.5077'453HDBTS617.174:4132°23.6573'139°48.0231'9207.25 22:0232°23.5690'139°48.2449'999HDHIGH	52	7.9	8:48	32°47.5329'	139°42.9557'	486	7.26 6:33	32°47.5342'	139°42.9881'	491	DAT	HIGH
54 7.9 9:40 32°42.2446' 139°44.0417' 441 7.26 4:55 32°42.2137' 139°43.9542' 440 HD HIGH 55 7.9 10:06 32°39.5916' 139°44.6195' 558 7.26 4:03 32°39.5290' 139°44.4857' 547 HD HIGH 56 7.9 10:32 32°36.9336' 139°45.1628' 886 7.26 3:06 32°36.8652' 139°45.0266' 914 HD BTS 57 7.9 10:58 32°31.6313' 139°45.7883' 998 7.26 2:02 32°31.5825' 139°45.7067' 1007 HD HIGH 58 7.9 11:28 32°31.6313' 139°47.7877' 679 7.25 23:931.5825' 139°45.7067' 1007 HD HIGH 59 7.9 12:02 32°29.0668' 139°47.7877' 679 7.25 23:09 32°26.49835' 139°47.7030' 652 DAT HIGH 60 7.9 12:36 32°26.6013' 139°49.5222' 512 7.25 23:00 32°26.4984' 139°49.5077'<	53	7.9	9:14	32°44.9051'	139°43.4758'	456	7.26 5:44	32°44.9238'	139°43.4645'	464	HD	BTS
55 7.9 10:06 32°39.5916' 139°44.6195' 558 7.26 4:03 32°39.5290' 139°44.4857' 547 HD HIGH 56 7.9 10:32 32°36.9336' 139°45.1628' 886 7.26 3:06 32°36.8652' 139°45.0266' 914 HD BTS 57 7.9 10:58 32°31.6313' 139°45.7883' 998 7.26 2:02 32°31.525' 139°45.7067' 1007 HD HIGH 58 7.9 11:28 32°31.6313' 139°46.4117' 985 7.26 1:02 32°31.5825' 139°46.3564' 989 HD HIGH 59 7.9 12:02 32°20.0668' 139°47.7877' 679 7.25 23:59 32°26.49835' 139°47.7030' 652 DAT HIGH 60 7.9 12:36 32°26.6013' 139°48.0231' 920 7.25 22:02 32°23.5690' 139°49.5077' 453 HD BTS 61 7.17 4:41 32°23.6573' 139°48.0231' 920 7.25 22:02 32°23.5690' 139°48.2449' 999	54	7.9	9:40	32°42.2446'	139°44.0417'	441	7.26 4:55	32°42.2137'	139°43.9542'	440	HD	HIGH
50 7.9 10:32 32°36.9336 139°45.1628 886 7.26 3:06 32°36.8652 139°45.0266 914 HD BTS 57 7.9 10:58 32°34.2739 139°45.7883 998 7.26 2:02 32°34.2505 139°45.7067 1007 HD HIGH 58 7.9 11:28 32°31.6313' 139°46.4117' 985 7.26 1:02 32°31.5825' 139°46.3564' 989 HD HIGH 59 7.9 12:02 32°29.0668' 139°47.7877' 679 7.25 23:00 32°26.4984' 139°49.5077' 453 HD BTS 60 7.9 12:36 32°26.6013' 139°49.5222' 512 7.25 23:00 32°26.4984' 139°49.5077' 453 HD BTS 61 7.17 4:41 32°23.6573' 139°48.0231' 920 7.25 22:02 32°23.5690' 139°48.2449' 999 HD HIGH	55	7.9	10:06	32°39.5916'	139°44.6195'	558	7.26 4:03	32°39.5290'	139°44.4857'	547	HD	HIGH
57 7.9 10.36 32°34.2739 139°40.7663 996 7.26 2:02 32°34.2505 139°40.7067 1007 HD HIGH 58 7.9 11:28 32°31.6313' 139°46.4117' 985 7.26 1:02 32°31.5825' 139°46.3564' 989 HD HIGH 59 7.9 12:02 32°29.0668' 139°47.7877' 679 7.25 23:59 32°28.9835' 139°47.7030' 652 DAT HIGH 60 7.9 12:36 32°26.6013' 139°49.5222' 512 7.25 23:00 32°26.4984' 139°49.5077' 453 HD BTS 61 7.17 4:41 32°23.6573' 139°48.0231' 920 7.25 22:02 32°23.5690' 139°48.2449' 999 HD HIGH	56	7.9	10:32	32°36.9336'	139°45.1628'	886	7.26 3:06	32°36.8652'	139°45.0266'	914		BI2
59 7.9 12:02 32°29.0668' 139°47.7877' 679 7.25 23:59 32°28.9835' 139°47.7030' 652 DAT HIGH 60 7.9 12:36 32°26.6013' 139°49.5222' 512 7.25 23:00 32°26.4984' 139°49.5077' 453 HD BTS 61 7.17 4:41 32°23.6573' 139°48.0231' 920 7.25 22:02 32°23.5690' 139°48.2449' 999 HD HIGH	58	7.9 79	11.00	32°31 6313'	139°46 4117'	990	7.26 2.02	32°31 5825'	139°46 3564'	989		HIGH
60 7.9 12:36 32°26.6013' 139°49.5222' 512 7.25 23:00 32°26.4984' 139°49.5077' 453 HD BTS 61 7.17 4:41 32°23.6573' 139°48.0231' 920 7.25 22:02 32°23.5690' 139°48.2449' 999 HD HIGH	59	7.9	12:02	32°29.0668'	139°47.7877'	679	7.25 23:59	32°28.9835'	139°47.7030'	652	DAT	HIGH
61 7.17 4:41 32°23.6573' 139°48.0231' 920 7.25 22:02 32°23.5690' 139°48.2449' 999 HD HIGH	60	7.9	12:36	32°26.6013'	139°49.5222'	512	7.25 23:00	32°26.4984'	139°49.5077'	453	HD	BTS
	61	7.17	4:41	32°23.6573'	139°48.0231'	920	7.25 22:02	32°23.5690'	139°48.2449'	999	HD	HIGH
62 7.17 5:11 32°21.0160' 139°48.5324' 1360 7.25 20:52 32°20.9693' 139°48.8367' 1343 HD HIGH	62	7.17	5:11	32°21.0160'	139°48.5324'	1360	7.25 20:52	32°20.9693'	139°48.8367'	1343	HD	HIGH

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

	Deployment				Retrieval					
	Time Coordinate		Time	ne Coordinate			HD	hyd		
Site	UTC	Lat(N)	Lon(E)	Dep (m)	UTC	Lat(N)	Lon(E)	Dep (m)	type	maker
63	7.17 5:40	32°18.3506'	139°49.1881'	1473	7.25 19:40	32°18.3663'	139°49.5359'	1477	HD	BTS
64	7.17 6:09	32°15.6741'	139°49.6407'	1490	7.25 18:25	32°15.7325'	139°49.8993'	1491	DAT	HIGH
65	7.17 6:37	32°13.6029'	139°50.2472'	1507	7.25 17:13	32°13.1428'	139°50.3812'	1511	DAT	HIGH
66	7.17 7:07	32°10.4126'	139°50.8219'	1371	7.25 16:00	32°10.4202'	139°50.8031'	1370	HD	BTS
67	7.17 7:39	32°07.7590'	139°51.3590'	777	7.25 14:45	32°07.7136'	139°51.2569'	871	DAT	HIGH
68	7.17 8:14	32°05.0347'	139°51.9773'	740	7.25 13:41	32°05.0766'	139°51.8554'	761	HD	HIGH
69	7.17 8:48	32°02.3938'	139°52.5741'	1130	7.25 12:47	32°02.3977'	139°52.4155'	1111	DAT	HIGH
70	7.17 9:23	31°59.7375'	139°53.1017'	1203	7.25 11:43	31°59.8145'	139°52.9783'	1206	DAT	HIGH
71	7.17 9:57	31°57.0879'	139°53.6996'	547	7.25 10:36	31°57.1222'	139°53.5391'	554	HD	HIGH
72	7.17 10:31	31°54.2542'	139°53.0792'	571	7.25 9:33	31°54.2410'	139°53.0278'	599	HD	HIGH
73	7.17 11:08	31°51.6931'	139°54.7198'	509	7.25 8:40	31°51.6639'	139°54.6491'	524	DAT	HIGH
74	7.17 11:41	31°49.0870'	139°55.3074'	685	7.25 7:48	31°49.1061'	139°55.3021'	686	HD	HIGH
75	7.17 12:12	31°46.4370'	139°55.8638'	982	7.25 6:50	31°46.4527'	139°55.1694'	956	HD	HIGH
76	7.17 12:54	31°43.8164'	139°56.4298'	1298	7.25 5:48	31°43.8605'	139°56.5399'	1302	DAT	HIGH
77	7.17 13:24	31°41.1461'	139°56.9711'	1312	7.25 4:37	31°41.2242'	139°57.0474'	1316	HD	HIGH
78	7.17 13:57	31°38.4285'	139°57.4973'	1288	7.25 3:26	31°38.5160'	139°57.4633'	1289	HD	HIGH
79	7.17 14:29	31°35.7668'	139°58.0642'	1233	7.25 2:25	31°35.8296'	139°57.9818'	1232	DAT	HIGH
80	7.17 15:00	31°33.1823'	139°58.6134'	1123	7.25 1:22	31°33.2641'	139°58.6127'	1115	DAT	HIGH
81	7.17 15:32	31°30.5132'	139°59.8531'	384	7.25 0:20	31°30.5848'	139°59.0903'	444	HD	HIGH
82	7.17 16:04	31°27.8560'	139°59.6767	466	7.24 23:33	31°27.9494'	139°59.5912'	462	HD	HIGH
83	7.17 16:38	31°25.2004'	140°00.2412'	605	7.24 22:44	31°25.2481'	140°00.0941'	607	HD	BTS
84	7.17 17:12	31°22.5731'	140°00.7332'	935	7.24 21:50	31°22.5656'	140°00.4859'	918	HD	HIGH
85	7.17 17:47	31°19.8922'	140°01.3412'	981	7.24 20:51	31°19.9772'	140°01.1996'	982	HD	HIGH
86	7.17 18:20	31°17.2481'	140°01.9020'	746	7.24 19:49	31°17.4175'	140°01.8327'	781	HD	BTS
87	7.17 18:56	31°14.5850'	140°02.4534'	515	7.24 18:51	31°14.7776'	140°02.3930'	502	HD	HIGH
88	7.17 19:45	31°11.8840'	140°03.0239'	1036	7.24 17:56	31°12.1258'	140°02.8968'	1019	HD	HIGH
89	7.17 20:20	31°09.2171'	140°03.5222'	1270	7.24 16:54	31°09.4270'	140°03.4101'	1252	HD	HIGH
90	7.17 20:53	31°06.5626'	140°04.1144'	1383	7.24 15:40	31°06.7778'	140°04.0735'	1373	HD	HIGH
91	7.17 21:23	31°01.9196'	140°04.6504'	1453	7.24 14:33	31°04.1247'	140°04.6286'	1447	HD	HIGH
92	7.17 21:53	31°01.2719	140°05.1062'	1506	7.24 13:24	31°01.4220′	140°05.1315'	1499	DAI	HIGH
93	7.17 22:24	30°58.6112'	140°05.6668'	1594	7.24 12:14	30°58.7885'	140°05.6968'	1579	HD	HIGH
94	7.17 22:58	30°55.9322'	140°06.2266'	1631	7.24 11:05	30°56.1104'	140°06.2660'	1629	DAT	HIGH
95	7.17 23:32	30°53.2696'	140°06.7287	1611	7.24 9:50	30°53.3763'	140°06.8534'	1610	HD	HIGH
96	7.18 0:06	30°50.6045'	140°07.2597	1610	7.24 8:38	30°50.7606'	140°07.4818'	1613	DAI	HIGH
97	7.18 0:38	30°47.9458'	140°07.7964'	1625	7.24 7:25	30°48.1156'	140°08.0447'	1624		HIGH
98	7.18 1:10	30°45.2803	140°08.3288°	1616	7.24 6:13	30°40.5523	140°08.6671°	1620		HIGH
99	7.18 1:42	30°42.6457	140°08.8618	1547	7.24 4:57	30°42.8620'	140°09.0339'	1526		HIGH
	7.18 2:13	30°39.9617	140°09.4246	1543	7.24 3:34	30°40.1191	140°09.6578	1536		HIGH
	7.18 2:44	30°37.3478	140°09.9888	1524	7.24 2:22	30°37.5083	140°10.2124	1210		BI2
102	7.18 3:16	30°34.7220	140°10.5903	1321	7.24 1:14	30°34.9411	140°10.7383	1342		HIGH
103	7.18 3:46	30°32.0630'	140°11.1398'	1212	7.23 23:53	30°32.2720'	140°11.2453'	1183	DAI	HIGH

Table 3: (continued).

Table 4: Sensitivities of geophone and hydrophone sensors.

Sensor type	Sensor name	Maker	Sensitivity	Frequency
Geophone				
(three components)	L-28LB.H.V	Mark Products	0.69 V/in/sec	4.5Hz (natural freq.)
Hydrophone	AQ-18	Benthos, inc.	-169 dB	1Hz - 12kHz
Hydrophone	HTI-99DY	HIGH TECH, inc	-165dB	2Hz - 20kHz

2.3 Multichannel hydrophone streamer

During airgun shooting, we towed a 12-channel hydrophone streamer to investigate the shallow structures, in particular, a distribution of sediments with low P-wave velocity (Figure 4). The hydrophone streamer (STEALTHARRAY ST-48) cable is solid type made by Input/Output Inc. The interval of each channel was 25 m. The lengths of active section and read-in cable from the stern are 300 m and 150 m, respectively. Hydrophone sensors (TYPE Bruel & Kjaer Free-field 1/2 Microphone) with sensitivity of -25.9dB re1V/Pa (50.4mV/Pa) were used and analog signals from five sensors in the same channel were stacked before A/D conversion. The A/D conversion kit was attached in the



Figure 6: Flow chart for the MCS recording system. Circled numerals show the timing flow of this seismic system.

recording system, the StrataVisor NX Marine made by Geometrics Inc, and digitized data was recorded on 3490E tapes with SEG-D format. No recording delay was set. The sampling rate was 4 msec and the record length was 13.5 sec. Because seismic record from eighth channel is no good during this cruise, we omitted the traces.

2.4 Seismic recording/shooting system

A seismic system of R/V 'Kaiyo' consists of a navigation system with software SPECTRA, a recording system (StrataVisor NX Marine) and a gun controller system (GCS90), and these systems are connected via RTN μ in shown by Figure 6. As mentioned above, we adapted Starfire as a navigation source of seismics. Navigation data collected from Starfire and Skyfix for the ship's navigation system was sent to the RTN μ via the terminal server connected to the ship LAN of the ship and this MCS system. The RTN μ obtains time signals of GPS (Starfire) from original antenna. Then, the navigation data is sent to the PC Linux machine installed SPECTRA software and monitored on the dis-



Figure 7: Vertical record section recorded by OBS#6. All traces are filtered by 5-15 Hz. Vertical and horizontal axes are offsets from OBS and reduced traveltimes by 8 km/s.



Figure 8: Vertical record section recorded by OBS#30. The details are same as for Figure 7.



Figure 9: Vertical record section recorded by OBS#95. The details are same as for Figure 7.



Figure 10: Horizontal record sections recorded by OBS#30. All traces are filtered by 5-15 Hz. The reduced velocity is 4.62 km/s. (a) Horizontal component-1. (b) Horizontal component-2.

play. Timing of the system start, shot number and so on are set on the SPECTRA software. The system start signal generated from the SPECTRA was sent to the gun controller and the recording system as a trigger signal via the RTN μ . The gun controller sends back the internal time break signal to the master clock and RTN μ just after getting trigger signals. Then the trigger signals is sent to eight airguns as shot signals, and the recording system starts to record seismic data from a hydrophone streamer. The first break signal is sent to the gun controller from the airguns at the same timing with the shot, and then the gun controller sends the shot data to RTN μ .

3. Data

In this chapter, we introduce some representative examples of the seismic data obtained by OBSs and MCS. Vertical components of OBS#6, OBS#30 and OBS#95, and horizontal components of OBS#30 are described in section 3.1. MCS data are described in section 3.2.

3.1 OBS

We retrieved all OBSs, however, recording system of five OBSs had troubles. The reason is due to troubles of a sub-standard hard disk or digital audio tape inside the recorder. Except some OBS data with recorder troubles, the data quality of available OBSs is basically good and we can trace the first phases on vertical records until 100 km distance from each OBS. Horizontal records also show good quality despite of poorer S/N ratio than the vertical, and we can see converted S arrivals until about 100 km from the OBS. We describe characteristics of OBS data using vertical record sections of OBS#6 (Figure 7), OBS#30 (Figure 8) and OBS#95 (Figure 9) as follows.

OBS#6 was deployed in the Sagami Bay. We can trace first arrivals to an offset of 170 km from the OBS (Figure 7). The apparent velocities of the first phases in the northern side are 3.7 km/s, 5.5 km/s and 6.1 km/s for offsets of 3-5 km, 5-10 km and 10-20 km, respectively. In the southern side, we can trace these phases with



Figure 11: MCS profiles.

apparent velocities of 4.7 km/s, 5.2 km/s, 6.7 km/s and 8.1 km/s to offsets of 11 km, 36 km, 145 km and 160 km, respectively. Variation of these apparent velocities drawing concave shape can be seen at offsets of -10 km, 20-30 km and 60-65 km due to some volcanoes. Reflections from the Moho (PmP) with high amplitudes can be also seen at an offset of 120-160 km.

OBS#30 was deployed on the southwestern offshore of Mikura Island. On the northern side, we can trace first phases with apparent velocities of 3.9 km/s, 5.0 km/s, 6.0 km/s, 6.5 km/s and 7.2 km/s in offsets of 5-6 km, 6-30 km, 30-50 km, 50-122 km and 150-155 km, respectively. In southern side, the apparent velocities of these phases are 3.9 km/s, 5.0 km/s and 6.9 km/s for offsets of 5-8 km, 8-24 km and 80-105 km, respectively. We can see the apparent velocity variation of first phases in the offsets of 30-80 km. This variation seems to be originated from the topography near the Hachijo Island and the Aoga-shima. Reflections from the Moho (PmP) with high amplitudes can be seen also at the northern offset of 100-120 km and the southern offset of 90-130 km.

OBS#95 was deployed between Sumisu Island and

Tori-shima. We can trace the first phases with apparent velocities of 3.9 km/s, 5.2 km/s, 6.2 km/s and 7.4 km/s in offsets of 4-7 km, 7-16 km, 16-25 km and 30-36 km, respectively. Two concave peaks of the variation of these phases were observed, which corresponds to the Sumisu Island and the Beyonesu Retsugan, respectively. In the southern part, the apparent velocity of the first phases are 4.5 km/s, 5.5 km/s, 6.1 km/s and 7.6 km/s in offsets of 4-10 km, 10-20 km, 20-38 km and 38-41 km, respectively. These variation is also effected the topography near the Tori-shima.

These record sections suggest roughly that the crustal structure of the northern part is thicker than that of the southern part according to the offsets identified refractions with apparent velocity of 6.5-7.5 km/s. On the record section of OBS#30, the offset identified the PmP phases with high amplitude is nearer in the southern side. This characteristic suggests also that the northern arc has thick crust than the southern part.

Figures 10a and 10b indicate two horizontal components of OBS#30 crossing perpendicular with each other. We can see many phases with the same apparent P-wave velocities. This record section seems to have much PSP phases. At the offset of 40-90 km and 8-11 sec in reduced time by 4.62 km/s in southern side, we can see some phases with slow apparent velocities and these phases correspond probably to PSS phases.

3.2 MCS

The reflection data recorded by 12-channel hydrophone streamer has also enough quality to pick the acoustic basement (Figure 11). Applied flows were a collection of spherical divergence, editing bad quality traces, a time variant filter (3-125 Hz), sorting by CDPs, an NMO correction with water velocity of 1500 m/s, a predictive deconvolution filtering using an operator length of 300 ms and an predictions distance of 24 ms, stacking, a time variant bandpass filter of 20-50 Hz and the auto gain control. Because of the channel interval of 25m and the shot interval of 200 m, the fold number was 1 or 2.

We interpret the shallow structure from rough characteristics of reflection image. Thick sediments under concave topography between the Sagami Bay and the Oshima, a small seamount with the intrusion at the northern offshore of the Oshima, thick sediments again under a flat seafloor between the Miyake and the Hachijo Islands can be seen. We can identify sediments between the Aoga-shima and the Myojin knoll, a caldera of the Myojin knoll with a height of about 1,200 m and thick sediments between the Sumisu Island and Tori-shima. At this moment, we cannot identify any proofs of crustal shortening between the Oshima and the Miyake Island relating to the new subduction at southern foot of the Zenisu ridge from this reflection image. After we process reflection data more or we get new reflection data using a 204-channel hydrophone streamer, we will try to identify such proofs showing the crustal deformation.

4. Summary

Due to good data quality of the OBSs, we can trace the first P-arrivals to the offsets of 100 km from each OBS. These OBS record sections suggest that the northern part of the Izu-Ogasawara arc has thicker crust than the southern part. The reflection image indicates the strong heterogeneity for the shallow structure. We will estimate the velocity structural variation over the entire of the arc-arc collision zone and general oceanic arc, and believe that we can clarify the crustal deformation by the collision.

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