Wide-angle seismic profiling across an active rifted zone in the middle Izu-Ogasawara arc - KY0511 cruise -

Narumi Takahashi¹, Aki Ito¹, Shuichi Kodaira¹ and Yoshiyuki Kaneda¹

Abstract We carried out a deep wide-angle seismic experiment using a large airgun array and total 110 ocean bottom seismographs (OBSs) in the middle Izu-Ogasawara arc area, which was conducted by R/V Kaiyo of Japan Agency for Marine-Earth Science and Technology (JAMSTEC) from October 5 to November 3, 2005 (KY05-11 cruise). Objectives of this cruise are to know a velocity structure of the across the northern Izu arc, especially velocity variation between an old Eocene arc beneath the forearc and a new active arc, and a relationship between the structural heterogeneity with the velocity variation and the active backarc rifting. These are important keys to clarify nature of the oceanic arc growth. An airgun-OBS seismic line was set from a trench slope break adjacent to the Izu-Ogasawara trench to the western Shikoku Basin through the forearc basin, the volcanic front, the Sumisu rift, the Miocene rear arc, the eastern Shikoku Basin and the Kinan seamount chain. 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 24-channel 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, backarc rifting

1. Introduction

The Izu-Ogasawara arc is typical oceanic island arc having andesitic middle crust with P-wave velocity 6 km/s (e.g., Suyehiro et al., 1996) and one of best examples to study continental growth. Because the andesitic oceanic island arc with relative light components has been produced from the oceanic crust with basaltic components through boninitic activities, the arc evolution study is comparable to know a process to remove heavy crustal components from the original crust.

The Izu-Ogasawara arc tectonic history is already known well from previous studies (e.g., Karig and Moore, 1975; Hall et al., 1995; Macpherson and Hall, 2001). At Eocene time, the initial island arc had been produced by subduction of the basaltic oceanic crust beneath the other basaltic oceanic crust. Then, the initial arc had developed there to Oligocene time. After the active rifting within the old arc, the Shikoku basin had spread during about 30-15 Ma (e.g., Okino et al., 1998) and the old arc had been divided two parts, which are the current Ogasawara ridge and the Kyushu Palau ridge, respectively (e.g., Hall et al., 1995). The volcanic activity within the arc during the opening of the Shikoku basin is still poorly understood, and had been activated again at the western adjacent region of the old arc at Miocene time (Taylor, 1992). The western area of the Izu-Ogasawara arc including en echelon seamount chain corresponds to the Miocene arc.

Here, we identify three scientific issues to be resolved considering above tectonics. These are (1) identification of the Eocene-Oligocene arc and the comparison with the Miocene arc and the current active arc based on a seismic structure, (2) relationship between the velocity variation and the rifting occurred behind the volcanic front and (3) the structure of the transition zone between the arc and the backarc. We summarize the objectives of this cruise and the background.

First objective is a continuity of the old Eocene-Oligocene arc. To understand nature of the crustal growth and estimate a crustal production rate, the geologic environment is important. It is clarified from petrologic studies that the Ogasawara ridge corresponds to the Eocene arc (e.g., Yuasa and Murakami, 1985) and the continuity is confirmed by only topographic fea-
tures. ODP Leg 125 found that boninites widely distribute around the outer arc high of the northern Izu-Ogasawara arc (e.g., Pearce et al., 1992). From seismic velocity model, there is a difference in the velocity gradient of the middle crust between the current rifted zone and the forearc (Takahashi et al., 1998). However, it is still unknown that this velocity variation between the rifted zone and the forearc can be applied at whole of the Izu-Ogasawara arc. To confirm the commonality of the distribution of the velocity variation and the continuity of the Eocene arc is one of important keys to understand past crustal growth history.

Another objective is a role of the backarc opening for the crustal growth. The andesitic middle crust with P-wave velocity of 6 km/s was detected in the northern Izu-Ogasawara arc (Suyehiro et al., 1996, Takahashi et al., 1998) and the Tonga arc (Crowford et al., 2003), but not in the central and eastern Aleutian arc (Holbrock et al., 1999; Fliedner and Klemperer, 2000), nevertheless above all arcs are the same oceanic island arcs. So, a crustal growth model, which could explain such structural variation is needed. One candidate reason for the difference might be a degree of crustal growth. Recently, it is suggested that the velocity model of the Mariana arc-backarc system has advanced crustal growth area adjacent to the Mariana trough backarc basin (Takahashi et al., in Prep). Because the Izu-Ogasawara and the Tonga arcs have backarc basin and the central Aleutian arcs does not have, the backarc opening might be one of candidates to contribute to the crustal growth. The Sumisu rift is initial backarc basin, and it is possible that we can understand an influence of the backarc opening for the velocity structure. If rising magmas through the upper mantle are underplated beneath the Moho actively, the velocities of the lower crust and the upper mantle may have anomaly just beneath the Sumisu rift. If the backarc opening promotes the crustal growth, the velocity of the lower crust just beneath the Sumisu rift might be relatively slower than 7 km/s according to example of Mariana arc. Recently, Nishizawa et al. (2003) indicated that the velocity structure across the middle Izu-Ogasawara arc (30 degree north), however, the above influence of the velocity structure by the backarc opening was not detected due to lack of number of ocean bottom seismographs (OBSs). Understanding of the backarc opening at the initial stage is one of the targets in this study.

The other objective is velocity variation of the arc-backarc transition region. In particular, the lower crust with high velocity of over 7 km/s at the arc-backarc transition region is reported frequently. The northern Izu-Ogasawara arc, the Mariana arc, the West Mariana ridge and the Tonga arc have such high velocity lower crust (Suyehiro et al., 1996; Takahashi et al., 2005; Crowford

Figure 1: Map of the experimental area. Solid circles indicate OBSs. We shot an airgun array on a thick black line.
Figure 2: Map for ship's track line. Cross marks indicates ship position of every 6 hours.

2. Experiments

We performed a wide-angle seismic profiling using 110 ocean bottom seismographs (OBSs), a large airgun array with capacity of 12,000 cubic inches and a 24-channel analogue streamer in middle Izu-Ogasawara arc (Figure 1). The period of this cruise using the R/V "Kaiyo" of Japan Agency for Marine-Earth Science and Technology (JAMSTEC) is from October 5 to November 3, 2005 (Figure 2). A main seismic line runs from a trench slope break near the Izu-Ogasawara trench to the western Shikoku Basin through the forearc basin, the volcanic front, the Sumisu rift, the Miocene arc, the eastern Shikoku Basin and the Kinan seamount chain. We divided the main line into two parts, which are the eastern part from the trench slope break to the eastern edge of the Shikoku basin and the western part from the rift zone to the western Shikoku basin (Figure 3). The R/V Kaiyo departed from Yokohama shinko at October 5, and 77 OBSs deployment on the eastern part of the main line was carried out from October 6 to 9. We shot the airgun from October 10 to 12 on the eastern half (Line IBr6_obs_0). Then, after long standing by due to tottery typhoon attack, we recovered 46 OBSs deployed in eastern part during October 21 to 23. After we deployed 33 OBSs again on the western half to October 25, airgun shooting was carried out to October 27 (Line...
IBr6_obs_1), and then we recovered 66 OBSs until October 30. An additional multichannel seismic survey with a 24-channel streamer was performed between October 30 and November 1 along an extended main line to east (Line IBr6_mcs_0). This aim is to clarify the crustal deformation of a subducting oceanic crust. Finally, we arrived at JAMSTEC at November 3. The actual activities are shown in Table 1 and Figure 2.

In this cruise, we performed OBS recorder test using different sampling rate and different dynamic range to investigate waveform distortion by digital conversion. As shown in 2.2 section, because we have two types of our OBS digital recorder, we deployed three OBSs at the same location on the forearc region (Site#21). One OBS has a 16 bit recorder with sampling rate of 100 Hz. Another has a 20 bit recorder with sampling rate of 100 Hz. The other has a 20 bit recorder with sampling rate of 250 Hz.

2.1 Airgun shooting

As above description, we shot the airgun array separately for the eastern half (Line IBr6_obs_0) and the western half (Line IBr6_obs_1). The overlap between the eastern and the western lines was about 150 km, because the offset of 150 km from the OBS should have refractions through the upper mantle. The airgun array with total capacity of 12,000 cubic inches consists of eight airguns (BOLT Technology Corporation, PAR Air Gun Model 1500LL) with 1,500 cubic inches capacity each. The gun array was shot with the shot interval of 200 m and the accuracy of the shot times was 1 msec. These guns were shot with the same timing within 2 msec. The gun depth was 10 m. 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 14 m length × 20 m width. Airgun’s position was kept 134.5 m behind the ship position (distances from ship antenna to the stern, and from the stern to center of the airgun array, are 29.5 m and 105 m, respectively). The shot times was measured by a TrueTime system (TrueTime GPS time & frequency receive, MODEL XL-AK) using GPS signals and the accuracy was 1 nsec.

For the MCS survey with a 24-channel streamer along the extended main line to east, a small airgun array with total capacity of 3,000 cubic inches (two airguns with 1,500 cubic inches capacity each) was shot. The shot interval was 50 m. A length of the airgun array was 5.5 m. Other specification of the airgun shooting, for example, accuracy of shot timing, the gun depth and the air pressure, were the same to that of shooting with interval of 200 m.

Skyfix system was used as the differential global
Table 1: Activity log during KY0511 cruise.

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<th>Date</th>
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<th>Remarks</th>
</tr>
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<td>October 08</td>
<td>CBS deployment (Site#40-Site#65)</td>
</tr>
<tr>
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<td>October 09</td>
<td>Finish of CBS deployment (Site#66-Site#77)</td>
</tr>
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<tr>
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<td>October 11</td>
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</tr>
<tr>
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<td>Finish of IBr6_obs_0 airgun shooting and avoidance due to bad sea states</td>
</tr>
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<td>October 13</td>
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</tr>
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<td>November 02</td>
<td>November 02</td>
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Figure 4: Side and up views for geometry of airgun system and the hydrophone streamer.
(a) Lines IBr6_obs_0 and IBr6_obs_1. (b) IBr6_mcs_0.
positioning system (DGPS) of the R/V Kaiyo’s navigation system. The base station was Naha, Okinawa, Japan. Because we have experienced the emergency stop of airgun shooting due to non-succession of GPS data in the past, we have adapted StarFire system as the seismic navigation system since 2004. Ship navigation system by Skyfix was used as backup of the seismic navigation system. The accuracy of shot position was about 40 cm.

2.2 Ocean Bottom Seismographs

We deployed 110 OBSs on the seismic line with the interval of 5 km (Figure 1, Table 3). Our seismic group in JAMSTEC has used 5 km as the OBS interval for the wide-angle seismic profiling carried out at the Izu-Ogasawara arc area to simplify comparison among the velocity models with the same resolution obtained along many seismic lines.

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). The digital recorder used a 16-bit/20-bit A/D converter and stored data on digital audio-tape or a hard disk sampling continuously with original format (Shinohara et al., 1993). The sampling rate is 10 msec. The electronic power for the recorder system of each OBS is supplied by rechargeable lithium-ion batteries. Above geophone sensors with gimbal-leveling mechanism, batteries and a recorder system are installed in 17-inch glass spheres made by Benthos, Inc, USA and Nautilus Marine Service GMGH, Germany. 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 vessels positioning system during the cruise. The accuracy of the OBS position determined by SSBL was about 100 m.

After the cruise, we edited the continuous OBS data with length of 70 sec and SEG-Y format. At the same time, the OBS clock was corrected by estimation of time differences between OBS original time and GPS time, which were measured immediately before OBS deployment and after OBS retrieval.

2.3 Multichannel hydrophone streamer

During airgun shooting, we towed a 24-channel hydrophone streamer to investigate the shallow structures, in particular, a distribution of sediments with low P-wave velocity and the fault configuration (Figure 4). Because one of the objectives of this cruise is to understand relationship between the velocity structure and the backarc opening, it is important to know the fault configuration within the Sumisu rift area. The hydrophone streamer (ITI, Stealtharray ST-48) cable is solid type and the interval of each channel was 25 m. The lengths of active section and read-in cable from the stern are 600 m and 150 m, respectively, and a distance from the ship stern to near channel is 161 m. The streamer depth was 15 m. Hydrophone sensors (TYPE Bruel & Kjaer Freefield 1/2 Microphone) with sensitivity of -197.5 dB re 1Vµ Pa (13.3V/Bar) 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 recording system, the StrataVisor NX Marine made

Table 2: Airgun shooting log.
Table 3: OBS information. Each recorder using DAT or hard disk is shown by each abbreviation of D or ‘H’. The ‘B’ and ‘H’ means that makers of the hydrophone sensor are Benthos Inc. and High Tech Inc., respectively.

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by Geometrics Inc, and digitized data was recorded on DLT tapes with SEG-D 8048 4byte floating point format. System delay, which equals recording start time minus system start time, was 50 msec. The sampling rate was 4 msec and the record length was 13.5 sec. Because seismic records from fifth and sixteenth channels were not 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 RTNµ as described by Takahashi et al. (2004). Navigation data collected from Starfire and Skyfix for the ship's navigation system was sent to the PC Linux machine installed SPECTRA software via the RTNµ. The Linux PC controls shot timing, assignment of shot number, and so on. Ship position (reference point of the vessel), shot time (sec), channel position estimated using cable leveler data and length of the read-in cable, water depth obtained by multi-narrow beam data system (Seabeam 2100 system), gun position, and shot number are stored with UKOOA P1/90 format. Added to above P1/90 format data, navigation data with interval of 1 sec, depth and direction of all cable leveler for all shots, gyrocompass data of the vessel, shot time received from GCS90 as time break signal (µ sec) and so on are stored with UKOOA P2/91 format. The system start signal generated by the SPECTRA was sent to the gun controller and the recording system as a trigger signal and the recording system started to store data on DLT tape. Then, the gun controller sends back the internal time break signal to the SPECTRA just after getting trigger signals. After 50 msec from arrival of system start signal to the gun controller, the trigger signals are sent to eight airguns as shot signals, and the recording system starts to record seismic data from a hydrophone streamer. It is reasonable to regard the time zero of recording start as just same timing to the gun fire.

3. Data

In this chapter, we introduce some representative examples of the seismic data obtained by OBSs and MCS. Vertical components of Site#13 on the forearc region, Site#35 near the volcanic front, Site#55 on the western side of the arc, Site#77 on the arc-backarc transition zone, and OBS#93 on the eastern Shikoku basin, and horizontal components of OBS#77 are described in Section 3.1. Multichannel seismic data (MCS data) are described in section 3.2.

3.1 OBS

We retrieved all OBSs, however, recording system of one OBS had troubles. Almost data quality of available OBSs is basically good and we can trace the first phases on vertical records until 150-200 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 Site#13 (Figure 5), Site#35 (Figure 6), Site#77 (Figure 7) and Site#93 (Figure 8) as follows.

OBS#13 was deployed on the eastern forearc region over the outer arc high. We can trace first phases to the western offset of 200 km from the OBS (Figure 5). The apparent velocities of the first phases in the eastern side are 2.5 km/s, 4.3 km/s, 6.5 km/s and 5.6 km/s for offsets of 3-7 km, 7-12 km, 12-28 km and over 28 km, respectively. The apparent velocity becomes small at the offset of 28 km due to the bathymetric change at the trench slope break. In the western side, we can trace them with apparent velocities of 3.3 km/s, 5.7 km/s, 7.2 km/s, 8.6 km/s and 8.0 km/s to offsets of 3-10 km, 10-20 km, 20-60 km except for 25-35 km, 60-100 km and over 28 km, respectively. Phases from the western side of over 130 km likely correspond to the refractions from the upper mantle (Pn). Severe variations of these apparent velocities at western offsets of 25-35 km and 100-130 km are due to topographic highs. Reflections from the Moho (PmP) with high amplitudes can be also seen at a western offset from 40 km. It is possible that a reflector with high amplitude at western offsets of 60-110 km indicates existence of a large faults developed within the arc.

OBS#35 was deployed near the volcanic front. The first phases could be traced 180 km (Figure 6). On the eastern side, we can trace first phases with apparent velocities of 3.0 km/s, 4.4 km/s, 5.7 km/s, 7.2 km/s and 7.8 km/s at offsets of 3-13 km, 13-20 km, 20-43 km, 43-
Figure 5: Vertical record section recorded by OBS#13. All traces are applied by deconvolution filter and the bandpass filter with 5-15 Hz. Vertical and horizontal axes are offsets (km) from OBS and traveltimes (sec) reduced by 8 km/s.

Figure 6: Vertical record section recorded by OBS#35. The details are same as for Figure 5.

Figure 7: Vertical record section recorded by OBS#77. The details are same as for Figure 5.
55 km and over 55 km, respectively. In the western side, the apparent velocities of these phases are 3.4 km/s, 5.5 km/s, 6.3 km/s, 6.6 km/s and 7.8 km/s for offsets of 3-14 km, 24-40 km, 45-66 km and over 120 km, respectively. The phases with apparent velocity 7.8 km/s might correspond to the Pn. The PmP phases with high amplitudes can be seen at the western offset of 50-130 km.

OBS#77 was deployed on the arc-backarc transition zone. The first phases from distances of 100-150 km in both sides can be identified (Figure 7). In the eastern side, we can trace the first phases with apparent velocities of 2.2 km/s, 4.0 km/s, 7.2 km/s and 8.9 km/s for offsets of 3-5 km, 5-10 km, 23-35 km and 48-105 km, respectively. Two concave shapes at offsets of 10-23 km and 35-48 km are affected Miocene volcanoes at the western side of the arc. In the western side, the apparent velocity of the first phases are 2.5 km/s, 4.8 km/s, 6.3 km/s, 7.0 km/s and 8.6 km/s for offsets of 3-5 km, 5-10 km, 10-27, 27-37 km and over 37 km, respectively. Clear PmP phases identified at the eastern offsets of 15-55 km and the western offsets of 10-50 km indicate that the crustal thickness is relatively thinner than the arc.

OBS#93 was deployed on the eastern Shikoku basin. The first phases from distances of 120 km can be seen (Figure 8). In the eastern side, we can trace the first phases with apparent velocities of 5.3 km/s, 6.0 km/s, and 8.0 km/s for offsets of 5-10 km, 10-35 km and over 35 km, respectively. Small amplitude refractions with apparent velocity of 8.0 km/s possibly correspond to the Pn. High amplitude reflections identified at offsets of 30-85 km possibly corresponds to the PmP. In the western side, the apparent velocity of the first phases are 5.2 km/s and 7.1 km/s for offsets of 5-10 km and 10-26 km, respectively. Large concave shape seen at offsets of 26-65 km/s are affected by the Kinan seamount chain. Because the apparent velocity of first phases becomes over 8 km/s and the velocity corresponds to the Pn, thin crust is expected.

Above record sections indicate that the arc area has relative thick crust and the backarc area has thin crust. In particular, it is interesting that the arc-backarc area has relative thin crust despite the water depth is shallower than the typical oceanic crust. The high velocity lower crust beneath the arc-backarc transition zone or slow mantle velocity are expected. This is an important key to understand the crustal growth of this area.

Figures 9a and 9b indicate two horizontal components of OBS#77 crossing perpendicular with each other. Because only P-waves are shot in the sea, we have to observe phases converted from the P-wave to S-wave to understand S-wave structure. In the eastern side, we can see the converted S-waves with apparent velocities of 3.0 km/s and 5.0 km/s at offsets of 15-30 km and over 30 km, respectively. In the western side, the clear converted S-waves with apparent velocities of 3.8 km/s and 5.0-5.5 km/s were observed at offsets of 15-25 km and over 15 km, respectively.

3.2 MCS

The MCS data recorded by a 24-channel hydrophone streamer has enough quality to understand shallow fault configuration. The eastern part of MCS profile (Line IBr6_obs_0) and the western part (Line IBr6_obs_1) are shown in Figures 10 and 11. Applied tentative flows were a collection of spherical divergence, editing bad quality traces, a time variant filter (3-125 Hz), brute stacking of shot gather, 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.

Figure 10 indicates the MCS profile from the eastern part of the Izu-Ogasawara arc (Site#78) to near trench (5 km west from Site#1) and its interpretation. This part runs from the Miocene old arc at the arc-back arc transition area to the adjacent to the Izu-Ogasawara trench through the Sumisu rift (distance from the western end of the line: 340-375 km), the volcanic front (380 km), the forearc basin (385-510 km) and the trench slope break (510 km). Figure 11 indicates the MCS profile from the western side of the arc to the western Shikoku basin through the arc-back arc transition zone (130-260 km), the eastern Shikoku basin (70-240 km) and the Kinan seamount chain (30-70 km).

Uppermost sediments are deformed and collapsed. The deep reflections seen at about 10 sec might be corresponds to a top of the subducting oceanic crust. Beneath the forearc basin, the basement of the possible Eocene-Oligocene old arc with rough topography and thick sediments are remarkable characteristics. The basement traced continuously beneath the forearc is interrupted at the eastern adjacency of the volcanic front (410 km). We can see a thick sedimentary basin at the eastern half of the forearc region (460-490 km). This sedimentary basin is filled by three sequences and the lowest one likely pinches out at both ends of this basin. Because the sedimentary layer thickens toward the western part of the forearc, and because the internal interfaces incline toward east, these sedimentary layers is likely volcanoclastic materials from volcanoes located on the volcanic front.

The rift zone has the same seamounts and the small basins including the Sumisu rift. Inside the Sumisu
Figure 8: Vertical record section recorded by OBS#93. The details are same as for Figure 5.

Figure 9: Horizontal record sections recorded by OBS#77. All traces are filtered by 5-15 Hz. The reduced velocity is 4.62 km/s. (a) Horizontal component-1. (b) Horizontal component-2.
rift, we can see some faults inclining toward east and a steep fault inclining toward west at the eastern edge of this rift. Some events with high amplitude also likely exist beneath the Sumisu rift. It is suggested that the initial backarc opening of this rift begins from forming asymmetric structure. At the western adjacent area of the Sumisu rift (295-335 km), events inclining toward east are detected. It might be speculated that the inclining events indicate existence of tilted block accompanied with the initial backarc opening. Between the distances of 270 km and 290 km, we can confirm a small basin bounded by intrusive seamounts.

In the arc-backarc transition zone, the water depth deepens gradually toward west. The height of seamounts lowers toward west. At the western side from distance of 200 km, seamounts and/or topographic high are covered with thick sediments. Sedimentary structure is also different between the eastern and the western sides in this area. The eastern side has relative thick sediments and the sedimentary structure consists of two or three layers. At the western side from 115 km distance, the sedimentary structure becomes simple with one acoustic transparency layer. The deeper events are also detected at depth of 8 sec and might correspond to the Moho.

The Kinan seamount chain consists of basaltic seamounts produced in last stage of the backarc opening (e.g., Okino et al., 1998). The seismic line goes across the summit of one of basaltic seamounts. The basement of the seamount in both sides has some terraces with the height of about 500-1500 msec. The seamount covered with the thin sediments has gentle and steep slope relating to the terraces of basement topography.

Line IBr6_mcs_0 runs from a trench slope break on the eastern forearc end to 145 degree east across a large transform fault. We can see the Moho interface at about 10 sec at western part of Figure 12. At east side from shot number of 26200, Moho interface indicates strong distortion changing the depth. We can confirm the severe topography at shot numbers between 27600 and 28200 and a normal and a reverse faults on western and eastern sides, respectively. The flower structure showing the transform components can not be seen, however, it look like that the fault configuration might indicate the slumping structure.

4. Summary

We carried out the large active seismics using 110 OBSs, a large airgun array with total capacity of 12,000 cubic inches and a 24-channel hydrophone streamer. Qualities of OBS and MCS data are good to understand the velocity structure and discuss the crustal growth in this area. The OBSs recorded clear phases to the offsets of 150-200 km from each OBS. A part of horizontal components of OBSs are also good and the converted S-waves could be recorded to the offsets of over 100 km. The OBS data suggests that the crustal thickness beneath the arc-backarc transition zone is relatively thin. The MCS data indicates the variation of the sedimentary structures, topography of the basement and the configuration of faults developed within the rift zone. We will construct the velocity model and understand structural variation suggesting crustal heterogeneity due to different age, the relationship between the crustal growth and the backarc opening, and structural characteristics of arc-backarc transition zone.

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Figure 10: Eastern half of MCS profile (Line IBr6_obs_0). Horizontal axis is shot number (SP). (a) Stacked section (b) Interpretation.

Figure 11: Western half of MCS profile (Line IBr6_obs_1). Horizontal axis is shot number (SP). (a) Stacked section (b) Interpretation.

Figure 12: MCS profile along Line IBr6_mcs_0. Horizontal axis is shot number (SP). (a) Stacked section (b) Interpretation.
Wide-angle seismic profiling across an active rifted zone in the middle Izu-Ogasawara arc

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