Long Term Observation by Ocean Bottom Seismometer Array on Trans-PHS Profile

Hajime Shiobara, Mamoru Kato, Masashi Mochizuki, Masanao Shinohara, Toshihiko Kanazawa
shio@eri.u-tokyo.ac.jp, mkato@eri.u-tokyo.ac.jp, mm@eri.u-tokyo.ac.jp, mshino@eri.u-tokyo.ac.jp, kanazawa@eri.u-tokyo.ac.jp
ERI, Univ. Tokyo, Yayoi 1-1-1, Bunkyo, Tokyo, 113-0032

Hiroko Sugioka, Shuichi Kodaira
hikari@jamstec.go.jp, kodaira@jamstec.go.jp
Jamstec, Natsushima 2-15, Yokosuka, 237-0061

Shinji Yoneshima, Kimihiro Mochizuki
shinji@ori.u-tokyo.ac.jp, kimi@ori.u-tokyo.ac.jp
ORI, Univ. Tokyo, Minamidai 1-15-1, Nakano, Tokyo, 164-0014

Ryota Hino
hino@aob.geophys.tohoku.ac.jp
RCPEVE, Fac. Sci., Tohoku Univ., Aramaki, Aoba, Sendai, 980-0845

1 Introduction

As a part of the Ocean Hemisphere network Project, we performed a long term ocean bottom seismic observation along the trans-Philippine Sea profile. The main aim of this experiment is to reveal an image of inhomogeneous mantle structure beneath the west Pacific region from analyses of body wave records of events occurred on the elongation of this profile, around Tonga and Fiji Islands. In this presentation, an outline of the observation and the preliminary result will be introduced.

2 Observation

From Nov. 1999 until July 2000, we conducted the observation by using 15 long term ocean bottom seismometers (LTOBS) equipped a semi broad band sensor (WB2023LP, PMD) along the profile (Figure 1). It has about 2800 km length, which starts near the Amami Ohshima Island (28°N, 130°E) and passes over the Saipan Island to the southeastern end (10°N, 151°E). Six ocean bottom electro-magnetometers were simultaneously deployed on the same profile to improve the image from an individual information of the deep structure. Details of the LTOBS are indicated in another presentation of this symposium, titled as "Long term OBS array observations - development and preliminary result -" as a poster.

During the deployment, a precise positioning of each LTOBS (Shiobara et al., 1997) was performed. To understand the crustal structure beneath the OBS position, one dimensional refraction with an airgun (1000cu.in.) and single channel reflection surveys were also performed at many stations as possible. Finally, 13 OBSs were recovered, but 4 of them did not work due to malfunction of a sensor control unit. Others, 9 OBSs recorded fine data and those were fortunately located almost evenly at three different basins, West Philippine, Shikoku and Mariana Basins.

3 Preliminary Result

Noise analyses are indicated in another presentation in details. Commonly observed high noise level in 0.1–1Hz can be an obstacle for the body wave analyses, especially in horizontal components. For this reason, we should mainly utilize the frequency band below 0.1Hz. Data quality is preliminarily examined with records band-passed in 30–100mHz band, using PDE catalog (Figure 2). Events with Mb 5.5 or larger within epicentral distances of 70 degrees are well recorded with adequately high S/N. Some large events are well recorded in lower frequency bands, though the noise level is slightly high in horizontal components. Most of them are shallow events, but several deep events in Japan, Izu-Mariana and Fiji are also recorded. Majority of recorded regional events are located in equatorial southern Pacific, from Philippine to Fiji Islands, and some events in Alaska are also well recorded with high S/N. Dispersion of Rayleigh waves from these shallow events are characterized by the oceanic signature, and our new data set will provide unique opportunity to investigate wave propagations and the upper mantle structure in oceanic regions.

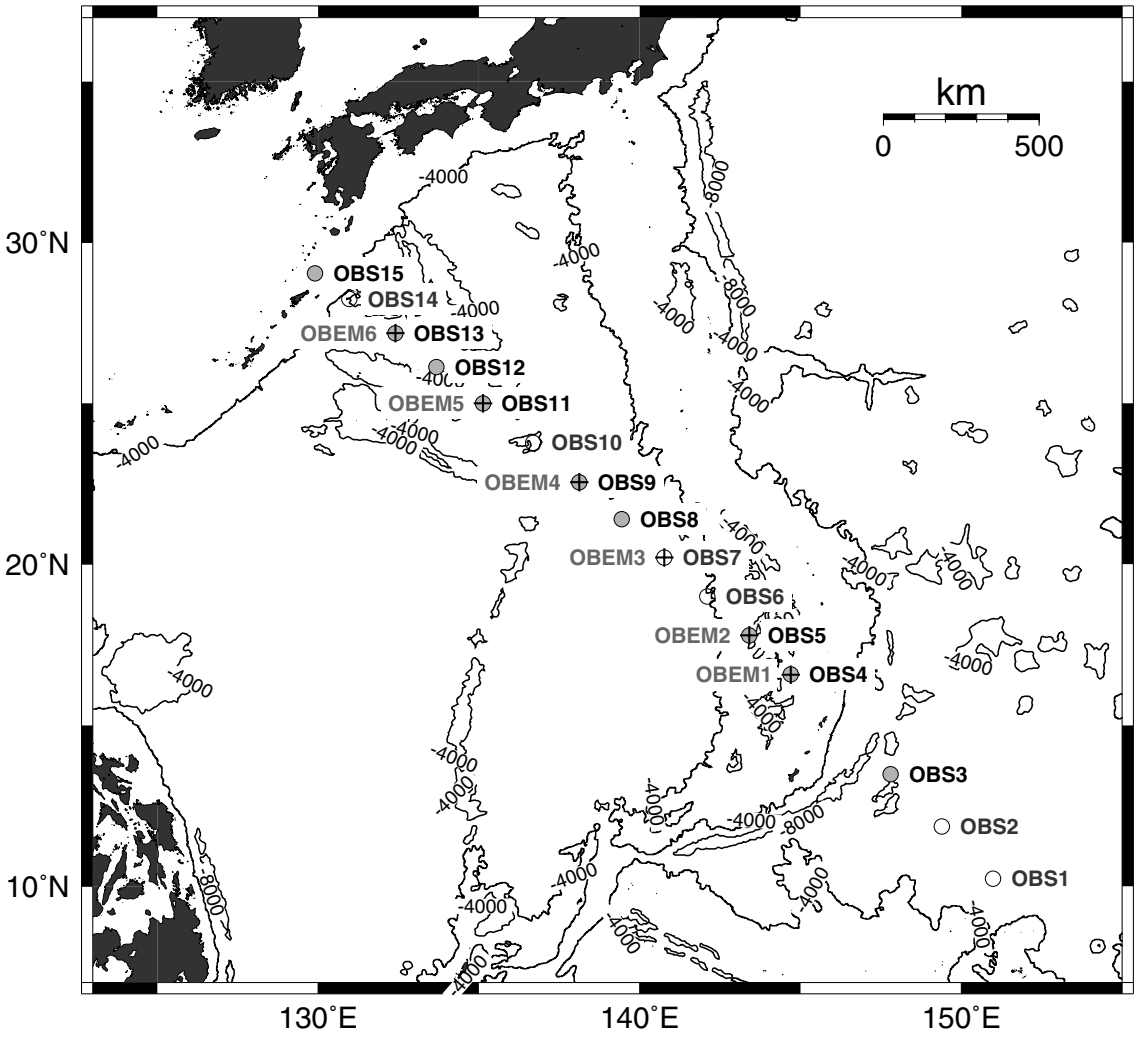

Figure 1. Location map. 15 LTOBSs are indicated as circles. Filled ones were successfully recovered, and open ones, except OBS7 and OBS14, were recovered with no data due to malfunction of the sensor control unit. 6 OBEMs are shown as crosses.

An example record section of synthetic seismograms with observed ones is shown in Figure 3. The event is a typical shallow earthquake occurred in Fiji. The synthetic records explain well for this event, but cannot for an intermediate depth event.

4 Conclusion

The long term seismic observation on the trans-Philippine Sea profile was almost successful as a first case. Its necessity for the construction of the fine deep image becomes apparent even from the preliminary result. For further understanding of the whole image of the mantle beneath the western Pacific, we should continue several long term ocean bottom observations strategically.

5 References

Shiobara, H., A. Nakanishi, R. Mjelde, T. Kanazawa, E. W. Berg and H. Shimamura, Precise Positioning of Ocean Bottom Seismometer by Using Acoustic Transponder and CTD, Mar. Geophys. Res., **19**, 199-209, 1997.

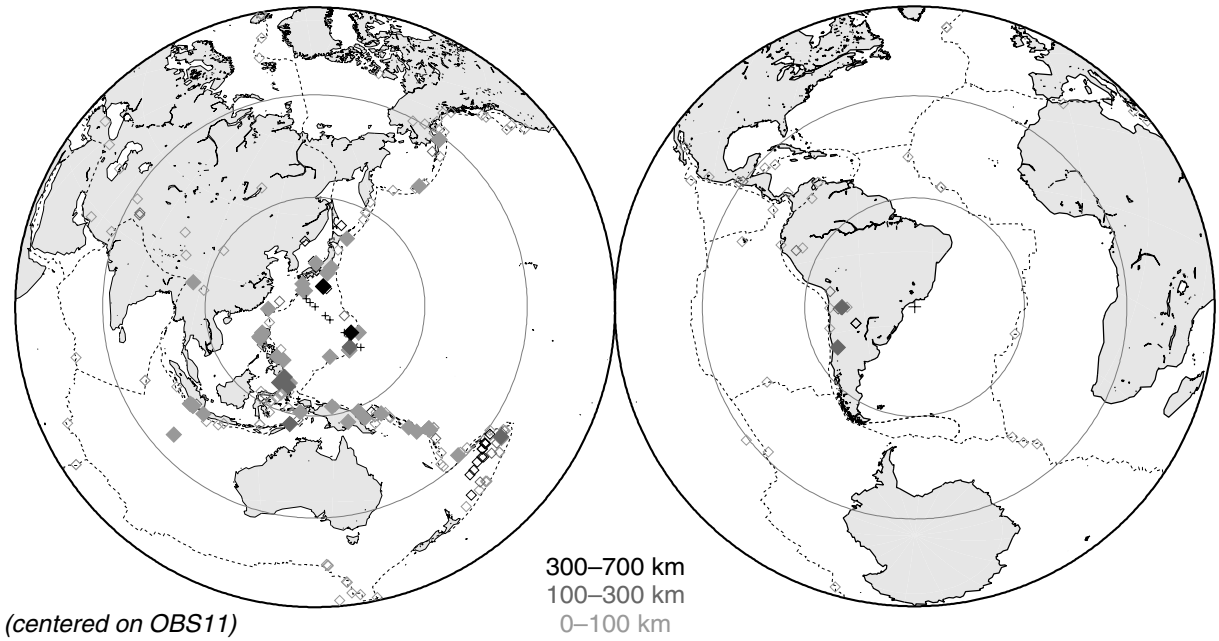

Figure 2. Quality map of the LTOBS array data. Signal to noise (S/N) ratios are examined for records of events with Mb>5.5 (PDE), filtered in 10–100 mHz band (Note: this may not be a suitable band to identify onset of direct P). Filled symbols are for "good" events, for which S/N ratios are high at more than three stations. Scale-over occurs for local events (<15°), especially for deep events.

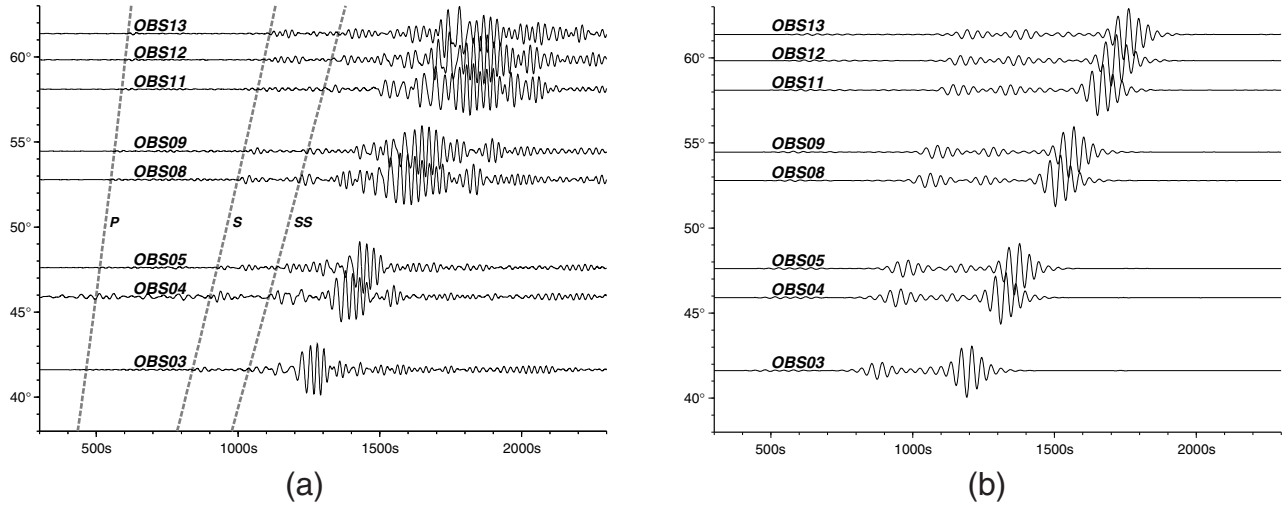
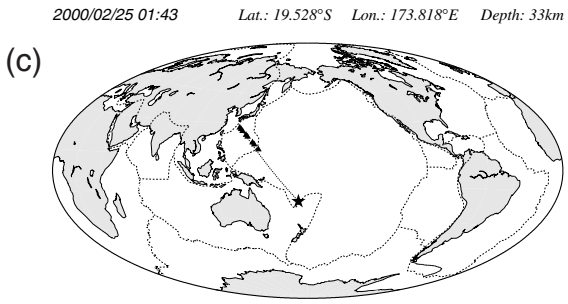
Figure 3. Example record section. A typical section for a shallow event in Fiji. (a) Observed data are of Z-component. Tilts of the sensors are not corrected. Dash lines in the section are theoretical travel time curves for P, S, and SS phases, calculated with the IASP91 model. (b) Synthetics are calculated with the DAM for the equivalent isotropic model of the PREM, and convolved with the sensor response for OBS11z. Harvard CMT mechanisms are assumed. Filtered in 10-30 mHz band. (c) Location of the event (star) and LTOBSs (triangles), and the ray path.