Deep seismic profiling across Mariana arc - backarc system

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We carried out a large deep seismic experiment in the Mariana area using an airgun array and Ocean Bottom Seismographs (OBSs) in January and February, 2003, in collaboration with Japan Marine Science and Technology Center (JAMSTEC), Earthquake Research Institute, University of Tokyo, and Stanford University as a part of the MARGINS program (US-JAPAN COLLABORATIVE RESEARCH: MULTI-SCALE SEISIC IMAGING OF THE MARIANA SUBDUCTION FACTORY).

Despite some seismic experiments carried out (e.g., Ambos and Hussong, 1982), the seismic structure of entire of Mariana arc-back arc system has been still unknown. A rough structure including distribution of the crustal thickness was obtained by the gravity analysis (e.g., Yang et al., 1992)lt is inadequate to understand development of the island arc system. A main purpose of this seismic profiling is to clarify the structural variation across the entire Mariana arc - backarc system. It is expected to understand the crustal variation related to developmental process of the Mariana arc, the distribution of the granitic layer with P-wave velocity of 6 km/s found by Kerr et al. (2002) across the Mariana arc, and finally common structural characteristrics of general island arc including Izu-Bonin-Mariana arc.

This experiment was performed by R/V Kaiyo of JAMSTEC. The seismic line with the length of about 700 km was set from the forearc region just on the serpentinite seamount to the Parece Vela basin through the double Mariana arc, the Mariana trough and the West Mariana ridge. We deployed 106 OBSs on the seismic line. The interval of each OBS is 5.4 km for the strong crustal variation or 10 km for the relative homogeneous area. The airgun array with total capacity of 12,000 cubic inches was shot with the pressure of 2000 psi and the interval of 200 m. During airgun shooting, we towed a 12-channel hydrophone streamer to know the distribution of sediments with low P-wave velocity. Due to the bad weather including the typhoon, the shooting area was limited to the eastern part from the boundary between the Mariana trough and the West Mariana ridge.

We retrieved almost OBSs data except 4 OBSs with recorder troubles. Because vertical records have good quality, we can identify the airgun signals until about 250 km from the OBS and trace first phases until about 200 km. This area which we can trace them covers the broad region from the forearc to the Mariana trough through the Mariana double arc, and it is possible that the structural variations of the crust and the upper mantle are clarified continuously. Horizontal records also show good quality despite of poorer S/N ratio than the vertical, and we can see after phases until about 100 km from the OBS. The reflection data recorded by 12-channel hydrophone streamer has also enough quality to pick the acoustic basement. In this presentation, we report the detail of this experiment, above seismic data and the preliminary results.