Postersession D

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Imaging the crustal and lithospheric structure of the Middle Mariana arc system with seismic traveltime tomography

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The Izu-Bonin-Mariana (IBM) arc system and its associated back-arc basins are a tectonic convergent boundary in the western Pacific, where the Pacific plate is subducting underneath the Philippine Sea plate. The IBM system developed as an oceanic island arc within a purely oceanic crust, without continental collision and fragmentation. Subduction initiation began ~50-40 Ma ago and the IBM arc and back-arc system experienced two phases of back-arc spreading: first phase began about 30 Ma ago and lasted until about 15 Ma ago followed by a second phase that started ~7 Ma ago and still continues.

Although oceanic arcs are regarded as prime locations producing continental crust, they have a predominantly intermediate to felsic composition with a lower silica content than continental crust. The composition of the island arcs and associated back-arc basins is controlled by the subducted slab, which regulates the mantle advection and melt generation.

To understand the crustal and lithospheric structure of the IBM system, active seismic data have been recorded by R/V KAIYO (JAMSTEC) on ocean bottom seismometers (OBSs) around the middle Mariana region in 2003. The refraction seismic profile extends over 700 km from the Parece Vela back-arc basin in the west to the forearc in the east, through the west Mariana ridge, the Mariana trough and the Mariana arc. The profile comprises 106 OBS with a spacing of 5 km over the ridges and 10 km within the basins.

Results of our P-wave traveltime tomography show different crustal structures within the Mariana Trough basin, Mariana arc, and forearc region. West of the Mariana arc, in the Mariana Trough basin, the crust is ~6-7 km thick, and the lower crust supports seismic P-wave velocities of 7.2-7.4 km/s. East of the Mariana arc, in the forearc region, the crust is ~8-9 km thick, and the lower crust indicates seismic velocities of 6.5-6.7 km/s. The variety of the seismic structures represent the different stages of the tectonic evolution of the IBM system, and is most likely caused by changes in hydrous melts from the subducted plate and mantle heterogeneity.