Phase speed structure beneath the Pacific Ocean using land and BBOBS station data

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Since 1990s, many broadband seismic stations in oceanic islands in the Pacific Ocean have been installed. Moreover, temporary long-term broadband seismic observations on the seafloor in the northwest and south Pacific Ocean have been conducted. These observations enable us to improve the spatial distribution of seismic stations.

We measured phase speeds of the fundamental and first three higher modes of Rayleigh waves for the source-station pairs within a latitudinal range from 80S to 80N and a longitudinal range from 110E to 60W, using a fully non-linear waveform inversion method by Yoshizawa and Kennett (2002). We obtained 12729,1484, 1177 and 1887 phase speed dispersion curves of the fundamental and first three higher modes of Rayleigh waves in a period range between 31 and 167 second, respectively. The measured multi-mode phase speeds are inverted to a 2-D shear wave phase speed structure using the inversion technique by Yoshizawa and Kennett (2004), which allows us to incorporate the effects of finite frequency as well as ray path deviation from the great-circle. The use of the multi-mode phase dispersion data should resolve better the depth variation of shear wave speed than the conventional analysis method of fundamental mode dispersion. Corrections for the off-great circle propagation and finite frequency effects should improve resolution and accuracy of a 2-D phase speed model as in the present case where the lateral variation in seismic wave speed is large and sharp.

Obtained 2-D phase speed maps of the fundamental mode show that the slow phase speed anomalies along the ridge in the Pacific Ocean and the fast phase speed anomalies in the western part of the Pacific Ocean corresponding to the age-dependence of seafloor age can be seen in a period shorter than 80 seconds. Slow phase speed anomalies beneath the Hawaii and south Pacific Superswell can be seen in the all modes. The fast phase speed anomalies of the subducted Pacific slab can be seen clearly beneath the Philippine Sea, Japanese islands and the Tonga islands in the 2-D phase speed maps of higher modes. The slow phase speed anomalies beneath the Mariana trough can be seen only in the fundamental mode maps and the slow speed anomalies beneath the south of Daito ridge and the southernmost part of the Philippine sea can be seen all mode maps. These suggest that the origin of the latter anomalies is from the deeper part of the mantle than the former.