Origin of the depression of the 660 km discontinuity and the motion of the Tonga slab

Satoshi Kaneshima[1]; Tomoaki Kubo[2]; Shoichi Yoshioka[3]

[1] Earth and Planetary Sci.,Kyushu Univ.; [2] Kyushu Univ.; [3] Dept. of Earth and Planetary Sci., Kyushu Univ.

Fine structure of the 660km discontinuity inside the Pacific slab at central Tonga near 20^{o}S is investigated by analyzing teleseismic short period array data. We analyze short period seismograms recorded at the seismic array of University of Washington and at F-Net of Japan for nearly 50 deep earthquakes with mb larger than 5.3 which occurred at Tonga from 19^{o}S to 21^{o}S during 18 years from 1986 to 2007. Focal depths of the events range from 300 to 640 km. We relocate these events, applying the master event technique to the P wave arrival times reported by ISC. The focal depths are estimated by differential travel times of pP relative to P. We then apply array processing techniques to the seismograms, and measure the arrival times of S660P, S-to-P converted waves at the 660 km discontinuity. The depths of the 660 km discontinuity are then computed for each deep earthquake. It is found that the discontinuity deepens beneath the deepest earthquakes near 600 to 640 km to about 680 km to 690 km, forming a narrow depression nearly 40 km wide. Most of the conversion points are probably located inside the Tonga slab, and the conversion depths recover to the normal depth of about 660 km inside the slab. We will show thermal structure models of this part of the Tonga slab which are computed based on the tomography models and the tectonic history of this region. By combining the seismic observations, thermal structure of the slab, and the recent mineralogical data on the kinetics of the post-spinel transformation, the origin of the depression of the 660 km discontinuity and the motion of the Tonga slab at the bottom of the upper mantle will be discussed.