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フィリピン海プレートの深い沈み込み
Aseismic deep subduction of the Philippine Sea plate

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The fundamental cause of the seismic and volcanic activities in the Japan Islands is the active subduction of the Pacific and Philippine Sea (PHS) plates. It has been well known that the Pacific plate has subducted deeply to the mantle transition zone and lower mantle, finally reaching the core-mantle boundary. In contrast, it is still not very clear whether the PHS plate has subducted deeply beyond the depth limit of the intraslab seismicity and how deep the tip of the slab has reached in the mantle. We attempt to address this issue in the present study. The PHS plate is one of the marginal sea complexes in the western Pacific and it started to subduct northwestwards ~40 Ma ago when the Pacific plate changed its direction of motion from NNW to WNW. Along the Nankai Trough off Southwest Japan, the PHS plate is composed of several blocks with ages increasing from the east to west, which are the Izu-Bonin arc and back-arc (0-2 Ma), Shikoku Basin (15-30 Ma), Kyushu-Palau Ridge, and Amami Plateau (40-49 Ma). Within the PHS slab, earthquakes occur actively down to ~80 km depth under western Honshu and down to ~180 km depth under Kyushu. Recently we have made great efforts to collect and combine a large number of high-quality local and teleseismic arrival-time data recorded by the dense seismic networks in both South Korea and Western Japan. As far as we know, this is the first time that a large number of Korean and Japanese seismic data sets are analyzed jointly. As a result, a high-resolution 3-D P-wave velocity model down to 700-km depth under South Korea and Western Japan is determined, which clearly shows that the PHS slab has subducted aseismically down to 460-km depth under the Japan Sea, Tsushima Strait and the East China Sea. The aseismic PHS slab is visible in two areas: one is under the Japan Sea off western Honshu (Shimane Prefecture), and the other is under the East China Sea off western Kyushu. However, the aseismic PHS slab is not visible between the two areas, where a slab window may be formed. The slab window is located beneath the center of the present study region where many teleseismic rays crisscross very well. Detailed synthetic tests were conducted, which indicate that both the aseismic PHS slab and the slab window are robust features. Using the teleseismic data recorded by the Japanese stations alone, the aseismic PHS slab and the slab window were also revealed (Zhao et al., 2012), but the ray paths in the Japanese data set do not crisscross well offshore. The local and teleseismic data recorded by the dense seismic networks in both South Korea and Japan lead to very good ray-path coverage under the Tsushima Strait area, hence our new results on the aseismic PHS slab and the slab window are much more robust and convincing. These new findings are considered to be important for improving our understanding of the subduction history of the PHS plate and the dynamic evolution of the Japan subduction zone.

Reference
Zhao, D., T. Yanada, A. Hasegawa, N. Umino, W. Wei (2012) Imaging the subducting slabs and mantle upwelling under the Japan Islands. Geophys. J. Int. 190, 816-828.

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