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P and S Waves Traversing Beneath the Seto Inland Sea and the Shape of the Subducting Philippine Sea Plate

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By examining later phases of P and S waves from slab earthquakes at depths of ˜40-50 km around Shikoku, we obtain constraints on the shape of the subducting Philippine Sea plate and the structure around the mantle wedge. Although the mantle wedge structure as well as the location of contact between the island arc and oceanic crusts can control shallow mantle flow, affecting thermal structure around the plate boundary, it is not easy to infer them because the target often lies beneath the ocean with sparse seismic stations. For slab earthquakes at depths of 45-49 km in northwestern Shikoku, we observe two arrivals of P wave at the Hi-net stations in the azimuth range from the north to the east, which are located on the downdip side. The apparent velocities of the initial and later phases are about 8 and 6.7 km/s, approximating P velocities in the mantle and crust, respectively. Dominant S waves propagate by apparent velocity of about 3.8 km/s, which corresponds to a crustal speed. Because the slow phases at the crustal speeds are not observed or observable only at small distances in the northwestern direction, it is unlikely that the earthquakes occurred within the island arc crust. The observations imply that the oceanic crust where the earthquakes occurred is connected with the island arc crust in the northeastern direction, whereas it is not in the northwestern direction. Synthetic waveforms computed by the 3-D Gaussian beam method do not predict slow phases crossing mantle wedge of high velocity. The observations of the slow phases thus suggest that high-velocity mantle does not intrude the region beneath the Takanawa, Ehime, Peninsula. For an earthquake at a depth of 39km in central Shikoku, we also observe later phases in the downdip direction. For earthquakes at depths of 40-45 km in northeastern Shikoku, on the other hand, we do not observe later phases to the downdip direction.