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Converted Ps amplitude variations on the dipping slab Moho beneath the Kii Peninsula

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Using the delay times of Ps converted phases in receiver functions (RFs), one can estimate the depth of interfaces underneath a seismic station. One can also evaluate elastic properties at an interface from changes of Ps polarity and Ps amplitude. Ps amplitude depends primarily on the impedance contrast at an interface, but the variation of Ps amplitude on back azimuth (BAZ) of the incoming P wave is affected if the interface is dipping and/or anisotropic rock surrounds the interface. In this study, we define "standard amplitude" of a converted phase at a dipping interface beneath a station, based on back azimuth dependence of the Ps amplitudes. We apply this analysis to the stations located within the Kii Peninsula, central Japan and discuss the spatial variations of the standard amplitudes.
First, we estimate the plunge azimuth of the dipping oceanic Moho beneath a station from the delay-time moveout of the Moho-converted Ps phase using the method by Park et al. (2007; AGU FM) and Shiomi and Park (2008; JGR). Using the theoretical Ps arrival time evaluated from this information, we read the amplitudes of RFs. Since this amplitude data shows strong scatter and back-azimuth distribution of data is unequal, we calculate an average and its standard deviation for each 5-degree bin, and fit a simple function constructed sin(BAZ), sin(2xBAZ) and constant harmonic terms with a least-squares algorithm. The component of sin(BAZ) corresponds mainly to the contribution from the dipping interface, and that of sin(2xBAZ) indicates the strength of anisotropy near the velocity interface. Shiomi and Park (2008) have already reported that the subducting slab beneath the Kii Peninsula can be divided into three regions: southwest (region A), central (region B), and northeast (region C). In this study, we found that the standard amplitudes depend on the oceanic-Moho depth, and the features in three regions are clearly different among each other. As the oceanic Moho deepens to ~40 km, the Ps amplitudes at the stations located within regions A and B decrease from 13% to 10% of the primary P wave. On the other hand, the amplitudes at the stations in region C are constant, roughly at 9-10% of the primary P wave for oceanic Moho depth < 55 km. Since it is hard to explain these larger amplitudes in regions A and B with isotropic media, we hypothesize that the anisotropic rock surrounds the Moho. This hypothesis is consistent with the results of travel-time tomography and a previous RF analysis. In region A, Ps amplitudes flatten at 5 ? 7% of the primary P wave for oceanic Moho depth > 40 km. This region corresponds to the area where the seismic velocity of the slab mantle becomes relatively low [Nakajima and Hasegawa (2007; EPSL)]. In region C, we observe a decrease in the Ps amplitude for oceanic Moho depth > 55 km. In the Kii Peninsula region, temperature at the bottom of the oceanic Moho is 400?450 degree. Thus, the Ps-amplitude decrease likely reflects a phase transition from lawsonite blueschist to lawsonite-amphibole eclogite as water is released to the overlying mantle wedge. We expect metamorphic fluids likely influence the occurrence of low-frequency nonvolcanic tremor and megathrust earthquakes along the subducting slab.

Keywords: Receiver function, Kii Peninsula, Philippine Sea plate, Conversion rate