Geometry of the upper boundary of the Pacific plate beneath the Hokkaido region

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Geometry of the upper boundary of a subducting plate has been estimated from various kinds of seismic observation, such as the spatial distribution of seismicity, the converted or reflected phases from natural or artificial sources, and receiver function analysis. In this study, we made use of the converted phase from S wave reflected at the core-mantle boundary and propagating nearly vertically called ScS phase, then converted to P wave at the upper boundary of the subducting plate, which is called ScSp phase, as a precursor of ScS phase. The travel time difference between ScS and ScSp phase enables us to estimate the depth of the plate boundary where the conversion takes place. The major difficulty in this approach is very weak ScSp phase. We estimated the detailed geometry of the upper boundary of the Pacific plate beneath the Hokkaido region, by taking the advantage of the dense seismic network named Hi-net.

Since signals of ScSp phase are generally very weak compared with those of ScS, we stacked recorded seismograms twice to detect the travel time difference between ScS and ScSp phases clearly. At first, we picked several axes with directions that the plate in the corresponding areas is subducting grossly, and divided stations into blocks of the axes. The seismograms of the stations within a given block

were stacked applying the weight in the shape of a Gaussian function to represent the seismogram in center of each block. Secondly, we stacked the seismograms stacked above around the apparent slowness of ScSp in each profile, based on Neighbourhood Algorithm (NA). The final 3-D plate geometry was estimated by combining these inverted plate models with a 3-D spline function, and we compared it with the seismicity in this region.

In order to refine the above result, we performed

frequency-wavenumber (f-k) analysis. We assumed seismic arrays by grouping adjacent stations of each staion, which is called the reference station(the total of 112 stations or seismic arrays). We conducted the beam-forming of the seismograms and calculated the f-k power spectrum in each seismic array. The direction of arrival and slowness were obtained from the spectrum, estimating the conversion point of ScSp for each reference station, whose 3-D varieties were visualized more reliably. Finally, we compared the plate model obtained by the NA inversion with the conversion depth refined by f-k analysis. As a result, the geometry of the upper boundary of the subducting Pacific plate obtained from f-k analysis seemed to be consistent more than with the seismicity re-examined by Katsumata et al. (2003), in the slab beneath the Hokkaido region.