# Sensitivity of Core Phases on F-layer

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Last year we showed that the dispersion in PKPbc and differential traveltimes between PKiKP and PKPbc are particularly sensitive to the F-layer structure (lowermost outer core) and are insensitive to the structure of the other parts of the Earth (Ohtaki and Kaneshima, 2015). In previous studies, the Vp structure of the F-layer have been investigated using absolute traveltimes of PKPbc/c-diff, differential traveltimes between PKPbc/c-diff and PKIKP, amplitude ratios between PKPbc/c-diff and PKIKP, and the position of the C-cusp. PKIKP pierces the inner-core boundary and turns in the inner core; PKPbc turns in the lower part of the outer core; PKPc-diff diffracts on the inner-core boundary beyond the C-cusp; PKiKP reflects on the inner core boundary.
In this study we discuss the sensitivity of various core phases (PKIKP, PKPbc, PKPc-diff, and PKiKP) to the F-layer structure in detail. Among these observations, absolute traveltimes of PKPbc are affected by crustal and mantle structures that are strongly heterogeneous and are not precisely known, which indicates benefits of analyzing differential travels times. Differential traveltimes suppress the effects of heterogeneous structures as well as the discrepancy between a reference seismic model and the real Earth above the turning depths of rays. However, it is difficult to discriminate the P-wave velocity of the F-layer from that of the inner core using the differential traveltimes between PKPbc/c-diff and PKIKP, because the inner core is more heterogeneous than the F-layer. Fine structure of the F-layer is also poorly constrained by the amplitude ratios because of the low sensitivity of the ratios to the Vp gradient and of a trade-off between the Vp profile of the F-layer and the attenuation values in the inner core. The C-cusp position can be constrained only poorly by the amplitude observations, and there exist many velocity profiles that yield the same C-cusp position. In summary, conventional observations are obviously insufficient to resolve detailed F-layer structure.
In our previous study (Ohtaki et al., 2012), we examined the seismic structure near the inner core boundary beneath the South Pole. In that study, we investigated the velocity above the inner core boundary using the amplitude ratios between PKIKP and PKPbc/c-diff, assuming a constant velocity in the F-layer, because the ratio is not so sensitive to the velocity gradient, as mentioned above. In this study, we also examine a tolerance level of a velocity gradient there.

Keywords: Seismic velocity, Outer Core

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