Configuration of slab beneath Ogasawara Islands and P-wave time differences between high and low frequencies

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Here I examine arrival time differences in P wave between high and low frequencies, and see a link with the configuration of the descending Pacific slab beneath Ogasawara Islands.

Furumura and Kennett (JGR 2005) showed that P and S waves from intraslab earthquakes beneath the Sea of Japan have low-frequency onsets followed by high-frequency long-duration signals, suggesting the result of small-scale quasi-laminar heterogeneity within the subducting Pacific slab. The late arrivals of high-frequency P and S signals are enhanced for earthquakes deeper than 400 km, probably, due to the low-velocity wedge in the slab (Furumura et al., JGR 2016). By exploring broadband seismograms of regional P waves from deep earthquakes (depth>300 km) worldwide, Ohata and Kuge (JpGU 2017) suggested a possibility of similar observations to Furumura’s in other western Pacific regions. Ohata and Kuge (JpGU 2018) showed the observations from deep earthquakes beneath Fiji and Kermadec Islands.

These previous studies indicate the presence of heterogeneity within the subducting Pacific slab that causes arrival time differences in P wave between high and low frequencies. This also suggests that time delay of high-frequency P waves can be used as a measure to find out if the P waves have traveled within a subducting slab. Based on the idea, I examined arrival time differences of P-wave peaks between high and low frequencies for deep earthquakes beneath Ogasawara Islands.

For an aftershock (USGS depth 678 km) of the isolated 2015 deep large earthquake, time differences of P-wave peaks between high and low frequencies were insignificant to the northwest and east. High-frequency P peaks from a deep earthquake in the nearby Wadati-Benioff zone were, however, delayed, compared with low-frequency ones. The Pacific slab is likely to be absent in the northwestern side of the aftershock. If the Pacific slab extends to the aftershock, its bend toward the east above the aftershock can explain the observation.

