We report that a sharp lateral boundary exists at the southern edge of the Pacific superplume. The set of SHdiff waveforms, which graze the South Pacific superplume, have similar features to those observed previously at the southeastern edge of the African superplume. The similarity of the two observed SHdiff waveform sets at relatively high frequencies indicates that the low velocity regions in the lower mantle under Pacific and Africa, observed as the strong degree-2 pattern in shear velocity tomographic models, have a similar nature also at finer scales. We used the coupled mode/spectral element method (CSEM)(Capdeville et al, 2003), which can handle strong lateral variations of the velocity in the D″, to construct synthetic waveforms. Figure(b) left shows that the postcursors are refraction from the lateral boundary in D″ region. The existence of these pulses suggests that modeling of heterogeneity outside of the great circle path can help constrain the 3D structure, especially the shape and velocity contrast at the boundary, at the base of the mantle.


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(a) Observed velocity waveforms. Left; SHdiff Waveforms which sample the southern boundary of the African super plume. Event at 1997 Sep 04 in Fiji-Tonga region recorded at South Africa (PASSEK) experiment SASEK. Right; SHdiff waveforms that sample the southern boundary of the pacific superplume. Events are in Fiji-Tonga region recorded at the station BDFB of Global Telemetered Southern Hemisphere Network in Brazil. All the waveforms are collected through IRIS. Both waveform sets show a rapid shift of the arrival time with respect to the azimuth and are followed by a secondary or multiple pulses.

(b) Synthetic waveforms calculated by CSEM down to 8 seconds. They are calculated for the source and station configuration which samples the southern border of the African super plume. The left panel shows the waveforms from the original tomographic model, which do not show the secondary arrivals nor the broadening of the first arrivals. The right panel show waveforms constructed from a model, whose anomaly is saturated to either -1.75% or 2.75% based on the original tomographic model. The waveforms constructed from the modified model capture the features of observed waveforms (right panel of Figure 1a). The azimuth where the jump of the first arrival is observed matches the data well and they are followed by secondary or multiple arrivals.