後続波は地震波トモグラフィーにとっても重要である

Importance of later-phase data in seismic tomography

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Seismic later-phase (reflected and converted wave) data contain abundant information on the Earth's interior structure. Because the trajectories of later phases are quite different from those of the first P and S waves, the addition of the later phase data can improve the ray path coverage, in particular, ray crisscrossing, leading to the improvement of spatial resolution. Hence recent tomographic studies have started to use later-phase data and have achieved unexpected new advances. The discovery of every new later phase and its use in tomography open a new window for us to reveal new features of the Earth structure. For example, the detection of sP depth-phase from earthquakes under the Pacific Ocean off Northeast Japan leads to the precise location of the suboceanic earthquakes (Umino et al., 1995), and the use of the sP depth-phase in tomography enables us to determine the 3-D velocity structure outside a seismic network (Zhao et al., 2007). The detection and use of multiple reflected waves in the crust (SmS, sSmS) in Southern California result in a high-resolution crustal tomography with only two stations (Zhao et al., 2005). The use of Moho reflected waves (PmP) in tomography leads to a better imaging of the lower crustal structure under active volcanoes in Northeast Japan (Xia et al., 2007). The addition of various reflected, transmitted and diffracted waves in the mantle and core in global tomography leads to a better ray path coverage under the oceanic regions, which enables a better imaging of the deep mantle plumes and subducting slabs (Zhao, 2001, 2004; Lei and Zhao, 2006).

The later phases are usually difficult to detect in high-frequency waveforms of local and regional earthquakes, but such a problem can be resolved by carefully scrutinizing the observed seismograms (e.g., Umino et al., 1995) and by exploiting new technologies of waveform modeling (e.g., Helmberger et al., 2001; Abdelwahed and Zhao, 2005). With more and more later-phase data available, seismic tomography will have greater advances and will be able to reveal more details of the Earth's interior structure from local to global scales, greatly improving our understanding of the seismic and volcanic activity and geodynamic processes of the Earth.

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