Modeling guided waves to constrain the velocity structure of the oceanic crust in the subduction zone of eastern Alaska

Xiaoyu Guan¹, Yuanze Zhou¹, and Takashi Furumura²
¹College of Earth and Planetary Sciences, University of Chinese Academy of Sciences, Beijing, China
²Earthquake Research Institute, The University of Tokyo, Tokyo, Japan

Fitting subduction zone guided waves with synthetics is an ideal choice for studying the velocity structure of the oceanic crust. After an earthquake occurs in subduction zones, seismic waves can be trapped in the low-velocity oceanic crust and propagated as guided waves. The arrival time and frequency characteristics of the guided waves can be used to image the velocity structure of the oceanic crust. The analysis and modeling based on guided wave observations provide a rare opportunity to understand the velocity structure of the oceanic crust and the variations in oceanic crustal materials during the subduction process.

High-frequency guided waves have been observed in the subduction zone of eastern Alaska. On several sections, observed seismograms recorded by seismic stations show low-frequency (<2Hz) onsets ahead of the main high-frequency (>2Hz) guided waves. Differences in the arrival times and dispersion characteristics of seismic phases are related to the velocity structure of the oceanic crust, and the characteristics of coda waves are related to the distribution of elongated scatters in the oceanic crust. Through fitting the observed broadband waveforms and synthetics modeled with the 2-D FDM (Finite Difference Method), we obtain the preferred oceanic crustal velocity models for several sections in the subduction zone of eastern Alaska. The preferred models can explain the seismic phase arrival times, dispersions, and coda characteristics in the observed waveforms. With the obtained P- and S-wave models of velocity structures on several sections, the material compositions they represent are deduced, and the variations of oceanic crustal materials during subducting can be understood. This provides new evidence for studying the details of the subduction process in the subduction zone of eastern Alaska.