

Structural evolution of the incoming oceanic plate and its along-trench variation

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The dehydration process and the expelled water from the subducting oceanic plate are expected to affect various subduction zone processes, including the arc volcanism, generation of the intermediate-depth earthquakes and the seismic coupling of plate interface. To better understand these subduction zone dynamics, it is essential to clarify the amount of water that is being subducted within the incoming oceanic plate into the subduction zone.

Recent seismic and thermal structure studies have suggested that most water percolation and oceanic plate hydration are associated with the plate bending-related faulting in the trench-outer rise region. To confirm the structural evolution and its along-trench variation prior to subduction in the northwestern Pacific margin, where extremely old (more than 120Ma) oceanic plate is subducting, we have conducted extensive wide-angle seismic reflection and refraction surveys since 2009. Obtained seismic data of vertical and horizontal components were of good quality and we successfully revealed the progressive changes in V_p , V_s , and V_p/V_s ratio within the incoming plate just before subduction. These seismic velocity models indicate the water content within the incoming oceanic plate increases toward the trench accompanied with the development of the bending-related fractures at the top of the oceanic crust, suggesting the seawater percolation into the incoming plate near the trench.

In addition, we observed a remarkable along-trench structural variation within the incoming Pacific plate in the northern Japan trench region. In this region, it has been suggested that the along-trench variation in the distribution of large interplate earthquakes are well correlated with the along-trench variation in the outer trench seafloor roughness (the degree of horst and graben development). As expected, our seismic velocity models within the incoming plate clearly show that seismic velocities are low and V_p/V_s ratio is high in the region where the seafloor bathymetry is rough, suggesting that water percolation and/or hydration within the incoming oceanic plate is high in the region where the seafloor is rough.

In this presentation, we will show the regional variation of the seismic structure within the incoming plate, and discuss its origin and the impact on the subduction zone dynamics.

Keywords: outer rise, structural evolution, along-trench structural variation, wide-angle seismic survey, water contents, hydration