Seismic velocity and seismicity in the subducting crust of the Pacific slab beneath the eastern part of Hokkaido

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Fluid in subduction zones is considered to play important roles for genesis of intermediate-depth earthquakes (e.g., Kirby et al., 1996) and arc magmatism (e.g., Nakajima et al., 2013). The subducting crust located at the uppermost part of the oceanic plate involves a large amount of water in form of hydrous minerals, and released fluid by dehydration reaction of the hydrous minerals lowers seismic velocity (Hacker et al., 2003). Therefore, it is important to reveal the detailed seismic velocity structure in the subducting crust to understand seismogenesis and water circulation in the subduction zones.
At the western side of the Hidaka mountain range, distinct later phases are often observed for intermediate-depth earthquakes in the Pacific slab (e.g., Shimizu and Maeda, 1980; Abers, 2005). The later phases that are recorded for earthquakes occurred near the upper boundary of the Pacific slab are interpreted as guided waves propagating in the subducting crust (Shiina et al., 2014). In this study, we estimated P- and S-wave velocities in the subducting crust beneath the eastern part of the Hokkaido by using travel times of the guided waves. The number of earthquakes that guided-P and the guided-S waves were identified in this study were 315 and 275, respectively. Then, we obtained P-wave velocity of 6.5-7.5 km/s, S-wave velocity of 3.6-4.2 km/s, and Vp/Vs of 1.80 at depths of 50-100 km. The P- and S-wave velocities at depths shallower than 80 km are lower than those expected for the fully-hydrated MORB (e.g., Hacker et al., 2003), and the low-velocity anomalies can be explained by the existence of 1 vol% of aqueous fluid.
The P-wave velocity obtained at depths of <80 km beneath the eastern Hokkaido is coincident with that observed in Tohoku (Shiina et al., 2013), while the P-wave velocity at depths of 80-100 km are faster than that estimated in Tohoku district. It is expected that temperatures around the upper boundary of the Pacific slab beneath the eastern Hokkaido are higher than beneath Tohoku, as a result of an oblique subduction of the Pacific slab (e.g., Kita et al., 2010; Abers et al., 2013; Wada et al., 2015). High temperatures beneath eastern Hokkaido may affect location of dehydration reactions of hydrous minerals and fluid migration paths from the subducting crust to the mantle wedge. Therefore, the differences in P-wave velocities between the eastern part of Hokkaido and Tohoku at depths of 80-100 km may be caused by the differences in the amount of fluids trapped in the crust.

Keywords: Subducting crust, Seismic velocity, Guided wave, Upper plane seismic belt

