# Tomography and megathrust earthquakes in the Tohoku forearc

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Tomographic studies have been made continuously for the Tohoku forearc region in the past two decades. Using P-wave arrival-time data recorded at land-based seismic stations of suboceanic earthquakes relocated with sP depth phases (Umino et al., 1995), Zhao et al. (2002) and Mishra et al. (2003) determined the first 3-D P-wave velocity (Vp) images of the Tohoku forearc from the Japan trench to the Pacific coast and found a correlation between the Vp variations of the megathrust zone and the hypocentral distribution of large megathrust earthquakes (M> 6.0). Later studies of both Vp and Vs tomography of the region have confirmed the first findings (Mishra & Zhao, 2004; Wang & Zhao, 2005; Zhao et al., 2007, 2009; Huang et al., 2011). Since the occurrence of the great 2011 Tohoku-oki earthquake (Mw 9.0), more tomographic studies have been made using P and S wave data of the aftershocks relocated with sP depth phases (Zhao et al., 2011; Huang & Zhao, 2013a,b; Liu et al., 2014; Zhao, 2015; Liu & Zhao, 2018). Zhao et al. (2011) relocated the Tohoku mainshock, 339 foreshocks and 5609 aftershocks during 9–27 March 2011 using a 3-D velocity model and local P and S wave arrival times, and suggested that the rupture nucleation of the largest events in the Tohoku-oki sequence, including the mainshock, was controlled by structural heterogeneities in the megathrust zone. Liu & Zhao (2018) constrained the structure of the Tohoku forearc using seismic tomography, residual topography, and gravity data, which reveal a close relationship between structural heterogeneities in and around the megathrust zone and rupture processes of the 2011 Tohoku-oki earthquake. They suggested that the structural heterogeneities in and around the megathrust zone originate from both the overriding Okhotsk plate and the subducting Pacific plate, which controlled the nucleation and rupture processes of the Tohoku-oki earthquake. Recently, P and S wave arrival-time data of suboceanic events recorded by the permanent ocean-bottom seismic network (S-net) have been used to improve the tomographic images of the Tohoku forearc, in particular, near the Japan trench (Hua et al., 2020; Yu & Zhao, 2020; Katayama et al., 2021). All these results indicate structural control on the generation of megathrust earthquakes in the Tohoku forearc.

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